Appendix I: Minister's Consent for Building an Access to Property

Minister's Consent
For Building and Access to Property

(Check one or both as applicable)

☐ Application is hereby made for the Minister's consent for **The Erection of A Structure** within 100 metres of the centreline of a listed highway; the location, description and purpose of said structure being as described below:

☐ Application is hereby made for the Minister's consent for the **Access To A Listed Highway**; the location and description being as described below:

Name of Subdivision _____

Name of Highway _____ Side of Highway _____ (North, South, East, West)

Name of Village _____ County _____

Distance _____ (KM) _____ (Enter North, South, East, West) From _____ (nearest intersection, bridge or other definite point on the highway)

Distance of nearest part of structure to centreline of highway _____ metres

Purpose of Structure _____ Type of Structure _____

Distance from centreline of highway to well, spring, etc. _____ metres

- Please identify your lot so that it may be recognized, e.g. name on stake or post.
- Please place stakes in ditch 7 metres apart at desired access location.

Name of Applicant (print) _____ Signature of Applicant _____

Address _____ Date _____

Postal Code _____ COMPLETE SKETCH AND NOTE CONDITIONS ON REVERSE SIDE

FOR DEPARTMENT USE ONLY

S.S.D. Available: _____ Direction: _____ Grade: _____ S.S.D. Required: _____

S.S.D. Available:. _____ Direction: _____ Grade: _____ S.S.D. Required: _____

Pipe Required: Yes _____ No _____ Size _____

Site Checked By _____ Speed Zone _____ Km/Hr

Comments: _____

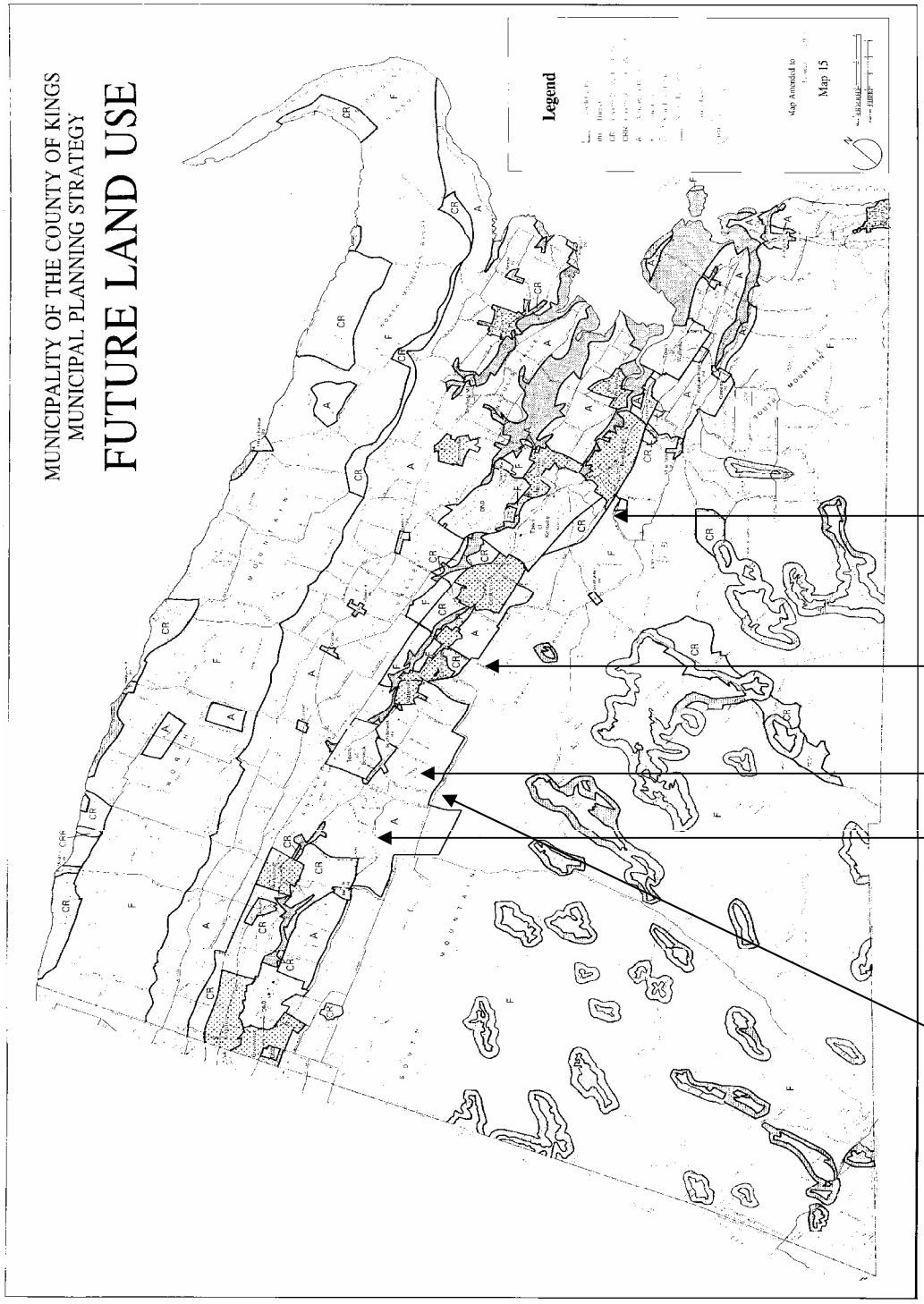
In consideration of an application as set forth above for the Minister's consent for access to a listed highway and/or erection of a structure within 100 m of the centreline of a listed highway; consent is hereby given, subject to the conditions listed on reverse.

_____ Dated _____ 19 ____

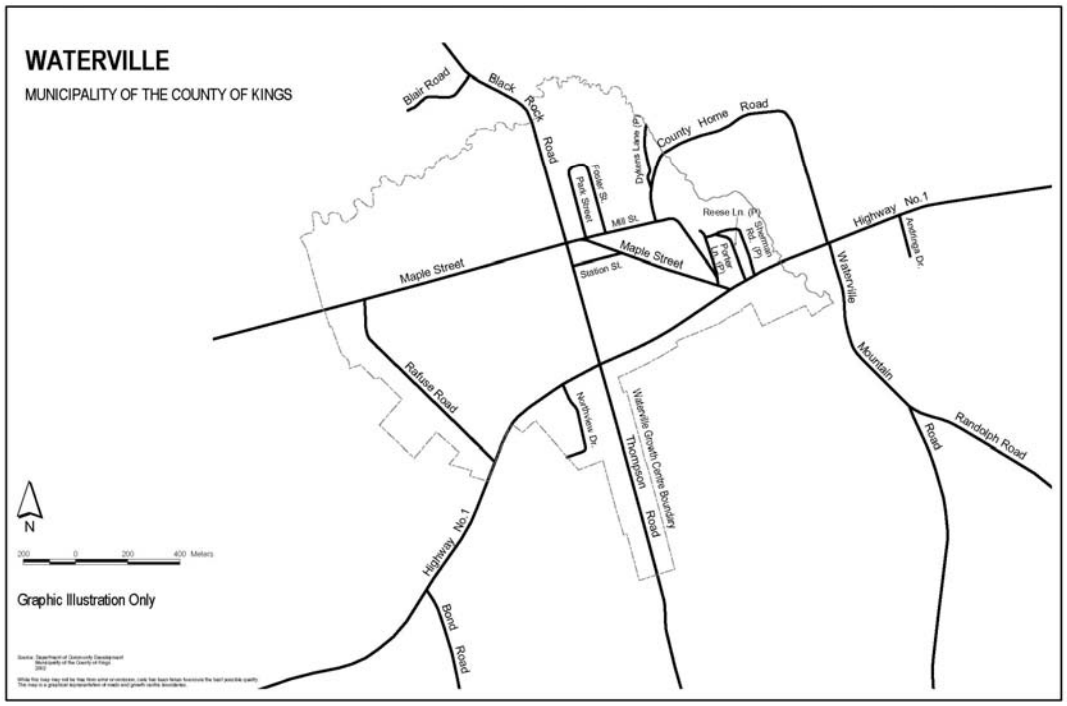
Division Engineer for Minister of Transportation and Public Works

FORM 13O /0221D
REV. 01/98

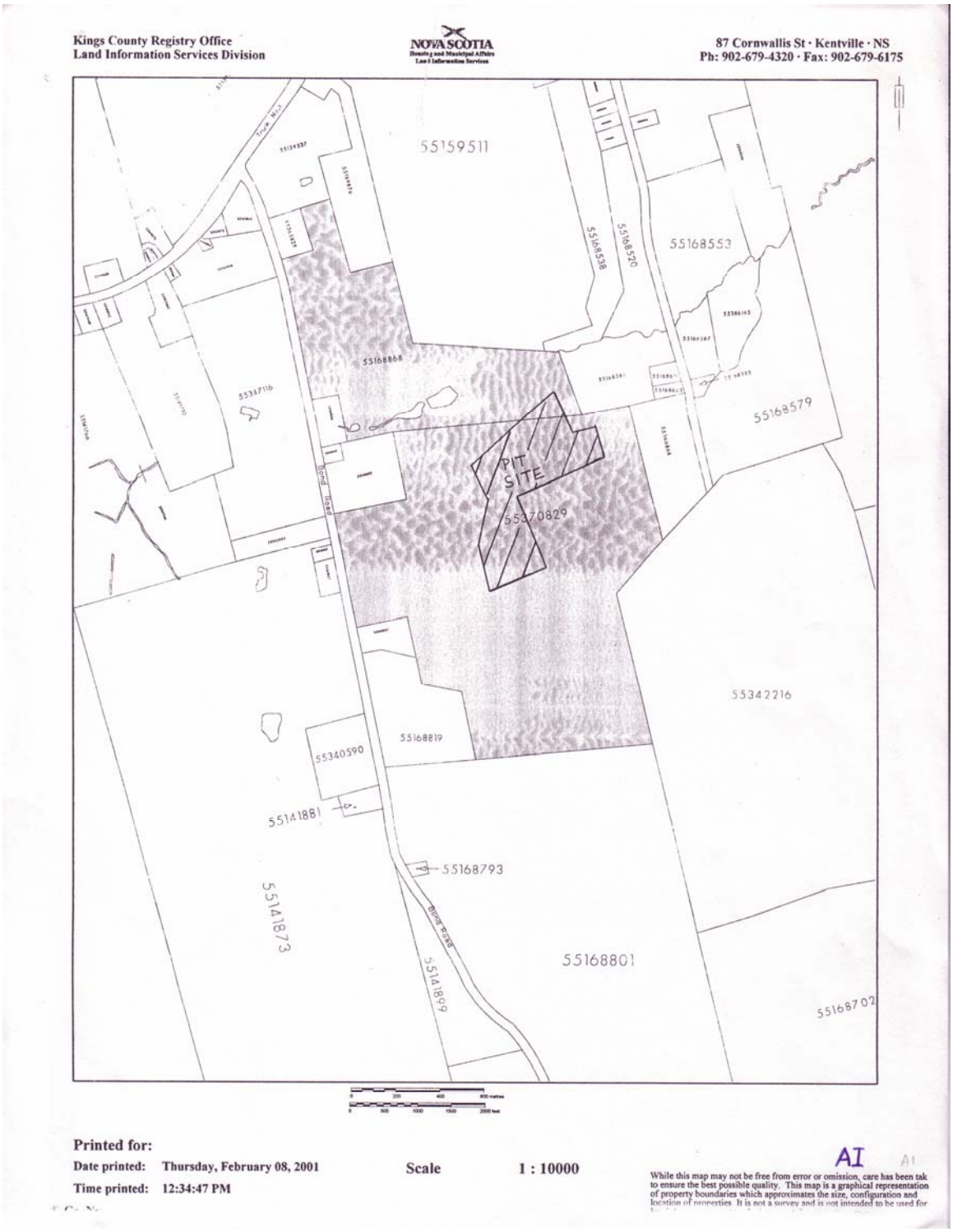
Appendix II: Zoning Designations



Appendix III: Map of Waterville



Appendix IV: PID Map



Appendix V: Property Deed

THIS WARRANTY DEED made this 9th day of ~~September~~, A.D., 1997;

BETWEEN:

NORMA MILNE, formerly Norma Tweedie, of Waterville, in the County of Kings and Province of Nova Scotia, and **MURRAY H.TWEEDIE** of Kouchibouguac, in the Province of New Brunswick, by his Lawful Attorney **ERIC O. STURK**, of Berwick, in the County of Kings and Province of Nova Scotia,

being the owner of the lands described in Schedule "A" herein,

DEC 0 8 1997
61.0953

hereinafter called the "GRANTOR

OF THE ONE PART

- and -

TWIN MOUNTAIN CONSTRUCTION LIMITED, a body corporate with its head office at RR #2 Waterville, in the County of Kings and Province of Nova Scotia.
hereinafter called the "GRANTEE"

OF THE OTHER PART

WITNESSETH THAT in consideration of the sum of ONE DOLLAR ($1.00) and other good and valuable consideration;

THE GRANTOR hereby conveys to the Grantee, the lands described in Schedule "A" to this Warranty Deed and hereby consents to this disposition, pursuant to the Matrimonial Property Act of Nova Scotia.

THE GRANTOR covenants THAT the Grantee shall have quiet enjoyment of the lands, THAT the said Grantor has a good title in fee simple to the lands and the right to convey them as hereby conveyed, THAT they are free from encumbrances and THAT the said Grantor will procure such further assurances as may be reasonably required.

IN THIS WARRANTY DEED the singular includes the plural and the masculine includes the feminine, with the intent that this Warranty Deed shall be read with all appropriate changes of number and gender.

IN WITNESS WHEREOF the said Grantor has properly executed These Presents the day and year first above written.

SIGNED, SEALED AND DELIVERED)
-in the presence of -)

Jane Grant)

Norma Milne
NORMA MILNE

Eric Sturk
MURRAY TWEEDIE, by his Lawful Attorney, ERIC O. STURK

Appendix VI: Compost site approval

NOVA SCOTIA

DEPARTMENT OF THE ENVIRONMENT

Industrial Approval

Pursuant to the Environment Act and Regulations made pursuant thereto, and subject to the Terms and Conditions contained in the Approval, this Approval is granted to Twin Mountain Construction Limited to operate a composting facility, in Waterville, in the Municipality of the County of Kings, Province of Nova Scotia.

Granted at Kentville, in the County of Kings, Province of Nova Scotia, this 31st *day of* July, *A.D. 1997.*

97-IAW-016
APPROVAL NUMBER

ADMINISTRATOR

Appendix VII: Agricultural Survey

Jeff Wentzell, P.Ag.
Site 11, Box 11, R.R. #3
Middleton, Nova Scotia
B0S 1P0
Cell: (902) 825-9891 Fax: (902) 825-6218
email: jeff.wentzell@ns.sympatico.ca

Environmental Impact Assessment

Reducing Impact to Agricultural Production After Reclamation of Proposed Excavation Sites

Prepared For: Twin Moutain Construction
Robie Carty
R.R. #2 Waterville
Kings County, Nova Scotia

Prepared by: Jeff Wentzell, P.Ag.

Site 11, Box 11, R.R. #3 Middleton, Nova Scotia B0S 1P0

Cell: (902) 825-9891 Fax: (902) 825-6218email:

jeff.wentzell@ns.sympatico.ca

Site Location: Bond Road Sand Pit, Kings County

**** Note that from hereon, numbering, etc. for the following tables, maps, and their appendices restart for each report/Appendix.***

Table of Contents

Objective

The purpose of this report is to evaluate the potential impacts of (proposed) sand excavation on a property owned by Twin Mountain Construction in Waterville, Kings County, Nova Scotia (PID 55370829 and 55168868). This report will make recommendations with regards to the eventual reclamation of the agriculture portion of the property once excavated. To that end, this report will document soil types on the proposed site and current agricultural potential. The soils in the forested area have been categorized. Consideration will also be given as to their potential for agriculture production after reclamation. Suggestions will be made to lesson or mitigate any potential impacts on agricultural production associated with this undertaking. Recommendations will be made to minimize the impacts of the proposed undertaking on the agricultural potential of the reclaimed land area.

Map 1: Location of Proposed Site

Soil Type and Characteristics

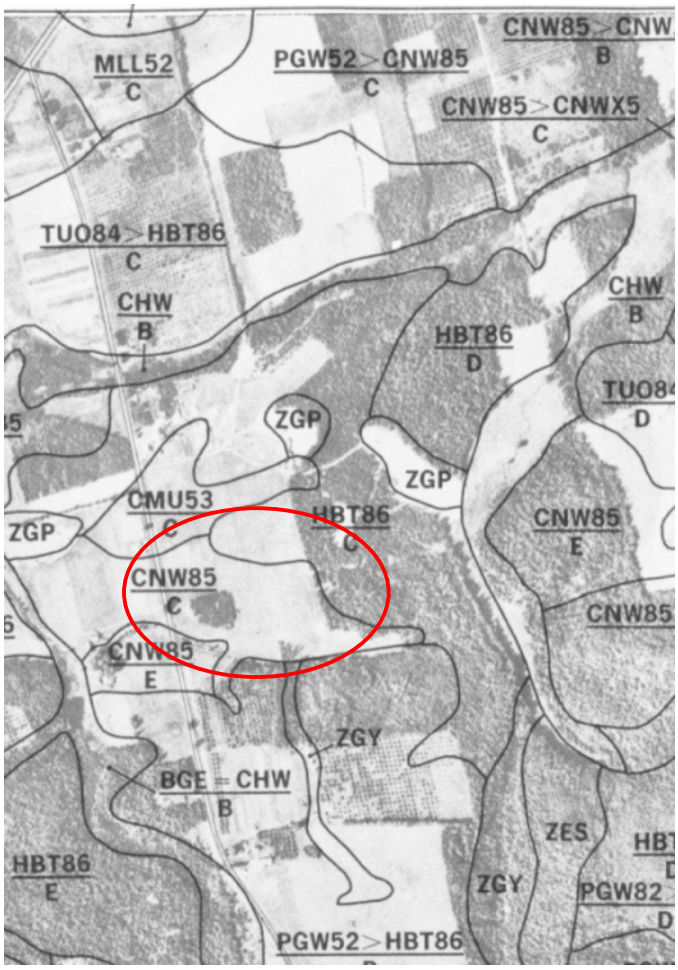
The Cambridge area has several soil types found throughout this map unit. The information on the main soil types found in the proposed gravel pit site are taken from the Agriculture Canada publication, Soils of the Cambridge Station Map Sheet (21H/02-T3), Nova Scotia Soil Survey Report #25, they include:

TUO84 > HBT86 CHW HBT86 CMU53 CNW85 ZGP
C B C C C

Symbol	Name	Drainage	Lower Soil Material
CNW	Cornwallis	Well	Loose sandy glaciofluvial sediments
TUO	Truro	Well	Friable fine sandy glaciofluvial sediments
CHW	Chaswood	Poor	Friable coarse loamy to loose sandy-gravely alluvium
HBT	Hebert	Rapid	Loose sandy-gravely glaciofluvial sediments
CMU	Comeau	Imperfect	Loose sandy-gravely to sandy-skeletal glaciofluvial sediments
ZGP	Designation for Gravel Pit		

Table 1: Summary of Soil Characteristics of Types Dominant in Proposed Site
Source: Holstrom, D.A. (1988)

Cornwallis **CNW85**
C



Map 2 – Cornwallis Soil Type Area (Source: Holstrom, D.A. (1988)

This area is a map unit with the Cornwallis soil type. The CNW85 indicates the Cornwallis soil type, the 8 represents the depth class of the surface material – greater than eighty (80 cm) centimetres and the 5 represents the family particle size of the surface material – in this classification the 5 represents sandy. The C is for the slope class of this area – C indicates a slope of two (2%) to five (5%) percent. The CLI capability classifications for agriculture rating for this area would be 3M for the Cornwallis soil type. The class 3 rating represents soils that have moderately severe limitations that restrict the range of crops grown; the M is the subclass for lack of water adversely affecting crop growth.

The major limitation of Cornwallis soil type for agricultural production is the low water holding capacity and the rapid movement of water and nutrients through the sandy soil profile. Agricultural production on this soil type has potential, but only with the addition of high volumes of water brought about by way of irrigation and supplemental nutrients to meet the crop requirements throughout the growing season.

