

Report Prepared for:
**NORTH SHORE MICMAC DISTRICT COUNCIL ABORIGINAL AQUATIC RESOURCE & OCEANS
MANAGEMENT AND METEPENAGIAG MI'KMAQ NATION**

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LITTLE SOUTHWEST MIRAMICHI RIVER RESTORATION PROJECT – THE OXBOW

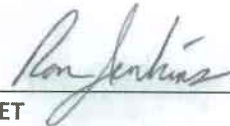
Report prepared for North Shore MicMac District Council Aboriginal Aquatic Resource & Oceans Management and Metepenagiag Mi'kmaq Nation, June 2015

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DISCLAIMER

We certify that this report is accurate and complete and accords with the information available during the site investigation. Information obtained during the site investigation or provided by third parties is believed to be accurate but is not guaranteed. We have exercised reasonable skill, care and diligence in assessing the information obtained during the preparation of this report.

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1 THE PROPONENT

1.1 Name of Proponent

North Shore MicMac District Council Inc.

1.2 Address of Proponent

32 MicMac Road, Eel Ground, New Brunswick, E1V 4B1

1.3 Chief Executive Officer

Chief George H. Ginnish, President and CEO, (506) 627-4611

1.4 Principal Contact Person for purposes of Environmental Impact Assessment

Pam Ryan, NSMDC AAROM Environmental Services Program, (506) 627-2730

1.5 Property Ownership

See attached letter from Metepenagiag Mi'kmaq Nation.

* Note : One end of the channel has potential for Crown Land implications and we are awaiting the final decision.

2 THE UNDERTAKING

2.1 Name of Undertaking

Little Southwest Miramichi River Restoration Project – The Oxbow

2.2 Project Overview

The proposed undertaking involves the implementation of a restoration design developed to minimize erosion occurring along the north valley wall of the Little Southwest (LSW) Miramichi River. The high rate of erosion exhibited along this bank has resulted in loss of property and excess sedimentation downriver of the site, impacting channel form and aquatic habitat. The proposed design includes construction of an overflow channel, approximately 355 m in length, along the southern floodplain of the river. In addition, the existing point bar on the south bank of the LSW Miramichi River, immediately adjacent to the eroding valley wall, is to be excavated and reformed. Together, the proposed design components will reduce the shear stress forces exerted on the north bank during high flow events, returning the rate of erosion to a natural state.

Due to the presence of Wood Turtle (*Glyptemys insculpta*) on the southern floodplain, which is protected under the federal Species at Risk Act (SARA), an Environmental Impact Assessment was triggered in response to the proposed Schedule A undertakings. This document has been prepared in general accordance with *New Brunswick Department of Environment and Local Government* document "A Guide to Environmental Impact Assessment in New Brunswick" issued in April 2012.

2.3 Purpose/Rationale/Need for the Undertaking

In 2002, a hydrological assessment of the study area was undertaken by TAP Environmental Resources Inc. to evaluate the erosional characteristics of the study area, known as "The Oxbow" on the LSW Miramichi River. Through aerial photo analysis it was determined that the rate of erosion increased from 0.15 meters/year, between the years of 1944-45 and 1983, to 1.6 meters/year, between the years of 1983 to 1999. The increased rate of erosion coincided with intensified excavation of sand and gravel along the northern river bank in the gravel pit known as Johnston's pit.

The extent of erosion has continued to compromise private property and negatively impact biophysical features on and near the site. In particular, the Miramichi River system supports a historically large run of Atlantic salmon (*Salmo salar*), which has been classified as a species of "Special Concern" by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC, 2010). Declining salmon returns combined with expected water temperature rise and lower low flow levels (Miramichi River Environmental Assessment Committee, 2007) make it imperative to protect critical habitat. Excess sediment loading from the eroding bank at the Oxbow contributes to aggradation in the channel, which causes shallowing of the river and potentially warming of the water. Also, excessive bed load movement can be detrimental to Atlantic salmon spawning redds and egg survival.

In response, Parish Aquatic Services, A Division of Matrix Solutions Inc. (formerly Parish Geomorphic Ltd.) was retained to complete a restoration design. The primary purpose of the proposed design is to improve the river system's stability and reduce bank erosion along the north valley wall. In order to address the environmental risk associated with erosion occurring along the failing bank, a list of remediation alternatives have been developed. To determine the most suitable approach, a number of evaluation factors have been developed to identify which alternatives pose the greatest negative impacts to the site and which will provide a positive effect. Through this process, the alternatives that pose highly negative effects on the Evaluation Factors can be screened out as undesirable approaches. By following this process, a preferred alternative was selected which best addressed the project goal, while ensuring minimal negative impacts associated with the undertaking.

2.3.1 Alternatives Assessment

The following represents the list of alternative remediation options included in this assessment:

Alternative A: Do Nothing

Alternative B: Stabilize the eroding valley walls *in situ*

Alternative C: Construct an overflow channel and reshape the LSW Miramichi River point bar

2.3.1.1 Evaluation Factors

In order to assess the potential positive and negative impacts of the alternative remediation options, various Evaluation Factors were established for consideration. These have been organized into five main categories as follows:

1. Biophysical Environment
2. Social
3. Economic
4. Constructability
5. Functional

Each of the five categories was further assessed based on a subset of specific factors:

1. Biophysical Environment
 - a. *River Function* – impacts a proposed alternative would have on the physical functions of the river (e.g. discharge, sediment transport).
 - b. *Slope Stability* – impacts a proposed alternative would have on the future stability of the valley slopes within the study area.
 - c. *Terrestrial and Aquatic Ecology* – impacts a proposed alternative would have on the biological functions of the valley and river system (e.g. fisheries, fish habitat, wildlife, vegetation).
2. Social
 - a. *Culturally Significant Lands* – impacts a proposed alternative would have on culturally significant lands.
 - b. *Private Lands* – impacts a proposed alternative would have on the future stability and safety of private lands.
3. Economic
 - a. *Capital Costs* – costs associated with designing and implementing the preferred alternative.
 - b. *Maintenance Costs* – costs associated with maintaining the integrity of the constructed works in the future.
4. Constructability
 - a. *Ease of Construction and Accessibility* – the level of difficulty to construct each proposed alternative during implementation of the design.
 - b. *Expected Disturbance to Existing Natural Features* – the level of disturbance that the construction of each alternative will have on the existing natural features of the site during implementation of the design.
5. Functionality

- a. *Protect Property* – the ability of the proposed alternatives to protect private properties affected by the erosion issues.
- b. *Stabilize River* – the ability of the proposed alternatives to stabilize the identified erosion issues within the river.

The aforementioned Evaluation Factors and associated criteria were considered as part of this assessment for the respective long list of alternative remediation options.

2.3.1.2 *Technical Screening of Alternatives*

Alternative A: “Do-Nothing”

An Environmental Assessment requires consideration of the “do-nothing” option as a baseline for the assessment of alternatives. For this study, the “do-nothing” alternative would involve no intervention measures taken to stabilize the river and eroding valley wall. This approach would not address the erosion problem outlined in the study’s problem statement, and may result in significant social and biophysical impacts. However, this approach is an economically sound alternative as no costs would be incurred in the immediate future.

The Miramichi River system is known to support a historically large run of Atlantic salmon (*Salmo salar*), which has been classified as a species of “Special Concern” by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC, 2010). The “do-nothing” approach will allow erosion to continue along the valley wall, the slope will remain unstable and promote excess sediment downriver. Sediment loading from the eroding bank at the Oxbow contributes to aggradation in the channel, which causes decreased water depth of the river and potentially warming of the water. Also, excessive bed load movement can be detrimental to Atlantic salmon spawning redds and egg survival. Conversely, the “do-nothing” alternative will likely have a neutral impact on Bank Swallow habitat by promoting maintenance of nesting habitat along the eroding bank.

The “do-nothing” alternative also has the potential to result in significant cultural impacts to the Metepenagiag Mi’kmaq First Nations. By allowing the current rates of erosion to continue along the north bank of the oxbow bend, major changes are anticipated to occur to the channel planimetric form downriver of the site, potentially impacting the Augustine Mound National Historic Site. This cultural site represents one of the most significant aboriginal heritage archeological areas in eastern Canada which was inhabited by the Mi’kmaq First Nation for over 3,000 years. By not addressing the erosion at the oxbow, significant costs may be incurred in the future to protect the Augustine Mound site from erosion and channel migration due to excessive aggradation in the river.

From a social aspect, the “do-nothing” alternative will not protect private property within the study area, resulting in loss of property and site inaccessibility due to valley wall erosion. Consequently, the livelihood of the local landowner may be compromised. To adequately protect private property a

monitoring program would be required to observe and document changes to the eroding slopes. Monitoring would be required on a regular basis, as well as following major flow events when greater rates of erosion typically occur. This alternative provides an opportunity to stagger expenditures for acquisition of private land and undertaking a long-term monitoring program.

Alternative B: “Stabilize the Eroding Valley Wall in Situ”

To mitigate erosion occurring along the affected valley wall of the study area, one potential alternative would be to stabilize the eroding wall in place by implementing erosion control measures along the toe of the valley wall. Due to the nature of the sandy soil, and the magnitude of the erosion occurring along the valley wall, the erosion control measures would need to be constructed of large stone material in order to stabilize the existing channel planform and prevent the river from eroding the valley wall, while ensuring the stone material does not become mobile under high flows. To sufficiently stabilize the 275 m of actively eroding bank on the outside (north) bank of the LSW Miramichi River, large stone would be required to armour an area of approximately 8000 m². The costs associated with undertaking this alternative remediation option is very high due to the extent of large stone required along the length of the bank to ensure bank protection. These costs would also be incurred all at once.

While this alternative option would address the immediate impacts to private lands and provide stability to the failing slope, these works would only serve to help stabilize this section of the river. The river processes that dictate channel form will continue to act upon the stone bank treatment, which will translate these erosive forces downriver, potentially causing geomorphic instability to downriver reaches of the river system.

In terms of the impacts this alternative will have on aquatic and terrestrial habitats, the construction of a stone structure to stabilize the bank would significantly alter the existing type of sandy soils and resulting habitat that currently exists. In particular, the valley wall provides active Bank Swallow nesting habitat, which is listed as a species at risk. Altering the material composition and angle of the bank would detrimentally impact the available Bank Swallow habitat as this species requires particular site attributes for nesting colonies. Furthermore, this treatment could also serve to minimize available habitat for aquatic species by removing natural woody debris built up along the toe of the valley wall and minimizing the quantity of interstitial spaces within the substrate following installation of a large armor stone toe within the channel. Armouring the bank also has the potential to remove a sediment source immediately downriver required to maintain point bar features, resulting in a loss of Wood Turtle nesting habitat. On the other hand, stabilizing the valley wall could serve to improve the water quality for local aquatic habitat by preventing further excessive erosion along the bank and deposited downriver.

Alternative C: Construct and Overflow Channel and Re-shape the Right Bank Point Bar

The approach taken in Alternative C involves mitigation of the erosion issues associated with the valley wall contact, while providing due consideration for the biophysical environment in which the study area occurs. In this alternative, the point bar on the inside bend would be sculpted to increase the bankfull capacity and provide high flow relief on the north bank of the proposed project site located on the LSW Miramichi River. Additionally, a shallow floodplain overflow channel would be excavated in the floodplain to further convey flows and reduce erosive forces exerted on the outside bend of the LSW Miramichi River in the proposed project location.

Implementation of this alternative would provide relief from the erosive forces acting on the valley wall, thereby reducing the erosion hazard and protecting private lands. Implementation of this alternative approach would permit natural river processes to continue throughout the study area with little to no impact on the downriver reaches. Rather, by reducing shear stress forces exerted on the outside bend, the local water quality is expected to improve as excess sedimentation will be reduced during high flow events.

Environmentally, by leaving the valley wall unchanged, Bank Swallow habitat will remain intact for an area known to be utilized by a colony for nesting cavities. A potential impact associated with the construction phase of this alternative is the disturbance of Wood Turtle habitat along the southern floodplain during the construction phase of the project, which must be mitigated. Overall, the proposed project is expected to increase the area of habitat availability for Wood Turtle through the creation of the proposed overflow channel. This feature will augment the existing wetland feature, situated to the south of the proposed overflow channel that is currently occupied by several Wood Turtles. Although minor disturbance to potential Wood Turtle habitat during the construction phase of work may occur, it is anticipated that the restoration works will provide an overall benefit to the species.

A monitoring program would be included as part of this alternative to provide adaptive management of the proposed undertaking. Monitoring would include cross-sectional and longitudinal profiles, and substrate characterization of the LSW Miramichi River and the proposed overflow channel during the spring freshet when erosive forces are greatest. In addition, Wood Turtle would continue to be monitored by trained members of the Metepenagiag Míkmaq First Nation to ensure site fidelity following construction works.

Economically, this option is much less expensive than alternative B as significantly less rock material will be required for the design.

2.3.2 Preferred Solution

The three alternatives have been assessed on the basis of the evaluation factors related to impacts associated with each approach. Based on the results of the evaluation, as well as input received from the public and technical agencies, Alternative C has been selected as the preferred design approach. This alternative provides the most balanced approach to mitigating the identified erosion issue, addressing the initial project goal identified at the outset of this study, while also giving due consideration for all

the Evaluation Factors assessed. This alternative will provide a sustainable option for minimizing erosion along the northern valley wall which will improve channel function and local water quality. In addition, this alternative is an economically viable option.

Due to the nature of the erosion issues being experienced within the study area and the need to undertake near-water work to mitigate these erosion issues, this report outlines the EIA results in support of this restoration design.

2.4 Project Location

The project site is situated along the lands adjacent to the LSW Miramichi River, approximately 3 kilometers upstream from the confluence with the Northwest Miramichi River. The specific area of concern occurs along the north valley wall of the LSW Miramichi River where the river has migrated into the adjacent land at Johnston's Pit (PID: 40125882, Latitude: 46.959700° Longitude: -65.850459°), within the Parish of Northesk, Northumberland County. The proposed overflow channel and point bar reshaping is to be constructed in the floodplain to the south of the LSW Miramichi River. This land parcel is part of the Metepenagiag Mi'kmaq First Nation Reserve No. 4 (PID: 40305105).

2.5 Siting Considerations

The proposed overflow channel is to be constructed along the southern floodplain of the LSW Miramichi River, immediately across from the oxbow bend. A review of aerial photography indicated the presence of multiple historic overflow channels on the floodplain which have left scar depressions on the land. The identification of these scar features was used in conjunction with topographic and lidar mapping of the floodplain to select a historic overflow channel as the preferred location of the proposed overflow channel, which is best suited to the site gradient.

In addition, the inlet location of the proposed channel on the south bank of the LSW Miramichi River will tie-in with the existing overflow channel that currently provides flood relief. The outlet of the proposed channel will be situated at an area of low bank height on the south bank of the Miramichi River that was eroded from the historic overflow channel. The placement of the inlet and outlet locations at historic overflow channel areas will minimize the required disturbance to the LSW Miramichi River.

The radius of curvature for the proposed channel was also calculated and compared to the upstream and downstream bends on the LSW Miramichi River to ensure it has a radius of curvature that is appropriate for the channel meander pattern.

The point bar, situated on the south bank of the LSW Miramichi River, is to be excavated and reshaped as this location is immediately opposite to the bank erosion occurring on the north bank. By excavating this point bar, the channel capacity will be increased directly in the location of the eroding valley wall, which will reduce shear stress forces exerted on the outer bank of the LSW Miramichi River during high

flow events. This additional flood relief should reduce the extent of erosion on the north valley wall and help minimize excessive sedimentation of the channel downriver.

Wood Turtle have been observed along the south bank of the LSW Miramichi River, near the outlet of the existing overflow channel. The placement of the proposed overflow channel was selected to the north of this area to avoid direct impacts on known habitat used by Wood Turtle, as nesting site fidelity is typically high for the species (Walde et. al., 2007).

The access route was selected to minimize impacts to the existing topography and vegetation on site by using the driveway off NB Route 420 to Metepenagiag Outdoor Adventure Lodge. Existing access roads continue to the floodplain along the west side of the Metepenagiag Mi'kmaq First Nation property where it is expected minimal to no vegetation will be removed for large machinery access. As Wood Turtles have been observed on the east side of the study area floodplain, the west access route was selected to avoid impacts from machinery movement in and out of the site.

