



GEOMORPHIC ASSESSMENT OF THE MARGAREE RIVER MARGAREE SALMON ASSOCIATION

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Report prepared for the Margaree Salmon Association, October 2017

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EXECUTIVE SUMMARY

A geomorphic assessment of the Margaree River was completed in June of 2017. The assessed section was the main stem of the Margaree River from Forest Glen Brook to Tidal Pool, a distance of approximately 37 kilometres. The river was divided into 28 reaches which were defined by hydraulic conditions influencing the flow.

The average migration rate for the outer bends of all the reaches assessed is 1.6 metres/5.3 feet per year. The majority of the reaches were determined to be in a state of transition with the primary geomorphic process driving the current river conditions to be channel widening with the secondary geomorphic process being aggradation. The river was broken into four sections for ease of defining locations and points on a map.

The Forest Glen Brook to the bridge crossing at Portree section contained Reaches 1 through 8. The majority of reaches were in a state of degradation and in a state of transition. Only the reach above MacKenzie pool was found to be in regime or stable. However the outer bank migration was calculated to be 1.8 m/6 feet per year. Between Cemetery Pool and Wards Rock Pool the channel is migrating at approximately 2.4 m/8 feet per year in the outside bends.

The section of river between Portree to Cranton Crossing Bridge was found to be the most unstable section of the Margaree River that was assessed. This section contained Reaches 9 through 17 and was found to be excessively downgrading and cutting deep into the channel bed. The amount of bed degradation indicates that this section is unstable and contributing to sediment inputs downstream. The most unstable reach, reach 13, from the confluence of Ingram Brook to the hydrometric station just upstream of the Crowdis Crossing Bridge is undergoing planform adjustment brought on by excessive aggradation. A rapidly migrating outside bend just downstream of the Nile Brook confluence on the next turn (right bank) is estimated to be migrating at a rate of 3.6 m /12 feet per year, despite the bank being well vegetated.

The section of river from Cranton Crossing Bridge to Southwest Margaree Confluence contained Reaches 18 through 26. This stretch of river was also relatively unstable. Reaches were mostly in a transitional state and the remaining reaches were in adjustment. Changes in channel planform were frequent, with the river splitting into multiple channels and abandoning old channels for new ones.

Reaches 27 and 28 covered the section of river from the Southwest Margaree Confluence to end of assessment (Tidal Pool). These reaches were also transitional and/or in a state of adjustment with aggrading and widening as the driving geomorphic processes. Some aggradation and channel widening would be typical in the lower reaches of a major system, especially with the addition of a major tributary such as the Southwest Margaree River; however, the number of geomorphic indicators identified suggests these lower reaches are also experiencing instability outside the normal range expected. Long stretches of river from the SW Margaree confluence to the Tidal Pool were without good pool habitat due to the excessive deposition in the channel bed.

There is opportunity for restoration options and a priority list has been created which identifies the most critical reaches. Ideally the restoration activities should focus on reducing channel width and controlling sediment input and the accumulation of bedload material. With the abundance of bedload material the riverbed elevation continues to build then collapse creating a constant widening and then a rapid degradation of the channel. This type of situation is very difficult to create successful aquatic habitat projects. Any restoration projects should focus on proper bank restoration and meander development.

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1 INTRODUCTION

Located in western Cape Breton, Nova Scotia, the Margaree River watershed covers approximately 1057 square kilometers. Land use in the watershed is primarily forested, with a significant amount of agricultural and cropland in the river corridor, a small percentage of the watershed is residential. The watershed is world renowned as highly productive grounds for Atlantic salmon with excellent water quality.

The following report outlines geomorphic and habitat data collected on the Margaree River during the summer of 2017. Information was first gathered through desktop review, and then geomorphic conditions were assessed in the field. This report provides a better understanding of the present state of geomorphology in the river. Information presented in this report will provide guidance and an opportunity for stakeholders to help preserve or improve the long term health of the watershed.

1.1 Purpose

The purpose of this project is to categorize and assess the geomorphic condition of stream reaches in the Margaree River. Disruptions in the natural geomorphic processes of channel development reflect changes in the watershed and can cause degradation of the aquatic habitat. Therefore, problematic or unstable reaches were identified to guide restoration efforts in the future. Restoration efforts that are based on an understanding of underlying geomorphic conditions not only restore aquatic habitat, they restore the natural geomorphic processes that create and maintain aquatic habitat over the long term.

1.2 Objectives

A series of objectives were addressed in order to complete the geomorphic study. They were as follows:

- Collect geomorphic data.
- Interpret the data to assess the current state of the watershed, including identification of key fluvial adjustment processes and root causes of instability.
- Identify where and how the river channels are responding to historical human modifications
- Develop a restoration strategy that prioritizes the areas in the greatest need of stabilization, based on, fish habitat, the need to protect private property and infrastructure; in combination with the areas that were the best candidates for success.
- Ensure that all restoration recommendations consider the root causes of instability while enhancing or restoring aquatic habitat and the riverine ecosystem.

- Provide a document that functions as a roadmap for watershed management and for pursuing and evaluating future restoration projects in the Margaree River watershed.

2 BACKGROUND REVIEW

A review of published background material was completed to avoid redundancies in data collection and to provide additional insight on the characteristics of the watershed. It included the review of published reports and natural sciences information: including climate data and geological mapping, topographic mapping and air photography.

The following information sources were specifically reviewed:

- Geographic Information System data from a Hydrological Study by Fred Baechler in 2016, provided by the Margaree Salmon Association
- Aerial photography from the 1990's provided by the Margaree Salmon Association
- Recent aerials were obtained from base mapping provided through ESRI ArcMap
- Topographic maps through Natural Resources Canada, CanMatrix georeferenced NTS maps

2.1 Basin Characteristics

The basin scale assessment is a desktop exercise that is vital to the understanding of the big picture of the physical interactions of water and sediment within the watershed, such as the location of production, transfer and deposition zones. The assessment includes a characterization of the watershed, land use, geology and climate. An understanding of the natural and anthropogenic controls that affect the form and condition of streams within the Margaree River watershed is also obtained. This helps to provide context for the findings of the reach assessment.

2.1.1 Land use and setting

The Margaree River is located in western Cape Breton, Nova Scotia and has two main branches: the Northeast and Southwest Margaree River. The Northeast Margaree River flows in a southerly direction before meeting the Southwest Margaree River, then turning north before entering the Gulf of St. Lawrence. The Southwest Margaree River flows in a northerly direction before meeting the Northeast branch. The Margaree system drains forest, wetlands and agricultural areas. Land use within the watershed is varied; the majority of the watershed is dedicated to forestry and some agricultural operations. Refer to Appendix A for a graphical depiction of the landuse within the watershed according to land cover vector data produced by Natural Resources Canada (circa 2000).

2.1.2 Watershed morphology

A desktop assessment of the watershed shape, pattern and grade parameters attempts to relate basin and stream network geometries to the transmission of water and sediment through the basin. The size of a drainage basin influences the amount of water yield; the length, shape, and relief affect the rate at which water is discharged from the basin and the total yield of sediment; the length and character of the streams channels affect the availability of sediment for stream transport and the rate at which water and sediment are discharged. Figure 1 highlights the Margaree River watershed and major tributaries draining into or just upstream of the assessed reaches.

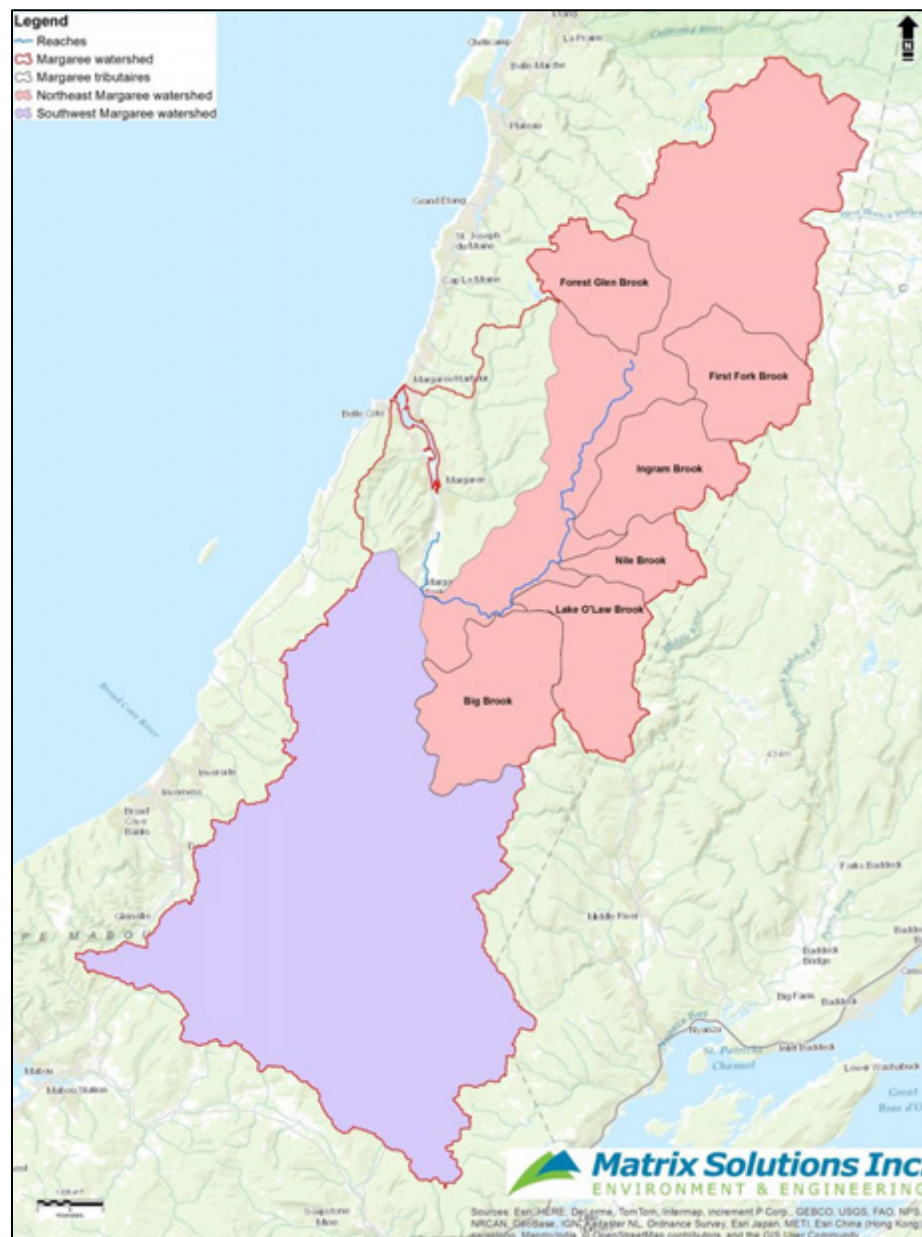


Figure 1. Margaree watershed and major tributaries

Table 1 summarizes watershed characteristics of the main Margaree River watershed to the end of the assessments as well as its major sub-watersheds draining into or just upstream of the assessed reaches.

Table 1. Watershed characteristics

Parameter	Margaree River	NE Margaree River	SW Margaree River	Big Brook	Lake O'Law Brook	Nile Brook	Ingram Brook	Forest Glen Brook	First Fork Brook
Drainage density	1.171	1.126	1.214	1.189	1.178	1.195	1.064	1.012	1.013
Bifurcation ratio	2	4	2	2	5	2	2	2	4
Gradient	0.008	0.007	0.006	0.018	0.018	0.030	0.026	0.022	0.029
Sinuosity	1.855	1.577	1.700	1.413	1.667	1.628	1.497	1.240	1.238

Drainage density is the total length of all the streams and rivers in a drainage basin divided by the total area of the drainage basin. This can affect the shape of a river's hydrograph. Rivers that have a high drainage density will often have a more 'flashy' hydrograph and be prone to a greater flood risk.

The bifurcation ratio is calculated by dividing the number of first order streams by the number of second order streams, then dividing the second order streams by the next highest order, and so on. If the bifurcation ratio is low, there is a higher chance of flooding, as the water will be concentrated in one channel rather than spread out, as a high bifurcation ratio would indicate. The bifurcation ratio can also show which parts of a drainage basin is more likely to flood, comparatively, by looking at the separate ratios.

The gradient is the gross slope of the watercourse. The calculation is simply the difference in elevation between the river's source and the river's confluence or mouth divided by the total length of the river or stream. A high gradient indicates a steep slope and rapid flow of water (ie. more ability to erode); whereas a low gradient indicates a more level stream bed and sluggishly moving water, that may be able to carry only small amounts of very fine sediment. High gradient streams tend to have steep, narrow V-shaped valleys, and are referred to as young streams. Low gradient streams have wider and less rugged valleys, with a tendency for the stream to meander.

The sinuosity refers to the channel length compared to the valley length of a watercourse. If the sinuosity ratio is 1.5 or greater the channel is considered to be a meandering one.