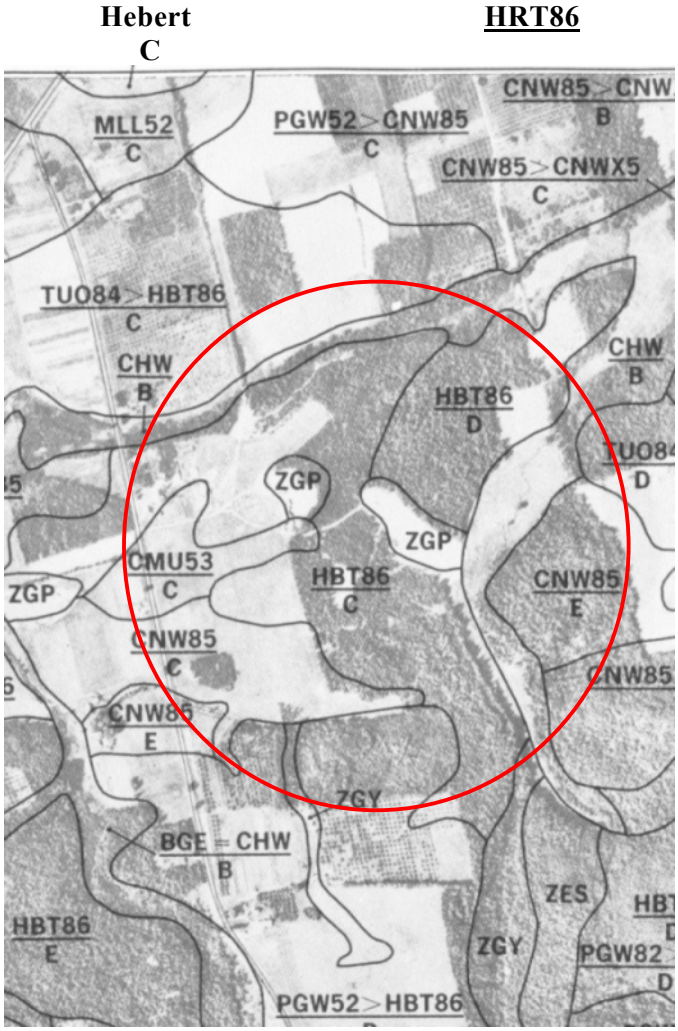
The Cornwallis soil type provides an opportunity for excavation sites and least potential impact on agriculture production for the reclaimed sites. With the topsoil layer removed, the subsoil layer has a sufficient depth to allow for the removal of the desired sand material while leaving approximately one (1 m) of the subsoil layer to provide adequate depth for a root zone for most crops after the topsoil is returned to this area. The growing conditions should be similar with respects to water consumption and nutrient requirements.

A Horizon	Range	Mean
Thickness (cm)	12 –57	26
Particle Size – Sand %	75 – 95	84
Particle Size – Silt %	1 – 21	11
Particle Size – Clay %	1 – 9	5
B Horizon		
Thickness (cm)	6 –75	33
Particle Size – Sand %	72 – 97	90
Particle Size – Silt %	0 –20	7
Particle Size – Clay %	0 –10	3
C Horizon		
Particle Size – Sand %	67 – 99	91
Particle Size – Silt %	0 – 23	6
Particle Size – Clay %	0 – 10	3

Table 2 – Cornwallis Profile Characteristics (Holstrom and Thompson, 1989)

It would be beneficial to leave approximately one (1 m) of the subsoil materials after excavation is complete. This will provide similar conditions for water and nutrient movement through the

sandy topsoil and subsoil layers. Similar to present conditions, crop production on this site will require large volumes of water provided with irrigation and the application of high levels of fertility.



Map 3 – Soil Type Area (Source: Holstrom, D.A. (1988)
Appendix 3, 4 & 5 - Scale & Legend

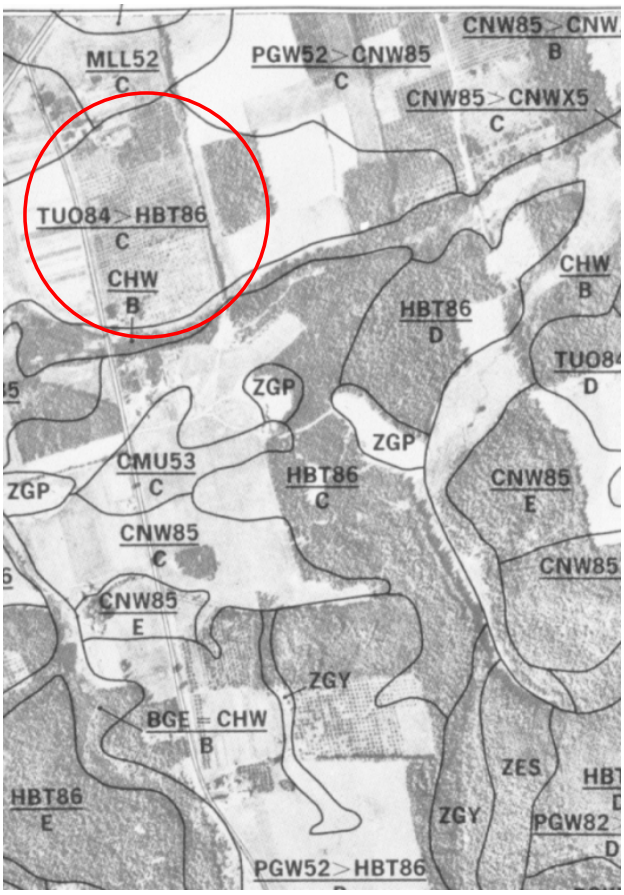
The area with this designation is a simple map unit with the Hebert soil type. The soil type has a depth class of surface material at 8 – greater than eighty (80 cm) centimetres, the particle size class is 6 that represents sandy-gravely. The C is for the slope class of this area – C indicates a slope of two (2%) to five (5%) percent. The CLI capability classifications for agriculture rating for this area would be 4M for the Hebert soil type. The class 4 rating represents soils that have

severe limitations that restrict the range of crops grown; the M is the subclass for lack of water adversely affecting crop growth.

A Horizon	Range	Mean
Thickness (cm)	10 –40	24
Particle Size – Sand %	76 – 93	81
Particle Size – Silt %	4 – 20	16
Particle Size – Clay %	1 – 6	3
B Horizon		
Thickness (cm)	11 – 50	37
Particle Size – Sand %	78 – 98	87
Particle Size – Silt %	0 – 20	10
Particle Size – Clay %	0 – 6	3
C Horizon		
Particle Size – Sand %	78 – 99	91
Particle Size – Silt %	0 – 22	7
Particle Size – Clay %	0 – 5	2

Table 3 – Herbert Profile Characteristics (Holstrom and Thompson, 1989)

Truro - Herbert TUO84 > HBT86
C



Map 4 – Soil Type Area (Source: Holstrom, D.A. (1988)
Appendix 3, 4 & 5 - Scale & Legend

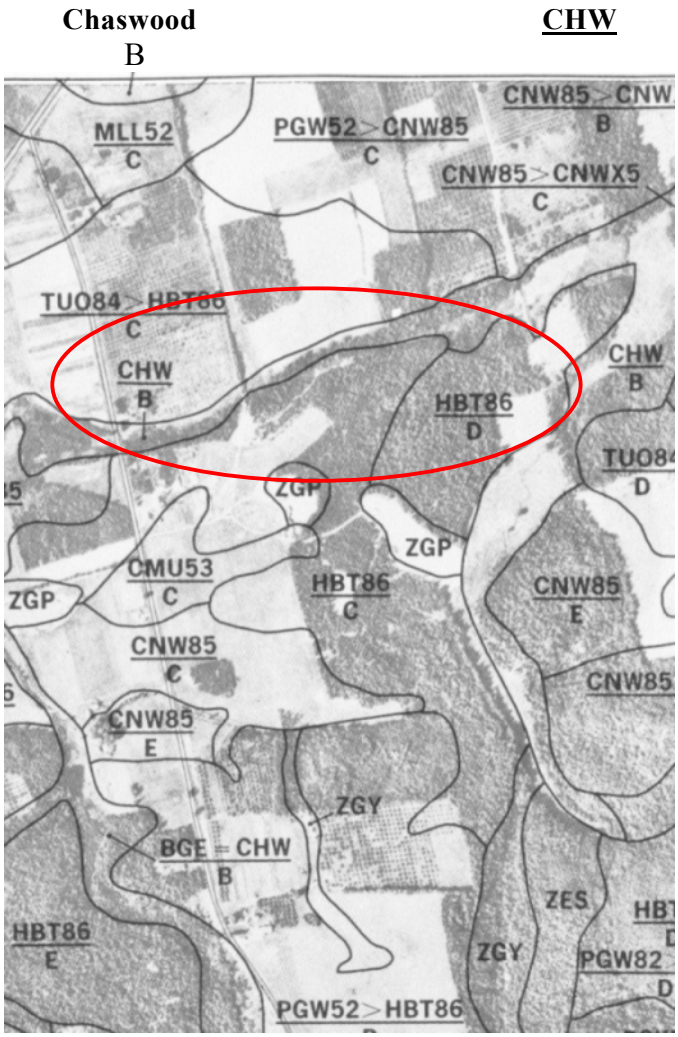
The area with this designation is a complex map unit with Truro and Hebert soil types. The Truro soil type is 70% dominant in this map unit. The Herbert soil type is documented in the previous section of this report and represents 30% of this map unit. The Truro soil type has a depth class of surface material at 8 – greater than eighty (80 cm) centimetres, the particle size class is 4 that represents fine sandy. The C is for the slope class of this area – C indicates a slope of two (2%) to five (5%) percent. The CLI capability classifications for agriculture rating for this area would be 2C > 4M for the map unit. The class 2 rating for CLI represents soils, which have moderate limitations for crop growth, the C represents adverse climate indicating inadequate heat units for a wide range of crops. The class 4 rating represents soils that have

severe limitations that restrict the range of crops grown; the M is the subclass for lack of water adversely affecting crop growth.

The Truro soil type, similar to the Cornwallis soil type, provides an opportunity for excavation sites and least potential impact on agriculture production for the reclaimed sites. With the topsoil layer removed, the subsoil layer has a sufficient depth to allow for the removal of the desired sand material while leaving approximately one (1 m) of the subsoil layer to provide adequate depth for a root zone for most crops after the topsoil is returned to this area. The growing conditions should be similar with respects to water consumption and nutrient requirements.

A Horizon	**Range**	**Mean**
Thickness (cm)	10 – 55	26
Particle Size – Sand %	79 –89	84
Particle Size – Silt %	6 – 16	11
Particle Size – Clay %	5 – 6	5
B Horizon		
Thickness (cm)	10 – 70	32
Particle Size – Sand %	76 - 90	84
Particle Size – Silt %	8 - 19	12
Particle Size – Clay %	3 – 5	4
C Horizon		
Particle Size – Sand %	72 - 98	90
Particle Size – Silt %	0 - 23	6
Particle Size – Clay %	2 - 6	4

Table 4 – Truro Profile Characteristics (Holstrom and Thompson, 1989)



Map 5 – Chaswood Soil Type Area (Source: Holstrom, D.A. (1988)

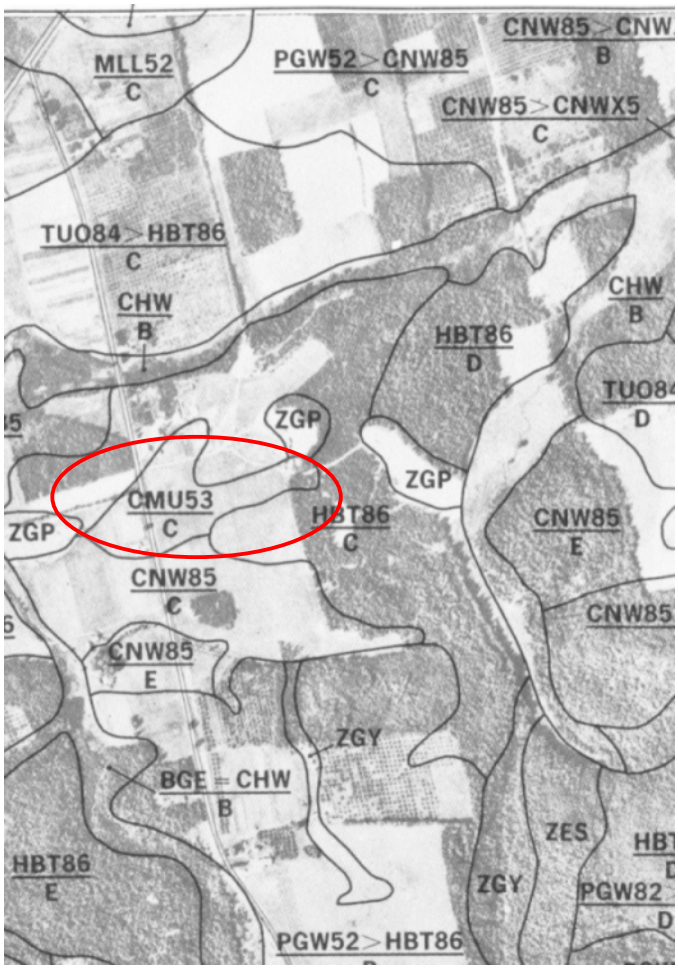
This area is a map unit with the Chaswood soil type. The CHW indicates the Comeau soil type. The B is for the slope class of this area – B indicates a slope of zero (0%) to two (2%) percent. The CLI capability classifications for agriculture rating for this area would be 5IW for this soil type. The class 5 rating represents soils that have very severe limitations that restrict the range of crops grown; the I is the subclass for inundation by lakes and streams and the W represents adverse conditions from excess water.

A Horizon	Range	Mean
Thickness (cm)	5 - 48	21
C Horizon		
Particle Size – Sand %	-	79
Particle Size – Silt %	-	13
Particle Size – Clay %	-	8

Table 5 – Chaswood Profile Characteristics (Holstrom and Thompson, 1989)

Comeau **CMU53**

C



Map 6 – Comeau Soil Type Area (Source: Holstrom, D.A. (1988)

This area is a map unit with the Comeau soil type. The CMU53 indicates the Comeau soil type, the 5 represents the depth class of the surface material – greater than fifty (50 cm) centimetres and the 3 represents the family particle size of the surface material – in this classification the 3 represents coarse loamy-gravely. The C is for the slope class of this area – C indicates a slope of two (2%) to five (5%) percent.

The CLI capability classifications for agriculture rating for this area would be 2C for the Comeau soil type. The class 2 rating represents soils that have moderate limitations that restrict the range of crops grown; the C is the subclass for climate – inadequate heats units for a wide range of crops.

A Horizon	Range	Mean
Thickness (cm)	17 – 36	24
Particle Size – Sand %	51 – 74	67
Particle Size – Silt %	21 – 40	27
Particle Size – Clay %	4 – 9	6
B Horizon		
Thickness (cm)	19 - 48	31
Particle Size – Sand %	67 - 94	80
Particle Size – Silt %	4 – 29	16
Particle Size – Clay %	2 – 5	4
C Horizon		
Particle Size – Sand %	75 -98	90
Particle Size – Silt %	0 - 22	7
Particle Size – Clay %	2 – 5	3

Table 6 – Comeau Profile Characteristics (Holstrom and Thompson, 1989)

Site Preparation and Reclamation

Removing the topsoil, stock piling, and removing the subsoil layer, to be used later is an acceptable and recommended practice in agriculture, for example during land levelling. Laurie Cochrane5, Soil and Water Engineer, with the Nova Scotia Department of Agriculture and Fisheries suggests that levelling and sloping of agricultural production areas can provide benefits by optimizing productivity, particularly where slope contributes to erosion.

Recommended Land Preparation

1. Remove the topsoil from the proposed site area,
2. Reuse the topsoil to reclaim an existing excavated site or stockpile the topsoil for later use in reclamation, and
3. Add recommended additions to the soil as indicated by the soil test and reseed the reclaimed area. Manure application at this point can provide both nutrients and organic

[5] Consultation with Laurie Cochrane, Engineer, Nova Scotia Department of Agriculture and Fisheries

matter that would benefit crop production. If the topsoil is to be stockpiled a cover crop can be seeded to prevent potential movement of the material.

Topsoil

Remove at least thirty (30 cm) centimetres of the surface material layer - topsoil; remove all the topsoil to the actual depth where deeper levels are present. The required depth can be determined by observation of the surface material class while removing the surface material during stockpiling. The more topsoil available at reclamation, the greater the impact on the potential crop production of the reclaim area.

The topsoil can be handled in two ways. One method is to strip the topsoil from the site and move it directly to a site being reclaimed. Such will minimize the amount of topsoil stockpiled at any one time. The alternative is to stockpile the topsoil close to the reclamation site, in small piles, to minimize the potential for erosion. The stockpiles can be temporarily seeded with grass seed to prevent movement of this material. Soil test should be taken before the excavation and stripping process to document the present soil characteristics of a given area.

Soil Testing - Soil tests should be taken after the reclamation process to determine the appropriate inputs for the crop to grown. The organic matter should be above three (3%) percent for plant growth. If the organic matter is low, amendments can be added before the crop is planted, these would include compost, solid livestock or other sources of organic matter. The pH should be in the range of 6.0 to 6.5 for most crops, limestone could be incorporated at reclamation, if the pH needs to be increased. Nutrient requirements for a particular crop, organic matter percentage and rates for limestone application are provided on a standard soil test from the Department of Agriculture and Fisheries.

Compaction – There is potential risk of compaction during the excavation process. Testing before reclamation with a soil probe can be used to determine the extent of the compaction. If compaction has occurred, an excavator, conventional ripper or subsoil implement can be used to break up the compacted layer.

Slope – During the reclamation process, consideration should be given to the slope of the fields being reclaimed. The excavation and reclamation of the site provides an opportunity to deal with existing and potential surface drainage and run-off. Laurie Cochrane6, Engineer, recommended that the reclaimed fields should have a slight slope so that, any excess surface water will be will not remain in the field. The reclaimed area should have a gentle slope (15 cm every30 metres) to allow excess surface water to leave the field area.

General Recommendations

1. Ideally, the topsoil should be used immediately, stripping a new pit area to reclaim an existing excavated site. If stockpiling occurs, the topsoil should be stockpiled close to the reclamation site, in small piles to minimize the potential for erosion. The stockpiles can be temporarily seeded with grass seed to prevent erosion,
2. It will be beneficial to leave approximately one (1 m) of the subsoil materials over the clay layer present and observed in the current pit. This will provide an adequate root zone for future cropping considerations on the reclaimed land area,
3. The reclaimed area should have a slope (15 cm every30 metres) to allow for excess surface water to leave the field area,
4. Testing before reclamation with a soil probe can used to determine the extent of the compaction and if action should taken, and
5. Soil tests should be taken before the sites are excavated and after reclamation process to determine the appropriate inputs for optimal plant growth.

Conclusions

There are several soil types present in the proposed site area. The best potential sites for excavation of sand and gravel and reclamation for agriculture are on the Cornwallis, Truro and Hebert soil types. These soil types all have limitations for agricultural production. There are potential problems with the areas of the Comeau and Chaswood soil types.

Based on field observations, literature review, and consultation with experts, the proposed reclamation process should have minimal impact on the agricultural potential of the Cornwallis, Truro and Hebert soil types at the site that have been documented in this report.

[6] Consultation with Laurie Cochrane, Engineer, Nova Scotia Department of Agriculture and Fisheries

Aerial Photo 1 – Property

References

Title	Source
Soils of Cambridge Station Map Sheet (21H/02-T3) Nova Scotia, Report #25	Holstrom, D.A. (1988) Research Branch, Agriculture Canada
Soils of the Annapolis Valley Area of Nova Scotia, Report #22	Holstrom, D.A. and Thompson, B.L. (1989) Agriculture Development Branch, Agriculture Canada

Appendix 1 – Scanned Map of the Soils of the Cambridge Station Map Sheet

Appendix VIII: Flora/Plant Survey

Plant Survey of a Property on Bond Road, Waterville, Kings County, Nova Scotia

by

Ruth E. Newell, M.Sc.
General Delivery,
Wolfville,
Nova Scotia
B0P 1X0

June 23, 2002

Plant Survey of a Property on Bond Road, Waterville, Kings County, Nova Scotia

Introduction

This report represents the results of a plant survey, conducted June 8th and 15th, 2002, on a property located on Bond Road, Waterville, Kings County, Nova Scotia. This area is composed of various farmed areas, a sand extraction pit, several wooded areas of varying ages and a brook (with several ponds). The survey was focused primarily on the various waterways, wetlands and tree stands present on the property. An inactive pit area was also surveyed.