2.6 Physical Components and Dimensions of the Project

A preliminary site plan has been provided showing the various physical components of the proposed undertaking and environmental features on and near the site (Figure 1). For detailed CAD illustrations of the restoration plan refer to the design drawings in Appendix A.



Figure 1. Project site plan and environmental features

The proposed undertaking is to take place on a land parcel that is part of the Metepenagiag Mi'kmaq First Nations reserve. The property lines encompass a total area of 561,327 m² which extends from the southern floodplain of the LSW Miramichi River, at the oxbow, and continues southeast to the confluence of the Northwest Miramichi River. The property is bound to the south by NB Route 420 and to the east by the LSW Miramichi River. In total, the proposed undertaking is to impact an area of 16,820 m², including the point bar on the south bank of the LSW Miramichi River which accounts for 6170 m² and 10,650 m² associated with construction of the overflow channel on the southern floodplain.

The primary goal of the project is to reduce the erosion along the left (north) bank of the LSW Miramichi River. To accomplish this, shear stress and/or flow velocity needs to be reduced along the bank and bank toe (i.e., near the point of contact between the highly erodible bank and the channel bed). Two strategies will be implemented to reduce erosive forces on the left bank of the oxbow:

1. The point bar on the right (south) bank will be re-shaped by removing 1543 m³ of existing material. This will enlarge the channel and create more room for water to flow, thereby reducing pressure on the left bank.
2. There is an existing overflow channel through the floodplain that conveys a portion of the river's flow during a high flow event. A second overflow channel will be constructed by removing vegetation and excavating floodplain material so that an even larger portion of high flows can be conveyed across the floodplain and away from the eroding left bank. At the 2-year flood level, when the energy of the flow is confined within the channel banks and erosive forces are high, the two overflow channels will help transfer flows over the floodplain and dissipate energy away from the left bank. A portion of the flow will be transferred between the bends in the river, essentially by-passing the Oxbow. The new overflow channel, through the floodplain, will be constructed with a radius of curvature of 230 m, which aligns with topographic evidence on the floodplain of where the historic river channel used to be. The channel is to be trapezoidal in shape with the following dimensions: 30 m width; 355 m length; 1 m depth; and bank slopes at 2H:1V.

The proposed overflow channel will have the capacity to convey 12.3% of the 2-year flood discharge of 252 m³/s calculated for the LSW Miramichi. This will augment the existing overflow channel, which has the capacity to convey 46.63 m³/s (18.5% of the flow during a 2-year flood). Combined with the secondary overflow channel that will be constructed, which can convey 12.3% of the flow, approximately 31% of the flow can be alleviated from the main channel during a 2-year flood. These flows were determined using existing and design overflow channel characteristics (Table 1).

Table 1. Existing overflow channel and design overflow channel characteristics

Geomorphic Parameter	Existing Overflow Channel	Design Overflow Channel
Surface Width (m)	23.00 m	30.00 m
Bank Slope (Run/Rise)	2.50 m	2.50 m
Depth at Channel Centerline (m)	1.72 m	1.00 m
Depth at Bank Toe (m)	1.00 m	0.90 m
Channel Slope	0.16 %	0.16 %
Manning's n Roughness Value	0.033*	0.033*
Design Radius of Curvature	NA	230 m

*Manning's n roughness coefficient calculated based on channel and floodplain characteristics using the method described in Arcement and Schneider (1989).

In order to ensure stability of the constructed channel, a rock spur will be installed in the river upstream of the outlet of the overflow channel to turn water away from the bank. A rock grade control will also be installed at the outlet of the designed overflow channel. This will prevent head cutting in the overflow channel (i.e., prevent material from migrating into the river) and serve as a rock toe for the right bank of the LSW Miramichi River to prevent scour. Rocks for the spur and grade control will be securely embedded into the banks to prevent out-flanking.

During the construction phase of the design activities, it is anticipated that there will be a minimal increase in vehicular traffic along NB Route 420 associated with transportation of excavated native material off-site.

2.7 Construction Details

2.7.1 Construction Sequencing

Phase 1 – Preparation (1 week total)

- Implement and maintain erosion and sediment control measures (silt fencing) and establish staging and stockpiling areas for rock material (2 days);
- Establish stable site access to the upstream end of the existing overflow channel along the gravel road from Red Bank lodge (1 day);
- Grub and remove trees to establish a temporary road along the design overflow channel corridor for access to the lower end (3 days);

Phase 2 – Construction (3 weeks total)

- Install rock spur near outlet of the overflow channel to divert flows away from the bank (1 day);
- Install rock grade control at design overflow channel outlet (1 day);
- Working from downstream to upstream, excavate overflow channel to design specifications and remove material from site (9 days);

- Harden overflow channel bed at road crossing to maintain ford site near inlet to ensure stable crossing site for floodplain/river users (1 day);
- Seed floodplain channel and disturbed area adjacent to channel for stabilization (1 day);
- Re-grade point bar on right bank of the LSW Miramichi (3 days).

Phase 3 – Finishing

- Contractor to dispose of excess materials appropriately off-site;
- Restore access routes to pre-existing conditions as best as possible;
- Seed disturbed areas;
- Remove erosion control measures once site is stable (i.e., when vegetation has established).

2.7.2 Hours of Work

The approximate hours of construction are to occur between 7 am to 5 pm, Monday to Friday.

2.7.3 Equipment

In order to complete the objectives of the proposed channel design, the following construction equipment will be required:

1. Excavator – will be used to excavate native material from the point bar and new overflow channel and shaped the banks to design criteria.
2. Loader – will be required to move stockpiled material, removed by the excavator during construction of the overflow channel, into dump trucks for transportation off-site.
3. Dump truck – will be used to transport excavated material off-site for disposal.

2.7.4 Proposed Start Date

The proposed date of first physical construction-related activity on site will be August 1, 2015.

2.7.5 Potential Sources of Pollutants

The use of large machinery during construction introduces potential noise disturbances to wildlife including migratory birds. In addition, vehicular refueling and maintenance may result in entry of petroleum products into the surrounding watercourse. During construction, exposed soil from excavation also has the potential to runoff during storm events causing excessive sedimentation into the watercourse.

To avoid these potential sources of pollutants fueling and maintenance of machinery will occur at a minimum of 30 metres away from the watercourse. Any exposed soils at the end of the work day will be

covered with straw/hay to reduce the potential of sediment runoff. The contractor will also be required to have emergency spill response kits onsite during the construction phase.

2.7.6 Waste Removal

No emissions or effluents will be generated during construction that require disposal.

2.7.7 Site Access

Site access will occur from the Metepenagiag Mi'kmaq First Nation Reserve No. 4 (PID: 40305105), immediately north of Micmac Road (NB Route 420) along an existing network of dirt access roads. The access roads will require minimal to no tree removal to access the point bar feature on the south side of the LSW Miramichi River and the adjacent floodplain to the south.

2.7.8 Clearing and Grubbing

The design of an overflow channel along the floodplain to the south of the LSW Miramichi River will require removal of vegetation prior to excavation of the channel along an area of 10650 m². This will be completed by a crew using thinning chainsaws. Once trees have been removed a bulldozer and excavator will remove the remaining vegetation along the overflow channel corridor to be excavated. Merchantable timber is not anticipated during tree thinning; however if acquired it will be utilized by the First Nations land owners. Top soil excavated during construction is to be stored onsite and will be used during the final stages of construction of the overflow channel to provide adequate soil for seeding.

2.7.9 Fill Material

Large stone material used for the design will be sourced from the contractor pit which is located locally within a few kilometers of the project site.

2.7.10 Construction near Natural Features

The proposed design will occur along the south bank and adjacent floodplain of the LSW Miramichi River. The point bar feature on the inside bend of the river will be excavated to the proposed design criteria. Excavation and grading of the overflow channel will also involve the installation of a rock spur and grade control along the south bank and floodplain of the river. Silt fencing is to be installed at the downstream extent of the overflow channel during construction to prevent sedimentation of the watercourse. Exclusion fencing is also to be used to isolate the construction site as Wood Turtle have been identified along the south bank of the river, near a wetland feature along the existing overflow channel. To ensure minimal impact to the species, First Nations members will search the site prior to construction work and continuously monitor for the species throughout the duration of construction. Erosion and sediment control fencing will exclude machinery from approaching the wetland feature and site access will be gained from the west side of the property.

The presence of Bank Swallow cavities have been noted along the eroding (north) bank of the LSW Miramichi. This is a species at risk and will not be impacted by the construction work, as the bank will remain unchanged from the proposed undertaking and is situated outside of the work area. In addition, construction is to occur outside of the migratory breeding season to further minimize impacts to Bank Swallow colonies.

2.8 Operation and Maintenance Details

Following completion of the proposed undertakings, maintenance of the site will involve removal of all erosion control measures once the site has been stabilized and vegetation has established. The proposed undertakings will have no operation component following the construction of the proposed undertaking to address the eroding bank.

2.9 Future Modification, Extensions, or Abandonment

There are no future modifications, extensions, abandonments, demolitions, or rehabilitation of the site following the restoration undertakings.

2.10 Project Related Documents

2.10.1 Existing Documents

Hydrological Assessment of "The Oxbow" Little Southwest Miramichi River

This document provides an assessment of the rates of erosion occurring along the LSW Miramichi River in the immediate location of the project study area. The report includes aerial photographic analysis of imagery between 1944-45 to 1999 to estimate erosion rates and document land-use changes over a period of 58 years. Several recommendations were also provided for rehabilitation of the site.

3 DESCRIPTION OF THE EXISTING ENVIRONMENT

This section includes a description of features that are found within the project location, as well as those components of the environment potentially affected by the proposed project. Figure 1 provides an overview of the existing environment within the project area. The following subsections include details on the environmental setting of the project, including the physical and natural features, cultural features, and existing and historic land uses.

3.1 Physical and Natural Features

3.1.1 Topography

The project area elevation ranges between 25 metres and approximately 0 metres above sea level. The maximum elevation is far up on river right bank of the LSW Miramichi River, near the Metepenagiag

Outdoor Adventure Lodge. No survey elevation data was available for the channel bed of the LSW Miramichi River; this was estimated to be the lowest point with an elevation of 0 metres. The maximum gradient in the project area is 1:1, occurring on the steepest slopes of the eroding left riverbank. The lowest gradient in the project area is 400:1; this is the slope of the LSW Miramichi River through the site. Where work is proposed the steepest slope is 6:1, which is located on the point bar on the river right bank. The lowest slope where work is proposed is through the floodplain which is 360:1. The gradients were calculated using a topographic survey conducted in November in 2014 and LiDAR data from 2010 (Figure 2).

3.1.2 General Surface Drainage

On the South side of the LSW Miramichi River, within the project area, the majority of the area generally drains north off the high elevations and then east through the floodplain into the LSW Miramichi River. This drainage pattern was interpreted off the topographic survey and LiDAR data (Figure 2).

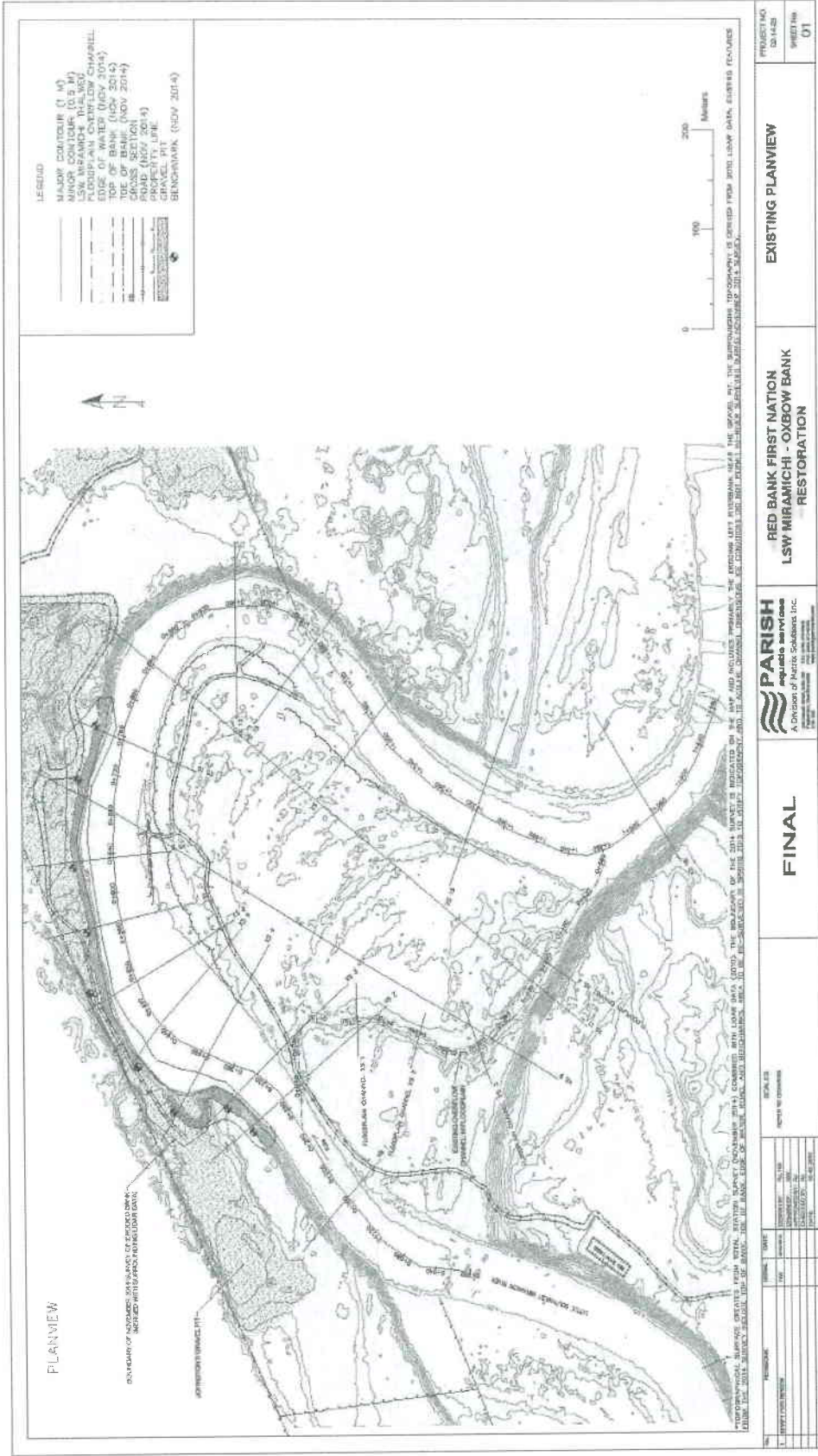


Figure 2. Existing topography of the project area

3.1.3 Water Features

The project area is mostly bounded by the LSW Miramichi, the only lotic system at the site. The LSW Miramichi River generally flows eastward through its watershed before joining with the Northwest Miramichi River, continuing on to form the Miramichi River and emptying into the Southern Gulf of Saint Lawrence. Another water feature near the project site is a wetland, located in the floodplain, where an overflow channel meets the LSW Miramichi River (Figure 1).

3.1.4 Water Classification Regulation

No watercourses or water bodies adjacent to the project area have been classified according to the *Water Classification Regulation* (NB DELG, 2015e).

3.1.5 Soil, Geological, and Hydrogeological Features

The underlying bedrock geology of the site is composed of terrestrial sedimentary rocks from the Late Carboniferous geological era. These rocks are characterized as being dominantly red to grey, arkosic sandstone, conglomerate, and shale (New Brunswick Department of Natural Resources, 2000).

According to Colpitts et al. 1995, the soil layer of the work area is part of the Sunbury Forest Soil Unit. These soils are characterized as non-compact tills derived from grey lithic-feldspathic sandstones with a medium to high coarse fragment content and a depth to compact subsoil or bedrock greater than 100 centimeters. The texture of the parent and solum materials is coarse to medium-coarse, respectively, and is dominantly well drained (Colpitts et al. 1995).

On the eroding left bank adjacent to the project area, sandstone and pebble conglomerate exposures exist; these types are present as opposed to the sedimentary mudstones due to their comparatively high resistance to erosion. Medium and coarse grained sandstone and pebble conglomerate formations on the north side of the river provide control and act as a barrier for the northward migrating river. These are absent around the apex of the outside bend allowing the river to erode the less resistant unconsolidated deposits (TAP Environmental Resources Inc. 2002).