2.1.3 Geology

A general understanding of the underlying geology provides insight into the existing channel form. The underlying geology influences the rate of channel change (e.g., migration), the sediment input (i.e., amount and type), and channel geometry. The underlying geology of the Margaree watershed is primarily sandstone, coal, siltstone, shale, and conglomerates from the early Carboniferous epoch. Pockets of granite, granodiorite, diorite, diabase, and gabbro exist particularly in the upper part of the watershed. Surficial geology mostly consists of bedrock, colluvial deposits, and residuum. These were formed before and during the retreat of ice sheets during the Wisconsin ice age. Refer to Appendix B for graphical depictions of the geology described above.

2.1.4 Climate

The average temperatures of western Cape Breton range from -5.9 degrees Celsius in January to 18.1 degrees Celsius in July. Average yearly precipitation is 1383.1 millimeters with the most precipitation on average falling in the month of December.

3 GEOMORPHIC ASSESSMENT

With any fluvial geomorphological assessment, there are important components that must be considered. Specifically, scale, ranging from watershed to reaches to individual cross-sections; and time, which describes how the features of spatial scales change. A comprehensive fluvial geomorphic assessment of the Margaree Watershed involved linking channel functions and cause and effect relations between distinct channel types, ranging from steep headwater sources to lower gradient and sinuous reaches in the urbanized lower reaches. Primary components to the Fluvial Geomorphic Assessment are described and listed below.

3.1 Reach Delineation

Topographic mapping, geological mapping and aerial photographs were used to understand channel and valley form. Channel form is a product of the flow (magnitude) and the channel materials (sediment type, supply, and bed/bank strength). If one of these is altered, the channel adjusts its form to retain or find a new 'dynamic equilibrium'. The characteristics of the flow or channel materials can change along a brook, stream or river. In order to account for these changes, channels are separated into reaches – normally several hundred metres to kilometres in length. A reach displays similarity with respect to its physical characteristics, such as channel form, function, and valley setting. Delineation of a reach considers sinuosity, gradient, hydrology, local geology, degree of valley confinement, and vegetative control. Topographic maps and aerial photographs were assessed and twenty-eight reaches were identified on the Margaree River from the Tidal Pool upstream to the confluence of Forest Glen Brook. Refer to Figure 2 that highlights the assessed reaches. Once reaches had been defined through mapping

procedures, reaches were assessed using Rapid Geomorphic Assessment (RGA) and Rapid Stream Assessment (RSAT) procedures.

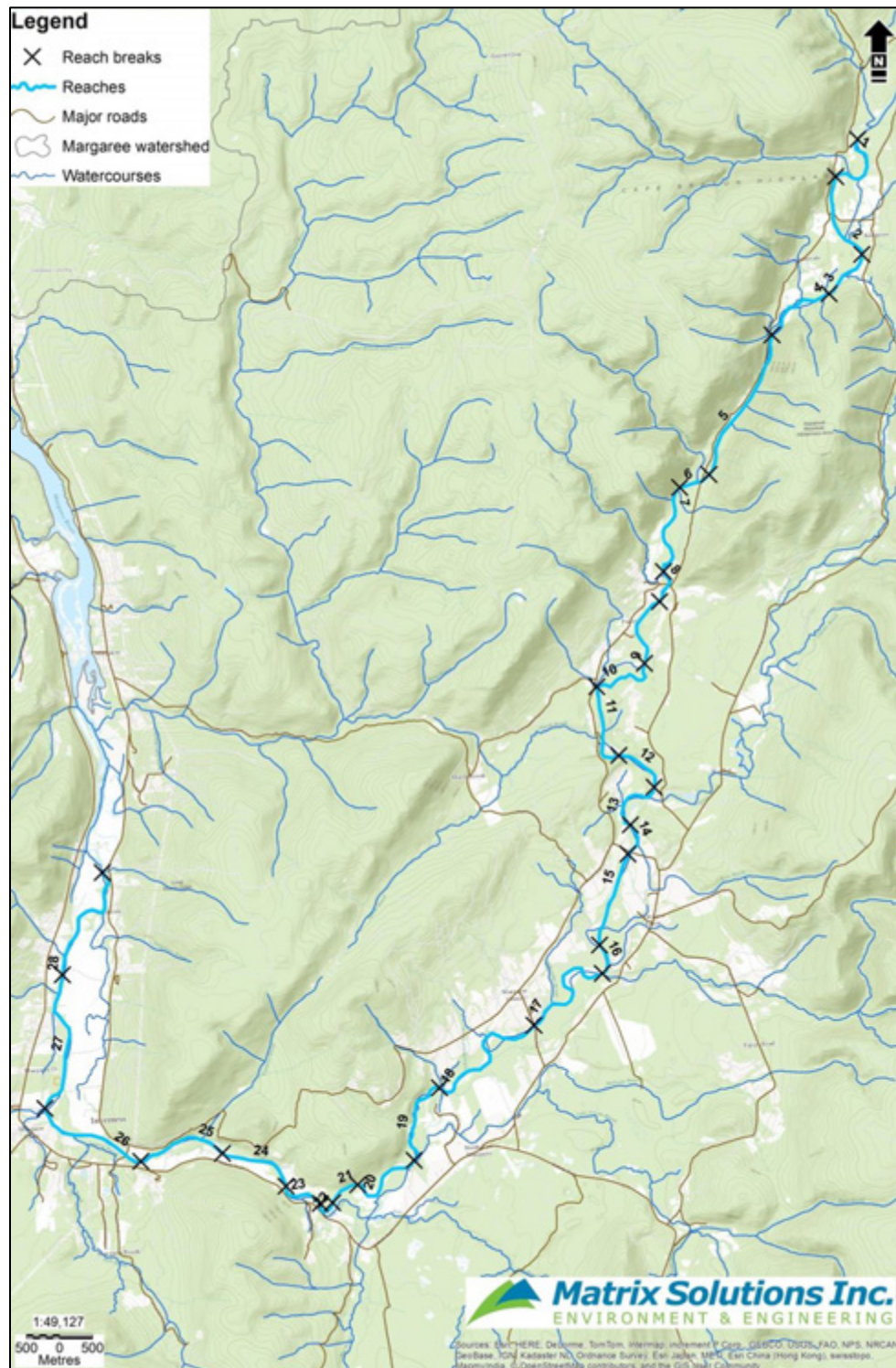


Figure 2. Margaree River reaches

3.2 Rapid Reach Assessments

Rapid Reach Assessments provide a qualitative assessment of channel stability, health and function. They are intended to be quick to implement and synoptic so to allow all reaches in a study area to be assessed similarly and the results to be compared relative to the other reaches. During field reconnaissance, all reaches were canoed and rapid assessments were completed using Rapid Geomorphic Assessment (RGA) and Rapid Stream Assessment Technique (RSAT) data sheets. Areas of substantial erosion or other characteristics that have potential to influence the watercourse within the reach were identified. Additionally, semi-quantitative measures of bankfull channel dimensions, type of substrate, vegetative cover, and channel disturbance were noted.

4 METHODS

Rapid Geomorphic Assessments document observable indicators of channel instability (Ontario Ministry of Environment, 1999). Observations are quantified using an index that identifies channel sensitivity based on evidence of aggradation, degradation, channel widening and planimetric adjustment. The index produces values that indicate whether the channel is stable/in regime (score <0.20), stressed/transitional (score 0.21-0.40) or adjusting (score >0.41).

An RSAT provides a broader view of the system by also considering the ecological functioning of the stream (Galli, 1996). Observations include instream habitat, water quality, riparian conditions, and biological indicators. RSAT scores rank the channel as maintaining a low (<20), moderate (20-35) or high (>35) degree of stream health. It should be noted that stability and stream health are not synonymous. Although these parameters are linked, streams can potentially have lower stability scores but a higher stream health value. This is often a good indication that habitat type and quality will change in this area as the channel form continues to adjust.

4.1 Aggradation

Channel aggradation may occur when the sediment load to a river increases (due to natural processes or human activities) and it lacks the capacity to carry it. Piles of sediment in the river can re-direct flows against the banks, leading to erosion and channel widening. Some indicators of aggradation include:

- Shallow pool depths
- Abundant sediment deposition on point bars
- Extensive sediment deposition around obstructions, channel constrictions, at upstream ends of tight meander bends, and in the overbank zone

4.2 Degradation

Degradation occurs as the river cuts deeper into the land and decreases its gradient. This can occur from a rapid removal of streambed material due to an increase in discharge, water velocity, or a decrease in sediment supply. Bed lowering can move in both an upstream (as a headcut or nick point) and/or downstream direction. Indicators of this include:

- Elevated tree roots
- Bank height increases as you move downstream
- Absence of depositional features such as bars
- Head cutting of the channel bed
- Cut face on bar forms
- Channel worn into undisturbed overburden/bedrock

4.3 Widening

Widening typically follows or occurs in conjunction with aggradation or degradation. With aggradation, banks collapse when flows are forced on the outside, and the river starts to widen. Wide, shallow watercourses have a lower capacity to transport sediment and flows continue to concentrate towards the banks. Widening can also be seen with degradation, as it occurs with an increase in flows or decrease in sediment supply. Widening ultimately occurs because the stream bottom materials eventually become more resistant to erosion (harder to move) by the flowing waters than the materials in the stream banks. Indicators of widening include:

- Active undermining of bank vegetation on both sides of the channel, and many unstable bank overhangs that have little vegetation holding soils together
- Erosion on both right and left banks in riffle sections
- Recently exposed tree roots
- Fracture lines at the top of banks that appear as cracks parallel to the river, which is evidence of landslides and mass failures
- Deposition on mid-channel bars and shoals

4.4 Planform Adjustment

These are the changes that can be seen from the air when looking down at the river. The river's pattern has changed. This can happen because of channel management activities (such as straightening the bends of the river with heavy equipment). Planform changes also occur during floods. When there is no streambank vegetation with roots to hold soil in place, rivers cut new channels in the weak part of the bank during high water. Planform adjustments typically are responses to aggradation, degradation, or widening geomorphic phases. Indicators of planform change include:

- Flood chutes, which are longitudinal depressions where the stream has straightened and cut a more direct route usually across the inside of a meander bend
- Channel avulsions, where the stream has suddenly abandoned a previous channel alignment
- Change or loss in bed form structure, sometimes resulting in a mix of plane bed and pool-riffle forms
- Island formation and/or multiple channels
- Additional large deposition and scour features in the channel length typically occupied by a single riffle/pool sequence (may result from the lateral extension of meander bends)
- Thalweg not lined up with planform. In meandering streams, the thalweg typically travels from the outside of a meander bend to the outside of the next meander bend. During planform adjustments, the thalweg may not line up with this pattern.

4.5 Watercourse Channel Stability

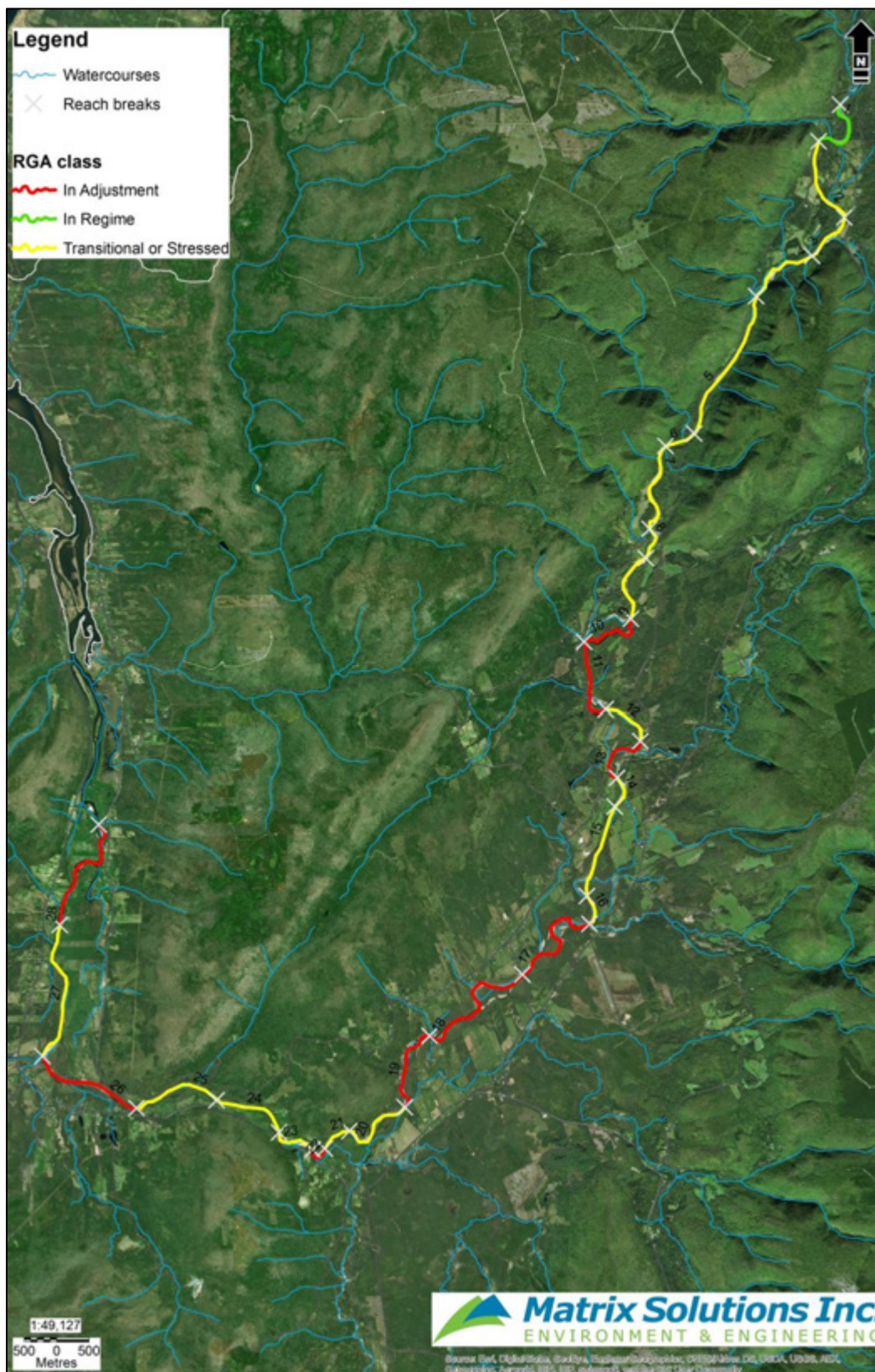
The stream geomorphic condition is a key piece of data obtained from the RGA. This is based on the degree of departure of the channel from its reference stream type and is evaluated by the magnitude and combination of adjustments underway in the stream channel. Upon completion of the field inspection, indicators were tallied by category and used to calculate an overall reach stability index. There are three stability classes that refer to a relative sensitivity to altered sediment and flow regimes (Table 2):