A list of all plant species observed during this survey and the areas (habitats) where they were found is presented in Table 1. Locations of the various areas described are shown on the air photo included with this report.

Locations of rare species were documented with a Garmin 12 GPS unit. These locations are indicated by asterisks on the air photo.

Plant species that flower and/or fruit later in the growing season may have been missed during this survey.

Bond Road Property: Habitat Descriptions

Ponds, brook & floodplains (Habitat 1)

A brook, which includes two man-made ponds, occurs in the northern half of the property. The direction of flow is roughly west to east and the brook eventually joins the Rochford Brook to the east of the survey site (part of the Cornwallis River watershed).

At the time of the botanical survey, there was little aquatic or emergent vegetation evident in the two ponds with the exception of a small amount of Duckweed (*Lemna minor*), a very small amount of Pondweed (*Potamogeton* sp.) and occasional patches of Bur-reed (*Sparganium* sp.) and Broad-leaved Cattail (*Typha latifolia*) around the edges. The open grassy banks around much

of the ponds are dominated by Reed Canary Grass (*Phalaris arundinacea*) with a variety of other herbaceous, wetland species thinly scattered throughout, e.g. Meadow-rue (*Thalictrum pubescens*), Rough Aster (*Aster puniceus*), Blue Flag (*Iris versicolor*), Swamp Candle (*Lysimachia terrestris*), etc. Speckled Alder (*Alnus incana*), Willow (*Salix eriocephala*) and Meadowsweet (*Spiraea alba*) occur as occasional shrubs within the Reed Canary Grass zone. Beyond the Reed Canary Grass floodplain, the terrain rises and a narrow band of trees (Red Maple, Red Oak, White Spruce, etc.) separates the ponds from the surrounding farmland to the north and the sand extraction pit to the south.

The brook is relatively narrow (2-4 m wide), shallow, and sandy and/or rocky bottomed. In many places it is shaded by a variety of tree or shrub species, e.g., Red Maple (*Acer rubrum*), Speckled Alder, poplars (*Populus* spp.), Chokecherry (*Prunus virginiana*), willows (*Salix* spp.), Eastern Hemlock (*Tsuga canadenis*), Yellow Birch (*Betula lutea*), etc. Herbaceous species on these shaded floodplains include: Jack-in-the-pulpit (*Arisaema triphyllum*), False Solomon's-seal (*Smilacina racemosa*), Skullcap (*Scutellaria lateriflora*), several species of Wood Ferns (*Dryopteris* spp.), etc. On the east side of the property, in addition to wooded floodplain, the brook flows through several small, open grassy meadows. A variety of herbaceous species occur here including: Blue-joint (*Calamagrostis canadensis*), Reed Canary Grass, Stinging Nettle (*Urtica dioica*), Cinnamon Fern (*Osmunda cinnamomea*), Fowl Meadow Grass (*Poa palustris*), etc. Several small patches of Ostrich Fern (*Matteucia struthiopteris*) occur just east of the easternmost pond.

Rare species:

One large shrub of Salix petiolaris (Meadow Willow) was found along the brook (Map coordinates: 20T 0368007E, 4988452N). This willow species is ranked by the Atlantic Canada Conservation Data Center as an S3 species (i.e. uncommon throughout its range in the province).

Swamp (Habitat 2)

In the lower half of the property (Map coordinates: 20 T 0368015E, 4987929N; wooded area south of the active and inactive pits) there is a small swamp (wooded wetland). This area is composed primarily, of shrub thickets with standing, stagnant water. Common species in this habitat included Red Maple, Speckled Alder, Canada Holly (*Ilex verticillata*), Blue Flag, sedge species (*Carex* spp.), Bugleweed (*Lycopus uniflorus*), Wood Horsetail (*Equisetum sylvaticum*), Sensitive Fern (*Onoclea sensibilis*), Cinnamon Fern and Marsh Fern (*Thelypteris palustris*). Sphagnum moss is abundant in the wetter areas. Open areas tend to be dominated by Blue Joint.

Rare species:

No rare species were found in this habitat at the time of this survey.

Forest (Habitat 3a and 3b) - on east side of property, immediately south of the brook and the east pond

The western end of this woodland (3a) consists of a narrow treed ridge separating the easternmost pond on the north and the pit area on the south. This is a somewhat disturbed, open woodland (Large-toothed Aspen, Red Oak, White Pine), with extensive graminoid vegetation, e.g., Hair Fescue (*Festuca filiformis)*, Common Hair Grass (*Deschampsia flexuosa)*, Common Woodrush (*Luzula multiflora,* intermixed with patches of blueberries (*Vaccinium angustifolium*, *V. myrtilloides*), Bracken and Wild Lily-of-the-valley. The trees are not as old as those at the east end of this wooded section.

The eastern portion of this forested area (3b) is composed of a mix of mature White Pine (*Pinus strobus*), Red Maple, Large-toothed Aspen (Populus grandidentata), White Birch (Betula papyrifera), Red Oak (*Quercus rubra*), Red Spruce (*Picea rubens*) and Eastern Hemlock. In the northeastern corner of this area, the land slopes steeply downwards to the brook. Here, at the top of the slope and on the slope, Eastern Hemlock dominates. A few Yellow Birch occur amongst the Hemlock. Also occurring at the top of and on the slope are several very large patches of Yew (*Taxus canadensis*) - some of these covering hundred's of square meters.

Herbaceous vegetation includes: Painted Trillium (*Trillium undulatum*), Wild Lily-of-the-valley (*Maianthemum canadense*), Wild Sarsaparilla (*Aralia sarsaparilla*), Bracken (*Pteridium aquilinum*), Clintonia (*Clintonia borealis*) plus a variety of other common, woodland species. Ground cover is fairly continuous.

Rare species:

No rare plant species were observed in this forested area at the time of this survey.

Forest (Habitat 4) - central forested area to the south of the active and inactive pit areas

Dominant trees in this dry, forested area include mature White Pine, Large-toothed Aspen, and Red Maple with lesser amounts of Trembling Aspen (*Populus tremuloides*), Red Spruce, Red Oak, White Birch and Balsam Fir (*Abies balsamea*). Hemlock occurs on sloped areas.

Ground cover is extensive. Some of the common herbaceous species found here include: Pink Lady's-slipper (*Cypripedium acaule*), Wild Lily-of-the-valley, Cow-wheat (*Melampyrum lineare*), Velvet-leaf Blueberry (*Vaccinium myrtilloides*), Prince's-pine (*Chimaphila umbellata*), etc.

A low, swampy area occurs in one small section of this woodland. This habitat is described elsewhere in this report.

Rare Species:

No rare species were observed in this forested section at the time of this survey.

Forest (Habitat 5) - Forested slope at south end of property

This is a rectangular forested area located at the very southern end of the Bond Road property. The western edge of this forest is made up primarily of mature deciduous trees (Red Oak, Sugar

Maple, White Birch, Trembling Aspen, Ironwood (*Ostrya virginiana*) and Large-toothed Aspen). To the east however, Eastern Hemlock becomes dominant with scattered American Beech (*Fagus grandifolia*), White Birch and Red Oak. Some of the largest trees observed during this survey occur in this area.

Herbaceous vegetation is generally sparse except in valley areas where there is seasonal water flow. Ferns, e.g., Lady Fern (*Athyrium filix-femina*), Interrupted Fern (*Osmunda claytoniana*), Evergreen Wood Fern (*Dryopteris intermedia*), Bracken and Sensitive Fern, are a conspicuous component of these damp areas. One seasonal, stream valley near the west edge of this forest, had a few species indicative of relatively rich soil conditions, i.e., Toothwort (*Cardamine diphylla*), Purple Trillium (*Trillium erectum*), Nodding Trillium (*Trillium cernuum*), False Solomon's Seal, Red Baneberry (*Actaea rubra*).

Rare Species:
A clump of twenty to thirty, young, Eastern White Cedar (Thuja occidentalis) was noted in this forested section (Map co-ordinates: 20 T 0367782E 4987581N). This species is listed by Pronych & Wilson (1993) as rare in Nova Scotia. The Atlantic Canada Conservation Data Center ranks this species as an S1S2 species.

Two small clumps of Purple Trillium (Trillium erectum) were found in the same area as the Eastern White Cedar. This species is listed by Pronych & Wilson (1993) as rare in Nova Scotia. It is ranked by the Atlantic Canada Conservation Data Center as an S3 species.

Cutover Area (Habitat 6) - on east side of active pit area
This area has recently been cutover (within the last 10 years) and is in the process of active regeneration. A mix of saplings of White Pine, Large-toothed Aspen, Wire Birch (Betula populifolia), White Birch, Shadbush (Amelanchier sp.), Red Oak, Red Spruce, Red Maple, Pin Cherry (*Prunus pensylvanica*), a number of common willow species, American Beech, Balsam

Fir and Eastern Hemlock are found here. The groundcover is dominated by blueberries with lesser amounts of a large variety of other forb species, shrubs and graminoids.

Rare species:

No rare plant species were observed in this section at the time of this survey.

Inactive Pit (Habitat 7)

This is an inactive, pit area located to the southeast of the main, active extraction site. It has begun to grow in with scattered saplings of Wire Birch, White Birch, Trembling Aspen, Large-toothed Aspen, White Pine, and Willow. One Jack Pine (Pinus banksiana) was also observed in this area. The ground is primarily bare sand with scattered plants of the following graminoid species: Starved Witchgrass (Panicum depauperatum), White-hair Witchgrass (Panicum villosissimum), Poverty Grass (Danthonia spicata), Hair Fescue. Forbs present include: Pinweed (Lechea intermedia), Sheep Sorrel (Rumex acetosella), hawkweeds (Hieracium spp.), Pearly Everlasting (Anaphalis magaritacea), Pussy-toes (Antennaria neglecta), and sedge species.

Rare species:

No rare plant species were observed in this habitat at the time of this survey.

Results and Recommendations

Three species that are considered rare in Nova Scotia were found during this survey. **Meadow Willow (*Salix petiolaris*)** was located beside the brook (Habitat 1). The other two species, **Purple Trillium (*Trillium erectum)*** and **Eastern White Cedar (*Thuja occidentalis*)** were both found in close proximity to each other, in the woodland (Habitat 5) at the south end of the Bond Road Property. These locations are indicated with asterisks on the air photo. These sites should be left undisturbed with an appropriate buffer zone.

Table 1.

Plant Species List for Bond Road Property. This botanical survey was conducted on June 8th and 15th, 2002. Nomenclature used in this report follows Roland (1998).

		Habitats on Site							
Scientific Name	*Common Name*	**1. Ponds, brook and floodplains**	**2. Swamp**	**3a & b. Forest in northeast corner of property (south of brook)**	**4. Central forested areas (immediately south of active pit area)**	**5. Forested rise at south end of property**	**6. Recently cutover area east of active pit**	**7. Inactive pit area**	Comments
Abies balsamea	Balsam Fir	X		X	X	X	X		
Acer pensylvanicum	Moose Maple			X	X				
Acer rubrum	Red Maple	X	X	X	X		X		
Acer saccharum	Sugar Maple			X		X			
Acer spicatum	Mountain Maple	X		X					
Actaea rubra	Red Baneberry					X			
Alnus incana	Speckled Alder	X	X						
Amelanchier sp.	Shadbush	X		X		X	X		
Anaphalis margaritacea	Pearly Everlasting						X	X	
Antennaria neglecta	Pussy-toes						X	X	
Anthoxanthum odoratum	Sweet Vernal Grass	X		X	X	X	X		
Apocynum androsaemifol-ium	Spreading Dogbane	X					X		

Aralia hispida	Bristly sarsaparilla			X					
Aralia nudicaulis	Wild Sarsaparilla			X	X	X	X		
Arenaria lateriflora	Sandwort	X				X			
Arisaema triphyllum	Jack-in-the-pulpit	X							
Aronia sp.	Chokeberry		X						
Aster acuminatus	Wood Aster		X						
Aster cordifolius	Heart-leaved Aster	X			X	X			
Aster lateriflorus	Calico Aster			X					
Aster puniceus	Rough Aster	X	X						
Aster sp.	aster	X							
Athyrium filix-femina	Lady Fern	X				X			
Barbarea vulgaris	Yellow Rocket	X							
Betula lutea	Yellow Birch			X					
Betula papyrifera	Paper Birch	X		X	X	X	X	X	
Betula populifolia	Wire Birch	X		X			X	X	
Calamagrostis canadensis	Blue-joint	X	X						
Calla palustris	Wild Calla	X							
Cardamine diphylla	Toothwort					X			
Cardamine pratense	Cuckoo Flower	X	X			X			
Carex arctata	Sedge	X		X		X			
Carex	Sedge					X			

brunnescens									
Carex canescens	Sedge		X						
Carex communis	Sedge	X							
Carex crinita	Sedge	X	X						
Carex deweyana	Sedge					X			
Carex gracillima	Sedge					X			
Carex intumescens	Sedge	X	X			X			
Carex leptonervia	Sedge	X							
Carex nigra	Sedge		X						
Carex novae-angliae	Sedge	X		X		X			
Carex pallescens	Sedge		X				X		
Carex pensylvanica	Sedge				X				
Carex projecta	Sedge	X							
Carex scabrata	Sedge	X							
Carex sp.	sedge					X	X	X	
Carex stipata	Sedge		X						
Carex umbellata	Sedge								In open sand on periphery of active pit area
Chelone glabra	Turtle-head	X							
Chimaphila umbellata	Prince's Pine			X	X				
Clematis virginiana	Virgin's Bower	X							
Clintonia borealis	Clintonia			X	X				
Coptis trifolia	Goldthread			X					
Cornus alternifolia	Alternate-leaved Dogwood					X			

Cornus canadensis	Bunchberry			X	X		X		
Corydalis sempervirens	Pink Corydalis						X		
Corylus cornuta	Beaked Hazelnut			X		X			
Crataegus sp.	Hawthorn	X							
Cypripedium acaule	Pink Lady's-slipper			X	X		X		
Danthonia spicata	Poverty Grass							X	
Deschampsia flexuosa	Common Hair Grass			X	X		X		
Diervilla lonicera	Bush-honeysuckle			X	X	X	X		
Dryopteris carthusiana	Spinulose Wood Fern	X							
Dryopteris intermedia	Evergreen Wood Fern	X				X			
Epigaea repens	Mayflower				X		X		
Epilobium sp.	Willow-herb	X							
Epipactis helleborine	Helleborine					X			Tentative identification – plants very young
Equisetum arvense	Field Horsetail	X							
Equisetum sylvaticum	Wood Horsetail		X						
Eupatorium perfoliatum	Boneset	X	X						
Fagus grandifolia	Beech	X		X		X	X		
Festuca filiformis	Hair Fescue			X			X	X	
Festuca rubra	Red Fescue					X			
Fragaria virginiana	Wild Strawberry	X					X		

Fraxinus americana	White Ash	X		X		X			
Galeopsis tetrahit	Hemp-nettle	X	X						
Galium asprellum	Rough Bedstraw	X							
Galium sp.	bedstraw	X	X			X			
Gaultheria procumbens	Teaberry	X		X	X		X		
Geum sp.	Avens	X							
Glyceria sp.? (not flowering)	Manna-grass	X							
Glyceria striata	Fowl Manna-grass					X			
Gymnocarpium dryopteris	Oak Fern					X			
Hamamelis virginiana	Witch-hazel		X						
Hieracium sp.	hawkweed	X		X		X	X	X	
Hypericum perfoliatum	Common St. John's-wort						X		
Ilex verticillata	Canada Holly		X						
Impatiens sp.	Touch-me-not	X							
Iris versicolor	Blue Flag	X	X						
Juncus effusus	Soft Rush		X						
Juncus sp.	Rush	X							
Kalmia angustifolia	Sheep Laurel			X	X		X		
Lechea intermedia	Pinweed							X	
Lemna minor	Duckweed	X							
Linnaea borealis	Twin-flower			X	X		X		
Lonicera canadensis	Fly-honeysuckle			X	X	X	X		
Lonicera sp. (garden escape)	Honeysuckle			X					

Luzula acuminata	Wood Rush			X	X	X			
Luzula multiflora	Common Woodrush	X		X	X	X	X		
Lychnis flos-cuculi	Ragged Robin	X							
Lycopodium obscurum (s.l.)	Ground-pine			X	X	X			
Lycopus americanus	Water-horehound	X							
Lycopus uniflorus	Bugle-weed	X	X						
Lysimachia terrestris	Swamp Candle	X							
Maianthemum canadense	Wild Lily-of-the-valley	X		X	X	X	X		
Matteucia struthiopteris	Ostrich Fern	X							
Melampyrum lineare	Cow-wheat			X	X		X		
Mentha sp.	Mint	X							
Mitchella repens	Partridgeberry	X		X	X	X			
Myosotis scorpoides	Forget-me-not	X							
Myrica pensylvanica	Bayberry						X		
Nemopanthus mucronata	False Holly		X						
Onoclea sensibilis	Sensitive Fern	X	X			X			
Oryzopsis asperifolia	Rice-grass				X				
Osmunda cinnamomea	Cinnamon Fern	X	X	X					

Osmunda claytoniana	Interrupted Fern					X			
Osmunda regalis	Royal Fern		X						
Ostrya virginiana	Ironwood					X			
Panicum capillare	Old Witch Panic-grass								Last year's seed heads found on edge of forest habitat 3b – possibly blown in from the active pit area
Panicum depauperatum	Starved Witchgrass							X	
Panicum villosissimum	White-hair Witchgrass							X	
Phalaris arundinacea	Reed Canary Grass	X							
Phegopteris connectilis	Beech Fern					X			
Picea glauca	White Spruce	X		X	X	X	X		
Picea rubens	Red Spruce			X	X		X		
Pinus banksiana	Jack Pine							X	
Pinus strobus	White Pine			X	X		X	X	
Poa compressa	Canada Bluegrass	X		X					
Poa palustris	Fowl Meqdowgrass	X							
Poa pratensis	Kentucky Bluegrass	X		X		X			
Polygonum sagittatum	Tear Thumb	X							
Polystichum acrostichoides	Christmas Fern					X			
Populus grandidentata	Large-toothed Aspen	X		X	X	X	X	X	

Populus tremuloides	Trembling Aspen	X	X	X	X	X	X	X	
Potamogeton epihydrus	Pondweed	X							
Prenanthes sp.	Lion's Paw	X			X	X			
Prunus pensylvanica	Pin Cherry			X			X		
Prunus virginiana	Chokecherry	X							
Pteridium aquilinum	Bracken	X		X	X	X	X		
Pyrola elliptica	Shinleaf					X			
Pyrola rotundifolia	Round-leaved Pyrola			X	X				
Pyrola virens	Grenn-flowered Shinleaf				X				
Pyrus malus	Apple	X				X			
Quercus rubra	Red Oak	X		X	X	X	X		
Ranunculus acris	Tall Buttercup					X			
Ranunculus repens	Creeping Buttercup	X				X			
Rhododendron canadense	Rhodora		X						
Ribes glandulosum		X							
Rosa virginiana	Wild Rose	X	X						
Rubus allegheniensis	Common Blackberry	X							
Rubus hispidus	Swamp Dewberry		X	X					
Rubus sp.	Blackberry		X				X		
Rubus strigosus	Wild Raspberry	X		X			X		
Rumex	Sheep Sorrel	X		X			X	X	

acetosella									
Rumex sp.	Dock	X							
Salix bebbiana	Beaked Willow		X						
Salix discolor	Pussy Willow		X						
Salix eriocephala	Willow	X							
Salix lurida	Shining Willow	X							
Salix petiolaris	**Meadow Willow**	**X**							**One large shrub on brook edge; ranked as S3 by ACCDC (Atlantic Canada Conservation Data Center)**
Salix sp.	willow						X	X	
Sambucus canadensis	Canada Elderberry	X		X					
Sambucus racemosa	Red-berried Elderberry				X				
Scirpus sp.	Bulrush	X							
Scutellaria galericulata	Marsh Skullcap	X							
Scutellaria lateriflora	Skullcap	X							
Sedum telephium	Live-forever	X							
Sium sauve	Water Pasnip	X							
Smilacina racemosa	False Solomon's-seal	X				x			
Solanum dulcamara	Bittersweet	X				X			
Solidago canadensis	Canada Goldenrod	X							

Solidago rugosa	Rough Goldenrod	X		X		X	X		
Solidago sp.	Goldenrod				X		X		
Sparganium sp.	Bur-reed	X							
Spiraea alba	Meadowsweet	X	X						
Stellaria sp.	Chickweed			X					
Taxus canadensis	Yew	X		X					
Thalictrum pubescens	Meadow-rue	X							
Thelypteris noveboracensis	New York Fern	X	X		X	X			
Thelypteris palustris	Marsh Fern		X						
Thuja occidentalis	**Eastern White Cedar**					**X**			**1 small stand of approx. 25 young trees near south boundary of survey site; listed as rare for Nova Scotia by Pronych & Wilson (1993); ACCDC ranking: S1S2**
Tilia sp.	Basswood	X							
Triadenum fraseri	Marsh St. John's-wort	X							
Trientalis borealis	Star Flower			X	X	X			
Trillium cernuum	Nodding Trillium					X			
Trillium erectum	**Purple Trillium**					**X**			**2 clumps of plants near south boundary of survey site; listed as rare for Nova Scotia by Pronych & Wilson (1993); ACCDC ranking: S3**

Trillium undulatum	Painted Trillium			X	X				
Tsuga canadensis	Eastern Hemlock	X		X	X	X	X		
Typha latifolia	Broad-leaved Cattail	X							
Urtica dioica	Stinging Nettle	X							
Vaccinium angustifolium	Lowbush Blueberry			X	X	X	X		
Vaccinium myrtilloides	Velvet-leaf Blueberry	X		X	X		X		
Veronica officinalis	Common Speedwell	X		X	X	X	X		
Viburnum alnifolium	Hobblebush	X		X					
Viburnum nudum	Wild Raisin		X	X	X		X		
Viola cucullata	Blue Violet	X							
Viola renifolia	Violet				X				

Literature Cited

Pronych, G. and A. A. Wilson. 1993. *Rare Vascular Plants of Nova Scotia*. Nova Scotia Museum, Halifax. 2 vols. 331 pp.