Alluvial sand and gravel, as well as thick outwash sands and gravels that are blanketed by >0.6 m of ablation till make up the unconsolidated deposits of the eroding left bank. Glacial outwash sands and gravels, deposited 12,000 years ago by retreating glaciers, comprise the eroding bluffs at the site. Gravel and cobble sized materials sourced from glacial deposits and bedrock reworked by the river make up the alluvial river deposits. These unconsolidated materials, particularly the fine glacial outwash sands, are easily eroded (TAP Environmental Resources Inc. 2002).

3.1.6 Adverse Environmental Conditions

In terms of adverse environmental conditions at the site, the proposed work area is located in the floodplain of the LSW Miramichi River and is prone to flooding. In the winter, the LSW Miramichi River has experienced ice jams at the project location and ice has been deposited on the floodplain in the work area.

3.1.7 Potable Water

There are no municipal wells, municipal wellfields, or protected watersheds located within 500 metres of proposed activities (New Brunswick Department of Environment and Local Government 2015a, 2015b). The project site is located within 500 metres of some private wells associated with residential properties on the Red Bank First Nation reserve (New Brunswick Department of Environment and Local Government, 2015c).

3.1.8 Ambient Air Quality

Air quality monitoring in New Brunswick is a partnership between the Federal Government (Environment Canada) and the Provincial Department of Environment and Local Government (DELG). The provincial network is comprised of 16 air quality monitoring stations. There are a total of 46 instruments (monitoring 74 parameters) operating at these stations at all times. The Province also requires the operators of large industrial facilities to participate in air quality monitoring. During the 2013 reporting year there were 30 industry-operated stations, with 48 instruments (monitoring 51 parameters), dedicated to continuously monitoring the ambient concentrations of industry specific contaminants in nearby communities. Air quality is measured based on provincial air quality objectives (see Table 2), which were established under the Clean Air Act in 1997 (New Brunswick Department of Environment and Local Government, 2015d).

Table 2. New Brunswick air quality objectives

Pollutant	Averaging Period			
	1 Hour	8 Hour	24 Hour	1 year
Carbon Monoxide	35,000 µg/m ³ (30 ppm)	15,000 µg/m ³ (13 ppm)		
Hydrogen Sulphide	15 µg/m ³ (11 ppb)		5 µg/m ³ (3.5 ppb)	
Nitrogen Dioxide	400 µg/m ³ (210 ppb)		200 µg/m ³ (105 ppb)	100 µg/m ³ (52 ppb)
Sulphur Dioxide	900 µg/m ³ (339 ppb)		300 µg/m ³ (113 ppb)	60 µg/m ³ (23 ppb)
Total Suspended Particulate			120 µg/m ³	70 µg/m ³

In general, the Air Quality in New Brunswick is very good. The majority of exceedances of the objectives are of Hydrogen Sulphide and Sulphur Dioxide in Saint John and Belledune. The nearest monitoring stations to the project area are industrial monitoring stations in Lower Newcastle. Only one of these stations had exceedances. In 2013, the 24-hour objective ($120 \mu\text{g}/\text{m}^3$) was exceeded on two occasions at the Fire Ponds (Arbec) monitoring station (New Brunswick Department of Environment and Local Government, 2015d).

Possible sources of air contamination arise from the open gravel pits, located immediately adjacent to the project area. Thus potential air contamination exists as total suspended particulate matter, particularly during operation of machinery in the pits with dust generation from vehicles.

The nearest industrial facility to the project is the Arbec oriented strand board (OSB) mill, located roughly 27 kilometers to the east of the project site. The primary emission sources at the OSB mill are the wood-fired furnace, dryers and press vents. Sources of fugitive emissions include the storage and handling of wood residuals. Emissions from the dryers include wood dust and other solid particulate matter, volatile organic compounds (VOCs), and products of combustion from the wood waste furnace. Combustion products include carbon monoxide, carbon dioxide, nitrogen oxides and possibly sulphur dioxide if the back-up fuel, #2 fuel oil, is being burned (New Brunswick Department of Environment and Local Government, 2012).

3.1.9 Ambient Noise Levels

The project area and surrounding environment is mostly rural. Sources of existing sound in the area would primarily be vehicle traffic on Highway 420 and Back Road. Other sources include anthropogenic noise in the nearby community, as well as wildlife and wind noise. Occasional increases in background noise would arise from operation of heavy equipment in the gravel pits surrounding the site.

3.1.10 Existing Vegetation

According to the Department of Natural Resources Ecological Land Classification (ELC) document for New Brunswick, the project area is part of the Eastern Lowlands ecodistrict - Red Bank ecoregion (see Figure 3). This category of the ELC is described as having forests dominated by black spruce and red spruce, often in association with balsam fir and hemlock, or, less commonly, jack pine and white pine. Refer to Figure 4, modified from the ELC document, which depicts percent forest cover of the project area (NB DNR, 2007).

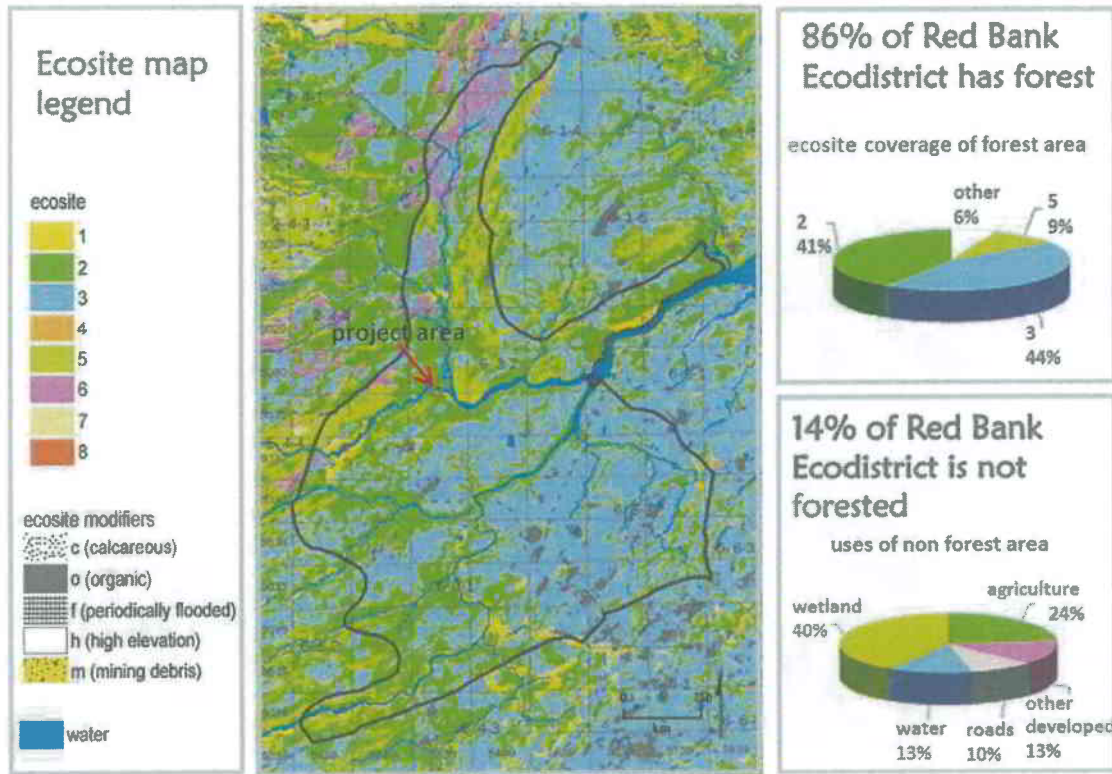


Figure 3. ELC - Red Bank ecodistrict

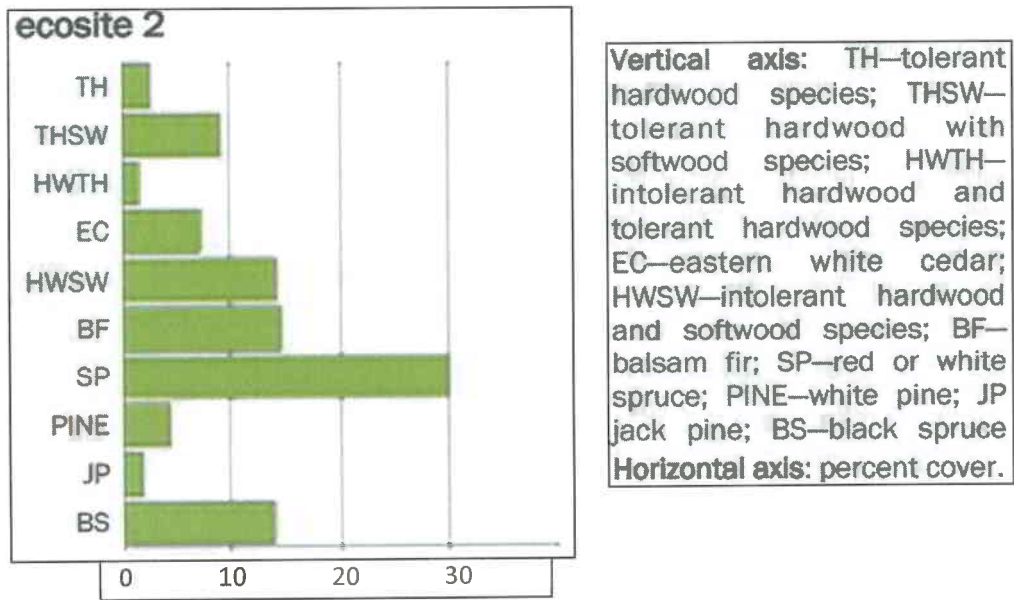


Figure 4. Percent forest cover from ELC

3.1.11 Existing Fish and Wildlife/Fish and Wildlife Habitat

According to the Ecological Framework of Canada, the Atlantic Maritime Ecozone - which encompasses the project area - supports a wide variety of critical terrestrial and freshwater environments. Rivers draining the area are vital for the commercially important Atlantic salmon and other ocean fish that return to inland streams to spawn. Brook Trout, Gaspereau, Halibut, and Bass are highly valued by recreational and commercial fishers (Environment Canada, n.d.).

Lakes and shaded waterways within forests supply habitat for herons, loons, and freshwater ducks, while osprey and eagles nest in tall trees. Canada Goose, Blue-winged Teal, Ring-necked Duck, and 31 other bird species breed exclusively in the unique freshwater habitats of the Atlantic region (Environment Canada, n.d.).

Much of the ecozone's wildlife is dependent on forest ecosystems. Terrestrial mammals include Black Bear, Bobcat, Snowshoe Hare, Northern Flying Squirrel, and White-tailed Deer. Large moose herds concentrate in various regions. Wolves, Mink, and the occasional Lynx also reside in this ecozone (Environment Canada, n.d.).

3.1.12 Species at Risk

A number of species at risk (i.e., endangered, threatened, of special concern, and rare species), are known to frequent the project area (see Table 3). These are of concern due to potential disturbances as a result of the project. Sources of available information on known species at risk in the project area included published listings such as: the Species at Risk Public Registry (SARPR, 2015a), the Committee on the Status of Endangered Wildlife in Canada (COSEWIC, n.d.), and the Province of New Brunswick's Species at Risk Act (NB SARA, 2013).

Table 3. Species at risk in the project area

Common name	Scientific name	NB SARA status	COSEWIC status	SARA status
American Eel	<i>Anguilla rostrata</i>	Threatened	Threatened	N/A
Atlantic Salmon	<i>Salmo salar</i>	N/A	Special Concern	Special Concern
Bald Eagle	<i>Haliaeetus leucocephalus</i>	Endangered	Not at Risk	N/A
Bank Swallow	<i>Riparia riparia</i>	N/A	Threatened	N/A
Striped Bass	<i>Morone saxatilis</i>	Special concern	Special concern	N/A
Wood Turtle	<i>Glyptemys insculpta</i>	Threatened	Threatened	Threatened

3.1.12.1 Bank swallow habitat

One bird species of particular conservation concern identified in the area was the Bank Swallow (*Riparia riparia*). Nesting cavities were observed on a field visit on November 25-26, 2015 (see Figure 5). The nesting cavities were observed on the north bank (eroding left bank) of LSW Miramichi River near the project site.



Figure 5. Bank swallow nesting cavities near the project site (photo taken Nov. 26, 2014)

The Bank Swallow is a migratory species which establishes nesting colonies in areas where a watercourse is actively eroding banks composed of silt or sand, with a strong preference for vertical faces which are renewed each year (Givertz, 2010; Wright et al., 2011). Nests are located in the top third of the bank, low enough such that predators cannot dig in from the top of bank and high enough as to be inaccessible from the toe or talus. This position also offers protection from flooding and limits the negative effects of rainwater percolating into the nest (Heneberg, 2013). Colonies exhibit some breeding site fidelity, with most individuals returning to a suitable bank within a ten kilometer radius of the original site. It should be noted that banks or bluffs which are not actively eroding are used less over time, presumably due to a lack of favorable nesting sites (Szabo, 2010; Wright et al., 2011).

3.1.13 Potential Habitat for Species at Risk

3.1.13.1 Wood Turtle

Another species of particular conservation concern was the Wood Turtle (*Glyptemys insculpta*); the floodplain and existing overflow channel in the project area provide potential habitat for this species at risk. According to the Species at Risk Public Registry, the Wood Turtle needs water for many of its vital functions, including mating, hibernation and temperature regulation. It generally hibernates at the bottom of the water, spends spring and fall in or near water and summers on the ground. However, it is considered a semi-aquatic turtle because it spends a great deal of time on land, although it rarely strays farther than 300 meters from water. This species is associated with rivers and streams with sandy or gravelly-sandy bottoms and prefers clear meandering watercourses with a moderate current. The Wood Turtle's natural nesting sites are found on sand or gravel-sand beaches and banks. Although they prefer riparian areas with diverse, patchy cover, females also lay in gravel holes, at the edges of roads and railways, in utility right-of-ways, in farming fields, pastures and former fields – any sunny and easily dug spot. Other habitats used less frequently by the Wood Turtle include bogs, marshy pastures, beaver ponds, shrubby cover, meadows, coniferous forests, mixed forests, hay, and agricultural fields and pastures (SAPR, 2015b).

In addition to known wood turtle locations indicated in Figure 1, additional Wood Turtle data from the North Shore MicMac District Council and the Atlantic Canada Conservation Data Centre was provided by Environment Canada. Figure 6 presents this data georeferenced and overlain with existing site features. The light blue dots indicate North Shore MicMac District Council Wood Turtle locations, the green dots represent Atlantic Canada Conservation Data Centre Wood Turtle locations, and the solid red outline represents the area of critical Wood Turtle habitat (Figure 6). Though the proposed construction works do not overlap with known Wood Turtle locations, nearly the entire project area is located in critical Wood Turtle habitat.