Table 2. RGA factor value classifications

Factor Value	Classification	Interpretation
≤0.20	In Regime or Stable (Least Sensitive)	The channel morphology is within a range of variance for streams of similar hydrographic characteristics – evidence of instability is isolated or associated with normal river meander propagation processes
0.21-0.40	Transitional or Stressed (Moderately Sensitive)	Channel morphology is within the range of variance for streams of similar hydrographic characteristics but the evidence of instability is frequent
≥0.41	In Adjustment (Most Sensitive)	Channel morphology is not within the range of variance and evidence of instability is wide spread

5 RESULTS AND DISCUSSION

Complete results for each reach from the geomorphic assessments can be found in Appendix C. Figure 3 provides a map highlighting the RGA scores for the reaches assessed. The results of the RGA surveys indicate the majority of reaches are in a 'Transitional or Stressed' state (64%). These reaches exhibited frequent evidence of instability and are moderately sensitive to altered sediment and flow regimes which will lead to instability. Some reaches were identified as 'In Adjustment' (32%) while 4% of reaches were found to be 'In Regime'. Areas of erosion and pool habitats were also noted during the assessments, GPS coordinates for these locations can be found in Appendix D.



Widening was identified as the most common primary geomorphic process (50%), with degradation being the second most common primary process (25%) within the Margaree River watershed. Aggradation was also observed as a primary geomorphic process (21%), with 4% of reaches experiencing planform adjustment. Channel degradation appears to occur in the upper portions of the assessed reaches of the watershed whereas aggradation and widening are concentrated more centrally and at the confluence Figure 4.

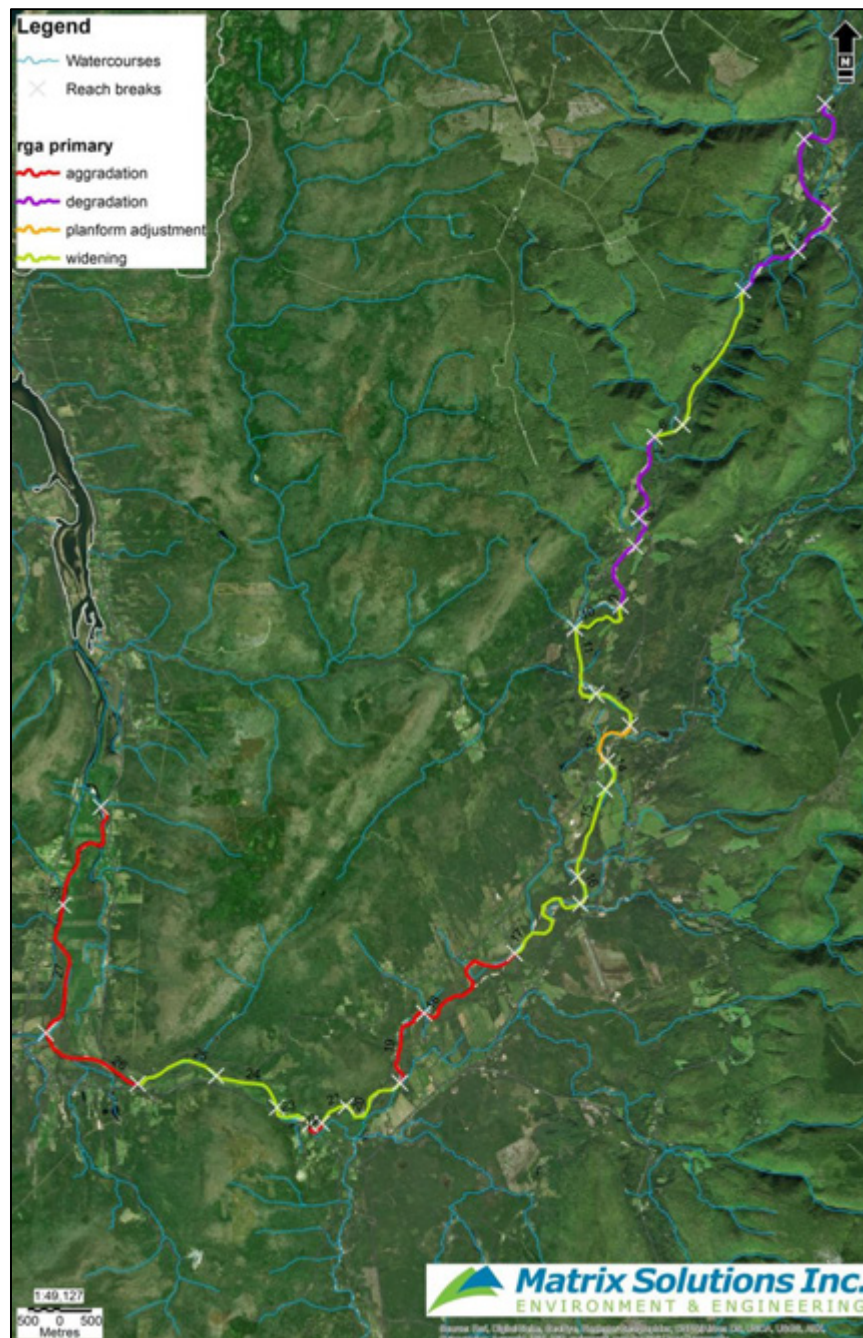


Figure 4. Margaree River geomorphic processes in assessed reaches

5.1 Forest Glen Brook to Portree

The upper reaches of the Margaree River between Forest Glen Brook and the bridge crossing at Portree were comparatively stable with good aquatic habitat. The majority of these reaches were degrading and in a transitional stability state. This was evidenced by the channel being worn into bedrock, elevated tree roots above the channel bed, cut face on bar forms, and head-cutting of the channel bed. Only the upper reach, upstream of MacKenzie Pool, was in regime. The river was found to be over-widened and shallow in a reach from Wards Rock to Black Rock Pool, particularly in front of the Big Intervale Fishing Lodge. A few areas of channel migration and excessive erosion were noted in this stretch of river.

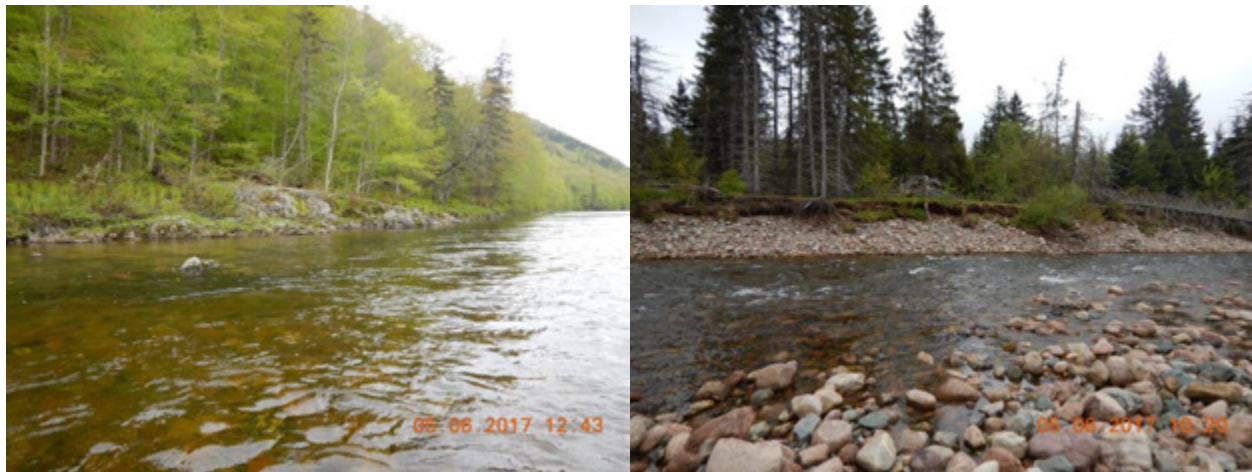


Figure 5. Exposed bedrock and elevated tree roots in upper reaches of the Margaree

Upstream of MacKenzie Pool, at the upper extent the assessments, the outer bend of the main channel of the Margaree River is extending further into the bank when compared to 1984 imagery. The migration rate at this bend, approximately 6 feet per year, is comparable to migration rates calculated at outer bends throughout the assessed reaches and is slightly above the average (approximately 5 feet/year). Migration rates were calculated by comparing distances between the apex of outer bends and fixed points, such as buildings or roads, on 1984 and 2013 imagery (Figure 6).

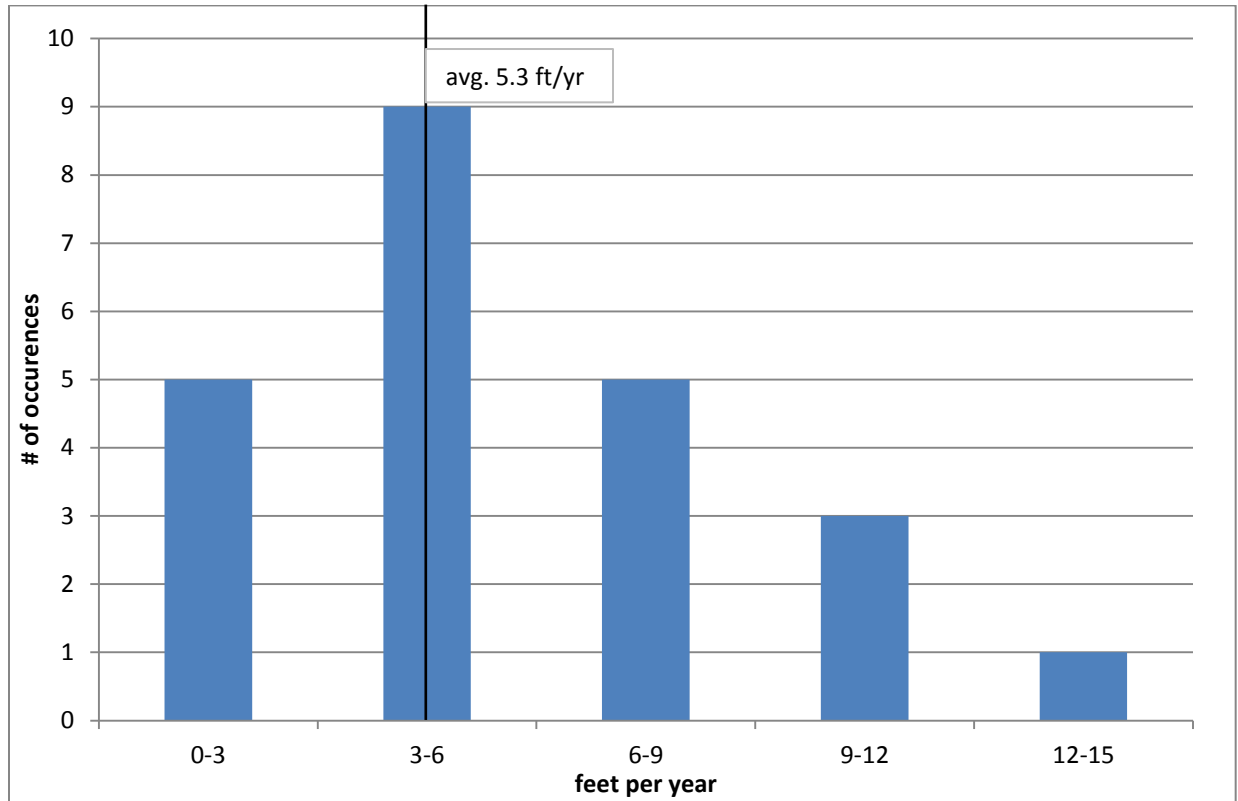


Figure 6. Outer bend migration rates on the Margaree River

Also, the main channel of the Margaree had previously cut through the floodplain at MacKenzie Pool. Barring human intervention, the new channel would have cut off the previous channel and changed the conditions of MacKenzie Pool. A rock wall was installed to prevent the new channel from going through the floodplain and keep the pool where it was. The migrating channel upstream may, in turn, put pressure on the bank upstream of the rock wall and cause instability; however, the bend immediately upstream of the wall has not migrated significantly since 1984 and is relatively stable (Figure 7).