Roland, A.E. 1998. *Roland's Flora of Nova Scotia*. 3rd edition. Nimbus Publishing and the Nova Scotia Museum, Halifax, N.S.

Web Sites

Atlantic Canada Conservation Data Center: http://www.accdc.com

Appendix

Explanation of the Plant Ranking System Used by the ACCDC (Atlantic Canada Conservation Data Center); this information is available on the ACCDC Web Site.

Sub-national Rank Definitions: S-ranks

S1
Extremely rare throughout its range in the province (typically 5 or fewer occurrences or very few remaining individuals). May be especially vulnerable to extirpation.

S2
Rare throughout its range in the province (6 to 20 occurrences or few remaining individuals). May be vulnerable to extirpation due to rarity or other factors.

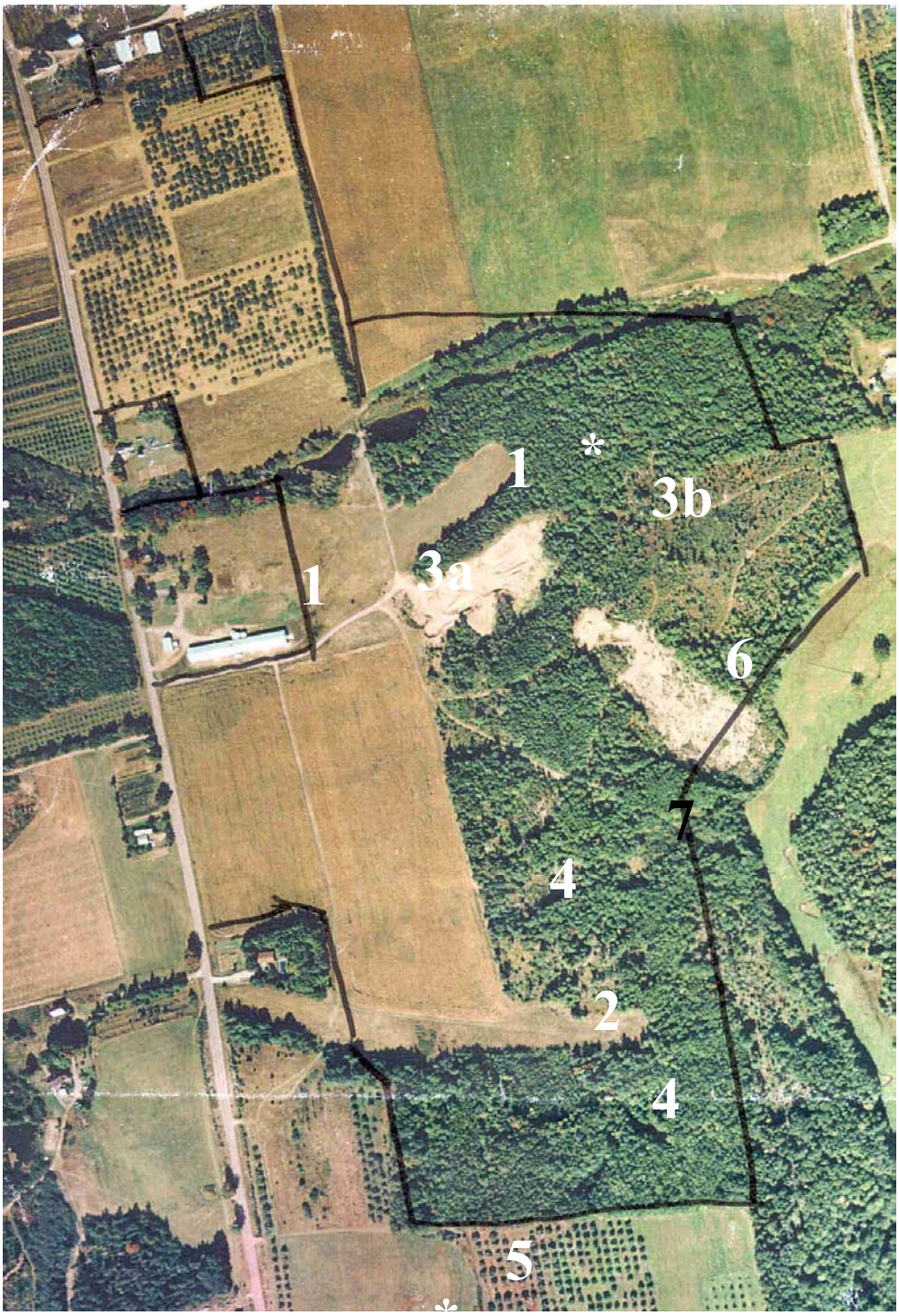
S3
Uncommon throughout its range in the province, or found only in a restricted range, even if abundant in at some locations. (21 to 100 occurrences).

S4
Usually widespread, fairly common throughout its range in the province, and apparently secure with many occurrences, but the Element is of long-term concern (e.g. watch list). (100+ occurrences).

S5
Demonstrably widespread, abundant, and secure throughout its range in the province, and essentially ineradicable under present conditions.

S#S#
Numeric range rank: A range between two consecutive numeric ranks. Denotes uncertainty about the exact rarity of the Element (e.g., S1S2).

Air photo of Bond Road property. Numbers indicate locations of the various habitats surveyed. The asterisks indicate locations of rare plant species found on the site. Property extent is outlined in black.



Plant Survey of a Property on Bond Road, Waterville, Kings County, Nova Scotia – Addendum

by

Ruth E. Newell, B.Sc. (Hons.), M.Sc.

164 Schofield Road, RR 2,

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B4P 2R2

October 27, 2003

Plant Survey of a Property on Bond Road, Waterville, Kings County, Nova Scotia – Addendum

This study presents the results of a plant survey conducted on September 29, 2002 as a follow up to an earlier survey conducted June 8th and 15th, 2002 on a property located on the Bond Road in Waterville, Kings County, Nova Scotia – see "Plant Survey of a Property on Bond Road, Waterville, Kings County, Nova Scotia" (Newell, 2002). Botanist Ruth E. Newell, M.Sc., B.Sc.

(Hons.) conducted both surveys. Surveying several times over the course of a growing season ensures that a more complete plant list for a particular area will be obtained. Plant species flower and fruit at different times throughout the spring, summer and fall. In most cases, depending on the particular species, either flowers or fruit are necessary for a positive identification to the species level.

The species listed in Table1 below represent additions to the plant list presented in the first report and/or additions to specific habitats. The air photo from the original report showing locations of specific habitats has been included in this report. Please refer to Newell (2002) for a description of the various habitats found on the property.

No additional rare species were found during this follow up survey.

Table 1.

Plant Species List for Bond Road Property (addendum). This botanical survey was conducted on September 29th, 2002. The species listed here represent additions to the plant list presented in the first report (Newell, 2002) and/or additions to specific habitats. Nomenclature used in this report follows Roland (1998).

		Habitats on Site (see Newell, 2002 for map)							
Scientific Name	**Common Name**	**1. Ponds, brook and floodplains**	**2. Swamp**	**3a & b. Forest in northeast corner of property (south of brook)**	**4. Central forested areas (immediately south of active pit area)**	**5. Forested rise at south end of property**	**6. Recently cutover area east of active pit**	**7. Inactive pit area**	Comments
Acer rubrum	Red Maple					X			
Actaea rubra	Red Baneberry				X				
Agrimonia gryposepala	Hooked Agrimony	X							
Aralia hispida	Bristly Sarsaparilla							X	
Aster cordifolius	Heart-leaved Aster			X					
Aster lateriflorus	Calico Aster	X	X		X	X			
Bidens cernua	Nodding Bur-marigold	X							
Brachyelytrum erectum var. *septentrionale*	Northern Short-husk		X						
Carex arctata	Black Sedge				X				

		Habitats on Site (see Newell, 2002 for map)							
Scientific Name	**Common Name**	**1. Ponds, brook and floodplains**	**2. Swamp**	**3a & b. Forest in northeast corner of property (south of brook)**	**4. Central forested areas (immediately south of active pit area)**	**5. Forested rise at south end of property**	**6. Recently cutover area east of active pit**	**7. Inactive pit area**	Comments
Carex projecta	Necklace Sedge			X					
Chimaphila umbellata	Princes'-pine						X		
Danthonia spicata	Poverty Grass				X				
Diphasiastrum digitatum	Crowfoot Club-moss				X				
Epifagus virginiana	Beech-drops					X			
Euthamia graminifolia	Narrow-leaved Goldenrod			X			X		
Galeopsis tetrahit	Hemp-nettle					X			
Galium palustre	Marsh Bedstraw		X						
Glyceria striata	Fowl Manna-grass	X	X						
Gnaphalium macounii	Winged Cudweed							X	
Hamamelis virginiana	Witch-hazel				X				
Hieracium	Rough				X				

		Habitats on Site (see Newell, 2002 for map)							
Scientific Name	**Common Name**	**1. Ponds, brook and floodplains**	**2. Swamp**	**3a & b. Forest in northeast corner of property (south of brook)**	**4. Central forested areas (immediately south of active pit area)**	**5. Forested rise at south end of property**	**6. Recently cutover area east of active pit**	**7. Inactive pit area**	Comments
scabrum	Hawkweed								
Hypericum mutilum	Slender St. John's-wort	X							
Juncus canadensis	Canada Rush	X							
Leersia oryzoides	Rice-cutgrass	X							
Monotropa uniflora	Indian Pipe				X	X			
Osmunda claytoniana	Interrupted Fern		X						
Picea rubens	Red Spruce					X			
Prenanthes trifoliolata	Lion's-paw	X							
Pteridium aquilinum	Bracken		X						
Pyrola elliptica	Shinleaf				X				
Rosa nitida	Swamp-rose	X							
Rubus idaeus	Wild Raspberry					X			
Rumex obtusifolius	Blunt-leaved Dock	X							
Salix eriocephala	Heart-leaved Willow		X						
Sambucus	Red-berried					X			

		Habitats on Site (see Newell, 2002 for map)							
Scientific Name	**Common Name**	**1. Ponds, brook and floodplains**	**2. Swamp**	**3a & b. Forest in northeast corner of property (south of brook)**	**4. Central forested areas (immediately south of active pit area)**	**5. Forested rise at south end of property**	**6. Recently cutover area east of active pit**	**7. Inactive pit area**	Comments
racemosa	Elder								
Scirpus cyperinus	Common Wool-grass	X							
Scutellaria lateriflora	Mad-dog Skullcap		X						
Solidago bicolor	White Goldenrod			X	X		X	X	
Solidago nemoralis	Old-field Goldenrod							X	
Solidagp puberula	Downy Goldenrod			X	X		X	X	
Sorbus aucuparia	Rowan						X		
Sparganium americanum	American Bur-reed	X							
Taxus canadensis	Canada Yew				X				
Viola selkirkii	Great-spurred Violet				X				This was incorrectly identified as *Viola renifolia* during the spring survey

References

Newell, Ruth E. 2002. Plant Survey of a Property on Bond Road, Waterville, Kings County, Nova Scotia.

Roland, A.E. 1998. *Roland's Flora of Nova Scotia.* 3rd edition. Nimbus Publishing and the Nova Scotia Museum, Halifax, N.S. 2 vols. 1297 pp.

Appendix IX: Faunal/Wildlife Survey

Faunal Analysis of an Aggregate Extraction Operation on Bond Road, Waterville, Kings County, Nova Scotia

W. George Alliston, Ph.D.

Revised 31 December 2003

TABLE OF CONTENTS

INTRODUCTION

This report assesses the use of the aggregate pit and surrounding woodlands and agricultural lands owned by Twin Mountain Construction Ltd by species of amphibians and reptiles, breeding birds, and mammals currently considered at risk in Nova Scotia; the possible impacts the continuing operations of the aggregate pit might have on these species and the possible mitigative measures that might be taken.

AGGREGATE EXTRACTION OPERATIONS

Site Description

The aggregate extraction operation is situated on a 46-ha property located near Waterville, Kings County, Nova Scotia, on the Bond Road near its intersection with Highway 1 (N45°02' W64°41') (Figure 1) (PID #'s 55168868 and 55370829). The pit, aggregate storage area and "industrial topsoil" preparation area currently cover an area of approximately 7 ha. The property also includes lands currently being used for agricultural production including grain (9 ha), hay (1 ha), orchard (4 ha), old field (1 ha) and forestry (24 ha). The mixed forest that surrounds much of the aggregate extraction operation varies from new regeneration in areas that have been clear cut as little as ten years ago to areas that have been selectively cut thus leaving some older trees. Dominant species in these "older" forested areas include White Pine, White and Red Spruce, Eastern Hemlock, Red Oak, Red and Sugar Maple and American Beech (see Botanical Report by R. Newell). A habitat map, based on forest cover of the Twin Mountain Construction Ltd. and adjacent properties, is presented in Figure 2.

A small stream, with two small ponds, flows to the east along the northern boundary of the property. This stream flows into Rochford Brook which flows in a northerly direction and is immediately east of the east boundary of the property. At the northeastern extremity of the pit site a shallow sky pond has formed.

Figure 1. Twin Mountain Construction Ltd. Bond Road Property (2002 Aerial Photo)

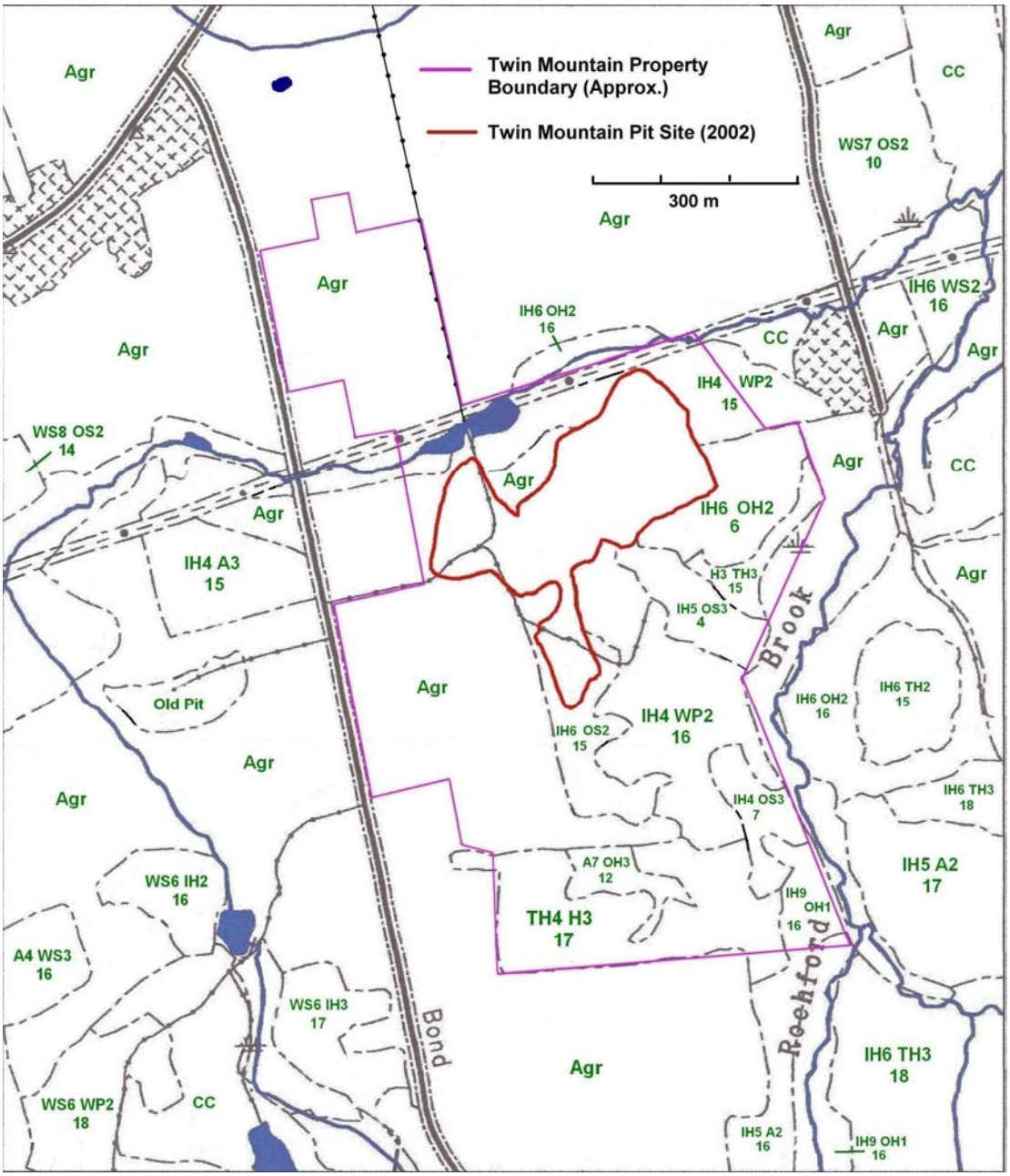

Figure 2. Habitats based on forest cover of Twin Mountain Construction Ltd. and adjacent properties (for Legend see following page)

Legend - Figure 2, Habitat map based on forest cover.

Dominant forest cover tree species

A	Aspen
H	Hemlock
IH	Intolerant Hardwoods
OS	Other Softwoods
S	Red or Black Spruce
TH	Tolerant Hardwoods
WP	White Pine
WS	White Spruce

Forest Stand Description Example

H5 IH3 = Hemlock 50% Intolerant Hardwoods 30%

15 = Height (m)

Activities at Pit Site

Aggregate extraction has been conducted at this site for more than a quarter of a century. The current owner has been operating the site for about six years. Operations consist of the removal, screening and loading of aggregate onto trucks. Working in the pit are a backhoe, a screener and two front end loaders. Large trucks are constantly being loaded during periods of active demand. The pit is worked on a year round basis as demand requires. Demand, and therefore the level of pit activity, varies throughout the year with the peak demand during the May through September period tailing off in fall and winter and reaching its lowest levels in March when highway weight restrictions are in place. Excavation and screening operations are generally conducted between 6:00 a.m. and 5:00 p.m. During peak periods of demand, truck loading can begin as early as 3:30 a.m. Explosives are not used in the extraction process.

Future extraction activities at the pit are expected to remain at levels similar to that of the past six years.

The pit area houses an aggregate storage area (including some aggregates imported from other sites) and an "industrial topsoil" preparation and storage area.

Site Reclamation

Although no reclamation work has been undertaken yet, the owner understands that such reclamation work must be initiated prior to extending the pit into new areas.

METHODS

Lands owned by Twin Mountain Construction Ltd. on the Bond Road were visited by the author on four occasions between 2 May 2002 and 23 June 2002 and also on 17 November 2003. While information was gathered on all taxa of interest during each visit, the primary focus varied with each visit.

2 May 2002 - (1:30 p.m. to 5:00 p.m.; overcast, light winds, ~12°C) - A general reconnaissance of the property was conducted, various habitats were noted, information was gathered on bird, mammal and herptile species and the current boundaries of the aggregate operation (both extraction and storage) were mapped using a GPS (Garmin GPS 76).

