ENVIRONMENTAL ASSESSMENT REGISTRATION

NICTAUX PIT AND QUARRY DEVELOPMENT PROJECT

WARD AGGREGATES LTD.

PROJECT NO. NSD18995

PROJECT NO. NSD18995

REPORT TO

WARD AGGREGATES LTD.

ON

ENVIRONMENTAL ASSESSMENT REGISTRATION
NICTAUX PIT AND QUARRY DEVELOPMENT PROJECT

Jacques Whitford Limited
3 Spectacle Lake Drive
Dartmouth, NS B3B 1W8
Tel: 902-468-7777
Fax: 902-468-9009

April 28, 2005

EXECUTIVE SUMMARY

Ward Aggregates Ltd. (Ward Aggregates) wishes to develop a gravel pit and rock quarry operation on the south side of the Route 201 in Nictaux, Annapolis County, NS. The proposed development is immediately adjacent to the former R.B. Paving Ltd. gravel pit operation, which has been recently closed and reclaimed. The proposed development would supply gravel and aggregates for asphalt production and to various local markets including residential and commercial construction, municipal infrastructure projects (*i.e.*, water and sewer) and road building.

The proposed development will be approximately 28.9 ha (71.4 acres) in size (proposed Project area). The Project includes development of a gravel pit approximately 11.4 ha in size and a quarry development approximately 4.25 ha in size. The remaining area, which has been developed by previous owners, will accommodate a laydown area for temporary crushing equipment, stockpiles and a buffer zone. It is anticipated that the majority of the products will be hauled to the R.B. Paving asphalt plant, which is under common ownership with Ward Aggregates, approximately 6 km east.

Proposed project activities will be consistent with the previous adjacent pit operation approved by the Nova Scotia Environment and Labour (NSEL) and in accordance with the Nova Scotia Pit and Quarry Guidelines (NSDOE 1999). Generally, the site will be developed from north to south. Gravel extracted from the proposed pit areas will be stockpiled on-site until portable crushing equipment is brought to the site for processing. Once processed, gravel may be stockpiled or loaded directly into trucks and hauled off-site. Rock will be removed by mechanical means (*i.e.*, ripping); there will be no blasting. Again, portable crushing equipment will be brought to the site to process the rock as needed. Aggregates may be stockpiled at the site until they are transported to local markets via tandem trucks or tractor trailer trucks. The average number of trucks hauling aggregates from the quarry will be 5 to 6 per day, depending on market demand. This could increase to as much as 10-12 per day, for a short period, if a large aggregate supply contract were awarded.

The anticipated average production rate is approximately 20,000 to 25,000 tonnes per year. The operating schedule will be based on 10 hrs/day, 5 days/week, and 28 weeks/year (May to November), weather permitting.

Ward Aggregates is required to register this project as a Class I Undertaking pursuant to the Nova Scotia *Environment Act* and Environmental Assessment Regulations. The environmental assessment registration document has been prepared by Jacques Whitford Limited, on behalf of Ward Aggregates to fulfill these regulatory requirements. Other relevant provincial regulations include the Activities Designation Regulations, which requires an Industrial Approval from NSEL for the pit/quarry operation. Provincial guidelines to be adhered to include the Nova Scotia Pit and Quarry Guidelines (NSDOE

1999). Relevant federal legislation includes the *Fisheries Act*, *Species at Risk Act* and the *Migratory Birds Convention Act*.

This environmental assessment registration document evaluates the potential environmental effects of the Project and identifies appropriate mitigation and monitoring to minimize these effects. The document focuses on those aspects of the environment of most concern. Components evaluated include:

- surface water and fish and fish habitat;
- rare and sensitive flora;
- wildlife (including herpetiles and breeding birds);
- wetlands;
- groundwater resources;
- archaeological and heritage resources;
- air quality; and
- socio-economic environment.

Environmental effects of the Project will include the loss of terrestrial habitat within the Project area**.** Field surveys conducted to date indicate the presence of one yellow-listed plant species (NSDNR 2002). Additional/follow-up surveys will be undertaken in 2005 to establish the abundance and distribution of the yellow-listed species and identify additional species. If Project approval is received, Ward Aggregates will limit development activities in the 2005 season until such time as the results of the follow-up surveys are interpreted and appropriate mitigation is developed to minimize the potential environmental effects on rare or sensitive species.

Assuming the mitigative measures specified in this report are implemented, and the pit/quarry is operated according to provincial guidelines and approvals, no significant adverse residual environmental or socio-economic effects are likely to occur. Development of the pit/quarry operation will result in economic benefits, including employment and ongoing business opportunities.

TABLE OF CONTENTS

Page No.

LIST OF TABLES

Page No.

LIST OF FIGURES

Page No.

LIST OF PHOTOS

Page No.

LIST OF APPENDICES

1.0 PROPONENT AND PROJECT IDENTIFICATION

1.1 Proponent Information

Ward Aggregates Ltd. (Ward Aggregates: the Proponent) was incorporated as a Nova Scotia company in 2003, where it carries out its materials related business. Ward Aggregates and affiliated company R.B. Paving Company Ltd. have been in the asphalt production and materials related business in Nova Scotia since R.B. Paving was incorporated more than 35 years ago. A copy of the Certificate of Incorporation and a copy of the Registry of Joint Stocks are included in Appendix A.

Name of the Proponent:	Ward Aggregates Limited
Postal Address:	Wilmot, NS B0P 1W0
Tel:	(902) 825-6550
Fax:	(902) 825-2296

Company President, Chief Executive Officer and/or Environmental Assessment Contact:

Name:	Robert Ward
Official Title:	President
Address, Tel, Fax:	Same as above

Environmental Consultant Contact:

Name:	Janice Comeau
Official Title:	Environmental Assessment Coordinator
Address:	Jacques Whitford Limited 3 Spectacle Lake Drive Dartmouth, NS B3B 1W8
Tel:	(902) 468-7777, ext. 251
Fax:	(902) 468-9009

Signature of Signing Officer

26 Apr/05
Date

1.2 Project Information

Name of the Undertaking:	Ward Aggregates Nictaux Pit and Quarry Development
Location of the Undertaking:	Nictaux, Annapolis County, Nova Scotia

2.0 DESCRIPTION OF THE UNDERTAKING

Ward Aggregates wishes to develop a gravel pit and rock quarry operation located in Nictaux, Annapolis County, NS (the Project) (Figure 1). The proposed Project is immediately adjacent to the former R.B. Paving Company Ltd. gravel pit operation, which has been recently closed and reclaimed. The proposed Project would supply gravel and aggregates primarily for asphalt production and to various local markets including residential and commercial construction, municipal infrastructure projects (*i.e.*, water and sewer) and road building.

The proposed Project area encompasses approximately 28.9 ha (71.4 acres). The Project includes development of two separate gravel pits totalling approximately 11.4 ha in size and a quarry development approximately 4.25 ha in size. The remaining area, which has been developed by previous owners, may remain untouched, with the exception of the use of the access road; however, it may accommodate a laydown area and temporary/portable crushing equipment and aggregate stockpiles. The majority of the products will be hauled to R.B. Paving's asphalt plant, which is under common ownership with Ward Aggregates, approximately 6 km east.

Ward Aggregates is required to register this Project as a Class I Undertaking pursuant to the Nova Scotia *Environment Act* and Environmental Assessment Regulations. A detailed description of the proposed undertaking is provided in the following sections.

2.1 Geographical Location

The proposed gravel pit and rock quarry operation is located on the south side of the Route 201 in Nictaux, Annapolis County, NS (Figure 1). The proposed Project area varies from 100 m in width in the northern end to 150 m in the southern end. The property extends approximately 2 km south from Route 201. The Project area is located 1.5 km south of Nictaux, 2.4 km east of Nictaux West, and 0.7 km west of Nictaux Falls. Residences associated with these communities extend along Trunk 10 and Route 201, with those closest to the Project site situated adjacent to the north end of the site along Route 201, some 30 m away, and to the east of the site at distances some 150 m or more off of Trunk 10. As shown on the mapping, there are 243 buildings/structures within 500 m of the quarry boundary, 557 within 1 km, 728 within 1.5 km and 855 within 2 km.

The topography across much of the northern end of the site is flat-lying with an elevation of 35 m, whereas the southern portion of the site encroaches into the bottom of South Mountain and rises to an elevation of 80 m at its southern end. The site's surficial geology includes glaciofluvial gravel and sand deposits on the northern, lower lying portion of the site, and a silty glacial ground moraine till plain in the southern end of the site. Bedrock underlying the site is comprised of conglomerate, sandstone and minor shale units of the Wolfville Formation from the Fundy Group.

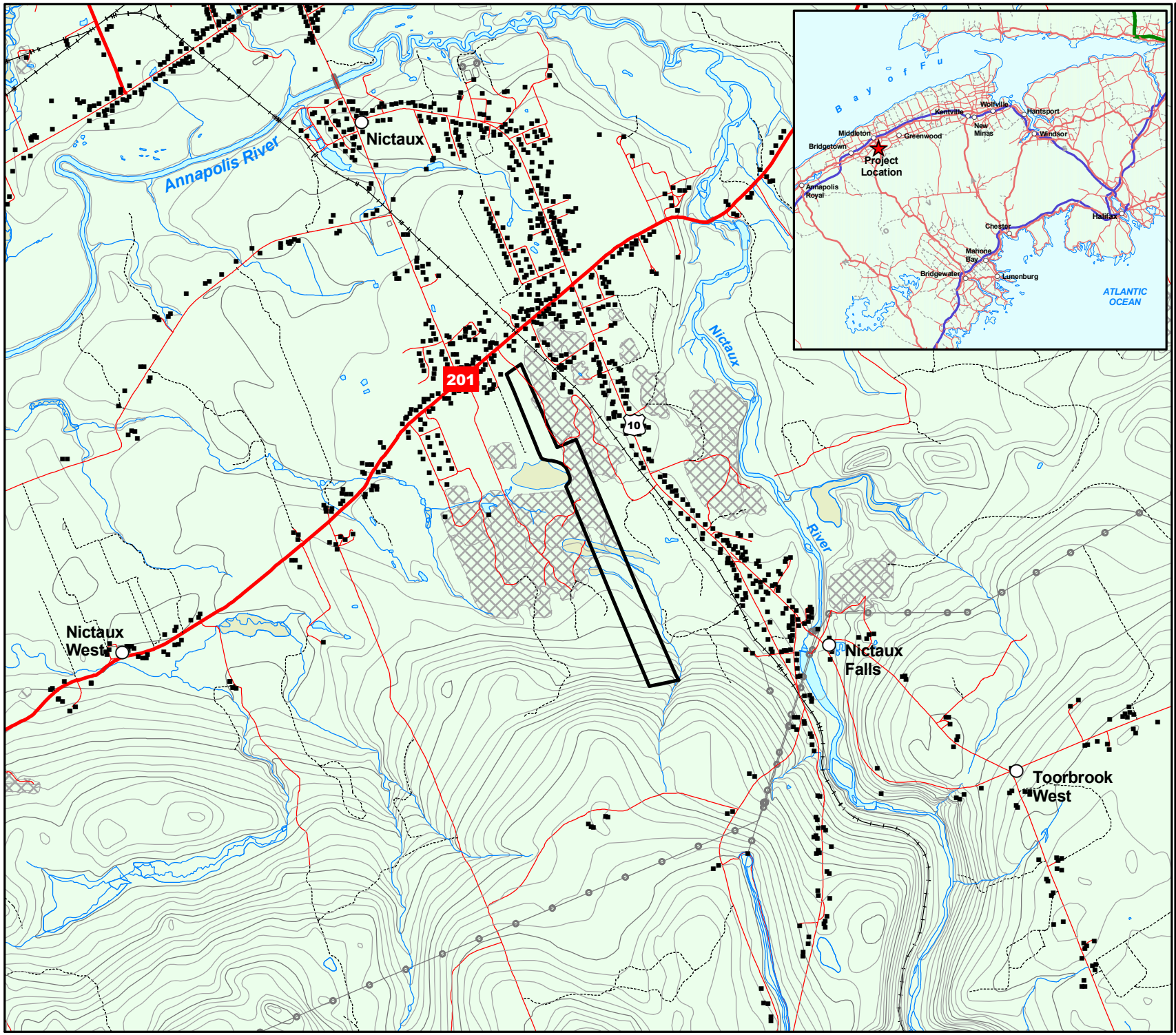

Figure 1

Project Location

Project Components
- Proposed Permitted Area

Topography
- Building/Structure

Roads
- Minor Road
- Major Road
- Trail/Track
- Rail

- Contour
- Utility Line
- Watercourse
- Waterbody
- Land
- Wetland
- Pit

Ward Aggregates
Proposed Gravel Pit
and Quarry
Development

N

0 250 500 750 1000

Meters

Map Parameters
Projection: UTM
Zone: 20
Datum: NAD 83
Scale: 1:30,000
Project Number: NSD18995
Date: February 18, 2005

Jacques Whitford

Habitat types within the Project area vary considerably and have been classified into 13 distinct habitat types ranging from mature forest to grubbed clearcut to basin bogs and stream swamps. There is one stream that crosses the proposed Project area, flowing east to west across the site and generally north to the Annapolis River (refer to Figure 2).

2.2 Physical Components

The proposed Project consists of a gravel pit and rock quarry. There is currently no infrastructure on site. As the Project is developed, temporary stockpile areas (for processed and unprocessed materials) will be established. It is anticipated that these areas and piles will be limited in size given the relative short duration of on-site storage (*i.e.*, a few weeks). Topsoil will be stockpiled/windrowed so as not to interfere with operations. A laydown area will be prepared, as required, to accommodate portable crushing equipment.

As part of this Project, existing access roads within the site will be used; no additional access roads are planned. Access to the site will be gained via an access road through the adjacent property (owned by R.B. Paving), connecting to Route 201 immediately adjacent to the railway crossing (*i.e.*, north and east of the Project area). There is no fuel storage, storage of dangerous goods, pipelines, port facilities or railways associated with the proposed Project.

Project activities will be in accordance with the Nova Scotia Pit and Quarry Guidelines (NSDOE 1999).

2.3 Site Preparation and Development

The Project area can be divided into four sections, based on the proposed development (Figure 2). Generally, development of the site will begin in the north and move south. It is Ward Aggregates' intention to extract gravel from two distinct areas within the proposed site (Figure 2). The proposed gravel pit in the northern end of the site is approximately 6 ha is size. Initial site preparation will consist of harvesting of remaining timber from the site. This portion of the site was clear cut within the last three years, shortly after the property was purchased. Only occasional trees remain. Topsoil and ground vegetation will be stripped, stockpiled/windrowed (for future use during rehabilitation), and stabilized to minimize erosion. To minimize the potential for erosion and sedimentation, removal of topsoil and the vegetative mat will be conducted on an as needed basis to accommodate advancement of the operation.

Gravel will be excavated to a depth of 6 to 8 feet (1.8 to 2.5 m). Given the proposed production rate of approximately 20,000 to 25,000 tonnes per year, it is estimated that it will take about five years to fully develop this area. Once this area is developed, the Proponent will move to the southern end of the Project area for additional gravel extraction.

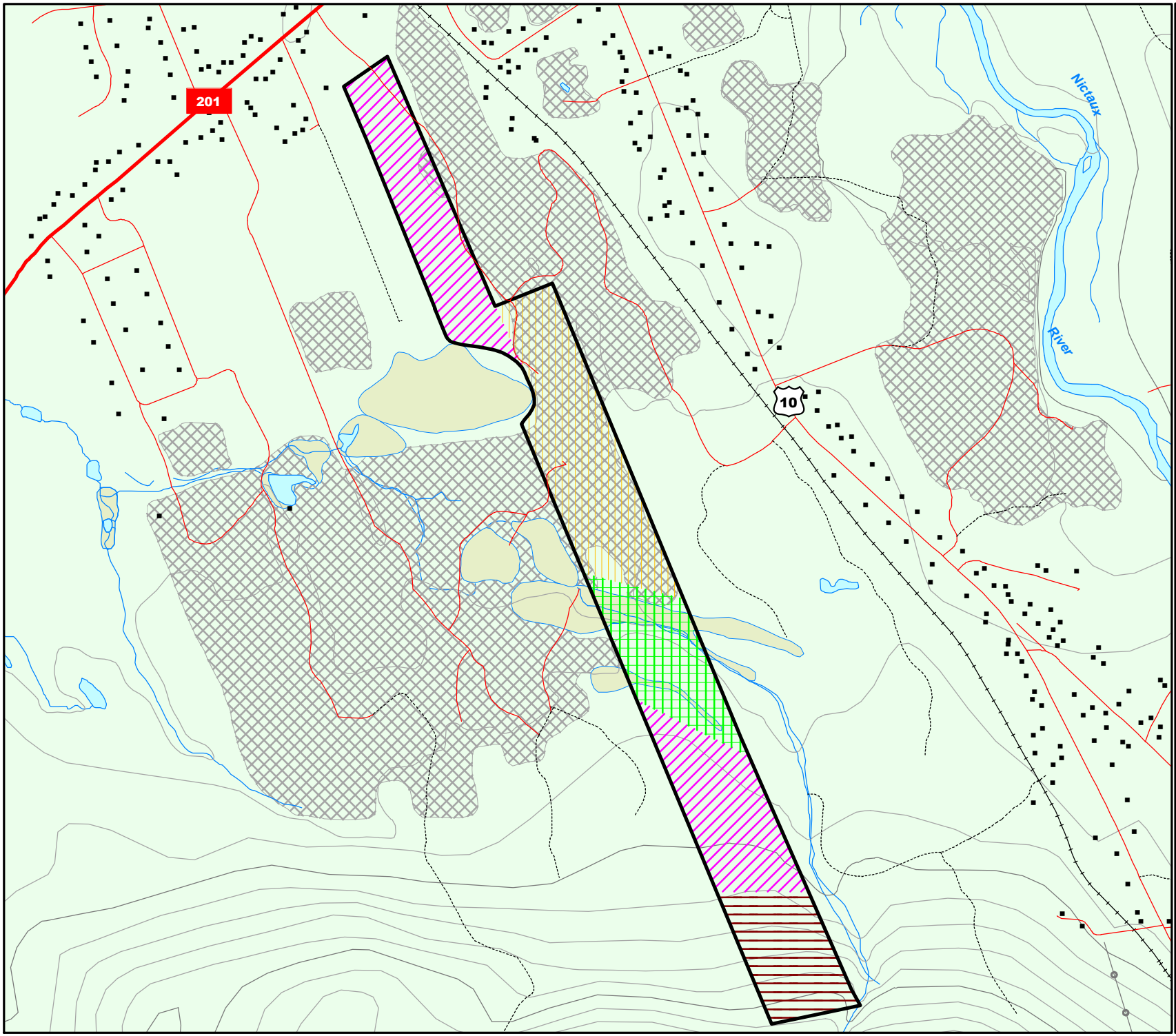

Figure 2

Site Layout

Project Components
- Proposed Permitted Area
- Proposed Gravel Pit
- Proposed Buffer Area
- Proposed Quarry Area
- Proposed Stockpile and Laydown Area

Topography
- Building/Structure

Roads
- Minor Road
- Major Road
- Trail/Track
- Rail

- Contour
- Utility Line
- Watercourse
- Waterbody
- Land
- Wetland
- Pit

Ward Aggregates
Proposed Gravel Pit
and Quarry
Development

N

0 100 200 300

Meters

Map Parameters
Projection: UTM
Zone: 20
Datum: NAD 83
Scale: 1:10,000
Project Number: NSD18995
Date: April 26, 2005

Jacques Whitford

The second (southern) gravel extraction area is approximately 5.4 ha in size. It will be developed in the same manner as the area in the northern end. This portion of the Project area has not been cleared. Clearing will be undertaken prior to development and will be conducted to avoid sensitive periods for most breeding birds (*i.e.,* outside of the mid-April to early August breeding period) and the Proponent will implement other measures as required to ensure compliance with the *Migratory Birds Convention Act*.

The proposed quarry area is approximately 4.2 ha in size. As described above, clearing will be undertaken prior to development. It is anticipated that the gravel pit will be fully developed prior to development of the quarry. It is estimated that it will take four to five years to develop this portion of the gravel pit and about five to seven years to develop the quarry.

As previously indicated, a significant portion of the site has been developed by previous owners. There is no gravel left to be extracted in this area (approximately 8.6 ha). Although the history of development of this site is not known, gravel and aggregate extraction in the general area has been ongoing since the early 1920s, when the railway was constructed, and over the years for various road and highway construction projects. Aside from the access road that runs along the eastern edge of this previously developed portion of the site, this area is likely to remain untouched. It may be used as a laydown area for portable crushing equipment or for stockpiles if space is limited once the southern end of the Project area is developed. A portion of this area (*i.e.*, approximately 4.65 ha, see Figure 2) is designated as buffer to protect the small stream that crosses the site as well as to avoid wetland habitat. The existing access road through the site crosses the stream. A small corrugated steel culvert accommodates the stream flow.

During the initial pit/quarry development phase, provision will be made to collect surface runoff in a sedimentation pond with spillway. The floor of the pit and quarry areas can also serve as surface runoff and drainage collection ponds.

2.4 Operation and Maintenance

2.4.1 Quarry Operation Activities

The proposed Project activities will be operated in accordance with the Pit and Quarry Guidelines (NSDOE 1999). These guidelines apply to all pit and quarry operations in the Province of Nova Scotia and provide separation distances for operations and guidance on activities including blasting, liquid effluent discharge level limits, suspended particulate matter limits, sound level limits, and requirements for a rehabilitation plan and security bond.

Gravel will be excavated using heavy equipment (*i.e.,* backhoe and/or front-end loader) and stockpiled temporarily until portable crushing equipment is brought to the site for processing. Crushing activities will be sub-contracted to another company. Processed material may be stockpiled or loaded directly onto trucks where it will be transported to the R.B. Paving asphalt plant located approximately 6 km east of the proposed Project area or other markets/users.

Rock will be removed by mechanical means (*e.g.*, ripping); there will be no blasting. Quarrying will likely occur to a depth of 10 to 15 feet (3.0 to 4.5 m). Portable crushing equipment will be brought to the site to process the removed rock as needed. Processed material may be stockpiled or loaded directly onto trucks where it will be transported to the R.B. Paving asphalt plant located approximately 6 km east of the proposed Project area or other markets/users.

The average number of trucks hauling material from the pit/quarry is expected to be 5 to 6 per day. This could increase to as much as 10-12 per day, for a short period, if a large material or asphalt supply contract were awarded.

The anticipated average production rate is approximately 20,000 to 25,000 tonnes per year. The operating schedule will be based on 10 hrs/day, 5 days/week, and 28 weeks/year (May to November), weather permitting.

There is no anticipated requirement for washing of rock on site.

It is anticipated that the operation will employ four to seven individuals during production to operate heavy equipment (*i.e*., loaders, back-hoes), crushing and mobile equipment, and conduct general labour activities. Hauling of materials from the quarry involves additional resources, employing two individuals.

2.4.2 Effluents and Emissions

Erosion and Sediment Control

In accordance with best practices and standard NSEL requirements, erosion and sedimentation controls will be in place to ensure that effluent generated during operations is managed appropriately. This will include diversion of clean surface drainage away from disturbed areas, coordination of activities with seasonal constraints (*i.e.,* to the extent possible, avoid periods of heavy precipitation and snow melt), and minimization of the amount and duration of erodible soil at all times. Additional measures to minimize erosion may be required, such as ditching, sediment fencing, and check dams. Prior to temporary and winter shut down, Ward Aggregates will ensure the site is left in a stable condition to minimize the potential for erosion and subsequent sedimentation during these non-operational periods.

A hydrological review of the proposed development was conducted by Hydro-Com Technologies Limited (refer to Appendix B). The purpose of the study was to estimate quantities of surface runoff from the site's drainage areas (assuming a fully developed site) to ultimately estimate the size and design discharge capacity of flow retention structures (assuming fully developed site) and to assess potential effects of the development on downstream flows and water quality.

Given the different pit/quarry development areas within the Project area and the different drainage areas of the proposed development, estimates for flow retention structures are provided for the two distinct development areas. Assuming full development, the peak flow resulting from a 100 year return period storm event was estimated to be 0.38 m^3/s for the northern end and 1.29 m^3/s for the southern end. Again, assuming a full development, the required capacity of the retention structures for the northern end should have a volume of no less than 500 m^3 and 1,500 m^3 in the southern end in order to accommodate the site runoff from the quarry at the proposed ultimate level of development. These values are considered to be worse case scenarios given that they assume the entire areas is completely developed, with no progressive rehabilitation. As previously indicated, rehabilitation will occur progressively.

The review concluded that the effects on the downstream flows and water quality associated with a fully developed pit/quarry can be fully mitigated using the placement of free-draining material (*i.e.*, rock/gravel) and/or proper/timely stabilization of erodible material and properly sized flow retention/siltation treatment structures/areas. Following the use of these mitigative measures, the remaining residual effects on downstream flows and water quality are expected to be minor.

Overflow from the retention structures will be monitored, sampled and reported according to the Pit and Quarry Guidelines or as prescribed in the terms and conditions of the Industrial Approval to ensure total suspended solids levels do not exceed the approved final effluent discharge limits. In the unlikely event that overflow from the quarry exceeds final effluent discharge limits as determined through monitoring or is sediment laden (based on a visual inspection), contingency measures that may be employed include pumping of sediment laden water to vegetated areas (away from watercourses) or through filter bags for additional filtration and/or use of additional filtration devices or structures. The equipment and materials required to employ these contingency measures will be readily available and accessible. More specific details related to erosion and sediment control, where required, will be identified in the Industrial Approval application.

Dust

Dust emissions will be controlled with the application of water obtained from the sedimentation pond or pools on the pit/quarry floor. Stockpiles/windrows of topsoil and vegetative material may be seeded and/or covered with mulch to minimize erosion and dust generation. To minimize the effects of dust on

neighbouring residences, access to and from the Project area will be via existing access roads through the adjacent former pit, which connects to Route 201 at the railway crossing. Monitoring of airbourne particulate emissions (dust) will be conducted at the request of NSEL and in accordance with the Pit and Quarry Guidelines.

Noise

As per the Pit and Quarry Guidelines, sound levels from operation will be maintained at a level not to exceed the following sound levels (Leq) at the property boundaries:

Leq 65dBA 0700-1900 hours (Days)
60dBA 1900-2300 hours (Evenings)
55dBA 2300-0700 hours (Nights)

Sound monitoring will be conducted at the request of NSEL.

GHG Emissions

Combustion emissions will be generated from the operation of vehicles and equipment. This will include small quantities of greenhouse gas (GHG) emissions, including CO_2, SO_2 and NO_x. Given the scope of the planned operations, these emissions will be minimal and localized. Emissions will be reduced through proper equipment maintenance and inspection, and reduction of engine idling when not in use.

Solid Waste

Solid waste generated on-site will be minimal (office and domestic refuse). All solid waste will be properly collected and stored until such time that it can be transported to a recycling facility (where appropriate) or a provincially approved waste disposal facility.

Acid Rock Drainage

Acid drainage conditions could occur if bedrock from the Halifax Formation is excavated or exposed to atmospheric conditions. The general direction of the pit and quarry development will be south, likely stopping short of contact with the Halifax Formation. Prior to quarry development, rock will be sampled and tested to confirm the suitability of the aggregate and confirm that the Halifax Formation slates, known widely to be acid producing, will not be encountered/disturbed. A groundwater monitoring program will be developed to detect any changes to groundwater quality associated with the proposed

quarry. Details of the monitoring program (*i.e.*, monitoring parameters and frequency) will be developed in consultation with NSEL.

2.4.3 Hazardous Materials and Contingency Planning

There is no planned storage of hazardous materials or petroleum products at the site. A qualified company will be contracted to conduct regular maintenance of equipment. Used oil and filters will be removed from the site and disposed of in an appropriate manner.

Refuelling of equipment will be conducted on a regular basis, under contract by a tanker truck, onsite. Refuelling activities will not be conducted within 100 m of any watercourse, and equipment operators will remain with the equipment at all times during refuelling in accordance with the Petroleum Management Regulations of the Nova Scotia *Environment Act*.

In the event of a leak or spill during refuelling, maintenance, or general equipment operation, immediate action will be taken to stop and contain the spilled material. All contaminated material will be collected and stored in an appropriate manner so as not to be re-released to the environment until such time as it will be transported to an approved treatment/disposal facility. All spills will be reported to the 24-hour environmental emergencies reporting system (1-800-565-1633) in accordance with the Emergency Spill Regulations of the Nova Scotia *Environment Act.*

As a requirement of the Industrial Approval application for this Project, Ward Aggregates will prepare a contingency plan for accidental events for NSEL approval. The Canadian Standards Association publication, *Emergency Planning for Industry (CAN/CSA-Z731-95),* will be consulted as a reference in the preparation of the contingency plan.

2.5 Decommissioning and Reclamation

Ward will undertake a progressive rehabilitation program at the pit/quarry site. As distinct areas within the pit/quarry become inactive, the area will be graded to a stable slope, covered with topsoil that has been stripped and stockpiled/windrowed, and seeded. Where practical, this may occur prior to seasonal shut-down. At the end of the pit/quarry operation (within six months of abandonment), rehabilitation will consist of: grading and contouring of all slopes and exposed rock faces in consideration of rock falls, slope stability, and safety; spreading existing stockpiled topsoil; and hydroseeding.

3.0 SCOPE

As it is Ward Aggregates' intent to develop a gravel pit and rock quarry operation greater than 4 ha, the Project must be registered for Environmental Assessment under the Environmental Assessment Regulations of the Nova Scotia *Environment Act* as a Class I Undertaking. This report fulfills the primary requirements for Project registration under this legislation.

3.1 Scope of the Undertaking

The proposed Project, as described in Section 2.0, consists of the development of a gravel pit (two areas comprising a total area 11.4 ha in size) and a quarry development approximately 4.25 ha in size. The two gravel pit areas are separated physically by a designated equipment laydown and stockpile area and a buffer area. The gravel within the proposed laydown/stockpile area was excavated many years ago by previous owners. Although it is likely that this area will remain untouched, with the exception of the use of the access road that runs along the eastern edge of the property, this area could accommodate aggregate stockpiles, and a laydown area for temporary crushing equipment if space becomes limited during development of the pit and quarry areas. Access to the site will be gained via an access road through the adjacent property (owned by R.B. Paving), connecting to Route 201 immediately adjacent to the railway crossing (*i.e.*, north and east of the Project area). This will create consistency in operations for local residents, as this is the same access location used for the previous adjacent operation.

Gravel will be excavated using heavy equipment (*i.e.*, backhoe and/or front-end loader) to a depth of 6 to 8 feet. Rock will be removed by mechanical means (*e.g.*, ripping) to a depth of 10 to 15 feet; there will be no blasting. Material will be stockpiled temporarily until portable crushing equipment is brought to the site for processing. Crushing activities will be sub-contracted to another company. Processed material may be stockpiled or loaded directly onto trucks where it will be transported along Route 201 to the R.B. Paving asphalt plant located approximately 6 km east of the proposed Project area or other markets/users. There is no anticipated requirement for washing of rock on site.

