14.0 APPENDICES

Appendix 1: Industrial Approval No. 2002-031347

NOVA SCOTIA
Department of Environment and Labour

APPROVAL

Province of Nova Scotia
***Environment Act*, S.N.S. 1994-95, c.1**

APPROVAL HOLDER: **V J Rice Concrete Limited**

APPROVAL NO: **2002-031347**

EFFECTIVE DATE: **January 30, 2003**

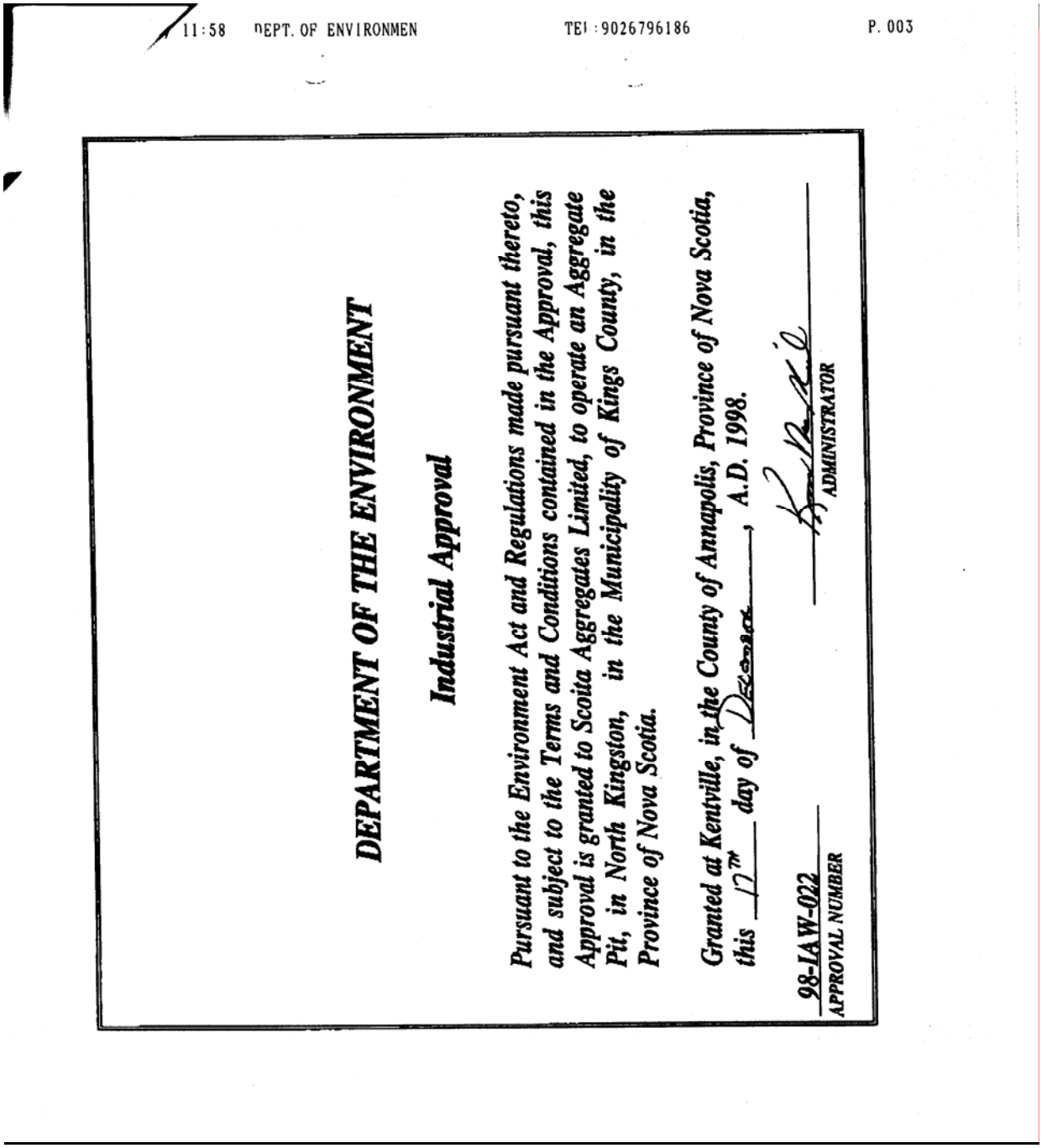
EXPIRY DATE: **January 30, 2013**

Pursuant to Part V of the *Environment Act*, S.N.S. 1994-95, c.1 as amended from time to time, approval is granted to the Approval Holder subject to the Terms and Conditions attached to and forming part of this Approval, for the following activity:

Construction and operation of a Sand Pit, and associated works, at or near Kingston, Kings County in the Province of Nova Scotia.

Administrator
Date Signed January 30/2003

Industrial Approval No. 98IAW-022



11:58 DEPT. OF ENVIRONMEN TEI :9026796186 P. 003

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 Scotia Aggregates Limited, to operate an Aggregate Pit, in North Kingston, in the Municipality of Kings County, in the Province of Nova Scotia.

Granted at Kentville, in the County of Annapolis, Province of Nova Scotia, this 17th day of December, A.D. 1998.

98-IAW-022
APPROVAL NUMBER

By
ADMINISTRATOR

Lease Agreement

THIS LEASE made the 20th day of November, 2002

BETWEEN:

SCOTIA AGGREGATES LIMITED, a body corporate,

(the "Landlord")

- and -

V.J. RICE CONCRETE LIMITED, a body corporate,

(the "Tenant")

WITNESSES that in consideration of the rents reserved and the covenants and agreements herein contained on the part of the Tenant, the Landlord hereby leases the premises described in the Schedule marked "A" hereto annexed together with an easement over the existing private roadway to gain access to the premises (the "Premises") in accordance with the following terms and conditions.

1. **TERM**

The term shall be for a period Ten (10) years and shall commence on January 1, 2003 and terminate on January 1, 2013 subject to termination at any time for any cause whatsoever, by the Landlord on ninety (90) days prior notice to the Tenant. Upon receipt of notice from the Landlord, the Tenant agrees to vacate the Premise.

IN WITNESS WHEREOF the parties hereto have set their hands and affixed their seals this 20th day of November 2002.

SIGNED, SEALED AND DELIVERE in the presence of:

Brenda D. Barry

Brenda D. Barry

SCOTIA AGGREGATES LIMITED

Per: _____

V.J. RICE CONCRETE LIMITED

Per: _____

Appendix 2: Ariel Images of Study Area

Plate #1; Date 1977

Plate #2; Date 1987

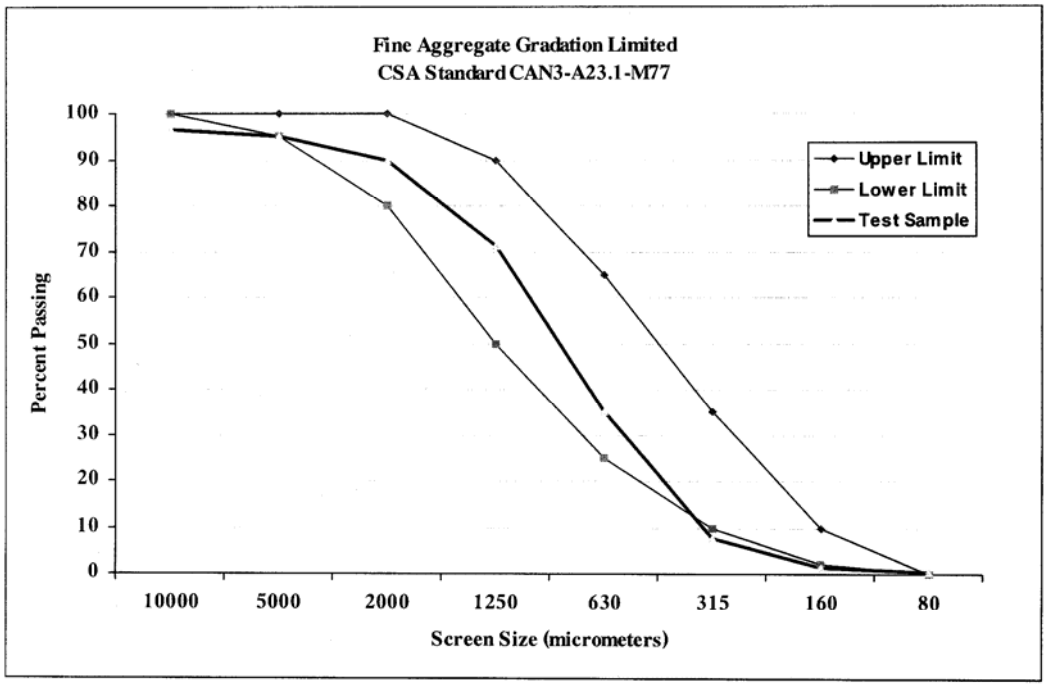
Plate #3; Date 2001

Appendix 3: Aggregate Reports

CONCRETE AGGREGATE REPORT - Gradation of Readymix Ma 1319

MaterialUse:
MaterialSource: keddy Pit - Pit Floor-Marshall Rd
ScreenSize:
ScreenType:
SampledBy: Tim Rice SampleDate
TestedBy: Scott Ritchie TestDate: 9/27/05

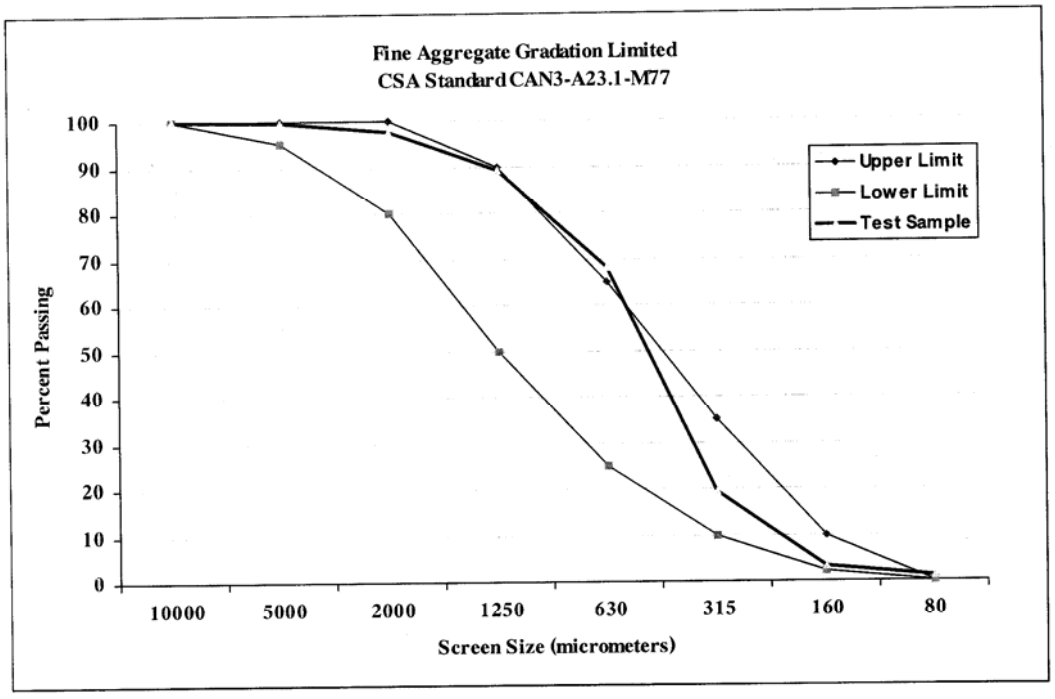
Sieve Size	Weight	Weight	Percent	Individual	Cumulative
10000 um (3/8")	25.0	702.0	96.6%	3.4%	3.4%
5000 um (No.4)	10.0	692.0	95.2%	1.4%	4.8%
2000 um (No.8)	38.0	654.0	90.0%	5.2%	10.0%
1250 um (No.16)	135.0	519.0	71.4%	18.6%	28.6%
630 um (No.30)	264.0	255.0	35.1%	36.3%	64.9%
315 um (No.50)	199.0	56.0	7.7%	27.4%	92.3%
160 um (No.100)	47.0	9.0	1.2%	6.5%	98.8%
80 um (No.200)	6.0	3.0	0.4%	0.8%	99.6%
Pan	3.0	0.0	0.0%	0.4%	100.0%
Total Weight	727.0			**F.M.**	**3.03**



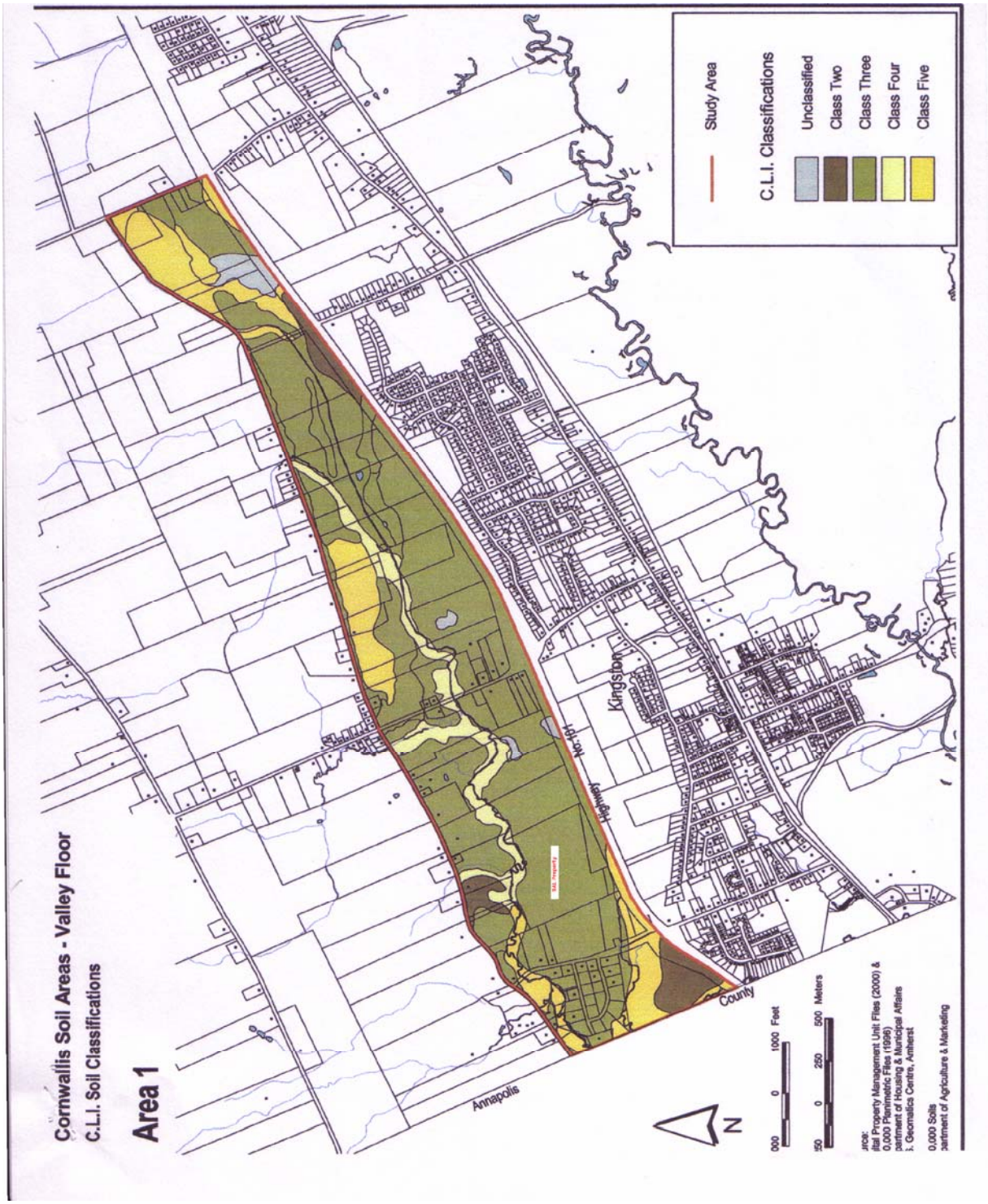
CONCRETE AGGREGATE REPORT - Gradation of Readymix Ma 1320

MaterialUse:
MaterialSource: keddy Pit - Top Of Pit
ScreenSize:
ScreenType:
SampledBy: Tim Rice SampleDate
TestedBy: Scott Ritchie TestDate: 9/27/05

Sieve Size	Weight	Weight	Percent	Individual	Cumulative
10000 um (3/8")	0.0	781.0	100.0%	0.0%	0.0%
5000 um (No.4)	4.0	777.0	99.5%	0.5%	0.5%
2000 um (No.8)	14.0	763.0	97.7%	1.8%	2.3%
1250 um (No.16)	67.0	696.0	89.1%	8.6%	10.9%
630 um (No.30)	164.0	532.0	68.1%	21.0%	31.9%
315 um (No.50)	381.0	151.0	19.3%	48.8%	80.7%
160 um (No.100)	125.0	26.0	3.3%	16.0%	96.7%
80 um (No.200)	17.0	9.0	1.2%	2.2%	98.8%
Pan	9.0	0.0	0.0%	1.2%	100.0%
Total Weight	781.0			F.M.	2.23



Appendix 4: Soil Classifications & Land Use



Land Use


Cornwallis Soil Areas - Valley Floor
Area 1
Study Area
Agricultural Land Use
Forested Areas
Gravel Pits
Source:
Digital Property Management Unit Files (2000) &
1:10,000 Planimetric Files (1996)
Department of Housing & Municipal Affairs
N.S. Geomatics Centre, Amherst
Agricultural Land Identification Project
Department of Agriculture and the Municipality
of the County of Kings
1998
Old Field Returning To Forest - Wet Areas
Old Field Returning To Forest
Shrubs
Hardwoods
Lands - Barren
Old Field
Aldens
Campground
Annapolis
Kingston
No. 101
Highway
County
N
1000 Feet
0
1000
500 Meters
0
250
250

Appendix 5: Botanical Survey

Botanical Survey for Proposed Marshall Road Sand Pit Expansion

Prepared for: Scotia Aggregates Ltd.
Prepared by: Ruth E. Newell, B.Sc. (Hons.), M.Sc.
164 Schofield Road
Wolfville, NS
B4P 2R2
Survey Date: 2005

1.0 Introduction

Vascular plant surveys were conducted within the proposed sand pit expansion area by botanist Ruth E. Newell, B.Sc. (Hons.), M.Sc., on the following dates: June 18th, 26th and July 22nd, 2005. Approximately 7-8 hours were spent on the study site during each visit. All habitats present within the property boundaries were visited at least once. Habitats with high potential for rare species were surveyed two or more times. Rare species located during these surveys were geo-referenced (excluding those species with numerous occurrences) with a Garmin 12 GPS unit and photographed. Botanical nomenclature used in this report follows Roland (1998).

Prior to the conduction of fieldwork, a short list of priority species was developed based on several information sources including herbarium records, Atlantic Canada Conservation Data Centre Element Occurrences, the provincial SigHab database, etc. This list included the following species: Rockrose (*Helianthemum canadense*), Hudsonia (*Hudsonia ericoides*), (Cut-leaved Coneflower (*Rudbeckia laciniata* var. *gaspereauensis*), Tower-mustard (*Arabis glabra*), Oval-leaved Bilberry (*Vaccinium ovalifolium*), Northern Dewberry (*Rubus flagellaris*), Arrow-leaved Violet (*Viola sagittata*), Northern White Cedar (*Thuja occidentalis*), Porcupine Sedge (*Carex hystericina*), Swan Sedge (*Carex swanii*), Dudley's Rush (*Juncus dudleyi*), Purple Trillium (*Trillium erectum*), and Cutleaf Grape-fern (*Botrychium dissectum*). All of these species have habitat requirements in line with habitats present on the site.

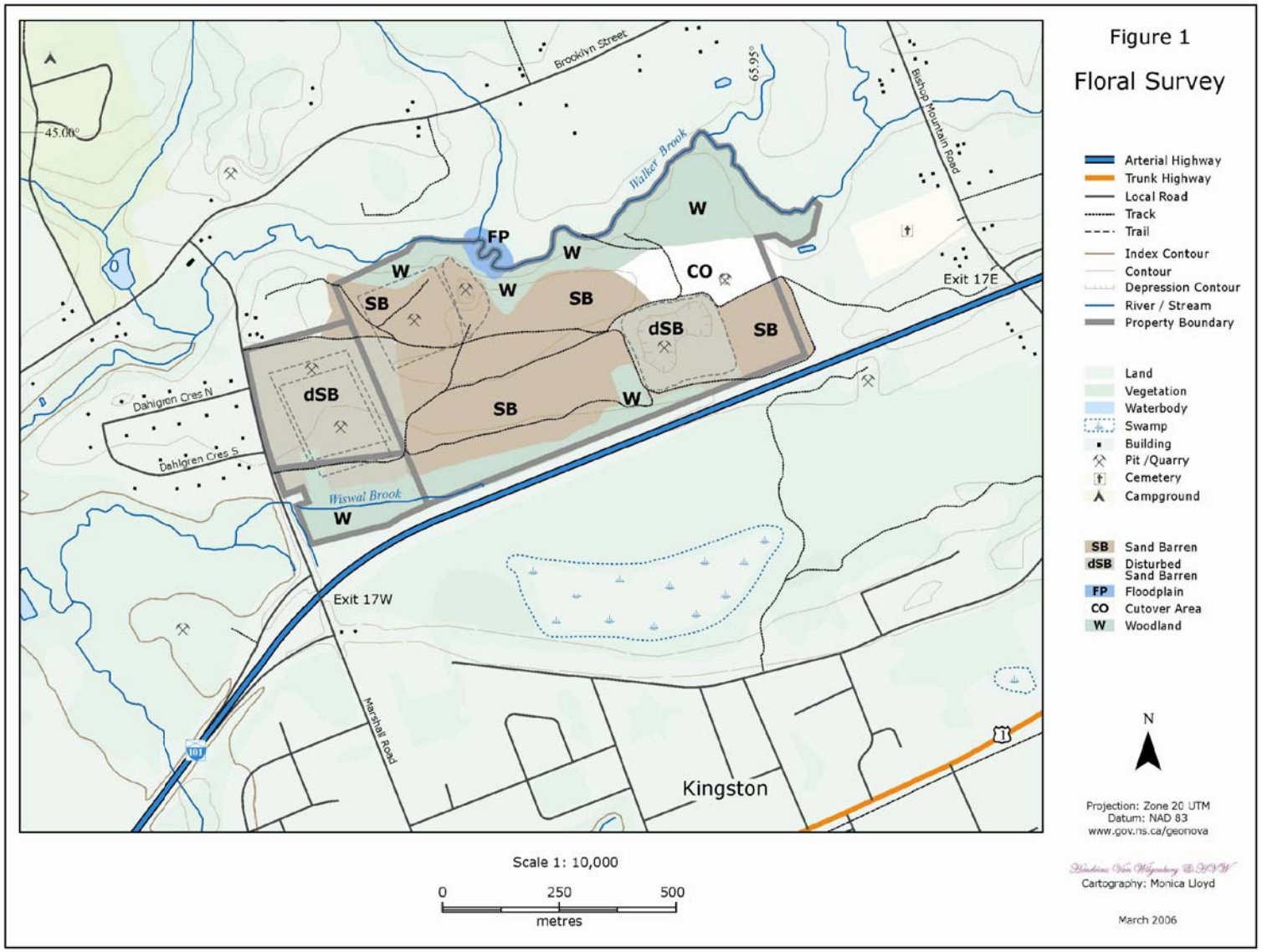


Figure 1
Floral Survey
Brooklyn Street
Walker Brook
Bishop Mountain Road
Exit 17E
Exit 17W
Dahlgren Cres N
Dahlgren Cres S
Wiswal Brook
Marshall Road
Kingston
FP
W
SB
dSB
CO
Arterial Highway
Trunk Highway
Local Road
Track
Trail
Index Contour
Contour
Depression Contour
River / Stream
Property Boundary
Land
Vegetation
Waterbody
Swamp
Building
Pit /Quarry
Cemetery
Campground
Sand Barren
Disturbed Sand Barren
Floodplain
Cutover Area
Woodland
N
Projection: Zone 20 UTM
Datum: NAD 83
www.gov.ns.ca/geonova
Cartography: Monica Lloyd
March 2006
Scale 1: 10,000
0
250
500
metres

2.0 Results & Recommendations (Summary)

2.1 Rare Plant Species

1) There were no plant species listed by COSEWIC under the Federal Species-at-Risk Act (SARA 2003) located on the proposed development site.

2) There were no plant species listed under the Nova Scotia Endangered Species Act (NSESA 1999) located on the proposed development site.

3) There were 3 plant species of Conservation Concern as listed under the Nova Scotia General Status of Wild Species website (http://www.gov.ns.ca/natr/wildlife/genstatus/) located on the development site. These are presented in TABLE 1 along with their ACCDC (Atlantic Canada Conservation Data Centre) provincial status ranking (http://www.accdc.com/info).

TABLE 1. Rare plant species located during this survey.

Scientific Name	Common Name(s)	Provincial Color status	ACCDC Status	Geo-referenced locations on proposed development property (NAD 83)
Helianthumum canadense	Rockrose, Canada Frostweed	Red	S1	two locations: 20T 0346165, 4984369 (fig. 6); 20T 0345372, 4984340 (fig. 7)
Hudsonia ericoides	Hudsonia, Golden-heather	Yellow	S2	occasional to scattered clumps throughout undisturbed sand barren habitat
Viola sagittata	Arrow-leaved Violet	Yellow	S3S4	uncommon to thinly scattered in both undisturbed and disturbed sand barren habitat on east side of property; 20T 0345742, 4984464

2.2 Recommendations

It has recently been reported that less than 3% of the original sand barren (heathland) habitat remains in the Annapolis Valley with habitat loss primarily attributed to road construction, residential and commercial development and agriculture (Catling *et al.*, 2004). Fire suppression has also led to significant loss of open barren habitat through succession to woodland. Because of the unique qualities of this particular habitat in this part of the province, many of the common species occurring here (e.g., blackberries, cherries, Juneberries, etc.) may have distinctive genotypes relative to plants of these species occurring elsewhere in the province (Catling *et al*., 2004).

In light of the extreme rarity of Rockrose (*Helianthemum canadense*) within the province of Nova Scotia as well as the uniqueness of and ongoing threats to the sand barren habitat in

which it occurs, the primary recommendation of this report would be to avoid disturbance in all currently undisturbed sand barren habitat which is present on the property.

2.0 Report

3.1 General Habitat Descriptions

Habitats present within the proposed sand pit expansion area include:

a) sand barren
b) disturbed sand barren
c) brook floodplain
d) woodland

Figure 1a shows the general locations of each of these habitat types. Habitat descriptions follow.