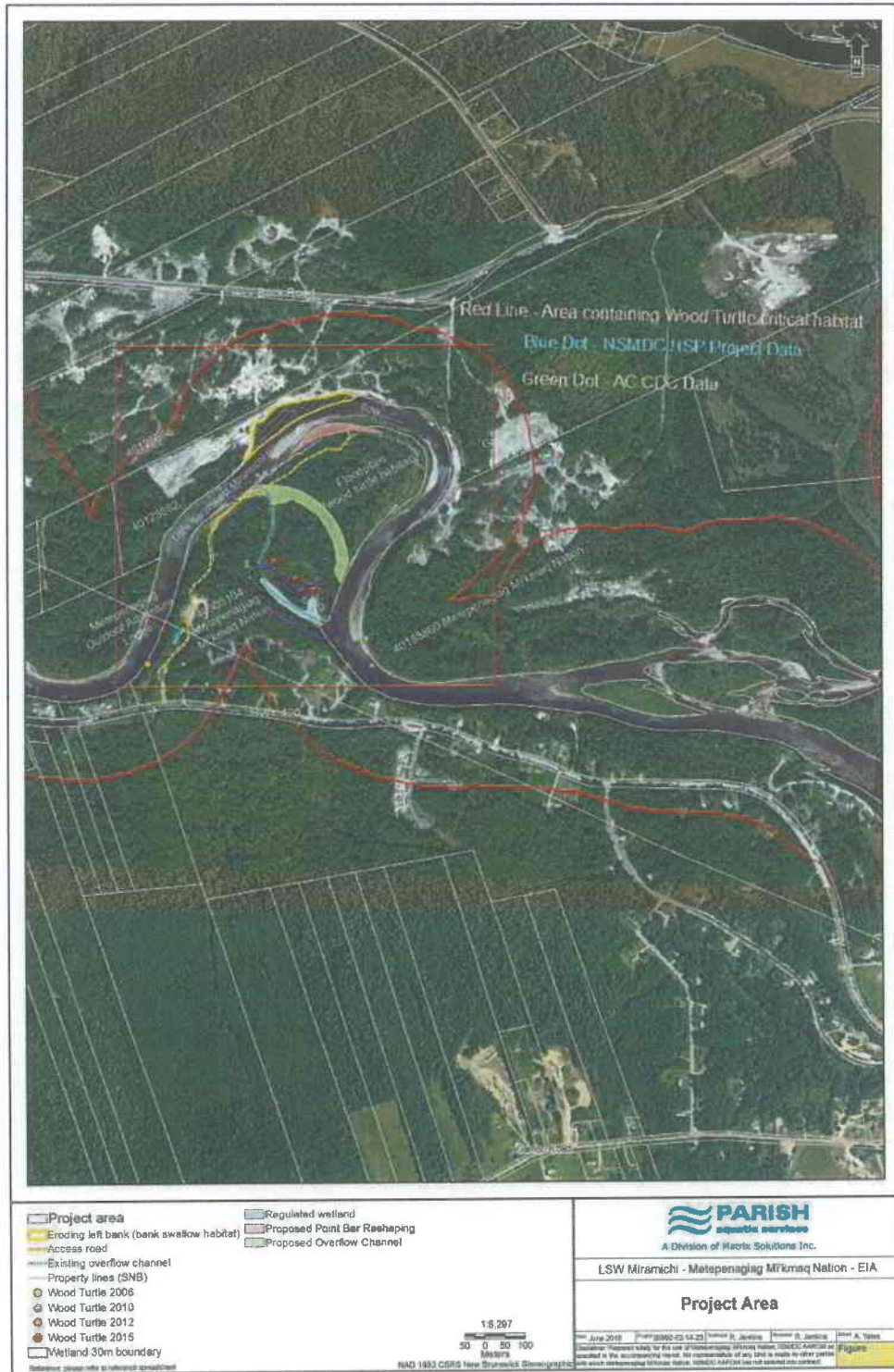


Figure 6. Existing environmental features and wood turtle locations provided by Environment Canada

3.2 Cultural Features

The proposed undertaking is located in the Metepenagiag Heritage Park in Metepenagiag (Red Bank), which is the ancestral home of the Metepenagiag Mi'kmaq First Nation. This park includes two of the most significant aboriginal heritage archeological sites in eastern Canada which includes the Augustine Mound National Historical Site and Oxbow National Historic Site. Through archaeological excavations, evidence has been found indicating the site has been continuously inhabited by the Mi'kmaq First Nation for over 3,000 years. In addition, the area is host to locally significant tourism operations including the Metepenagiag Outdoor Adventure Lodge. Heritage resource testing will be done in the channel footprint prior to construction with more details to follow. The following cultural features are located near the project vicinity:

3.2.1 Oxbow National Historic Site of Canada

The Oxbow site is a culturally significant site within the reserve land of the Metepenagiag Mi'kmaq Nation, which was identified as a National Historic Site of Canada in 1982. The site feature is an oxbow bend in the LSW Miramichi River, which follows the north bank of river where stratified archaeological resources are buried in alluvial deposits of the river bank to a depth of up to two meters. Archaeological evidence was found of a stratified Maritime Woodland period village of the Mi'kmaq community. The site contains artifacts and resources dating 3000 years of Mi'kmaq history that is buried within the banks along the LSW Miramichi River (Parks Canada, 2015).

3.2.2 Augustine Mound National Historic Site of Canada

The Augustine Mound is an archaeological site situated within the Metepenagiag Mi'kmaq Nation, New Brunswick reserve land and was recognized as a National Historic Site of Canada in 1975. This cultural feature is a circular ritual site surrounding a slightly elevated burial mound on the north side of the LSW Miramichi River, approximately 700 meters east of the Oxbow National Historic Site of Canada. Evidence of the ceremonial burial mound dates to around 2,500 years ago and contains human remains and archaeological artifacts. The site continues to retain a significant spiritual and ritual place in the Mi'kmaq community.

3.2.3 The Metepenagiag Outdoor Adventure Lodge

This lodge is situated on the south bank of the LSW Miramichi River, immediately adjacent to the Metepenagiag Heritage Park, and provides year round accommodations, recreational opportunities, dining, and conference room facilities. The facilities include a ten bedroom lodge and a conference centre that can accommodate 100 people. Recreational opportunities include Atlantic Salmon Fishing in privately owned pools, canoe excursions, wildlife viewing, and Mi'kmaq cultural opportunities at the nearby Metepenagiag Heritage Park.

3.3 Existing and Historic Land Uses

3.3.1 Historic Land Uses

A hydrological assessment of “The Oxbow” study area was undertaken by TAP Environmental Resources Inc. (2002) which included aerial imagery analysis of land use changes between 1944-45 and 1999. This background report was used in conjunction with recent digital aerial imagery from 2010 to provide a description of previous and existing uses of the subject property and adjacent lands.

The aerial photo analysis, undertaken by TAP Environmental Resources Inc. (2002), indicates that in 1944-45 there was minimal commercial or residential development in the vicinity of the study area. The lands to the north of the oxbow are forested, with several swaths of land cleared for agricultural use, upstream of the study site. Along the southern floodplain of the oxbow bend, there is evidence of an overflow channel. Between 1946 and 1956 evidence of Johnston’s Pit emerges within the forested lands northwest of the oxbow bend. By 1965, Johnston’s Pit is expanded 170 meters to the southwest and 540 meters to the southeast when compared to the 1965 aerial imagery. The 1965 air photos also shows roughly 90 meters of vegetation removed along the north riverbank in area of The Oxbow. The pit continued to expand to the west by approximately 400 meters by 1975. In addition, a second pit is visible roughly 200 meters southeast of Johnston’s Pit which extends approximately 380 meters to the south, as seen in imagery from 1975. The deforested portion of land, to the immediate north of the LSW Miramichi River increased to approximately 190 meters to the southwest by 1975 as part of the Johnston’s Pit expansion. Recession of the north bank is visible in the 1975 aerial imagery due to erosion with the formation of a lateral side bar approximately 40 meters downriver of this point. Upriver of the study area, the use of land for agriculture along the north bank of the LSW Miramichi River appears to have stopped, allowing for establishment of vegetation. According to TAP Environmental Resources Inc. (2002), the most observable impact in the 1983 photographs was the further expansion of Johnston’s Pit towards the southwest, along the left riverbank, that extends approximately 260 meters in length. Roughly 1058 m² of surface area has eroded along the north bank of the LSW Miramichi River immediately adjacent the area that lacks a buffer at Johnston’s Pit. By 1999, excavation at Johnston’s pit continued along the left north river bank, moving southwest approximately 330 meters. This expansion resulted in a loss of 240m of treed buffer along the north river bank. During this time, the river continued to erode into the north bank by an average width of 25 meters, and a maximum width of 40 meters between 1983 and 1999. The 1999 aerial imagery also shows a slightly greater density of residential homes along NB Route 420. While it could not be observed prior to 1983, due to photo quality, the 1983 and 1999 imagery show evidence of access trails along the floodplain immediately south of “The Oxbow”, which area associated with the Metepenagiag Heritage Park.

3.3.2 Existing Land Uses

Recent imagery from 2010 shows continued use of pits along the north banks of the LSW Miramichi River, though minimal change is observed since 1999. The north bank continues to lack a vegetated

buffer along a large proportion of Johnston's Pit and has continued to erode in comparison to the 1999 photos. On the southern floodplain of "The Oxbow" site, a trail network continues to be observed, with the lands primarily forested. Several buildings are located in the tablelands of the Metepenagiag Heritage Park including an art facility to the east and the Metepenagiag Outdoor Adventure Lodge to the west, with two associated parking lots between the facilities. Minimal changes in residential development are apparent along NB Route 420 between 1999 and 2010. Agricultural fields, along the south bank of the LSW Miramichi continue to remain active upriver of the study area.

4 SUMMARY OF ENVIRONMENTAL IMPACTS

This section includes a description of potential environmental effects of the project on the surrounding environment during the construction phase, as well as reasonably foreseeable cumulative effects on the environment following the completion of the project. Further discussion of the potential impacts is provided in the following report sub-sections where each impact is assessed in more detail.

4.1 Physical and Natural Features

4.1.1 Topography and Surface Drainage

The topography of the project site will be altered by removing materials from the floodplain and by re-grading the point bar at the project site. The materials to be removed are expected to be free of contaminants and will be disposed of appropriately off-site by a contractor. The material to be removed from the point bar for re-grading will be dispersed on the floodplain.

The proposed overflow channel will capture surface drainage that might have otherwise drained into the LSW Miramichi River or the existing overflow channel. The anticipated impact to the surrounding environment is low due to the small area that is being drained in the project site. However, cutting and filling of material can lead to erosion and sedimentation of the watercourse from run-off.

4.1.2 Water Features

The installation of an overflow channel through the floodplain and re-grading of the point bar on the inside bend of the LSW Miramichi River has the potential to impact channel form resulting in changes in geomorphic processes impacting overall channel stability. The proposed design will involve a re-direction of high flows through the floodplain via the additional overflow channel. One expected outcome will be a reduction of the erosion occurring on the left bank due to reduced pressures during flood events.

In addition, the wetland feature, situated to the south of the proposed overflow channel has the potential to be impacted by release of deleterious substances or sedimentation. The use of construction

machinery near the site may result in damage to the wetland drainage features and surrounding vegetation.

4.1.3 Geological, Hydrogeological, and Soil Features

Effects on the underlying geology are expected to be minimal since excavations will only be a metre deep on average and the soil layer is described as being greater than a metre in depth (Colpitts et al. 1995). Removal of soils and disposal off-site is expected to have minimal effect on the environment since they are expected to be free of contaminants. The removal of materials to create an overflow channel may change subsurface flows and draw groundwater into the overflow channel. However, these changes will occur in a small area and are expected to be minimal.

4.1.4 Potable Water

The change in topography for the planned overflow channel may affect subsurface water flow. However, no impact is expected for nearby domestic wells since the project site is located at least 200 metres from the nearest possible location for a well and will not involve any groundwater withdrawals. Also, the project site is located downslope hydraulically. Any groundwater movement through the project area is likely mimicking the topography and being drawn to the project site as is. It is not expected that changing the surface topography in this area will have any adverse effects on groundwater movement upslope.

4.1.5 Ambient Air Quality

The operation of heavy equipment during the construction phase has the potential to increase ambient levels of total suspended particles (TSP) in the air. This will depend on the weather conditions prior to the construction phase. A drier summer will lead to an increased chance for heavy equipment to cause increases in TSP while travelling along the site access route. These disturbances in the project area will be short in duration; isolated to the time period required for the construction phase. The increases in TSP are not expected to be more compared to other road traffic travelling on unpaved roads in the area (ie. vehicles, ATV's, heavy equipment in the gravel pits).

4.1.6 Ambient Noise Levels

Large machinery will be required to construct the proposed overflow channel and point bar feature on site which will result in temporary, short-term elevated noise levels that will be restricted to the construction of the proposed undertaking. Construction equipment includes a large number of machines powered by internal combustion engines which create exhaust noise when operated. In addition, clearing and grubbing activities will include the use of chainsaws which have a high-pitch whine when running.

As the proposed undertaking is situated in a wooded floodplain, elevated noise levels have the potential to disturb local wildlife species. In addition, as a cultural heritage park, noise levels may deter visitors from use of the site during the construction phases.

4.1.7 Woodlands

The proposed overflow channel is to be constructed along the southern floodplain of the LSW Miramichi River, over an area of 10650 m². Land cover, within this portion of the floodplain includes woodland cover. Removal of trees will be required to excavate the proposed overflow channel. In addition, the use of large machinery in the project area has the potential to result in damage to surrounding trees.

4.1.8 Existing Fish and Wildlife/Fish and Wildlife Habitat

Fish and wildlife in the project area may be affected by construction activities. Adverse effects may occur if erosion and sediment control measures fail and a release of sediment occurs in the surrounding environment. Operation of heavy equipment within the floodplain, near aquatic environments, presents a risk in terms of contaminant releases if equipment is not properly maintained, fuelled, and/or inspected. Wildlife in the floodplain may also be affected as heavy equipment traverses, stockpiles and removes materials in the project area. Though terrestrial habitat will be destroyed in the floodplain by removal of soils and vegetation, new aquatic habitats will be created through the presence of the additional overflow channel.

4.1.9 Species at Risk

Species at Risk may be affected during the construction phase of the project. Aquatic species at risk may be affected if sediment and erosion control measures are not properly implemented and a release of sediment into the aquatic environment. Terrestrial and aquatic species at risk may also be affected due to operation of heavy equipment within the floodplain, where a risk in terms of contaminant releases exists if equipment is not properly maintained, fuelled, and/or inspected. Destruction of certain habitat types within the floodplain may have an effect on Wood Turtles that reside in the area. It is not expected that the project will have an effect on Bald Eagles or Bank Swallows in the project area.

4.1.10 Potential Habitat for Species at Risk

The possibility for adverse effects on potential habitat for species at risk exists during the construction phase if sediment and erosion control measures are not properly implemented or if heavy equipment is not properly maintained, fuelled, and/or inspected. Upon project completion, and in the long term, it is expected that potential habitat for species at risk will improve. This will be due to expected reductions in sedimentation in the LSW Miramichi River, which will improve habitat for aquatic species at risk. The project will increase potential habitat in the floodplain for the semi-aquatic Wood Turtles. Potential Bank Swallow habitat on the eroding left bank will not be disturbed since project activities are not planned in that area.

4.2 Cultural Features

4.2.1 Historic Sites and Metepenagiag Outdoor Adventure Lodge

It is not expected that the project will not have any effect on the nearby Historic Sites. No work is planned in these areas; project work will be isolated to the floodplain of the LSW Miramichi River in the project area. Changes to the hydrology of the LSW will be localized to the section of river running by the eroding left bank and only high flows will be affected (reduced). Thus, changes in LSW flows through the project area are not expected to have adverse effects on the Historic Sites. Heritage resource testing will be done in the channel footprint prior to construction with more details to follow.

The Metepenagiag Outdoor Adventure Lodge may be affected as heavy equipment travels to and from the project site. Site access routes to the site are adjacent to, and run through the parking lot of the lodge.

4.3 Existing Land Uses

Existing land uses may be affected by the project. Access to the trail system in the floodplain will be restricted while construction activities are ongoing. Upon completion of the project, access to the lower trail system in the floodplain will be restricted during high flows. This is due to the placement of the overflow channel, which crosses over the trail approximately midpoint along its path. Access will remain unchanged during normal flows in the LSW which will be the vast majority of the time. The existing land use of the gravel pits may be improved due to expected reduced erosion along the left bank, potentially

5 SUMMARY OF THE PROPOSED MITIGATION

The proposed undertaking was developed as the preferred alternative to address erosion occurring along the LSW Miramichi River while avoiding and mitigating the impacts associated with site restoration. The following recommendations have been proposed to mitigate impacts to the environmental components of concern identified in the environment impact assessment:

5.1 Physical and Natural Features

5.1.1 Topography and Surface Drainage

- To minimize impacts associated with excavation and grading of the floodplain topography, the proposed overflow channel was selected in a location of a historic overflow channel. Consequently, less site grading will be required to construct the new overflow channel to the design specifications as a depression in the topography remains from the historic overflow channel.

- The inlet of the proposed channel will tie into the south bank of the LSW Miramichi River at the location of the existing overflow channel. Lower bank height at this location will require less excavation and grading along the river, minimizing changes to existing topography of the floodplain. In addition, the outlet of the proposed overflow channel is to tie in with the south bank of the LSW Miramichi River at the location of the historic overflow channel. This portion of the river has a natural depression and lower bank heights from high flows conveyed by the historic overflow channel which will reduce the required excavation of the floodplain.
- The construction of the proposed overflow channel along the floodplain to the south of the LSW Miramichi River will require site grading over an area of 10650 m². The impacts associated with changes to topography on surface drainage will be minimal as this area represents a negligible overall proportion of the subwatershed area.
- To mitigate potential run-off, associated with exposed soil during excavation activities, and erosion and sediment control plan has been developed to prevent entry of sediment into the LSW Miramichi River. Erosion and sediment fencing will remain installed on the project site until the site has stabilized following seeding.
- Excavation and site grading, associated with the construction of the proposed overflow channel and point bar reshaping, has the potential to impact surface drainage by altering the existing site grade.