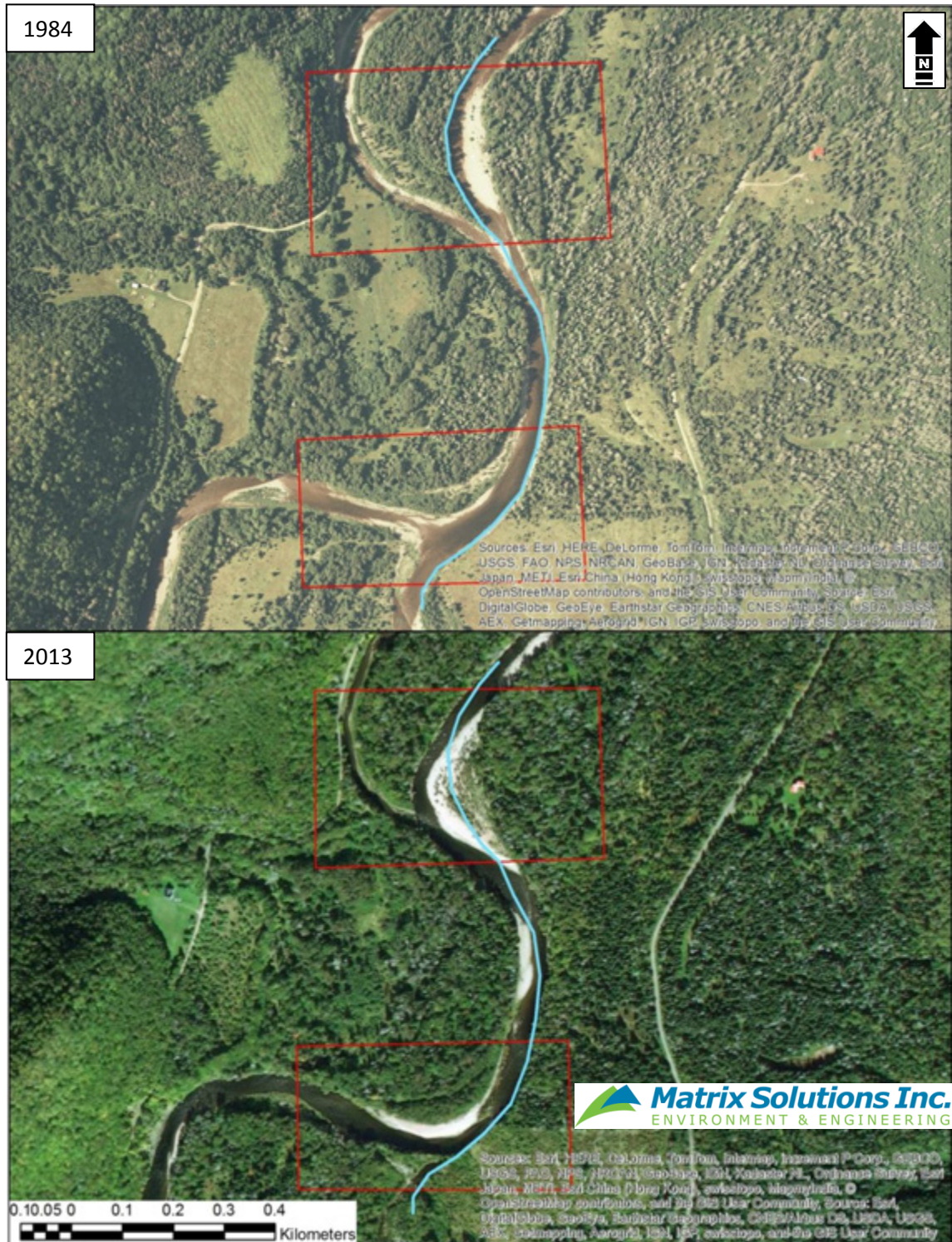


Figure 7. Channel migration in upper reach of Margaree River

The channel is also migrating at approximately 8 feet per year, 3 feet above the average, in the outside bends between Cemetery Pool and wards rock pool (Figure 8). The outer bend at Cemetery Pool has

eroded far enough to jeopardize an existing powerline (a power pole has fallen from the bank and is standing nearly within the main channel).



Figure 8. Channel migration between Cemetery Pool and Wards Rock

Just upstream of the Portree bridge, adjacent to an apple orchard, another rapidly eroding bank was noted. This bend is eroding at a rate of approximately 3.5 feet per year, lower than the average of 5 feet per year. However, a rock wall installed at the upstream extent of the bend may accelerate erosion downstream in the unprotected sections of the bend (Figure 9).

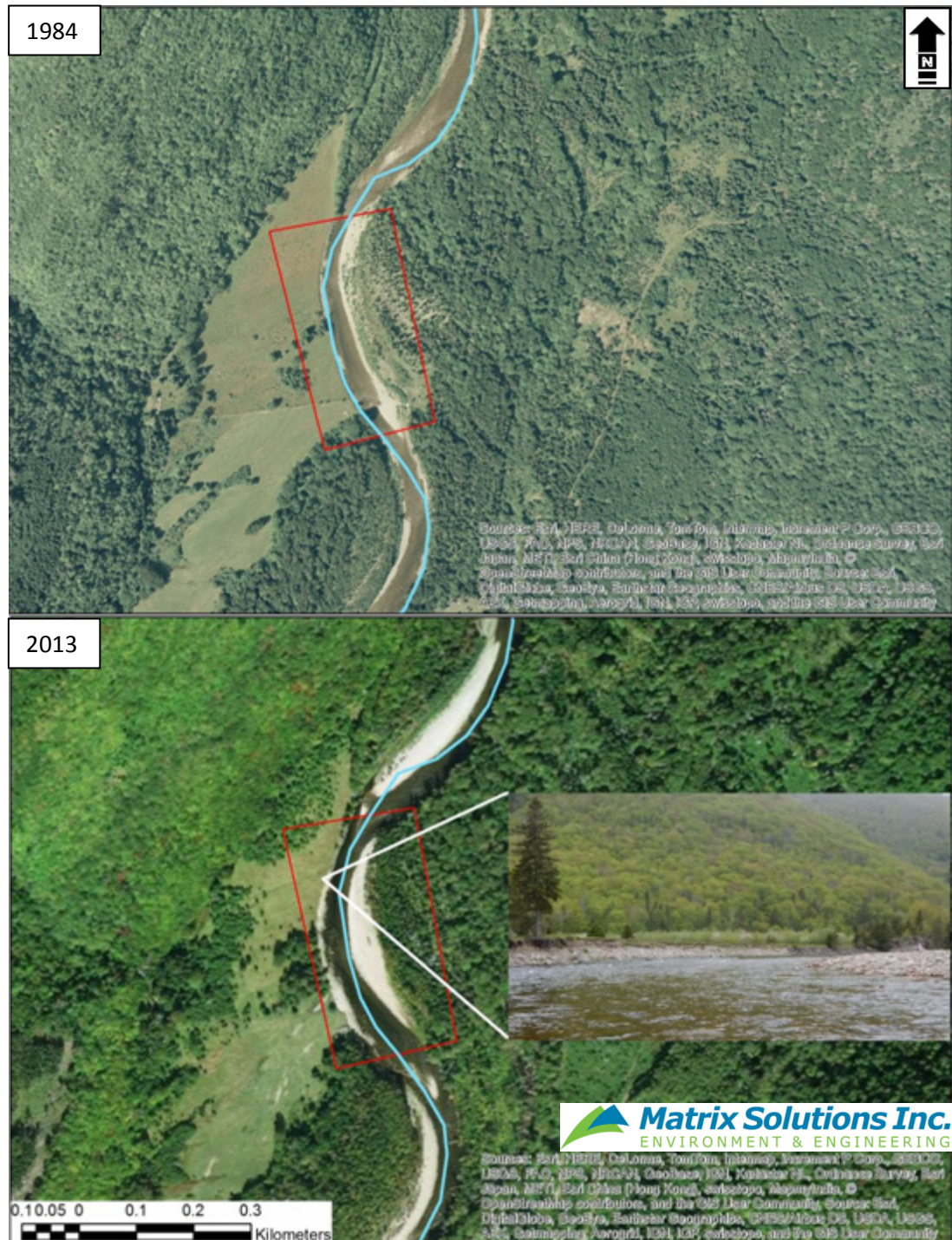


Figure 9. Eroding outer bend upstream of Portree Bridge

5.1.1 Lane's Balance

An important concept in geomorphology is Lane's Balance, or the concept of channel equilibrium. This concept, which is visually illustrated in Figure 10, assumes that channels work to produce equilibrium between erosive and resisting forces acting within the channel. This balance can be simplified to four parameters: sediment discharge; sediment particle size; stream flow; and stream slope. Equilibrium occurs when all four are in balance. If one parameter changes, there must be a proportional adjustment in the other parameters before new equilibrium can be reached. These adjustments can occur over a range of time scales and in many cases systematic adjustments may be observed long after the initial perturbation has occurred. These observations are useful for making qualitative predictions and in explaining observed adjustments in channel geometry. As downstream reaches 'feel' the accumulative adjustment of the upstream reaches, downstream impacts can be dramatic. This is particularly true when the upstream reaches are adjusting in similar ways to similar pressures, such as fluctuations in flow due to logging and land clearing practices.

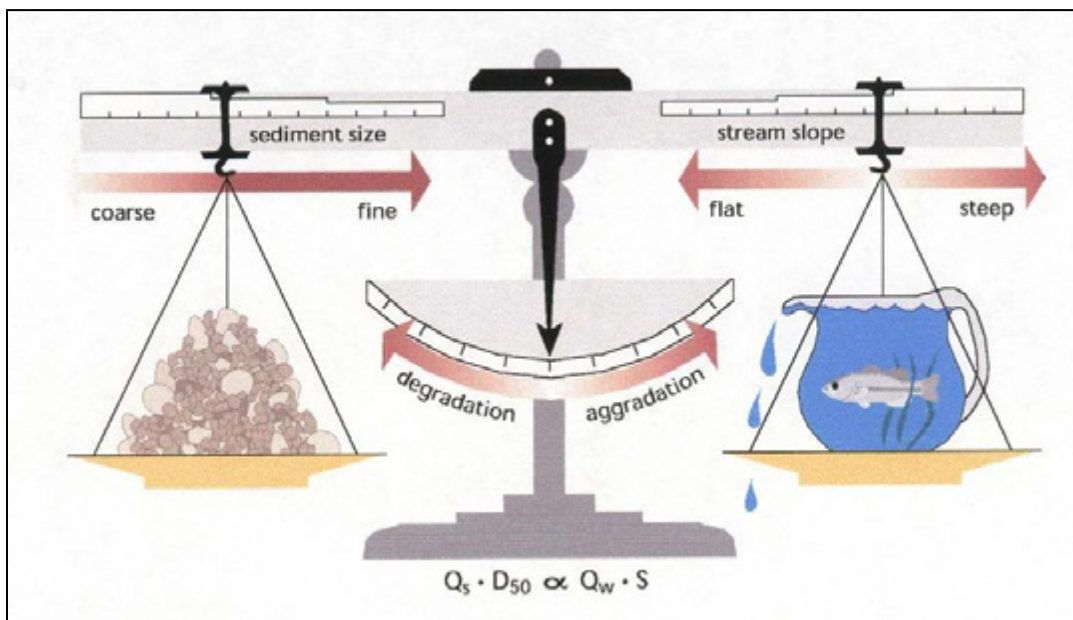


Figure 10. Lane's balance (source: Rosgen, 1996 in USDA, 1998)

The degradation observed in these upper reaches may possibly be attributed to higher fluctuations in flow brought on by a combination of land use changes in the headwaters of the watershed and climate change. Anthropogenic activities such as forestry can influence changes in the form, condition, discharge regime, and temperature of streams. Clearcuts mean the removal of trees and other vegetation that normally dissipate rain water and allow it to permeate into the soil. Clearcutting within a watershed can potentially increase flow intensities and has even been shown to elevate groundwater and stream water temperatures (Alexander et al. 2003; Bourque and Pomeroy 2001; Curry et al. 2002). Compounding these issues further, climate change is expected to bring warmer average temperatures, more extreme

rainfalls and storm flooding, frequent and extreme storms, as well as higher high flows and lower low flows (Vasseur and Catto, 2008).