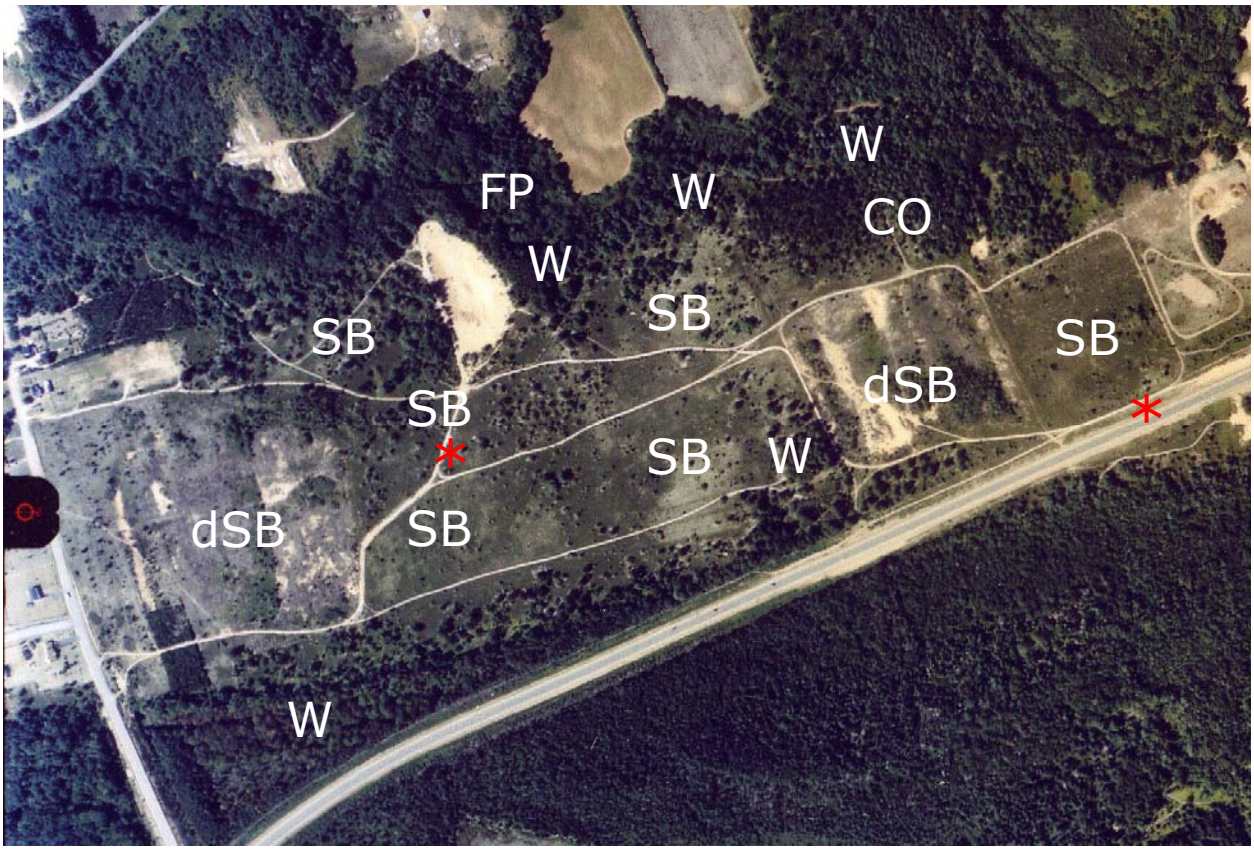


Fig. 1a. Air photo of proposed development site. The red asterisks indicate areas where Rockrose populations were found. SB=sand barren, dSB=disturbed sand barren, FP=floodplain, CO= cutover area, W= woodland.

a) Sand Barren (Photo 2) – Moreorless undisturbed sand barren (also known as Annapolis heathland) habitat occupies a significant proportion of the property. These are open areas (i.e., unforested) with a nearly continuous cover of the low shrub, Broom Crowberry (*Corema conradii*). These areas are not completely undisturbed as frequent all-terrain vehicle (ATV) usage occurs within this habitat type as well as within most of the other habitats present on the property. Other commonly occurring, native species in this habitat include Bearberry (*Arctostaphylos uva-ursi*), reindeer moss lichens (*Cladina* spp.), Huckleberry (*Gaylussacia baccata*), Common Hairgrass (*Deschampsia flexuosa*), Lowbush Blueberry (*Vaccinium angustifolium*), Sweet Fern (*Comptonia peregrina*), Hidden Sedge (*Carex umbellata*), Starved Witchgrass (*Panicum depauperatum*), Pinweed (*Lechea intermedia*), etc. Scattered trees and saplings occur throughout the sand barren habitat. These include: White, Red and Jack Pine (*Pinus strobus*, *P. resinosa*, *P. banksiana*), Wire Birch (Betula populifolia), several species of shadbushes (Juneberries) - including Dwarf Serviceberry (*Amelanchier spicata*). Also occurring occasionally is Common or Ground Juniper (*Juniperus communis*).

Trailing Blackberries (*Rubus* spp.) are fairly common throughout both disturbed and undisturbed sand barren.

b) Disturbed Sand Barren (Photo 3) – Disturbed sand barren are those areas that have conspicuously reduced amounts of native sand barren vegetation such as Broom Crowberry and Bearberry, and a significant non-native component indicating or suggesting that man has severely impacted this habitat in the past. Introduced species i.e., non-natives, commonly occurring within this habitat include hawkweeds (*Hieracium* spp.), Canada Bluegrass (*Poa compressa*) and Hair Fescue (*Festuca filiformis*). Poverty Grass (*Danthonia spicata*), a native grass, is also very common in these areas. Pin Cherry (*Prunus pensylvanica*) is a commonly scattered, small tree occurring throughout this habitat. There is a large area on the west side of the property that falls within the category of disturbed sand barren as well as one area near the east side of the property. The latter area appears to have been a large sand extraction pit at one time in the past.

Plants present in the photo include scattered small mats of Broom Crowberry (*Corema conradii*) plus extensive areas of Mouse-eared Hawkweed (*Hieracium pilosella*) (yellow-flowering plant). There are also scattered young cherry trees - primarily Pin Cherry (*Prunus pensylvanica*).

c) Floodplain (Photo 4) – The north boundary of the sand pit expansion area follows along Walker Brook. The narrow floodplain along the south edge of this brook was surveyed. Common floodplain plant species present include the following: Reed Canary Grass (*Phalaris arundinacea*), Spotted Touch-me-not (*Impatiens capensis*), Speckled Alder (*Alnus incana*), Jack-in-the-pulpit (*Arisaema triphyllum*), Fowl-meadow Grass (*Glyceria striata*), Chokecherry (*Prunus virginiana*), Rough Goldenrod (*Solidago rugosa*), Sensitive Fern (*Onoclea sensibilis*), Fringed Loosestrife (*Lysimachia ciliata*), Virgin's Bower (*Clematis virginiana*), several aster species (*Aster umbellatus*, *S. puniceus*, etc.), *Meadow-rue* (Thalictrum pubescens), Red Maple (*Acer rubrum*), etc. There were several alien species present in this habitat including Dame's Rocket (*Hesperis matronalis*) and Moneywort (*Lysimachia nummularia*).

d) Woodland – Woodland occurs in various parts of the property. The two most extensive forested areas occur along the north edge of the proposed development area between the brook floodplain and the open sand barren, and in the southwest corner of the property adjacent to Hwy 101. There are also several scattered smaller tree stands.

The mature, mixed woodland along the north edge of the property has White Pine (*Pinus strobus*), Red Pine (*P. resinosa*), Red Oak (*Quercus rubra*), Red Maple (*Acer rubrum*), Trembling Aspen (*Populus tremuloides*), Large-toothed Aspen (*P. grandidentata*), Red Spruce (*Picea rubens*), and White Spruce (*P. glauca*). In areas where pines dominate, the understory vegetation is somewhat sparse with thin mats of Broom Crowberry, patches of Huckleberry (*Gaylussacia baccata*), Lowbush Blueberry (*Vaccinium angustifolium*) and Common Hairgrass (*Deschampsia flexuosa*) and thinly scattered Pink Lady's-slippers (*Cypripedium acaule*). In areas with a mix of soft- and hardwood tree species there is generally an abundance of herbaceous and shrub species including Wild Sarsaparilla (*Aralia nudicaulis*), Wild Lily-of-the-valley (*Maianthemum canadense*), Starflower (*Trientalis borealis*), Bunchberry (*Cornus canadensis*), Bracken (*Pteridium aquilinum*), Huckleberry (*Gaylussacia baccata*), Lowbush Blueberry (*Vaccinium angustifolium*), Common Hairgrass (*Deschampsia flexuosa*) and Pink Lady's-slipper (*Cypripedium acaule*).

The woodland in the southwest corner of the proposed development site becomes increasingly moist east to west. At the west end, there is an extensive flooded area with standing, stagnant water still present at mid summer. Because of the gradient in soil

moisture content, wetland species become more prevalent as one proceeds from east to west. Trees present at the east end of this wooded area include: Wire Birch (*Betula populifolia*), Red Pine, White Pine, Red spruce, White Spruce and Red Maple. At the west end Red Maple dominates in the vicinity of the flooded area. Common shrubs in this woodland include: Rhodora (*Rhododendron canadense*), Sheep Laurel (*Kalmia angustifolia*), Wild Raisin (*Viburnum nudum*), Lowbush Blueberry, Huckleberry, False Holly (*Nemopanthus mucronata*), Canada Holly (*Ilex verticillata*) and Meadowsweet (*Spiraea alba*).

There are several small mature Red Pine stands on the property that have a relatively open understory, i.e., they are relatively sparsely vegetated at ground level. Species diversity is also reduced in these areas. Species present are usually limited to Huckleberry (*Gaylussacia baccata*), Broom Crowberry (*Corema conradii*) - *Corema* mats become less dense and less extensive in shade than they are in full sun, Common Hairgrass (*Deschampsia flexuosa*), Lowbush Blueberry (*Vaccinium angustifolium*) and Pink Lady's-slipper (*Cypripedium acaule*).

On the west side of the property, there are two adjacent, small plantations – one of young Red Pine (approximately 10 yrs old?) and one of Balsam Fir.

There is a recent cutover located on the east side of the property (fig. 1a), north of sand barren habitat. Local residents encountered while conducting this survey, mentioned that Lodgepole Pine (*Pinus contorta*) had at one time been planted in this particular area. No trees of this species were observed during this survey. The cutover is currently filling in with a variety of early successional shrub and tree species.

3.2 Rare Plants

3.2.1 Rockrose (*Helianthemum canadense*)

Rockrose (*Helianthemum canadense*) plants (Photo 1) were found in two very localized areas during this survey (fig. 1a, TABLE 1).

One location is on the lower east side of the property very close to Hwy. 101 (Photo 5). There were approximately 130-140 stems in 5 groupings or clusters along a distance or stretch of about 15 meters paralleling the highway (and an ATV trail). Most plants were located approximately 4 m away from the base of a slope adjacent to the highway shoulder. This area has a mix of native sand barren species (*Arctostaphylos uva-ursi*, *Corema*

conradii, *Panicum depauperatum*, *Hudsonia ericoides*, Pinweed - *Lechea intermedia*) and introduced species (*Hieracium pilosella*, *Festuca filiformis*, Rabbit's-foot Clever - *Trifolium arvense*).

The second location for Rockrose was in the vicinity of an intersection of three ATV trails southwest of a large sand pit (about mid-property). Here plants occurred in four different groupings along a 40 m stretch of an ATV trail (Photo 6). There were 40 stems in total growing either in bare sand along the edge of the ATV trail or up through a Broom Crowberry (*Corema conradii*) mat adjacent to the ATV trail.

3.2.2 Hudsonia (Hudsonia ericoides)

Hudsonia (*Hudsonia ericoides*) (Photo 7), although scarce on the west side of the property in disturbed sand barren habitat, ranged from uncommon to locally common elsewhere in undisturbed sand barren (Photo 8). In particular, it is most common where there are gaps in the Broom Crowberry (*Cormea conradii*) mats or where these mats are relatively thin.

3.2.3 Arrow-leaved Violet (*Viola sagittata*)

The Arrow-leaved Violet (*Viola sagittata*) (Photo 9) was observed on the east side of the property only. It was located in both undisturbed and disturbed sand barren habitat. More plants were observed in disturbed sand barren habitat than in undisturbed sand barren. This may be due to the fact that plants are less visible in the dense vegetation on the undisturbed sand barren than in areas of open sand in disturbed sand barren.

4.0 Bibliography

Catling, P.M., S. Carbyn, S.P. vander Kloet, K. MacKenzie, S. Javorek and M. Grant. 2004. Saving Annapolis Heathlands. CBA/ABC Bulletin, 37(1): 12-14.

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

Appendix 1

Photo 1. Rockrose (*Helianthemum canadense*) on proposed development site.

Photo 2. Sand barren habitat showing OHV trails. The dominant ground cover is Broom Crowberry (*Corema conradii*). The small yellow patches are the yellow-listed plant species, Hudsonia (*Hudsonia ericoides*).

Photo 3. Disturbed sand barren habitat on the west side of the property. Plants present in the photo include scattered small mats of Broom Crowberry (Corema conradii) plus extensive areas of Mouse-eared Hawkweed (Hieracium pilosella) (yellow-flowering plant). There are also scattered young cherry trees - primarily Pin Cherry (Prunus pensylvanica).

Photo 4. Floodplain habitat along Walker Brook (north boundary of survey area). In this particular area, ferns and grasses are dominant species in the riparian or floodplain zone.

Photo 5. Habitat where one population of Rockrose was found on the proposed development site. Highway 101 is on the left side of the photo and an OHV trail is on the right side of the photo. Most Rockrose plants found in this area were approximately halfway between the highway and the OHV trail.

Photo 6. Habitat where a second population of Rockrose was found on the proposed development site. Rockrose plants occurred either in bare sand near the edges of the Broom Crowberry mat or in the Broom Crowberry mat itself immediately adjacent to the OHV trail.

Photo 7. Hudsonia (*Hudsonia ericoides*) in undisturbed sand barrens on proposed development site.

Photo 8. Sand barren with scattered Hudsonia (*Hudsonia ericoides*) plants (yellow flowers).

Photo 9. Arrow-leaved Violet (*Viola sagittata*) in sand in disturbed sand barren habitat.

Appendix 6: Faunal Study

Fauna / Wildlife Species and Habitat Study

Prepared for: Scotia Aggregates Ltd.
Prepared by: W. George Alliston, Ph.D.

Survey Date: 3 September 2005

TABLE OF CONTENTS

1.0 INTRODUCTION

Scotia Aggregates Ltd. is applying to expand its sand extraction operations on a 60 ha property near Kingston, Kings County, Nova Scotia. On behalf of the proponent, for inclusion in the Environmental Assessment Registration, the author has conducted an assessment of the use of this property by species of amphibians, reptiles, breeding birds, and mammals considered at risk in Nova Scotia. Field studies were conducted between April and July, 2005. This report presents the findings of these studies and recommendations for potential impact mitigation.

2.0 SUMMARY

Two species at risk, the Wood Turtle and the Vesper Sparrow, were found using the property. The Wood Turtle is listed as a species of Special Concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and is listed as Vulnerable under the Nova Scotia Endangered Species Act. The Vesper Sparrow is not listed by COSEWIC or under the Nova Scotia Endangered Species Act but is assigned a Yellow (Sensitive) status under the General Status Ranks of Wild Species in Nova Scotia.

2.1 Wood Turtles

Excavation of the existing "active" pit adjacent to Walker Brook has created excellent nesting habitat for Wood Turtles and, in taking advantage of this, the Wood Turtles are being exposed to impacts by pit operations and by the recreational activities of off-highway-vehicle (OHV) users who view this pit site as a destination. Even without extraction operations it seems unlikely that this small population can be sustained given the current level of OHV activity in their nesting area.

Studies of this recently discovered, isolated, upper Annapolis River drainage Wood Turtle population were initiated by the Nova Scotia Department of Natural Resources (NSDNR) in 2005 and, while absolute population levels are not known, it appears that the Wood Turtles nesting at this pit site could represent about ten percent of the upper Annapolis River population as we currently know it.

The potential direct impacts of both pit and OHV activities would be primarily the destruction of Turtle nests. Turtle eggs are incubated by heat from the sun and could reside in the pit site for three months before hatching and the hatchlings leaving (September or October). Adults could also be killed or injured by these activities; however, since their time in the pit is measured in hours, not months, the likelihood of this happening is far less but,

if it does, the impact on the population is great. Potential indirect impacts could be caused by noise from operations or activities during the Wood Turtles' nesting period (late May to early July).

Given the current situation, effective mitigation measures taken by the project could result in a positive impact on this population of Wood Turtles.

I can suggest three possible approaches for mitigation of direct impacts. These approaches assume that OHV activity will continue on the property. All are experimental and would require input from an experienced herpetologist in their final design and a monitoring program to evaluate their effectiveness. These three approaches may not be equally effective and are listed in the reverse order of their effectiveness as perceived by the author:

1) Attempt to "short stop" nesting Wood Turtles by creating and maintaining desirable nesting habitat between the current pit site and Walker Brook (i.e. on the floodplain and/or the embankment).
2) Erect a barrier near the top of the embankment to prevent the movement of Wood Turtles into the pit site, combined with the enhancement of potential nesting habitat preferably at the top of the embankment. This could be arranged so that no existing OHV trails would be blocked.
3) Erect barriers that allow Wood Turtles access to some or all of their nesting habitat, which is restricted to the northern half of the existing pit, while denying OHVs access to this area.

Mitigation measures associated with indirect impacts due to the noise of operations would be to leave a buffer zone (200 m suggested) between pit operations and known Wood Turtle nesting areas during the nesting period (late May to early July).

Effective implementation of measures to mitigate direct impacts could be difficult, particularly so in the case of suggestion 3). Education and outreach to OHV users would be essential. Given current interest in this Wood Turtle population by government, the academic community and Environmental Non-Governmental Organizations (ENGOs), there is an opportunity for a co-operative approach in which all could benefit.

2.2 Vesper Sparrows

Seventeen territorial pairs of Vesper Sparrows were identified using open barrens habitats on the property. The current "best estimate" of the Nova Scotia breeding population, which is admittedly "little more than guesswork", is 200 pairs (Erskine, 1992). Territorial birds seemed to be somewhat more concentrated in the western half of the property where they used disturbed habitats as much or more than relatively undisturbed ones. None was observed in the recently cutover area and only one pair was observed at the old pit site. These territorial birds appeared to be very tolerant of the noise and traffic of Highway 101 with four territorial birds having singing perches within 20 m of the highway.

Impacts of pit operations on nesting Vesper Sparrows will result mainly from habitat removal with little indirect impact expected from noise created by these operations. Suggested mitigation measures would involve:

1) where possible, avoiding areas used by nesting Vesper Sparrows in favour of areas that they avoid (cutover, open woodland);
2) minimizing the footprint of pit operations in areas used by nesting Vesper Sparrows by:
    a) locating ancillary facilities (if any) in areas not favoured by these birds;
    b) promptly initiating appropriate revegetation of areas where excavation has been completed.

It is also suggested that an annual census of the breeding Vesper Sparrow population be conducted on the property.

2.3 Migratory Birds Convention Act (1994)

To meet its obligations under the Migratory Birds Convention Act, it is recommended that Scotia Aggregates Ltd. should:

1) remove overburden only during the time period when most migratory birds are not nesting (August through March);
2) not excavate embankments used by nesting birds during periods when their nests are active (May through July);
3) avoid, where possible, the nests of ground-nesting bird species that are sometimes attracted to extraction pits;
4) assure that toxic materials are not accessible to birds and that accidental spills of toxic materials are dealt with expeditiously using appropriate protocols.

3.0 SITE DESCRIPTION

This 60 ha property is on the floor of the Annapolis Valley just north of the Village of Kingston at the western boundary of Kings County, Nova Scotia. It is bounded on the south by Highway 101, on the west by Marshall Road, and Walker Brook forms most of its northern boundary (Figure 1). The area surrounding the property is heavily impacted by human activity: residential, commercial, agricultural and military. This property is part of the Annapolis heathlands (or sand barrens) which is one of the rarer ecosystems in Nova Scotia. Catling *et al.* (2004) estimate that less than three percent of the original heathlands remains.

In this report all plant and animal species are referred to by their common names. A reference list of the common and scientific names for all species mentioned in this report is presented in Appendix 1.

3.1 Habitats

This property contains several distinct habitats which run in an east-west direction and appear to be related to moisture availability (Figure 1). If we proceed from the northern boundary southward through the central and least disturbed portion of the property, we encounter the following habitats. Walker Brook forms much of the northern boundary of the property and has a rather narrow floodplain that, along most of the boundary, is a closed forest dominated by Red Maples with a shrub layer (hawthorns, Beaked Hazelnut) and a well developed herbaceous layer. At the north-eastern extremity of the property, the floodplain becomes a meadow dominated by sedges and alders. At the southern edge of the floodplain is a wooded embankment that in some places rises quite steeply to a closed woodland at the crest. This woodland is dominated by Red and White Pines with some Jack Pine, Red Maple, White Spruce, Paper Birch and Red Oak (saplings). In addition to these species, a scattering of American Beech, Eastern Hemlock, Red Spruce and poplars can be found along the embankment. In the closed forest at the top of the embankment, there is essentially no shrub layer and the ground layer is dominated mainly by blueberries.

The land slopes gently from north to south. As the distance from Walker Brook increases, the forest becomes more open and Broom Crowberry becomes the dominant ground cover in the open areas with blueberries and grasses in the more shaded areas. South of this narrow band of open woodland is the open heathland (or sand barrens) with only scattered trees (Red Pine, White Pine, Jack Pine, Red Maple, Paper Birch); the ground cover is

dominated by Broom Crowberry with some Bearberry and a scattering of Juniper. In the driest areas, reindeer lichens are much in evidence. Bracken and Sweet Fern are common in some areas.

Near the southern boundary of the property there is a narrow band of open woodland similar to that adjacent to the northern boundary.

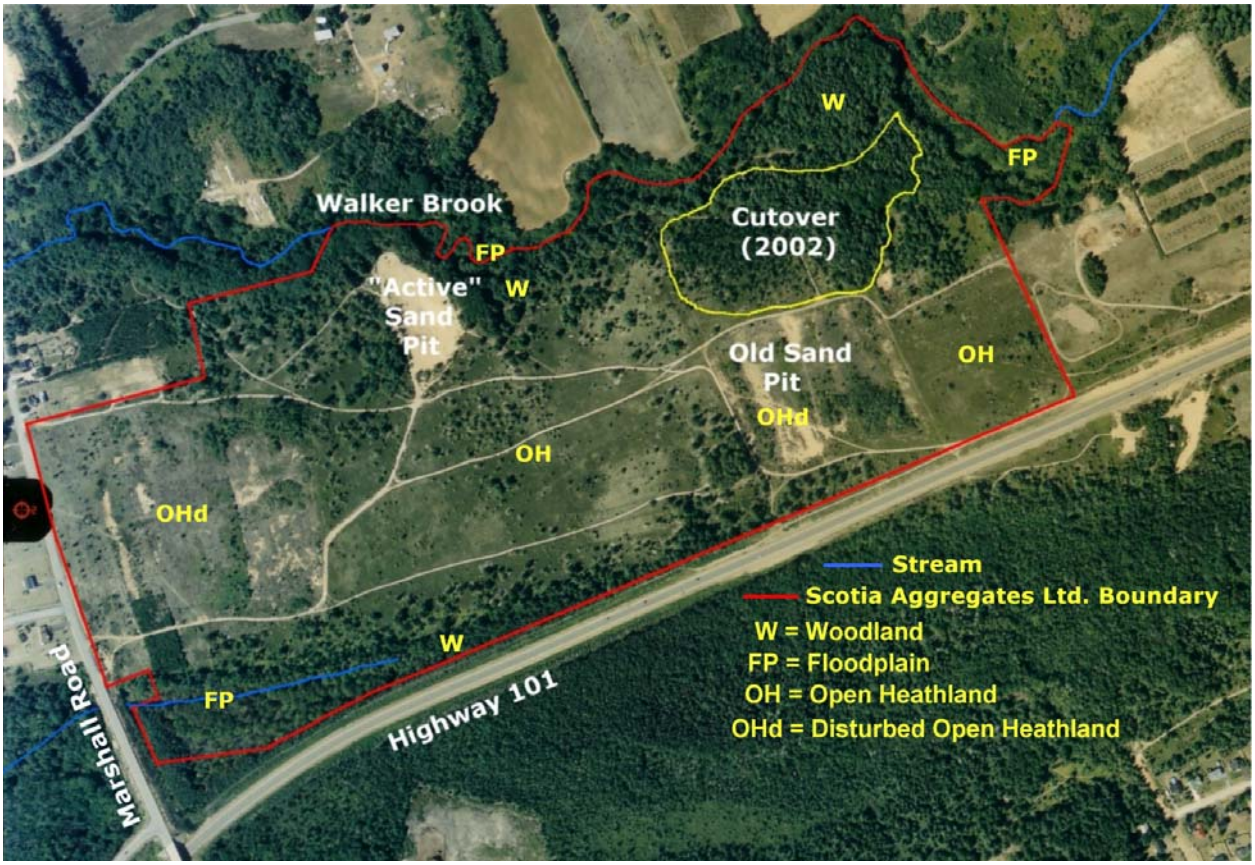


Figure 1. Habitats of the Scotia Aggregates Ltd. property, Kingston, Nova Scotia.

Much of the area along the southern boundary of the property is a wetland that is the headwaters of a small stream that flows westward into Walker Brook. The forest here is closed and dominated by Red Maples. Near the edge of this wetland, Kalmia and Rhodora and other "bog plants" can be found.

While the above is a general description of the least disturbed parts of the property, significant portions of the property have been altered by recent human activity.

In 2002 much of the largest forested area on the property was cut (4.5 ha). The ground cover of the original forest remains: blueberries, grasses and some Bracken in areas where forest cover was densest and Broom Crowberry, Bearberry and some Sweet Fern in areas that had been more open. There are few trees remaining in this area except for resprouts of the cut deciduous trees (Paper Birch, Red Oak, Red Maple, Pin Cherry) and saplings of White Pine, Red Pine, Jack Pine and Red Oak.

Immediately south of the cutover area is a large pit site that has not been extensively used for many years and much of which has been revegetated by natural processes. The southeastern quadrant of the pit supports a dense growth of young, early successional trees: Paper Birch, poplar and Pin Cherry. Some Red Oak, Red Pine and White Spruce are present. The herbaceous layer includes blackberry, goldenrod and some grasses. The remainder of the vegetated area is dominated mainly by Broom Crowberry and Bearberry but in some locations grasses, hawkweed, blueberries and Sweet Fern are abundant. About 20 % of this site remains unvegetated. Trees in this area are widely scattered and small and consist mainly of Pin Cherry, Paper Birch and Red Pine.

An "active" pit site is located near the northern boundary of the property. This site is completely lacking in vegetation.

A large area at the northwestern end of the property has been disturbed in the past, presumably by agricultural activities. There is currently a small very dense plantation of young Red Pines at the southern end of this area. Immediately north of this plantation is a somewhat unsuccessful planting of Balsam Fir as well as a recent planting of Red Pine seedlings. There are still patches of exposed sand in this area; however, more than 90 % of the area has been revegetated. Trees in this area are small and scattered and consist mainly of poplars and Pin Cherry. Broom Crowberry covers only about ten percent of the area with sparse grasses, hawkweed and some blueberries constituting most of the remaining ground cover.

There is other evidence of human habitation of this property in the more distant past: a small cemetery dating to the early 19th century, a basement, and what appears to be a sluiceway for a sawmill.

3.2 Current Human Activity

The "active" pit site is currently being used very sparingly for sand extraction. There was no sand extraction during our studies at this site.

As can be seen from Figure 1, there are many OHV trails on the property. These trails, and particularly the "active" pit site, are heavily used by OHVs. The steep slopes, particularly on the south end of this pit, make this a destination for those seeking the thrills and challenges of navigating these embankments. There are essentially no areas of this pit that are not impacted by OHV activity. It is my understanding that the levels of OHV activity at this site have increased significantly in recent years.

4.0 SPECIES AT RISK

I have derived the following list (Table 1) of species at risk that are known or believed to occur within the Annapolis Valley region of Nova Scotia, the area within which the proposed development is located. I have defined the Annapolis Valley region to include the North (terrestrial areas only) and South Mountains as well as the Valley floor.

Species at risk have been identified from three priority lists:

1) species listed as Endangered, Threatened or of Special Concern by COSEWIC;
2) species listed as Endangered, Threatened or Vulnerable under the Nova Scotia Endangered Species Act;
3) species assigned a status Red (At Risk or Maybe at Risk) or Yellow (Sensitive) under the General Status Ranks of Wild Species in Nova Scotia.

For a summary of the definitions used in deriving these priority lists, the reader is referred to Appendix 2.

Table 1. Species at risk that might be found in the Annapolis Valley region of Nova Scotia.