The average number of trucks hauling material from the operation is expected to be 5 to 6 per day. This could increase to as much as 10 to 12 per day, for a short period, if a large material or asphalt supply contract were awarded.

The anticipated average production rate is approximately 20,000 to 25,000 tonnes per year. The operating schedule will be based on 10 hrs/day, 5 days/week, and 28 weeks/year (May to November), weather permitting.

Ward will undertake progressive rehabilitation as the Project proceeds. Refer to Section 2 for further information.

3.1.1 Purpose and Need for the Undertaking

The materials to be produced at the pit/quarry are an important requirement in road and highway construction and maintenance projects in the region, as well as municipal and residential construction projects. The gravel will serve as a source supply for the R.B. Paving asphalt plant, which is under common ownership with Ward Aggregates.

The Project under consideration, as well as other similar pit and quarry developments in Nova Scotia, is an important component of the natural resource sector of the economy and provides essential raw materials to the province's construction industry. The quarry also provides direct and indirect employment for its workers and suppliers, as well as for the transportation and construction industries.

3.1.2 Project Alternatives

Due to the nature and characteristics of the material being removed from the site, it is feasible to conduct pit and quarry operations solely through mechanical means (*i.e.*, blasting is not required). Although it is possible to manage the impacts of blasting through standard mitigation measures (*e.g.*, pre-blast surveys, appropriate blast designs), mechanical means of gravel and rock extraction is likely preferable from the perspective of local residents. It is also a more cost-effective alternative to blasting.

An alternative facility location is not a feasible alternative. The operation is occurring in an area that is has already been heavily exposed to mining/quarrying activities. Development of the proposed Project will not require the construction of any new facilities, as the existing facilities (*e.g.*, roads and staging area) are sufficient for proposed operations. Relocation of the Project to another location may likely require development of a new site, construction of new facilities, and would potentially have greater effect on the surrounding biophysical and socio-economic environment. This site is also located within a short distance of the asphalt plant, making it a cost-effective source of gravel.

3.2 Scope of the Environmental Assessment

The proponent is required to register this Project as a Class I Undertaking pursuant to the Nova Scotia *Environment Act* and Environmental Assessment Regulations. Other relevant provincial regulations and guidelines include the Nova Scotia Pit and Quarry Guidelines (NSDOE 1999). Relevant federal legislation includes the *Species at Risk Act (SARA)*, *Fisheries Act* and the *Migratory Birds Convention Act.*

The scope of the environmental assessment in relation to the proposed Project has been determined by the Proponent and their consultant and is based upon the proposed Project elements and activities, the professional judgement and expert knowledge of the study team, consultations with the public and regulatory authorities on this and similar projects, and the results of field studies conducted at the site. The *Guide to Preparing an EA Registration Document for Pit and Quarry Developments in Nova Scotia* (NSDEL 2002) was also used to determine/focus the scope of the assessment.

The proponent and their consultant met with NSEL, the provincial regulatory agency, on December 8, 2004 to discuss the location, proposed expansion area, and elements and activities associated with the proposed Project, in an effort to focus the scope of the assessment. Project Information Bulletins were distributed to residents in the immediate vicinity of the Project, along Route 201 for the purpose of issue identification (see Section 4.0). Additional bulletins were posted at a local convenience store.

This environmental assessment evaluates the potential environmental effects of the proposed Project elements and activities, for all Project phases, with regard to each of the identified Valued Environmental Components (VECs) and Valued Socio-economic Components (VSCs). By assessing potential impacts on VECs/VSCs within the study boundaries, a meaningful evaluation of Project effects on relevant environmental parameters is achieved. Components evaluated include:

- fish and fish habitat;
- rare and sensitive flora;
- wetlands;
- wildlife (including herpetiles and breeding birds);
- groundwater resources;
- archaeological and heritage resources;
- air quality; and
- socio-economic environment.

Based on professional judgement and existing information, and given the size, nature and location of the proposed Project, the Proponent and its consultants are confident that the zones of influence and subsequent boundaries of the assessment for this Project are limited. The physical footprint of the pit/ quarry activities will only be 28.9 ha in total, a portion of which has been previously disturbed and developed, and the majority of emissions and discharges will likely be confined to the immediate vicinity of the Project area. Therefore, consideration of the above noted environmental components is focussed on their status in the general area of the Project and potential effects within the Project area.

As part of the scoping and assessment process, the Nova Scotia Government's Significant Species and Habitat database was consulted to determine the presence of high priority areas within the general area of the Project (*i.e.*, within 20 km). This database is maintained by the Nova Scotia Department of Natural Resources (NSDNR) and contains information on sites within Nova Scotia that contain species at risk, species of special conservation concern, specialized habitats that could be jeopardized by human activities, sites of high biodiversity and sites of local natural historic interest. The results of this search are provided in Figure 3. As shown, there are no sensitive habitats within 3 km of the site, with the exception of the Nictaux River, which has been identified as supporting a species at risk. This is likely related to the potential presence of Inner Bay of Fundy Salmon populations, which are listed as Endangered on Schedule 1 of *SARA*. The Annapolis River has been identified as supporting this species and the Nictaux River flows into the Annapolis River. It could also be related to the presence of wood turtle.

As stated above, this Project must comply with *SARA*, which requires proponents to demonstrate that no harm will occur to listed species, their residences or critical habitat. *SARA* serves to protect listed species by prohibiting activities that may harm individuals or critical habitat. *SARA* has been linked to the *Canadian Environmental Assessment Act (CEAA)* through requirements in both Acts. Section 79 of *SARA* requires that a Responsible Authority (RA) must notify the competent minister (likely DFO or Environment Canada) in writing if a project being assessed is likely to affect a listed wildlife species or its critical habitat. The RA must identify the adverse effects of the project on the species/critical habitat and, if the project is carried out, must ensure that measures are taken to avoid or lessen the effects and to monitor them. The measures must be taken in a way that is consistent with any applicable recovery strategy and action plan. *CEAA* specifically includes within its definition of "environmental effect" any change a project may cause to a listed wildlife species (*i.e.*, listed under *SARA*), its critical habitat (*i.e.*, the habitat that is necessary for the survival or recovery of a listed species and that is identified in the recovery strategy or action plan for the species) or the residences of individuals of that species (*i.e.*, a dwelling place, such as a den, nest or other similar area or place, that is occupied or habitually occupied by one or more individuals during all or part of their life cycles, including breeding, rearing, staging, wintering, feeding or hibernating).

It is understood that the recovery plan for the Inner Bay of Fundy Salmon populations is under development and critical habitat has not yet been defined (T. Wheaton, DFO, pers. comm. 2005). For this Project, particular consideration will be given to the potential for the Project to interact with fish habitat supporting Inner Bay of Fundy salmon populations. Note that the Wood Turtle is listed as a Species of Special Concern on Schedule 3 of *SARA*.

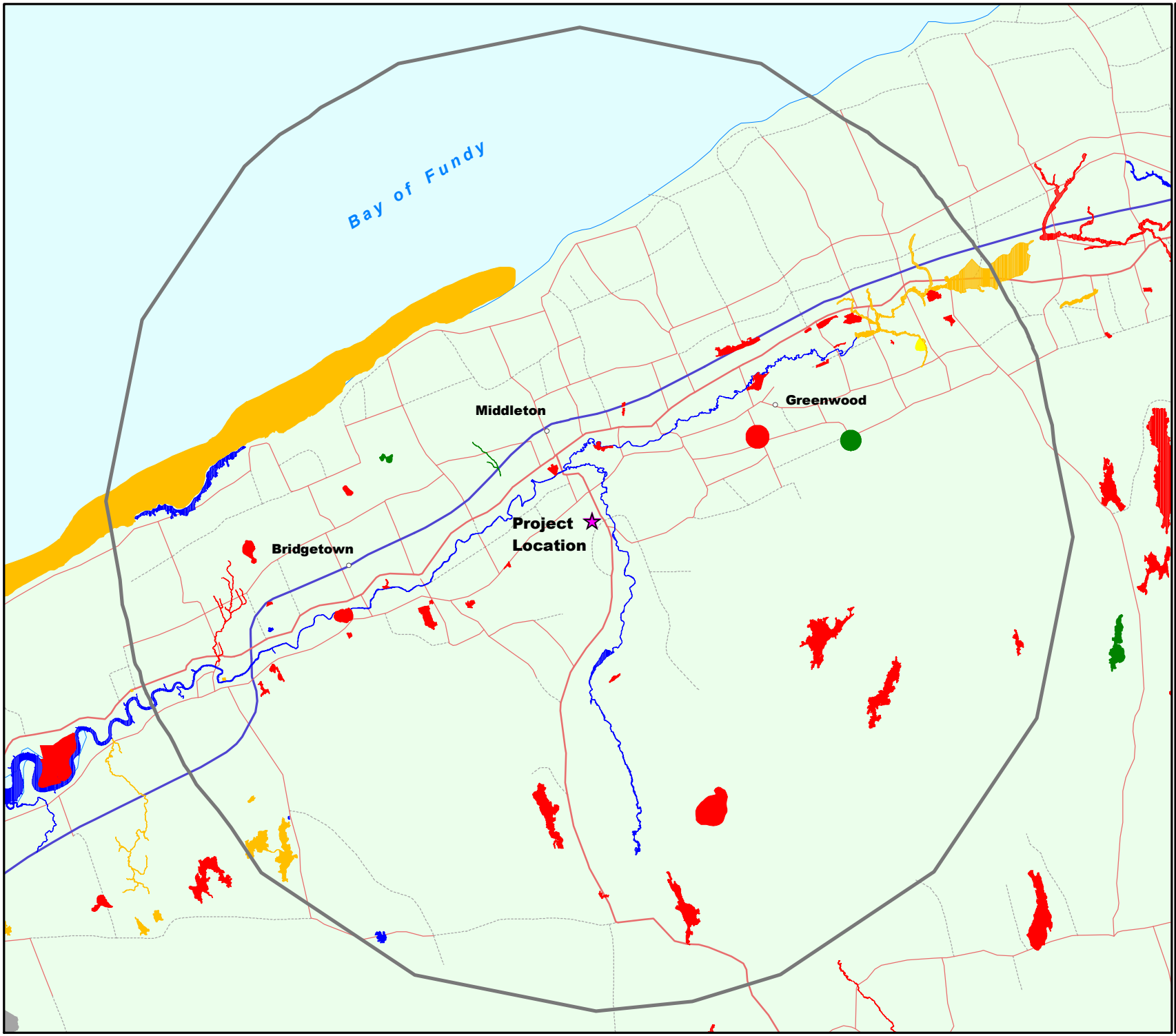

Figure 3

Significant Habitat

Project Components

- Project Location
- 25 Kilometre Buffer

Significant Habitat

- Migratory Bird
- Of Concern
- Other Habitat
- Rare Plant
- Species at Risk
- Land

Ward Aggregates
Proposed Gravel Pit
and Quarry
Development

N

0 5 10

Kilometres

Map Parameters
Projection: UTM
Zone: 20
Datum: NAD 83
Scale: 1:275,000
Project Number: NSD18995
Date: February 18, 2005

Jacques Whitford

4.0 PUBLIC INVOLVEMENT

4.1 Methods of Involvement

On December 19, 2004, a Project information bulletin was distributed to all landowners and a local business in the immediate vicinity of the proposed Project along Route 201. (Appendix C). A total of 14 bulletins were delivered to residents, and an additional 15 copies were delivered to the Needs Convenience Store, located at the intersection of Trunk 10 and Route 201.

4.2 Stakeholder Comments and Steps Taken to Address Issues

Table 1 summarizes the comments received and issues raised as a result of a meeting held with regulatory agencies (December 8, 2004) and the information bulletin that was distributed to residents within the immediate vicinity of the proposed Project. Comments received by regulatory agencies during a review of the draft environmental assessment report are also included. Ward's response/proposed resolution is provided for each issue raised.

Table 1 Summary of Comments and Concerns Raised by Stakeholders

Raised by:	Issue/Concern	Response/Proposed Resolution
NSDNR/NSEL/ Environment Canada	Timing of field surveys	A rare plant field survey was conducted in the study area in September 2004. A rare plant modelling exercise identified 37 vascular plant species that could occur on the property, most of which could be reliably be identified, if present, during the September survey. There are five species that could be present on the site and potentially affected by the Project, but would not have been easily identified during the September survey. Follow-up plant surveys will therefore be conducted in June and August 2005 and results will be forwarded to NSDNR, along with recommended mitigation and avoidance measures.
NSDNR	Protection of wetlands	Wetlands are recognized as intrinsically valuable ecosystems. The Project has been designed to avoid the footprint of all three wetlands on site. Buffer zones have been established around the wetlands to minimize potential for adverse effects on wetland hydrology (refer to Section 5.4).
NSNDR/DFO	Protection of fish habitat	There is one stream that crosses the proposed Project area. The existing access road crosses the stream via a steel culvert. Other than the use of the existing access road, a buffer zone will be maintained on both side of the stream (see Section 5.2.2). A site reconnaissance survey was conducted in October 2004. A fish habitat survey was conducted on Kempt Brook in April 2005. Although Kempt Brook contains fish habitat, there is no upstream access for fish to the Ward Aggregates property since the channel and fish habitat has been heavily impacted downstream of the proposed Project (refer to Section 5.2.1).

Table 1 Summary of Comments and Concerns Raised by Stakeholders		
Raised by:	**Issue/Concern**	**Response/Proposed Resolution**
Environment Canada	Potential for acid generating bedrock	Acid drainage conditions could occur if bedrock from the Halifax Formation, known widely to be acid producing, is mined or exposed to the atmosphere. The general direction of quarry advancement will be north to south, likely stopping short of contact with the Halifax Formation. As stated in Section 5.6.2, rock will be sampled and tested to confirm Halifax Formation slates that may be acid producing, will be not encountered/disturbed. If testing reveals risk of acid producing bedrock, these areas will be avoided.
Local Resident	Access to and from proposed Project Area	Ward Aggregates will access the Project area along existing access roads through the adjacent property to ensure consistency of operations for local residents.
Albert Dunphy, Planner with Municipality of Annapolis	Land use compatibility	The Municipality of the County of Annapolis was consulted to provide clarification regarding the current zoning for the site and applicability of the Municipal Planning Strategy and Land Use By-law. It is understood that municipalities do not have the jurisdictional authority to control the location of pits and quarries. The siting of these operations is a provincial issue. Municipalities do have some control over the location of components and infrastructure within a pit or quarry (i.e., location of stockpiles and crushers).
NSEL	Contact with First Nations	The nearest Mi'kmaq band is the Annapolis Valley First Nation, which is located in Cambridge, approximately 50 km from the Project site. Contact was not made with this band or the Confederacy of Mainland Mi'kmaq regarding the Project.
NSDNR/ Environment Canada	Erosion and sediment control	Erosion and sediment control measures are discussed generally in Section 2.4.2. Additional information will be provided in the Industrial Approval application.
NSEL	Groundwater resources	Section 5.4 and 5.6 of the draft environmental assessment report were revised to provide clarity on groundwater interaction with wetlands and direction of groundwater flow.
Environment Canada	*Species at Risk Act*	Section 3.2 discusses the applicability of the *Species at Risk Act* to the Project.
Environment Canada	Management of hazardous materials and wastes	Section 2.4.3 contains information on hazardous materials and contingency planning. There is no planned storage of hazardous materials or petroleum products at the site. Refueling activities will not be undertaken within 100 m of any watercourse. Ward Aggregates will prepare a contingency plan for accidental events for NSEL approval as a requirement of the Industrial Approval application.
Environment Canada	Effect of the environment on the Project	It is recognized that climate change could result in an increased likelihood of extreme precipitation events in the future. Planning, design and construction strategies will be directed at minimizing potential effects of heavy rainfall/flooding events. Also, the Project will operate from May to November, thereby limiting effects of severe winter weather on operations. Prior to winter shutdown, the quarry will be stabilized to minimize potential for siltation events.
Environment Canada	Greenhouse gas releases	Greenhouse gas emissions (*e.g.*, CO_2, SO_2, and NO_x) will generated by the Project as a result of operations of vehicles and equipment. These emissions will be minimal and localized. Emissions will be reduced through proper equipment maintenance and reduction of engine idling.

5.0 VALUED ENVIRONMENTAL/SOCIOECONOMIC COMPONENTS (VEC/VSC) AND EFFECTS MANAGEMENT

5.1 Methodology

Field studies were conducted by Jacques Whitford Limited on September 21 and 22 and October 4, 2004 and April 21, 2005 to investigate and establish existing conditions and to determine appropriate mitigation, if necessary, to minimize environmental effects from the proposed expansion Project. These surveys consisted of: vegetation surveys; mammal survey; herpetile survey; and fish habitat survey. These surveys were undertaken by qualified personnel employed by Jacques Whitford. An assessment of potential archaeological and heritage resources was undertaken by a qualified archaeologist. Additional information, in support of the field studies and the assessment, was gathered through a review of: air photos; site mapping; and other information sources, such as the Nova Scotia Museum.

Temporal and spatial boundaries encompass those periods during, and areas within which, the VECs are likely to interact with, or be influenced by, the Project. Both the temporal and spatial boundaries for the assessment vary according to the VEC, but are generally limited to the duration of, and for a period of time after, the activities and the immediate Project area unless otherwise noted.

To assess the potential environmental effects of a project and determine the significance of an effect, it is important to consider the magnitude, frequency, duration, geographical extent and reversibility of the potential effect. The study team has considered these elements for each VEC/VSC, as well as the following:

- negative effects on the health of biota;
- loss of rare or endangered species;
- reductions in biological diversity;
- loss of critical/productive habitat;
- fragmentation of habitat or interruption of movement corridors and migration routes;
- transformation of natural landscapes;
- discharge of persistent and/or toxic chemicals;
- toxicity effects on human health;
- reductions in the capacity of renewable resources to meet the needs of present and future generations; and
- loss of current use of lands and resources for traditional purposes by Aboriginal persons.

5.2 Surface Water and Fish and Fish Habitat

5.2.1 Description of Existing Environment

A review of 1:10,000 scale NTS mapping and aerial photographs of the area revealed the presence of a small stream, known as Kempt Brook, crossing the proposed Project area. According to the available mapping, Kempt Brook originates approximately 750 m south of the Project area (in South Mountain), flows through the site and adjacent property pits, crosses Route 201, and discharges into the Annapolis River, about five kilometres downstream (north) of the Project Area (Figure 2). Historically, many tributaries within the Annapolis watershed have supported healthy, self-sustaining populations of native brook trout (*Salvelinus fontinalis*) and Atlantic salmon (*Salmo salar*). Due to habitat loss and degradation through land clearing practices in agriculture, forestry, urban and industrial developments within the watershed, many of these streams are now unable to sustain the number of fish they once produced. Trout and salmon habitat loss and degradation in this area have occurred for many years.

The Annapolis River is known to support a population of the Inner Bay of Atlantic salmon, a species population that is listed under Schedule 1 of the *Species at Risk Act* as an endangered species. It is therefore subject to the prohibitions under Section 32(1), Section 33 and Section 58 of the *Act*. The potential for effects on water quality and quantity as a result of the proposed Project are discussed/addressed below.

A fish habitat survey was conducted on Kempt Brook on April 21, 2005. The most upper reach of Kempt Brook flows parallel with the eastern boundary of the Ward Aggregate property and down a steep grade which forms a step series of small scale cascades, riffles and plunge pools. As the grade levels out, the single channel is relatively straight, about 50 cm wide at high water (freshette event), and very shallow (10 cm). The substrate consists of assorted sizes of clean gravels (4.8 to 75 mm) with little to no fines. The banks are relatively low, about 25 cm. Overhead cover is predominantly deciduous. Bank cover consists largely of gramminoid vegetation. Instream cover is low and consists of woody debris. During the summer season and under low water flow conditions, this reach of Kempt Brook would not be favourable to support salmonid species. There is insufficient water depth and physical habitat features to accommodate cold water species.

Below this reach, Kempt Brook flows through a wetland (Wetland 2). Photo 1 was taken in October 2004. Photos 2 and 3 were taken April 2005 the day after a relatively light rainfall and snowfall.

Photo 4 was taken upstream of the access road culvert and shows the significant flooding in the wetland.

Photo 1 **Kempt Brook Downstream of Property Access Road – October 2004**

Photo 2 **Kempt Brook Downstream of Property Access Road – April 2005**

Photo 3 **Looking Further Downstream of Culvert on Property Access Road – April 2005**

Photo 4 **Kempt Brook Upstream of the Access Road**

The wetland and watercourse cross the property as Kempt Brook flows west into the downstream adjacent property which is another sand and gravel extraction operation. There is fish habitat in this reach of Kempt Brook, albeit limited in the drier seasons. However, there is no access for fish due to the alteration of Kempt Brook's channel and fish habitat from historic off-site activities downstream of the proposed Project.

On the adjoining property, the stream flows through two pits, which are flooded during precipitation events and snowmelt. Discharge from the second pit is through an excavated trench into a flooded

wetland from which a stream channel is reformed as it flows through a culvert in an access roads. The watercourse follows a defined channel that has been modified by pushed off overburden. The watercourse flows into a large wetland that brackets another access road. Three culverts allow drainage under the road. The wetland drains out through two small channels; one has an old, small beaver dam which created this wetland and the other channel spills overland under high water conditions. The latter channel flows through another pit. It is at this point and downstream where many young-of-year trout were observed during the April survey. Downstream of this pit development, the stream is relatively undisturbed and supports excellent salmonid habitat as indicated by the habitat features present and the abundance of trout fry. There is no upstream access for these fish or any other species to the Ward Aggregates property as a result of historic alteration of fish habitat on the downstream adjacent property.

The site survey in October revealed the surficial geology to consist predominantly of unconsolidated gravels with underlying sand. Therefore, surface runoff contributes a minor component to the brook hydrology and groundwater base flow (springs) is likely the dominant source. The persistent nature of the flow is unknown for this watercourse; however anecdotal information indicated that the stream bed is dry for the majority of the summer and fall.

The Clean Annapolis River Project does not include Kempt Brook as a study tributary at this time; therefore, there is no historical water quality or fish habitat data for this watercourse.

5.2.2 Potential Effects, Proposed Mitigation, Monitoring and Follow-up

Water Quality and Quantity

Site preparation (*i.e.*, clearing, grubbing, and topsoil stripping) and pit and quarry activities (excavation, and hauling) will increase the potential for sediment erosion and deposition in Kempt Brook and downgradient, particularly during periods of heavy rainfall or snow melt. Clearing and grubbing will also result in a reduction of evapotranspiration and a (potential) corresponding increase in surface runoff (depending upon site grading and geology), which in turn increases potential for sediment erosion and deposition.

The upper section of the property has some clay content in the surficial soils. To minimize the potential for sediment laden runoff, clean surface drainage will be directed away from disturbed areas. The design of proper site drainage and road drainage and use of properly sized flow retention structures are expected to mitigate erosion and sedimentation. There will be no direct discharge of water from a ditch or retention pond into Kempt Brook. Filtration of surface runoff through a vegetative area or infiltration can mitigate potential adverse effects on water quality of the watercourse. As indicated in Section 2.4.2, effects on the downstream flows and water quality associated with the proposed Project can be fully mitigated using the placement of free-draining material (*i.e.*, rock/gravel) and/or proper and timely

stabilization of erodible material and properly sized flow retention structures/areas. Following the use of these mitigative measures, the remaining residual effects on downstream flows and water quality are expected to be minor.

Overflow from the retention structures will be monitored, sampled and reported according to the Pit and Quarry Guidelines or as prescribed in the terms and conditions of the Industrial Approval to ensure total suspended solids levels do not exceed the approved final effluent discharge limits. Baseline water quality data will be collected for Kempt Brook in conjunction with the fish and fish habitat survey.

The Pit and Quarry Guidelines also require a 30 m separation distance be maintained between active areas (*e.g.*, crushing equipment and stockpiles) and the bank of any watercourses or the ordinary high water mark. The proposed buffer to be maintained on either side of the stream (*i.e.*, approximately 60 m north and more than 100 m south) more than satisfy this requirement.

Fish and Fish Habitat

Section 35 of the *Fisheries Act* requires approval by Fisheries and Oceans Canada (DFO) for any alteration, disruption or destruction of fish habitat (*i.e.,* a HADD authorization) and also triggers the requirement for a federal environmental assessment under the *Canadian Environmental Assessment Act*.

The potential environmental effects of blasting in and adjacent to watercourses (*i.e*., potential harmful effects on fish, fish eggs and larvae) are not an issue as this activity will not be carried out.

All physical works, stockpiles of aggregates etc. will not be undertaken or placed within at least 60 m of the stream. Equipment refuelling will not be undertaken within 100 m of the stream. Due to the distance of physical works and activities from Kempt Brook and with implementation of effective spill response, it is not considered likely that any small spills of hydrocarbons that could occur on-site would have the potential of reaching or impacting any stream. As described in Section 2.4.3, all spills will be reported to the 24-hour environmental emergencies reporting system.

5.2.3 Summary

Based on the results of the analysis and the limited potential for interaction with Kempt Brook, with adequate mitigation including maintenance of a buffer zone, redirection of clean intercepted baseflow into Kempt Brook, and collection of surface and stormwater runoff into properly sized and designed flow retention structures allowing for infiltration back into the groundwater and/or filtration through a vegetative area, there is limited potential for quarry activities to interact with surface water or fish and fish habitat. With effective sediment and erosion control measures and compliance with the existing guidelines, effects on fish habitat will likely be non-significant. With zero offsite discharge of

deleterious substances within the guideline limits, no significant adverse effects on Inner Bay of Fundy Atlantic Salmon or the habitat of this species are likely to occur in the Annapolis River as a result of the proposed Project. In summary, significant adverse Project-related effects on surface water and fish habitat are not likely to occur.

5.3 Rare and Sensitive Flora

5.3.1 Description of the Existing Environment

Prior to conducting field surveys, aerial photography of the site was reviewed to determine the number and distribution of various habitats on the property. During the field survey conducted on September 21 and 22, 2004, examples of each of the habitat types were visited and described. A total of 13 distinct habitat types are present on the property. These include mature aspen – sugar maple forest, mature red maple – red oak forest, mature spruce – red oak forest, immature gray birch – pin cherry forest, clear-cut, grubbed clear-cut, low shrub thicket, abandoned gravel pit, coniferous treed basin bog, low shrub dominated basin bog, deciduous treed stream swamp, tall shrub dominated stream swamp, and tall shrub dominated spring swamp. Each of these habitats is described in Appendix D.

Rare Vascular Plants

The habitat survey was used to assist in a rare plant modelling exercise. As part of the modelling exercise, all records of vascular plant species listed by the Nova Scotia Department of Natural Resources as at risk (Red listed) or sensitive to human activities or natural events (Yellow listed) (NSDNR 2002) within a radius of 100 km were compiled by means of an Atlantic Canada Conservation Data Centre (ACCDC) data search. The habitat requirements of these species were compared to the habitat descriptions compiled for the study area to determine if suitable habitat was present in the study area for these species. In instances where appropriate habitat was present, for a particular species, that species was considered to be potentially present and the suitable habitat in the study area was identified as a target for field surveys. The phenology and ease of identification of each of the species potentially present in the study area was also incorporated into the model in order to determine the best times to conduct the field surveys.

The results of the model are presented in Appendix E Table 1. A total of 98 red or yellow-listed species have been recorded within 100 km of the study area. Based on the results of the model, 36 red or yellow-listed species could potentially be present in the study area. Table 2 lists these species and the habitats present in the study area where they could potentially be found.

Table 2 Rare and Sensitive Vascular Plant Species Potentially Present in the Study Area				
Binomial	**Common Name**	**NSDNR Provincial Status**	**ACCDC Provincial Status**	**Habitats in which the Species may be Present in the Study Area**
Eupatorium dubium	Joe-Pye Thoroughwort	Red	S2	Deciduous treed stream swamp, tall shrub dominated stream swamp, tall shrub dominated spring swamp
Helianthemum canadense	Canada Frostweed	Red	S1	Grubbed clear-cut, abandoned gravel pit
Desmodium canadense	Showy Tick-Trefoil	Red	S1	Aspen – sugar maple forest, red maple – red oak forest
Hepatica nobilis	Round –leaved Liverleaf	Red	S1	Aspen – sugar maple forest, red maple – red oak forest
Thuja occidentalis	Northern White Cedar	Red	S1S2	Deciduous treed stream swamp, tall shrub dominated stream swamp, tall shrub dominated spring swamp
Carex castanea	Chestnut-coloured Sedge	Red	S2	Deciduous treed stream swamp, tall shrub dominated stream swamp, tall shrub dominated spring swamp
Carex prairea	Prairie Sedge	Red	S1	Deciduous treed stream swamp
Carex tuckermanii	Tuckerman Sedge	Red	S1	Deciduous treed stream swamp
Goodyera pubescens	Downy Rattlesnake-Plantain	Red	S1	Aspen – sugar maple forest, red maple – red oak forest, spruce – red oak forest, gray birch – pin cherry forest
Listera australis	Southern Twayblade	Red	S1	Coniferous treed basin bog
Panicum xanthophysum	Slender Dichanthelium	Red	S1	Gray birch – pin cherry forest
Rudbeckia laciniata	Cut-leaved Coneflower	Yellow	S2S3	Deciduous treed stream swamp, tall shrub dominated stream swamp, tall shrub dominated spring swamp
Betula nana	Swamp Birch	Yellow	S2	Coniferous treed basin bog, low shrub dominated basin bog
Campanula aparinoides	Marsh Bellflower	Yellow	S3?	Abandoned gravel pit
Hudsonia ericoides	Golden-Heather	Yellow	S2	Abandoned gravel pit, grubbed clear-cut
Fraxinus nigra	Black Ash	Yellow	S3	Deciduous treed stream swamp, tall shrub dominated stream swamp, tall shrub dominated spring swamp
Epilobium coloratum	Purple-Leaf Willow-Herb	Yellow	S2?	Deciduous treed stream swamp, tall shrub dominated stream swamp, tall shrub dominated spring swamp, abandoned gravel pit
Polygala sanguinea	Field Milkwort	Yellow	S2S3	Red maple- red oak forest, clear-cut
Polygonum arifolium	Halberd-Leaf Tearthumb	Yellow	S2	Tall shrub dominated stream swamp, tall shrub dominated spring swamp
Salix pedicellaris	Bog Willow	Yellow	S2	Coniferous treed basin bog, low shrub dominated basin bog
Salix sericea	Silky Willow	Yellow	S2	Low shrub thicket, abandoned gravel pit.
Geocaulon lividum	Northern Commandra	Yellow	S2S3	Coniferous treed basin bog, low shrub dominated basin bog
Laportea canadensis	Wood Nettle	Yellow	S3	Deciduous treed stream swamp
Viola nephrophylla	Northern Bog Violet	Yellow	S2	Spruce – red oak forest, Deciduous treed stream swamp, Coniferous treed basin bog
Juncus marginatus	Grassleaf Rush	Yellow	S2S3	Deciduous treed stream swamp, tall shrub dominated stream swamp, abandoned gravel pit
Platanthera flava	Southern Rein Orchid	Yellow	S2	Deciduous treed stream swamp, tall shrub dominated stream swamp, tall shrub dominated seepage track swamp, Coniferous treed basin bog
Platanthera macrophylla	Large Round-Leaved Orchid	Yellow	S2	Spruce – red oak forest

Table 2 Rare and Sensitive Vascular Plant Species Potentially Present in the Study Area				
Binomial	**Common Name**	**NSDNR Provincial Status**	**ACCDC Provincial Status**	**Habitats in which the Species may be Present in the Study Area**
Spiranthes ochroleuca	Yellow Nodding Ladies'-Tresses	Yellow	S2	Abandoned gravel pit
Calamagrostis stricta	Bentgrass	Yellow	S1S2	Coniferous treed basin bog, low shrub dominated basin bog
Panicum linearifolium	Slim-Leaf Witchgrass	Yellow	S2?	Grubbed clear-cut, Abandoned gravel pit
Piptatherum canadense	Canada Mountain-Ricegrass	Yellow	S2	Grubbed clear-cut, Abandoned gravel pit
Woodwardia areolata	Netted Chainfern	Yellow	S2	Deciduous treed stream swamp, tall shrub dominated stream swamp, tall shrub dominated spring swamp, Coniferous treed basin bog
Equisetum pratense	Meadow Horsetail	Yellow	S2	Red maple- red oak forest
Botrychium lanceolatum	Lance-leaf Grape-Fern	Yellow	S2	Aspen – sugar maple forest
Botrychium simplex	Least Grape-Fern	Yellow	S2S3	Deciduous treed stream swamp
Ophioglossum pusillum	Adder's Tongue	Yellow	S2S3	Tall shrub dominated stream swamp

The rare plant modelling exercise suggests that all habitats in the study area could provide habitat for rare or sensitive vascular plant species.

