DND EA Form

PART I PROJECT IDENTIFICATION

Note: This part must be submitted to the Base/Wing Environmental Officer for registration on the Canadian Environmental Assessment Registry within 14 days of the commencement of the environmental assessment.

Annexes: Annex A – Figures
Annex B – Reports and Information collected during the CEAA
Annex C – Federal Correspondence

1.0 Project Title: Sackville River Wetland Compensation Project at the Bedford Rifle Range

1.1 Description of the project: The Sackville Wetland Complex at the Bedford Rifle Range was the site of a gravel extraction operation up until the early 1960s. Although the site has been relatively undisturbed since that time, it has a number of impaired ecological functions related to the existing flow patterns of the Sackville River resulting from the historical gravel extraction activities.

Several desktop and field studies have been conducted, and the current restoration plan is based on field information gathered in 2009-2011 to further characterize the wetland and fish habitat at the site, including improved habitat for a listed SARA species (wood turtle). The proposed project will be conducted in three phases (year 1, year 2 and year 3) and will include both wetland and fish habitat components. The project footprint will extend along the Sackville River, from Boland's Farm to Peverill's Brook (see Annex B).

The fish habitat restoration work will include:

1. Rocking of the banks of the Sackville River to stabilize the slopes and prevent further bank erosion;
2. Construction of gradient control structures (rock sills and berms); and
3. Construction of salmonid spawning areas

The fish habitat restoration work will be conducted in the dry, using sand bags or an aquadam as temporary dams, to redirect the flow and prevent siltation. An excavator will be used to place all materials, and all work will be done from the banks or in the areas isolated by the coffer dams from the flowing water of the Sackville River. The intent of the project is to work with the natural features to develop a diversity of habitats and increase the overall productivity of the aquatic ecosystem without creating new problems.

The wetland habitat work will involve restoration, creation and expansion of the existing habitats. Some of the work will be complementary to the fish habitat restoration work, and will be include:

1. Construction of gradient control structures (berms) to control, capture and retard drainage of flood events and encourage deposition of organic matter and formation of wetland soils.
2. Excavation of select areas to create marsh habitats for improved herptofaunal (turtle) and waterfowl habitat; and
3. Selected flora planting to improve species diversity.

The wetland work has been designed to minimize the disturbance to existing vegetative cover. Although increased ground cover and plant diversity is desired in several areas, these objectives are to be achieved primarily through addressing functions of soil formation and hydrology. It is anticipated that functionally improved areas will then passively obtain increased plant coverage and diversity.

There are a limited number of areas for which plant diversity appears robust, and compensation activities have been designed to leave these areas completely undisturbed, while working on adjacent subunits to promote improved wetland functions. Improving functions in adjacent areas will allow the spread of seed from the diverse vegetative communities. In the limited areas where soils may be disturbed as part of the compensation activities, some inoculation with appropriate native wetland plantings from the more diverse areas of the wetland complex is proposed.

The work plan has been proposed in a manner that limits the need for machinery to enter the wetland. Machinery use is limited to alder swamp areas and adjacent to perched wetlands that exist on firm sand gravel substrate. The work plan minimizes cutting tree saplings (mostly alder for use in thatching structures). Activities such as placement of large woody debris, blocking of abundant floodplain drainage channels, and construction of flow control structures at floodplain channel inlets and outlets will occur in areas where alder thinning is also proposed. By using a very small-sized excavator and a front-end loader on rubber tracks, machinery movement can occur primarily along the corridors cleared for alder thatching and the old roads throughout the site.

1.2 Project schedule: Summer 2011 to Fall 2013, with subsequent years for monitoring. The construction schedule has been revised to anticipated start in the Winter 2012 and completion in the Fall 2014. The revised schedule is based on the EA Review and assumes that there will not be any access issues for the completion of the work. Additional time may be required to complete the work should there be any site access limitations. Monitoring is expected to be completed in 2019.

1.3 Project Location: Bedford Rifle Range, Bedford, NS

1.4 Originating Directorate, Base, or Unit: The project is funded by the Nova Scotia Department of Transportation, Infrastructure and Renewal and is to be conducted on DND, MARLANT – Bedford Rifle Range property.

1.5 EA Start Date: 7 July 2011 (original date was 25-May-2011, however the EA was not determined to require registration until 7 July 2011).

1.6 Type of Project:

a) Physical work Yes [ ] Cannot be excluded under Part 7(49d).
b) Physical Activity Yes [X] (Inclusion List #31)
c) Other (non-*CEAA* EA)

1.6.1 EA "Trigger":

a) Proponent Yes [ ]
b) Funding Yes [ ]
c) Land Yes [X]
d) Permit Yes [ ]
e) Non-applicable (non-*CEAA* EA)

1.7 OPI's EA/project File reference #: MARLANT EA# 1267-0100-1114

1.7.1 CEA Registry # : CEARIS # 11-01-62942

1.8 Other Responsible Federal authorities: DFO, EC, TC

1.9 Federal Environmental Assessment Coordinator: Lisa MacIsaac, SO EA, FSE, DND

1.10 Contacts:

1.10.1 FEAC Point of Contact: The principle initial point of contact between DND and the public on environmental concerns relating to the EA, the EA report and follow-up.

a) Lisa MacIsaac, B.Sc., C.E.T., PMP, SO Environmental Assessment
b) Formation Safety and Environment
Maritime Forces Atlantic
PO Box 99000, Station Forces
Halifax, NS, B3K 5X5
c) Telephone No. 902-721-5486
d) Fax No. 902-721-5417
e) Email (Internet) Lisa.macisacc2@forces.gc.ca

1.10.2 Project OPI/principle point of contact: The person who is responsible for ensuring that the environmental assessment is conducted for the project.

a) Bob Pett, Ph.D.
b) Nova Scotia Transportation and Infrastructure Renewal
Environmental Services Section
Johnston Building, 3rd Floor, 1672 Granville Street,
PO Box 186 Halifax, Nova Scotia, B3J 2N2
c) Tel: 902-424-4082
d) Fax: 902-424-7544
e) Email: pettrj@gov.ns.ca

a) Jeremy Gammon, Staff Officer Natural Resources
b) Formation Safety and Environment
Maritime Forces Atlantic
PO Box 99000, Station Forces
Halifax, NS, B3K 5X5
c) Telephone No. 902-721-8340
d) Fax No. 902-721-5417
e) Email (Internet) jeremy.gammon@forces.gc.ca

a) CPO2 Andrew Marchand, Range Chief, Bedford Rifle Range
b) Bedford Rifle Range
P.O. Box 99000 Stn. Forces
Halifax, NS B3K 5X5
c) Telephone No. 902-427-7734
d) Fax No. 902-427-7739
e) Email (Internet) andrew.marchand@forces.gc.ca

1.11 Public Notification: Describe any public notices, other than the EA Registry, used for public notification of:

a) Requests for public input to the screening

None required.

b) Termination of the screening (if applicable)

Not Applicable

PART II ASSESSMENT OF EFFECTS AND CONCLUSIONS

Note: This part must be submitted to the Base/Wing Environmental Officer for registration on the Canadian Environmental Assessment Registry. See Steps 3A, B&C: EA Manual

2.0 Assessment of environmental effects

The detailed assessment of environmental effects and supporting documentation is at Annex A (with additional annexes or enclosures as necessary)

2.1 Executive Summary

The Sackville Wetland Complex at the Bedford Rifle Range was the site of a gravel extraction operation up until the early 1960s. Although the site has been relatively undisturbed since that time, it has a number of impaired ecological functions related to the existing flow patterns of the Sackville River resulting from the historical gravel extraction activities.

Several desktop and field studies have been conducted, and the current restoration plan is based on field information gathered in 2009-2011 to further characterize the wetland and fish habitat at the site, including improved habitat for a listed SARA species (wood turtle). Detailed restoration plans have been submitted to DND, DFO, CWS and NSE for comments. The proposed project will be conducted in three phases (year 1, year 2 and year 3) and will include both wetland compensation and fish habitat rehabilitation components. It is anticipated that the Project field work will begin in the winter of 2012 (clearing of an access road) and continue through completion in the fall of 2014. The Project schedule is dependent on the timing of the approval to begin work and permission to access the Project site due to ongoing operations at the rifle range.

The project footprint will extend along the Sackville River, from Boland's Farm to Peverill's Brook (see Annex A).

The fish habitat restoration work will include:

1. Stabilizing the banks of the Sackville River through rock armouring at erosion-prone slopes and riverbends
2. Construction of gradient control structures (rock sills and berms)
3. Construction of salmonid spawning areas (riffles)

The fish habitat restoration work will be conducted in the dry, using sand bags or an aquadam as temporary coffer dams, to redirect the flow and prevent siltation. An excavator will be used to place all materials, and all work will be done from the banks or in the areas isolated by the coffer dams from the flowing water of the Sackville River. The intent of the project is to work with the natural features to develop a diversity of habitats and increase the overall productivity of the aquatic ecosystem without creating new problems.

The wetland habitat work will involve restoration, creation and expansion of the existing habitats. Some of the work will be complementary to the fish habitat restoration work, and will be include:

1. Construction of gradient control structures (berms) to control, capture and retard drainage of surface flow and of flood events to encourage deposition of organic matter and formation of wetland soils
2. Excavation of select areas to create marsh habitats for improved herptofaunal and waterfowl habitat
3. Selected vegetative planting to improve species diversity

The wetland work has been designed to minimize the disturbance to existing vegetative cover. Although

increased ground cover and plant diversity is desired in several areas, these objectives are to be achieved primarily through addressing functions of soil formation and hydrology. It is anticipated that functionally improved areas will then passively obtain increased plant coverage and diversity. There are a limited number of areas for which plant diversity appears robust, and compensation activities have been designed to leave these areas completely undisturbed, while working on adjacent subunits to promote improved wetland functions. Improving functions in adjacent areas will allow the spread of seed from the diverse vegetative communities. In the limited areas where soils may be disturbed as part of the compensation activities, some inoculation with appropriate native wetland plantings from the more diverse areas of the wetland complex is proposed. The work plan has been proposed in a manner that limits the need for machinery to enter the wetland, contains machinery use to alder swamp areas and adjacent to perched wetlands that exist on firm sand gravel substrate, and that limits the need to cut sapling of tree stratum vegetation. This has been achieved by ensuring that activities such as placement of large woody debris, blocking of abundant floodplain drainage channels, and construction of flow control structures at floodplain channel inlets and outlets are proposed in area where alder thatching is also proposed. By using a very small size excavator and a front-end loader on rubber tracks, machinery movement can occur primarily along the corridors cleared for alder thatching and the old roads throughout the site.

There are no major risks to the environment that cannot be mitigated. Erosion and sedimentation controls will be in place during all of the wetland restoration and fish habitat rehabilitation work. All work will be staged to occur during times of low flow through the Sackville River to minimize the impact to the fish moving through the water courses.

FSE and DFO must be notified 10 days in advance of any work.

The contractor will ensure minimal affects on the surrounding environment, and will put best management practices, such as having Safety & Environmental Response Plans in place and ensuring that all workers on site are familiar with these plans. The project will abide by relevant regulations described within the EA. The contractor will follow all mitigation measures and letters of advice to ensure that there will be minimal affects to the surrounding environment.

2.2 EA Determination

On the basis of this EA Report, it has been determined that the impact of this project on the environment is as follows (indicate with an X):

- EA terminated with no determination. Project **cannot** proceed: [ ]
- Project is not likely to cause significant adverse environmental effects. The project **can** proceed with application of the mitigation measures specified in this report: [X]
- The project is likely to cause significant adverse environmental effects. The project **cannot** proceed: [ ]
- Refer the project, through the chain of command and **only on the recommendation of ECS environmental advisor and DGE**, to the Minister of Environment for referral to a mediator or panel review: [ ]

2.3 Follow-up

Is a follow up or monitoring program required? Yes [ ] No [X]

Describe the follow-up program and how and by whom it will be implemented.

No follow-up monitoring is required related to the CEAA requirements for the completion of the project. However, habitat monitoring will be required by DFO and NSE to determine the success of the overall compensation project constructed by the Nova Scotia Department of Transportation and Infrastructure Renewal (NSTIR).

The NSTIR or its agent will undertake a monitoring program to document the success and effectiveness of the wetland and fish habitat restoration and rehabilitation compensation work. The monitoring of the wetland and fish habitat work will be conducted annually for at least five years after the completion of the work.

River monitoring will include measurement of physical parameters including stream pattern, profile and dimensions metrics, water temperature, dissolved oxygen content, pH, stream substrate characteristics, erosion patterns and biological parameters that may include the density and diversity of reptiles, amphibians, fish or other fauna at sites in and above the restored reach. Photographic documentation will be included in the monitoring effort.

Wetland rehabilitation will address growth and percentage survival of planted wetland trees, percent cover by ground-cover and shrub species, presence/absence of invasive plant species and evidence of wildlife utilization of the site.

Annual monitoring reports will be prepared and provided to the appropriate Provincial and Federal agencies.

PART III RECOMMENDATIONS AND SIGN-OFF

3.0 EA Report prepared by:

Andrew McIntosh, M.Eng., Maritime Testing (1985) Limited — Date: 13 January 2012

3.1 EA Report reviewed by (with recommendation by NDHQ, Formation or Base/Wing Environmental Specialist Staff if applicable)

Lisa MacIsaac, Staff Officer - EA, FSE — Date: 6 January 2012

3.2 EA Report reviewed by (with recommendation by NDHQ, Formation or Base/Wing Environmental Specialist Staff if applicable)

Date

3.3 EA Report reviewed by (Nova Scotia Transportation and Infrastructure Renewal)

Dr. Bob Pett, NSTIR, Environmental Services Section — Date: 13 January 2012

3.4 EA Report accepted and approved by

The undersigned accepts the determination and recommendations of this environmental screening report. The undersigned also accepts the responsibility to incorporate the recommendations of the report into the project design and implementation

Date

3.5 EA Report accepted and approved by

The undersigned accepts the determination and recommendations of this environmental screening report. The undersigned also accepts the responsibility to incorporate the recommendations of the report into the project design and implementation.

Dr. Bob Pett, NSTIR, Environmental Service Section — Date: 13 January 2012

Part IV ASSESSMENT OF ENVIRONMENTAL EFFECTS

4.0 Project Description and Scope: See Step 2A: EA Manual

a. **General Description of the project**:

The Sackville Wetland Complex at the Bedford Rifle Range was the site of a gravel extraction operation up until the early 1960s. Although the site has been relatively undisturbed since that time, it has a number of impaired functions ecological functions related to the existing flow patterns of the Sackville River resulting from the historical gravel extraction activities.

The project includes a reach of the Sackville River totalling 1100 metres (m) in length and approximately 18 hectares (ha) of wetland area surrounding the Sackville River. Figure 1 (Annex A) indicates the location of the compensation project on the DND property.

Fish habitat restoration efforts will include the reshaping the river channel to a more natural state and reducing the erosion of the river banks during high flow events. Wetland rehabilitation will result in the expansion of certain wetland formations and ensure a regular source of hydrology other than from direct precipitation.

Several desktop and field studies have been conducted, and the current restoration plan is based on field information gathered in 2009-2011 to further characterize the wetland and fish habitat at the site, including improved habitat for a listed SARA species (wood turtle). Detailed restoration plans have been submitted to DND, DFO, CWS and NSE for comments. The proposed project will be conducted in three phases (year 1, year 2 and year 3) and will include both wetland compensation and fish habitat rehabilitation components. The project footprint will extend along the Sackville River, from Boland's Farm to Peverill's Brook (see Annex A).

The fish habitat restoration work will include:
1. Stabilizing the banks of the Sackville River through rock armouring at erosion-prone slopes and riverbends
2. Construction of gradient control structures (rock sills and berms)
3. Construction of salmonid spawning areas (riffles)

The fish habitat restoration work will be conducted in the dry, using sand bags or an aquadam as temporary coffer dams, to redirect the flow and prevent siltation. An excavator will be used to place all materials, and all work will be done from the banks or in the areas isolated by the coffer dams from the flowing water of the Sackville River. The intent of the project is to work with the natural features to develop a diversity of habitats and increase the overall productivity of the aquatic ecosystem without creating new problems.

The wetland habitat work will involve restoration, creation and expansion of the existing habitats. Some of the work will be complementary to the fish habitat restoration work, and will be include:
1. Construction of gradient control structures (berms) to control, capture and retard drainage surface flow and of flood events to encourage deposition of organic matter and formation of wetland soils
2. Excavation of select areas to create marsh habitats for improved herptofaunal and waterfowl habitat
3. Selected vegetative planting to improve species diversity

The wetland work has been designed to minimize the disturbance to existing vegetative cover. Although increased ground cover and plant diversity is desired in several areas, these objectives are to be achieved

primarily through addressing functions of soil formation and hydrology. It is anticipated that functionally improved areas will then passively obtain increased plant coverage and diversity. There are a limited number of areas for which plant diversity appears robust, and compensation activities have been designed to leave these areas completely undisturbed, while working on adjacent subunits to promote improved wetland functions. Improving functions in adjacent areas will allow the spread of seed from the diverse vegetative communities. In the limited areas where soils may be disturbed as part of the compensation activities, some inoculation with appropriate native wetland plantings from the more diverse areas of the wetland complex is proposed. The work plan has been proposed in a manner that limits the need for machinery to enter the wetland, contains machinery use to alder swamp areas and adjacent to perched wetlands that exist on firm sand gravel substrate, and that limits the need to cut sapling of tree stratum vegetation. This has been achieved by ensuring that activities such as placement of large woody debris, blocking of abundant floodplain drainage channels, and construction of flow control structures at floodplain channel inlets and outlets are proposed in area where alder thatching is also proposed. By using a very small size excavator and a front-end loader on rubber tracks, machinery movement can occur primarily along the corridors cleared for alder thatching and the old roads throughout the site.

b. **Project components, scope, and timeframe**:

The work is scheduled to start in the Winter of 2012 and be completed by the Fall of 2014. The in-stream work will be limited to period of May through September each season.

The project can be broken down into seven main components:

1. Pond habitat enhancement
2. Enhancement of wetland classification quality
3. Alteration of wetland classification/type
4. Wetland habitat expansion
5. Construction of rock sills
6. Construction of berms
7. Placement of bank rocking.

4.1 Description of the existing environment: See Step 2B: EA Manual

a. **Sources of information, including site visits**

- Rehabilitation Plan: Sackville River Restoration Requirements for Fish Habitat (Including Atlantic Salmon Habitat). Prepared by Jacques Whitford, dated 27 March, 2008
- Wetland Compensation Project at the DND Property, Sackville, Halifax County: Part 1 - Wetland Delineation and Compensation Concept. Prepared by East Coast Aquatics, dated March 2010.
- Wetland Alteration Application DND Property Sackville, Halifax County. Prepared by East Coast Aquatics, dated April 2010.
- Wetland Compensation Project at the DND Property, Sackville, Halifax County: Part 2 - Fish Habitat Restoration Requirements. Prepared by Bob Rutherford, dated March 2010.
- Training Area Management Plan (TAMP) for Bedford Rifle Range. Prepared by Jacques Whitford, dated 23 March 2006.
- Integrated Resource Area Management Plan (2003-2008) MALANT Bedford Rifle

Range. Prepared by Dillon Consulting Limited, dated September 2003.

b. **Boundaries**

The site consists of both the section of the Sackville River and surrounding wetland complexes located at the Bedford Rifle Range on the DND property, located at 252 Bicentennial Drive on the border between Lower Sackville and Bedford, consisting of an area of approximately 281 hectares (PID No. 00361212). The project site is located south of Highway 101 in the Sackville river floodplain, eastward from the confluence of the Sackville River and Peverill's Brook and westward upstream, to the DND property boundary. Project location and drawings are provided in Annex A.

c. **General description**

The Bedford Rifle Range property (Nova Scotia Property Records Database 2003) is owned and managed by DND MARLANT, reporting to N4 Materiel at Formation Halifax.

This property consists of 281 ha and is located in the Bedford area of the Halifax Regional Municipality (HRM), Nova Scotia. The civic address is 252 Bicentennial Drive. The property is accessed from the off-ramp from Highway 101 to the Bicentennial Highway (Highway 102). Figure 2.1 (Annex A) provides the site location. A powerline corridor borders the property to the southwest, while private forested lands and residential areas are adjacent to the west border. Highway 101 and residential areas lie to the north, while a highway interchange and the Bicentennial Highway abuts the eastern border. There is some history of noise complaints from neighbouring residents and trespassing on the property.

The property is crossed by the Sackville River, which flows from northwest to southeast, and crosses the range area. It forms a portion of the property's northern boundary and flows through the shooting range before crossing the eastern boundary of the site. A small watercourse, known as Peverils Brook, branches off the Sackville River at the centre of the property and crosses the southern boundary of the site. A major water transmission line and its associated access road cross the property to the west of the range area. A Nova Scotia Power Inc./Emera transmission line crosses the centre of the property and a second powerline parallels the west portion of the southern boundary. A March 2003 forest inventory did not observe any recent impacts to the property from offsite activities (AGFOR Inc. 2003).

A summary of the ecological characteristics is provided in the Wetland Alteration Application (Annex B). Additional information describing the existing hydrological and hydrogeological conditions is also supplied in the same document.

The assessed Sackville Wetland is a moderate sized complex dominated by tall shrub swamp, which covers approximately 78% of the 17.9 ha delineated wetland area. Smaller embedded treed bog (9%) and graminoid/low shrub marsh (8%) subunits add to the site complexity. It is likely that the surface water hydrology was modified by past land use activity across the site, a gravel extraction operation. It is likely that more frequent flooding of the valley floor has been facilitated by complete devegetation of the valley floor, and excavation and channeling of the floodplain within the project reach. Gradient breaks on the Sackville River exist both at the upstream and downstream ends of the wetland complex providing for a low gradient channel

along the 1 km long reach. The floodplain, which corresponds to the wetland boundary in the project area, has naturally become more stabilized and vegetated since the 1960s when gravel extraction ceased. The current surface hydrology appears to have been unaltered since this time, and the site has been left to natural reclamation.

Although virtually all of the Sackville Wetland Complex is currently vegetated, past removal of surface soils has left a very porous and well drained gravel substrate across much of the complex. Many areas lack both floral diversity and density. There are some debris items, such as metal and tires, on the site. The upland riparian buffers of the wetland exist in a relatively natural state, and the watershed upstream of the project site is virtually all forested. A cleared power line corridor exists at the downstream extent of the project area where it intersects the wetland complex, and an area of windfall remnant from Hurricane Juan exists on the north side buffer of the wetland.

A number of old road beds, failed culvert structures and berms are interspersed on the site, particularly in the southeast portion of the complex. A number of herptofuana, mammals, and waterfowl/avian species were observed in and around the wetland complex during field assessments. The diversity of vernal pools, ponds, and wetland types would suggest that the site has moderate wildlife values, which would be further enhanced by the forested riparian buffers and large tracts of undisturbed forest surrounding much of the Sackville Wetland Complex. A Wood turtle (*Glyptemys insculpta*) which is identified as a Threatened species by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), listed in Schedule 1 of the Species At Risk Act, and a listed provincially as a vulnerable species, was identified on the site. Additionally, suitable habitat for the Wood turtle was noted through the Project site.

d. **Valued Ecosystem Components**

The VECs for this project include:

Atmosphere
Surface Water
Ambient Noise
Terrestrial Animals
Terrestrial Habitat
Aquatic Habitat
Aquatic Animals
People/Health

4.2 Consultation: See Step 1C&D, Annex A&B: EA Manual

a. Consultation within DND

Lisa MacIsaac, Formation Staff Officer - EA, FSE
Jeremy Gammon, Staff Officer, Natural Resources, FSE

b. Consultation with the Public

Members of the public are contacted during the assessment if they could potentially be affected by, or concerned with, the possible environmental effects of a proposed project. Input from interested parties may also be used when they can provide knowledge or information that can improve the quality of the EA and help inform decision makers.

Public consultation was determined to not be required for this project. The determination to not involve the public was made based on the fact that activities are anticipated to have little impact to the environment. Additionally, the assessed activities are not likely to affect the public given the restricted access to the project site.

c. Consultation with other Dept's, agencies or jurisdictions

Department	Correspondence	Response
Department of Fisheries and Oceans (DFO)	2 December 2011	- has expert advice - requires additional information to make a determination
Environment Canada (EC)	Email 6 October 2011	- has expert advice - EC would appreciate the receipt of reports as the project progresses to gain insight from the experiences of the Nova Scotia Department of Transportation and Infrastructure Renewal. - The Canadian Wildlife Service has reviewed the proposed wetland compensation project at the Bedford Rifle Range and is of the opinion that the Project constitutes a well-considered compensation plan.
Transport Canada	Email 13 October 2011	- require additional information in order to determine our role as a RA or FA in the Environmental Assessment, and further that a NWPA application will be required.

See Annex C.

The NSTIR (the Project proponent) is undertaking the Bedford Rifle Range stream rehabilitation project through the Nova Scotia Salmon Association (NSSA) and its partners. The NSSA implements the Nova Scotia Liquor Commission (NSLC) Adopt-a-Stream program, and has a blanket NSE Watercourse Alteration permit approval for all projects conducted within this program, and includes the Bedford Rifle Range stream rehabilitation project.

The blanket permit is reviewed and approved annually through a Federal-Provincial Technical Committee that includes regulatory agencies such as the Nova Scotia Environment (NSE), Nova Scotia Fisheries (NSF) and Fisheries and Oceans Canada (DFO). The work to be completed is outlined in the blanket permit and formal letters are prepared for each of the approved Projects. This is the process to be followed to ensure that all permits are in place for all in-stream work.

The Navigable Waters Protection Act application was submitted on 16 November 2011 by the Sackville Rivers Association on behalf of the NSTIR.

4.3 References *List and state the relevance of any applicable laws, regulations, SOPs, reports, etc. used to complete this EA report.*

a. **Regulations and Policies**

Act/Regulation/Policy	Relevance to the Project
DND EA Guidance, 2003	Provides guidance on EA requirements.
DAOD 4003-2 Environmental Assessments	Provides guidance on EA requirements.
Canadian Environmental Assessment Act and *Regulations*	Governs requirements of the EA.
Species at Risk Act	Governs potential and existing species at risk at the site.
Fisheries Act and *Regulations*	Governs issues related to fish habitat. States deleterious substances shall not be deposited into waterways.
Migratory Birds Convention Act and *Regulations*	Governs for the protection of migratory birds, their eggs, and their nests from hunting, trafficking and commercialization.
HRM Noise By-Law	Regulates the amount of noise allowed by machinery on site during any work that occurs after hours.
Nova Scotia Environment Act and *Regulations*	Provides guidance on certain specific issues, such as wetland alteration.
Canadian Labour Code – Part II	Provides guidance on Safety at the site
Occupational Health and Safety Act	Provides guidance on Safety for the project.

b. Other References

AGFOR Inc. 2003. Bedford Rifle Range, Forestry Inventory.

East Coast Aquatics Inc. 2010a. Wetland Project at the DND Property, Sackville, Halifax County: Part 1 – Wetland Delineation and Compensation Concept.

East Coast Aquatics Inc. 2010b. Wetland Alteration Application, DND Property Sackville, Halifax, Co. Prepared for submission to Nova Scotia Environment.

Jacques Whitford. 2005. Rehabilitation Plan: Sackville river Restoration Requirements for Fish Habitat (Including Atlantic Salmon Habitat). Prepared for the Department of National Defence, Maritime Forces Atlantic, Halifax, Nova Scotia.

Rutherford, B. 2010. Wetland Project at the DND Property, Sackville, Halifax County: Part 2 – Fish Habitat Restoration Requirements.

4.4 Environmental Effects: See Step 2C: EA Manual

Refer to matrix, see next page.

4.4.1 ENVIRONMENTAL EFFECTS MATRIX

PROJECT COMPONENT Enter each component e.g. phases of construction, aspects of operation.	VALUED ECOSYSTEM COMPONENTS Add to/delete from matrix below as necessary) Show potential effects with an "X"																			
	PHYSICAL							BIOLOGICAL						SOCIAL						
	Atmosphere	Surface Water	Ground Water	Soils	Terrain	Ambient Noise		Terrestrial Animals	Terrestrial Habitat	Aquatic Animals	Aquatic Habitat	Vegetation		Heritage/Historical	Recreation/Aesthetic	People/Health	Economy	Services	Land Use	
WETLAND RESTORATION																				
Pond Habitat Enhancement	X	X		X		X		X	X	X	X	X				X				
Wetland Habitat Expansion	X	X		X		X		X	X	X	X	X				X				
Wetland Classification/Type Alteration	X	X		X		X		X	X	X	X	X				X				
Wetland Classification Quality Enhancement	X	X		X		X		X	X	X	X	X				X				
FISH HABITAT REHABILITATION																				
Rock Sill Construction	X	X				X				X	X					X				
Berm Construction	X	X				X				X	X					X				
Bank Rock Stabilization	X	X				X				X	X					X				

4.5 Discussion of Effects and Mitigation: See Steps 2D, 2E and 2F: EA Manual

4.5.1 Wetland Restoration

There are four main components for the Wetland Restoration portion of the compensation project. Each of the components of the work has the same general environmental impacts, and therefore, will have similar mitigation requirements. NSTIR will ensure that the work will be completed through its contracts with the contractors and technical consultants for each component of the Wetland Restoration (overall supervision by the NS Salmon Association – NSLC Adopt-a-Stream Program). Due to this, each of the Wetland Restoration components is described below in Section (a) with the Effects and Mitigation sections being the same for each component.

a) Project Activity or Component (s)

(i) Pond Habitat Enhancement

This work will include the restoration and enhancement of Ponds 1, 2 and 9 as identified on Figure 5 (Annex A). The total work for these three areas will total 2400 m^2 of wetland; Ponds 1 and 2 are 400 m^2 each, and Pond 9 is 1600 m^2. These will be enhanced to become fringe wetlands suitable to support amphibian reproduction, aquatic invertebrate production and increased diversity of wetland plants.

Fringe wetland habitat will be created in each pond, and also adding gravel based turtle nesting ridges and structures for waterfowl perches and turtle basking sites. The work includes excavating along the pond gradients of 0.15m – 0.00m below the ponds' mean high water level to form shallow water to lacustrine shore marsh types. A layer of salvaged wetland soils will be spread over the newly excavated sites and inoculated with a diversity of appropriate native hydrophytic vegetation.

Overburden removed from the formation of the shore marsh on the fringe of the ponds will be used to further complex the pond habitats. Gravel ridge islands are to be created based on the availability of appropriate material. The final ridge height would extend approximately 0.2m above the mean high water level of the ponds to form turtle nesting areas.

To provide waterfowl perches and turtle basking sites, large logs placed parallel to the pond water surface will be keyed into the shoreline. The logs will be sourced from the timber removed during the establishment of the site access routes. Additionally large rocks or small boulders will be placed in the ponds such that they are exposed at varying pond water levels.

(ii) Wetland Habitat Expansion

The two areas for wetland habitat expansion are identified as Perch 1 and Perch 2 on Figure 5 (Annex A). These areas are characterized by small pockets of hydrophytic vegetation and are slightly elevated, approximately 1-2m, above the active floodplain. Each area has a small feeder stream as the primary water source.

To ensure that water stays within the perched areas, a primary discharge location will be selected and a "v-notched" armoured berm and discharge channel will be installed. The remaining berm

low points will be filled in to an elevation of 1m with fine textured material suitable to prevent the movement of water from the perched area to the valley floor.

These measures will provide a concentrated single outflow directed to an appropriate receiving area in the adjacent wetland on the valley floor. To ensure a diversity of vegetation at the sites, wetland plants will be transplanted at the sites. A soil profile assessment will be completed for each site to aid in the plant species selection for inoculation of the sites to be restored. The most likely plant sources are areas Alder 7 and Marsh 5 for Perched 1 and 2, respectively, as shown in Figure 5 (Annex A).

(iii) Wetland Classification/Type Alteration

The project areas for this work include the expansion of Treed Bog 1 into Alder 5 and the expansion of northern upland/wetland boundary of Alder 2 to form bog areas. The work includes measures to capture sheet flows through the addition of berm structures and adding salvaged organic wetland soils to the areas to be restored. Introducing the biotic material should initiate the natural processes including increasing the soil moisture content and growth of appropriate hydrophytic species.

(iv) Wetland Classification Quality Enhancement

There are 3 main components of this work: (i) increasing the organic matter in specific locations, (ii) increasing the period of water retention, and (iii) restoring the floodplain roughness function.

(i) Increasing the organic matter in soils for the alder swampland units:
Test plots of areas for treatment with peat layers ranging in thickness between 15 to 40 cm, will be compared to untreated areas. The actual test planting locations will be selected in the field at the time of construction activities.

No vegetation stratum from the test areas will be removed during the installation of the peat material. Salvaged material used in planting will be assessed for invasive species prior to collection and application. This measure will minimize the risk of introducing invasive species to the project site.

(ii) Increasing the period of water retention through the use of water dispersal across the floodplain.
This work includes the filling in of smaller channels to encourage the dispersal of flow across the broader floodplain. A select number of smaller drainage channels across a number of the alder swamp areas are identified for filling in of the downstream extent. A selection of hardy pioneer species from on site will be transplanted to the small areas of disturbance to promote quick vegetative cover. The organics and fine material that may exist on the bottom of the existing drainage channels will be removed prior to infill and then used as a topping material over the sites.

These activities will occur in both the northern and southern floodplain areas on the project site.

(iii) Restoring floodplain roughness function.
The floodplain roughness function will be restored in the alder swamp areas that have been impaired due to the removal of vegetation and structure during gravel extraction activities. This

will enhance the energy dissipation function that these features provide within the wetland complex. Natural roughness of dense vegetation, course woody debris (CWD), and larger rocks all dissipate flood water energy on floodplains and promote deposition of fines and retention of small organic debris. These are fundamental floodplain functions for soils formation that are currently impaired. Two approaches are recommended. The first is that CWD be placed on the floodplain in the relatively high energy alder swamp areas of the Sackville Wetland Complex, particularly at the upstream extent of the DND property. The use of whole tree placements, with limbs and roots, will become anchored in existing alder vegetation. Most placements should take place within approximately 30m of the delineated upland/wetland boundary in order to most accurately recreate natural recruitment from the upland areas. It further limits he presence of CWD next to the open Sackville River channel where there would be an increased risk of placements being moved by buoyancy.

The second approach is to create alder thatchings, particularly at locations where CWD availability or access to make placements is limited. In such areas the existing alder cover would be cut to within 30 cm of the ground along a 2 m wide strip such that they may sprout new growth. The strips would be cut perpendicular to the direction of flow across the floodplain. Spacing of the parallel strips would be 10 m. Slash material from the cut alders would be used to thatch (weave) a low elevation "fence" (30-50 cm high) on the downstream side of the 2 m wide cut strip. The woven slash would be tied with a hemp twine to standing alders. This thatching would be continuous from high ground to small floodplain drainage channels for which infilling to disperse flow has been prescribed as described above. They should not be placed across a floodplain channel in which through flow is to be maintained, as identified by the lack of any proposed compensation activity.

b) Valued Ecosystem Component(s) Affected

Atmosphere
Surface Water
Soils
Ambient Noise
Terrestrial Animals
Terrestrial Habitat
Aquatic Habitat
Aquatic Animals
Vegetation
People/Health

c) Description of the Effect

Atmosphere	- Could be negatively affected by exhaust and dust emissions
Surface Water	- Could be negatively affected by land based sediment and run-off from excavation, land clearing, restoration/rehabilitation activities, accidental leaks, or spills and malfunctions (see Section 4.7).
Soils	- Could be negatively affected by soil exposure resulting in erosion and sedimentation - Reduced capacity through compaction and rutting, and mixing of topsoil and layers below
Ambient Noise	- Could be negatively affected by operating equipment.
Aquatic habitat	- Could be negatively impacted by land based sediment entering river or

and animals	the surrounding wetlands and ponds. - Could be negatively impacted by operation of heavy machinery during restoration activities in or adjacent to the river
Terrestrial habitat and animals	- Could be negatively impacted by operation of heavy machinery during the restoration activities in surrounding wetlands and ponds. - Could be impacted by the loss of habitat with the expansion of the wetland area. - Could introduce invasive or non-native plant species to the Project site. - Could impact Wood turtle habitat (Species at Risk).
Vegetation	- Introduction of non-native species, including opportunistic species - Loss of vegetated cover
People/Health	- Could be negatively affected if Contractor does not implement a health and safety plan

d) Mitigation Measures

Atmosphere	- During the activities, equipment in good working order with no unusual exhaust emissions or noise pollution will be used. - Idling of equipment will be avoided - Dust and control measures, approved by DND, will be employed by the Contractor during periods of significant dust generation.
Surface water, Aquatic habitat and Animals	- NSTIR must have a Navigable Waters Protection approval from Transport Canada prior to initiating any in water work. - DFO and NSE will be notified 10 days in advance of any work in the Sackville River. - Prior to any work for this project, the appropriate erosion and sediment controls necessary for protecting the natural environment will be implemented. These measures will be left in place until all disturbed areas on the work site have been stabilized. Any remaining disturbed areas on the work site will be stabilized as soon as possible after project completion. - Miscellaneous debris will be removed from the project area prior to restoration/rehabilitation activities. - Minimize duration of in-water work whenever possible. - Work will be conducted in the dry utilizing sand bags or aquadams as temporary coffer dams, to redirect the flow away from the work area and prevent siltation. - Upon completion of the in-water work, remove all sandbags or other temporary dams structure or material from the river. - Any water within excavated areas will be pumped to a vegetated area at least 30 m from the river. - Every effort shall be made to minimize the disturbance of the river, including the discharge of silt, harmful materials or any other deleterious substance(s) into the aquatic environment. - Deleterious substances, including land-based sediments, will not be permitted for release into the river; any releases could result in a contravention of Section 36 of the *Fisheries Act*. - Hazardous wastes, if any are produced, will be handled in accordance with approved regulations and practices. - Runoff from any temporary storage areas will be controlled and sediment prevented from entering the river.

	- Equipment will only be refuelled in a designated level area that is a minimum of 30 meters away from the water. - All equipment and machinery will be in good working order, free of leaks, or will be repaired immediately or removed from the site. - The contractor will prepare an EPP prior to mobilizing at the site. The EPP will include a Contaminant Prevention Plan and a Spill Control Plan. As part of the EPP, the contractor will be required to ensure that spill kits are on-site and that personnel are familiar with their use. - The contractor will be briefed and given the phone numbers for the Fire Department. - All work will be carried out in accordance with applicable regulations and legislation (such as *Fisheries Act*, etc). - All spills regardless of size must be reported to the 24 hour emergencies reporting line at 1-800-565-1633 (DFO). -
Ambient Noise	- During the activities, equipment in good working order with no unusual noise pollution will be used. - Idling of equipment will be avoided. - This work will fall under the guidelines laid out in the HRM noise by-laws.
Soil	- If a prolonged period of exposure is expected, stabilize the surface using temporary cover (e.g. mulch, gravel, erosion blanket), as appropriate - Phase work to minimize duration of exposure of the disturbed areas at risk - Avoid working during wet conditions and/or confine operations to paved or gravel surfaces - Maximize use of existing access roads and trails. - Whenever possible, strip and store topsoil separately from the layers below and return to excavation in sequence
Terrestrial habitat and Animals	- Use existing trails, roads or cut lines to avoid or minimize disturbance to the Sackville River or wetlands areas. - Vegetation removal should be kept to a minimum and clearing should be limited to designated areas. - Use of native plant species and re-use of native materials. - Implement Wood turtle management plan to reduce impact to Wood turtle habitat.
Vegetation	- For re-vegetation purposes, use locally sourced seed mixes that contain native species - Salvage and replant important species in areas designated for protection - Restore area with native species adapted to the project area to enhance that local plant community
People/Health	- The contractor will be required to develop and implement a safety plan for the work site. - All personnel will be required to wear proper PPE.

e) Residual Effects - are there likely to be significant adverse impacts after mitigation? Are there any significant unresolved issues or major areas of uncertainty?

No residual adverse affects or areas of uncertainty are expected from the project. The project's main focus is the restoration/rehabilitation of the area for both fish habitat and wetlands, therefore only a positive impact is anticipated.

f) Follow-up and monitoring

Routine monitoring by DND, DCC and their representatives will be carried out throughout the project to ensure the contractor follows the mitigation measures. NSTIR or its agent will monitor the effectiveness of the restoration/rehabilitation measures as described in the "Wetland Compensation Project at the DND Property Sackville, Halifax, County: Part 1 – Wetland Delineation and Compensation Project" (Annex B).

4.5.2 Fish Habitat Rehabilitation

There are three main components for the Fish Habitat Restoration portion of the compensation project. Each of the components of the work has the same general environmental impacts, and therefore, will have similar mitigation requirements. NSTIR will ensure that the work will be completed through its contracts with the contractors and technical consultants for each component of the Fish Habitat Rehabilitation (overall supervision by the NS Salmon Association – Nova Scotia Liquor Corporation (NSLC) Adopt-a-Stream Program). Due to the similar mitigation techniques, each of the Fish Habitat Rehabilitation components is described below in Section (a) with the Effects and Mitigation sections being the same for each component.

a) Project Activity or Component(s)

(i) Rock Sill Construction

Rock sills are placed so they can form a "sill" for the water to cascade over. This action will cause a natural digging action that forms a pool below the sill and stirs up gravel resulting in the creation of attractive spawning areas for salmonids, including the Atlantic salmon.

Spawning riffle structures will also be created. They will have the same dimensions as shapes as the rock sills, but they will be set at the crest of the existing shallow areas in an existing run section of the river at an elevation that is 50 cm above summer flow.

As noted for the berms, armour stone will consist of hard, durable, field or quarry stone, free of splits, seams or defects likely to impact its surroundings during handling or by the actions of water and ice. Shale, slate or rocks within thin foliations will not be acceptable.

(ii) Berm Construction

Berms will be used to control the flow in and out of the wetland areas and to keep the majority of the 1:2 year flow within the river in order to maintain the pools, riffles, and the point bars that are essential to a productive aquatic habitat. The berms will maintain water levels in the wetland to prevent the wetlands from drying out for long periods during the summer.

The V-slots in berms are sized to permit a flow to the down gradient wetland areas during low summer flows but limit higher flows to reduce erosion, excessive flushing and maintain flushing conditions in the river.

Berm SR-B8 is set back 20-25 m into the low floodplain to keep the water in the river for: (i) riffle, pool and point bar developments, and (ii) to keep from cutting new channels through this floodplain area. The river is trying to increase its length on the right bank between the two left pools at SR-27L and SR-26C. This berm will not reduce flooded areas below as the water will flood around the low right bank at the end and back from Boland's Pool and through the notch opening to supply water to the wetlands below. This berm is ideally constructed as an earthen structure from on-site materials and subsequently planted and faced with rock to prevent erosion. Velocities along this berm will be very low as water is running through existing alders. A gravel-sand mix will be placed on the top to provide turtle nesting habitat similar to that currently used by the turtles on the old road bed at the lower end of Boland's Pool. The elevation on the bottom of the berm V-notch will be set to carry a shallow flow in low water level.

Berm SR-B7 will consist of four small berms designed to close off braided channels that are out of pattern and in both cases lowering the summer flow to the adjacent wetlands. They are low berms that will just come up to the height of the surrounding floodplain and will over-top in high flows.

(iii) Bank Rock Stabilization

Details of the bank rocking are provided in Drawing 1034314-109 (Annex C) of the Rutherford (2010) fish habitat report. The areas to be stabilized range in height between 2.0 and 5.5 m and the armour rock will be placed to a thickness of 1.2 m±. If water control is required, then an aquadam or sand bags will be placed upstream of each area where rock banking is required, to divert flow away from the work areas.

Similar to the berms, the armour rock will consist of hard, durable, field quarry stone, free of splits, seams or defects likely to impair its soundness during handling or by the actions of water and ice. Shale, slate or rocks with thin foliations will not be acceptable.

b) Valued Ecosystem Component(s) Affected

Atmosphere
Surface water
Ambient noise
Aquatic animals
Aquatic habitat
People/Health

c) Description of the Effect

Atmosphere	- Could be negatively affected by exhaust and dust emissions
Surface Water	- Could be negatively affected by land based sediment and run-off from excavation, land clearing, restoration/rehabilitation activities, accidental leaks, or spills and malfunctions (see Section 4.7).
Ambient Noise	- Could be negatively affected by equipment operating.
Aquatic habitat and animals	- Could be negatively impacted by land based sediment entering river or the surrounding wetlands and ponds.
People/Health	- Will be positively affected by tendering of contract to have the work conducted.

d) Mitigation Measures

Atmosphere	- During the activities, equipment in good working order with no unusual exhaust emissions or noise pollution will be used. - Idling of equipment will be avoided - Dust and control measures, approved by DND, will be employed by the Contractor during periods of significant dust generation.
Surface water, Aquatic Habitat and Animals	- NSTIR must have a Navigable Waters Protection approval from Transport Canada prior to initiating any in water work. - DFO will be notified 10 days in advance of any work in the Sackville River. - Prior to any work for this project, the appropriate erosion and sediment controls necessary for protecting the natural environment will be implemented. These measures will be left in place until all disturbed areas on the work site have been stabilized. Any remaining disturbed areas on the work site will be stabilized as soon as possible after project completion. - Miscellaneous debris will be removed from the project area prior to restoration/rehabilitation activities. - Minimize duration of in-water work whenever possible. - Work will be conducted in the dry utilizing sand bags or aquadams as temporary dams, to redirect the flow away from the work area and prevent siltation. - Upon completion of the in-water work, remove all sandbags or other temporary dams structure or material from the river. - Any water within excavated areas will be pumped to an area at least 30 m from the river. - Every effort should be made to minimize the disturbance of the river, including the discharge of silt, harmful materials or any other deleterious substance(s) into the aquatic environment. - Deleterious substances, including land-based sediments, will not be permitted for release into the river; any releases could result in a contravention of Section 36 of the *Fisheries Act*. - Hazardous wastes, if any are produced, will be handled in accordance with approved regulations and practices. - Temporary storage of hazardous material, if required, will be located over 30 meters from river, with appropriate measures to contain the materials (e.g. tarps). - Runoff from any temporary storage areas will be controlled and sediment prevented from entering the river. - Equipment will only be refuelled in a designated level area that is a minimum of 30 meters away from the water. - All equipment and machinery will be in good working order, free of leaks, or will be repaired immediately or removed from the site. - The contractor will prepare an EPP prior to mobilizing at the site. The EPP will include a Contaminant Prevention Plan and a Spill Control Plan. As part of the EPP, the contractor will be required to ensure that spill kits are on-site and that personnel are familiar with their use. - The contractor will be briefed and given the phone numbers for the Fire Department. - All work will be carried out in accordance with applicable regulations

	and legislation (such as *Fisheries Act*, etc). - All spills regardless of size must be reported to the 24 hour emergencies reporting line at 1-800-565-1633 (DFO). - DND, or delegate (i.e. DCC) will carry out regular monitoring including regular visual inspection of the water surrounding the work area(s) to determine the quality of water.
Ambient noise	- During the activities, equipment in good working order with no unusual noise pollution will be used. - Idling of equipment will be avoided. - This work will fall under the guidelines laid out in the HRM noise by-laws.
People/Health	- The contractor will be required to develop and implement a safety plan for the work site. - All personnel will be required to wear proper PPE.

e) Residual Effects - are there likely to be significant adverse impacts after mitigation? Are there any significant unresolved issues or major areas of uncertainty?

No residual adverse affects or areas of uncertainty are expected from the project. The project's main focus is the restoration/rehabilitation of the area for both fish habitat and wetlands, therefore only a positive impact is anticipated.

f) Follow-up and monitoring

Routine monitoring by DND, DCC and their representatives will be carried out throughout the project to ensure the contractor follows the mitigation measures. NSTIR or its agent will monitor the effectiveness of the restoration/rehabilitation measures as described in the "Wetland Compensation Project at the DND Property Sackville, Halifax, County: Part 1 – Wetland Delineation and Compensation Project" (Annex B).

4.6 Cumulative Effects: See Step 2G: EA Manual

a) Identify other existing or future projects that affect or may affect the same VECs as this project.

Additional projects have been completed upstream of the project site along the Sackville River wihin the past 2 years and additional projects will be performed in 2012 by the Sackville River Association in association with the NSLC Adopt-a-Stream Program.

b) Describe the potential cumulative environmental effects

The upstream, project is very similar in nature to the one proposed by NSTIR for the DND Bedford Rifle Range. These projects will combine to have a net positive result for the Sackville River and adjacent wetlands area. A cumulative positive effect in the creation of increased natural terrestrial and fish habitat will be the result of the combined projects.

A cumulative effect related to erosion and sedimentation from the projects may impact the downstream area. Erosion and sedimentation effects will be minimized through the implementation of mitigation measures presented above.

c) Describe the required mitigation measures

During the activities, erosion and sedimentation controls will be in place during the construction activities. Additionally, the work will be staged such that it will occur during low flow conditions in the Sackville River to minimize any impact on fish habitat and surrounding wetland environment.

d) *Will the residual effects be significant*?

It is unlikely that these projects will cause any significant negative cumulative residual effects on the environment. However, it is expected that a significant positive cumulative environmental effect will result from these projects.

4.7 Accidents and malfunctions

- A POL spill from machinery could affect surface water quality, aquatic animals and aquatic habitat.

The contractor will prepare an Environmental Protection Plan (EPP) prior to mobilizing at the site. The EPP will include a Contaminant Prevention Plan and a Spill Control Plan. As part of the EPP, the contractor will be required to ensure that spill kits are on-site and that personnel are familiar with their use. The contractor will also be briefed and given the phone numbers for the Fire Department who is trained in responding to petroleum spills on both land and in water courses. There are unlikely to be significant adverse impacts after mitigation.

The work area will be enclosed with erosion and sedimentation controls that will prevent migration of any sediment and other material out of the work area. No hazardous materials have been identified and are anticipated within the project area. There are unlikely to be significant adverse impacts after mitigation.

4.8 Effects of the environment on the project

Possible effects of the environment of the project include storm events (e.g. precipitation) that may impact erosion and sediment control on the site. Any effects of storm events on the project will be mitigated by carrying out the work in accordance with “Best” Environmental Management

Practices, contractor contingency plans, including installation of the silt/turbidity curtain. There are unlikely to be significant adverse impacts after mitigation.

4.9 Follow-up program: See Step 2H: EA Manual

Follow-up program required for the project Yes [ ] No [X]

If yes, provide details of the program.

No follow-up monitoring is required related to the CEAA requirements for the completion of the project. However, habitat monitoring will be required by DFO and NSE to determine the success of the overall compensation project constructed by the Nova Scotia Department of Transportation and Infrastructure Renewal (NSTIR).

The NSTIR or its agent will undertake a monitoring program to document the success and effectiveness of the wetland and fish habitat restoration and rehabilitation compensation work. The monitoring of the wetland and fish habitat work will be conducted annually for at least five years after the completion of the work.

River monitoring will include measurement of physical parameters including stream pattern, profile and dimensions metrics, water temperature, dissolved oxygen content, pH, stream substrate characteristics, erosion patterns and biological parameters that may include the density and diversity of reptiles, amphibians, fish or other fauna at sites in and above the restored reach. Photographic documentation will be included in the monitoring effort.

Wetland rehabilitation will address growth and percentage survival of planted wetland trees, percent cover by ground-cover and shrub species, presence/absence of invasive plant species and evidence of wildlife utilization of the site.

Annual monitoring reports will be prepared and provided to the appropriate Provincial and Federal agencies.

4.10 Summary Table (optional)
Below is a summary table of all effects and proposed mitigation measures.

Mitigation
NSTIR must have a Navigable Waters Protection approval from Transport Canada prior to initiating any in water work.
All machinery equipment in good working order with no unusual exhaust emissions will be used.
Idling of equipment will be avoided.
Dust control measures, approved by DND, will be employed by the contractor during periods of significant dust generation.
This work will fall under the guidelines laid out in the HRM noise by-laws.
Equipment in good working order with no unusual noise pollution will be used. This work will fall under the guidelines laid out by the HRM noise bylaws.
The contractor (or DND) will be required to develop and implement a safety plan for the work place.

All personnel will be required to wear proper PPE.
DFO will be notified 10 days in advance of any work at Sackville River.
Prior to any work for this project, the appropriate erosion and sediment controls necessary for protecting the natural environment will be implemented. These measures will be left in place until all disturbed areas on the work site have been stabilized. Any remaining disturbed areas on the work site will be stabilized as soon as possible after project completion (DFO).
Heavy equipment will not operate in flowing water of the Sackville River.
Deleterious substances, including land based sediments, will not be permitted to be released into the Harbour; any releases could result in a contravention of Section 36 of the *Fisheries Act* (DFO).
Hazardous wastes, if any produced, will be handled in accordance with approved regulations and practices.
Temporary storage of hazardous materials, if required, will be located over 30 metres from the river, with appropriate measures to contain the materials (e.g tarp).
Miscellaneous debris will be removed from the Sackville River prior to restoration/rehabilitation activities.
Minimize duration of in-water work whenever possible.
Work will be conducted in the dry utilizing sand bags or aquadams as temporary coffer dams, to redirect the flow away from the work area and prevent siltation.
Upon completion of the in-water work, remove all sand bags or other temporary dam structures or material from the river.
Any water within the excavated area will be pumped to a vegetated area at least 30m from the river.
Every effort shall be made to minimize the disturbance of the river, including the discharge of silt, harmful materials or any other deleterious substance(s) into the aquatic environment.
Use existing trails, roads or cut lines to avoid or minimize disturbance to the Sackville River or wetlands areas.
Vegetation removal should be kept to a minimum and clearing should be limited to designated areas.
Temporary storage of hazardous material will be located over 30 meters from the Sackville River, with appropriate measures to contain the materials (i.e. tarps).
Runoff from any temporary storage areas will be controlled and sediment prevented from entering the Sackville River by erosion and sedimentation control measures.
If prolonged period of exposure is expected, stabilize the surface using temporary cover (e.g. mulch, gravel, erosion blanket) as appropriate.
Phase work to minimize duration of exposure of the disturbed areas at risk.
Avoid working during wet conditions, and/or confine operations to paved or gravel surfaces.
Whenever possible, strip and store topsoil separately from the layers below and return to excavation in sequence.
Use of native plant species and re-use of native materials.
Implement Wood turtle management plan to reduce impact to Wood turtle.
For re-vegetation purposes, use locally sourced seed mixes that contain native species.
Salvage and replant important species in areas designated for protection.
Restore area with native species adapted to the project areas to enhance the local plant community.
Equipment will only be refuelled in a designated paved, level area that is a minimum of 30 meters away from the water.
All equipment and machinery will be in good working order, free of leaks, or will be repaired immediately or removed from the site.

The contractor will prepare an Environmental Protection Plan (EPP) prior to mobilizing at the site. The EPP will include a Contaminant Prevention Plan and a Spill Control Plan. As part of the EPP, the contractor will be required to ensure that spill kits are on-site and that personnel are familiar with their use.
All personnel will be required to wear proper PPE.
Spill response equipment will be on site and the contractor's personnel trained in spill response.
The contractor will be briefed and given the phone numbers for the Fire Department.
All work will be carried out in accordance with applicable regulations and legislation (such as *Fisheries Act*, etc).
All spills regardless of size must be reported to the 24 hour emergencies reporting line at 1-800-565-1633 (DFO).
DND, or delegate (i.e. DCC) will carry out regular monitoring including regular visual inspection of the water inside and outside the boom and silt curtain to determine the quality of water.

4.11 Conclusions

The overall assessment is that all effects are insignificant or will be mitigated and that the project should proceed. Mitigation during this construction will be maintained and managed using mitigation measures, including erosions and sediment controls, and good work practices. No long term adverse effects or risk to the public are anticipated with this project.

Annex A

Figures

Annex A
to MARL: 1267-0100-1114

Figure 1: Location of Sackville River Wetland Compensation Project (Source: Google Earth)

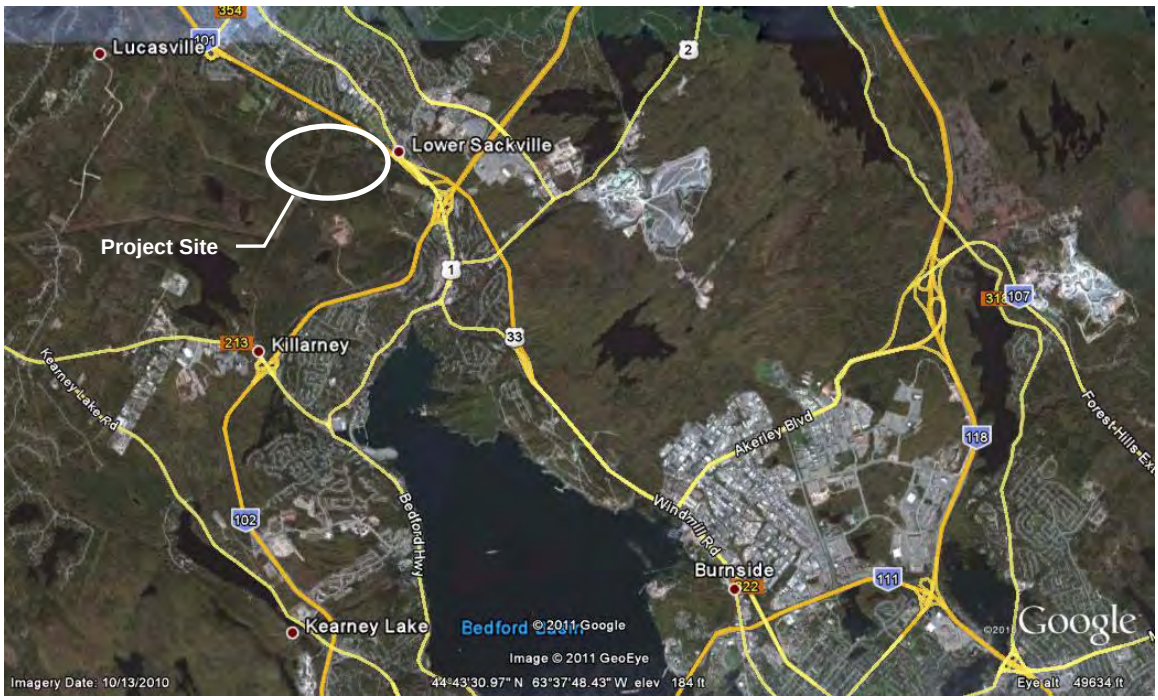


Figure 2: Extent of the Sackville River Wetland Compensation project on the DND Bedford Rifle Range. (Source: East Coast Aquatics Inc. March 2010)

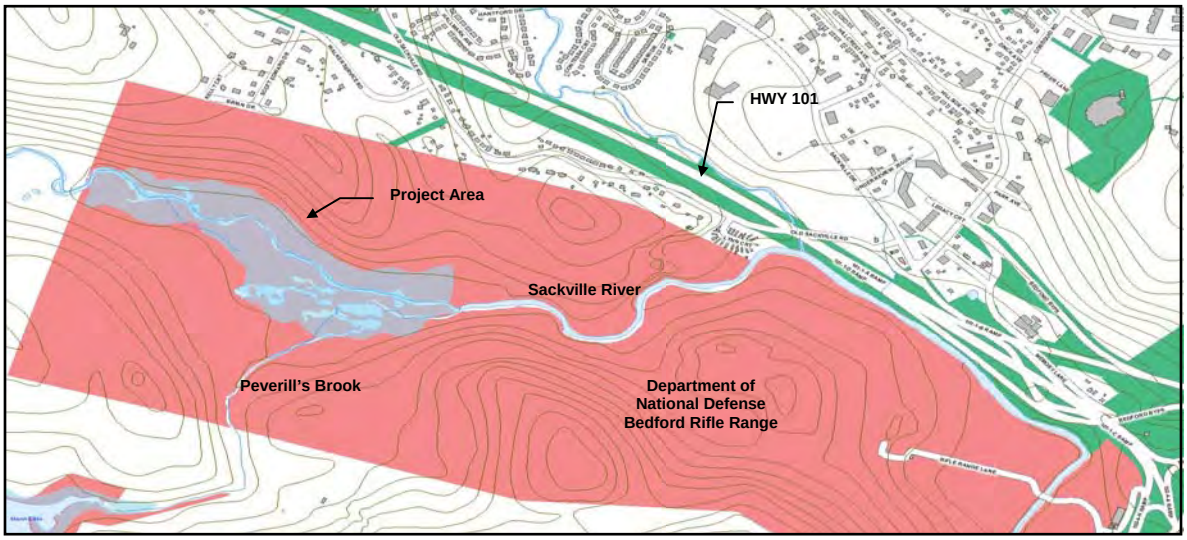


Figure 3. Wetland compensation areas on the Bedford Rifle Range.
(Source: East Coast Aquatics Inc. April 2010)

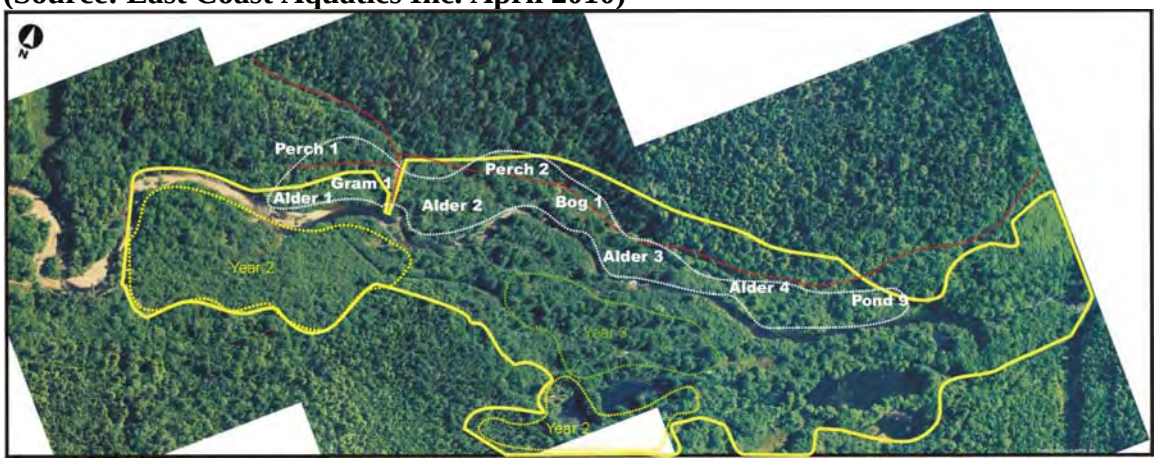


Figure 4. Fish habitat restoration areas on the Bedford Rifle Range, Year 1.
(Source: Rutherford 2010)

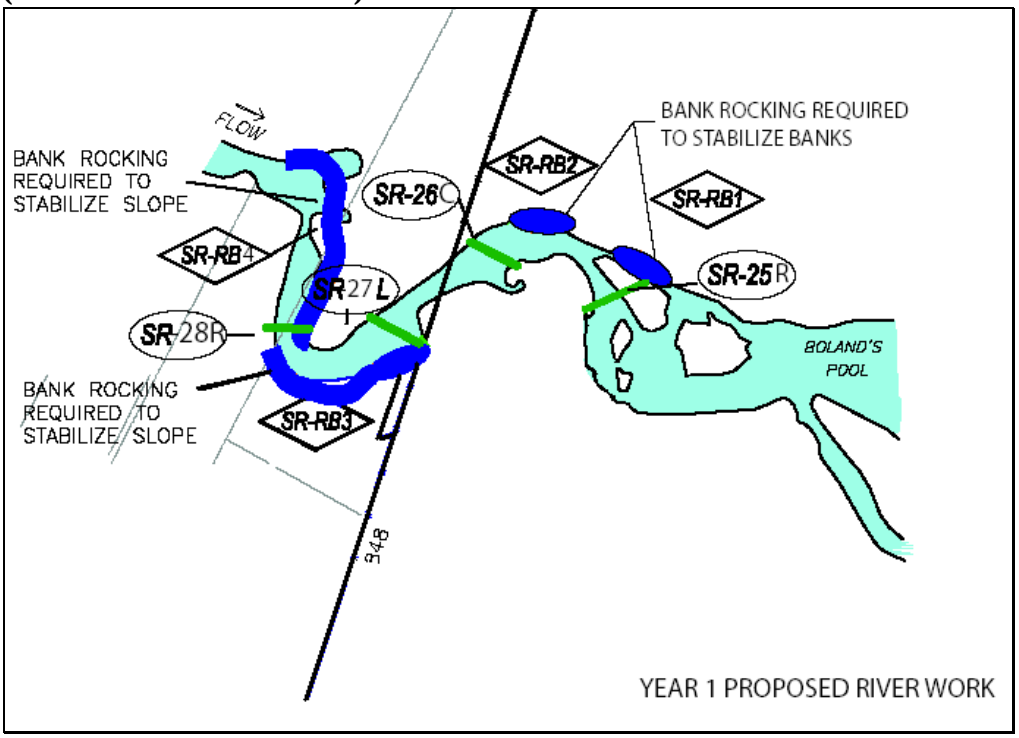


Figure 5. Fish habitat restoration areas on the Bedford Rifle Range, Year 2. (Source: Rutherford 2010)

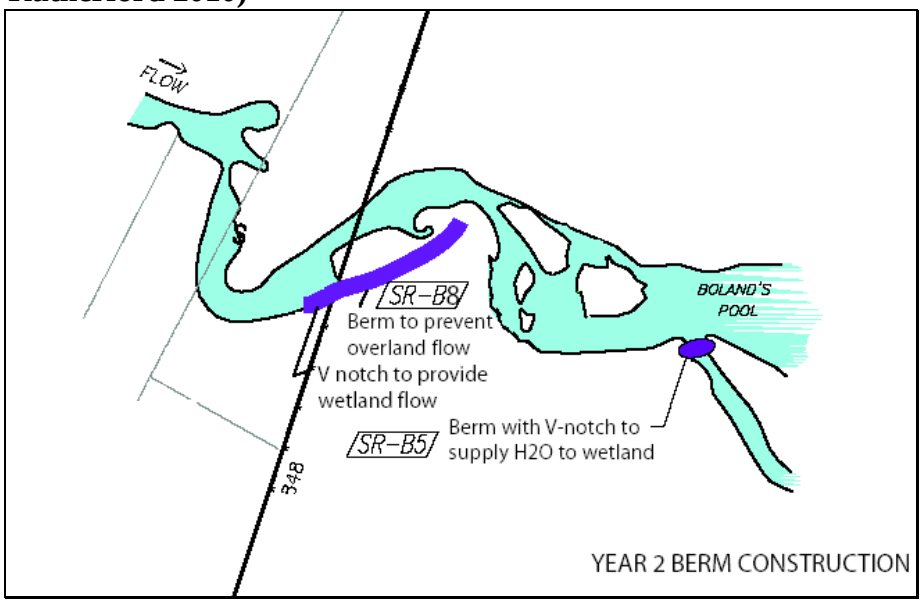


Figure 6. Fish habitat restoration areas on the Bedford Rifle Range, Year 3. (Source: Rutherford 2010)

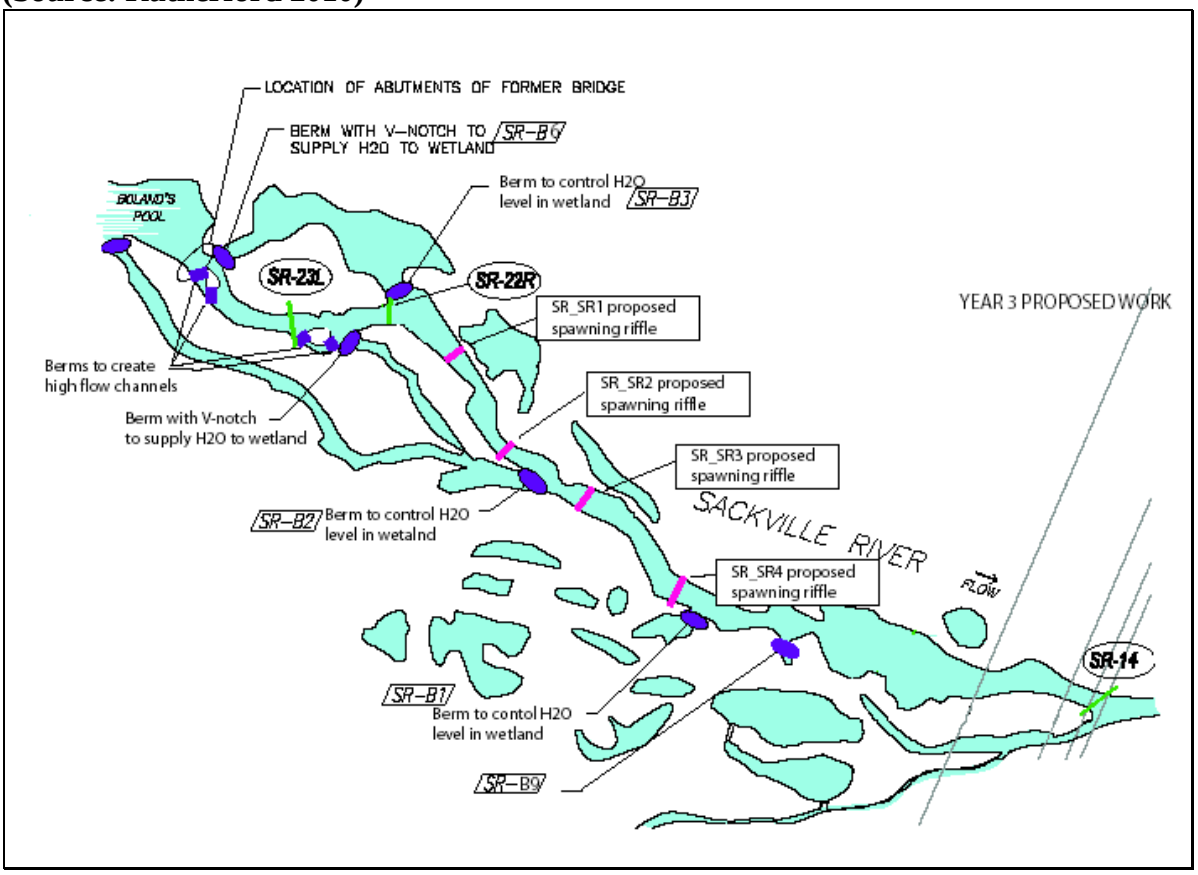
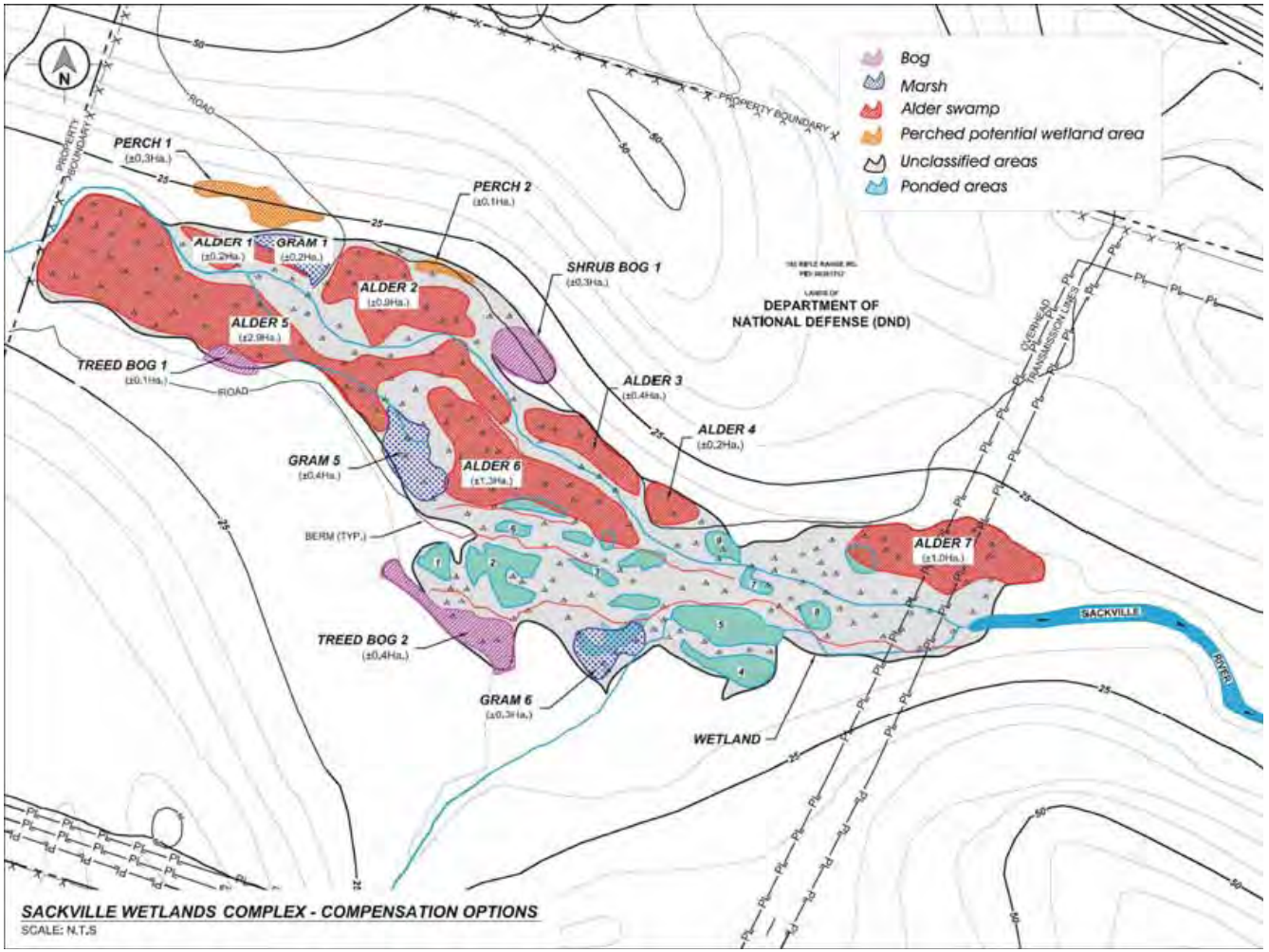


Figure 7. Sackville Wetland complex showing relative boundaries of largest sub-units. (Source: East Coast Aquatics Inc. April 2010)



Annex B

Reports and Information Collected During the CEAA

Wetland Compensation Project at the DND Property, Sackville, Halifax County: Part 1 -Wetland Delineation and Compensation Concept. Prepared by East Coast Aquatics, dated March 2010.