	Canadian Ranking	Nova Scotia Ranking	
	COSEWIC	Endangered Species Act	General Status
Amphibians			
Four-toed Salamander	-	-	yellow
Reptiles			
Wood Turtle	special concern	vulnerable	yellow
Breeding Birds			
Common Loon	not at risk	-	yellow
Northern Goshawk	not at risk	-	yellow
Peregrine Falcon	threatened	threatened	red
Common Tern	not at risk	-	yellow
Long-eared Owl	-	-	yellow
Short-eared Owl	special concern	-	yellow
Eastern Bluebird	not at risk	-	yellow
Vesper Sparrow	-	-	yellow
Nelson's Sharp-tailed Sparrow	not at risk	-	yellow
Bobolink	-	-	yellow
Eastern Meadowlark	-	-	yellow
Mammals			
Long-tailed Shrew	-	-	yellow
Little Brown Bat	-	-	yellow
Northern Long-eared Bat	-	-	yellow
Eastern Pipistrelle	-	-	yellow
Southern Flying Squirrel	special concern	-	yellow
American Marten	-	endangered	red
Fisher	-	-	yellow
Moose	-	endangered	red

A review of the list of species at risk presented in Table 1 in the context of habitats available on or adjacent to the Scotia Aggregates Ltd. property permits the elimination of a number of these as priority species because of lack of critical habitats as shown in Table 2.

Table 2. Species at risk that might be found in the Annapolis Valley region of Nova Scotia but lack critical habitat on or adjacent to the Scotia Aggregates Ltd. property.	Critical habitat not present on or adjacent to the property
Amphibians	
Four-toed Salamander	ponds or pools with sphagnum borders
Breeding Birds	
Common Loon	large lakes
Peregrine Falcon	cliffs
Common Tern	islands and sandy beaches in shallow lakes or large rivers
Short-eared Owl	open, grassy coastal areas
Nelson's Sharp-tailed Sparrow	coastal marshes
Mammals	
Long-tailed Shrew	talus slopes
Northern Long-eared Bat	heavily forested areas
Southern Flying Squirrel	mature mixed or deciduous forest containing seed-producing oaks
American Marten	large areas of mature softwood and mixed forests
Fisher	large areas of mixed forest
Moose	large areas of second-growth or intermediate forest interspersed with bogs, rivers and streams

One species at risk, the Wood Turtle, is known to have occurred on the property. Photographic evidence collected by naturalist and teacher, Catherine Crook, was presented to John Mills, Regional Biologist, NSDNR, in 2003 and, in 2004, he and NSDNR staff confirmed the presence of Wood Turtles on the north boundary of the property. Other naturalists (Judy Tufts, Bernard Forsythe) have observed territorial Vesper Sparrows on an adjacent property.

A search of the Significant Species and Habitat database revealed that much of the open heathlands of the Scotia Aggregates Ltd. property, as well as some other nearby areas, has been identified as being important to Species of Special Concern. A check with NSDNR staff revealed that these sites are identified because of their importance to plant species at risk. These issues are addressed in the associated botanical report prepared by Ruth Newell.

A search of the Atlantic Canada Conservation Data Centre (ACCDC) database indicated that, in addition to the two species indicated above, Northern Goshawks, Eastern Bluebirds and Bobolinks have been reported within 5 km of this site. While habitat on or adjacent to this property would be, at best, marginal for all three species, particularly the Northern Goshawk and Bobolink, they have been retained on our list of priority species because of their

occurrence in this general area. The Eastern Meadowlark has also been retained even though habitat on the property is, at best, marginal. While potential habitat for the Long-eared Owl on this property appears to be far from optimal and none has been reported in this general area, I have retained this species as a priority species since so very little is known of the distribution of this secretive, quiet, nocturnal bird that uses a number of habitat types.

The only mammal species at risk that have a reasonable likelihood of using this area are two species of bat: the Little Brown Bat and the Eastern Pipistrelle. I consider it likely that Little Brown Bats and possibly even Eastern Pipistrelles might visit the property during their nocturnal foraging. I have not identified either of these as priority species since, while they may forage on the property, it is highly unlikely that critical bat habitats would be found there.

Little Brown Bats are a generalist species associated with forests and human-dominated environments and are the most common bat species in Nova Scotia (Broders *et al.*, 2003). Critical habitats for this species are associated with maternity colonies where females rear their young and with hiberniculae where these mammals spend the winter months. Little Brown Bats hibernate in buildings where they can find an appropriate temperature regime or in caves, neither of which exist on this property. Although maternity colonies can be in tree cavities, female Little Brown Bats show a decided preference for buildings (Peterson, 1966; Schowalter *et al.*, 1979). No buildings are present on the property but there are many buildings in areas surrounding the property. Hollow trees suitable for maternity colonies are generally found in mature forests which would not describe the restricted woodlands of this property.

Eastern Pipistrelles can be locally common and typically forage over water (Broders *et al.*, 2003). Critical habitats for this species would also be associated with maternity colonies and hiberniculae. Eastern Pipistrelles hibernate in caves and there are no caves on the property. In other parts of North America, maternity colonies have been found in buildings, tree foliage and rock crevices. It is currently thought that Eastern Pipistrelle maternity colonies are "often (hidden) inside a clump of dead leaves in an otherwise healthy (deciduous) tree" (Kurta, 2001). There are neither rock crevices nor buildings on the property and any deciduous trees of moderate size are found mainly in the floodplain of Walker Brook and the

headwaters of the small tributary, neither of which would be directly impacted by pit operations.

Our priority list of species is presented in Table 3 and contains seven species: one reptile (Wood Turtle) and six birds. In the following sections I present the studies conducted, the results obtained and the conclusions reached regarding these priority species.

Table 3. Priority species at risk that might be found on or adjacent to the Scotia Aggregates Ltd. property.

	Canadian Ranking	Nova Scotia Ranking	
	COSEWIC	Endangered Species Act	General Status
Reptiles			
Wood Turtle	special concern	vulnerable	yellow
Breeding Birds			
Northern Goshawk	not at risk	-	yellow
Long-eared Owl	-	-	yellow
Eastern Bluebird	not at risk	-	yellow
Vesper Sparrow	-	-	yellow
Bobolink	-	-	yellow
Eastern Meadowlark	-	-	yellow

5.0 PERSONNEL AND TIMING

5.1 Personnel

Mr. Bernard Forsythe and I conducted field work for the preparation of this report. Mr. Forsythe is a well known and respected naturalist with special interests in birds and orchids. Mr. Forsythe has conducted studies and restoration work with raptors, particularly Barred Owls, for 30 years. In this study, he was involved in all of the bird censuses and the two surveys we conducted of Walker Brook. In addition to the information Mr. Forsythe and I collected, this report contains information collected and provided by NSDNR and Clean Annapolis River Project (CARP) biologists and volunteers in their wider-ranging study of the Wood Turtles of the upper Annapolis River watershed (see Acknowledgements).

Naturalists Catherine Crook and Michael Inkpen, who made the existence of this Wood Turtle population known to NSDNR, at my request kindly made observations regarding

Turtle tracks in the "active" pit on one occasion as well as sharing their insight into the behaviour of these Turtles based on 18 years of daily walks in this area.

5.2 Timing

Wood Turtles are difficult animals to census; the best time to do so is soon after they have emerged from hibernation (mid-April to early May) when they spend considerable time on warm sunny days basking along the edges of streams at a time before the growth of vegetation compromises the observer's ability to see them. Although surveys are most efficient when carried out between mid-April and mid-May, they can still be productive until July (Pulsifer *et al.*, 2004).

Nesting by Wood Turtles can occur from early June through early July so potential nesting areas would have to be monitored during that time period.

Raptorial birds generally begin their nesting activities earlier than songbirds so it is desirable to conduct separate surveys for these two groups. This is particularly so when one of the priority species is the Long-eared Owl. To have the best opportunity of detecting this reclusive, nocturnal and generally quiet species, it is desirable to conduct a survey during its early nesting period when they are more vocal. Since egg-laying generally begins in mid- to late-April (Tufts, 1986), a survey conducted at this time might have a better chance of identifying this elusive species. Northern Goshawks begin nesting earlier than Long-eared Owls but Northern Goshawks are usually anything but reclusive when their nests are approached.

Surveys of breeding songbirds are best conducted in late May or June after spring migration is complete and when most species have initiated nesting activities. Of the four priority species identified, the Eastern Bluebird and Vesper Sparrow begin nesting in early to mid-May while Bobolinks and Eastern Meadowlarks begin in early June (Tufts, 1986). Considering the backwardness of spring in 2005, a mid-June survey was considered appropriate for these species.

As part of this research, the property was visited 13 times, two of which were only brief opportunistic visits. A listing of the dates, times, objectives and weather conditions experienced during these visits is presented in Table 4. In addition to these visits, parts of

the property were surveyed on six occasions by NSDNR and/or CARP staff and volunteers as part of their Wood Turtle studies.

Table 4. Scotia Aggregates Ltd. site visits, April - July, 2005.

Date (2005)	Ob-serv-ers	Purpose of visit	Duration of visit From	Duration of visit To	Conditions Weather	Conditions Wind	Conditions Temp (°C)
26 April	GA BF	-reconnaissance of site -survey riparian habitat on Walker Brook -survey of raptorial birds	0924 h	2053 h	Clear	L-S	10-15
25 May	BF	-check for presence of passerine species at risk	~1300 h	~1330 h	Cloudy	S	14
9 June	GA BF	-survey of passerine birds -survey riparian habitat on Walker Brook -survey potential Wood Turtle nesting sites	0500 h	1835 h	Mostly cloudy	C-L	12-15
11 June	GA	-survey "active" pit for nesting Wood Turtles -meet on site with C. Crook & M. Inkpen	1505 h	1635 h	Clear	L	25
14 June	GA	-survey "active" pit for nesting Wood Turtles	1905 h	2130 h	Cloudy	L	15
18 June	GA BF	-check known Vesper Sparrow territories for singing birds	~1730 h	~1740 h	Cloudy	L	14
23 June	GA BF	-Vesper Sparrow surveys -survey potential Wood Turtle nesting sites	0517 h	1237 h	Clear	C-L	9-20
29 June	GA BF	-survey potential Wood Turtle nesting sites	0745 h	1149 h	Cloudy Fog Showers	L-M	22-28
30 June	CC MI	-survey "active" pit for nesting Wood Turtles	~1530 h	~1600 h	Cloudy	L	19
1 July	GA	-survey potential Wood Turtle nesting sites	0806 h	1021 h	Fog Drizzle	L	15-18
3 July	GA	-survey potential Wood Turtle nesting sites - vegetation survey and mapping	0751 h	1145 h	Clear	L	18-23
5 July	GA	-survey "active" pit for nesting Wood Turtles	2000 h	2047 h	Mostly cloudy	C	19
22 July	GA	-final check of "active" pit -vegetation survey with Ruth Newell	0813 h	1103h	Mainly clear	L	20-28

Observers

GA	George Alliston
BF	Bernard Forsythe
CC	Catherine Crook (Volunteer)
MI	Michael Inkpen (Volunteer)

Wind

Code	kph
C - Calm	0-5
L - Light	6-15
M - Moderate	16-25
S - Strong	>25

6.0 AMPHIBIANS AND REPTILES

6.1 Wood Turtles

6.1.1 Background

Wood Turtles are found in scattered, isolated populations throughout southeastern Canada (southern Ontario and Québec, New Brunswick and Nova Scotia) and the northeastern United States (south to Virginia and west to eastern Minnesota). Until recently it was thought that, in Nova Scotia, Wood Turtle populations were found only in the northeastern mainland and southwestern Cape Breton Island (Gilhen, 1984). The largest Wood Turtle population in Nova Scotia (and perhaps in Canada) inhabits the watershed of the St. Marys River (Guysborough and Pictou Counties). This population, which could number as many as 1,200, is believed to have declined during the past 40 years (Pulsifer *et al.*, 2004; Juurlink, 2005).

Only in recent years has the scientific community become aware of an apparently small isolated population of Wood Turtles on the upper Annapolis River and its tributaries. In 2005 NSDNR, with the assistance of CARP, initiated a study of this population.

"Wood Turtles inhabit slow-moving, meandering intervale streams which have some sand and gravel banks for nesting and which often flow through prime agricultural land." (Gilhen, 1984). They hibernate, sometimes in groups (Harding and Bloomer, 1979; Pulsifer *et al.*, 2004), generally in deeper pools on the bottoms of streams and rivers away from the main current. In April or early May they leave their hibernation sites and move to the banks of the stream or river where, on sunny days in the late morning and afternoon, they bask for extended periods absorbing solar radiation to help in their thermoregulation. This behaviour can last for several weeks.

During June and early July, mature females seek out sand and gravel banks where they excavate a nest and lay their eggs. This process generally occurs over a period of about three hours and involves the digging of several "test holes". In some cases, this process can be repeated for several days before the eggs are finally laid and then covered with sand or gravel (Juurlink, 2005). The number of eggs laid by each female can vary from three to 13 with "normal" clutches being in the range of eight to ten (Brooks *et al*, 1992; Ernst *et al.*, 1994).

Eggs are incubated by heat from the sun and the incubation period in Nova Scotia is about 80 days but is variable depending upon weather and the microclimate of the nest site (Pulsifer *et al.*, 2004; Juurlink, 2005). Hatchlings generally emerge in September or October and make their way to streams where they overwinter.

The Wood Turtle is the most terrestrial of our four native turtle species and, in summer, can range far from water. Wood Turtles are opportunistic omnivores feeding on a variety of plants, berries and invertebrates such as slugs and earthworms.

Wood Turtles are long-lived (to 50+ years) and late to become sexually mature (> 10 years, (Harding and Bloomer, 1979)). Eggs and young Turtles have high mortality rates and recruitment rates into the breeding population are low.

Wood Turtles are quite tolerant of human activity and can be quite adaptable. However, interactions with human activity that increase mortality rates in adults and/or decrease further the naturally low rates of recruitment into the breeding population make this species very vulnerable.

Wood Turtles may be at the greatest risk of any of Nova Scotia's turtle species even if they are the most widespread. With the notable exception of the St. Marys River population, populations are believed to be small and scattered, often inhabiting areas where they come in conflict with human activities, and there are no known populations inhabiting protected areas (Herman, 1997).

Wood Turtles are under protective legislation throughout their entire range. In 1996 Wood Turtles were listed as a species of Special Concern by COSEWIC. In 2000 they were listed as Vulnerable under the Nova Scotia Endangered Species Act and are given a Yellow (Sensitive) status in the General Status Ranks of Wild Species in Nova Scotia.

6.1.2 Study Objectives

The main objectives of the Wood Turtle study were:

1) to confirm their presence or absence on or adjacent to the Scotia Aggregates Ltd. property
2) if present,
    a. to determine if, where, and when nesting occurred
    b. to offer suggestions regarding possible measures that might be taken to mitigate potential impacts of pit expansion and operation.

I have assumed that pit operations will have no impact on possible Wood Turtle hibernation sites in Walker Brook so no study was conducted to identify these areas.

6.1.3 Methods

To achieve objective 1) (above) surveys of the riparian area along Walker Brook between Marshall Road and Bishop Mountain Road were conducted on foot between mid-April and mid-June, 2005. Observers walked along the Brook parallel to the shoreline. The amount of habitat searched was dependent upon the number of observers which varied from one to four. A single observer could effectively search a zone extending 5 to 10 m inland from the shoreline, the width of the search zone being dependent upon the stage of growth of herbaceous vegetation. Additional observers could extend the coverage by 5 to 10 m depending on vegetation.

Locations where Wood Turtles were found were recorded using a global positioning system (GPS) (Garmin GPS76). Data collected from the Wood Turtles included sex, age, weight, marginal scute count (11 or 12), injuries and any identifying features. Sex could be determined in adult Turtles by plastron morphology; the adult male plastron is concave while the female's is flat. Age can be estimated by counting the annular growth rings on the plastron and carapace. Weights were taken using Pesola spring balances (1,000 and 2,000 g). When forest callipers were available, morphological measurements were taken (to the nearest mm) including maximum and minimum plastron and carapace lengths, maximum carapace width, width at bridge and maximum height. When callipers were not available, dorsal and ventral photographs were taken on a background of ¼-inch-square graph paper. Photographs were taken using both digital and 35-mm-film cameras. In addition to the above information, the date and time an animal was captured and the dominant vegetation of the location were recorded.

Except for nesting females, or when a number assignment was not available, Turtles were marked using an individual number code based on a system of notching marginal scutes originated by Cagle (1939) and revised by Dr. Tom Herman of Acadia University. Scutes were notched using a 6-mm triangular file.

To achieve objective 2)a., four potential nesting areas on the property and one on an adjacent property, all of which had been created by vegetation being mechanically removed leaving significant areas of exposed sand, were monitored between early June and early July, the period when Wood Turtles normally nest. Two of these sites are large sand extraction pits, Site 1 being the "active" sand pit and Site 2 being part of an exhausted pit that has not had any significant sand extraction in many years and is about 80 % revegetated. Site 3 is a small excavation, possibly a test pit, and Site 4 is a small, flat area that has been recently (post 2001) stripped of all vegetation and the top few inches of sand. Site 5 is a very small extraction pit on the north side of Walker Brook opposite Site 1. Sites 1 and 5 are immediately adjacent to Walker Brook whereas the other sites are at considerable distances from the Brook.

Continuous monitoring would be required over the nesting period to obtain a complete record of Turtle nesting; this is obviously impractical. However, Turtles traversing areas of exposed sand leave distinctive tracks. Heavy rains and human activity such as OHV use can obliterate tracks and light rains and wind can degrade them. However, records of the presence and location of Turtle tracks and their condition (fresh or degraded), taken periodically, together with hourly weather information available from the nearby weather station at Greenwood, provide a crude measure of timing and use of these areas during the nesting season.

During each visit to a site, a visual check was first made of the area to see if any Turtles were present. If none was present, a search was made of all the exposed sand in the area to identify Turtle tracks. If tracks were present, their location and condition (fresh or degraded) was noted and the tracks were followed in an attempt to find signs of nesting activity. If signs of nesting activity were found, the sand was carefully removed to a depth of about 15 cm to see if eggs were present. Attempts were also made to separate tracks to obtain an indication of the numbers of animals involved.

6.1.4 Results

6.1.4.1 Walker Brook Riparian Surveys

Between 18 April 2005 and 9 June 2005, four surveys were conducted of portions of Walker Brook between Marshall Road and Bishop Mountain Road (see Figure 2 and Table 5). During about 24 person-hours of survey effort, two Wood Turtles were found. Both were adults: one male and one female (see Appendix 3 for details). The shell of an adult female was also found. The shell was collected and deposited with Dr. Tom Herman of Acadia University.

All of these observations, together with observations of fresh Turtle tracks, occurred on the north boundary of the property adjacent to the large active pit (Figure 3). All of these observations took place within a distance of 110 m.

In addition to observations made during the surveys we received one report of a Wood Turtle in this area. On 24 April 2005 Catherine Crook and Michael Inkpen observed a basking Wood Turtle on the north bank of Walker Brook about 220 m east of the easternmost of our observations (see Figure 3).

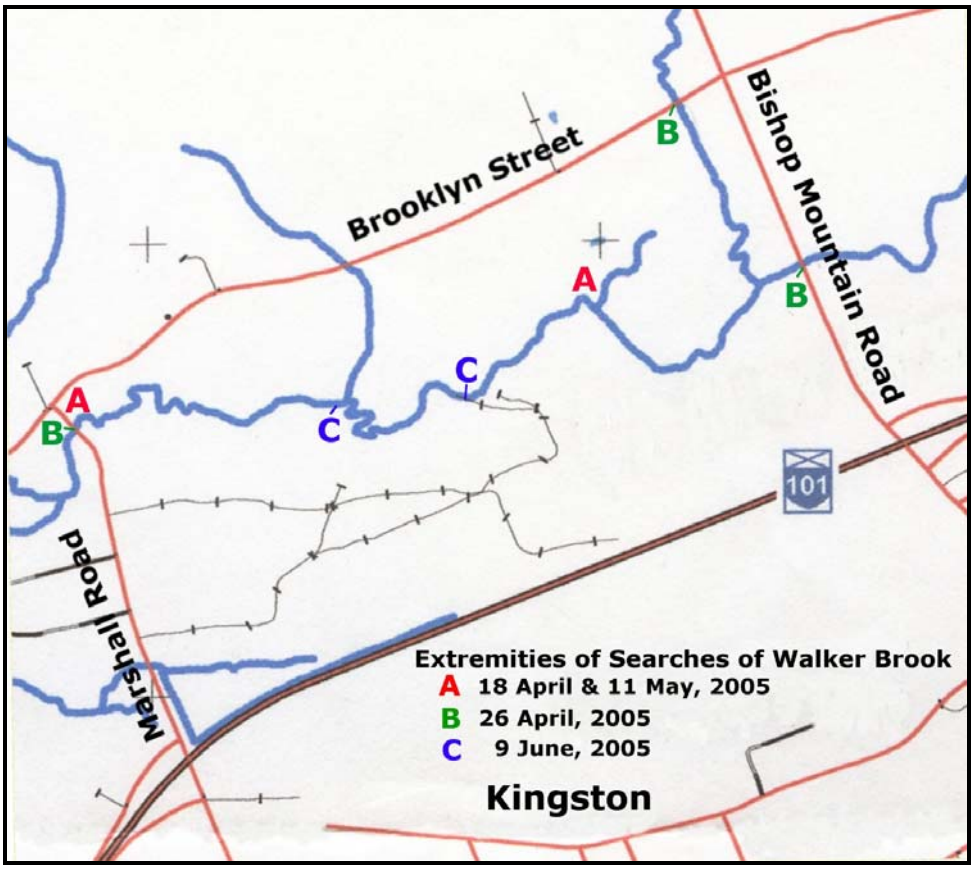


Figure 2. Locations and dates of Wood Turtle surveys conducted along Walker Brook between Marshall Road and Bishop Mountain Road, 2005.

Table 5. Searches of Walker Brook riparian areas for basking Wood Turtles in the area bounded by Marshall Road, Brooklyn Street and Bishop Mountain Road, April - June, 2005.

Date (2005)	Observers	Extremities of Search (see Figure 2) West	North	East	Person-hrs	Wood Turtles Found #	Sex	Comments
18 April	Kim Huskins (NSDNR)	A		A	4	0		
26 April	George Alliston Megan Beveridge (CARP) Bernard Forsythe John Mills (NSDNR)	B	B	B	12	1	M	-marked #501 * -also observed 2 sets of fresh Wood Turtle tracks *
11 May	John Belbin (CARP) Kim Huskins (NSDNR) Laura Van Hatten-Contant (NSDNR)	A		A	6	0		
9 June	George Alliston Bernard Forsythe	C		C	2.3	1 1	F F	-not marked * -("Turtle A") -shell only of dead Wood Turtle* -collected and deposited with Tom Herman, Acadia University.
TOTAL					**24.3**	**2**	**(living)**	

CARP Clean Annapolis River Project
NSDNR Nova Scotia Department of Natural Resources

* see Appendix 3 for co-ordinates and other details.

6.1.4.2 Nesting Study

Between 7 June 2005 and 5 July 2005, the property was visited on eleven days. Sites 1 and 4 were inspected on all nine visits conducted by the author. Sites 2 and 3 were inspected on four occasions and Site 5 was visited on six occasions. The results of these visits are summarized in Table 6.

OHVs used this property frequently during the month of June and, although some activity was observed in three of the five study sites (none in Sites 3 and 5), the activity in Sites 2 and 4 was very minor in comparison with that in Site 1. The relief in this pit makes it a destination for those whose interests are in the thrill of descending and climbing steep slopes. From the remains of campfires and broken bottles at the north end of the pit, it was apparent that this area was also a party site.

At Site 5 there had been some minor excavation done between our visits of 9 June and 23 June. The other areas were not subjected to any other obvious human impacts, other than the actions of OHVs, during this study period.

By happy coincidence, no OHVs were encountered during the times the author was collecting data at these sites. OHV activity at Site 1 made the collection of data from the observation of Turtle tracks particularly difficult. Turtle tracks were obliterated by OHV activities. Some of the tire tracks, particularly after they had been degraded by wind and rain, can look very much like Turtle tracks. Turtles would sometimes travel for some distance along depressions left by tires. So, while identification of fresh Turtle tracks was quite straightforward, the identification of tracks that had been somewhat degraded by precipitation and/or wind required very careful attention.

The only area in which Wood Turtles or their tracks were observed was Site 1. The first visit to this site was made on 7 June 2005 by Amy Marsters (NSDNR) and no Turtles or Turtle tracks were recorded. Drizzle and rain showers had occurred on 5 June, 6 June and the early hours of 7 June and would have greatly degraded or obliterated any tracks that may have been made prior to 7 June.

Thunderstorms and heavy rains on the night of 7 June would certainly have erased any tracks made prior to that time. Bernard Forsythe and I visited the site at about noon on 9 June and Wood Turtle tracks were found at several locations in the pit. The tracks were somewhat degraded suggesting that they may have been made soon after the rains of 7 June. While it appeared that there were four sets of tracks, this cannot be stated with certainty since OHVs had been in the pit subsequent to when the Turtle tracks were made disrupting the tracks and making them impossible to follow continuously. In the sections of the tracks that we were able to follow, we found no evidence of nesting activity. One set of tracks was obviously smaller than the others so we can be certain that at least two turtles were involved. It seems quite unlikely that the smaller turtle was an Eastern Painted Turtle. No Eastern Painted Turtles were observed in this section of Walker Brook during our surveys or those conducted by NSDNR and CARP (A. Marsters, *pers. comm.*). Catherine Crook and Michael Inkpen have never observed Eastern Painted Turtles in this portion of Walker Brook in their years of daily visits to this area.

Just after dawn on 11 June there were rain showers. I visited Site 1 at 1530 h with Catherine Crook and Michael Inkpen. The degraded tracks we had observed on 9 June were still visible and a single fresh set of tracks was recorded in the northeast section of the pit. I could find no evidence of nest digging activity along this track.

My visit to Site 1 on 14 June 2005 was unproductive. OHVs had been particularly active at this site sometime prior to our evening visit and had impacted almost the entire surface of the site. I remained at the site from 1915 h until dusk (2120 h) and no Turtles appeared.

Our next visit to Site 1 was on 23 June 2005 at about 1000 h. There had been showers the previous afternoon and no OHVs had visited the pit since the showers. No Wood Turtles or Turtle tracks were found.

Our next visit was on the morning of 29 June (~ 0800 h) and there had been no appreciable rainfall since our previous visit on 23 June. There were many fresh Turtle tracks in the northern half of the pit and a female Wood Turtle on the northwest embankment of the pit.

We viewed this female at a distance until about 1040 h by which time she had dug five "test holes". After she had abandoned the fifth "test hole", we captured, weighed, photographed and released the Turtle (see Turtle B, Appendix 3). We continued to view this Turtle at a distance until 1133 h by which time she had completed her sixth "test hole" and was continuing to explore the pit. We did not examine closely the other Turtle tracks for fear of further disturbing the nesting female.

On the early morning of 30 June we experienced our heaviest rainfall of the month. This rainfall would have certainly wiped out the tracks we had observed on 29 June. Catherine Crook and Michael Inkpen kindly responded to my request to check the pit for Turtle tracks during their afternoon walk in this area. They reported many fresh Turtle tracks in the northern half of the pit.

There had been some drizzle in the early morning of 1 July. I arrived at the pit at 0813 h and found no Turtles or fresh Turtle tracks; however, the somewhat degraded tracks reported the previous day were still very evident. The tracks from the Turtle we had monitored on 29 June were not. There had been some disruption of the tracks by a pickup truck. I followed the tracks and dug in several depressions along the tracks but was unsuccessful in locating a Turtle nest.

Visits to the pit on 3 July (Alliston), 4 July (Marsters), and 5 July (Alliston) indicated no further Turtle activity.

Although the five areas monitored for use by nesting Wood Turtles include the major available areas, there are many other small areas of exposed sand scattered over the property. Some of these areas were examined on an opportunistic basis in the course of our work. No evidence of Turtle activity was observed in any of these locations.