5.1.2 Water Features

- The topographical survey and LiDAR data used for restoration designs did not provide details on the LSW Miramichi River below the water surface, thus a hydraulic analysis through the project site could not be completed. Information on hydrology was gathered through previous studies in the project area and from available scientific resources. This was deemed acceptable by regulators to support the restoration designs (DFO, June 5th 2015, personal communication).
- The reduction of this flow in the LSW Miramichi River will have minimal impact to the environment as the mean annual flow will remain unchanged in the LSW. The proposed overflow channel will convey 12.3 % of a 2-year flow event on the LSW Miramichi in order to reduce shear stress exerted on the outer meander bend, providing greater channel stability. Under this design natural river processes would be permitted to continue with little to no impact on the channel form.
- An Erosion and Sediment Control Plan has been developed to minimize the risk of sedimentation of the river during the construction phase of the project. Erosion and sediment fencing will remain installed on the project site until the site has stabilized following seeding. This will also act to prevent construction machinery from damage to features outside of the

construction zone including the wetland feature situated north of the proposed overflow channel.

- All activities, including maintenance procedures, will be controlled to prevent the entry of Petroleum products, debris, sediment or other deleterious substances into the water. Vehicular equipment refueling and maintenance will be conducted in approved area only.
- If during the construction of the channel, wood turtle nesting areas are discovered or appear to be present adjustments to the channel alignment will be made to avoid these areas.

5.1.3 Soil, Geological, and Hydrogeological Features

- In order to preserve topsoil, that is to be excavated from the floodplain to create the proposed overflow channel, a stockpiling area will be established separately and protected with erosion control fencing. This topsoil material will be used as a cap for seeding following excavation of the overflow channel.
- The potential to impact subsurface drainage patterns has been minimized by selecting a historic overflow channel scar on the floodplain as the location for the proposed overflow channel construction. Existing site grading along this portion of land will minimize the changes to the subsurface drainage as excavation will only require between 0.5 – 1.5 m of soil removed to create the overflow channel.

5.1.4 Potable Water

- No impact is expected for nearby domestic wells since the project site is located at least 200 metres from the nearest possible location for a well and will not involve any groundwater withdrawals. Also, the project site is located downslope hydraulically. Any groundwater movement through the project area is likely mimicking the topography and being drawn to the project site as is. It is not expected that changing the surface topography in this area will have any adverse effects on groundwater movement upslope.

5.1.5 Ambient Air Quality

- Periodic inspections should be completed of the construction site, during dry and windy conditions to identify areas likely to cause emission of dust into the air.
- Construction machinery and crew vehicles should reduce speeds in areas of exposed soil to prevent generation of dust.
- Apply water to disturbed areas, where required, to reduce dust generated by vehicular traffic.

- All disturbed areas should be seeded and re-vegetated as per design criteria following completion of construction activity.

5.1.6 Ambient Noise Levels

- Construction timing was selected to occur outside of the breeding period of Wood Turtle after the end of June (Quinn and Tate, 1991).
- In addition, construction activities are to be restricted from occurring during the breeding bird season from the beginning of April to mid-July in accordance with the Migratory Birds Convention Act.
- During construction activities, work will be completed on a regular schedule between 7:00 am and 5:00 pm Monday to Friday.

5.1.7 Woodlands

- The access route was selected through an existing road network in order to minimize the impacts to the floodplain woodlot and reduce the number of trees required for removal.
- Hoarding should be placed around the drip line of significant tree species identified along the access route and adjacent to the proposed overflow channel to avoid damage to trees from machinery.
- Any hanging tree limbs lower than 6m should be pruned to prevent injury to tree limbs.

5.1.8 Existing Fish and Wildlife/Fish and Wildlife Habitat

- The point bar feature will be reshaped by excavating 1543 m³ of material. This geomorphic feature will remain intact following construction and continue to provide shallow refuge substrate and flow diversity within the LSW Miramichi River.
- Construction of the rock spur embedded in the south bank of the LSW Miramichi River will train the thalweg slightly towards the centre of the channel within the pool to provide stability to the overflow channel outlet. This feature will promote the required thalweg development to maintain the pool along the bend and improve Fish Habitat overall.
- Removal of vegetation, during construction activities, should be restricted from occurring between the beginning of April to mid-July in accordance with the Migratory Birds Convention Act, and the Migratory Birds Regulations, to avoid impacting migratory birds, nests, and eggs during the breeding season.

- Upon completion of the project, it is expected that fish habitat downriver of the proposed project site will remain as is or improve due to the decrease in sediment input from the eroding bank in the LSW Miramichi River.

5.1.9 Species at Risk

5.1.9.1 Wood Turtle

- The location of the proposed overflow channel has been selected to avoid direct impacts to the location of known Wood Turtles observed in the wetland feature at the outlet of the existing overflow channel.
- The impact area, or area to be excavated in the floodplain, does not appear to offer suitable nesting habitat for wood turtle, although it may provide foraging habitat for turtles that might be present in the area (NB Museum, personal communication, June 4th, 2015). Prior to clearing and grubbing of vegetation in the proposed construction area, members of the First Nation, trained in Wood Turtle identification and ecology, will attempt to locate foraging Wood Turtles. If detected in the work area, the turtles are to be relocated outside of the construction zone, within the adjacent riparian habitat of the floodplain.
- Exclusion fencing will be used in high probability areas to reduce the accessibility to the work site for turtles. At minimize a light-duty geotextile fabric should be used, buried 10 – 20 cm underground to a height of 60 cm above ground level. Once installed, a survey of the enclosed area should be conducted immediately following installation to ensure no Wood Turtles have been trapped within the exclusion zone (OMNR, 2013). The fencing should be monitored periodically throughout the duration of construction phase to inspect for damages or openings
- Prior to the commencement of each work day, the site will be surveyed to locate Wood Turtles within the work site and relocate them to adjacent riparian corridor.
- During construction of the proposed undertaking, First Nation members will be onsite to inspect the work area for Wood Turtles. Construction crews will be informed of the potential presence of Wood Turtles on site and will immediately cease work and inform First Nation members on site to relocate them to adjacent suitable habitats.
- Waste shall be secured in containers to deter wildlife and are to be disposed of in a designated area away from Wood Turtle habitat. Waste is to be removed from the site on a regular basis to a nearby waste management facility.
- The mitigation measured outlined above will not jeopardize the survival or recovery of the species. The proposed undertaking will improve channel stability and prevent excessive erosion on the north bank of the LSW Miramichi River, reducing excessive sedimentation downriver.

5.1.9.2 *Bank Swallow*

- No Bank Swallow habitat will be altered during the construction of the proposed undertaking.
- Construction activities should be restricted from occurring between the beginning of April to mid-July in accordance with the Migratory Birds Convention Act, to avoid impacting the migratory Bank Swallows, including their nests and eggs during the breeding season.

5.1.10 Potential Habitat for Species at Risk

5.1.10.1 *Wood Turtle*

- During the design of the proposed undertaking, consideration was given to the existing land cover and the anticipated impacts on Wood Turtle habitat associated with site alteration to accommodate an overflow channel through the floodplain. As Wood Turtles require a diversity of habitat, including sand or gravel bars, deep pools or log jams, open/herbaceous, short shrub, tall shrub and wooded habitat types present in the riparian zone (Wesley 2006), avoidance of disturbing areas where possible was considered. Access routes were selected along existing road networks within the study area to avoid unnecessary removal of vegetation. In addition, the proposed overflow channel is to be situated along the floodplain, north of known Wood Turtle locations.
- Open areas near the banks of the LSW Miramichi River should not be used as turnaround or stockpiling locations during construction to avoid impacting the vegetation community.
- Hoarding and fencing should be used to protect significant tree and vegetation species, where possible, to avoid damage from construction equipment and to maintain tree canopy cover where possible.
- It is anticipated that following construction works, the overflow channel will provide additional habitat for Wood Turtle as the site grading will provide low herbaceous and shrub vegetation for habitat diversity.
- Changes to stream flow pattern associated with the proposed undertaking will not adversely impact sand bar habitat used by Wood Turtles for nesting. The proposed channel design was created to reduce shear stress on the north bank of the LSW Miramichi River during high flow events and will encourage the channel to return to natural rates of erosion and deposition. As such, sandy point bar features will continue to be maintained along the inside bends of the meandering channel.
- All activities, including maintenance procedures, will be controlled to prevent the entry of Petroleum products, debris, sediment or other deleterious substances into the water. Vehicular

equipment refueling and maintenance will be conducted in approved area only where Wood Turtle habitat will not be impacted.

5.2 Cultural Features

Though the construction works will occur outside of both Historic Sites, heritage resource testing will be done in the channel footprint prior to construction. This will be conducted via test pitting and will include mitigation measures for avoiding wood turtles, reducing vegetation damage, etc. Details regarding the methodology of test pitting and specific mitigation measures were not available for inclusion in this document. However, this information is forthcoming and will be provided to regulators prior to construction. Submission of these details in this manner was deemed acceptable (NB DELG, June 4th 2015, personal communication).

5.2.1 Oxbow National Historic Site of Canada

- The proposed design alternative was selected to avoid impacting the Oxbow National Historic Site of Canada, located on the north banks of the LSW Miramichi River. No construction work is to be undertaken on the north bank or adjacent north floodplain. Rather, construction of the proposed overflow channel on the southern floodplain and reshaping of the south bank point bar will reduce the rate of erosion along the north bank. It is therefore expected that the proposed undertaking will assist in stabilizing the north bank, preserving the archaeological site.

5.2.2 Augustine Mound National Historic Site of Canada

- Excessive sedimentation of the LSW Miramichi River associated with erosion along the north bank of the oxbow has likely resulted in the downriver aggradation, observed near the Augustine Mound National Historic Site of Canada. Such aggradation appears to have influenced channel dynamics resulting in the planimetric adjustment of channel form in the vicinity of the Mound historic site which has the potential to impact the site. By minimizing the erosion along the oxbow bend, downriver sedimentation is expected to be reduced, allowing the channel to return to a dynamic state of equilibrium. It is anticipated that the proposed undertaking will assist in reducing the downriver impacts on the Augustine Mound site.
- No construction work will take place near the Mound historic site.

5.2.3 Metepenagiag Outdoor Adventure Lodge

Construction access roads will follow the existing driveway to the Metepenagiag Outdoor Adventure Lodge. High noise levels, dust, and traffic have the potential to disrupt recreational users of the lodge. To minimize disruption of the business operation the following guidelines should be considered:

- Construction activities should be completed on a regular schedule between 7:00 am and 5:00 pm Monday to Friday. Weekend work should be avoided as it is expected increased use of the facility during none weekdays.
- Vehicular and construction machinery should reduce speeds near the lodge to minimize dust.

6 PUBLIC INVOLVEMENT

As per Step 1, 4 and 8 of Appendix C (Minimum Proponent Sponsored Public Involvement Standards for Registered Projects), a Notification Letter about the project and its location will be sent to all stakeholders affected by the proposed project, including elected officials (MLA Lisa Harris), Chief and Council of Metepenagiag Mi'kmaq Nation, community members of Metepenagiag Mi'kmaq Nation, environmental groups (Miramichi Watershed Management Committee, Miramichi River Environmental Assessment Committee and Miramichi Salmon Association), Sunny Corner Local Service District, and the adjacent landowner, John Johnston.

Secondly, copies of the project registration document will be made available to any interested members of the public, stakeholder or First Nation and a copy will be deposited, along with any subsequent revision, with the appropriate DELG office, where it will be available for public review.

Finally, within sixty days of project registration, a report documenting the above public involvement activities (as per the required format) will be submitted to the Department of Environment and Local Government.

7 APPROVAL OF THE UNDERTAKING

Watercourse and Wetland Alteration Permits issued by the Department of Environment and Local Government (DELG) under the Watercourse and Wetland Alteration Regulation of the Clean Water Act

Other: Species at Risk Act Permit, SAR Public Registry, Environment Canada, Canadian Wildlife Services

8 FUNDING

Atlantic Salmon Conservation Foundation, 480 Queen St, Fredericton, NB

Department of Fisheries and Oceans Canada – Gulf Region, P.O. Box 5030, Moncton, NB

NB Department of Environment, P.O. Box 6000, Marysville Place, Fredericton, NB

NB Department of Aboriginal Affairs Secretariat, 440 Kings Place, Fredericton, NB

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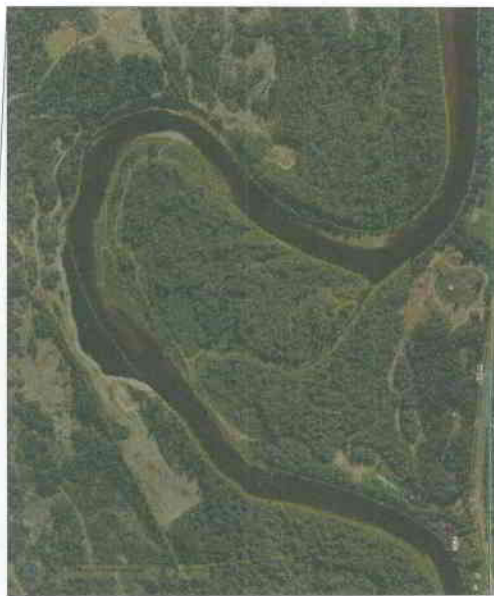
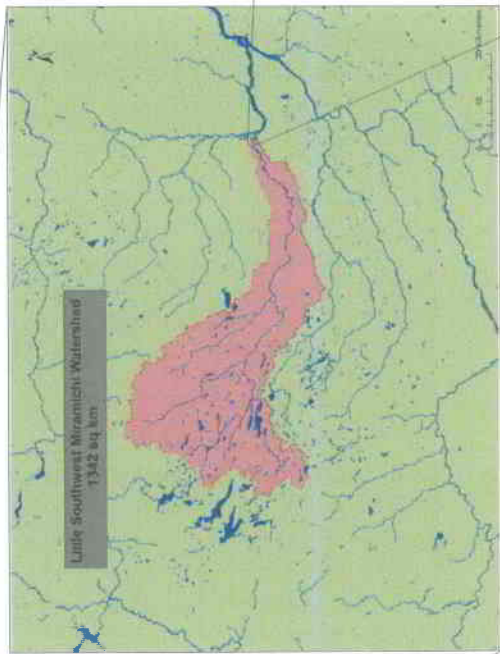
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APPENDIX A RESTORATION DESIGN SHEETS