Wetland Compensation Project at the DND Property, Sackville, Halifax County: Part 2 - Fish Habitat Restoration Requirements. Prepared by Bob Rutherford, dated March 2010.

Wetland Alteration Application DND Property Sackville, Halifax County. Prepared by East Coast Aquatics, dated April 2010.

Wetland Compensation Project at the DND Property Sackville, Halifax County:

Part 1 – Wetland Delineation and Compensation Concept

March 2010

Prepared by:
East Coast Aquatics Inc.
P.O. Box 129
Bridgetown, Nova Scotia
B0S 1C0

Table of Contents

1.0 Introduction 5
1.1 Background 6

2.0 Assessment of Existing Wet Areas 7
2.1 Wetland Delineation 10
Hydrology 10
Soils 10
Vegetation 12
Delineation 15
2.2 Biota observed 18

3.0 Impaired Functions 20

4.0 Compensation Opportunities 23
4.1 Compensation Approach 23
4.2 Pond Habitat Enhancement 25
4.3 Wetland Habitat Expansion 27
4.4 Alteration of Wetland Classification/Type 28
4.5 Enhancement of Existing Wetland Classification Quality 28
4.6 Compensation Options for Species at Risk 39

5.0 Implementation Approach 41

6.0 Monitoring Program 41
6.1 Monitoring Methods Considerations 43

7.0 References 47

1.0 Introduction

This report, Part 1 – Wetland Delineation and Compensation Concept developed by East Coast Aquatics Inc., is the first document of a two-part habitat compensation project. Part 2 – Fish Habitat and Compensation Concept has been produced under a separate cover by Bob Rutherford of Thaumas Environmental Consultants Ltd. Although these two compensation concepts exist under separate reports, they are complementary in nature. Direct design linkages have been made between the activities proposed in Part 1 and Part 2 to ensure that they are supportive and complementary based on field visits and office consultations carried out by a team of staff from both firms. This report, Part 1, refers to proposed activities and structure identification numbers contained within the Part 2 report such that the reader may follow the linkages between the floodplain wetland work and in stream channel habitat work.

The following is a summary of field identified opportunities for wetland compensation on the DND Rifle range property in Sackville, Nova Scotia along the Sackville River (see Figure 1). The project site was a former gravel quarry that was active until the 1960's. This area of focus is within the Sackville River floodplain from the confluence of the Sackville River and Peverell's Brook in an upstream direction to the DND property boundary, a linear distance of 1.1 km and an area of approximately 18 hectares.

The general location and nature of the opportunities for wetland compensation have been identified, as well as some preliminary suggestions on appropriate methodologies at each site. Neither the field limitations of access and source of material, nor the cost of implementation of the various methods have been considered at this point. A number of priorities have been identified, and specific activities to achieve target objectives have been proposed. A series of ongoing monitoring activities have also been proposed as a means of evaluating the implemented compensation activities.

Figure 1: The yellow block identifies PID 0361212 owned by the Department of National Defence, and the site of proposed wetland compensation activities. The proposed compensation activities are to take place adjacent to the Sackville River from its confluence with Peverell's Brook in an upstream direction to the west property boundary.

1.1 Background

The wetland compensation project is the site of a former gravel pit that was last used in the early 1960's. As shown in Figure 2, the site had been striped of vegetation at that point in time, and Sackville River water flow extended, at least periodically, across the entire pit area. Some localized channelization that was evident in the early 1960's exists to this day, and it appears that all settling ponds that existed in the area immediately west of the confluence with Peverell's Brook and south of the Sackville River remain. Visible driving surfaces in the 1960's photo have changed quite significantly and are often fragmented by low wet areas and flood plain flow. It is not known how much of this alteration to the former roads is from decommissioning activities or from erosion patterns that may have occurred during high flows across the destabilized valley floor. Remnants of wooden box culverts were observed at some locations during field surveys.

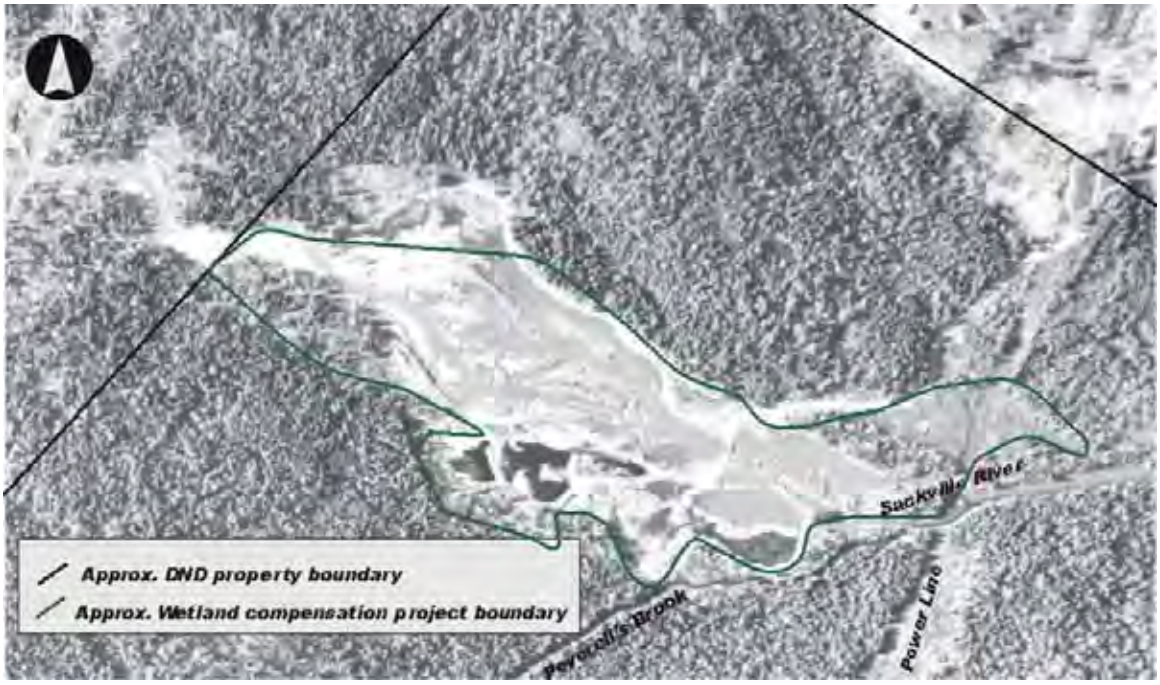


Figure 2: Image DND property former gravel pit site in the early 1960's, and site of the proposed wetland compensation activities. Nearly eighteen (17.9) ha of wet area falls within the boundary delineated by East Coast Aquatics in the fall of 2009. Dark water in some of the southern ponds indicates their isolation from the turbid Sackville River water in this image.

The project site, referred herein as the Sackville Wetland Complex, is located in the Eastern Interior ecodistrict of the Eastern ecoregion of Nova Scotia. An estimated 85 % of the site lies on an IMHO ecosection, characterized by imperfectly drained medium textured soils on hummocky terrain. As shown in Figure 3 the remainder of the project site is on the WFDM ecosection that is characterized by well-drained fine textured soil on drumlins or flutes. This latter area is limited to the most northern fringe of the project site and a small area north from the pond on Peverell's Brook across the valley floor.

As shown in Figure 4, the NSDNR Significant Habitats mapping indicates most of the project area (15.31 ha) is tall shrub swamp with a contiguous small area of tall shrub marsh (3.37 ha) around the former settling ponds in the southeast portion of the project area. This total wetland area of 18.68 ha identified by NSDNR through air photo interpretation differs slightly from the total 17.9 ha identified by East Coast Aquatics staff during on the ground surveys in the fall of

2009 along a 3.47 km perimeter boundary. A significant portion of the field total 17.9 ha of wetland area would be considered upland according to provincial definitions (MCFT 2009). This is the result of a mosaic of upland mounds, berms, and former road beds that exist within the boundary of the wetland. The significantly altered state of soils and hydrology (see Section 2.1) at the project site does not allow for reasonable quantified estimation of the total upland area within the boundary based on transect methodologies derived for difficult wetland situations (MCFT 2009), such as the wetland/non-wetland mosaic that exists on site. Qualitatively it is estimated that the upland area located within the boundary of the Sackville Wetland Complex would amount to 20-30 % of the total area.

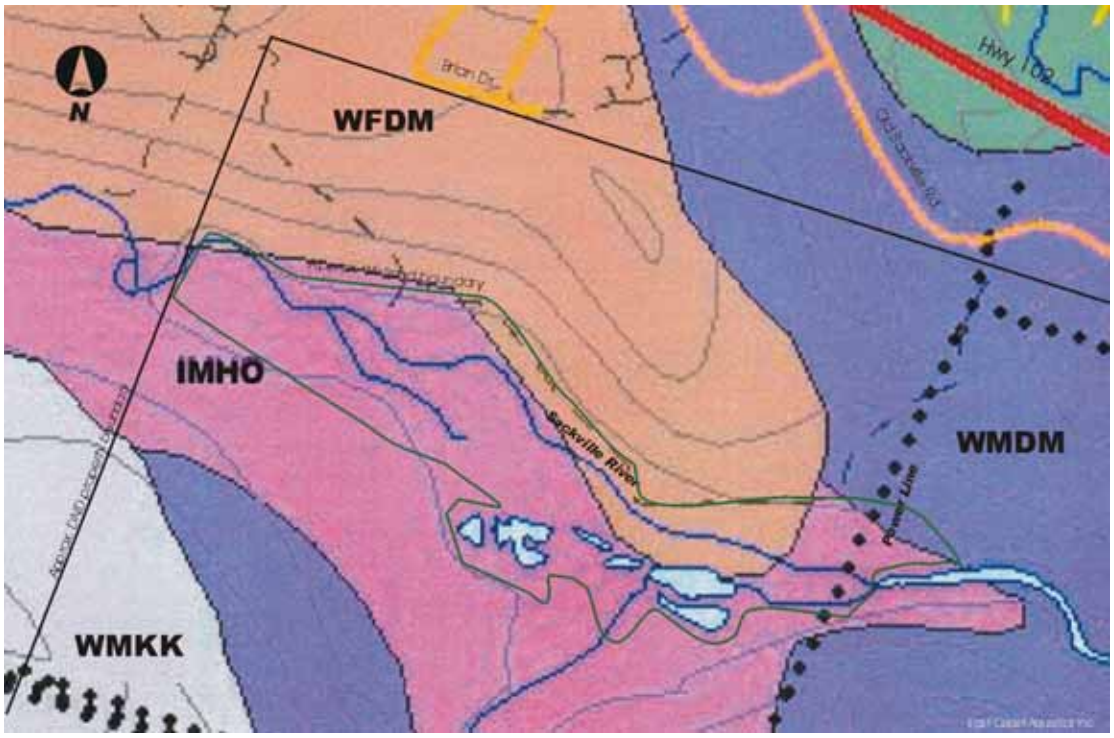


Figure 3: NSDNR ecological land classification for the Sackville Wetlands site indicates that most of the area is IMHO, or imperfectly drained medium textured soil on hummocky terrain. Small portions near the wetland perimeter occur on well-drained soil ecosection classifications of fine and medium textured soils (Source: modified from NSDNR 2009a).

2.0 Assessment of Existing Wet Areas

Both wetland and upland sites have been assessed at three paired plot locations around the Sackville DND wetland complex based on wetland alteration approval requirements and delineation methodologies (MCTF 2008) for Nova Scotia. This assessment included establishment of quantitative vegetation plots, soil profile analysis, and hydrology assessment. The three paired sample site locations are associated with wetland units Alder 2, Alder 5, and Gram Marsh 5 (see accompanying map) as shown in Figure 5. The data collected allows for classification of those wetland areas, delineation of the wetland boundary, and general characterization of the entire complex. In addition to the formal delineation methods carried out on August 27th and September 10th, 2009, the boundaries of eighteen wetland units (>0.2 ha) were later walked and marked with a hand held GPS unit. The location of primary wetland units is presented in Figure 8. This field delineation allowed determination of hydrological linkages between wetland units, quantification of wetland types that are present, and identification of the relative spatial distribution of wetlands within the complex. The final field phase in the assessment of the existing wetlands was identification of compensation opportunities. This

assessment involved the examination of each of the twenty-four wetland units/ponds, and identifying GPS coordinates and general dimensions for compensation structures to be constructed, and appropriateness of other approaches such as soil amendments, floodplain roughness features, herptofaunal habitat enhancements, and vegetation strategies. All potential compensation activity locations are indicated on the map accompanying this report and are presented in further detail in Section 4.0 of this report. During all fieldwork visits opportunistic sightings of fauna and significant habitat use (breeding, nesting, rearing etc) were noted, and GPS locations documented as appropriate.

Figure 4: Nova Scotia Department of Natural Resources wetlands database mapping indicates 15.31 ha of tall shrub swamp (green) and 3.37 ha of tall shrub marsh (yellow) exist on the Sackville wetlands site (Source: modified from NSDNR 2009c).

Detailed wetland assessments at the three paired plot locations document the current state of the plant community, soil profile, and hydrology. All three of these measured parameters must independently indicate wetland conditions to confirm the presence of a wetland. As might be anticipated, the soils were significantly altered from their natural state due to gravel extraction. Within the wetland boundary the soils are currently poorly developed, consisting of coarse sand/gravel with little to no organic layer being present. It is believed that the current soil conditions allow relatively rapid groundwater fluctuations within the project area, and influence the limited diversity of the plant community. These conditions will further influence the faunal community found within the Sackville Wetland Complex.

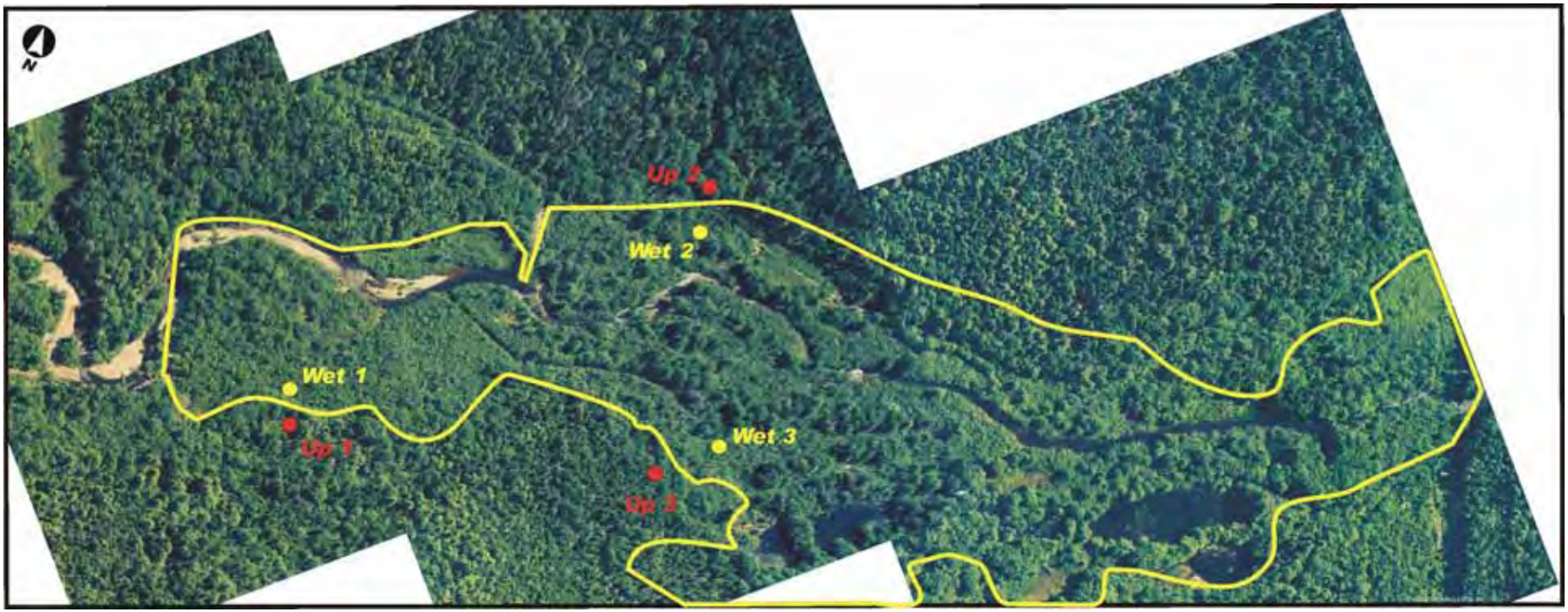


Figure 5: The three paired upland/wetland plot locations, and the delineated wetland boundary of the Sackville Wetland. This image is derived from 2001 air photos.

2.1 Wetland Delineation

Wetland delineation is based on confirmation of wetland hydrology, hydric soils, and hydrophytic vegetation (MCFT 2009). All three must be present to confirm a wetland. Field surveys assessed these three parameters at the Sackville Wetland Complex as part of the delineation process. The following discussion highlights the results of those field surveys.

Hydrology

Wetland hydrology indicators of the project site are numerous. Most are directly related to the flow patterns of the Sackville River. The most obvious is surface water and inundation during the growing season. Although a number of ponds exist, pockets of surface water can be observed in many locations where microtopographic relief creates depressions. The site is also prone to flooding across the full width of the valley, and high water covered the entire valley floor to 20+cm across the project area during an August 27th visit. Sediment deposits, drift deposits, and multiple channel drainage patterns are also visible across large portions of the Sackville wetland. It does appear that the water table drops quickly, likely due to the coarse nature of soils on the floodplain and the multiple channels that allow the floodplain to quickly drain to the main Sackville River channel. The floodplain has a large number of small braids that appear to carry some volume of flow nearly year round. These channels influence local water table profiles creating drawdown zones near the channels, much as a drainage ditch might.

Three bog areas exist on the outer perimeter of the Sackville Wetland Complex, and the hydrology of these areas differs from the majority of the complex. Much of the hydrological influence on these bog areas is from upland surface sheet flow, and not from changes in the Sackville River stage height. Therefore the nutrient regime and soil forming processes in the bogs are different than other areas within the complex.

The final hydrology influence on the Sackville complex is a series of small feeder channels that enter the floodplain from high ground to the north or south. The majority of these channels enters from the north, and tends to be <0.3m wide. The volume of water being carried is always relatively small, and the hydrology influence is likely limited to the immediate wetland area in to which individual streams discharge.

Soils

NSDNR ecological land classification (NSNDR 2009a) for the Sackville Wetlands site indicates that most of the area is IMHO, or imperfectly drained medium textured soil on hummocky terrain (see Figure 3). The soils on the site were significantly altered by decades of gravel removal across the valley floor. Long berms of overburden material exist along portions of the north and south wetland boundaries running parallel to the Sackville River valley. Several other bermed areas run in a general east west direction in the southeast corner of the project area, separating a number of excavated ponds and ponded areas. It appears that some of these berms were used as driving surfaces during gravel extraction. In some cases the berms have moderate topographic relief, extending 1-2 m above the surrounding valley floor. In other cases the berms are less than 0.5 m above the surrounding topography, and provide flow pathways during even moderately low flood conditions.

Three wetland soil profiles are presented from each of the paired field assessment sites in Tables 1-3. Plots Wet 1 and Wet 3 generally meet the hydric soil indicator of a depleted matrix given the matrix Munsell color and relatively low value and chroma. Plot Wet 2 soils do not meet any hydric soil indicators despite being within the wetland complex boundary and exhibiting both hydrophytic vegetation and wetland hydrology at the assessed site. A thin sandy clay/loam layer (Thein 1979) generally overlays a very coarse sand/stone substrate that was reached at 8-15cm depths (see Figure 6). None of the assessed sites had significant organic layers.

Table 1: Soil profile for site Wet 1 located on the southwest portion of the project area. No redox features were present, and root material was present throughout the soil matrix. This soil appears hydric and generally meets the hydric soil indicator "Depleted Matrix" (F3) (MCFT 2009).

				Redox Features				
Depth (cm)	**Horizon**	**Matrix Munsell**	**%**	**Mottle Munsell**	**% Mottle**	**Type[1]**	**Loc[2]**	**Texture/Von Post**
10	B	10YR 3/2	100		None			Sandy clay loam
11+	C							Sandy gravel

1Type: C-concretion, D - depletion, RM - reduced matrix, CS - covered or coated sand. 2 Locations: PL - pore lining, M - matrix

Figure 6: Wet 1 soil profile from Alder 5 shows consistent coloring (10 YR 3/2). Note gravel and rock fragments below 10 cm.

Table 2: Soil profile at Wet 2 located in Alder 2 on the north side of the project site. The site was very sandy and stony at approximately 12 cm depth, preventing further hand excavation of a soil pit. Roots and leaves were readily identifieable and not decomposed down to the sand layer, indicating relatively recent deposition. No redox features were present. These soils do not meet typical hydric soil indicator requirements (MCFT 2009).

				Redox Features				
Depth (cm)	**Horizon**	**Matrix Munsell**	**%**	**Mottle Munsell**	**% Mottle**	**Type[1]**	**Loc[2]**	**Texture/Von Post**
0-1	O							Undecomposed leaf litter
0-8	A	7.5 YR 4/3	100		none			Silty clay loam
8-12+	C							Sand – does not form ball

1Type: C-concretion, D - depletion, RM - reduced matrix, CS - covered or coated sand. 2 Locations: PL - pore lining, M - matrix

Table 3: Soil profile for site Wet 3 located at a marsh area (Gram marsh 5) on the south portion of the project area. Approximately 5% of the matrix had red redox features along pore linings. The underlying soil was coarse material of sand and gravel that would not form a ball. This soil appears hydric and generally meets the hydric soil indicator "Depleted Matrix" (F3) (MCFT 2009).

				Redox Features				
Depth (cm)	**Horizon**	**Matrix Munsell**	**%**	**Mottle Munsell**	**% Mottle**	**Type[1]**	**Loc[2]**	**Texture/Von Post**
0-15		10YR 3/2	95	2.5YR 4/8	5	C	PL	Clay – roots visible
15+								Sand/gravel – does not form ball

1Type: C-concretion, D - depletion, RM - reduced matrix, CS - covered or coated sand. 2 Locations: PL - pore lining, M - matrix

Figure 7: Soil profile at site Wet 3 located in Marsh 5 on the southern extent of the project area. Undecomposed roots are visible throughout the matrix. Note the large stone at 12 cm. Sand/gravel/stone layer existed below 15cm.

Vegetation

Three paired wetland/upland plots were evaluated at the locations shown in Figure 5. Wet 1 and Wet 2 were tall shrub swamp areas, whereas Wet 3 was a shrub marsh location. Circle plots with 10 m radiuses were used for tree and sapling stratum. A 5 m radius plot was used to assess shrubs and herbs. Typically a number of $1m^2$ quadrants were evaluated within the circle plot for herb layers. A dominance test was then applied to each stratum of each plot. A 50%/20% rule was applied to identify the dominant plant species for each stratum of each plot. The results of this assessment are summarized in Table 4.

Table 4: Dominant plot species by stratum. A 50/20 rule was applied to determine plant dominance for each stratum.

Sampling stratum	Wet 1	Wetland Indicator Status	Up 1	Wetland Indicator Status
Dominant Tree Stratum Species	Red Maple *Acer Rubrum*	FAC	Red Spruce *Picea rubens*	FACU
	Green Ash *Fraxinus pennsylvania*	FACW		
Dominant Sapling Stratum Species	Speckled Alder *Alnus Incana*	FACW	Balsam fir *Abies balsamea*	FAC
			Red Spruce *Picea rubens*	FACU
Dominant Shrub Stratum Species	*NONE*		*None*	
Dominant Herb Stratum Species	Rough stemmed goldenrod *Solidago rugosa*	FAC	*None - mosses*	
	Viola spp.	FACW		
Sampling stratum	**Wet 2**	**Indicator Status**	**Up 2**	**Indicator Status**
Dominant Tree Stratum Species	Black Cherry *Prunus serotina*	FACU	Balsam fir *Abies balsamea*	FAC
	Red Maple *Acer Rubrum*	FAC		
Dominant Sapling Stratum Species	Speckled Alder *Alnus Incana*	FACW	Red Maple *Acer Rubrum*	FAC
			Balsam fir *Abies balsamea*	FAC
Dominant Shrub Stratum Species	Broadleaved Meadowsweet *Spirea Latifolia*	FAC	*None*	
	Speckled alder *Alnus incana*	FACW		
Dominant Herb Stratum Species	Rough stemmed goldenrod *Solidago rugosa*	FAC	Canada Mayflower *Maianthemum canadense*	FAC
	Swamp dewberry *Rubus hispidus*	FACW	Crested fern *Dryopteris cristata*	FACW
Sampling stratum	**Wet 3**	**Indicator Status**	**Up 3**	**Indicator Status**
Dominant Tree Stratum Species	Red Maple *Acer Rubrum*	FAC	Red Maple *Acer Rubrum*	FAC
			Red Spruce *Picea rubens*	FACU
Dominant Sapling Stratum Species	Speckled Alder *Alnus Incana*	FACW	Red Spruce *Picea rubens*	FACU
			Hemlock *Tsuga canadensis*	FACU
Dominant Shrub Stratum Species	*NONE*		Red Spruce *Picea rubens*	FACU
Dominant Herb Stratum Species	Arrowhead Tearthumb *Polygonum sagittatum*	OBL	Canada Mayflower *Maianthemum canadense*	FAC
	Manna grass *Glyceria spp.*	OBL	Red Maple *Acer Rubrum*	FAC
	Rubus sp.	NA	Hemlock *Tsuga canadensis*	FACU

A basic Dominance Test was applied to the plants shown in Table 4 based on their relative Wetland Indicator Status (USDA 2009). If dominant species that have Facultative (FAC) to Obligate (OBL) wetland indicator status comprise >50% of the dominant plant community across all stratum, the community is considered hydrophytic, or a wetland community.

Wet 1 and Wet 2 are relatively poorly vegetated tall shrub alder swamps. Sediment deposits and bare mineral soils cover a moderate percentage of these sites. In contrast, Wet 3, a shrub marsh, appeared to have a relatively high diversity and density of plants present, particularly within the herbs stratum. Fourteen species were identified in this stratum of Wet 3, and the four quadrants assessed showed moderate spatial variability. Wet 3 appears to be one of the most well recovered areas within the Sackville Wetland Complex from the past gravel extraction activities, both in terms of soil formation and plant community diversity.

As noted, an assessed site typically must exhibit wetland hydrology, hydric soils, and a hydrophytic plant community to be considered a wetland. A summary of the assessment for all three of these parameters, at each plot location, is shown in Table 5. As shown in Table 5, all of the wetland plots had a dominant hydrophytic vegetation community present as would be expected. Although Wet 2 soils did not indicate hydric conditions, the true nature of the soils are likely hidden by the problem nature of the site. Past disturbances and several small drainage channels surrounding the plot location may influence the documented soil profile. However, both hydrophytic vegetation and wetland hydrology are present at the site, and it is quite likely that the soils could be hydric. The use of more intensive soil testing would likely be necessary to confirm hydric soils as being present, but given the strength of other indicators using professional judgment to confirm hydric soils is appropriate (Veneman, P., pers. com. 2010). Similarly, not all of the predicted upland sites were clearly upland. At Up 2 a small spring emerges adjacent to the assessed plot. Heavy rainfall around the time of the field surveys appear likely to have resulted in the positive hydrology indicators of surface water. Groundwater was confirmed at 27cm at this location, despite the nearby surface flow. The immediate hydrology likely influences a dominance of FAC indicator status species observed at the site. This is the lowest wetland indicator status, and plants are equally likely to occur in wetlands or non-wetlands (USDA 2009). Soils were clearly not hydric at Up2 and the elevated location above the floodplain, moderate sloping topography are further indicators that the site is upland despite the presence a wetland community and hydrology on the date the site was surveyed. Finally, at Up 3 there appears to be wetland hydrology present. This results from very hummocky terrain that appears modified by machinery capturing surface water, and some localized water retention behind the berm that defines the boundary between the upland and wetland. Despite hydrology indicators of surface water and water stained leaves, the indicators are not consistent and are not supported by the vegetation and soils assessment. Therefore the site is considered upland.

Table 5: The following summarizes the results of plot surveys at the wetland plots and adjacent upland plots. The mixed results highlight the impacted functions of the Sackville Wetland Complex.

	Wet 1	Up 1	Wet 2	Up 2	Wet 3	Up 3
Hydrophytic vegetation present?	Yes	No	Yes	Yes	Yes	No
Hydric soils present?	Yes	No	No	No	Yes	No
Wetland hydrology present?	Yes	No	Yes	Yes	Yes	Yes
Site is a wetland	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**

Delineation

The data collected and analyzed for the three paired plot locations was used to delineate the primary boundary around the Sackville Wetland Complex. A total area of 17.9 ha falls within the boundary, and most boundary areas are readily identifiable. Some of the south central boundary is less apparent because of hummocky terrain and a lack of obvious gradient break between the upland and wetland, which precludes an abrupt change in vegetative community and hydrology indicators. Additional soil analysis would be necessary to confirm the precise location of the boundary in the south central portion of the wetland complex.

Once the primary wetland boundary was identified, an additional categorization of a total of 9.9 ha of wet areas (sub-units) *within* the Sackville Wetland Complex was completed. These areas were delineated and classified based only on visual assessment of changes in the vegetative communities. As shown in Figure 8, fifteen wetland sub-units were informally delineated and classified. This process was carried out to better understand the diversity within the complex and the linkages between the different wetland types. The results, presented in Table 6, highlight the number and approximate area within each wetland grouping. Only relatively well defined wetland areas >0.1 ha in area were informally delineated, and number of smaller embedded units exist within those that have been highlighted. In particular a number of small gaminoid marsh areas exist embedded within the alder swamp regions of the wetland complex. The existing wetlands within the project boundary that were informally delineated consist of approximately 78% alder swamp, 9% bog, and 8% marsh. The majority of the area is characteristic of alder swamp. Soils in these areas are very well drained and poorly formed due to past gravel extraction that appears to have occurred over the entire area covered by this wetland grouping. The Sackville River regularly floods the areas, and visible water velocity was apparent through these areas in their entirety during high water in late August 2009. Many small channels transect these areas and promote rapid drainage of the floodplain to the main river any time floodwaters recede. Predominant shrub coverage is Speckled alder (*Alnus incana*) and herbaceous undercover is only moderately dense with exposed mineral soil visible in many locations. These areas would typically be classed as riparian swamps either of a floodplain or riverine nature (Warner and Rubec 1997).

Table 6: Informal wet area classifications that exist within or associated with the DND Sackville Wetland Complex. Total estimated area of each classification is in hectares. Specific wetland locations are presented in Figure 8.

Informal Wet Area Classification	Number of areas	Estimated total area
Tall Shrub alder swamp	7	6.9 ha
Shrub/Graminoid marsh	3 large, numerous pockets	0.9 ha
Treed /Shrub bogs	3	0.8 ha
Perched potential wetland areas	2	0.4 ha
Existing ponds/ponded areas	9+	2.2 ha
Unclassified “grey” areas	1	5.8 ha

The three larger shrub/graminoid marsh areas appear to have the most natural wetland characteristics, including moderately well formed hydric soils. The dense herbaceous vegetation in these areas likely promotes capture and deposition of fines, resulting in a slightly thicker soil horizon above the sand/gravel subsoil that appears over most of the site. There are numerous small marsh areas, which are 100 m^2 or smaller, along the main stem river were floodplain braid channels re-enter the main Sackville river channel. Due to their small size they have not been separately delineated nor included in the estimated total area of marsh, but do add to the

complexity of the entire complex. The plant community at the largest marsh area (0.4 ha – Gram 5), located in the south central area of the complex appears to have the greatest plant diversity with graminoid and shrub areas.

The three existing bog areas within the wetland complex are generally well protected from the regular flooding that occurs across the Sackville river valley within the project. All are treed in nature with virtually no shrub layer. Unlike most of the Sackville Wetland Complex that is influenced by water fluctuations in the main river, hydrology to these bog areas is primarily influenced by surface sheet flows. Peat development is generally shallow, but more significant than any other areas of the complex. It is possible that these areas were not disturbed during gravel extraction, but it is not known if they were treed bogs at that point in time or have formed subsequently.

As shown in Table 6 there are numerous areas of open water wetlands, which were either constructed ponds or areas that have become ponded over time. Virtually all of these are located in the south central to southeast portion of the Sackville Wetland Complex. The constructed ponds likely drop off quickly to a moderate depth, as evidenced by the lack of wetland fringe anywhere along their perimeter and the steep above water shoreline gradient. Other ponded areas between the numerous berms tend to be of moderate to shallow depth, often with emergent aquatic vegetation at least along a portion of the shoreline. It appears that these areas are formed by the east west running berms and shallow topographic changes that hold flood water from the main river and in some cases capture drainage from the multiple flood plain braids.

As previously noted, the Sackville Wetland Complex is a mosaic not only of wetland types, but also of wetland and upland areas. There are elevated areas of mounds, berms, and old road prisms within the Sackville wetland that are not themselves wetland. Often, in undisturbed areas, mosaics can be relatively easily quantified. However, defining the boundaries of the wetland/non-wetland mosaic areas at the project site would require extensive work as the plant communities do not always vary significantly, and soils are poorly formed. These factors eliminate these two elements as quick means of delineation *within* the wetland complex as might normally be employed with a transect methodology (MCFT 2009). Accurate portrayal of the relative upland/wetland mosaic proportions within the larger defined wetland boundary could be achieved with significant additional effort. Additional approaches of using IRIS tubes, or alpha-alpha dipyridyl to confirm the presence of reduced iron within the soils could be employed to determine these boundaries. Although the upland/wetland mosaic has not been fully delineated within the Sackville Wetland Complex, upland features critical for the proposed compensation activities have been documented. Working with the known topographic relief across the floodplain, site hydrology can be modified by compensation activities to increase retention and dispersion of water on the floodplain, and hence sediment deposition and soil formation. Therefore, the accurate quantification of the mosaic is not necessary to successfully undertake the proposed compensation activities.

The grey portions of Figure 8 and on the map accompanying this report primarily represent the most complex wetland/upland mosaic areas within the Sackville Wetland Complex. Many small sub-units exist within these areas, and a diversity of wetland classifications can be found. However, it would appear they are in approximately the same classification percentages as identified above. Alder swamp dominates the “grey” mapped areas, although small marsh areas are further embedded in the mosaic. No bogs units exist within the grey mapped areas. The complexity of the microtopography would make mapping of these subunits extremely laborious. The compensation activities proposed for the grey mapped area (see Section 4) of the Sackville Wetland Complex do not necessitate the further detailed identification of subunits within the area.

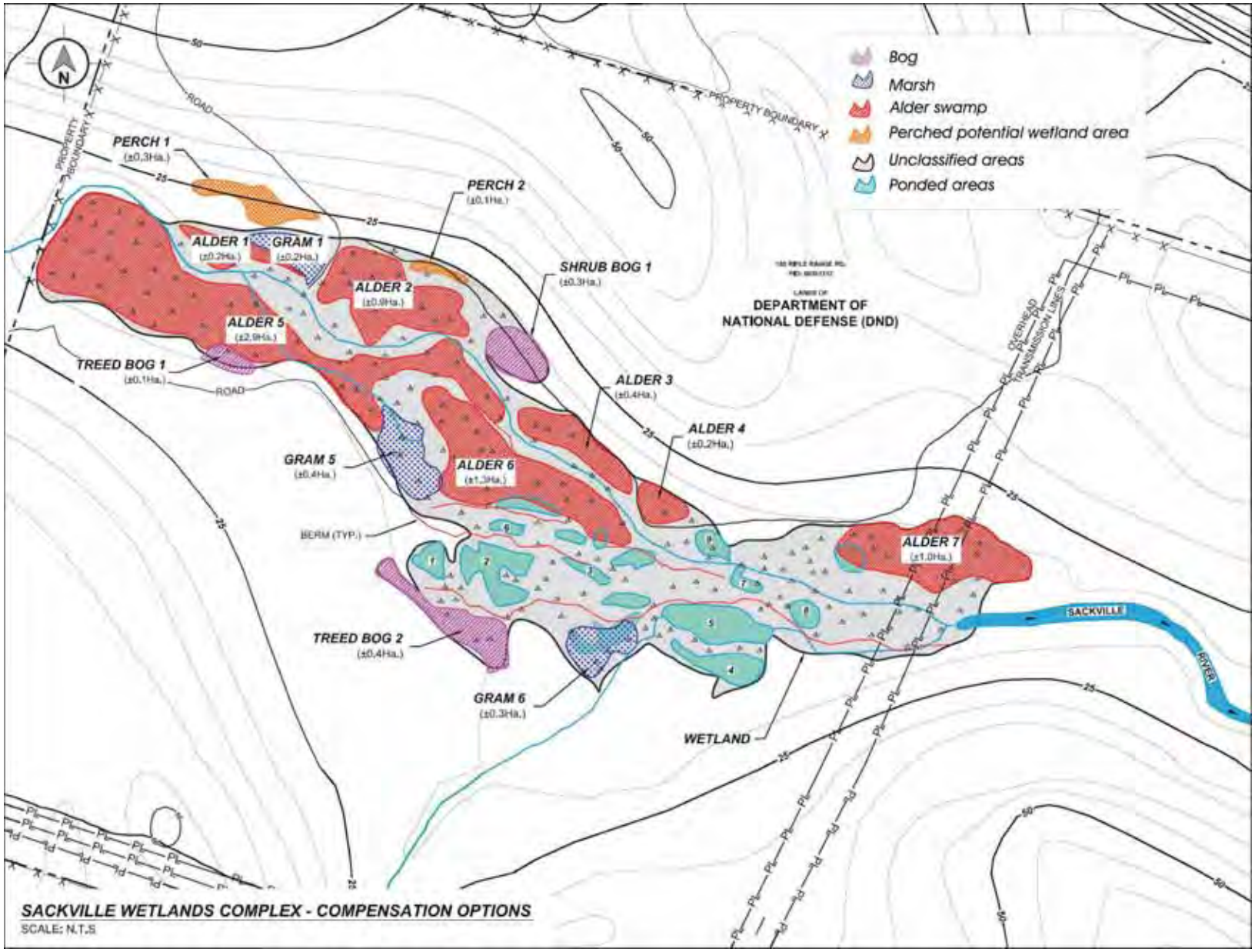


Figure 8: Vegetative delineation of sub units within the Sackville Wetland Complex shows relative boundaries of the largest sub-units**.**

2.2 Biota observed

A number of biota were observed within the Sackville Wetland Complex during field assessment, and compensation efforts need to ensure that habitats appropriate to these species are maintained or enhanced so that individuals are not displaced. Table 7 presents the incidental faunal observations of both individuals and animal signature during fall 2009 field assessments. Most observations are not unexpected, but they do present some understanding of current use of the Sackville Wetland Complex.

Table 7: Incidental faunal observations documented during fall 2009 field surveys of the Sackville Wetland Complex. (UN=unknown).

Species	Common Name	Observation	Locations Observed
Rana palustris	Pickerel Frog	Adult	NA
Bufo americanus	American Toad	Adult	NA
Bufo americanus	American Toad	Tadpole	Alder 1
Rana clamitans	Green frog	Tadpole	Small pocket of surface water north of Pond 2, Oct. 29th.
Glyptemys insculpta	Wood turtle	Shell, recent mortality	Alder 1, floodplain about 10m from rivers edge
UN	Turtle	Turtle nests	Edge of roadway between Alder 1 and Alder 2, edge of Pond 1.
Procyon lotor	Raccoon	Footprints, adult	Alder 2, next to main river
Castor Canadensis	Beaver	Two houses, dams, cuttings	Houses in Pond 2, and on main river adjacent to Alder 3 and Pond 9, several small dams on floodplain back channels, cuttings throughout, heavy use path between Alder 4 and main river
Odocoileus virginianus	White tailed deer	Doe and fawn, footprints	Doe and fawn observed crossing river near Gram 1, tracks observed throughout
UN	Vole/shrew	Adult in herb stratum	Alder 1
UN	Ducks	Two adults (female mallard?)	Small body of open water northeast corner of Gram 5.
Ardea herodias	Blue Heron	Adult in flight	Near Alder 5 on main river

It is also important to be wary of potential species at risk that might utilize the habitats of the Sackville Wetland Complex, including those that were not identified during field assessments. Table 8 is the list of the closest individual species at risk observation records available from the Atlantic Canada Conservation Data Center (ACCDC) for a 25 km radius boundary around the project site. Thirteen species of biota that are protected by either Federal or Provincial Species At Risk legislation have been documented within 25 km of the site. The closest species are the Wood turtle (*Glyptemys insculpta*), Rusty Blackbird (*Euphagus carolinus*) and Eastern White Cedar (*Thuja occidentalis*), all species that might be found within a freshwater wetland habitat. All three of these have been considered in developing the compensation activities that are presented in as presented in section 4.6.

Table 8: Presented is the closest record for each of thirteen Federally or Provincially listed Species at Risk that have been found within 25km of the Sackville Wetland Complex and documented by the Atlantic Canada Conservation Data Center (Source: Atlantic Canada Conservation Data Center).

Scientific Name	Common Name	National Status	Provincial Status	Dist from site (km)
Sterna dougallii	Roseate Tern	**Endangered**	**Endangered**	25 ±0.1
Erioderma pedicellatum	Boreal Felt Lichen	**Endangered**	**Endangered**	15 ±1
Calidris canutus rufa	Red Knot (rufa ssp)	**Endangered**	**Endangered**	24 ±0.5
Helianthemum canadense	Canada Frostweed		**Endangered**	14 ±1
Alces americanus	Moose		**Endangered**	21 ±10
Glyptemys insculpta	Wood Turtle	**Threatened**	**Vulnerable**	1 ±1
Morone saxatilis	Striped Bass	**Threatened**		21 ±10
Caprimulgus vociferus	Whip-Poor-Will	**Threatened**		9 ±5
Clethra alnifolia	Coast Pepper-Bush	**Special Concern**	**Vulnerable**	20 ±0.1
Thuja occidentalis	Eastern White Cedar		**Vulnerable**	8 ±1
Pseudevernia cladonia	Ghost Antler Lichen	**Special Concern**		18 ±0
Danaus plexippus	Monarch Butterfly	**Special Concern**		16 ±0
Euphagus carolinus	Rusty Blackbird	**Special Concern**		1 ±5

Figure 9: Wood turtle (*Glyptemys insculpta*) shell was found within Alder 1. Legs and tail were visible within the 9cm x 7.5cm carapace, but the head appeared to have been removed by a predator.

Of all the species in Table 8, Wood turtle was the only one for which evidence was found within the Sackville Wetland Complex during the fall 2009 field surveys. A recently predated juvenile Wood turtle was found during field surveys on the north side of the river within wetland sub unit Alder 1(see Figure 8). No White Cedar or Rusty Blackbird was noted, although portions of the

project area might be considered appropriate habitat. Cedar requires cool, moist, nutrient-rich sites on calcareous or neutral soils (soil pH commonly ranges from 5.5 to 7.2)(Newell 2005). Although it is not known if areas of the Sackville Wetland Complex might meet the chemical conditions, other conditions of moist, well-drained soils do exist. Nova Scotia is part of the summer breeding habitat of the Rusty Blackbird, which is characterized in part by forest wetlands, such as slow moving streams, peat bogs, marshes, swamps, and beaver ponds (COSEWIC 2006). Each of these habitat types does exist to some degree within the Sackville Wetland Complex. Habitat considerations and compensation /monitoring activities are proposed for Wood turtle and White Cedar at the Sackville Wetland Complex.

The remaining species at risk identified in Table 8 are either not found in freshwater wetland habitats, are highly mobile species that would not use a single wetland habitat, or are not likely to be found associated with the habitats identified at the Sackville Wetland Complex. As such they have not been discussed further.

3.0 Impaired Functions

Studies suggest that if there is a choice in compensation options between restoration and creation, wetlands should be restored rather than created (Bruland and Richardson 2006). In many ways the current project falls into the restoration envelope, as much of the existing project area is wetland. The project area consists of a large proportion of wetland that has formed naturally on a very disturbed site, and as such has many of the characteristics of a poorly constructed wetland. Gravel extraction completely removed plant cover and top soil. As the ground level was lowered through gravel extraction, the water table was approached. The site was then left to naturally regenerate with no apparent remediation. Since that time in the late 1960's vegetation has reclaimed the Sackville wetlands project area, and a hydrophytic community dominates much of the area. However, significant wetland soil and hydrology functions remain impaired, and in turn impact the diversity and density of biota found on the site. It is the impaired functions of the Sackville Wetland Complex that are the target of proposed compensation activities.

Nova Scotia Wetland Assessment Method (NovaWAM) (MCFT 2009) evaluates a number of wetland functions. The following discussion is based in part on the terminologies and functions identified in that methodology, focusing on impairment of soil and hydrology functions.

Several hydrology functions are impaired or non-functioning at the Sackville Wetland Complex. These functions include surface water retention, subsurface storage capacity, and sediment and particulate retention. The lotic marsh and swamp wetlands that exist on the project site are predicted to have a high surface water retention function (MCFT 2009). The landscape placement of the wetland would suggest that the area is a groundwater discharge zone. However, both of these functions appear impaired. Although the project area is a floodplain that is regularly inundated with water, it does not appear that this water is attenuated during flood times or detained within the wetland post flood. During 2009 surveys water was observed covering virtually all areas during a flood to the depth of >30 cm, with visible water current movement through the vegetation adjacent to the valley walls. In less than a week flood waters had receded to the main channel, and no standing water was observed in soil test pits dug to a depth of ~20 cm. This occurs despite the prediction that ground water levels are close to the surface across much of the Sackville Wetland Complex as shown in the NSDNR Wet Area Mapping (Figure 10). The multiple floodplain channels, left remnant from gravel extraction operations, the porous soils, the poor vegetation density in alder swamp areas, and the complete lack of roughness features (large rocks and woody debris) on the floodplain facilitate the quick drainage of the floodplain wetland areas. (It further impairs stream habitat, limiting the abundance and diversity of fish as discussed in Part 2 of this report by Thaumas Environmental Consultants Ltd.) Several of these same characteristics hinder the predicted slow groundwater

discharge to the river system, a process that helps maintain base flows. Improvement of these hydrology functions is one of the two main focal areas for the proposed wetland compensation activities. The second area of focus is soils related functions.

Wetland soils and hydrology are closely linked. As previously noted, soils have undergone severe disturbance during gravel extraction operations at the project site. They have since been left to naturally repair. However, the existing coarse nature of disturbed soils on the project area floodplain, poor vegetative cover, lack of roughness features, and the multiple floodplain channels that allow the floodplain to quickly drain have impaired soils formation and hinder the proper functioning of these soil building processes in a wetland ecosystem. Sediments and detritus are poorly captured on the floodplain wetlands of the Sackville complex. The regular flooding of the complex and subsequent quick drainage prevents the accumulation of detritus and sediments that are necessary for soil formation. The multiple drainage channels and porous substrate limits the period of inundation/saturation that is necessary for creating anoxic conditions and hydric soils. The NovaWAM wetland functions of nutrient transformation, sediment retention and carbon sequestration ought to be high in the wetland types present within the Sackville complex (MCFT 2009). However, soils remain poorly developed and hydrology remains significantly impaired as evidenced by the site analysis results collected in the fall of 2009. There is no organic layer to the soils present throughout all but the bog areas of the wetland complex, and it is anticipated that there is low organic content within the mineral soils. This likely creates a “drier” soil than might occur in a more natural setting with better soil formation. Texture analysis indicates that there is little silt and clay within the soil. The lack of silts and clays further hinder the “wicking” of groundwater saturation closer to the surface, and retention of water within the surface soil profile.

In equating the Sackville complex to a poorly created wetland, the scientific literature further explains some of the functional problems that have been observed at such sites. Studies suggest that there is little evidence to indicate that the plant biomass in created wetlands is finding its way into the soil as organic matter (Cole et. al. 2001). Studies have shown soils in created wetlands have less organic matter than natural wetlands (Bruland and Richardson 2006, Campbell et al. 2002, Bishel-Machunge et al. 1996). And, in some cases, there has been no apparent relationship between time elapsed since construction and soil organic matter content in wetland creation projects. Furthermore, while reference sites have more clay loam textures with high silt content, sandy clay loam textures predominate in created sites (Campbell et al. 2002). As shown in Tables 1-3, thin sandy clay loams were dominant at soil sample locations evaluated in the Sackville Wetland Complex, with gravel/sand substrates being encountered 8 – 15 cm depth. It would appear that the soil profile is similar to wetland creation projects, which have been shown to contain more sand and less clay or silt at 5 cm and 20 cm depth than is contained in natural wetlands soil (Bishel-Machung et. al. 1996).

These observations in created wetlands, and within the Sackville Wetland Complex, highlight the need to improve soil forming processes, capturing silts and fines on the sites, retaining organic debris, and altering the site hydrology by dispersing and retaining all water sources on the floodplain for a longer period of time, and slowing the drainage rate of the floodplain post flood.

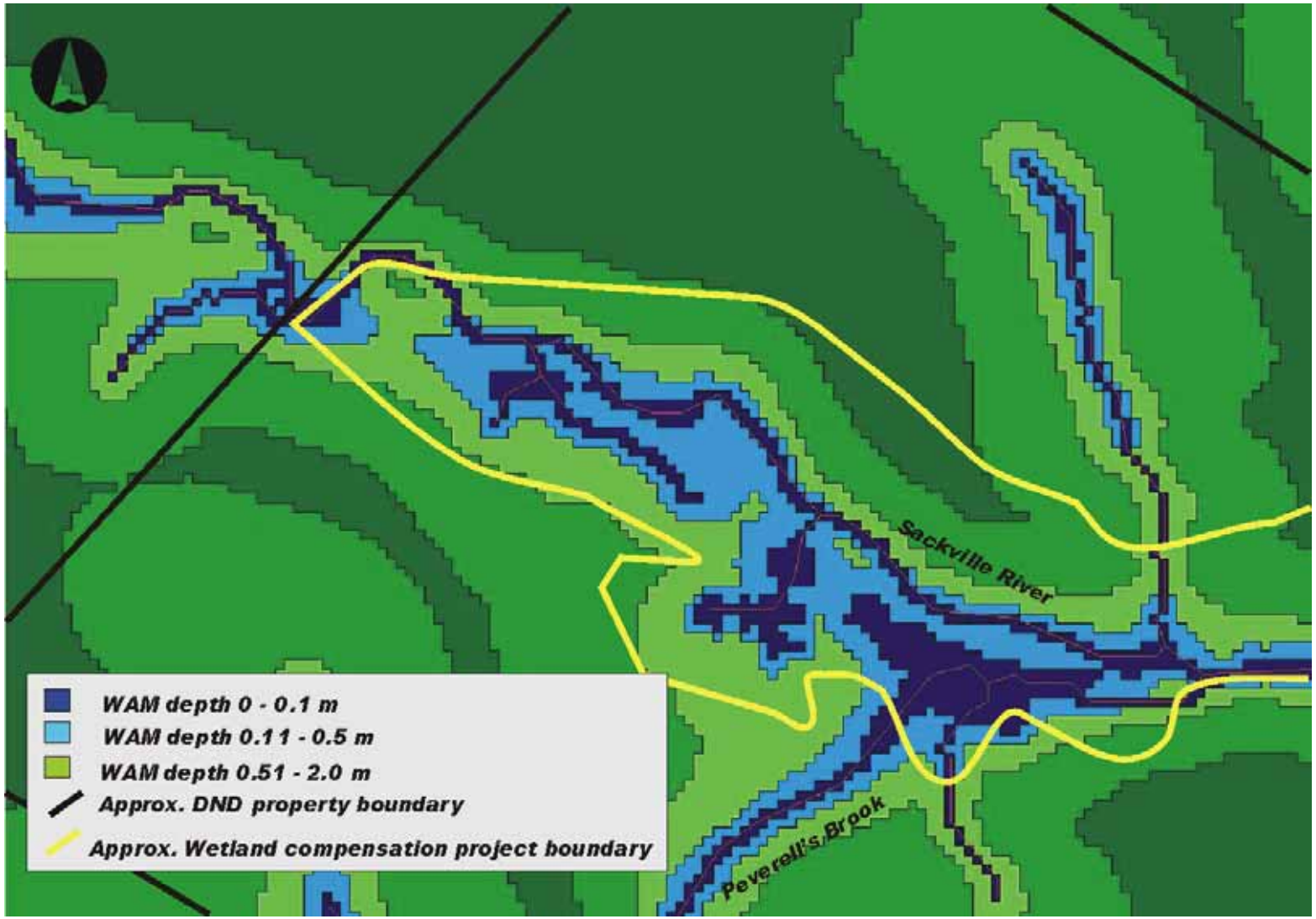


Figure 10: This figure shows the provincial Wet Areas Mapping (WAM) layer and the approximate Sackville DND wetland complex boundary. It demonstrates the approximate depth to groundwater of the area within the boundary, thereby helping identify the areas most appropriate to particular wetland types, and the amount of material that may need to be removed to create particular wetland types (Source: modified from NSDNR 2009d).

4.0 Compensation Opportunities

As the Sackville Wetland Complex is a significantly disturbed site, the opportunity to carry out any of a number of compensation activities is presented by the site. However, much natural regeneration has occurred on the site, and the site has begun to find a new stability. Therefore, the proposed approach focuses on restoration of the impaired wetland hydrology and soils functions that currently exist, while creating minimal disturbance of the established vegetation and floodplain stability that has developed. The following section highlights the wetland compensation priorities, objectives, and proposed activities. Additional compensation activities designed to enhance fish production will also take place (see Part 2 of this report), and the suite of activities for wetlands and stream restoration were designed to mutually complement each other.

4.1 Compensation Approach

Studies suggest that recreating wetland types native to the area should result in increased similarity between created and natural wetlands (Campbell et al. 2002). This belief is part of the reason that the compensation activities proposed build on the existing wetland types, expanding the footprint of some types, but not completely altering one type for another, and not introducing wetland types not currently found on the site. Based on the assessment completed to date, two general priorities have been identified for the project site. These priorities are derived from the most impaired wetland functions that exist at the project site; wetland hydrology and soil formation. Hydrology and soils are the foundation upon which a particular wetland community becomes established, and by addressing the function impairments of these components naturally diverse and functioning biological communities should become established. Therefore, the compensation priorities identified for the Sackville Wetland Complex are:

1. Improve the wetland hydrology by undertaking compensation activities that will hold water on the flood plain for a longer period of time.
2. Improve the hydric soil formation by undertaking compensation activities that will promote the capture of fines (silt and clay particles) and reduce the removal of small organic debris from the floodplain, or that add appropriate salvaged hydric soils to the project site.

In addition to the two overall wetland compensation priorities aimed at addressing impaired functions, a series of objectives have been outlined for the site based on the assessed habitats, and the existing functions found at the site. These additional compensation objectives are:

1. Existing bogs and marshes are to generally remain unaltered as they represent more limited wetland types within the Sackville Wetland Complex, and as they represent better recovered/less disturbed areas of the complex than the alder swamp areas.
2. Some bog and marsh areas may be expanded by the proposed compensation activities, but none will be converted to another wetland type.
3. Only alder swamp areas, which represent some 78+% of the assessed area, will be converted or undergo intensive compensation activities to address impaired functions.
4. Hydrology function will be improved not by redirecting surface flow, but either by capturing existing flows on the floodplain or by slowing the rate at which surface water drains from the floodplain. This will best be achieved by two general approaches
    a. Connecting areas of high ground such that they better capture flood water, or hold small feeder stream flow on the floodplain landscape longer, and
    b. Eliminate the downstream portion of numerous braids that exist across the floodplain such that flood water and groundwater does not quickly drain through the channels, but instead becomes dispersed across the floodplain where it will move more slowly the floodplain or through the floodplain substrate.

5. Wetland soil functions will be enhanced at selected sites by three general approaches that target soil formation processes;
    a. Improve hydrology as noted in (4) above. The hydrology approaches should both increase the period of soil saturation and promote deposition of fines and retention of organic matter on the floodplain by reducing the rate at which flood waters leave the floodplain.
    b. Increasing the hydraulic drag over the floodplain as a means of slowing flood water velocities and promoting deposition of fines and retention of organics. Achieve this increase in roughness by placing coarse woody debris or alder thatching within the alder swamp portions of the project site as might be found on a undisturbed floodplain.
    c. At appropriate sites add salvaged natural wetland soils in order to increase the depth of the organic layer to minimum wetland standards for hydric soils of organic composition, to increase the organic and fines content of surface soil, and to diversify the seed bank that will eventually enhance further plant growth and soil formation.
6. Although additional open water habitat is not needed on the site, most existing ponds were built for sediment settling, and therefore lack the complexity that would improve their habitat value and support a wider diversity of biota. Such habitats should be complexed in a manner that supports existing herptofaunal and waterfowl populations (e.g. creation of shallow fringe wetlands, turtle nesting areas, basking and perching sites).

Improving hydrophytic vegetation coverage and diversity is not a priority objective that requires focused compensation activities because site assessment has already confirmed that the project area has a hydrophytic vegetation community across much of the area, and has some areas with significant diversity. Furthermore, addressing hydrology and soils formation should allow for a better density and diversity of wetland plants to become established. Therefore, it is believed that actively expanding and enhancing existing wetland types through hydrology and soils forming activities will passively establish a more balanced diversity of wetland flora and habitats. However, studies of wetland restoration and creation projects suggest that the use of naturally derived plugs to promote diversity is an appropriate activity, and as such a limited amount of transplanting has been proposed to facilitate the rate at which a more diverse community becomes established at the project site.

Consideration of the above noted priorities and objectives have lead to the proposed list of remediation activities in Table 9. Table 9 outlines the sites, approximate area in hectares to be modified, the general level of compensation activity intensity, a short description of activities to be undertaken, and functions to be improved. There are four general activities that are being proposed in Table 9, and individual sites may undergo none or all of the general activities. The four general activities, in no particular order of priority, are:

1). Pond habitat enhancement,
2). Enhancement of wetland classification quality,
3). Alteration of wetland classification/type, and
4). Wetland habitat expansion.

The combination of compensation activities prescribed for a given site is dependant on observed site characteristics and impaired functions.

Finally, there is remnant garbage debris across the site at a number of locations. This typically includes old tires and rims, and various pieces of metal. This material should be removed as encountered as part of the wetland restoration efforts.

4.2 Pond Habitat Enhancement

As shown Figure 8 and the accompanying large format map, "Sackville Wetland Complex – Compensation Options", there are sixteen or more pond areas in the Sackville Wetland Complex. There are numerous other shallow water areas that are not mapped. These ponds, and the open water areas of the Sackville River floodplain eliminate the need for the creation of additional open water habitat. However, as is the goal for all wetland areas, the functions of these ponds need restoration or enhancement.

Most of the pond locations appear to have remained unchanged and stable since the 1960's. As evidenced in the Figure 2, several are well protected from flood waters of the Sackville River, while others are regularly inundated by even moderate water levels. The most southerly ponds are best protected from Sackville River flood waters, lying behind remnant berms that connect to high ground. However, these ponds to the south appear to have been built, and lack the complexity that would improve their habitat value and support a wider diversity of biota. The ponds are typical of excavated ponds in that the shoreline drops off abruptly to the excavated depth, and has limited shoreline length. The ponds also have no structure (rocks or logs) breaking the surface of the water. Excavated ponds typically result in little littoral habitat, and no wetland fringe exists at the ponds. As such, productivity associated with such areas in a natural system is lacking in the excavated pond ecotypes. Habitat complexity and biological productivity can be improved by creating fringe wetland habitat, adding gravel based turtle nesting ridges, and adding within pond structure for waterfowl perches and turtle basking sites.