On 29 June we discovered a small area (about 4 m long) in an incompletely vegetated patch at the western edge of a field to the north of the Scotia Aggregates Ltd. property (see Figure 3) that contained twelve small "pits" that might have been the work of turtles. We dug in several of these pits but found they were shallow and contained no turtle eggs. These pits were much smaller than would be expected if they were dug by Wood Turtles. I returned to this area on 1 July and 5 July but no further activity was observed.

In summary, our observations on the Scotia Aggregates Ltd. property during the 2005 Wood Turtle nesting season indicated that:

1) Wood Turtles used only one of the five potential nesting sites that were monitored.
2) Wood Turtles used this area starting in early June and ending the last day of June.
3) Although no nest sites were found, nesting activity was directly observed on 29 June 2005 and could be inferred from the activities of the Turtles as displayed by their tracks.
4) While the activities of Turtles using the pit earlier in June appeared to be somewhat more widespread, during late June, when nesting activity was confirmed, the Turtles were restricting their activities to the northern half of the pit.

Table 6. Surveys of potential Wood Turtle nesting sites - 7 June - 5 July, 2005.

Date (2005)	Observers	Time (h) (Site 1)	Turtle Tracks Site 1	2	3	4	5	Last Rainfall Date (2005)	Time (h)	P*	Comments (Site 1)
7 June	AM	0930-1030	NT	-	-	-	-	Ø	Ø	Ø	Ø intermittent D, RS on 5 June - 7 June
9 June	GA BF	1130-1200	T_d	NT	NT	NT	NT	7 June	2200-2300	HR	Turtle tracks in all sections of the pit
11 June	GA CC MI	1530-1615	T_f T_d	-	-	NT	-	11 June	0600-0800	RS	single set of new tracks (ne portion of pit)
14 June	GA	1915-2120	NT	-	-	NT	-	11 June	0600-0800	RS	entire pit surface disturbed by recent heavy OHV use
23 June	GA BF	1000-1021	NT	NT	NT	NT	NT	22 June	1200-1700	RS	no OHV activity since last rain
29 June	GA BF	0802-1133	T_f	-	-	NT	NT	22 June	1200-1700	RS	Wood Turtle digging "nest holes" during entire observation period. Many fresh Turtle tracks on n, ne and nw portions of pit
30 June	CC MI	~1530-1600	T_f	-	-	-	-	30 June	0200 0300-1200	HR RS	many fresh Turtle tracks on n, ne and nw portions of pit
1 July	GA	0813-1004	T_d	NT	NT	NT	NT	1 July	0200-0900	D	tracks are those made on 30 June
3 July	GA	0758-0809	T_d	NT	NT	NT	NT	2 July	0000-0400	RS	no new tracks
4 July	AM	~1800	NT	-	-	-	-	2 July	0000-0400	RS	
5 July	GA	2013-2037	T_d	-	-	NT	NT	2 July	0000-0400	RS	no new tracks

Observers

GA	George Alliston
BF	Bernard Forsythe
AM	Amy Marsters (Nova Scotia Department of Natural Resources)
CC	Catherine Crook (Volunteer)
MI	Michael Inkpen (Volunteer)

Site Codes

NT	no Turtle tracks
T_f	"fresh" Turtle tracks
T_d	"degraded" Turtle tracks

*** Precipitation Codes**

D	drizzle
HR	heavy rain
RS	rain showers

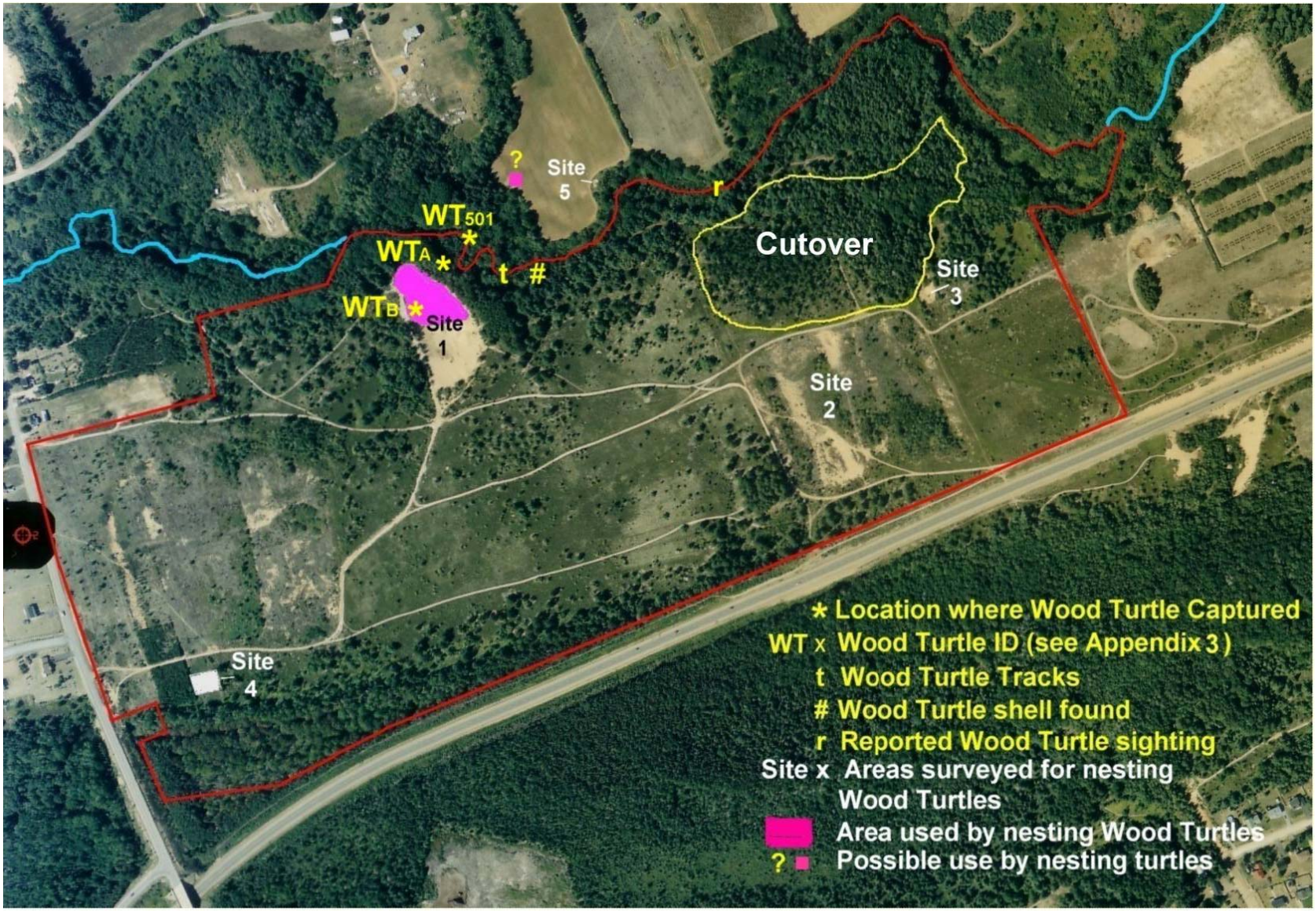


Figure 3. Wood Turtle observations and sites surveyed for nesting activity, 2005.

6.1.5 Discussion

Wood Turtles were not distributed randomly along Walker Brook. In the area between where the Brook crosses Highway 101 and the Bishop Mountain Road, all Turtles that have been found to date were found in the area adjacent to the "active" pit site (Site 1). In 2004, two Turtles were found in this area during a preliminary search conducted by John Mills, Amy Marsters and Kim Huskins of NSDNR. In 2005, three Turtles were captured in this area, the shell of a dead Turtle was found here, and it was the only portion of this section of the Brook where Turtle tracks were recorded in our 26 April search of riparian areas.

We do not have a good estimate of the numbers of Turtles using this area. A minimum estimate would be three (the number of individuals captured in 2005) or perhaps even four if we include the individual whose tracks were noticeably smaller than the others. More likely the real number is two to three times that number; however, this is speculation.

With the work conducted this year by NSDNR and CARP, we can view this subpopulation in the context of what is now known of this upper Annapolis River population. In 2005, 28 individual Turtles were captured (Amy Marsters, *pers. comm.*) three of which were in or adjacent to Site 1. This would suggest that the subpopulation using Site 1 could represent roughly 10 % of the upper Annapolis River Wood Turtle population as we currently know it.

Of the five potential nesting sites monitored for activity by Wood Turtles during June and early July, only in the "active" sand pit (Site 1) was any activity recorded. This sand pit is much closer to Walker Brook than all other sites except Site 5; it also provided the largest area of potential nesting habitat and more relief than any of the other areas censused.

Our observations indicated that in 2005 there were two periods of activity by Wood Turtles in the "active" sand pit: one in early June (*circa* 9 June) and the other in late June (*circa* 29 June and 30 June). After considerable activity on 29 June and 30 June, all Wood Turtle activity in the pit abruptly ceased.

We were able to confirm nesting activity only during the burst of activity in late June.

Our observations seem to coincide with the view put forward by naturalists Catherine Crook and Michael Inkpen developed from observations made during their daily walks through this area over the past 18 years. They have noted a period of activity in the pit site sometime

between mid-May and early June, depending on the earliness or lateness of the spring, followed by a period of little or no activity and then, in the latter half of June, a short period of intense activity. Their impression is that the early period of activity is an exploration of the site and that nesting does not occur until the burst of activity in the latter half of June.

On the other hand, at nearby Fales Brook, Amy Marsters (*pers. comm.*) recorded peak nesting activity occurring *circa* 9 June 2005, the same time we recorded our first period of activity at the pit site. Although we found no evidence of nesting at that time, our data is insufficient to rule out that possibility.

Wood Turtles did not use all areas of the "active" pit equally. On 9 June 2005, we observed one set of tracks that climbed the steep slope that forms the south end of the pit, and disappeared into the vegetated areas to the south. This was the only track we found on the south face of the pit during our investigation. Although the tracks were a bit more widely dispersed in the period of activity in early June, activity in late June, when nesting was confirmed, was confined entirely to the northern half of the pit. In late June we found tracks on both the east and west slopes of the northern portion of the pit and the Turtle we observed exhibiting nesting behaviour was active on the west side of the pit. Catherine Crook and Michael Inkpen's observations over the years suggested that most nesting activity occurred on the northeastern side of the pit.

The slope of the southern face of the pit site is very steep and Buech *et al.* (1997a) found that, in their Minnesota study area, nesting Wood Turtles did not use slopes of greater than 40° and, for slopes between 40° and 20°, preferred an east-southeast to west-southwest exposure which seems to agree with our observations. Buech *et al.* (1997a) found that if the slope was <20° no preference for exposure was found.

We obtained little data on the distances Wood Turtles moved from Walker Brook into surrounding habitats. The areas within the northern half of the "active" pit, where nesting was observed, were within a distance of about 100 m from Walker Brook. The furthest we observed a Turtle track from Walker Brook was about 180 m. Harding and Bloomer (1979) found most Wood Turtles in their Michigan study populations confined their activity to within 150 m of streams. Arvisais *et al.* (2002), using telemetry, found that in their southern Québec population, 90% of their Turtle sightings were within 150 m and no sightings were made beyond 300 m from a stream. Studies in southern Ontario by Forscani and Brooks

(1997) and Quinn and Tate (1991) found Wood Turtles ranging as far as 500 m from streams.

6.1.6 Conclusions and Recommendations

Buech *et al.* (1997a) state that "… Wood Turtles prefer nesting areas that are generally very sandy, bare, well exposed to solar radiation and close to water (<200 m) but elevated (>1 m above normal water level)." The "active" sand pit has provided Wood Turtles with such nesting habitat close to Walker Brook; however, the pit has also helped create an environmental trap for the small population that nests here.

Wood Turtle eggs and hatchlings normally suffer high mortality rates due largely to predation. Natural predators that occur in this area include the Raccoons and Striped Skunks that patrol the Brook and the neighbouring residences, Red Foxes that den near the pit, Coyotes that frequent the area, Common Ravens that nest in the pine trees immediately to the east of the pit site and American Crows that nest and forage in this area. However, it is the level of OHV activity in the pit site that currently poses the greatest threat to this population. The entire pit surface is impacted by these vehicles. If the level of activity observed in June continues through the incubation period (June through October), it is difficult to believe that any Wood Turtle nests in this pit could successfully produce young. If, as I suspect, most Turtles in this small subpopulation nest at the pit site, the chances of the subpopulation maintaining itself are next to nil. Since the current situation, if allowed to persist, will almost certainly decrease or eliminate recruitment and lead to further decline of this small subpopulation, effective mitigation measures associated with the proposed development could result in a positive impact upon this subpopulation. Current interest in the upper Annapolis River population of Wood Turtles by government agencies, the academic community and ENGOs provides an opportunity for a co-operative approach in arriving at a solution to this existing problem.

The elements involved include the Wood Turtles, the proposed development, and OHV activity. In the following suggestions, I have assumed that OHV activity will continue at some level on the property.

The only suggestion that I can offer that does not involve the use of barriers would be the establishment and maintenance of favourable nesting habitat on the floodplain of Walker Brook or the embankment between the pit site and Walker Brook in an attempt to "short

stop" nesting females before they reach the pit site. This would require the clearing of trees to allow adequate insolation of potential nesting areas and either surficial clearing or addition of substrate (sand) to provide the bare, sandy areas favoured by nesting Wood Turtles. Nesting areas on the floodplain should be at least 1 m higher than normal water levels and any sites on the embankment should have a slope of <20° (Buech *et al.*, 1997a). To do this could present some logistical challenges, would likely require regular maintenance and would have to be implemented very carefully so as not to impact Walker Brook or the embankment.

Other, perhaps better, options that I can suggest involve barriers and the problems that are associated with them: maintenance and vandalism. Barriers can serve the function of keeping OHVs out, keeping Wood Turtles in, or both, depending upon what is required.

One suggestion would be a barrier running parallel to the Brook, south of the top of the embankment north of the pit site. The primary function of this barrier would be to prevent access to the pit area by nesting Wood Turtles. The barrier could be constructed so that it blocks no existing OHV trails and also allows access by Turtles to potential nesting areas along the top of the embankment. Blockage of access to their preferred nesting habitat could present a challenge to the Turtles who are known to sometimes travel several kilometres in search of nest sites (Buech *et al.*, 1997b) and whose navigational skills are excellent. Their abilities to find their way through mazes are reported to be comparable to such highly intelligent mammalian species as the rat (Tinklepaugh, 1932). So as not to challenge these skills, it would be appropriate to conduct some nesting habitat enhancement in the area between the top of the embankment and the barrier.

A potential downside of this approach is that if the barrier were successful but the enhanced habitat was not, this could result in Turtles using nearby pits to the north of Walker Brook or, indeed, other areas of this property thus not solving the problem but transferring it to another location. A stepwise approach might be required if this approach were to be implemented.

A third suggestion is a variation on the second but extending the barrier into the north end of the pit to include some or most of the areas known to be used by nesting Wood Turtles. The primary function of this portion of the barrier would be to exclude OHVs from the areas used by nesting Turtles but not restrict access to the steep slopes of the southern half of the

pit used by the thrill-seeking OHV users. This barrier could also be constructed to restrict the travel of Turtles into the areas used by OHVs. While this might be the best approach as far as the Wood Turtles are concerned, it would most likely be the most difficult to implement. A barrier such as this would likely be viewed by some OHV users as a challenge to be overcome.

OHV users in this area are likely to be unaware that they are impacting a species at risk. Making OHV users aware of the presence and vulnerability of this species should be a straightforward task best performed by government, universities or ENGOs. Education is a necessary but not sufficient approach. A small but significant segment of the OHV users have limited respect for environmental concerns but a highly developed sense of entitlement.

For a scheme involving barriers to be successful, and particularly barriers that restrict access to areas "traditionally" used by OHV users, it is necessary to obtain some sort of "buy-in" by at least a portion of these OHV users. One of the ways to access OHV users is through local clubs but perhaps an even better way could be to approach those actually using the pit, explain the situation and solicit their opinions and input before any action is taken and, if possible, recruit stewards from their ranks. This is a tall order which may or may not be successful but should be tried, especially if the third option is selected. Dr. Tom Herman (*pers. comm.*), of Acadia University, has had some rather impressive success with this approach in the work he and his students are conducting on Blanding's Turtles. This would be a task best conducted through co-operation with academic institutions and/or ENGOs.

The construction of barriers will require appropriate design depending on their function. If the main function is to either prevent Wood Turtles from accessing an area or to direct them to another area, several features must be considered in the design: height, burying depth, opacity, mesh size, durability and maintenance (see Boarman *et al.*, 1997). Consideration must also be given to the potential effects of such a barrier on other wildlife species using the area.

Any of the above approaches are experimental and would require input from an experienced herpetologist for their final design. Annual monitoring would be required to assess the efficacy of the measures.

While the above suggestions focus on the correction of an existing problem, if effective they could also mitigate the potential impacts of the proposed expansion of extraction activities. I would recommend, however, that until mitigative measures are shown to be effective, that any new extraction activity be conducted in areas that are at least 300 m from Walker Brook.

Noise from pit activities could disturb and possibly displace Wood Turtles from their nesting habitat. I have not been successful in finding any research regarding the indirect impacts of noise on Wood Turtles; however, studies conducted by Garber and Burger (1995, 1997) indicate that Wood Turtles are sensitive to disturbance. It would seem prudent for pit operations to be excluded within a radius of 200 m from any known Wood Turtle nesting areas during the nesting period (late May to early July).

6.2 Other Amphibians and Reptiles

Observations of reptiles and amphibians, other than the Wood Turtle, were made opportunistically during the conduct of other studies. No additional reptile species were observed. Only three species of amphibians were recorded: Spring Peeper, Green Frog and American Toad.

7.0 BREEDING BIRDS

7.1 Breeding Bird Surveys

7.1.1 Objective

The primary objective of the surveys was to confirm the presence of any breeding bird species at risk and, in particular, the priority species identified above.

7.1.2 Methods

7.1.2.1 Raptorial Birds

A survey directed specifically at identifying any raptorial bird species at risk, namely Northern Goshawk and Long-eared Owl, was conducted during the evening (1818 h to 2053 h) of 26 April 2005. Mr. Forsythe and I walked the woodlands at the periphery of the property looking for raptors or their nests as well as the nests of American Crows and Common Ravens. Long-eared Owls often take over and use nests made by these birds. When a nest was found it was observed for activity and, if none was observed, the area under the nest was checked for fresh fecal material, feathers, and pellets. If these actions did not reveal the presence and identity of the potential occupant, where possible the tree

was climbed and the nest contents examined. The location of any nest sites were recorded using a global positioning system (Garmin GPS76).

As dusk approached we walked the edges of the woodland making calls of the Long-eared Owl, as well as those of Barred Owls, Great Horned Owls and Northern Saw-whet Owls, in an attempt to elicit a response should any of these species be present. Occasionally imitations of the squeaks of rodents would be made, again in an attempt to attract owls.

7.1.2.2 Songbirds

The priority species at risk for our census were Vesper Sparrows, Bobolinks, and Eastern Bluebirds, with Eastern Meadowlarks being a possibility. These birds breed in open areas; however, for the sake of completeness, our 9 June 2005 survey also included woodland habitats.

Since most breeding birds are most easily identified by their songs or calls, and peak singing by territorial birds usually occurs in the early morning, surveys were begun just before sunrise. Survey dates were chosen when the weather was neither rainy or windy, either of which could result in a decrease in bird song and impede our ability to hear these songs. Two observers, Bernard Forsythe and I, conducted these surveys. Both observers were equipped with 10x binoculars. Observations were recorded on a digital voice recorder. GPS positions were taken for observations of any species at risk. The routes taken during the survey were divided into transects based mainly on the habitat type being surveyed.

7.1.3 Results and Discussion

7.1.3.1 Raptorial Birds

Only a single raptorial bird was recorded on our 26 April visit to the property; a Merlin was heard calling somewhere north of the northeast boundary of the property. This was the only time a Merlin was recorded during any of our visits to the property. Nesting Merlins are very noisy, particularly so when intruders are near their nest site. Had there been a nest on the property it would have been found.

Two nests were found on our survey: one belonging to a Common Raven and another belonging to an American Crow. (For coordinates of these nests, see Appendix 4.) The Raven nest was in a stand of Red Pines immediately to the east of the active pit and contained unfledged Raven young. The Crow nest was in a small stand of Red Pines

immediately to the east of the property's east boundary. This nest had been used in 2005 but had been predated and was not occupied.

There was no indication of either Long-eared Owls or Northern Goshawks (both species at risk) using the property. Long-eared Owls are specialists that feed on mice and require substantial mouse populations to feed a nesting pair with young. The major habitat on this property is sand barren that does not support significant mouse populations. Even adjacent farm fields provide only moderate to poor mouse habitat. Barred Owls and Great Horned Owls have a much more diverse diet and would be more likely to occur here although neither species was recorded on any of our visits.

Although this property might constitute a small portion of the large home range of a Northern Goshawk, it does not contain appropriate nesting habitat. Northern Goshawks tend to prefer large tracts of mature forest in which to nest.

The only raptor actually seen during all our visits to the property was a Red-tailed Hawk that was observed flying over the property on 3 July.

7.1.3.2 Songbirds

This survey was conducted on 9 June 2005 between 0500 h and 0855 h.

The transects surveyed during this breeding bird survey of the entire property are shown in Figure 4. Transect F was confined to the disturbed sand barrens at the west of the property. Transect A includes observations from these same disturbed barrens as well as the narrow open forest transition and the forested wetlands to the south. Transect B includes observations from relatively undisturbed sand barrens as well as the small area of wetlands to the south. Transect C traversed a mix of both disturbed and relatively undisturbed barrens. Transect D was the longest transect and was through closed woodlands following the top of the embankment on the south side of Walker Brook. Observations taken along this transect include birds using floodplain habitats, which included both Red Maple dominated closed forest and sedge/alder dominated meadows (eastern extremity only), the closed drier forests of the embankment, the closed forest at the top of the embankment and the cutover area. Transect E was through an area of open forest.

Table 7 presents the information collected on bird species and their distribution on the property (also see Figure 4). The data in Table 7 were obtained primarily from the surveys of breeding birds conducted on 26 April and 9 June. However, when a species was observed only, or in greater numbers, on other visits to the property, these data are included in Table 7 and the inclusions noted. (Note: Data from the Vesper Sparrow survey (see below) are not included.)

A total of 59 bird species was recorded on or immediately adjacent to the property. Of these we can be quite certain that three (Red-tailed Hawk, Merlin, Herring Gull) did not nest on the property (see below) and another species, the Brown-headed Cowbird, is an obligate parasite that does not nest but deposits its eggs in the nests of other birds. While it is possible, I believe it to be unlikely that the small flocks of Red Crossbills observed during the survey and a single small flock of Evening Grosbeaks observed on 1 July indicated nesting by these species on this property.

A single Bobolink was recorded during an "opportunistic" visit to the property by Mr. Forsythe on 25 May. Since no subsequent observations were made of this species, I have concluded that this bird was a migrant and that Bobolinks did not nest on this or adjacent properties in 2005. Therefore, of the 59 species observed, 52 may have nested on the property in 2005. Only one of these species, the Vesper Sparrow, is considered a species at risk.

Eight Vesper Sparrows were recorded during the 9 June survey; four were on the Scotia Aggregates Ltd. property and four were on adjacent properties.

We observed during the 9 June survey and on visits to the property on 11 June, 14 June and 18 June, that territorial Vesper Sparrow males were reluctant singers. Short bursts of song were often followed by very long periods of silence. So while our survey of 9 June established the presence of this species on the property, it did not necessarily provide a good estimate of the numbers present or their distribution. To do this, another survey using different survey methods was devised and conducted (see "Vesper Sparrow Survey" below).

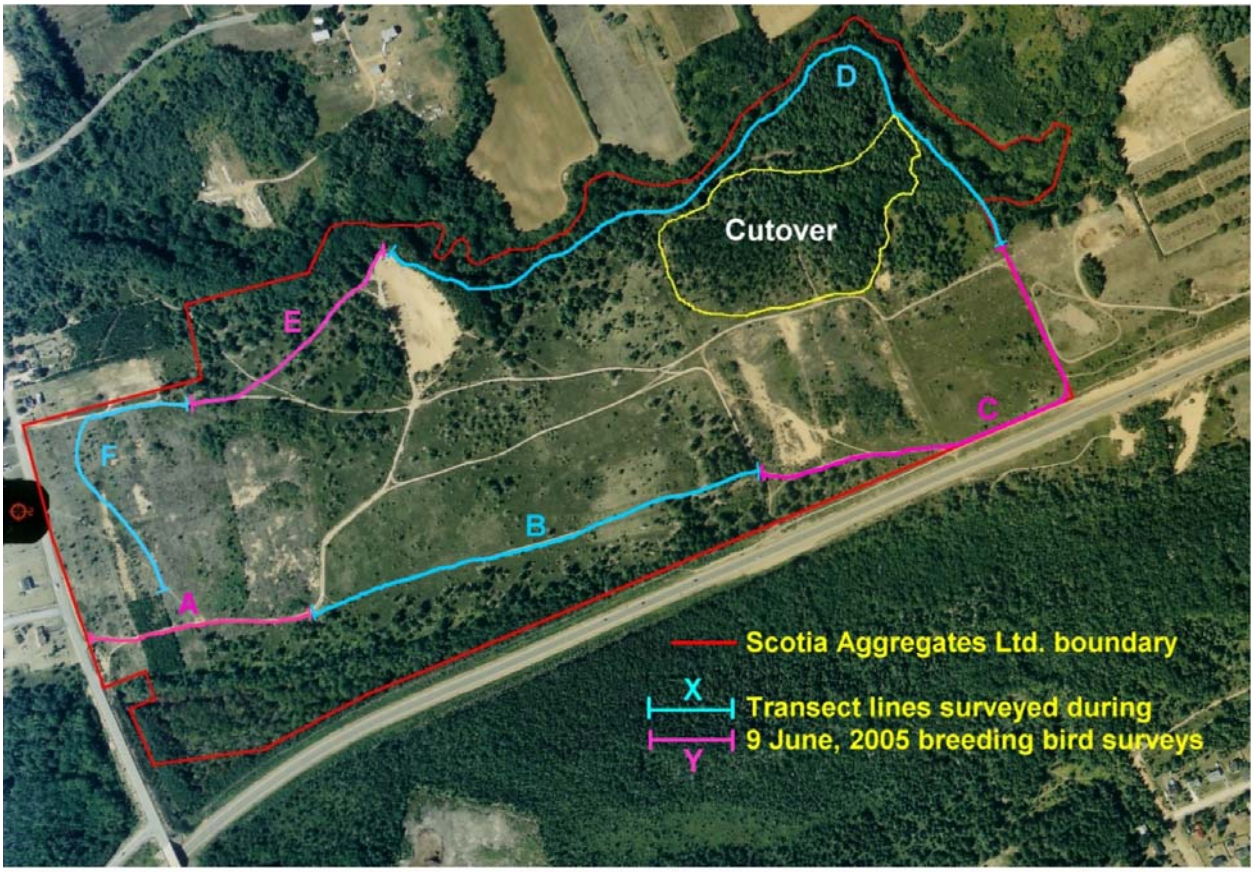


Figure 4. Transects followed during breeding songbird census, 9 June 2005.

Table 7. Scotia Aggregates Ltd. property - breeding bird surveys 26 April 2005 and 9 June 2005.