8 June 2002 - (4:47 a.m. to 10:30 a.m.; clear, calm, ~3°C to 9°C) - The main focus of this visit was to conduct a survey of the breeding birds using the property. The author was accompanied by Mr. Bernard Forsythe, a very experienced and respected amateur ornithologist and naturalist, during this survey. The surveyors traversed the various habitats on the property identifying bird species. Birds were identified primarily by their songs. The survey was conducted in the early morning hours when the frequency of bird song is greatest.

12 June 2002 - (8:10 p.m. to 10:30 p.m.; clear, calm, ~10°C) - The main focus of this visit was to conduct a census of nocturnal birds as well as mammals and amphibians. The author was again accompanied by Mr. Forsythe. The surveyors traversed the periphery of the pit and the interface between the woodland and agricultural land, listening and watching for wildlife. In an attempt to identify any owl species using the area, calls of Great Horned Owls, Barred Owls, Long-eared Owls and Northern Saw- whet Owls were made periodically in the hope of getting a response should any of these species be present.

23 June 2002 - (5:40 p.m. to 8:45 p.m.; overcast, winds moderate, ~20°C.) - The main focus of this visit was to complete the search of the ponds and stream for the presence of reptiles and amphibians. Imitations of rodent sounds periodically; this can sometimes entice owls to approach the source of these sounds.

17 November 2003 – (2:20 p.m. to 4:50 p.m.; clear, calm, ~7°C). - The purpose of this visit was to investigate a report that "cranes" (presumably Great Blue Herons) were nesting on or adjacent to the property. Great Blue Herons generally nest colonially making their large nests high up in tall trees. Nesting sites are generally associated with water, very often on islands. Nest structures in mixed forests would be much more visible at this time of year after leaf fall.

In this report "species at risk" refers to any terrestrial, amphibian, reptile, breeding bird and mammal species that is designated as colour rank red (at risk) or yellow (sensitive to human activities) by the Province of Nova Scotia or those that are ranked as being "extremely rare" (S1), "rare" (S2) or "uncommon" (S3) in the Province of Nova Scotia by the Atlantic Canada Conservation Data Centre (ACCDC) and those species that occur in Nova Scotia that have been designated as "endangered", "threatened", or of "special concern" by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). The definitions of the various rankings of these three systems are presented in this report (see **Amphibian, Reptile, Breeding Bird and Mammal Species at Risk in Nova Scotia**).

The possible use of this property, or properties immediately adjacent, by species at risk is based on the census work conducted on the property, assessment of the availability of suitable habitat

for these species and their known ranges as determined from personal knowledge, the literature, and the Atlantic Canada Conservation Data Centre database, communications with knowledgeable individuals. Lists of the amphibians, reptiles, breeding birds and mammals currently considered at risk in Nova Scotia and assessments of their actual or potential occurrence at this site are presented.

The common names of plants and animals are used in this report. The common and scientific species names are listed alphabetically in Appendix 1.

SPECIES OF FAUNA RECORDED DURING SITE VISITS
(May 2002 - June 2002)

Amphibians and Reptiles

No amphibian or reptile species at risk were recorded during our site visits.
The four amphibian species and one reptile species recorded during the site visits are listed in Table 1.

Northern Spring Peepers were heard in the woodlands to the north and east of the pit. Green Frogs were seen and heard in the larger (more easterly) pond on the brook. A Pickerel Frog was seen alongside this pond. Eastern Painted Turtles were observed in both ponds. Eastern American Toads were heard trilling from the sky pond area in the northeast section of the pit.

Table 1. Amphibians and Reptiles

	How Recorded	
Species	Seen	Heard
Eastern American Toad		3
Northern Spring Peeper		many
Green Frog	5	
Pickerel Frog	1	
Eastern Painted Turtle	4	

Breeding Birds

No bird species at risk was observed on the property during our site visits; however, Bobolinks were heard on properties adjoining the north boundary.

The routes taken during the 8 June 2002 bird survey are mapped in Figure 3. The route has been broken up into seven sections: four sections through woodlands (A through D), one section (E) along the edge between agricultural land (grain crops) and forest, one section (F) through the orchard and hayfield, and a circuit of the active pit site (G).

The woodland was divided into four sections according to the maturity of the forest being surveyed. Sections A and C are somewhat similar showing some signs of past selective cutting and containing some trees of moderate size. Dominant tree species in these sections include White Pine, White and Red Spruce, Eastern Hemlock, White Birch, Red Oak, Red Maple and Poplars. Section B is the youngest forest in the property; most of it has been clear cut, some parts as recently as about ten years ago. In addition to saplings of the dominant species in the more mature sections, and sprouts from deciduous trees cut previously, this area is dominated by early successional species such as White Spruce, Balsam Fir, White Birch and Poplar. Section D is the oldest forest on the property and, while no means mature, is dominated mainly by Eastern Hemlock, American Beech, Red Oak, and Sugar and Red Maple. (For a more complete description, see report by R. Newell.)

The survey for nocturnal species on the evening of 12 June 2002 was conducted along sections E and G. The results of these two surveys, along with other observations, are presented in Table 2.

A total of 46 bird species was observed on the property. As indicated, none was a designated species at risk. Notable species that were relatively common in the woodland and edge areas, in addition to the expected American Robin, American Crow, Blue Jay and Song Sparrow, were the White-throated Sparrow, Red-eyed Vireo, Ovenbird and Veery. Perhaps equally notable was the absence, or very low numbers, of bird species that might normally be expected in these habitats (e.g. Nashville Warbler, Magnolia Warbler, Yellow Warbler, American Redstart, etc.)

The large field to the west of the woodland area, with the exception of only a small strip along its southern extremity, and the small field immediately north of the pond are currently planted in grain crops and do not provide suitable habitat for breeding birds. Should these areas be converted to hayfields, they could attract such species as Bobolink and Savannah Sparrow. Neither of these two species was recorded in the small hayfield at the north of the property.

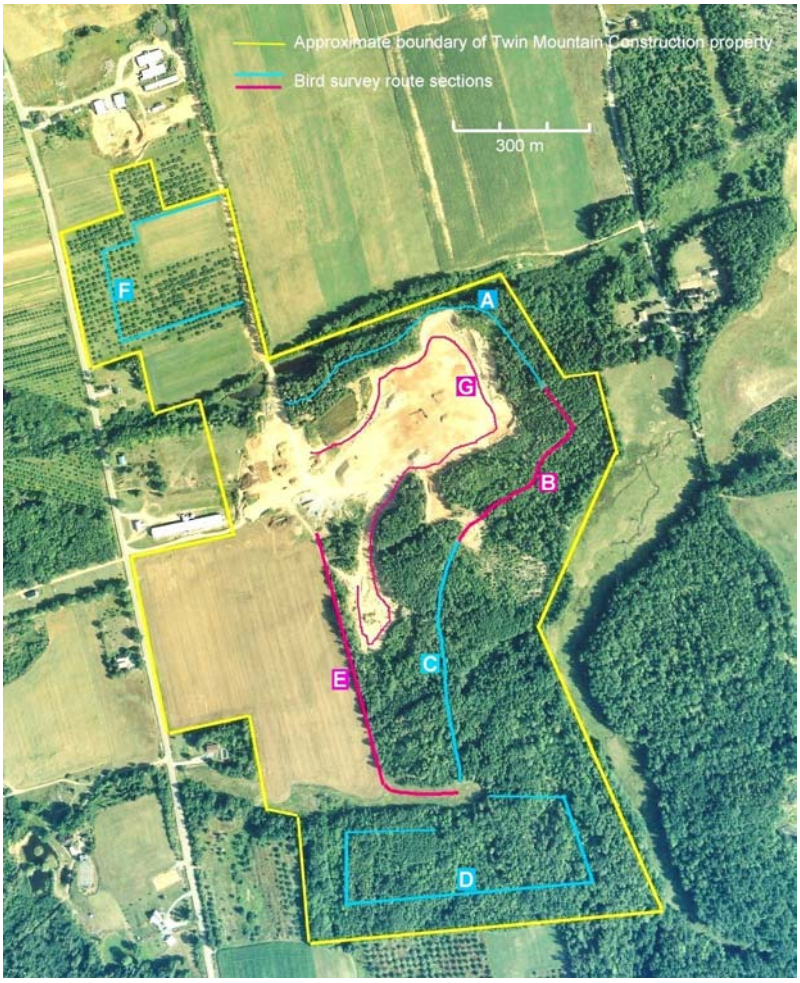

Figure 3. Routes followed when conducting breeding bird surveys on Twin Mountain Ltd. property 8 June 2002 and 12 June 2002

(2002 Aerial Photo)The orchard portion of the property is well managed from an agricultural perspective (well pruned, sprayed and mowed) thus providing limited habitat for breeding birds.

While the pit presents very limited habitat for breeding birds, a few species are attracted to such areas. During the first site visit on 2 May 2002, a pair of Belted Kingfishers was observed excavating a nest burrow on an embankment created by the extraction activities. In late June this pair was capturing fish in the ponds and attending young at the nest site. Two pairs of Bank Swallows had also excavated nest burrows in the embankments.

Two pairs of Killdeer were believed to have nested and are rearing broods in and adjacent to the pit site. A pair of Spotted Sandpipers is also believed to have nested in the pit near its eastern extremity adjacent to the sky pond. Common Nighthawks can also nest in such areas. Our single observation of a Common Nighthawk flying over the site did not suggest nesting activity.

The nocturnal survey did not reveal any owl species on the property. Other species such as the Common Nighthawk and American Woodcock were recorded only during the nocturnal survey.

My autumn 2003 visit to the site was to investigate a report of "cranes" (a colloquial term generally applied to Great Blue Herons) nesting on or adjacent to the property. Great Blue Herons are not considered a species at risk in Novas Scotia (green, S5B) although if there were a colony near the pit site, it should be documented.

Most of the search for Great Blue Heron nest structures (see Methods) was conducted in woodlands along both sides of Rochford Brook adjacent to the eastern boundary of the Twin Mountain property. No nest structures that might have been built by Great Blue Herons were found. This large and conspicuous bird was not observed during any of our spring and summer visits to the property when these birds are nesting.

It is possible that the "cranes" could have been American Bitterns. This species, which is an uncommon nesting bird in Nova Scotia but not considered a species at risk, is a solitary ground nesting species that nests in marshes and wetlands with cattail swales being a favoured habitat. There are no cattail swales on or adjacent to the property although small areas of rushes are present along Rochford Brook. The alluvial areas along Rochford Brook adjacent to the east boundary of the Twin Mountain property is used as pastureland. This pastureland is very heavily

grazed with grasses and sedges being cropped to ground level and even the rushes, which are not a favoured cattle food, being heavily cropped. In an area that, even without heavy grazing, would provide only marginal habitat for American Bitterns, it would seem most unlikely that these birds would attempt to nest here.

Mammals

One mammal species at risk, the Little Brown Bat, was observed during our visits.

Table 3 lists the ten mammal species whose presence on the site was determined either by observation or by sign (tracks, scats, burrows).

A single bat, believed to be a Little Brown Bat, was observed foraging for insects over the grain field during the evening survey conducted on 12 June 2002. Other mammals recorded were species that would be expected in the habitats found on the property. Our overall impression was that population levels of small mammals were low with few sightings of American Red Squirrel (1) and Eastern Chipmunk (1). The small, newly planted hayfield near the northern extremity of the property contained no obvious Meadow Vole runs. The orchard area contained very low densities of Meadow Vole runs.

Table 3. Mammals and Mammal Sign Observed

Species	How Detected: Seen	How Detected: Sign
Little Brown Bat	1	
American Red Squirrel	1	
Eastern Chipmunk	1	
Meadow Vole		√
American Porcupine	1	√
Coyote		√
Red Fox	1	√
Raccoon		√
Striped Skunk	1	√
White-tailed Deer	2	√

AMPHIBIAN AND REPTILE, BREEDING BIRD, AND MAMMAL SPECIES AT RISK IN NOVA SCOTIA

Derivation of Species at Risk Lists

As indicated above, I have derived species at risk lists for amphibians, reptiles, breeding birds and mammals from three sources: the General Status of Wild Species in Nova Scotia as defined by the Province of Nova Scotia, the Nova Scotia (sub-national) rankings defined by the Atlantic Canada Conservation Data Centre (ACCDC), and the Canadian rankings as defined by the Committee of the Status of Endangered Wildlife in Canada (COSEWIC).

I have considered all species designated by the Province of Nova Scotia as colour ranks Red and Yellow as “species at risk”. The definitions of the Province of Nova Scotia colour rankings are as follows:

"**BLUE** (Extirpated/Extinct) – Species that are no longer thought to be present in the province or in Canada, or that are believed to be extinct. Extirpated species have been eliminated from a given geographic area but may occur in other areas. Extinct species are extirpated worldwide (i.e. they no longer exist anywhere). Species listed by COSEWIC as extinct or nationally extirpated automatically receive an Extirpated/Extinct general status rank. This rank applies at the national level and in whichever province or territory the species formerly existed. Nationally Extirpated/Extinct species are not considered part of Nova Scotia's species richness.

RED (At Risk or Maybe at Risk) – Species for which a formal detailed risk assessment has been completed (COSEWIC assessment or a provincial equivalent) and that have been determined to be at risk of extirpation or extinction and are therefore candidates for interim conservation action and detailed risk assessment by COSEWIC or the Province.

YELLOW (Sensitive) – Species that are not believed to be at risk of immediate extirpation or extinction, but which may require special attention or protection to prevent them from becoming at risk.

GREEN (Secure) – Species that are not believed to be at risk, or sensitive. This category includes some species that have declined in numbers but remain relatively widespread or abundant.

UNDETERMINED – Species for which insufficient data, information, or knowledge is available to reliably evaluate their status."
(http://www.gov.ns.ca/natr/wildlife/genstatus/background.htm)

For further information on the Province of Nova Scotia status assessment process, see the above Government of Nova Scotia web site.

I have also considered all species designated by the Atlantic Canada Conservation Data Centre as sub-national (S) ranks S1, S2, S3 for the Province of Nova Scotia as "species at risk". The sub-national rank definitions used by ACCDC are as follows:

"**S1** – Extremely rare throughout its range in the province (typically 5 or fewer occurrences or very few remaining individuals). May be especially vulnerable to extirpation.

S2 – Rare throughout its range in the province (6 to 20 occurrences or few remaining individuals). May be vulnerable to extirpation due to rarity or other factors.

S3 – Uncommon throughout its range in the province, or found only in a restricted range, even if abundant in some locations. (21 to 100 occurrences).

S4 – Usually widespread, fairly common throughout its range in the province, and apparently secure with many occurrences, but the Element is of long-term concern (e.g. watch list). (100+ occurrences).

S5 – Demonstrably widespread, abundant, and secure throughout its range in the province, and essentially ineradicable under present conditions.

S#S# - Numeric range rank: A range between two consecutive numeric ranks. Denotes uncertainty about the exact rarity of the Element (e.g., S1S2).
SH - Historical: Element occurred historically throughout its range in the province (with expectation that it may be rediscovered), perhaps having not been verified in the past 20 - 70 years (depending on the species), and suspected to be still extant.

SU – Unrankable: Possibly in peril throughout its range in the province, but status uncertain; need more information."

Qualifiers for these ranks include:
"**B** – Breeding: Basic rank refers to the breeding population of the element in the province.

? – Inexact or uncertain: for numeric ranks, denotes inexactness, e.g. SE? denotes uncertainty of exotic status. (The ? qualifies the character immediately preceding it in the S rank)." (http://www.accdc.com/products/lists/ranks).

In addition, the ACCDC provides both national (N ranks) and global (G ranks) for those species. The N and G rank definitions are similar to the S ranks but applied at a national or global level. For more information on the ACCDC ranking system, see the above web site.

I have also considered those species which occur in Nova Scotia that have been designated by COSEWIC as being endangered (E), threatened (T) or of special concern (SC). The definitions for the designations used by COSEWIC are as follows:

Extinct (X)	A species that no longer exists.
Extirpated (XT)	A species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A species facing imminent extirpation or extinction.
Threatened (T)	A species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)	A species of special concern because of characteristics that make it particularly sensitive to human activities or natural events.
Not at Risk (NAR)	A species that has been evaluated and found to be not at risk.
Data Deficient (DD)	A species for which there is insufficient scientific information to support status designation.

(http://www.cosewic.gc.ca/eng/sct0/index_e.cfm)

COSEWIC's mandate is at the national level so its rankings may vary from the other two sources that take a provincial viewpoint. Further information can be obtained regarding COSEWIC at the above web site.

The following lists include the common name of each species at risk, their status rankings by the Province of Nova Scotia, the ACCDC and COSEWIC and an assessment of their possible occurrence at or immediately adjacent to the Twin Mountain Construction property. Assessments of the occurrence of each species is based on our survey work, the known distribution of the species and its habitat preferences.

Amphibians and Reptiles

	Status			
	Prov. of N.S.	ACCDC	COSEWIC	
Amphibian Species	Colour Ranking	N.S. S Ranking	Canadian Ranking	Possible Occurrence At or Adjacent to Sites
Four-toed Salamander	yellow	S3	NAR	highly unlikely

	Status			
	Prov. of N.S.	ACCDC	COSEWIC	
Reptile Species	Colour Ranking	N.S. S Ranking	Canadian Ranking	Possible Occurrence At or Adjacent to Sites
Blanding's Turtle	red	S1	T	highly unlikely
Wood Turtle	yellow	S3	SC	unlikely
Northern Ribbon Snake	yellow	S2S3	T	highly unlikely

Breeding Birds

Breeding Bird Species	Status: Prov. of N.S. Colour Ranking	Status: ACCDC N.S. S Ranking	Status: COSEWIC Canadian Ranking	Possible Occurrence At or Adjacent to Site
Peregrine Falcon	red	S1B	T	highly unlikely
Piping Plover	red	S1B	E	n/a
Roseate Tern	red	S1B	E	n/a
Common Loon	yellow	S4B	NAR	highly unlikely
Black-crowned Night Heron	yellow	S1B	-	highly unlikely
Northern Goshawk	yellow	S3B	NAR	unlikely
Common Tern	yellow	S3B	NAR	n/a
Arctic Tern	yellow	S3B	-	n/a
Razorbill	yellow	S1B	-	n/a
Atlantic Puffin	yellow	S1B	-	n/a
Long-eared Owl	yellow	S1S2B	-	unlikely
Short-eared Owl	yellow	S1S2B	SC	highly unlikely
Purple Martin	yellow	S1S2B	-	highly unlikely
Eastern Bluebird	yellow	S2S3B	NAR	unlikely
Bicknell's Thrush	yellow	S1S2B	SC	highly unlikely
Vesper Sparrow	yellow	S2S3B	-	unlikely
"Ipswich" Savannah Sparrow	yellow	S1S2B	SC	highly unlikely
Nelson's Sharp-tailed Sparrow	yellow	S2S3B	NAR	highly unlikely
Bobolink	yellow	S3B	-	observed
Eastern Meadowlark	yellow	S1S2B	-	highly unlikely
Least Bittern	green	S1B	T	highly unlikely
Northern Pintail	green	S2B	-	highly unlikely
Northern Shoveler	green	S2B	-	highly unlikely
Gadwall	green	S2B	-	highly unlikely
Common Goldeneye	green	S2B	-	highly unlikely
Red-breasted Merganser	green	S2S3B	-	highly unlikely
Cooper's Hawk	green	S1?B	NAR	highly unlikely
Merlin	green	S3S4B	-	unlikely

continued on next page

Breeding Bird Species (*cont.*)	Status			Possible Occurrence At or Adjacent to Site
	Prov. of N.S.	ACCDC	COSEWIC	
	Colour Ranking	N.S. S Ranking	Canadian Ranking	
Virginia Rail	green	S2B	-	highly unlikely
Common Moorhen	green	S1B	-	highly unlikely
American Coot	green	S2B	-	highly unlikely
Semipalmated Plover	green	S2B	-	highly unlikely
Greater Yellowlegs	green	S2B	-	highly unlikely
Solitary Sandpiper	green	S1B	-	highly unlikely
Upland Sandpiper	green	S1B	-	highly unlikely
Least Sandpiper	green	S1B	-	highly unlikely
Wilson's Phalarope	green	S1B	-	highly unlikely
Black-legged Kittiwake	green	S2B	-	n/a
Black Tern	green	S1B	NAR	highly unlikely
Black-billed Cuckoo	green	S3B	-	unlikely
Boreal Owl	green	S1?B	-	highly unlikely
Whip-poor-will	green	S2B	-	highly unlikely
Willow Flycatcher	green	S1B	-	highly unlikely
Eastern Phoebe	green	S2S3B	-	unlikely
Great Crested Flycatcher	green	S2S3B	-	unlikely
Horned Lark	green	S2B	-	unlikely
Boreal Chickadee	green	S3S4B	-	unlikely
Marsh Wren	green	S2B	-	highly unlikely
Wood Thrush	green	S2B	-	highly unlikely
Northern Mockingbird	green	S3B	-	unlikely
Brown Thrasher	green	S1S2B	-	highly unlikely
Loggerhead Shrike	accidental	SHB	E	highly unlikely
Warbling Vireo	green	S2B	-	highly unlikely
Philadelphia Vireo	green	S2B	-	highly unlikely
Scarlet Tanager	green	S3B	-	unlikely
Northern Cardinal	green	S3B	-	unlikely
Indigo Bunting	green	S2S3B	-	highly unlikely
Rusty Blackbird	green	S3S4B	-	highly unlikely
Baltimore Oriole	green	S3B	-	unlikely

Mammals

Mammal Species	Status			Possible Occurrence At or Adjacent to Site
	Prov. of N.S.	ACCDC	COSEWIC	
	Colour Ranking	N.S. S Ranking	Canadian Ranking	
Eastern Cougar	undetermined	SU	DD	highly unlikely
American Marten	red	S1	-	highly unlikely
Lynx	red	S1	NAR	highly unlikely
Moose	red	S1	-	highly unlikely
Eastern Pipistrelle	yellow	S1?	-	possible
Fisher	yellow	S2	-	unlikely
Gaspé Shrew	yellow	S2	SC	highly unlikely
Hoary Bat	yellow	S2?	-	unlikely
Little Brown Bat	yellow	S4	-	observed
Long-tailed Shrew	yellow	S1	-	highly unlikely
Northern Long-eared Bat	yellow	S2	-	possible
Red Bat	yellow	S2?	-	unlikely
Silver-haired Bat	yellow	S1?	-	unlikely
Southern Flying Squirrel	yellow	S1	SC	unlikely
Southern Bog Lemming	green	S3S4	-	highly unlikely
Rock Vole	green	S2	-	highly unlikely

IMPACT OF AGGREGATE PIT OPERATIONS

Nature of Potential Impacts

The main impacts of aggregate extraction operations on wildlife are:

1) the direct removal of habitat
2) an increase in noise levels and hence disturbance of wildlife in adjacent habitats.