In a limited number of instances the micro-topography surrounding the excavated ponds would facilitate the creation of fringe wetlands through excavation. Such wetlands would support amphibian reproduction, aquatic invertebrate production, and an increased diversity of wetland plants. Portions of shoreline adjacent to Ponds 1 and 2 appear to be candidate locations. At Pond 1 a minimum area of 20 m^2 (400 sq m) exists as a poorly vegetated gravel area of approximately 0.3-0.5 m above the mean high water of Pond 1. A similar situation exists at Pond 2 (see Figure 11) where 0.5-0.75 m of material above the mean high water could be excavated to create another 400 sq m of fringe wetland. Water levels appear very stable in both ponds and the sites are not at risk of flooding from the Sackville River. In both instances a limited number of trees would be removed, a fringe wetland would be excavated along a gradient from 0.15 m – 0.00 m below the mean high water of the ponds to form shallow water to lacustrine shore marsh wetland types. A layer of salvaged wetland soils would be spread over the newly excavated site, and the site inoculated with a diversity of appropriate hydrophytic vegetation.

Overburden removed from the formation of the shore marsh on the fringe of Ponds 1 and 2 will be used to further complex the pond habitats. It appears that this soil contains a high percentage of sand and gravel with very little fines. Exposed patches of mineral soil/gravel are visible in the proposed excavation areas, and woody plants have not been able to become established. The material will likely be appropriate to create turtle nesting areas within the ponds (If excavated material is found to be appropriate size class and adequately clean). Using the existing known turtle nesting areas within the Sackville Wetland Complex as a template for preferred particle size, it is proposed that a gravel ridge island be created in both Ponds 1 and 2. The final ridge dimensions would be based on availability of appropriate material, but would extend approximately 0.2 m above the mean high water of the pond to form turtle nesting areas. This structure would increase nesting of turtle species, and the isolated nature of the ridges within the ponds would reduce predation on eggs and newly hatched turtles. Former gravel pits are often used for turtle nesting, and nesting sites may have become more limited as the Sackville Wetland Complex has slowly become covered by vegetation.

The Pond 1 and Pond 2 habitats also provide significant opportunity for complexing that would provide waterfowl perches and turtle basking sites. There are no rocks or large logs within these wetland ponds that functionally provide these habitat requirements. Large logs can be keyed into the shoreline to prevent floating and displacement. The most readily available source would be derived from pushing grown trees over as access routes are established, and utilizing these trees for pond placements and for other project placements. Placed approximately parallel to the water surface the logs will provide perch and basking habitat to a number of species through a range of water levels. Similarly, if large boulders are available they can be placed such that they remain partially exposed through a range of water levels. Based on 2009 observations it is believed that water levels in these two ponds remains relatively constant and therefore provide a stable environment in which to install habitat complexing features.

Figure 11: Project potential site for a fringe wetland associated with Pond 2 (pond lies at evergreens in photo background). A 20+ m^2 fringe wetland could be created by removing 0.5-0.75 m of gravel overburden adjacent to the pond to create a lacustrine shore marsh.

Although the hydrology at Pond 9 on the north side of the valley is somewhat different than that of Ponds 1 and 2, the same habitat restoration approaches are recommended for Pond 9. The pond hydrology is considerably different as it is an area back flooded by the Sackville River through the range of flows. However, similar flat low elevation topography surrounds the north side of the pond, and a 40 m x 40 m (1600 sq m) area could be excavated to create a similar lacustrine shore marsh area. To address current water level fluctuations, water levels will be controlled by the construction of a no maintenance stone outlet structure as proposed in Table 9. Use of large logs to complex the pond habitat would be appropriate, although it is likely too small an open water area to develop a turtle nesting ridge as has been proposed for Ponds 1 and 2.

None of the ponds is large enough to facilitate the creation of nesting islands for waterfowl, and creation of such habitats could promote nesting and subsequent predation that would result in a

negative impact to waterfowl production. Therefore, no nesting islands are proposed. Instead, pond compensation activities facilitate feeding, rearing, and migration as targeted waterfowl functional objectives.

4.3 Wetland Habitat Expansion

There are two areas on the north side of the Sackville Wetland Complex that are hydrologically linked to the DND wetland complex through small surface water features, but that lie slightly upslope and behind former soil berms left by gravel excavation. These areas are both "perched" slightly above (1-2 meters) the active floodplain. Both have some pockets of hydrophytic vegetation, but may not currently support a hydrophytic community. The opportunity exists to create much larger and higher quality wetland areas at these two locations, shown on accompanying maps as Perched 1 and 2. Together they would create 0.4 ha of wetland. Because of their position they are quite isolated from the influence of Sackville River flooding. The berms are well vegetated and covered with trees. Both areas have very small surface water feeder streams (<0.3 m wide) as the primary water source, some of which are likely ephemeral.

Managing the discharge of these small streams within the confines of the perched areas will better establish hydrophytic vegetation to a dominant community. During low flow periods when the Sackville River has minimal influence on the soil saturation near the northern perimeter of the Sackville Wetland Complex, retaining the inflow from these small channels just above the floodplain for a longer period of time should positively influence the degree of saturation of the adjacent wetland units. By retaining more water in these upslope areas it is predicted that Perched 1 will become a treed swamp area, and Perched 2 will become a small riparian stream marsh area.

The push berms that form the southern boundary of these perched areas have a number of openings to the valley floor. It is proposed that a primary discharge location be selected for each site and an armoured discharge channel be constructed. Installing a "V-notch" armoured structure will be necessary at the outflow locations to ensure long term stability and maintenance of the design elevation. None of the structures will be built in a manner to limit fish passage, although it is highly unlikely that these water sources currently provide fish habitat given the current lack of defined channel, intermittent flow, and steep gradients immediately upslope of the proposed compensation locations. The remaining berm low points will be filled to an elevation of approximately 1 m with fine textured material that will prevent the movement of water from the perched area to the valley floor. In this way the perched area water table will become elevated, influencing the dominance of hydrophytic vegetation and formation of hydric soils north of the berms. The water that will be concentrated to a single outflow will be directed to an appropriate receiving area in the adjacent wetland on the valley floor as has been identified on the accompanying maps.

Because Perched 1 and Perched 2 are somewhat isolated from the floodplain and do not have significant watersheds in an upstream direction from which seed stock might be recruited, it is recommended that a diversity of wetland plants be transplanted to the sites as part of the compensation activities to ensure that a limited number of species do not become over dominant and limit potential diversity of these expanded wetland areas. Plant species for inoculation of the sites should be selected following a soil profile assessment at these sites. The most likely sources of plants will be from the relatively natural Alder 7 and Marsh 5 sites for Perched 1 and 2 respectively. Transplants are only meant to introduce a diversity of species, not to fully vegetate the new locations.

There are a number of articles of human debris at site Perched 1 including old tires and metal. These should be removed from the site as part of the restoration efforts.

4.4 Alteration of Wetland Classification/Type

There are a limited number of areas where it is proposed that a small portion of one wetland classification or type be actively modified toward another in order to create a greater spatial diversity and balance of wetland types within the Sackville Wetland Complex. Similarly, hydrology modification in some areas is anticipated to passively alter small areas of wetland classification, slightly reducing the area of alder swamp with a corresponding increase in bog. Sites of anticipated passive alteration of wetland type are identified in Table 9.

There are three bog areas on the outside perimeter of the Sackville Wetland Complex. These areas are deriving their hydrology primarily from surface sheet flows, and in that manner have a very different hydrology from most areas of the complex that have the Sackville River as the primary hydrological influence. The two treed bogs on the south side of the Sackville River have a fibric peat layer of approximately 10 cm. Based on the image from the 1960's (shown in Figure 2), it appears that these locations likely were not significantly altered by gravel extraction operations, although it is not apparent if they were treed bog at that point in time. Regardless, they provide a template of an appropriate fibric organic layer that ought to exist over similar areas.

In each instance where compensation activities are proposed to actively modify wetland type, the hydrology or main hydrologic influence can be altered with simple activities to allow surface sheet flow to be the primary surface water source. It is proposed that a combination of capturing surface sheet flows and adding salvaged organic wetland soils will facilitate the intended wetland classification alteration. Introduction of the appropriate biotic material should help initiate natural processes (Campbell et al. 2002), including increasing soil moisture content and growth of appropriate hydrophytic species. In all cases, a small area of alder swamp, or boundary upland/wetland terrain is the target area to be modified. These project sites include a slight expansion of Treed Bog 1 into Alder 5, and expansion of the upland/wetland boundary at point "Berm Close" in Alder 2 to form a bog area.

4.5 Enhancement of Existing Wetland Classification Quality

Enhancement of existing wetland classifications is the primary approach being proposed for the Sackville Wetland Complex. Restoration of wetland functions in these areas through compensation activities will take place over a larger area of the complex than all other approaches combined.

Recent research suggests that created wetlands do not look or function like natural systems (Campbell et al. 2002). Following the suggestion that much of the Sackville Wetland Complex exhibits the character of a constructed wetland, there are a number of functions that need to be improved over nearly the entire project area. The exception is the existing bog and marsh areas. These locations exhibit the most well formed hydric soil characteristics and wetland hydrology within the Sackville Wetland Complex. As such, these areas are to remain relatively unaltered by proposed compensation activities. Instead, enhancement activities are proposed primarily for alder swamp locations where soils are poorly formed, soil properties of clay and silt particle size content and organic content are lacking, plant density is low, and water retention are some of the impaired soil and hydrology functions.

Soil organic matter is a key indicator of hydric soil quality and is correlated to a number of soil processes such as respiration, denitrification, and phosphorus sorption (Bruland and Richardson 2006). Soil properties are often the least studied indicator of wetland quality, and

are often found not indicative of hydric soils in created wetlands. Failures in created/restored wetlands are often attributable to lack of soil development (Ahn and Peralta 2009). In contrast to natural wetlands, soils of constructed and restored wetlands appear to exhibit much less spatial variability (Bruland and Richardson 2005). Such appears to be the case at the Sackville Wetland Complex where soil profiles, even from different wetland classifications, were relatively similar (see Tables 1-3). Salvaged wetland soils have been useful for ameliorating poor substrate conditions and improving conditions for the establishment of additional species (McKinstry and Anderson 2005).

Floodplain and riverine swamps, such as are found over much of the project site typically have a shallow peat accumulation (Warner and Rubec 1997). However, as noted, soils formation has been very poor, and virtually no peat was found at any of the assessed locations. Therefore, increasing organic matter in soils of the Sackville Wetland Complex is an objective for nearly all alder swamp wetland units. Given the size of the area it is not feasible to layer the entire alder swamp area with salvaged wetland peat. However, it would be appropriate to cover test locations with a peat layer of 15-40 cm to compare functional recovery with other untreated areas within the complex. A number of such locations for treatment have been identified in Table 9, and implementation will need to be based on the availability of salvaged material. During installation no other vegetation stratum should be removed. Furthermore, soil amendments typically should be completed once other compensation activities have been completed, for if hydrology functions were not addressed first, the risk of soil amendments being removed from the site during significant flood events would be much greater. Appropriate sources of salvaged soils will require that the source site be assessed for invasive species prior to collection and application. More remote sites are less likely to support significant invasive populations. A similar survey of the Sackville Wetland Complex should be carried out. In this way, risk associated with the spread of new invasive species to the project site will be minimized.

Soil moisture content has been found to be significantly correlated with soil carbon content, because of the water retention properties of organics (Ahn and Peralta 2009). Placement of salvaged wetland soils is one way to achieve greater organic content within the soils. However, other compensation activities are proposed to assist in both the capture of organic detritus and fine particle clays and silts that are lacking in existing soil profiles of the large areas covered by alder swamp. The proposed activities alter hydraulics, in particular water movement across the flood plain, and thereby impact the manner in which sediments and organics become deposited on the floodplain.

It does appear that the water table drops quickly across most alder swamp areas, likely due to the coarse nature of soils on the floodplain and the multiple channels that allow the floodplain to quickly drain to the main Sackville River channel. Several approaches are prescribed for the alder swamp areas to hold water on the floodplain for a longer period of time. This water retention will increase the period of saturation, and should also assist in retaining organics and sediment fines on the floodplain, improving hydric soil formation.

One approach to increasing the period of water retention involves the promotion of water dispersion across the floodplain. There are a number of larger (2-4 m wide) floodplain channels that carry year round or seasonal flood flows across the floodplain. However, there are also a number of smaller channels that effectively flood and drain the floodplain in a rapid manner. This is particularly true of the alder swamp areas. These channels influence local water table profiles creating drawdown zones near the channels, much as a drainage ditch might. Proposed compensation activities aim to disperse the downstream flow within these channels across the broader floodplain.

A select number of the smaller drainage channels across a number of alder swamp areas haven been identified in Table 9 to be in filled at their downstream extent. This approach will allow rising river flow to enter the floodplain, but then force it to disperse across the floodplain and through floodplain surface soils instead of flowing through the channel and back into the mainstem of the river. As floodwaters recede, the in filled channels will serve to hold water on the floodplain for a longer period of time than currently occurs, saturating the surrounding floodplain soils. In areas where drainage channels are modified on the downstream end to disperse flow and slow floodplain drainage, it will be important to quickly establish vegetative growth. A selection of hardy pioneer species from onsite could be transplanted to these relatively small areas of disturbance to promote quick vegetative cover. Furthermore, to promote soils formation, the organics and fine material that may exist on the bottom of the existing drainage channels should be removed prior to infill, and then used as a topping material over the sites. This should provide both a better substrate for establishment of hydrophytic vegetation and should promote better soil formation within the area of the compensation activity.

This same approach to water retention on the floodplain is proposed for the southeastern floodplain area, yet is not associated with any numbered wetland sub-units. However, specific project locations have been mapped and GPS coordinates recorded and are presented Table 9. This area of the Sackville Wetland Complex is a mosaic of ponds, berms, and channels that interconnect in a complex manner. Surface flow features reverse flow direction at different flood stages. Filling the down gradient end of some of the small channels that facilitate draining of the floodplain during low flow conditions will promote water dispersion across the floodplain at moderate flows and retention during low flow periods.

Another proposed component of compensation in the alder swamp areas involves restoring the floodplain roughness function that would have been significantly impaired with the removal of vegetation and structure during gravel extraction, and thereby enhance the energy dissipation function that these features provide. Natural roughness of dense vegetation, coarse woody debris (CWD), and larger rocks all dissipate flood water energy on floodplains, and promote deposition of fines and retention of small organic debris. These are fundamental floodplain functions for soils formation that are currently impaired. Two approaches are recommended. The first is that coarse woody debris be placed on the floodplain in the relatively high energy alder swamp areas of the Sackville Wetland Complex, particularly at the upstream extent of the DND property. The use of whole tree placements, with limbs and roots, will be most stable on the floodplain, will become anchored in existing alder vegetation, and will most successfully repair the impaired functions of the floodplain associated with roughness. Target densities of CWD placements may be in part derived by the observation of CWD on the forest floor in other parts of Nova Scotia. Mature forest volumes range from approximately 13-21.5 m^3/ha of downed CWD (Stewart et al. 2003). This would equate to approximately 8-25 trees of 40 cm diameter (dbh) and 20 m tall per hectare. As the CWD placements themselves decay, they will further contribute to the organic component of the forming soils. Most placements should take place within approximately 30 m of the delineated upland/wetland boundary in order to most accurately recreate natural recruitment from the upland areas. It further limits the presence of CWD next to the open Sackville River channel where there would be an increased risk of placements being moved by buoyancy. The high density of alder shrub at the targeted locations will further prevent excessive movement of placements. The second approach is to create alder thatchings, particularly at locations where CWD availability or access to make placements is limited. In such areas the existing alder cover would be cut to within 30 cm of the ground along a 2 m wide strip such that they may sprout new growth. The strips would be cut perpendicular to the direction of flow across the floodplain. Spacing of parallel strips would be at 10m. Slash material from the cut alders would be used to thatch (weave) a low elevation “fence” (30-50 cm high) on the downstream side of the 2m wide cut strip. They woven slash would be tied with a hemp twine to standing alder. These thatchings would be continuous from high ground to within

5 m of the edge of the main river channel. Thatching would improve floodplain roughness, capture leaves and silt, and keep flood currents up off the wetland floor thereby improving soil formation functions. Thatchings should extend across any small floodplain drainage channels for which infilling to disperse flow has been prescribed as described above. They should not be placed across a floodplain channel in which through flow is to be maintained, as identified by the lack of any proposed compensation activities.

As the hydrology and soil functions of the floodplain alder swamp areas improve with the proposed compensation activities, hydrophytic communities should improve significantly both in diversity and density of plants. However, several studies suggest that a limited amount of effort to promote vegetation diversity on these sites is warranted. In created wetlands, above ground biomass is not a good indicator of organic content within the soil (Cole et. al. 2001), as very high plant density may not contribute to soils if detritus is not captured on the site in saturated conditions. Planted wetlands, as opposed to those allowed to vegetate naturally, do tend to be more diverse after even 10 years, but not as productive. However, the diversity appears to limit susceptibility of the community to stress (Mitsch et. al. 2005) as natural regeneration tends to initially create monoculture or low diversity communities. And if overall biomass does not positively correlate with soil organic content, the benefit of increasing diversity through selected planting of native hydrophytic vegetation should be seen in less variability in the community over time as stressors such as prolonged wet, dry, and ice load periods occur.

Although plant production in created wetlands is similar to natural wetlands, the structure is often different (Cole et. al. 2001). The density of the tree and shrub stratum appear to be structurally different throughout much of the Sackville Wetland Complex swamp areas compared to more undisturbed locations. With constructed wetland areas, a low diversity of plants, or virtual monoculture can become established. This is particularly true for marsh areas where monocultures of cattail (*Typha* spp) can become established. Introducing more desirable species during construction may reduce this probability (McKinstry and Anderson 2005). In terms of the most beneficial methodology for increasing plant diversity, naturally derived plugs have been shown to have greater survival than seeds or greenhouse stock (Amon et al. 2005).

Based on the studies of constructed wetlands, a limited amount of planting to promote diversity at compensation project sites has been proposed in Table 9. The diversity of the marsh at Gram 5 provides an onsite source for a limited transplanting program to other areas where compensation efforts are aimed at expanding existing marsh areas. Promoting the interspersion of native fruiting species from Gram Marsh 5, such as the cherries and blackberries, would be expected to benefit the Wood turtle, a local species at risk. Similarly, the plant diversity of Alder Swamp 7 appears to be more natural given the apparent lack of disturbance during gravel extraction operations. Although sapling and tree stratum has been removed from some portions of Alder 7 under the power transmission lines, natural plugs should be available for transplant from this area to other swamp areas around the Sackville Wetland Complex.

Table 9: A list of proposed compensation options sorted by wetland sub-units for the Sackville Wetland Complex.

Wetland ID	Area (sq m)	Existing Hydrology	Compensation Intensity	Proposed Compensation Activities	Targeted Functions
NORTH SIDE COMPENSATION OPPORTUNITIES					
Alder 1	2000	Charged by river floodwaters and surface flow from Perched 1	Moderate	Fill floodplain outlet (6m W x 1 m H x 10 m L) to slow drainage of floodplain post flood, create several shallow dispersion channels at upstream end of drainage channel infill. Remove any fines from bottom of channel and broadcast on floodplain, or on top of infilled material. Add anchored large wood to floodplain to increase roughness and promote soil and organics deposit.	Water retention by slowing drainage of floodwaters off floodplain, water dispersion by spreading flood inflow across floodplain, soils formation by utilizing channel fines and promoting higher water table saturation. Dissipate floodplain flow energy and promote deposit of fines and organics.
Gram Marsh 1	2000	Lower portion back flooded by river at even low water levels, upslope portion charged by river floodwaters and surface flow from Perched 1	Moderate	Infill outlet from the marsh from east end of Alder 1 across to road prism that forms east side of Gram Marsh (~18m W x 1.5m H). Form this outlet as a high flow drainage channel from the floodplain to the main river, with a crest at 0.2m below river bank full height.	Water Retention by slowing drainage of floodwaters and local surface water off floodplain. E elevate local water table by raising height of outflow control, soils formation by promoting higher water table saturation. Improved hydrology related to Perched 1 activities that will concentrate flow to Marsh 1. May increase footprint of marsh slightly northwest into a portion of Alder 1.
Perched 1	3000	Two small inflow channels of <0.5 m width from north. Multiple outflows to floodplain. No Sackville River influence likely.	Moderate	Fill or plug four of the five identified outflows from this elevated area in order to retain water, and raise local water table. Construct an elevated and armoured flow control structure at the location Close 2 to carry water to Gram 1 on the floodplain below, and to hold a depth of water (~0.2m) within the area Perched 1. Inoculate with a diversity of species appropriate to a treed swamp area.	Better establish a hydrophytic community by influencing the period of saturation, water retention by controlling discharge from the area.

Wetland ID	Area (sq m)	Existing Hydrology	Compensation Intensity	Proposed Compensation Activities	Targeted Functions
Alder 2	9000	Large inflow from main river immediately below old road crossing, Bank full flood channel from main river, small surface water channel (20cm Wbf) that come from Perched 2 and north hill slope.	High	Inlet control structure SRB 6 prescribed in fish habitat Part 2 Report. Control floodplain drainage at "flood in" with 4m long by 1m high of fill to create better separation between main river and floodplain. Fill bottom of one floodplain drainage channel (5m W x 1m H x 10m L) (point Open 3), and develop a low flow control structure on second drainage channel (5m W x 2 m H) tied to high elevation bank on east side (point Open 4) as per fish habitat structure SRB 3 in Part 2 Report. Connects high berm to east with floodplain elevation to the west, and has a low flow notch. This is the primary drainage channel for all of Alder 2, Needs to be well armoured and provide high flow capacity at flood, but improve floodplain water retention during low flow and dropping flood flows. Control surface sheet inflow in NE corner by connecting two berms (10-12m W x 1.5 m H fill) and facilitating new wetland formation upslope (point Berm close). Addition of peat soils would facilitate bog formation at this location. Control backchannel flow at N central location to enhance small existing graminoid marsh area (Gram 2) and slow floodplain drainage (rock control structure ~10m W) in area contained between two existing low level berms. Add anchored large wood to floodplain and/or thatched fences to increase roughness and promote soil and organics deposit. Point Open 3 is a small drainage channel from the floodplain that should be filled to dissipate water onto floodplain and slow floodplain drainage. Approximately 5m W x 1m H. A armoured high flow outlet should be constructed at ~10cm below floodplain elevation.	Water retention soils formation by promoting higher water table saturation and capture of organics. Enhance embedded graminoid marsh area (Gram) with higher water table. Improved flood plain energy dissipation through increased roughness coefficient to drop fines and organics for soils formation. Control site drainage by constructing control structures on outlet channels. Promote embedded complexity of bog formation and expanded marsh area within Alder 2. Dissipate water across floodplain by infilling small drainage channels at downstream end.
Perched 2	1000	Small feeder channel ~20cm wide from upslope area to N. High flood sheet flow from main river. Drains into Alder 2 at low flow.	Moderate	Control flooding and outflow of this low area contained between a berm to south and high ground to the north. Build a low level berm and discharge channel (7m W x 0.5m H) to create new wetland area at point Close 3. Also requires closure at point "Berm close" as noted in Alder 2 compensation activities. Add salvaged ~15 cm of hydric soils to enhance soils formation.	Creation of new riparian stream marsh area, water retention, hydric soils formation.

Wetland ID	Area (sq m)	Existing Hydrology	Compensation Intensity	Proposed Compensation Activities	Targeted Functions
Shrub Bog 1	3000	Contained by high ground. Infrequent flood inundation, and small volume of surface sheet flow.	Low	Evaluate soil profile and consider addition of salvaged hydric soil as appropriate.	Improve soils formation.
Alder 3	4000	River flood water and small floodplain side channel (Inflow 5)	Moderate	This area may be an old oxbow. Infill small floodplain drainage channel at downstream end (Close 4) to disperse flood flow and slow drainage. (~ 2m W x 1 m H). Fill in upstream direction approx. 20+m along channel. Build up floodplain outlet between points Close 5 and Close 5-2 by ~20cm to hold water on floodplain longer. Implement a armoured outlet with a low flow V notch at Close 5-2. Add organic peat layer to 15cm as comparison test with Alder 7. Access good via old roadbed on north side.	Water retention, soils formation.
Alder 4	2000	No surface inflow, charged by flood flows and rainfall. Outlet to river is below bank full elevation.	High	Add organic peat layer, build/enhance (+0.2m) low berm between Alder 3 and Alder 4 in north/south direction. Construct connection channel between two that functions at river bank full elevation. Enhance berm between Alder 4 and river by excavating edge of Alder 4 slightly. Add anchored large wood to floodplain to increase roughness and promote soil and organics deposit.	Water retention, soils formation.
Pond 9	1600	Backwater flooding by main river during flood flows through low flow. Woods road ditch water enters from north.	High	The downstream connection to the main river (Close Pond) appears to be at river bed height so the area back floods to the current depth of the river. It is well contained by higher ground on all other sides. Construct an outlet flow control structure at Close Pond (~20cm below floodplain) with armoured V notch. Excavate area 40m x40m to north at elevation 0.15m below the outlet flow control structure elevation to form a fringe marsh area. Add 0.15m of salvaged wetland soils to constructed marsh area and inoculate with diversity of marsh plants from Gram 6. Complex pool habitat with emergent large wood structure or boulders.	Floodplain water retention. Lacustrine shore marsh wetland community creation, herptofuanal and water fowl perching and nesting habitat, waterfowl feeding.

Wetland ID	Area (sq m)	Existing Hydrology	Compensation Intensity	Proposed Compensation Activities	Targeted Functions
Alder 7	10000	Some surface flow from ditch line of old road that approaches from north, toe of slope groundwater at gradient break on north boundary, likely some Sackville River flooding influence periodically.	Nil	This area appears largely natural with the exception of some cropping of shrub and taller stratum associated with the power line. Can serve as an unaltered control for onsite comparison monitoring with other alder areas for which treatments are prescribed.	
SOUTH SIDE COMPENSATION OPPORTUNITIES					
Alder 5	29000	Large high-water channel along southern boundary and numerous small high flow intermittent channels. No significant surface flow features from southern upland. Primarily river influenced.	High	Largest continuous unit, has a number of small embedded marsh features adjacent to main river where floodplain drainage channels re-enter the river. Flow to be regulated by stream structure SRB 8 described in Part 2 report. Add anchored large wood to the floodplain in order to dissipate flood water energy, and promote deposition of fines and detritus. Fill downstream end of intermittent drainage channel at point Close 7 (~2m W x 0.3 m H x 20 m L) to promote water dispersion. Remove fine sediment from drainage channel areas, add fill, and top with excavated fines. Inoculate disturbed area with diversity of native floodplain swamp plant species. Increase footprint of Bog 1 by building long low elevation (~0.5m H) berm that would enclose area immediately north of Bog 1 to the high ground, limiting the influence of river floodwater on the enclosed area. Add salvaged wetland peat soils 0.15m deep to area south of berm, but north of existing Treed bog.	Floodwater energy dissipation, floodplain roughage /stability, water retention, water dispersion across floodplain, detritus retention, soils formation. Treed bog community expansion.
Treed Bog 1	1000	Surface sheet flow from upslope areas. Sheet flow of Sackville River flood water at high flows.	Nil	Allow bog to maintain existing structure.	

Wetland ID	Area (sq m)	Existing Hydrology	Compensation Intensity	Proposed Compensation Activities	Targeted Functions
Gram Marsh 5	4000	Moderate dimension back channel river flow through northern and then eastern boundary of Gram 5.	Moderate	Although the effort here is moderate, this is a diverse and relatively natural marsh area that should not be disturbed. Wood turtle may utilize the marsh area and its fruiting species. All compensation efforts are intended to enhance the complexity of habitat that fringes this marsh area to the north between Alder 5 and Alder 6. Access to compensation areas should *not* be made across Gram 5. Pond Pot 2 is a site immediately NE of Gram 5 where open water habitat could be better defined by shallow excavation of existing standing surface water from 7mx7m to 30m x30m, maximum of 0.15m deep. Overburden could be placed along eastern extent to further contain area. Primary focus of this area would be for amphibian reproduction. Complex ponds with in water logs for turtle/waterfowl perch and cover.	Enhance existing open water features and quality of habitat for waterfowl and herptofauna.
Alder 6	13000	Influenced by a combination of main river flood flows and a series of side channels between Gram 5 and Alder 6,, and small high flow intermittent channels.	Moderate	Fill downstream end of intermittent drainage channel at point Close 8 (~2m W x 1.0 m H x 20 m L) to promote water dispersion. Remove fine sediment from drainage channel areas, add fill, and top with excavated fines. Inoculate disturbed area with diversity of native floodplain swamp plant species. Two beaver dams create ponding in eastern portion of Alder 6 at point “Firm dam”, helping to raise local water table and retain water on floodplain. These structures should formally established by adding soil cover and planting with conifer seedlings. Southern dam approx. 0.5 m H x 15 m L, north dam 4 m L x 0.5m H. Short portion of high ground exists between two dams.	Water dispersion across floodplain, detritus retention, soils formation.
Pond 1	400+	Very small inflow channel from Treed Bog 2, outflow to Pond 2. May have some spring water source.	High	Excavate a minimum 20mx 20m area adjacent to pond to create a fringe wetland at point “Dig Low”. Add salvaged wetland soils and inoculate with appropriate wetland species. Further complex pond with turtle nesting gravel ridge island and LWD perches. Determine substrate size to be used from turtle nesting area on old road prism located at north central portion of the complex.	Lacustrine shore marsh wetland community creation, herptofuanal perching and nesting habitat, waterfowl feeding.

Wetland ID	Area (sq m)	Existing Hydrology	Compensation Intensity	Proposed Compensation Activities	Targeted Functions
Pond 2	400+	Small inflow channel from Pond 1. May have some Sackville River flood water influence at very high flood levels. May have some spring water source. Small outflow East toward Pond 3.	High	Excavate a minimum 20mx 20m area adjacent to pond to create a fringe wetland at point “Dig Low 2”. Add salvaged wetland soils and inoculate with appropriate wetland species. Further complex pond with turtle nesting gravel ridge island and LWD perches. Determine substrate size to be used from turtle nesting area on old road prism located at north central portion of the complex.	Lacustrine shore marsh wetland community creation, herptofuanal perching and nesting habitat, waterfowl feeding.
Treed Bog 2	4000	Southern upslope surface sheet flow and poorly defined intermittent flows, Inflow 7 is a small 0.5m W x 0.15m deep channel.	Nil	Allow bog to maintain existing structure.	
Pond 3	NA	Inflow from pond 2, outflow eastward and northward.	Nil	Maintain existing structure	
Pond 4 (Peverell’s south)	NA	Subject to high water and velocities from Peverell’s Brook.	Nil	Maintain existing structure	
Gram Marsh 6	3000	No significant upland inflow features, fed by water off floodplain through point “breach”.	Nil	Relatively natural, although may have low plant diversity. Somewhat hydrologically isolated from main river fluctuations. Maintain existing structure.	
Pond 5 (Peverell’s north)	NA	Subject to high water and velocities from Peverell’s Brook. Some inflow from the main river routes through this pond at point “Breach out”	Nil	Maintain existing structure	
Pond 6	NA	NA	Nil	Maintain existing structure	
Pond 7	NA	Sackville River water through a wide range of flow levels. Flows out to main river or east to Pond 8 depending on flood stage.	Nil		

Wetland ID	Area (sq m)	Existing Hydrology	Compensation Intensity	Proposed Compensation Activities	Targeted Functions
Pond 8	400	Inflow from Pond 7 at wide range of flows, outflow to Peverell's Brook at point "Breach 2"	Low	Fill outlet channel at point Breach 2 3.5m W x 1.5 m deep to maintain water depth in Pond 8 during low flow periods. Construct as an armoured V notch structure. Should increase pond area from 7m x 7m to 15m x 15m.	Water retention,
Southeastern floodplain	NA		Moderate	This area is a web of interconnecting channels and discontinuous berms. There are numerous shallow surface water areas and some truly ponded areas. The above noted ponds are the only location where there are emergent aquatic macrophyte communities. Install flow control structure at point "Out" to within 0.15m of surrounding topography to hold water on floodplain. Need to fill approximately 2m W x 1m H x 4M long. Remove fine sediment from drainage channel areas, add fill, and top with excavated fines. Inoculate disturbed area with diversity of native floodplain swamp plant species. Point "Fill Channel" is an area of inflow from the main river toward Pond 5. That is not necessary to base flows in Pond 5 and lower Peverell's Brook, and could threaten the integrity of those bodies in a high flood event. Therefore, it is suggested that the channel between "Inflow 8" and Fill Channel be in filled to the height of the surrounding floodplain (~5m W x 1.5-2m H x 15 m long). Remove fine sediment from drainage channel areas, add fill, and top with excavated fines. Inoculate disturbed area with diversity of native floodplain swamp plant species. This should also increase the local groundwater table in the vicinity of the filled channel.	Water retention and dispersion., localized water table elevation, floodplain stability.

4.6 Compensation Options for Species at Risk

Species' specific compensation options have not been proposed as a general priority. Instead focus has been on restoring soil and hydrology functions within the various wetland units of the Sackville Wetland Complex. However, it is always appropriate to consider species at risk and their potential or confirmed use of a project site. It should be ensured that efforts are made to limit potential negative effects to such species, and to promote positive effects when possible. There are two Species at Risk for which direct compensation activities should be considered in the options employed at the Sackville Wetland Complex. These species are the Provincially vulnerable Eastern White Cedar (*Thuja occidentalis*) that has not been found on the site and that does not exist in significant numbers anywhere within Halifax County (Newell 2005), and the Federally Threatened/Provincially Vulnerable Wood turtle (*Glyptemys insculpta*) for which evidence has been found at the Sackville Wetland Complex project site.

As a compensation project site, the Sackville Wetland location is to be protected from future alteration activities (NSE 2009), and this inherently provides a greater value to trying to establish species at risk on the site. It is recommended that an effort to establish a number of Provincially vulnerable Eastern White Cedar be undertaken in the appropriate areas of the project site. This species is also part of the Acadian Forest, and is shade tolerant, which would allow it to be planted under the existing forest canopy (Simpson 2009). In Nova Scotia cedar occurs in part in swamps, forests (woodland), and forested brook- and stream-sides, all habitats associated with the Sackville wetland. Soil drainage and pH play an important role in the occurrence and performance of this species over its range. It is known to provide habitat for White tailed deer and Pileated woodpecker in Nova Scotia (Newell 2005). It is suggested that seedlings be used and that the sites be periodically tended for competition during the first three years achieve greatest survival. Tending would include cropping around individual planted seedlings until the cedar seedlings reach a height greater than the surrounding herb stratum; and, protecting young plants from deer browsing if such is observed. Cedar can be propagated vegetatively by cuttings, and this is a commonly used technique in the horticulture industry (Newell 2005). Use of this technique would provide an alternative to seedlings if an appropriate source stock could be located nearby. However, most cedar stands today exist in the southwestern portion of the province. The ACCDC identified only nine records between 1912 and 2008 within 100 km of the Sackville wetland. Of thee records, only one site, located >85 kilometers away, has a significant number of plants identified. The benefit to using a natural source through propagating cuttings is promoting plants that are genetically consistent to native plants. Although genetic differences to ornamental cultivars that may be obtained from a nursery may be significant, a wide genetic variability appears to exist naturally as well (Newell 2005). Seedlings have heavy shade tolerance for a few years, but later need partial sunlight to continue growing (Simpson 2009). Therefore, depending on final site selection, it may be necessary to slightly open the local canopy around the seedlings in year three given initial survival at individual sites.

Cedar requires cool, moist, nutrient-rich sites on calcareous or neutral soils (soil pH commonly ranges from 5.5 to 7.2). Although the soil pH around the Sackville wetland is not known at this point, sampling could quickly identify if sites with appropriate chemistry exist. Although cedar trees generally grow best on neutral or slightly alkaline soil, the seedlings appear to do best on neutral or slightly acid soil. Eastern White cedar is also known to grow well on moderately well to well drained soils (Newell 2005). The northeast portion of the project area exists on well drained soils (NSDNR 2003), and the sand/gravel substrates and hummocky terrain observed across the project area during 2009 field visits may provide numerous appropriate cedar stocking sites.

The second species at risk for which there are targeted compensation activities is the Wood turtle, which evidence suggests lives in or very near the Sackville Wetland Complex. Creation of openings in the woods along streams, where herbaceous vegetation and berries can thrive may be a necessary management activity in some areas. Plants in the Wood turtle diet include strawberries, blackberries, cinquefoil, violets, algae, moss, willow, as well as alder leaves and grasses (MacGregor and Elderkin 2003). The presence of a number of *Rubus spp*. (blackberries and raspberries) observed across the project area may provide an appropriate food source to the Wood turtle. This could be particularly true for areas such as Gram 5 where *Rubus spp*. are found in the marsh portions of the wetland. Cherry trees, another fruit consumed by the Wood turtle, has also been identified in different areas of the Sackville wetland, and alder dominants much of the landscape.

Alder thickets and alder swale have been identified as the preferred or most-used habitats in numerous locations, including Nova Scotia (COSEWIC 2007). As noted earlier, field surveys identified alder swamp (NovaWAM 2009) as covering as much as 78 % of the Sackville Wetland Complex. Woodland bogs and marshy areas are well utilized habitats. The creation of a greater area of these wetland types within the Sackville complex, as is proposed in Table 9, would be expected to indirectly benefit the species. Promoting the interspersion of fruiting species in marshy areas would be expected to benefit the Wood turtle. This activity has been proposed under Section 4.5.

It is suggested that Wood turtle habitat improvement is probably best aimed at nesting, basking, and hibernating sites (ACCDC 2009). Wood Turtles prefer sandy substrate, not gravels. Turtle nesting was observed along an old road prism near the Sackville River, although it is not known if Wood turtle or common Snapping turtles (*Chelydridae serpentine*) may have nested at the location. These two species are known to sometimes use the same nesting locations (ACCDC 2009). Altering the structure of this nesting location should not occur. Former gravel pits are often used as nesting sites by turtles, and the slow vegetation colonization of the Sackville Wetland Complex may have limited a significant number of former nesting sites. It is therefore proposed that the size of the particles at the current nesting site be assessed as a template, such that nesting areas to be constructed at Pond 1 and Pond 2 may be covered with a similar sized substrate. The proposed gravel “nesting ridges” within the ponds may serve to reduce predation that is likely on mainland nesting locations. The main predators of adult and juvenile Wood turtles are raccoons, coyotes, and foxes (COSEWIC 2007). The sites are closely associated with the marsh area Gram 5, which has a number of fruiting species of plants. Development of the nesting ridges is discussed further in Section 4.2 and Table 9. It is believed that this approach would likely increase the breeding potential by local turtle species. Wood turtle nesting occurs during the last two weeks of June and first week of July (NS Museum 2010), and compensation activity movement/traffic should seek to avoid the area of the known nesting on the old road prism, and a second potential nesting site near Pond 1, during this period. If nests are found to be established, they should be flagged to ensure they are not disturbed prior to hatching. Basking sites are also to be established at three pond locations (Pond 1,2, and 9) through the placement of large wood structure into the ponds. These structures will be keyed into the adjacent bank in a manner that allows them to remain emergent from the ponds through a range of water levels. If available, it is proposed that large boulders also be placed within the ponds as basking sites.

Rusty Blackbird has also been documented by the ACCDC as occurring near or within the Sackville Wetland Complex. Although no compensation activities will directly be carried out to enhance Rusty Blackbird habitat, all activities should serve to better the summer breeding habitat of the species. Rusty Blackbird habitat is characterized in part by forest wetlands, such as slow moving streams, peat bogs, marshes, swamps, and beaver ponds (COSEWIC 2006).

Several of these features exist, and proposed compensation activities will create a better balance of these habitats and increase the floral diversity associated with the habitats.

5.0 Implementation Approach

There are several challenges associated with implementation of the wetland compensation project for the Sackville Wetlands including site access, coordination with in stream restoration efforts, and the variety and complexity of compensation activities. Access to the various project sites ranges from moderately difficult to difficult, as no currently drivable road access exists to the site. Some project site locations could be accessed with moderate road upgrades, while other areas have no existing roadway structure. In order to maximize likelihood of success, it is recommended that a three year approach be employed in the implementation of the proposed compensation activities. The proposed sequencing of activities focuses on completing heavy machinery work within a given area in a single year so that multiple disturbances are not necessary. It further initiates activities in an order that will create the greatest opportunity for success by allow preliminary restoration of some functions (i.e., water retention, energy dissipation) prior to implementing activities that are influenced by those functions (i.e., placement of salvaged wetland soils). Finally, the proposed approach incorporates working from the most stable areas and upstream areas toward the more active and downstream areas, thereby improving floodplain functions in a sequenced manner and improving the opportunity for success.

Year 1 – Focus on north side compensation activities with particular attention to construction of access routes, perched wetland area construction, and Pond habitat enhancements. Establish drivable access to the south side of the Sackville River and project site to facilitate year 2 work. Promote marsh area vegetative diversity by transplanting from Gram 5 to other marsh areas across the complex, with a focus on species favoured by Wood turtle. Select and begin establishment of Eastern White Cedar plots.

Year 2 – Focus on south side compensation activities. Construct Pond 1 and 2 habitat enhancements, expand Treed bog 1 footprint, infill identified dispersion channel areas, add large wood to alder floodplain areas. Transplant diversity of swamp plants form Alder 7 to appropriate locations on south side and north side. Complete north side construction activities of flow control structures on floodplain outlet channels. Complete any additional planting of Eastern White Cedar plots and tend plots as proposed.

Year 3 – Focus on placement of salvaged wetland soils on all remaining project locations including proposed alder swamp locations. Implement southeastern floodplain channel compensation activities. Complete all final planting. Tend Eastern White Cedar plots as proposed.

It should be noted that a challenge to implementation may be the available scheduling of time to undertake compensation activities around DND activities on the property. Typically all areas of the DND property are closed while firing practice is occurring, and in the past this has limited access to a afternoon hours each day through the week, and one or two weekend days. The propensity of the Sackville to flood within the project area following moderate to high rainfalls may also periodically limit access to proposed project sites during available work hours, and provide challenges to establishing stability of during construction of habitat improvement features.

6.0 Monitoring Program

It is recommended that wetland compensation projects' monitoring programs consider soils, hydrology, vegetation, animals and water quality (USEPA 2003). The latter of these, water quality monitoring, is not proposed for the Sackville Wetland Complex compensation project

because of the nature of the project. There has not been an identified water quality concern to be addressed by the project; and, the wetland is not a through flow wetland with a true inflow and outflow over which a change in water quality might be anticipated and measured. In addition, minimal animal monitoring is proposed as there is a lack of background faunal baseline data, and observed variability in faunal surveys that could not reasonably be attributable to the wetland compensation activities. Instead the proposed monitoring will focus on soils, hydrology, and vegetation, to determine if there is an improvement in related functions as has been targeted by the compensation activities. This will involve particular attention to soils and hydrology as the components that will actively be modified, and vegetation as the responding parameter.

The three critical components of wetland formation (soils, hydrology, and vegetation) determine the type of wetland that will exist. Monitoring these components will document their changing nature, and will identify whether compensation targets are being met. In much of the project area focus will be on changing hydrology and soils, and therefore monitoring will focus on these components. It is anticipated that vegetation changes will occur primarily as a response to the changes in hydrology and soils. Periodic assessment of hydrophytic vegetation plot density and diversity will serve to describe some of the plant community changes that occur. A number of relevant monitoring activities are proposed in Table 10. Quantitative methodologies are to be employed to the maximum extent possible in any monitoring activities to limit subjective interpretation of observations. Development of detail monitoring approach for all monitoring activities should be completed prior to implementation, with methodologies and field sheets being vetted through appropriate NSDNR SAR biologists, NSE wetlands staff, and academic researchers. This will not only ensure the appropriateness of monitoring efforts, but ensure that collected data can be incorporated readily into existing or ongoing studies elsewhere and thereby provide a wider context for interpretation of the results.

A second focus of the monitoring program will be on Species at Risk (SAR), and will in part include the only proposed animal monitoring. In particular Wood turtles and Eastern White Cedar will be tracked through monitoring activities. The intent of the compensation project activities is to enhance habitat features important to the Wood turtle and thereby support the local population that may exist. However, spatial use of habitats is not well understood locally or even Provincially. Therefore, monitoring proposed for the Wood turtle will focus on better understanding the local population and its spatial/temporal use patterns of habitats of the Sackville Wetland Complex. The second compensation project SAR component is the proposed establishment of a local stand of Eastern White Cedar that would improve provincial distribution of this species within a county that is currently limited in known tree presence. Proposed monitoring efforts will determine growth and survival of planted cedar, and make recommendations for any maintenance necessary to ensure survival.

Monitoring will begin in year 1 of the three-year compensation implementation approach (Summer 2010), and as feasible, should occur prior to the implementation of any compensation activities in order to serve as a pre-construction baseline. At the end of year 1, and based on this first year data, a number of quantitative targets could be established for the compensation activities. Future, monitoring will then help determine if targets are met by the compensation activities. Such monitoring will not only target documentation of long term changes in soils, hydrology, and vegetation, but will also entail a component that will improve our understanding of the current site conditions. The Year 1 monitoring data (baseline) should also be considered in a manner that would allow for final modification of compensation plan activities to maximize the likelihood of success.

The current monitoring design does have limitations because it is not linked to a natural control site. Therefore, the results of the monitoring program at the Sackville Wetland Complex can only

be expected to document changes that occur over a period of time after the implementation of a variety of compensation activities within the complex and its different wetland classifications. Some “intra-wetland” comparisons may be made, and identification of trends will be possible. However, as none of the areas within the wetland complex can be considered “natural”, providing the results in context to a natural system will be limited. To determine if the wetland complex areas are approaching a natural system, or if they have the same variability as a natural system for the parameters measured, low impact reference locations outside of the Sackville Wetland Complex would need to be identified and monitored for the same parameters at the same points in time. Furthermore, it would be necessary to increase the suite of monitored parameters in order to identify causes of observed variability.

Table 10 provides a summary of proposed monitoring activities to take place over a 10 year period. This timeline is proposed based on previous studies of wetland compensation projects. Early monitoring of created wetlands noted that it was premature to evaluate the outcome of the creation efforts, even after a decade (Confer and Niering 1992). Other data has indicated that 20 years may not be long enough to track changes related to wetland compensation (USEPA 2003). Given the magnitude and nature of this project as one of the first of its kind in the Province of Nova Scotia, it provides a platform on which much can be learned about the methods and results implemented if a comprehensive and long term monitoring program is undertaken.

As can be seen in Table 10, most monitoring occurs in the front end of the proposed 10 year program. This reflects the desire to collect near baseline data and the expectation that some basic changes will occur quite rapidly. Other changes are predicted to occur more slowly, and therefore a more infrequent sampling regime is appropriate later in the program.

6.1 Monitoring Methods Considerations

The following is a not intended to be a comprehensive outline of monitoring methods. Instead it identifies the reasoning behind the inclusion of some proposed monitoring parameters, and current knowledge based on recent studies of wetland compensation projects.

The proposed compensation activities target alteration of soil formation properties, and these physiochemical properties can be monitored through a variety of means. Vegetation attributes are often used as a quick measure of mitigation success in created wetlands. However, much of the biological response is dependant on the soils (Ahn and Peralta 2009). Therefore, evaluation of soils physiochemical properties is an appropriate monitoring activity to better understand the biological response to compensation activities. Past monitoring efforts of created riverine wetlands have shown that soil color (matrix chroma) and organic content begin to reflect that of hydric soils within a few years, and that organic matter in surface soils might change in the order of 1% per 3 year period (Mitsch et al. 2005). Along with soil color and organic matter content, total nitrogen, and particle size analysis have been correlated with the intended changes of increased organic content and increased silt and clay content targeted for the Sackville Wetland Complex (Campbell et al. 2002). Along with quantifiable measures of soil particle size by a certified lab to determine % of clay and % silt, qualitative field assessments based on texture can be employed (Thien 1979). Standard soil assessment parameters such as Munsell color, redox potential (mV), extractable phosphorous, iron, manganese, bulk density, and organic matter content have been used to document soil changes within created wetland areas (Ahn and Peralta 2009, Gilliam et al. 1999).

Table 10: Summary of proposed Sackville Wetland Complex monitoring activities, general approach, and timing to document changes in hydrology and soils, and corresponding plant community change.

Monitoring Class	General Approach	Location	Timing
Hydrology Monitoring			
Surface water wells	Data logger installed in a hand installed well. Monitor depth to water table.	Alder swamp locations where drainage, roughness, organics properties have been altered. Plus onsite control	Logger installed July - September annually. Manual readings any time on site for other monitoring activities
IRIS Tubes	Hand installed IRIS tubes to monitor period of soil saturation and iron reducing conditions/microbes	Alder swamp locations where drainage, roughness, organics properties have been altered. Plus onsite control	Two week period based on annual low flow.
Soils Monitoring			
Munsell color	Full profile to 30 cm	Alder swamp locations where drainage, roughness, organics properties have been altered. Plus onsite control	Year 1,2,5,8,10
Soil Organic content	Surface 10 cm. Field collected soil sample analyzed by certified laboratory.	Alder swamp locations where drainage, roughness, organics properties have been altered. Plus onsite control	Year 1,2,5,8,10
Extractable Nutrients	Surface 10cm. Extractable P, Ca, Mg, K, Fe, and Mn. N and NH_4-N. Field collected soil sample analyzed by certified laboratory.	Alder swamp locations where drainage, roughness, organics properties have been altered. Plus onsite control	Year 1,2,5,8,10
Bulk density	Bulk density of surface 10 cm. Field collected soil sample analyzed by certified laboratory.	Alder swamp locations where drainage, roughness, organics properties have been altered. Plus onsite control	Year 1,2,5,8,10
Particle size analysis	To determine % clay and silt within top 10 cm of soil over time. (1) Collect sample and provide to certified lab for analysis. (2) Complete on site soil texture classification based on feel.	Alder swamp locations where drainage, roughness, organics properties have been altered. Plus onsite control	Year 1,2,5,8,10
Redox potential and pH	Measure soil redox potential and pH with portable meter and probe at 10 and 20 cm depths to provide quantification of potential and variability over time and space.	Alder swamp locations where drainage, roughness, organics properties have been altered. Plus onsite control	During any monitoring related field visit.
Vegetation Monitoring			
Biomass plot	Harvest all plant material in herb through shrub stratum within a $1m^2$ plot, dry and	Alder swamp locations where drainage, roughness, organics properties have been altered. Plus onsite	Annual – early August

	weigh.	control	
Dominant community plots	Estimate aerial coverage of dominant plant species at each stratum. Use several permanent $1m^2$ quadrates for herbaceous, and circle plots for other stratum.	Alder swamp locations where drainage, roughness, organics properties have been altered. Plus onsite control, bog plot, and marsh plot	Annual – early August
Diversity plots	Complete inventory of all plants within a series of $1m^2$ quadrates along a fixed transect across the wetland unit.	Alder swamp locations where drainage, roughness, organics properties have been altered. Plus onsite control, bog plot, and marsh plot	Annual – early August
Cedar Seedling or cutting survival	GPS general planting locations, flag every individual planting, identify survival rate, Measure height, widest cover diameter, and stem diameter with calipers at each interval.	All locations planted	Year 1, 2, 3, 5, 8, 10
Photo stations	Install or identify fixed feature that adds perspective to documenting all vegetative stratum.	Alder swamp locations where drainage, roughness, organics properties have been altered. Plus onsite control	Annual – early August
Herptofaunal Faunal Monitoring			
Wood Turtle Habitat	Radio telemetry to identify spatial and temporal use of habitats that may be associated with life cycle activities such as nesting, and habitat requirements such as overwintering and feeding.	Sackville Wetland Complex	Year 1, Year 2
Wood Turtle Monitoring	Population census by stream float during first annual emergence.	Sackville River mainstem.	Year 1, 2, 3 in late April and early May
Wood Turtle Monitoring	Nest count	Old road prism on North side, adjacent to Pond 1, constructed nesting ridges in Pond 1 and 2.	Year 1, 2, 5, 8, 10 last two weeks of June and first week of July

Soil physiochemical measures are relatively easy collect in the field, or to analyze at a certified laboratory. However, these measures are all indicators of hydric soil that are a surrogate for biological activity associated with saturation and low oxygen conditions. Soil bacterial communities are rarely examined, and typically involve significant technical methods to complete (Ahn and Peralta 2009). However, a relatively recent method of evaluating reduction in soils that relies directly on the presence of iron reducing bacteria further confirms that the appropriate biological response of hydric soil formation exists (Castenson and Rabenhorst 2006). This method is particularly valid in disturbed soils where more traditional physiochemical measures may be poorly developed and provide conflicting results. Such is the case with the observed soil profiles at the Sackville Wetland Complex. Installation of tubes painted with iron ferrihydrite paint (IRIS tubes) document removal of the iron by microbes in the soil. The percent removal relates to the period of saturation and existence of hydric soil conditions. It is the only low cost biological assessment that confirms hydric soil conditions and indicates the magnitude of microbial activity.

IRIS tubes bridge the gap between hydric soils and wetland hydrology indicating a period of saturation and presence of microbial activity. However, site hydrology is best measured in a quantifiable means by examining the water table. Data loggers installed in surface water monitoring wells will document not only the ground water level, but the rate at which the ground water fluctuates. As compensation activities are targeting both of these hydrological characteristics, installing data loggers in wells through the growing season would provide the best quantitative data regarding local hydrology. Soil moisture content has been found to be significantly correlated with soil carbon content, because of the water retention properties of organics (Ahn and Peralta 2009). So although not directly a hydrology measure, the monitoring of bulk density and carbon content of soils does provide somewhat of a surrogate measure for moisture.

Key Species at Risk monitoring is proposed for the Provincially threatened Wood turtle in order to better understand its spatial use of habitats in and around the Sackville Wetland Complex. Studies suggest that home range of the Wood turtle is likely smaller in areas where habitat alteration is more prevalent, as is the case in the Sackville River watershed. Radio telemetry could be used to quantify the home range of Wood turtles that use the Sackville Wetland Complex, and to identify and describe important areas for life cycle functions such as nesting, hibernation, and feeding both within and outside of the project area. Such a monitoring effort would address the Nova Scotia Provincial Stewardship Plan's (MacGregor and Elderkin 2003) recommendation to focus research on characterizing wood turtle habitat (i.e. basking, foraging, nesting, overwintering sites, movement corridors), and spatially identifying key habitats in each population.

In addition to documenting Wood turtle habitat, simple surveys can be conducted to estimate population size and nesting frequency. It is essential to conduct Wood Turtle census monitoring at the proper time of the year. A good idea of population size can be obtained by walking or floating a stream when the turtles first emerge from hibernation (ACCDC 2009). In Nova Scotia this occurs in late April/early May (NS Museum 2010). Three years of census are recommended to get an accurate estimate of population size (ACCDC 2009). A number of potential nesting sites have been identified during 2009 field assessments. Ideally, sites should be revisited during the nesting season to check nesting sites for signs of reproduction. Counting the number of nesting females is another method of estimating population size, since sex ratios are generally 1: 1. Wood turtle nesting occurs during the last two weeks of June and first week of July (NS Museum 2010).

7.0 References

ACCDC. 2009. Wood turtle. 8pp.

Ahn, C. and R. Peralta. 2009. *Soil bacteria community structure and physiochemical properties in mitigation wetlands created in the Piedmont region of Virginia (USA)*. Ecological Engineering. 35:1036-1042.

Amon, J. C. Jacobson and M. Shelley. 2005. *Construction of fens with and without hydric soils*. Ecological Engineering. 24(4): 341-357.

Anonymous. 2006. *Atlantic Canada Conservation Data Centre*. http://www.accdc.com/index2.html. Website accessed November 2009.

Anonymous. 2006. *Nova Scotia Herptofaunal Atlas*. http://landscape.acadiau.ca/herpatlas/. Website accessed December 5, 2009.

Bishel-Machung, L., R. Brooks, S. Yates and K. Hoover. 1996. *Soil Properties of Reference Wetlands and Wetland Creation Projects in Pennsylvania.* Wetlands. 16(4): 532-541.

Blouin, G. 2004. *Weeds of the Woods. Small trees and shrubs of the eastern forest*. Nimbus Publishing. 125 pp.

Bruland, G., and C. Richardson. 2006. *Comparison of soil organic matter in created, restored and paired natural wetlands of North Carolina*. Wetlands Ecology and Management. 14: 245-251.

Bruland, G., and C. Richardson. 2005. *Spatial Variability of Soil Properties in Created, Restored and Paired Natural Wetlands.* Soil Science Society of America Journal. 69:273-284.

Campbell, D., C. Cole and R. Brooks. 2002. *A comparison of created and natural wetlands in Pennsylvania, USA*. Wetlands Ecology and Management. 10(1): 41-49.

Castenson, K. and M. Rabenhorst. 2006. *Indicator of Reduction in Soil (IRIS): Evaluation of a new approach for assessing reduced conditions in soil.* Soil Science Society of America Journal. 70:1222-1226.

Cole, C., R. Brooks and D. Wardrop. 2001. *Assessing the relationship between biomass and soil organic matter in created wetlands of central Pennsylvania, USA.* Ecological Engineering. 17(4): 423-428.

Confer, S. and W. Niering. 1992. *Comparison of created and natural freshwater emergent wetlands in Connecticut (USA).* Wetlands Ecology and Management 2(3):143-156.

COSEWIC. 2007. *COSEWIC assessment and update status report on the Wood Turtle Glyptemys insculpta in Canada*. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 42 pp. (www.sararegistry.gc.ca/status/status_e.cfm).

COSEWIC 2006. *COSEWIC assessment and status report on the Rusty Blackbird Euphagus carolinus in Canada*. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 28 pp.

Government of Nova Scotia. 1998. *Endangered Species Act as amended up to Reg. 393/200.* http://www.gov.ns.ca/just/regulations/regs/eslist.htm. Website accessed June 2008.

Hanson, A. L. Swanson, D Ewing, G. Grabas, S. Meyer, L. Ross, M. Watmough, and J. Kirkby. 2008. *Wetland Ecological Functions Assessment: an Overview of Approaches.* Environment Canada Technical Report Series Number 497. Atlantic Region. 59pp.

Hinds, H. 2000. *Flora of New Brunswick*. Second Edition. Biology Department. University of New Brunswick. 699pp.

Horner, R. R. and K. J. Raedeke. 1989. *Guide for Wetland Mitigation Project Monitoring*. Washington State Department of Transportation, Olympia.

MacGregor, M. and M. Elderkin. 2003. *Protecting and Conserving Wood Turtles: A Stewardship Plan for Nova Scotia.* Biodiversity Program, Wildlife Division Nova Scotia Department of Natural Resources. 23pp.

MCFT. 2009. *Nova Scotia Advanced Wetlands Delineation & Evaluation Course.* Maritime College of Forest Technology and Nova Scotia Department of Environment. Course Methods binder.

MCFT. 2008. *Nova Scotia Wetlands Delineation Course*. Maritime College of Forest Technology and Nova Scotia Department of Environment. Course Methods binder.

McKinstry, M. and S. Anderson. 2005. *Salvaged-wetland soil as a technique to improve aquatic vegetation at created wetlands in Wyoming, USA.* Wetlands Ecology and Management. 13:499-508.

Mitsch, W., L. Zhang, C. Anderson, A. Altor and M. Hernadez. 2005. *Creating riverine wetlands: Ecological succession, nutrient retention, and pulsing effects.* Ecological Engineering 25: 510-527.

Newell R. 2005. *Provincial (Nova Scotia) Status Report on Northern White Cedar Thuja occidentalis.* Nova Scotia Department of Natural Resources. 25pp.

NSDNR. 2009a. Ecological Land Classification Map and Database. http://www.gov.ns.ca/natr/forestry/ecosystem/elcpg1.htm. website accessed November 25, 2009.

NSDNR. 2009b. Species at Risk in Nova Scotia. http://www.speciesatrisk.ca/SARGuide/. Website accessed November 25, 2009.

NSDNR. 2009c. Significant Species and Habitats Database. http://www.gov.ns.ca/natr/wildlife/Thp/disclaim.htm. Website accessed December 3, 2009.

NSDNR. 2009d. Wet Areas Mapping and Flow Accumulation Channels. http://www.gov.ns.ca/natr/forestry/GIS/wamdownload.htm. website accessed December 3, 2009.

NSDNR. 2003. *Ecological Land Classification for Nova Scotia. Volume 1 - Mapping Nova Scotia's Terrestrial Ecosystems.* Nova Scotia Department of Natural Resources. Renewable Resources Branch. Report DNR 2003 –2. 83pp.

NSE. 2009. *A Proponent's Guide to Wetland Conservation – Draft for Consultation*. September 29, 2009. 30pp + Apps.

NS Government. 1998. Endangered Species Act. Bill No. 65. 1st Session, 57th General Assembly. Chapter 11 of the Acts of 1998.

NS Museum. 2010. *More details about Wood turtles in Nova Scotia*. http://museum.gov.ns.ca/mnh/nature/turtles/woodd.htm. Website visited January 25, 2010.

Roland, A. E. and E. C. Smith. 1969. *The Flora of Nova Scotia.* Nova Scotia Museum. Pp. 756.

SARA. 2009. Species at Risk Public Registry. www.sararegistry.com. Website accessed December 06th, 2009.

SARA. 2002. Species at Risk Act. Chapter 29. Department of Justice. 93pp.

Simpson, J. 2009. *Restoring the Acadian Forest. A Guide to Forest Stewardship for Woodlot Owners in the Maritimes*. Advocate Printing and Publishing. 154 pp.

Stewart, B., P. Neily, E. Quigley, A. Duke and L. Benjamin. 2003. *Selected Nova Scotia old-growth forests: Age, ecology, structure, scoring*. The Forestry Chronicle. Vol. 79. No. 3.

Thien, S. 1979. *A flow diagram for teaching texture by feel analysis*. Journal of Agronomic Education. 8:54-55.

Tiner, R. 1994. *Maine Wetlands and Their Boundaries*. State of Maine. Department of Economic and Community Development. Augusta, Maine. 74.

Tiner, R. 2005. *In Search of Swampland, a wetland sourcebook and field guide*. Second Edition, Revised and Expanded. Rutgers University Press. 330 pp.

US Army Corps of Engineers. 2008. Chapter 4. Wetland Hydrology Indicators. In, *Draft Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region*. Draft for Peer Review and Field Testing 7-3-2008.

USDA. 2009. *Wetland Indicator Status: Region 1*. www.plants.usda.gov. Website accessed September 27th, 2009.

USDA. 2006. *Field Indicators of Hydric Soils in the United States, Version 6.0*. G.W. Hurt and L. M. Vasilas (eds.) USDA, NRCS, in cooperation with the National Technical Committee for Hydric Soils. 38pp.

USEPA. 2003. *An Introduction and User's Guide to Wetland Restoration, Creation, and Enhancement.* Interagency Workgroup on Wetland Restoration. 95pp.

Veneman, P. 2010. Department of Plant and Soil Sciences. University of Massachusetts. Personal communication. January 19th, 2010.

Warner, B. and C. Rubec. 1997. *The Canadian Wetland Classification System*. Second Edition. Wetlands Research Centre. University of Waterloo. 68pp.

Wetland Compensation Project at the DND Property, Sackville, Halifax County: Part 2 – Fish Habitat Restoration Requirements

March 2010

Prepared by

Bob Rutherford
Thaumas Environmental Consultants Limited

1.0 Introduction

Part 2 of the Sackville River Compensation Proposal is a summary of the fish habitat restoration work that complements the proposed wetland restoration, enhancement and creation work outlined by East Coast Aquatics Inc. This report builds on an earlier report prepared by Jacques Whitford Limited (JWEL) for DND: "Rehabilitation Plan: Sackville River Restoration Requirements for Fish Habitat (including Atlantic salmon)" (March 27, 2008; prepared for Jeremy Gammon, SO Natural Resources Management, Formation Safety and Environment, Maritime Forces Atlantic DOC # HX 069-007). The 2008 study was undertaken during the winter months and was based on earlier river surveys and air photos. It was not ground truthed due to winter conditions and relatively high flows.

In September 2009 a fish habitat survey was done with a focus on fish habitat restoration to both ground truth the earlier study and to identify changes that might be needed to integrate it with the wetland compensation plan. The river was surveyed from Boland's farm property just upstream of the DND property downstream to the confluence of Peverill's Brook (Figure 1). Peverill's Brook and the lower part of the main Sackville River were not surveyed as they were outside of the wetland compensation planning area. The following text highlights the revisions to Sections 3.4.2 Construction for Rock Sills 14 to 27, and Section 3.4.3 Construction of Berms at Six (6) Locations.

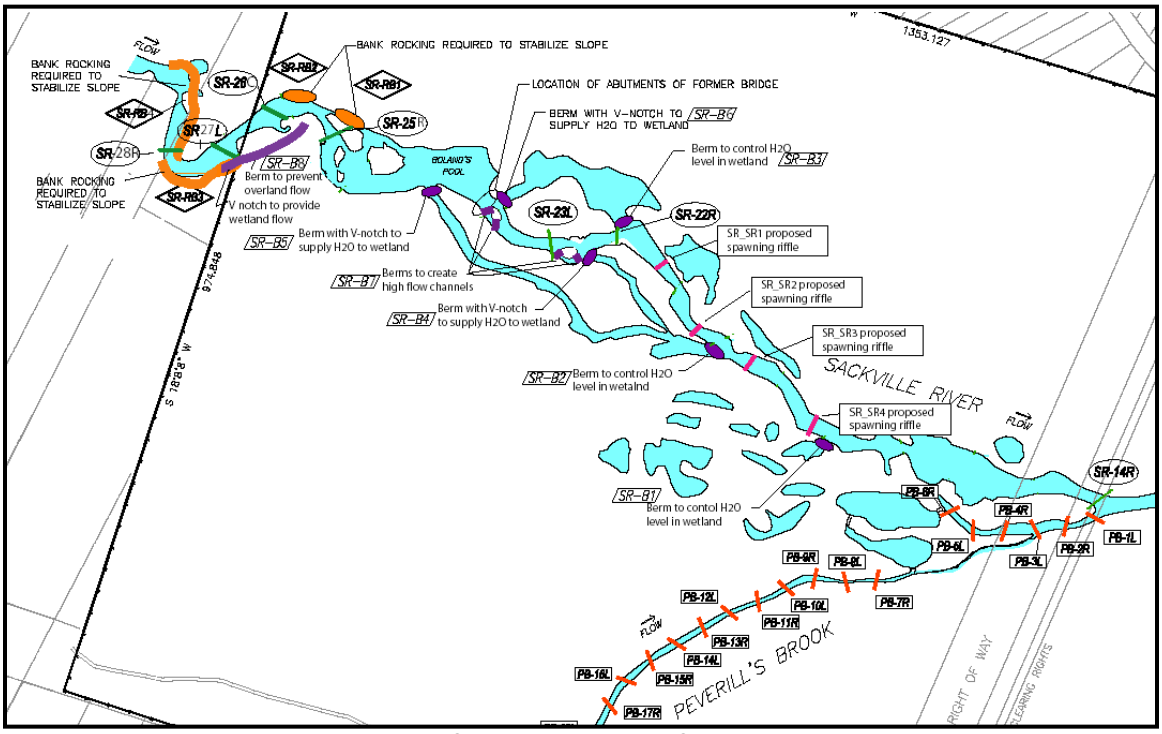


Figure 1 The Sackville River from Boland's farm to Peverill's Brook

2.0 Changes to the Rock Sill Plan

The river at the upstream end of the project area and approximately 200m upstream of the DND property line is very unstable (Figure 2). This portion of the river has extensive bank erosion, long diagonal bars, and sharp turns. The upper meander pattern fits with the pattern upstream coming down from Walkers Pit to rock sill location SR –27L, then there is another meander pattern, likely established by the old road crossing, that fits with rock sill SR- 26C and downstream. This gives two left pools in series and the river is trying to widen its meander to pick up the missing right pool within? 12 channel widths or 168m of length. At this point, the river is cutting into the bank at three locations marked for "bank rocking" – SR-RB2, SR-RB3 and SR-RB4. It is not feasible to re-establish a proper meander pattern by taking the river further into these high banks or adding a river section on the right bank. This would require a major river realignment and disruption of adjacent wetlands. The option chosen is to stabilize the channel in the current location and use gradient controls to take up some of the head and straighten the diagonal riffles reducing the pressure on the banks.