	Transect (see Figure ?)						
	A	B	C	D	E	F	Total
Wood Duck					1 *		1
American Black Duck				1			1
Ring-necked Pheasant		1		2			3
Ruffed Grouse				2 *			2
Red-tailed Hawk				1 **			1
Merlin				1 *			1
Wilson's Snipe				1 *			1
American Woodcock						2 *	2
Herring Gull		3					3
Mourning Dove	2		1	3			6
Belted Kingfisher		1		1			2
Downy Woodpecker			1	1			2
Hairy Woodpecker				1			1
Northern Flicker		1	2				3
Eastern Wood-Pewee		1		7	1		9
Alder Flycatcher		4	2	11			17
Blue-headed Vireo		2					2
Red-eyed Vireo	1			5	2		8
Blue Jay			2	3			5
American Crow	7	11	1	3			22
Common Raven		2		6			8
Black-capped Chickadee	2	8		6	1	2	19
Red-breasted Nuthatch				3			3
White-breasted Nuthatch				2			2
Brown Creeper		1		1			2
Veery				4			4
Hermit Thrush		1	2	2			5
American Robin	7	6	1	6	2	4	26
Gray Catbird				2			2
European Starling			5	4		2	11
Cedar Waxwing				2			2
Nashville Warbler		1		3	1		5
Northern Parula				5			5
Yellow Warbler				2	1		3
Chestnut-sided Warbler			2	6	1		9
Magnolia Warbler		2					2
Yellow-rumped Warbler		2	1	2	1		6
Black-and-white Warbler	2	4		5			11
American Redstart				2			2
Ovenbird		1	1		1		3
Northern Waterthrush		1					1
Common Yellowthroat				3	1		4

Table 7 (continued)**. Scotia Aggregates Ltd. property - breeding bird surveys 26 April 2005 and 9 June 2005.**

Chipping Sparrow						2	2
Vesper Sparrow		1	3	3 Ø		1	8
Savannah Sparrow						1	1
Song Sparrow	7	3	5	6	1	7	29
Swamp Sparrow				1			1
White-throated Sparrow	3	8	1	4	1		17
Dark-eyed Junco	2	7	4	4	5	3	25
Bobolink	1 Ω						1
Rose-breasted Grosbeak				1			1
Red-winged Blackbird		2		1			3
Common Grackle	2	1		3		1	7
Brown-headed Cowbird				3	2		5
Purple Finch	2	2					4
Red Crossbill	3	4	6	4			17
Pine Siskin				2			2
American Goldfinch		10	2	18	2	6	38
Evening Grosbeak	6 ***						6
TOTAL	**47**	**91**	**42**	**159**	**24**	**31**	**394**

* recorded on 26 April 2005
** observed flying over property on 3 July 2005
*** observed as a flock on 1 July 2005
Ø in fields north of Walker Brook
Ω recorded on 25 May 2005

7.2 Vesper Sparrow Survey

7.2.1 Objectives

The objectives of this study were:

1) to attempt to gain a better understanding of the numbers and distribution of territorial Vesper Sparrows on the property using different methods than those used in the 9 June survey;
2) to compare the results of the "new" survey methods with those obtained using the previous survey methods.

7.2.2 Background

"The Vesper Sparrow is distributed across North America from the Maritimes to British Columbia and from California to North Carolina. Its main range comprises the prairie grasslands of the west, but it is scattered thinly across the more open areas of the Maritimes. It is characteristic of areas with short grass or low shrubs, such as pastures,

blueberry fields and clearings where scattered trees and taller shrubs are used as song posts." (Erskine, 1992)

It seems likely that Vesper Sparrows were rare in Nova Scotia prior to European settlement since the habitats they prefer would have been quite rare. The sand barrens would have been one such naturally occurring habitat that could have been used by Vesper Sparrows.

Settlement and the clearing of the forests greatly expand the habitat available to this species and for a century it prospered. During the past half century, however, poor farmlands have been abandoned and either developed or allowed to return to forest while good farmland has been subjected to intensive agricultural practices. With these changing land practices Vesper Sparrow numbers have decreased markedly in Nova Scotia and throughout southeastern Canada. It is the rarest regularly breeding sparrow species in the Maritimes and Erskine (1992), based on a very limited database, estimates the Nova Scotia breeding population at about 200 pairs.

In some situations Vesper Sparrows can be a very resilient species. In the plains and prairies of North America, where few species of birds have been able to coexist with the extensive monocultures of modern agriculture, Vesper Sparrows are one of the most common breeding birds (Rodenhouse and Best, 1983, 1994). These Vesper Sparrows use hedgerows for singing perches and forage along the edges of these fields. In these situations, these ground-nesting birds generally build their nests in the crop fields.

Vesper Sparrows are given a Yellow (Sensitive) designation in the General Status Ranks of Wild Species in Nova Scotia but are not recognized as a species at risk by COSEWIC or under the Nova Scotia Endangered Species Act.

7.2.3 Methods

In this study two consecutive surveys of the property were conducted for Vesper Sparrows. Both surveys were confined to the open habitats on the property where use by Vesper Sparrows had been established by our previous work. The first survey was conducted using the same methods as in the 9 June survey (see above) only the survey route was confined to the vehicle trails that circumscribe the areas of open habitat. This survey was followed immediately by a second survey, this time following an irregular course through the centre of the open habitat playing a tape recording of the song of a Vesper Sparrow. A sequence of

five to ten songs was played and we would then wait for several minutes to observe any reaction (singing/scolding) by territorial birds. This was repeated one or more times. Vocalizing birds were noted and GPS positions were taken of their singing perches. We then moved on for 100 m or so and repeated the process. Best efforts were made to keep track of birds so that repeat counts of the same bird were not made.

7.2.4 Results

During the first survey conducted on 23 June (0517 h to 0650 h), using the same methods as in the 9 June survey, we recorded five territorial Vesper Sparrows, the same number as recorded in this area on our 9 June survey.

During the second survey (on 23 June, 0650 h to 1101 h) in which we used the recorded Vesper Sparrow songs, 17 vocalizing Vesper Sparrows were recorded on the property and another two were recorded on adjacent properties to the east. The locations of the singing perches of these birds, plus three birds recorded in fields north of the property on our 9 June survey (this area was not surveyed on 23 June) are presented in Figure 5. The coordinates of these singing perches are recorded in Appendix 4.

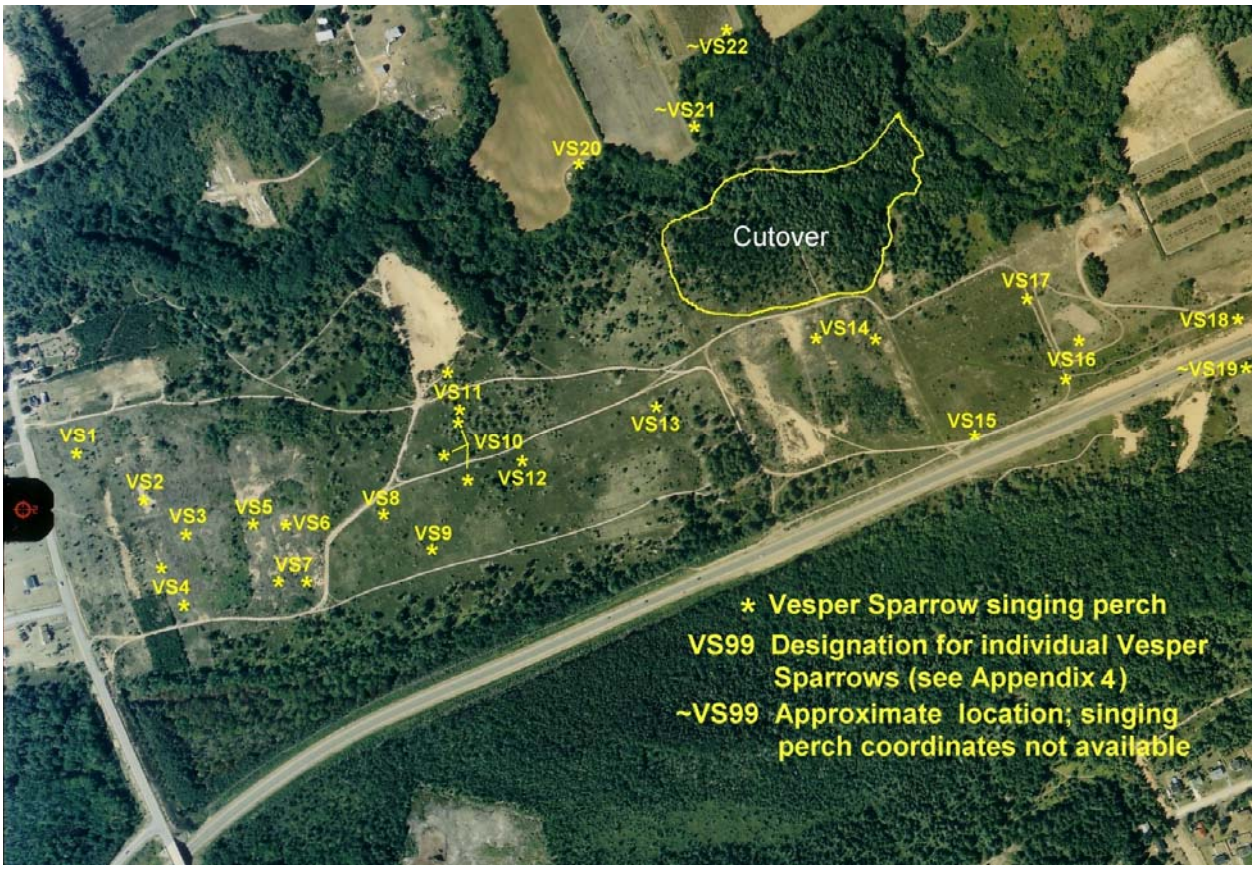


Figure 5. Singing perches of Vesper Sparrows recorded during a census conducted on 23 June 2005.

Table 8. Mammals and mammal sign recorded on the Scotia Aggregates Ltd. property - April - July, 2005.

	Observed	Sign
American Red Squirrel	√	√
Eastern Chipmunk	√	
American Beaver		√
Coyote		√
Red Fox	√	√
Raccoon		√
Striped Skunk		√
White-tailed Deer	√	√

7.2.5 Discussion

While the results of the surveys conducted on 9 June and 23 June using the same methods produced the same numerical results (five), these varied markedly from the survey in which recordings of Vesper Sparrows were used, almost four times (19) as many territorial birds being recorded using the latter methods. The apparent reticence of these Vesper Sparrows to sing is in sharp contrast with the author's previous experience with this species.

Vesper Sparrows did not appear to be uniformly distributed throughout available habitats. Highest densities appeared to occur in the western half of the property. While the area that was cut over in 2002 appeared as if it could provide appropriate habitat, no Vesper Sparrows were observed there during our surveys or any of our visits to this area. Only a single Vesper Sparrow was recorded using the old pit site.

At the eastern end of the property, where Vesper Sparrow habitat intersects with Highway 101, Vesper Sparrows did not appear to avoid the areas immediately adjacent to this very busy highway. We observed singing perches of four Vesper Sparrows that were within about 20 m of the highway. On one occasion I watched for about ten minutes as a Vesper Sparrow foraged along the shoulder of Highway 101 sometimes approaching as close as a metre to the pavement as traffic sped by.

A total of 22 Vesper Sparrow territories were identified during this study: 17 on the Scotia Aggregates Ltd. property and five on properties immediately adjacent. Erskine (1992) estimates the breeding population of the entire province at 200 pairs although he indicated that, "Estimates of numbers here are little more than guesswork…". Even if Erskine's estimates are low by several hundred percent, it would seem that this population of Vesper Sparrows is a significant one. Unlike for the Wood Turtle where, thanks to the work carried out by NSDNR and CARP, we have a local context within which to view our data, such information does not exist for the Vesper Sparrow.

7.2.6 Conclusions and Recommendations

Despite their significant decline in recent decades throughout eastern North America, Vesper Sparrows are in many ways a fairly resilient species. Their ability to adapt and survive, although not necessarily prosper, in areas of intensive agriculture is quite unique (Rodenhouse and Best, 1983, 1994; Alliston, 2003). In the situation we are currently investigating, it seems clear that this local population has adapted to the noise and

disturbance caused by the busiest highway in the region. At the western end of the Scotia Aggregates Ltd. property, where past disturbance (presumably agriculture) has altered the vegetation of the open barrens, territorial Vesper Sparrows were found in as high, and possibly higher, densities than on the adjacent relatively undisturbed open sand barrens. (This cannot be said for the old pit site.)

Despite their apparent adaptability, and their adaptations to life in sparsely vegetated habitats, Vesper Sparrows will be excluded from areas stripped of vegetation to accommodate pit operations. The larger the area of open barrens that is denuded of vegetation at any time, the smaller the Vesper Sparrow population the property will support. The smaller the population the more subject it is to impacts from "random" events, either natural or man-induced. It is possible that this population is just a portion of a much larger local population; however, this is not known and cannot be assumed in evaluating potential impacts.

The impact of extraction activities on the population of Vesper Sparrows will be largely a function of the extent vegetation is cleared from the open barrens at any given time to accommodate pit operations.

Pit operations in the open forest or cutover areas at the north of the property would cause a minimal impact on Vesper Sparrow populations since they do not use these areas. However, this would have to be weighed against potential impacts on Wood Turtles.

Minimizing impacts of pit operations in the open barrens used by Vesper Sparrows would involve minimizing the footprint of the operation in this habitat. The allocation of ancillary facilities associated with the operation (if, in fact, there are any) to less sensitive areas could be a possibility. The prompt replanting of areas where excavation had been completed could, if the proper conditions exist and when properly executed, speed the process of restoring Vesper Sparrow nesting habitat and help to minimize the effective footprint of the operation.

I also recommend the breeding Vesper Sparrow population be monitored by conducting an annual census on the property.

8.0 MAMMALS

Mammals and their sign were observed opportunistically during the conduct of other studies. A list of the eight mammal species recorded is presented in Table 8. The mammal species recorded are mainly the common species found in this area. American Beaver activity was frequently noted along Walker Brook and at the headwaters of its tributary. A Beaver dam was observed on Walker Brook just west of Marshall Road and another dam where the tributary to Walker Brook passes under Marshall Road had been recently removed.

Four Red Fox dens were found on the property (see Appendix 5 for coordinates); two were active in 2005 but probably not simultaneously. No sign of Varying Hare was observed on the property.

9.0 MIGRATORY BIRDS CONVENTION ACT (1994)

While the Migratory Birds Convention Act (1994) deals mainly with regulations concerning the hunting, capture and possession of migrating birds and their eggs and nests, it also applies to situations where "nests may be damaged, destroyed, removed or disturbed". To meet these obligations under this Act, it is recommended that Scotia Aggregates Ltd. should:

1) remove overburden, and the wildlife and bird nesting habitat it supports, only during the time period when migratory birds do not normally nest (August through March);
2) not remove sand from embankments used for nesting by such species as the Belted Kingfisher and Bank Swallow during periods when their nests are active (May through July);
3) avoid, where possible, the nests of ground-nesting birds species that are sometimes attracted to extraction pits (e.g. Killdeer, Spotted Sandpiper, Common Nighthawk);
4) assure that all toxic materials that might be used in the pit operations (e.g. 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 appropriate protocols.

10.0 ACKNOWLEDGEMENTS

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John Mills, Regional Biologist, NSDNR, for "showing us the ropes" by permitting Bernard Forsythe and me to join him and other staff from NSDNR, CARP and Acadia University in his first survey effort on Walker Brook in 2005.

Amy Marsters, Forestry Technician Assistant, NSDNR, for sharing information relevant to the area we were studying collected by NSDNR, CARP and volunteers during their broader investigation of the Wood Turtles of the upper Annapolis River watershed.

Dr. Tom Herman, Professor, Acadia University, for sharing his insights into Wood Turtle behaviour and for allowing me to access his library.

Catherine Crook and Michael Inkpen for sharing their observations and insight, gained through 18 years of daily walks in this area, into the behaviour of this small Wood Turtle population and also for responding to my request and making observations at the pit site on a day I could not be there.

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Inkpen, Michael, Naturalist, Kingston, Nova Scotia.

Marsters, Amy, Forestry Technician Assistant, Nova Scotia Department of Natural Resources, Kentville, Nova Scotia.

Tufts, Judy, Naturalist, Wolfville, Nova Scotia.

11.3 Web Sites

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

COSEWIC – http://www.cosewic.gc.ca
COSEWIC – Species Assessment - http://www.cosewic.gc.ca/en/sct0/index_e.cfm

Department of Justice, Canada – Migratory Birds Convention Act, 1994

http://laws.justice.gc.ca/en/M-7.01/

Environment Canada – Species at Risk - http://www.speciesatrisk.gc.ca/

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

Government of Nova Scotia – Endangered Species Act
http://www.gov.ns.ca/legi/legc/bills/57th_1st/3rd_read/b065.htm

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

Nova Scotia Department of Natural Resources – Endangered Species List
http://www.gov.ns.ca/natr/wildlife/endngrd/specieslist.htm

Nova Scotia Department of Natural Resources -
General Status Ranks of Wild Species in Nova Scotia -
http://www.gov.ns.ca/natr/wildlife/genstatus/

Nova Scotia Department of Natural Resources -
Significant Species and Habitat Database -
http://www.gov.ns.ca/natr/wildlife/Thp/disclaim.htm

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/

WoodTurtle.com – http://www.woodturtle.com

12.0 APPENDICES:

12.1 Appendix 1 – Common and scientific names of plants and animals cited in this report

Plants		Invertebrates	
Common Name	Scientific Name	Common Name	Scientific Name
Alders	*Alnus spp.*	Earthworm	*Lumbricus spp.*
American Beech	*Fagus grandifolia*	Slug	*Deroceras spp.*
Balsam Fir	*Abies balsamea*		
Beaked Hazelnut	*Corylus cornuta*		
Bearberry	*Arctostaphylos uva-ursi*	Amphibians	
Blackberries	*Rubus spp.*	Common Name	Scientific Name
Blueberries	*Vaccinium spp.*	American Toad	*Bufo americanus*
Bracken	*Pteridium equilinum*	Four-toed Salamander	*Hemidactylium scutatum*
Broom Crowberry	*Cormea conradii*	Green Frog	*Rana clamitans*
Eastern Hemlock	*Tsuga canadensis*	Spring Peeper	*Pseudacris crucifer*
Goldenrod	*Solidago spp.*	Reptiles	
Grasses	*Graminaceae spp.*	Common Name	Scientific Name
Hawkweeds	*Hieracium spp.*	Blanding's Turtle	*Emydoidea blandingi*
Hawthorns	*Crataegus spp.*	Eastern Painted Turtle	*Chrysemys picta picta*
Jack Pine	*Pinus banksiana*	Wood Turtle	*Glyptemys insculpta*
Juniper	*Juniperus communis*		
Kalmia	*Kalmia angustifolia*		
Lichens	*Cladina spp.*		
Paper Birch	*Betula papyrifera*		
Poplar species	*Populus spp.*		
Red Maple	*Acer rubrum*		
Red Oak	*Quercus rubra*		
Red Pine	*Pinus resinosa*		
Red Spruce	*Picea rubens*		
Pin Cherry	*Prunus pennsylvanica*		
Rhodora	*Rhododendron canadense*		
Sedges	*Carex spp.*		
Sweet Fern	*Myrica asplenifolia*		
White Pine	*Pinus strobus*		
White Spruce	*Picea glauca*		

Birds			
Common Name	Scientific Name	Common Name	Scientific Name
Alder Flycatcher	*Empidonax alnorum*	Long-eared Owl	*Asio otus*
American Black Duck	*Anas rubripes*	Killdeer	*Charadrius vociferus*
American Crow	*Corvus brachyrhynchos*	Magnolia Warbler	*Dendroica magnolia*
American Goldfinch	*Carduelis tristis*	Merlin	*Falco columbarius*
American Redstart	*Setophaga ruticilla*	Mourning Dove	*Zenaida macroura*
American Robin	*Turdus migratorius*	Nashville Warbler	*Vermivora ruficapilla*
American Woodcock	*Scolopax minor*	Nelson's Sharp-tailed Sparrow	*Ammodramus nelsoni*
Bank Swallow	*Riparia riparia*	Northern Flicker	*Colaptes auratus*
Barred Owl	*Strix varia*	Northern Goshawk	*Accipiter gentilis*
Belted Kingfisher	*Ceryle alcyon*	Northern Parula	*Parula americana*
Black-and-white Warbler	*Mniotilta varia*	Northern Saw-whet Owl	*Aegolius acadicus*
Black-capped Chickadee	*Poecile atricapilla*	Northern Waterthrush	*Seiurus noveboracensis*
Blue Jay	*Cyanocitta cristata*	Ovenbird	*Seiurus aurocapillus*
Blue-headed Vireo	*Vireo solitarius*	Peregrine Falcon	*Falco peregrinus*
Bobolink	*Dolichonyx oryzivorus*	Pine Siskin	*Carduelis pinus*
Brown Creeper	*Certhia americana*	Purple Finch	*Carpodacus purpureus*
Brown-headed Cowbird	*Molothrus ater*	Red Crossbill	*Loxia curvirostra*
Cedar Waxwing	*Bombycilla cedrorum*	Red-breasted Nuthatch	*Sitta canadensis*
Chestnut-sided Warbler	*Dendroica pensylvanic a*	Red-eyed Vireo	*Vireo olivaceus*
Chipping Sparrow	*Spizella passerina*	Red-tailed Hawk	*Buteo jamaicensis*
Common Grackle	*Quiscalus quiscula*	Red-winged Blackbird	*Agelaius phoeniceus*
Common Loon	*Gavia immer*	Ring-necked Pheasant	*Phasianus colchicus*
Common Nighthawk	*Chordeiles minor*	Rose-breasted Grosbeak	*Pheucticus ludovicianus*
Common Raven	*Corvus corax*	Ruffed Grouse	*Bonasa umbellus*
Common Yellowthroat	*Geothlypis trichas*	Savannah Sparrow	*Passerculus sandwichensis*
Common Tern	*Sterna hirundo*	Short-eared Owl	*Asio flammeus*
Dark-eyed Junco	*Junco hyemalis*	Song Sparrow	*Melospiza melodia*
Downy Woodpecker	*Picoides pubescens*	Spotted Sandpiper	*Actitis macularia*
Eastern Bluebird	*Sialia sialis*	Swamp Sparrow	*Melospiza georgiana*
Eastern Meadowlark	*Sturnella magna*	Veery	*Catharus fuscescens*
Eastern Wood-Pewee	*Contopus virens*	Vesper Sparrow	*Pooecetes gramineus*
European Starling	*Sturnus vulgaris*	White-breasted Nuthatch	*Sitta carolinensis*
Evening Grosbeak	*Coccothraustes vespertinus*	White-throated Sparrow	*Zonotrichia albicollis*

Great Horned Owl	*Bubo virginianus*	Wilson's Snipe	*Gallinago delicata*
Gray Catbird	*Dumetella carolinensis*	Wood Duck	*Aix sponsa*
Hairy Woodpecker	*Picoides villosus*	Yellow Warbler	*Dendroica petechia*
Hermit Thrush	*Catharus guttatus*	Yellow-rumped Warbler	*Dendroica coronata*
Herring Gull	*Larus argentatus*		

Mammals			
Common Name	Scientific Name	Common Name	Scientific Name
American Beaver	*Castor canadensis*	Moose	*Alces alces*
American Red Squirrel	*Tamiasciurus hudsonicus*	Northern Long-eared Bat	*Myotis septentrionalis*
American Marten	*Martes americana*	Norway Rat	*Rattus norvegicus*
Coyote	*Canis latrans*	Raccoon	*Procyon lotor*
Eastern Chipmunk	*Tamias striatus*	Red Fox	*Vulpes vulpes*
Eastern Pipistrelle	*Pipistrellus subflavus*	Striped Skunk	*Mephitis mephitis*
Fisher	*Martes pennanti*	Southern Flying Squirrel	*Glaucomys volans*
Little Brown Bat	*Myotis lucifugus*	Varying Hare	*Lepus americanus*
Long-tailed Shrew	*Sorex dispar*	White-tailed Deer	*Odocoileus virgianus*

Appendix 2 – Definitions of "species at risk"

This Appendix contains the definitions of "species at risk" used in the three priority lists of wild species that were the basis of the priority list derived for this property: COSEWIC, the Nova Scotia Endangered Species Act and the Nova Scotia General Status of Wild Species.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC)
The definition 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.

For further information, consult (http://www.cosewic.gc.ca/eng/sct0/index_e.cfm)

Nova Scotia Endangered Species Act

The definitions used for the designations under the Nova Scotia Endangered Species Act are as follows:

" "extinct species" means a species that no longer exists and is listed as an extinct species …"

" "extirpated species" means a species that no longer exists in the wild in the Province but exists in the wild outside the Province and is listed as an extirpated species …"

" "endangered species" means a species that faces imminent extinction or extirpation and is listed as an endangered species …"

" "threatened species" means a species that is likely to become endangered if the factors affecting its vulnerability are not reversed and is listed as a vulnerable species …"

" "vulnerable species" means a species of special concern due to characteristics that make it particularly sensitive to human activities and natural events and that is listed as a vulnerable species …"

For further information, consult
http://www.gov.ns.ca/legi/legc/bills/57th_1st/3rd_read/b065.htm

General Status of Wild Species in Nova Scotia

The definitions used for the colour designations given in the General Status of Wild Species in Nova Scotia 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."

For further information, consult
http://www.gov.ns.ca/natr/wildlife/genstatus/background.htm

Appendix 3 – Evidence of Wood Turtles along Walker Brook

In 2005, the following evidence was collected of the presence of Wood Turtles along Walker Brook between Marshall Road and Bishop Mountain Road:

Wood Turtle #501

Captured and marked:	26 April 2005, ~ 1130 h
Survey Team:	John Mills, Megan Beveridge, Bernard Forsythe
Location:	north bank of Walker Brook immediately north of Scotia Aggregates Ltd. "active" pit.
GPS Reading:	20T 0345.443 4984.632 (Garmin GPS76: WGS-84)
Description:	Sex: male (adult)
Note:	John Mills, Regional Biologist, NSDNR, has a complete set of measurements and photographs of this animal.

Wood Turtle A

Captured:	9 June 2005, 1205 h
Survey Team:	George Alliston, Bernard Forsythe
Location:	southern edge of floodplain of Walker Brook immediately north of Scotia Aggregates Ltd. "active" pit.
GPS Reading:	20T 0345.411 4984.613 (Garmin GPS76: WGS-84)
Habitat:	floodplain area dominated by grasses and Sensitive Ferns within about 3 m of the embankment leading up to the pit. 2 m to the north, the floodplain ground cover was Sensitive Fern with alders forming a thick shrub layer.
Description:	Sex: female (adult) Weight: 930 g (Pesola 1000 g spring balance) Scutes: 11 Distinguishing features: appears in good condition. Scutes 9 and 10 on the right side have been broken giving a concave "scalloped appearance to each of these scutes.
Photographs:	none

Wood Turtle B

Captured:	29 June 2005, 1040 h
Survey Team:	George Alliston, Bernard Forsythe
Location:	northwest embankment of Scotia Aggregates Ltd. "active" sand pit.
GPS Reading:	20 T 0345.380 4984.552 (Garmin GPS76: WGS-84)
Habitat:	sand pit, no vegetation
Description:	Sex: female Age: 23± years Weight: 930 g (Pesola 1000 g spring balance) Scutes: 12 Distinguishing features: unmarked. Left front foot severed and healed. Damage to the humeral and pectoral plates of the plastron on both left and right sides. Damage particularly severe on right side (see photos). Small hole drilled in carapace on rear left side.
Comments:	Turtle was observed from 0802 h to 1133 h during which time she dug 6 separate "test holes" in the embankment. Three of these holes were checked and contained no eggs. Prior to "processing" (1040 h), the Turtle had dug 5 holes. In the hour after processing the Turtle dug a sixth hole. When we left at 1133 h, she was still in the pit about 8 m from where she had been processed. As we left, she was abandoning the sixth "test hole".

Photographs:

Wood Turtle B, 29 June 2005.

Wood Turtle B – dorsal view on ¼" graph paper background, 29 June 2005.

Wood Turtle B – ventral view on ¼" graph paper background, 29 June 2005.

Wood Turtle B digging "test" nest, 29 June 2005.