A rare plant field survey was conducted in the study area on September 21 and 22, 2004. All of the habitats present in the study area were surveyed. All species of vascular plant encountered during the survey were identified and their population status in Nova Scotia were determined through a review of the species status reports prepared by NSDNR (NSDNR 2002; NSDNR 2003), ACCDC (ACCDC 2004), and the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2004). A list of the 261 vascular plant species found on the site is presented in Appendix E Table 2.

None of the species encountered during the field survey are considered to be endangered, vulnerable or of special concern by COSEWIC (2004). Seven uncommon or rare vascular plant species were found in the study area. These included tall hairy groovebur (*Agrimonia gryposepala*), hop sedge (*Carex lupulina*), panicled hawkweed (*Hieracium paniculatum*), slim-leaf witchgrass (*Panicum linearifolium*), Appalachian polypody (*Polypodium appalachianum*), swamp rose (*Rosa palustris*), and hooded ladies'-tresses (*Spiranthes romanzoffiana*). Note that six of the seven species were not identified during the modelling exercise. The exercise is based on recorded instances within a 100 km radius of the Project area and should not be considered exhaustive. It also only focusses on NSDNR species at risk.

The slim-leaf witchgrass is yellow-listed by NSDNR indicating that it is sensitive to human activities or natural events. Hop sedge is considered to be uncommon by ACCDC and is listed as status undetermined by NSDNR indicating that there is insufficient data available to determine its population status in Nova Scotia. Appalachian polypody is considered to be uncommon by ACCDC although its

status is uncertain. NSDNR has not assessed the population status of this species. Appalachian polypody has only recently been identified as a species. It was formerly considered as a variety of rock polypody (*Polypodium virginianum*).

The four remaining species are considered to be uncommon by ACCDC and are listed as secure species (green listed) by NSDNR. Figure 4 shows the distribution of these species in the study area. The distribution of slim-leaf witchgrass is approximate. This species is difficult to identify in the field and was only recognized after specimens had been collected and examined in the laboratory. Slim-leaf witchgrass was found in the recent clear-cut present in the northern end of the property. The clear-cut is approximately two years old and was formerly a conifer stand dominated by red pine (*Pinus resinosa*). The shrub layer was open and composed of a mixture of black cherry (*Prunus serrotina*), red oak (*Quercus rubra*) and white spruce (*Picea glauca*) seedlings along with blackberry (*Rubus sp.)* and American fly-honeysuckle (*Lonicera canadensis*). The ground vegetation layer was composed mainly of white-grained mountain-ricegrass (*Oryzopsis asperifolia*), poverty oat-grass (*Danthonia spicata*), bracken fern (*Pteridium aquilinum*), and goldenrod (*Solidago puberula* and *S. bicolor*). The southern half of the clear-cut had been grubbed. This area contained only scattered shrubs, mainly black cherry and red oak, and a very dense ground vegetation cover composed mainly of bracken fern. Of interest is the presence panic-grass (*Panicum sp.)* in this area. This area may support slim-leaf witchgrass.

Hop sedge was found growing in swamp habitats present on the property, specifically deciduous treed stream swamp, tall shrub dominated stream swamp, and tall shrub dominated spring swamp. It was typically found in more open areas dominated by grasses and sedges such as manna grasses (*Glyceria striata* and *G. canadensis*), and the sedges (*Carex lurida* and *C. gynandra*).

Appalachian polypody was found at the southern end of the property on a stony hillside. It was typically found growing in shady areas on the tops of exposed boulders along with Virginia polypody. It was associated with the mature mesic aspen – sugar maple forest.

Tall hairy groovebur was encountered at a number of locations on the property. It was typically found in forest habitat, generally growing in small gaps in the canopy. It was also found in swamps on the property. The plant communities in which this species was found include mature mesic aspen – sugar maple forest, mature mesic red maple – red oak forest and deciduous treed stream swamp.

Swamp rose was found in the deciduous treed stream swamp community. It was typically found in the interior of the wetland associated with blue-joint grass (*Calamagrostis canadensis*), speckled alder (*Alnus incana*) and narrow-leaved meadow-sweet (*Spiraea alba*).

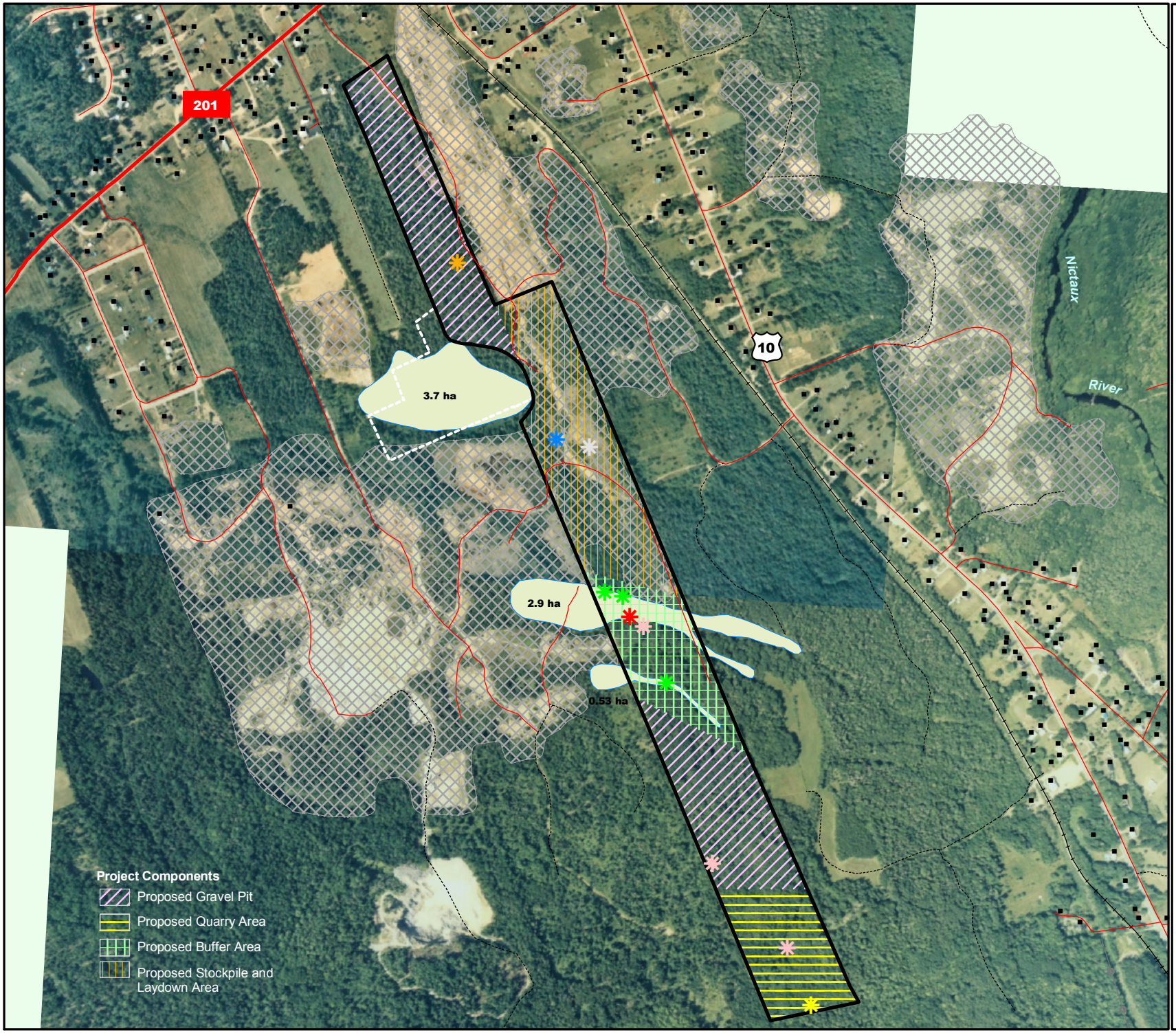

Figure 4

Habitat Survey Results

Rare & Uncommon Plant Locations
- Slim-leaf Witchgrass
- Hop Sedge
- Appalachian Polypody
- Hooded Ladies'-tresses
- Panicled Hawkweed
- Swamp Rose
- Tall Hairy Groovebur

Project Components
- Ward Aggregates Owned
- Proposed Permitted Area

Topography
- Building/Structure

Roads
- Minor Road
- Major Road
- Trail/Track
- Rail

- Wetlands
- Pits

Ward Aggregates Proposed Gravel Pit and Quarry Development

N

0 100 200 300

Meters

Map Parameters
Projection: UTM
Zone: 20
Datum: NAD 83
Scale: 1:10,000
Project Number: NSD18995
Date: February 18, 2005

Jacques Whitford

Hooded ladies'- tresses was found in the abandoned gravel pit in the center of the property. It was found in flat low-lying areas that are inundated early in the spring season and dry out in the summer (probably by early July). It was associated with species such as Nova Scotia false-foxglove (*Agalinus purpurea var. neoscotica*), spreading bentgrass (*Agostis stolonifera*), Canadian St. John's-wort (*Hypericum canadense),* and small sundrops (*Oenothera perennis*). Panicled hawkweed was found in the same plant community but occurred in drier areas.

5.3.2 Potential Effects, Proposed Mitigation, Monitoring and Follow-up

One yellow-listed species, one species with undetermined status and one species whose status has not been assessed by NSDNR were encountered on the property. In addition, four other species considered to be uncommon by ACCDC but considered to be secure by NSDNR were also found on the property. Four of these species are not expected to be affected by operation of the quarry including hop sedge, swamp rose, hooded ladies'-tresses, and panicled hawkweed. Hop sedge and swamp rose are found only in wetlands on the property. Ward Aggregates has committed to avoiding disturbance to wetlands. These wetlands and a surrounding buffer zone will be preserved. Hooded ladies'-tresses and panicled hawkweed were found in the portion of the property that has been previously developed. It is not expected that this area will be heavily disturbed in the future due to the proposed Project. There is some potential that parts of it may be used for aggregate storage laydown for temporary crushing equipment. There should be enough room to allow these activities and provide a protected area for these uncommon species.

The Appalachian polypody found on the property will probably be lost as a result of the proposed quarry at the southern end of the property. The population status of this species is currently poorly understood since it has only recently been split from the rock polypody as a separate species. It is likely that this species is secure in Nova Scotia. Loss of the population on the Ward Aggregates property is not expected to have any significant effect on provincial or local populations of this species.

Tall hairy groovebur was found at three locations on the property, with a total of 31 plants recorded. Two of the three sites are expected to be lost as a result of the proposed development resulting in the loss of 24 out of 31 plants. This species is considered to be uncommon by ACCDC, but is listed as secure in Nova Scotia by NSDNR. It is not anticipated that the Project will have a significant adverse effect on local populations of this species. No mitigation is proposed for this species.

Slim-leaf witchgrass was found in the recent clear-cut located at the northern end of the property. Ward Aggregates intends to extract gravel from this area so it is likely this species would be affected by the Project. This species is yellow-listed indicating that its populations in Nova Scotia is sensitive to human activities and natural events. There are five known records of this species in the province. According to Sean Blaney of ACCDC, this species is likely under-reported (even more so than the average rare plant)

because of its general obscurity and close resemblance to the more common P. depauperatum (S. Blaney, pers. comm. 2005). Although the field survey was conducted at the appropriate time for this species, the abundance and distribution on the property is poorly understood since it is difficult to identify in the field. In order to accurately assess the potential impact of the Project on this species and develop mitigative measures to minimize adverse effects on it, it will be necessary to conduct directed field surveys to establish its abundance and distribution. The best time to detect slim-leaf witchgrass is August or September. Once the distribution and abundance of this species is known, it will be possible to assess the significance of the populations and develop mitigative measures to minimize the effects of the Project on these species.

The rare plant modelling exercise identified 37 vascular plant species that could occur on the property. Twenty-seven of these species, if present, could be reliably identified at the time that the field survey was conducted (September 21 and 22). The remaining ten species could not be reliably identified in late September. Two of the orchid species, downy rattlesnake-plantain (*Goodyera pubescens*) and large round-leaved orchid can be excluded from the site by process of exclusion. Rattlesnake plantains as a group are easily identified by leaf shape and the distinctive white patterns on their leaves. No rattle-snake plantains were observed during the survey so it is unlikely that downy rattlesnake plantain was present. There are two Platanthera species in Nova Scotia that have broad elliptical basal leaves. No round-leaved Platanthera species were encountered during the survey so it can be assumed that large round-leaved orchid is unlikely to be present.

Three early flowering species that could occur on the property can be eliminated from consideration due to the fact that their preferred habitats will not be affected by the Project. These include southern twayblade (*Listera australis*), bog willow (*Salix pedicellaris*) and southern rein orchid (*Platanthera flava var. flava*), all of which are associated with wetland habitats. Wetland habitats will be avoided and buffer zones will be established around them to minimize the potential for adverse hydrological effects.

This leaves five species that could be present on the site, are potentially located in areas affected by the proposed pit and quarry activities, and are difficult or impossible to detect late in the summer. These include Canada frostweed (*Helianthemum canadense*), marsh bellflower (*Campanula aparinoides*), silky willow (*Salix sericea*), Canada mountain-ricegrass (*Oryzopsis canadense*), and northern bog violet.

Canada frostweed, silky willow, Canada mountain-ricegrass, and northern bog violet can be reliably identified in June, consequently, a second rare plant survey should be conducted at this time. Marsh bellflower flowers in August which coincides with the flowering period for slim-leaf witchgrass. A search for marsh bellflower could be combined with the survey used to determine the abundance and distribution of slim-leaf witchgrass. The effect of the project on rare plant species will be reassessed once the results of these supplemental surveys are compiled and interpreted. Once this information is

acquired, appropriate mitigative measures can be developed to minimize adverse effects of the Project on these species.

In an effort to allow the Project to commence in advance of completion of the additional field surveys, Ward Aggregates will limit its activities to the northern most portion of the Project area in the 2005 season. Pit development will not proceed beyond 150 m south of the proposed Project boundary, until the results of the additional field surveys are interpreted and appropriate mitigation is developed. This will afford a buffer of 250 m around the location where the species was collected. Once the results of the additional field surveys are interpreted, this information will be reported to NSDNR, along with recommended mitigation and avoidance measures.

Generic mitigative measures that help to minimize the effects of the Project on plant communities include the use of seed mixtures free of noxious weed during site reclamation. Wherever practical, native plants will be used for site reclamation.

5.3.3 Summary

In summary, additional field surveys will be conducted to assess the effects of the Project on rare plant species. Limitation of activity to avoid the habitat in which these species may exist in 2005, until follow-up surveys are complete, will minimize potential adverse effects of the Project on these species. Results of the additional rare plant surveys will be reported to NSDNR, along with recommended mitigation and avoidance measures.

5.4 Wetlands

5.4.1 Description of Existing Conditions

Wetlands are recognized as intrinsically valuable ecosystems. In order to assess the value of the wetland relative to the value of the Project, wetland evaluations are required by the province. The use of this regulatory tool results in wetlands with varying relative value and requires the evaluator to make judgments based on specified criteria. The references in the following descriptions to the "value" of the wetlands found on the property are made within this context and are not intended to imply that all wetlands do not play important functions as wildlife habitat.

Three wetlands were found on the property. This included a basin bog (Wetland 1), a stream swamp (Wetland 2) and a spring swamp (Wetland 3) (Figures 2, 4). Wetland 1 is found near the northern end of the property and is 3.7 ha in size. It is a wetland complex composed of two distinct bog types, Coniferous treed basin bog and low shrub dominated basin bog. Coniferous treed basin bog is found around the periphery of the bog. Tree cover consists of an open canopy consisting of black spruce

(*Picea mariana*). The shrub understory is composed mainly of low ericaeous shrub species including rhodora (*Rhododendron canadense*), leatherleaf (*Chamaedaphne calyculata*) and Labrador tea (*Ledum groenlandicum*). Some taller shrubs are also present, the most abundant of which are mountain holly (*Nemopanthus mucronata*), red chokeberry (*Aronia arbutifolia*) and possum-haw viburnum (*Viburnum nudum*). The ground vegetation layer consists of a carpet of moss species, mainly Schreber's moss (*Pleurozium schreberi*) and sphagnum moss (*Sphagnum* spp.).

The low shrub dominated basin bog is similar in species composition to the coniferous treed basin bog except that the tree layer is reduced to a few scattered black spruce and the shrub layer consists almost exclusively of low ericaceous shrubs including sheep laurel (*Kalmia angustifolia*), Labrador tea and rhodora. The ground layer consists mainly of Schreber's moss, sphagnum moss and reindeer moss lichen (*Cladonia alpestris*). This community is found in the wetter central portion of the bog.

Appendix E lists the vascular plant species found in this wetland. Animals recorded in the wetland include varying hare (*Lepus americanus*), white-tailed deer (*Odocoileus virginianus*), red squirrel (*Tamiasciurus hudsonicus*), raccoon (*Procyon lotor*), Black-capped Chickadee (*Poecile atricapillus*), and Northern Flicker (*Colaptes auratus*). None of the plant or animal species recorded in the wetland is considered to be uncommon or rare in Nova Scotia (ACCDC 2004; NSDNR 2002; NSDNR 2003) or Canada (COSEWIC 2004).

The basin bog contains no open water habitat and has little significance as waterfowl habitat. The wetland does not provide habitat for any uncommon, rare or endangered species of plant or animal. Basin bogs such as this are a common wetland type in Nova Scotia. Although this wetland may receive seasonal shallow groundwater when the groundwater table is high, it is inferred that a zone of low permeability soils underlie the basin bog which creates a perched groundwater table condition. The wetland may help to regulate the local flow of surface waters; however, given the small size of the wetland, its effect on local hydrology is probably not significant. The wetland may play a role in maintenance of surface water quality. Disturbed areas are located on two sides of the wetland. The wetland may act as a sediment pond filtering sediment laden surface waters. It is not believed that the wetland plays a significant role in removing sediment from surface waters since most of the surrounding disturbed areas are pits that drain away from the wetland. There is no evidence to indicate that the wetland is used for recreational purposes. It has no potential for either agricultural production or peat harvesting. Overall, the wetland is not considered to be relatively valuable:

- it is relatively small;
- it is very dry with no standing water;
- there are only 13 species of vascular plant in the wetland;
- the wetland does not provide good habitat for amphibians, waterfowl or semi-aquatic mammals;

- the wetland is unlikely to support more than five bird species and a similar number of mammal species;
- there are few obligate wetland plant or animal species present;
- the potential for rare species to be present is very low; and
- the wetland class to which this wetland belongs (bog) is the most abundant wetland class in Nova Scotia.

Wetland 2 is found near the center of the property and is 2.9 ha in size (Figures 2, 4). The wetland has developed in the flood plain of a small intermittent stream (Kempt Brook). At the time of the survey (September 21 and 22), the stream was not flowing and only a few small pools were present. Wetland two is a wetland complex composed of two wetland types including deciduous treed stream swamp and tall shrub dominated stream swamp. Deciduous treed stream swamp occurs mainly along the margins of the wetland. It is characterized by a moderately dense tree canopy composed of a mixture of red maple (*Acer rubrum*) and gray birch (*Betula populifolia*). The shrub understory is relatively sparse and consists of a mixture of speckled alder (*Alnus incana*), black holly (*Ilex verticillata*), narrow-leaved meadow-sweet (*Spiraea alba*), and advanced regeneration of balsam fir (*Abies balsamea*). Sedge (*Carex gynandra*), cinnamon fern (*Osmunda cinnamomea*), sensitive fern (*Onoclea sensibilis*), and fowl mannagrass (*Glyceria striata*) are the dominant species of the ground vegetation layer.

The tall shrub stream swamp is characterized by a sparse tree canopy composed of a mixture of red maple, gray birch, balsam fir and American larch (*Larix laricina*). The shrub understory is dense and composed largely of speckled alder, pussy willow (*Salix discolor*), swamp rose (*Rosa palustris*), and narrow-leaved meadow-sweet. The ground vegetation layer is lush and composed of a variety of sedges, grasses and ferns including blue-joint reedgrass (*Calamagrostis canadensis*), sensitive fern, American mannagrass (*Glyceria canadensis*), shallow sedge (*Carex lurida*) and sedge (*C. gynandra*).

A list of vascular plants found in this wetland is presented in Appendix E. Three of the vascular plant species found in the wetland are considered to be uncommon in Nova Scotia (ACCDC 2004). These included hop sedge (*Carex lupulina*), swamp rose (*Rosa palustris*) and tall hairy groovebur (*Agrimonia gryposepala*). The Nova Scotia populations of swamp rose and tall hairy groovebur are considered to be secure (NSDNR 2002). The status of hop sedge is undetermined indicating that there is insufficient data regarding the abundance and distribution of this species to assess its population status. Refer to Section 5.3 for further information on these species.

Animals recorded in the wetland included white-tailed deer, eastern chipmunk (*Tamias striatus*), Hermit thrush (*Catharus guttatus*), American Robin (*Turdus migratorius*), Blue Jay (*Cyanocitta cristata*), Red-breasted nuthatch (*Sitta canadensis*), Black-capped Chickadee, Swamp Sparrow (*Melospiza georgiana*), northern spring peeper (*Pseudocaris crucifer*), and green frog (*Rana clamitans*). None of the animals found in this wetland are considered to be uncommon or rare in Nova Scotia. A number of white-tailed

deer beds were found in the wetland. The dense cover of grasses, sedges and ferns would provide good cover and the damp soil would provide a cool bedding area.

Wetland 2 appears to be a groundwater discharge site and may play a small role in stream flow regulation by storing and slowly releasing surface water. At the time of the survey in late September there was no indication that the wetland was providing water to the stream. Upstream of the wetland, the stream flows through a small hay field. The wetland may help to reduce nutrient concentrations in surface waters draining from this field. There is a well defined channel through the wetland, so the ability of the wetland to absorb nutrients and contaminants from these surface waters would be limited, particularly during low flow periods. There was no evidence that the wetland was used for recreational or commercial purposes. The portion of the wetland downstream of the property had been affected by past quarrying activities.

Overall, Wetland 2 is considered to be of moderate value. It provides habitat for three uncommon plant species and probably helps to regulate stream flow and stream water quality.

Wetland 3 is located approximately 100 m south of Wetland 2 and is a 0.53 ha tall shrub dominated spring swamp. The vegetation of the wetland is characterized by a sparse tree canopy and dense shrub and ground vegetation layers. The most abundant tree species are red maple and gray birch. Speckled alder is the most abundant shrub species. The ground vegetation layer is composed of a mixture of sensitive fern, spotted Joe-Pye weed (*Eupatorium maculatum*), blue-joint reedgrass, and sedge (*Carex gynandra*). Hop sedge, an uncommon species whose population status in Nova Scotia is undetermined was found in the wetland. Animals recorded in the wetland included white-tailed deer, eastern chipmunk, star-nosed mole (*Condylura cristata*), Swamp Sparrow, green frog, wood frog (*Rana sylvatica*) and leopard frog (*Rana pipiens*). None of these species is considered to be uncommon, rare or sensitive in Nova Scotia. Part of the wetland had been ditched creating a shallow pool. This pool provides suitable breeding habitat for ephemeral pool nesting amphibians, such as northern spring peeper, wood frog and yellow-spotted salamander (*Ambystoma maculata*), as well as good foraging habitat for a variety of other amphibian species.

Wetland 3 appears to be a groundwater discharge site and may help to regulate surface water flow in downslope watercourses. Given the small size of the wetland, this function would not be significant. Given the location of the wetland, it may receive some surface drainage from a nearby hay field that may be enriched in nutrients. There was no evidence of any recreational or commercial activity in the wetland.

Overall, Wetland 3 is considered to have low to moderate value. It may play a small role in surface water flow regulation and may help to immobilize nutrients in surface water run-off. The wetland also provides habitat for an uncommon vascular plant species.

5.4.2 Potential Effects, Proposed Mitigation, Monitoring and Follow-up

As stated earlier, it is recognized that all wetlands represent important wildlife habitat, and given the cumulative loss of wetlands in the Annapolis Valley, impacts to wetlands should be avoided where possible. The proposed Project has been designed to avoid the footprint of all three wetlands. Figures 2 and 4 illustrate the locations of the proposed pit and quarry areas relative to the three wetlands. The hydrologic assessment and addendum report (Appendix B) assesses the potential effects on the hydrology of the wetlands and provides mitigation. Buffer zones have been established around the wetlands to minimize the potential for adverse effects on wetland hydrology. The size of the buffer zone varies from approximately 25 to 35 m. Mitigation to minimize hydrologic effects on Wetland 3 may include directing flow through a vegetated area and back to the wetland. This would in turn minimize the hydrologic effect on Wetland 2. Implementation of proper retention/siltation structures upstream of the Wetland 1 will prevent the wetland from being affected.

5.4.3 Summary

It is anticipated that with implementation of appropriate mitigation, Project activities will not adversely affect the three wetlands or significantly alter their functions. In summary, significant Project-related effects on wetlands are not likely to occur.

5.5 Wildlife

5.5.1 Description of the Existing Environment

Birds

Given the timing of the field survey (September 21 and 22, 2004), it was not possible to conduct a breeding bird survey on the site. Incidental bird observations were recorded during the field surveys. A total of 21 species were observed (Table 1 Appendix F). The species observed probably consist of a mixture of birds that have nested in the general area and early migrants. None of the species recorded during the field surveys is considered to be rare or sensitive to human activities. One species, Black-backed Woodpecker (*Picoides arcticus*), is listed as an uncommon to fairly common resident by ACCDC. NSDNR considers the Nova Scotia population to be secure. Information regarding breeding birds that may be present on the property was derived from a review of the Atlas of Breeding Birds of the Maritime Provinces (Erskine 1992). The breeding bird data for the two atlas squares (10 km X 10 km) within which the study area is located was reviewed, and a list of all birds found there along with their breeding status (possible breeder, probable breeder, or confirmed breeder) in the atlas square or study area was compiled (Table 2 Appendix F). Fifty-four species have been recorded in the two atlas

squares. In total, sixty-three species have been recorded in the general vicinity of the Project area (atlas data and field data combined).

The population status of each species was determined from existing literature. Lists of provincially uncommon, rare or sensitive birds were derived from the ACCDC (ACCDC 2004), Endangered Species and Status of Wildlife in Nova Scotia (NSDNR 2003) and General Status of Species in Nova Scotia (NSDNR 2002) while nationally rare species were derived from COSEWIC (2004).

Six of the species recorded in the atlas square are considered by ACCDC (2004) to be uncommon or rare breeding species in Nova Scotia. These include Brown Thrasher (*Toxostoma rufum*) (S1S2), Eastern Bluebird (*Sialis sialis*) (S2S3), Eastern Phoebe (*Sayornis phoebe*) (S2S3), Bobolink (*Dolichonyx oryzivorous*) (S3), Northern Oriole (*Icterus galbula*) (S3), and Rusty Blackbird (*Euphagus carolinus*). The populations of all but two of these species (Eastern Bluebird and Bobolink) are considered to be secure (Green listed) in Nova Scotia (NSDNR 2002). Eastern Bluebird and Bobolink are Yellow listed indicating that their populations in Nova Scotia are sensitive to human activities and natural events. Suitable breeding habitat is present on the property for Eastern Bluebird and Brown Thrasher. Eastern Bluebirds prefer to nest in open areas with scattered trees and natural or manmade nest cavities. In Nova Scotia, they are typically found in orchards and clear-cuts. The recent clear-cut at the northern end of the property contains large scattered red pine that could provide suitable perching sites and nesting cavities.

Brown Thrashers nest in dense thickets. The shrub thickets and immature forest found near the center of the property would provide suitable nesting sites.

Bobolinks nest in dense grasslands such as hayfields and pastures. There is no suitable habitat for this species on the property; however, they may nest in a hay field located on an adjacent property near the southern end of the proposed quarry area.

Eastern Phoebe generally nest in open habitats with scattered trees. Their nests are often placed on man-made structures such as bridges and buildings. Suitable nesting habitat is found in the Nictaux area, but not within the Project area.

Northern Orioles also prefer to nest in semi-open habitats. They typically site their nests in tall shade trees, particularly elms. In Nova Scotia, Northern Orioles generally nest in shade trees in towns and cities. Northern Orioles may nest in the village of Nictaux, but are unlikely to nest within the Project area.

Rusty Blackbirds typically nest in swamps and bogs flanking sluggish streams in the interior of the province. This species generally nests in areas remote from human habitation. The Project area does not provide suitable nesting habitat for this species.

Mammals

Information regarding the presence of rare mammals and sensitive mammal habitat within the study area was derived from field surveys and a review of data compiled by NSDNR and ACCDC. A review of these records did not reveal the presence of any rare mammal species in the immediate vicinity of the study area.

The field survey was conducted concurrently with the vegetation survey of September 21 and 22, 2004. The field survey provides a good indication of the presence of large mammal species in the study area. Obtaining site specific knowledge of the distribution of small mammals in the study area is limited by their secretive nature and the undesirable requirement to conduct intensive small mammal trapping programs to determine their presence in the area. Fortunately, many small, rare mammals have very specific habitat requirements, which can be used to predict areas where they are likely to be found.

Habitat in the study area is relatively diverse and is composed of hardwood and mixedwood forest, shrub thickets, disturbed areas including regenerating gravel pits and recent clear-cuts, deciduous treed swamp, tall shrub swamp and bog. No areas of natural talus slope, large expanses of mature forest or other habitat features associated with rare mammal species in Nova Scotia are present in the Project area.