Poor pool development below rock sills SR-27L and SR-26C, and the diagonal riffles associated with them, together with the eroding banks and a high sand bed load, contribute to low salmon spawning potential and persistent habitat degradation both here and in the downstream, eastern half of the project area. The diagonal bars also present partial migration problems under low flows as the water is spread over a wide area, there is a short steep drop-off, and there is no thalweg development.

Rock sill SR- 24 is not required as it is within the upper part of Boland's pool.

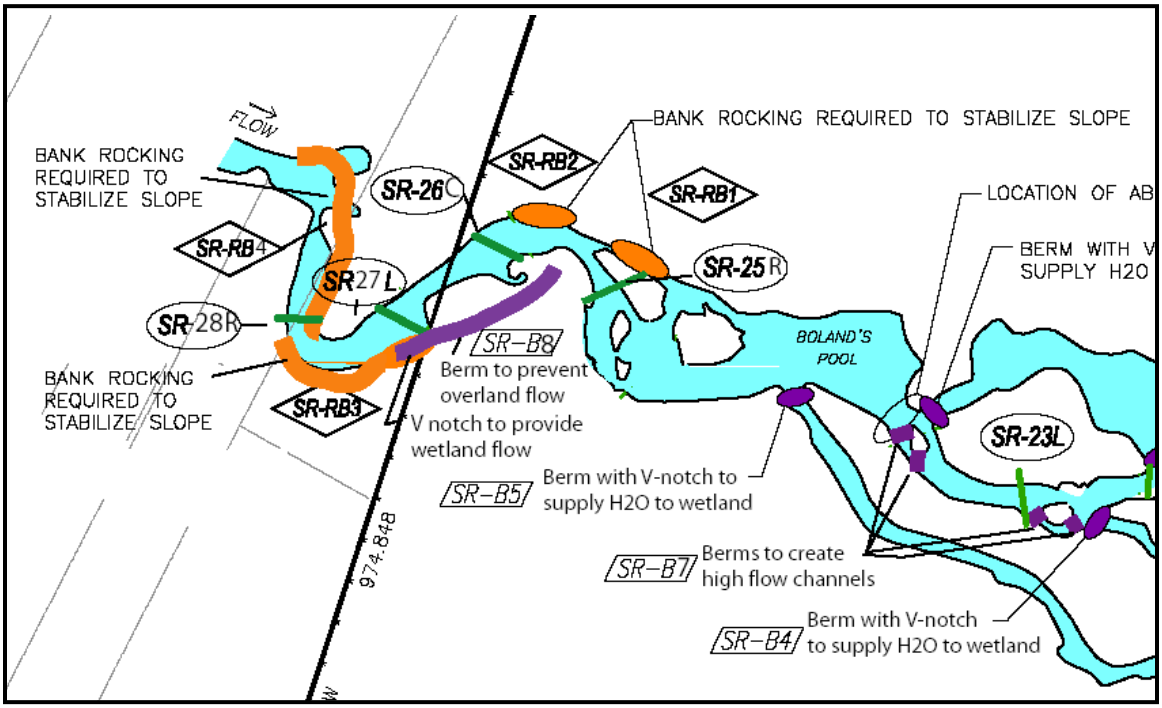


Figure 2. The Sackville River from Boland's Farm to Boland's pool

Proposed work in the eastern half of the project area is summarized in Figure 3. Rock sills SR-21 to SR-15 are not needed as this section of the river is a long stillwater ranging in depth from 35cm to over 175cm in low summer flows. However, there are shallow sections in the stillwater that fall on some of the previously proposed sills. These could be used to build salmonid spawning areas. Four of these sites have been selected based on the river alignment and shallow depth (Figure 3). The high banks at these locations will allow the channel to carry the 1:2 year storm within the banks after the spawning riffles are constructed. The alignment of the riffles with the river downstream is good at all four sites so the constructed spawning riffles will not create upstream or downstream erosion. These spawning riffle structures will have the same dimensions and shape as the rock sills but will be set on the crest of the existing shallow area at an elevation that is 50cm above summer low flow. The upstream area will be filled with spawning gravel, which is a mix of half 5cm to 7.6cm pea stone and the other half 1.3 cm pea stone, on a 2.5% slope to a low flow depth of 50cm then the upstream end armored with R2 rock to fit the existing bottom. The downstream end will be armored with R2 rock on a 1.5% slope to a water depth of 1 meter or 20m which ever comes first. This will create a head across the structure of up to 50 cm and result in a flow through the spawning gravel attractive to salmonids particularly Atlantic salmon. These are now labeled as SR-SR 1 to4.

Rock sill SR-14 is retained in this revised plan because it is important to establish a pool at the confluence of the Sackville River and Peverill's Brook to act as a resting/holding place for fish heading into Peverill's Brook and the nearby wetland ponds and streams. This will be particularly important for Alewife who will use the pond areas for spawning and juvenile rearing and the extensive lake areas further up the system. This pool is also important for salmonids that migrate in and out of the Peverill system. Currently fish passage in the lower section of Peverill's is poor and the fish have to wait for the proper flows.

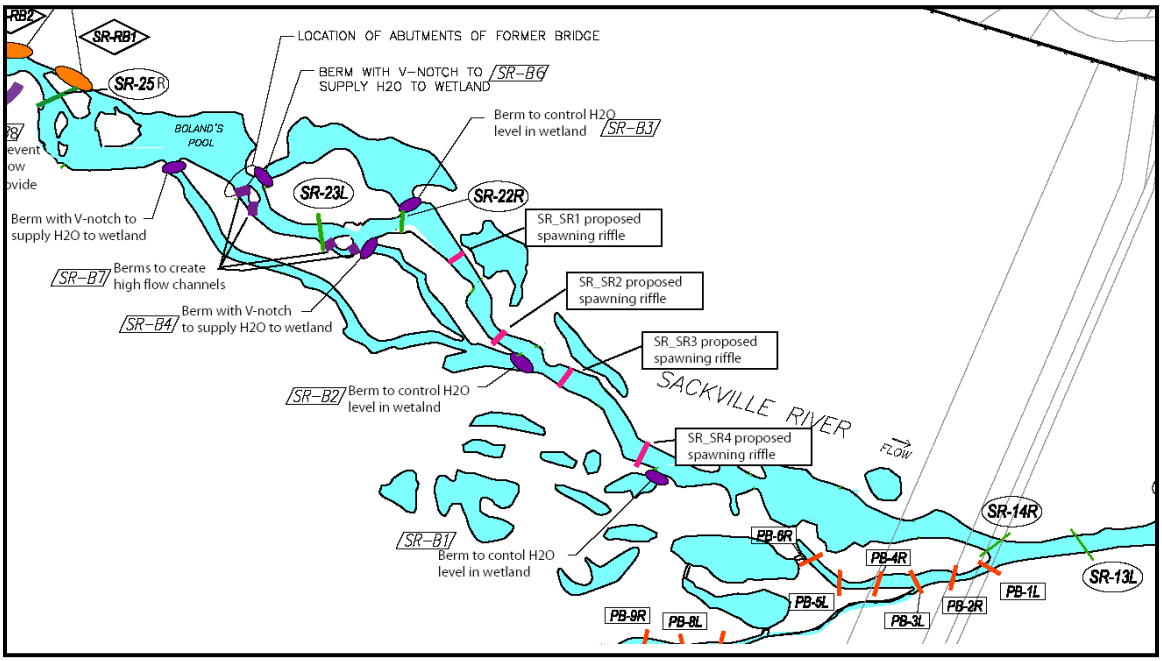


Figure 3. The Sackville River from Boland's pool to Peverill's Brook confluence

Construction sequence and environmental controls are provided below, as summarized from the DFO document, *Ecological Restoration of Degraded Aquatic Habitats* (2006). Based on historical precedence, it is anticipated that regulators will not require water control measures for this river restoration work. Previous rehabilitation work carried out on the Sackville River was done during low summer flows by an excavator that was supplied with material by a front-end loader. A DFO Habitat Management representative supervised the work and no water or silt controls were required. These were the conditions dictated on the permit granted for the work by the Province, which will include the DFO requirements. A similar method of installation is also planned for upcoming work on the Sackville River being completed by the Sackville Rivers Association (SRA).

If water control measures are required for this new work, it is anticipated that the substantial size and flow of the Sackville River through the DND property will prevent the use of a dam and pump system at the gradient control construction sites. Instead, large sand bags can be placed by an excavator to divert the flowing water around the construction area for half the width of the river. The sand bags can then be moved to the other half of the river to finish the sill. Excess silty water can be pumped into the woods for filtering.

Construction of Rock Sills SR-14L, SR-22R and SR-23L, SR-25R to SR-28R

Construction details for the seven rock sills located from just above the DND western property boundary to Peverill's Brook were provided in the Jacques Whitford Limited (2008) report. Copies of selected drawings are included in Appendix 1 (Drawing Nos. 1034314-101, 1034314-102, 1034314-105, and 1034314-106 from JWEL Appendix D).

The following table provides a breakdown of material, labour, and machinery costs to construct rock sills SR-14L, SR-22R and SR-23L, SR-25R to SR-28R. Material costs (rip rap) do not include access and trucking costs to the site.

Table A: Estimated Cost of Rock Sills

Location	Length (m)	Estimated cost	Plan type
SR-14R	17.2	$2,091.00	Right Pool
SR-22R	10.4	$1,932.00	Right Pool
SR-23L	17.5	$2,609.00	Left Pool
SR-25R	41.7	$5,241.00	Right Pool
SR-26C	23.6	$3,064.00	Center V-Rock Sill
SR-27L	30.3	$2,890.00	Left Pool
SR-28R	56.0	$5,600.00	Right pool
Sub-Total Materials	196.7	$23,427.00	
Labour & Equipment		$10,432.00	
Total		$33,859.00	

Water Control

If water control is required, then large sand bags will be placed by an excavator upstream of each rock sill to divert flow around the construction area for half the river. Once the sill on that side is installed, the sandbags will be removed and placed on the other side of the river to finish the construction of the sill. Water encountered during the excavation to place the riprap will be pumped to a vegetated area, with the discharge location a minimum of 30 m from the watercourse. Discharge will be to a 10-m section of perforated PVC pipe.

Construction Materials

Sills are to be constructed of RI Rip Rap with a depth and a width dimension of between 0.50 m and 0.70 m. In areas where the channel design width (CDW) is greater than 14 m, R2 Rip Rap will be used to construct a berm across the remainder of the river channel. R2 Rip Rap will also be used to stabilize the banks on either side of the sill/berm. R2 Rip Rap is to consist of rock with 70% of the material being between 0.30 m and 0.45 m. R1 and R2 Rip Rap will consist of hard, durable, field or quarry stone, free of splits, seams or defects likely to impair its soundness during handling or by the actions of water and ice. Shale, slate or rocks with thin foliations will not be acceptable.

Construction Sequencing

1) As required by regulators, sandbags will be placed in the river by an excavator (tracked hoe) working from the bank of the river to divert water away from the construction area.

2) The excavator will excavate the bottom of the river to a depth of approximately 30 cm and to a width large enough to accept the Rip Rap to construct the rock sill.
3) Subject to conditions of approvals, any silt-laden water resulting from this excavation will be pumped to a discharge location a minimum of 30 m from the river.
4) R1 and R2 Rip Rap will be placed by the excavator; some hand work will be required of labourers to backfill around the rip rap with native material.
5) Subject to conditions of approvals, once approximately half of the sill is completed, the sandbags will be removed and placed on the other side of the river.
6) Once the sandbags have been installed, work will commence on the construction of the other half of the sill using the same construction methods as defined above.
7) A front end loader (pay loader) will be used to transport Rip Rap from the project storage location to the construction site if practical.

Equipment
All equipment working around the river will be checked for any leaks on a daily basis to ensure that no fuel, oil, or greases enter into the river. Refueling will not be permitted within 60 m of any watercourse.

3.0 Berms

Berms will be used to control the flow in and out of the wetland areas and to keep the majority of the 1:2 year flow within the river in order to maintain the pools, riffles, and point bars that are essential to a productive aquatic habitat (see Figures 2 and 3). The V-slots in berms SR-B4, 5, 6, and 8 are sized to permit a flow to the downgradient wetland areas during low summer flows but limit higher flows to reduce erosion, excessive flushing and maintain flushing conditions in the river. These notches will be 40cm wide at the base and slope up on 1:1 sides. The top elevation of the berms exceeds the 1:100 year flood level and on-site will match the level of the existing berms along the riverbanks adjacent to the respective wetlands.

Berms SR-B1, 2, and 3 are low berms with tops set at elevations that will maintain water levels in the wetlands above (Figure 3). Both sets of berms will prevent the wetlands from drying out for long periods in the summer.

Berm SR-B8 is an addition to the Jacques Whitford (2008) plan and is set back 20m to 25m into the low floodplain to keep the water in the river for (1) riffle, pool and point bar development and (2) to keep flows from cutting new channels through this floodplain area (see Figure 2). As noted above, the river is trying to increase its length on this right bank between the two left pools at SR-27L and SR-26C. This berm will not reduce flooded areas below as the water will flood around the low right bank at the end and back from Boland's Pool and through the notch opening to supply water to the wetlands below. This berm is ideally constructed as an earthen structure from on-site materials and subsequently planted and faced with rock to prevent erosion. Velocities along this berm will be very low as water is running through existing alders. A gravel-sand mix will be placed on the top to provide turtle nesting habitat similar to that currently used by the turtles on the old road bed at the lower end of Boland's Pool. The V-notch in this berm should be 1m wide at the base with side slopes on a 1:1 slope. The elevation on the bottom will be set to carry a shallow flow in low water. This will require a 1m wide

channel to be constructed from the pool above SR-27L to the notch with 2:1 side slope to meet the existing grade.

Berm SR-B7 is actually four small berms designed to close off braided channels that are out of pattern and in both cases lowering the summer flow to the adjacent wetlands (see Figure 3). They are low berms that will just come up to the height of the surrounding floodplain and will over-top in high flows.

The estimated costs for the berms in Table B, below, are much higher than originally proposed because of the addition of the B7 berms and the necessary engineering design required for the B8 earthen structure. The rock cost estimates do not include access and trucking costs to the site.

Table B: Estimated Cost of Rock Berms

Location	Length (m)	Estimated cost for rock	Type
SR-B1	5.0	$1,440.00	
SR-B2	27.0	$320.00	
SR-B3	20.0	$640.00	V-Notch in berm
SR-B4	12.0	$384.00	
SR-B5	10.0	$684.00	V-Notch in berm
SR-B6	10.0	$160.00	
SR-B7	4 x 15.0	$1,920.00	
SR-B8	140.0	$40,320.00*	V- notch in berm
Wages /equipment for 19 days		$44,080.00	
Total		$84,400.00	

* Cost may be lower if local material can be used for the berm with rock only on the surface and V-notch.

Construction of Berms at Eight (8) Locations

Construction details for the eight berms were provided in the Jacques Whitford Limited (2008) report. Drawing number 1034314-108 is included in Appendix 1(from JWEL Appendix D). Berms are to be constructed to help consolidate the flow through this section of the river and regulate flows to adjacent wetlands. Three of the berms are new structures and five involve the replacement of existing berms that are deteriorating and not functioning properly. In four of the berms, a V-notch will be left in the berm to allow flow into the wetland. Berms will vary in height depending on the location with a top width of 2m and a bottom width of at least 5m and a slope of 1.5:1.

Water Control

If water control is required, large sand bags will be placed by an excavator upstream of each berm to be constructed in order to divert flow away from the construction site.

Construction Materials
Armour rock will consist of hard, durable, field or quarry stone, free of splits, seams or defects likely to impair its soundness during handling or by the actions of water and ice. Shale, slate or rocks with thin foliations will not be acceptable. Armour rock will have the following gradation.

TABLE R1/R2 Armour Rock

Maximum Dimension (mm)	**Percent Smaller Than**	
	R1	R2
1,050	100	
850		100
650	0-50	
550		0 - 50
300	0 - 15	
230		0-15

Construction Sequencing
1) As required by regulators, sandbags will be placed in the river by an excavator (tracked hoe) working from the banks of the river to divert water away from the construction area.
2) The excavator will place the armour rock working from the banks of the river.
3) The front face of the berm will be constructed first to minimize the release of sediment.
4) Berms will be constructed to the lines and grades shown in Drawing No. 1034314-108 in Appendix D of the Jacques Whitford Limited (2008) report (see Appendix 1 in this report).
5) A front-end loader (pay loader) will be used to transport armour rock from the dumping location to the construction site if practical.

Equipment
All equipment working around the river will be checked for any leaks on a daily basis to ensure that no fuel, oil, or greases enter into the river. Refueling will not be permitted within 60 m of any watercourse.

4.0 Bank Rocking

The Jacques Whitford Limited (2008) report focused on the DND property but the erosion problems affecting the DND lands start approximately 200m upstream of the DND property line (adjacent to the Boland farm; see Figure 2). Also it is not feasible to rock just the lower 30 m of a 61 m long eroding bank at SR-RB3 as the flows would quickly cut behind the rocking. It is proposed to rock all of SR-RB3 and approximately 95m of the left back of the river at SR-RB4. Site SR-RB2 needs to be rocked as proposed but SR-RB1will be rocked in connection with SR-25R and will not require as much rock as originally proposed.

Bank Rocking

Location	Length (m)	Height (m)	Estimated cost
SR-RB1	30.0	3.5	$1,260.00
SR-RB2	30.0	2.0	$720.00
SR-RB3	61.0	5.5	$4,026.00
SR-RB4	95.0	2.0	$2,280.00
Sub-Total – Rock			$8,286.00
Labour and machines			$23,200.00
Total cost			$31,486.00

Bank Rocking at Four (4) Locations

Details of the bank rocking were provided in Drawing 1034314-109 (Appendix D) of the Jacques Whitford Limited (2008) report. The areas to be stabilized range in height between 2.0 and 5.5 m and the armour rock will be placed at a thickness of 1.2 m ±. The cost of the R2 armour rock only includes the cost to purchase the material and does not include access and trucking costs to the site. If water control is required, then large sand bags will be placed by an excavator upstream of each area where rock banking is required to divert flow away from the work areas.

Construction Materials

As noted for the Berms, armour rock will consist of hard, durable, field or quarry stone, free of splits, seams or defects likely to impair its soundness during handling or by the actions of water and ice. Shale, slate or rocks with thin foliations will not be acceptable. armour rock will have the following gradation.

TABLE R1/R2 Armour Rock

Maximum Dimension (mm)	**Percent Smaller Than**	
	R1	R2
1 050	100	
850		100
650	0-50	
550		0 - 50
300	0 - 15	
230		0-15

Construction Sequencing

1) As required by the regulators, sandbags will be placed in the river by an excavator (tracked hoe) working from the bank of the river to divert water away from the areas requiring rock (tracked hoe) working from the bank of the river to divert water away from the areas requiring rock banking.

2) The excavator will place the armour rock, working from the banks of the river (whenever possible).

3) It may be necessary to construct a temporary working pad consisting of R2 armour rock in the river above the water elevation to enable the excavator to place the armour rock on the slopes.
4) Rocking will occur to the lines and grades shown in Drawing no. 1034314-109 in Appendix D in the Jacques Whitford (2008) report.
5) A front-end loader (pay loader) will be used to transport armour rock from the dumping location to the construction site where practical.

Equipment

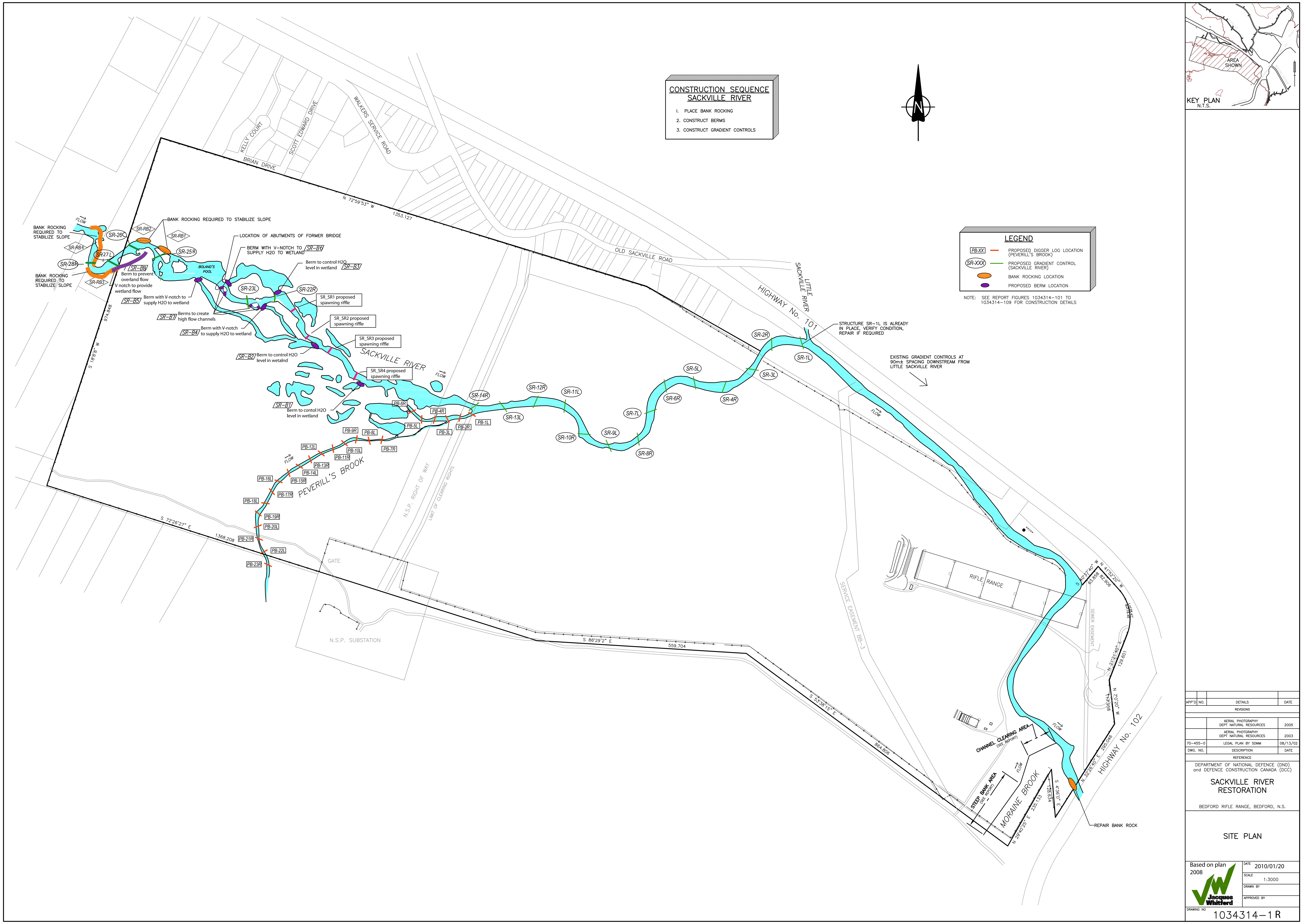
All equipment working around the river will be checked for any leaks on a daily basis to ensure that no fuel, oil, or greases enter into the river. Refueling will not be permitted within 60 m of the watercourse.

Appendix 1

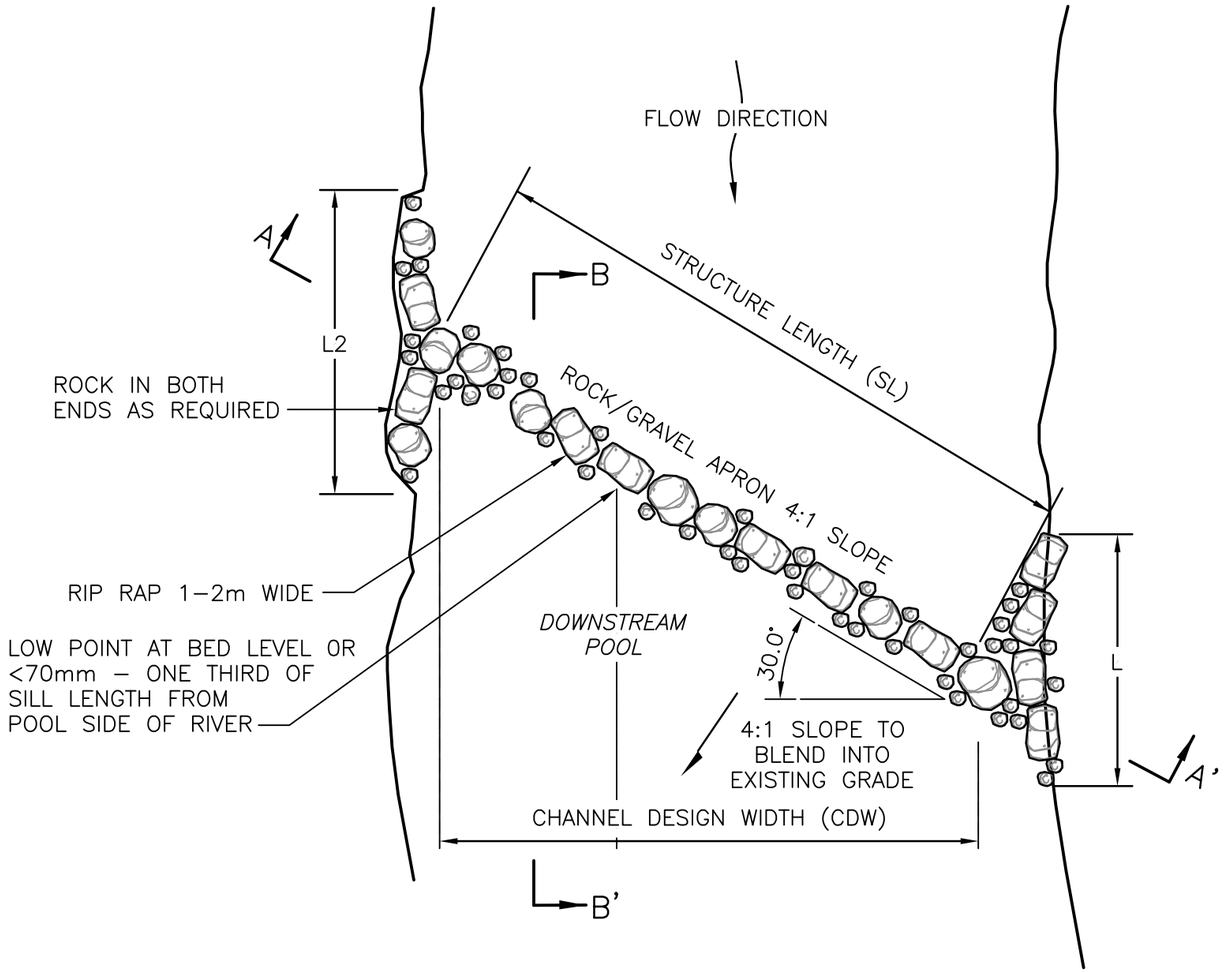
Overall plan revised from JWEL report

JWEL plan drawings
1034314-101 Typical gradient control right pool
1034314-102 Typical gradient control left pool
1034314-105 Typical gradient control channel width exceeded right pool
1034314-106 Typical gradient control channel width exceeded left pool
1034314-108 Typical Berm

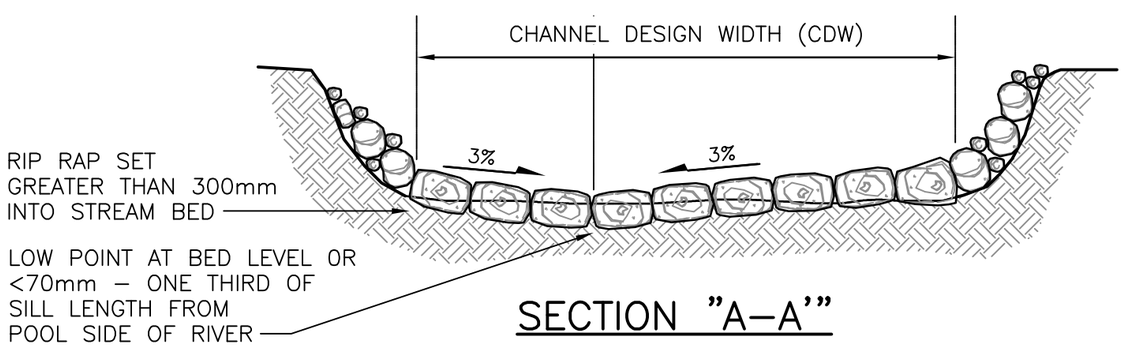
Typical Spawning Bed



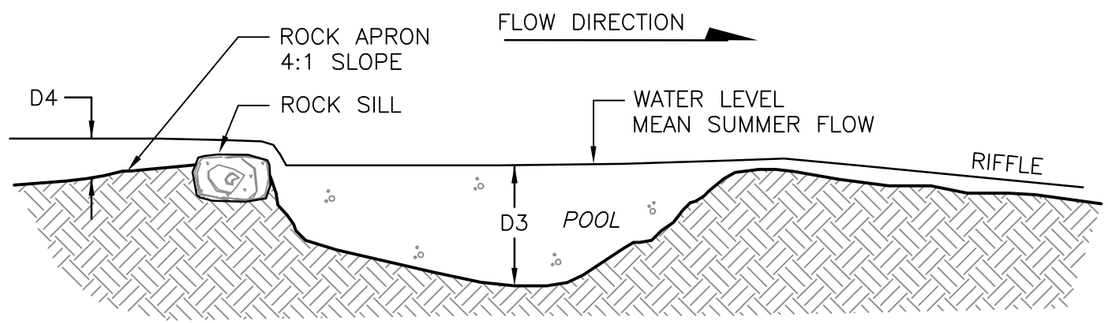
CONSTRUCTION SEQUENCE SACKVILLE RIVER
1. PLACE BANK ROCKING
2. CONSTRUCT BERMS
3. CONSTRUCT GRADIENT CONTROLS
LEGEND
PB-XX PROPOSED DIGGER LOG LOCATION (PEVERILL'S BROOK)
SR-XXX PROPOSED GRADIENT CONTROL (SACKVILLE RIVER)
BANK ROCKING LOCATION
PROPOSED BERM LOCATION
NOTE: SEE REPORT FIGURES 1034314-101 TO 1034314-109 FOR CONSTRUCTION DETAILS
KEY PLAN N.T.S.
AREA SHOWN
SACKVILLE RIVER
PEVERILL'S BROOK
MORAINE BROOK
HIGHWAY No. 101
HIGHWAY No. 102
OLD SACKVILLE ROAD
LITTLE SACKVILLE RIVER
RIFLE RANGE
N.S.P. SUBSTATION
STRUCTURE SR-1L IS ALREADY IN PLACE, VERIFY CONDITION, REPAIR IF REQUIRED
EXISTING GRADIENT CONTROLS AT 90m± SPACING DOWNSTREAM FROM LITTLE SACKVILLE RIVER
REPAIR BANK ROCK
BANK ROCKING REQUIRED TO STABILIZE SLOPE
LOCATION OF ABUTMENTS OF FORMER BRIDGE
BERM WITH V-NOTCH TO SUPPLY H2O TO WETLAND
CHANNEL CLEARING AREA
STEEP BANK AREA
DEPARTMENT OF NATIONAL DEFENCE (DND) and DEFENCE CONSTRUCTION CANADA (DCC)
SACKVILLE RIVER RESTORATION
BEDFORD RIFLE RANGE, BEDFORD, N.S.
SITE PLAN
Based on plan 2008
DATE 2010/01/20
SCALE 1:3000
Jacques Whitford
DRAWING NO 1034314-1 R



L	
L2	
D3	<2.8m
D4	30cm
CDW	14m
SL	16m



SECTION "A–A'"



SECTION "B–B'"

T:\1034XXX\1034314 DND Sackville River\1034314-101.dwg 2008/03/25 - 11:19am br23825

Jacques Whitford

REFERENCE:

SCALE :	NTS
DATE :	2008/02/07
DRAWN BY :	STAFF
APPROVED BY :	

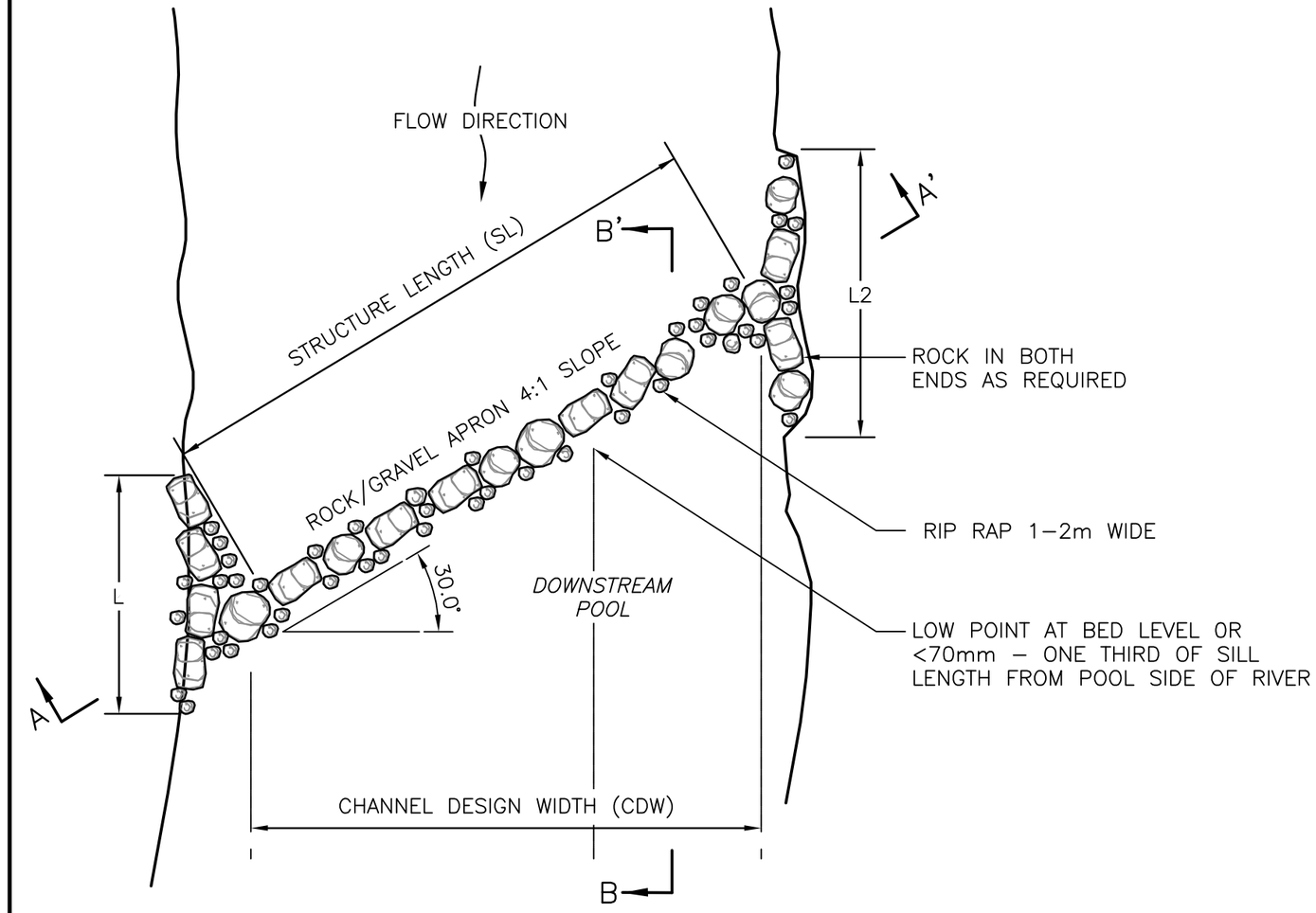
DEPARTMENT OF NATIONAL DEFENCE (DND)
and DEFENCE CONSTRUCTION CANADA (DCC)

SACKVILLE RIVER RESTORATION

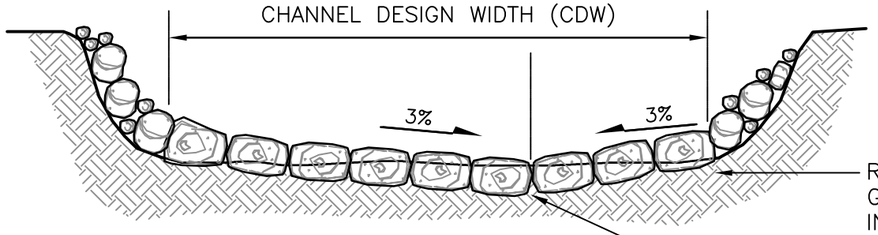
BEDFORD RIFLE RANGE, BEDFORD, N.S.

GRADIENT CONTROL RIGHT POOL

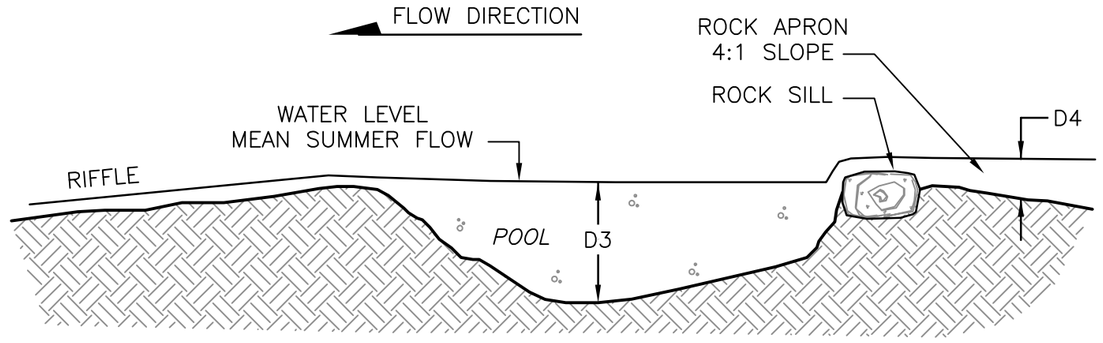
DRAWING NO. 1034314–101



L	
L2	
D3	<2.8m
D4	30cm
CDW	14m
SL	16m



SECTION "A–A'"



SECTION "B–B'"

T:\1034XXX\1034314 DND Sackville River\1034314-102.dwg 2008/03/25 - 11:20am br23825

Jacques Whitford

REFERENCE:

SCALE :	NTS
DATE :	2008/02/07
DRAWN BY :	STAFF
APPROVED BY :	

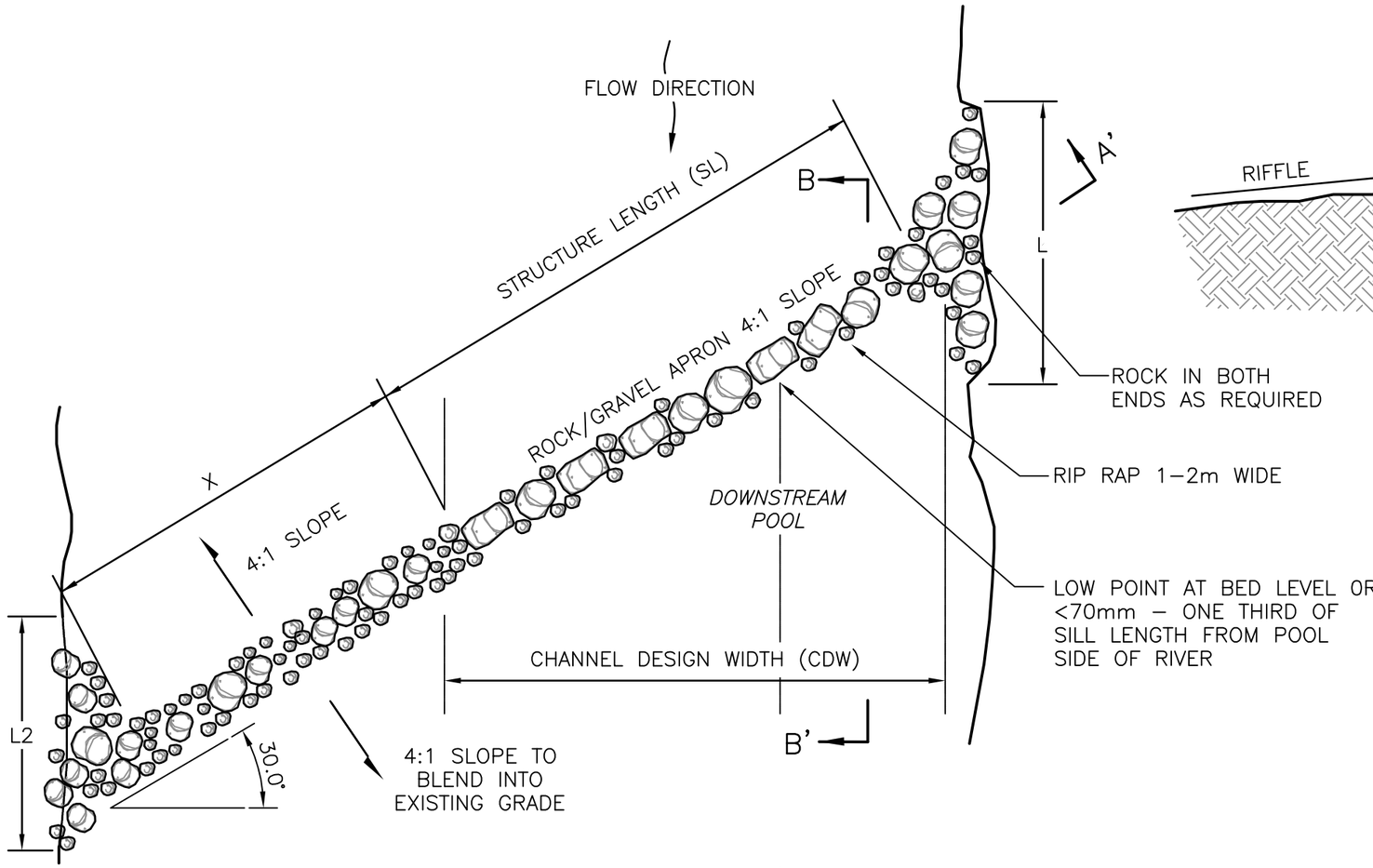
DEPARTMENT OF NATIONAL DEFENCE (DND)
and DEFENCE CONSTRUCTION CANADA (DCC)

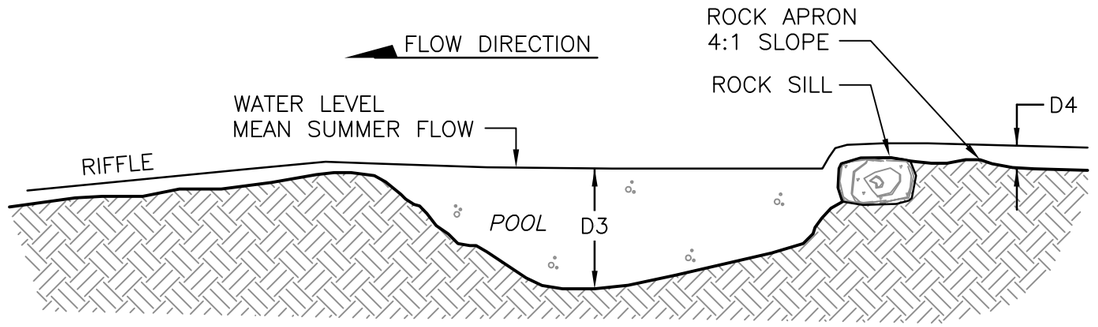
SACKVILLE RIVER RESTORATION

BEDFORD RIFLE RANGE, BEDFORD, N.S.

GRADIENT CONTROL LEFT POOL

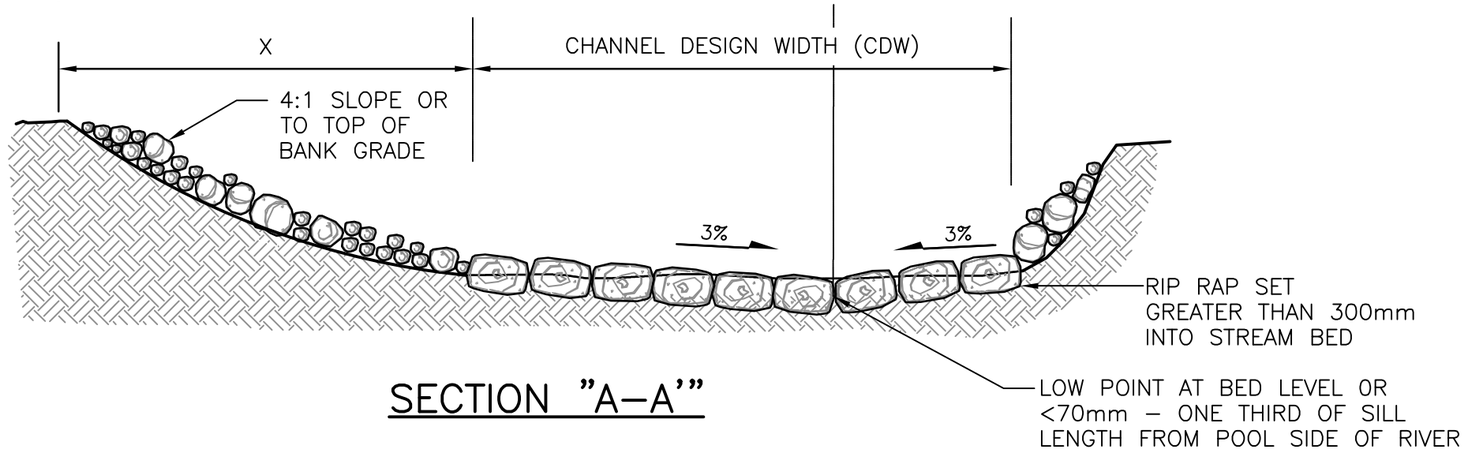
DRAWING NO. 1034314–102





SECTION "B–B'"

L	
L2	
D3	<2.8m
D4	30cm
CDW	14m
SL	16m
X	



SECTION "A–A'"

Jacques Whitford

REFERENCE:

SCALE : NTS
DATE : 2008/02/07
DRAWN BY : STAFF
APPROVED BY :

DEPARTMENT OF NATIONAL DEFENCE (DND) and DEFENCE CONSTRUCTION CANADA (DCC)

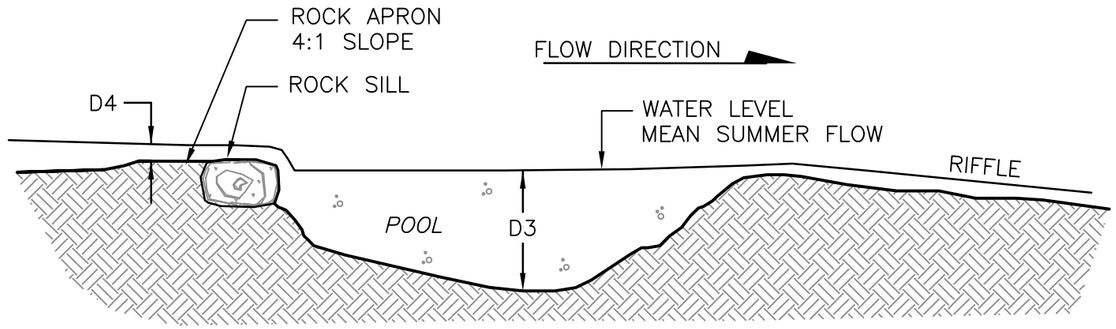
SACKVILLE RIVER RESTORATION

BEDFORD RIFLE RANGE, BEDFORD, N.S.

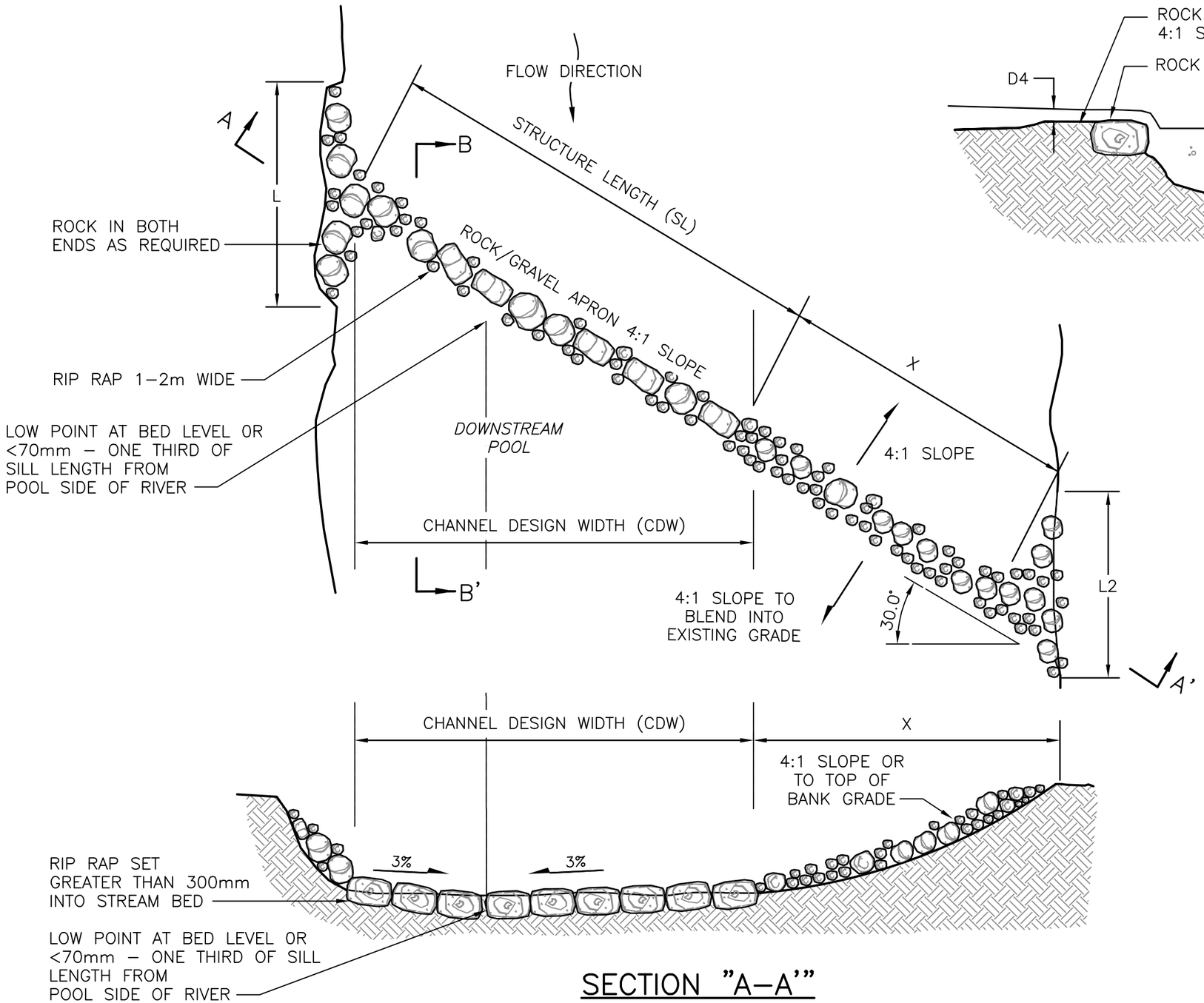
GRADIENT CONTROL LEFT POOL CDW EXCEEDED

DRAWING NO. 1034314–105

T:\1034XXX\1034314 DND Sackville River\1034314-105.dwg 2008/03/25 - 11:26am br23825



SECTION "B–B'"



SECTION "A–A'"

L	
L2	
D3	<2.8m
D4	30cm
CDW	14m
SL	16m
X	

T:\1034XXX\1034314 DND Sackville River\1034314-106.dwg 2008/03/25 - 11:28am br23825

Jacques Whitford

REFERENCE:

SCALE :	NTS
DATE :	2008/02/07
DRAWN BY :	STAFF
APPROVED BY :	

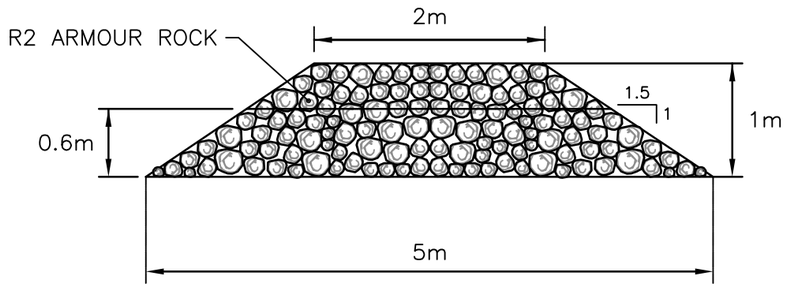
DEPARTMENT OF NATIONAL DEFENCE (DND)
and DEFENCE CONSTRUCTION CANADA (DCC)

SACKVILLE RIVER RESTORATION

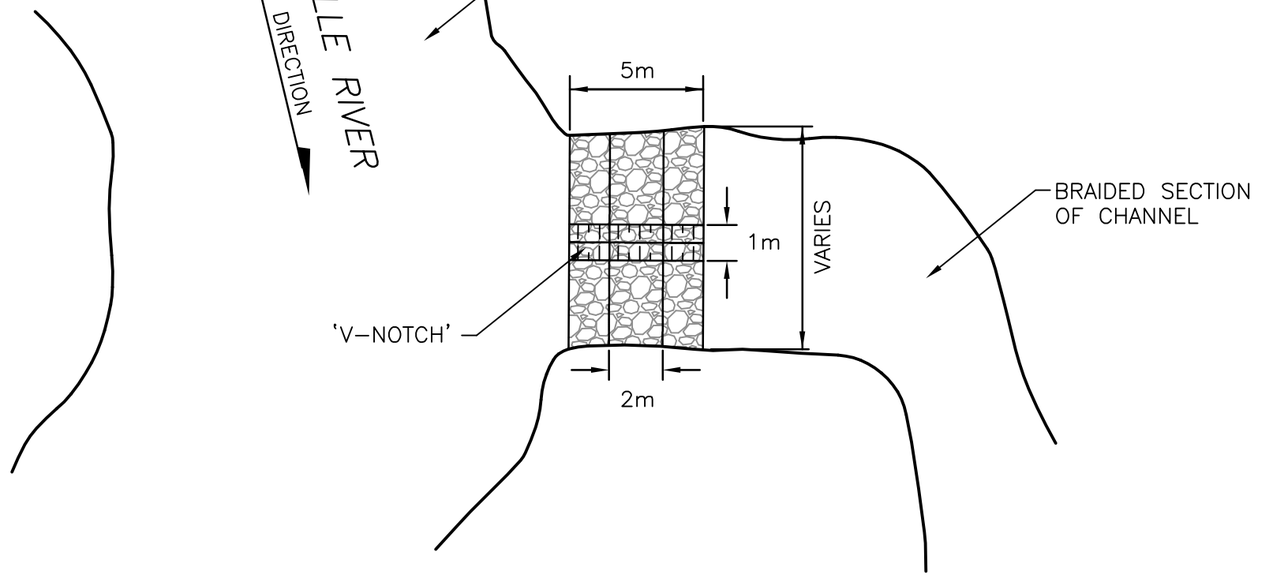
BEDFORD RIFLE RANGE, BEDFORD, N.S.

GRADIENT CONTROL RIGHT POOL CDW EXCEEDED

DRAWING NO. 1034314–106



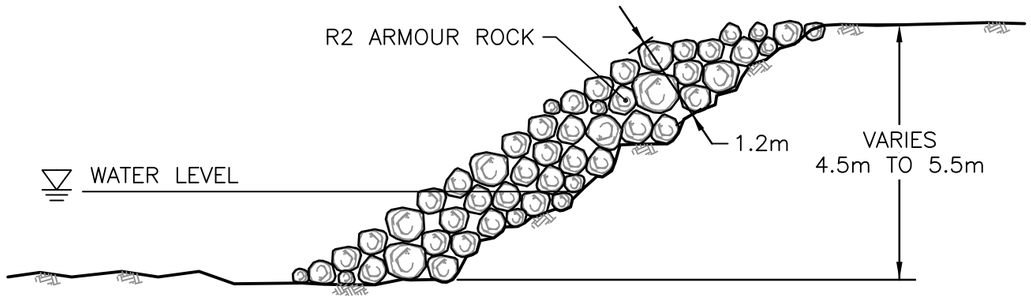
ELEVATION VIEW
NTS



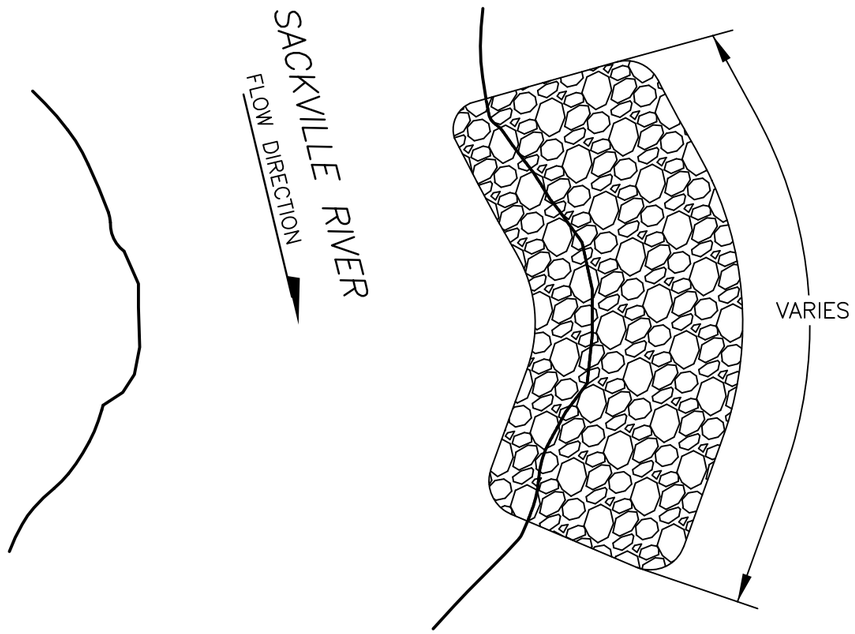
PLAN VIEW
NTS

T:\1034XXX\1034314 DND Sackville River\1034314-108.dwg 2008/03/26 - 1:48pm br23825

Jacques Whitford	REFERENCE:	SCALE : AS SHOWN DATE : 2008/03/25 DRAWN BY : STAFF APPROVED BY :	DEPARTMENT OF NATIONAL DEFENCE (DND) and DEFENCE CONSTRUCTION CANADA (DCC) SACKVILLE RIVER RESTORATION BEDFORD RIFLE RANGE, BEDFORD, N.S.	TYPICAL BERM DETAIL DRAWING NO. 1034314–108



ELEVATION VIEW
NTS



PLAN VIEW
NTS

Jacques Whitford

REFERENCE:

SCALE :	AS SHOWN
DATE :	2008/03/25
DRAWN BY :	STAFF
APPROVED BY :	

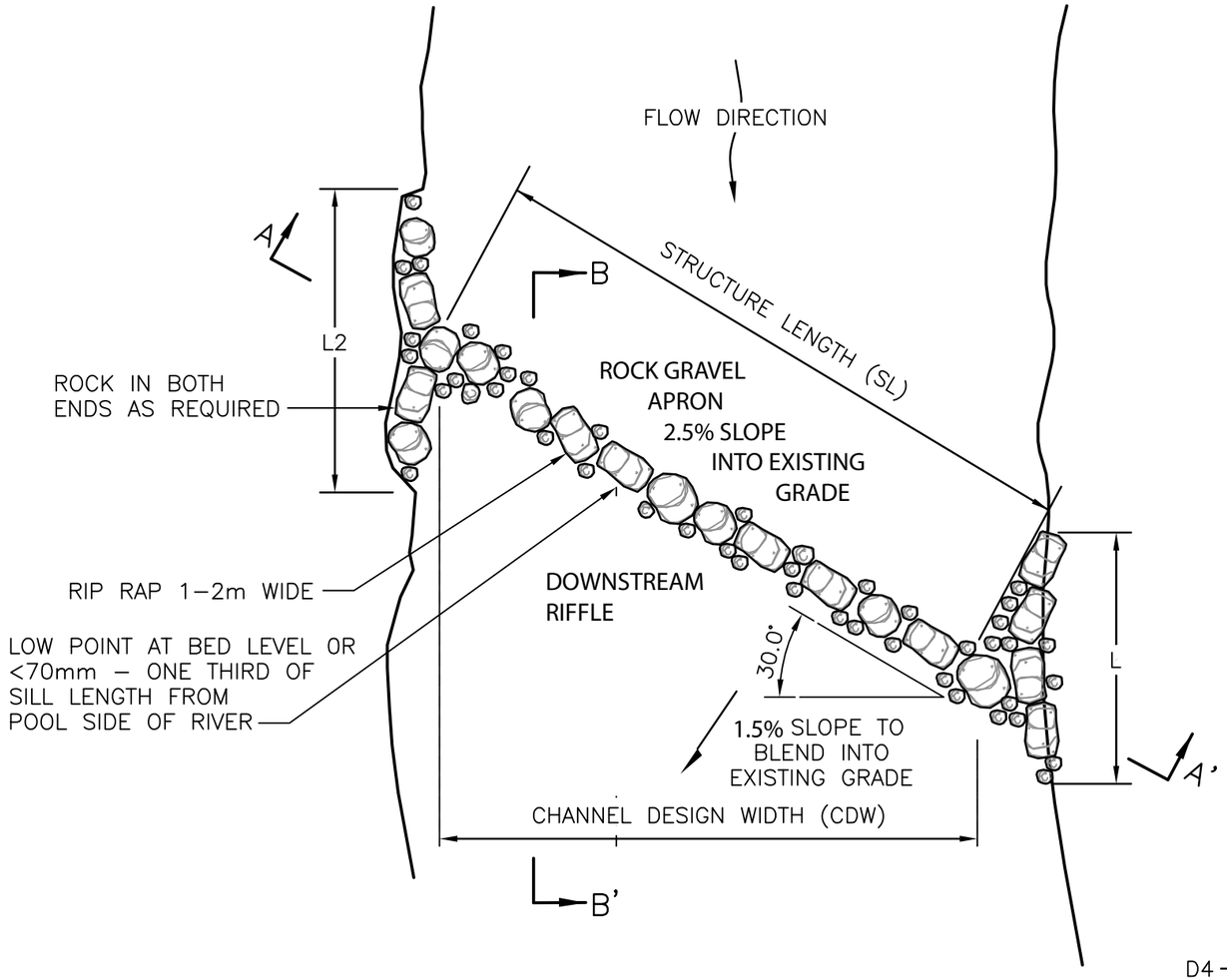
DEPARTMENT OF NATIONAL DEFENCE (DND)
and DEFENCE CONSTRUCTION CANADA (DCC)

SACKVILLE RIVER RESTORATION

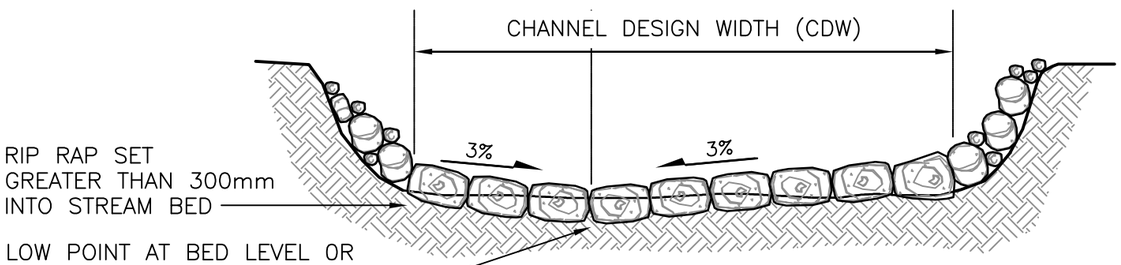
BEDFORD RIFLE RANGE, BEDFORD, N.S.

TYPICAL BANK ROCKING DETAIL

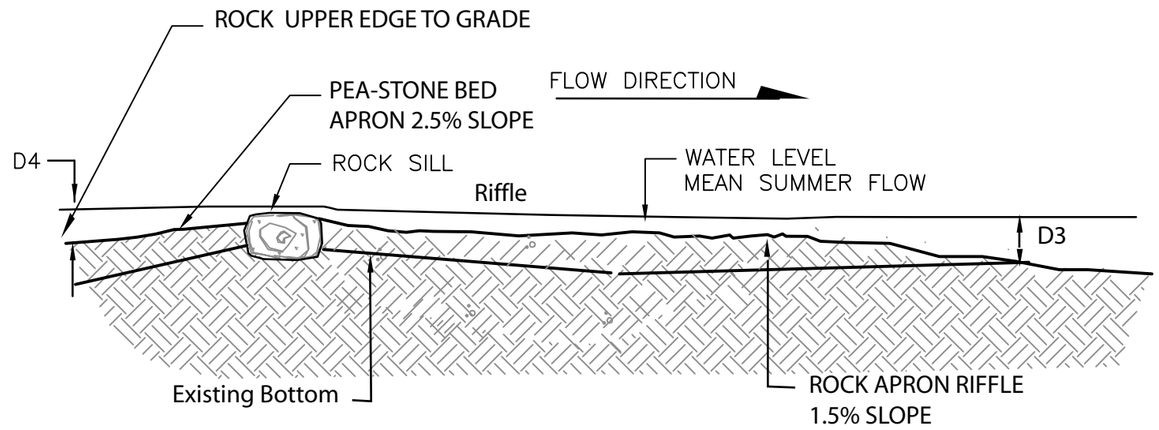
DRAWING NO. 1034314-109



L	
L2	
D3	1.0 M
D4	0.5M
CDW	14m
SL	16m



SECTION "A–A'"



SECTION "B–B'"

	REFERENCE:	SCALE : NTS DATE : DRAWN BY : APPROVED BY :	SACKVILLE RIVER RESTORATION BEDFORD RIFLE RANGE, BEDFORD, N.S.