Wood Turtle Shell

Found:	9 June 2005, 1250 h
Survey Team:	George Alliston, Bernard Forsythe
Location:	south side of Walker Brook on floodplain about 3 m from embankment.
GPS Reading:	20T 0345.518 4984.583 (Garmin GPS76: WGS-84)
Description:	Sex: female Age: approximately 19 years Scutes: 12 Condition: only shell and pelvic girdle remain; all soft tissue had decayed. No significant damage to shell.
Disposition:	shell was collected and deposited with Dr. Tom Herman, Acadia University.

Wood Turtle Sighting

Date:	24 April 2005, ~1530 h
Observers:	Catherine Crook, Michael Inkpen
Location:	north bank of Walker Brook
GPS Reading:	20T 0345.725 4984.660 (Garmin GPS76: WGS-84)

Fresh Wood Turtle Tracks

Date:	26 April 2005, 1640 h
Observers:	George Alliston, Bernard Forsythe
Location:	north bank of Walker Brook
GPS Reading:	20T 0345.482 4984.594 (Garmin GPS76: WGS-84)
Comment:	two sets, separated by about 20 m, of fresh Turtle tracks on bank of Walker Brook.

12.4 Appendix 4 - Breeding birds

12.4.1 Coordinates of Vesper Sparrow singing perches recorded during the 23 June 2005 survey (see Figure 5).

Vesper Sparrow ID	Vesper Sparrow Singing Perch Coordinates Location (UTM, WGS-84)		
	Zone	Easting	Northing
VS01	20T	0344.970	4984.369
VS02	20T	0345.055	4984.306
VS03	20T	0345.102	4984.264
VS04	20T	0345.101	4984.177
	20T	0345.076	4984.221
VS05	20T	0345.191	4984.277
VS06	20T	0345.227	4984.268
VS07	20T	0345.213	4984.202
	20T	0345.250	4984.201
VS08	20T	0345.349	4984.282
VS09	20T	0345.410	4984.236
VS10	20T	0345.461	4984.320
	20T	0345.427	4984.350
	20T	0345.445	4984.397
VS11	20T	0345.448	4984.403
	20T	0345.441	4984.460
VS12	20T	0345.525	4984.340
VS13	20T	0345.698	4984.406
VS14	20T	0345.971	4984.480
	20T	0345.891	4984.480
VS15	20T	0346.079	4984.358
VS16	20T	0346.216	4984.475
	20T	0346.201	4984.429
VS17	20T	0346.159	4984.525
VS18	20T	0346.416	4984.485
VS19	not recorded	not recorded	not recorded
VS20	20T	0345.609	4984.707
VS21	not recorded	not recorded	not recorded
VS22	not recorded	not recorded	not recorded

12.4.2 Coordinates of corvid nest sites found during the 26 April 2005 survey.

	Location (UTM, WGS-84)		
	Zone	Easting	Northing
American Crow Nest (predated)	20T	0346.241	4984.522
Common Raven Nest (containing young)	20T	0345.484	4984.544

12.5 Mammals

12.5.1 Coordinates and status of Red Fox dens on Scotia Aggregates Ltd. property, 2005.

Den No.	Date (yymmdd)	Status	Location (UTM, WGS-84) Zone	Easting	Northing
1	050426	inactive	20T	0345.469	4984.155
2	050609	active - with pups	20T	0345.984	4984.570
	050623	inactive			
	050701	inactive			
3	050623	active - with pups	20T	0345.264	4984.339
4	050623	inactive	20T	0345.222	4984.176

Appendix 7: Fish and Fish Habitat Study

Fish and Fish Habitat Survey of Walker Brook (Tributary of the Annapolis Watershed Drainage)

Prepared for: Scotia Aggregate Ltd.
Prepared by: Derick Fritz, Fisheries Biologist, Ocean Valley Aquatics Consulting
Survey Dates: June 19 & 23, 2005
Research team: Derick Fritz, Sarah Sabean & Andrea Fritz
GPS Setting: UTM, NAD83, Metres

1.0 Description of Existing Environment

A review of 1:10,000 scale topography maps and aerial photographs of the study area indicated that the Walker Brook, which is a third order stream, borders the north side of the proposed project area. According to the respective maps and a preliminary investigation, the headwaters of Walker Brook begin approximately four (4) km northwest of the project area, flow east through the proposed site and adjacent properties, and discharge into the Annapolis River about five (5) km downstream (south) of the project area. Historically, most of the Annapolis watershed tributaries have supported healthy, self-sustaining populations of native brook trout (*Salvelinus fontinalis*); a similar condition holds true in some measure for Atlantic salmon (*Salmo salar*) populations in the same geographical area. Due to environmental and economical stress in both fresh water and marine environments, Atlantic salmon have sustained a tremendous decline in populations within all Maritime rivers.

The Annapolis River is considered an Atlantic salmon run river and supports a population of anadromous outer Bay of Fundy Atlantic salmon. This assemblage, along with all assemblages of Atlantic salmon, has been listed under Schedule 1 of the *Species at Risk Act* (*SARA*) as an endangered species. The species is therefore subject to the prohibitions under Section 32(1), Section 33 and Section 58 of the *SARA*. They are also subject to the prohibitions under Section 32(1), Section 34, Section 35(1), and Section 37(1) of the *Federal Fisheries Act*. The probable effects and mitigation of the proposed project on water quality, fish habitat (HADD), and incidental harm of any fish species have been outlined in the matrix below (Table 1).

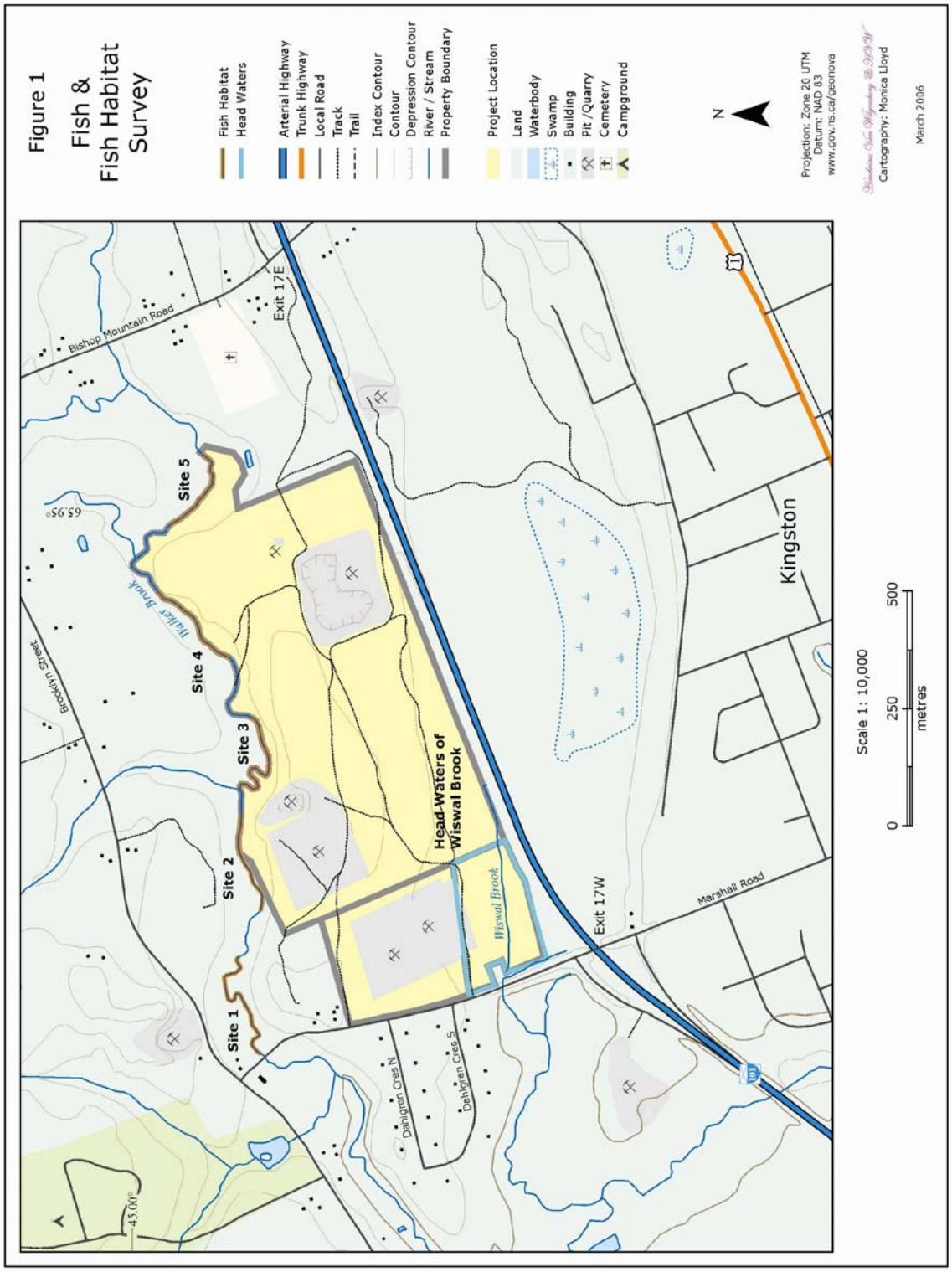
Figure 1
Fish & Fish Habitat Survey
Fish Habitat
Head Waters
Arterial Highway
Trunk Highway
Local Road
Track
Trail
Index Contour
Contour
Depression Contour
River / Stream
Property Boundary
Project Location
Land
Waterbody
Swamp
Building
Pit /Quarry
Cemetery
Campground
N
Projection: Zone 20 UTM
Datum: NAD 83
www.gov.ns.ca/geonova
Cartography: Monica Lloyd
March 2006
Bishop Mountain Road
Exit 17E
Site 5
Site 4
Site 3
Site 2
Site 1
Head Waters of Wiswal Brook
Wiswal Brook
Exit 17W
Marshall Road
Kingston
Brooklyn Street
Dahlgren Cres N
Dahlgren Cres S
Scale 1: 10,000
0
250
500
metres

1.1 Fish Habitat

On June 17, 2005 a site specific fish habitat survey was designed and conducted on Walker Brook and the Wiswal Brook headwaters. Walker Brook flows parallel to the north boundary of the SAL property. As the brook meanders across the low gradient topography it contains pools, runs and riffles. As the river meanders along the foothills of the North Mountain, the single channel braids, at this point the brook is approximately 5 metres wide, and between 0.3 to 1.0 metres deep. The substrate consists largely of well sorted sand with sections of embedded boulders and cobble. The stream banks are somewhat high, (roughly 1.0 to 7.0 metres above base level); this is an effect of continued fluvial incision that has resulted in the brook assuming a lower elevation than the adjacent properties. Overhead and riparian cover is predominantly deciduous and consists primarily of maple, oak, and alder. In-stream cover is abundant and consists of large woody debris and confined populations of macrophytes. Although this reach of Walker Brook experiences low flows (0.1 to 0.3 mps) during the summer months, Brook Trout and the other fish species appear to thrive in this habitat. There is adequate water depth, water quality, in-stream habitat, and cool water temperatures to accommodate native cold water fish species (see photo #1).

Walker Brook flows towards the west between the North Mountain and the Village of Kingston flowing parallel to the property boundary of the proposed site. There is fish habitat in this reach of Walker Brook, although there does not appear to be suitable salmonid spawning substrate present. However, isolated reaches of coarse sand and gravel do exist. The morphology of Walker Brook consists of sections dominated by pools and runs separated by the occasional riffle. There is a great deal of in-stream woody debris that acts as cover for fish as well as natural digger logs that scour large pools for existing fish populations to exploit.

1.2 Methodology

The fish habitat survey consisted of a visual examination of the entire project area and adjacent environs on June 14, 2005 followed by a day of water sampling and electrofishing on June 17, 2005. Dissolved oxygen (DO) levels and temperature measurement were recorded in the streams using a (YSI Model 55 handheld DO and temp system); pH was recorded with a (hand help pH metre). The electroseining was carried out with a Smith-Root model electrofisher, and a presence/absence method was used to assess populations.

Fish sampling was carried out by Derick Fritz, Fish Biologist; Sarah Sabean, Fish Technician; and Andrea Fritz, Field Technician (Ocean Valley Aquatics Consulting). Fish were collected using dipping nets and a Smith Root back-pack 24 volt electro fisher; quick identification and release was emphasized. Sampling was carried out at 5 sites on the Walker Brook. Electroseining was done without barrier nets and sampled at predetermined areas along Walker Brook (see Figure 1).The results of the stream survey indicated that the surficial geology adjacent to Walker Brook consists predominantly of unconsolidated aggregate that overlies sandstone (see Hydrogeology & Geology section). Therefore, surface runoff and groundwater are major contributors to the brook's flow (see Hydrogeology & Geology section).

Groundwater base flow (springs) and small feeder streams are likely the dominant input along the section of Walker Brook adjacent to the proponents' property. This brook is classified as a gaining stream which is fed predominantly by cold water springs, surface water run off, and small feeder streams flowing in to it from the north. No historical stream hydrology, chemistry, or fisheries data on Walker Brook was available, DFO and CARP have not investigated this tributary in the past and the Nova Scotia Department of Agriculture and Fisheries (Inland Fisheries Division) also have no data on this brook. Therefore, there is no historical water quality or fish habitat data for this watercourse.

1.3 Description of other Water-ways

Of the two potential water bodies identified on the proposed site property, only one presently sustains a healthy population of a coldwater fish species (Walker Brook). The Wiswal Brook headwaters do not have a defined inflow in the vicinity of the Scotia Aggregate property. The headwater of this small brook is runoff collected from Highway 101 and the adjacent subdivision. This ephemeral water body is suspected to have been created by anthropogenic modifications to the local topography and now retains water in this localized area. The upper portions of Wiswal Brook near the study area do not contain quality fish habitat thus limiting cold water fish species from entering this area. The water quality appears to be significantly degraded with high observed values of dissolved organic matter (DOM) and particulate organic matter (POM) dominating the water body and creating eutrophic conditions. Low dissolved oxygen levels (<52%) would make it hard for coldwater fish to populate this area. The dark color of the standing water appears to be caused by tannic acids from incompletely decomposed organic material thus creating a condition where the water absorbs heat, generating temperatures in excess of (30.5°C).

1.4 Water Quality and Quantity

Site preparation and proposed activities (excavation, and transportation of aggregate) can increase the potential for sediment erosion and deposition in adjacent waterways down gradient for the proposed site, particularly during periods of prolonged and sustained input and consequently high surface runoff. Land clearing can also result in an increased potential for sediment erosion and deposition. However, as the proposed site is composed primarily of well sorted sand, most surface water will be absorbed quickly and transferred to the watertable as through-flow rather than overland flow (see Hydrogeology & Geology section). Secondary drainage ditches should be constructed to ensure that no surface water erosion from the site will run directly into Walker Brook. All drainage ditches should either be directed away from Walker Brook or proper sediment control structures should be implemented.

In the most northerly section of the project area, surface runoff should have a thirty (30) metre buffer zone of vegetation that will be maintained to filter all sediment out off any surface water before it enters Walker Brook. This procedure should mitigate the potentially adverse effects of sediment erosion on water quality in the watercourse. Baseline water quality data has been collected for Walker Brook in conjunction with the fish and fish habitat survey. The proponent recognizes that the Pit and Quarry Guidelines require a thirty (30) metre separation distance to be maintained between active areas (*i.e.* equipment and stockpiles) and the bank of any watercourses or the ordinary high water mark. The proposed buffer to be maintained on proposed site may exceed thirty (30) metres.

The quality and quantity of the water in Walker Brook with respect to fish appears to be acceptable and all tested parameters (dissolved oxygen, temperature, pH) were well within the required levels for fish populations to thrive. A very healthy population of fresh water muscles (*Margaritifera sp.*) exists in Walker Brook and this species could potentially aid in the filtration of stream water. For additional water quality parameters tested for on the proposed property, refer to the Hydrogeology & Geology section.

1.5 Fisheries

Section 35 of the *Fisheries Act* states Hazardous Alteration, destruction, disruption of fish habitat (HADD) permitting must be obtained through DFO for any alteration, disruption, or destruction of fish habitat. If any application is made for HADD this could also trigger the requirements for a federal environmental assessment under the *Canadian Environmental Assessment Act*.

In the proposed project potential adverse environmental effects to adjacent watercourses and any fish or fish habitat are not foreseen to be an issue as all activities will be carried on outside the waterway and buffer zone.

All physical works, stockpiles of aggregates etc. should not be undertaken or placed within at least 60 m of the stream. Equipment refuelling should not be undertaken within 150 m of the stream. Due to the distance of activities from Walker Brook and the highly conductive composition (sand) of the geological strata, special consideration and care should be taken with all chemicals and petroleum products. Protocols will be designed and set in place so as to deal with any fuel spills or oil leaks before they could potentially interact with the groundwater and the aquatic environment. With these protocols set in place it is not likely that minor petroleum spills would have the potential of reaching or impacting any watercourse on the proponent's property.

1.6 Habitat Compensation

No habitat compensation should be needed due to the predicted insignificance of the project impacts on habitat in the localized area. Activity must be localized in an area to the south of the brook at an appropriate setback to minimize impacts on the surrounding fresh water biota and any habitat as defined by HADD.

2.0 Summary

Based on the results of the fish and fish habitat survey of Walker Brook, the data indicate that there are healthy fish populations present, consisting of several species including Brook Trout. With adequate mitigation, including maintenance of a buffer zone and proper petroleum spill protocols, no harm should result to fish or fish habitat as a result of the proposed development. Although the high conductivity of the underlying sand may result in rapid surface infiltration (see Hydrogeology & Geology section), there is some potential for surface water runoff to interact directly with the groundwater and the lower elevation gaining streams in the area. With appropriate sediment and erosion control measures, petroleum spill procedures and compliance with the existing guidelines, the effects of development on fish habitat should be minimal.

The most important result of this survey is that fish have been confirmed to be present within the Walker Brook and the trout population in this particular brook is of recreational value to local fishermen. With this in mind the proponent must take every precaution to prevent harm to the fish and fish habitat in all waterways located on the proposed site. In

addition all guidelines and relevant regulations pertaining to fish and fish habitat will be respected and abided by.

The headwaters of the Wiswal Brook that are located on the southwest corner of the proposed development and adjacent to Highway 101, do not appear to support fish life and lack the key components for critical fish habitat. Although this area will not sustain fish populations it is sensitive in the sense that it is a recharge area for lower Wiswal Brook. Wiswal Brook historically has had small populations of fish in its lower reaches, as such, all protocols that have been set forth for Walker Brook must also apply for the recharge area of Wiswal Brook.

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Photo 1. Walker Brook

Table 1. Potential Changes in the Fish and Lotic Environment Caused by the Project (Significance: 0-None, 1-Insignificant, 2-Significant, 3-Unknown, 4-Positive)

Valued Ecosystem Component (VEC)	Project Activity	Potential Effects	Significance Before Mitigation	Mitigation Measures	Significance of Residual Effects	Follow Up Monitoring
Species at Risk (Atlantic Salmon)	Blocking River Channel	Trapping, Blocking Migration, Disturbing local population	0	There will be no work conducted in-stream or within the suggested buffer zone. There are no documented or suspected populations of Atlantic salmon in Walker or Wiswal Brook.	0	Future fish habitat and water quality assessments.
Fish Habitat	Channel Excavation, Sedimentation, General disturbance	Destruction of habitat	0	There will be no work conducted in-stream or within the suggested buffer zone.	0	Future fish habitat and water quality assessments.
Water Quality	Channel Excavation, Sedimentation, Petroleum spill, reintroduction of sediment locked heavy metals and pesticides.	Destruction of fish habitat, Fish mortalities.	0	There will be no work conducted in stream or within the suggested buffer zone.	0	Future fish habitat and water quality assessments.
Fish Migration or Movement	Blocking River Channel	Trapping, Blocking Migration, Disturbing local population	1	There will be no work conducted in stream or within the suggested buffer zone.	1	Future fish habitat and water quality assessments.
Recreational Fisheries	Possible access road crossing brook	This could cause a barrier to fish movement. Possible brook trout moving from head water to catchment area or sea run brook trout migration.	2	If there is a brook crossing constructed for use as an access road, the implementation would follow the Navigable Waters Protection Act, HADD, and Fisheries Act regulations. Any and all structures that could be constructed would be designed with the welfare of the fish in mind.	2	Future fish habitat and water quality assessments.
Noise	Noise and vibrations that may occur as a result of heavy equipment operating near waterway.	May disturb fish movement or disturb spawning.	1	No or little literature exists showing conclusively any effects of the sort. Also there has been an existing aggregate operation and agriculture operations in the vicinity of the brook that seems to have had minimal effects with respect to noise.	1	Future fish habitat and water quality assessments.

Table 2. Effects Resulting from Accidents and Malfunctions
(Significance: 0-None, 1-Insignificant, 2-Signficant, 3-Unknown, 4-Positive)

Accident or Malfunction	Potential Effects	Significance Before Mitigation	Mitigation Measures	Significance of Residual Effects	Follow Up Monitoring
Accidental fuel spill	Fuel may leach very quickly into the groundwater and be transported into local streams possibly impacting fish populations.	2	Minimum of 160 m set back from waterway when equipment is being refuelled. Emergency spill procedures put into place.	1	Testing wells installed along lower section of the property to be tested periodically.
Non-aqueous motor oil or hydraulic oil spills	Although effects would be considerably slower to interact with ground water than residual effects would be the same as a fuel spill.	2	Minimum of 160m set back from water way when refilling oils into equipment and when maintenance is being conducted. Emergency spill procedures put into place. Proper maintenance of equipment hydraulic systems.	2	Testing wells installed along lower section of the property to be tested periodically.
Chemical spill	Spills of aqueous and non-aqueous chemicals may interact with groundwater and surface water	0	There will be **no** chemical or petroleum storage on/in the proposed site property boundaries.	0	No follow up monitoring will be required.

Table 3. Changes to the Project Caused by the Environment
(Significance: 0-None, 1-Insignificant, 2-Significant, 3-Unknown, 4-Positive)

Environmental Factor	Potential Effects on the Project	Significance Before Mitigation	Mitigation	Significance of Residual Effects	Follow Up Monitoring
Heavy Rain Fall	Excessive erosion and in-stream sedimentation	2	Design of proper water diversion structures and sediment control structures.	3	Visual observations made by project managers and inspectors.

Appendix 1

Table 4. Illustrates fish presence/absence data, water quality and physical fish habitat in Walker and Wiswal Brook

Site	Location	Suckers	Creek Chubs	American Eel	Sea Lamprey Eel	Stickle Back	Brook Trout	length/sec EF
Scientific Name		*Catostomus*	*Semotilus atr*	*Anguilla rostr*	*Petromyzon*	*Gasterosteus*	*Salvelinus fo*	
1	Walker Br	>6	>30	2	3	>10	>6	100 metres/5
2		>11	>11	>2	1	11	>4	100 metres/4
3		0	>6	3	2	>5	>8	120 metres/6
4		2	>4	0	1	6	>3	130 metres/5
5		2	7	0	0	4	8	100 metres/4
6	Wiswal Br	0	0	0	0	0	0	0

Site#	UTM coordinates	Canopy Cover (%)	Riparian Edge (%)	Stream Run (m)	Stream width (m)/depth (m)
1	21T-127840 / 5013693	75%	65%	100	5.2 m /0.6 m
2	21T-127650 / 5013678	65%	60%	100	4.9 m /0.3 m
3	21T-127413 / 5013681	60%	55%	120	3 m / 0.15 m
4	21T-127230 / 5013714	70%	60%	130	4 m / 0.25 m
5	21T-127150 / 5013751	85%	60%	100	5.45 m / 0.15 m

Site#	DO (mgl/%)	pH	Flow (m/s)	Water Temp (°C)	Visual Observations of Aquatic Environment
1	9.42/84%	7.7	0.3	15.2	
2	8.6/81.2%	7.3	0.5	15.6	
3	8.02/81.3%	7.3	0.8	15.9	
4	7.5/76.2%	7.4	0.5	16.2	
5	6.79/70.2%	7.3	0.3	16.9	
6	4.22/52%	4.7	0	30.5	Headwater of the Wiswal Brook

Site#	1st Dominant Substrate	2nd Dominant Substrate	Visual Habitat Observations
1	Sand	Gravel	very good population and diversity of aquatic invertebrates.
2	Sand	Cobble/Boulder	very good population and diversity of aquatic invertebrates.
3	Sand	Cobble/Gravel	Adequate Salmonid spawning habitat
4	Sand	Cobble/Boulder	very good population and diversity of aquatic invertebrates.
5	Sand	Gravel	very good population and diversity of aquatic invertebrates.
6	Silt/organic material		

Appendix 8: Groundwater and Hydrogeology Study

Groundwater Resources and Hydrogeology Report

Prepared for: Scotia Aggregates Limited
Prepared by: Dr. Ian Spooner and William Shaw & Associates
Study Date: January-June, 2005

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List of Figures:

1.0 Introduction

W.G. Shaw & Associates Ltd. and Dr. Ian Spooner were commissioned by SAL to address the following components of the environmental assessment registration document for the Marshall Road sand pit expansion located immediately north of Highway 101, in the vicinity of the Town of Kingston, Kings County, Nova Scotia:

1) the amount of sand resource available for extraction;
2) surface water resources, and;
3) groundwater resources.

The land area under consideration consists of a roughly rectangular area that is 1,200 metres long (E-W) by 450 metres wide (N-S) that aggregates approximately 60.7 hectares. This is referred to as the "Marshall Road Project Area" or the "Project Area". The geographic area considered in this environmental impact assessment is referred to as the "Study Area" which is shown on Figures #1 and #2).

The Project Area is located in the north-central part of a large deposit of sand and gravel that is in the order of 8 kilometres long (E-W) by about 1.5 kilometres wide (N-S) and underlies most of the Kingston–Greenwood area.

In order to estimate the amount of resource available for extraction we considered the land area defined by the SAL property boundary with the exclusion of the following:

- a 25 metre buffer in the vicinity of the "old cemetery" and the "house feature";
- a 30 metre separation distance from Walker Brook and the Wiswal Brook;
- a 30 metre separation distance from adjoining property boundaries and public roads (see Figure #3).

On this basis the Project Area is roughly fifty (50) hectares in size. In order to determine the resource of sand available for extraction, we included allowance for a 1:1 slope around the margins of the Project Area and an additional 10% for heterogeneities of the sand resource. The maximum depth of sand extraction, below current grade, is set at one (1) metre above the watertable elevation in the spring season. Evidence from drilled well records and topographic maps indicates the elevation the of the watertable in spring is from 22 to 26 metres above sea level which would be from 4 to 8 metres of sand resource above the maximum extraction depth. This translates into sand resource estimate of 3 million tonnes. Within the Project Area, there are four (4) small sand pits that were operational from the early 1960s to the present; these are labelled the "Old Pit" and the "New Pit" on Figure #3. Approximately 100,000 tonnes of sand resource have been extracted from the Old Pit and approximately 20,000 tonnes have been extracted from the New Pit.