Removal of habitat generally leads to a decrease in the numbers of those species dependent upon that habitat. Noise can similarly lead to the exclusion of sensitive individuals or species from appropriate habitats or lead to increased mortality or depressed reproductive rates in those individuals occupying the disturbed habitats.

The Twin Mountain Construction Ltd. pit site has been in operation for many years, and at its current levels of activity for the past several years. Wildlife currently using adjacent habitats must be, to some degree, acclimated to the noise levels in the area and species or individuals that are very noise intolerant would have already been displaced. If, as anticipated, no substantial increase in activity occurs at the pit, impacts due to noise will not increase above current levels.

We should, however, place the level of noise generated by the operation in perspective. There is a maximum of four pieces of machinery that are working in the pit at any one time (excluding truck traffic): two front-end loaders, a backhoe and a screener. Because the removal, screening, loading and stockpiling occur mainly within the pit, there is some degree of shielding of adjacent areas from the noise generated. The property is located adjacent to Highway 1 and the Bond Road and is surrounded by working farms where heavy machinery is in use. So, while the noise generated by the aggregate extraction operations may compete with the roads as one of the more continuous noise sources in the immediate area, it is by no means the only source.

As the pit expands into new areas, wildlife habitat will be removed. It is my understanding that restoration efforts will begin in exhausted areas of the pit prior to any further expansion. I also understand that restoration efforts will involve transplanting specimens of tree and shrub species that are collected on site. If successful, this method should, over an extended period of time, replace habitats being removed, by similar habitats.

The property includes a small stream and two ponds. These areas and the wildlife they support could potentially be impacted by the fouling of the stream through runoff from pit-associated operations and the inadvertent diversion of the stream or draining of the ponds through excavation activities.

Adherence to the setback and other guidelines recommended by the Province of Nova Scotia should help prevent impacts on the physical integrity of the stream and ponds. (The current northeast boundary of the pit approaches the setback recommendation (30 m) and there has been no obvious impact on the integrity of the stream.) The current placement of stored aggregate within the pit site poses no threat of runoff entering the stream.

Perhaps even more important than the runoff from the aggregate is the potential for runoff from "industrial topsoil" entering the watercourse. The topsoils contain organic materials and nutrients that could cause eutrophication and the reduction of oxygen levels in the stream which could affect survival of amphibian larvae and possibly even hibernating reptiles and amphibians.

Amphibians and Reptiles

The only amphibian species at risk in Nova Scotia is the Four-toed Salamander (yellow, S3S4). The small stream and ponds on the property do not have the sphagnum borders required by this species for breeding. We therefore think it highly unlikely that this species occurs on this property.

Two of the three reptile species at risk, Blanding's Turtle (red, S1) and the Northern Ribbon Snake (yellow, S2S3), are relic disjunct populations confined to central southwestern Nova

Scotia. The third species, the Wood Turtle (yellow, S3), is widely dispersed with most records coming from the northeastern mainland and southwestern Cape Breton.

The ACCDC database identifies the Wood Turtle as a species at risk that might possibly occur in this area. This is based on a single dead specimen found in the area in 1950. In the late summer of 2002, a live Wood Turtle was found in Coldbrook near the Cornwallis River (Tom Herman, *pers. comm.*.). Although it is not absolutely certain that this turtle had not been released from captivity, Dr. Herman's opinion is that it was a wild specimen.

The very small stream and ponds on the property could conceivably provide marginal habitat for Wood Turtles, particularly young turtles. Visits to the site when Wood Turtles might be expected to be basking (early May) and during nesting (late June) were unsuccessful in finding any Wood Turtles although Eastern Painted Turtles were found. I believe it unlikely that Wood Turtles occur on this property.

Breeding Birds

The only bird species at risk recorded during our site visits was a Bobolink (yellow, S3B); this bird was not on the Twin Mountain property but in an adjacent field to the north. Bobolinks nest in open, lushly vegetated areas: meadows, hayfields and pastures. The small hayfield at the north end of the property is small enough (~1ha) to be, at best, marginal habitat for Bobolinks. The grain crops currently grown in the large field bounded on the west side by the Bond Road do not provide suitable Bobolink habitat. If hay crops were part of the crop rotation regime for this field, Bobolinks could be attracted to the site during this phase of the rotation.

In the past Bobolinks have benefited from the clearing of the forest and the conversion of these lands into hayfields and pastures thereby providing greatly expanded potential nesting areas. The dramatic decline in Bobolink populations in recent years appears to be associated with the reduction in land area used for hay crops and pasture and the earlier harvesting of hay crops. In this area, Bobolink young fledge about the first week of July. In fields where Bobolinks nest, harvesting of hay crops before this time, now a common practice, almost invariably leads to nest failure. Potential impacts on any Bobolinks that might nest on this property would be influenced by agricultural practices and not by the aggregate extraction operation *per se* since they are not particularly sensitive to noise. Delaying the harvest of hay crops until mid-July can greatly reduce the impacts upon these birds.

Although our site visits and nocturnal survey did not reveal the presence of any owl species, there is a remote possibility that Long-eared Owls (yellow, S1S2B) could nest on the site. This secretive and generally quiet species, which confines its hunting until after dark and roosts in dense conifers in the day, is very difficult to detect. Long-eared Owls nest in "thick evergreen woods usually, if not always, near the edge of a cleared space" (Tufts, 1986). Many such potential nesting sites exist in the patchwork of forest and agricultural lands in this part of the Annapolis Valley. Nest sites adjacent to open areas supporting high densities of their main prey, mice and voles, would provide optimal foraging opportunities. Pasture, uncut hayfields and neglected orchards can provide excellent habitat for mice. The grain crops grown on this property do not support large mouse populations. An examination of Meadow Vole runs in the orchard and small hayfield on this property suggests very low population levels. The pastureland along Rochford Brook, to the east of the Twin Mountain property, was so heavily grazed that little potential mouse habitat was available. The hayfields to the north, belonging to adjacent landowners, were not examined for Meadow Vole populations. Agricultural management practices on this and adjacent properties can influence mice populations and hence the attractiveness of the woodlands of this property as a potential nesting site for Long-eared Owls.

Mr. Forsythe, who has worked with nesting owls for almost 30 years, feels that, given current agricultural practices in this area, this site offers only marginal Long-eared Owl habitat.

If Long-eared Owls were to nest in the woodlands adjacent to the pit, the increased activity of the pit during spring and early summer could increase the disturbance of the birds to the point that fledging success would be affected or could lead to the abandonment of the nest site.

It appears that Long-eared Owls are tolerant of at least moderate levels of human activity. Bernard Forsythe has observed several instances where Long-eared Owls nested very close to dwellings, completely unbeknownst to the residents, and successfully reared broods.

A search of the ACCDC database indicated that one breeding bird species at risk (Baltimore Oriole: green, S3B) has been recorded within 5 km of the site and five additional species have been recorded within 10 km of the site. These five species are: Northern Goshawk (yellow, S3B); Eastern bluebird (yellow, S2S3B); Eastern Phoebe (green, S2S3B); Scarlet Tanager (green, S3B); and Rusty Blackbird (green S3S4B). In some recent studies I have conducted within 10 km of this site (Alliston, 2003), I have found two additional species at risk apparently nesting: the Vesper Sparrow (yellow, S2S3B) and Horned Lark (green, S2B). With minor exceptions, appropriate nesting habitat is not available for these uncommon species either on or immediately adjacent to the Twin Mountain property.

Nesting Northern Goshawks can have very large home ranges, sometimes exceeding 2000 ha. Although these home ranges can include a variety of habitats the nest site is generally confined to very specific habitat. Their preferred nesting habitat is in sizeable tracts of tall mature trees with a somewhat open understory. Nesting Northern Goshawks are particularly sensitive to human disturbance in the vicinity of their nest sites (Mark Elderkin, *pers. comm.*.). The lack of appropriate nesting habitat and the general level of human activity on and adjacent to this property make it unlikely that Northern Goshawks would nest on or adjacent to the Twin Mountain property.

Eastern Phoebes generally nest near water, often on man-made structures: culverts, bridges, overhangs on buildings and rock walls, as well as naturally occurring rock faces. With the exception of a single, relatively small culvert, these habitats do not occur on this property.

Scarlet Tanagers prefer mature deciduous forests while Baltimore Orioles prefer open deciduous forests and show a marked preference for nesting in American Elm trees. Rusty Blackbirds show a preference for nesting in bogs, fens, swamps and swales. None of these habitats is present either on or immediately adjacent to the Twin Mountain property.

Open areas with low vegetation and scattered trees containing cavities for nesting are required habitat for Eastern Bluebirds. The orchard on this property could provide potential nesting habitat for Eastern Bluebirds. The sparsely vegetated old field area at the southern extremity of the grain field might provide some potential nesting habitat for Vesper sparrows. Both these habitat types are widely available within the Annapolis Valley region.

This property does not provide the very large open areas that appear to be required by nesting Horned Larks.

Mammals

Although only one bat, believed to be a Little Brown Bat (yellow, S4), was observed during our nocturnal survey, it is possible that several bat species considered at risk in Nova Scotia could frequent the property during their nocturnal foraging.

There is, however, little information available concerning the distribution, numbers and habitat use of bats in Nova Scotia. Recent work by Broders *et al.* (*in press*) confirms that, in southwestern Nova Scotia, the two *Myotis* species (Little Brown Bat and Northern Long-eared Bat(yellow, S2)) are the most common species and the Eastern Pipistrelle (yellow, S1?) may be locally common. Broders *et al.* suggest that the small numbers of observations recorded for the other three species (Hoary (yellow, S2?), Red (yellow, S2?) and Silver-haired (yellow, S1?) Bats) in Nova Scotia might represent extralimital occurrences.

Three bat species (Silver-haired, Red and Hoary) that are solitary during June and July, when the young are reared, roost singly in trees during daylight hours. Noise from the pit operations could cause these bats to change their day roost sites. In the unlikely event that these bat species were to occur here, alternate roost sites would probably be found easily and the potential for impact on these species is probably minimal.

The females of the two *Myotis* species often form "maternity" colonies where the young are reared. Disturbance of these colonies could impact the survival of the young. Although maternity colonies of both species can be in tree cavities, female Little Brown Bats show a decided preference for buildings (Peterson, 1974; Schowalter *et al.*, 1979.). In southern New Brunswick, Broders and Forbes (*in press*) found that female Northern Long-eared Bats that had maternity colonies in tree cavities showed a very marked preference for shade tolerant hardwood trees in mature hardwood dominated stands. Conversely, the males of both the Northern Long-eared Bat and the Little Brown Bat showed a marked preference for roosting sites in softwood trees in softwood stands or softwood dominated mixed stands. Since there are no mature shade-tolerant hardwood stands on or adjacent to this site, it would appear that the pit site and adjacent woodlands would provide much better habitat for roosting males than for maternity colonies of females. Alternate roost sites for singly roosting male Northern Long-eared and Little Brown Bats would probably be easily found.

Female Eastern Pipistrelles are also known to form maternity colonies; in other parts of North America colonies have been recorded in buildings, tree foliage and rock crevices. Rock crevices are not present on or immediately adjacent to this property. Current thinking is that maternity colonies are "often (hidden) inside a clump of dead leaves in an otherwise healthy (deciduous) tree" (Kurta, 2001.) although this is based on rather limited data. Alternate tree roost sites would probably be found easily.

There are no known caves on the property that could provide roosts or hibernacula for any of the resident bat species.

While it was previously thought that the Southern Flying Squirrel (yellow, S1) was restricted to southwestern Nova Scotia, in the mid-1980's this species was found in Kings County. Recent studies have shown this species to be more wide spread with scattered records from various locations in the Annapolis Valley and elsewhere (Amanda Lavers, unpublished). Southern Flying Squirrels have been recorded as close to the pit site as Kentville (~ 17 km).

This secretive nocturnal species is generally associated with older mixed forests where snags and cavities in old living trees provide it with shelter, and fungi from the forest floor and mast crops from Red Oak and American Beech provide a food supply. Current thinking is that the two essential elements of habitat required to support a Southern Flying Squirrel population in Nova Scotia are the presence of tree cavities and acorn-producing Red Oaks (Tom Herman, *pers. comm.*). There are Red Oaks of seed producing size in the small mixed woodland at the southern boundary of the property. However, this small woodland is by no means mature and it seems unlikely that it would support Southern Flying Squirrels.

Summary

1) The continuation of aggregate extraction and storage and "industrial topsoil" operations should not have any detrimental impacts on any mammal species considered at risk in Nova Scotia.
2) Although the site might provide marginal nesting habitat for Long-eared Owls, it is unlikely that they would occur here. Bobolinks were recorded on adjacent properties but not on this property. Operations at the aggregate extraction site should have no impact on Bobolinks nesting on adjacent properties.
3) The one amphibian species at risk in Nova Scotia, the Four-toed Salamander, is not believed to occur on this property.
4) Of the three reptile species at risk in Nova Scotia, marginal habitat for one species, the Wood Turtle, occurs on this property; however it is unlikely that they occur here.

IMPACT MITIGATION

It is unlikely that the Twin Mountain Construction Ltd. operations on this property pose a threat to individuals of any amphibian, reptile, breeding bird, or mammal species considered at risk in Nova Scotia. The site does, however, contain marginal habitat for two species at risk, the Long-eared Owl and the Wood Turtle. In the unlikely event that either species should be found here in the future, some mitigative measures might be necessary.

If Long-eared Owls were found nesting in the vicinity of the active pit site, it might be necessary to curtail or relocate some activities (for example, excavating and screening) to minimize disturbance of these birds during their early nesting period (April and May) when they are most sensitive to disturbance.

Adherence to recommended setbacks and containment of runoff from stored aggregate and "industrial topsoil" should address most concerns surrounding the integrity of the aquatic habitats required by the Wood Turtle. It might also be necessary to monitor or temporarily close the road that passes over the stream should Wood Turtles be found to use the road for basking (late April and early May). Adherence to setback recommendations (30 m) might also assure the preservation of adequate nesting habitat for Wood Turtles.

To meet its obligations under the Migratory Birds Convention Act, Twin Mountain Construction should consider:

1) not removing material from embankments used for nesting by such species as Belted Kingfisher and Bank Swallows during the period when nests are active (May through July);
2) stripping areas of their vegetation cover, and the wildlife and bird nesting habitat it supports, only during the period when birds are not nesting (August through March);
3) avoiding, where possible, the nests of ground-nesting species that are attracted to extraction sites (e.g. Killdeer, Spotted Sandpiper, Common Nighthawk);
4) assuring that all toxic materials that are used in the extraction operations (gasoline, diesel fuel, engine oil, hydraulic fluid, antifreeze, etc.) are not accessible to birds and other wildlife. Any accidental spills of toxic materials should be dealt with expeditiously using protocols that are described elsewhere in this submission.

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Herman, Thomas B., Professor, Biology Department, and Co-director, Centre for Wildlife Conservation Biology, Acadia University, Wolfville, Nova Scotia.

Web Sites

Atlantic Canada Conservation Data Centre – http://www.accdc.com

COSEWIC – http://www.cosewic.gc.ca

Environment Canada - http://www.speciesatrisk.gc.ca/

Environment Canada - http://www.on.ec.gc.ca/wildlife/wildspace/

Nature Serve – http://www.natureserve.org

Nova Scotia Department of Natural Resources - http://www.gov.ns.ca/natr/wildlife/

Nova Scotia Museum of Natural History - http://museum.gov.ns.ca/mnh/

University of Michigan, Museum of Zoology - http://www.ummz.lsa.umich.edu/

U.S. Forestry Service - http://www.fs.fed.us/database/feis/

Herptofaunal Atlas - database - http://landscape.acadiau.ca/herpatlas/

APPENDIX 1

COMMON AND SCIENTIFIC NAMES OF PLANTS AND ANIMALS CITED IN THIS ANALYSIS

Trees

Common Name	Scientific Name
American Beech	*Fagus grandifolia*
Balsam Fir	*Abies balsamea*
Eastern Hemlock	*Tsuga canadensis*
Poplar species	*Populus spp.*
Red Maple	*Acer rubrum*
Red Oak	*Quercus rubra*
Red Spruce	*Picea rubens*
Sugar Maple	*Acer saccharum*
White Birch	*Betula papyifera*
White Pine	*Pinus strobus*
White Spruce	*Picea glauca*

Amphibians

Common Name	Scientific Name
Eastern American Toad	*Bufo americanus americanus*
Four-toed Salamander	*Hemidactylium scutatum*
Green Frog	*Rana clamitans melanota*
Northern Spring Peeper	*Hyla crucifer crucifer*
Pickerel Frog	*Rana palustris*

Reptiles

Common Name	Scientific Name
Blanding's Turtle	*Emydoidea blandingi*
Eastern Painted Turtle	*Chrysemys picta picta*
Northern Ribbon Snake	*Thamnophis sauritus septentrionalis*
Wood Turtle	*Clemmys insculpta*

Birds

Common Name	Scientific Name
Alder Flycatcher	*Empidonax alnorum*
American Bittern	*Botaurus lentiginosus*
American Black Duck	*Anas rubripes*
American Coot	*Fulica americana*
American Crow	*Corvus brachyrhynchos*
American Goldfinch	*Carduelis tristis*
American Redstart	*Setophaga ruticilla*
American Robin	*Turdus migratorius*
American Woodcock	*Scolopax minor*
Arctic Tern	*Sterna paradisaea*
Atlantic Puffin	*Fratercula arctica*
Baltimore Oriole	*Icterus galbula*
Bank Swallow	*Riparia riparia*
Barn Swallow	*Hirundo rustica*
Barred Owl	*Strix varia*
Belted Kingfisher	*Ceryle alcyon*
Bicknell's Thrush	*Catharus bicknelli*
Black Tern	*Chlidonias niger*
Black-and-white Warbler	*Mniotilta varia*
Black-billed Cuckoo	*Coccyzus erythropthalmus*
Black-capped Chickadee	*Poecile atricapilla*
Black-crowned Night Heron	*Nycticorax nycticorax*
Black-legged Kittiwake	*Rissa tridactyla*
Black-throated Green Warbler	*Dendroica virens*
Blue Jay	*Cyanocitta cristata*
Blue-headed Vireo	*Vireo solitarius*
Bobolink	*Dolichonyx oryzivorus*
Boreal Chickadee	*Poecile hudsonica*
Boreal Owl	*Aegolius funereus*
Brown Thrasher	*Toxostoma rufum*
Brown-headed Cowbird	*Molothrus ater*
Chestnut-sided Warbler	*Dendroica pennsylvanica*
Common Goldeneye	*Bucephala islandica*
Common Grackle	*Quiscalus quiscula*
Common Loon	*Gavia immer*
Common Moorhen	*Gallinula chloropus*
Common Nighthawk	*Chordeiles minor*
Common Raven	*Corvus corax*
Common Snipe	*Gallinago gallinago*