SPAWNING BED RIGHT RIFFLE

DRAWING NO.

T:\1034XXX\1034314 DND Sackville River\1034314-101.dwg 2008/03/25 - 11:19am br23825

Nova Scotia Department of Environment and Labour

Wetland Alteration Application
DND Property
Sackville, Halifax Co.

April 2010

Prepared by:
East Coast Aquatics Inc.
P.O. Box 129
Bridgetown, Nova Scotia
B0S 1C0

Table of Contents

1.0 Wetlands Information 2
1.1 Weltand Location 2

2.0 Ecological Character 4
2.1 Wetland Characterization/Delineation 6
Hydrology 6
Soils 7
Vegetation 9
Delineation 11
2.2 Herptofaunal Characterization 14

3.0 Species at Risk Assessment 15
3.1 Species at Risk 16
3.2 Provincially Rare Species 17

4.0 Hydrological/hydrogeological Character 18

5.0 Functional Assessment 21

6.0 Reference Material 22

7.0 Purpose and Description of the Alteration 26
7.1 Reason for the Alteration 26
7.2 Description of the Alteration 26
7.3 Alternatives Considered and mitigation proposed 26
7.4 Identifiable impacts 27
7.5 Description of past impacts 28

8.0 Property Information 28

Appendix A - ACCDC Report 30
Appendix B – Sackville Wetland Species List 39
Appendix C – Field Data Sheets 42
Appendix D – NOVA WAM Functional Assessment 69

Nova Scotia Environment and Labour
Wetland Alteration Application

Application Date: _____

Composed by: Michael Parker
East Coast Aquatics Inc.
P.O. Box 129
Bridgetown, Nova Scotia
B0S 1C0
(902) 665-4682

On Behalf of: NS Transportation and Infrastructure Renewal
Johnston Building
1672 Granville St.
Halifax, Nova Scotia
B3J 2N2

Contact: Bob Pett
Environmental Services
NS Transportation and Infrastructure Renewal
(902) 424-4082

1.0 Wetlands Information

The Sackville Wetland Complex was the site of a gravel extraction operation up until the early 1960s. As such the site has a number of impaired function, and the alteration proposed is to restore, enhance and expand the existing wetland. The alteration is detailed in a separate report titled *Wetland Compensation Project at the DND Property Sackville, Halifax County: Part 1 – Wetland Delineation and Compensation Concept*, produced by East Coast Aquatics for the NS Department of Transportation and Infrastructure Renewal in March 2010.

The Sackville Wetland Complex was formally delineated based on soils, hydrology, and vegetation as outlined by Nova Scotia Wetlands Delineation Course methodologies (MCFT 2008). The results are presented in this report Section 2.1, Wetland Characterization/Delineation. A functional assessment of the wetland was completed based on the Nova Scotia Advanced Wetlands Delineation and Evaluation Course (MCFT 2009), the results of which are presented in Section 5.0 and Appendix E. The wetland area that was delineated and functionally assessed on the ground as part of this application was nearly 18 ha. Further desktop evaluation of the immediate area and larger watershed was also completed in order to develop this application for a Wetland Alteration Approval.

1.1 Wetland Location

The wetland assessed for this Alteration Approval, herein referred to as the Sackville Wetland Complex, is located south of Highway 101 and the community of Lower Sackville, Halifax County, Nova Scotia (see Figure 1). The site is part of the Eastern Interior ecodistrict in the Western ecoregion (NSDNR 2003). The wetland assessed is not a coastal wetland, but a freshwater flooplain system of the Sackville River. The Sackville River flows to the Bedford Basin and head of tide, approximately 4km downstream of the Sackville Wetland Complex.

The assessed Sackville River Wetland area exists entirely on PID 00361212, which is owned by Department of National Defence. The proponent is the Provincial Department of Transportation and Infrastructure Renewal (see Figure 14 in Section 8 for property boundary map image).

The approximately 17.9 ha (179,000 m^2) Sackville Wetland Complex area consists primarily of swamp, but also includes small areas of bog and marsh, as well as a number of open water ponds. The area is a complex wetland / upland mosaic derived from previous gravel extraction operations across the site. It is estimated that at least 20-30 % of the area within the complex consists of upland mounds and berms.

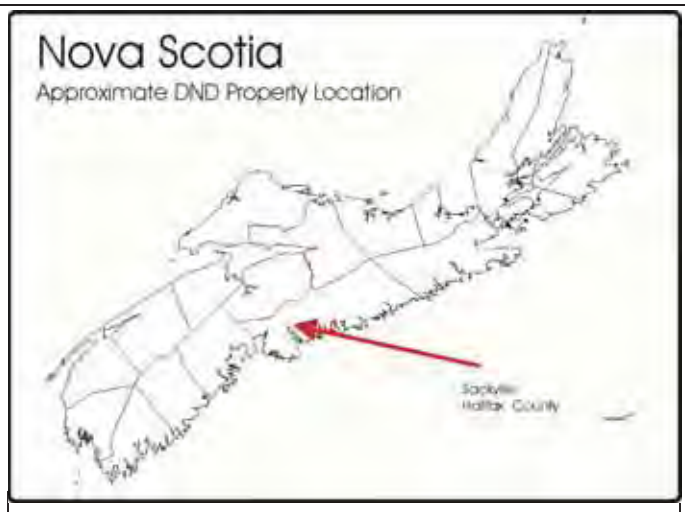


Figure 1: General location of DND property and assessed wetland at Sackville, Halifax County.

As shown in Figure 2, the Nova Scotia Department of Natural Resources (NSDNR) has identified the Sackville Wetland Complex within their Significant Species and Habitats database (NSDNR 2009c), although at a slightly greater area (18.67 ha) than the field verified boundary. Approximately 880 ha of wetlands have been identified by the Department within the Sackville River watershed upstream of the project site, or 8.8% of the watershed area. It is likely that the wetland area is somewhat greater than that which is currently reported.

Figure 2: Nova Scotia Department of Natural Resources wetlands database mapping indicates 15.31 ha of tall shrub swamp (green) and 3.37 ha of tall shrub marsh (yellow) exist on the Sackville Wetland Complex (Source: modified from NSDNR 2009c).

The property was visited by East Coast Aquatic's staff on August 27th and September 10th, 2009, for the purpose of delineating the wetland, and was further assessed on a number of days through to late November 2009. A series of three paired upland and wetland delineation surveys (soils, vegetation, and hydrology) were conducted (see Figure 3), opportunistic wildlife and herptofaunal searches were completed, and hydrological character assessed. These results are presented in the subsequent sections of this document.

2.0 Ecological Character

It is estimated that over 14, 000 ha of peatlands exist in Halifax County (Anderson and Broughm 1988). At least five wetlands exist within approximately 1km of the Sackville Wetland Complex as indicated by NSDNR (2009c). The Provincial Significant Species and Habitats database indicates approximately 880 ha of wetland in the 9950 ha watershed that exists upstream of the project site. These are further broken into 21% marsh, 38% bogs/fens, and 41% swamp. Bogs and swamps are likely underrepresented in the mapped data. The assessed Sackville Wetland is a moderate sized complex dominated by tall shrub swamp, which covers approximately 78% of the 17.9 ha delineated wetland area. Smaller embedded treed bog (9%) and graminoid/low shrub marsh (8%) subunits add to the site complexity. It is likely that the surface water hydrology has been modified by past land use activity across the site, a gravel extraction operation. It is likely that more frequent flooding of the valley floor has been facilitated by complete devegetation of the valley floor, and excavation and channeling of the floodplain within the project reach. Gradient breaks on the Sackville River exist both at the upstream and downstream ends of the wetland complex providing for a low gradient channel along the 1 km long reach. The floodplain, which corresponds to the wetland boundary in the project area, has naturally become more stabilized and vegetated since the 1960s when gravel extraction ceased. The current surface hydrology appears to have been unaltered since this time, and the site has been left to natural reclamation.

Although virtually all of the Sackville Wetland Complex is currently vegetated, past removal of surface soils has left a very porous and well drained gravel substrate across much of the complex. Many areas lack both floral diversity and density. There are some debris items, such as metal and tires, on the site. The upland riparian buffers of the wetland exist in a relatively natural state, and the watershed upstream of the project site is virtually all forested. A cleared power line corridor exists at the downstream extent of the project area where it intersects the wetland complex, and an area of windfall remnant from Hurricane Juan exists on the north side buffer of the wetland. A number of old road beds, failed culvert structures and berms are interspersed on the site, particularly in the southeast portion of the complex.

A number of herptofuana, mammals, and waterfowl/avian species were observed in and around the wetland complex during field assessments. The diversity of vernal pools, ponds, and wetland types would suggest that the site has moderate wildlife values, which would be further enhanced by the forested riparian buffers and large tracts of undisturbed forest surrounding much of the Sackville Wetland Complex.

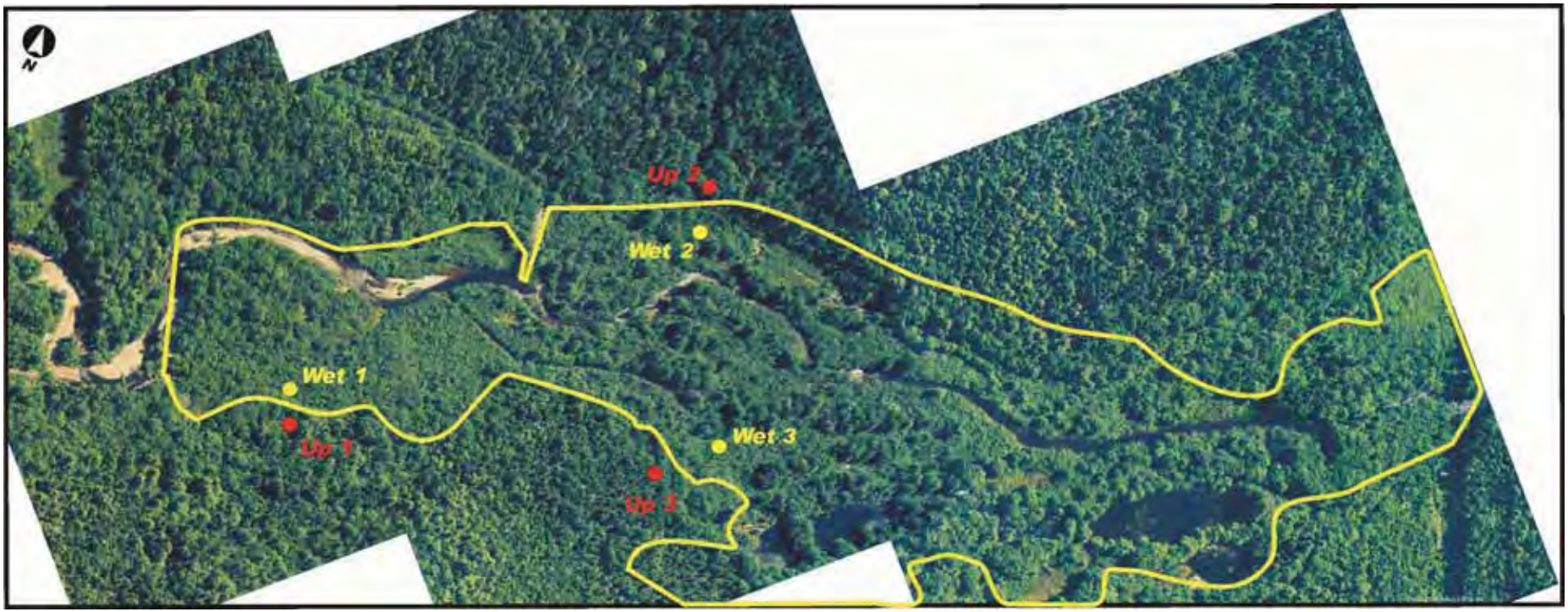


Figure 3: The three paired upland/wetland plot locations, and the delineated wetland boundary of the Sackville Wetland. This image is derived from 2001 air photos.

There were a total of 48 vascular taxa identified (45 to their species epithet) through the delineation portion of field assessments (see Appendix B for species list). Although the seasonal timing of the surveys preempted the opportunity to complete a comprehensive botanical survey, four exotic species were identified within or adjacent to the wetland. Such observation is not unusual in wetlands adjacent to developed areas, residential areas. Ten faunal species were identified through direct observation or sign collected during field assessments. One Species-at-Risk was identified (Wood turtle), and one Provincially Rare species identified (Green ash). These species are discussed further in Section 3.0.

The following sections detail field survey results for the Sackville Wetland Complex that support this ecological characterization. Field data sheets are presented in Appendix D. A detail functional analysis of the wetland, based on Nova Scotia Advanced Wetland Delineation and Assessment methodologies (MCFT 2009) is presented in Section 5.0 with supporting data sheets in Appendix E.

2.1 Wetland Characterization/Delineation

Wetland delineation is based on confirmation of wetland hydrology, hydric soils, and hydrophytic vegetation (MCFT 2009). All three must be present to confirm a wetland. Field surveys were undertaken to assess these three parameters at the Sackville Wetland Complex as part of the delineation process. The following discussion highlights the results of those field surveys.

Hydrology

Wetland hydrology indicators of the project site are numerous. Most are directly related to the flow patterns of the Sackville River. The most obvious is surface water and inundation during the growing season. Although a number of ponds exist, pockets of surface water can be observed in many locations where microtopographic relief creates depressions. The site is also prone to flooding across the full width of the valley, and high water covered the entire valley floor to 20+cm across the project area during an August 27th visit. Sediment deposits, drift deposits, and multiple channel drainage patterns are also visible across large portions of the Sackville wetland. It does appear that the water table drops quickly, likely due to the coarse nature of soils on the floodplain and the multiple channels that allow the floodplain to quickly drain to the main Sackville River channel. The floodplain has a large number of small braids that appear to carry some volume of flow nearly year round. These channels influence local water table profiles creating drawdown zones near the channels, much as a drainage ditch might.

Three bog areas exist on the outer perimeter of the Sackville Wetland Complex, and the hydrology of these areas differs from the majority of the complex. Much of the hydrological influence on these bog areas is from upland surface sheet flow, and not from changes in the Sackville River stage height. Therefore the nutrient regime and soil forming processes in the bogs are different than other areas within the complex.

A small but important surface hydrology influence on the Sackville Complex is a series of small feeder channels that enter the floodplain from high ground to the north or south. The majority of these channels enters from the north, and tends to be <0.3m wide. The volume of water being carried is always relatively small, and the hydrology influence is likely limited to the immediate wetland area in to which individual streams discharge.

A broader context of the hydrology is discussed in Section 5 of this document, whereas specific hydrology indicators for delineation are documented on the field data sheets in Appendix C.

Soils

NSDNR ecological land classification (NSNDR 2009a) for the Sackville Wetlands site indicates that most of the area is IMHO, or imperfectly drained medium textured soil on hummocky terrain. The soils on the site have been significantly altered by decades of gravel removal across the valley floor. Long berms of overburden material exist along portions of the north and south wetland boundaries running parallel to the Sackville River valley. Several other bermed areas run in a general east west direction in the southeast corner of the project area, separating a number of excavated ponds and ponded areas. It appears that some of these berms were used as driving surfaces during gravel extraction. In some cases the berms have moderate topographic relief, extending 1-2 m above the surrounding valley floor. In other cases the berms are less than 0.5 m above the surrounding topography, and provide flow pathways controls during even moderately low flood conditions.

Three wetland soil profiles are presented for each of the three paired field assessment sites in Tables 1-3. Plots Wet 1 and Wet 3 generally meet the hydric soil indicator of a depleted matrix given the matrix Munsell color and relatively low value and chroma. Plot Wet 2 soils do not meet any hydric soil indicators despite being within the wetland complex boundary and exhibiting both hydrophytic vegetation and wetland hydrology at the assessed site. At all wet sites a thin sandy clay/loam layer (Thein 1979) generally overlays a very coarse sand/stone substrate that was reached at 8-15cm depths(see Figure 4). None of the assessed sites had measurable organic layers.

Table 1: Soil profile for site Wet 1 located on the southwest portion of the project area. No redox features were present, and root material was present throughout the soil matrix. This soil appears hydric and generally meets the hydric soil indicator "Depleted Matrix" (F3) (MCFT 2009).

				Redox Features				
Depth (cm)	**Horizon**	**Matrix Munsell**	**%**	**Mottle Munsell**	**% Mottle**	**Type[1]**	**Loc[2]**	**Texture/Von Post**
10	B	10YR 3/2	100		None			Sandy clay loam
11+	C							Sandy gravel

1Type: C-concretion, D - depletion, RM - reduced matrix, CS - covered or coated sand. 2 Locations: PL - pore lining, M - matrix

Table 2: Soil profile at Wet 2 located in Alder 2 on the north side of the project site. The site was very sandy and stony at approximately 12 cm depth, preventing further hand excavation of a soil pit. Roots and leaves were readily identifieable and not decomposed down to the sand layer, indicating relatively recent deposition. No redox features were present. These soils do not meet typical hydric soil indicator requirements (MCFT 2009).

				Redox Features				
Depth (cm)	**Horizon**	**Matrix Munsell**	**%**	**Mottle Munsell**	**% Mottle**	**Type[1]**	**Loc[2]**	**Texture/Von Post**
0-1	O							Undecomposed leaf litter
0-8	A	7.5 YR 4/3	100		none			Silty clay loam
8-12+	C							Sand – does not form ball

1Type: C-concretion, D - depletion, RM - reduced matrix, CS - covered or coated sand. 2 Locations: PL - pore lining, M - matrix

Figure 4: Wet 1 soil profile from Alder 5 shows consistent coloring (10 YR 3/2). Note gravel and rock fragments below 10 cm.

Table 3: Soil profile for site Wet 3 located at a marsh area (Gram marsh 5) on the south portion of the project area. Approximately 5% of the matrix had red redox features along pore linings. The underlying soil was coarse material of sand and gravel that would not form a ball. This soil appears hydric and generally meets the hydric soil indicator "Depleted Matrix" (F3) (MCFT 2009).

				Redox Features				
Depth (cm)	**Horizon**	**Matrix Munsell**	**%**	**Mottle Munsell**	**% Mottle**	**Type[1]**	**Loc[2]**	**Texture/Von Post**
0-15		10YR 3/2	95	2.5YR 4/8	5	C	PL	Clay – roots visible
15+								Sand/gravel – does not form ball

1Type: C-concretion, D - depletion, RM - reduced matrix, CS - covered or coated sand. 2 Locations: PL - pore lining, M - matrix

Figure 5: Soil profile at site Wet 3 located in Marsh 5 on the southern extent of the project area. Undecomposed roots are visible throughout the matrix. Note the large stone at 12 cm. Sand/gravel/stone layer existed below 15cm.

Although none of the soil sites assessed for wetland delineation exhibited strong wetland soil properties (likely as a result of past soil removal), soils examined at three other locations (Alder 7, Bog 1, and Bog 2) provided considerably different results. Each of these three sites had a 10-17cm fibric peat layer, and a high percentage of redox features in the underlying soil horizon. It is expected that these sites may have had limited or no disturbance during past land use practices, and therefore reflect a more natural soil profile. As such they also provide some template considerations for proposed compensation activities at the site, and target soil characteristics to be evaluated through proposed monitoring.

Vegetation

Three paired wetland/upland plots were evaluated at the locations shown in Figure 3. Wet 1 and Wet 2 were tall shrub swamp areas, whereas Wet 3 was a shrub marsh location. Circle plots with 10 m radiuses were used for tree and sapling stratum. A 5 m radius plot was used to assess shrubs and herbs. Typically a number of $1m^2$ quadrants were evaluated within the circle plot for herb layers. Evaluation of these plots during September 2009 created an inventory of vascular flora. A total of 48 vascular taxa (45 identified to their species epithet) as presented in Appendix B and D. No Species-at-Risk were identified. Four exotic species, predominantly upland species, were identified.

A dominance test was applied to each stratum of each plot. A 50%/20% rule was applied to identify the dominant plant species for each stratum of each plot. The results of this assessment are summarized in Table 4.

Table 4: Dominant plot species by stratum. A 50/20 rule was applied to determine plant dominance for each stratum. Detail plot results are presented in Appendix D.

Sampling stratum	Wet 1	Wetland Indicator Status	Up 1	Wetland Indicator Status
Dominant Tree Stratum Species	Red Maple *Acer Rubrum*	FAC	Red Spruce *Picea rubens*	FACU
	Green Ash *Fraxinus pennsylvania*	FACW		
Dominant Sapling Stratum Species	Speckled Alder *Alnus Incana*	FACW	Balsam Fir *Abies balsamea*	FAC
			Red Spruce *Picea rubens*	FACU
Dominant Shrub Stratum Species	*NONE*		*None*	
Dominant Herb Stratum Species	Rough Stemmed Goldenrod *Solidago rugosa*	FAC	*None - mosses*	
	Viola spp.	FACW		
Sampling stratum	**Wet 2**	**Indicator Status**	**Up 2**	**Indicator Status**
Dominant Tree Stratum Species	Black Cherry *Prunus serotina*	FACU	Balsam Fir *Abies balsamea*	FAC
	Red Maple *Acer Rubrum*	FAC		
Dominant Sapling Stratum Species	Speckled Alder *Alnus Incana*	FACW	Red Maple *Acer Rubrum*	FAC
			Balsam Fir *Abies balsamea*	FAC
Dominant Shrub Stratum Species	Broadleaved Meadowsweet *Spirea Latifolia*	FAC	*None*	
	Speckled Alder *Alnus incana*	FACW		
Dominant Herb Stratum Species	Rough Stemmed Goldenrod *Solidago rugosa*	FAC	Canada Mayflower *Maianthemum canadense*	FAC
	Swamp Dewberry *Rubus hispidus*	FACW	Crested Fern *Dryopteris cristata*	FACW
Sampling stratum	**Wet 3**	**Indicator Status**	**Up 3**	**Indicator Status**
Dominant Tree Stratum Species	Red Maple *Acer Rubrum*	FAC	Red Maple *Acer Rubrum*	FAC
			Red Spruce *Picea rubens*	FACU
Dominant Sapling Stratum Species	Speckled Alder *Alnus Incana*	FACW	Red Spruce *Picea rubens*	FACU
			Hemlock *Tsuga canadensis*	FACU
Dominant Shrub Stratum Species	*NONE*		Red Spruce *Picea rubens*	FACU
Dominant Herb Stratum Species	Arrowhead Tearthumb *Polygonum sagittatum*	OBL	Canada Mayflower *Maianthemum canadense*	FAC
	Manna Grass *Glyceria spp.*	OBL	Red Maple *Acer Rubrum*	FAC
	Rubus sp.	NA	Hemlock *Tsuga canadensis*	FACU

A basic Dominance Test was applied to the plants shown in Table 4 based on their relative Wetland Indicator Status (USDA 2009). If dominant species that have Facultative (FAC) to Obligate (OBL) wetland indicator status comprise >50% of the dominant plant community across all stratum, the community is considered hydrophytic, or a wetland community.

Wet 1 and Wet 2 are relatively poorly vegetated tall shrub alder swamps. Sediment deposits and bare mineral soils cover a moderate percentage of these sites. In contrast, Wet 3, a shrub marsh, appeared to have a relatively high diversity and density of plants present, particularly within the herbs stratum. Fourteen species were identified in this stratum of Wet 3, and the four quadrants assessed showed moderate spatial variability. Wet 3 appears to be one of the most well recovered (or least impacted?) areas within the Sackville Wetland Complex from the past gravel extraction activities; both in terms of soil formation and plant community diversity.

As noted, an assessed site typically must exhibit wetland hydrology, hydric soils, and a hydrophytic plant community to be considered a wetland. A summary of the assessment for all three of these parameters, at each plot location, is shown in Table 5. As shown in Table 5, all of the wetland plots had a dominant hydrophytic vegetation community present as would be expected. Although Wet 2 soils did not indicate hydric conditions, the true nature of the soils are likely hidden by the problem nature of the site. Past disturbances and several small drainage channels surrounding the plot location may influence the documented soil profile. However, both hydrophytic vegetation and wetland hydrology are present at the site, and it is quite likely that the soils could be hydric. The use of more intensive soil testing would likely be necessary to confirm hydric soils as being present, but given the strength of other indicators using professional judgment to confirm hydric soils is appropriate (Veneman, P., pers. com. 2010). Similarly, not all of the predicted upland sites were clearly upland. At Up 2 a small spring emerges adjacent to the assessed plot. Heavy rainfall around the time of the field surveys appear likely to have resulted in the positive hydrology indicators of surface water. Groundwater was confirmed at 27cm at this location, despite the nearby surface flow. The site hydrology likely influences a dominance of FAC indicator status species observed at the site. This is the weakest wetland indicator status, and plants are equally likely to occur in wetlands or non-wetlands (USDA 2009). Soils were clearly not hydric at Up2 and the elevated location above the floodplain, moderate sloping topography are further indicators that the site is upland despite the presence a wetland community and hydrology on the date the site was surveyed. Finally, at Up 3 there appears to be wetland hydrology present. This results from very hummocky terrain that appears modified by machinery capturing surface water, and some localized water retention behind the berm that defines the boundary between the upland and wetland. Despite hydrology indicators of surface water and water stained leaves, the indicators are not consistent and are not supported by the vegetation and soils assessment. Therefore the site is considered upland.

Table 5: The following summarizes the results of plot surveys at the wetland plots and adjacent upland plots. The mixed results highlight the impacted functions of the Sackville Wetland Complex.

	Wet 1	Up 1	Wet 2	Up 2	Wet 3	Up 3
Hydrophytic vegetation present?	Yes	No	Yes	Yes	Yes	No
Hydric soils present?	Yes	No	No	No	Yes	No
Wetland hydrology present?	Yes	No	Yes	Yes	Yes	Yes
Site is a wetland	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**

Delineation

The data collected and analyzed for the three paired plot locations was used to delineate the primary boundary around the Sackville Wetland Complex. A total area of 17.9 ha falls within the boundary, and most boundary areas are readily identifiable. Some of the south central boundary is less apparent because of hummocky terrain and a lack of obvious gradient break between the

upland and wetland, which precludes an abrupt change in vegetative community and hydrology indicators. Additional soil analysis would be necessary to confirm the precise location of the boundary in the south central portion of the wetland complex.

Once the primary wetland boundary was identified, an additional categorization of a total of 9.9 ha of wet areas (sub-units) *within* the Sackville Wetland Complex was completed. These areas were delineated and classified based only on visual assessment of changes in the vegetative communities. As shown in Figure 6, fifteen vegetated wetland sub-units were informally delineated and classified. This process was carried out to better understand the diversity within the complex and the linkages between the different wetland types. The results, presented in Table 6, highlight the number and approximate area within each wetland grouping. Only relatively well defined wetland areas >0.1 ha in area were informally delineated. A number of smaller embedded units do exist within those subunits that have been highlighted. In particular a number of small gaminoid marsh areas exist embedded within the alder swamp regions of the wetland complex. The existing wetlands within the project boundary that were informally delineated consist of approximately 78% alder swamp, 9% bog, and 8% marsh. The majority of the area is characteristic of alder swamp. Soils in these areas are very well drained and poorly formed due to past gravel extraction that appears to have occurred over the entire area covered by this wetland grouping. Predominant shrub coverage is Speckled alder (*Alnus incana*) and herbaceous undercover is only moderately dense with exposed mineral soil visible in many locations. Under the Canadian Wetlands Classification System, these areas would typically be classed as riparian swamps either of a floodplain or riverine nature (Warner and Rubec 1997). The Sackville River regularly floods the areas, and visible water velocity was apparent through these areas in their entirety during high water in late August 2009. Many small channels transect these areas and promote rapid drainage of the floodplain to the main river any time floodwaters recede.

Table 6: Informal wet area classifications that exist within or associated with the DND Sackville Wetland Complex. Total estimated area of each classification is in hectares. Specific wetland locations are presented in Figure 6.

Informal Wet Area Classification	Number of areas	Estimated total area
Tall Shrub alder swamp	7	6.9 ha
Shrub/Graminoid marsh	3 large, numerous pockets	0.9 ha
Treed /Shrub bogs	3	0.8 ha
Perched potential wetland areas	2	0.4 ha
Existing ponds/ponded areas	9+	2.2 ha
Unclassified “grey” areas	1	5.8 ha

The three larger shrub/graminoid marsh areas noted in Table 6 and Figure 6 appear to have the most natural wetland characteristics, including moderately well formed hydric soils. The dense herbaceous vegetation in these areas likely promotes capture and deposition of fines, resulting in a slightly thicker soil horizon above the sand/gravel subsoil that appears over most of the site. There are numerous small marsh areas, which are 100 m^2 or smaller, along the main stem river were floodplain braid channels re-enter the main Sackville river channel. Due to their small size they have not been separately delineated nor included in the estimated total area of marsh, but they do add to the complexity of the entire Sackville Wetland Complex. The plant community at the largest marsh area (0.4 ha – Gram 5), located in the south central area of the complex appears to have the greatest plant diversity with graminoid and shrub marsh areas.

The three existing bog areas within the wetland complex are generally well protected from the regular flooding that occurs across the Sackville river valley within the project. All are treed in

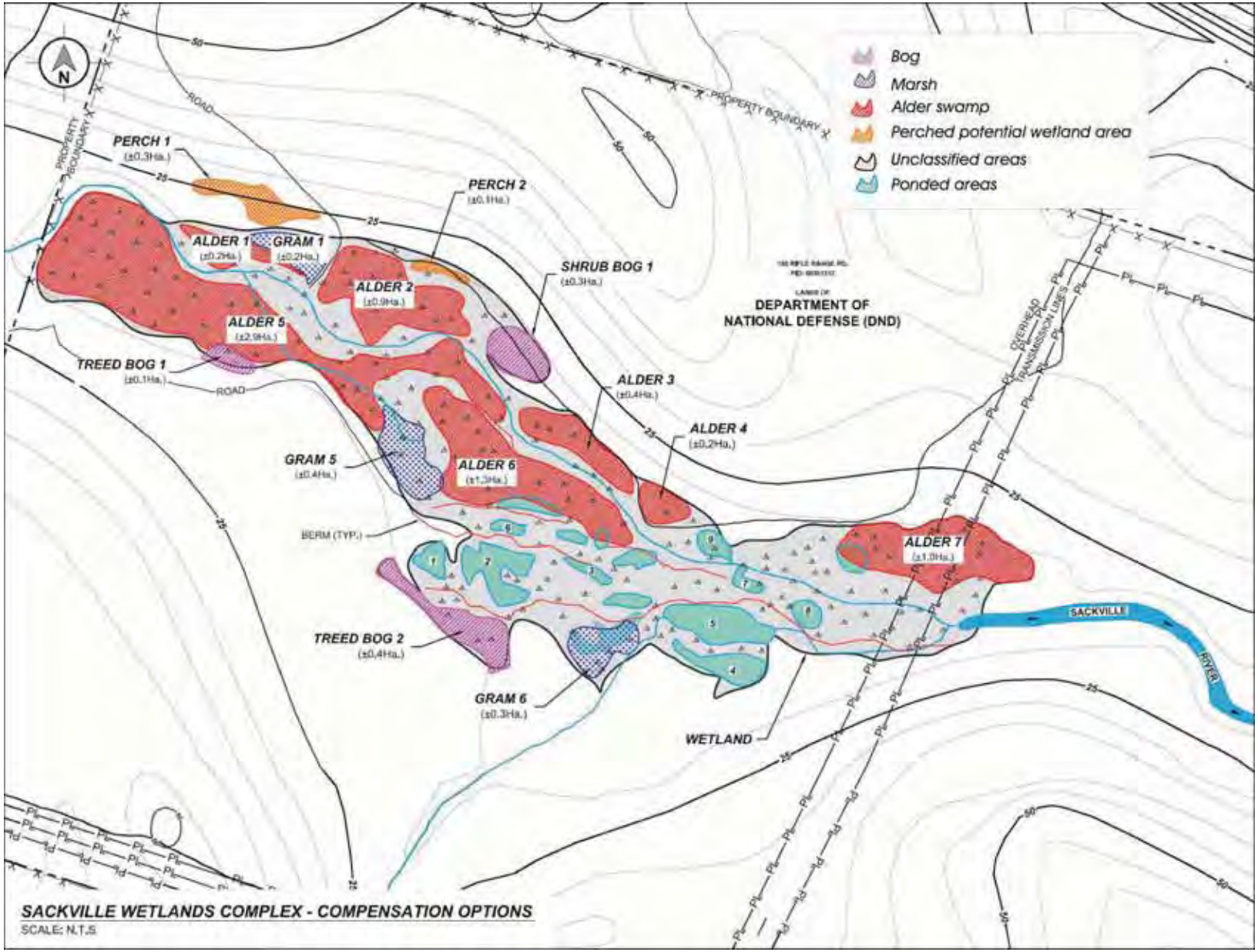


Figure 6: Vegetative delineation of sub units within the Sackville Wetland Complex shows relative boundaries of the largest sub-units**.**

nature with virtually no shrub layer. Unlike most of the Sackville Wetland Complex that is influenced by water fluctuations in the main river, hydrology to these bog areas is primarily influenced by surface sheet flows. Peat development is generally shallow, but more significant than any other areas of the complex. It is possible that these areas were not disturbed during gravel extraction, but it is not known if these were treed bogs at that point in time or have formed subsequently.

As shown in Table 6 there are numerous areas of open water wetlands, which were either constructed ponds or areas that have become ponded over time. Virtually all of these are located in the south central to southeast portion of the Sackville Wetland Complex. The constructed ponds likely drop off quickly to a moderate depth, as evidenced by the lack of wetland fringe anywhere along their perimeter and the steep above water shoreline gradient. Other ponded areas between the numerous berms tend to be of moderate to shallow depth, often with emergent aquatic vegetation at least along a portion of the shoreline. It appears that these areas are formed by the east west running berms and shallow topographic changes that hold flood water from the main river and in some cases capture drainage from the multiple flood plain braids.

As previously noted, the Sackville Wetland Complex is a mosaic not only of wetland types, but also of wetland and upland areas. There are elevated areas of mounds, berms, and old road prisms within the Sackville wetland that are not themselves wetland. Often, in undisturbed areas, mosaics can be relatively easily quantified. However, defining the boundaries of the wetland/upland mosaic areas at the project site would require extensive work as the plant communities do not always vary significantly, and soils are poorly formed. These factors eliminate these two elements as quick means of delineation *within* the wetland complex as might normally be employed with a transect methodology used to estimate relative percentage of upland and wetland (MCFT 2009).

The grey portions of Figure 6 and on the map accompanying this report primarily represent the most complex wetland/upland mosaic areas within the Sackville Wetland Complex. Many small sub-units exist within these areas, and a diversity of wetland classifications can be found. However, it would appear they are in approximately the same classification percentages as identified above. Alder swamp dominates the “grey” mapped areas, although small marsh areas are further embedded in the mosaic. No bogs units exist within the grey mapped areas. The complexity of the microtopography associated with past gravel extraction would make mapping of these subunits extremely laborious.

2.2 Herptofaunal Characterization

As shown in Table 7 several species of herptofauna were confirmed in the Sackville Wetland Complex during opportunistic surveys conducted during late August – November 2009 field visits. It is likely that an even greater number of species utilize the wetland, and may be more readily encountered earlier in the summer season. Searches included walking the perimeter of the entire wetland, walking along both banks of the Sackville River through the entire project site, and traversing into the middle of the wetland at numerous locations.

Table 7: Incidental herptofaunal observations documented during fall 2009 field surveys of the Sackville Wetland Complex. (UN=unknown).

Species	Common Name	Observation	Locations Observed
Rana palustris	Pickerel Frog	Adult	NA
Bufo americanus	American Toad	Adult	NA
Bufo americanus	American Toad	Tadpole	Alder 1
Rana clamitans	Green frog	Tadpole	Small pocket of surface water north of Pond 2, Oct. 29th.
Glyptemys insculpta	Wood turtle	Shell, recent mortality	Alder 1, floodplain about 10m from rivers edge
UN	Turtle	Turtle nests	Edge of roadway between Alder 1 and Alder 2, edge of Pond 1.

Figure 7: Wood turtle (*Glyptemys insculpta*) shell was found within Alder 1. Legs and tail were visible within the 9cm x 7.5cm carapace, but the head appeared to have been removed by a predator.

Figure 8: Green Toad *(Rana clamitans*) tadpole found in a small pool north of Pond 1 on Oct. 29th, 2009.

3.0 Species at Risk Assessment

The assessment of Species at Risk for the Sackville Wetland Complex involved both field searches and data searches. Hydrophytic and upland vegetation plots were evaluated as part of wetland delineation activities, documenting plot species at and adjacent to the proposed alteration location. In addition to the vegetation plots associated with wetland delineation, East Coast Aquatic's staff covered approximately 3000 m linear search along the boundary of the complex and numerous traverse routes of the wetland to complete informal delineation of sub units and to complete related compensation plan development fieldwork. Opportunistic search of vernal pools was conducted for amphibians. The Atlantic Canada Conservation Data Center (ACCDC) staff completed a data search and report for the region surrounding the coordinates of the proposed wetland alteration (See Appendix A). Finally, NSDNR Species and Habitats database was reviewed for mapped presence of any species at risk or species of conservation concern within the vicinity (NSDNR 2009c).

A single specimen of one Species at Risk listed under the Federal Species at Risk Act (SARA 2002) and Provincial Endangered Species Act (NS Government 1998) was found during site surveys of the DND property. NSDNR Species and Habitats database does not indicate any species at risk or species of conservation concern within the vicinity (NSDNR 2009c). The Atlantic Canada Conservation Data Centre has documented nine protected species as being found within 20 km of the assessed site (see Appendix A). There are also a number of Provincially rare species found within 5 km of the site.

3.1 Species at Risk

In addition to the biological surveys conducted on site, a data request was made of the Atlantic Canada Conservation Data Centre (ACCDC) to obtain records of rare species existing or historically found within the general location of the DND property (see Appendix A). The ACCDC data for a 100 km buffer around the property found "…a relatively small (quintile 1) density of taxa records: 2708 records of 431 taxa from 72 sources. (Data Density: 0.09 rec/km2)". Of those 431 taxa, 14 have been found within 5km of the Sackville Wetland Complex on the Sackville River. Our discussion of Species at Risk will focus on those listed species that are Federally or Provincially protected through Species at Risk legislation that fall within 20 km of the project site, or those that are ranked Provincially as either extremely rare (S1) or rare (S2) and that have been documented within 5 km of the project site by the Atlantic Canada Conservation Data Center (ACCDC). This list of 16 species is shown in Table 8.

A single individual Species at Risk was identified during field surveys of the Sackville Wetland Complex. As shown in Figure 7, a juvenile Wood Turtle (*Glyptemys insculpta*) was found in association with subunit Alder 1 on the north side of the Sackville River. It had been a recent mortality, and its size would suggest that reproduction could be occurring in the area. Plants in the Wood turtle diet include strawberries, blackberries, cinquefoil, violets, algae, moss, willow, as well as alder leaves and grasses (MacGregor and Elderkin 2003). The presence of a number of *Rubus spp*. (blackberries and raspberries) observed across the project area may provide an appropriate food source to the Wood turtle. This could be particularly true for areas such as Gram 5 where *Rubus spp*. are found in the marsh portions of the wetland. Cherry trees, another fruit consumed by the Wood turtle, has also been identified in different areas of the Sackville Wetland Complex, and alder dominants much of the landscape. Alder thickets and alder swale have been identified as the preferred or most-used habitats in numerous locations, including Nova Scotia (COSEWIC 2007). As noted earlier, field surveys identified alder swamp (NovaWAM 2009) as covering as much as 78 % of the Sackville Wetland Complex.

Of the nine Federally or Provincially listed species documented by the Atlantic Canada Conservation Data Center as being within 25km of the Sackville Wetland Complex, two others are commonly associated with wetland habitats. No White Cedar (*Thuja occidentalis)* or Rusty Blackbird (*Euphagus carolinus*) were found during field surveys, although portions of the project area might be considered appropriate habitat. Cedar requires cool, moist, nutrient-rich sites on calcareous or neutral soils (soil pH commonly ranges from 5.5 to 7.2)(Newell 2005). Although it is not known if areas of the Sackville Wetland Complex might meet the chemical conditions, other conditions of moist, well-drained soils do exist. Nova Scotia is part of the summer breeding habitat of the Rusty Blackbird, which is characterized in part by forest wetlands, such as slow moving streams, peat bogs, marshes, swamps, and beaver ponds (COSEWIC 2006). In eastern Canada, the Rusty Blackbird uses scrub riparian habitats of islands, lakes, rivers and streams as well as alder and willow thickets. In wooded areas, the Rusty Blackbird only rarely enters the forest interior. During the winter, the Rusty Blackbird mainly frequents damp forests (SARA 2009). Each of these habitat types does exist to some degree within or around the Sackville Wetland Complex. Habitat considerations and compensation /monitoring activities are proposed for Wood Turtle and White Cedar at the Sackville Wetland Complex.

Other species are highly unlikely to be associated with the site because of lack of appropriate habitat within or adjacent to the Sackville Wetland Complex. The Monarch's (*Danaus plexippus)* northern habitat would more typically be weedy fields. Golden crest tends to inhabit rocky shorelines adjacent to open water and grows on substrates such as sand, peat and floating peat mats (NSDNR 2009b). Whip-Poor-Will *(Caprimulgus vociferous)*, although observed close by in 1986, have generally been observed much farther away, and prefer habitat of forest cover structure that is semi-open or patchy with clearings, barrens, and areas with little ground cover (COSEWIC 2009). Such habitat is limited in the immediate vicinity of the Sackville Complex.

The remaining species at risk identified in Table 8 are either not found in freshwater wetland habitats, are highly mobile species that would not use a single wetland habitat, or are not likely to be found associated with the habitats identified at the Sackville Wetland Complex. As such they have not been discussed further (Rockrose, Boreal Felt Lichen, Coast Pepperbush, Ghost Antler Lichen).

Table 8: Nine (9) species that are Federally and/or Provincially protected species at risk are documented through the Atlantic Canada Conservation Data Center as having been found within 20 km of the Sackville Wetland Complex. Another seven species (7) are documented within 5km, and that are ranked Provincially as extremely rare (S1) or rare (S2).

Scientific name	Common name	Federal Rank	Federal Protection	Provincial Rank	Provincial Protection	Dist. Away (KM)
Erioderma pedicellatum (Atlantic pop.)	Boreal Felt Lichen	G1G2Q	Endangered	S1S2	Endangered	15 ±1
Helianthemum canadense	Canada Frostweed	G5		S1	Endangered	14 ±1
Caprimulgus vociferus	Whip-Poor-Will	G5	Threatened	S1?B		9 ±5
Glyptemys insculpta	Wood Turtle	G4	Threatened	S3	Vulnerable	1 ±1
Thuja occidentalis	Eastern White Cedar	G5		S1S2	Vulnerable	8 ±1
Clethra alnifolia	Coast Pepper-Bush	G5	SC	S1S2	Vulnerable	20 ±0.1
Pseudevernia cladonia	Ghost Antler Lichen	G2G4	SC	S2		18 ±0
Danaus plexippus	Monarch Butterfly	G5	SC	S2B		16 ±0
Euphagus carolinus	Rusty Blackbird	G4	SC	S3B		1 ±5
Amblyscirtes hegon	Salt and Pepper Skipper	G5		S2		3 ±10
Minuartia groenlandica	Mountain Sandwort	G5		S2		1 ±10
Salmo salar	Atlantic Salmon	G5		S2		1 ±10
Satyrium calanus	Banded Hairstreak	G5		S2		3 ±10
Symphyotrichum undulatum	Wavy-leaf American-Aster	G5		S2		1 ±10
Piranga olivacea	Scarlet Tanager	G5		S2B		1 ±5
Alasmidonta undulata	Triangle Floater	G4		S2S3		1 ±10

3.2 Provincially Rare Species

As shown in Table 8, there have been seven provincially ranked S1 and S2 species that have been documented within 5 km of the Sackville River Complex that are not protected by Federal or Provincial Acts. All seven are rare (S2) within their range in the Province of Nova Scotia. None of these species was identified during fall 2009 field surveys of the Sackville Wetland Complex project site on the DND Property.

Two of these Provincially rare species are lepidopteron (moths and butterflies) and another is an avian species. Their mobility allows them to move around a number of preferred habitats as appropriate. One species of fish, Atlantic Salmon, is known to use the main river habitat

adjacent to the wetland complex. However, it is unlikely that any of the side channels or pond habitat provide appropriate habitat for this species based on the observations made during field surveys. Side channels tend to be mucky and heavily encroached by vegetation. Ponds are connected by very low flow channels, and typically are shallow and warm. As such they do not present preferred habitat for salmon. The Triangle floater is a freshwater bivalve. Although it would not be typically be found in the wetland habitat, it might be associated with the sand and gravel habitat of the main Sackville River.

Finally, the two floral species that have been identified in Table 8 as Provincially ranked S2, and documented within 5 km of the proposed project site, are both upland floral species. The Mountain Sandwort, favours dry and barren ground while the Wavy Leaved Aster is found in dry forested sites. As such neither is likely to be found in, or to favour, the Sackville Wetland Complex habitats.

In addition to the ACCDC data for the site, field surveys identified the Provincially ranked S1 Red listed species Green ash (*Fraxinus pennsylvanica*) at the Wet 1 survey plot.

4.0 Hydrological/hydrogeological Character

The hydrological/hydrogeological character description provided of the DND property and associated Sackville Wetland Complex is based on several activities. First, a review of available geologic maps and surficial geology resources was undertaken. Other available watershed mapping and Environment Canada precipitation data was reviewed. Air photo review, review of topographic relief, and digital delineation of watershed area and drainage basin area were undertaken to facilitate development of flow discharge estimates. Finally, numerous site visits were undertaken between late August and early October 2009 during which time surface water features and movement were noted, channel characteristics measured, and basic chemistry measures collected.

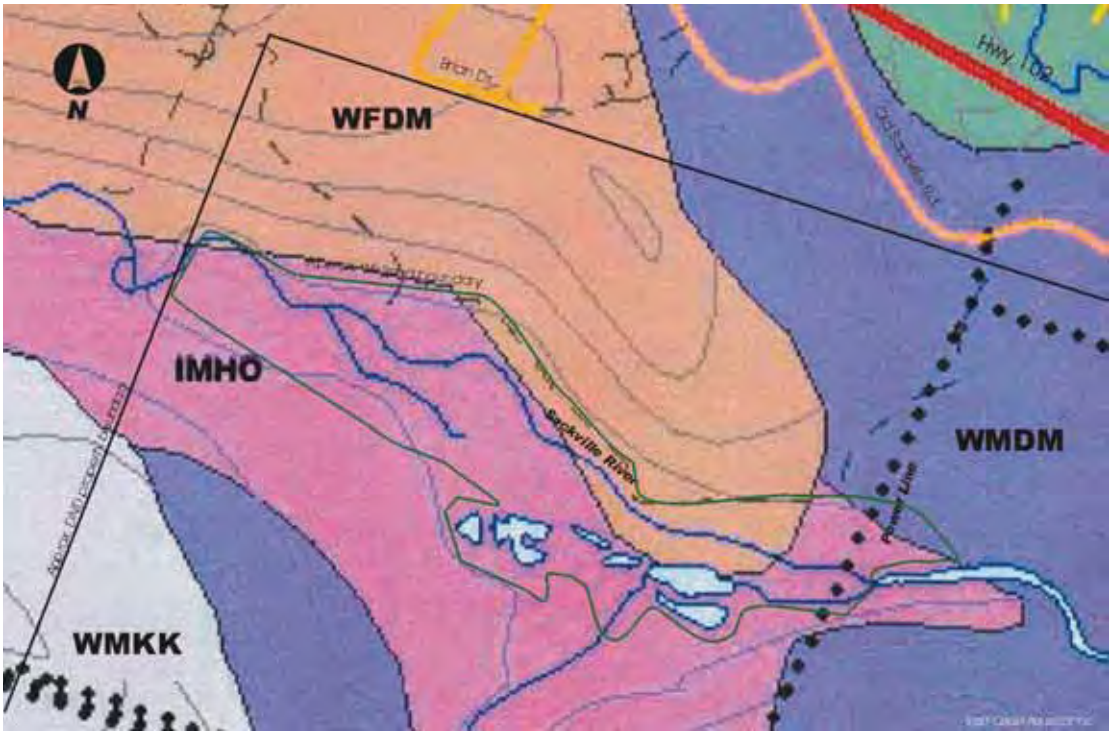


Figure 9: NSDNR ecological land classification for the Sackville Wetland Complex site indicates that most of the area is IMHO, or imperfectly drained medium textured soil on hummocky terrain. Small portions near the wetland perimeter occur on well-drained soil ecosection classifications of fine and medium textured soils (Source: modified from NSDNR 2009a).

The bedrock geology that underlies the site is late Cambrian rock designated as the Goldenville Formation of the Meguma Group. This unit is comprised of greywacke, quartzite, slate, schist, and gneiss (NS Government 1994). The Sackville Wetland Complex is part of the Eastern Ecoregion, the eastern extension of the Appalachian peneplain that slopes towards the Atlantic Ocean. The south sloping upland interior, and the warm summers and cooler winters are distinguishing features of this ecoregion (NSDNR 2003).

The project site is located in the Eastern Interior ecodistrict of the Eastern ecoregion of the Province. An estimated 85 % of the Sackville Wetland Complex site lies on an IMHO ecosection, characterized by imperfectly drained medium textured soils on hummocky terrain. As shown in Figure 9 the remainder of the project site is on the WFDM ecosection that is characterized by well-drained fine textured soil on drumlins or flutes. This latter area is limited to the most northern fringe of the project site as well as a small area north from the pond on Peverell's Brook across the valley floor.

Hydrologic Setting

Regional surface water drainage is southeastward to the Bedford Basin and the Atlantic Ocean. The Sackville River flows in this direction, and transects the Sackville Wetland Complex that is located within the active floodplain of the river. Locally, the topography around the Sackville Wetland Complex forms a northwest/southeast trending valley that slopes moderately strong toward the river. A number of moderate sized lakes (Drain, McCabe, Webber, Pentz and Tomahawk) and some 880 ha of wetland upstream of the project site are likely to attenuate flood flows and regulate low flows within the system by providing storage and retention capacity. The watershed is largely forested (~97%), and therefore should respond much like a natural system to heavy rainfall, and summer draught.

Figure 9: This small spring in the north side location of plot Up2 was flowing on the surface some 30m to subunit Alder 2.

Figure 10: This small inflow channel (~0.5m width) to subunit Perched 1 is typical of the surface water features that flow into the Sackville Wetland Complex.

Field surveys identified eight small (<1.0 m width) channels entering the complex from the adjacent southern and northern uplands (see Figures 9 and 10). Total input of these systems would be minimal relative to the Sackville River. The most significant of these was a channel that enters subunit Alder 7 in the northeast portion of the complex. Peverell's Brook is a moderate sized stream channel that enters the southeast corner of the complex, fed by Sandy and Marsh Lakes and other upstream topography to the south (see Figure 11). Other than the Sackville River, Peverell's Brook is the most significant surface water feature entering the Wetland Complex. It supports a number of pond habitats that have aquatic flora. However, it drains primarily through a well confined channel in relative isolation from most of the complex.

Figure 11: Peverell's Brook as it enters Pond 5 in the southeast portion of the Sackville Wetland Complex.

Figure 12: This floodplain drainage channel is characteristic of the larger (~2.5 m wide) channels that drain floodplain water to the main river.

Using topographic information for the watershed, the local catchment area above the proposed project area (Sackville Wetland Complex) was calculated to be 9950 ha (99.5 sq km). The Sackville Wetland Complex appears to function primarily as a discharge area, drawing its hydrology primarily from local groundwater. Provincial Wet Areas Mapping (WAM) indicates that in the vicinity of the Sackville Wetland Complex, the depth to groundwater is typically less than 0.5m (NSDNR 2009d). The porous mineral soils of the site allow for better groundwater interaction than organic soil. The perennial outlet (through flow) promotes draining of the surface water, a factor enhanced by the additional drainage channels that exist across the floodplain such as is shown in Figure 12. Much of this channelization is not natural. The location of the wetland complex, low in the topography (valley), promotes discharge of groundwater to the wetland and the Sackville River. All of these factors influence groundwater discharge as being the primary hydrological character for the site. However, it is also acknowledged that the Sackville River floods the wetland regularly and will have a significant influence on hydrologic character of the Wetland Complex.

It is not unusual for the project area to become flooded either in the spring or fall, and for a period of several days the entire floodplain was inundated to depths estimated at 20+cm adjacent to the valley wall during the fall 2009 sampling period.

Using historical rainfall data provided by an Environment Canada (2009) weather station located in Pockwock Lake (~12km northwest), the average annual precipitation in the area is 127 mm/month, or 4.2 mm/day. The highest recorded rainfall for this area from between 1971 to 2000 was 133 mm/day (which occurred on September 2nd, 1996). There is an annual spring

peak monthly rainfall occurring in April (116 mm), while the annual monthly high occurs in November (147mm). August is the period of lowest annual monthly precipitation (89mm).

The Canadian Wetlands Classification would categorize the Sackville Wetland Complex as a minerotrophic system, where the water has come from groundwater and is more apt to carry dissolved minerals such as calcium, magnesium and sodium. Much of the complex would be considered a littogenous subsystem with a riverine riparian regime based on the hydrological influence and interaction with the Sackville River (Warner and Rubec 1997).

5.0 Functional Assessment

A detailed functional assessment was completed for the Sackville Wetland Complex as presented in Appendix E. The following is a summary of the field observations and relevant literature descriptions of the project areas' biophysical character.

The Sackville Wetland Complex falls within one of the largest ecodistricts in the province, the 3,693 km^2 Eastern Interior ecodistrict. Where the till is thick, such as north and south of the Sackville Wetland Complex, the typical bedrock ridged topography is masked and thick softwood forests occur. The ecodistrict is heavily covered with freshwater lakes (27,312 hectares or 7.4%). The eight largest ecosections (excluding water) make up 80.9% of the ecodistrict. The second most common ecosection (~22%) is the imperfectly drained medium textured soil on hummocky terrain (IMHO). This classification covers virtually all of the Sackville Complex. The ecodistrict is underlain by resistant Meguma Group quartzite and slate. The thickness of the till is quite variable across the ecodistrict, ranging from 1 - 10 m but averaging less than 3 m. The predominant soils are sandy loams, often quite stony and well drained on till derived from quartzites. There are a few drumlins and hills scattered throughout the ecodistrict with fine textured soils derived from slates (NSDNR 2003). These tend to border portions of the north boundary of the Sackville complex.

The composition of the forests in this ecodistrict strongly reflect the depth of the soil profile. Thus, many climax compositions can be found throughout. On the deeper, well drained soils stands of red spruce will be found (NSDNR 2003). Red Spruce was the dominant tree stratum species at two of the three upland vegetation plots assessed for wetland delineation.

The Nova Scotia Department of Natural Resources (NSDNR) has identified approximately 880 ha of currently mapped wetlands of all types within the Sackville River watershed upstream of the project site through their Significant Species and Habitats database (NSDNR 2009c), or ~9% of the watershed. Based on this data the Sackville Wetland Complex comprises approximately 2% of the total wetland area located within the watershed. Proportionally, there is less swamp and more bogs and marshes represented in the watershed than in the Sackville Wetland Complex. It is estimated that 97% of the watershed is forested. There are wide natural wooded buffers to the Sackville Complex .

The size and diversity of wetland types at the Complex, including 16+ ponds and channel habitats provides higher wildlife values than single isolated wetlands. The depth of ponds, being greater than 1m, limits potential for winter kill and increases the habitat value to amphibians. It is possible that some of the ponds are isolated from the main river and may have limited fish populations, and therefore limited predation pressure on amphibians as well. Large natural riparian borders, and lack of development in the vicinity of the wetland further enhance its values. A residential development and 100 series highway to the north provide minimal barriers to wildlife movement given their distance from the site and lack of high value wildlife habitat in the developed lands to the north in the community of Lower Sackville. Lotic swamps, which dominate the Sackville Wetland Complex, along perennial streams can provide good Wood Duck (*Aix sponsa*) habitat. The habitat is likely used by a number of songbird species and

waterfowl based on field observations. Blue Heron (*Ardea herodias)* was observed foraging in the pond habitats of the complex. The Sackville River is known to support a recreational fishery, and both Brook trout (*Salvelinus fontinalis*) and Atlantic Salmon (*Salmo salar*) inhabit the reach through the Sackville Wetland Complex. As shown in Appendix – A, a number of species of conservation concern exist or likely exist within the wetland complex, including several Provincially S1 ranked species and the Federally listed Wood turtle (*Glyptemys insculpta*). Turtle nests were identified on the project site, although the host species was not known.

The current hydrologic conditions would indicate that the Sackville Wetland Complex functions primarily as a discharge wetland, drawing primary hydrology from groundwater instead of surface water. A number of wetland functions for the Sackville Wetland Complex are predicted to be high based on the classification as a lotic throughflow floodplain swamp in an unconfined valley. However, field assessments indicate that many of the floodplain functions in this complex are impaired, and likely provide less than predicted performance level "high". It is these impaired functions that are being targeted for compensation activities. For example, it is predicted that sediment and other particulate retention should be high, yet soil analysis indicates little fines have accumulated on the site since gravel removal. It is believed that high near substrate flood water velocities limit deposit accumulation of both organic and mineral particulates. Surface water detention is also predicted to be high in the Sackville Wetland complex, yet the porous floodplain soils and numerous floodplain drainage channels that were left by gravel removal operations appear to greatly limit the water retention time on the floodplain. This negatively influences functions of surface and subsurface storage capacity and duration. Nutrient transformation is predicted to be high, yet there is generally poor vegetative cover over the swamp areas, and soils have no dark organic layer of peat or muck despite the regular flooding across the valley floor.

The Atlantic Canada Conservation Data Center identified two Managed Areas with some degree of protected status, in the 5km vicinity of the study area (see map 2 Appendix A). They are the Second Lake Provincial Park and the East Hants Municipal Water Supply. Neither of the managed areas is connected through surface hydrology to the Sackville Wetland Complex watershed.

Identified wetland stressors include, eroding banks along the main Sackville River, channelized floodplain channels, areas of berming and fill, exotic plant species, surface mining of soils and gravel substrates, garbage and debris, and high beaver activity of tree removal and damming. Despite these stressors, it appears the area is trending toward stability and recovery. There are no signs of stressed plants, such as excessive dead and dying vegetation. However, in much of the swamp areas there is a relatively low diversity and density of plants. Low vegetation density is highlighted by exposed patches of mineral soil that are apparent in the swamps. Low density at the herb and shrub stratum limits the effectiveness of the vegetation as a roughness factor during flood flows. Bogs and the larger marsh areas appear to be relatively more productive and diverse. There are no signs of nutrient loading to the wetland.

6.0 Reference Material

Anderson, A. and W. Broughm. 1988. *Evaluation of Nova Scotia's Peatland Resource*s. Nova Scotia Department of Mines and Energy. Bulletin 6. 107p.

Anonymous. 2006. *Atlantic Canada Conservation Data Centre*. http://www.accdc.com/index2.html. Website accessed November 2009.

Anonymous. 2006. *Nova Scotia Herptofaunal Atlas*. http://landscape.acadiau.ca/herpatlas/. Website accessed December 5, 2009.

Blouin, G. 2004. Weeds of the Woods. Small trees and shrubs of the eastern forest. Nimbus Publishing. 125 pp.

COSEWIC. 2009. COSEWIC assessment and status report on the Whip-poor-will *Caprimulgus vociferous* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 28 pp.

COSEWIC. 2009. COSEWIC assessment and status report on the Brook Floater *Alasmidonta varicose* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 79 pp.

COSEWIC 2006. COSEWIC assessment and status report on the Rusty Blackbird *Euphagus carolinus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 28 pp.

Davis, D. and S. Browne. Eds. 1996a. *Natural history of Nova Scotia: Volume one, topics and habitats.* Rev. ed. Nimbus Publishing. ISBN 1-55109-236-0. 518 p.

Davis, D.S. and S. Brown, Eds. 1996b. *The Natural History of Nova Scotia: Volume two, theme regions.* Revised Edition. Nimbus Publishing. ISBN 1-55109-238-7. 304 p.

Environment Canada. 2009. Canadian Climate Normals 1971-2000. http://climate.weatheroffice.ec.gc.ca/climate_normals/index_e.html. Website accessed November 29, 2009.

Government of Nova Scotia. 1998. *Endangered Species Act as amended up to Reg. 393/200.* http://www.gov.ns.ca/just/regulations/regs/eslist.htm. Website accessed June 2008.

Hanson, A. L. Swanson, D Ewing, G. Grabas, S. Meyer, L. Ross, M. Watmough, and J. Kirkby. 2008. Wetland Ecological Functions Assessment: an Overview of Approaches. Environment Canada Technical Report Series Number 497. Atlantic Region. 59pp.

Hinds, H. 2000. Flora of New Brunswick. Second Edition. Biology Department. University of New Brunswick. 699pp.

MCFT. 2009. Nova Scotia Advanced Wetlands Delineation & Evaluation Course. Maritime College of Forest Technology and Nova Scotia Department of Environment. Course Methods binder.

MCFT. 2008. Nova Scotia Wetlands Delineation Course. Maritime College of Forest Technology and Nova Scotia Department of Environment. Course Methods binder.

NSDNR. 2009a. Ecological Land Classification Map and Database. http://www.gov.ns.ca/natr/forestry/ecosystem/elcpg1.htm. website accessed November 25, 2009.

NSDNR. 2009b. Species at Risk in Nova Scotia. http://www.speciesatrisk.ca/SARGuide/. Website accessed November 25, 2009.

NSDNR. 2009c. Significant Species and Habitats Database. http://www.gov.ns.ca/natr/wildlife/Thp/disclaim.htm. Website accessed December 3, 2009.

NSDNR. 2009d.Wet Areas Mapping and Flow Accumulation Channels. http://www.gov.ns.ca/natr/forestry/GIS/wamdownload.htm. website accessed December 3, 2009.

NSDNR. 2009e. Nova Scotia's Eastern Ribbonsnake Conservation and Recovery. http://www.speciesatrisk.ca/ribbonsnake/habitat.htm. Website accessed December 8, 2009.

NSDNR. 2003. Ecological Land Classification for Nova Scotia. *Volume 1 - Mapping Nova Scotia's Terrestrial Ecosystems.* Nova Scotia Department of Natural Resources. Renewable Resources Branch. Report DNR 2003 –2. 83pp.

NSDoE. 2009. A Proponent's Guide to Wetland Conservation – Draft for Consultation. September 29, 2009. 30pp + Apps.

NS Government. 1998. Endangered Species Act. Bill No. 65. 1st Session, 57th General Assembly. Chapter 11 of the Acts of 1998.

NS Government. 1994. Nova Scotia Geology Map. Nova Scotia Department of Natural Resources and Department of Education, Atlantic Geoscience Society.

NS Museum. 2009. Nova Scotia Frogs. http://museum.gov.ns.ca/mnh/nature/frogs/. Website visited November 29th, 2009.

Pinchin LeBlanc Environmental Ltd. 2009. Enhanced Phase I Environmental Site Assessment 15094 Highway #3 Hebbville, Nova Scotia. Pinchin File: 01-01-00155.

Roland, A. E. and E. C. Smith. 1969. *The Flora of Nova Scotia.* Nova Scotia Museum. Pp. 756.

SARA. 2009. Species at Risk Public Registry. www.sararegistry.com. Website accessed December 06th, 2009.

SARA. 2002. Species at Risk Act. Chapter 29. Department of Justice. 93pp.

Thein, S. 1979. A flow diagram for teaching texture by feel analysis. Journal of Agronomic Education. 8:54-55.

Tiner, R. 1994. Maine Wetlands and Their Boundaries. State of Maine. Department of Economic and Community Development. Augusta, Maine. 74.

Tiner, R. 2005. In Search of Swampland, a wetland sourcebook and field guide. Second Edition, Revised and Expanded. Rutgers University Press. 330 pp.

US Army Corps of Engineers. 2008. Chapter 4. Wetland Hydrology Indicators. In, Draft Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region. Draft for Peer Review and Field Testing 7-3-2008.

USDA. 2009. Wetland Indicator Status: Region 1. www.plants.usda.gov. Website accessed September 27th, 2009.

USDA. 2006. Field Indicators of Hydric Soils in the United States, Version 6.0. G.W. Hurt and L. M. Vasilas (eds.) USDA, NRCS, in cooperation with the National Technical Committee for Hydric Soils. 38pp.

Warner, B. and C. Rubec. 1997. *The Canadian Wetland Classification System*. Second Edition. Wetlands Research Centre. University of Waterloo. 68pp.

Zinck, M. 1998. *Rolands Flora of Nova Scotia*. Nimbus Publishing, Nova Scotia.

7.0 Purpose and Description of the Alteration

The following section outlines the need for the proposed wetland alteration and describes the alteration in detail. The proposed compensation for the site has been presented.

7.1 Reason for the Alteration

The Nova Scotia Department of Transportation and Infrastructure Renewal has proposed this alteration as part of a compensation plan for wetland impacted by the development and expansion of Provincial Highways.

7.2 Description of the Alteration

The alterations proposed are to restore, enhance, and expand the existing wetlands within the Sackville Wetland Complex that were impacted by past gravel extraction operations. The proposed alteration activities are presented in detail in a separate report titled *Wetland Compensation Project at the DND Property Sackville, Halifax County: Part 1 – Wetland Delineation and Compensation Concept* (produced by East Coast Aquatics for the NSDTIR in March 2010). The activities are to address impaired wetland soil, hydrology, and vegetation functions as have been described in the Part 1 document and in Section 5.0 of this document.

7.3 Alternatives Considered and mitigation proposed

Due to the complexity of the proposed compensation activities, which will lead to some wetland alteration requiring this application for approval, it is necessary for the reader to consider the separate report titled *Wetland Compensation Project at the DND Property Sackville, Halifax County: Part 1 – Wetland Delineation and Compensation Concept* (produced by East Coast Aquatics for the NSDTIR in March 2010) in order to fully appreciate the relevance of the alternatives considered and mitigation proposed. Although the proposed project is intended to improve the existing wetland functions and expand the existing area and diversity of wetland, the following is a summary of the relevant alternatives and mitigation that were incorporated into the wetland compensation options in order to limit any negative impacts of the proposed compensation activities.