LITTLE SOUTHWEST MIRAMICHI RIVER OXBOW BANK RESTORATION

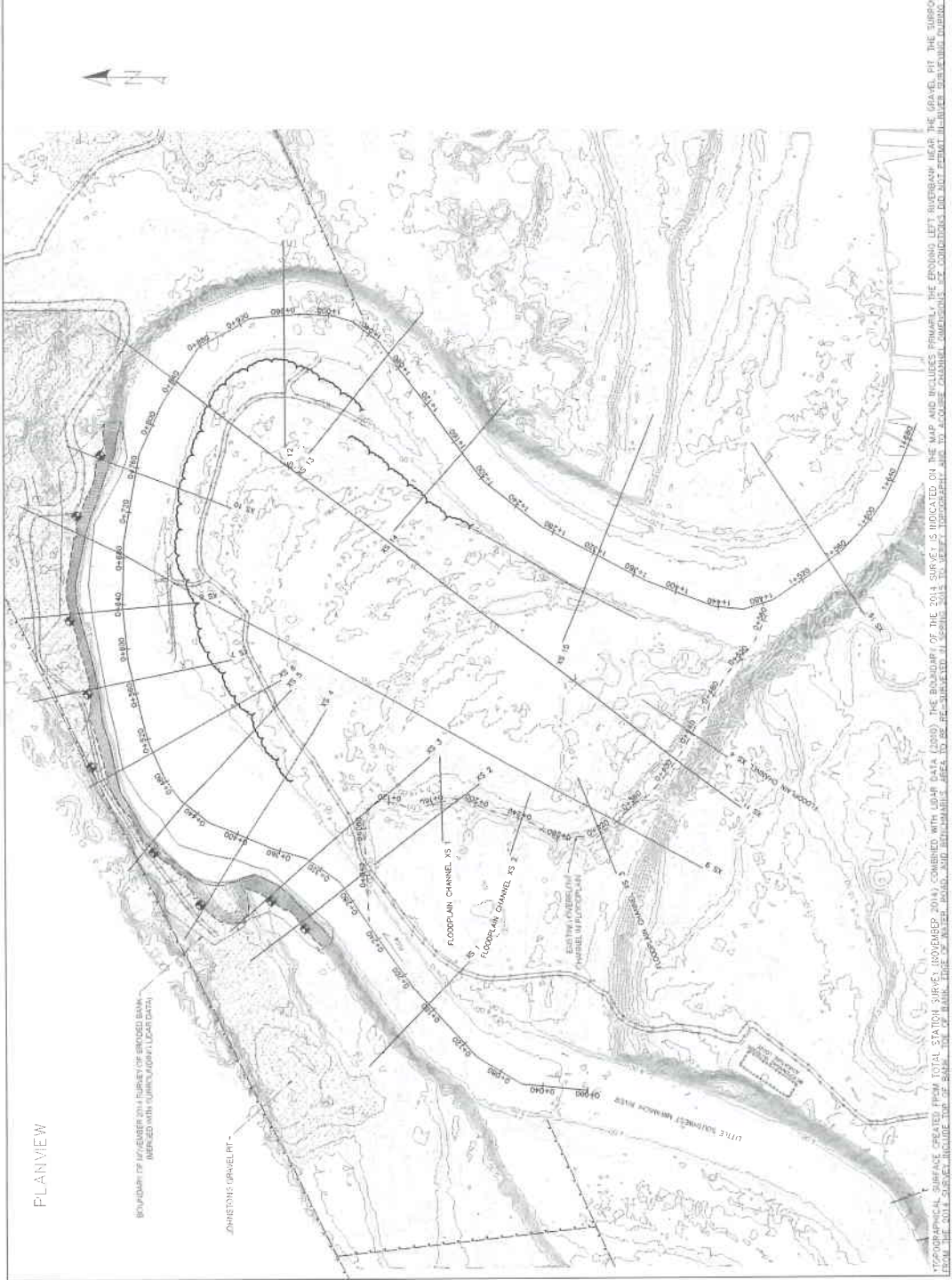


- 01--07 EXISTING PLANVIEW
- 02--07 DESIGN PLANVIEW
- 03--07 CROSS SECTIONS
- 04--07 CROSS SECTIONS (2)
- 05--07 DESIGN OVERFLOW CHANNEL PROFILE & CROSS SECTIONS
- 06--07 DETAILS
- 07--07 EROSION AND SEDIMENT CONTROL & CONSTRUCTION SEQUENCING

PROJECT NO 10-14-21	OVERVIEW	MATEPENAGIAG MIKMAQ NATION LSW MIRAMICHI - OXBOW BANK RESTORATION			
SHEET NO		FINAL			
TITLE				PARISH aquatic services A Division of Marsh Solutions Inc. 1400 Avenue Road, Miramichi, NB E3B 5E8 Tel: 506-753-8881 Fax: 506-753-9988 www.parish-aquaticsolutions.com	
				ROLE:	
				DESIGNER:	
				DATE:	DATE:
				DATE:	DATE:

LEGEND

- MAJOR CONTOUR (1 M)
- MINOR CONTOUR (0.5 M)
- LSW MEANLOW THALWEG
- FLOODPLAIN OVERFLOW CHANNEL
- EDGE OF WATER (NOV 2014)
- TOE OF BANK (NOV 2014)
- CROSS SECTION
- ROAD (NOV 2014)
- PROPERTY LINE
- GRAVEL PIT
- BENCHMARK (NOV 2014)



TOPOGRAPHICAL SURFACE CREATED FROM TOTAL STATION SURVEY (REVISED 2014) COMBINED WITH LIDAR DATA (2010). THE BOUNDARY OF THE 2014 SURVEY IS INDICATED ON THE MAP AND INCLUDES FROM THE BARRAGE LEFT THROUGHOUT THE RANGE. FOR THE SURVEYING INFORMATION, THE SURVEYING IS DERIVED FROM 2010 LIDAR DATA. EXISTING FEATURES FROM THE 2014 SURVEY INCLUDE THE TOP OF BANK, EDGE OF WATER, ROAD, AND BENCHMARK. AREA TO BE RECONSTRUCTED IS SHOWN WITH A DOTTED BOUNDARY. THE TOPOGRAPHICAL SURFACE IS DERIVED FROM 2010 LIDAR DATA. EXISTING FEATURES FROM THE 2014 SURVEY INCLUDE THE TOP OF BANK, EDGE OF WATER, ROAD, AND BENCHMARK. AREA TO BE RECONSTRUCTED IS SHOWN WITH A DOTTED BOUNDARY.

NO.	REVISIONS	DATE	BY	CHECKED BY	SCALE
1	ISSUED FOR REVIEW	2014-11-10	J. BARNETT	M. BARNETT	1:1000
2	REVISED	2014-11-10	J. BARNETT	M. BARNETT	1:1000
3	APPROVED FOR CONSTRUCTION	2014-11-10	J. BARNETT	M. BARNETT	1:1000
4	ISSUED FOR CONSTRUCTION	2014-11-10	J. BARNETT	M. BARNETT	1:1000

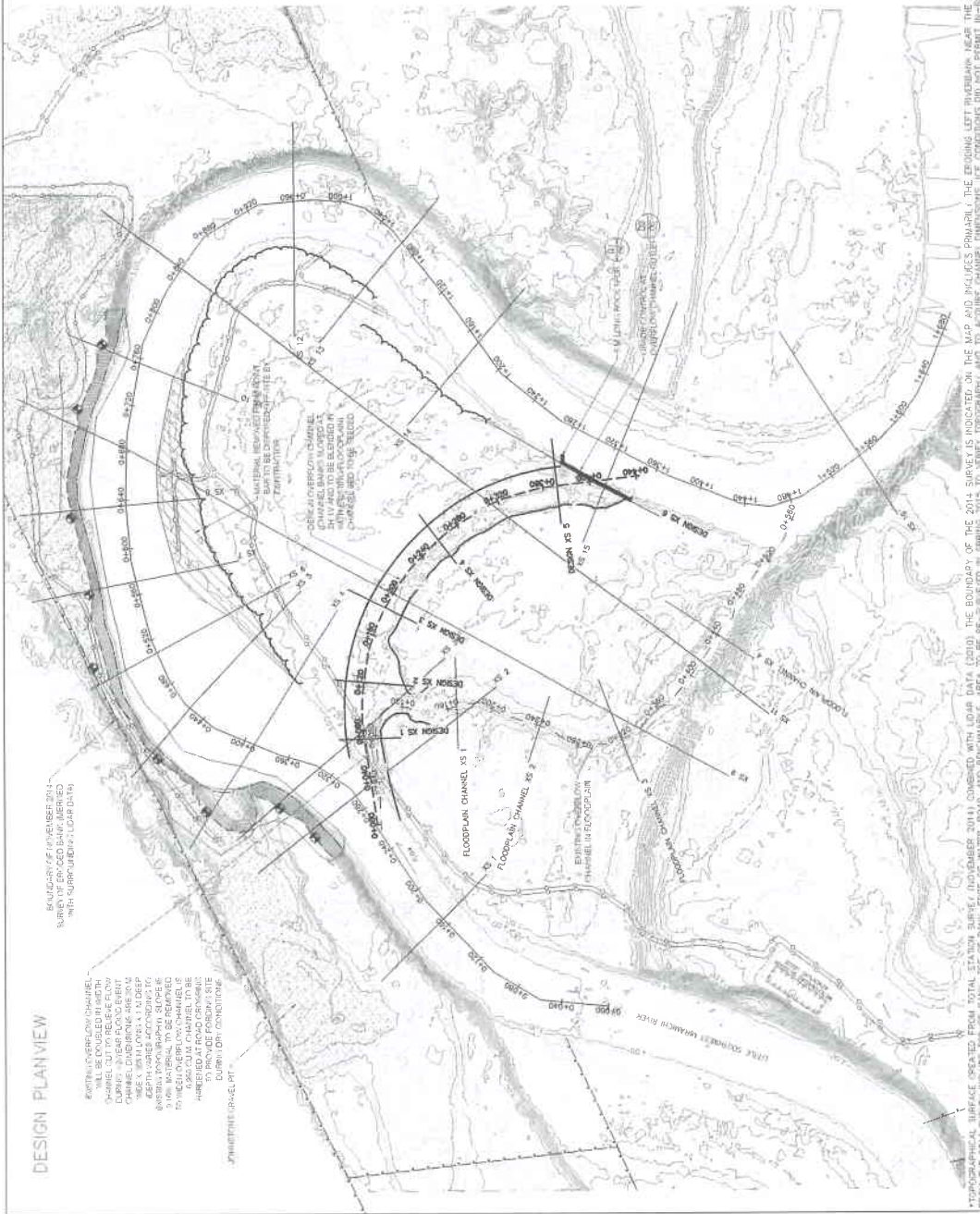
PARISH aquatic services
 A Division of North Solutions Inc.
 10000 Highway 101, Suite 100
 Miramichi, NB E3B 1K6
 Tel: 506-733-1111
 Fax: 506-733-1112

FINAL

**METEPENAGIAG MIKMAQ NATION
 LSW MIRAMICHI - OXBOW BANK
 RESTORATION**

EXISTING PLANVIEW

PROJECT NO: 10142
 SHEET NO: 01



LEGEND

- MAJOR CONTOUR (1 M)
- MINOR CONTOUR (0.5 M)
- FLOODPLAIN OVERFLOW CHANNEL
- EDGE OF WATER (NOV 2014)
- TOP OF BANK (NOV 2014)
- CRASS SECTION (NOV 2014)
- ROAD (NOV 2014)
- PROPERTY LINE
- GRAVEL PIT
- BENCHMARK (NOV 2014)

DESIGN FEATURES

- OVERFLOW CHANNEL CENTRELINE
- OVERFLOW CHANNEL TOP OF BANK
- GRAVEL CONTROL POINT SECTION
- GRAVEL CONTROL POINT SPUR
- REGRAINED POINT BAR

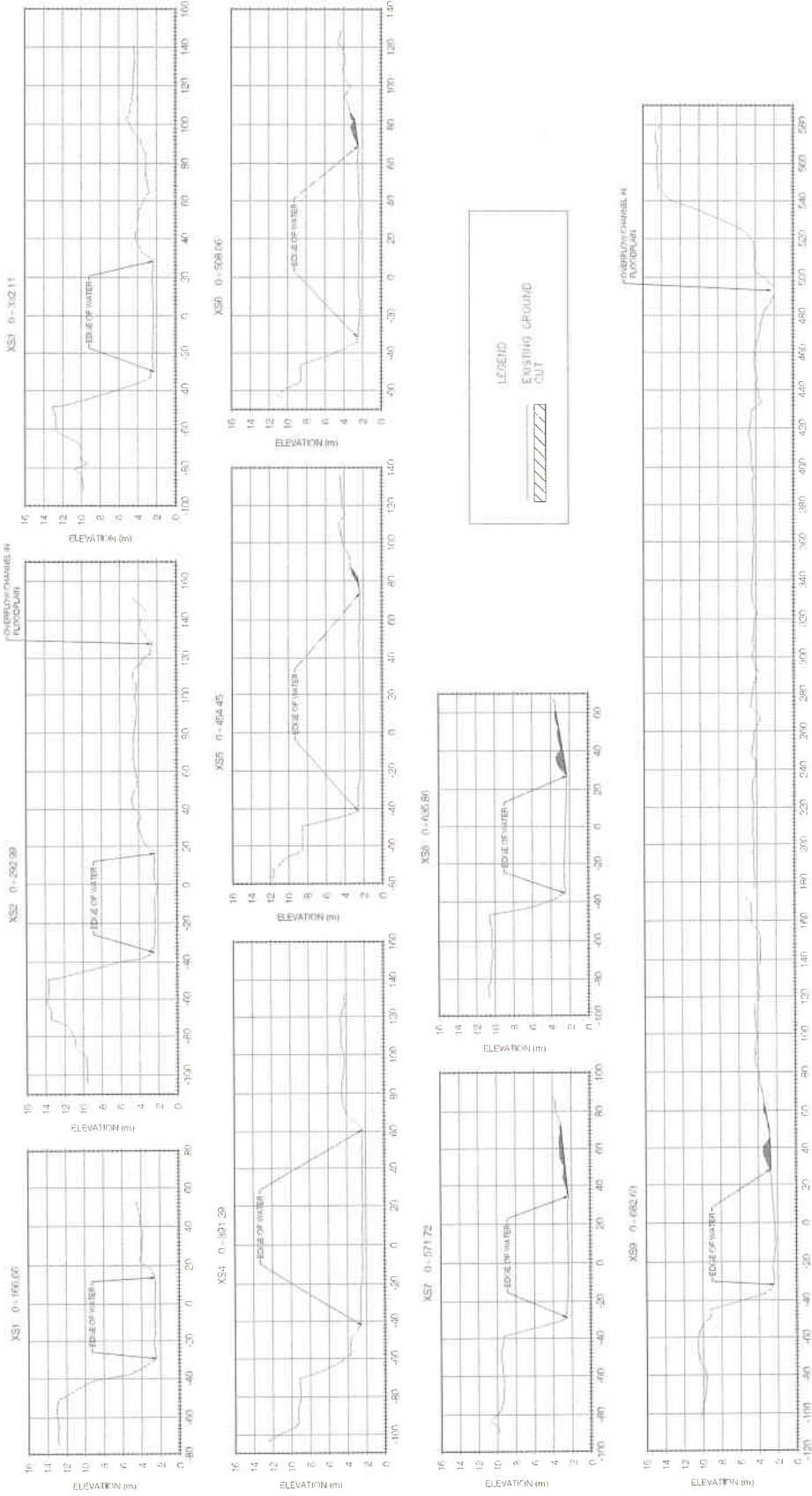


DESIGN PLANVIEW

HYDROLOGICAL MODEL CREATED FROM TOTAL STATION SURVEY (UNRESOLVED) COMBINED WITH LIDAR DATA (2014). THE BOUNDARY OF THE 2014 SURVEY IS INDICATED ON THE MAP AND INCLUDES PROBABLY THE EXISTING LEFT BENCHMARK NEAR THE GRAVEL PIT. THE SURROUNDING TOPOGRAPHY IS DERIVED FROM 2010 LIDAR DATA. EXISTING FEATURES FROM THE 2014 SURVEY SHALL BE SHOWN IN LIGHT GRAY. THE 2014 SURVEY SHALL BE REGRADED TO 6% TO 8% SLOPE TO FACILITATE CHANNEL TO BE HERBICIDED FOR WEED CONTROL DURING DRY CONDITIONS.