5.1.2 Flow Frequency

Flow frequency within a watercourse relates a flow volume to a frequency of occurrence. Often the frequency is represented by a return interval, or the period that on average one would expect to experience a given flow event. In a flow frequency analysis report by the Department of Fisheries and Oceans Canada (Caissie, 2012), historical and year 2011 data on precipitation were obtained from Environment Canada and used to calculate high and low flow characteristics for different recurrence intervals on the Margaree River.

The following table (Table 3) outlines flows (in cubic meters per second) and expected return years for the Northeast Margaree River at the hydrometric gauge station (coordinates for gauge station: 46° 22' 08" N, 60° 58' 31" W).

Table 3. Flow recurrence intervals for the Northeast Margaree River at the hydrometric gauge station

Recurrence interval	Flow (cu. m/sec.)
QD2	166
QD10	266
QD20	306
QD50	359
QD100	400

Figure 11 compares daily flows from the gauge station (1916 to 2013) to the flow recurrence intervals.

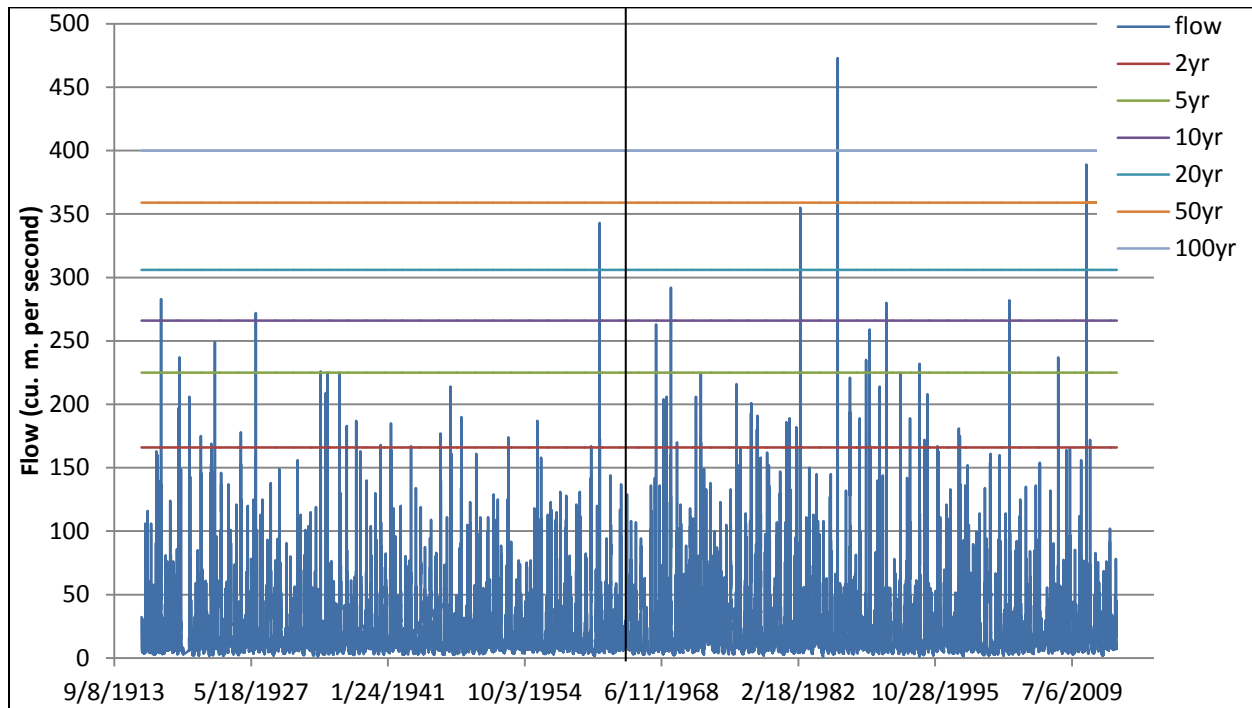


Figure 11. Daily flows on the NE Margaree River at the gauge station with flow recurrence intervals

The recurrence intervals represent a time interval over which, on average, one can expect a given flow. For the most part, the daily flows observed at the gauge station fit the number of times a flow should occur in the given time interval. For example, the number of years over which flow data was recorded is 97 years and the 100 year flow occurred once (approximately 1%). An irregularity that was noted in the daily flow data was the number of times that the 2 year flow occurred over the 97 year time span (66 times or 68%), higher than what would be expected (50%). Looking more closely at the latter half of the recorded data (mid-1964 onward – right side of the black line on Figure 7), it was found that the 2 year flow occurred 41 times or 85%; this is much higher than the expected 50%. As stated previously, changes in landuse and/or climate change may be contributing to abnormal flows. This, in turn, may be affecting stream dynamics, channel dimensions, and sediment transport causing instability as the river tries to adjust to the new flow regime.

5.2 Portree to Cranton Crossing Bridge

The reaches of the Margaree River between the bridge crossing at Portree and the bridge crossing at Cranton Crossing were the most unstable when compared to other assessed reaches. The majority of these reaches were widening and in a transitional stability state. This was evidenced by fallen/leaning trees/fence posts/etc., occurrence of large organic debris, steep bank angles, basal scour on inside meander bends and fracture lines on top of the banks. See Figure 12 for images of a couple of the indicators of widening discovered in these reaches. The most unstable reach of all the assessed reaches is located in this section of river. It is located downstream of the fish hatchery, from the confluence of

Ingram brook to the hydrometric station, where the channel splits into three then converges into a single channel again. Areas of channel migration and excessive erosion were also noted in this stretch of river.



Figure 12. Indicators of widening in channel reaches (basal scour on inside bend in left image, fallen and leaning trees on the right)

Downstream of the Portree Bridge, the first outer bend on the right bank of the main channel of the Margaree River is extending further into the bank when compared to 1984 imagery. The migration rate at this bend, 5.1 feet per year, is comparable to migration rates calculated at outer bends throughout the assessed reaches and is about average (approximately 5 feet/year). However, it was noted that this section in particular was excessively downgrading, cutting deep into the channel bed (Figure 13). This was observed by suspended armour layers suspended in the bank. Though the outer bend migration is within a comparable range to other reaches, the amount of bed degradation indicates that this section is unstable and contributing to sediment inputs downstream.



Figure 13. Suspended armour layer in reach 9, just downstream of Portree Bridge

According to soils data from Agriculture and Agri-Food Canada's soil landscapes of Canada (SLC) and Revised Universal Soil Loss Equation for Application in Canada (RUSLEFAC), the soils in this section of river (Portree to Cranton Crossing) are more erodible compared to soils underlying the upstream

reaches. The percent compositions of sand, silt, and clay within the soil from the SLC data give it a textural class of loam and a soil erodibility factor of 0.045 in RUSLEFAC which is classified as highly susceptible to water erosion. This soil type also underlies the remaining downstream assessed reaches (Figure 14). The comparably susceptible soils of the reaches downstream of Portree may be a contributing factor to the observed instability, since these are more responsive to extreme rainfall events and changes to flow regime.

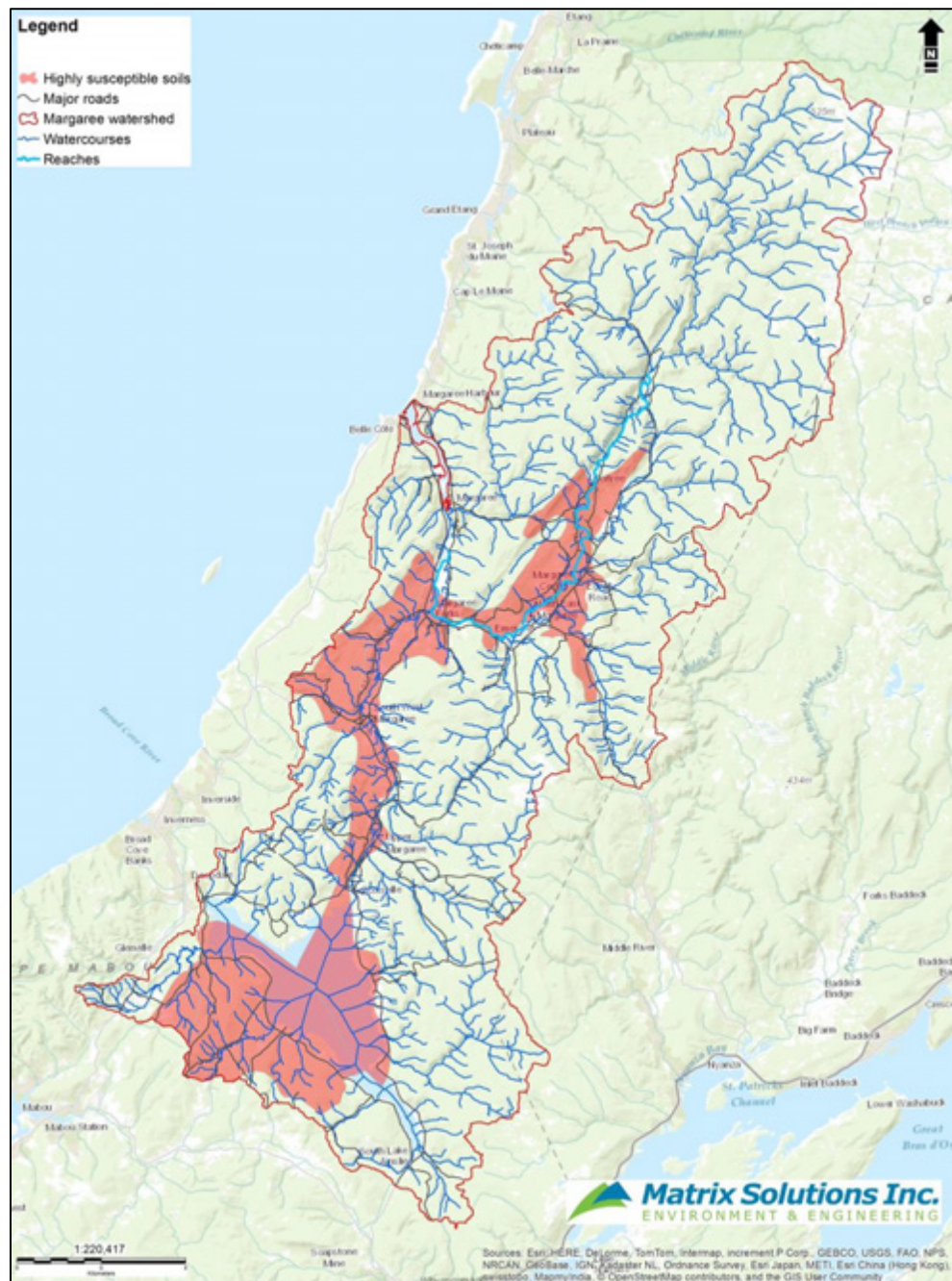


Figure 14. Highly susceptible soil groups in the Margaree watershed

The most unstable reach, reach 13, from the confluence of Ingram Brook to the hydrometric station just upstream of the Crowdis Crossing Bridge is undergoing planform adjustment brought on by excessive aggradation. This was evidenced by multiple channels, chutes, cut off channels, poorly formed bars, as well as excessive deposition on the bars, in the channel bed and in the overbank zone. Figure 15 includes photographs taken from this reach. See Figure 16 for comparisons between 1984 and 2013 imagery. Though the evidence of planform adjustment is widespread, the migration rates through this reach were comparable to other reaches.