The species recorded in the study area are generally typical of woodland habitats, and are widespread and common in Nova Scotia. Species recorded during the field survey included star-nosed mole (*Condylura cristata*), white-tailed deer (*Odocoileus virginianus*), varying hare (*Lepus americanus*), red squirrel (*Tamiasciurus hudsonicus*), eastern chipmunk (*Tamias striatus*), coyote (*Canis latrans*), red fox (*Vulpes vulpes*), raccoon (*Procyon lotor*), and American black bear (*Ursus americanus*). There was no evidence that moose were present in the study area. Furthermore, the nature of the general habitat in the Project area offers little in the way of important core habitat for large mammals or for deer wintering.

Herpetiles

Information regarding amphibians and reptiles and their habitat within the study area was derived from a review of existing literature, as well as the September 21 and 22, 2004 field survey. The number of amphibian species recorded in the proposed Project area and adjacent areas was low. Species recorded during the field survey included northern spring peeper (*Pseudocaris crucifer*), green frog (*Rana clamitans*), leopard frog (*Rana pipiens*), and wood frog (*Rana sylvatica*).

Within the Project area, there was one shallow permanent pond, and a number of marginal ephemeral pools. This habitat is suitable for ephemeral pool breeding amphibians such as wood frog, northern spring peeper, pickerel frog (*Rana palustris*), and yellow-spotted salamander (*Ambystoma maculatum*). The shallow permanent pool was located in tall shrub dominated spring swamp habitat located in Wetland 3 near the center of the property. This pond was created as a result of road construction and subsequent ditching of a portion of the wetland.

The marginal ephemeral pools are located in an abandoned portion of the quarry. It appears that much of this area is shallowly flooded in the early spring and dries out over the growing season. These pools are probably dry by early July. They may provide water long enough to provide suitable breeding habitat for ephemeral pool nesting species.

A small stream crosses the center of the property. At the time of the field survey, this stream was dry except for a few small pools. This habitat may provide suitable feeding and escape habitat for green frogs, leopard frogs and pickerel frogs.

Terrestrial habitats on the property can be expected to support a variety of amphibian species including red-back salamander (*Plethodon cinereus*), yellow-spotted salamander, blue-spotted salamander (*Ambystoma laterale*) and American toad (*Bufo americanus*).

No potential breeding habitat for the four-toed salamander (*Hemidactylium scutatum*) was noted on or adjacent to the Project area. The bog at the northern end of the property is relatively dry and contains no sphagnum lined pools that are used as breeding sites by this species. It is unlikely that this species is present in the Project area.

No reptile species were noted in the area during the survey period. Snake species that are expected to be present in this area include the Maritime garter snake (*Thamnophis sirtalis*), northern redbelly snake (*Storeria occipitomaculata),* and eastern smooth green snake (*Liochlorophis vernalis*). Northern ring-neck snake (*Diadophis vernalis*) may also be present. Northern ribbon snake (*Thamnophis sauritis*) and Blanding's turtle (*Emydoidea blandingii*) populations in the Province are located to the south and these species would not be expected to be present. No core habitat for aquatic turtles such as eastern painted turtle (*Chrysemys pictiventris*) or common snapping turtle (*Chelydra serpentina*), was found on the property.

Wood turtles have been recorded in the Nictaux River and associated riparian habitats and may occur within 700 m of the Project area. The one stream (Kempt Brook) that crosses the property and which would provide a suitable conduit for foraging wood turtles does not drain into the Nictaux River. In the Project area, Kempt Brook does not offer any core habitat for wood turtles. Kempt Brook drains across extensive pre-existing quarry works west and northwest of the Project area and then exits this open area.

The brook eventually drains into the Annapolis River. Gravid female wood turtles present in the Annapolis River at the Kempt Brook confluence, or from the lower portion of Kempt Brook seeking out open friable nest sites would tend to nest along the open section of the old quarry works western edge. Nesting females would not be expected to venture beyond this existing quarry area to seek nests in any newly exposed areas developed by the proponents proposed quarry operations.

Any wood turtles present in the nearby Nictaux River and seeking nesting sites would tend to nest in old quarry works immediate to the river's west edge. The housing area and open field edges to the west of the Nictaux would tend to offer potential nesting sites and a barrier to wood turtle movement further west. In the unlikely event that a nest prospecting wood turtle did move that far away from the river and across Trunk 10, it would be intercepted by the railway line just west of the road.

5.5.2 Potential Effects, Proposed Mitigation, Monitoring and Follow-up

Two of the three uncommon or rare bird species recorded in the two atlas squares within which the Project area is located may nest in the Project area. These include Eastern Bluebird, a Yellow listed species and Brown Thrasher, a species listed as a very rare to rare breeding species in Nova Scotia by ACCDC, but considered to be secure in Nova Scotia by NSDNR. A third species, Bobolink, that is Yellow listed may nest in a hay field located adjacent to the quarry expansion area. If these species are present, the Project could result in the loss of nesting habitat for the Eastern Bluebird which may consist of the recent clear-cut at the northern end of the property. Suitable Brown Thrasher nesting habitat is located near the center of the property in areas where past gravel extraction has occurred. It is not anticipated that these areas will be directly affected by the Project. Brown Thrashers that might nest here would be exposed to noise disturbance associated with the Project. Brown Thrashers are quite adaptable and often nest in close proximity to human habitation. Proposed Project activities are unlikely to cause them to abandon the area. Similarly, Bobolinks that may nest in the hay field adjacent to the proposed development would not directly lose nesting habitat as a result of the Project although they would be exposed to noise from on-site activities. Bobolinks nest in agricultural lands and are not readily disturbed by human activities such as vehicle traffic and other sources of noise.

Migratory birds, their eggs and young are protected under the *Migratory Birds Convention Act*. In order to avoid violating the *Act*, clearing will be conducted outside of the breeding season for most species of migratory birds in order to prevent the destruction of eggs and unfledged young. In Nova Scotia, most species nest between mid-April and early August, although it is acknowledged that some species breed at other times of the year (*i.e.*, White-winged Crossbills and Red Crossbills). Ward Aggregates proposes to conduct clearing activities outside of the nesting period for the majority of species (*i.e.*, outside of the mid-April to early August period) and will implement additional measures as required to ensure compliance with the *Act*.

No deer wintering habitat and habitat supporting mainland moose are known to occur near the property. An ACCDC data review did not reveal the presence of any other rare mammal species in the vicinity of the study area. The results of the field survey support this existing knowledge. The habitats present in the study area are commonly encountered throughout the province and are unlikely to provide habitat for rare small or large mammal species. The species recorded in the study area are generally typical of second growth woodland habitats. As described above, Project activities will not result in any alterations in habitat (*i.e.,* terrestrial or freshwater) beyond the Project area and Project activities (*i.e.,* noise disturbance and truck traffic) will be limited to the immediate vicinity of the development. Activities at the recently closed R.B. Paving gravel pit and pits immediately adjacent to the proposed Project have been ongoing for many years. Wildlife species particularly sensitive to human activities are not expected to be present in the area.

None of the species of amphibians or reptiles present or expected to be present at this site are considered to be rare or of particular concern in the Province of Nova Scotia (ACCDC 2004; NSDNR 2002; NSDNR 2003) or in Canada (COSEWIC 2004). The Project area does not provide unique or particularly valuable or productive herpetile habitat. The Project is not likely to have any significant adverse effects on local herpetile populations. Wood turtles have been recorded in the Nictaux River and associated riparian habitats and may occur within 700 m of the Project area. The one stream (Kempt Brook) that crosses the property and which would provide a suitable conduit for foraging wood turtles does not drain into the Nictaux River. As such, the potential for wood turtles to be present on the property is low.

There is a negligible likelihood that the proposed Project site would attract nesting wood turtles from any of the nearest watercourses. Therefore, there is little potential for the site to become a reproductive sink for wood turtles. This proposed Project site is too far from existing suitable watercourses to attract nesting wood turtles, and there are many potentially suitable areas closer to these watercourses that would intercept them. As such, the potential for wood turtles to be present on the property is low, and the potential that nesting females would be attracted into the proposed Project area for nesting sites is negligible. It is therefore not recommended that additional mitigation, such as drift fencing, would be required for this Project. In addition, this stream and the wetland habitat surrounding it will not be disturbed during Project operations.

5.5.3 Summary

In summary, significant Project-related effects on mammals and herpetiles are not likely to occur. Additional information is required to determine whether or not rare or sensitive bird species, such as Eastern Bluebird are present in the Project area. To this end, it is proposed that a breeding bird survey be conducted in June 2005. Surveys should be conducted on two dates to reduce the chances of missing birds due to temporal variation in singing activity.

5.6 Groundwater Resources and Hydrogeology

The following discussion of the local groundwater resources and hydrogeology is based on a desktop study and does not include any site-specific geological mapping, water well or groundwater sampling and analysis, or groundwater depth measurements.

5.6.1 Description of Existing Environment

The Project area is 100 to 150 m in width (east/west) and approximately 2 km in length extending to the south from Route 201 (Figure 5, 6). The topography across much of the site is flat-lying with a low elevation of 35 m. The southern portion of the site encroaches into the bottom of South Mountain and rises to an elevation of 80 m.

The site's surficial geology includes glaciofluvial gravel and sand deposits on the northern, lower lying portion of the site, and a silty glacial ground moraine till plain in the southern end of the site (Figure 5). The upper layers of the glaciofluvial deposits are proposed to be mined in the gravel pit operation.

Bedrock underlying the site is reported by NSDNR (Map ME2000-1) to comprise conglomerate, sandstone and minor shale units of the Wolfville Formation from the Fundy Group (Figure 6). An east/west trending geological contact with slate from the Halifax Formation of the Meguma Group is located to the south of the site, and extends through the community of Nictaux Falls to the east. However, other published geological information suggests that the geological contact lies further to the north and falls within the southern portion of the subject site.

An inference of the regional groundwater flow direction has been made based on topography. South Mountain, which lies south of the study area, forms a major regional topographic divide, resulting in groundwater flow in the vicinity of the site to be towards Annapolis River to the north/northwest. Therefore, since the site is situated near the base of South Mountain, on the southern limits of the Annapolis Valley, groundwater flow beneath the site is in a general northerly direction. Although Nictaux River lies several hundred meters to the east, it is not likely that any significant amount of groundwater from the site would discharge into this river, but rather towards Annapolis River and several of its small tributaries that lie north of the site.

Much of the site is expected to lie within a groundwater recharge area, but groundwater discharge may seasonally occur in the form of springs at the base of South Mountain, near the south end of the site, or into the basin bog (Wetland 1). A perched groundwater condition may also exist at the basin bog.

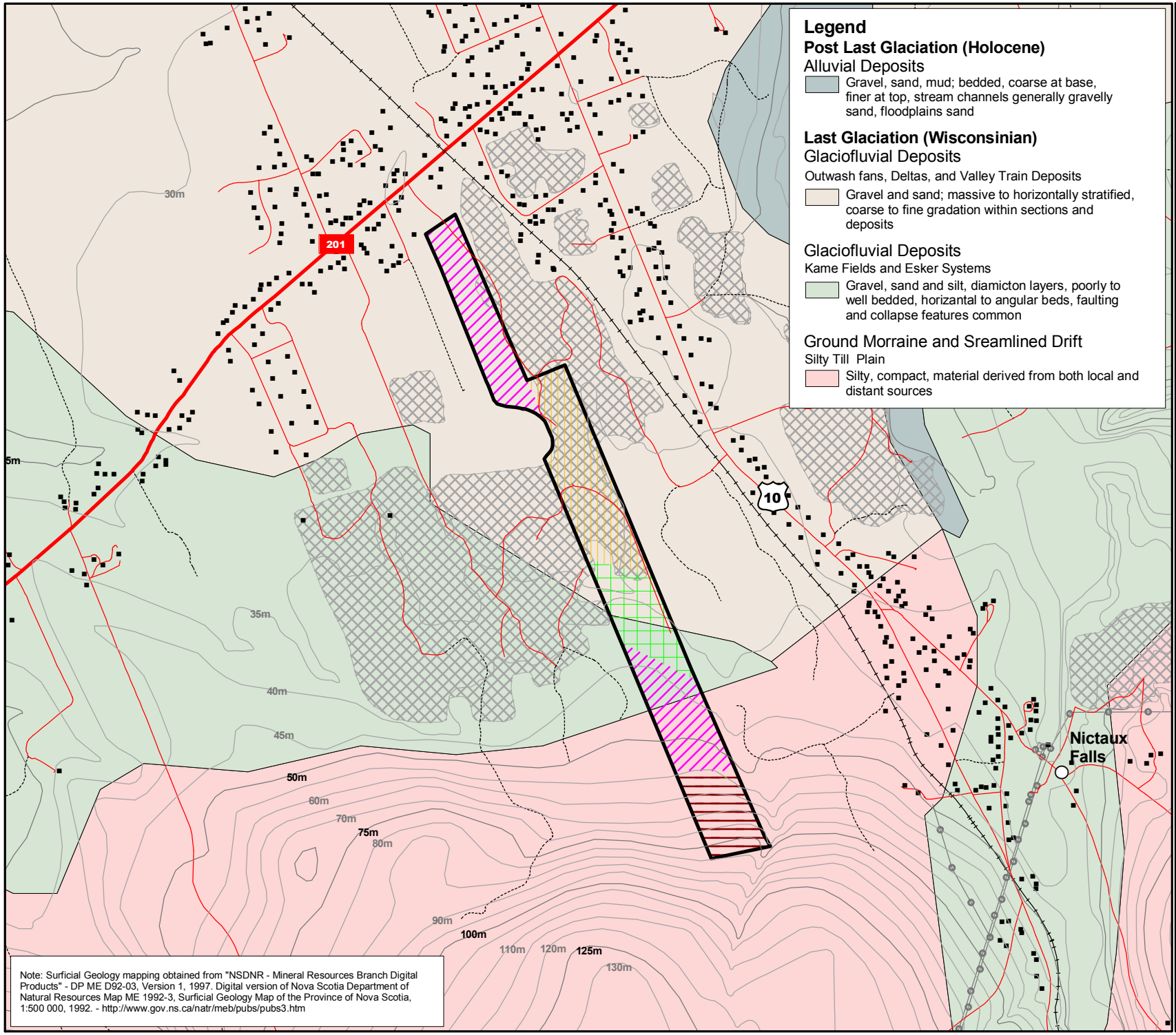

Figure 5

Surficial Geology

Project Components
- Proposed Permitted Area
- Proposed Gravel Pit
- Proposed Buffer Area
- Proposed Quarry Area
- Proposed Stockpile and Laydown Area

Topography
- Building/Structure

Roads
- Minor Road
- Major Road
- Trail/Track
- Rail

- Contour
- Utility Line
- Pit

Ward Aggregates Proposed Gravel Pit and Quarry Development

N

0 250 500

Meters

Map Parameters
Projection: UTM
Zone: 20
Datum: NAD 83
Scale: 1:15,000
Project Number: NSD18995
Date: April 27, 2005

Jacques Whitford

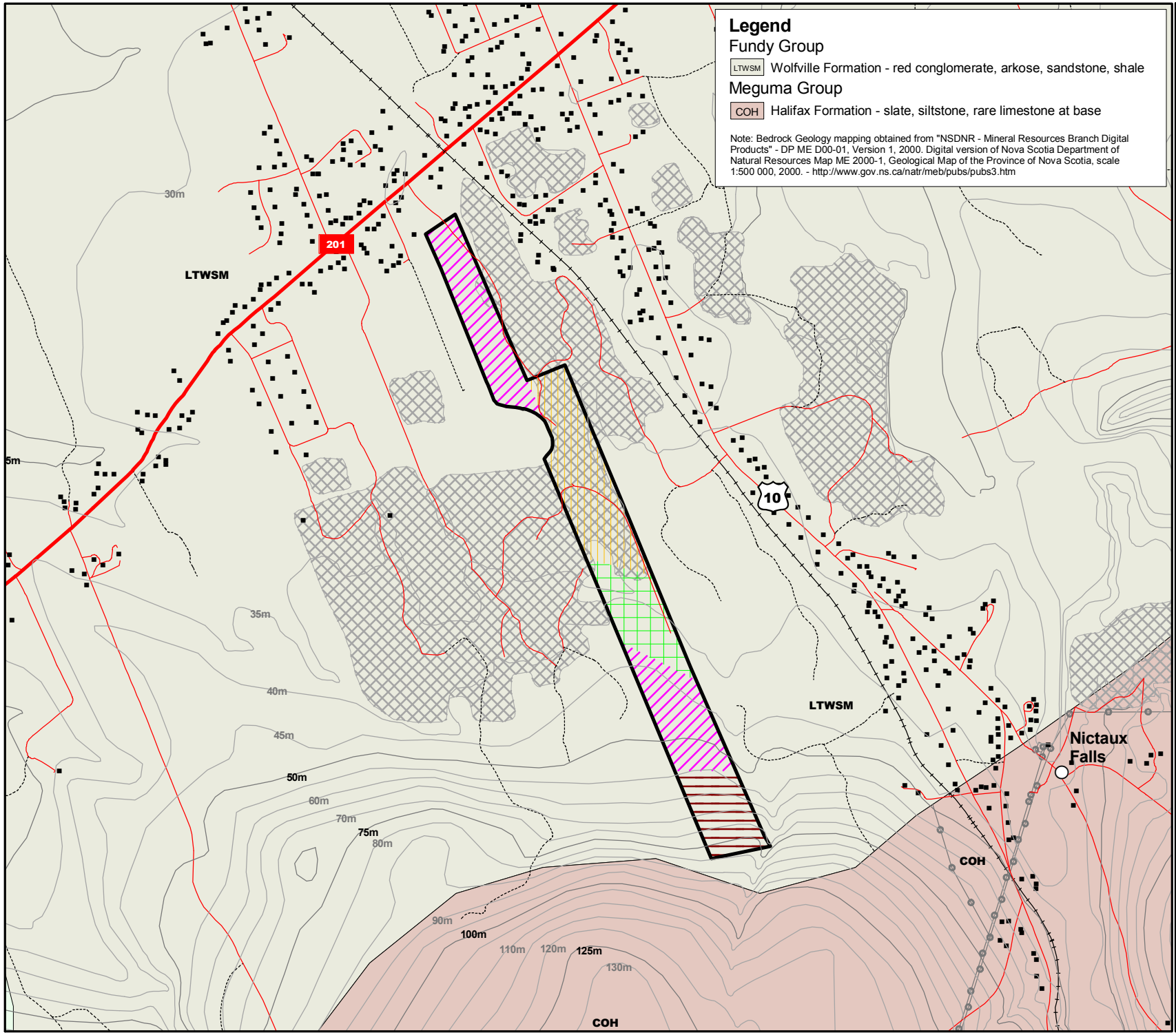

Figure 6

Bedrock Geology

Project Components

- Proposed Permitted Area
- Proposed Gravel Pit
- Proposed Buffer Area
- Proposed Quarry Area
- Proposed Stockpile and Laydown Area

Topography

- Building/Structure

Roads

- Minor Road
- Major Road
- Trail/Track
- Rail

- Contour
- Utility Line
- Pit

Ward Aggregates
Proposed Gravel Pit and Quarry Development

N

0 250 500

Meters

Map Parameters
Projection: UTM
Zone: 20
Datum: NAD 83
Scale: 1:15,000
Project Number: NSD18995
Date: April 27, 2005

Jacques Whitford

Water supply for most residences located off Trunk 10 and Route 201 are derived primarily from privately owned wells. Most of these wells are inferred to be drilled wells, however some shallower dug wells may exist in the area. Residences associated with these communities extend along Trunk 10 and Route 201, with those closest to the Project site situated adjacent to the north end of the site along Route 201, some 30 m away, and to the east of the site at distances some 150 m or more off of Trunk 10.

Details of the water wells servicing residential homes located nearest the Project area were not available for this desktop study. However, a review of available NSEL well records provides information for fifty drilled well logs that were constructed in the community of Nictaux Falls between 1979 and 2000. The locations of these wells were not verified, but it is expected that many are associated with residences located off Trunk 10 and Route 201. Of these fifty well records, at least half are reported to be constructed in slate or shale bedrock, which is inferred to be of the Halifax Formation. The remainder of the wells are inferred to be constructed in either surficial deposits and/or bedrock units inferred to be associated with the Wolfville Formation.

The well construction details for these fifty drilled wells are summarized in Table 3. The wells average 50.3 m in depth, have an average 17.4 m of casing, and yield in the range of 0.0 to 25 gpm, with a median value of 2.5 gpm. Depth to the water table ranges from 3.0 m to 22.9 m below grade. The wells with deeper water table depths are expected to typically be located on properties that lie higher in elevation, (*i.e.*, in the southern regions of Nictaux Falls) whereas wells with shallower water table depths are expected to typically lie near Nictaux River to the east or in lower lying flatter areas (*i.e.*, along Route 201). The average (10.3 m) and median (10.7 m) water table depths suggest that the groundwater table lies at some depth below the proposed pit floor depth (*i.e.*, 3 m).

Table 3 Summary of Domestic Water Wells Records for Nictaux Falls

	Well Depth (m)	Casing Length (m)	Estimated Yield (gpm)	Water Depth (m)	Overburden Thickness (m)
Minimum	11.6	1.5	0.0	3.0	0.9
Maximum	129.6	62.2	25	22.9	61.9
Average	50.3	17.4	5.1	10.3	15.8
Median	45.7	17.4	2.5	10.7	13.7
Number	50	50	50	29	40

Note: An updated Well Log Database including wells constructed between 1940 and 2004 was not readily accessible during preparation of this document. However, it is noted that the updated database reports 69 well records between 1940 and 2004 in the same area.

A small stream that originates on South Mountain, south of the Project area, extends northward along the eastern side of the southern third of the site at which point it crosses through the site towards a small wetland area (Wetland 2) located immediately west of the site (Figure 2). This stream, Kempt Brook, may be partially fed from groundwater springs that may occur near the base of the mountain. A review of 2002 aerial photographs indicates that this stream is intermittent and that it is not clearly defined in the vicinity of the boggy area. This suggests that surface water captured at higher elevations on South Mountain (either from groundwater springs or surface water run-off) starts to seep into the unsaturated

sandy soil as it flows southward and into the region containing the glaciofluvial deposits. The aerial photos also indicate that surficial sandy soil on neighbouring properties has been mined in areas to a depth of several metres below that of the proposed Project area. The exposed un-vegetated surface across most of the off-site past mined areas appeared dry, with the exception of a small excavated area located immediately south of the boggy area that contained pooled surface water. This suggests that the groundwater table lies within the surficial deposits at a depth below the adjacent mined areas.

Water Quality

The water quality from wells constructed in conglomerate and sandstone units of the Wolfville Formation is expected to be good, with most parameters meeting the Canadian Drinking Water Guidelines (Health Canada 2003). However, water wells constructed within the Halifax Formation frequently encounter groundwater quality problems due to acid drainage associated with elevated iron and sulphide mineralization in the slate. Exposure of the slate to atmospheric conditions could also introduce acid drainage affects into any nearby surface water bodies.

5.6.2 Potential Effects, Proposed Mitigation, Monitoring and Follow-up

The wells at most potential risk are those located nearest the proposed development, including those along Route 201 to the north and Trunk 10 to the east. Potential impacts to residential water wells will be a function of distance, location of a well with respect to groundwater flow directions, and individual well construction methods.

Provided that the both the gravel pit and the rock quarry do not extend into the groundwater table, and that there will be no blasting for the quarrying operation, as proposed, potential impacts from this operation include possible water quality deterioration of down-gradient wells from surface runoff and/or accidental releases of deleterious substances, such as fuel oil within the quarry area. Acid drainage conditions could also occur if bedrock from the Halifax Formation is mined or exposed to atmospheric conditions.

Lowering of the groundwater table and decreasing well yield is not expected (either temporary or permanent) provided the operation does not extend into the groundwater table.

It is not anticipated that surface water flowing into the gravel pit at the sites would collect or pool in a manner that will require dewatering. Further, due to the granular nature of the shallow surficial deposits, perched groundwater conditions are not anticipated to exist and therefore groundwater flow through the pit walls is not expected across much of the site. However, in the southern limits of the site where the glacial till deposits are reported to exist, groundwater seepage into nearby excavated pit areas might seasonally occur.

In the unlikely event that the water levels were to be lowered by deeper gravel or rock excavation, the degree of water level decline at a domestic well would be proportional to distance from the edge of the excavation, decreasing exponentially with distance.

In the event of water quality deterioration, mitigation of short-term impacts (*i.e.*, turbidity) would likely involve temporary provision of bottled water to affected residents, or provision of an in-line dirt filter. In the unlikely event of persisting long-term water quality or well yield loss event, the proponent will replace or repair any water supply well found to be adversely affected by the proposed operation to the satisfaction of the owner.

The general direction of the development will be south, likely stopping short of contact with the Halifax Formation. Acid drainage conditions could occur if bedrock from the Halifax Formation is excavated or exposed to atmospheric conditions. Prior to quarry development, rock will be sampled and tested to confirm the suitability of the aggregate and confirm that the Halifax Formation slates, known widely to be acid producing, will not be encountered/disturbed. A groundwater monitoring program will be developed to detect any changes to groundwater quality associated with the proposed quarry.

5.6.3 Summary

In summary, significant Project-related effects on groundwater resources are not likely to occur provided that bedrock from the Halifax Formation is not quarried and/or exposed to the atmosphere. However, a groundwater monitoring program will be developed and implemented to allow for the collection of site specific groundwater data (*i.e.*, depth and chemistry). Details of the monitoring program (*i.e.*, monitoring parameters and frequency) will be developed in consultation with NSEL.

5.7 Archaeological and Heritage Resources

5.7.1 Description of the Existing Environment

For the purposes of this assessment, archaeological and heritage resources are defined as physical remains that inform us of the human use of and interaction with the physical environment. These resources may be above or below the surface of the ground and cover the earliest Pre-Contact times to the relatively recent past.

Heritage resources are generally considered to include historic period sites such as cemeteries, heritage buildings and sites, monuments, and areas of significance to First Nations or other groups. Pre-Contact refers to the time before the arrival of non-Aboriginal peoples.

The assessment of heritage resource potential within the study area included archaeological site records at the Nova Scotia Museum and archival resources. There are no recorded archaeological sites within or adjacent to the study area (Nova Scotia Museum Archaeological Sites Database; Stephen Powell, pers. comm.).

Background research was conducted using the records at the Public Archives of Nova Scotia. Maps consulted included those by A.F. Church (1874) and Faribault. These maps cover the period from the middle of the nineteenth century to the beginning of the twentieth century. There are no recorded pre-Contact archaeological sites within or adjacent to the study area. The only potential for pre-Contact archaeological material (400 to 500 years ago) would be in the area of the Nictaux River, particularly at Nictaux Falls. As it stands, the potential for the study area to contain pre-Contact archaeological material should be considered low.

There are no recorded historic archaeological sites within the study area. The historic settlement of the land around the study area would have been centered on the development of the roads to Annapolis and to Bridgewater/Liverpool. As can be seen in modern maps, settlement at that time would have grown parallel to those roads. The major settlement of the area takes place in the nineteenth century when Nictaux Falls was the location of an iron mining and smelting operation, which operated from the middle to the end of the nineteenth century. No records were found to indicate any historic settlement within the study area and the historic archaeological potential should be considered low.

Both archival research and geographic data suggests that there is low potential for the study area to contain pre-Contact and/or historic archaeological resources. The potential for pre-Contact archaeological sites is elevated along the Nictaux River, which contained exploitable resources (*e.g.*, fish and wildlife) and could be used as a transportation route.

5.7.2 Potential Effects, Proposed Mitigation, Monitoring and Follow-up

Certain activities associated with the Project (*i.e.*, grubbing, grading), could affect archaeological or heritage sites if they were present within the zone of surficial and subsurface disturbance. These disturbances, if unmitigated, could result in the loss of resources and the potential knowledge to be gained from its interpretation.

The study area has only limited potential for identifiable human use in the pre-Contact and historic periods. No archaeological/heritage resources were identified in the study area during the visual reconnaissance. Nictaux River was identified as an area for elevated potential as it contained exploitable resources (*e.g.*, fish and wildlife) and could be used as a transportation route. It is assumed that no areas beyond the study area will be disturbed during the development and operation of the proposed Project area. As such, development and operation of the proposed Project are not expected to have any adverse environmental effects on heritage resources.

If heritage resources are discovered during development and operation of the Project, the find will be immediately reported to the Curator of Archaeology and the Curator of Special Places at the Nova Scotia Museum. If the resources are thought to be First Nations, the Chief of the nearest Mi'kmaq band (Annapolis Valley First Nation) will also be contacted. In the case of suspected human remains, the RCMP will be called. The appropriate authorities will determine further actions to be undertaken which could include avoidance and further assessment.

5.7.3 Summary

In summary, assuming appropriate measures are undertaken in the event archaeological or heritage resources are discovered, significant Project-related effects on these resources are not likely to occur.

5.8 Air Quality

5.8.1 Description of the Existing Environment

NSEL monitors air quality at ten stations across Nova Scotia susceptible to air quality problems. Common air pollutants monitored regularly are sulphur dioxide (SO_2), particulate matter (PM), carbon monoxide (CO), ground level ozone (O_3), nitrogen dioxide (N_2O), and hydrogen sulphide (H_2S). Exceedances for these contaminants are generally small and infrequent in Nova Scotia. Overall, Nova Scotians enjoy good air quality (NSDEL 1999). The closest NSEL monitoring site to the proposed Project area is located at Aylesford Mountain, more than 20 km west of the site.

Motor vehicles, electrical power generation, pulp and paper processing and oil refining are the major local sources of air pollutants in the province. Port Hawkesbury is the only area in the province that experiences periodic exceedences in air quality. All other air quality exceedences in the province are caused by ground level ozone, generated outside the region (NSDEL 1998).

The Ward Aggregates Project is located in a rural setting with little or no industry within a radius of 10 km. It is not anticipated that the common air pollutants are exceeded at the Project location due to the separation distance between the Project area and any urban or industrialized centre.

5.8.2 Potential Effects, Proposed Mitigation, Monitoring and Follow-up

Project activities can generate dust (*i.e.*, particulate matter) which has the potential to be transported offsite. As per the Pit and Quarry Guidelines, particulate emissions will not exceed the following limits at the site property boundaries:

- Annual Geometric Mean 70 µg/m^3
- Daily Average (24 hrs) 120 µg/m^3

Efforts to minimize the generation and transport of dust at the site will include water sprays and stabilization of erodible soils. Use of existing access roads within the adjacent property will ensure consistent operations for local residents. Monitoring of particulate emissions (dust) will be conducted at the request of NSEL.

GHG emissions will be reduced through proper equipment maintenance and inspection, and reduction of engine idling when not in use.

5.8.3 Summary

In summary, assuming appropriated mitigation to minimize dust generation and transport, significant Project-related effects on air quality are not likely to occur.