PROJECT NO. 2014-02		DESIGN PLANVIEW	METEPENAGIAG MI'KMAQ NATION LSW MIRAMICHI - OXBOW BANK RESTORATION	PARISH aquatic services A Division of Matrix Solutions Inc. <small>248 Queen Street East, Suite 200 Miramichi, NB E1V 2E5 Tel: 506-853-8888 Fax: 506-853-8889 Email: info@parish-aquatic.com</small>	FINAL	SCALES: 1:100 (1:50 meters)
SHEET NO. 02						

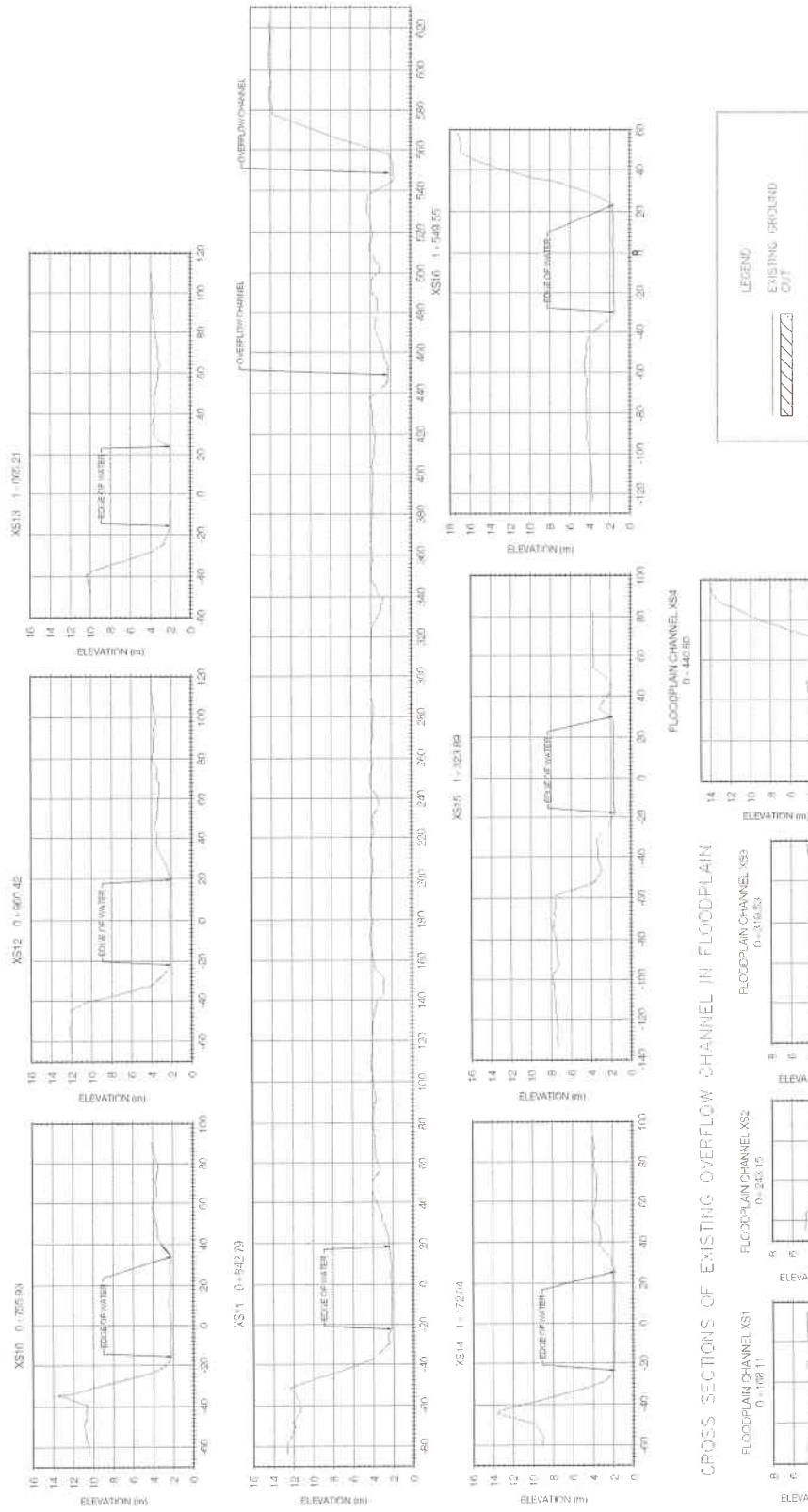
CROSS SECTIONS



*CROSS SECTIONS SHOWN WITH 5% VERTICAL EXAGGERATION
 **CROSS SECTIONS DERIVED FROM TOTAL STATION SURVEY AND LIDAR DATA (CHANNEL GEOMETRY BEHIND WATER SURFACE OF RIVER CROSS SECTIONS NOT SHOWN)

PROJECT NO:	08-14-20	CROSS SECTIONS
SHEET NO:	03	METEPENAGIAG MI'KMAQ NATION LSW MIRAMICHI - OXBOW BANK RESTORATION
FINAL		
DATE:	DATE:	SCALE:
BY:	DATE:	PROJECT:
CHECKED:	DATE:	DRAWN:
DATE:	DATE:	DATE:
DATE:	DATE:	DATE:

CROSS SECTIONS (2)

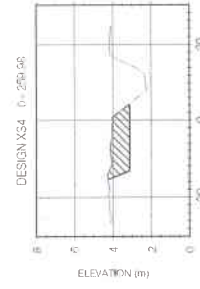
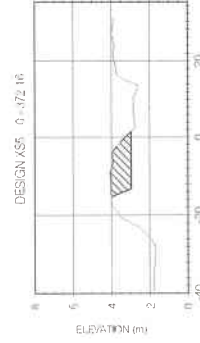
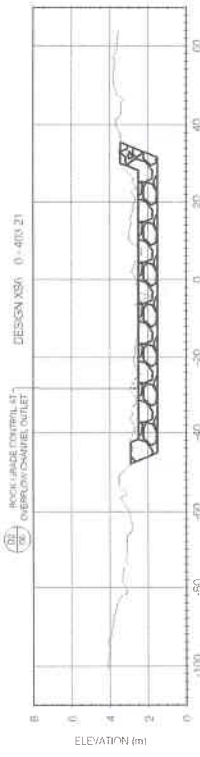
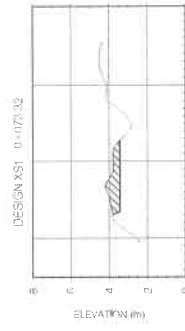
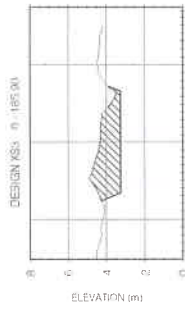
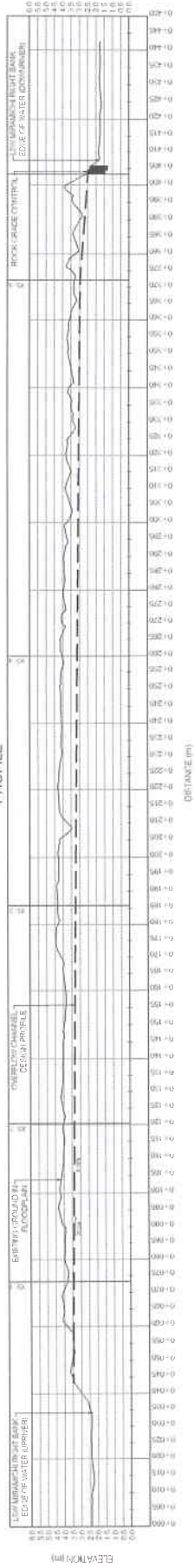


CROSS SECTIONS SHOWN WITH 5% VERTICAL EXAGGERATION
*CROSS SECTIONS DERIVED FROM TOTAL STATION SURVEY AND LIDAR DATA. CHANNEL GEOMETRY BEGETH WATER SURFACE ON RIVER CROSS SECTIONS (NOT SHOWN)

PROJECT NO. 08-14-25	CROSS SECTIONS (2)
SHEET NO. 04	
METEPENAGIAG MI'KMAQ NATION LSW MIRAMICHI - OXBOW BANK RESTORATION	
 A Division of Matrix Solutions Inc. 1000 St-James St. Suite 100 Moncton, NB E1C 1B8 Tel: (506) 853-2861 Fax: (506) 853-2862 www.parrish-aquatic.com	
FINAL	
DATE	SCALE
PROJECT	PROJECT NO.
DRAWN BY	DRAWN BY
CHECKED BY	CHECKED BY
DATE	DATE

DESIGN OVERFLOW CHANNEL PROFILE & CROSS SECTIONS

PROFILE



PROFILE & CROSS SECTIONS SHOWN WITH SIX VERTICAL EXAGGERATION



FINAL

**METEPENAGIAG MIKMAQ NATION
 LSW MIRAMICHI - OXBOW BANK
 RESTORATION**

**DESIGN OVERFLOW CHANNEL
 PROFILE & CROSS SECTIONS**

REVISIONS		SCALE	
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2	ISSUED FOR CONSTRUCTION		
3	ISSUED FOR AS-BUILT		
4	ISSUED FOR FINAL		

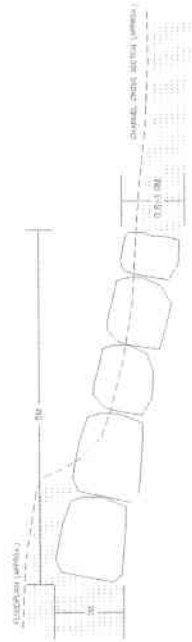
DETAILS

OVERFLOW CHANNEL DETAIL (N.T.S.)

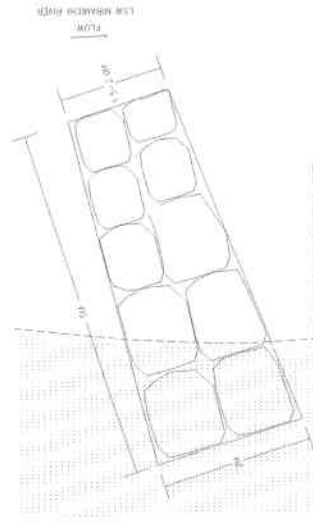


CROSS SECTION VIEW OF OVERFLOW CHANNEL (N.T.S.)

ROCK SPUR DETAIL (N.T.S.)



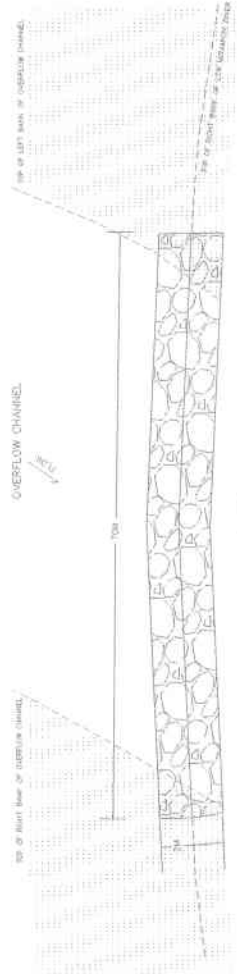
CROSS SECTION VIEW OF SPUR (N.T.S.)



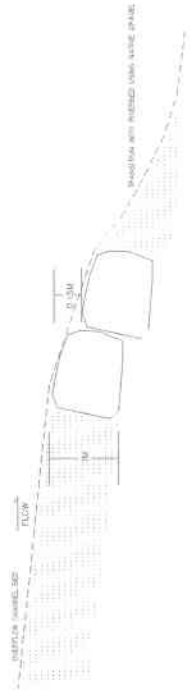
GRADE CONTROL DETAIL (N.T.S.)



CROSS SECTION VIEW OF SPUR (N.T.S.)



PLANVIEW OF GRADE CONTROL (N.T.S.)



PROFILE VIEW OF GRADE CONTROL (N.T.S.)

NO.	REVISION	BY	DATE	SCALE
1	ISSUED FOR BIDDING	SEE FILE	10/10/2014	AS SHOWN
		APPROVED BY		
		DATE		
		BY		
		DATE		

PARISH
aquatic services
A Division of Parikh Solutions, Inc.
14000 West 24th Ave. #200
Eden Prairie, MN 55324
612.439.1100
www.parishmn.com