Figure 15. Reach 13 photographs

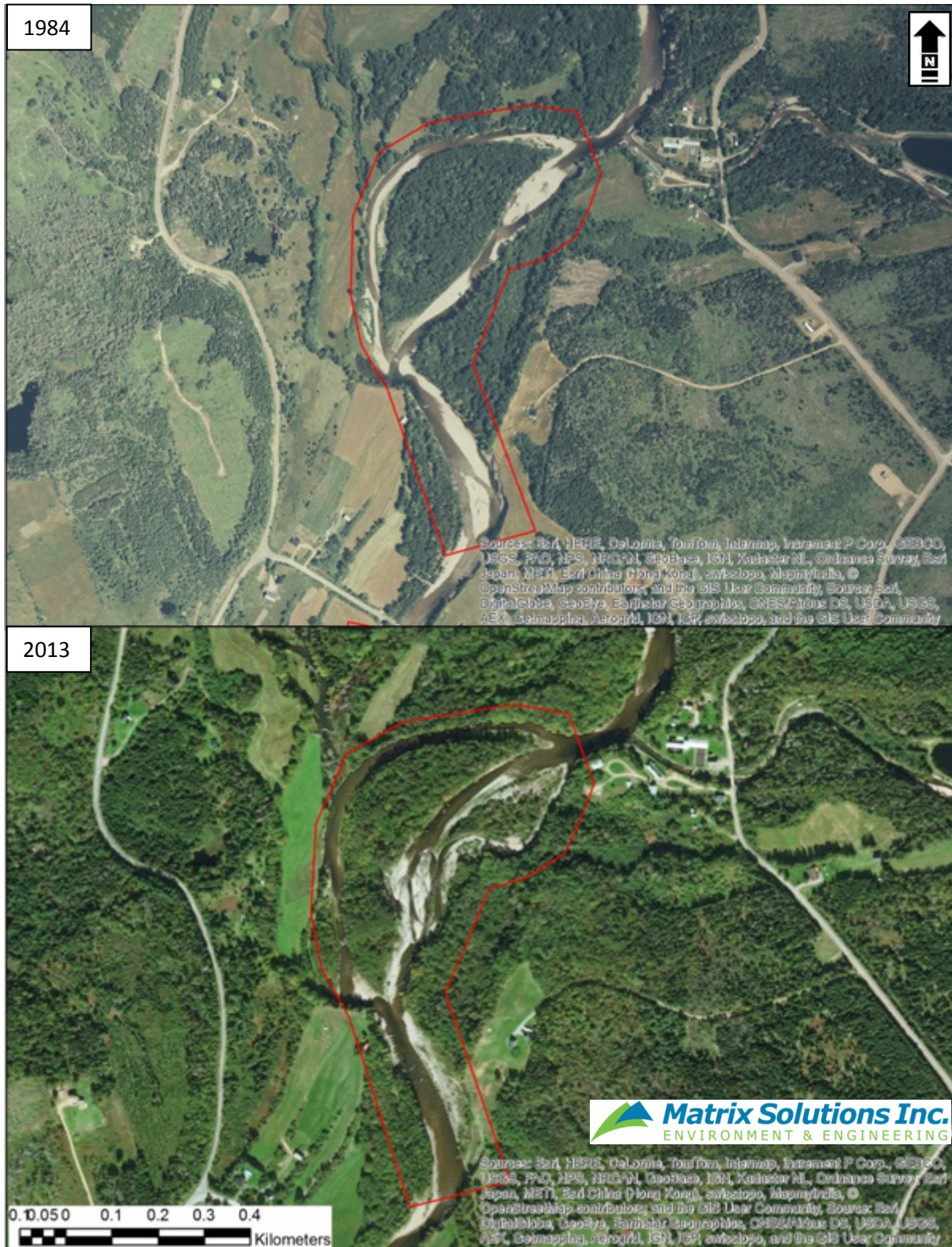


Figure 16. Reach 13 aerial photographs

Another area of instability with the stretch between Portree Bridge and Cranton Crossing was noted at the mouth of Nile Brook and downstream of the brook confluence. The mouth of the brook itself was highly elevated from the river, severely aggraded, with cut face on bar forms, braided channels and high eroding banks. The mouth of the brook was not assessed for geomorphic conditions but photographs were taken. See Figure 17 for pictures of the mouth of Nile Brook.



Figure 17. Nile Brook confluence

The migration rate of the last outer bend in the brook before it meets the river is 6ft/yr, approximately 1 ft/yr more than the average in the river. Another rapidly migrating outside bend in the same located in the river just downstream of the Nile Brook confluence on the next turn (right bank). The outer bend in this location has migrated the most compared to other bends, and also moved slightly downstream. It is estimated that this bank is migrating at approximately 12 feet per year, despite the bank being well vegetated. Refer to Figure 18 for comparisons between 1984 and 2013 imagery of the area.



Figure 18. Aerial imagery of Nile Brook confluence and downstream

5.3 Cranton Crossing Bridge to Southwest Margaree River Confluence

The stretch of river between the Cranton Crossing Bridge and the Southwest Margaree River were also relatively unstable. Reaches were mostly in a transitional state and the remaining sections were in adjustment. The dominant geomorphic processes alternated between widening and aggradation. The majority of these reaches were widening and in a transitional stability state. This again was evidenced by fallen/leaning trees/fence posts/etc., occurrence of large organic debris, steep bank angles, basal scour on inside meander bends and fracture lines on top of the banks as well as excessive deposition in the channel bed and banks. See Figure 19 for examples of geomorphic indicators observed in these reaches.



Figure 19. Representative photographs from reaches between Cranton Bridge and SW Margaree

Areas of channel migration and excessive erosion were also noted in this stretch of river. Migration rates of the outside bends in this section of river were close to the average. Changes in channel planform were frequent, with the river splitting into multiple channels and abandoning old channels for new ones. This was particularly in reaches 18 and 19 between Cranton Crossing Bridge and the confluence of Lake O'Law Brook. See Figure for an aerial comparison of the Margaree River between Cranton Crossing Bridge and Lake O'Law Brook for 1984 and 2013.

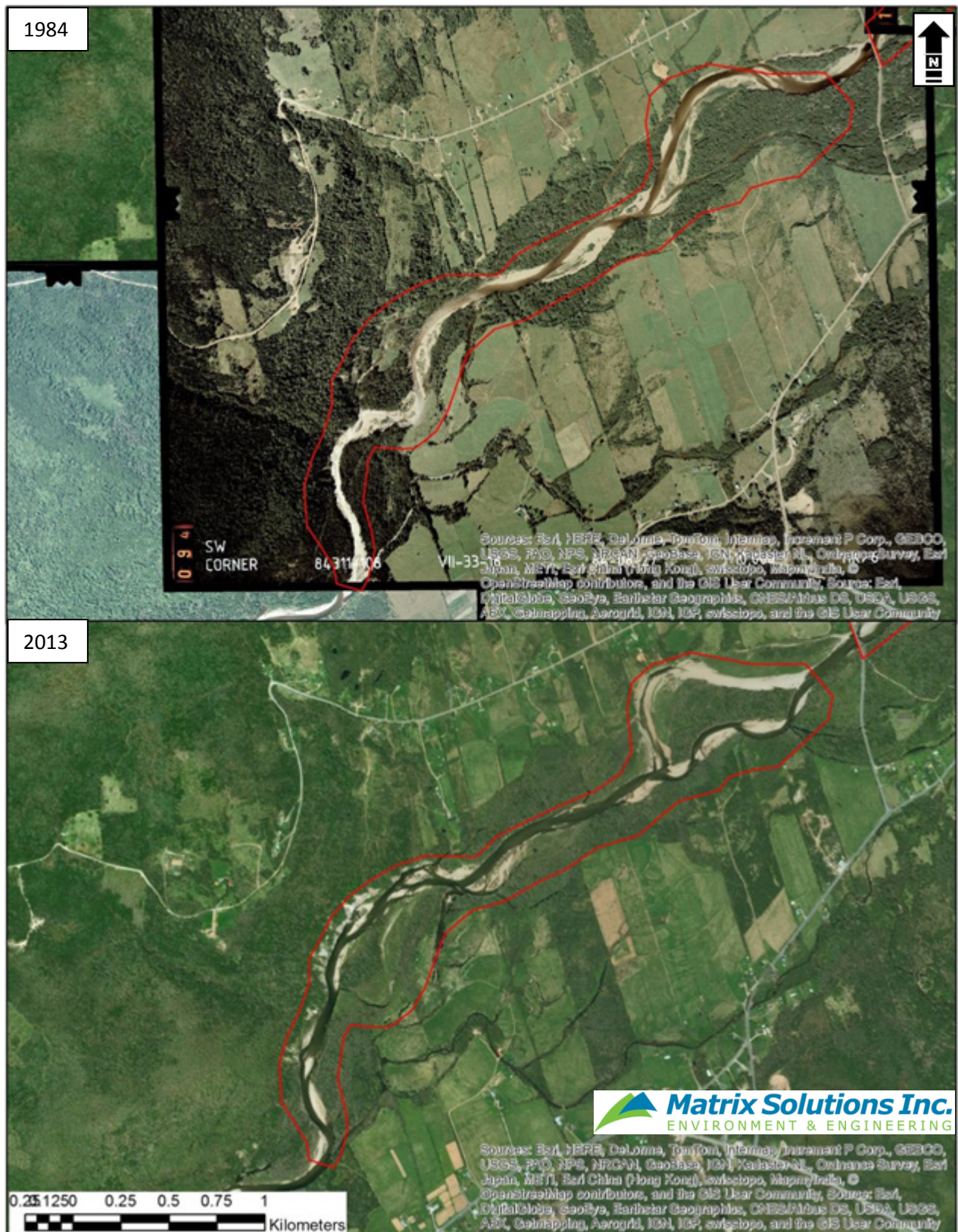


Figure 20. Reach 18 and 19 aerial imagery

Another area of note in this section of river was in reach 22, at the confluence of Big Brook. This reach was heavily aggraded, with excessive depositions at the mouth of Big Brook. This is likely due to the river coming to a sharp bend as it meets the Cabot trail. As the river comes into this hard bend and hits the riprap along the bank/road berm, the flow is abruptly slowed, allowing material to drop out of suspension. Some material may be originating from the brook and dropping out at the confluence as well.



Figure 21. Big Brook confluence

5.4 Southwest Margaree River to Confluence

The remaining reaches contain the lower portion of the river. These were also transitional and in adjustment as well as aggrading and widening. Some aggradation and channel widening would be typical in the lower reaches of a major system, especially with the addition of a major tributary such as the Southwest Margaree River; however the number of geomorphic indicators identified indicates these lower reaches are also experiencing instability outside the normal range expected. The riparian zones in this section of river have been altered to open agricultural lands and some bank erosion was noted. With the lower slope and therefore reduced energy, the migration rates in these reaches were comparable or lower than the average compared to other outside bend migrations. Long stretches of river from the SW Margaree confluence to the Tidal Pool were without good pool habitat due to the excessive deposition in the channel bed. Increased turbidity was also noted originating from the Southwest Margaree River, which may be due erosion upstream in the system. Erodible soils also underlie the majority of the main channel of the SW Margaree. See Figure 22 and Appendix E for representative photographs of these reaches.



Figure 22. Representative photos of Margaree River between Southwest confluence and Tidal Pool

6 MEANDER BELTWIDTH ANALYSIS

Watercourses such as the Margaree River are dynamic features on the landscape. Through time, their configuration and position on the floodplain changes as part of meander evolution, development, and migration processes. When meanders change their shape and shift in their position, the associated erosion and deposition that enable these changes to occur, can cause loss or damage to private properties and/or structures. For this reason, when development or other activities are contemplated near a watercourse, it is desirable to designate a corridor that is intended to contain all of the natural meander and migration tendencies of the channel. Outside of this corridor, it is assumed that private property and structures will be safe from the erosion potential of the watercourse.

For the purpose of this assessment of the Margaree River a historical analysis was completed using aerial photographs from 1984 and 2013. The intent of the analyses is to identify the type and rate of migration and meander development processes that have occurred during the available air photo record and the area that the watercourse has occupied. It can reasonably be expected that the historic channel processes will continue into the future and are therefore used in the meander belt delineation process to identify the area that the reach could occupy in the future. The air photographs also enable human alterations of the channel form to be identified, some of which are not always readily discernible.

Aerial photographs from 2013 were overlaid onto aerial photographs from 1984. This enables channel changes to be viewed in the context of their general setting. After the overlay was assembled, and before the meander belt boundaries were determined, several simple measurements and observations were made:

- For the meanders that define the meander belt boundary (i.e., outer most meanders of the reach planform), the rate of lateral meander migration (i.e., across the floodplain) was calculated. When no change in hydrologic regime is anticipated, the migration was calculated

using photos that represent approximately 20 – 30 year time interval before the most recent available photo. When a change in hydrologic regime was anticipated, then the rate of migration was determined for the entire period of the historic information (i.e., earliest available and most recent coverage).

- Identify the position of meander belt axis for each historic reach position;
- If the meander belt axis had shifted, then the rate of the shift was calculated;
- Identify evidence of relatively recent meander migration on the floodplain (e.g., meander scars, oxbow lakes, meander cut-off – width of channel in these features should be within several metres of existing channel width).

When there has been evidence of meander migration during the historic air photographic interpretation record, this information becomes particularly important in guiding the delineation of the meander belt. In each of the meander belt delineation procedures, the results of the historic analyses will be used to quantify with accuracy the meander belt width for the study area. The following table identifies the calculated/measured meander belt width for the reaches assigned to the Margaree River for the purposes of this assessment.