5.9 Socioeconomic Environment

5.9.1 Description of the Existing Environment

Population and Employment

The quarry is located on the south side of Route 201 in Nictaux, Annapolis County. The area's general population, including Middleton, is approximately 5,085 (Statistics Canada 2001). The population of Annapolis County has decreased by only 2.5% from 1996 to 2001, with a population decrease in the area of the Project of approximately 1.5% in the same period. The nearest town is the Town of Middleton, approximately 5 km southwest, with a population of approximately 1,744 (Statistics Canada 2001).

The employment rate in Annapolis County is 47.3%, while the unemployment rate is 11.4% (Statistics Canada 2001). The majority of the work force is spread out over the manufacturing and construction sector, agriculture and other resource based industries, wholesale and retail sales, health and education, and business services sector.

It is anticipated that the operation will employ four to seven individuals during production to operate heavy equipment (*i.e*., loaders, back-hoes), crushing and mobile equipment, and conduct general labour activities. Hauling of materials from the quarry involves additional resources, employing two individuals.

Land Use

The proposed development is immediately adjacent to the former R. B. Paving gravel pit operation, which has been recently closed and reclaimed. As shown in Figure 7, much of the area in the vicinity of

the proposed Project has been previously mined/quarried. Residential development in the area of the Project is limited (*i.e*., approximately 855 buildings within a 2 km radius).

Industrial or commercial developments are limited within a 5 km radius of the proposed Project; however, according to area maps and anecdotal information, the Nictaux Falls and Nictaux West communities have been exposed to this type of development for decades (Figure 7). Dexter Construction operates a rock quarry within 2 km west of the proposed Project. As well, there is a Needs convenience store, a gas station and several small businesses within a 5 km radius.

The proposed quarry development area is located within the Annapolis County East End Area municipal planning area which is covered by the Annapolis County East End Area Municipal Planning Strategy (MPS) and Land Use By-law (Municipality of Annapolis 2004). The property is currently zoned Nictaux Commercial (C-1) and General Residential (R-2). Future Land Use designation for this land is Residential and Agricultural.

Transportation

As indicated in Section 2.5.1, products will be transported from the Project area via tandem and tractor trailer trucks to the R.B. Paving operation east of the site along Route 201, and possibly to other markets along Route 201, Highway 1, Trunk 10, and Highway 101. Route 201 has a paved surface and a posted speed limit of 60 km/hr. Portions of Route 201 can accommodate loads up to 38,500 kg; however, certain sections are subject to spring weight restrictions and some bridge structures have year round weight restrictions (Paul Stone, NSTPW, pers. comm., 2005).

Recreation and Tourism

Anecdotal information on recreational land use from a resident/landowner in the general area of the proposed Project included historical use of lands for hunting. There are no parks in the vicinity of the pit and quarry. Recreational fishing may occur in the Nictaux River, east of the Project area and the Annapolis River, downstream and north of the Project area.

Human Health

Human health related aspects and potential effects on environmental health include potential impacts on well water quality, air quality (*i.e.*, particulate emissions) and safety of commuters along Route 201. Well water quality is addressed in Section 5.6, air quality is addressed in Section 5.8, and Section 5.9.2 includes a discussion of the transportation along the Route 201.

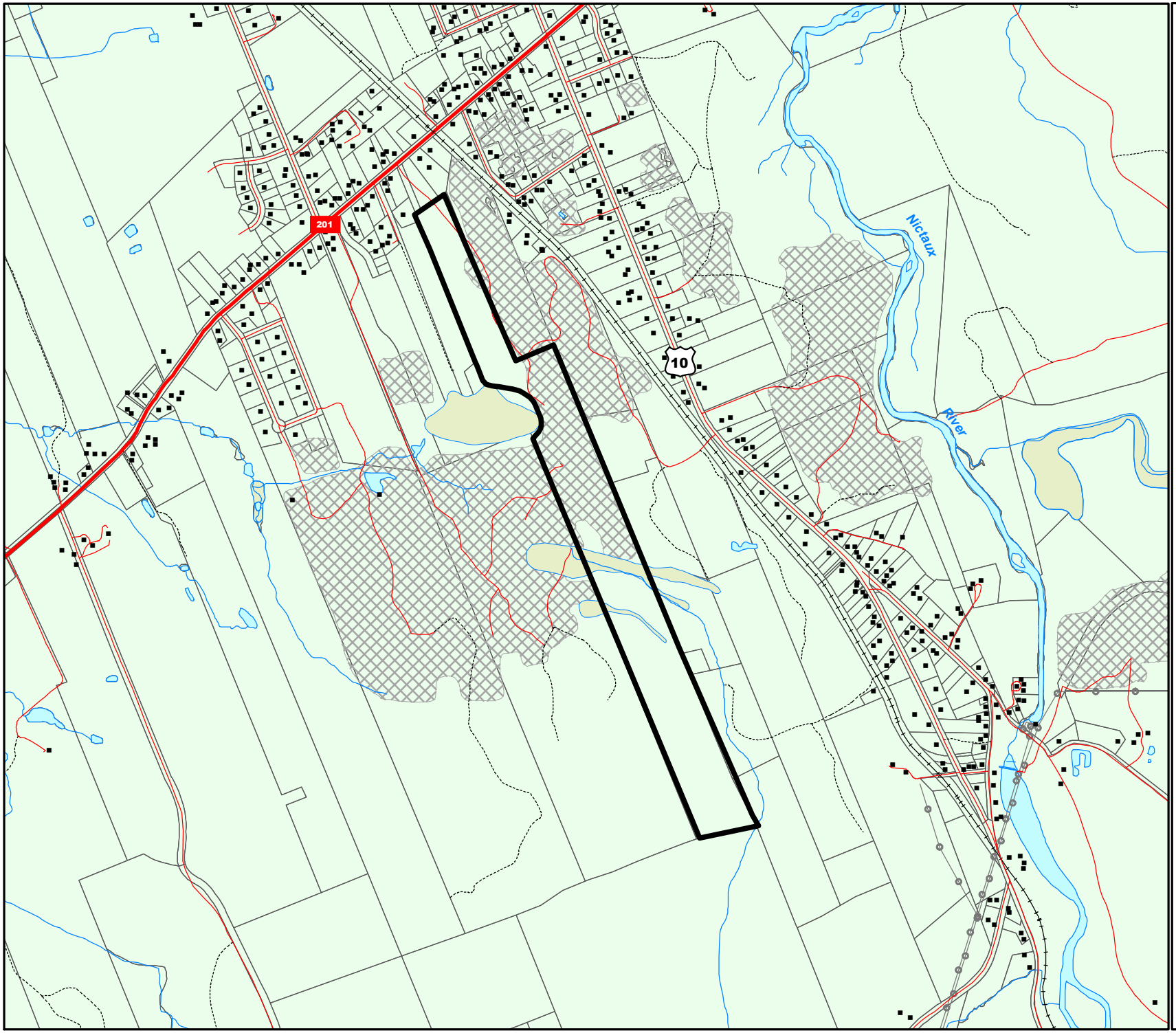

Figure 7

Adjacent & Historic Landuse

Project Components
- Proposed Permitted Area

Topography
- Building/Structure

Roads
- Minor Road
- Major Road
- Trail/Track
- Rail

Watercourse
Waterbody
Land
Wetland
Pit

Ward Aggregates Proposed Gravel Pit and Quarry Development

N

0 250 500

Meters

Map Parameters
Projection: UTM
Zone: 20
Datum: NAD 83
Scale: 1:15,000
Project Number: NSD18995
Date: February 18, 2005

Jacques Whitford

5.9.2 Potential Effects, Proposed Mitigation, Monitoring and Follow-up

Population and Employment

Project activities will produce noise from equipment operation. The majority of residences near the Project area are located along Route 201 and Trunk 10. There are 243 buildings within 500 m of the boundary of the proposed development. Due to the proximity of a number of residences within 800 m of the Project area, there will be no blasting. Rock will be removed by mechanical means (*i.e.*¸ripping). The potential for noise from the pit quarry site to have a significant effect on residents is minimal.

In accordance with the Pit and Quarry Guidelines, sound levels from the operation in the expansion area will be maintained at a level not to exceed the following sound levels (Leq) from the property boundaries:

Leq 65dBA 0700-1900 hours (Days)
60dBA 1900-2300 hours (Evenings)
55dBA 2300-0700 hours (Nights)

Sound monitoring will be conducted at the request of NSEL.

Economic benefits from the proposed Project will accrue to the regional and provincial economies. Project development will allow for continued supply of materials and asphalt for provincial highway construction and maintenance projects, as well as other industrial and residential construction-related projects. The Project will continue to generate employment, the majority of which is sourced locally.

Land Use

According to the existing Municipal Planning Strategy and Land Use By-Law, the Project may appear to be inconsistent with existing and future land use. It is understood that Municipal governments do not have the authority, under the *Municipal Government Act*, to control the locations of pits and quarries in the Nova Scotia. The municipality may have the authority to control the location of supporting infrastructure (*e.g.*, stockpiles, processing equipment). Ward Aggregates will consult with the Municipality of Annapolis with regards to the proposed Project. Pit and quarry activities will be conducted in accordance with the Pit and Quarry Guidelines and all setback distances specified in the Guidelines will be maintained.

Transportation

No new access roads are required for this Project. The average number of trucks hauling material from the pit/quarry is expected to be 5 to 6 per day. This could increase to as much as 10-12 per day, for a short period, if a large material or asphalt supply contract were awarded. Route 201 in the area of the Project currently accommodates truck traffic associated with similar developments. Ward Aggregates will comply with all road and bridge weight restrictions, when/as appropriate. Due to the relatively low level of truck traffic associated with the proposed Project, significant impacts on transportation infrastructure are not likely to occur.

Recreation and Tourism

The proposed Project may have limited interaction with hunting. A significant portion of the proposed Project area is situated on cleared lands adjacent to a road, which are not considered suitable conditions for hunting. Land in the general area of the Project is mostly privately owned therefore hunting is likely to be fairly limited. Given that there is no interaction with the Nictaux River and the significant distance to the Annapolis River, the proposed Project is not likely to have an impact on recreational fishing.

Human Health

Human health related issues are discussed in Section 5.6 Groundwater Resources, Section 5.8 Air Quality and Sections 5.9.1 and 5.9.2 Transportation. The health and safety of nearby residences is not expected to be affected by the Project.

5.9.3 Summary

In summary, assuming effective application of mitigative measures (*e.g.*, Pit and Quarry Guidelines, dust suppression) significant adverse Project-related effects on the socio-economic environment are not likely to occur. The Project will likely result in economic benefits, including employment and ongoing business opportunities.

5.10 Other Undertakings in the Area

As indicated in Section 2.0, the general area within which the Project is located has been historically used as a source of gravel and rock for construction of roads and highways as well as other infrastructure, including the nearby railway in the early 1920s. Dexter Construction operates a rock quarry within approximately 2 km of the Project Area. Although aggregates from this operation are also likely transported along Route 201, the increase of 5 to 6 trucks per day associated with the proposed Project is not considered significant.

6.0 EFFECTS OF THE PROJECT ON THE ENVIRONMENT

Activities associated with this proposed Project will be conducted in accordance with the terms and conditions of the Pit and Quarry Guidelines (NSDOE 1999) and the terms and conditions provided in the Industrial Approval (required under the Activities Designation Regulations). Environmental effects of the Project will include the loss of terrestrial habitat within the Project area**.** Field surveys conducted to date indicate the presence of one yellow-listed plant species. Follow-up surveys will be undertaken in 2005 to establish the abundance and distribution of the yellow-listed species and identify additional species. Based on the results of the follow-up survey, appropriate mitigation and monitoring will be developed to minimize the potential environmental effects on the species.

Assuming the mitigative measures specified in this report and follow-up survey reports are implemented and the pit and quarry areas are operated according to provincial guidelines and approvals, no significant adverse residual environmental or socio-economic effects are likely. Project development will result in economic benefits, including employment and ongoing business opportunities.

7.0 EFFECTS OF THE ENVIRONMENT ON THE PROJECT

The definition of an environmental effect often includes any change to the project that may be caused by the environment. In the case of a pit and quarry operation, potential effects of the environment on the Project are limited to climate and meteorological conditions, particularly precipitation. Precipitation and runoff may cause temporary delays in construction, operation, and rehabilitation activities. Wet weather or snow may also affect hauling of material from the site.

On a national basis, Canada shows a warming and cooling pattern with a higher overall warming trend of approximately 1.1 ºC since 1895. The Atlantic Region, however, shows a warming trend from 1895 which peaked in the mid 1950s, followed by a cooling trend in the 1990s. The overall warming trend of 0.4 ºC in Atlantic Canada since 1895 is not statistically significant. With respect to precipitation, the Atlantic Region shows an overall increasing trend in precipitation since 1948, with an increasing trend in the number of daily precipitation events above 20 mm and a slightly increasing trend in the number of daily snowfall events above 15 cm (Lewis 1997). Although climate change is not considered a significant issue for this development, it is recognized that climate change could result in an increased likelihood of extreme precipitation events in the future.

There is a number of planning, design and construction strategies directed at minimizing the potential effects of heavy rainfall/flooding events on the Project so that the risk of damage to the Project or interruption of service can be reduced to acceptable levels. Mitigation measures include, but are not limited to, designing and installing erosion and sediment control structures to accommodate appropriate levels of precipitation and consideration of weather conditions when scheduling activities. As well, the pit/quarry will operate from May to November, which will limit the potential effects of severe winter weather conditions. Prior to winter shutdown, the quarry will be stabilized to minimize potential for siltation events.

In summary, climate and meteorological conditions, including climate change, are not anticipated to significantly effect the operation of the quarry over its proposed lifetime.

8.0 OTHER APPROVALS REQUIRED

As stated in Section 2.0, the Proponent is required to register this Project as a Class I Undertaking pursuant to the Nova Scotia *Environment Act* and Environmental Assessment Regulations. In addition to the Environment Assessment Regulations, the Activities Designation Regulations is the other relevant provincial regulation which requires an industrial approval from the NSEL for operation of the Project. Provincial guidelines to be adhered to include the Pit and Quarry Guidelines (NSDOE 1999). Examples of other relevant federal legislation include the *SARA*, the *Fisheries Act* and the *Migratory Birds Convention Act*. It is not anticipated that any federal permits or approvals will be required for this Project.

9.0 FUNDING

The proposed expansion will be 100 percent privately funded.

10.0 ADDITIONAL INFORMATION

No additional information is provided in support of this document.

11.0 REFERENCES

11.1 Literature Cited

Atlantic Canada Conservation Data Centre (ACCDC). 2004. Species Lists and Rare Species. Internet Publication: http://www.accdc.com/products/lists/.

COSEWIC. 2004. Canadian Species at Risk. Committee on the Status of Endangered Wildlife in Canada. Ottawa, ON.

Church, A.F. 1874. Colchester County.

Erskine, A. J. 1992. Atlas of Breeding Birds of the Maritime Provinces. Nimbus Publishing and the Nova Scotia Museum, Halifax, 270 pp.

Faribault, E.F. Province of Nova Scotia, Colchester County, Map Sheet #57.

Health Canada. 2003. Guidelines for Drinking Water Quality.

Lewis, P. J. 1997. Trends. In: Shaw, R.W. (ed.). Climate Variability and Climate Change in Atlantic Canada. Proceedings of a Workshop Halifax, Nova Scotia, 3-6 December 1996. Prepared for Environment Canada.

Municipality of Annapolis. 2004. Annapolis County East End Area Municipal Planning Strategy and Land Use By-Law. June 23, 2004.

Nova Scotia Department of Environment and Labour (NSDOE). 1999. Pit and Quarry Guidelines. Revised May 1999.

NSDEL. 1998. The State of the Nova Scotia Environment.1998. Halifax, NS.

NSEL. 2002. Guide to Preparing an EA Registration Document for Pit and Quarry Developments in Nova Scotia. Nova Scotia Environment and Labour, December 2002.

NSDEL. Water Well Records. Annual Publications 1965-1978; Database Inventory 1978-2001.

Nova Scotia Department of Natural Resources (NSDNR). 2002. General Status Ranks of Wild Species in Nova Scotia. Internet Publication: http://www.gov.ns.ca/natr/WILDLIFE/genstatus/

NSDNR 2003. Species at Risk in Nova Scotia. Wildlife Species Protected under the Endangered Species Act in Nova Scotia. http://www.gov.ns.ca/natr/wildlife/endngrd/specieslist.htm.

Statistics Canada. 2001. Community Profiles, Nova Scotia, Statistics Canada, 1996 and 2001. Internet Publication: www.statscan.ca.

11.2 Personal Communications

Blaney, Sean. Botanist and Assistant Director, ACCDC. February 2005.

Powell, Stephen. Assistant Curator Archaeology, Nova Scotia Museum. Nova Scotia Museum, Maritime Archaeological Resource Inventory. January 2005.

Stone, Paul. Area Manager. Nova Scotia Department of Transportation and Public Works. February 2005.

Wheaton, Thomas. Area Habitat Coordinator. Department of Fisheries. April 2005.

APPENDIX A

CERTIFICATE OF STATUS AND REGISTRY OF JOINT STOCKS

Nova Scotia

CERTIFICATE OF INCORPORATION

Companies Act

Registry Number

3078993

Name of Company

WARD AGGREGATES LIMITED

I hereby certify that the above-mentioned company was incorporated this date under the Companies Act and that the company is limited.

Karen Richard

Deputy Registrar of Joint Stock Companies

June 10, 2003

Date of Incorporation

NOVA SCOTIA
Service Nova Scotia and Municipal Relations
Registry of Joint Stock Companies

Print | Close Window

PROFILE - WARD AGGREGATES LIMITED - as of 2005-02-19 10p.m.

Company/Society Name:	WARD AGGREGATES LIMITED
Registry ID:	3078993
Type:	N.S. Limited Company
Nature Of Business:	
Status:	Active
Jurisdiction:	Nova Scotia
Registered Office:	9633 HWY 201 RR1 WILMOT NS B0P 1W0
Mailing Address:	9633 HWY 201 RR1 WILMOT NS B0P 1W0

PEOPLE

Name	Position	Civic Address	Mailing Address
ROBERT B. WARD	Director	RR 1 9633 HIGHWAY 201 WILMOT NS B0P 1W0	
ROBERT B. WARD	PRESIDENT & SECRETARY	RR1 9633 HIGHWAY 201 WILMOT NS B0P1W0	
ROBERT B. WARD	Recognized Agent	9633 HWY 201 RR1 WILMOT NS B0P 1W0	9633 HWY 201 RR1 WILMOT NS B0P 1W0

ACTIVITIES

Activity	Date
Incorporated and Registered	2003-06-10
Special Resolution	2003-07-02
Address Change	2003-07-02
Appoint an Agent	2003-07-02
Change of Directors	2003-07-02
Annual Renewal	2004-05-14
Annual Statement Filed	2004-05-14

RELATED REGISTRATIONS

There are no related registrations on file for this company.

APPENDIX B

NICTAUX PIT AND QUARRY HYDROLOGY

January 19, 2005 Project 05001

Ms. Katherine Fleet
Jacques Whitford Environment Limited
3 Spectacle Lake Drive
Dartmouth, NS
B3B 1W8

Re: Ward Aggregates Ltd. Pit/Quarry Hydrology

Dear Ms. Fleet:

Hydro-Com Technologies Limited, acting at your request, has performed a review of the proposed *Ward Aggregates Ltd.* Pit/Quarry development project. The objective of the review was to determine the hydrologic effects of this development. This report has been prepared solely for the project described above and contains a description of our methodologies and our findings.

Site Description

The plan view of the proposed pit/quarry development area is presented in Figure 1. The pit/quarry development area (outlined with a thick black line) is approximately 29.2 ha in size. This pit/quarry borders areas of previous gravel pit development and is traversed by a stream which runs toward the Annapolis River. The stream alignment from the western edge of the proposed development area to a stream reach approximately 300 m downstream is not shown on this mapping and has been heavily impacted by previous pit development. It is our understanding that the alignment of the stream reach crossing the proposed gravel/pit development area will be conserved by maintaining proper buffer distances from its banks as established by environmental regulations.

The southern portion of the proposed development area (labelled as Area 1 on Figure 1) is of average slope (approximately 5 %) and drains north. This portion of the development area comprises both gravel pit and quarry developments. The area outlined in green (labelled Watershed 1 in Figure 1) presents the drainage area which currently contributes surface flow to Area 1. It is assumed in this study that surface runoff upstream of the quarry/pit boundaries will be diverted around the pit/quarry development.

The northern portion of the proposed development area (labelled as Area 2 on Figure 1) is mildly sloped (less than 1%) and drains south. This portion of the development area is designated for gravel pit development only. The area onlined in orange (labelled Watershed 2 in Figure 1) presents the drainage area which currently contributes surface flow to Area 2. It is

assumed in this study that surface runoff upstream of the quarry/pit boundaries will be diverted around the gravel pit develpment. The roadways and rail line and previous pit development influence the local drainage patterns in this area. According to 1:10,000 scale mapping, a number of residential properties exist along Highway 201 and Highway 10 in this area. It is our understanding that Watershed 2 discharges its surface flow into a 3.7 ha wetland located on the western side of the development area. This wetland represents the headwater of the stream network downstream of the pit/quarry development that conveys flows toward Annapolis River. Based on 1:10,000 scale mapping, there is little residential development along the stream network downstream of the proposed pit/quarry area.

The central portion of the pit/quarry development area has been proposed as a stockpile and laydown area. This area has been heavily impacted by previous pit development, and surface flows currently drain west. Because the hydrologic properties of this area will not be greatly affected by the pit/quarry development, its contribution to surface flows has been omitted from the report.

It is our understanding that as pit/quarry development progresses, runoff from Areas 1 & 2 will continue to drain in their current flow directions. Ultimately, following excavation and landforming, both impacted areas (Areas 1 & 2) will direct runoff toward centrally located flow retention/siltation structures upstream of their respective outlets.

Figure 2 presents the location of two (2) wetlands within the proposed development area and one (1) immediately adjacent to the western side. The two wetlands that are less than 2.0 ha in size (1.8 ha and 0.28 ha) are located near the existing stream and within the proposed stockpile and laydown area. The third wetland, a bog area greater than 2.0 ha in size (3.7 ha), will not be directly impacted by the footprint of the development project.

Objectives

Based on our discussions, the objectives for this assignment are as follows:

- estimate quantities of surface runoff from the site's different drainage areas for the currently proposed ultimate level of pit/quarry development,
- estimate the size and design discharge capacity of the flow retention/siltation structures required for the currently proposed ultimate level of pit/quarry development,
- assess potential effects of the pit/quarry on downstream flows and water quality for the currently proposed ultimate level of pit/quarry development, and
- perform a hydrological evaluation of the wetlands impacted by the development.

Methodology

The methodologies that were used to satisfy the above objectives were as follows:

- the annual volume of runoff from Areas 1 & 2 associated with the ultimate site development was estimated using proration of mean annual flows from a nearby hydrometric station and using values from the MacLaren Atlantic Limited (1980) study,
- the size and design discharge capacity of the required flow retention/siltation structures were determined using a HEC-1 runoff model and the Rational Method and physiographic parameters of Areas 1 & 2,
- the effects on downstream flows and water quality were assessed based on experience with similar developments, and
- the hydrological attributes of the wetlands were evaluated using the relevant sections of the Nova Scotia Department of Environment Wetlands Directive (for wetlands smaller than 2.0 ha) and the North American Wetlands Conservation Council Wetland Evaluation Guide (for wetlands larger than 2.0 ha).

The following physiographic parameters were obtained from the available project mapping:

- drainage areas within the proposed pit/quarry development area: Area 1 = 11.3 ha and Area 2 = 5.99 ha;
- drainage slopes of areas within the proposed pit/quarry development area: Area 1= 5.6% and Area 2= 0.74%;
- times of concentrations: Area 1 = 0.38 hrs (23 minutes) and Area 2 = 0.64 hrs (38 minutes);
- coefficients of runoff of the proposed development areas at the ultimate development condition: Area 1 (gravel pit and quarry)= 0.41; Area 2 (gravel only)= 0.30;
- Soil Conservation Service (SCS) land use curve number of the proposed development areas at the ultimate development condition for average antecedent moisture conditions (AMC II): Area 1 = 71, Area 2 = 66, and
- drainage area upstream of the culvert at Highway 201 (labelled as Watershed 3 and outlined in blue in Figure 1): 3.86 km^2.
- size of wetlands impacted by the pit/quarry development: 3.7 ha, 1.8 ha and 0.28 ha

Mean Annual Site Runoff

The mean annual runoff for Areas 1 & 2 within the proposed pit/quarry development was estimated using a number of different approaches for comparison purposes. The upper bound of the mean annual runoff volume was first calculated assuming that all precipitation contributes to runoff (using local climatic data). The lower bounds were obtained using area-based proration from a nearby hydrometric station and using mean annual runoff values for the area from the report by MacLaren Atlantic Ltd (1980). Because both of the estimation methods for the lower bounds derive mean annual runoff volumes from larger watersheds containing undeveloped areas (which results in reduced overland runoff volumes), the expected runoff volumes were increased from the lower bounds by a reasonable amount to reflect hydrological conditions associated with full development in the pit/quarry.

Based on historical climatic data at the Greenwood Airport climate station (approximately 13 km away) (1971-2000), the average annual precipitation at the site is 1127.3 mm. If all of this precipitation is converted into surface runoff (which would represent an upper bound on the expected average annual runoff), the annual volume of runoff from Area 1 at the currently proposed ultimate level of development would be 127,400 m^3, which corresponds to a mean annual flow of 4.04 L/s. The annual volume of runoff from Area 2 at the currently proposed ultimate level of development would be 76,300 m^3, which corresponds to a mean annual flow of 2.42 L/s.

A lower bound for the expected annual volume of site runoff was established by drainage area based proration of flows from a nearby hydrometric station. The hydrometric station 01DD004 (1966-1995), Sharpe Brook at Lloyd's, whose drainage area is 8.81 km^2, was chosen as most representative for proration purposes as its drainage area and hydrological characteristics were most similar to those at the pit/quarry site. By prorating flows from the hydrometric station, a mean annual flow of 2.83 L/s was calculated for Area 1 at the currently proposed ultimate level of development, and 1.50 L/s for Area 2. These mean annual flows correspond to annual runoff volumes of 89,300 m^3 and 47,300 m^3, respectively.

A second approach was used to estimate the lower bound of the expected annual runoff at the site for comparison purposes. MacLaren Atlantic Ltd. (1980) has compiled a graph presenting the spatial distribution of runoff volumes throughout Nova Scotia. A mean annual runoff depth of 800 mm was selected from this figure to determine the runoff at the site. Based on this approach, the mean annual runoff flow of 2.86 L/s was computed for Area 1 and 1.52 L/s for Area 2. These mean annual flows correspond to annual runoff volumes of 90,400 m^3 and 48,000 m^3, respectively.

Development of the pit/quarry will involve the removal of vegetative cover and topsoil. Clearing the land of vegetative cover will reduce interception and temporary storage of precipitation. This hydrologic change will result in more direct runoff from the site, and less evapotranspiration (which encompasses both evaporation and transpiration from the soil-plant matrix). Average potential evapotranspiration rates at Greenwood Airport are approximately 587 mm (Dzikowski et al, 1984). By assuming a reduction in actual evapotranspiration rates of 250 mm, a direct increase in runoff to reflect the currently proposed ultimate level of development was estimated. Adjustment of the lower bounds of average annual runoff as presented above resulted in average expected annual runoff volumes of 114,600 m^3 for Area 1 and 62,610 m^3 for Area 2 based on both the proration and the MacLaren Atlantic study methods. These annual volumes correspond to mean annual flows of 3.63 L/s and 1.98 L/s respectively.

Flow Retention/Siltation Treatment Structures

Peak design flows and the retention volumes associated with the flow retention/siltation structures above the outlets of both Areas 1 & 2 at the currently proposed ultimate level of development were also determined. These calculations are based solely on the drainage areas associated to Areas 1 & 2 and assume that the surface runoff upstream of the development areas will be diverted around the quarry/pit development. The peak design flow for the structures consisted of the peak flow resulting from a 100 year return period storm event, while the minimum pond volume was to be equal to the runoff volume of a 6 hour duration storm event with a 25 year return period. Note that the low lying areas of the pit/quarry floor can provide adequate retention/siltation treatment, provided it meets the runoff volume retention standards.

Based on the Rational Method and HEC-1 modelling, and using a time of concentration of 23 minutes, the peak flow resulting from a 100 year return period storm event was estimated to have a magnitude of 1.29 m^3/s for Area 1. Using a time of concentration of 38 minutes, this peak flow was estimated as 0.38 m^3/s for Area 2. All of the hydraulic control structures at the currently proposed ultimate level of development should thus be designed for a peak flow magnitude of no less than 1.29 m^3/s for Area 1 and 0.38 m^3/s for Area 2.

Using HEC-1 modelling, the runoff volume resulting from a 6 hour duration storm event with a 25 year return period was estimated to be approximately 1,500 m^3 for Area 1, and 500 m^3 for Area 2. The flow retention/siltation structures (or capacity of pit/quarry floor allowing for water accumulation between the interstices of porous media) above the outlet of Area 1 should have a volume of no less than 1,500 m^3, and that above the outlet of Area 2, a volume of no less than 500 m^3 to accommodate for site runoff at the currently proposed ultimate level of development.

Effects on Downstream Flows and Water Quality

The currently proposed ultimate level of pit/quarry development is expected to reduce the amount of evapotranspiration from the pit/quarry site and increase the volume of mean annual surface runoff. The magnitude of the above change is estimated to be approximately 43,200 m^3/year, representing an approximate increase of 19% of the mean annual flows from the quarry site. Based on a 0.173 km^2 drainage area associated with Areas 1 & 2 within the proposed ultimate level of quarry development, and the 3.86 km^2 drainage area of the watershed within which the quarry is located (Watershed 3), the above change in the volume of mean annual surface runoff from the quarry would result in an increase in the mean annual flows at culvert at Highway 201 of approximately 1.4%.

Although the pit/quarry development will also result in an increase in the peak rates of surface runoff at the outlets of the pit/quarry site and a reduction of the low flows (i.e. water will run off more quickly following additional pit/quarry development), the placement of free-draining material over the disturbed areas and the use of properly sized flow retention structures (or

holding areas along the pit/quarry floor) is expected to fully mitigate these changes in temporal flow patterns.

The potential effects of the pit/quarry development on downstream water quality include an increase in the total sediment loading and an increase in chemical parameters associated with the rock being quarried. It is understood that the acid generating potential of the quarried rock will be analysed previous to the commencement of the project and must meet environmental standards. The placement of free-draining material over all disturbed areas and the use of properly sized flow retention/siltation structures (or holding areas along the pit/quarry floor) is expected to fully mitigate the potential increase in downstream sediment loading. As the amount of freshly exposed rock within the pit/quarry is likely to remain relatively constant (it should be a function of the production rate, rather than the overall pit/quarry size), the effects of the pit/quarry on downstream water quality are expected to be relatively minor and the downstream water quality should return to background levels following the termination of active pit/quarrying operations.

In summary, we believe that the effects on the downstream flows and water quality associated with the currently proposed ultimate level of pit/quarry development can be greatly mitigated using the placement of free-draining material and properly sized flow retention/siltation structures. Following the use of these mitigative measures, the remaining residual effects on downstream flows and water quality are expected to be minor.