As the site is currently vegetated, proposed compensation options have been designed to minimize the disturbance to existing vegetative cover. Although increased ground cover and plant diversity is desired in several areas, these objectives are to be achieved primarily through addressing functions of soil formation and hydrology. It is anticipated that functionally improved areas will then passively obtain increased plant coverage and diversity. There are a limited number of areas for which plant diversity appears robust, and compensation activities have been designed to leave these areas completely undisturbed, while working on adjacent subunits to promote improved wetland functions. Improving functions in adjacent areas will allow the spread of seed from the diverse vegetative communities. In the limited areas where soils may be disturbed as part of the compensation activities, some inoculation with appropriate native wetland plantings from the more diverse areas of the wetland complex is proposed.

In order to change floodplain hydrology in a manner that will promote water retention, reduce near ground floodwater velocities, and slow the rate of floodplain drainage some compensation activities that require the use of heavy machinery have been proposed. However, design has been proposed in a manner that limits the need for machinery to enter the wetland, contains machinery use to alder swamp areas that exist on firm sand gravel substrate, and that limits the need to cut sapling of tree stratum vegetation. This has been achieved by ensuring that activities such as placement of large woody debris, filling of abundant floodplain drainage channels, and construction of flow control structures at floodplain channel inlets and outlets are proposed in area where alder thatching is also proposed. By using a very small size excavator, machinery movement can occur primarily along the corridors cleared for alder thatching.

The final targeted function for compensation activities is soils formation. Across much of the area, soil formation will be improved by altering site hydrology in a manner that retains water on the floodplain longer, reduces floodplain floodwater velocities near the ground and thereby promoting retention of organics and deposition of fines. However, there are areas for which the use of salvaged wetland soils is proposed. In order to minimize the impact of transporting and placing such materials, these sites are limited to locations that are adjacent to the upland and in close proximity to existing woods roads. Such site selection will greatly limit the need to clear vegetation to access the sites, and will minimize potential for machinery impact to the compensation activity site. In order to limit any potential introduction of invasive species with salvaged soils it is proposed that plant inventories be conducted at the relevant source sites prior to removal of soils.

7.4 Identifiable impacts

As this is a compensation project, and not an alteration for development, the area of impact has not been quantified. In the long term it is anticipated that the compensation activities will create a net gain in total wetland area, floral diversity and density, and wildlife habitat values. In the short term there are likely to be minor impacts associated with implementation of compensation activities. These impacts include limited removal of sapling and tree stratum vegetation to provide machinery access, mechanical disturbance of shrub and herb stratums along access corridors by machinery, potential exposure of mineral soil by machinery disturbance along access corridors, limited exposure of mineral soils to unanticipated dry season flood water at proposed locations of drainage channel infilling.

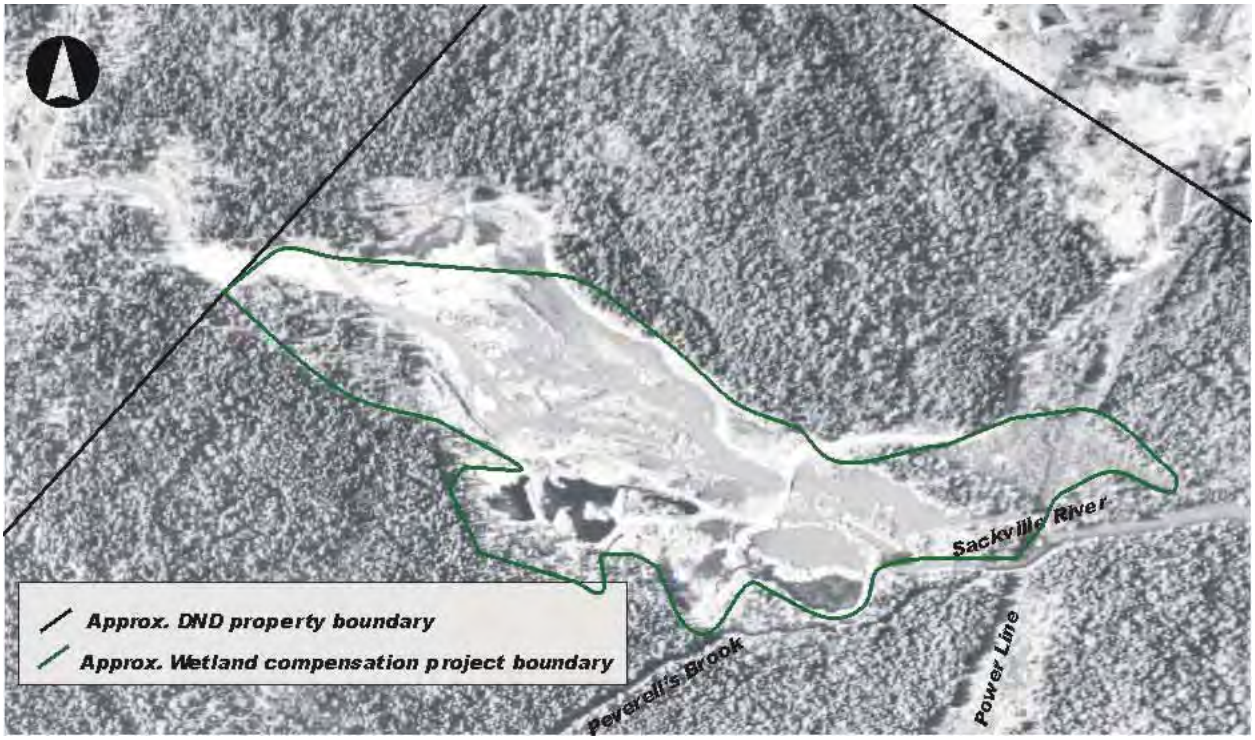


Figure 13: Image DND property former gravel pit site in the early 1960's, and site of the proposed wetland compensation activities. Nearly eighteen (17.9) ha of wet area falls within the boundary delineated by East Coast Aquatics in the fall of 2009. Dark water in some of the southern ponds indicates their isolation from the turbid Sackville River water in this image.

7.5 Description of past impacts

The wetland compensation project is the site of a former gravel pit that was last used in the early 1960's. As shown in Figure 13, the site had been striped of vegetation at that point in time, and Sackville River water flow extended, at least periodically, across the entire pit area. Some localized channelization that was evident in the early 1960's exists to this day, and it appears that all settling ponds that existed in the area immediately west of the confluence with Peverell's Brook and south of the Sackville River remain intact today. Visible driving surfaces in the 1960's photo have changed quite significantly and are often fragmented by low wet areas and flood plain flow. It is not known how much of this alteration to the former roads is from decommissioning activities or from erosion patterns that may have occurred during high flows across the destabilized valley floor. Remnants of wooden box culverts were observed at some locations during field surveys. As noted earlier in this report these activities had a significant impact on hydrology, soils, and vegetative community across the site, and many related functions remain impaired today.

Having been a former industrial site, there are small remnant piles of debris such as tires, and metal. No metal closed containers that might be of further concern were observed. There is also present day garbage across the site that floats in during flood events. These are primarily plastics that are scattered across the site.

As the site if downstream of developed and residential lands there are some exotic plants present on the site including Coltsfoot, Wild Radish, Virginia Creeper and Japanese Knotweed.

8.0 Property Information

The requested alteration approval is for work to be completed on a single property. The Service Nova Scotia and Municipal Relations (SNSMR) Land Information Centre identifies the property as PID 00361212 owned by the Department of National Defence. The SNSMR mapped property boundaries are presented on the property map shown in Figure 14. The relevant property identification number for this Wetland Alteration Approval is:

PID 00361212
National Defence Her Majesty the Queen
Rifle Range Lane
Bedford, Halifax County
Nova Scotia

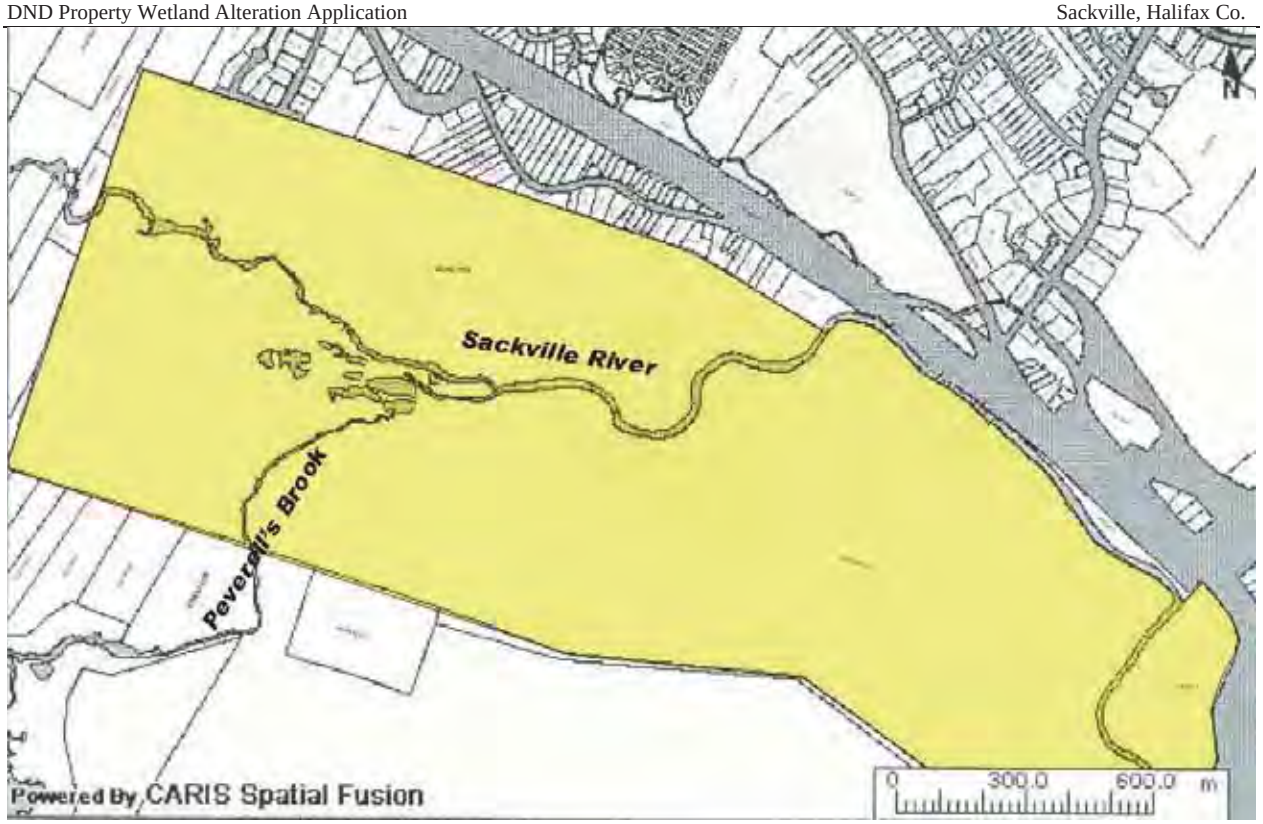


Figure 14: PID number 00361212 is the relevant property for the proposed Sackville Wetland Complex alteration.

Appendix A - ACCDC Report

DATA REPORT 3577: Lower Sackville, NS

Prepared 1 October, 2009
by S.H. Gerriets

CONTENTS OF REPORT

1.0 Preface
1.1 Caveats
1.2 Additional Information
2.0 Study Area Results
2.1 Flora
2.2 Fauna
Map 1: Flora and Fauna
3.0 Special Areas
3.1 Managed Areas
3.2 Significant Areas
Map 2: Special Areas
4.0 Taxa List
5.0 Source Bibliography

1.0 PREFACE

The Atlantic Canada Conservation Data Centre (ACCDC) is part of a network of circa 85 NatureServe data centres & heritage programs in 10 provinces, 1 territory, 50 states, plus several Central and South American countries. The NatureServe network is more than 30 years old and shares a common conservation data methodology. The ACCDC was founded in 1997, and maintains data for the jurisdictions of New Brunswick, Nova Scotia, Prince Edward Island, Newfoundland and Labrador. Although a non-governmental agency, the ACCDC is supported by 6 federal agencies, plus 4 provincial governments, outside grants and data processing fees. URL: www.ACCDC.com.

Upon request, the ACCDC provides known occurrence data for rare and endangered flora and fauna, in and near a specified study area. As a standard supplement to that data, the ACCDC includes locations of managed areas with some level of protection for flora and fauna, and also known sites of ecological interest, e.g. NB DOE Environmentally Significant Areas. Floral, faunal and Special Areas data are attached to our e-mail response as *.dbf files which may be opened from within data software (e.g. Excel, Access) or mapped in GIS (e.g. ArcView, MapInfo, AutoCAD).

1.1 CAVEATS

While the ACCDC makes a strong effort to verify the accuracy of all the data it obtains, generates and manages, it shall not be held responsible for any inaccuracies in any data that it provides. The following CAVEATS apply:
a.) Data is restricted to use by the specified Data User; any third party requiring data must make its own data request.
b.) To ensure the currency of data, the ACCDC requires Data Users to cease using data 12 months after receipt; if data is still needed after that term, the ACCDC will supply current data as a replacement.
c.) ACCDC data responses are restricted to that data in our Data System at the time of the data request.
d.) Data is qualified as to location (Precision) and time (SurveyDate); cf Data Dictionary for details.
e.) ACCDC data reports are not to be construed as exhaustive inventories of taxa in an area.
f.) The non-occurrence of a taxon cannot be inferred by its absence in an ACCDC data report.

1.2 ADDITIONAL INFORMATION

Please direct biological questions about ACCDC data to: Sean Blaney, ACCDC: (506) 364-2658, and technical data queries to: Stefen Gerriets, ACCDC: (506) 364-2657.

For provincial information on rare taxa and protected areas, or information on game animals, deer yards, old growth forest, archeological sites, fish habitat etc, please contact Sherman Boates, NSDNR: (902) 679-6146.
For more specific information about Peregrine Falcon locations, please contact: Diane Amirault, CWS: (506) 364-5060.

2.0 RARE AND ENDANGERED TAXA

A 100km buffer around the study area contains a relatively small (quintile 1) density of taxa records: 2708 records of 431 taxa from 72 sources. (Data Density: 0.09 rec/km2).

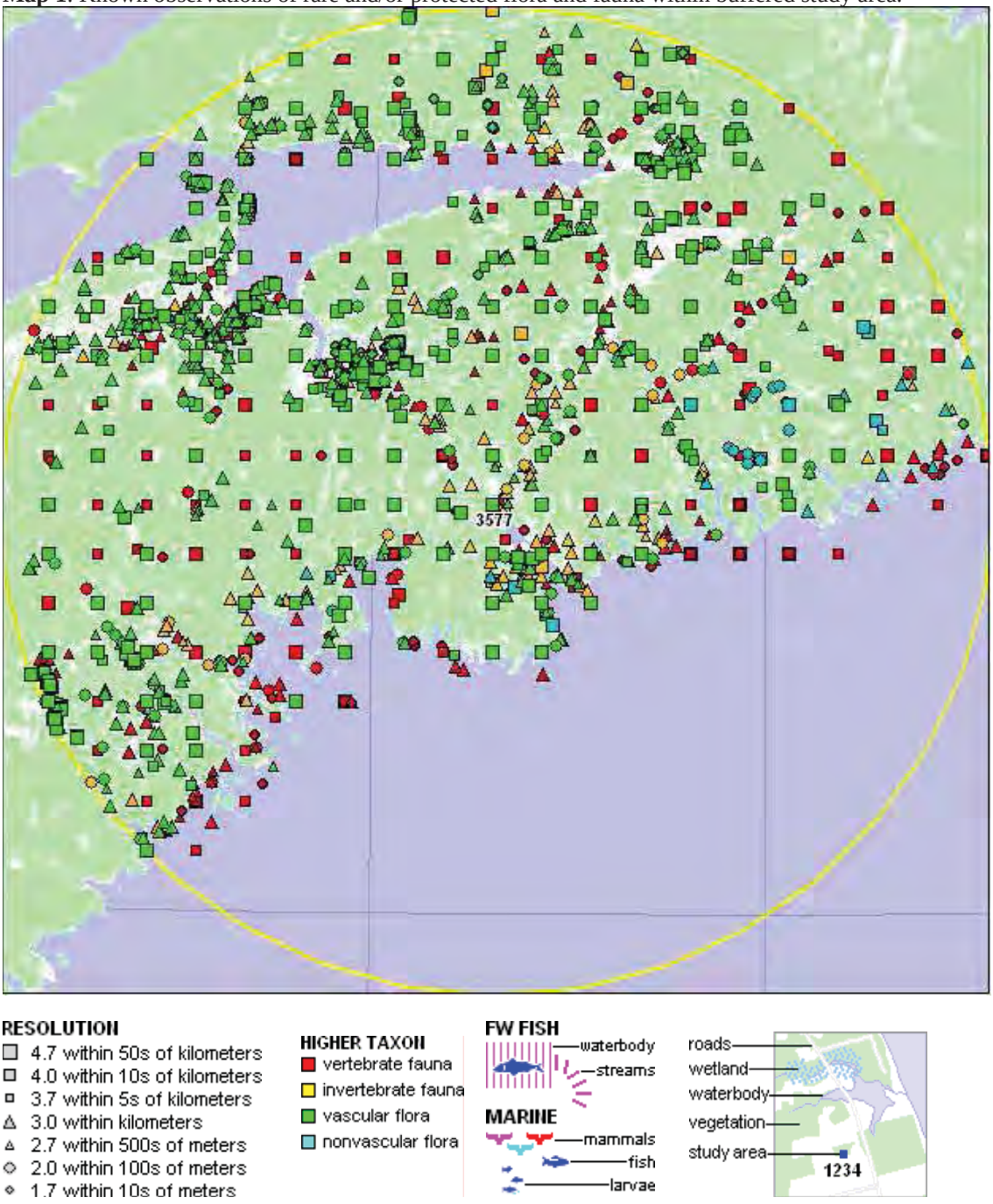
2.1 FLORA

A 100km buffer around the study area contains 1333 records of 286 vascular, 44 records of 9 nonvascular flora (see attached *eo.dbf).

2.2 FAUNA

A 100km buffer around the study area contains 1030 records of 78 vertebrate, 301 records of 58 invertebrate fauna (cfattached *eo.dbf). Sensitive data: Wood Turtles are PRESENT in the study area (cf attached WOTU.rtf).

Map 1: Known observations of rare and/or protected flora and fauna within buffered study area.



3.0 SPECIAL AREAS

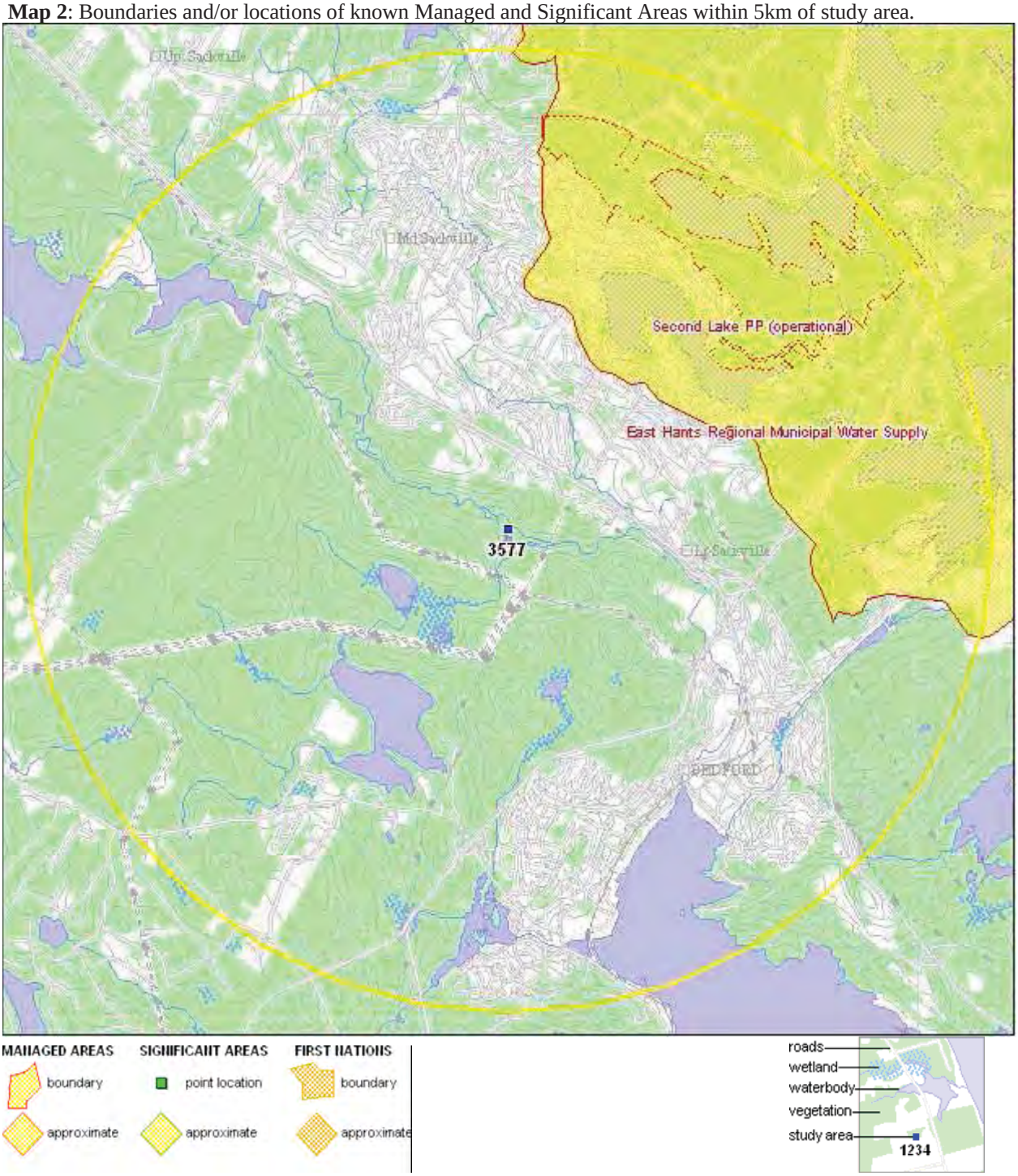
3.1 MANAGED AREAS

The GIS scan identified 2 Managed Areas with some degree of protected status, in the vicinity of the study area (see attached *ma.dbf).

3.2 SIGNIFICANT AREAS

No biologically significant areas identified.

Map 2: Boundaries and/or locations of known Managed and Significant Areas within 5km of study area.



4.0 TAXON LIST

Flora and fauna within the buffered area listed in order of concern, beginning with any legally listed taxa, including the number of observations per taxon and the distance in kilometers from study area centroid to the closest observation. This list has been abbreviated for use in this report by East Coast Aquatics Inc. to include only Federally and Provincially listed Species At Risk and Provincially extremely rare (S1) species located within 25km of the proposed project area. The complete ACCDC data list is available upon request.

Scientific name	Common name	Federal Rank	Federal Protection	Provincial Rank	Provincial Protection	Dist. Away (KM)
Sterna dougallii	Roseate Tern	G4	Endangered	S1B	Endangered	25 ±0.1
Erioderma pedicellatum (Atlantic pop.)	Boreal Felt Lichen	G1G2Q	Endangered	S1S2	Endangered	15 ±1
Calidris canutus rufa	Red Knot (rufa ssp)	G5T1	Endangered	S3M	Endangered	24 ±0.5
Alces americanus	Moose	G5		S1	Endangered	21 ±10
Helianthemum canadense	Canada Frostweed	G5		S1	Endangered	14 ±1
Morone saxatilis	Striped Bass	G5	Threatened	S1		21 ±10
Caprimulgus vociferus	Whip-Poor-Will	G5	Threatened	S1?B		9 ±5
Glyptemys insculpta	Wood Turtle	G4	Threatened	S3	Vulnerable	1 ±1
Thuja occidentalis	Eastern White Cedar	G5		S1S2	Vulnerable	8 ±1
Clethra alnifolia	Coast Pepper-Bush	G5	SC	S1S2	Vulnerable	20 ±0.1
Pseudevernia cladonia	Ghost Antler Lichen	G2G4	SC	S2		18 ±0
Danaus plexippus	Monarch Butterfly	G5	SC	S2B		16 ±0
Euphagus carolinus	Rusty Blackbird	G4	SC	S3B		1 ±5
Coenagrion resolutum	Taiga Bluet	G5		S1		9 ±1
Elymus wiegandii	Wiegand's Wild Rye	G4G5		S1		14 ±10
Enallagma signatum	Orange Bluet	G5		S1		14 ±0.1
Fraxinus pennsylvanica	Green Ash	G5		S1		20 ±0.5
Gomphus ventricosus	Skillet Clubtail	G3		S1		23 ±0.5
Hypericum majus	Larger Canadian St. John's Wort	G5		S1		14 ±10
Listera australis	Southern Twayblade	G4		S1		18 ±0.1
Lycaena hyllus	Bronze Copper	G5		S1		20 ±1
Montia fontana	Fountain Miner's-Lettuce	G5		S1		15 ±1
Oeneis jutta	Jutta Arctic	G5		S1		22 ±1
Ophiogomphus aspersus	Brook Snaketail	G3G4		S1		23 ±0.1
Plebejus saepiolus	Greenish Blue	G5		S1		12 ±1
Polygonia satyrus	Satyr Comma	G5		S1		14 ±1
Somatochlora franklini	Delicate Emerald	G5		S1		22 ±1
Solidago hispida	Hairy Goldenrod	G5		S1?		14 ±10
Toxostoma rufum	Brown Thrasher	G5		S1?B		14 ±5
Vireo gilvus	Warbling Vireo	G5		S1?B		9 ±5
Calidris minutilla	Least Sandpiper	G5		S1B,S5M		11 ±5
Asio otus	Long-eared Owl	G5		S1S2		12 ±0.1
Callophrys lanoraieensis	Bog Elfin	G3G4		S1S2		9 ±1
Carex pensylvanica	Pennsylvania Sedge	G5		S1S2		18 ±0.1
Juncus greenei	Greene's Rush	G5		S1S2		14 ±10

Nymphalis vaualbum j-album	Compton Tortoiseshell	G5T5		S1S2		13 ±1
Ophiogomphus rupinsulensis	Rusty Snaketail	G5		S1S2		23 ±0.5
Ranunculus sceleratus	Cursed Crowfoot	G5		S1S2		20 ±1
Somatochlora kennedyi	Kennedy's Emerald	G5		S1S2		20 ±1
Stylurus scudderi	Zebra Clubtail	G4		S1S2		23 ±0.5
Plantago rugelii	Black-Seed Plantain	G5		S1SE		15 ±0.1
Polygala polygama	Racemed Milkwort	G5		S1SE		14 ±1
Amblyscirtes hegon	Salt and Pepper Skipper	G5		S2		3 ±10
Amblyscirtes vialis	Common Roadside-Skipper	G5		S2		9 ±1
Betula michauxii	Michaux's Dwarf Birch	G2G4		S2		13 ±10
Callophrys henrici	Henry's Elfin	G5		S2		22 ±1
Callophrys niphon	Eastern Pine Elfin	G5		S2		9 ±1
Cypripedium parviflorum var. pubescens	Large Yellow Lady's-Slipper	G5T5		S2		9 ±10
Eleocharis olivacea	Capitate Spikerush	G5		S2		9 ±10
Epitheca princeps	Prince Baskettail	G5		S2		9 ±0.1
Hudsonia ericoides	Golden-Heather	G4		S2		14 ±10
Minuartia groenlandica	Mountain Sandwort	G5		S2		1 ±10
Myriophyllum farwellii	Farwell's Water-Milfoil	G5		S2		22 ±10
Nymphalis milberti	Milbert's Tortoiseshell	G5		S2		14 ±1
Pieris oleracea	Mustard White	G4G5		S2		9 ±1
Piptatherum canadense	Canada Mountain-Ricegrass	G5		S2		21 ±1
Polygonia comma	Eastern Comma	G5		S2		13 ±1
Ranunculus flammula var. flammula	Greater Creeping Spearwort	G5T4T5		S2		21 ±0.5
Salix sericea	Silky Willow	G5		S2		21 ±1
Salmo salar	Atlantic Salmon	G5		S2		1 ±10
Satyrium calanus	Banded Hairstreak	G5		S2		3 ±10
Somatochlora forcipata	Forcipate Emerald	G5		S2		20 ±1
Spiranthes ochroleuca	Yellow Nodding Ladies'-Tresses	G4		S2		21 ±10
Symphyotrichum undulatum	Wavy-leaf American-Aster	G5		S2		1 ±10
Vaccinium uliginosum	Alpine Blueberry	G5		S2		23 ±10
Hieracium kalmii	Kalm's Hawkweed	G5		S2?		7 ±5
Hieracium umbellatum	Umbellate Hawkweed	G5		S2?		22 ±10
Anas strepera	Gadwall	G5		S2B		14 ±5
Cardinalis cardinalis	Northern Cardinal	G5		S2B		11 ±5
Piranga olivacea	Scarlet Tanager	G5		S2B		1 ±5
Rallus limicola	Virginia Rail	G5		S2B		21 ±0.1
Bucephala clangula	Common Goldeneye	G5		S2B,S4N		14 ±5
Eremophila alpestris	Horned Lark	G5		S2B,S4N		13 ±5
Tringa melanoleuca	Greater Yellowlegs	G5		S2B,S5M		11 ±5
Calidris bairdii	Baird's Sandpiper	G5		S2M		24 ±0.5
Calidris maritima	Purple Sandpiper	G5		S2N		23 ±10

Alasmidonta undulata	Triangle Floater	G4		S2S3		1 ±10
Asclepias incarnata ssp. pulchra	Swamp Milkweed	G5T5		S2S3		20 ±5
Carex adusta	Crowded Sedge	G5		S2S3		18 ±0
Empetrum eamesii	Rock Crowberry	G5		S2S3		14 ±10
Erynnis juvenalis	Juvenal's Duskywing	G5		S2S3		9 ±1
Hypericum dissimulatum	Disguised St. John's-Wort	G5		S2S3		6 ±0.5
Limosella australis	Mudwort	G4G5		S2S3		23 ±0.5
Ophioglossum pusillum	Adder's Tongue	G5		S2S3		9 ±10
Polygala sanguinea	Field Milkwort	G5		S2S3		14 ±10
Rudbeckia laciniata var. gaspereauensis	Cut-Leaved Coneflower	G5TNR		S2S3		23 ±10
Suaeda calceoliformis	American Sea-Blite	G5		S2S3		14 ±10
Sialia sialis	Eastern Bluebird	G5	NAR	S2S3B		21 ±5
Myiarchus crinitus	Great Crested Flycatcher	G5		S2S3B		9 ±5
Pooecetes gramineus	Vesper Sparrow	G5		S2S3B		14 ±5
Sayornis phoebe	Eastern Phoebe	G5		S2S3B		14 ±5
Limosa haemastica	Hudsonian Godwit	G4		S2S3M		24 ±0.5
Oenothera fruticosa ssp. glauca	Shrubby Sundrops	G5T5		S2SE		21 ±10
Hemidactylium scutatum	Four-toed Salamander	G5	NAR	S3		1 ±10
Aeshna clepsydra	Mottled Darner	G4		S3		10 ±1
Aeshna constricta	Lance-Tipped Darner	G5		S3		19 ±1
Bartonia virginica	Yellow Screwstem	G5		S3		21 ±10
Enodia anthedon	Northern Pearly-Eye	G5		S3		9 ±1
Equisetum variegatum	Variegated Horsetail	G5		S3		23 ±0.1
Euphydryas phaeton	Baltimore Checkerspot	G4		S3		9 ±1
Euthamia caroliniana	Grass-Leaved Goldenrod	G5		S3		1 ±10
Fraxinus nigra	Black Ash	G5		S3		9 ±10
Gomphaeschna furcillata	Harlequin Darner	G5		S3		12 ±1
Goodyera tesselata	Checkered Rattlesnake-Plantain	G5		S3		24 ±1
Hesperia comma laurentina	Laurentian Skipper	G5T5		S3		3 ±1
Lycopodiella appressa	Southern Bog Clubmoss	G5		S3		20 ±5
Nannothemis bella	Elfin Skimmer	G4		S3		3 ±1
Ophiogomphus carolus	Riffle Snaketail	G5		S3		14 ±0.1
Polygonia faunus	Green Comma	G5		S3		9 ±1
Satyrium liparops	Striped Hairstreak	G5		S3		9 ±1
Schizaea pusilla	Curly-Grass Fern	G3G4		S3		19 ±1
Somatochlora tenebrosa	Clamp-Tipped Emerald	G5		S3		16 ±0.5
Verbena hastata	Blue Vervain	G5		S3		22 ±10
Carex foenea	Dry-Spike Sedge	G5		S3?		18 ±0
Sparganium fluctuans	Floating Bur-Reed	G5		S3?		7 ±0.5
Accipiter gentilis	Northern Goshawk	G5	NAR	S3B		11 ±5

Ammodramus nelsoni	Nelson's Sharp-tailed Sparrow	G5	NAR	S3B		21 ±5
Sterna hirundo	Common Tern	G5	NAR	S3B		8 ±0.1
Coccyzus erythropthalmus	Black-billed Cuckoo	G5		S3B		21 ±5
Dolichonyx oryzivorus	Bobolink	G5		S3B		11 ±5
Icterus galbula	Baltimore Oriole	G5		S3B		14 ±5
Mergus serrator	Red-breasted Merganser	G5		S3B		22 ±5
Mimus polyglottos	Northern Mockingbird	G5		S3B		1 ±5
Polygonia interrogationis	Question Mark	G5		S3B		12 ±1
Sterna paradisaea	Arctic Tern	G5		S3B		19 ±5
Numenius phaeopus	Whimbrel	G5		S3M		24 ±0.5
Aythya marila	Greater Scaup	G5		S3N		22 ±5
Callophrys polios	Hoary Elfin	G5		S3S4		9 ±1
Euthamia galetorum	Narrow-Leaf Fragrant Golden-Rod	G3		S3S4		11 ±10
Feniseca tarquinius	Harvester	G4		S3S4		6 ±1
Liparis loeselii	Loesel's Twayblade	G5		S3S4		14 ±5
Loxia curvirostra	Red Crossbill	G5		S3S4		8 ±0.1
Polygonia progne	Gray Comma	G5		S3S4		8 ±0.5
Potamogeton confervoides	Algae-Like Pondweed	G4		S3S4		14 ±0.1
Speyeria aphrodite	Aphrodite Fritillary	G5		S3S4		10 ±1
Phalaropus lobatus	Red-necked Phalarope	G4G5		S3S4M		24 ±0.5
Pluvialis dominica	American Golden-Plover	G5		S3S4M		24 ±0.5

5.0 SOURCE BIBLIOGRAPHY

The recipient of this data shall acknowledge the ACCDC and the data sources of the dataset in any documents, reports,
publications or presentations, in which this dataset makes a major contribution. The sources listed below contributed data contained in this report:

recs source

386 Lepage, D. 2009. Maritime Breeding Bird Atlas Database. Bird Studies Canada, Sackville NB, 143,180 recs.
369 Newell, R.E. 2000. E.C. Smith Herbarium Database. Acadia University, Wolfville NS.
335 Benjamin, L.K. (compiler) 2007. Significant Habitat & Species Database. Nova Scotia Dept of Natural Resources, 8439 recs.
278 Erskine, A.J. 1992. Maritime Breeding Bird Atlas Database. NS Museum & Nimbus Publ., Halifax. 82,125 recs.
242 Pronych, G. & Wilson, A. 1993. Atlas of Rare Vascular Plants in Nova Scotia. Nova Scotia Museum, Halifax NS, I:1-168, II:169-331.
164 Blaney, C.S.; Mazerolle, D.M.; Oberndorfer, E. 2007. AC CDC Fieldwork 2007. Atlantic Canada Conservation Data Centre. Sackville NB,
147 Layberry, R.A. & Hall, P.W., LaFontaine, J.D. 1998. The Butterflies of Canada. University of Toronto Press. 280 pp+plates.
124 Brunelle, P.-M. (compiler) 2009. ADIP/MDDS Odonata Records Database: data to 2006 inclusive. Atlantic Dragonfly Inventory Program (ADIP), 24200 recs.
106 Newell, R.E. 2005. E.C. Smith Digital Herbarium. E.C. Smith Herbarium, Irving Biodiversity Collection, Acadia University.
89 Benjamin, L.K. (compiler) 2002. Significant Habitat & Species Database. Nova Scotia Dept of Natural Resources. 32 spp, 683 recs.
76 Roland, A.E. & Smith, E.C. 1969. The Flora of Nova Scotia, 1st Ed. Nova Scotia Museum, Halifax. 743pp.
75 McNeil, J. 2008. Map of Thamophis sauritus sightings, 1998-2007 & historical. Parks Canada, 117 recs.
70 Blaney, C.S.; Spicer, C.D. 2001. Fieldwork 2001. Atlantic Canada Conservation Data Centre. Sackville NB.
65 Zinck, M. & Roland, A.E. 1998. Roland's Flora of Nova Scotia. Nova Scotia Museum, 3rd ed., rev. M. Zinck; 2 Vol., 1297 pp..
65 Morrison, Guy 2006. Maritime Shorebird Survey (MSS) database. Canadian Wildlife Service, Environment Canada, 52 taxa, 570 sites, 11496 surveys.
51 Roland, A.E. 1976. The Coastal Plain Flora of Kejimkujik National Park. Parks Canada Report, 238 pp.
49 Benjamin, L.K. (compiler) 2001. Significant Habitat & Species Database. Nova Scotia Dept of Natural Resources. 15 spp, 224 recs.
47 Roland, A.E. 1980. Checklist of Vascular Plants of Kejimkujik National Park in Lichens, Liverworts, Mosses and Flowering Plants of Kejimkujik National Park. Roland, A.E. (ed.) Parks Canada Report, pp. 52-140, 160 pp.
42 Blaney, C.S. 2000. Fieldwork 2000. Atlantic Canada Conservation Data Centre. Sackville NB.
34 Scott, F.W. 2002. Nova Scotia Herpetofauna Atlas Database. Acadia University, Wolfville NS. 8856 recs.
33 Blaney, C.S. 2004. Fieldwork 2004. Atlantic Canada Conservation Data Centre. Sackville NB.
24 Chardine, J.W. & et al. 2008. Colonial Waterbird Database. Canadian Wildlife Service, Sackville NB, 2699 sites, 9623 recs (7882 obs).
23 Morrison, Guy 2007. Maritime Shorebird Survey (MSS) database. Canadian Wildlife Service, Environment Canada, 1149 recs (1373 by species).
22 Cameron, E. 2008. Canadian Gypsum Co. survey 2007-08. Conestoga-Rovers & Assoc., 623 recs.
19 Basquill, S.P. 2003. Fieldwork 2003. Atlantic Canada Conservation Data Centre, Sackville NB. 69 recs.
16 Edsall, J. 2007. Personal Butterfly Collection: specimens collected in the Canadian Maritimes, 1961-2007. J. Edsall, unpubl. report, 137 recs.
13 Catling, P.M. 1981. Taxonomy of autumn-flowering Spiranthes species of southern Nova Scotia in Can. J. Bot. 59:1250-1273.
13 Boyne, A.W. & Grecian, V.D. 1999. Tern Surveys. Canadian Wildlife Service, Sackville NB. unpublished data.
12 Benjamin, L.K. & Boreal Felt Lichen, Mountain Avens, Orchid and other recent records 2009. . Nova Scotia Dept of Natural Resources, 105 recs.
10 Bayne, D.M. 2007. ACPF records from Nova Scotia Nature Trust, 2004-06. Nova Scotia Nature Trust, Pers. comm. to C.S. Blaney. 57 recs.
9 Adams, J. & Herman, T.B. 1998. Thesis, Unpublished map of C. insculpta sightings. Acadia University, Wolfville NS.
8 Cameron, R. 2009. Nova Scotia nonvascular plant observations, 1995-2007. Nova Scotia Dept Natural Resources, 27 recs.
7 Oldham, M.J. 2000. Oldham database records from Maritime provinces. Oldham, M.J; ONHIC.
7 Goltz, J.P. & Bishop, G. 2005. Confidential supplement to Status Report on Prototype Quillwort (Isoetes prototypus). Committee on the Status of Endangered Wildlife in Canada (COSEWIC),
7 Cameron, R.P. 2009. Erioderma pedicellatum database, 1979-2008. Nova Scotia Environment & Labour, 103 recs.
5 Hill, N. 1995. Rare and Uncommon Plants of the Kejimkujic Seaside Adjunct. Biology Dept., Mount Saint Vincent University.
4 MacKinnon, D.S. & O'Brien, M.K.H.; Cameron, R.P. 2002. Fieldwork 2000. Dept of Environment and Labour, Protected Areas Branch.
4 Downes, C. 1998-2000. Breeding Bird Survey Data. Canadian Wildlife Service, Ottawa.
4 Connell Herbarium Specimen Data . University New Brunswick, Fredericton. 2003.
4 Christie, D.S. 2000. Christmas Bird Count Data, 1997-2000. Nature NB.
4 Cameron, R.P. 2009. Cyanolichen database. Nova Scotia Environment & Labour, 1724 recs.
4 Blaney, C.S.; Spicer, C.D.; Popma, T.M.; Hanel, C. 2002. Fieldwork 2002. Atlantic Canada Conservation Data Centre. Sackville NB.
4 Amirault, D.L. 2005. 2005 Peregrine Falcon Survey. Canadian Wildlife Service, Sackville NB. unpublished data.
3 Mills, Pamela 2007. Iva frutescens records. Nova Scotia Department of Natural Resources, Wildlife Division, Pers. comm. to S. Basquil. 4 recs.
3 Hope, P. 2002. Field survey of Goodyera pubescens population at Kejimkujik National Park. Kejimkujik National Park,
3 Herbarium Specimens. Nova Scotia Agricultural College, Truro. 2003.
3 Clayden, S.R. 2005. Confidential supplement to Status Report on Ghost Antler Lichen (Pseudevernia cladonia). Committee on the Status of Endangered Wildlife in Canada (COSEWIC),
3 Clayden, S.R. 1998. NBM Science Collections databases to 1998. New Brunswick Museum, Saint John NB.
3 Chaput, Gerald 2002. Atlantic Salmon: Maritime Provinces Overview for 2001. Dept of Fisheries & Oceans, Atlantic Region. Science Stock Status Report D3-14.
3 Cameron, E. 2007. Canadian Gypsum Co. survey 2005-07. Dillon Consulting Ltd, 40 recs.
3 Bradford, Rod 2004. Coregonus huntsmani locations. Dept of Fisheries & Oceans, Atlantic Region. Pers. comm. to K. Bredin.
3 Blaney, C.S. 1999. Fieldwork 1999. Atlantic Canada Conservation Data Centre. Sackville NB.
2 Scott, F.W. 1988. Status Report on the Southern Flying Squirrel (Glaucomys volans) in Canada. Committee on the Status of Endangered Wildlife in Canada (COSEWIC),
2 O'Grady, Sally 2005. Blandings Turtle Database 1946-2005. Kejimkujik National Park, 5133 Recs.
2 Newell, R.E. 2000. Eleocharis tuberculosa records in NS, 1994-99. Acadia University, Wolfville NS, Pers. comm. to S.H. Gerriets, Feb. 11. 32 recs.
2 Newell, R. E., MacKinnon, C. M. & Kennedy, A. C. 2006. Botanical Survey of Boot Island National Wildlife Area, Nova Scotia, 2004.
2 Nelly, T.H. 2006. Cypripedium arietinum in Hants Co. Pers. comm. to C.S. Blaney. 22 recs.
2 MacKinnon, D.S. 2000. Fieldwork 2000. Department of Environment and Labour, Protected Areas Branch.

2 Connell Herbarium Specimens, Digital photos. University New Brunswick, Fredericton. 2005.
2 Cody, W.J. 2003. Nova Scotia specimens of Equisetum pratense at the DAO herbarium in Ottawa. Pers. comm. to C.S. Blaney. 4 recs.
2 Bredin, K.A. 2002. NS Freshwater Mussel Fieldwork. Atlantic Canada Conservation Data Centere. 30 recs.
2 Blaney, C.S.; Spicer, C.D.; Mazerolle, D.M. 2005. Fieldwork 2005. Atlantic Canada Conservation Data Centre. Sackville NB.
2 Blaney, C.S. 2003. Fieldwork 2003. Atlantic Canada Conservation Data Centre. Sackville NB.
1 Whittam, R.M. 1999. Status Report on the Roseate Tern (update) in Canada. Committee on the Status of Endangered Wildlife in Canada (COSEWIC),
1 Standley, L.A. 2002. Carex haydenii in Nova Scotia. Pers. comm. to C.S. Blaney. 4 recs.
1 Speers, L. 2008. Butterflies of Canada database: New Brunswick 1897-1999. Agriculture & Agri-Food Canada, Biological Resources Program, Ottawa, 2048 recs.
1 Sollows, M.C. 2008. NBM Science Collections databases: herpetiles. New Brunswick Museum, Saint John NB, download Jan. 2008, 8636 recs.
1 Powell, B.C. 1967. Female sexual cycles of Chrysemy spicta and Clemmys insculpta in Nova Scotia. Can. Field-Nat.. 81:134-139.
1 Plant Specimens. Nova Scotia Dept Natural Resources, Truro. 2006.
1 Plant specimens from Nictaux, NS sent to Sean Blaney for identification. Jacques Whitford Limited. 2005.
1 McAlpine, D.F. 1998. NBM Science Collections databases to 1998. New Brunswick Museum, Saint John NB.
1 MacKinnon, D.S. 2002. Fieldwork 2002. Dept of Environment and Labour, Protected Areas Branch.
1 Honeyman, K. 2006. J.D. Irving Unique Areas Database, 2005 Rare Plant Data . 40 recs.
1 Herman, T.B. & Power, T.D., Eaton, B. 1995. Population status of Blanding's Turtle (Emydoidea blandingii) in Nova Scotia. Can. Field-Nat.. 109: 182-191..
1 Elderkin M.F. 2007. Selaginella rupestris, Iris prismatica & Lophiola aurea records in NS. NS Dept of Natural Resources, Wildlife division, Pers. comm. to C.S. Blaney.
1 Dibble, A. 1992. Rare plant field form for Amelanchier nantucketensis on McLean Is., Shelburne Co., NS in 1992. University of Maine, Orono. 2 pp.
1 Daury, R.W. & Bateman, M.C. 1996. The Barrow's Goldeneye (Bucephala islandica) in the Atlantic Provinces and Maine. Canadian Wildlife Service, Sackville NB. 47pp.
1 Crowell, Art 2004. Cypripedium arietinum in Weir Brook, Hants Co. Pers. comm. to S. Blaney.
1 Broders, H.G. 2006. Unpublished data. 24 recs.
1 Basquill, S.P.; Quigley, E. 2006. New Minuartia groenlandica record for NS. Pers. comm. to C.S. Blaney, Oct 6.
1 Basquill, S.P. 2004. C. americana and Sedum sp records, 2002. Pers. comm. to C.S. Blaney. 2 recs.
1 Arsenault, R. 2009. Goodyera pubescens record in Kejimkujik National Park.
1 Archibald, D.R. 2003. NS Freshwater Mussel Fieldwork. Nova Scotia Dept Natural Resources. 213 recs.

Appendix B – Sackville Wetland Complex Species List

Table B1: The following is an inventory of wetland vegetation that was confirmed during field surveys of the Sackville Wetland in September 2009. An inventory of the vascular flora found a total of 48 vascular taxa (45 identified to their species epithet). No Species-at-Risk were identified.

Wet 1 Plot species				
Latin Name	**Common Name**	**Indicator Status**	**NS Rank**	**Notes**
Solidago Rugosa	Rough Stemmed Goldenrod	FAC	Green/S5	
Glyceria striata	Manna grass	OBL	Green/S5	
Polygonum sagittatum	Arrowhead tearthumb	OBL	Green/S5	
Rubus pubescens	Dwarf Raspberry		Green/S5	
Onclea sensibilis	Sensitive fern	OBL	Green/S5	
Viola spp. (nephrophylla?)	violet	FACW	NA	
Parthenocissus quinoquefolia	Virginia Creeper	FACU	SE	exotic
Acer rubrum	Red Maple	FAC	Green/S5	
Rubus Hispidus	Trailing Blackberry	FACW	Green/S5	
Bidens frondosa	Devils Beggar Ticks	FACW	Green/S5	
Rubus setosus	Blackberry	FACW	Green/S4?	
Alnus incana	Speckled alder	FACW	Green/S5	
Fraxinus pennsylvania	Green ash	FACW	Red/S1	
Up1 Plot Species				
Latin Name	**Common Name**	**Indicator Status**	**NS Rank**	**Notes**
Spirea latifolia	Broadleaved meadowsweet	FAC	NA	
Abies balsamea	Balsam fir	FAC	Green/S5	
Acer rubrum	Red Maple	FAC	Green/S5	
Pinus strobus	White pine	FACU	Green/S5	
Fagus grandifolia	Beech	FACU	Green/S5	
Tsuga canadensis	Hemlock	FACU	Green/S4S5	
Picea rubens	Red Spruce	FACU	Green/S5	
Betula alleghaniesis	Yellow Birch	FAC	Green/S5	

Wet 2 Plot species				
Latin Name	**Common Name**	**Indicator Status**	**NS Rank**	**Notes**
Prunus serotina	Black Cherry	FACU	Green/S5	
Acer rubrum	Red Maple	FAC	Green/S5	
Alnus incana	Speckled alder	FACW	Green/S5	
Prunus virginicana	Choke Cherry	FACU	Green/S5	
Spirea latifolia	Broadleaved meadowsweet	FAC	NA	
Polygonum sagitatum	Arrowhead tearthumb	OBL	Green/S5	
Solidago Rugosa	Rough Stemmed Goldenrod	FAC	Green/S5	
Rubus Hispidus	Trailing Blackberry	FACW	Green/S5	
Rubus setosus	Blackberry	FACW	Green/S4?	
Parthenocissus quinoquefolia	Virginia Creeper	FACU	SE	exotic
Rapheus Raphanistrum	Wild radish	NA	SE	exotic
Thalictum pubescens	Meadow Rue	FACW	Green/S5	
Up2 Plot Species				
Latin Name	**Common Name**	**Indicator Status**	**NS Rank**	**Notes**

Abies balsamea	Balsam fir	FAC	Green/S5	
Picea Rubens	Red Spruce	FACU	Green/S5	
Fraxinus Americana	White ash	FACU	Green/S5	
Acer rubrum	Red Maple	FAC	Green/S5	
Pinus strobus	White pine	FACU	Green/S5	
Thelypteris Helypteroides	Marsh fern	FACW	Green/S5	
Athyrium filix-femina	Lady fern	FAC	Green/S5	
Dryoptris cristata	Crested fern	FACW	Green/S5	
Trientalis borealis	Star flower	FAC	Green/S5	
Maianthemum canadense	Canada Mayflower	FAC	Green/S5	

Wet 3 Plot species				
Latin Name	**Common Name**	**Indicator Status**	**NS Rank**	**Notes**
Acer rubrum	Red maple	FAC	Green/S5	
Alnus incana	Speckled alder	FACW	Green/S5	
Prunus virginicana	Choke Cherry	FACU	Green/S5	
Polygonum sagitatum	Arrowhead tearthumb	OBL	Green/S5	
Spirea alba latifolia	Broadleaved meadowsweet	FAC	S5	
Doellingeria aster umbellatus	Parasol White-Top	FACW	Green/S5	
Solidago uliganosa	Bog Goldenrod	OBL	Green/S5	
Calamagrostis canadensis	Blue Joint	FACW	Green/S5	
Glyceria striata	Manna grass	OBL	Green/S5	
Rubus spp.	A raspberry	NA	NA	
Parthenocissus quinoquefolia	Virginia Creeper	FACU	SE	exotic
Dryoptris cristata	Crested fern	FACW	Green/S5	
Symphyotrichum lateriflorum	Farwell Summer	FACW	Green/S5	
Thalictum pubescens	Meadow Rue	FACW	Green/S5	
Onclea sensibilis	Sensitive fern	OBL	Green/S5	
Carex spp.	A sedge	OBL	NA	
Prunus serotina	Black Cherry	FACU	Green/S5	
Euthamia graminifolia	Narrow leaved goldenrod	FAC	Green/S5	
Up3 Plot Species				
Latin Name	**Common Name**	**Indicator Status**	**NS Rank**	**Notes**
Picea rubens	Red Spruce	FACU	Green/S5	
Larix laricina	Tamarack/Larch	FACW	Green/S5	
Acer rubrum	Red Maple	FAC	Green/S5	
Tsuga canadensis	Hemlock	FACU	Green/S4S5	
Trientalis borealis	Star flower	FAC	Green/S5	
Maianthemum canadense	Canada Mayflower	FAC	Green/S5	
Incidental Observations				
Latin Name	**Common Name**	**Indicator Status**	**NS Rank**	**Notes**
Jucus effusus	Soft Rush	FACW	Green/S5	Wet3
Scirpus cyperinus	Wool grass	FACW	Green/S5	Wet 3
Osmunda cinnamomea	Cinnamon fern	FACW	Green/S5	Wet 3
Carex lurida	Lurid sedge	OBL	Green/S5	Wet 3
Carex crinita	Fringed sedge	OBL	Green/S4S5	Wet 3
Impatiens capensis	Jewel weed	FACW	Green/S5	Wet 3
Pontederia cordata	Pickerel weed	OBL	Green/S5	
Toxicodendron radicans	Eastern Poison Ivy	FAC	Green/S4	

Polygonum cuspidatum	Japanese knotweed	FACU	SE	exotic, Alder 2 hi grnd
Tussilago farfara	Coltsfoot	FACU	SE	Exotic, widespread

Table B2: Incidental faunal observations documented during fall 2009 field surveys of the Sackville Wetland Complex. (UN=unknown). One Species at Risk, Wood turtle, was found.

Species	Common Name	Observation	Locations Observed
Rana palustris	Pickerel Frog	Adult	NA
Bufo americanus	American Toad	Adult	NA
Bufo americanus	American Toad	Tadpole	Alder 1
Rana clamitans	Green frog	Tadpole	Small pocket of surface water north of Pond 2, Oct. 29th.
Glyptemys insculpta	Wood turtle	Shell, recent mortality	Alder 1, floodplain about 10m from rivers edge
UN	Turtle	Turtle nests	Edge of roadway between Alder 1 and Alder 2, edge of Pond 1.
Procyon lotor	Raccoon	Footprints, adult	Alder 2, next to main river
Castor Canadensis	Beaver	Two houses, dams, cuttings	Houses in Pond 2, and on main river adjacent to Alder 3 and Pond 9, several small dams on floodplain back channels, cuttings throughout, heavy use path between Alder 4 and main river
Odocoileus virginianus	White tailed deer	Doe and fawn, footprints	Doe and fawn observed crossing river near Gram 1, tracks observed throughout
UN	Vole/shrew	Adult in herb stratum	Alder 1
UN	Ducks	Two adults (female mallard?)	Small body of open water northeast corner of Gram 5.
Ardea herodias	Blue Heron	Adult in flight	Near Alder 5 on main river

Appendix C – Field Data Sheets

WETLAND DETERMINATION DATA FORM – NOVA SCOTIA

Project/Site: Sackville River Municipality/County: _____ Sampling Date: Aug 27/09

Applicant/Owner: DND Sampling Point: WET 2

Investigator(s): Parker Affiliation: East Coast Aquatics Inc

Landform (hillslope, terrace, etc.): Floodplain Local relief (concave, convex, none): hummocky

Slope (%): _____ Lat: 20T 0445695 Long: 4955896 Datum: _____

Soil Map Unit Name/Type: _____ Wetland Type: swamp

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil ✓, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes _____ No ✓

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✓ No _____	Is the Sampled Area within a Wetland?	Yes ✓ No _____
Hydric Soil Present?	Yes _____ No ✓	If yes, optional Wetland Site ID:	_____
Wetland Hydrology Present?	Yes _____ No _____		

Remarks: (Explain alternative procedures here or in a separate report.)
Water was high over site 1 week ago post hurricane but have returned to typical

VEGETATION – Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size: 10m)			
1. Black cherry (Prunus serotina)		D	FACU
2. Red Maple (Acer rubrum)		D	FAC
3.			
4.			
5.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: 5m Radius)			
1. Speckled Alder (Alnus Rugosa)	Stems 64 Cover 5	D	FACW
2.			
3.			
4.			
5. Broadleaved Meadowsweet (Spiraea latifolia) Alnus Rugosa FACW FAC	3 1	5	
	= Total Cover		
Herb Stratum (Plot size: 5m² - 4 1m² quadrats)			
1. Solidago rugosa		D	FAC
2. Rubus hispidus		D	FACW
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
	= Total Cover		
Woody Vine Stratum (Plot size: _____)			
1.			
2.			
	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 4 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 80% (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species _____	x 1 = _____
FACW species _____	x 2 = _____
FAC species _____	x 3 = _____
FACU species _____	x 4 = _____
UPL species _____	x 5 = _____
Column Totals: _____ (A)	_____ (B)

Prevalence Index = B/A = _____

Hydrophytic Vegetation Indicators:

- X Rapid Test for Hydrophytic Vegetation
- ✓ Dominance Test is >50%
- ___ Prevalence Index is ≤3.0[1]
- ___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✓ No _____

Remarks: (Include photo numbers here or on a separate sheet.)
American Toad, Green frog

Adapted from U.S. Army Corps of Engineers form for Northeast-North Central Supplement for use in Nova Scotia (2009)

SOIL

Sampling Point: WDT2

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-8cm	7.5YR4/3						Silty Clay Loam	
8-12cm							SAND	Does not form a ball
								Picture

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Depleted Dark Surface (F7)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Polyvalue Below Surface (S8)
- ___ Thin Dark Surface (S9)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Redox Depressions (F8)
- ___ Red Parent Material (TF2)

Indicators for Problematic Hydric Soils[3]:

- ___ Sandy Gleyed Matrix (S4)
- ___ Coast Prairie Redox (A16)
- ___ 5 cm Mucky Peat or Peat (S3)
- ___ Iron-Manganese Masses (F12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes _____ No ✓

Remarks: So sandy/stoney @ ~12cm deep can not dig soil profile, roots & bark readily identifiable and not decomposed down to sand layer. No redox. 0-1cm of leaf plant debris on surface, not decayed

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ✓ Surface Water (A1) Aug 31
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ✓ Water Marks (B1)
- ✓ Sediment Deposits (B2)
- ✓ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ✓ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ✓ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ✓	No ✓	Depth (inches): 20cm - Aug 31 pH 6.4, none Sept 10
Water Table Present?	Yes _____	No _____	Depth (inches): _____
Saturation Present? (includes capillary fringe)	Yes _____	No _____	Depth (inches): _____

Wetland Hydrology Present? Yes _____ No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Adapted from U.S. Army Corps of Engineers form for Northeast-North Central Supplement for use in Nova Scotia (2009)

Multiple Small-quadrat Sampling Data Sheet Herbs <1m

Site: Wet 2
Date: Sept 10, 2009 **Investigator:** Parker
Plant Community ID:

1m² quadrats in 5m Radius.

	Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Total Cover
OBL	Polygonum Sagittatum arrowleaf Tearthumb	2%	–	–	–							2
FAC	Rough Stemmed Goldenrod. Solidago Rugosa	20%	5	75%	30							130 D
FACW	Trailing Blackberry, Swamp dewberry Rubus Hispidus	30%	80	20%	15							145 D
FAC	Spiraea latifolia Broadleaved meadowsweet	2	–	–	–							2
5 leafs lance FACW	Rubus setosus Blackberry	2%	-	–	2							4
take sample FACU	Virginia Creeper Parthenocissus quinquefolia	5	20	2	5							32
OBL	Yellow loosestrife. Lysimachia terrestris	5%	–	–	25							30
WEED NI	Wild Radish Raphanus Raphanistrum	1	–	–	–							1
FAC	Red Maple Acer Rubrum	–	2	–	–							2
FACW	Meadow Rue Thalictrum pubescens	–	–	–	2							2

Total Cover for All Quadrats 350

50% of Total Cover 175
20% of Total Cover 70

List Dominants: Solidago Rugosa, Rubus Hispidus

Vegetation Analysis Field Data Form - Shrub Stratum
For Estimating Cover based on Canopy Diameters

Site: Wet 2
Date: Aug 27 **Investigator:** Parker
Plant Community ID:

Sample Plot Size (circle): 15-foot radius or 30-foot radius

Species	% Cover/Canopy C1	C2	C3	C4	C5	C6	C7	C8	Total Cover	Indicator Status
(Spiraea latifolia) Broad leaved Meadowsweet	5								5	FAC D
Alnus Rugosa (Alder)	5								5	FACW D

Total Cover for the Plot 10
50% of Total Cover 5
20% of Total Cover 2

List Dominant Species Spiraea latifolia, Alnus rugosa

Vegetation Analysis Field Data Form - Shrub Stratum
For Estimating Cover based on Canopy Diameters

Site: Wet 2
Date: Aug 27 **Investigator:** Parker
Plant Community ID:

Sample Plot Size (circle): 15-foot radius or 30-foot radius

Species	% Cover/Canopy C1	C2	C3	C4	C5	C6	C7	C8	Total Cover	Indicator Status
(Spiraea latifolia) Broad leaved Meadowsweet	5								5	FAC D
Alnus Rugosa (Alder)	5								5	FACW D

Total Cover for the Plot 10
50% of Total Cover 5
20% of Total Cover 2

List Dominant Species Spiraea latifolia, Alnus rugosa

Vegetation Analysis Field Data Form For Determining Dominants based on Stem Counts - Tree, Sapling, or Woody Vine Stratum

Site: WET 2
Date: Aug 27, 2009 **Investigator:** PARKER
Plant Community ID: _____

Sample Plot Size (circle): 15-foot radius, 30-foot radius, other (specify) _____

Stratum (circle): Tree, Sapling, Woody Vine

1 in count
½ if on border } by species
0 if no count.

Species (Indicator Status	Stem Counts		Total
TREES ≥3" 30ft.			
FACU Black cherry (Prunus serotina)	1	FACU	2 D
Red Maple (Acer Rubrum)	2	FACU	2 D
			4/
		50=	2/
		20	= 0.4
SAPLINGS ≥3" 15ft			
Count Speckled Alder (Alnus incana ssp rugosa)	64	Cover 80% FACW	64 D
FACU Choke Cherry (Prunus virginiana)	1	2% FACU	1
FACU Black Cherry (Prunus serotina)	3	10% FACU	3
			4
		50% =	32
		20% =	13.6

Total Counts for the Plot _____

50% of Total Counts _____

20% of Total Counts _____

List Dominant Species _____

WETLAND DETERMINATION DATA FORM – NOVA SCOTIA

Project/Site: Sackville DND Municipality/County: _____ Sampling Date: Sept 10, 2009

Applicant/Owner: NSTIR Sampling Point: WET3

Investigator(s): Parker Affiliation: EAST COAST AQUATICS INC.

Landform (hillslope, terrace, etc.): Flood plain Local relief (concave, convex, none): Flat

Slope (%): _____ Lat: 20T 0445656 Long: 4955932 Datum: _____

Soil Map Unit Name/Type: _____ Wetland Type: MARSH

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes ✓ No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✓	No _____	**Is the Sampled Area within a Wetland?** Yes ✓ No _____
Hydric Soil Present?	Yes ✓	No _____	If yes, optional Wetland Site ID: _____
Wetland Hydrology Present?	Yes ✓	No _____	

Remarks: (Explain alternative procedures here or in a separate report.)

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 10m)	Absolute % Cover	Dominant Species?	Indicator Status
1. Acer rubrum	95 tms	D	FAC
2.			
3.			
4.			
5.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: 10m)			
1. Alnus incana	235 tms	D	FACW
2.			
3. no shrubs.			
4.			
5.			
	= Total Cover		
Herb Stratum (Plot size: _____)			
1. Polygonum sagittatum	135	D	OBL
2. Glyceria sp.	129	D	OBL
3. Rubus sp.	95	D	NA
4.			
5.			
6.			
7.			
8.			
9.			
10.			
	= Total Cover		
Woody Vine Stratum (Plot size: _____)			
1.			
2.			
	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 4 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species _____	x 1 = _____
FACW species _____	x 2 = _____
FAC species _____	x 3 = _____
FACU species _____	x 4 = _____
UPL species _____	x 5 = _____
Column Totals: _____ (A)	_____ (B)

Prevalence Index = B/A = _____

Hydrophytic Vegetation Indicators:

- ✓ Rapid Test for Hydrophytic Vegetation
- ✓ Dominance Test is >50%
- ___ Prevalence Index is ≤3.0[1]
- ___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✓ No _____

Remarks: (Include photo numbers here or on a separate sheet.)

Great diversity of species across this marsh.