Table 4. Margaree River meander beltwidth assessment results

Reach	Bankfull Width (m)*	Bankfull Depth (m)*	Gradient (%)*	Sinuosity*	MBW (m)
r1	35	1.5-3	2-2.5	Sinuuous	250
r2	35	1.5-3	2	Sinuuous	500
r3	30	1.5-3	2.5	Sinuuous	160
r4	35-60	3.5	2.5	Sinuuous	160
r5	42	2	2	Sinuuous	180
r6	50	2	2	Sinuuous	140
r7	35	1-4	2	Sinuuous	400
r8	43	2-6	2	Sinuuous	400
r9	35	2-4	1	Sinuuous	180
r10	80	1-4	1.5	Sinuuous	400
r11	45	3-5	1-2	Sinuuous	400
r12	>100	3-5	2	Sinuuous	400
r13	>100	2-4	1-2	Sinuuous	300
r14	38	2-5	2	Sinuuous	300
r15	43	1.5-3	1	Sinuuous	300
r16	40	2-5	1-2	Sinuuous	300
r17	>100	1-4	1-2	Sinuuous	300
r18	80	2-4	2	Sinuuous	200
r19	60	2-5	2	Sinuuous	300
r20	40	2-6	2	Sinuuous	140
r21	40	2-6	2	Sinuuous	130
r22	70	2-6	2	Sinuuous	100
r23	50	2-5	2	Sinuuous	120
r24	60	2-5	2	Sinuuous	300
r25	60	2-5	2	Sinuuous	300
r26	50	2-5	1-2	Sinuuous	400
r27	60	3-5	1-2	Sinuuous	400
r28	60	2-6	1-2	Sinuuous	500
*From results of rapid assessments					

With meander belt widths' ranging from 100 metres to 500 metres it becomes clear which reaches are more confined by the valley walls and which reaches have the available area for the channel to migrate between the valley walls. By identifying the meander belt width and comparing it to the bankfull width a calculation of the percentage of channel occupancy can be made for each reach. For example in R11 (taken from Table 4) the bankfull width was measured to be 45 metres with a meander belt width

calculated at 400 metres. This means that the channel is currently occupying just over 11% of the overall meander belt width calculated for this reach. This information becomes relevant by knowing the position of the current channel relative to the valley channel when designing restoration activities or protecting infrastructure from future flooding events.

7 RECOMMENDATIONS

The majority of the assessed reaches of the Margaree River are either in a geomorphic state of stress or adjustment. The primary responsible geomorphic indicator varies from degradation and widening in the upper reaches to widening and aggradation in the lower reaches.

Knowing the reference reach and geomorphic process that is driving the instability is important when planning a restoration project, particularly when it comes to restoring an aquatic habitat, such as a pool, or protecting a bank from higher than average erosional rates. Many projects have a low success rate when these factors are not considered. An example of this would be a restoration effort to restore a salmon pool. If the pool is located in a reach of a channel that has been identified as collecting sediment and bedload material, structures or techniques used would not want to be the type that promote or enhance depositional features without careful consideration as to where those depositional features might occur. More importantly when considering bank restoration knowing the location of the channel relative to the valley walls, the erosional rates of the reach, and the radius of curvature of the eroding bank are vital to a successful project.

With an average outer bend migration rate of 5.3 feet per year bank restoration projects should target areas where the outer bend migration rates exceed this ratio. Reach 13 for instance has been noted as the most unstable reach with outer bend migration rates calculated at 12 feet per year. As well Reach 13 is located between Portree and the Cranton Bridge crossing and according to the Agriculture and Agri-Food Canada's soil landscapes of Canada, the soils are more erodible compared to soils underlying the upstream reaches. Restoration projects that focus on the reduction of sediment input from this section of the Margaree River should be considered.

The following table outlines the reaches and prioritizes each reach as low, medium, or high when considering where to implement restoration activities. Eleven reaches have a High Priority rating. Of these eleven reaches that have a High Priority rating, three are marked with an asterisk and should be consideration as areas to focus initial restoration activities.

The table above provides the starting point for managing aquatic habitat and bank restoration efforts on the Margaree River. In order to move forward with implementing projects, site selection based not only on the priority ranking of each reach but also on site access, protection of infrastructure, cost, available funding and overall value of the project to enhance the river is required. Once sites have been selected for restoration and/or protection the following steps will be necessary:

1. Conduct a detailed geomorphic assessment and topographic survey of the project site and sections of the reach in which the project site is located. This detailed assessment and survey provides the details necessary to develop a design that works to improve or re-establish the more natural local hydrology, geomorphology, and meander/thalweg pattern of the river.
2. Develop a design based on the survey and assessment data acquired. The design will provide quantities and type of material required or to be removed from the site. From the design a cost estimate will be developed that includes material, contractor, construction oversight, post construction survey/report, and post construction monitoring costs.

Typical fees associated with item one range in the ten to thirty thousand dollar range. This however is dependent on the size of the project, accessibility and location. Typical fees associated with item 2 vary but a low range would be in the order of twenty thousand dollars with much larger projects exceeding fifty thousand dollars or more. Again the variability in the cost is dependent on such factors as the size of the project, accessibility and location.

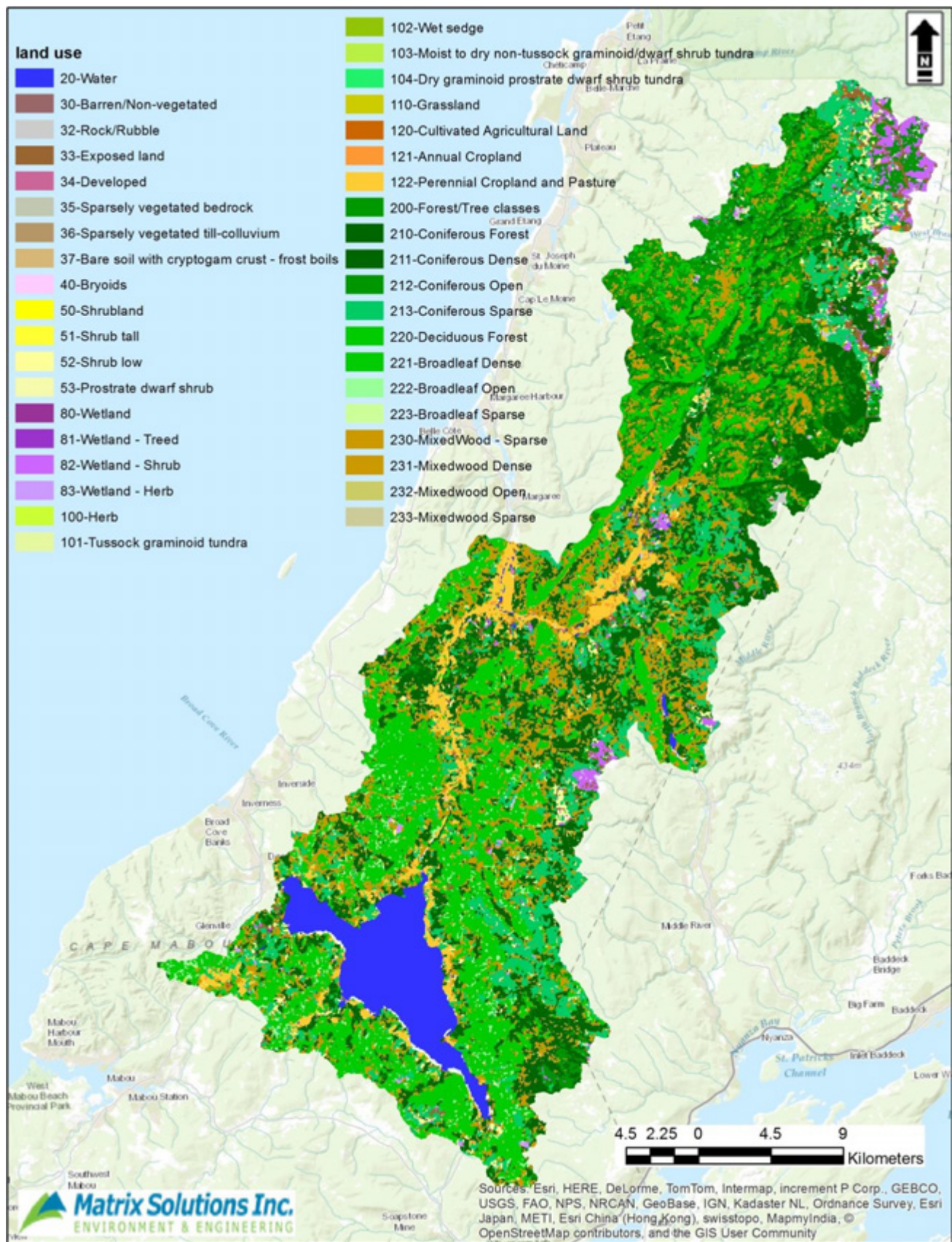
There are grants and government funds available for projects of this nature and with great emphasis being placed on Atlantic salmon and promoting their survival and habitat protection, a well design project that has potential for high success to improve or protect habitat and good public perception is usually the type of project that funders are looking for.

Utilizing this report in managing where aquatic or bank restoration occurs and the type of restoration activities or techniques to implement will lead to successful projects and improve the overall health of the Margaree River.