Wetland evaluation

The three (3) wetlands located in close proximity to the proposed quarry/pit development are presented in Figure 2. A 3.7 ha wetland is located at the outlet of Area 2, a 1.8 ha wetland is located north of the existing stream and within the proposed stockpile and laydown area, and a 0.28 ha wetland is located south of the stream at the northern fringe of Area 1 also within the proposed stockpile and laydown area. All three (3) wetlands have been hydrologically evaluated using the appropriate guidelines. The comments presented below related to the hydrology of these wetlands are based on available mapping and wetland observations provided by Jacques Whitford Environment Ltd.

The proposed footprint of the project will heavily impact the wetlands of 1.8 ha and 0.284 ha as they would be filled with stockpile and laydown material. The proposed development will not directly impact the 3.7 ha wetland; however approximately 12% of its drainage area is located within the proposed development area

Based on these observations, the hydrological and water treatment values of the wetlands are presented below.

Pit/quarry development is expected to heavily impact the 1.8 ha & 0.28 ha wetlands; however, these wetlands currently have little water treatment or flood mitigation value. Pit/quarry development will increase annual runoff volume and sediment loading into the 3.7 ha wetland. The 3.7 ha wetland has minimal flood protection value, but may help filter surface water originating from previously developed areas. In addition, an increase in sediment loading from the proposed gravel pit may affect its water treatment value. Implementation of proper retention/siltation structures upstream of the wetland will prevent the 3.7 ha wetland from being affected.

Table 1: Evaluation of 0.28 ha & 1.8 ha wetlands

Wetland Numbers	NA
Wetland sizes	0.28 ha & 1.8 ha
Description	Located to the south and north of the existing stream, respectively.
Evaluation process used	NSDOE Wetland Directive
NSDOE Step 4: Surface Flow Regulation	Insignificant due to small size of wetlands and little inflow into wetlands.
NSDOE Step 6: Water Treatment	Insignificant due to lack of upstream development and little inflow into wetlands.

Table 2: Evaluation of 3.7 ha Wetland

Wetland Values (3.7 ha Wetland)
Based on North American Wetlands Conservation Council Wetland Evaluation Guide

	Are Criteria Present?	Level of Criterion Significance	Expected Impact of Project Upon Wetland Values	Describe Function (Provide Highlights Only)
LIFE SUPPORT VALUES: Hydrological Values Value of the wetland in contributing to surface and groundwater stocks				
* Does the wetland contribute to recharge of regional water supply aquifers?	N	NA	NA	No regional aquifer water supply.
* Does the wetland provide flood protection benefits?	P	NE	L	Negligible flood protection benefits as upstream drainage area is very mildly sloped.
Does the wetland contribute to usable surface water?	P	L	M	The wetland does potentially filter surface water from previously developed areas for surface water usage downstream (agricultural).
Does the wetland provide erosion control?	N	NA	NA	Banks along downstream channel are stable due to low slope profile.
Does the wetland provide flow augmentation to users through a headwater position in the catchment basin?	P	L	L	Headwater of stream network may provide flow augmentation for potential surface water users downstream (agricultural).
* Does the wetland reduce tidal impacts?	N	NA	NA	No tidal influence due to its headwater location along the stream.

Key:
* = Critical Values

Are Criteria Present?
Y = Yes: confirmed presence
L = Likely: data suggests the presence but the presence is unconfirmed
P = Possibly: location and circumstance suggests presence but no data are available
N = No: not present
U = Unknown

Level of Criterion Significance:
N = National
P = Provincial
R = Regional
L = Local
NE = Negligible
NA = Not Applicable

Expected Impact of Project Upon Wetland Values:
H = High
M = Moderate
L = Low
NA = Not Applicable

See pages 52-53 of Wetland Evaluation Guide (NAWCC 1992) for guidance.

References

Dzikowski, P.A., G. Kirby, G. Read, W.G. Richards. 1984. *The Climate for Agriculture in Atlantic Canada.* Publication No. ACA 84-2-500. Agdex No. 070. 19 pp.

MacLaren Atlantic Limited. 1980. *Regional Flood Frequency Analysis for Mainland Nova Scotia Streams*. Canada- Nova Scotia Flood Reduction Program. Figure 3.1.

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

Yours truly,

Hydro-Com Technologies Limited

Neil McLaughlin, M.Sc.E., EIT

Hans Arisz, M.Sc.E., P.Eng.

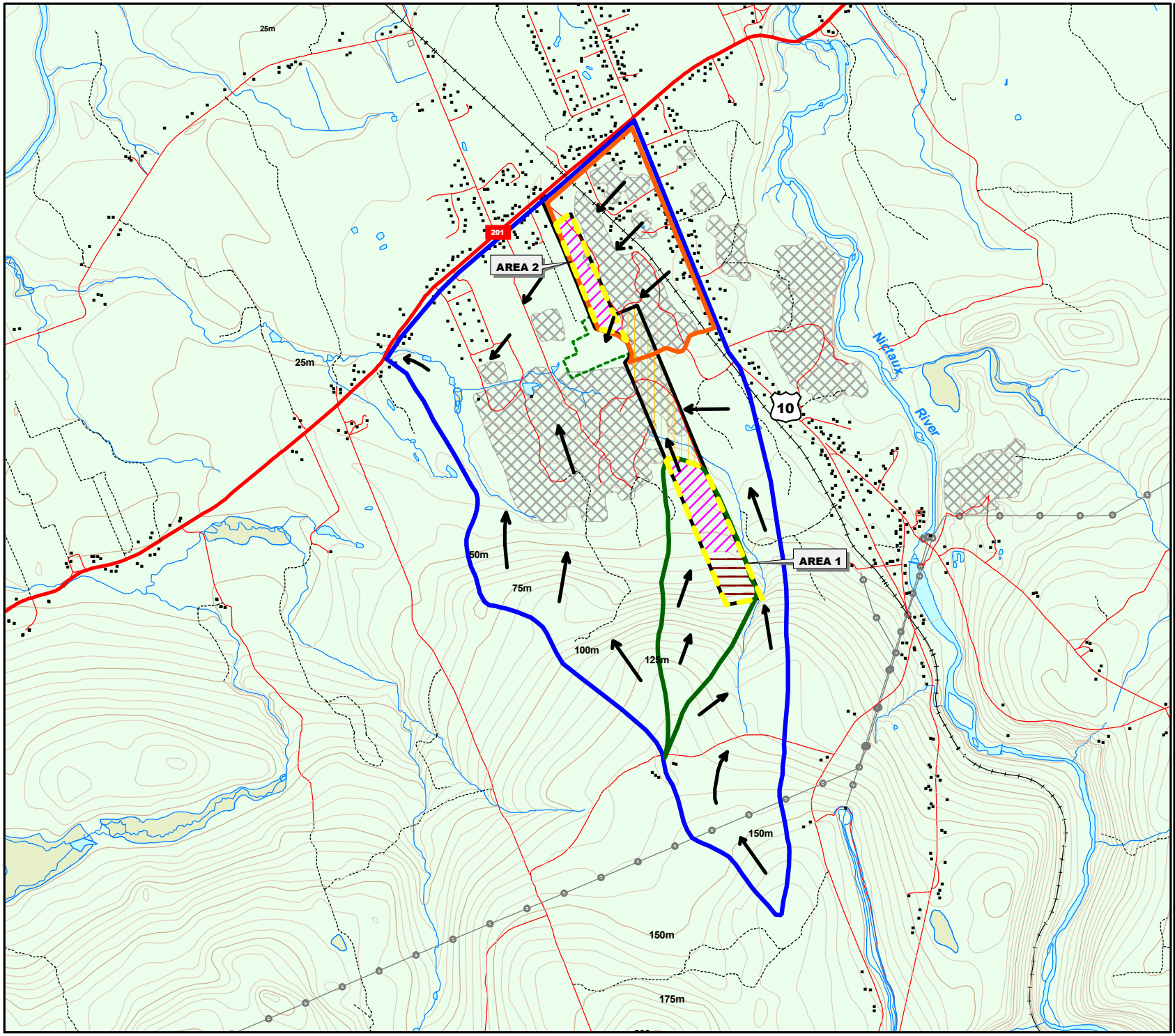

Figure 1

Watershed Delinations of Ward Aggregates Proposed Gravel Pit and Quarry Development

Drainage Areas
- Watershed 1
- Watershed 2
- Watershed 3
- Drainage Direction

Project Components
- Ward Aggregates Owned
- Proposed Permitted Area
- Proposed Gravel Pit
- Proposed Quarry Area
- Proposed Stockpile and Laydown Area

Topography
- Building/Structure

Roads
- Minor Road
- Major Road
- Trail/Track
- Rail

- Contour
- Utility Line
- Watercourse
- Waterbody
- Land
- Wetland
- Pit

N

0 250 500 750

Meters

Map Parameters
Projection: UTM
Zone: 20
Datum: NAD 83
Scale: 1:25,000
Project Number: NSD18995
Date: January 2005

Jacques Whitford

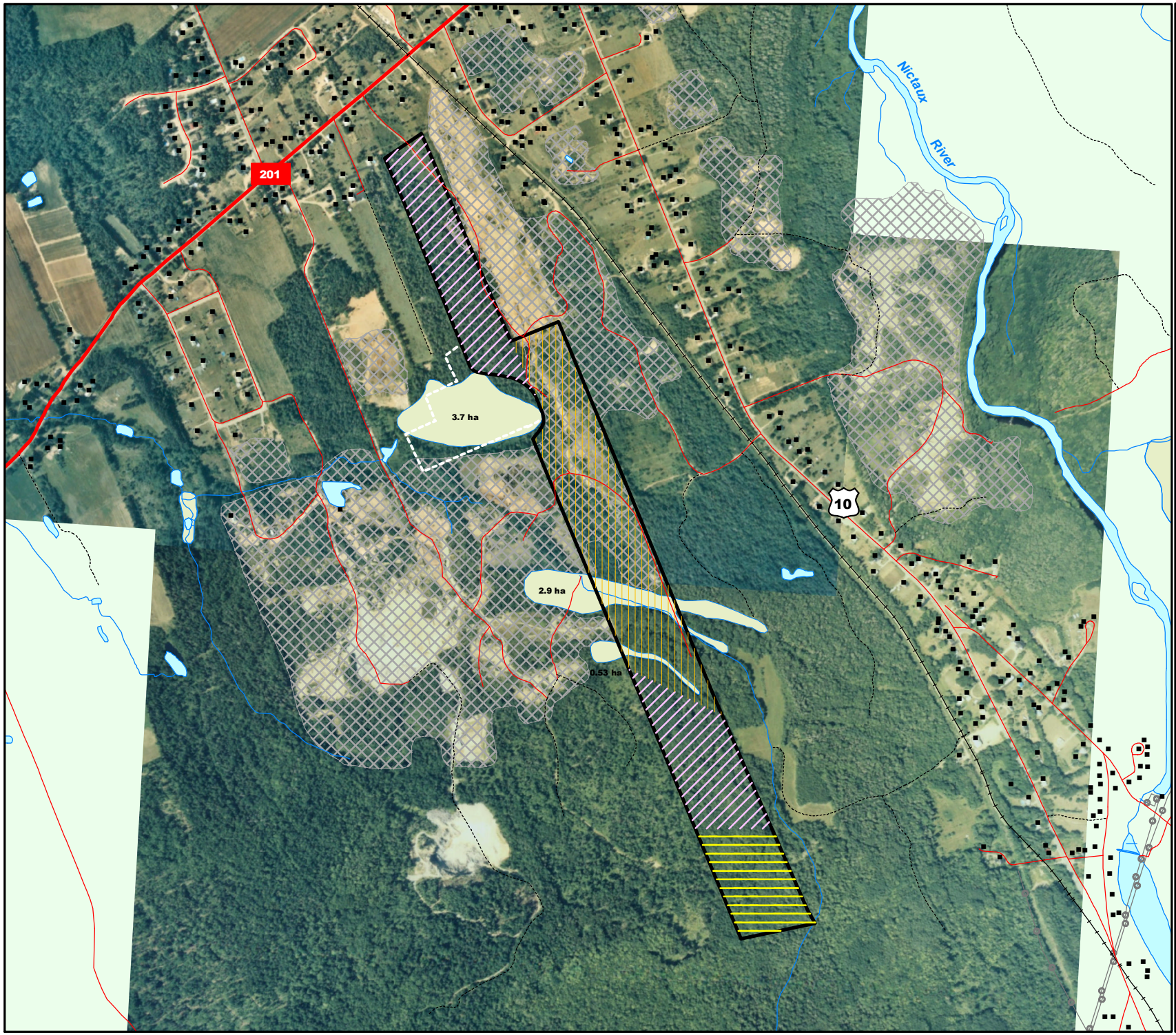

Figure 2

Ward Aggregates Proposed Gravel Pit and Quarry Development

Project Components
- Ward Aggregates Owned
- Proposed Permitted Area
- Proposed Gravel Pit
- Proposed Quarry Area
- Proposed Stockpile and Laydown Area

Topography
- Building/Structure

Roads
- Minor Road
- Major Road
- Trail/Track
- Rail
- Contour
- Watercourse
- Waterbody
- Wetlands

N

0 200 400

Meters

Map Parameters
Projection: UTM
Zone: 20
Datum: NAD 83
Scale: 1:12,000
Project Number: NSD18995
Date: December 2004

Jacques Whitford

Hydro-Com Technologies
a division of R.V. Anderson Associates Limited

445 Urquhart Crescent
Fredericton New Brunswick E3B 8K4 Canada
Tel 506 455 2888 Fax 506 455 0193
Web www.hydro-com.com

FAX TRANSMISSION

TO:	Janice Comeau	**DATE:**	February 22, 2005
COMPANY:	Jacques Whitford Ltd	**FAX NO.**:	(902) 468-9009
FROM:	Neil McLaughlin	**OUR REF NO.:**	05001
SUBJECT:	Addendum to Report		
CC:			

TOTAL NUMBER OF PAGES [3] (including this page)

☐ **Original will not be sent unless requested**
☐ **Original will be sent by courier**
☒ **Original will be sent by email**

Dear Janice,

This letter is intended to respond to the proposed changes to site layout of the Ward Aggregates Quarry around the 0.28 ha (WL-3) and 1.8 ha (WL-2) wetlands (see attached figure). In our previous report of January 19, 2005, the development layout included these wetlands within a stockpile and laydown area. However, as shown in the attached figure, a buffer area has been established around both wetlands (presented in green) to prevent direct impacts of development on these wetlands. The paragraphs below describe the expected hydrological impacts of the proposed development as presented on these wetlands.

The proposed development area, shown as Area 1 (outlined in red in the attached figure), comprises both gravel pit and quarry areas. Currently, runoff within Area 1 drains north. A portion of this runoff drains into WL-3, while the remaining portion drains into the stream which flows along the area's eastern border. Overflow from WL-3 drains north toward WL-2. Surface water from WL-2 is then drained towards the stream which conveys flows west.

Based on 1:15,000 scale mapping, approximately 10.0% of the current drainage area of WL-3 will be impacted by development. It is understood that, following ultimate development of Area 1, runoff upstream of the quarry/pit boundary will continue to be diverted around Area 1 and into WL-3 and ithe stream draining into WL-2. It is also expected that following ultimate development of Area 1, flows from this section of the pit/quarry area will be discharged into WL-3. Due to an expected increase in contributing drainage area to WL-3 (approximately 64%), and a reduction in evapotranspiration from Area 1, the annual runoff volume to WL-3 is expected to increase. Peak flows from Area 1 are also expected to increase following ultimate development. However, increases in peak flows can be fully mitigated by the placement of free-draining material over the disturbed areas and the use of properly sized flow retention/siltation structures (or holding areas along the pit/quarry floor). In addition, these mitigation measures will minimize potential water quality issues (i.e. total suspended solids) with runoff draining into WL-3.

Based on 1:15,000 scale mapping, approximately 8.4 % of the drainage area of WL-2 will be impacted by development. During pre-development conditions, a portion of Area 1 drained toward

the stream that conveyed flows to WL-2, while the remaining portion drained toward WL-3. Following ultimate development, all runoff from Area 1 will be diverted through WL-3 before entering WL-2. Annual runoff volumes from Area 1 are expected to increase following ultimate development due to a reduction in evapotranspiration. However, due to water detention at WL-3 and at the retention/siltation structures (or holding areas along the quarry floor), the expected changes in peak flows and water quality at WL-2 following ultimate development are expected to be minor.

Although annual runoff volumes entering WL-2 and WL-3 are expected to increase, the impacts of ultimate development on peak flows and water quality of runoff entering WL-2 and WL-3 are expected to be minor due to the implementation of the mitigative measures described above.

We trust this meets your current needs. If you have any questions or require additional information, please contact us at your convenience.

Yours truly,

Hydro-Com Technologies

Neil McLaughlin, MSc., EIT

Hans Arisz, MSc.E., P.Eng.

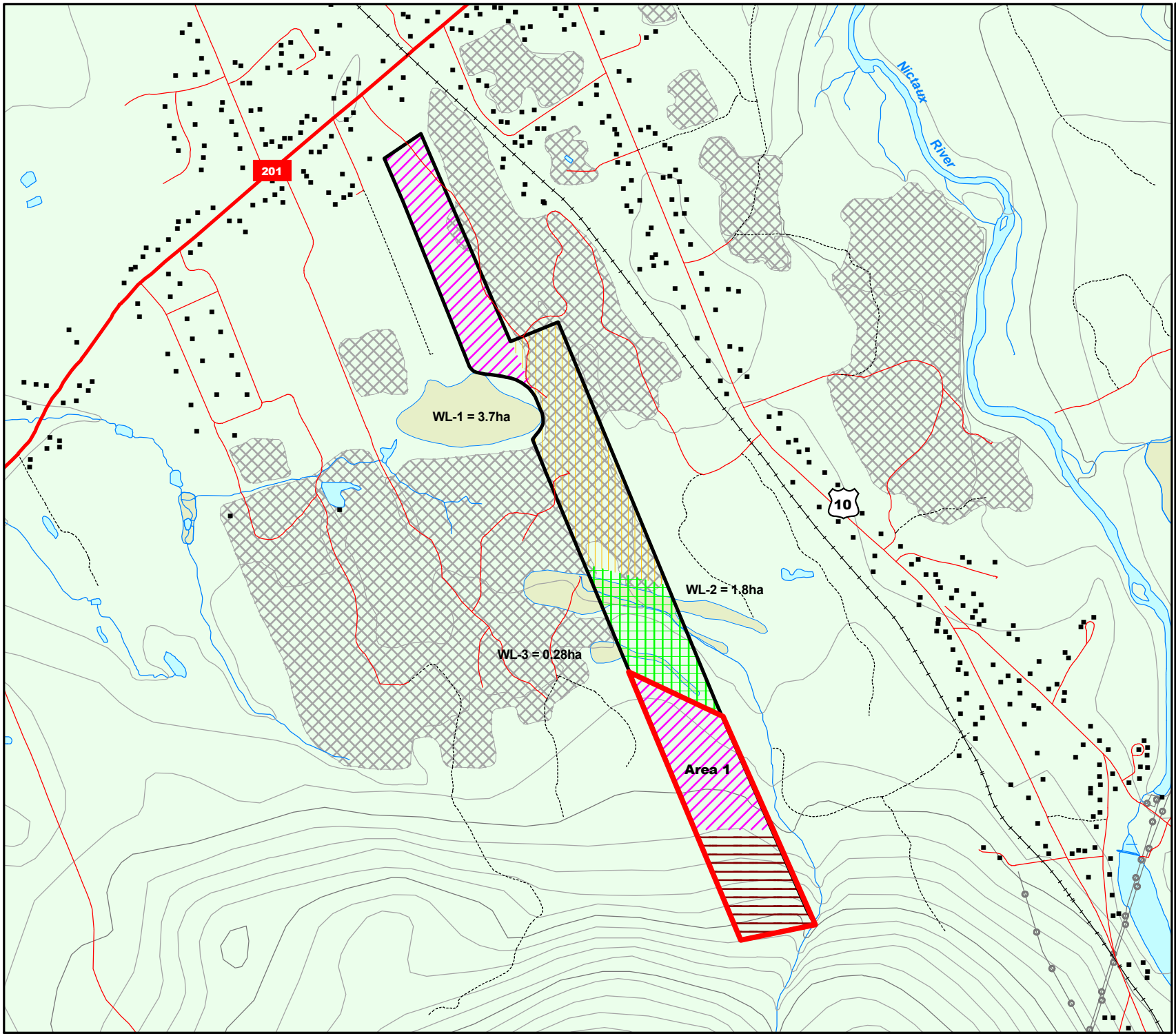

Figure 1

Site Layout

Project Components
- Proposed Permitted Area
- Proposed Gravel Pit
- Proposed Buffer Area
- Proposed Quarry Area
- Proposed Stockpile and Laydown Area

Topography
- Building/Structure

Roads
- Minor Road
- Major Road
- Trail/Track
- Rail

- Contour
- Utility Line
- Watercourse
- Waterbody
- Land
- Wetland
- Pit

Ward Aggregates
Proposed Gravel Pit
and Quarry
Development

N

0 200 400

Meters

Map Parameters
Projection: UTM
Zone: 20
Datum: NAD 83
Scale: 1:12,000
Project Number: NSD18995
Date: December 2004

Jacques Whitford

APPENDIX C

PROJECT INFORMATION BULLETIN

Ward Aggregates Limited
Nictaux Pit/Quarry Expansion Project
Project Information Sheet

Project Overview

Ward Aggregates Limited (Ward Aggregates) wishes to develop a gravel pit and rock quarry operation on the south side of the 201 Highway in Nictaux, Annapolis County, NS (see Figure 1 on reverse). The proposed development is immediately adjacent to the former R. B. Paving Ltd. gravel pit operation, which has been recently closed and reclaimed. The proposed development would supply gravel and aggregates for asphalt production and to various local markets including residential and commercial construction, municipal infrastructure projects (*i.e.*, water and sewer) and road building.

The proposed development will be approximately 29.2 ha (72 acres) is size (proposed Project area). The Project includes development of a gravel pit approximately 13.5 ha in size and a quarry development approximately 4.25 ha in size. The remaining area, which has been developed by previous owners, will accommodate aggregate stockpiles, a laydown area and temporary crushing equipment. The majority of the products will be hauled to R.B. Paving asphalt plant, which is under common ownership with Ward Aggregates, approximately 6 km east.

Proposed project activities will be consistent with the previous adjacent pit operation approved by the Nova Scotia Environment and Labour (NSEL) and in accordance with the Nova Scotia *Pit and Quarry Guidelines* (NSEL 1999). There will be no blasting; rock will be removed by mechanical means (*i.e.*, ripping). Portable crushing equipment will be brought to the site to process the removed rock as needed. Various products (*i.e.*, various aggregate sizes) will be stockpiled at the pit/quarry site until they are transported to local markets via tandem trucks or tractor trailer trucks. The average number of trucks hauling aggregates from the quarry will be 5 to 6 per day, depending on market demand. This could increase to as much as 10-12 per day, for a short period, if a large aggregate supply contract were awarded.

The anticipated average production rate is approximately 20,000 tonnes per year. The operating schedule will be based on 10 hrs/day, 5 days/week, and 28 weeks/year (May to November), weather permitting.

Environmental Assessment Process

Ward Aggregates Limited is required to register this project as a Class I Undertaking pursuant to the Nova Scotia *Environment Act* and *Environmental Assessment Regulations*. The environmental assessment registration is currently being prepared by environmental consultants Jacques Whitford Limited, on behalf of Ward Aggregates to fulfill these regulatory requirements. Other relevant provincial regulations include the *Activities Designation Regulations*, which requires an Industrial Approval from the Nova Scotia Department of Environment and Labour for the pit/quarry operation. Provincial guidelines to be adhered to include the Nova Scotia *Pit and Quarry Guidelines* (NSEL 1999).

The environmental assessment registration will evaluate potential environmental effects of the project and identify appropriate mitigation and monitoring to minimize these effects. The environmental assessment registration document will be available for public review and comment once it is filed with the NSEL.

Environmental Document Components

The environmental registration document focuses on those aspects of the environment of most concern. Components to be evaluated include:

- rare and sensitive flora;
- wildlife;
- wetlands;
- groundwater resources;
- surface water resources, freshwater fish and fish habitat;
- archaeological and heritage resources;
- air quality; and
- socio-economic environment.

Potential effects of quarry activities on these components will be addressed in the registration document.

Contacts

If you have any questions or concerns about this project please contact:

Robert Ward, President
Ward Aggregates Limited
(902) 825-6550 (tel.)
(902) 825-2296 (fax)

or

Janice Comeau, Environmental Analyst / Project Manager
Jacques Whitford Limited
3 Spectacle Lake Drive, Dartmouth, NS B3B 1W8
(902) 468-7777 ext. 251 (tel.)
(902) 468-9009 (fax)

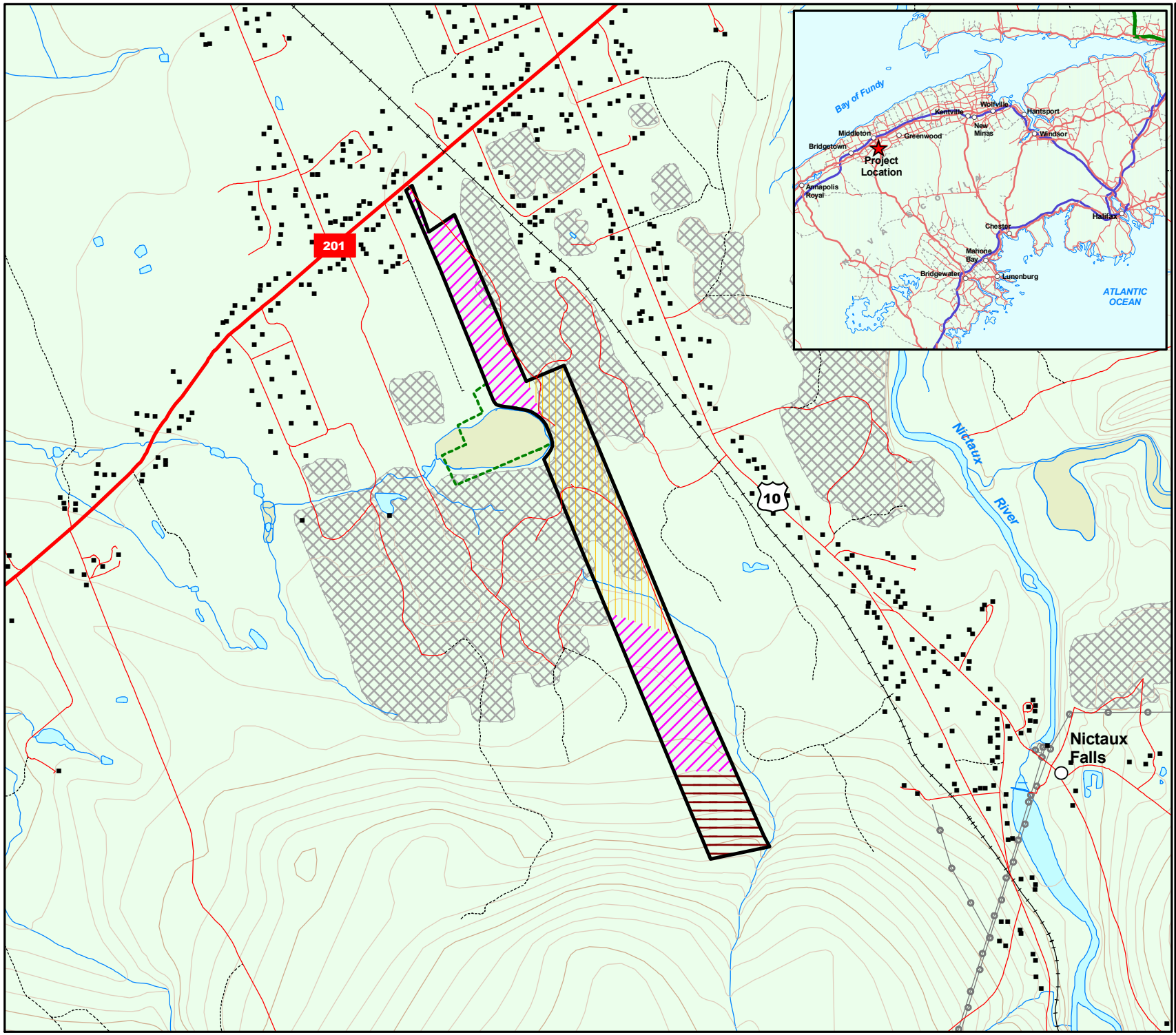

Figure 1

Ward Aggregates Proposed Gravel Pit and Quarry Development

Project Components
- Ward Aggregates Owned
- Proposed Permitted Area
- Proposed Gravel Pit
- Proposed Quarry Area
- Proposed Stockpile and Laydown Area

Topography
- Building/Structure

Roads
- Minor Road
- Major Road
- Trail/Track
- Rail

- Contour
- Utility Line
- Watercourse
- Waterbody
- Land
- Wetland
- Pit

N

0 250 500

Meters

Map Parameters
Projection: UTM
Zone: 20
Datum: NAD 83
Scale: 1:15,000
Project Number: NSD18995
Date: December 2004

Jacques Whitford

APPENDIX D

PROJECT AREA HABITAT DESRIPTIONS

Field Descriptor	Mature Aspen – Sugar Maple Forest
Estimated Stand Age	Approximately 60 years
Ecological Moisture Regime	Mesic
Dominant Tree Layer Species (Percent Cover)	*Populus grandidentata* (25%), *Acer saccharum* (20%), *Populus tremuloides* (15%), *Abies balsamea* (2%)
Dominant Shrub Layer Species (Percent Cover)	*Abies balsamea* (5%)
Dominant Ground Vegetation Species (Percent Cover)	*Thelypteris noveboracensis* (20%), *Polystichum acrostichoides* (12%), *Osmunda claytoniana* (10%)
Uncommon, Rare or Sensitive Species	Appalachian polydody (*Polypodium appalachianum*), NSDNR Green listed (secure), ACCDC S3?

Field Descriptor	Mature Red Maple – Red Oak Forest
Estimated Stand Age	Approximately 30 years
Ecological Moisture Regime	Mesic
Dominant Tree Layer Species (Percent Cover)	*Acer rubrum* (30%), *Quercus rubra* (20%), *Fraxinus americana* (10%), *Picea glauca* (5%)
Dominant Shrub Layer Species (Percent Cover)	*Abies balsamea* (1%)
Dominant Ground Vegetation Species (Percent Cover)	*Osmunda claytoniana* (20%), *Polytrichum commune* (7%), *Pleurozium schreberi* (5%), *Dicranum* sp. (5%), *Carex* sp. (2%), *Hylocomium splendens* (2%)
Uncommon, Rare or Sensitive Species	Tall Hairy Groovebur (*Agrimonia gryposepala*), NSDNR Green listed, ACCDC S3?