Birds (continued)

Common Name	Scientific Name
Common Tern	*Sterna hirundo*
Common Yellowthroat	*Geothlypis trichas*
Cooper's Hawk	*Accipiter cooperii*
Dark-eyed Junco	*Junco hyemalis*
Downy Woodpecker	*Picoides pubescens*
Eastern Bluebird	*Sialia sialis*
Eastern Meadowlark	*Sturnella magna*
Eastern Phoebe	*Sayornis phoebe*
Eastern Wood-Pewee	*Contopus virens*
European Starling	*Sturnus vulgaris*
Evening Grosbeak	*Coccothraustes vespertimus*
Gadwall	*Anas strepera*
Gray Catbird	*Dumetella carolinensis*
Great Blue Heron	*Ardea herodias*
Great Crested Flycatcher	*Myiarchus crinitus*
Great Horned Owl	*Bubo virgianus*
Greater Yellowlegs	*Tringa melanoleuca*
Hermit Thrush	*Catharus guttatus*
Horned Lark	*Eremophila alpestris*
Indigo Bunting	*Passerina cyanea*
"Ipswich" Savannah Sparrow	*Passerculus sandwichensis princeps*
Killdeer	*Charadrius vociferous*
Least Bittern	*Ixobrychus exilis*
Least Sandpiper	*Calidris minutilla*
Loggerhead Shrike	*Lanius ludovicianus*
Long-eared Owl	*Asio otus*
Magnolia Warbler	*Dendroica magnolia*
Marsh Wren	*Cistothorus palustris*
Merlin	*Falco columbarius*
Mourning Dove	*Zenaida macroura*
Nashville Warbler	*Vermivora ruficapilla*
Nelson's Sharp-tailed Sparrow	*Ammodramus nelsoni*
Northern Cardinal	*Cardinalis cardinalis*
Northern Flicker	*Colaptes auratus*
Northern Goshawk	*Accipiter gentilis*
Northern Mockingbird	*Mimus polyglottos*
Northern Pintail	*Anas acuta*
Northern Saw-whet Owl	*Aegolius acadicus*
Northern Shoveler	*Anas clypeata*

Birds (continued)

Common Name	**Scientific Name**
Ovenbird	*Seiurus aurocapillus*
Peregrine Falcon	*Falco peregrinus*
Philadelphia Vireo	*Vireo philadelphicus*
Pileated Woodpecker	*Dryocopus pileatus*
Piping Plover	*Charadrius melodus*
Purple Martin	*Progne subis*
Razorbill	*Alca torda*
Red-breasted Merganser	*Mergus serrator*
Red-breasted Nuthatch	*Sitta canadensis*
Red-eyed Vireo	*Vireo olivaceus*
Red-tailed Hawk	*Buteo jamaicensis*
Ring-necked Pheasant	*Phasianus colchicus*
Roseate Tern	*Sterna dougallii*
Rusty Blackbird	*Euphagus carolinus*
Savannah Sparrow	*Passerculuc sandwichensis*
Scarlet Tanager	*Piranga olivacea*
Semipalmated Plover	*Charadrius semipalmatus*
Short-eared Owl	*Asio flammeus*
Solitary Sandpiper	*Tringa solitaria*
Song Sparrow	*Melospiza melodia*
Spotted Sandpiper	*Actitis macularia*
Tree Swallow	*Tachycineta bicolor*
Upland Sandpiper	*Bartramia longicauda*
Veery	*Catharus fuscescens*
Vesper Sparrow	*Pooecetes gramineus*
Virginia Rail	*Rallus limicola*
Warbling Vireo	*Vireo gilvus*

Whip-poor-will	*Caprimulgus vociferus*
White-throated Sparrow	*Zonotrichia albicollis*
Willow Flycatcher	*Empidonax trailii*
Wilson's Phalarope	*Phalaropus tricolor*
Wood Thrush	*Hylocichla mustelina*
Yellow Warbler	*Dendroica petechia*
Yellow-rumped Warbler	*Dendroica coronata*

Mammals

Common Name	**Scientific Name**
American Marten	*Martes americana*
American Porcupine	*Erethizon dorsatum*
American Red Squirrel	*Tamiasciurus hudsonicus*
Coyote	*Canis latrans*
Eastern Cougar	*Felis concolor*
Eastern Chipmunk	*Tamias striatus*
Eastern Pipistrelle	*Pipistrellus subflavus*
Fisher	*Martes pennanti*
Gaspé Shrew	*Sorex gaspensis*
Hoary Bat	*Lasiurus cinereus*
Little Brown Bat	*Myotis lucifugus*
Long-tailed Shrew	*Sorex dispar*
Lynx	*Lynx canadensis*
Meadow Vole	*Microtus pennsylvanicus*
Moose	*Alces alces*
Northern Long-eared Bat	*Myotis septentrionalis*
Raccoon	*Procyon lotor*
Red Bat	*Lasiurus borealis*
Red Fox	*Vulpes vulpes*

Rock Vole	*Microtus chrotorrhinus*
Silver-haired Bat	*Lasionycteris noctivagans*
Striped Skunk	*Mephitis mephitis*
Southern Bog Lemming	*Synaptomys cooperi*
Southern Flying Squirrel	*Glaucomys volans*
White-tailed Deer	*Odocoileus virgianus*

Appendix X: Fish & Fish Habitat Survey

Fish Habitat Survey of Rochford Brook (Cornwallis Watershed)

Prepared for: Twin Mountain Construction Ltd.

Prepared by: Derick Fritz, Aquaculture Technologist, Fish Biologist, Ocean Valley Aquatics

Survey Dates: October 15 & 30, 2003

Research team: Derick Fritz & Derek Andrews

GPS Setting: UTM, NAD83, Meters

Limitations of Data

The purpose of the survey is to inventory the riparian and aquatic environment of the Rockford Brook and its tributaries. The data in this report is meant to determine the distribution and quality of fish habitat in this area. Given the dynamic nature of riparian environments, the data reported herein represents the condition of the stream at the time of the survey.

Executive Summary

A survey of fish habitat in waters and streams draining on or near the site (Bond Road) of the sand pit being proposed by Twin Mountain Construction Ltd. was requested by Hendricus Van Wilgenburg, acting on behalf of Twin Mountain Construction (the proponent).

For the purpose of this report, a fish habitat survey and a review of relevant fish population and water quality reports were conducted, and communications with John MacMillan - Fisheries Biologist, Inland Fisheries Division, Pictou, N.S. Results indicate the presence of good fish habitat within Rochford Brook located near the Twin Mountain Construction site.

Introduction

As part of the environmental assessment of the proposed pit expansion site, a fish habitat survey within the Rochford Brook system was conducted on October 15 and 30, 2003. The purpose of the survey was to determine if fish species and suitable habitat were found within Rochford Brook. The aim of the survey was to evaluate the quality of fish habitat (i.e., good or poor), and find evidence of fish populations and fish habitat in Rochford Brook located on the property where the proposed pit expansion is to take place.

Methodology

The survey consisted of a walk-through of the entire area on October 15, 2003 followed by a day of water sampling and a fish habitat survey. Dissolved oxygen (DO) and temperature were recorded using a YSI Model 95 handheld DO and Temperature System, and pH was recorded with a standard pH meter.

The fish habitat potential of any inlets or outlets was determined through visual observation and recording of physical data, using standard methodologies outlined in the Fish/Habitat Inventory and Information Program (1987 Adopt A Steam: Field Manual). Onsite anglers were interviewed opportunistically.

Photo documentation of the investigation was also completed (see Figures 2, 3 and 4 for photo locations).

October 15, 2003

The walk-through was made by Derick Fritz, Aq.t / Fish Biol (Ocean Valley Aquatics), beginning at the stream crossing at the entrance to the proposed pit expansion site. The entire watercourse was "walked" from the proposed pit expansion site to the mouth of Rochford Brook. Visual observations were made as to the general quality of fish habitat, and any fish sightings were documented.

October 30, 2003

A water quality and fish habitat survey was conducted by Derick Fritz and Derek Andrews, Field Technician. Water was sampled using an YSI Model 95 handheld DO and Temperature System, and pH was recorded with a standard pH meter. Sampling was carried out at 6 sites on the Rochford Brook (Figure 1). Quality of fish habitat was documented and canopy cover, riparian growth, substrate and flow were recorded.

Results

This study has shown the presence of good fish habitat within Rochford Brook located near the proposed pit expansion site. Table1 summarizes the observations made at each sampling site, including visual observations of fish found at each location. Through visual observations a number of fish where seen at several of the sites.

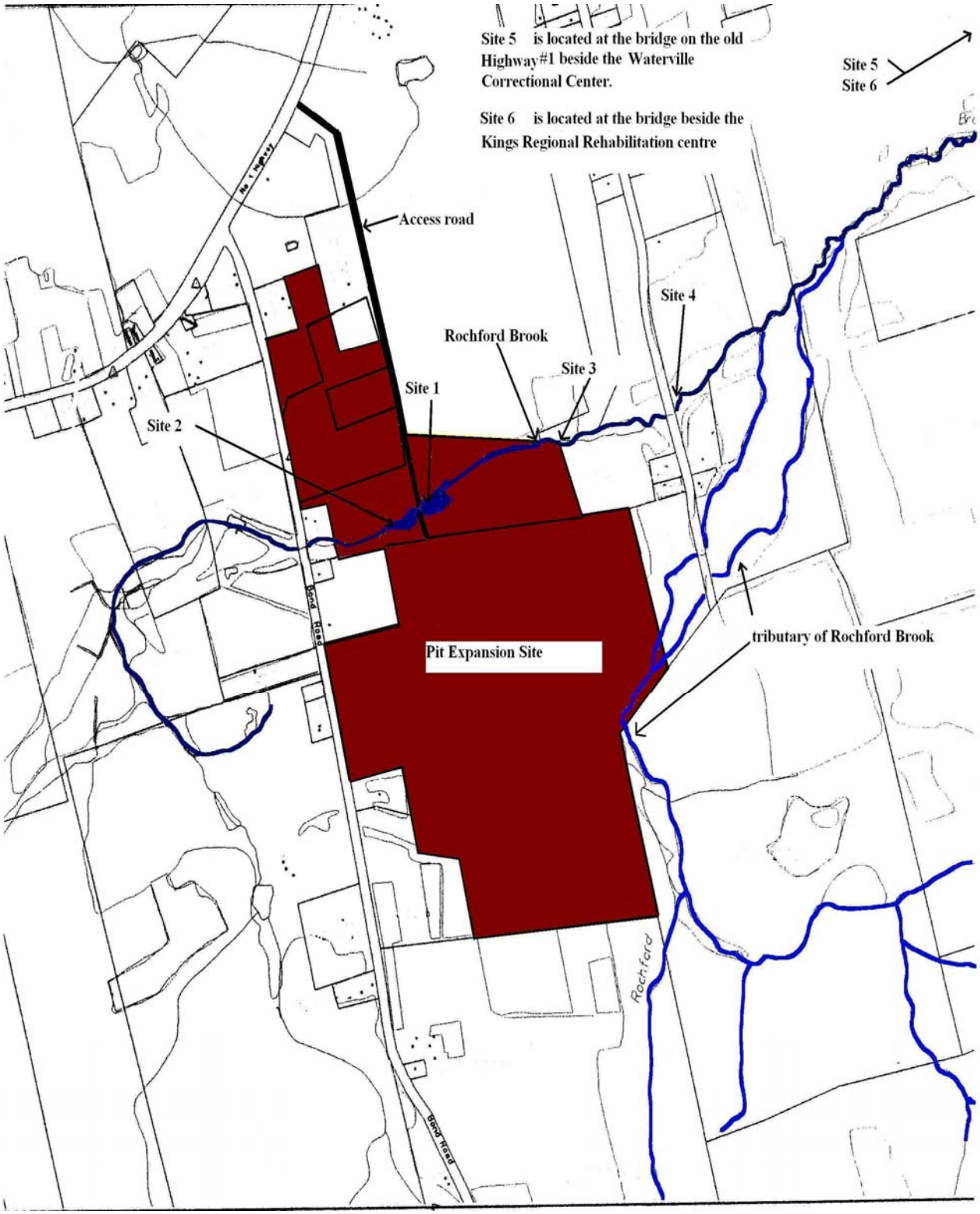

Figure #1 Map of Twin Mountain Construction pit expansion site and testing sites on Rochford Brook**. (not to scale)**

Table 1

Site#	UTM coordinates	Canopy Cover (%)	Riparian Edge (%)	Stream Run	Stream width (m)/depth (m)
1	0367704 / 4988346	0	95	Pond area	25 / 0.5-1.5
2	0367661 / 4988300	0	100	Pond area	20 / 0.5-2.5
3	0367800 / 4988391	10	95	Riffles	2 / 0.5-0.9
4	0368251 / 4988491	60	100	Riffle	2 - 4 / 0.5-0.9
5	0368678 / 4990097	20	90	Straight run	3-4.5 / 0.5-1.5
6	0368242 / 4990532	70	70	Pool	3-4.5 / 0.5-2

Site#	DO (mgl/%)	pH	Conductivity (µ)	Flow (m/s)	Water Temp (ºC)	Visual Observations of Aquatic Fauna
1	7.1 / 60	8.6	70	0.3	7.6	Minnows present
2	7.3 / 62	7.5	80	N/A	7.5	
3	8.1 / 70	7.0	80	0.6	8.0	Minnows present
4	8.4 / 73	7.8	120	0.8	7.8	Minnows & Salmonids(trout) present
5	9.4 / 78	8.0	130	1.0	7.5	Minnows & Salmonids(trout) present
6	9.6 / 82	7.5	100	0.8	8.0	Minnows & Salmonids(trout) present

Site#	1st Dominant Substrate	2nd Dominant Substrate	Visual Habitat Observations
1	Gravel	Cobble	Good fish along edges of pond
2	Pebble	Sand	Excessive amounts of macrophyte growth
3	Gravel	Cobble	Adequate for spawning
4	Gravel	Cobble	Sites 4, 5 & 6 all have very good riparian overgrowth that is good for fish cover and other aquatic species to thrive.
5	Sand	Gravel	
6	Gravel	Pebble	

Table 2: Substrate Sizes

Silt	<0.1cm
Sand	0.1-0.6cm
Pebble	0.6-2.0cm
Gravel	2.0-6.4cm
Cobble	6.4-25cm
Boulder	>25cm

Discussion

Located in Kings County N.S. Rochford Brook is one of the main tributaries of the Cornwallis River, with its head waters originating on the South Mountain of the Annapolis Valley located just south of the proposed pit expansion site. Rochford Brook Flows in a Northerly direction down the mountain, meandering across the valley floor finally emptying in to the Cornwallis River near the Black Rock road bridge in Waterville.

The Cornwallis River is the main channel of the Cornwallis watershed which is also part of the Inner Bay of Fundy waterways (IBOFWW) and one of the main watersheds within the Minas Basin Watershed. Most of the Inner Bay of Fundy waterways are classed as Atlantic Salmon (*Salmo salar)* run rivers. Given that the Inner Bay of Fundy Atlantic Salmon are an endangered species, (www.cosewic.gc.ca), the IBOFWW should be considered important habitat and care should be taken to preserve the biodiversity in and around them.

Conclusion

The most important conclusion from this study is that fish have been confirmed to be present within the Rochford Brook. Although we have not conducted fish seining or electro seining which would help to identify fish species, we visually observed several fish in the area of the survey.

Even though identification of the fish could not be determined by visual observations, I am confident from my experience working on the Cornwallis watershed and from numerous conversations with the Provincial Inland Fish Biologist, John McMillan, of the species that would be found within Rochford Brook had a fish seining survey been conducted ***(John McMillan, Provencal Fish Biologist, 2003, Per Comm.)***.

Some of the fish that are found within the tributaries of the Cornwallis watershed and most likely in the Rochford Brook system are: Brook Trout (*Salvelinus foninalis*), Killifish (*Fundulus spp.*), American Eel (*Anguilla rostrata*), White Sucker fish (*Catostomus commersoni*), Creek Chubs, Stickleback, and possibly Atlantic Salmon (*Salmo salar)*. ***(Derick fritz, Acadia University, Electrofishing Report, 2003, 16 p.) and (John McMillan, FCRS, Electrofishing Data, 2001-2003, 07 p.)***

The apparent condition of fish habitat at the Rochford Brook sites is very good at the present time. Although the proposed pit expansion site is located close to the headwaters or recharging areas of Rochford Brook, it seems to have had minimal effects on the fish and aquatic habitat of Rochford Brook. However until a fish and/or invertebrate survey is carried out within the brook,

a definite number of species, their diversity and the health of the ecology within Rochford Brook will remain unknown.

Figure 2 Picture of Rochford Brook on the east side of the Twin Mountain pit expansion site.

Figure 3 Picture of Rochford Brook west of entrance in the pit area.

Figure 4 Picture of Rochford Brook east of entrance in the pit area showing through flow of Rochford Brook.

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Appendix XI: Geology, Geomorphology, Surface Water

Environmental Assessment of

Bond Road Sand Pit Site

Geology, Geomorphology, Surface Water

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Summary

Cambridge Aggregate Site

Geology, Geomorphology, and Surface water

The Bond Road Sand Pit site lies within the Annapolis-Cornwallis Valley (Triassic-Jurassic) physiographic region (Roland 1982) and is characterised by gently rolling topography and thick overburden that is well to excessively drained. Surficial sediment cover at the site is characterized by a thin soil (< 50 cm) that overlies thick deposits of ice contact gravel, coarse outwash and lacustrine sand which in turn overlie Wisconsin (Lawrencetown) Till (Stea et al., 1992). At depth similar stratigraphy may be repeated. The saturate thickness of unconsolidated sediment may exceed 12 m at the site (Trescott, 1968) Till does not outcrop at the site but exposures at nearby locations indicate that it is compact, clay- rich, and has low hydraulic conductivity. The site is not susceptible to either mass movement or excessive erosion. Outwash gravel has limited economic value due to its coarseness, variable thickness, and textural immaturity. The underlying sand appears to be adequate for specialized use (silt/clay < 7%) however grading appears to be variable.

Limited sampling indicated that surface water quality at the site was moderate to good. Samples obtained in the north branch of Rochford Creek which bisects the property exhibited neutral pH, low conductivity, and low nitrate levels. Surface infiltration is rapid to excessive and storage potential is variable being moderate in the lacustrine sand and silt deposits and low in the overlying outwash sand and gravel. Rochford Creek is perennial and is fed primary by through flow generated from local perched aquifers located within the regionally extensive sand and gravel deposits. Some input from springs may occur at the headwaters of the creek (south of the property). The North Branch of Rochford Creek has been altered to accommodate an access road.

Future extraction will result in the loss of a very small percentage of potential unsaturated zone storage within the Rochford Creek watershed. As a result, throughflow transfer of precipitation may be locally accelerated. The current depth of the excavation should not be exceeded as a positive gradient to both branches of Rochford Creek should be maintained. There

appears to be little potential that extraction will result in the exposure of bedrock at the site. Modification of Rochford Creek near the access road crossing may result in locally elevated water temperature and reduced water velocity.

Geological Assessment

1.1 Geology

Two rock types have the potential to underlie the Bond Road site. The Wolfville Formation sandstone is a braided river deposit that consists of trough cross-bedded conglomerates and very coarse grained pebbly sandstones. This sandstone commonly exhibits high primary porosity (up to 20%) though where calcite cement is common porosity can be reduced. The Halifax Formation is a fine grained slate that may weather to a rusty brown because of the presence of iron pyrite (FeS_2) and occasionally pyrrhotite and arsenopyrite. Wolfville Formation sandstone most likely underlies most of the Bond Road Sand Pit though regional mapping indicates that Halifax Formation slate could be present at the southern boundary of the property. The contact between these two units is poorly constrained due to lack of surface outcrop and poor subsurface control as both units are buried beneath relatively thick glacial outwash and till deposits and few well logs with detailed bedrock descriptions exist (Donohoe and Grantham, 1989). Fluvial incision is prevalent east and west of the southern extent of the property (Figure 1b); at these sites bedrock may be exposed along the creek bed. Fowler (1985) has noted in the Industrial Minerals of Nova Scotia map that the site is a prominent sand and gravel location; no other mineral deposits have been identified in the vicinity. No outcrop was identified on the property and the overburden appears to be uniformly thick.