Adapted from U.S. Army Corps of Engineers form for Northeast-North Central Supplement for use in Nova Scotia (2009)

SOIL

Sampling Point: Test 3

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-15	10YR3/2	95	2.5YR4/8	5	C	PL	Clay	Roots visible.
15+							Sand/Gravel.	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Depleted Dark Surface (F7)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Polyvalue Below Surface (S8)
- ___ Thin Dark Surface (S9)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ✓ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Redox Depressions (F8)
- ___ Red Parent Material (TF2)

Indicators for Problematic Hydric Soils[3]:

- ___ Sandy Gleyed Matrix (S4)
- ___ Coast Prairie Redox (A16)
- ___ 5 cm Mucky Peat or Peat (S3)
- ___ Iron-Manganese Masses (F12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes ✓ No ___

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ✓ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ✓ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ✓ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ✓ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ✓ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No ✓ Depth (inches): _____

Water Table Present? Yes ___ No ✓ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes ✓ No ___ Depth (inches): 8cm

Wetland Hydrology Present? Yes ✓ No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Adapted from U.S. Army Corps of Engineers form for Northeast-North Central Supplement for use in Nova Scotia (2009)

Multiple Small-quadrat Sampling Data Sheet

Site: Wet 3 Sept 10/09 Herbs

Date:

Investigator: Parker

Plant Community ID:

1m² quadrats 5m Radius

Species	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Total Cover
(Polygonum sagittatum) arrowleaf TearThumb	45	55	25	10						OBL	135 D
Flat topped white aster	15	2	–	–						[illegible]	7
(Sorrea latifolia) Broad leaved Meadowsweet	20	–	–	–						FAC	20
OBL Solidago uliginosa	30	4	–	24						OBL	58
FACW Calamagrostis Blue joint - canadensis	8	–	–	–						FACW	8
Manna Grass	15	15	99	–							129 D
Rubus Sp.	45	40	–	10							95 D
check VIRGINIA Creeper Parthenocissus quinquefolia	25	4	–	10						FACU	39
FacW Crested Fern	5	–	–	–							5
NA Aster Lateriflorus	2	12	–	12							26
SENSITIVE FERN (Onoclea sensibilis)	–	40	–	45						FACW	85
FacW Meadow Rue (Thalictrum pubescens)	–	4	–	–						FACW	4
OBL Carex spp.	–	4	–	–						OBL	4
Narrow leaved Goldenrod. Euthamia graminifolia	–	–	–	40						FAC	40

Total Cover for All Quadrats 655

50% of Total Cover 327.5

20% of Total Cover 131

List Dominants: Site Diverse well beyond quadrats sampled

SAPLINGS No shrub stratum

Vegetation Analysis Field Data Form - ~~Shrub~~ Stratum
For Estimating Cover based on Canopy Diameters

Site: West 3
Date: Sept 10/09 **Investigator:** [illegible]
Plant Community ID: _____

Sample Plot Size (circle): 15-foot radius or (30-foot radius)

Species	% Cover/Canopy C1	C2	C3	C4	C5	C6	C7	C8	Total Cover	Indicator Status
Black cherry	III								3	
Alder. Alnus Rugosa	HH	X	HH	III					23	D FACW
Choke cherry	III								3	
Red maple Acer Rubrum	HH								5	

Total Cover for the Plot 34
50% of Total Cover 17
20% of Total Cover 6.8

List Dominant Species _____

Vegetation Analysis Field Data Form For Determining Dominants based on Stem Counts - Tree, Sapling, or Woody Vine Stratum

Site: wet 3
Date: Sept 10/07 **Investigator:** [illegible]
Plant Community ID:

Sample Plot Size (circle): 15-foot radius, 30-foot radius, other (specify)

Stratum (circle): Tree, Sapling, Woody Vine

1 in count } by species
½ if on border
0 if no count

Species (Indicator Status	Stem Counts	Total
(Acer Rubrum) FAC Red Maple	9	9 D

Total Counts for the Plot	9
50% of Total Counts	4.5
20% of Total Counts	1.8

List Dominant Species Acer Rubrum

WETLAND DETERMINATION DATA FORM – NOVA SCOTIA

Project/Site: SACKVILLE WETLAND-DND Municipality/County: HALIFAX Sampling Date: Sept 14, 2009

Applicant/Owner: DND / DOT Sampling Point: UP3

Investigator(s): PARKER Affiliation: EAST COAST AQUATICS

Landform (hillslope, terrace, etc.): Hillslope Local relief (concave, convex, none): _____

Slope (%): 3 Lat: 20T 0445589 Long: 4955718 Datum: _____

Soil Map Unit Name/Type: _____ Wetland Type: NONE

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes ✓ No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____	No ✓	**Is the Sampled Area within a Wetland?** Yes _____ No ✓
Hydric Soil Present?	Yes _____	No ✓	If yes, optional Wetland Site ID: _____
Wetland Hydrology Present?	Yes ✓	No _____	

Remarks: (Explain alternative procedures here or in a separate report.) WENT THIS FAR INLAND TO AVOID HUMMOCKY Bermed Terrain adjacent to wetland and "wet pockets" south of bermed area

VEGETATION – Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size: 10m)			
1. Acer Rubrum	22 stems	D	FAC
2. Picea Rubens	13 stems	FD	FACU
3.			
4.			
5.		= Total Cover	
Sapling/Shrub Stratum (Plot size: 5m)			
SAP 1. Picea Rubens	5 stem	D	FACU
2. Tsuga Canadensis	4 stem	D	FACU
3.			
Shrub 4. Red spruce Picea Rubens	4 stem	FACU	D
5.		= Total Cover	
Herb Stratum (Plot size: 3x1m² quadrats)			
1. Maianthemum Canadense	28	D	FACU
2. Acer Rubrum	26	D	FAC
3. Tsuga canadensis	18	D	FACU
4.			
5.			
6.			
7.			
8.			
9.			
10.		= Total Cover	
Woody Vine Stratum (Plot size: _____)			
1.			
2.		= Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 7 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 43 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species _____	x 1 = _____
FACW species _____	x 2 = _____
FAC species _____	x 3 = _____
FACU species _____	x 4 = _____
UPL species _____	x 5 = _____
Column Totals: _____ (A)	_____ (B)

Prevalence Index = B/A = _____

Hydrophytic Vegetation Indicators:

- ✓ Rapid Test for Hydrophytic Vegetation
- ✓ Dominance Test is >50%
- ___ Prevalence Index is ≤3.0[1]
- ___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No ✓

Remarks: (Include photo numbers here or on a separate sheet.) Evidence of small borrow pit S of sample site. Formerly logged. Beaver have felled poplar to this area

Adapted from U.S. Army Corps of Engineers form for Northeast-North Central Supplement for use in Nova Scotia (2009)

SOIL

Sampling Point: DP3

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
O Org 0-4								DP3 very wet/saturated decomposed vegetation
A 4-12	10YR2/2	100%					SANDY Clay	
B 12+	10YR5/4	60%	7.5YR5/8	15%	C	M	SANDY CLAY LOAM	
			7.5YR5/1	2	C	M		
			5YR 3/4	1	C	M		

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Depleted Dark Surface (F7)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Polyvalue Below Surface (S8)
- ___ Thin Dark Surface (S9)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Redox Depressions (F8)
- ___ Red Parent Material (TF2)

Indicators for Problematic Hydric Soils[3]:

- ___ Sandy Gleyed Matrix (S4)
- ___ Coast Prairie Redox (A16)
- ___ 5 cm Mucky Peat or Peat (S3)
- ___ Iron-Manganese Masses (F12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes _____ No ✓

Remarks: Several hydrology indicators in the vicinity (5-10m).

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ✓ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ✓ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ✓ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ✓ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes _____ No ✓ Depth (inches): _____

Water Table Present? Yes _____ No ✓ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No ✓ Depth (inches): _____

Wetland Hydrology Present? Yes ✓ No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Several hydrology indicators present within 5-10m Radius but not consistent across landscape

Adapted from U.S. Army Corps of Engineers form for Northeast-North Central Supplement for use in Nova Scotia (2009)

Multiple Small-quadrat Sampling Data Sheet

Site: UP3
Date: Sept 14, 2009 **Investigator:** Pete
Plant Community ID:

	Species (1m² quadrats unless otherwise noted)	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Total Cover
FACU	Hemlock TSUGA CANADENSIS	4	2	2	10							18 D
FAC	STAR FLOWER TRIENTALIS BOREALIS	4	8	-	-							12
FAC	RED MAPLE ACER Rubrum	8	8	6	4							26 D
FACU	RED SPRUCE PICEA Rubra	4	-	-	-							4
FAC	CANADA MAYFLOWER MAIANTHEMUM CANADENSE	6	2	4	16							28 D

Total Cover for All Quadrats 88

50% of Total Cover 44
20% of Total Cover 17.6

List Dominants:

Vegetation Analysis Field Data Form - Shrub Stratum
For Estimating Cover based on Canopy Diameters

Site: VP 3
Date: Sept 14, 2009 **Investigator:** Parker
Plant Community ID: _____

Sample Plot Size (circle): (Complete) 15-foot radius or 30-foot radius

Species	% Cover/Canopy C1 ~~C2 C3 C4 C5 C6~~ C7 C8	Total Cover	Indicator Status
Red Spruce (Picea rubens)	4%	4	FACU
VIRTUALLY NO SHRUB LAYER			

Total Cover for the Plot _____
50% of Total Cover _____
20% of Total Cover _____

List Dominant Species _____

Vegetation Analysis Field Data Form For Determining Dominants based on Stem Counts - Tree, Sapling, or Woody Vine Stratum

Site: UP 3
Date: Sept 14, 2009 **Investigator:** PARKER
Plant Community ID: _____

Sample Plot Size (circle): 15-foot radius, 30-foot radius, other (specify) _____

Stratum (circle): Tree, Sapling, Woody Vine

1 in a count } by species
½ if on border }
0 if in no count.

Species (Indicator Status	Stem Counts	Total
TREES 10m Radius stem count > 7.5cm DbH		
FAC RED MAPLE	++++ ++++ ++++ |||	22 D
FACU RED SPRUCE	++++ ++++ |||	13 D
FACW TAMARACK LARIX LARICINA	1 (By Borrow pit with standing water)	1 / 36
		50% = 18 20% = 7.2
SAPLINGS 5m Radius stem count. < 7.5cm DbH > 1m Tall.		
FACU RED SPRUCE Picea Rubens	++++	5 D
FACU Hemlock TSUGA CANADENSIS	|||	4 D
FAC Red maple Acer Rubrum	||	2 / 11
		50% = 5.5 20% = 2.2

Total Counts for the Plot _____

50% of Total Counts _____

20% of Total Counts _____

List Dominant Species _____

_____

WETLAND DETERMINATION DATA FORM – NOVA SCOTIA

Project/Site: UP 2 - Sackville River Municipality/County: HALIFAX Sampling Date: Aug 31/09

Applicant/Owner: DND Sampling Point: UP 2

Investigator(s): Parker Affiliation: EASTCOAST AQUATICS.

Landform (hillslope, terrace, etc.): hillslope Local relief (concave, convex, none): sloped 2-6%

Slope (%): _____ Lat: 20T 0445727 Long: 4955933 Datum: _____

Soil Map Unit Name/Type: _____ Wetland Type: NONE

Are climatic / hydrologic conditions on the site typical for this time of year? Yes _____ No ✓ (If no, explain in Remarks.) recent heavy rain

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes ✓ No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✓ No _____	Is the Sampled Area within a Wetland? Yes _____ No ✓
Hydric Soil Present?	Yes _____ No ✓	
Wetland Hydrology Present?	Yes ✓ No _____	If yes, optional Wetland Site ID: _____

Remarks: (Explain alternative procedures here or in a separate report.)
Supports some FACT veg, but elevated site from floodplain and hillslope further support. Surface spring seep makes area wet and Therefore not wetland.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 10m)	Absolute % Cover	Dominant Species?	Indicator Status
1. Abies balsamea	10 5km	D	FAC
2.			
3.			
4.			
5.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: 10m)			
1. Acer Rubrum	5 5km	D	FAC
2. Abies balsamea	4 5km	D	FAC
3.			
4.			
5. No Shrub			
	= Total Cover		
Herb Stratum (Plot size: 10m)			
1. Dryopteris cristata	12	D	FACW
2. Maianthemum canadense	4	D	FAC
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
	= Total Cover		
Woody Vine Stratum (Plot size: _____)			
1.			
2.			
	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 6 (A)

Total Number of Dominant Species Across All Strata: 6 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species _____	x 1 = _____
FACW species _____	x 2 = _____
FAC species _____	x 3 = _____
FACU species _____	x 4 = _____
UPL species _____	x 5 = _____
Column Totals: _____ (A)	_____ (B)

Prevalence Index = B/A = _____

Hydrophytic Vegetation Indicators:

- X Rapid Test for Hydrophytic Vegetation
- ✓ Dominance Test is >50%
- ___ Prevalence Index is ≤3.0[1]
- ___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✓ No _____

Remarks: (Include photo numbers here or on a separate sheet.)
Photo of spring at UP 2, PH4.8

Adapted from U.S. Army Corps of Engineers form for Northeast-North Central Supplement for use in Nova Scotia (2009)

SOIL

Sampling Point: WP2

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-8cm	5YR 2.5/1							Non Post 4. (Fibric, weakly decomposed)
8-27cm	10YR 3/3		2.5YR 4/6	2-5%	C	PL	Clay loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Depleted Dark Surface (F7)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Polyvalue Below Surface (S8)
- ___ Thin Dark Surface (S9)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Redox Depressions (F8)
- ___ Red Parent Material (TF2)

Indicators for Problematic Hydric Soils[3]:

- ___ Sandy Gleyed Matrix (S4)
- ___ Coast Prairie Redox (A16)
- ___ 5 cm Mucky Peat or Peat (S3)
- ___ Iron-Manganese Masses (F12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes _____ No ✓

Remarks: Chroma + value too high along with too small % redox features to constitute a hydric soil

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ✓ Surface Water (A1) – Spring
- ___ High Water Table (A2)
- ✓ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ✓ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ✓ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ✓ Drainage Patterns (B10) – Spring seepage
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes _____ No ✓ Depth (inches): _____

Water Table Present? Yes ✓ No _____ Depth (inches): 8cm

Saturation Present? (includes capillary fringe) Yes ✓ No _____ Depth (inches): 27cm

Wetland Hydrology Present? Yes ✓ No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Recent heavy rainfall is likely reason for observed surface water and high water table in soil pit (27cm)

Adapted from U.S. Army Corps of Engineers form for Northeast-North Central Supplement for use in Nova Scotia (2009)

Vegetation Analysis Field Data Form - Herb Stratum

Site: UP2
Date: Aug 31 Investigator: Parker
Plant Community ID:

Sample Plot Size (circle): 5-foot radius; other (specify) 3ft

Species	% Cover	Wetland Indicator Status
Thelypteris thelypteroides marsh FERN FACW	<1	FACW
ATHYRIUM FILIX-femina LADY FERN	<1	
DRYOPTERIS cristata crested fern	2	FACW D
TRIENTALIS borealis STAR FLOWER	<1	FAC
MAIANTHEMUM CANADENSE CANADA MAYFLOWER	4	FAC D
	9	

Total Cover for the Plot 9
50% of Total Cover 4.5
20% of Total Cover 1.8
List Dominant Species

PREDOMINANTLY DUFF ON FOREST FLOOR.

Vegetation Analysis Field Data Form For Determining Dominants based on Stem Counts - Tree, Sapling, or Woody Vine Stratum

Site: UP2
Date: Aug 31/09 **Investigator:** PARKER
Plant Community ID:

Sample Plot Size (circle): 15-foot radius, 30-foot radius, other (specify) Prism

Stratum (circle): Tree, Sapling, Woody Vine

1 for a count, ½ if on border, 0 for no count. } by species

Species (Indicator Status	Stem Counts	Total
SAPLING <3" 15ft		
(Abies balsamea) Balsam Fir FAC	HH HH	10 D
Picea Rubens. RED SPRUCE FACU	I	1
Fraxinus Americana WHITE ASH FACU	II	2
		13 50=6.5 20=2.6
TREE: Prism cont 2m		
RED RUBRUM FAC	HH	5 D
Balsam Fir FAC	IIII	4 D
~~Beech~~ White Ash FACU	I	1
White Pine (Pinus strobus) FACU	I	1
		11 50= 5.5 20= 2.2
	Total Counts for the Plot	
	50% of Total Counts	
	20% of Total Counts	

List Dominant Species

Black capped chickadee.

WETLAND DETERMINATION DATA FORM – NOVA SCOTIA

Project/Site: UPI - SACKVILLE WETLAND Municipality/County: HALIFAX Sampling Date: AUG 27, 2009

Applicant/Owner: NSTIR Sampling Point: _____

Investigator(s): Parker Affiliation: EAST COAST AQUATICS.

Landform (hillslope, terrace, etc.): SLOPE Local relief (concave, convex, none): NONE

Slope (%): _____ Lat: 20TD445337 Long: 4955869 Datum: _____

Soil Map Unit Name/Type: _____ Wetland Type: NONE

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes ✓ No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____	No ✓	Is the Sampled Area within a Wetland? Yes _____ No ✓
Hydric Soil Present?	Yes _____	No ✓	If yes, optional Wetland Site ID: _____
Wetland Hydrology Present?	Yes _____	No ✓	

Remarks: (Explain alternative procedures here or in a separate report.)

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: Base 2 Prism)	Absolute % Cover	Dominant Species?	Indicator Status
1. Picea Rubens	7	D	FACU
2.			
3.			
4.			
5.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: 5km 5m)			
1. Picea Rubens	14	D	FACU
2. Abies balsamea	4	D	FAC
3.			
4.			
5.			
	= Total Cover		
Herb Stratum (Plot size: _____)			
1. MOSSES			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
	= Total Cover		
Woody Vine Stratum (Plot size: _____)			
1.			
2.			
	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 33% (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species _____	x 1 = _____
FACW species _____	x 2 = _____
FAC species _____	x 3 = _____
FACU species _____	x 4 = _____
UPL species _____	x 5 = _____
Column Totals: _____ (A)	_____ (B)

Prevalence Index = B/A = _____

Hydrophytic Vegetation Indicators:

- X Rapid Test for Hydrophytic Vegetation
- X Dominance Test is >50%
- ___ Prevalence Index is ≤3.0[1]
- ___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No ✓

Remarks: (Include photo numbers here or on a separate sheet.)

Adapted from U.S. Army Corps of Engineers form for Northeast-North Central Supplement for use in Nova Scotia (2009)

SOIL

Sampling Point: VP1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
10cm A0	2.5YR 2.5/2							
11+ A	7.5YR 4.5/3		NONE				CLAY	Cobble and stone inclusions

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Depleted Dark Surface (F7)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Polyvalue Below Surface (S8)
- ___ Thin Dark Surface (S9)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Redox Depressions (F8)
- ___ Red Parent Material (TF2)

Indicators for Problematic Hydric Soils[3]:

- ___ Sandy Gleyed Matrix (S4)
- ___ Coast Prairie Redox (A16)
- ___ 5 cm Mucky Peat or Peat (S3)
- ___ Iron-Manganese Masses (F12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes _____ No ✓

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes _____ No _____ Depth (inches): _____

Water Table Present? Yes _____ No _____ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No _____ Depth (inches): _____

Wetland Hydrology Present? Yes _____ No ✓

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Adapted from U.S. Army Corps of Engineers form for Northeast-North Central Supplement for use in Nova Scotia (2009)

Vegetation Analysis Field Data Form For Determining Dominants based on Stem Counts - Tree, Sapling, or Woody Vine Stratum

Site: UP 1
Date: AUG 27, 2009 **Investigator:** PARKER
Plant Community ID:

Sample Plot Size (circle): 15-foot radius, 30-foot radius, other (specify)

Stratum (circle): Tree, Sapling, Woody Vine

1 in prism count
½ if on border } by species
0 in no count

Species (Indicator Status	Stem Counts	Total
TREE - prism count.	PRISM (Basal Area)	
FACU Red Spruce Picea rubens	7	7 D
FACU WHITE PINE Pinus strobus	1	1
FAC RED MAPLE Acer rubrum	2	2
FAC Yellow Birch Betula alleghaniensis	1	1
FACU HEMLOCK EASTERN Tsuga canadensis	1	~~1~~ 12
SAPLINGS ≥ 7.5cm	STEMS	50 = 6 / 20 = 2.4
FAGUS GRANDIFOLIA Beech FACU	1	1
FACU Picea Rubens Red Spruce T	14	14 D
FAC ABIES balsamea Balsam Fir (Sapling)	4	4 D
FACU TSUGA CANADENSIS Hemlock Eastern	1	~~1~~ 20
Total Counts for the Plot		50 = 10 / 20 = 4
50% of Total Counts		
20% of Total Counts		

List Dominant Species

WETLAND DETERMINATION DATA FORM – NOVA SCOTIA

Project/Site: DND SACKVILLE Municipality/County: HALIFAX Sampling Date: AUG 27/09

Applicant/Owner: DND Sampling Point: WET 1

Investigator(s): Parker Affiliation: ECA

Landform (hillslope, terrace, etc.): _____ Local relief (concave, convex, none): Hummocky / Braided

Slope (%): _____ Lat: 20T0445356 Long: 4955893 Datum: NAD83

Soil Map Unit Name/Type: _____ Wetland Type: ALDER SWAMP

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil ✓, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes _____ No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✓	No _____	**Is the Sampled Area within a Wetland?** Yes ✓ No _____
Hydric Soil Present?	Yes ✓	No _____	If yes, optional Wetland Site ID: _____
Wetland Hydrology Present?	Yes ✓	No _____	

Remarks: (Explain alternative procedures here or in a separate report.)

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: _____)	Absolute % Cover	Dominant Species?	Indicator Status
1. Acer Rubrum		D	FAC
2. Fraxinus pennsylvanica		D	FACW
3.			
4.			
5.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: _____) NO Shrubs, all saplings.			
1. Alnus Incana		D	FACW
2.			
3.			
4.			
5.			
	= Total Cover		
Herb Stratum (Plot size: 5m 4x1m² quadrats)			
1. Solidago Rugosa	196	D	FAC
2. Viola spp.	125	D	FACW
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
	= Total Cover		
Woody Vine Stratum (Plot size: _____)			
1.			
2.			
	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 5 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species _____	x 1 = _____
FACW species _____	x 2 = _____
FAC species _____	x 3 = _____
FACU species _____	x 4 = _____
UPL species _____	x 5 = _____
Column Totals: _____ (A)	_____ (B)

Prevalence Index = B/A = _____

Hydrophytic Vegetation Indicators:

X Rapid Test for Hydrophytic Vegetation

✓ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✓ No _____

Remarks: (Include photo numbers here or on a separate sheet.)

Adapted from U.S. Army Corps of Engineers form for Northeast-North Central Supplement for use in Nova Scotia (2009)

SOIL

Sampling Point: wet

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
10	10YR 3/2		No concentrations, roots present				SANDY CLAY LOAM	No redox features / WIS 1.66
11+							SANDY GRAVEL	surface soil deposition

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Depleted Dark Surface (F7)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Polyvalue Below Surface (S8)
- ___ Thin Dark Surface (S9)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ✓ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Redox Depressions (F8)
- ___ Red Parent Material (TF2)

Indicators for Problematic Hydric Soils[3]:

- ___ Sandy Gleyed Matrix (S4)
- ___ Coast Prairie Redox (A16)
- ___ 5 cm Mucky Peat or Peat (S3)
- ___ Iron-Manganese Masses (F12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes ✓ No ___

Remarks: No organic layer. All soil quite coarse sand/gravel. Very difficult to dig pit.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ✓ Sediment Deposits (B2)
- ✓ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ✓ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No X Depth (inches): _____

Water Table Present? Yes ___ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes ✓ No ___ Depth (inches): 0

Wetland Hydrology Present? Yes ✓ No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Leopard frog (8 rectangular spots), deer prints.
soil was moist to surface, but sandy nature did not present obvious saturation line

Adapted from U.S. Army Corps of Engineers form for Northeast-North Central Supplement for use in Nova Scotia (2009)

Multiple Small-quadrat Sampling Data Sheet

Herbs

Site: WET 1
Date: Aug 27 2009 **Investigator:** Peter
Plant Community ID:

	Species	1m² quadrats 5m radius — Percent Cover/Quadrat Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Total Cover
	Rowan seedling Goldenrod Solidago Rugosa	95	75	10	16							196 D
OBL	Manna Grass Glyceria Striata	2	15	30	-							47
OBL	Polygonum Sagittatum Arrowhead Tearthumb	1	-	-	-							1
	Dwarf Raspberry Rubus Pubescens	3	-	-	-							3
FACW	Plant topped white Aster Aster Umbellatus	3	24	8	-							35
OBL	Onoclea Sensibilis Sensitive Fern	3	-	-	85							88
FACW	Viola Nephrophylla? 3 pts. Violet (Viola sp.)	30	-	20	~~95~~							125 D
Picture sheet FACU	VIRGINIA creeper	2	-	10	5		5 plants in a clump					17
	Acer Rubrum (Red Maple)	-	1	-	-							1
	Rubus Hibiscus	-	1	40	-							41
FACW	Devils Beggar Ticks Bidens frondosa	-	1	-	-							1
Flower Bells	4 sided stem opposite side leaves	-	1	1	-							2
	Rubus Setosus	-	-	2	-							2

Total Cover for All Quadrats 559

50% of Total Cover 279.5
20% of Total Cover 111.8

List Dominants:

Vegetation Analysis Field Data Form For Determining Dominants based on Stem Counts - Tree, Sapling, or Woody Vine Stratum

Site: WET 1 SACKVILLE WETLAND
Date: AUG 27, 2009 **Investigator:** PARKER
Plant Community ID: _____

Sample Plot Size (circle): 15-foot radius, 30-foot radius, other (specify) _____

Stratum (circle): Tree, Sapling, Woody Vine

1 in count, ½ if on border, 0 if no count — by species

Species (Indicator Status	Stem Counts	Total
SAPLINGS		
Alnus Rugosa Speckled alder (FACW)	1 ~~ins~~ 40% cover	D
TREES		
Fraxinus pennsylvanica Green Ash FACW (FACW)	2 8%	D
Red maple Acer Rubrum FAC	8 30%	D
	10	
	50% = 5	
	20% = 2	

Total Counts for the Plot _____

50% of Total Counts _____

20% of Total Counts _____

List Dominant Species _____

Appendix D – NOVA WAM Functional Assessment

NovaWAM (Version 1.0)

FOR ASSESSING WETLAND CONDITION AND FUNCTIONS

NovaWAM (Nova Scotia Wetland Assessment Method) is a method designed to assess the condition and functions of Nova Scotia wetlands. It is intended to provide the Nova Scotia Environment (DNS) with basic information on project site wetlands, the surrounding landscape, and the contributing watershed to help evaluate the condition of the wetlands in a project area and the functions of the wetlands affected by the proposed wetland alteration. It is a two-step process involving offsite assessment using maps and aerial imagery and onsite evaluation to confirm or modify the offsite interpretation and to record site-specific information on wetland characteristics and indicators of wetland functions for wetlands in the project area. The end result of the analysis is a characterization of the wetland condition and likely functions, the condition of the wetland buffer, the relationship between wetlands in a project area and neighboring wetlands and waterbodies, and a general assessment of the contributing watershed. The method does not generate a numeric score and does not compare the subject wetland with similar wetlands of the type. No detailed studies of wetlands in Nova Scotia have been performed to examine a representative suite of reference wetlands that could yield information for creating a rating system for wetlands in the province.

The offsite portion of this method was adapted from a landscape-level functional assessment developed by the U.S. Fish & Wildlife Service for the northeastern United States called the Watershed-based Preliminary Assessment of Wetland Functions (W-PAWF; Tiner 2005, 2003). The method is based on wetland classification and available geospatial information (e.g., aerial imagery, maps, and geospatial data accessible via geographic information system - GIS). It is intended to provide a preliminary assessment of wetland functions based on correlations between wetland characteristics and a number of functions. The correlations were derived from the scientific literature and peer reviewed by professional wetland scientists. They were simplified for NovaWAM based on the wetland classification used in mapping the Province's wetlands. This landscape-level approach has been expanded to include a characterization of the wetland buffer and the contributing watershed requiring an examination of existing aerial imagery or thematic maps.

The onsite portion of this method was adapted chiefly from Minnesota's rapid assessment method (MnRAM 3.2; Minnesota Board of Water & Soil Resources 2008), but significantly expanded by contributions from other assessment methods developed by North Carolina (North Carolina Department of Environment and Natural Resources 2009), Oregon (Adamus et al. 2009) and California (Collins et al. 2008) and from method reviews by Hanson and others (2008) and Fennessy and others (2004). This step addresses site-specific characteristics of the area of the proposed wetland alteration.

NovaWAM is intended for use in evaluating vegetated wetlands and not for nonvegetated wetlands like tidal flats, cobble-gravel streambanks, and similar areas devoid of vegetation. *It is not an official DNS procedure or standard, but is an approach designed to provide the DNS with pertinent information to aid in their assessment of the impact of a proposed wetland alteration.* This information is intended to be included in a project's environmental assessment report and not to replace such report as more detailed information on project design, alternatives analysis, and compensation/monitoring are required.

NovaWAM includes four basic forms: 1) a project overview form (Form P-1), 2) an offsite environmental assessment form (Form A-1), 3) an onsite characterization form (Form A-2), and 4) an onsite wetland functional assessment form (Form A-3). In addition to the forms, various maps and supplemental materials are recommended for inclusion in the assessment report.

The method was prepared by Ralph Tiner, adjunct professor, University of Massachusetts to provide students in an "advanced wetland delineation and evaluation" course with a solid foundation for understanding and evaluating wetland functions and condition when considering alteration of wetlands in Nova Scotia. It is an approach that combines both landscape-level assessment and rapid onsite assessment of wetland condition and functions into a single methodology. The method will undoubtedly benefit from applications and reviews by individuals familiar with Nova Scotia wetlands. Comments on this method are welcomed (contact: rtiner@pssci.umass.edu).

References

Adamus, P., J. Morlan, and K. Verble. 2009. Manual for the Oregon Rapid Wetland Assessment Protocol (ORWAP). Version 2.0. Oregon Department of State Lands, Salem, OR.
http://www.oregon.gov/DSL/WETLAND/docs/orwap_manual_v2.pdf

Collins, J.N., E.D. Stein, M. Sutula, R. Clark, A.E. Fetscher, L. Grenier, C. Grosso, and A. Wiskind. 2008. California Rapid Assessment Method (CRAM) for Wetlands. User's Manual. Version 5.0.2. San Francisco Estuary Institute, Oakland, CA and Southern California Coastal Water Research Project, Costa Mesa, CA, California Coastal Commission, Santa Cruz, and Moss Landing Marine Laboratories, Moss Landing, CA. (CRAM Field Books for Estuarine, Depressional and Riverine Wetlands) http://www.cramwetlands.org/

Fennessy, M.S., A.D. Jacobs, and M.E. Kentula. 2004. Review of Rapid Methods for Assessing Wetland Condition. U.S. Environmental Protection Agency, National Health and Environmental Effects Laboratory, Corvallis, OR. EPA/620/R-04/009.
http://www.epa.gov/owow/wetlands/monitor/RapidMethodReview.pdf

Hanson, A., L. Swanson, D. Ewing, G. Grabas, S. Meyer, L. Ross, M. Watmough, and J. Kirkby. 2008. Wetland Ecological Functions Assessment: An Overview of Approaches. Canadian Wildlife Service, Atlantic Region. Technical Report Series No. 497. http://www.wetkit.net/docs/WA_TechReport497_en.pdf

Minnesota Board of Water & Soil Resources. 2008. Comprehensive General Guidance for Minnesota Routine Assessment Method (MnRAM) Evaluating Wetland Functions. Versions 3.1 and 3.2. St. Paul, MN. http://www.bwsr.state.mn.us/wetlands/mnram/index.html

North Carolina Wetland Functional Assessment Team. 2008. N.C. Wetland Assessment Method (NC WAM) User Manual. Version 1 (April 30, 2008). North Carolina Division of Water Quality, Raleigh, NC.
http://h2o.enr.state.nc.us/ncwetlands/Rick%20for%20Program%20Development%20Web%20Page/NCWAMDocuments.htm

Tiner, R.W. 2005. Assessing cumulative loss of wetland functions in the Nanticoke River watershed using enhanced National Wetlands Inventory data. Wetlands 25(2): 405-419.
http://library.fws.gov/Wetlands/TINER_WETLANDS25.pdf

Tiner, R.W. 2003. Correlating Enhanced National Wetlands Inventory Data With Wetland Functions for Watershed Assessments: A Rationale for Northeastern U.S. Wetlands. U.S. Fish and Wildlife Service, National Wetlands Inventory Program, Northeast Region, Hadley, MA.

http://library.fws.gov/Wetlands/corelate_wetlandsNE.pdf

PROJECT OVERVIEW (Form P-1)

PROJECT NAME: SACKVILLE WETLAND COMPLEX COMPENSATION PROJECT

SITE LOCATION: DND PROPERTY SACKVILLE HALIFAX

Address City/Town/Village County

(Attach map showing specific location of project area with road names.)

EVALUATOR: PARKER **DATE** NOV. 2009

AFFILIATION: EAST COAST AQUATICS **Phone/email** 6054682, MIKE@EASTCOASTAQUATICS.CA

Proposed Alteration: Filling___ Draining___ Excavating___ Flooding___ Discharge of Pollutants ___
Other ✓ (specify: RESTORATION, ENHANCEMENT & ENLARGEMENT OF EXISTING WETLAND)

Wetland(s) to be Altered: Salt Marsh___ Marsh___ Fen ___ Swamp✓ Bog ✓ (indicate specific type: TALL SHRUB SWAMP, TREED BOG)

Size of Wetland Impact Area: 17.9ha

Briefly explain the proposed alteration: THIS ALTERATION IS PART OF A COMPENSATION PROJECT DESIGNED TO IMPROVE FUNCTIONS AND DIVERSITY OF THE EXISTING WETLAND THAT HAS SLOWLY FORMED AFTER A GRAVEL EXTRACTION OPERATION COMPLETELY ALTERED THE NATURAL SOILS, HYDROLOGY AND VEGETATION ON THE SITE.

(Note: If the proposed activity results in impacts to fish and/or fish habitat that are prohibited by the habitat protection provisions of the Fisheries Act or provisions of the Species At Risk Act, contact the Federal Department of Fisheries and Oceans for required authorization.)

Explain why alteration could not be avoided: NOT APPLICABLE - COMPENSATION PROJECT. SEE ASSOCIATED REPORT "WETLAND COMPENSATION PROJECT AT THE DND PROPERTY SACKVILLE, HALIFAX COUNTY: PART I - WETLAND DELINEATION AND COMPENSATION CONCEPT" MARCH 2010 BY EAST COAST AQUATICS INC. FOR BOB PETT-NSDTIR.

(Note: The Department of Natural Resources requires a detailed avoidance/mitigation plan for any potential disturbance/disruption to species of conservation concern.)

ATTACH ALTERNATIVES ANALYSIS REPORT (list of alternative locations explored, explain why such sites were unacceptable, list of all landowners contacted re: these locations and copies of their written responses to any requests to purchase or lease such lands).

How will impact be compensated? (Check all applicable and describe on separate sheet) Restoration✓
Enhancement✓ Creation✓ In-kind___ Out-of-kind___ Onsite✓ In-watershed___
Out-of- watershed___ Securement of wetland___

ATTACH COMPENSATION AND MITIGATION PLAN (if applicable)

CHECKLIST OF ASSESSMENT FORMS: P-2 (Offsite Environmental Assessment)✓
P-3 (Onsite Wetland Characterization) ___✓ P-4 (Onsite Functional Assessment) ✓

OFFSITE ENVIRONMENTAL ASSESSMENT (Form A-1)

Preliminary Assessment based on Data from Maps and Interpretation of Aerial Imagery

The offsite method involves interpretation data from maps and aerial imagery. The method yields a preliminary assessment of site conditions, wetland functions, the surrounding landscape, and contributing watershed. These findings for the impacted wetlands will be subsequently refined through onsite, in-field evaluation. Note: One copy of this form is completed for the entire site.

PROJECT NAME: SACKVILLE WETLAND COMPLEX COMPENSATION PROJECT

SITE LOCATION: DND PROPERTY SACKVILLE HALIFAX

City/Town/Village County

EVALUATOR: PARKER **DATE OF EVALUATION** SEPT 2009

MAPS

Provide three types of maps: 1) general map showing the location of the subject area's position in the watershed, 2) detailed map showing all wetlands (label each wetland with a unique number), waterbodies, property boundaries, nearby roads/highways, buildings, and a north-south directional indicator, and 3) land use/land cover map or aerial image for the watershed.

WATERSHED CHARACTERISTICS

Watershed Name: SACKVILLE RIVER Size of Watershed: 99.5 km^2 (UPSTREAM OF SITE

(https://www.gov.ns.ca/nse/water/docs/WaterStrategy_NSWatershedMap.pdf)

Estimate the percent of the watershed that is in each land cover (from aerial imagery or maps):

% Forest 97 % Open Natural Land ___ % Lawn ___ % Cropland ___ % Grazed ___

% Impervious 1 % Other Developed 2 (specify: RESIDENTIAL)

Estimate the percent of wetlands in the watershed: 9 % How estimated? GIS ✓ Visual Estimate ___

Calculated sum of NSDNR sensitive habitats mapped wetlands. Likely underestimated

WETLAND CHARACTERISTICS

Number of wetlands on the project area: ONE - WITH 30+ SUBUNITS INCLUDING PONDS.

Classify each wetland in the project area (on attached sheet(s)) by the descriptors that follow.

Wetland #1: DOMINANT - NOT ALL (30') characterized here. ONLY DOMINANT THAT COVERS NEARLY 80% of project area.

General Type: TALL SHRUB SWAMP

Landscape Position: LOTIC RIVER UNCONF Landform: FLOODPLAIN FLAT

Water Flow Path: THROUGHFLOW Wetland Water Regime: SEASONALLY FLOODED

Wetland Origin: CREATED ? Wetland Soils: MINERAL

Human Impacts: SIGNIFICANT - FORMER GRAVEL PIT SITE.

Other Descriptors: _____

Wetland Intactness: ≥90% of original size ✓ <90% of original size ___ BUT MAY NOT BE NATURAL

Is this wetland part of a complex? Yes ✓ No ___ If yes, complete similar information for the wetland types in this complex (number this one as #_A and the others as #_B, #_C, etc.).

Wetland #___:

General Type: _____

Landscape Position: _____ Landform: _____

Water Flow Path: _____ Wetland Water Regime: _____

Wetland Origin: _____ Wetland Soils: _____

Human Impacts: _____

Other Descriptors: _____

Wetland Intactness: ≥90% of original size___ <90% of original size___

Wetland #___:

General Type: _____

Landscape Position: _____ Landform: _____

Water Flow Path: _____ Wetland Water Regime: _____

Wetland Origin: _____ Wetland Soils: _____

Human Impacts: _____

Other Descriptors: _____

Wetland Intactness: ≥90% of original size___ <90% of original size___

Moderate Other vegetated wetlands

PRELIMINARY WETLAND FUNCTIONAL ASSESSMENT

d likely functions performed and predicted level of performance for each wetland using the above table (circle potential):

ion	Wetld #_1_		Wetld #___		Wetld #___		Wetld #___		Wetld #___		Wetld #___		Wetld #___	
SURFACE ce Water Detention	(H)	M	H	M	H	M	H	M	H	M	H	M	H	M
STREAM nflow Maintenance	H	(M)	H	M	H	M	H	M	H	M	H	M	H	M
NUTRIENT nt Transformation	(H)	M	H	M	H	M	H	M	H	M	H	M	H	M
SEDIMENT ient/Particulate Retention	(H)	M	H	M	H	M	H	M	H	M	H	M	H	M
CARBON n Sequestration:	(H)	M	H	M	H	M	H	M	H	M	H	M	H	M
COASTAL al Storm Surge Detention	H	M	H	M	H	M	H	M	H	M	H	M	H	M
nd Shellfish Habitat	H	M	H	M	H	M	H	M	H	M	H	M	H	M
M WATER fowl and Waterbird Habitat	H	M	H	M	H	M	H	M	H	M	H	M	H	M
Wildlife Habitat	(H)	M	H	M	H	M	H	M	H	M	H	M	H	

100m BUFFER CHARACTERISTICS

For wetlands in the project area, characterize the 100m upland buffer by reviewing the most recent aerial imagery. For wetlands that extend outside the project area, do the entire buffer of the wetland unless it is a lotic wetland; for lotic wetlands characterize the buffer for 200m upstream and downstream of the proposed alteration.

Date of imagery examined: 2002 **Source of imagery:** ARC GIS EXPLORER

Buffer for Wetland # 1

Estimate the percent of the buffer zone (100m) that is in each land category:
% Forest 100 % Open Natural Land___ % Lawn___ % Cropland___ % Grazed___ % Impervious___
% Other Developed____ (specify:_____)
How estimated? GIS__ Visual Estimate ✓ Other __ (specify:
_____)

General description of soil(s) in buffer zone (from soil maps; indicate texture and percent of buffer occupied by each soil in parentheses):
Soils: IMHO - imperfectly drained med. textured soil

Buffer for Wetland #___

Estimate the percent of the buffer zone (100m) that is in each land category:
% Forest____ % Open Natural Land___ % Lawn___ % Cropland___ % Grazed___ % Impervious___
% Other Developed____ (specify:_____)
How estimated? GIS__ Visual Estimate __ Other __ (specify:
_____)

General description of soil(s) in buffer zone (from soil maps; indicate texture and percent of buffer occupied by each soil in parentheses):
Soils: _____

Use additional sheets if more than two wetlands in the project area.

PROXIMITY TO OTHER WETLANDS AND WATERBODIES

For each wetland or wetland complex, identify the proximity to other wetlands and to waterbodies.

Wetland # 1 (check here, if wetland complex ✓)

Within 100m

Are any wetlands within 100m? Yes ___ No ✓
If yes, how many? ____ List the types of wetlands: _____

Is the wetland bordering a waterbody? Yes ✓ No___
If yes, what type? RIVER - SACKVILLE, 16 PONDS ONSITE, POWRELL'S BROOK
If no, are there waterbodies within 100m of the wetland boundary? Yes___ No ✓
If yes, how many?_____ List the types of waterbodies:_____

100-300m

Are any wetlands located 100-300m from wetland boundary? Yes ___ No ✓
If yes, how many? ____ List the types of wetlands: _____

Are any waterbodies located 100-300m from the wetland boundary? Yes___ No ✓
If yes, how many?_____ List the types of waterbodies:_____

301-500m

Are any wetlands located 300-500m from wetland boundary? Yes ✓ No __
If yes, how many? 1 List the types of wetlands: TALL SHRUB SWAMP - 1.08ha.

Are any waterbodies located 300-500m from the wetland boundary? Yes___ No ✓
If yes, how many?_____ List the types of waterbodies:_____

Date of imagery examined: _____ **Source of imagery:** SENS. SPECIES & HABITATS - NSDNR

Complete this sheet for all wetlands or wetland complexes in the project area.

ONSITE WETLAND CHARACTERIZATION (Form A-2)

Wetland and Buffer Characteristics for Wetland #__

Complete this form for *each wetland* identified on the project site.

PROJECT NAME: SACKVILLE WETLAND COMPLEX COMPENSATION PROJECT

SITE LOCATION: DND PROPERTY SACKVILLE, HALIFAX

City/Town/Village County

(Attach map showing specific location of project area with road names.)

EVALUATOR: PARKER **DATE OF VISIT** NOV 2009

AFFILIATION: EAST COAST AQUATICS INC.

RAINFALL CONDITIONS: Normal ✓ Above Normal___ Below Normal____ Drought____
Note unusual climatic conditions experienced during this assessment due to seasonal considerations and/or unusual existing hydrologic and climatologic conditions:

MAPS

Attach an aerial image showing the wetland and adjacent land and water (within 500m of the wetland edge) and identifying the approximate wetland-upland boundary.

---

1. WETLAND CHARACTERISTICS

Is this wetland represented by a single wetland type or by a complex of types?
Single type __ Wetland Complex ✓

If the former, check type? Salt Marsh__ Marsh__ Fen __ Swamp ✓ Bog__ (specify type from Canadian system used in Nova Scotia: TALL SHRUB SWAMP)

If a wetland complex, check of the types representing this wetland and estimate the percent of the wetland they represent: Salt Marsh__ (__%) Marsh__ (8%) Fen __ (__%) Swamp__ (78%) Bog__ (9%)

Estimated size of wetland in hectares: 17.9

What is the estimated area of the wetland's immediate drainage area in hectares? 9950ha

PLANT COMMUNITY

For each wetland in the project, verify the wetland classification based on direct observation (use separate sheets if more than one type represents the wetland):

General Wetland Type: TALL SHRUB SWAMP

Landscape Position: LOTIC RIVER UNCONFINED Landform: FLOODPLAIN FLAT
Water Flow Path: THROUGHFLOW Wetland Water Regime: SEASONALLY FLOODED

Wetland Origin: CREATED ? Wetland Soils: MINERAL

Human Impacts: SIGNIFICANT - FORMER GRAVEL PITSITE VEG. LOOK REMOVED, INVASIVE PLANTS.

Other Descriptors: _____

List dominant plants in each stratum (following the 50/20 rule); attach wetland delineation data sheets if completed for this wetland:

Trees: ACER RUBRUM, FRAXINUS PENNSYLVANIA

Saplings: ALNUS RUGOSA

Shrubs: NIL

Herbs: SOLIDAGO RUGOSA, VIOLA SPP.

Woody Vines: NIL

Is Sphagnum moss present? Yes __ No ✓

List other notable plants (e.g., rare or invasive species): _____

(For list of rare and invasive species, go to: http://www.gov.ns.ca/natr/wildlife/genstatus/ranks.asp)

SOILS (attach wetland delineation data sheet):

Soil Classification: 10YR 3/2 Soil Texture: SANDY CLAY LOAM OVER SANDY GRAVEL

Hydric Soil Indicator: DEPLETED MATRIX

HYDROLOGY

List Hydrology Indicators observed: SEDIMENT DEPOSITS (B2), DRIFT DEPOSITS (B3)
DRAINAGE PATTERNS (B10), SATURATION (A3)

2. DELINEATED WETLAND-UPLAND EDGE CHARACTERISTICS

Complete this section and Section 3 only if the wetland borders the upland.
Approximate length of delineated wetland-upland boundary: 3500 m

Does delineated boundary encompass entire wetland or only a portion of the wetland?
Entire wetland ✓ Only a portion of the boundary ___ (estimated % of entire wetland perimeter represented by the delineation = __%)
Estimate the percent of the delineated wetland-upland boundary that is in each land cover:
% Forest 100 % Open Natural Land___ % Lawn___ % Cropland___ % Grazed___
% Impervious ___ % Other Developed ____ (specify_____)
General description of soil at wetland-upland boundary:
Soil Classification: UPLAND
A-horizon: Thickness 10cm Matrix Color 2.5Y4/2 5/2 Ao
Subsoil: Depth 11+cm Matrix Color 7.5YR 4.5/3 Mottle Color_____ Mottle Percent_____
Soil Texture: CLAY - COBBLE/STONE INCURSIONS

3. WETLAND BUFFER ZONE CHARACTERISTICS (Within 100m of the delineated boundary)

Estimate the percent of the upland buffer zone that is in each land cover (from observations):
% Forest 100 % Open Natural Land___ % Lawn___ % Cropland___ % Grazed___
% Impervious___ % Other Developed____ (specify_____)

If natural buffer, invasive/non-native species present: Yes ✓ No___ (specify COLTSFOOT, JAPANESE KNOTWEED)

General Description of Soil(s) in Buffer Zone (from field observations):

Soil #1 Classification: UPLAND	Soil #2 Classification: UPLAND
Soil#1 Texture: CLAY	Soil#2 Texture: CLAY LOAM
Soil#1 Percent of Buffer: 70%	Soil#2 Percent of Buffer: 10
Soil #3 Classification: UPLAND	Soil #4 Classification:
Soil#3 Texture: SANDY CLAY LOAM	Soil#4 Texture:
Soil#3 Percent of Buffer: 20	Soil#4 Percent of Buffer:

4. STRESSORS IN WETLAND AND ALONG THE WETLAND EDGE

Check any stressors observed in and directly adjacent to the wetland:
Drainage ditch ✓ Tiles___ Dam___ Weir___ Dike___ Tide gate___ Water-control structure___
Oil/chemical spill___ Eroded bank ✓ Direct runoff from farmland___ Direct runoff from lawn__
Direct runoff from impervious surface___ Stormwater discharge___ Other point source discharge___
Exposed soil along wetland edge___ Channelized stream ✓ Dredged canal___ Fill ✓ Mowing___
Tree harvest___ Excessive burning___ Excessive herbivory___ Excessive sedimentation___
Defoliation___ Chlorotic vegetation___ Nutrient enrichment___ Dead/dying woody plants___
Invasive species ✓ Marina___ Golf course___ ATV/mountain bike trails___ Junkyard___ Surface mine ✓ Disposal of garbage/other wastes ✓ Discolored (milky-colored) water___ Odor from water___
Excessive algae___ Beaver dam ✓ Beaver tree removal ✓ Other___(specify_____)

ONSITE FUNCTIONAL ASSESSMENT (Form A-3)
For Wetland #__

A. IDENTIFICATION OF EXCEPTIONAL FEATURES

Is the wetland part of or directly adjacent to an area of special natural resource interest?
Check all those that apply:

1. ✓ Waterbody supporting fish, shellfish, or other species of commercial or recreational importance

   (especially estuaries and salmonid streams, their tributaries, and lakes)
2. ____ Plant species: naturally occurring, persistent populations that are:
   Federally listed: ____ Endangered ____ Threatened ___Special Concern
   (http://www.sararegistry.gc.ca)

   Provincial listed: ____ Endangered ____ Threatened ___ Species Concern (Vulnerable)
   (http://www.gov.ns.ca/natr/wildlife/biodiv/specieslist.htm;
   http://www.speciesatrisk.ca/municipalities/)

   List the species and their rating: _____
   _____
   _____
3. ✓ Plant species: naturally occurring, persistent populations that are rated as: S1, S2, or S3. (county occurrence data: http://www.accdc.com/products/NCounties.htm) SEE APPENDIX A & B

   Provincial Element Rank:
   S1: Critically imperiled in the province because of extreme rarity.
   S2: Imperiled in province because of rarity.
   S3: Rare or uncommon in province.
   S4: Apparently secure in province.
   S5: Demonstrably secure in province.

   List the species and their rating: _____
   _____
   _____
4. ✓ Wildlife species in or using the wetland that are:
   Federally listed: ____ Endangered ✓ Threatened ____Special Concern
   Provincial listed: ____ Endangered ____ Threatened ✓ Special Concern (Vulnerable)

   List the species and their rating: WOOD TURTLE – S3
   _____
   _____
5. ____ Wetland restored or preserved under a conservation easement or other agreement.
6. ____ Wetland restored or created for compensatory purposes from a previous wetland alteration.

7. ____ A public water supply system or other protected water areas (including any contributing watershed designated as protected for public water supply)
(specify:_____) (look under protected water areas online at: http://www.gov.ns.ca/just/regulations/rxaa-1.htm)
8. ___ Floodplain above an urban area or other area with known flooding problems
9. ____ Provincial or Federal fish and wildlife refuges and fish and wildlife management areas, water fowl protection areas, areas designated as significant wildlife habitats, or lands acquired for specific wildlife purpose (e.g., under North American Waterfowl Management Plan)
(specify:_____)
(http://www.gov.ns.ca/natr/wildlife/Thp/disclaim.htm)
10. ____ Provincial or Federally designated Natural Area, Nature Reserve, or Wilderness Area (specify:_____)
(http://www.gov.ns.ca/nse/protectedareas/docs/ProtAreas_map_color.pdf)
11. ____Provincial or Federally designated Beach (specify:_____)
(look under Beaches online at: http://www.gov.ns.ca/just/regulations/rxaa-1.htm)
12. ____ Provincial or Federally designated Park (specify:_____)
13. ____ Canadian Heritage River (specify:_____)
(http://www.gov.ns.ca/nse/protectedareas/docs/ProtAreas_map_color.pdf)
14. ____ Designated RAMSAR wetland of international importance
15. ____ Archeological or historic site as designated by the Provincial and Federal authorities.
(specify:_____)
16. ____ Local public park, forest, trail, or recreation area (specify: _____)

FINDING – Exceptional Features:

Wetland has exceptional qualities: Yes ✓ No ___

B. ONSITE EVIDENCE OF PERFORMANCE OF FUNCTIONS

1. Surface water retention
Check indicators: Standing water ✓ (depth: upto 1m) Water-stained leaves ✓
Water- carried debris ✓ Water marks___ (depth above ground surface_____)
Silt marks___ (depth above ground surface_____), Sediment deposits ✓
Algal deposits___ Iron deposits___ Pit and Mound Topography ✓ Aquatic Plants ✓
Aquatic Invertebrates___ Other___ (specify: AQUATIC FAUNA)

2. Stream flow maintenance
Wetland is the source of a stream: Yes___ No ✓
Wetland is along a headwater stream (order 1 or 2 perennial stream): Yes___ No ✓

3. Nutrient transformation
Soil is a peat or muck: Yes___ No ✓
Soil is a mineral soils with a histic epipedon: Yes___ No ✓
Soil is a mineral soil with a thick dark surface layer: Yes__ No ✓

Wetland is flooded seasonally or longer: Yes✓ No___

4. Carbon sequestration
Soil is a peat or muck: Yes___ No✓
Soil is a mineral soil with a histic epipedon: Yes___ No✓
Soil is a mineral soil with a thick dark surface layer: Yes___ No✓
Plant community is dominated by woody plants: Yes✓ No___
Plant community is dominated by perennial herbs: Yes___ No✓

5. Sediment and other particulate retention
Check indicators: Sediment deposits✓ Silt marks___ Water-carried debris✓

6. Shoreline stabilization
Wetland borders a waterbody: Yes✓ No___
Wetland dominated by woody plants or persistent herbs: Yes✓ No___

7. Coastal storm surge detention
Wetland is under tidal influence: Yes___ No✓
Wetland adjacent to tidal wetland and at low elevation so that it may experience flooding during storms:
Yes___ No✓

8. Provision of fish and shellfish habitat
Wetland is along a waterbody with a depth greater than 2m at low water and either tidally flooded, semipermanently flooded or permanently flooded: Yes___ No✓
Known fish nursery or spawning area: Yes✓ No___
Evidence of shellfish observed: Yes___ No✓
Briefly describe: _____
_____
Evidence of fish observed: Yes___ No✓
Briefly describe: _____
_____

9. Provision of waterfowl and waterbird habitat
Wetland is salt marsh with tidal creeks and neighboring tidal flats: Yes___ No✓
Wetland is freshwater marsh adjacent to open water: Yes✓ No✓ Portion - small <8%
Wetland is swamp with adjacent open water (e.g., beaver pond): Yes✓ No___
Evidence of waterfowl observed: Yes✓ No___
Briefly describe: NOT IDENTIFIED - 1 to 2 Pairs
_____
Evidence of other waterbirds observed: Yes✓ No___
Briefly describe: Blue Heron.
_____

10. Provision of habitat for other wildlife
Wetland contains vernal pools and is surrounded by woodland: Yes✓ No___

Wetland is a wetland complex composed of two or more wetland types: Yes ✓ No___
Wetland is a large wetland surrounded by forest or other natural plant communities: Yes ✓ No___
Logs floating in water (resting areas for turtles): Yes___ No ✓
Evidence of amphibians observed: Yes ✓ No___
Briefly describe: TADPOLES AND FROGS
Evidence of reptiles observed: Yes ✓ No___
Briefly describe: TURTLE NESTS, TURTLE SHELL.
Evidence of other birds observed: Yes ✓ No___
Briefly describe: SONGBIRDS
Evidence of beaver observed: Yes ✓ No___
Briefly describe: 3 BEAVER HOUSES, MANY CUTTINGS, SEVERAL SMALL BEAVER DAMS.
Evidence of muskrat observed: Yes___ No ✓
Briefly describe:
Evidence of other mammals observed: Yes ✓ No___
Briefly describe: DEER, SHREW OR VOLE, RACCOON PRINTS

FINDING - Functions:

Wetland shows evidence of temporarily storing surface water: Yes ✓ No___
Wetland shows evidence of contributing to maintaining stream flow: Yes___ No ✓
Wetland shows evidence of recycling nutrients: Yes ✓ No___
Wetland shows evidence of sequestering carbon: Yes ✓ No___
Wetland shows evidence of retaining sediment and other particulates: Yes ✓ No___
Wetland shows evidence of stabilizing shorelines: Yes ✓ No___
Wetland shows evidence of coastal storm surge detention: Yes___ No ✓
Wetland in a landscape position likely to detain coastal storm surges: Yes___ No ✓
Wetland shows evidence of providing fish and shellfish habitat: Yes ✓ No___
Wetland shows evidence of providing waterfowl and waterbird habitat: Yes ✓ No___
Wetland shows evidence of providing habitat for other wildlife: Yes ✓ No___

C. Plant Community Assessment

Guidance: The plant community assessment incorporates two principal components: diversity and integrity. **Diversity** refers to the number of distinct plant communities representing the wetland. One might give a more floristically diverse wetland a higher rating than a monospecific plant community. **Integrity** refers to the condition of the plant community in comparison to the reference standard for that community. The highest rating can be given to those wetlands that represent the characteristic condition of that wetland type. The degree (e.g., minor versus substantial) and type of disturbance typically play an important role in the diversity/integrity of plant communities. Some native plant communities are maintained by periodic, natural disturbances (e.g., fire and annual floods). For purposes of this

functional assessment, human-induced alterations (e.g., filling, dredging, drainage) are disturbances that are typically detrimental to vegetative diversity/integrity.

Vegetative Diversity and Integrity

1. **Number of plant communities associated with this wetland:** 3
2. **Check the types of plant communities associated with this wetland:**
   Salt Marsh___ Marsh✓ Fen___ Swamp✓ Bog✓
3. **List any dominant species that are non-native or invasive and the estimated cover of each:**

_____

_____

4. **Vegetation disturbance:** Undisturbed/relatively undisturbed✓ Minor___ Severe___
   Nature of disturbance: Harvest✓ Herbicides___ Salt Intrusion___ Grazing___ Mowing___ Reduced Diversity___ Ditching/drainage✓ Impoundment___ Other Altered Hydrology___ Insect Infestation___ Storm Damage___

5. **Vegetation stressed:** Dead woody plants___ Other ___(specify NONE)

6. **Characterize the current vegetative quality of each wetland community comprising at least 10% of the wetland.** Use the following definitions to determine the quality:

Exceptional Quality: Plant community is undisturbed, or sufficiently recovered from past disturbances, such that it represents pre-European settlement conditions. Non-native plant species are absent or, if present, constitute a minor percent cover of the community. Unique features (e.g., old growth forest, never-plowed, rare, T/E species) may also be present. Wetland is undisturbed, surrounded by native plant communities.

High Quality: Community composed of native species characteristic of the wetland type. Invasive species are absent or cumulatively comprise less than 20 percent cover of any stratum.

~~Medium Quality:~~ Community composed mostly of native species characteristic of the wetland type. ~~Invasive species~~ cumulatively comprise 20 to 50 percent cover of a stratum. – POOR DIVERSITY AND DENSITY.

Low Quality: Community where invasive species cumulatively comprise >50 percent cover of any stratum.

FINDING – Plant Community:

Wetland contains a diversity of wetland plant communities: Yes✓ No ___
Vegetative quality rating: Exceptional __ High __ Medium ✓Low __

D. HYDROLOGIC CONDITIONS AND INTEGRITY

Circle or check off the applicable characteristic for the wetland in question.

1. What is the expected water regime for the wetland? Regularly flooded tidal __ Irregularly flooded tidal__ Permanently flooded__ Semipermanently flooded__ Seasonally flooded tidal__ Temporarily flooded✓ Seasonally saturated__ Permanently saturated__ Artificially flooded__

2. Wetland is nontidal and is either the source of a stream or along a headwater stream (perennial stream of order 1 or 2)? Yes___ No✓

3. Describe the wetland surface and subsurface storage capacity and duration:

A = Water storage capacity and duration not altered; wetland retains its ability to maintain its characteristic hydrologic regime.

B = Minor alteration; constructed, reduced capacity outlet below the ground surface of the wetland; moderate indications of subsurface drainage; outlet raised but managed to mimic natural conditions; constructed outlets keep open-water wetlands open water or keep saturated wetlands saturated for some time – the wetland is able to provide some temporary and long-term water retention (i.e. the wetland is only partially drained).

C = Severe alteration; excavated or enlarged outlet constructed well below the ground surface of the wetland; intensive ditch network; strong indications of subsurface drainage; outlet removes most/all long-term and temporary storage; or outlet changes hydrologic regime drastically; signs of scouring/erosion may be present; include situations where the constructed outlet changes the wetland to non-wetland or to deepwater habitat or from saturated conditions to open water or from open water to saturated.

4. Describe water storage. (Will vary per wetland type.)

Majority of area ponds water: >30cm✓ 15-30cm___ up to 15cm___ No ponding___

5. Describe the dominant land use and condition of the immediate upland drainage area of wetland. If the immediate upland drainage is not evident, then within 100 meters. The more developed and intensively the watershed is used, the greater the delivery of runoff and sediments to the wetland is likely to be and the more likely the wetland will have the opportunity to minimize flooding downstream.

A = Watershed conditions essentially unaltered; < 10% impervious (i.e., low density residential, >0.4 hectare lots); land use development minimal, idle lands, lands in hay or forests or low intensity grazing.

B = Watershed conditions somewhat modified; e.g., 10–30 % impervious (i.e., medium density residential, 0.133 to 0.4 hectare lots); moderate intensity grazing or haying with some bare ground; conventional till with residue management on moderate slopes, no-till on steep slopes.

C = Watershed conditions highly modified; e.g., >30 % impervious surfaces (i.e., high density residential, lots smaller than 0.133 hectare, industrial, commercial, high impervious institutional) maximizing overland flow to the wetland; intensive agriculture or grazing with a high amount of bare

ground, no residue management on moderate or steep slopes, intensive mining activities.

6. Describe the condition of the wetland soils:

A = Undisturbed or relatively undisturbed; no signs or only minor evidence of recent disturbance or alteration to the wetland soils; idle land, hayed or lightly to moderately grazed or logged; minimal compaction, rutting, trampling, or excavation damage to wetland.

B = Minor disturbance; some evidence of disturbance or alteration to the wetland soils; wetland heavily grazed in most years; logging or other activities have created some compaction, rutting, trampling, or excavation in wetland is evident.

C = Severe disturbance; evidence of significant disturbance or alteration to the wetland soils; wetland tilled in most (>75%) years; significantly impacted (e.g., fill, sediment deposits, cleared, excavated); logging or other activities (e.g., ATV use) have created severe compaction, rutting, trampling, or excavation damage to wetland.

7. Enter the percent of the wetland that is vegetated with marsh, swamp, bog, or fen vegetation and the percent that is open water.

90+ % vegetated 10- % open water

8. Rate the degree of interspersion (circle answer): High (dense vegetative cover) >75%; Medium (combination some unvegetated open water and vegetative cover) = 25 – 75%; Low (primarily unvegetated open water) = <25%. Isolated wetlands, which are perfect containers of floodwaters, should be rated 100%. VARIES SIGNIFICANTLY BY POND

9. For wetlands along a waterbody and subject to periodic flooding, describe the roughness coefficient of the potential surface water flow path in relation to wetland vegetation biomass, numeric density and plant morphology:

A = Dense shrub understory, heavy stand of timber with or without downed trees, or mature field crops with flow at half or less of crop height.

B = Dense grass with rigid stems, weeds, tree seedlings, or shrub vegetation where flows can be two to three times the height of the vegetation.

C = Primarily flexible turf grass or other supple vegetative cover or unvegetated.

N/A = Not applicable if wetland is isolated.

Significance: Forest cover and other woody stems increase surface roughness resulting in an increased detention of high flows with the cumulative effect being reduced peak flows downstream. A forest with a dense understory is best for detaining high flows. Manning's roughness coefficient decreases as water depth increases above the macrophytes and other surface roughness characteristics. Dense, robust, tall vegetation is best for floodplains. Without a forest present, woody shrubs can be extremely effective but lose effectiveness once high flows approach and exceed the woody shrub height. Dense, non-woody vegetation (e.g., cattails and tall grasses) are effective at detaining minor flood flows but lay down to higher flows and the surface roughness greatly diminishes. Turf grass and other supple vegetation has minimal effects on flood flows. Open water wetlands with submergent and scattered emergent vegetation are part of the channel characteristics and have minimal effect on detaining flood flows.

10. Describe the extent of observable/historical sediment delivery to the wetland from anthropogenic sources including agriculture and developed areas:

A =No evidence of sediment delivery to wetland.

B =Minor evidence of accelerated sediment delivery in the form of stabilized deltas, sediment fans, or sediment deposits on vegetation.

C = Major sediment delivery evidenced by buried A-horizon (through examination of soil profile), recent deposition of water-carried debris, sand and gravel deposits on surface, or recent deltas, sediment plumes, etc. in areas of concentrated flow or sedimentation raising elevation of wetland.

Significance: Wetlands filled by sediment from anthropogenic sources will have reduced capacity to store stormwater. Land use, ground slope, and erodibility characteristics of the soils affect the potential for sediment delivery to the wetland.

11. Describe the predominant upland soils within the wetland's immediate drainage area that affect the overland flow characteristics to the wetland:

A = Sands

B = Silts or loams

C = Clays or shallow to bedrock

Significance: Greater runoff and higher flood peaks occur in watersheds having primarily impermeable soils. These types of soils impede water infiltration and so produce increased runoff. Wetlands located downslope of more impermeable soils are more likely to provide flood attenuation.

12. Describe the characteristics of stormwater, wastewater, or concentrated agricultural runoff detention/water quality treatment prior to discharging into the wetland:

A = Receives significant volumes of untreated/undetained stormwater runoff, wastewater, or concentrated agricultural runoff directly, in relation to the wetland size.

B = Receives moderate volumes of directed stormwater runoff, wastewater, or concentrated agricultural runoff in relation to wetland size, which has received some treatment (sediment removal) and detention.

C = Does not receive directed stormwater runoff, wastewater, or concentrated agricultural runoff; receives small volumes of one or more of these sources in relation to wetland size; or stormwater is treated to approximately the provincial standards; and runoff rates controlled to nearly predevelopment conditions.

Significance: An opportunity metric - wetlands receiving undetained, directed stormwater from developed areas generally provide a higher functional level for flood/stormwater storage than do similar wetlands receiving stormwater at rates of, and with water quality equivalent to, that prior to development.

13. Describe the proportion of wetlands within the provincial primary watershed and the opportunity for contributing to floodwater detention:

(A) Mapped wetlands make up less than 10% of the minor watershed area. 8.8% likely underest.
B = Mapped wetlands make up 10-20% of the minor watershed.
C = Mapped wetlands make up more than 20% of the minor watershed.

Significance: The density of wetlands in the watershed will determine the benefit each provides downstream. Wetlands reduce flood peaks up to 75 percent compared to rolling topography when they occupy only 20 percent of the total basin. When wetland densities in the watershed exceed 20% total cover, the flood storage benefits of additional wetlands rapidly decrease.

14. Describe the functional level of the wetland in retarding or altering flows based on the surface flow characteristics through the wetland:

A = No channels present.
B = Channels present, but not connected, or meandering channels.
(C) Channels connecting inlet to outlet.

Significance: Channels are formed in the underlying substrate, not just as paths through emergent vegetation. Sheet flow, rather than channel flow, offers greater frictional resistance. The potential for floodflow desynchronization is greater when water flows through the wetland as sheet flow. Connecting channels will carry water directly from the inlet to the outlet preferentially in the channel. Channels not connected indicate that some channelized flow may occur within the wetland but not all the way through the wetland via a single channel; some sheet flow will occur. No channels present represents wetlands in which water from the inlet will spread out over the wetland to the outlet (e.g., unchannelized meadows, shallow marshes, deep marshes, ponds, typical floodplains without meander channels, etc.).

15. Water source.

(A = Natural.

B = Mostly natural; some effect from modified hydrology; agricultural lands comprise less than 20% of the contributing watershed or only a few storm drains and scattered homes within 2 km; no large dams upstream.

C = Water affected by urban runoff, artificially impounded water (e.g., in-stream pond), water diversions, or other major alteration

D = Water under direct control of upstream reservoir; water flow not natural.

16. Hydrology of tidal wetlands.

A = Tidal flow unrestricted. NA

B = Tidal flow is reduced but tidal cycle remains normal (e.g., causeway across marsh).