Field Descriptor	Mature Spruce – Red Oak Forest
Estimated Stand Age	Approximately 40 to 50 years old
Ecological Moisture Regime	Mesic
Dominant Tree Layer Species (Percent Cover)	*Picea glauca* (25%), *Quercus rubra* (20%), *Picea rubens* (15%), *Abies balsamea* (10%), *Betula papyrifera* (10%), *Pinus strobus* (2%)
Dominant Shrub Layer Species (Percent Cover)	*Abies balsamea* (10%), *Quercus rubra* (2%), *Crataegus* sp. (2%)
Dominant Ground Vegetation Species (Percent Cover)	*Pleurozium schreberi* (35%), *Pteridium aquilinum* (25%), *Aralia nudicaulis* (10%), *Mitchella repens* (5%), *Maianthemum canadense* (2%)
Uncommon, Rare or Sensitive Species	None

Field Descriptor	Immature Gray Birch – Pin Cherry Forest
Estimated Stand Age	Approximately 15 to 20 years old
Ecological Moisture Regime	Submesic
Dominant Tree Layer Species (Percent Cover)	*Betula populifolia* (25%), *Prunus pensylvanica* (20%), *Quercus rubra* (10%), *Populus tremuloides* (10%), *Betula papyrifera* (5%)
Dominant Shrub Layer Species (Percent Cover)	*Rubus allegheniensis* (25%), *Prunus pensylvanica* (5%), *Spiraea alba* (2%)
Dominant Ground Vegetation Species (Percent Cover)	*Solidago rugosa* (15%), *Solidago canadensis* (10%), *Anaphalis margaritacea* (5%)
Uncommon, Rare or Sensitive Species	None

Field Descriptor	Clear-cut
Estimated Stand Age	Approximately 2 years old
Ecological Moisture Regime	Submesic
Dominant Tree Layer Species (Percent Cover)	Pinus resinosa (5%)
Dominant Shrub Layer Species (Percent Cover)	Prunus serotina (5%), Rubus sp. (5%), Quercus rubra (4%), Lonicera Canadensis (1%), Picea glauca (1%)
Dominant Ground Vegetation Species (Percent Cover)	Oryzopsis asperifolia (20%), Danthonia spicata (10%), Pteridium aquilinum (7%), Solidago puberula (5%), Solidago bicolor (2%)
Uncommon, Rare or Sensitive Species	May support slim leaf witchgrass (*Panicum linearifolium*) (NSDNR Yellow listed, ACCDC S2?)

Field Descriptor	Grubbed Clear-cut
Estimated Stand Age	Approximately 2 years old
Ecological Moisture Regime	Submesic
Dominant Tree Layer Species (Percent Cover)	*Pinus resinosa* (0.5%)
Dominant Shrub Layer Species (Percent Cover)	*Prunus serotina* (0.5%), *Quercus rubra* (0.5%)
Dominant Ground Vegetation Species (Percent Cover)	*Pteridium aquilinum* (70%), *Panicum* sp. (5%), *Danthonia spicata* (1%), *Veronica officinalis* (1%), *Viola* sp. (0.5%)
Uncommon, Rare or Sensitive Species	Slim leaf witchgrass (*Panicum linearifolium*) (NSDNR Yellow listed, ACCDC S2?)

Field Descriptor	Low Shrub Thicket
Estimated Stand Age	Unknown
Ecological Moisture Regime	Submesic
Dominant Tree Layer Species (Percent Cover)	None
Dominant Shrub Layer Species (Percent Cover)	*Comptonia peregrina* (50%), *Rubus* sp. (15%), *Betula populifolia* (15%), *Juniperus communis* (5%), *Picea glauca* (2%)
Dominant Ground Vegetation Species (Percent Cover)	*Solidago puberula* (5%), *Solidago bicolor* (4%), *Agrostis capillaris* (3%), *Danthonia spicata* (2%), *Veronica officinalis* (2%)
Uncommon, Rare or Sensitive Species	None

Field Descriptor	Abandoned Gravel Pit
Estimated Stand Age	Unknown
Ecological Moisture Regime	Subhygric
Dominant Tree Layer Species (Percent Cover)	None
Dominant Shrub Layer Species (Percent Cover)	*Salix lucida* (15%), *Alnus incana* (10%)
Dominant Ground Vegetation Species (Percent Cover)	*Agalinus purpurea* (15%), *Agrostis stolonifera* (15%), *Hypericum canadense* (10%), *Oenothera perennis* (10%), *Lysimachia terrestris* (5%), *Euthamia graminifolia* (2%)
Uncommon, Rare or Sensitive Species	Hooded ladies'-tresses (Spiranthes romanzoffiana) (NSDNR Green listed, ACCDC S3S4), panicled hawkweed (*Hieracium paniculatum*) (NSDNR Green listed, ACCDC S3)

Field Descriptor	Coniferous Treed Basin Bog
Estimated Stand Age	Unknown
Ecological Moisture Regime	Subhydric
Dominant Tree Layer Species (Percent Cover)	*Picea mariana* (30%)
Dominat Shrub Layer Species (Percent Cover)	*Rhododendron canadense* (40%), *Chamaedaphne calyculata* (15%), *Nemopanthus mucronata* (7%), *Ledum groenlandicum* (5%), *Aronia arbutifolia* (5%), *Viburnum nudum* (2%)
Dominant Ground Vegetation Species (Percent Cover)	*Pleurozium schreberi* (60%), *Sphagnum* spp. (10%)
Uncommon, Rare or Sensitive Species	None

Field Descriptor	Low Shrub Dominated Basin Bog
Estimated Stand Age	Unknown
Ecological Moisture Regime	Subhydric
Dominant Tree Layer Species (Percent Cover)	*Picea mariana* (2%)
Dominant Shrub Layer Species (Percent Cover)	*Kalmia angustifolia* (35%), *Ledum groenlandicum* (20%), *Rhododendron canadense* (15%), *Aronia arbutifolia* (2%)
Dominant Ground Vegetation Species (Percent Cover)	*Pleurozium schreberi* (40%), *Sphagnum* spp. (20%), *Cladonia alpestris* (20%)
Uncommon, Rare or Sensitive Species	None

Field Descriptor	Deciduous Treed Stream Swamp
Estimated Stand Age	Unknown
Ecological Moisture Regime	Subhydric
Dominant Tree Layer Species (Percent Cover)	*Acer rubrum* (50%), *Betula populifolia* (5%)
Dominant Shrub Layer Species (Percent Cover)	*Alnus incana* (5%), *Ilex verticillata* (2%), *Spiraea alba* (1%), *Abies balsamea* (1%)
Dominant Ground Vegetation Species (Percent Cover)	*Carex gynandra* (25%), *Osmunda cinnamomea* (15%), *Onoclea sensibilis* (10%), *Glyceria striata* (10%), *Solidago rugosa* (5%), *Brachyelytrum erectum* (5%)
Uncommon, Rare or Sensitive Species	Hop sedge (*Carex lupulina*) (NSDNR Undetermined, ACCDC S3), Tall hairy groovebur (*Agrimonia gryposepala*) (NSDNR Green listed, ACCDC S3?)

Field Descriptor	Tall Shrub Dominated Stream Swamp
Estimated Stand Age	Unknown
Ecological Moisture Regime	Subhydric
Dominant Tree Layer Species (Percent Cover)	Acer rubrum (5%), Betula populifolia (3%), Larix laricina (1%), Abies balsamea (1)
Dominant Shrub Layer Species (Percent Cover)	Alnus incana (30%), Salix discolor (15%), Rosa palustris (5%), Spiraea alba (2%)
Dominant Ground Vegetation Species (Percent Cover)	Calamagrostis canadensis (35%), Onoclea sensibilis (30%), Glyceria canadensis (10%), Carex gynandra (5%), Carex lurida (5%)
Uncommon, Rare or Sensitive Species	Hop sedge (*Carex lupulina*) (NSDNR Undetermined, ACCDC S3), swamp rose (*Rosa palustris*) (NSDNR Green listed, ACCDC S3)

Field Descriptor	Tall Shrub Dominated Spring Swamp
Estimated Stand Age	Unknown
Ecological Moisture Regime	Hydric
Dominant Tree Layer Species (Percent Cover)	*Acer rubrum* (5%), *Betula populifolia* (5%)
Dominant Shrub Layer Species (Percent Cover)	*Alnus incana* (35%), *Spiraea alba* (5%), *Salix discolor* (2%)
Dominant Ground Vegetation Species (Percent Cover)	*Onoclea sensibilis* (60%), *Eupatorium maculatum* (25%), *Calamagrostis canadensis* (5%)
Uncommon, Rare or Sensitive Species	Hop sedge (*Carex lupulina*) (NSDNR Undetermined, ACCDC S3)

APPENDIX E

VASCULAR PLANTS RECORDED IN THE STUDY AREA

Table E1 Rare Plant Modelling for Ward Aggregates Site

Binomial	Common Name	Habitat	COSEWIC Status	NSDNR Status	ACCDC Status	Phenology and Ease of Identification	Possible Presence on Site
Toxicodendron vernix	Poison Sumac	Swampy lakeshores, marshy areas.	-	Red	S1	May to July, readily identified outside of flowering period.	No
Hydrocotyle umbellata	Many-Flowered Pennywort	Wet, sandy and gravelly lake margins.	Endangered	Red	S1	July to September, readily identified when not in flower.	No
Lilaeopsis chinensis	Eastern Lilaeopsis	Muddy and rocky tidal banks, in estuaries.	-	Red	S1	July and August, can be identified when not in flower.	No
Sanicula odorata	Black Snake-Root	Rich , alluvial woods and along intervales.	-	Red	S1	July to August	No
Eupatorium dubium	Joe-Pye Thoroughwort	Rocky shores, swamps and damp thickets	-	Red	S2	August and September, can be identified when not in flower.	Possible
Caulophyllum thalictroides	Blue Cohosh	Deciduous and intervale forest	-	Red	S2	April to early June, can be identified when not in flower	No
Cynoglossum virginianum var. boreale	Northern Wild Comfrey	Open beech woods, on dryish soils or on gypsum. Woods and thickets.	-	Red	S1	May and June, can be identified when not in flower.	No
Arabis hirsuta var. pycnocarpa	Hairy Rock-Cress	Dry cliffs, crevices, ledges, talus slopes and gravel.	-	Red	S1S2	May and June	No
Cardamine maxima	Large Toothwort	By woodland streams or in calcareous woods.	-	Red	S1	May, can be identified when not in flower. A spring ephemeral that senesces during summer.	No
Helianthemum canadense	Canada Frostweed	Sand barrens	-	Red	S1	June and early July.	Possible
Clethra alnifolia	Coast Pepper-Bush	Shores of lake headwaters, swamps, damp thickets and sandy woods	Vulnerable	Red	S1S2	Late September to October, can be identified when not in flower.	No
Vaccinium ovalifolium	Oval-Leaf Huckleberry	Moist or mesic coniferous woods. An arctic/alpine species.	-	Red	S1	Late July to early September, can be identified when not in flower.	No
Astragalus robbinsii var. minor	Robbins' Milk-Vetch	Exposed cliff headlands.	-	Red	S1	June	No
Desmodium canadense	Showy Tick-Trefoil	Open woods and river banks	-	Red	S1	Late July to early September, can be identified when not in flower.	Possible
Oxytropis campestris var. johannensis	St. John's Oxytrope	Exposed cliff crevices, gravelly or rocky scree, and headlands.	-	Red	S1	June to July, can be identified when not in flower.	No

Table E1 Rare Plant Modelling for Ward Aggregates Site

Binomial	Common Name	Habitat	COSEWIC Status	NSDNR Status	ACCDC Status	Phenology and Ease of Identification	Possible Presence on Site
Sabatia kennedyana	Plymouth Gentian	Cobbly, sandy beaches and the peaty margins of lakes, rivers, and boggy savannahs.	Endangered	Red	S1	August and September, can be identified when not in flower.	No
Podostemum ceratophyllum	Threadfoot	Fast-flowing gravelly streams.	-	Red	S1	July to September, readily identified when not in flower.	No
Hepatica nobilis var. obtusa	Round-Leaved Liverleaf	Dry, usually mixed deciduous forests.	-	Red	S1	Early May, can be identified when not in flower.	Possible
Salix candida	Hoary Willow	Calcareous bogs and thickets.	-	Red	S1	April to June, can be identified when not in flower or fruit.	No
Dirca palustris	Eastern Leatherwood	Rich deciduous or mixed woods.	-	Red	S1	Late May, can be identified when not in flower.	No
Thuja occidentalis	Northern White Cedar	Lakesides and swamps or old pastures.	-	Red	S1S2	Can be identified when not in flower.	Possible
Carex castanea	Chestnut-Colored Sedge	Swamps and wet meadows, cliff crevices and ledges.	-	Red	S2	Seeds (perigynia) required for identification. Can be identified from June through September.	Possible
Carex hirtifolia	Pubescent Sedge	Calcareous regions, in meadows and thickets, forest slopes.	-	Red	S1S2	Seeds (perigynia) required for identification. Can be identified from May through September.	No
Carex livida var. radicaulis	Livid Sedge	Calcareous bogs and meadows.	-	Red	S1	Seeds (perigynia) required for identification. Can be identified from June through September.	No
Carex prairea	Prairie Sedge	Typha swamp.	-	Red	S1	Seeds (perigynia) required for identification. Can be identified from June through September.	Possible
Carex tuckermanii	Tuckerman Sedge	Swales	-	Red	S1	Seeds (perigynia) required for identification. Can be identified from June through September.	Possible
Lachnanthes caroliana	Carolina Redroot	Peaty shores and lakeside marshes.	Threatened	Red	S1	July to September.	No

Table E1 Rare Plant Modelling for Ward Aggregates Site							
Binomial	**Common Name**	**Habitat**	**COSEWIC Status**	**NSDNR Status**	**ACCDC Status**	**Phenology and Ease of Identification**	**Possible Presence on Site**
Iris prismatica	Slender Blue Flag	Wet ground near the coast.	-	Red	S1	Mid-July.	No
Allium tricoccum	Small White Leek	Rich, deciduous forests and intervales.	-	Red	S1	Late July	No
Lophiola aurea	Golden Crest	Lakeshores, wet savannas, and sphagnous swales.	Threatened	Red	S2	August through early September.	No
Cypripedium arietinum	Ram's-Head Lady's-Slipper	Karst topography around gypsum sinkholes.	-	Red	S1	Late May.	No
Cypripedium reginae	Showy Lady's-Slipper	Alkaline swamps and bogs.	-	Red	S2	June through August.	No
Goodyera pubescens	Downy Rattlesnake-Plantain	Woodlands and thickets.	-	Red	S1	July and August.	Possible
Listera australis	Southern Twayblade	Among the shaded sphagnum moss of bogs or damp woods.	-	Red	S1	June. Quickly senesces after flowering.	Possible
Malaxis brachypoda	White Adder's-Mouth	Moss cushions and wet, mossy cliff-edges, where there is little competition from other plant species.	-	Red	S1	Late May and June.	No
Panicum xanthophysum	Slender Dichanthelium	Open thickets, in dry, sandy or rocky soils.	-	Red	S1	June to September.	Possible
Festuca subverticillata	Nodding Fescue	Rich, deciduous forested slopes and alluvial woods.	-	Red	S1S2	June and early July. Can be identified as long as seeds are present.	No
Panicum dichotomiflorum var. puritanorum	Spreading Panic-Grass	Sandy and gravelly shores of lakes and savannas.	-	Red	S1?	June to October	No
Adiantum pedatum	Northern Maidenhair-Fern	In fertile or quite alkaline soils. Under oak-birch-sugar maple-elm trees, on intervales.	-	Red	S1	Readily identified by vegetative features.	No
Isoetes prototypus	Prototype Quillwort	Deep water in nutrient-poor, acidic lakes.	-	Red	S1	Summer. Megaspores required for identification.	No
Conioselinum chinense	Hemlock Parsley	Swamps, mossy coniferous woods or swales, and seepy slopes near the coast.	-	Yellow	S2S3	August to October	No
Rudbeckia laciniata var. gaspereauensis	Cut-Leaved Coneflower	Swales, the edges of swamps, or in gullies - in small colonies	-	Yellow	S2S3	August, can be identified when not in flower.	Possible

Table E1 Rare Plant Modelling for Ward Aggregates Site

Binomial	Common Name	Habitat	COSEWIC Status	NSDNR Status	ACCDC Status	Phenology and Ease of Identification	Possible Presence on Site
Solidago latissimifolia	Elliott Goldenrod	Boggy swales, clearings, damp thickets, spruce and maple swamps, and lake shores.	-	Yellow	S3	August and September, can be identified when not in flower.	No
Impatiens pallida	Pale Jewel-Weed	Rich alluvial soils, damp thickets, and along intervales	-	Yellow	S2	July and August.	No
Alnus serrulata	Brook-Side Alder	Lakeshores.	-	Yellow	S2	February to May, can be identified when not in flower.	No
Betula nana	Swamp Birch	Peat and sphagnous bogs.	-	Yellow	S2	June and July, can be identified when not in flower.	Possible
Arabis drummondii	Drummond Rockcress	Usually on dry slopes and talus, but occassionally in more fertile locations at lower elevations.	-	Yellow	S2	May to July.	No
Draba arabisans	Rock Whitlow-Grass	Muddy soils or on calcareous rocks, in cliff crevices and ledges.	-	Yellow	S2	May to July	No
Campanula aparinoides	Marsh Bellflower	Meadows, ditches and river banks.	-	Yellow	S3?	August	Possible
Minuartia groenlandica	Mountain Sandwort	Granitic ledges and gravel, on coasts at higher elevations.	-	Yellow	S2	June to August	No
Hudsonia ericoides	Golden-Heather	Dry, rocky, and sandy barrens, recently disturbed areas or on open sandy soils.	-	Yellow	S2	Late May to early July. Can be identified when not in flower.	Possible
Shepherdia canadensis	Canada Buffalo-Berry	Gypsum or talus slopes and along the coast within reach of salt spray.	-	Yellow	S2	April to June. Can be identified when not in flower.	No
Proserpinaca pectinata	Comb-Leaved Mermaid-Weed	Wet savannas, sphagnous swales, and the sandy, gravelly, or muddy borders of lakes or ponds.	-	Yellow	S3	June to October. Can be identified when not in flower.	No
Floerkea proserpinacoides	False Mermaid-Weed	Deciduous ravine slopes, river margins, and intervale forests.	-	Yellow	S2S3	Late May to late June. Can be identified when not in flower.	No
Utricularia gibba	Humped Bladderwort	Shallow lake margins, small pools and small ponds in quagmires or peaty situations.	-	Yellow	S2	Late June to September. Can be identified without flowers.	No

Table E1 Rare Plant Modelling for Ward Aggregates Site							
Binomial	**Common Name**	**Habitat**	**COSEWIC Status**	**NSDNR Status**	**ACCDC Status**	**Phenology and Ease of Identification**	**Possible Presence on Site**
Decodon verticillatus	Hairy Swamp Loosestrife	Quaking margins of ponds or lakes.	-	Yellow	S2S3	July and August. Can be identified without flowers.	No
Rhexia virginica	Virginia Meadow-Beauty	Peaty lake margins and swales, or wet thickets.	-	Yellow	S3	July and August. Can be identified without flowers.	No
Fraxinus nigra	Black Ash	Low ground, damp woods and swamps.	-	Yellow	S3	May and June. Can be identified without flowers.	Possible
Epilobium coloratum	Purple-Leaf Willow-Herb	Low-lying ground, springy slopes and similar locations.	-	Yellow	S2?	July and October. Seeds required for identification.	Possible
Polygala sanguinea	Field Milkwort	Poor or acidic fields, damp slopes, and open woods or bush.	-	Yellow	S2S3	Late June to October.	Possible
Polygonum arifolium	Halberd-Leaf Tearthumb	Thickets, marshy borders, usually under alders. Typically found in rich alluvial soil.	-	Yellow	S2	Flowers not required for identification.	Possible
Samolus valerandi ssp. parviflorus	Water Pimpernel	Brackish meadows, tidal banks and the edge of salt marshes.	-	Yellow	S2	July to September.	No
Anemone canadensis	Canada Anemone	Damp thickets, meadows and gravelly shores, on calacareous or alluvial soils.	-	Yellow	S2	May to July.	No
Anemone quinquefolia var. quinquefolia	Wood Anemone	Wooded riverbanks and shaded intervales.	-	Yellow	S2	Late May to early June.	No
Anemone virginiana var. virginiana	River Anemone	Intervales and streamsides. Calcareous and slaty ledges, shores and thickets.	-	Yellow	S2	Early July.	No
Ranunculus flammula var. flammula	Greater Creeping Spearwort	Semi-aquatic, in bogs and cold streams.	-	Yellow	S2	July to September.	No
Cephalanthus occidentalis	Common Buttonbush	Granite boulders, rocky shores, about lakes.	-	Yellow	S2S3	July 15 to August 15. Can be identified without flowers.	No
Salix pedicellaris	Bog Willow	Acid bogs and sphagnous lake shores.	-	Yellow	S2	May to July.	Possible
Salix sericea	Silky Willow	Low thickets and streambanks.	-	Yellow	S2	Late March to early May.	Possible
Geocaulon lividum	Northern Comandra	Usually found on sterile soils and damp sands, in acid or peaty locations.	-	Yellow	S2S3	Late May to early August. Can be identified without flowers.	Possible

Table E1 Rare Plant Modelling for Ward Aggregates Site							
Binomial	**Common Name**	**Habitat**	**COSEWIC Status**	**NSDNR Status**	**ACCDC Status**	**Phenology and Ease of Identification**	**Possible Presence on Site**
Limosella australis	Mudwort	Low areas by ponds, gravel lakeshores, the muddy edges of ponds behind barrier beaches and muddy river margins.	-	Yellow	S2S3	Late June to October.	No
Laportea canadensis	Wood Nettle	Alluvial woods of mixed or deciduous trees. Floodplains on the Cape Breton plateau. Only in the most fertile locations.	-	Yellow	S3	July to September. Can be identified without flowers.	Possible
Viola nephrophylla	Northern Bog Violet	Cool mossy bogs, the borders of streams, and damp woods.	-	Yellow	S2	May to July.	Possible
Eleocharis olivacea var. olivacea	Capitate Spikerush	Peaty muck of bogs, wet sandy shores, and swales.	-	Yellow	S2	June to October. Mature achenes required for identification.	No
Scirpus longii	Long's Bulrush	Peaty and mucky shores, stillwater meadows and fens.	Vulnerable	Yellow	S2	June and early July. Can be in summer and early fall using seeds.	No
Juncus marginatus	Grassleaf Rush	Clayey roadsides, damp fields, and brooksides.	-	Yellow	S2S3	June to September.	Possible
Coeloglossum viride var. virescens	Long-Bract Green Orchis	Boggy spots, damp mature woods, and fir or floodplain forests.	-	Yellow	S2	May to August.	No
Platanthera flava var. flava	Southern Rein Orchid	Sandy or gravelly beaches, wet peat, and lake or river margins. Bogs, swamps, and meadows.	-	Yellow	S2	May to August.	Possible
Platanthera macrophylla	Large Round-Leaved Orchid	Damp woods in deep shade.	-	Yellow	S2	August	Possible
Spiranthes ochroleuca	Yellow Nodding Ladies'-Tresses	Characteristic of the driest sand barrens in southwestern counties. Also near rivers, and in dry habitats such as roadsides and fields.	-	Yellow	S2	September to October.	Possible
Calamagrostis stricta var. stricta	Bentgrass	Around lakes and bogs, wet cliff-faces.	-	Yellow	S1S2	June to September.	Possible

Table E1 Rare Plant Modelling for Ward Aggregates Site							
Binomial	**Common Name**	**Habitat**	**COSEWIC Status**	**NSDNR Status**	**ACCDC Status**	**Phenology and Ease of Identification**	**Possible Presence on Site**
Panicum linearifolium	Slim-Leaf Witchgrass	Dry sandy soils.	-	Yellow	S2?	July to October.	Possible
Piptatherum canadense	Canada Mountain-Ricegrass	Dry, sandy soils.	-	Yellow	S2	May to June.	Possible
Panicum philadelphicum	Philadelphia Panic Grass	Floodplains and cranberry bogs.	-	Yellow	S1SE	June to October.	No
Panicum rigidulum var. pubescens	Redtop Panic Grass	Sandy and peaty beaches, gravelly lake margins.	-	Yellow	S2	July onwards. Matures late in the season.	No
Poa glauca ssp. glauca	White Bluegrass	Cliff crevices, on shelves, and talus slopes.	-	Yellow	S2S3	July and August. Can be identified post flowering until early October.	No
Sphenopholis intermedia	Slender Wedge Grass	Cliff faces, where the roots are in contact with limestone, basalt or gypsum.	-	Yellow	S3S4	June to August. Can be identified post-flowering until early October.	No
Potamogeton zosteriformis	Flatstem Pondweed	Lakes and deep rivers in less acid regions.	-	Yellow	S2S3	July to September. Can be identified when not in flower.	No
Cryptogramma stelleri	Fragile Rockbrake	Shaded limestone cliffs, and shaded crevices in conglomerate cliff-face.	-	Yellow	S1S2	Late May to September. Can be identified when sporangia are not present.	No
Asplenium trichomanes-ramosum	Green Spleenwort	Shaded cliffs along streams, on limestone or other basic rocks.	-	Yellow	S2	Can be identified without sprangia.	No
Woodwardia areolata	Netted Chainfern	Swamps, bog margins, and particularly along streams	-	Yellow	S2	July to October. Can be identified without sporangia.	Possible
Dryopteris fragrans var. remotiuscula	Fragrant Fern	Dry, overhanging cliffs, and in cliff crevices along streams or near waterfalls.	-	Yellow	S2	June to September. Can be identified without sporangia.	No
Woodsia glabella	Smooth Woodsia	Shaded vertical cliffs, and along streams in northern Cape Breton.	-	Yellow	S2	June to August. Can be identified without sporangia.	No
Equisetum pratense	Meadow Horsetail	Open woods and wet meadows, usually in circumneutral soils.	-	Yellow	S2	Can be identified by vegetative characteristics.	Possible
Isoetes acadiensis	Acadian Quillwort	Water up to 1 m deep, bordering lakes or ponds, and occassionally along rivers.	-	Yellow	S3?	Megaspores required for identification.	No

Table E1 Rare Plant Modelling for Ward Aggregates Site							
Binomial	**Common Name**	**Habitat**	**COSEWIC Status**	**NSDNR Status**	**ACCDC Status**	**Phenology and Ease of Identification**	**Possible Presence on Site**
Botrychium lanceolatum var. angustisegmentum	Lance-Leaf Grape-Fern	Rich wooded hillsides.	-	Yellow	S2	July and August. Can be identified until early October if sporophore is present.	Possible
Botrychium simplex	Least Grape-Fern	Usually on lakeshores or the mossy edges of streams or waterfalls although it has been reported in a wide variety of habitats.	-	Yellow	S2S3	Late May and June. Can be identified until early October if sporophore is present.	Possible
Ophioglossum pusillum	Adder's Tongue	Sterile meadows, grassy swamps, and damp, sandy, or cobbly beaches of lakes.	-	Yellow	S2S3	Late May to August. Can be identified until early October if stipe and sporangia are present.	Possible

Table E2 Vascular Plant Species Found in the Ward Aggregates Study Area		
Common Name	**Binomial**	**ACCDC Provincial Status**
Balsam Fir	*Abies balsamea*	S5
Red Maple	*Acer rubrum*	S5
Sugar Maple	*Acer saccharum*	S5
Nova Scotia False-Foxglove	*Agalinus purpurea var. neosctica*	S4
Tall Hairy Groovebur	*Agrimonia gryposepala*	S3?
Woodland Agrimony	*Agrimonia striata*	S5
Colonial Bentgrass	*Agrostis capillaris*	SE
Rough Bentgrass	*Agrostis hyemalis*	S5
Perennial Bentgrass	*Agrostis perennans*	S4S5
Spreading Bentgrass	*Agrostis stolonifera*	S5SE
Broad-Leaved Water-Plantain	*Alisma triviale*	S5
Speckled Alder	*Alnus incana*	S5
Green Alder	*Alnus viridis*	S5
Shadbush	*Amelanchier sp.*	N/A
Pearly Everlasting	*Anaphalis margaritacea*	S5
Sweet Vernal Grass	*Anthoxanthum odoratum*	SE
Spreading Dogbane	*Apocynum androsaemifolium*	S5
Bristly Sarsaparilla	*Aralia hispida*	S5
Wild Sarsaparilla	*Aralia nudicaulis*	S5
Lesser Burdock	*Arctium minus*	SE
Bearberry	*Arctostaphylos uva-ursi*	S4
Swamp Jack-In-The-Pulpit	*Arisaema triphyllum*	S4S5
Red Chokeberry	*Aronia arbutifolia*	S4S5
Common Wormwood	*Artemisia vulgaris*	SE
Whorled Aster	*Aster acuminatus*	S5
Farewell-Summer	*Aster lateriflorus*	S5
Large-Leaf Wood-Aster	*Aster macrophyllus*	S5
New Belgium American-Aster	*Aster novi-belgii*	S5
Swamp Aster	*Aster puniceus*	S5
Parasol White-Top	*Aster umbellatus*	S5
Lady-Fern	*Athyrium filix-femina*	S5
Gray Birch	*Betula populifolia*	S5
Tall Bur-Marigold	*Bidens vulgata*	SE?
Bearded Short-Husk	*Brachyelytrum erectum*	S4S5
Blue-Joint Reedgrass	*Calamagrostis canadensis*	S5
Vernal Water Starwort	*Callitriche palustris*	S5
Black Sedge	*Carex arctata*	S5
Yellow Sedge	*Carex flava*	S5
Graceful Sedge	*Carex gracillima*	S4S5
A Sedge	*Carex gynandra*	S5
Bladder Sedge	*Carex intumescens*	S5
Bristly-Stalk Sedge	*Carex leptalea*	S5
Hop Sedge	*Carex lupulina*	S3
Shallow Sedge	*Carex lurida*	S5
Necklace Sedge	*Carex projecta*	S4S5
Cyperus-Like Sedge	*Carex pseudocyperus*	S4S5
Rough Sedge	*Carex scabrata*	S5
Pointed Broom Sedge	*Carex scoparia*	S5
Stalk-Grain Sedge	*Carex stipata*	S5
Three-Seed Sedge	*Carex trisperma*	S5
Inflated Sedge	*Carex vesicaria*	S4S5
Black Starthistle	*Centaurea nigra*	SE
Leatherleaf	*Chamaedaphne calyculata*	S5