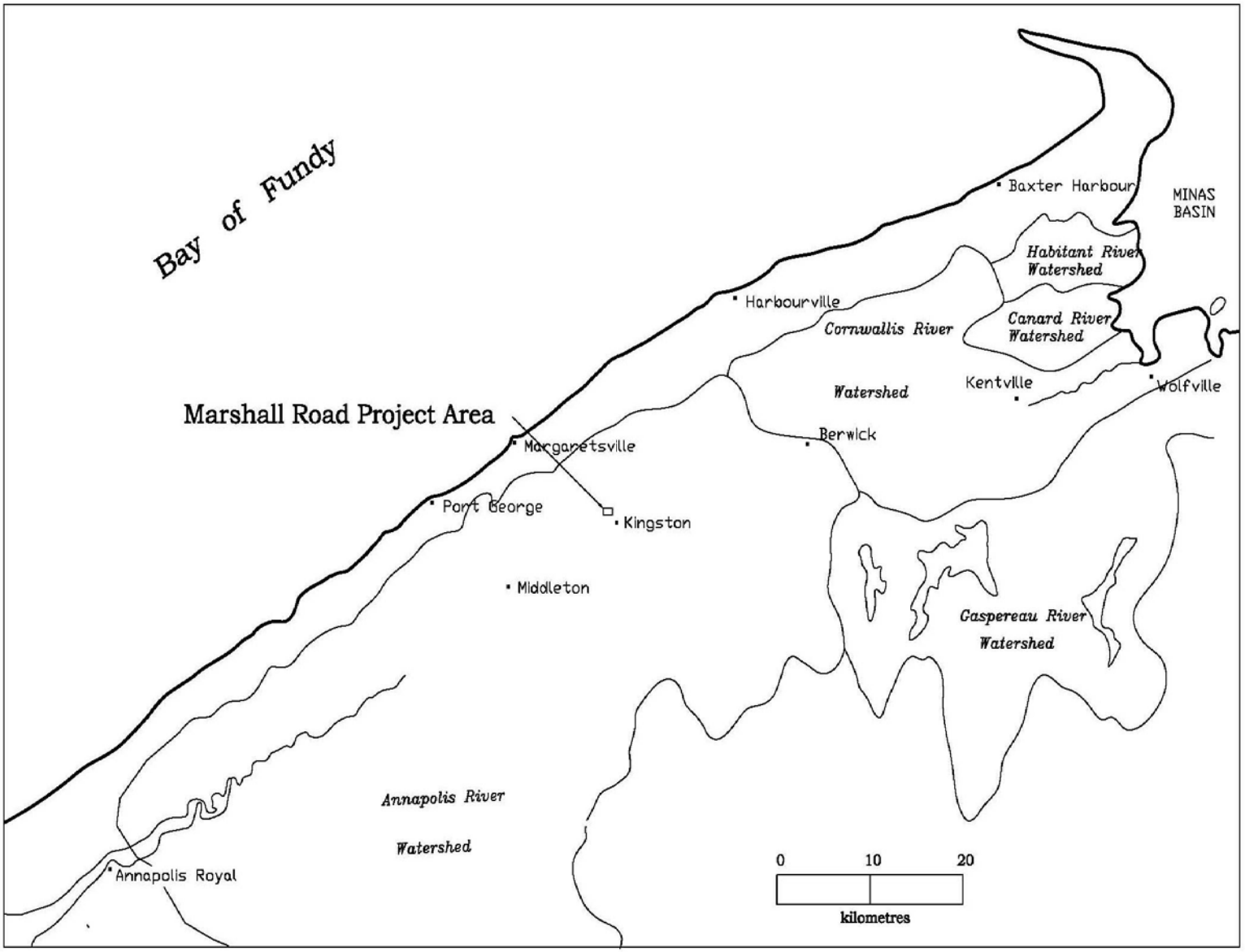
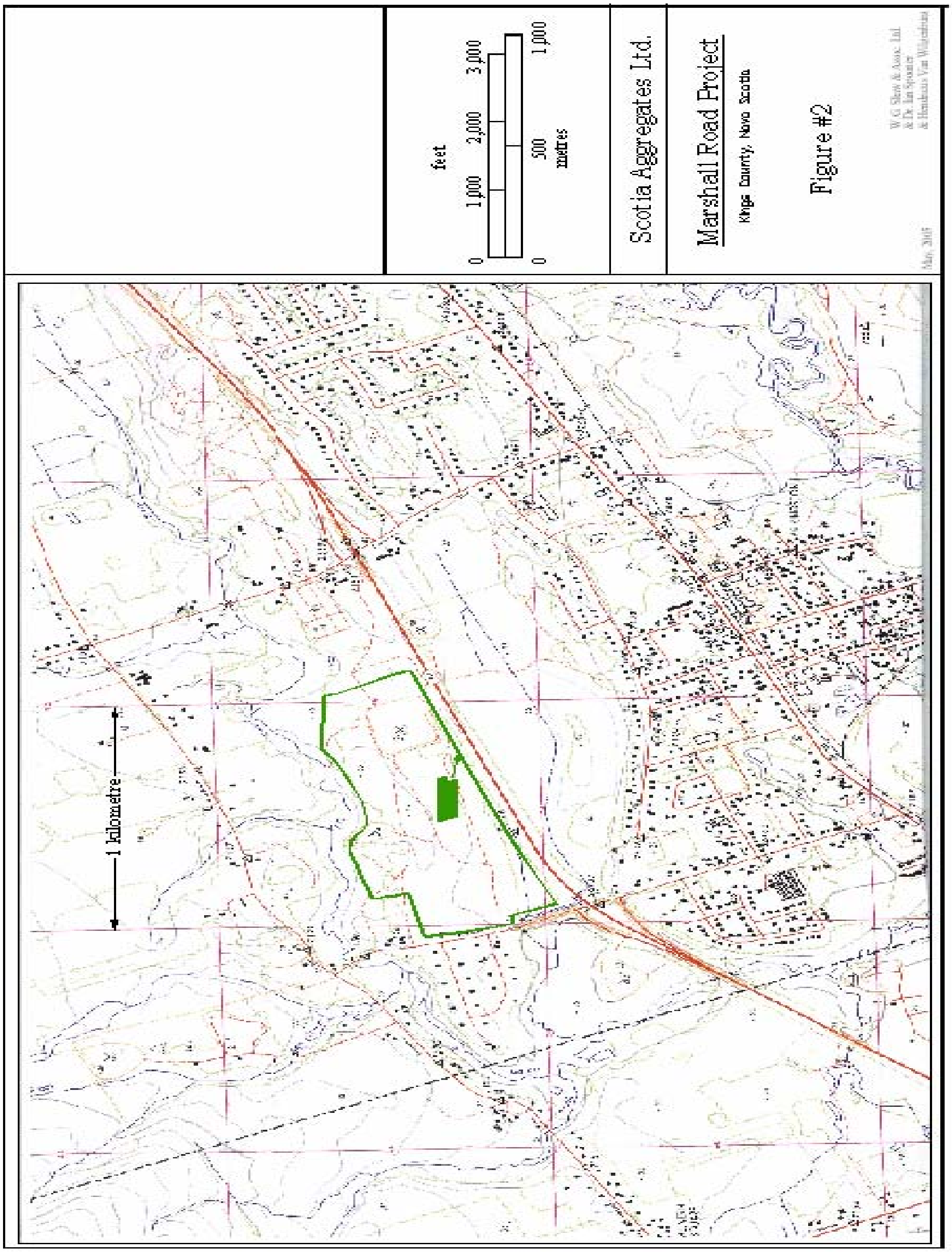
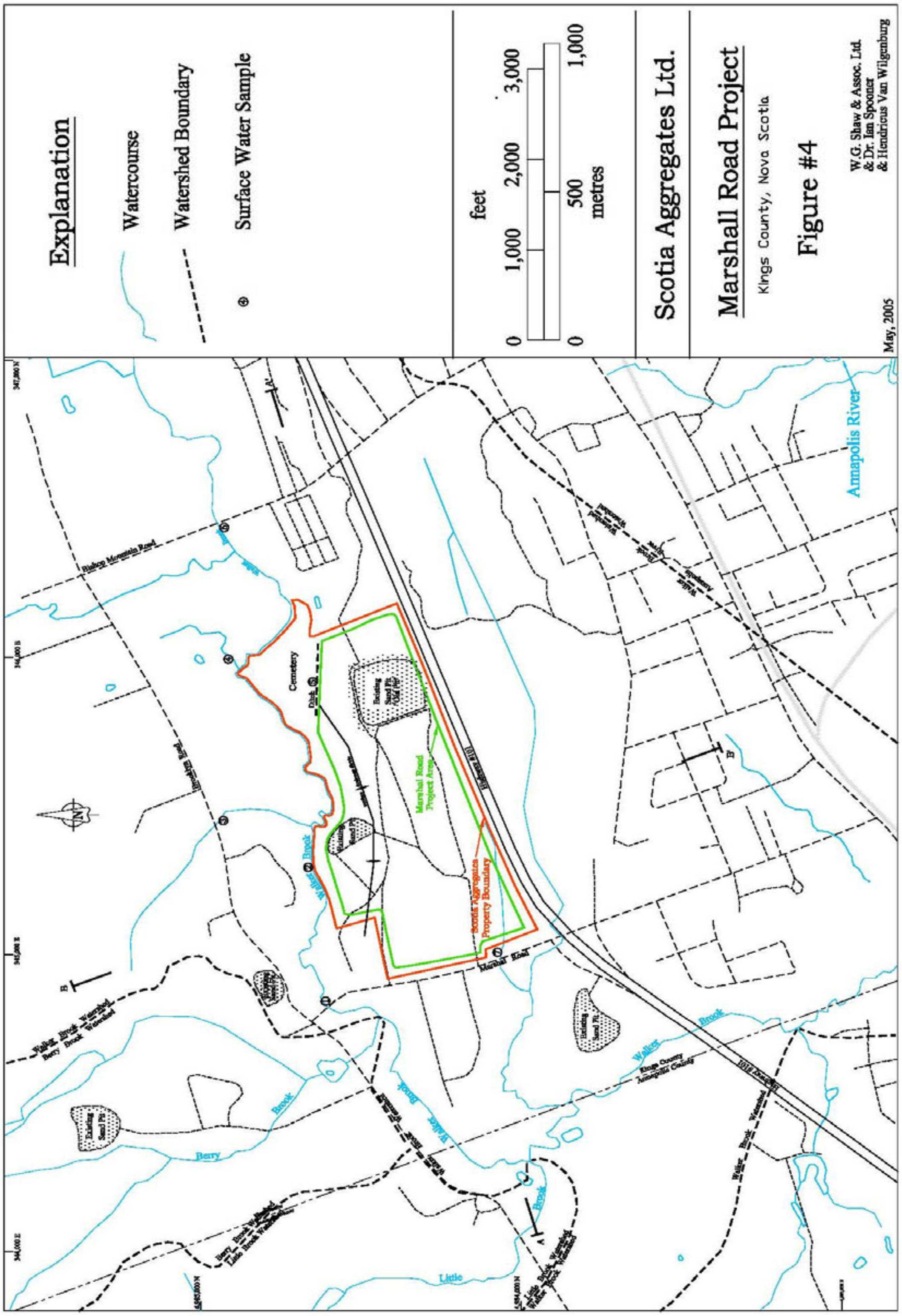


Figure #1 Marshall Road Project on Map of Major Watersheds


1 kilometre
feet
0
1,000
2,000
3,000
0
500
1,000
metres
Scotia Aggregates Ltd.
Marshall Road Project
Kings County, Nova Scotia
Figure #2


Explanation
Watercourse
Watershed Boundary
Surface Water Sample
feet
0
1,000
2,000
3,000
0
500
1,000
metres
Scotia Aggregates Ltd.
Marshall Road Project
Kings County, Nova Scotia
Figure #4
W.G. Shaw & Assoc. Ltd.
& Dr. Ian Spooner
& Hendricus Van Wilgenburg
May, 2005
Annapolis River
Marshall Road
Cemetery
Marshall Road Project Area
Scotia Aggregates Property Boundary
Walker Brook
Berry
Brook
Little

2.0 Regional Setting of the Project Area

2.1 Natural Landscape

The Marshall Road Project Area is located near the centre of the Annapolis-Cornwallis Valley natural landscape, midway between the Minas Basin and the Annapolis Basin. The Valley is a long and narrow lowland that trends east-northeast and occupies an area of about 800 square kilometres (Figure #1).

The centre of the Annapolis Valley is dominated by the headwaters of the Annapolis River which flows southwest for about 80 kilometres at which point it discharges into the tidewater. The River drains over 2000 square kilometres of land and has an average discharge of approximately one cubic kilometre per year.

The morphology of the local landscape is variable. The Project Area has relatively flat to gently sloping topography with elevations from 28 to 36 metres. Stream incision and micro relief is present along the northern boundary of the where lands disturbance is minimal. South of the Walker Brook the property is more subdued and has been largely modified by aggregate extraction and highway construction practices. The Project Area is located on an extensive valley-parallel ridge of ice contact stratified drift as mapped by Hickox (1962). This deposit has been mined sporadically for at least eighty (80) years and is generally considered to be a source of lower grade sand with minor gravel.
Climate and Precipitation

2.2 Climate

The Project Area has a humid, temperate, continental climate that is somewhat modified by the proximity to the Bay of Fundy. The mean annual temperature is 6.8 $C^{o.}$ The warmest temperatures are generally in July, with a mean of 21 C^{o}, and the coldest temperatures are in February with a mean of -4^{o}.

2.3.1 Precipitation

The Project Area receives total precipitation of from 90 to 140 centimetres (35 to 55 inches) with a mean annual figure of 128 centimetres (48 inches). Much of the precipitation and moisture surplus occurs within one distinct wet season from mid-November to mid-March. Snowfall events occur from late November to early April, with typical total yearly snowfall accumulations in the order of 2.2 metres. A warming trend from March through April releases the snow pack, and eliminates the frost cover to generate a major surface water run-off and groundwater recharge event from March to May. There is generally a significant

dry season that lasts from late May to mid-September. The summer months are often particularly dry and rainfall accumulations of less than 7 cm in the months of June and July are not uncommon. The representative weather station for the site is located in Greenwood, Kings County.

2.2.2 Climate Change Impacts on Surface Water Resources

Though Atlantic Canada is not expected to experience the same degree of warming as central Canada, wetter, milder winters coupled with drier, longer summers are expected to have a significant effect on stream baseflow. Watercourses may experience greater spring runoff with highest flows earlier than present (April rather than May). Summer flows are expected to be less than present. An increase in the frequency and magnitude of summer rainstorms may lead to greater overland flow (and less groundwater recharge) as the infiltration capacity of soils is exceeded (C-CIARN 2003).

2.2.3 Climate Change Impacts on Groundwater Resources

Historical climate data indicates that both temperature and precipitation in the region have been increasing since the beginning of the twentieth century, while the annual groundwater recharge has been either stable or gently decreasing over time. Michaud et al. (2005) predict that a subtle lowering of the groundwater table linked to predicted increases in evapotranspiration, surface runoff (which is related to land use), and pumping may occur over the next few decades. Predictive modeling suggests that private well owners with shallow wells and small rivers and creeks are at the highest risk.

2.3 Regional Surface Drainage

The Project Area is located within the Annapolis River Watershed (Figure #3). Surface drainage originates on the north-facing escarpment of South Mountain and the south-facing escarpment of North Mountain in a series of third and second order dendritic stream, which flows toward the valley floor, ultimately discharging into the Annapolis River. The Annapolis River flows westward for seventy-five (75) kilometres at which point it discharges into Annapolis Basin (Figure #1).

Within the Project Area, due to the highly porous and permeable nature of the soils, overland flow is limited and surface drainage systems are not particularly complex. Walker Brook is the dominant surface drainage feature in the study area. It has a gradient of less than 5% and can be considered ungraded along much of its length. Walker Brook is a tributary of the Annapolis River. No natural lakes or ponds are evident on the property.

3.0 Soils Conditions

For the purpose of this report, soils are defined by "earth material that has been modified by chemical, physical and biological processes that it will support the growth of root plants". In the Project Area, the soil horizon occurs from the ground surface to depths of from 5 to 40 centimetres below ground and is directly underlain by the "surficial sediments" (see Section 5.8.2).

Soils in the region have a complex provenance and parent material can range from till to glacial outwash to post-glacial marine deposits. The study site itself is mantled by a thin soil that exhibits excessive surface drainage because of the high permeability of the sediments. This soil is called the Cornwallis soil, which at the study area is characterized by a compound map unit (CNW 85-CNW X5). Hydraulic conductivity of this unit is extremely high (about 10 cm/h) and the pH of the soil water is characteristically acidic (average pH 5.5). The Cornwallis soils may have lenses of fine sandy glaciofluvial sediment and coarse loamy layers. They are best developed on low slopes (2.5%), are well to rapidly drained, and have very low stone and rock percentages. The thickness of both the A and B horizons within these soils average 30 cm. At the study site the CNW X5 is characterized by a cemented layer that is present to depths of 40 cm (Figure #2). These soils are susceptible to wind deflation due to their fine grained nature and low moisture content. Due to the high infiltration capacity and relatively low silt/clay content of the soils in the study area overland flow, surface runoff and subsequent siltation rarely occurs. It was noted that where soil cementation was well developed reduced infiltration may lead to some overland flow; however, these are very localized conditions. Rills and gully erosion were noted only on select, very steep slopes associated with river cutbank incision.

There are no significant peat deposits in the study region (Anderson and Broughm 1986).

4.0 Geomorphology and Surface Water Resources

4.1 Alluvial Systems

Walker Brook is a significant alluvial system and is one of the larger tributaries to the Annapolis River. Walker Brook is moderately incised, has a sand to gravel bedload and has a medium gradient (<5%). Most of the brook is graded with a sand to fine gravel substrate. Some reaches are ungraded as the watercourse encounters both bedrock and man-made obstacles (Photo #3).

Walker Brook has many well-developed meanders and associated cutbanks and point bars but straight sections dominated by riffles and runs are also common. There is much evidence of lateral and downstream bank migration. During bankfull stage, Walker Brook has an average depth of 70 centimetres with deeper pools in excess of 1.5 metres; however, during baseflow the average depth is about 25 centimetres with a requisite decline in pool depth as well.

During heavy sustained rainfall events (> 60 mm over 24 hrs) and spring runoff when snow-water content is high river discharge may exceed the bankfull capacity and the alluvial plain may flood. Recently deposited flood debris was observed on terraces and was most likely deposited during a regional flooding event that occurred on late March, 2003. This debris did not extend far inland or upslope indicating that the flood event peaked and receded rapidly most likely due to the relatively deep river incision and the high infiltration capacity of the alluvial plain sediments. Spring floods and flooding associated with intense and prolonged rainstorms are expected to have little direct impact on the proposed development.

4.2 Sediment Stability and Erosion

Local surface slopes at the site are generally less than 10°, except along the incised riverbanks of Walker Brook where they can reach angle of repose (30°). During our field examination, there was no evidence of mass wasting at the site. Surface deflation was common at recently disturbed sites, especially where the underlying glaciofluvial sediment is fine grained. Sediment erosion by natural processes was relatively rare and was most common along the cutbanks of the Walker Brook and associated tributaries.

Some siltation of Walker Brook and its tributaries was noted and tended to occur where OHV paths and local trails forded the watercourses.

4.3 Surface disturbance

The site has been extensively altered both by historical aggregate extraction operations and by a variety of other commercial and recreational activities which has resulted in several subtle terraces (former shallow excavation sites, Photo #2), numerous roads, irregularly spaced hills (old waste piles) and, in places, very thin soil development. Where soil is thin to non-existent surface drainage is exceedingly high. Particularly interesting was a long, straight excavation in the eastern end of the property (dashed line, Figure #3). A water sample taken in this ditch had very low pH and moderately high nitrate levels. Also of note

was an old cemetery located in the northeast corner of the property (Figure #3). The extent of this cemetery is uncertain.

5.0 Surface Water

5.1 Introduction

Little surface water was found at the site due to the excessive drainage of the glacial sediments and the very thin to non-existent soil cover. During input events, through-flow dominates at the site. There was little evidence of gullying, rilling, or surface erosion that might have been caused by overland flow (Fetter 1994). A local surface water divide is located near the northern boundary of the property (Figure 3). As a consequence, if overland flow were to occur, the dominant flow direction would be to the south.

The water table during the time of the survey was estimated to be eight (8) metres below the crest of the stratified drift within the "Old Pit" (Figure #3). Observations did occur in April, therefore this can be considered to be somewhat higher than might be expected later in the year. Site three at the bottom of the pit was saturated and excavation to a depth of 70 centimetres with a power auger indicated saturated conditions below the pit floor. It is likely that the base of the pit represents a locally perched water table; downward flow may be impeded by silt and clay layers. Standing water was observed south of Water Sample Site #7 and probably represents a combination of a locally perched water table and ponding as a result of impeded flow.

Surface drainage at the site is poorly developed and ephemeral due to poor soil development over excessively drained glacial sediments. Even during the early spring, no surface drainage was noted. This indicates that all snow melt and input was transferred directly to the groundwater system.

5.2 Surface Water Quality

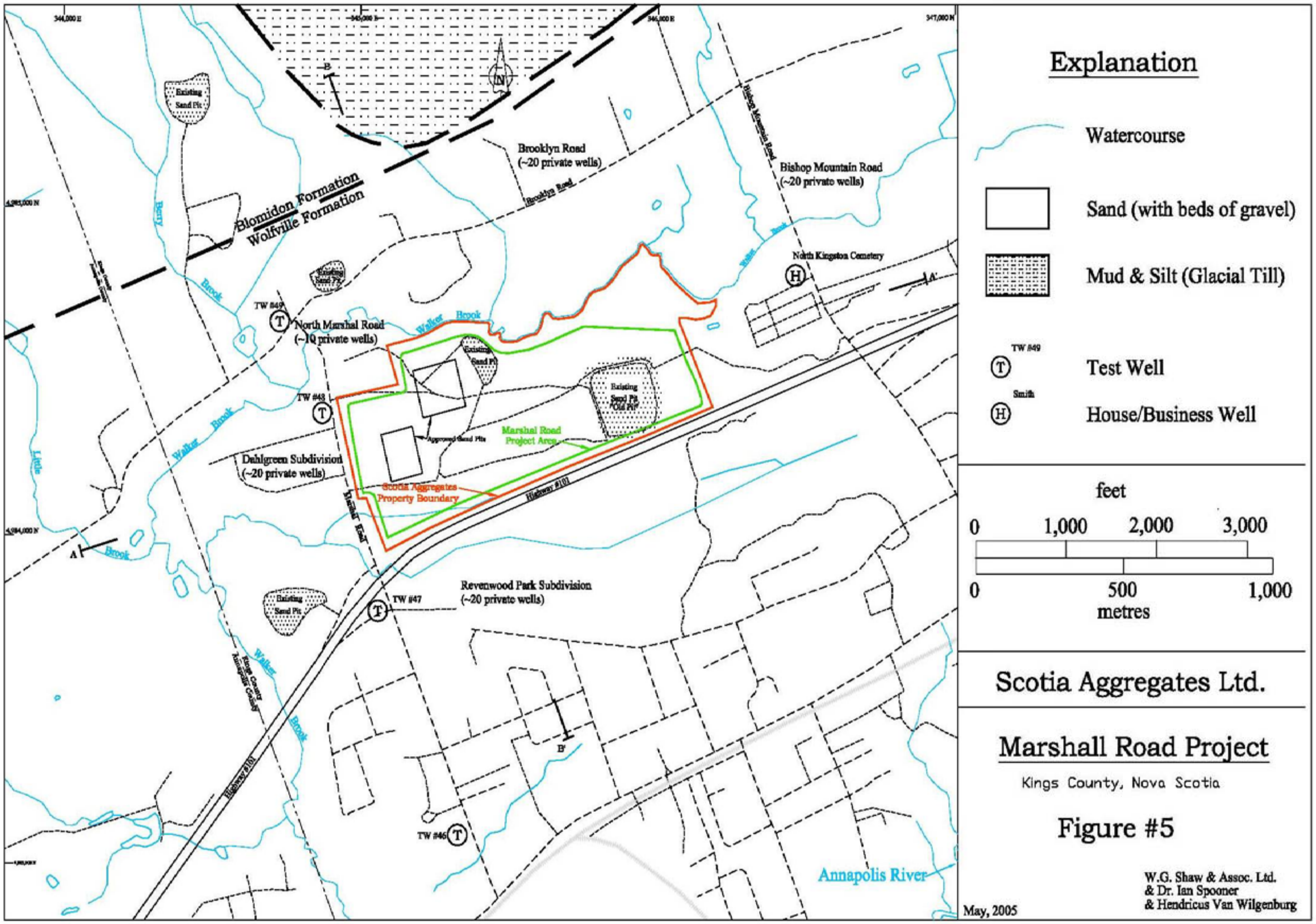
Surface water quality samples were gathered and analysed to determine if unique conditions exist at the site that may warrant a more detailed investigation. Surface water quality samples were gathered at seven (7) sites on April 30 of 2005 and these samples were analysed on site for a variety of water quality indicators. An YSI 650 MDS water quality metre was used to determine temperature, dissolved oxygen, pH, and conductivity. A Chemetrics VWR Field Photometer was used to determine Nitrate, Chloride, and Iron, and a Vernier Labpro turbidity metre was used to measure turbidity. The samples were taken after a period of relatively low precipitation though the streams sampled were still at (or

close to) the bankfull stage. Samples #2005-1, 2, 3, 4, and 6 were all taken from flowing systems whereas samples 2005-5 and -7 were taken from standing water that was not flowing. These latter two samples were highly coloured (most likely from tannic acids) and consequently displayed higher turbidity values.

In general the water samples indicate moderate to fair water quality (Canadian Drinking Water Standards 1998), pH is, in general low, especially in the standing water samples (5, 7). Conductivity measurements (an indication of ions in solution) were highly variable for reasons that are not immediately apparent, but most likely indicate variation is due to local land use practices. Nitrate values were relatively high and may indicate that surface and near surface runoff is still quite active in the watershed. High nitrate concentrations were also noted by Kempt (1996) and were attributed to local farming operations and land use practices. Iron values are also high and may reflect the Triassic provenance of both the outwash sands and the high permeability of these sands. Chloride values were also elevated, especially in sample 2005-7, and may reflect the proximity of this sample site to Highway 101 and road salt use. Turbidity values are characteristic of the time of year during which the analyses were done and are not deemed to be excessive. In general, the sampling indicates that water quality in Walker Brook and tributaries is consistent with the wide range of land use in the study region; thus, further testing is not warranted (see Table 1).

Table 1. Results of Walker Brook water samples

Sample #	pH	D.O. (mg/l)	Conductivity (uS/cm)	T (˚C)	Nitrate (ppm)	Chloride (ppm)	Iron (ppm)	Turbidity (NTU)
2005-1	5.38	10.2	188	5.2	0.21	0.14	0.60	14
2005-2	5.82	10.6	180	5.8	0.53	0.17	0.40	17
2005-3	6.02	10.3	81	4.8	0.41	0.00	0.35	3
2005-4	6.13	10.1	103	5.3	1.10	0.13	0.40	23
2005-5	5.40	7.1	49	7.2	0.72	0.23	1.50	53
2005-6	6.20	10.1	98	5.2	0.56	0.22	0.45	24
2005-7	5.16	7.3	158	6.9	4.11	0.73	1.80	71


Explanation
Watercourse
Sand (with beds of gravel)
Mud & Silt (Glacial Till)
Test Well
House/Business Well
feet
0
1,000
2,000
3,000
0
500
1,000
metres
Scotia Aggregates Ltd.
Marshall Road Project
Kings County, Nova Scotia
Figure #5
W.G. Shaw & Assoc. Ltd.
& Dr. Ian Spooner
& Hendricus Van Wilgenburg
May, 2005
Blomidon Formation
Wolfville Formation
Brooklyn Road
(~20 private wells)
Bishop Mountain Road
(~20 private wells)
North Kingston Cemetery
North Marshal Road
(~10 private wells)
Dahlgreen Subdivision
(~20 private wells)
Revenwood Park Subdivision
(~20 private wells)
Marshal Road
Project Area
Scotia Aggregates
Property Boundary
Walker Brook
Annapolis River
Highway #101
TW #49
TW #48
TW #47
TW #46

6.0 Hydrogeologic Units and Aquifers

6.1 Introduction

The Annapolis valley is a subsequent valley that is underlain by Triassic age sandstone and shale that dips shallowly to the northwest and is mantled by stratified glacial drift (Roland 1982). Within the Project Area, bedrock has little influence on the overlying topography. The only outcrops are usually located along the bed of the Annapolis River and some of its tributaries. The floor of the Annapolis Valley is flat to gently rolling with maximum local relief in the order of 20 metres. Till is relatively rare and usually occurs as isolated "islands" of Lawrencetown Till that protrude through the overlying stratified drift cover (Stea 1992).