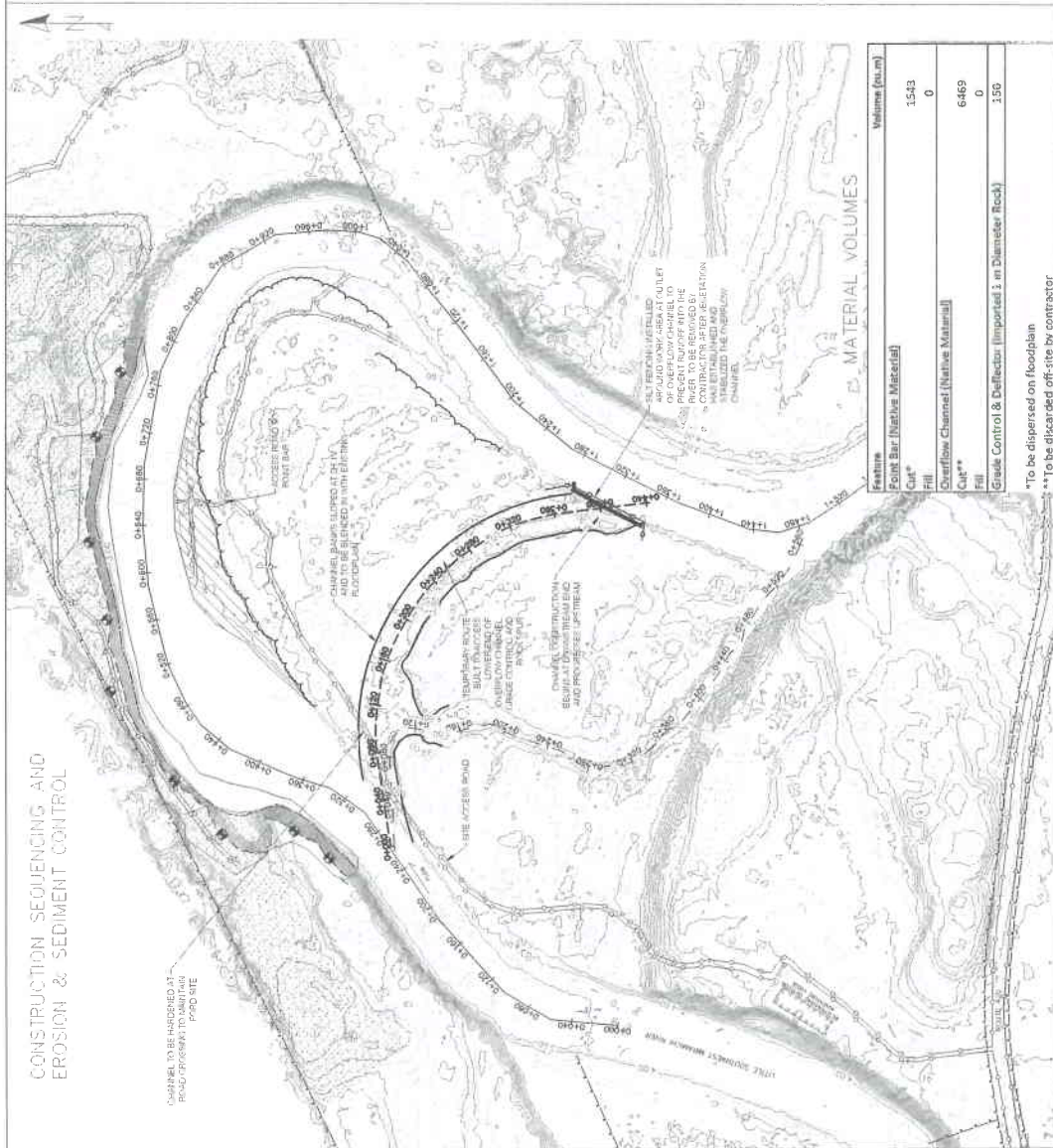
METEPENAGIAG MI'KMAO NATION
LSW MIRAMICHI - OXBOW BANK
RESTORATION

PROJECT NO.
14-20
SHEET NO.
06

FINAL

DETAILS

CONSTRUCTION SEQUENCING AND EROSION & SEDIMENT CONTROL



- CONSTRUCTION PHASING**
- GENERAL NOTES**
- THE FOLLOWING DETAILED EROSION CONTROL AND CONSTRUCTION PHASING METHODS ARE RECOMMENDED BASED ON THE CONSTRUCTION PHASING AND SEQUENCING METHODS. THE CONTRACTOR AND DESIGNER MAY WISH OR NEED TO ALTER THE METHODS BASED ON SITE CONDITIONS IDENTIFIED AT THE TIME OF CONSTRUCTION.
- PHASE 1 - PREPARATION**
- WORK INCLUDES
1. ESTABLISH STABLE SITE ACCESS ALONG EXISTING GRAVEL ROAD LEADING DOWN TO THE FLOODPLAIN FROM METEPENAGIAG MIK'KMAQ OUTDOOR ADVENTURE LODGE.
 2. ESTABLISH A TEMPORARY ROAD FOR ACCESS TO THE LOWER END OF THE CHANNEL. THIS WILL LATER BE USED TO DISPOSE OF SITE BY CONTRACTOR.
 3. ENSURE PROTECTION OF EXISTING VEGETATION TO THE CHANNEL POSSIBLE OUTSIDE GRADING LIMITS OF THE NEW CHANNEL.
 4. ESTABLISH TRAINING COUPLING AREAS ALONG THE BANK OF RIVER WHERE THE POINT BAR WILL BE REGRADED.
- PHASE 2 - CONSTRUCTION**
- WORK INCLUDES
1. CONSTRUCTION WILL BEGIN AT THE DOWNSTREAM END OF THE OVERFLOW CHANNEL AND PROGRESS UPSTREAM.
 2. ROCK SPUR WILL BE INSTALLED AT THE LOWER END OF THE CHANNEL.
 3. THE ROCK SPUR WILL BE INSTALLED TO TURN WATER FROM THE FLOODPLAIN INTO THE CHANNEL.
 4. ROCK SPUR WILL BE INSTALLED AT THE LOWER END OF THE OVERFLOW CHANNEL. THE GRADE CONTROL WILL ALSO SERVE TO PREVENT COLLAPSE OF THE RIGHT BANK OF THE RIVER AND WILL PREVENT COLLAPSE OF THE LEFT BANK OF THE RIVER.
 5. ROCK SPUR AND GRADE CONTROL TO BE COVERED WITH ROCK TO BE SECURED EMBEDDED INTO BANKS TO PREVENT OUTFLANKING.
 6. SILT FENCING TO BE INSTALLED ALONG DOWNSTREAM END OF OVERFLOW CHANNEL TO PREVENT TRUCKS FROM ENTERING THE CONSTRUCTION AREA.
 7. OVERFLOW CHANNEL TO BE REGRADED TO PREVIOUS GRADE OF 0.10%.
 8. THE CONTRACTOR SHALL REMOVE EXCESS MATERIAL FROM DOWNSTREAM TO MAINTAIN A GRADE OF 0.10%.
 9. ACCESS ROAD ALONG THE CHANNEL CORRIDOR. TEMPORARY ACCESS ROAD ALONG THE CHANNEL CORRIDOR.
 10. AFTER EXCAVATION IS COMPLETE, EXPOSED GROUND ALONG SALT FENCING AT OVERFLOW CHANNEL OUTLET TO BE LEFT IN PLACE UNTIL VEGETATION HAS ESTABLISHED AND REGRADED.
 11. REGRADING THE POINT BAR (1.54 CU M) OF MATERIAL REMOVED ALONG THE RIGHT BANK OF THE RIVER SHALL BE REGRADED TO PREVIOUS GRADE OF 0.10%.
 12. THE CONTRACTOR SHALL REMOVE EXCESS MATERIAL FROM THE OVERFLOW CHANNEL DURING THIS WORK TO BE MAINTAINED UNDER CONTRACTOR CONTROL.
- PHASE 3 - FINISHING**
- WORK INCLUDES
1. ALL EXCESS MATERIAL SHALL BE REMOVED FROM THE SITE AND DISPOSED OF BY THE CONTRACTOR.
 2. ALL EXCESS MATERIAL SHALL BE REMOVED FROM THE SITE AND DISPOSED OF BY THE CONTRACTOR.
 3. ALL EXCESS MATERIAL SHALL BE REMOVED FROM THE SITE AND DISPOSED OF BY THE CONTRACTOR.
 4. ALL EXCESS MATERIAL SHALL BE REMOVED FROM THE SITE AND DISPOSED OF BY THE CONTRACTOR.

- CONSTRUCTION AND STAGING NOTES**
1. ALL MATERIALS AND EQUIPMENT USED FOR THE PURPOSE OF SITE PREPARATION AND PROJECT COMPLETION SHOULD BE OPERATED AND STORED IN A MANNER THAT PREVENTS ANY EXCESS MATERIALS FROM BEING DISPERSED TO ADJACENT AREAS.
 2. STOCKPILED MATERIALS SHOULD BE STORED AND STABILIZED AWAY FROM THE WATER IN DESIGNATED AREAS.
 3. STOCKPILED MATERIALS SHOULD BE STORED AND STABILIZED AWAY FROM THE WATER IN A CONTROLLED MANNER TO PREVENT FUEL SPILLAGE.
 4. STOCKPILED MATERIALS SHOULD BE STORED AND STABILIZED AWAY FROM THE WATER IN A CONTROLLED MANNER TO PREVENT FUEL SPILLAGE.
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 9. STOCKPILED MATERIALS SHOULD BE STORED AND STABILIZED AWAY FROM THE WATER IN A CONTROLLED MANNER TO PREVENT FUEL SPILLAGE.

- EROSION AND SEDIMENT CONTROL**
1. SEDIMENT AND EROSION CONTROL MEASURES SHOULD BE IMPLEMENTED PRIOR TO WORK AND MAINTAINED DURING THE WORK. GENERAL RECOMMENDATIONS ARE LISTED BELOW.
 2. WORK SHALL BE COMPLETED DURING LOW WATER.
 3. CONSTRUCTION SHALL BE COMPLETED DURING LOW WATER.
 4. ALL WORKS ON THE NEW REGRADED OVERFLOW CHANNEL SHOULD BE COMPLETED AND VEGETATION ESTABLISHED PRIOR ALLOWING WATER INTO THE CHANNEL.
 5. ROCK SPUR AND GRADE CONTROL TO BE COVERED WITH ROCK TO BE SECURED EMBEDDED INTO BANKS TO PREVENT OUTFLANKING.
 6. SILT FENCING TO BE INSTALLED ALONG DOWNSTREAM END OF OVERFLOW CHANNEL TO PREVENT TRUCKS FROM ENTERING THE CONSTRUCTION AREA.
 7. OVERFLOW CHANNEL TO BE REGRADED TO PREVIOUS GRADE OF 0.10%.
 8. THE CONTRACTOR SHALL REMOVE EXCESS MATERIAL FROM DOWNSTREAM TO MAINTAIN A GRADE OF 0.10%.
 9. ACCESS ROAD ALONG THE CHANNEL CORRIDOR. TEMPORARY ACCESS ROAD ALONG THE CHANNEL CORRIDOR.
 10. AFTER EXCAVATION IS COMPLETE, EXPOSED GROUND ALONG SALT FENCING AT OVERFLOW CHANNEL OUTLET TO BE LEFT IN PLACE UNTIL VEGETATION HAS ESTABLISHED AND REGRADED.
 11. REGRADING THE POINT BAR (1.54 CU M) OF MATERIAL REMOVED ALONG THE RIGHT BANK OF THE RIVER SHALL BE REGRADED TO PREVIOUS GRADE OF 0.10%.
 12. THE CONTRACTOR SHALL REMOVE EXCESS MATERIAL FROM THE OVERFLOW CHANNEL DURING THIS WORK TO BE MAINTAINED UNDER CONTRACTOR CONTROL.

LEGEND

- OVERFLOW CHANNEL CENTRELINE
- OVERFLOW CHANNEL GRADE CONTROL & ROCK SPUR
- REGRADED POINT BAR
- SILT FENCE

LEVELS

- WATER CONTOUR (1.0 M)
- WATER CONTOUR (0.5 M)
- LSW MIRAMICHI THALWEG
- FLOODPLAIN OVERFLOW CHANNEL
- EDGE OF WATER (NOV 2014)
- TOP OF BANK (NOV 2014)
- TIE OF BANK (NOV 2014)
- ROAD (NOV 2014)
- PERFECT LINE
- CONSTRUCTION LINE
- BOUNDARY (NOV 2014)

DESIGN FEATURES

- OVERFLOW CHANNEL CENTRELINE
- OVERFLOW CHANNEL GRADE CONTROL & ROCK SPUR
- REGRADED POINT BAR
- SILT FENCE

MATERIAL VOLUMES

Feature	Volume (cu.m)
Point Bar (Native Material)	1543
Cut*	0
Fill	0
Overflow Channel (Native Material)	6469
Cut**	0
Fill	150

Grade Control & Deflector (Important 1 m Diameter Rock)

*To be dispersed on floodplain
**To be discarded off-site by contractor

APPENDIX B SITE PHOTOGRAPHS

1. Upstream end of site – looking downstream towards bank erosion



Photograph taken by N. Wilbur – November 26, 2014

2. Upstream end of overflow channel through the floodplain (right bank)



Photograph taken by N. Wilbur – November 26, 2014

3. View taken from top of left (north) bank – looking upstream at erosion.



Photograph taken by N. Wilbur – November 25, 2014

4. View looking at sand material on right (north) bank.



Photograph taken by N. Wilbur – November 25, 2014

5. Upstream end of site – looking downstream towards bank erosion on left (north) bank.



Photograph taken by N. Wilbur – November 25, 2014

6. Downstream end of site – looking upstream towards bank erosion.



Photograph taken by N. Wilbur – November 25, 2014

7. Upstream end of site – looking downstream towards bank erosion on left (north) bank.



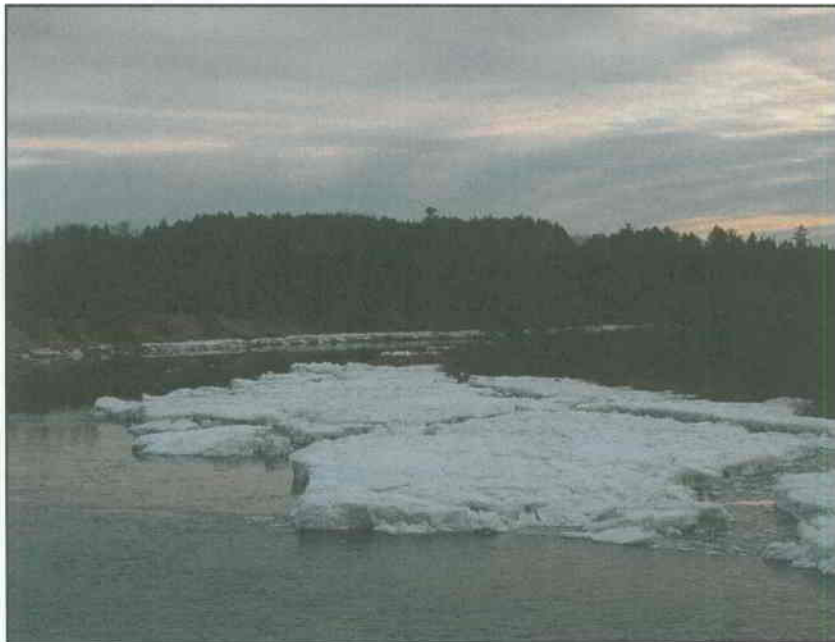
Photograph taken by N. Wilbur – November 25, 2014

8. Upstream end of site – view looking at left bank erosion (north bank)



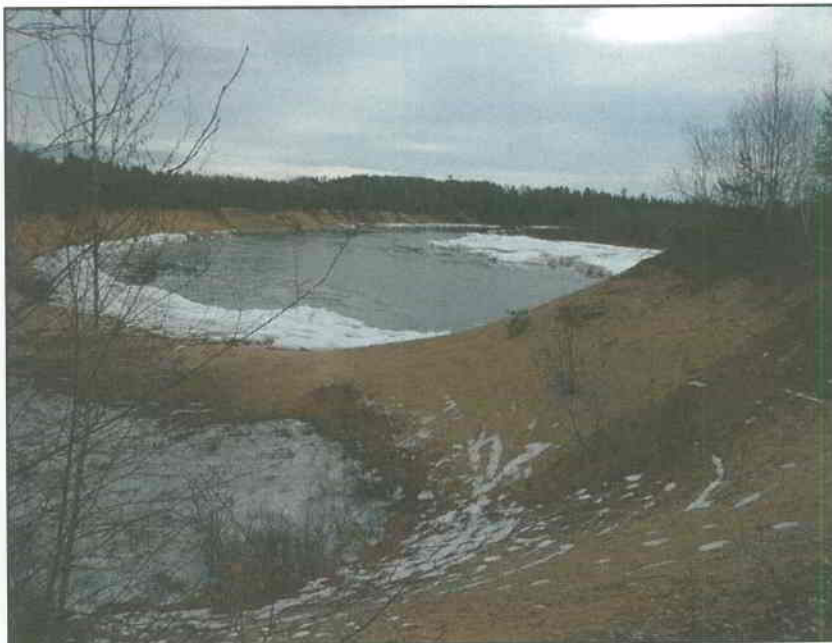
Photograph taken by N. Wilbur – November 25, 2014

9. Upstream end of site – looking downstream towards point bar location on right (south) bank.



Photograph taken by N. Wilbur – November 25, 2014

10. Downstream end of eroding left (north) bank – looking upstream



Photograph taken by N. Wilbur – November 25, 2014

11. Upstream end of site – looking downstream towards floodplain on right (south) bank.



Photograph taken by N. Wilbur – November 25, 2014

12. Erosion at top of left (north) bank.



Photograph taken by N. Wilbur – November 25, 2014

13. Upstream end of site – looking downstream towards bank erosion on left (north) bank. Note access road for Johnson's Pit on left of photo.



Photograph taken by N. Wilbur – November 25, 2014

14. Downstream end of site – looking upstream.



Photograph taken by N. Wilbur – November 25, 2014

15. Downstream end of site – looking downstream towards bank erosion.



Photograph taken by N. Wilbur – November 25, 2014

16. Downstream end of site – looking upstream at erosion on left (north) bank.
Note deposition of gravels at toe of bank.



Photograph taken by N. Wilbur – November 25, 2014

17. Downstream end of site – looking upstream towards point bar on right (south) bank (left side of photo).



Photograph taken by N. Wilbur – November 25, 2014

18. Downstream end of river – view looking downstream towards bend.



Photograph taken by N. Wilbur – November 25, 2014

19. View taken from left bank towards right (south) bank floodplain.



Photograph taken by N. Wilbur – November 25, 2014

20. View taken from top of left (north) bank towards right bank.



Photograph taken by N. Wilbur – November 25, 2014

21. View looking at left (north) bank – note bank swallow nests in eroding bend



Photograph taken by N. Wilbur – November 26, 2014

22. View looking downstream – looking at bank materials of eroding bend (left bank)



Photograph taken by N. Wilbur – November 26, 2014



Ecosystems Management Branch
Gulf Region
343 Université Avenue, P.O. Box 5030
Moncton, NB E1C 9B6

June 8, 2015

Mr. James Ward
Manager, North Shore Micmac District Council
Aboriginal Aquatic Resources and Oceans Management
32 MicMac Road
Eel Ground, NB E1V 4B1

Dear Mr. Ward:

RE: Letter of Support – Lower Southwest Miramichi Bank Remediation at Metepenagiag First Nation

We would like to thank your organization for the commitment it has made in conserving and protecting fish habitat. We also congratulate you for receiving funding from the Department of Fisheries and Oceans Canada (DFO)'s Recreational Fisheries Conservation Partnerships Program (RFCPP).

We understand that your group intends to undertake a project that will reduce erosion of the river bank at the "oxbow" location that is adjacent to the Metepenagiag First Nation. The intent of this letter is to indicate our general support for your plan to remove a portion of the point bar and enhancing an existing overflow channel in the floodplain. We understand that the proposed overflow channel will only function when the river is at bankfull stage (i.e., at the two-year flood event) and should help in alleviating some erosion of the river bank. The project is in line with the RFCPP's program objective of restoring, rebuilding, and rehabilitating recreational fisheries habitat.

Please be reminded that this letter should not be construed as regulatory advice or as a permit to undertake the project. In this regard, your group will need to apply for the province's watercourse and wetland alterations permit and possibly undertake an environmental impact assessment (EIA).

We look forward to our future involvement with your organisation and we will continue to assist you as best we can. In the meantime, should you have any questions, please feel free to contact Terry Melanson by telephone at (506) 851-3740 or email at terry.melanson@dfo-mpo.gc.ca.

Sincerely,

Charles Gaudet
Regional Director

Chief
Freeman Ward

Metepenagiag Mi'kmaq Nation



Councillors
Bill Ward
Tracy Anne Cloud
Austin Tracy Cloud
Laurie Watson
Alan Michael Blowers
Patricia Ward

June 4, 2015

To Whom It May Concern:

Re: Written Consent for the LSWMR Restoration Project EA Registration

This letter is to confirm that North Shore Micmac District Council Aboriginal Aquatic Resources and Oceans Management (NSMDC AAROM), known as the proponent, hereby has permission to submit the Registration document as well as undertake restoration activities, on Metepenagiag Lands, as identified in the Design document completed by Parish Aquatic Services in March 2015.

For several years, Metepenagiag Mi'kmaq Nation has been the lead stakeholder in this critical environmental issue and taken an active role via its' coordinator, Roger Ward; Band Manager, Adam Augustine and all members of Chief and Council. As such, we are pleased to see the process moving forward that will result in the completion of proposed restoration activities in the very near future. Please do not hesitate to contact myself or those copied, for further information.

Sincerely,

A handwritten signature in black ink, appearing to read "Chief Freeman Ward". The signature is fluid and cursive.

Chief Freeman Ward,
Metepenagiag Mi'kmaq Nation

cc. Councilor Tracy Anne Cloud, MMN Lands Manager
Roger Ward, MMN Project Coordinator
Jim Ward, GM NSMDC AAROM