Table E2 Vascular Plant Species Found in the Ward Aggregates Study Area		
Common Name	**Binomial**	**ACCDC Provincial Status**
White Turtlehead	*Chelone glabra*	S5
White Goosefoot	*Chenopodium album*	SE
Common Wintergreen	*Chimaphila umbellata*	S4
Oxeye Daisy	*Chrysanthemum leucanthemum*	SE
American Golden-Saxifrage	*Chrysosplenium americanum*	S5
Swamp Thistle	*Cirsium muticum*	S5
Bull Thistle	*Cirsium vulgare*	SE
Virginia Virgin-Bower	*Clematis virginiana*	S5
Clinton Lily	*Clintonia borealis*	S5
Sweet Fern	*Comptonia peregrina*	S5
Canada Horseweed	*Conyza canadensis*	S5
Goldthread	*Coptis trifolia*	S5
Broom Crowberry	*Corema conradii*	S4
Alternate-Leaf Dogwood	*Cornus alternifolia*	S5
Dwarf Dogwood	*Cornus canadensis*	S5
Pale Corydalis	*Corydalis sempervirens*	S4S5
Beaked Hazelnut	*Corylus cornuta*	S5
Hawthorn	*Crataegus sp.*	N/A
Smooth Hawksbeard	*Crepis capillaris*	SE
Pink Lady's-Slipper	*Cypripedium acaule*	S5
Poverty Oat-Grass	*Danthonia spicata*	S5
Wild Carrot	*Daucus carota*	SE
Northern Bush-Honeysuckle	*Diervilla lonicera*	S5
Smooth Crabgrass	*Digitaria ischaemum*	SE
Spoon-Leaved Sundew	*Drosera intermedia*	S5
Mountain Wood-Fern	*Dryopteris campyloptera*	S5
Spinulose Shield Fern	*Dryopteris carthusiana*	S5
Crested Shield-Fern	*Dryopteris cristata*	S5
Evergreen Woodfern	*Dryopteris intermedia*	S5
Marginal Wood-Fern	*Dryopteris marginalis*	S5
Barnyard Grass	*Echinochloa crus-galli*	SE
Least Spike-Rush	*Eleocharis acicularis*	S5
Blunt Spike-Rush	*Eleocharis ovata*	S4S5
Slender Spike-Rush	*Eleocharis tenuis*	S5
Trailing Arbutus	*Epigaea repens*	S5
Hairy Willow-Herb	*Epilobium ciliatum*	S5
Eastern Helleborine	*Epipactis helleborine*	SE
Field Horsetail	*Equisetum arvense*	S5
Fireweed	*Erechtites hieraciifolia*	S5
Daisy Fleabane	*Erigeron strigosus*	S5
Spotted Joe-Pye Weed	*Eupatorium maculatum*	S5
Common Boneset	*Eupatorium perfoliatum*	S5
Flat-Top Fragrant-Golden-Rod	*Euthamia graminifolia*	S5
American Beech	*Fagus grandifolia*	S5
Hair Fescue	*Festuca filiformis*	SE
Red Fescue	*Festuca rubra*	S5
Virginia Strawberry	*Fragaria virginiana*	S5
White Ash	*Fraxinus americana*	S5
Small Bedstraw	*Galium trifidum*	S5
Teaberry	*Gaultheria procumbens*	S5
Herb-Robert	*Geranium robertianum*	S4S5
Rough Avens	*Geum laciniatum*	S4S5
Large-Leaved Avens	*Geum macrophyllum*	S5

Table E2 Vascular Plant Species Found in the Ward Aggregates Study Area		
Common Name	**Binomial**	**ACCDC Provincial Status**
Purple Avens	*Geum rivale*	S5
Canada Manna-Grass	*Glyceria canadensis*	S5
American Mannagrass	*Glyceria grandis*	S4S5
Fowl Manna-Grass	*Glyceria striata*	S5
Low Cudweed	*Gnaphalium uliginosum*	SE
Northern Oak Fern	*Gymnocarpium dryopteris*	S5
Meadow Hawkweed	*Hieracium caespitosum*	SE
Panicled Hawkweed	*Hieracium paniculatum*	S3
Mouseear	*Hieracium pilosella*	SE
Rough Hawkweed	*Hieracium scabrum*	S5
Common Velvet Grass	*Holcus lanatus*	SE
Canadian St. John's-Wort	*Hypericum canadense*	S5
Orange-Grass St. John's-Wort	*Hypericum gentianoides*	SE
A St. John's-Wort	*Hypericum perforatum*	SE
Black Holly	*Ilex verticillata*	S5
Spotted Jewel-Weed	*Impatiens capensis*	S5
Blueflag	*Iris versicolor*	S5
Jointed Rush	*Juncus articulatus*	S5
Narrow-Panicled Rush	*Juncus brevicaudatus*	S5
Canada Rush	*Juncus canadensis*	S5
Soft Rush	*Juncus effusus*	S5
Slender Rush	*Juncus tenuis*	S5
Ground Juniper	*Juniperus communis*	S5
Sheep-Laurel	*Kalmia angustifolia*	S5
Wild Lettuce	*Lactuca sp.*	N/A
American Larch	*Larix laricina*	S5
Common Labrador Tea	*Ledum groenlandicum*	S5
Autumn Hawkbit	*Leontodon autumnalis*	SE
Old-Field Toadflax	*Linaria canadensis*	SE
Indian-Tobacco	*Lobelia inflata*	S5
American Fly-Honeysuckle	*Lonicera canadensis*	S5
Tartarian Honeysuckle	*Lonicera tatarica*	SE
Marsh Seedbox	*Ludwigia palustris*	S5
Large-Leaved Lupine	*Lupinus polyphyllus*	SE
Common Woodrush	*Luzula multiflora*	S5
Running Pine	*Lycopodium clavatum*	S5
Tree Clubmoss	*Lycopodium obscurum*	S5
American Bugleweed	*Lycopus americanus*	S5
Northern Bugleweed	*Lycopus uniflorus*	S5
Swamp Loosestrife	*Lysimachia terrestris*	S5
Wild Lily-of-The-Valley	*Maianthemum canadense*	S5
Corn Mint	*Mentha arvensis*	S5
Partridge-Berry	*Mitchella repens*	S5
Indian-Pipe	*Monotropa uniflora*	S5
Fall Dropseed Muhly	*Muhlenbergia uniflora*	S5
Small Forget-Me-Not	*Myosotis laxa*	S5
Mountain Holly	*Nemopanthus mucronata*	S5
Common Evening-Primrose	*Oenothera biennis*	S5
Small Sundrops	*Oenothera perennis*	S5
Sensitive Fern	*Onoclea sensibilis*	S5
White-Grained Mountain-Ricegrass	*Oryzopsis asperifolia*	S5
Cinnamon Fern	*Osmunda cinnamomea*	S5
Interrupted Fern	*Osmunda claytoniana*	S5

Table E2 Vascular Plant Species Found in the Ward Aggregates Study Area		
Common Name	**Binomial**	**ACCDC Provincial Status**
Royal Fern	*Osmunda regalis*	S5
Eastern Hop-Hornbeam	*Ostrya virginiana*	S5
Upright Yellow Wood-Sorrel	*Oxalis stricta*	S5
Northern Witchgrass	*Panicum boreale*	S5
Old Witch Panic-Grass	*Panicum capillare*	SE
Slim-Leaf Witchgrass	*Panicum linearifolium*	S2?
Hawkweed	*Panicum villosissimum*	Unknown
Reed Canary Grass	*Phalaris arundinacea*	S5
Northern Beech Fern	*Phegopteris connectilis*	S5
White Spruce	*Picea glauca*	S5
Black Spruce	*Picea mariana*	S5
Red Spruce	*Picea rubens*	S5
Red Pine	*Pinus resinosa*	S4S5
Eastern White Pine	*Pinus strobus*	S5
Scotch Pine	*Pinus sylvestris*	SE
Nipple-Seed Plantain	*Plantago major*	SE
White-Fringe Orchis	*Platanthera blephariglottis*	S4
Leafy Northern Green Orchis	*Platanthera hyperborea*	SRF
Small Purple-Fringe Orchis	*Platanthera psycodes*	S4
Canada Bluegrass	*Poa compressa*	SE
Fowl Bluegrass	*Poa palustris*	S5
Kentucky Bluegrass	*Poa pratensis*	S5
Marshpepper Smartweed	*Polygonum hydropiper*	SE
Mild Water-Pepper	*Polygonum hydropiperoides*	S5
Lady's Thumb	*Polygonum persicaria*	SE
Arrow-Leaved Tearthumb	*Polygonum sagittatum*	S5
Appalachian Polypody	*Polypodium appalachianum*	S3?
Rock Polypody	*Polypodium virginianum*	S5
Christmas Fern	*Polystichum acrostichoides*	S5
Quaking Aspen	*Populus tremuloides*	S5
Norwegian Cinquefoil	*Potentilla norvegica*	S5
Old-Field Cinquefoil	*Potentilla simplex*	S5
Tall Rattlesnake-root	*Prenanthes altissima*	S4S5
Three-Leaved Rattlesnake-root	*Prenanthes trifoliolata*	S5
Self-Heal	*Prunella vulgaris*	S5
Fire Cherry	*Prunus pensylvanica*	S5
Wild Black Cherry	*Prunus serotina*	S5
Bracken Fern	*Pteridium aquilinum*	S5
Shinleaf	*Pyrola elliptica*	S5
American Wintergreen	*Pyrola rotundifolia var. americana ameri*	S5
Common Apple	*Pyrus malus*	SE
Northern Red Oak	*Quercus rubra*	S5
Tiny All Seed	*Radiola linoides*	SE
Tall Butter-Cup	*Ranunculus acris*	SE
Creeping Butter-Cup	*Ranunculus repens*	SE
Rhodora	*Rhododendron canadense*	S5
Staghorn Sumac	*Rhus typhina*	S4S5
Smooth Gooseberry	*Ribes hirtellum*	S5
Watercress	*Rorippa nasturtium-aquaticum*	SE
Swamp Rose	*Rosa palustris*	S3
Allegheny Blackberry	*Rubus allegheniensis*	S5
Smooth Blackberry	*Rubus canadensis*	S5
Bristly Dewberry	*Rubus hispidus*	S5

Table E2 Vascular Plant Species Found in the Ward Aggregates Study Area		
Common Name	**Binomial**	**ACCDC Provincial Status**
Red Raspberry	*Rubus idaeus*	S5
Dwarf Red Raspberry	*Rubus pubescens*	S5
a bramble	*Rubus recurvicaulis*	S?
Garden Sorrel	*Rumex acetosa*	SE
Bebb's Willow	*Salix bebbiana*	S5
Pussy Willow	*Salix discolor*	S5
Heart-Leaved Willow	*Salix eriocephala*	S5
Prairie Willow	*Salix humilis*	S5
Shining Willow	*Salix lucida*	S5
A Willow	*Salix x smithiana*	SE
Common Elderberry	*Sambucus canadensis*	S5
Red Elderberry	*Sambucus racemosa*	S5
Cottongrass Bulrush	*Scirpus cyperinus*	S5
Mad Dog Skullcap	*Scutellaria lateriflora*	S5
Robbins Squaw-Weed	*Senecio robbinsii*	S4S5
Pearl-Millet/ Yellow Foxtail	*Setaria glaucum*	SE
Climbing Nightshade	*Solanum dulcamara*	SE
White Goldenrod	*Solidago bicolor*	S5
Canada Goldenrod	*Solidago canadensis*	S5
Broad-Leaved Goldenrod	*Solidago flexicaulis*	S5
Downy Goldenrod	*Solidago puberula*	S5
Rough-Leaf Goldenrod	*Solidago rugosa*	S5
Field Sowthistle	*Sonchus arvensis*	SE
European Mountain-Ash	*Sorbus aucuparia*	SE
American Bur-Reed	*Sparganium americanum*	S5
Large Bur-Reed	*Sparganium eurycarpum*	S4
Fresh Water Cordgrass	*Spartina pectinata*	S5
Narrow-Leaved Meadow-Sweet	*Spiraea alba*	S5
Hardhack Spiraea	*Spiraea tomentosa*	S5
Hooded Ladies'-Tresses	*Spiranthes romanzoffiana*	S3S4
Common Tansy	*Tanacetum vulgare*	SE
Tall Meadow-Rue	*Thalictrum pubescens*	S5
New York Fern	*Thelypteris noveboracensis*	S5
Marsh St. John's-Wort	*Triadenum fraseri*	S5
Northern Starflower	*Trientalis borealis*	S5
Low Hop Clover	*Trifolium campestre*	SE
Nodding Trillium	*Trillium cernuum*	S4
Eastern Hemlock	*Tsuga canadensis*	S4S5
Broad-Leaf Cattail	*Typha latifolia*	S5
American Elm	*Ulmus americana*	S4
Late Lowbush Blueberry	*Vaccinium angustifolium*	S5
Velvetleaf Blueberry	*Vaccinium myrtilloides*	S5
Mountain Cranberry	*Vaccinium vitis-idaea*	S5
Great Mullein	*Verbascum thapsus*	SE
Gypsy-Weed	*Veronica officinalis*	S5SE
Possum-Haw Viburnum	*Viburnum nudum*	S5
Marsh Blue Violet	*Viola cucullata*	S5
Lance-Leaf Violet	*Viola lanceolata*	S5
Wooly Blue Violet	*Viola sororia*	S5

Table E3 Plants Found in Wetland 1		
Common Name	**Binomial**	**ACCDC Rank**
Black Spruce	*Picea mariana*	S5
Rhodora	*Rhododendron canadense*	S5
Sheep-Laurel	*Kalmia angustifolia*	S5
Leatherleaf	*Chamaedaphne calyculata*	S5
Red Chokeberry	*Aronia arbutifolia*	S4S5
Possum-Haw Viburnum	*Viburnum nudum*	S5
Late Lowbush Blueberry	*Vaccinium angustifolium*	S5
Teaberry	*Gaultheria procumbens*	S5
Mountain Holly	*Nemopanthus mucronata*	S5
Eastern White Pine	*Pinus strobus*	S5
Shadbush	*Amelanchier sp.*	N/A
Speckled Alder	*Alnus incana*	S5
Bracken Fern	*Pteridium aquilinum*	S5

Table E4 Plant Found in Wetland 2		
Common Name	**Binomial**	**ACCDC Rank**
Red Maple	*Acer rubrum*	S5
Blue-Joint Reedgrass	*Calamagrostis canadensis*	S5
Rough-Leaf Goldenrod	*Solidago rugosa*	S5
Black Holly	*Ilex verticillata*	S5
A Sedge	*Carex gynandra*	S5
Narrow-Leaved Meadow-Sweet	*Spiraea alba*	S5
Fowl Manna-Grass	*Glyceria striata*	S5
Rose	*Rosa sp.*	N/A
Sensitive Fern	*Onoclea sensibilis*	S5
Spotted Jewel-Weed	*Impatiens capensis*	S5
Climbing Nightshade	*Solanum dulcamara*	SE
Swamp Loosestrife	*Lysimachia terrestris*	S5
American Bugleweed	*Lycopus americanus*	S5
Creeping Butter-Cup	*Ranunculus repens*	SE
Speckled Alder	*Alnus incana*	S5
Canada Manna-Grass	*Glyceria canadensis*	S5
Pussy Willow	*Salix discolor*	S5
Blueflag	*Iris versicolor*	S5
Sedge	*Carex Sp.*	N/A
Cottongrass Bulrush	*Scirpus cyperinus*	S5
Spotted Joe-Pye Weed	*Eupatorium maculatum*	S5
Swamp Aster	*Aster puniceus*	S5
Canada Goldenrod	*Solidago canadensis*	S5
American Elm	*Ulmus americana*	S4
Evergreen Woodfern	*Dryopteris intermedia*	S5
Virginia Virgin-Bower	*Clematis virginiana*	S5
Arrow-Leaved Tearthumb	*Polygonum sagittatum*	S5
Red Raspberry	*Rubus idaeus*	S5
Necklace Sedge	*Carex projecta*	S4S5
Corn Mint	*Mentha arvensis*	S5
Marsh Blue Violet	*Viola cucullata*	S5
American Larch	*Larix laricina*	S5
Purple Avens	*Geum rivale*	S5
Northern Bugleweed	*Lycopus uniflorus*	S5
Swamp Jack-In-The-Pulpit	*Arisaema triphyllum*	S4S5
Tall Meadow-Rue	*Thalictrum pubescens*	S5
Northern Red Oak	*Quercus rubra*	S5
Gray Birch	*Betula populifolia*	S5
Eastern Hop-Hornbeam	*Ostrya virginiana*	S5
White Spruce	*Picea glauca*	S5
Bristly Dewberry	*Rubus hispidus*	S5
Cinnamon Fern	*Osmunda cinnamomea*	S5
Dwarf Red Raspberry	*Rubus pubescens*	S5
Three-Leaved Rattlesnake-root	*Prenanthes trifoliolata*	S5
Bearded Short-Husk	*Brachyelytrum erectum*	S4S5
Farewell-Summer	*Aster lateriflorus*	S5
Parasol White-Top	*Aster umbellatus*	S5
Balsam Fir	*Abies balsamea*	S5
New York Fern	*Thelypteris noveboracensis*	S5
Lady-Fern	*Athyrium filix-femina*	S5
Spinulose Shield Fern	*Dryopteris carthusiana*	S5
White Ash	*Fraxinus americana*	S5
Shallow Sedge	*Carex lurida*	S5

Table E4 Plant Found in Wetland 2		
Common Name	**Binomial**	**ACCDC Rank**
Mad Dog Skullcap	*Scutellaria lateriflora*	S5
Bladder Sedge	*Carex intumescens*	S5
Virginia Strawberry	*Fragaria virginiana*	S5
Whorled Aster	*Aster acuminatus*	S5
Smooth Gooseberry	*Ribes hirtellum*	S5
Crested Shield-Fern	*Dryopteris cristata*	S5
Black Sedge	*Carex arctata*	S5
Goldthread	*Coptis trifolia*	S5
Marsh Seedbox	*Ludwigia palustris*	S5
Wild Sarsaparilla	*Aralia nudicaulis*	S5
Quaking Aspen	*Populus tremuloides*	S5
Yellow Sedge	*Carex flava*	S5
Soft Rush	*Juncus effusus*	S5
Red Fescue	*Festuca rubra*	S5
Fowl Bluegrass	*Poa palustris*	S5
Old-Field Cinquefoil	*Potentilla simplex*	S5
Stalk-Grain Sedge	*Carex stipata*	S5
Spreading Bentgrass	*Agrostis stolonifera*	S5SE
Common Elderberry	*Sambucus canadensis*	S5
Large-Leaf Wood-Aster	*Aster macrophyllus*	S5
Bracken Fern	*Pteridium aquilinum*	S5
Field Horsetail	*Equisetum arvense*	S5
Large Bur-Reed	*Sparganium eurycarpum*	S4
Willow	*Salix sp.*	N/A
American Mannagrass	*Glyceria grandis*	S4S5
American Bur-Reed	*Sparganium americanum*	S5
Heart-Leaved Willow	*Salix eriocephala*	S5
White Turtlehead	*Chelone glabra*	S5
Shinleaf	*Pyrola elliptica*	S5
Possum-Haw Viburnum	*Viburnum nudum*	S5
Interrupted Fern	*Osmunda claytoniana*	S5
Bristly-Stalk Sedge	*Carex leptalea*	S5
Hop Sedge	*Carex lupulina*	S3
Mild Water-Pepper	*Polygonum hydropiperoides*	S5
Field Horsetail	*Equisetum arvense*	S5
Blunt Spike-Rush	*Eleocharis ovata. turbicle broad as achene*	S4S5
White-Fringe Orchis	*Platanthera blephariglottis*	S4
Tall Hairy Groovebur	*Agrimonia gryposepala*	S3?
Robbins Squaw-Weed	*Senecio robbinsii*	S4S5
Shallow Sedge	*Carex lurida*	S5
New Belgium American-Aster	*Aster novi-belgii*	S5
Yellow Sedge	*Carex flava*	S5
Marsh Seedbox	*Ludwigia palustris*	S5
American Bur-Reed	*Sparganium americanum*	S5
Jointed Rush	*Juncus articulatus*	S5

Table E5 Plants Found in Wetland 3		
Common Name	**Binomial**	**ADDCD Rank**
Red Maple	*Acer rubrum*	S5
White Ash	*Fraxinus americana*	S5
Northern Red Oak	*Quercus rubra*	S5
White Spruce	*Picea glauca*	S5
Balsam Fir	*Abies balsamea*	S5
Quaking Aspen	*Populus tremuloides*	S5
Gray Birch	*Betula populifolia*	S5
Speckled Alder	*Alnus incana*	S5
Narrow-Leaved Meadow-Sweet	*Spiraea alba*	S5
Black Holly	*Ilex verticillata*	S5
Red Elderberry	*Sambucus racemosa*	S5
Pussy Willow	*Salix discolor*	S5
Red Raspberry	*Rubus idaeus*	S5
Dwarf Red Raspberry	*Rubus pubescens*	S5
Smooth Gooseberry	*Ribes hirtellum*	S5
Sensitive Fern	*Onoclea sensibilis*	S5
Interrupted Fern	*Osmunda claytoniana*	S5
Crested Shield-Fern	*Dryopteris cristata*	S5
Spinulose Shield Fern	*Dryopteris carthusiana*	S5
Evergreen Woodfern	*Dryopteris intermedia*	S5
Christmas Fern	*Polystichum acrostichoides*	S5
Lady-Fern	*Athyrium filix-femina*	S5
Northern Beech Fern	*Phegopteris connectilis*	S5
Field Horsetail	*Equisetum arvense*	S5
Hop Sedge	*Carex lupulina*	S3
A Sedge	*Carex gynandra*	S5
Necklace Sedge	*Carex projecta*	S4S5
Shallow Sedge	*Carex lurida*	S5
Bladder Sedge	*Carex intumescens*	S5
Fowl Bluegrass	*Poa palustris*	S5
Red Fescue	*Festuca rubra*	S5
Bearded Short-Husk	*Brachyelytrum erectum*	S4S5
Fowl Manna-Grass	*Glyceria striata*	S5
Canada Manna-Grass	*Glyceria canadensis*	S5
Blue-Joint Reedgrass	*Calamagrostis canadensis*	S5
Spotted Joe-Pye Weed	*Eupatorium maculatum*	S5
Mad Dog Skullcap	*Scutellaria lateriflora*	S5
White Turtlehead	*Chelone glabra*	S5
Northern Bugleweed	*Lycopus uniflorus*	S5
American Bugleweed	*Lycopus americanus*	S5
Corn Mint	*Mentha arvensis*	S5
Marsh Seedbox	*Ludwigia palustris*	S5
Small Purple-Fringe Orchis	*Platanthera psycodes*	S4
Leafy Northern Green Orchis	*Platanthera hyperborea*	SRF
Soft Rush	*Juncus effusus*	S5
Canada Rush	*Juncus canadensis*	S5
Blunt Spike-Rush	*Eleocharis ovata. turbicle broad as achene*	S4S5
Self-Heal	*Prunella vulgaris*	S5
Arrow-Leaved Tearthumb	*Polygonum sagittatum*	S5
Small Forget-Me-Not	*Myosotis laxa*	S5
Purple Avens	*Geum rivale*	S5
Large-Leaved Avens	*Geum macrophyllum*	S5
Vernal Water Starwort	*Callitriche palustris*	S5

Table E5 Plants Found in Wetland 3		
Common Name	**Binomial**	**ADDCD Rank**
Swamp Jack-In-The-Pulpit	*Arisaema triphyllum*	S4S5
Rough-Leaf Goldenrod	*Solidago rugosa*	S5
Canada Goldenrod	*Solidago canadensis*	S5
Swamp Aster	*Aster puniceus*	S5
Parasol White-Top	*Aster umbellatus*	S5
Spotted Jewel-Weed	*Impatiens capensis*	S5
Climbing Nightshade	*Solanum dulcamara*	SE
Creeping Butter-Cup	*Ranunculus repens*	SE
Blueflag	*Iris versicolor*	S5
Virginia Virgin-Bower	*Clematis virginiana*	S5
Marsh Blue Violet	*Viola cucullata*	S5
Tall Meadow-Rue	*Thalictrum pubescens*	S5
Farewell-Summer	*Aster lateriflorus*	S5
Virginia Strawberry	*Fragaria virginiana*	S5
Goldthread	*Coptis trifolia*	S5
Old-Field Cinquefoil	*Potentilla simplex*	S5
Spreading Bentgrass	*Agrostis stolonifera*	S5SE
Inflated Sedge	*Carex vesicaria*	S4S5
Hairy Willow-Herb	*Epilobium ciliatum*	S5
Marshpepper Smartweed	*Polygonum hydropiper*	SE
Watercress	*Rorippa nasturtium-aquaticum*	SE
Rough Avens	*Geum laciniatum*	S4S5

APPENDIX F

BIRD SPECIES RECORDED IN THE STUDY AREA

Table F1 Bird Species Recorded During Field Survey (September 21-22, 2004)			
Scientific Name	**Common Name**	**NSDNR Status**	**ACCDC Status**
Accipiter striatus	Sharp-shinned Hawk	Green	S4B
Scolopax minor	American Woodcock	Green	S4S5B
Zenaida macroura	Mourning Dove	Green	S5B
Ceryle alcyon	Belted Kingfisher	Green	S5B
Picoides villosus	Hairy Woodpecker	Green	S5
Picoides arcticus	Black-backed Woodpecker	Green	S3S4
Colaptes auratus	Northern Flicker	Green	S5B
Dryocopus pileatus	Pileated Woodpecker	Green	S5
Cyanocitta cristata	Blue Jay	Green	S5
Corvus brachyrhynchos	American Crow	Green	S5
Corvus corax	Common Raven	Green	S5
Poecile atricapilla	Black-capped Chickadee	Green	S5
Sitta canadensis	Red-breasted Nuthatch	Green	S5
Sitta carolinensis	White-breasted Nuthatch	Green	S4
Catharus guttatus	Hermit Thrush	Green	S5B
Turdus migratorius	American Robin	Green	S5B
Bombycilla cedrorum	Cedar Waxwing	Green	S5B
Oporornis philadelphia	Mourning Warbler	Green	S5B
Passerculus sandwichensis	Savannah Sparrow	Green	S5B
Melospiza georgiana	Swamp Sparrow	Green	S5B
Carduelis tristis	American Goldfinch	Green	S5

Table F2 Bird Species Recorded in the Study Area				
Scientific Name	**Common Name**	**Breeding Status**	**NSDNR Status**	**ACCDC Status**
Anas platyrhynchos	Mallard	Confirmed (b)	Green	S5 B
Buteo jamaicensis	Red-tailed Hawk	Confirmed (b)	Green	S5 B
Falco sparverius	American Kestrel	Confirmed (a)	Green	S5 B
Phasianus colchicus	Ring-necked Pheasant	Confirmed (a & b)	Introduced	SE B
Charadrius vociferus	Killdeer	Possible (a); Confirmed (b)	Green	S5 B
Scolopax minor	American Woodcock	Possible (a)	Green	S4S5 B
Columba livia	Rock Dove	Confirmed (a)	Introduced	SE B
Zenaida macroura	Mourning Dove	Possible (a); Confirmed (b)	Green	S5 B
Bubo virginianus	Great Horned Owl	Confirmed (b)	Green	S5
Archilochus colubris	Ruby-throated Hummingbird	Confirmed (a & b)	Green	S5 B
Picoides pubescens	Downy Woodpecker	Confirmed (b)	Green	S5
Picoides villosus	Hairy Woodpecker	Confirmed (b)	Green	S5
Dryocopus pileatus	Pileated Woodpecker	Probable (a)	Green	S5
Empidonax flaviventris	Yellow-bellied Flycatcher	Possible (a)	Green	S5 B
Empidonax minimus	Least Flycatcher	Possible (a)	Green	S5 B
Sayornis phoebe	Eastern Phoebe	Confirmed (a)	Green	S2S3 B
Tyrannus tyrannus	Eastern Kingbird	Probable (a); Confirmed (b)	Green	S4S5 B
Tachycineta bicolor	Tree Swallow	Possible (a); Confirmed (b)	Green	S5 B
Riparia riparia	Bank Swallow	Confirmed (b)	Green	S5 B
Hirundo rustica	Barn Swallow	Confirmed (a & b)	Green	S5 B
Cyanocitta cristata	Blue Jay	Possible (a); Confirmed (b)	Green	S5
Corvus brachyrhynchos	American Crow	Confirmed (a & b)	Green	S5
Poecile atricapillus	Black-capped Chickadee	Confirmed (a & b)	Green	S5
Sitta carolinensis	White-breasted Nuthatch	Confirmed (b)	Green	S4
Regulus calendula	Ruby-crowned Kinglet	Possible (a)	Green	S5 B
Sialia sialis	Eastern Bluebird	Possible (a)	Yellow	S2S3 B
Turdus migratorius	American Robin	Confirmed (a & b)	Green	S5 B
Dumetella carolinensis	Gray Catbird	Confirmed (b)	Green	S5 B
Toxostoma rufum	Brown Thrasher	Possible (a)	Green	S1S2 B
Sturnus vulgaris	European Starling	Confirmed (a & b)	Introduced	SE
Vermivora peregrina	Tennessee Warbler	Probable (a)	Green	S5 B
Parula americana	Northern Parula Warbler	Possible (a)	Green	S5 B
Dendroica petechia	Yellow Warbler	Confirmed (a & b)	Green	S5 B
Dendroica pensylvanica	Chestnut-sided Warbler	Confirmed (a)	Green	S5 B
Dendroica magnolia	Magnolia Warbler	Confirmed (a)	Green	S5 B

Table F2 Bird Species Recorded in the Study Area				
Scientific Name	**Common Name**	**Breeding Status**	**NSDNR Status**	**ACCDC Status**
Dendroica coronata	Yellow-rumped Warbler	Confirmed (a & b)	Green	S5 B
Dendroica virens	Black-throated Green Warbler	Possible (a)	Green	S5 B
Mniotilta varia	Black-and-white Warbler	Probable (a); Confirmed (b)	Green	S5 B
Setophaga ruticilla	American Redstart	Probable (a); Confirmed (b)	Green	S5 B
Seiurus aurocapillus	Ovenbird	Probable (a)	Green	S5 B
Geothlypis trichas	Common Yellowthroat	Possible (a)	Green	S5 B
Wilsonia pusilla	Wilson's Warbler	Confirmed (b)	Green	S4 B
Pheucticus ludovicianus	Rose-breasted Grosbeak	Possible (a); Confirmed (b)	Green	S5 B
Spizella passerina	Chipping Sparrow	Confirmed (b)	Green	S5 B
Melospiza melodia	Song Sparrow	Confirmed (a & b)	Green	S5 B
Junco hyemalis	Dark-eyed Junco	Possible (a)	Green	S5
Dolichonyx oryzivorus	Bobolink	Possible (a); Confirmed (b)	Yellow	S3 B
Agelaius phoeniceus	Red-winged Blackbird	Confirmed (a & b)	Green	S3S4 B
Euphagus carolinus	Rusty Blackbird	Confirmed (b)	Green	S5 B
Quiscalus quiscula	Common Grackle	Confirmed (a & b)	Green	S5 B
Icterus galbula	Northern Oriole	Confirmed (a & b)	Green	S3 B
Pinicola enucleator	Pine Grosbeak	Confirmed (a)	Green	S5
Carduelis tristis	American Goldfinch	Confirmed (a)	Green	S5
Passer domesticus	House Sparrow	Confirmed (a & b)	Introduced	SE

Ward Aggregates Project area covers two atlas squares. West square =a; East square =b.
Total birds from Erskine 1992 = 54