1.2 Geomorphology

The Bond Road Sand Pit (and nearby environs; see Fig. 1) is located on the southern side of the east-west trending Annapolis Valley. The site proper is characterized by gently-rolling topography with some stream incision to the south and east. Gradient is moderate to low to the south and very low to the north. Surface drainage is primarily throughflow with very little overland flow due to the well drained nature of the sediment and poor soil development. Discharge within both the north and main branch of Rochford Creek appears to be fairly

uniform, especially where these creeks are in close proximity to the property. No natural lakes or ponds are evident on the property. Pools exist on the north branch of Rochford Creek on both sides of the access road overpass (see Fig. 1a, 7, 8 however these were constructed, at least in part, during the construction or modification of the access road.

Glacial Geology:

Three distinct glacial deposit types are found on the Bond Road Sand Pit (Graves and Finck, 1990). In the southern ¼ of the property cryptic ice contact (kame) terraces appear to be present. Surface topography is uneven, drainage is well-developed, and in limited exposures the sediment is coarse, moderately sorted immature gravel with occasional diamicton. The coarse sediment is generally sub-rounded to angular and its coarse fraction is composed primarily of locally derived rock (Trenhaile, 1998).

Ice contact sediment is also present on the northern 1/3 (north of the north branch of Rochford Creek; see: Figure 1b) of the property but has a streamlined surface expression. The sediment appears to either form or drape over an east-west trending streamlined feature that may be a relict drumlin. A small excavation into the side of this feature has exposed medium to coarse gravel and diamciton (Fig. 5, 6). The medium to fine sand observed in excavations in the central portion of the property was not evident.

Sedimentation in the central portion of the site is complex. Coarse grained, moderately to well sorted gravel (usually red- brown in colour; Figs.2,3, 4) of variable thickness (1- 3m) overlies moderately to well sorted medium to fine sand (tan to grey in colour, 3 – 5 m thickness; Figs. 2, 3, 4). The contact between these two units is sharp and erosive. The gravels are cross-bedded and contain both South Mountain and Triassic cobbles which are sub-rounded to sub-angular indicating limited transport. Open work structure (indicating substantial current and winnowing) is common. Occasional armoured till balls were also observed. This sediment suite is consistent with glaciofluvial deposition into standing water with ice in close proximity (Benn and Evans, 1995). The underlying sand unit is highly deformed (primarily plastic deformation), cross-bedded and cross-laminated, and horizontal laminations are also common. Occasional silt-clay laminae were noted however they account for less than 5% of the sediment. This sand unit was deposited in standing water by a lower velocity but consistent current and represents proximal glaciolacustrine deposition. The complex folding is an indication of post-depositional

loading, most likely by the overlying gravel and is also an indication that sedimentation took place rapidly. Taken together, the sand and overlying gravel are part of a prograding outwash fan that built into a standing body of water. The outwash deposits (Fig. 1b) show very little relief (in contrast to kame sediments) as their top surface mimics the horizontal water surface into which deposition most likely occurred. The observed thickening of the gravel to the south is consistent with a southern source for the fan. This sediment may be analogous to outwash valley – outwash plain deposits as described by Trescott (1968). The outwash valleys are sites where greater than usually thicknesses of stratified drift accumulated during meltwater discharge. One such valley exists just south of the property and a test hole there revealed 28 m of stratified sediment. It is likely that the outwash valley mapped by Trescott (1968) extends beneath the central portion of the property.

Wisconsinan Lawrencetown till is thought to be within 10m of the surface at undisturbed sites on the property and within 2 m of the surface on the pit floor. Lawrencetown till is a reddish-brown, moderately-compact massive till in which cobbles and larger sized clasts make up less than 5% of the till (Graves and Fink, 1990). This sediment exhibits very low permeability and hydraulic conductivity.

Late Wisconsinan post-glacial stratified sediment described above commonly overlies a substantial thicknesses (> 30 m) of undifferentiated non-consolidated deposits both of glacial and interglacial origin (unpublished maps, H. Cameron, Acadia University). These deposits may comprise till, gravel, sand, and possibly soils and though probably highly anisotropic may form locally, in some cases regionally significant aquifers due to the extremely high porosity and hydraulic conductivity of the gravel units (Trescott, 1968). The distribution and thickness of these sediments on a local scale is speculative, their presence is only inferred through the interpretation of regional test holes and by inference

1.3 Soils and Peat:

The Bond Road Sand Pit site is covered by Berwick and Nictaux soils, both of which are sandy loams that are well to rapidly drained (Cann et al., 1954; Cann and MacDougall, 1965). The Berwick soil is found in the northern and southern 1/3rd of the property in association with kame deposits (see: Fig. 1b). This soil is described as sandy till derived primarily from Triassic sediments (Wolfville Fm and Blomidon Fm for instance) however at many sites on the property

the soils parent material is water lain glacial sand and gravel (kame sediment). The Nictaux soil dominates the central portion of the property and is described as "water derived stratified gravel and coarse silica sand"; it is well to excessively drained (Cann and MacDougall, 1965). This soil is found in the same region from which aggregate has been extracted and is formed in part from glaciolacustrine sand. Investigations at the site indicated that though sand is common on this portion of the property it is usually covered by some gravel as well, thus the distinction between Berwick soil and Nictaux soil may not be as evident on site as indicated in the soil survey conducted by Cann and MacDougall (1965). The Berwick soil has been described as good crop land however the Nictaux soil has been described as poor cropland owing mainly to its inability to hold water. There are no significant peat deposits in the study region (Anderson and Broughm, 1986)

1.4 Surface Water

The coarse grained nature of both the kame and outwash sand and gravel results in high infiltration capacity and high hydraulic conductivity. The glaciolacustrine sand that underlies the gravel (in the outwash deposits) has moderate hydraulic conductivity and are somewhat anisotropic due to occasional horizontal silt and clay beds contained within. During input events throughflow dominates at the site, there was little evidence of rilling or surface erosion that might have been caused by excessive overland flow. Where the excavation comes in contact with clay rich till, infiltration and conductivity are low and overland flow is relatively high. Till was not observed at the site but an operator indicated that over compacted clay rich sediment (till?) has been encountered on the floor of the pit. Diamicton was exposed at surface and at depth in a borrow pit on the northern boundary of the property (Fig 1). The surface topography is uneven, drainage is well-developed, and, in limited exposures, the sediment is coarse, moderately sorted immature gravel with occasion diamicton. This diamicton had limited lateral extent and most likely represents debris flow sediment consistent with ice contact deposits. As well, standing water was common on the pit floor after rainfall events, an indication of the low permeability of the underlying strata and/or elevated "local" water table.

During heavy rains some overland flow may exist, particularly where pit wall grading has taken place or at locations where there are significant slopes. These slopes exist where stream incision has occurred (south of the property; see Fig.1b) and at some sites along the north branch

of Rochford Creek. Soil development is poor on these slopes and, as such, they are particularly vulnerable to disturbance. Overland flow will also occur where roads and excavations have resulted in compacted, low permeability surfaces. Overland flow has resulted in some minor erosion and sediment movement along the sand pit access road.

While Rochford Creek appears to be perennial in the immediate vicinity of the excavation it is likely ephemeral in its upper reaches (south of the proposed excavation) where baseflow discharge is low and the watercourse comes in direct contact with bedrock. This is consistent with similar sites that lie in transition between a valley side and valley bottom locations (Fenton 1998; Levy 1998). In the vicinity of the sand pit Rochford Creek has variable morphology but is typically narrow, has a sand and gravel bed, and has a relatively low width to depth ratio; depths of >2 m were noted. The creek has sections with both single and multiple thalwegs, changes in morphology are a results of both local base level controls due to disturbance and variances in bankside vegetation and substrate composition. Both throughflow and baseflow from unconsolidated sediments are the source of the water in Rochford Creek.

Surface Water Quality

Limited assessment of surface water quality and water chemistry was performed at two sites on the property in Nov. 2003 (see Figure 1, Table 1). The assessment of water chemistry consisted of analyses of pH, Conductivity, nitrate as NO_3-N, and phosphate as PO_4. These analyses were performed using a YSI water quality meter as well as a Chemetrics VVR Water Analysis System. A summary of the surface water chemistry is displayed in Table 1. The water chemistry data indicates moderate to good surface water quality at both sites (Canadian Drinking Water Standards, 1998).

Site	pH	Cond. (mmohs)	Nitrate NO_3-N	Phosphate PO_4
BR-1	5.9	.034	0.12 ppm	0.0 ppm
BR-2	6.1	.021	0.11 ppm	0.0 ppm
BR-3	6.3	.024	<0.01 ppm	0.0 ppm
BR-4	6.0	.031	0.03 ppm	0.0 ppm

Table1. Surface water chemistry results for sites indicated on Figure 1.

Impacts

Impact of Aggregate Extraction on Geology and Geomorphology

There is no indication that the proposed excavation, if it remains at or above the present elevation will result in surface exposure of bedrock. Though no direct data exists, nearby wells indicate that bedrock is > 10m below the floor of the present excavation. No evidence was observed that appreciable mass wasting has occurred in the past. Failure is possible along stream valley side as slopes can be locally significant and soil is poorly developed but the excessively well-drained nature of these soils is a limiting factor.

Impact of Aggregate Extraction on Surface water

A significant component of flow in both the main branch and the north branch of Rochford Creek is from water stored in unconfined sediment located above bedrock. The sand located above the present elevation of the pit floor is not part of this aquifer however is does represent at pathway to the aquifer. While the coarse gravels that cap the deposit have highly variable storage potential and moderate transmissitivity the underlying sands which have between 4 -8% silt and clay (locally higher) and in places are fine grained have reduced transmissitivity and also have the ability to retain significant moisture. The removal of this material effectively reduces the storage time for input events and in mid-summer and early fall (traditionally low input months) this could lead to reduced flow in Rochford Creek. However, flow reduction due to removal would be very minor as locally abundant, unexploited sand and gravel deposits exist up gradient from the site and provide ample storage potential.

Though aggregate removal will have a minor impact on the quantity and quality of water in upper Rochford Creek the present depth of the excavation should not be exceeded. It is essential that a positive surface gradient be maintained from the pit floor to both the north and south branches of Rochford Creek. Excavation below the bankfull level greatly increases the potential for flooding and local “loosing stream” conditions that would effect both water quality and quantity in Rochford Creek. The limited (spatially and temporally) water quality assessment that was done indicated that surface water quality is good. Nitrate concentrations indicate some agricultural impact, potentially from a poultry producer located upstream from the sampling sites (see figure 1).

The channel of the north branch of Rockford Creek has been substantially altered. Widening and rerouting have resulted in a shallower thalweg at some locations, as well, excavation has resulted in the development of a pool with maximum depths of 2.4m. Reduced flow velocity, reduced canopy, and the dark colour of the streambed substrate at this site may lead to locally elevated stream temperatures and reduced water quality during summer months. Culverts that have been placed under an access road that crosses the north branch of Rochford Creek may, at low flow periods act as an impediment to fish movement (see Fig. 8).

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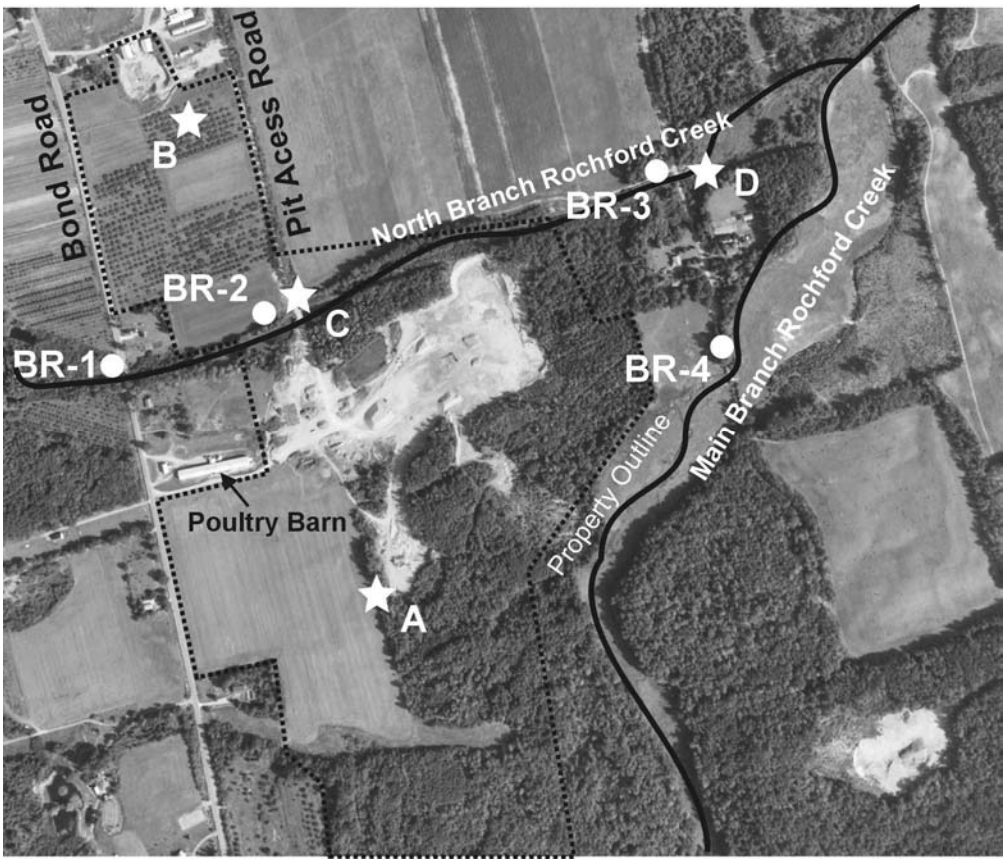

Figure 1a: Site map showing outline of property (dashed lines), photo locations and water quality collection sites.

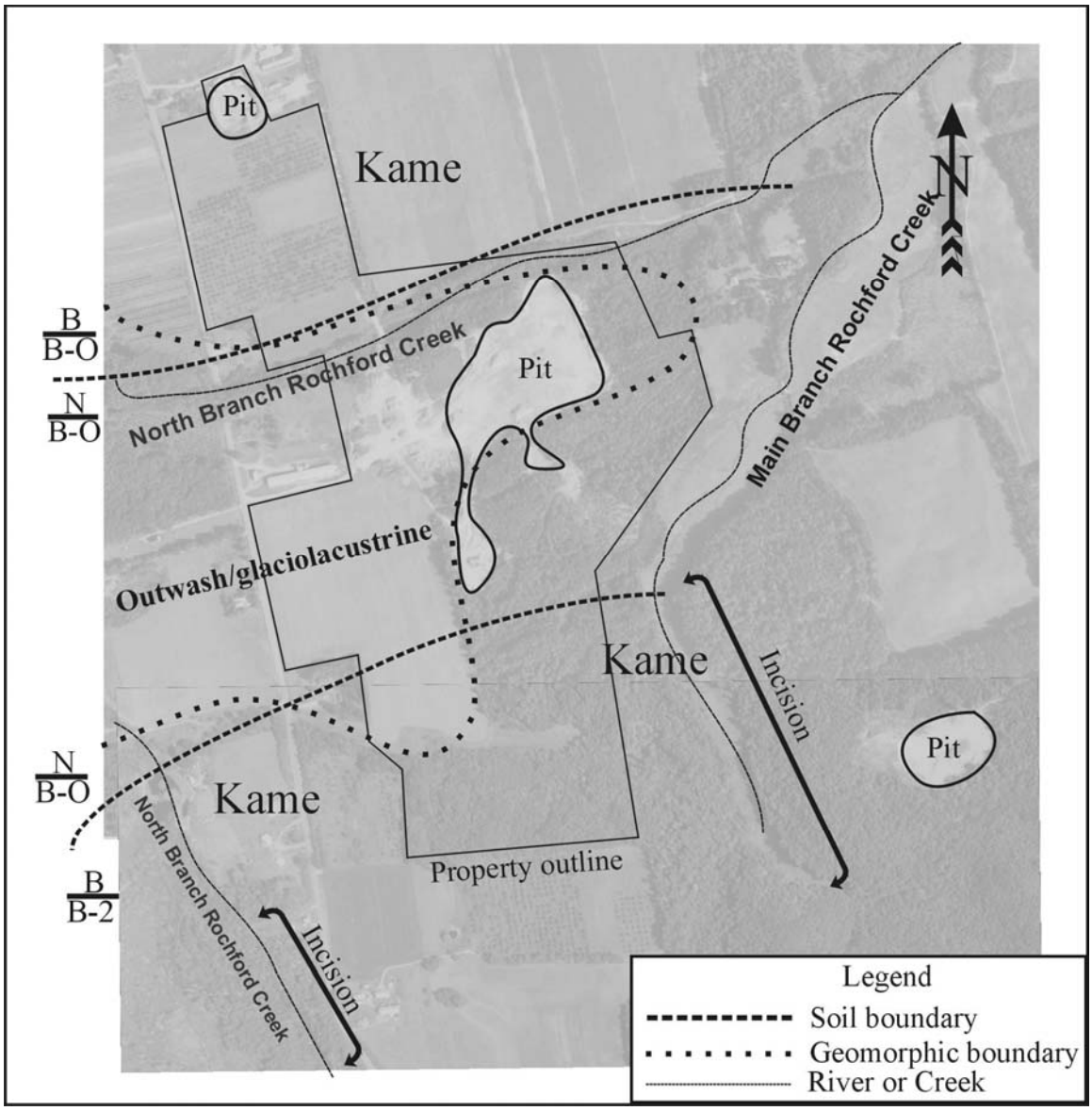

Figure 1b: Site map with geomorphology and soils boundaries overlain and pit locations indicated. Ice contact (Kame) sediment dominates the region but is thickest in the northern and southern 1/3 of the property. The kame to the north may be underlain by a drumlin. The central portion of the property is underlain primarily by finer grained outwash and glaciolacustrine sediment. Berwick (B) and Nictaux (N) soils dominate the site. Both are rapidly drained sandy loams.

Figure 2: Sediment at Site A (see Fig.1) Highly contoured but moderately to well sorted sand that is overlain by coarse, poorly sorted gravel. The sand is subaqueous with silt-clay percentages ranging from 5%- 10% in places. The gravel is proximal, was deposited by glaciofluvial processes and indicates that active ice was nearby. The sharp contact between these two units is pervasive at the site and indicates that these sediments were deposited by different systems

Figure 3: A large erratic in the pit floor that attests to the ice proximal nature of the sediment being mined (see: Site A, Fig. 1a).

Figure 4: Coarse poorly sorted (well graded) gravel at the southeast corner of the pit (see: Site A, Fig. 1a). The gravel clasts are texturally immature to submature and are of largely local origin (slate, granite, basalt and sandstone). The high clay content (up to 15% in places) and friable nature of this sediment indicates limited economic use.

Figure 5: Local borrow pit at the north end of the property (see: Site B, Fig. 1a). Sediment between the dashed lines contains much clay though clean exposures were not present. Near vertical contacts and variance in sediment sorting are common in ice contact sediment deposits.

Figure 6: Sediment near surface at north end of property (see: site B, Fig. 1a). Sediment is coarse grained and moderately sorted.

Figure 7: North Branch Rochford Creek west of pit access overpass (see: site C, Fig. 1). This portion of the creek has been widened and deepened to form a pond.

Figure 8: Culvert on pit access road (see: Site C, Fig. 1a). 5 Culverts are used, 2 of which are above the level of the pond and may impose an impediment to fish migration. Water sample BR-2 was taken at this site.

Figure 9: North branch of Rochford Creek east of pit (see: Site D, Fig. 1a). This creek has a low width to depth ratio which is typical of valley bottom tributaries. The depth of the creek at this site was 1.2 m. Water quality sample BR-3 was taken at this site.

Figure 10: Standing water on pit floor (see: Site A, Fig. 1a). The presence of excess standing water may be an indication that the underlying stratigraphy has low permeability and/or that the local water table is located just below the pit floor.