The Study Area is underlain by six (6) hydrogeologic units that can be grouped into two broad categories; they are as follows:

Surficial Sediments	Glacial Till Sandy Gravel (Esker) Sand with Gravel (Kame and Glacial Outwash) Recent Alluvium
Bedrock Units	Sandstone & Mudstone (Wolfville Formation) Mudstone & Siltstone (Blomidon Formation)

The following sections provide a description of each of the hydrogeologic units (HUs), which are listed in order of increasing geologic age and, in a general sense, from shallow to deep levels below the ground surface.

6.2 Surficial Sediments

6.2.1 Recent Alluvium

The channels and flood plains of Walker Brook, Berry Brook, Little Brook and the Annapolis River, and its tributaries, are underlain by recent alluvium. In the project area, these sediments are generally from several metres to 20 metres in thickness.

6.2.2 Sand HU (Kame and Glacial Outwash)

The Sand HU is the dominant surficial sediment type in the Project Area. Surface exposures, test well records and water well records indicate this unit underlies the entire project area and is from 20 to 30 metres thick. The Sand HU is dominated by reddish-brown to grey coloured, medium to coarse grained sand with subordinate amounts of granule, pebble and boulder gravel.

The Sand HU is an important unconfined aquifer in the area, which provides a private water supply to approximately twenty (20) wells within 500 metres of the Project Area.

6.2.3 Glacial Till

The Glacial Till HU is distributed over the northwest corner of the Study Area and is from 3 to 10 metres thick. The Glacial Till HU is dominated by reddish-brown coloured, gravely, sandy mud and silt.

This hydrogeologic unit has low permeability (estimated to be from 1×10^{-4} to 1×10^{-7} centimetres/second) and is suitable for the construction of domestic dug wells only.

6.3 Bedrock Units

6.3.1 Mudstone & Siltstone HU (Blomidon Formation**)**

The Mudstone - Siltstone HU is part of the regionally extensive Blomidon Formation and forms the bedrock under the north-central part of the Study Area. The Mudstone-Siltstone HU consists of interbedded reddish-brown coloured, mudstone, siltstone with minor sandstone.

6.3.2 Sandstone HU (Wolfville Formation)

The Sandstone HU is part of the regionally extensive Wolfville Formation and forms the bedrock under the entire most of the Study Area. In the vicinity of the Project Area, the Wolfville Formation is in the order of 600 metres thick.

The strata strike northeast and dip at angles of from five (5) to ten (10) degrees to the north. The Sandstone HU consists of interbedded reddish-brown coloured, mudstone, siltstone and sandstone.

The Sandstone HU is an important semiconfined aquifer in the area which provides a private water supply to approximately forty (40) wells within 500 metres of the Project Area.

6.4 Aquifers and Water Supply Wells

There are approximately sixty (60) private water supply wells within 500 metres of the project area. These wells derive potable water from two (2) aquifers: 1) the Sand HU, and 2) the Sandstone HU. The NSEL "Drilled Well Database" has 48 records for drilled wells listed under the community of "North Kingston". The maximum depth of these wells is 33.5 metres; the minimum depth is 14.3 metres and the average depth is 34.4 metres. The majority of these wells are drilled and cased in the Sandstone Aquifer; a minority produce

from the Sand Aquifer. The drilled well database indicates the average watertable depth is approximately 8.0 metres.

6.4.1 Valued Ecosystem Components (Geoscience Perspective)

Much of the proposed extraction site has been altered by previous activity. The only unique, relatively pristine landform that exists at the site is Walker Brook (and its associated tributaries). The relatively high amount of incision coupled with the highly conductive fluvial and alluvial sediments at the site has produced a somewhat unique fluvial corridor that is relatively rare in the Annapolis Valley.

Walker Brook is graded along much of it length and the meander/cutbank/thalweg morphology typically associated with larger, more mature rivers is well developed. Groundwater is efficiently transferred to the brook resulting in a relatively high resilience to drought. As well, the high infiltration capacity of the soils retards overland flow and ameliorates the effects of sustained precipitation events. There is no historical evidence of surface water collecting within the Project Area in such a way that would require dewatering.

Preservation of the integrity of groundwater resources in the vicinity of the Marshall Road Project is critical to protecting private water supplies in the North Kingston area. Avoiding any adverse effects on private wells is critical to the long-term operation of the Marshal Road Project. Lowering of the watertable, resulting in decreased yield of surrounding private wells, should not occur providing sand extraction does not exceed a depth defined by the highest seasonal watertable elevation. A network of groundwater monitoring wells at strategic locations around the perimeter of the Project Area will provide a suitable effects monitoring system (See Section 5.7.2).

7.0 Summary and Conclusions

i) The Project Area is 50 hectares in size and contains in the order of 3 million tonnes of sand resource available for extraction. The sand resource is relatively silt and clay free and is highly conductive.

ii) The Project Area has relatively flat to gently sloping topography with elevations from 28 to 36 metres. Stream incision and micro-relief is present along the northern boundary of the Project Area where land disturbance is minimal. South of the Walker Brook the property is more subdued and has been largely modified by historical aggregate extraction and highway construction practices.

iii) Little erosion or siltation was noted, roads and trails were the major erosion features.

iv) At the time of the surface water survey, surface water quality was variable and reflects regional land use practices.

v) The Project Area is mantled by a thin soil that exhibits excessive surface drainage because of the high permeability of the sediments. This soil is called the Cornwallis soil, which in the Project Area, is characterized by a compound map unit (CNW 85-CNW X5). Hydraulic conductivity of this unit is extremely high (about 10 cm/h) and the pH of the soil water is characteristically acidic (average pH 5.5).

vi) The Project Area is surrounded by private water supply wells. These wells derive potable water from two (2) aquifers: 1) the Sand HU, and 2) the Sandstone HU. The majority of these wells are drilled and cased in the Sandstone Aquifer; a minority produce from the Sand Aquifer. The drilled well database indicates the average watertable depth is approximately 8.0 metres. Preservation of the integrity of groundwater resources in the vicinity of the Marshall Road Project is critical to protecting private water supply wells in the North Kingston area.

vii) Much of the proposed extraction site has been altered by previous activity. The only unique, relatively pristine landform that exists at the site is Walker Brook (and its associated tributaries). Groundwater is efficiently transferred to the brook resulting in relatively high resilience to drought. As well, the high infiltration capacity of the soils retards overland flow and ameliorates the effects of sustained precipitation events.

8.0 Recommendations

8.1 Sand Extraction

To mitigate potential deterioration of groundwater resources, sand extraction should be governed by the Nova Scotia *Pit and Quarry Guidelines* with the following additions:

i) Extraction should be limited to depths that do not exceed 1 metre above the highest seasonal watertable;

ii) Extraction should be limited to the area defined at the Project Area in Figure #3;

iii) Access routes that cross running water should be properly constructed and should not impede natural migration (lateral and downstream) of fluvial systems within the alluvial corridor of Walker Brook and associated tributaries.

8.2 Surface Water Monitoring

Due to the numerous tributaries that supply both baseflow and overland flow to Walker Brook, it is likely that water chemistry and quality will be highly variable over very short time periods. Unlike groundwater systems, the very rapid changes that might occur in surface water chemistry in response to input events, thermal change, and land-use practices would make it very hard to interpret the results of a casual sampling program. As well, the mixed land-use in the watershed will make it very hard to determine the source of water quality degradation should it occur. As a result, we do not recommend surface water quality monitoring.

8.3 Groundwater Monitoring

We have no direct knowledge of potential groundwater gradients within the Project Area. However, if the groundwater gradients are a subdued replica of the topographic surface, there may be a groundwater flow divide that runs east-west through the center of the Project Area and the gradients will be very gentle. These features introduce considerable uncertainty of the direction and velocity of groundwater flow at many locations within the Project Area. If a deleterious substance is introduced within the Project Area, it is critical to know the direction of and velocity of groundwater flow in order to assess the risk to the integrity of the groundwater resources and the surrounding private wells the occur on all sides of the Project Area.

As a result, we recommend the construction of three (3) monitoring wells that can be utilized to determine the direction and velocity of groundwater flow and provide network of locations for water quality monitoring between the Project Area and the private wells. Two monitoring wells will be located in the north-eastern and north-western portions of the property, equidistant from the boundaries. The third monitoring well will be located in the south-central portion of the property. Well construction details should follow methods adopted as standard for the industry that include the following:

i) The depth of each well should be determined by the hydrostratigraphic sequence encountered during drilling, the depth of the watertable and anticipated seasonal fluctuation of the watertable;
ii) Each of the wells should be equipped with 5.0 centimetres diameter, schedule 40 PVC, flush joint pipe and screens with a suitable filter pack and bentonite grout at the appropriate depths in the well;
iii) An industry standard, locking well cap should be installed with key locks;

iv) The well should be completed in such a way to ensure surface water does not infiltrate the well or micro-annulus;

v) Steel casing should be installed to 50 cm above grade to provide access and preserve the structural integrity of the well.

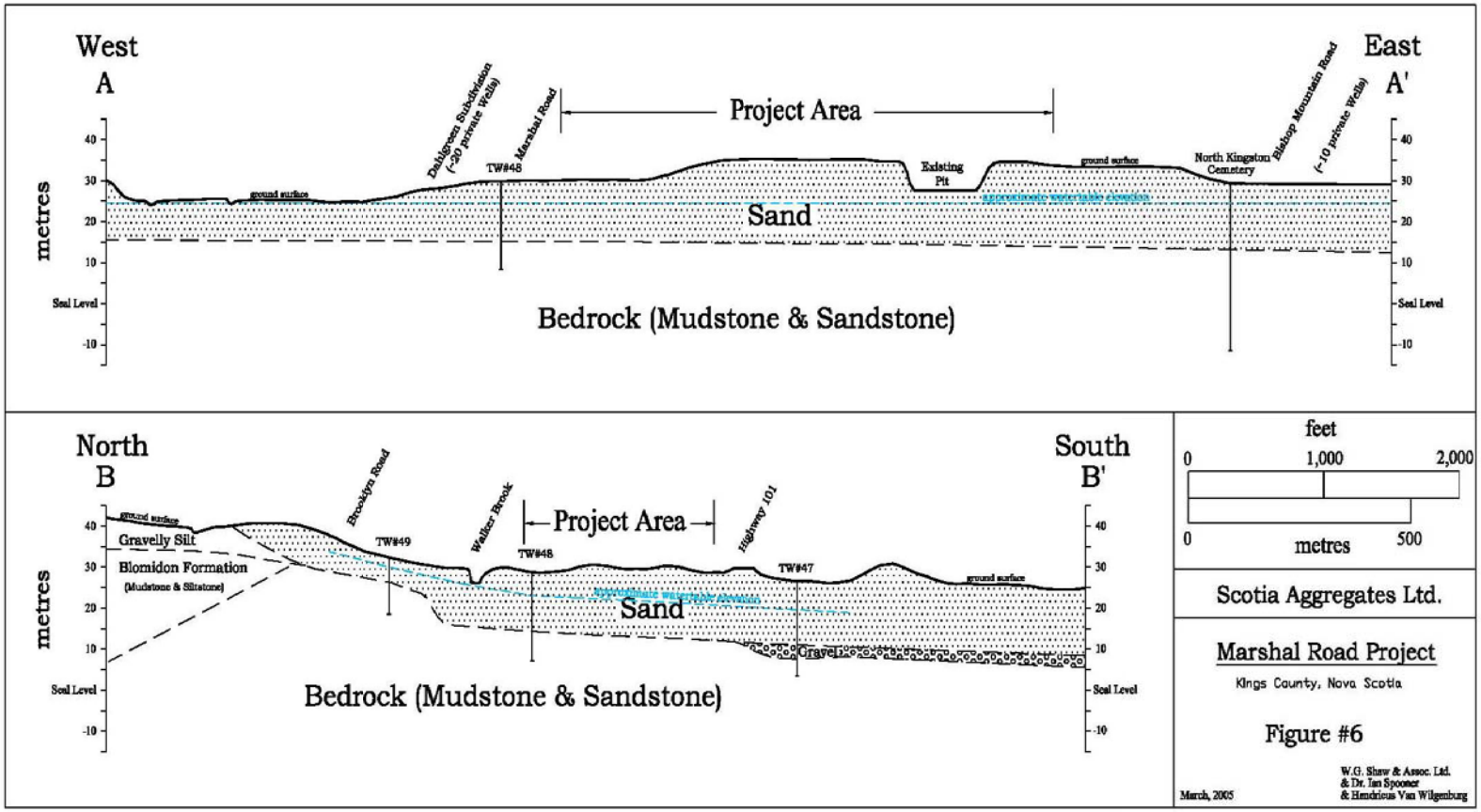
The elevation of the top of each monitoring well should be measured using the top of the PVC pipe as datum. The water level in each well should be measured on a monthly basis during the first two years of operation and then in the spring and fall seasons, thereafter. These data should be utilized to determine groundwater gradients and their change over time.

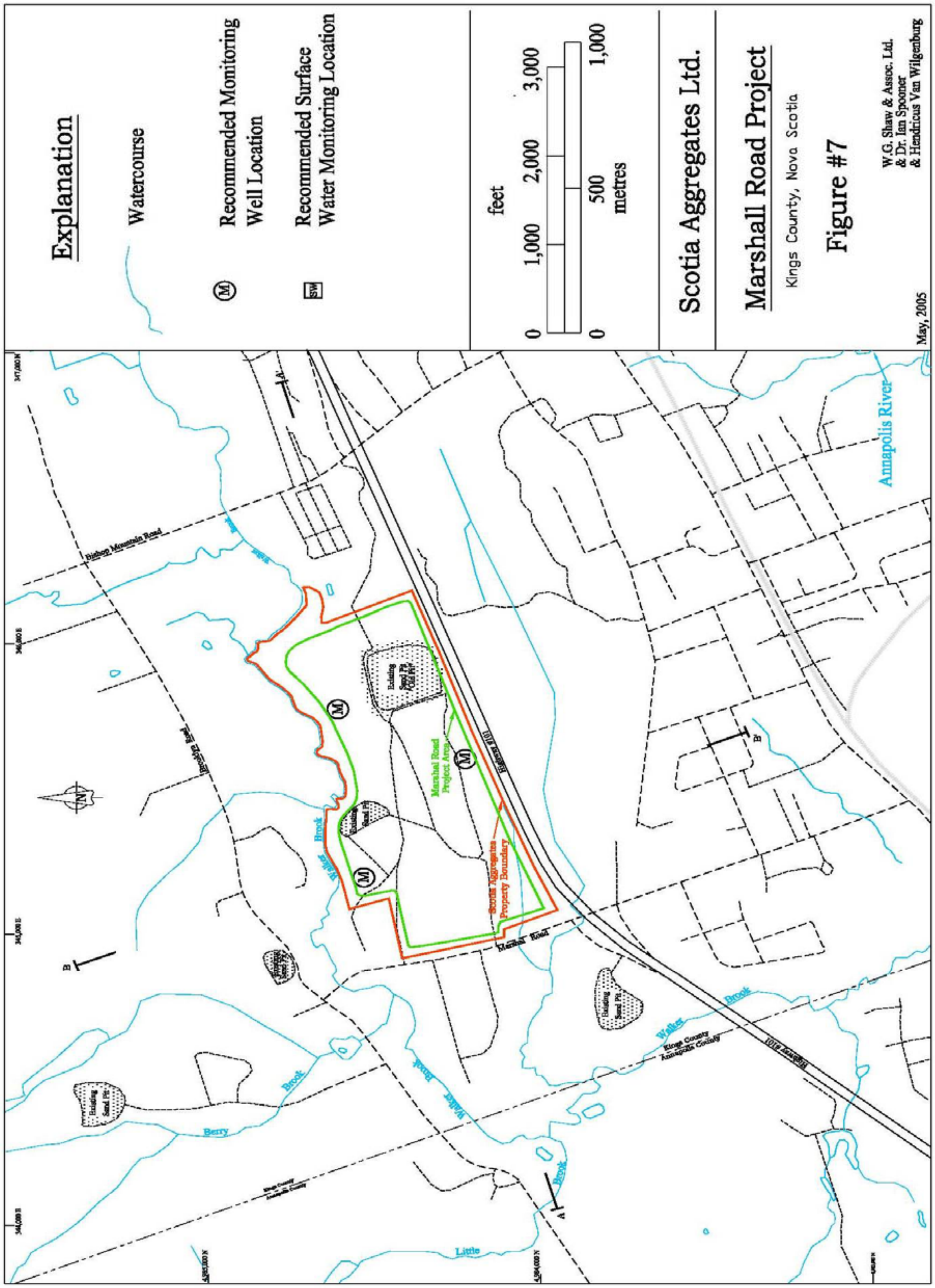
The wells should also be utilized to facilitate groundwater sampling and analyses in order to determine base line water quality and to track water quality changes over time. Water samples should be collected from all monitoring wells and analyzed for the pertinent parameters on a schedule listed below:

- coliform bacteria (once every six months)
- general inorganics + metals (once every six months)
- volatile organic compounds (once every year)

The wells should be equipped with dedicated Waterra sampling devices which should be used to purge the well of at least five (5) well bore volumes prior to sampling. Samples should be collected in containers recommended and supplied by the laboratory. The water samples should be stored in a cool environment and delivered to the laboratory within 24 hours of the sampling event.

The water quality monitoring program should be conducted by an independent geoscience or engineering consulting firm and the results of the monitoring should be compiled and interpreted by a professional geoscientist or engineer.


West
A
East
A'
Project Area
Dublocrest Subdivision (~30 private Wells)
Marshal Road
TW#48
Existing Pit
ground surface
North Kingston Cemetery
Bishop Mountain Road
(~10 private Wells)
metres
Sand
Bedrock (Mudstone & Sandstone)
Seal Level
North
B
South
B'
Brooklyn Road
Walker Brook
Highway 101
TW#49
TW#47
Gravelly Silt
Blomidon Formation
(Mudstone & Siltstone)
Gravel
feet
0
1,000
2,000
metres
500
Scotia Aggregates Ltd.
Marshal Road Project
Kings County, Nova Scotia
Figure #6
March, 2005
W.G. Shaw & Assoc. Ltd.
& Dr. Ian Spooner
& Hendricus Van Wilgenburg


Explanation
Watercourse
Recommended Monitoring Well Location
Recommended Surface Water Monitoring Location
feet
0 1,000 2,000 3,000
0 500 1,000
metres
Scotia Aggregates Ltd.
Marshall Road Project
Kings County, Nova Scotia
Figure #7
W.G. Shaw & Assoc. Ltd.
& Dr. Ian Spooner
& Hendricus Van Wilgenburg
May, 2005
Annapolis River
Highway #101
Marshall Road
Bishop Mountain Road
Brooklyn Road
Marshall Road Project Area
Scotia Aggregates Property Boundary
Walker Brook
Berry Brook
Little

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Appendix A

Photo #1. Photograph of Project Area from Marshall Road facing north

Photo #2. Photograph of "Old Pit", facing north. Terracing formed by previous disturbance of the site. Soils in these areas are very thin and surface drainage is excessive.

Photo #3. Sand pit located north of the property, facing north. Note the horizontal stratification near the top of the pit. These beds are climbing cross stratified and horizontally laminated fine sands and silts, both deposited in an ice-distal subaqueous environment.

Photo #4. Cornwallis soil (CWN X5) on top of outwash sands. The soil is sandy, about 20 cm thick and very porous. Note cementation near the base of the soil at about 30 cm depth, a characteristic of CWN X5 soils in the region The underlying sand is heavily oxidised and moderately cemented (iron precipitate as cement). Photo from SW corner of Project Area.

Appendix 9: Archaeological and Heritage Study

Archaeological and Heritage Survey of Marshall Road Property

Prepared for: Scotia Aggregate Ltd.
Prepared by: Laird Niven, Archaeologist
Survey Date: May 2005

1.0 Introduction

This report contains the findings of an archaeological assessment of a proposed expansion to an existing sand pit operation in Kingston, NS (see Figure 1). The assessment discovered a nineteenth century cemetery and a late-eighteenth to mid-nineteenth century cellar depression within the study area. Avoidance was recommended for both sites.

1.1 Study Area and Project Description

The study area is located north of the Town of Kingston and is bounded to the south by Highway 101, to the west by Marshall Road and to the north by Walker Brook. It is approximately 150 acres in area, the majority of which was cleared in the past and remains cleared. There is an existing sand pit operation on the site as well as a former apple orchard. A series of roads also cross the property.

2.0 Background Research

2.1 Aboriginal Archaeological Potential

There are no reported aboriginal archaeology sites within the study area. There is, however, a small stream running from the east to the west ends of the property (Photo4a). It was concluded that the stream was too small to have been subject to aboriginal activity in the past, particularly given the proximity of the Annapolis River. Aboriginal archaeological potential was deemed to be low.

2.2 Historic Archaeological Potential

While there are no reported archaeological sites within the study area, the proponent reported the existence of a cemetery associated with the Randall family. It was assumed that at least some of the family members lived within or very close to the study area and, if so, the remains of the settlement should be visible. Historic archaeological potential was deemed to be high.

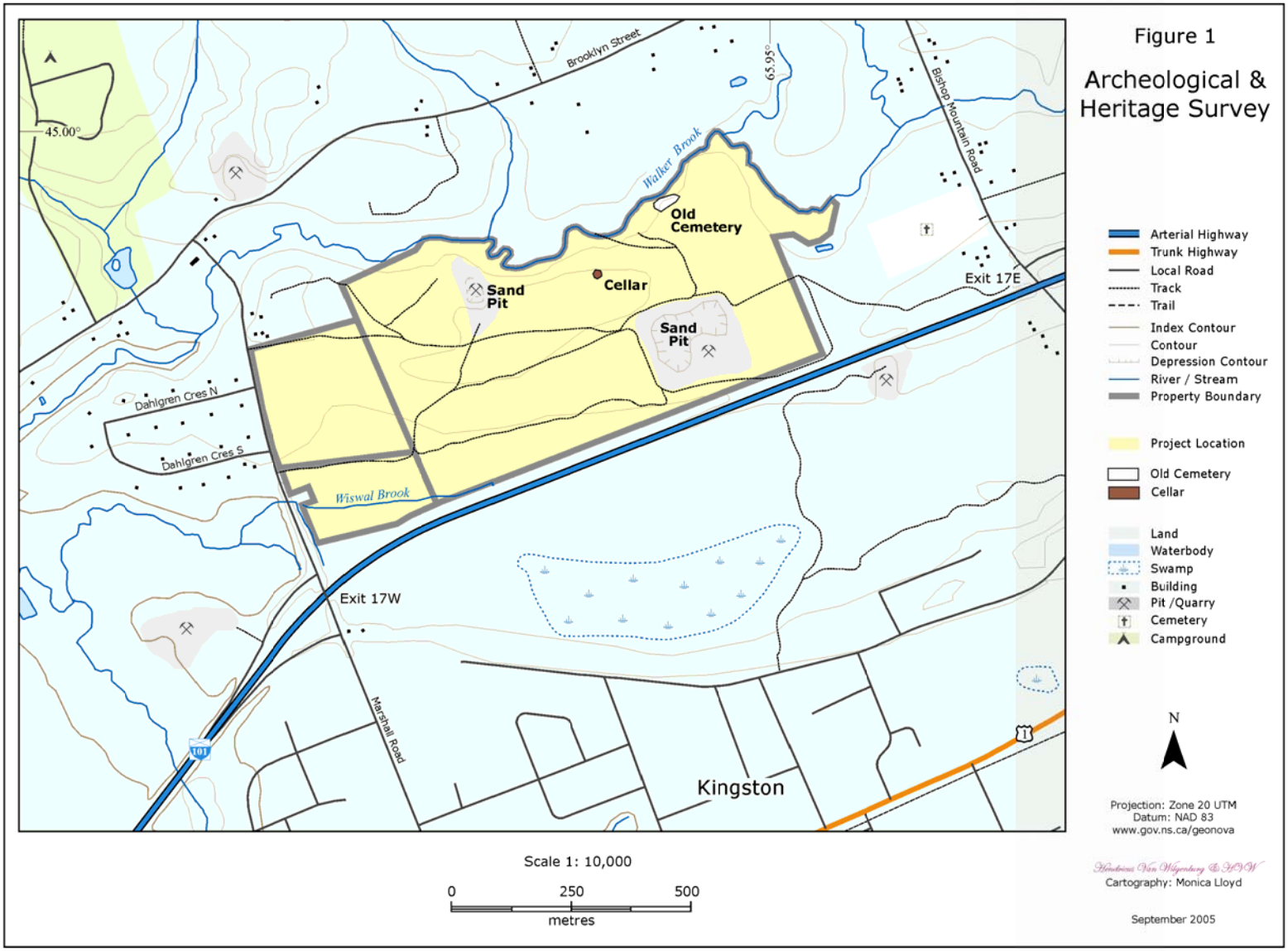
Figure 1
Archeological & Heritage Survey
Brooklyn Street
65.95°
45.00°
Walker Brook
Old Cemetery
Cellar
Sand Pit
Sand Pit
Bishop Mountain Road
Exit 17E
Dahlgren Cres N
Dahlgren Cres S
Wiswal Brook
Exit 17W
Marshall Road
Kingston
Arterial Highway
Trunk Highway
Local Road
Track
Trail
Index Contour
Contour
Depression Contour
River / Stream
Property Boundary
Project Location
Old Cemetery
Cellar
Land
Waterbody
Swamp
Building
Pit /Quarry
Cemetery
Campground
N
Projection: Zone 20 UTM
Datum: NAD 83
www.gov.ns.ca/geonova
Cartography: Monica Lloyd
September 2005
Scale 1: 10,000
0
250
500
metres

3.0 Description of Existing Environment

3.1 Field Survey

A pedestrian survey was conducted over the study area. It was evident from the beginning that the area had seen a great deal of past activity, which had created a very disturbed landscape. The southwest corner of the property was flooded, but the central area was almost completely clear. No evidence of any settlement features was observed during the survey of this area.

Once the survey of the central area was completed, the cemetery was located along the north central boundary of the study area. The cemetery is located on a small knoll just south of Walker Brook (Plates 4b and 5a) and contains three standing headstones, although these have been vandalized in the past (Plates 5b and 6a). The three headstones commemorate the burial of eight members of the Randall family, with burial dates between 1816 and 1882. However, grave depressions that were observed suggest there are approximately 15 to 20 burials in total on the knoll, within an area approximately thirty (30) metres from east to west and twenty (20) metres north to south.

The survey moved from the cemetery to the north edge of the study area, which was somewhat more wooded. It was hoped that some evidence of a former settlement would be found and it did not take long to discover a shallow depression that measured approximately 6 by 5 metres. Random shovel tests were dug on each side of the feature and a few artefacts were recovered from each test. The artefacts recovered included brick fragments and 11 small shards of refined earthenware. The earthenware is almost evenly divided between creamware (c.1760 to c.1820) and pearlware (c.1780 to 1830), which would be consistent with a dwelling occupied in the early 19th century (Lange and Carlson 1985, p. 104-105). This corresponds well with the burial dates on one of the surviving headstones (Photo5b), which range from 1816 to 1831. It would seem logical that a dwelling of this date, discovered within a couple of hundred metres of the cemetery, would be associated with the Randall family.

No other settlement features were observed during the rest of the survey.

4.0 Summary

The survey identified a nineteenth century cemetery, which may contain up to 20 burials, and an early nineteenth century cellar depression (house feature) within the study area. The cemetery is well-known to the proponent and there are plans to buffer the knoll where the burials are located. The knoll has not been flagged by an archaeologist but it is very easy to

identify. Avoidance is also recommended for the cellar depression, which should be in the form of a twenty-five (25) metre buffer. This area would have to be flagged by an archaeologist. Once these two areas of concern are delineated, it is recommended that the project proceed as planned.

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Appendix 1

Photo4a. Walker Brook north of Randall Cemetery

Photo4b. Path leading up to Randall Cemetery at the top of the knoll

Photo5a. View of cemetery knoll looking southwest

Photo5b. Headstone

Photo6a. Headstone

Photo6b. Cellar depression, looking south

Appendix 10: Reforestation & Preservation Images

Old orchard re-planted

Old wildlife tree

Managed forest West Paradise

Re-planted marsh

Plates above: Photos of the Rice family of companies reforestation and preservation practices