C = Tidal flow is restricted (limited tidal flooding) or altered so that drainage is inadequate (marsh remains flooded during low tide frequently for extended periods)

17. Signs of surface water detention observed.

Standing surface water__✓__ Water-carried debris__✓__ Water-stained leaves__✓__ Water marks__(indicate height of mark above ground surface:_____)

Other__(specify:_____)

FINDING – Hydrologic Condition and Integrity:

Wetland's hydrologic condition: Natural ___ Slightly Modified___ Significantly Modified✓___
Wetland is the source of a stream or along a headwater stream and is therefore important for maintaining stream flow: Yes___ No✓
Wetland's ability to detain surface water: High ___ Moderate ___ Low ✓

E. GROUNDWATER INTERACTIONS

Classification of a given site as a primarily recharge or discharge wetland will be based on how a majority of the questions are answered and does not offer a definitive result as to the actual movement of groundwater in the assessment area. When the primary hydrology comes from groundwater, wetlands are labeled discharge, whereas recharge wetlands are those whose hydrology is primarily supported by surface-water that then seeps into a ground-water system.

1. Describe the soils within the wetland: low?

Recharge = Mineral soils with a high organic content (all soils not included in discharge system).

Discharge = Organic soils, formed due to more continuous wetness associated with a ground water discharge system

Significance: Wetlands with mineral hydric soils typically represent drier hydrologic regimes where groundwater recharge is more likely (i.e. saturated, seasonally flooded, and temporarily flooded) where the wetness does not significantly limit oxidation of organic materials. Groundwater discharge wetlands represent more stable and permanent hydrologic regimes where excessive wetness limits the oxidation of organic matter resulting in the accumulation of peat and/or muck. In addition, coarser-grained mineral hydric soils may have higher permeabilities allowing groundwater recharge, while histosols generally have low permeabilities, reducing groundwater discharge. Disturbed soils in excavated wetlands or stormwater ponds are subject to best professional judgement for this question.

2. Describe the land use/runoff characteristics in the local subwatershed upstream of the wetland:

Recharge = Land is primarily developed to high-density residential, commercial, industrial and road land uses (equivalent to lots 0.10 hectare or smaller) indicating impervious surfaces (>38%), which result in more runoff to wetlands and lowered water tables creating a gradient for recharge under wetlands.

Discharge = Upland watershed primarily undeveloped or with low to moderate density residential development (i.e., lots larger than 0.10 hectare) with low percentage of impervious surfaces (<38%) so upland recharge (to groundwater) and higher water table will be more likely to contribute discharge to wetlands.

Significance: Watersheds with extensive paved surfaces, topographic disruptions, and the presence of wells are associated with human development that lowers the potentiometric contours. Lowered or diversified potentiometric contours enhance the likelihood of recharge, not discharge. Wetlands with unpaved watersheds are more likely to allow groundwater discharge to occur.

3. Indicate conditions that best fit the wetland based on wetland size and the hydrologic properties of the upland soils within 200 meters of the wetland.

Recharge = Wetland is <81 hectares and surrounding soils (within 200m) are primarily: 1) soils having a layer that impedes the downward movement of water, 2) soils of moderately fine texture or fine texture, 3) clays that have a high shrink-swell potential, 4) soils that have a high water table, 5) soils that have a claypan or clay layer at or near the surface, or 6) soils that are shallow over nearly impervious material.

Discharge = Wetland is >81 hectares in size or wetland is <81 hectares and the surrounding soils (within 152m) are primarily: 1) deep, very well drained to excessively drained sands, 2) gravelly sands, or 3) moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture.

Significance: The size or area of the wetland and the soil texture in the surrounding upland are two factors controlling the wetland's water budget. A large wetland with a proportionately small watershed may indicate subsidization of its water budget by groundwater discharge. The probability of groundwater discharge occurring may thus increase as the wetland/watershed ratio increases. The wetland size also controls the amount of recharge potential. The more fine-grained the soil texture in the surrounding uplands, the more water will flow to the wetland via overland flow and less likely water is to flow to the wetland via groundwater discharge. Williams (1968) observed that a small wetland situated in a large watershed favored groundwater recharge, because surface water inflow from a large watershed was sufficient to create a water mound conducive to recharge. Sandy and loamy upland soils allow more infiltration of precipitation than clayey soils. The infiltrated water will percolate downward vertically and/or flow laterally becoming groundwater discharge where wetlands intersect the water table.

4. Indicate the hydroperiod of the wetland:

Recharge = if temporarily flooded, seasonally flooded, seasonally flooded/well drained, seasonally saturated, and intermittently flooded as well as wetlands with the saturated water regime that: 1) are on flats; and/or 2) are acid bogs (indicates precipitation-driven systems).
Discharge = if semipermanently flooded, intermittently exposed, and permanently flooded), as well as wetlands with the saturated water regime that: 1) consist of sloping organic soils; 2) are on a river valley terrace or at the toe of a bluff or beach ridge, etc.; or 3) have any observed springs or seepages.

Significance: Permanently flooded, semipermanently flooded, and saturated water regimes often indicate groundwater discharge to a wetland; exceptions = saturated wetlands on flats or bogs (precipitation-driven systems). Seasonally or temporarily-flooded wetlands are more likely to recharge groundwater.

5. Describe the inlet/outlet configuration that best fits the wetland:

Recharge = No outlet or restricted outlet in natural wetlands, inflow wetlands, and lentic wetlands.
Discharge = Perennial outlet but no perennial or intermittent stream inlet; perennial lotic wetland.

Significance: A wetland with a permanent stream inlet but no permanent outlet is more likely to recharge groundwater than one with an outlet. Several factors support this ranking. First, a higher hydraulic gradient will likely be present in an area with no outlet, especially if an inlet is present. Second, the longer water is retained in an area, the greater the opportunity for it to percolate through the substrate. Third, wetlands without outlets generally experience more water-level fluctuations, resulting in inundation of unsaturated soils. Finally, lack of an outlet suggests that water is being lost either through

recharge or evapotranspiration, especially if an inlet is present. A wetland with a permanent outlet and no inlet is more likely to discharge groundwater than one with other combinations of inlets and outlets. Continuous discharge of water (i.e. permanent outlet) without surface water feeding the wetland through an inlet suggests an internal source of groundwater (e.g., springs or seeps). Throughflow wetlands would be considered discharge wetlands for the purposes of this question.

6. Characterize the topographic relief surrounding the wetland:

Recharge = Land slopes away from (below) the wetland (wetland is elevated in the subwatershed, e.g., at a high point).

Discharge = Topography characterized by a downslope toward the wetland around the majority of the wetland (wetland is found lower in the subwatershed).

Significance: Groundwater discharge is more likely to occur in areas where the topographic relief is characterized by a sharp downslope toward the wetland (i.e. wetland is located at the toe of a slope). Groundwater recharge is more likely in wetlands where the topographic relief is characterized by a sharp downslope away from most of the wetland. The slope of the water table with respect to the wetland influences the hydraulic gradient for groundwater movement. The water table usually slopes roughly parallel to the land surface topography. Thus, when local topography slopes sharply toward the wetland, the result is typically a hydraulic gradient favorable for groundwater discharge.

FINDING – Groundwater Interactions:

Wetland likely serves as a recharge site: Yes___ No✓

Wetland likely serves as a discharge site: Yes✓ No___

F. PROXIMITY TO WATERBODIES AND WATER SUPPLIES

1. Describe the proximity of the first recreational lake, recreational watercourse, spawning area or significant fishery, or water supply source down-gradient of the wetland:

A = Isolated wetlands or wetland with one or more resource within 0.8 km downstream via any form of channel or pipe.
B = One or more resource within 0.8 to 3.2 km downstream.
C = No significant resources are located within 3.2 km downstream.

Significance: The water quality function wetlands provide help disperse the physical, chemical, and biological impacts of pollution in downstream waters. Sensitive water resources located within 0.8 km downstream of the wetland will realize the greatest benefit to water quality from the wetland. As discharges from the wetland move farther downstream, the benefits to water quality provided by the wetland will continue to diminish.

FINDING – Proximity to Waterbodies and Water Supplies:

Wetland is in close proximity to one or more important downstream waterbodies and is likely to help sustain their water quality: Yes✓ No___
Name of important waterbodies: Sackville River, Salmon habitat, kayaking, fishing

G. SIGNS OF NUTRIENT LOADING

1. Does the wetland water quality and/or plant community exhibit signs of excess nutrient loading:

A = No evidence of excess nutrient loading or nutrient sources (e.g. evidence of diverse, native vegetative community, no pipes, etc.).

B = Some evidence of excess nutrient loading source and evidence in the plant communities such as dense stands of invasive species (e.g., purple loosestrife).

C = Strong evidence of excess nutrient loading by evident nutrient sources or evidence in the plant community such as algal mats or excessive growth of emergent, submergent and/or floating macrophytes, or milky-colored or foul-smelling water.

Significance: Excessive nutrient loading to a wetland can cause nuisance algal blooms and the production of monotypic stands of invasive or weed species. Observed point source or nonpoint source of nutrients may include but is not limited to: fertilized lawns, agricultural runoff, manure storage or spreading, concentrated stormwater runoff, or pet waste inputs.

FINDING – Signs of Nutrient Loading:

Wetland has evidence of excess nutrient loading: Yes___ No✓

H. SHORELINE CONDITION AND INTEGRITY

1. Is the wetland fringing deepwater habitat, a lake, or within a watercourse? Yes✓ No___

If "Yes" complete rest of questions in this section; if "No" proceed to next section (Section I).

If a stream, what is the width of the stream? >4m✓ ≤4m___

If a lake or estuary, is the waterbody exposed or sheltered? Exposed___ Sheltered___

Sheltered = waterbody <1000m wide and no regular boat traffic.

Exposed = waterbody ≥1000m or regular boat traffic.

Significance: Open water distances more than 1000m may permit significant fetch that can generate

wave sufficient to cause shoreline erosion.

2. Enter the percent cover of rooted wetland vegetation in the shallow water zone of the waterbody. Main River, High in some ponds.

40 % (High = Macrophyte cover in the wetland >50%; Medium = Macrophyte cover in the wetland is 10% - 50%; Low = Macrophyte cover in the wetland <10%.)

Significance: The erosive strength of waves and currents can be greatly dissipated by a dense vegetation cover including submerged macrophytes. The greater the vegetation density, the greater the shoreline protection.

3. Enter the average vegetated wetland width in meters between the shoreline/streambank and deep water/stream: >10 meters (High = Wetland width >10m ; Medium = Wetland width 3-10m ; Low = Wetland width <3m)

Significance: Deep water is defined by a depth of 2 meters or more. Wetlands with wide stands of vegetation are more likely to stabilize sediments than those with narrow stands. Knutson et al. (1981) found that wetlands wider than 10m reduced wave energy by 88% while emergent wetlands less than 2m wide were relatively ineffective in wave buffering. Measure width starting from the deepwater edge up to the normal water's edge, do not include the exposed shore (out of the water itself).

4. For marshes and fens/wet meadows along waterbodies, describe the emergent vegetation type and resistance within the shoreline wetland: N A

A = Dominance of emergent species with strong stems present all year and/or dense root mats in the wash zone (e.g., cattails, shrubs) that are resistant to erosive forces.

B = Presence of some emergent species with strong stems or dominance of weak-stemmed emergent species persisting most of the year and/or moderately dense root mats in the wash zone (e.g., bulrushes, grasses) that are resistant to erosive forces.

C = Presence of some weak-stemmed emergent species and/or no dense root mats in the wash zone (e.g., rushes).

Significance: The erosive strength of waves and currents can be greatly dissipated by a dense, emergent vegetation cover. In addition, species with stronger stems will provide greater protection than weak-stemmed species. The greater the vegetation density, the greater the shoreline protection.

5. Describe the shoreline erosion potential at the site:

A = Strong wave action or water current (e.g., most tidal wetlands, lentic wetlands facing greatest wind fetch on a lake or lotic wetlands on outside river bend); frequent boat traffic and restrictions that funnel boats into narrow passages; sandy soils or evidence of erosion or slope failure.

B = Moderate wave action or water current (e.g., tidal wetlands in protected coves, wetlands in small lakes or large ponds); moderate boat traffic with some evidence or potential for erosion or slope failure.

in between, River energy @ top erodic banks. Stable DS.

C = Negligible erosive forces (little open water or wave action or slow-moving, straight river); minimal

to no boat traffic or no-wake zone; no evidence of past erosion or slope failure.

Significance: Wetlands located in areas with strong currents and wave action have the greatest potential for protecting shoreline. Shorelines composed of sandy or erodible soils will benefit the most from shoreline wetland protection.

6. Describe the shoreline/streambank vegetation conditions up slope from the water level in relation to the ability to protect the bank from erosion or slope failure:

A = Lack of vegetation; regularly manicured, short-grass lawn.

B = Full vegetative cover composed of shrubs receiving only moderate maintenance or grasses/understory vegetation that is not manicured.

C = Deep-rooted vegetation not actively manicured (e.g., trees, shrubs and grasses).

D = Shoreline artificially protected by rip-rap or bulkhead.

Significance: The potential for erosion and/or slope failure of shoreline or streambank areas is also dependent on the land use and condition on the slope above the water level and on top of the bank. Bare soils or those with shallow rooted grasses that are manicured on a regular basis provide less protection than deep-rooted grasses allowed to grow naturally. For this question, consider that part of the wetland starting at the water's edge up to the upland edge, to encompass the shore area up out of the water itself.

FINDING – Shoreline Condition and Integrity:

Condition of shoreline: High ___ Moderate ✓ Low ___ MOVING TOWARD GREATER STABILITY WITH TIME.

Wetland's ability to stabilize shoreline: High ✓ Moderate ___ Low ___ N/A___

I. PROVISION OF FISH AND WILDLIFE HABITAT & HABITAT INTEGRITY

1. Is the wetland known to be used recently by rare wildlife species or wildlife species that are provincially or federally listed? Yes___ No✓ If yes, wildlife habitat rating = exceptional.
BUT SUSPECTED - WOODTURTLE.

2. For freshwater marshes or shallow open water-wetland types select the cover category that best illustrates the interspersion of open water and emergent, submergent, or floating-leaved vegetation within the wetland. High___ Medium✓ Low___ N/A___(Not applicable for other wetland types) IN SOME PONDS

What is the ratio of this vegetation to open water? 30%

Significance: Wetlands that contain vegetation interspersed with open water are more likely to support notably greater on site diversity and/or abundance of fish and wildlife species. Those with very dense vegetation and no channels or open water areas are less likely to support this function. Vegetation interspersion is a measure of the amount of edge between vegetation and open water, which is valuable to wildlife.

3. For wetlands having more than one vegetative community, indicate the interspersion category that best fits the wetland. High___ Medium✓ Low___ N/A = Only one community is present.

Significance: For wetlands that are characterized by multiple vegetative communities, the increased structural diversity and amount of edge associated with greater interspersion is generally positively correlated with wildlife habitat quality.

4. A healthy wetland will have detritus (vegetative litter) in several stages of decomposition. Describe the wetland condition:

A = The presence of litter layer in various stages of decomposition.

B = Some litter with apparent bare spots, or dense litter mat. between B-C

C = No litter layer.

N/A = Not applicable for marshes, shallow open water and bog communities.

Significance: Detritus or vegetative litter in various stages of decomposition is a sign of a healthy wetland. Detrital biomass impacts nutrient cycling processes and disturbance regime and thereby influences plant assemblages. Detritus maintains thermal regulation of rhizomes and propagules, and is essential to nutrient cycling. The integrity of the system's vegetation components supplies the bulk of the faunal habitat requirements. When assessing a site, consider that the amount of detritus will vary with the time of year; floodplain forests may show no litter after spring flood events, for example.

5. Describe the relative interspersion of various wetlands in the vicinity of the assessment wetland:

A = The wetland occurs in a complex of wetlands of various types (general guideline: at least three wetlands within 0.8 km of assessment wetland, at least one of which has a different dominant plant community than the assessment wetland); or the assessment wetland is the only wetland within a 3.2 km radius.

B = Other wetlands of the same plant community as the assessment wetland are present within 0.8 km.

C = No other wetlands are present within 0.8 km of the assessment wetland but are present within 3.2 km.

Significance: This question rates wetlands higher for having more wetland neighbors, recognizing, however, that research indicates that the critical radius varies by species. Wetlands that are isolated in the landscape may provide the last refuge for wetland dependent plant and animal species in an otherwise upland or developed area.

6. Habitat value diminishes when fragmented by barriers, which restrict wildlife migration and movement. Describe barriers present between the wetland and other habitats:

A = No barriers or minimal barriers present; i.e., low traffic; uncurbed roads, low density housing (> 0.4 hectare lots), golf courses, utility easements, or railroads.

B = Moderate barriers present; i.e., moderately traveled; curbed roads, moderate density housing (0.133 to 0.4 hectare lots), residential golf courses, low dikes, row crops.

C = Large barriers present; i.e., four-lane or wider, paved roads, parking lots, high-density residential (<0.133 hectare), industrial and commercial development.

Significance: This variable serves as a measure of habitat fragmentation of the wetland relative to other wetlands and native plant communities to indicate the ecosystem connectivity. It identifies barriers to wildlife migration ranging from very small barriers such as unpaved roads and low-density housing to large hydrologic barriers such as regional canals and levied roads. Reference area will affect this rating: "other habitats" includes upland areas usable as wildlife resting or reproductive habitat. For this question, cropland is not considered "habitat."

7. Amphibian breeding potential – hydroperiod (check one)

_✓_ Adequate; the wetland is inundated long enough in most years to allow amphibians to successfully breed

___ Inadequate; the wetland is not inundated long enough in most years for amphibians to successfully breed

Significance: Frogs, toads and salamanders reproduce at different times from late March into June, depending on the species. Early breeders (such as spring peepers, wood frogs, and salamanders) typically reproduce in shallow, seasonal wetlands. Green frogs reproduce in larger more permanent wetlands. For breeding to be successful, the wetland must remain inundated long enough for the larval stages to metamorphose into adults. Direct evidence of amphibian breeding may be an indication of a sufficient hydroperiod. Such evidence would include observations of frogs calling, egg masses in the water, presence of tadpoles or presence of young, newly metamorphosed frogs, toads or salamanders at the wetland. Note however, that some species are opportunistic and will lay eggs in temporary pools that will not remain inundated long enough for successful reproduction. Exercise caution when using this indicator.

8. Amphibian breeding potential – fish presence

A = Wetland is isolated so that predatory fish are never present.

(B) = Wetland may occasionally be connected to other waters; predatory fish may be present in some years.

C = Wetland is connected with a lake or river so that predatory fish are always present or the wetland is used for rearing of game fish.

Significance: Optimal amphibian breeding habitat is characterized by a lack of predatory fish. These habitats are wetlands that winterkill, dry periodically, are periodically anoxic, and are not connected to waters bearing predatory fish. The wetland should not be used to rear bait or game fish. This question utilizes observable characteristics of the wetland to infer about the status of fish. Direct observation or knowledge about fish presence should be substituted where possible.

9. Observed amphibian presence

Species observed in the wetland: Am. TOAD, Pickerel Frog, Green Frog.

Species heard calling: _____

Species with juveniles observed: Green Frog, American Toad

10. Amphibian and reptile overwintering habitat

A = Wetland is normally more than 1.5 meters deep (never or rarely winterkills).

B = Wetland is normally around 1 meter deep (may occasionally winterkill).

C = Wetland is normally less than 1 meter deep and often freezes to the bottom.

N/A = Wetland never or rarely contains standing water or is nearly always dry in winter.

Significance: Wetlands that are deep and well oxygenated provide overwintering habitat for leopard, green and mink frogs, as well as turtles. Evidence of over-wintering would be observations of migrations of frogs to the wetland in fall and away from the wetland in spring and basking turtles in the spring.

11. List any other noteworthy wildlife species observed or in evidence (e.g., tracks, scat, nest/burrow, calls, viewer reports), including birds, mammals, and reptiles (e.g., breeding, forage, resting, overwintering). *(Note: This list is for documentation only and is not necessarily an indication of habitat quality.)*

Duck Pair (2), Blue heron, Deer (Doe + Fawn), wood turtle shell, turtle nests, beaver, raccoon.

12. Is the wetland contiguous or intermittently contiguous with a permanent waterbody or watercourse such that it may provide spawning/nursery habitat for native fish species? Choose the condition from the following list that best describes the wetland in relation to fish habitat:

Exceptional = Wetland is a known spawning habitat for native fish of high importance/interest.

A = Wetland is lentic, lotic or estuarine or is otherwise contiguous with a permanent waterbody or watercourse and may provide spawning/nursery habitat, refuge for native fish species in adjacent waters, or provides shade to maintain water temperature in adjacent lakes, rivers or streams.

B = Wetland is intermittently connected to a permanent waterbody or watercourse that may support native fish populations as a result of colonization during flood events, or the wetland is isolated and supports native, non-game fish species.

C = Wetland is isolated from a permanent waterbody or watercourse or has exclusive high carp populations, which cause degradation to the wetland.

N/A = None of the above. Wetland does not have standing water during most of the growing season; site is not capable of supporting fish.

Significance: Generally, the value of a wetland for fish habitat is related to its connection with deepwater habitats. A wetland should be rated as having high value for fish if it provides spawning/nursery habitat, or refuge for *native* fish species in adjacent estuaries, lakes, rivers or streams. Some isolated deep marshes may intermittently support populations of sunfish and northern pike as a result of colonization during flood events. Permanently flooded isolated wetlands that support native populations of minnows provide moderate value. Wetlands with exclusive, high carp populations provide low value for fish

habitat because carp cause extreme degradation of the wetland. Isolated wetlands that are not permanently flooded do not generally support fish populations.

13. List any fish species observed or evidenced. *Note: This list is for documentation only and is not necessarily an indication of habitat quality.*

NIL

14. Is the wetland contiguous with a permanent waterbody or watercourse such that it may provide habitat for shellfish species? Choose the condition from the following list that best describes the wetland in relation to fish habitat:

Exceptional = Wetland is a known habitat for shellfish of high recreational or commercial importance.

A = Wetland is estuarine, or a semipermanently flooded lentic or lotic wetland and may provide or support shellfish habitat.

B = Wetland is along a permanent waterbody or watercourse and seasonally flooded and may support shellfish populations in that waterbody.

C = Wetland is isolated from a permanent waterbody or watercourse or the wetland does not have standing water during most of the growing season and is not capable of supporting shellfish.

15. List any shellfish species observed or evidenced. *Note: This list is for documentation only and is not necessarily an indication of habitat quality.*

NIL

16. Is the wetland part of a wildlife corridor or designated environmental corridor? Yes___ No✓

17. Wetland is part of a large block of contiguous upland or wetland: >50ha✓ 25-50ha___ 10-25ha___ <10ha___

FINDING – Provision of Habitat and Habitat Integrity:

Wetland provides habitat for: Amphibians and reptiles ✓ ***Waterfowl*** ✓ ***Waterbirds*** ✓
Mammals ✓ ***Fish*** ✓ ***Shellfish*** ?
Overall habitat quality: High ✓ ***Medium*** ___ ***Low*** ___
Explain if rated low: _____

_____

J. VISUAL, RECREATIONAL, AND EDUCATIONAL OPPORTUNITIES

1. Does the wetland provide a unique or rare educational, cultural, or recreational opportunity (e.g., located in an outdoor learning park focused on wetland study)? Yes___ No ✓ (If yes this function rates exceptional)

2. Is the wetland visible from vantage points such as: roads, waterways, trails, houses, and/or businesses?

A = Wetland is highly visible and can be seen from several public vantage points.
B = Wetland is somewhat visible and can be seen from a few vantage points.
(C) = Very limited visibility.

Significance: While dependent on accessibility, a wetland's functional level could be evaluated by the view it provides observers. Distinct contrast between the wetland and surrounding upland may increase its perceived importance. Multiple vantage points increase the likelihood and number of people that may view the wetland.

3. Is the wetland in/near a city, town, or village so as to generate aesthetic/recreation/ educational/cultural use? Yes ✓ **No**___

Significance: Accessibility of the wetland is key to its aesthetic or educational appreciation. Thus, proximity to population centers may increase its perceived importance. However, proximity to population centers and locations in public areas may have associated noise and/or pollution factors that could degrade the aesthetic and educational functional level.

4. Is any part of the wetland in public or conservation ownership?

(A) = Completely contained within publicly owned land or entirely within a conservation easement.

B = Partially within publicly owned land or partially within a conservation easement.

C = Privately owned or not within a conservation easement.

Significance: Wetlands located on lands in public ownership inherently will provide open accessibility. Wetlands being on lands within a conservation easement provides some certainty that the wetlands will not be subject to impact pressures.

5. Does the public have access to the wetland from public roads or waterways?

A = Direct access through a public facility with an established parking area or boat access.

B = Cumbersome access from a public facility (i.e. no established trails to or near wetland) or no public parking or boat access available.

C = No public access available. Accessible by river, but not permitted on DND property.

Significance: Accessibility of the wetland is key to its aesthetic or educational appreciation. Wetlands located on private lands are not likely to provide aesthetic or educational opportunities to the general public.

6. What are the obvious human influences on the wetland itself, such as:

A = No structures, pollution, trash, or other alteration present in the wetland.

B = Wetland only moderately disturbed by structures, pollution, trash, or alteration.

C = Wetland has signs of extensive pollution/trash, severe vegetative alteration, or multiple structures.

Significance: Wetlands subject to direct human disturbances/impacts are not likely to provide aesthetically pleasing natural environments.

7. What are the obvious human influences on the viewshed of the wetland, such as:

A = No or minimal buildings, roads, or altered land uses surrounding the wetland.

B = Surrounding area composed of mostly open space with a few buildings or roads, low intensity agriculture.

C = Wetland surrounded by residential, other intensively developed land uses, or intensive agriculture.

Significance: This assumes that the most appealing views of wetlands are from other areas of natural beauty such as an upland forest Wetlands occurring in densely developed urban areas equate with lower ratings. Excessive noise from nearby highway or factories could be considered an intrusive human influence.

8. Does the wetland and buffer area provide a spatial buffer between developed areas?

A = Spatial buffer more than 150m wide.
B = Spatial buffer between developed areas less than 150m wide.
C = Does not provide a spatial buffer—no developed land near the wetland.

Significance: Views of open water and open space in general are considered to be aesthetically appealing. Distinct contrast between the wetland and surrounding upland may increase its perceived importance. Expansive wetlands and associated buffer areas provide open space and a feeling of a natural environment while reducing the visibility of adjacent human development. If the wetland is surrounded by undeveloped land within its immediate viewshed, the wetland has little value as a spatial buffer. Developed lands across any portion of the wetland will benefit from the spatial buffering of the wetland. Spatial buffer is measured from the edge of the developed area, across the wetland, to the edge of the next developed area. The edge may be considered the end of manicured lawn or golf course, sidewalk or paved area, or to a wall or fence.

9. Is the wetland and immediately adjacent area assumed to be currently used for (or does it have the potential to be used for) recreational activities such as the following: education, cultural, scientific study, hiking, biking, skiing, hunting, fishing, trapping, boating, canoeing, wildlife observation, exploration, play, photography, or food harvest.

A = Evidence or a high probability for multiple recreational uses.
B = Evidence of or a high probability for a few recreational uses.
C = Low probability or potential for recreational use

FINDING – Visual, Recreational, and Educational Opportunities:

Wetland provides significant visual attraction: Yes___ No✓
Wetland provides significant opportunities for recreation: Yes___ No✓
Wetland provides significant opportunities for environmental education: Yes___ No✓

LIMITED TO EACH, BUT containing potential.

K. USE OF WETLAND FOR COMMERCIAL PURPOSES

1. Is the vegetation or hydrology currently controlled or modified to sustain a commercial product?

A = Highly sustainable use: commercial use of the wetland does not permanently alter the wetland characteristics.

B = Somewhat sustainable use: wetland characteristics have been altered but vegetation is still hydrophytic such as commercial cranberry bogs.

C = Hydrology dramatically altered to produce a commercial product such as row crops or peat (including tile-drained hayfields).

N/A = This wetland is not used for commercial products.

Significance: Sustainable uses of the wetland would not require modifying a natural wetland. Products in this category would include collection of botanical products, wet native grass seed, floral decorations, wild rice, black spruce, tamarack, and firewood. Other sustainable uses may require modification of the natural hydrology, such as for wetland-dependent crops that rely on the wetland hydrology for part of their life cycle (e.g., cranberries). Haying and grazing are less intrusive agricultural activities utilized more or less casually when hydrologic conditions permit; light pasture and occasional haying might be considered highly sustainable [A], whereas heavier use would result in a rating of [B]. Row crops can be planted in some wetlands after spring flooding has ceased and still have adequate time to grow to maturity. Peat-mining, cropping and tile-drainage to create pastures or hayfields are unsustainable uses of the wetland that result in severe alterations of wetland characteristics (soil, vegetation, hydrology).

FINDING – Use for Commercial Purposes:

Wetland provides commercial products: Yes___ No✓

L. BUFFER CONDITION AND INTEGRITY

1. Adjacent Buffer width: Average width of the naturalized buffer: >100 meters

Significance: Vegetated buffers around wetlands provide multiple benefits including wildlife habitat, erosion protection, and a reduction in surface water runoff. A naturalized buffer is an unmanicured vegetated area immediately adjacent to the wetland boundary, so do not include lawn areas. If the buffer varies from one side to another, take the average width over the entire perimeter.

Widths for Water Quality	**Widths for Wildlife Habitat**
High = >15 meters	High = >100 meters
Medium = 8 – 15 meters	Medium = 15-100 meters
Low = <8 meters	Low = <15 meters

TO RATE THE NEXT THREE FEATURES, consider a 15-meter ring around the wetland or assessment area (this area = "Adjacent Area"). Describe the condition (minimum 10%) of each category. Total for each question must equal 100%.

2. Adjacent area management: average condition of vegetative cover for water quality.

100 %Full vegetative cover

___%Manicured, primarily vegetated (i.e., short-grass lawn, mowing, haying, spraying or burning)

____%Lacking vegetation: bare soil or cropped, unfenced pasture, rip-rap, impervious/pavement.

3. Adjacent area diversity and structure (composition of characteristics for habitat)

100 %Full coverage of native non-invasive vegetation

____%Mixed native/non-native vegetation, moderate density coverage, or dense non-native cover

____%Sparse vegetation and/or impervious surfaces

Significance: Many wetland-associated wildlife utilize upland areas for breeding, nesting, and foraging activities. Quality of the upland will affect the diversity and stability of the wetland wildlife community. This question combines estimates of both diversity and density—most wetlands will fall in the middle.

4. Adjacent Upland Slope

60 % gentle slopes, 0-6%

40 % moderate slopes, >6-12%

____% steep slopes, >12%

Significance: Gentle slopes are associated with greater use by wildlife and also are less likely to erode. This measurement is best estimated on site.

FINDING – Buffer condition and integrity:

Buffer integrity rating for this wetland: High ___ Moderate ✓ Low ___
Buffer supports water quality: Yes ✓ No ___
Buffer supports wildlife habitat: Yes ✓ No ___

Annex C

Federal Consultation Correspondence:

- **Department of Fisheries**
- **Environment Canada**
- **Transport Canada**

Andrew McIntosh

From: Lisa.MacIsaac2@forces.gc.ca
Sent: Sunday, December 04, 2011 10:37 AM
To: deviner@dfo-mpo.gc.ca
Cc: Kurt.McAllister@dfo-mpo.gc.ca; Jeremy.Gammon@forces.gc.ca; PETTRJ@gov.ns.ca; amcintosh@maritimetesting.ca
Subject: FW: FCR Sacville compensation project
Attachments: 20111202141119776.pdf; _Certification_.txt

Follow Up Flag: Follow up
Flag Status: Flagged

Hi Rick,

Could you please provide more information on your concerns or requirements for the project. I understand from your response that you do not anticipate being an RA, however:

1. Does DFO have more info/advice to provide?

2. Does the Province need any permits from DFO? (assume no, if you are not anticipating being an RA) 3. Also, you indicate that you do not have enough information (question 4) - I am not sure what else we can provide you...can you review and let me know what else you need.

4. Do you want to be informed of the project, or are there any other mitigation you wanted in the EA?

We are looking at finalizing this EA very soon.

Thanks

Lisa

-----Original Message-----

From: Devine, Richard [mailto:Richard.Devine@dfo-mpo.gc.ca]

Sent: Friday, 2, December, 2011 14:13 PM

To: MacIsaac LA@Marlant HQ N48 Formation Safety and Environment@Halifax

Cc: McAllister, Kurt D

Subject: FCR Sacville compensation project

Hi Lisa,

Sorry for the delayed response here is the FCR form completed. I will be out of the office till December 16th but will be checking emails. Any questions email me and I will respond. I am very familiar with the project.

Thanks

Rick Devine, B.Sc.

>Habitat Protection & Sustainable Development Division / Protection de

>l'Habitat et Développement Durable Oceans, Habitat, and Species at Risk

>Branch / Direction des océans, de l'habitat et des espèces en péril

>Fisheries and Oceans Canada / Pêches et Océans P.O. Box 1006 / C.P.

>1006 Dartmouth, Nova Scotia / Dartmouth, Nouvelle-Ecosse B2Y 4A2 Office

>/ Bureau: 902-426-7818 Cell / Mobile : 902-222-0689 Fax : 902-426-1489

>E-mail / Internet: deviner@dfo-mpo.gc.ca

Annex C
to MARL: 1262-7 (N48)
23 September 2011

RA RESPONSE FORMS

Sackville River Wetland Compensation Project at the Bedford Rifle Range, NS.

We request that you inform this office within 14 days upon receipt of this notice if your department or agency:

1) Has now or anticipates identifying on the basis of information supplied to date, a responsibility under section 5 of CEAA to assess the environmental effects of the project (i.e. is there a trigger).

Yes ( ) No (✓)

2) Can provide specialist advice with respect to an environmental assessment of the proposed project pursuant to section 12(3) of CEAA to a responsible authority.

Yes (✓) No ( )

3) Will provide DND with technical or scientific advice and or comments on the issues raised by this project, based on the information supplied to date (please provide details including other federal legislative and/or policy requirements).

Yes (✓) No ( )

4) Does not have sufficient information to enable you to identify any concerns related to your mandate. Please clearly identify additional requirements below.

Yes (✓) No ( )

Annex C
to MARL: 1262-7 (N48)
September 2011

Additional Requirements

All departments or agencies are requested to sign the signature block and date below and fax the response to the office within the time frame specified.

Rick Devine
Signature of Department Responder

Rick Devine
Print Name

Habitat Biologist
Title of Responder

December 02 2011
Date

Andrew McIntosh

From: Lisa.MacIsaac2@forces.gc.ca
Sent: Thursday, October 06, 2011 12:10 PM
To: PETTRJ@gov.ns.ca; amcintosh@maritimetesting.ca
Subject: FW: Sackville River Wetland Compensation Project at the Bedford Rifle Range, NS (2011-298)

Follow Up Flag: Follow up
Flag Status: Flagged

EC Response

From: McCracken,Ian [Dartmouth] [mailto:Ian.McCracken@EC.GC.CA]
Sent: Thursday, 6, October, 2011 12:06 PM
To: MacIsaac LA@Marlant HQ N48 Formation Safety and Environment@Halifax
Cc: Corkum,Jeffrey [Dartmouth]; Gautreau,Rachel [Sackville]
Subject: Sackville River Wetland Compensation Project at the Bedford Rifle Range, NS (2011-298)

Lisa,

The Canadian Wildlife Service of Environment Canada (EC) has reviewed the proposed wetland compensation project at the Bedford Rifle Range and is of the opinion that the it constitutes a well considered compensation plan.

EC would appreciate the receipt of reports as the project progresses to gain insight from the experiences of the Nova Scotia Department of Transportation and Infrastructure Renewal.

Regards,

Ian

Ian McCracken
Environmental Assessment and Marine Programs
Environmental Protection Operations Directorate - Atlantic
Environmental Stewardship Branch
Environment Canada
45 Alderney Drive, 16th Floor
Dartmouth, Nova Scotia B2Y 2N6
ian.mccracken@ec.gc.ca
Telephone 902-426-9662
Facsimile 902-426-8373
Government of Canada
Website www.ec.gc.ca

Ian McCracken
Évaluation environnementale et programmes marins
Direction des activités de protection de l'environnement – Atlantique
Direction générale de l'intendance environnementale
Environnement Canada
45 promenade Alderney, 16e Étage
Dartmouth, Nouvelle-Écosse B2Y 2N6
ian.mccracken@ec.gc.ca
Téléphone 902-426-9662
Télécopieur 902-426-8373
Gouvernement du Canada
Site Web www.ec.gc.ca

Andrew McIntosh

From: Lisa.MacIsaac2@forces.gc.ca
Sent: Tuesday, October 25, 2011 3:01 PM
To: Lisa.MacIsaac2@forces.gc.ca; PETTRJ@gov.ns.ca
Cc: amcintosh@maritimetesting.ca; Jeremy.Gammon@forces.gc.ca
Subject: RE: Update on FCR Determination: Sackville River Wetland Compensation Project - Bedford Rifle Range - NS (8200-05-2079)

Follow Up Flag: Follow up
Flag Status: Flagged

wrt the timeline question I asked, they have replied with the following:

At this point we could not give timelines. However we are working within a new "NWPP Modernization Pilot Project" which has guidelines for application processing. The timeframes start once we have a complete application but does not include time periods where the NWP is looking for info from outside the program, public comments, advertising, Aboriginal consultation etc. Presently the timeframe is 30 days to process a complete application within the NWPP review. This is flexible(and slower) at this point since it is a pilot project but that would be our goal.
Stan.

From: MacIsaac LA@Marlant HQ N48 Formation Safety and Environment@Halifax
Sent: Tuesday, 25, October, 2011 14:58 PM
To: 'Bob Pett'
Cc: 'Andrew McIntosh'; Gammon JP@Marlant HQ N48 Formation Safety and Environment@Halifax
Subject: FW: Update on FCR Determination: Sackville River Wetland Compensation Project - Bedford Rifle Range - NS (8200-05-2079)

Hi Bob,

Please see email traffic below. Nav Waters has requested the attached application be completed and submitted. Could you please complete this requirement from your office and keep us in the loop.
The application will not affect the EA, however it may slow down your project.

I believe this was the last response we were waiting for the project wrt the EA, therefore, please submit the draft EA for our review at your convenience. The EA needs to state that an application will be submitted and that the project will proceed only after any nav waters direction are satisfied...or wording similar to that.

Thanks!
Lisa

From: MacIsaac LA@Marlant HQ N48 Formation Safety and Environment@Halifax
Sent: Tuesday, 25, October, 2011 14:36 PM
To: 'Myers, Stanley'
Cc: Gammon JP@Marlant HQ N48 Formation Safety and Environment@Halifax
Subject: RE: Update on FCR Determination: Sackville River Wetland Compensation Project - Bedford Rifle Range - NS (8200-05-2079)

Hi Stanley,

Thank you for the quick response. I will contact the Province to discus and we will get back to you (it is a Provincial project).
Can you give me an idea of the timelines - once we submit the application, how long do you think it will take for a decision?

The Province has contracted a consultant to complete the EA. It is registered on CEAR (CEAR #: 11-01-62942).

Thanks
Lisa

From: Myers, Stanley [mailto:stanley.myers@tc.gc.ca]
Sent: Tuesday, 25, October, 2011 13:29 PM
To: MacIsaac LA@Marlant HQ N48 Formation Safety and Environment@Halifax
Cc: Navigable Waters Protection Program - Maritimes/Programme de protectiondes eaux navigables - maritimes; Prentiss, Jon
Subject: RE: Update on FCR Determination: Sackville River Wetland Compensation Project - Bedford Rifle Range - NS (8200-05-2079)

Hi Lisa,
Although access is not permitted from DND property as you have indicated, it is our understanding that the public is not challenged when using the Sackville river and continue their navigation through the DND property in the course of navigating the river. We have been in contact with users who indicate that they regularly canoe/kayak this particular stretch of the river and know that the range is in use when the red flags are flying. Therefore it would be our opinion that the public has access and use the waterway for navigation.
Having said that, the users have indicated that they welcome rehabilitation of the river. "Not likely" to require an EA is an indication that the NWP Program based on the information provided would consider this project as an "other than substantial" interference to navigation, however an application is required.
Do not hesitate to call if you require anything further.
Stan.

From: Lisa.MacIsaac2@forces.gc.ca [mailto:Lisa.MacIsaac2@forces.gc.ca]
Sent: October 25, 2011 12:25 PM
To: Myers, Stanley
Cc: Navigable Waters Protection Program - Maritimes/Programme de protection des eaux navigables - maritimes
Subject: RE: Update on FCR Determination: Sackville River Wetland Compensation Project - Bedford Rifle Range - NS (8200-05-2079)

Hi Stanley,

I need a bit more clarification on this one.

Based on previous emails, the SR, at the DND property, is not navigable due to DND's "ownership" of that stretch of the river/property. Access to the public is not permitted, therefore not navigable, therefore without navigable water, is there any reason to submit the application?

Please clarify - I am not clear on the grounds to which a permit would be required.

If it easier to call - please do so - 902-721-5486.

Thanks
Lisa

From: Myers, Stanley [mailto:stanley.myers@tc.gc.ca]
Sent: Tuesday, 25, October, 2011 12:08 PM
To: MacIsaac LA@Marlant HQ N48 Formation Safety and Environment@Halifax
Cc: Navigable Waters Protection Program - Maritimes/Programme de protectiondes eaux navigables - maritimes
Subject: "":Update on FCR Determination: Sackville River Wetland Compensation Project - Bedford Rifle Range - NS (8200-05-2079)

Good afternoon Lisa,
Just to follow up on Jason's comment, although an Environmental Assessment is not likely to be required, as indicated previously a NWPA application should be submitted for review for any works placed "in, on, over, under, through or across" a navigable water. I have included the application guide and sample plans to assist you with your application.
Hope this helps to clarify things for you.
Regards, Stan.

Stanley J. Myers

Navigable Waters Protection Program | Programme de protection des eaux navigables
Maritimes | Maritimes
Transport Canada | Transports Canada
Atlantic Region | Région de l'Atlantique
P.O. Box 1013, Dartmouth | C.P. 1013
Dartmouth N. S. | N. - É. B2Y 4K2
stanley.myers@tc.gc.ca
Tel./Tél.: 902-426-2726 | Fax/Téléc.: 902-426-7585
http://www.tc.gc.ca/marinesafety/oep/nwpp/menu.htm
Government of Canada | Gouvernement du Canada

National Défense
Defence nationale

Maritime Forces Atlantic
PO Box 99000 Stn Forces
Halifax NS B3K 5X5

MARL: 1262-7 (N48)
TD: 2011-000619

23 September 2011

Fisheries and Oceans Canada
Referrals Secretariat (Habitat, Maritimes Region)
B505, 5th Floor
PO Box 1006
1 Challenger Drive
Dartmouth NS B2Y 4A2
fcrmaritimes@mar.dfo-mpo.gc.ca

Dear Sir/Madam:

This letter serves to formally notify your Department of an environmental assessment (EA) screening being conducted for the Department of National Defence (DND) for the proposed project identified as: **Sackville River Wetland Compensation Project at the Bedford Rifle Range, Nova Scotia (CEARIS # 11-01-62942).**

This project is subject to an EA under the *Canadian Environmental Assessment Act*. An EA is considered a self-directed process and as such, the responsibilities of DND, as the Responsible Authority (RA), include:

- determining the scope of the EA;
- ascertaining the factors to be considered;
- directly managing the EA; and
- ensuring that an EA report is prepared.

In accordance with the Federal Coordination Regulations, DND has the responsibility as the RA to provide written notice to federal authorities that are likely to exercise a power in respect to the project or be in possession of specialist or expert information that is necessary to conduct the EA for the project. DND may use this information to determine the scope of the project, the scope of assessment, and the necessity for public consultations.

Canada

The Department of Fisheries and Oceans is responsible for administering several statutes focused on protecting water environments, as well as promoting several policies and programs that aid federal departments in the management of their habitats and water resources; therefore, your department was identified as an expert federal authority and potential RA for this project.

The enclosed Annexes A and B provide background to the project to assist you in determining your Department's role in this EA. At this time we request that you review the information and provide a written response, detailing your potential role in the EA for this project, as well as any concerns, comments or other information which will assist in the EA.

DND request that you complete the Response Form (Annex C), including any associated documentation, letters or advice etc. and forward your response to the point of contact by **4 October 2011**. Should you require additional information respecting the project, please forward your request to this office within 10 days of receipt of this letter.

The response can be sent to the following contact (email preferred):

Lisa MacIsaac
Staff Officer, Environmental Assessment
Formation Safety & Environment
Building S-90, Room 334
Maritime Forces Atlantic
PO Box 99000, Station Forces
Halifax NS B3K 5X5
Telephone: 902-721-5486
Fax: 902-721-5417
E-mail: +N48Formation SafetyandEnvironment@forces.gc.ca
Copy Email to: lisa.macisaac2@forces.gc.ca

Please note that a similar letter has been sent to Environment Canada and Transport Canada.

Sincerely,

Carol Lee Giffin
Formation Safety and Environmental Officer
for Commander

Annexes:

Annex A: Project Description
Annex B: Figures
Annex C: RA Response Form

EA File Number: 1267-0100-1114

Annex A
to MARL: 1262-7 (N48)
23 September 2011

Sackville River Wetland Compensation Project, Bedford Rifle Range, Bedford, NS.

Purpose

The Department of National Defence (DND) is providing land access to permit the Nova Scotia Department of Transportation and Infrastructure Renewal (NSTIR) to undertake a wetland compensation project at the Bedford Rifle Range (BRR) in Bedford, NS. The project will be funded and managed by the NSTIR. The project is being completed as compensation for damage caused to wetlands at unrelated NSTIR construction project sites within Halifax Regional Municipality.

Project Description

The Sackville Wetland Complex (SWC) located along the Sackville River (SR) at the BRR (Figure 1 and Figure 2, Annex B) was the site of a gravel extraction operation that ended in the early 1960s. Although the site has been relatively undisturbed since that time, it has a number of impaired ecological functions related to the existing flow patterns of the SR as a result of historical gravel extraction activities. Several desktop reviews and field studies have been conducted in the past few years to gather information on the site and determine methods to improve ecological functions at the site.

The area is approximately 281 hectares in size (Figure 2, Annex B). Work in the SR floodplain extends upstream from the confluence of the SR and Peverill's Brook to the DND property boundary. The project footprint will extend along the SR and surrounding flood plain, upstream from Boland's Farm at the DND property boundary to downstream to the confluence of SR and Peverill's Brook. Peverill's Brook is not included in the scope of work.

The project involves both wetland and fish habitat improvement. The project will restore, enhance and/or create approximately 18 ha of wetlands within the historically damaged SR floodplain. It will also include improvements to the Sackville River itself by restoring fish habitat and passage. The proposed compensation project will be conducted over four years, identified as Year 1, Year 2, Year 3 and Year 4. Initial work in Year 1 will be to provide access to the Project restoration and rehabilitation areas. The main compensation work will occur in Years 2 through 4.

Fish Habitat

The intent of the fish habitat restoration is to work with the natural meander features of the river to develop a diversity of habitats and increase the overall productivity of the aquatic ecosystem. The fish habitat restoration work will use the Department of Fisheries and Oceans (DFO) standard techniques to stabilize the banks and river bed. These techniques have been successful in restoring fish habitat upstream of this site

and have the approval of DFO Habitat Management Maritimes Region. The fish habitat restoration work will include the following components to be conducted in Year 2, Year 3, and/or Year 4 as illustrated in Figures 3 to 5 (as year 1, 2 and 3), respectively of Annex B:

1. Rocking of the banks of the SR to stabilize the slopes and prevent further bank erosion;
2. Constructing gradient control structures (rock sills and berms) involving placement of a band of rip rap rock across the river at the current bed level, located at the head of pools in the meander pattern, to keep the river bed from shifting laterally and prevent further down cutting; and
3. Constructing salmonid spawning areas. The lower section of the site is a long stillwater created by river gravel removal. River gravel suitable for Atlantic salmon spawning will be placed at sites where the river bottom currently rises to near the surface to create a riffle.

The fish habitat restoration work will be conducted in a dry environment, using sand bags or an aquadam as temporary dams, to redirect the flow and prevent siltation. An excavator will be used to place all materials, and all work will be done from the banks or in areas of the riverbed isolated by the coffer dams from the flowing water of the SR. Additional information and descriptions of the fish habitat portion of the Project is presented in the report Fish Habitat Restoration Requirements (Thaumas Environmental Consultants Limited, March 2010).

Wetland

The wetland habitat work will involve restoration, creation and expansion of the existing habitats. Some of the work will be complementary to the fish habitat restoration work over a three year period (Figure 6, Annex B), and will be include the following:

1. Construction of gradient control structures (berms) to control, capture and retard drainage of flood events and encourage deposition of organic matter and formation of wetland soils;
2. Excavation of select areas to create marsh habitats for improved herptofaunal (Wood turtle) and waterfowl habitat. Additional information for the Wood turtle plan is included in the Wetland Delineation and Compensation Concept report and
3. Selected flora planting to improve species diversity over time.

The wetland work has been designed to minimize the disturbance to existing vegetative cover. Although increased ground cover and plant diversity is desired in several areas, these objectives are to be achieved primarily through addressing functions of soil formation and hydrology. It is anticipated that functionally improved areas will then passively obtain increased plant coverage and diversity.

Additional information and a description of the existing wetland environment and proposed compensation activities is included in the Wetland Delineation and Compensation Concept report (East Coast Aquatics, March 2010).

Mitigation

Mitigation measures that will be included in the environmental assessment for the project include:

- Heavy equipment will not be used in the wetland work, instead relying on compact machinery with rubber tracks that will limit soil disturbance, compaction, and damage to rooted vegetation; the bank rocking and gradient controls can be placed with this same equipment. (Note: The construction of the berm downstream of the DND property line will require a larger excavator but this will be operating at least 15m from the watercourse along the back of the flood plain);
- Deleterious substances, including eroded soils, will not be released into the Sackville River;
- Exposed soils will be covered with hay to prevent erosion and sedimentation to downstream aquatic environments;
- All machinery used on site will be in good repair and have no leaks;
- Machinery used in the wetland work will use vegetable based grease, and vegetable based oil in the hydraulics;
- Equipment will only be refueled in a designated paved, level area that is a minimum of 30 meters away from the water;
- Spill response equipment will be on site and the contractor's personnel trained in spill response;
- The contractor will be required to have an approved spill response plan, in place before work commences;
- The contractor will be required to develop and implement a safety plan for the work place; and
- All work will be carried out in accordance with "Best" Environmental Management Practices and Letters of Advice from the Regulators.

Monitoring

Proposed wetland monitoring will include evaluation of soils, hydrology, and vegetation for up to ten years to determine the nature and magnitude of functional changes associated with restoration activities. Fish habitat restoration areas will be monitored for five years post construction. Additionally, an evaluation of habitat use by the Wood turtle within the project area is intended to identify important habitats, and allow restoration to enhance appropriate habitats over a ten year period. Information on the proposed wetland and the Wood turtle monitoring plans are included in the Wetland Delineation and Compensation Concept report (East Coast Aquatics, March 2010).

The Canadian Wildlife Service (CWS) has been provided the baseline materials (which include formal wetland assessments) as follow up to the NSDTIR commitments in federal EAs conducted for the original projects (interchanges on Highways 101 and 102 at Margeson Drive in Sackville and Larry Uteck Blvd in Halifax).

The baseline wetland compensation documents have also been sent to NS Environment, NS Natural Resources and DFO. The local community is also aware of the project through efforts of our partner, the Sackville Rivers Association. There have been no negative comments on the proposed work.

References

Dillon Consulting Limited, September 2003.Integrated Resource Area Management Plan (2003-2008) MARLANT Bedford Rifle Range.

DFO 2006, Fisheries and Oceans Canada, Oceans and Science Branch, Gulf Region. Ecological Restoration of Degraded Aquatic Habitats Pg 147to 152. http://www.dfo-mpo.gc.ca/library/321286.pdf

East Coast Aquatics Inc., March 2010.Wetland Compensation Project at the DND Property, Sackville, Halifax County: Part 1 -Wetland Delineation and Compensation Concept (included in email).

East Coast Aquatics Inc., April 2010. Wetland Alteration Application DND Property Sackville, Halifax County (included in email).

Jacques Whitford Limited, March 2006.Training Area Management Plan (TAMP) for Bedford Rifle Range.

Jacques Whitford Limited, 2008. Rehabilitation Plan: Sackville River Restoration Requirements for Fish Habitat (Including Atlantic Salmon Habitat).

Thaumas Environmental Consultants Limited (Bob Rutherford), March 2010.Wetland Compensation Project at the DND Property, Sackville, Halifax County: Part 2 – Fish Habitat Restoration Requirements (included in email).

File No.: 1267-0100-1114

Figure 1: Location of Sackville River Wetland Compensation Project. (Source: Google Earth).

Figure 2: Extent of the Sackville River Wetland Compensation project on the DND owned Bedford Rifle Range. (Source: East Coast Aquatics Inc. March 2010).

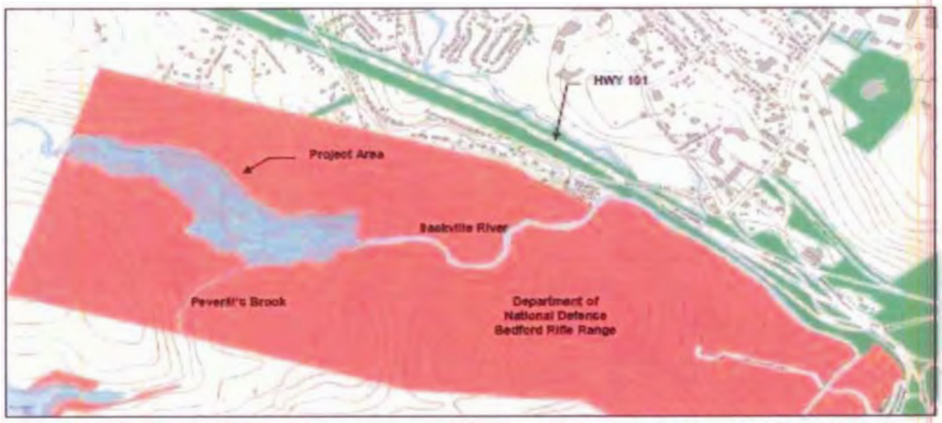


Figure 3: Fish habitat restoration areas on Bedford Rifle Range – Year 1. (Source: Rutherford 2010).

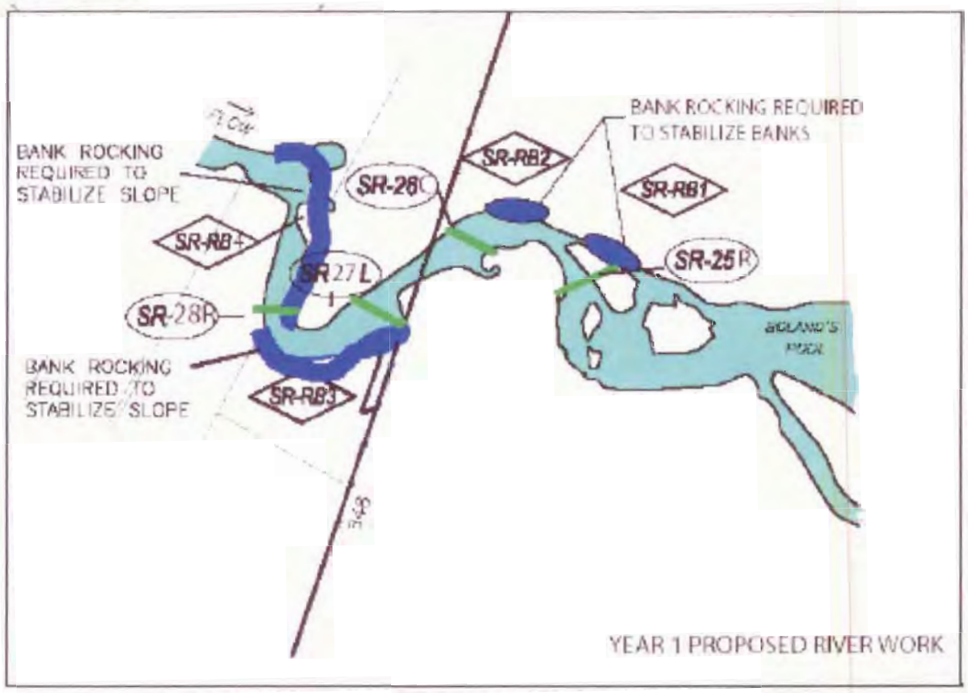


Figure 4: Fish habitat restoration areas on the Bedford Rifle Range – Year 2. (Source: Rutherford 2010).

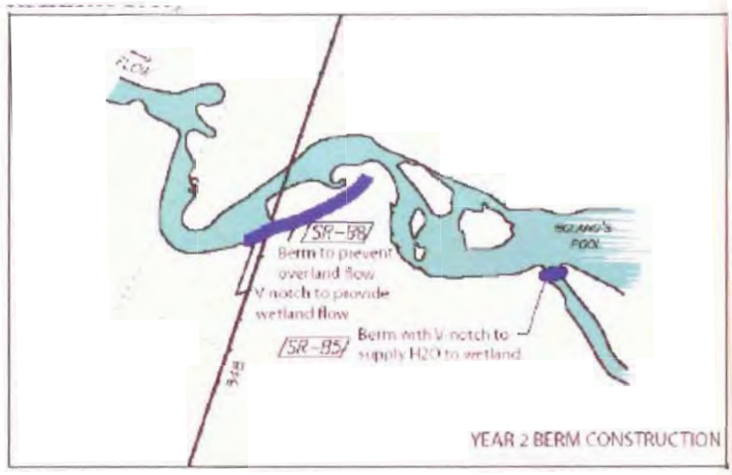


Figure 5: Fish habitat restoration areas on the Bedford Rifle Range – Year 3. (Source: Rutherford 2010).

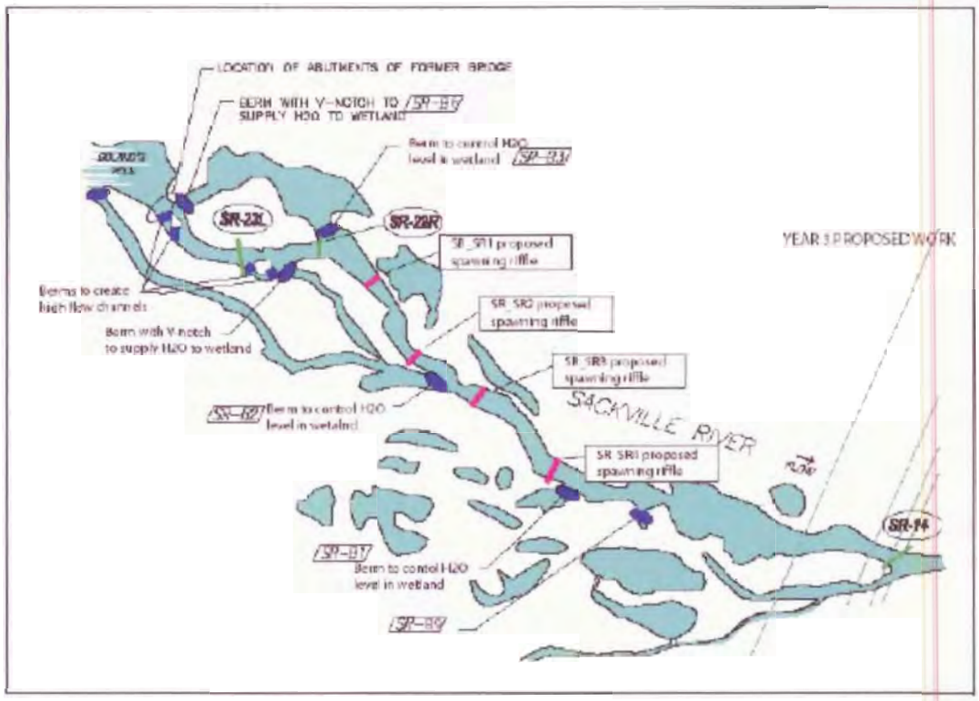


Figure 6: Wetland compensation areas at Bedford Rifle Range (Source: East Coast Aquatics Inc. April 2010).

Annex C
to MARL: 1262-7 (N48)
23 September 2011

RA RESPONSE FORMS

Sackville River Wetland Compensation Project at the Bedford Rifle Range, NS.

We request that you inform this office within 14 days upon receipt of this notice if your department or agency:

1) Has now or anticipates identifying on the basis of information supplied to date, a responsibility under section 5 of CEAA to assess the environmental effects of the project (i.e. is there a trigger).

Yes ( ) No ( )

2) Can provide specialist advice with respect to an environmental assessment of the proposed project pursuant to section 12(3) of CEAA to a responsible authority.

Yes ( ) No ( )

3) Will provide DND with technical or scientific advice and or comments on the issues raised by this project, based on the information supplied to date (please provide details including other federal legislative and/or policy requirements).

Yes ( ) No ( )

4) Does not have sufficient information to enable you to identify any concerns related to your mandate. Please clearly identify additional requirements below.

Yes ( ) No ( )

Additional Requirements: _____

_____

_____

_____

_____

_____

All departments or agencies are requested to sign the signature block and date below and fax the response to the office within the time frame specified.

_____ _____

Signature of Department Responder **Print Name**

_____ _____

Title of Responder **Date**

National Défense
Defence nationale

Maritime Forces Atlantic
PO Box 99000 Stn Forces
Halifax NS B3K 5X5

MARL: 1262-1 (N48)
TD: 2011-000620

23 September 2011

Federal Environmental Assessment Coordinator
Environment Canada
16th Floor, Queen Square,
45 Alderney Drive
Dartmouth NS B2Y 2N6
FCR_Tracker@ec.gc.ca

Dear Sir/Madam:

This letter serves to formally notify your Department of an environmental assessment (EA) screening being conducted for the Department of National Defence (DND) for the proposed project identified as: **Sackville River Wetland Compensation Project at the Bedford Rifle Range, Nova Scotia (CEARIS # 11-01-62942).**

This project is subject to an EA under the *Canadian Environmental Assessment Act.* An EA is considered a self-directed process and as such, the responsibilities of DND, as the Responsible Authority (RA), include:

- determining the scope of the EA;
- ascertaining the factors to be considered;
- directly managing the EA; and
- ensuring that an EA report is prepared.

In accordance with the Federal Coordination Regulations, DND has the responsibility as the RA to provide written notice to federal authorities that are likely to exercise a power in respect to the project or be in possession of specialist or expert information that is necessary to conduct the EA for the project. DND may use this information to determine the scope of the project, the scope of assessment, and the necessity for public consultations.

Environment Canada (EC) is responsible for administering several statutes that are focused on protecting the environment, as well as, promoting several policies and programs that aid federal departments in the management of wetlands and species of special status; therefore, your department was identified as a potential expert federal authority and potential responsible authority for the project.

Canada

The enclosed Annexes A and B provide background to the project to assist you in determining your Department's role in this EA. At this time we request that you review the information and provide a written response, detailing your potential role in the EA for this project, as well as any concerns, comments or other information which will assist in the EA.

DND request that you complete the Response Form (Annex C), including any associated documentation, letters or advice etc. and forward your response to the point of contact by **4 October 2011**. Should you require additional information respecting the project, please forward your request to this office within 10 days of receipt of this letter.

The response can be sent to the following contact (email preferred):

Lisa MacIsaac
Staff Officer, Environmental Assessment
Formation Safety & Environment
Building S-90, Room 334
Maritime Forces Atlantic
P.O. Box 99000, STN Forces
Halifax NS B3K 5X5
Telephone: 902-721-5486
Fax: 902-721-5417
E-mail: +N48Formation SafetyandEnvironment@forces.gc.ca
Copy Email to: lisa.macisaac2@forces.gc.ca

Please note that a similar letter has been sent to the Department of Fisheries and Oceans and Transport Canada.

Sincerely,

Carol Lee Giffin
Formation Safety and Environmental Officer
for Commander

Annexes:

Annex A: Project Description
Annex B: Figures
Annex C: RA Response Form

EA File Number: 1267-0100-1114

National Défense
Defence nationale

Maritime Forces Atlantic
PO Box 99000 Stn Forces
Halifax NS B3K 5X5

MARL: 1262-1 (N48)
TD: 2011-000621

23 September 2011

Transport Canada
95 Foundry Street, P.O. Box 42
Heritage Court
Moncton, NB E1C 8K6
TCFCRMAR@TC.GC.CA

Dear Sir/Madam:

This letter serves to formally notify your Department of an environmental assessment (EA) screening being conducted for the Department of National Defence (DND) for the proposed project identified as: **Sackville River Wetland Compensation Project at the Bedford Rifle Range, Nova Scotia (CEARIS # 11-01-62942).**

This project is subject to an EA under the *Canadian Environmental Assessment Act*. An EA is considered a self-directed process and as such, the responsibilities of DND, as the Responsible Authority (RA), include:

- determining the scope of the EA;
- ascertaining the factors to be considered;
- directly managing the EA; and
- ensuring that an EA report is prepared.

In accordance with the Federal Coordination Regulations, DND has the responsibility as the RA to provide written notice to federal authorities that are likely to exercise a power in respect to the project or be in possession of specialist or expert information that is necessary to conduct the EA for the project. DND may use this information to determine the scope of the project, the scope of assessment, and the necessity for public consultations.

Transport Canada's Navigable Waters Protection Program (NWPP) implements the *Navigable Waters Protection Act* to ensure the public maintains its right to navigate public waters without obstruction. DND requests advice with respect to permitting requirements under the Navigable Waters Program. Transport Canada was identified as an expert federal authority and potential RA for the project.

Canada

The enclosed Annexes A and B provide background to the project to assist you in determining your Department's role in this EA. At this time we request that you review the information and provide a written response, detailing your potential role in the EA for this project, as well as any concerns, comments or other information which will assist in the EA.

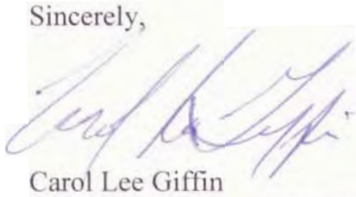
DND request that you complete the Response Form (Annex C), including any associated documentation, letters or advice etc. and forward your response to the point of contact by **4 October 2011**. Should you require additional information respecting the project, please forward your request to this office within 10 days of receipt of this letter.

The response can be sent to the following contact (email preferred):

Lisa MacIsaac
Staff Officer, Environmental Assessment
Formation Safety & Environment
Building S-90, Room 334
Maritime Forces Atlantic
P.O. Box 99000, STN Forces
Halifax NS B3K 5X5
Telephone: 902-721-5486
Fax: 902-721-5417
E-mail: +N48Formation SafetyandEnvironment@forces.gc.ca
Copy Email to: lisa.macisaac2@forces.gc.ca

Please note that a similar letter has been sent to Environment Canada and the Department of Fisheries and Oceans.

Sincerely,



Carol Lee Giffin
Formation Safety and Environmental Officer
for Commander

Annexes:

Annex A: Project Description
Annex B: Figures
Annex C: RA Response Form

EA File Number: 1267-0100-1114