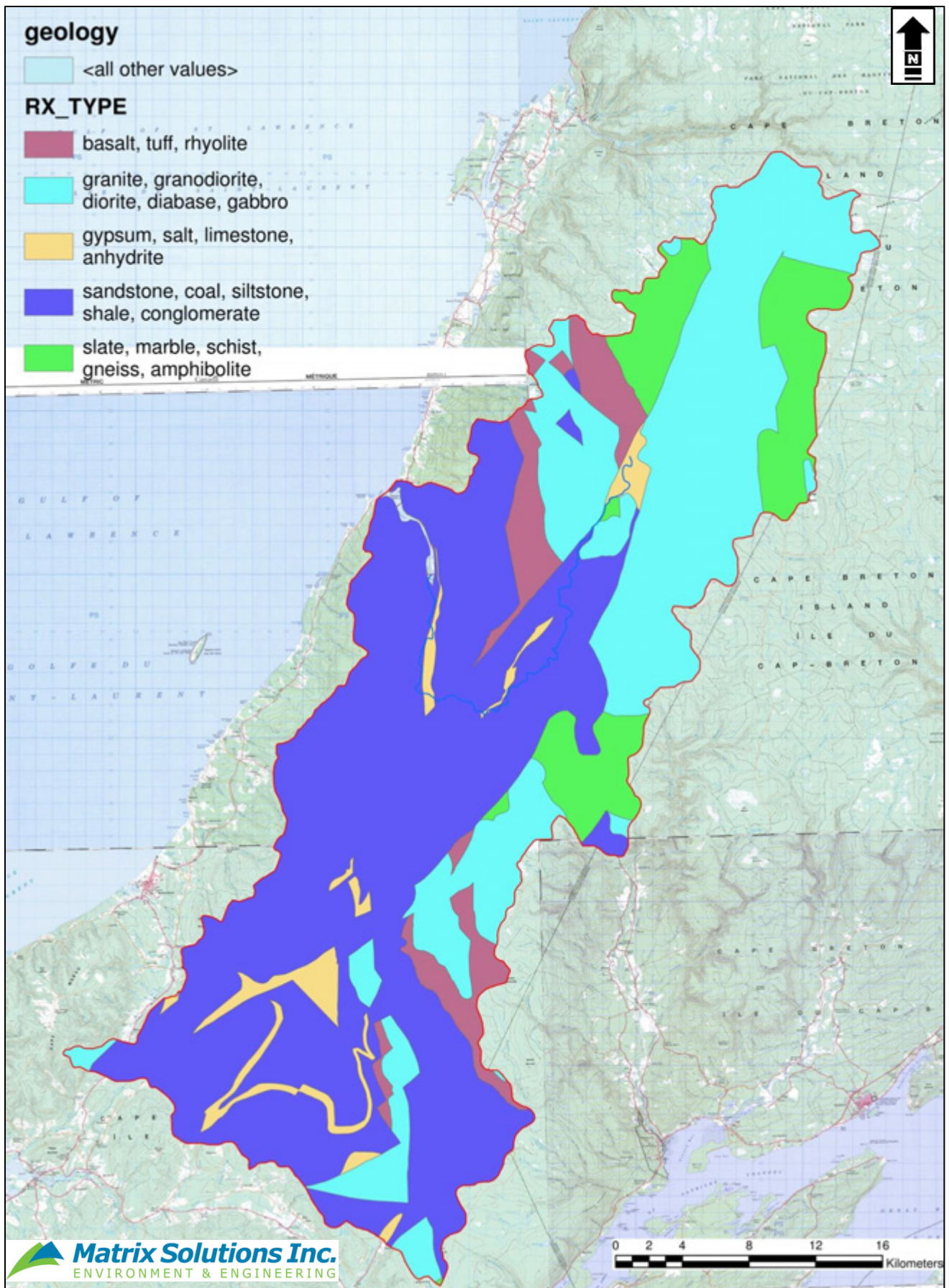
8 REFERENCES

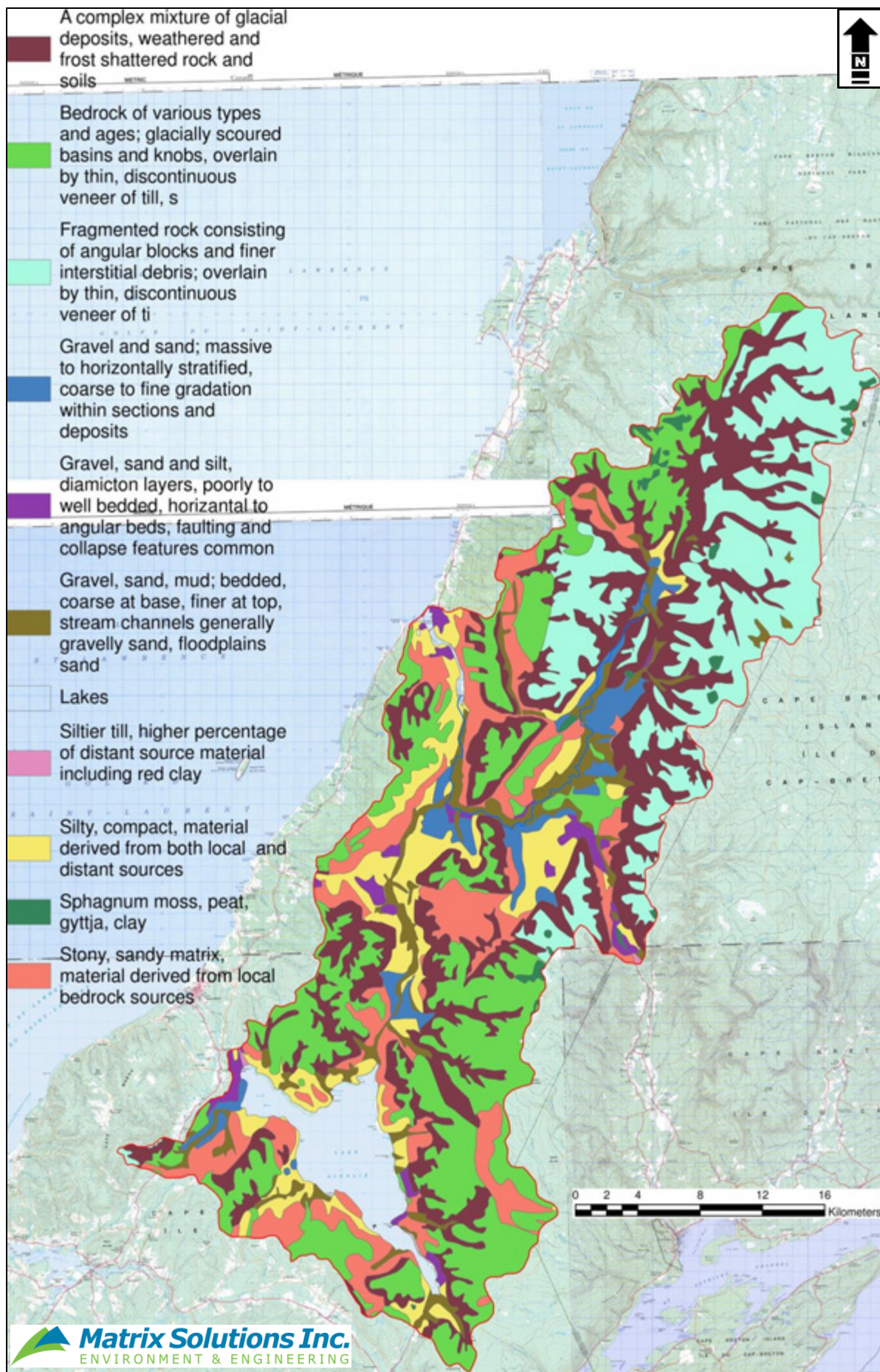
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APPENDIX A LANDUSE



APPENDIX B GEOLOGY





APPENDIX C FIELD DATA

Site ID	reach 1	reach 2	reach 3	reach 4	reach 5
Location	Reach 1 (u/s of MacKenzie Pool)	Reach 2 (between MacKenzie and Cemetery Pool)	Reach 3 (d/s of Cemetery Pool)	Reach 4 (u/s of Wards Rock)	Reach 5 (d/s of Wards Rock)
Weather	Overcast 10 degrees C	Overcast 10 degrees C	Overcast 10 degrees C	Overcast 10 degrees C	Overcast 10 degrees C
Date Assessed	6/5/2017	6/5/2017	6/5/2017	6/5/2017	6/5/2017
Stream Name	NE Margaree River	NE Margaree River	NE Margaree River	NE Margaree River	NE Margaree River
Crew	AY NT	AY NT	AY NT	AY NT	AY NT
Recorder	AY	AY	AY	AY	AY
Channel Stability (0-11)	5.00	6.00	6.00	8.00	6.00
Scour/ Deposition (0-8)	5.00	6.00	6.00	6.00	6.00
Instream Habitat (0-8)	6.00	6.00	6.00	6.00	5.00
Water Quality (0-8)	6.00	6.00	6.00	6.00	6.00
Riparian Condition (0-7)	5.00	5.00	5.00	5.00	5.00
Biological Indicators (0-8)	6.00	5.00	6.00	6.00	6.00
Total	33.00	34.00	35.00	37.00	34.00
Stability Ranking	Moderate	Moderate	Moderate	High	Moderate
Bankful Width (m)	35.00	35.00	30.00	35-60	42.00
Wetted Width (m)	30.00	30.00	30.00	30.00	40.00
Bank Height (m)	2-4	2-4	2-5	2-5	2
Pool - Riffle Spacing (m)	50-60	70.00	100.00	60-80	>100
Bankful Depth (m)	1.5-3	1.5-3	1.5-3	3.50	2.00
Wetted Depth (m)	1-2.5	1-2.5	1-2.5	0.50	0.50
Entrenchment (m)	>100	0 - >100	0 - >100	0 - >100	0 - 100 (entrenched)
Bank Angle (Degrees) LEFT	30.00	30-90	30-90	30-90	30-90
Bank Angle (Degrees) RIGHT	30.00	30-90	30-90	30-90	30-90
Pool % Sand, Silt, or Clay	10.00	15.00	15.00	5.00	15.00
Pool % Gravel	25.00	20.00	20.00	10.00	10.00
Pool % Cobble	40.00	40.00	40.00	50.00	50.00
Pool % Boulder	25.00	25.00	25.00	25.00	25.00
Pool % Bedrock	NA	NA	NA	10.00	NA

Site ID	reach 1	reach 2	reach 3	reach 4	reach 5
Riffle % Sand, Silt, or Clay	5.00	5.00	5.00	5.00	10.00
Riffle % Gravel	5.00	5.00	5.00	5.00	10.00
Riffle % Cobble	60.00	60.00	60.00	60.00	60.00
Riffle % Boulder	30.00	30.00	30.00	20.00	20.00
Riffle % Bedrock	NA	NA	NA	10.00	NA
Sinuosity	sinuous	sinuous	sinuous	sinuous	sinuous
Gradient	2-2.5	2.00	2.50	2.50	2.00
Dominant Bank Material	sandy loam	sandy	sandy loam- bedrock	sandy loam-cobbles-bedrock	sandy loam-cobbles
Channel Hardening	yes, rock wall	yes @ bridge	no	no	no
Bend Radius (m)	see maps	see maps	see maps	see maps	see maps
Woody Debris	minor	minor	minor	minor	minor
Dominant Vegetation	mixed forest, shrubs	mostly shrubs	mixed forest	mostly deciduous	mostly deciduous
% Channel Area Disturbed	10.00	10.00	0.00	0.00	0.00
Other Comments	Start @ gps pt 012. Stretch between where channel becomes one main channel after splitting to MacKenzie Pool. Some soft deposition in side channel at start. Main channel bed is solid. Weir structure upstream of rock wall is failing. Typical riffle/run. Good pool habitat @ rock wall (large brook trout). Water temp. is 9 degrees C. Photos 435-485	Start at gps pt 022. Torvane = 0 @ outer bend d/s of cemetery pool. Photos 485-527. Water temp is 9 degrees C. Stretch between MacKenzie Pool and Cemetery Pool. Armouring along bridge, erosion u/s of armour. Some finer material in Cemetery Pool (sand). Major erosion on outside bend @ Cemetery pool. Power line pole almost in river.	Photos 527-541. Stretch between Cemetery Pool and pool adjacent to bedrock valley wall (GPS Pt. = "Pool Bedrock"). Larger substrate here, did pebble count @ GPS Pt. #4. Water temp is 9 degrees C.	Photos 541-558. Between start of bedrock valley wall and Ward's Rock. Bedrock throughout. High gradient, larger substrate. Channel widens into long run after pool and before riffle section. Water temp is 9.8 degrees C.	Start at GPS pt 062. Photos 558-581. Straight, riffle dominated, last pool is Wards Rock. Very straight section from Ward's Rock to where valley opens up (GPS pt. 6). Very wide, shallow, steep. Nice pool habitat @ Wards Rock. Erosion u/s of pool on right bank. This section runs past intervale lodge.
Lobate Bar	no	no	no	no	no
Coarse materials in riffles embedded	no	no	no	no	no
Siltation in pools	no	no	no	no	no
Mid-channel bars	no	no	no	no	no
Deposition on point bars	yes	yes	yes	yes	no
Poor longitudinal sorting of bed materials	yes	no	no	no	no
Soft, unconsolidated bed	no	no	no	no	no
Evidence of deposition in/around structures	no	no	no	no	no
Deposition in the overbank zone	no	yes	yes	no	yes
(AI) Sum of "NO"	7.00	7.00	7.00	8.00	8.00
(AI) Sum of "YES"	2.00	2.00	2.00	1.00	1.00
(AI) Factor Value	0.22	0.22	0.22	0.11	0.11

Site ID	reach 1	reach 2	reach 3	reach 4	reach 5
Channel worn into undisturbed overburden / bedrock	no	yes	yes	yes	yes
Elevated tree roots/root fans above channel bed	yes	yes	yes	yes	yes
Bank height increases	no	no	no	no	no
Absence of depositional features (no bars)	no	no	no	no	no
Cut face on bar forms	yes	yes	yes	yes	no
Head cutting due to knick point migration	no	no	no	no	no
Suspended armour layer visible in bank	no	no	no	no	no
(DI) Sum of "NO"	5.00	4.00	4.00	4.00	5.00
(DI) Sum of "YES"	2.00	3.00	3.00	3.00	2.00
(DI) Factor Value	0.29	0.43	0.43	0.43	0.29
Fallen / leaning trees / fence posts / etc.	yes	yes	yes	yes	yes
Occurrence of large organic debris	no	no	no	no	no
Exposed tree roots	yes	yes	yes	yes	yes
Basal scour on inside meander bends	no	no	no	no	no
Toe erosion on both sides of channel through riffle	no	no	no	no	no
Steep bank angles through most of reach	no	no	no	no	no
Length of basal scour >50% through subject reach	no	no	no	no	no
Fracture lines along top of bank	no	yes	yes	yes	yes
(WI) Sum of "NO"	6.00	5.00	5.00	5.00	5.00
(WI) Sum of "YES"	2.00	3.00	3.00	3.00	3.00
(WI) Factor Value	0.25	0.38	0.38	0.38	0.38
Formation of chute(s)	no	no	no	no	no
Single thread channel to multiple channel	no	no	no	no	no
Evolution of pool-riffle form to low bed relief form	no	no	no	no	no
Cut-off channel(s)	no	no	no	no	no
Formation of island(s)	no	no	no	no	no
Thalweg alignment out of phase meander form	no	no	no	no	no
Bar forms poorly formed / reworked / removed	no	no	no	no	yes
(PI) Sum of "NO"	7.00	7.00	7.00	7.00	6.00
(PI) Sum of "YES"	0.00	0.00	0.00	0.00	1.00
(PI) Factor Value	0.00	0.00	0.00	0.00	0.14
Stability Index	0.19	0.26	0.26	0.23	0.23
Condition	In Regime	Transitional or Stressed	Transitional or Stressed	Transitional or Stressed	Transitional or Stressed

Site ID	reach 6	reach 7	reach 8	reach 9	reach 10
Location	Reach 6 (d/s of Intervale lodge - island section)	Reach 7 (ends @ rapids u/s Portree Bridge)	Reach 8 (between GPS pt. 7-8)	Reach 9 (between GPS pt. 8-9)	Reach 10 (between GPS pt. 9-131)
Weather	Overcast 10 degrees C	Overcast 10 degrees C	Sunny 10 degrees C	Sunny 10 degrees C	Sunny 10 degrees C
Date Assessed	6/5/2017	6/5/2017	6/6/2017	6/6/2017	6/6/2017
Stream Name	NE Margaree River	NE Margaree River	NE Margaree River	NE Margaree River	NE Margaree River
Crew	AY NT	AY NT	AY NT	AY NT	AY NT
Recorder	AY	AY	AY	AY	AY
Channel Stability (0-11)	8.00	5.00	6.00	5.00	5.00
Scour/ Deposition (0-8)	6.00	5.00	5.00	4.00	5.00
Instream Habitat (0-8)	5.00	5.00	6.00	4.00	5.00
Water Quality (0-8)	6.00	6.00	5.00	5.00	6.00
Riparian Condition (0-7)	5.00	4.00	5.00	5.00	5.00
Biological Indicators (0-8)	6.00	6.00	6.00	6.00	6.00
Total	36.00	31.00	33.00	29.00	32.00
Stability Ranking	High	Moderate	Moderate	Moderate	Moderate
Bankful Width (m)	50.00	35.00	43 (bridge is 37)	35.00	80 (@ braided section/end of reach)
Wetted Width (m)	50.00	35.00	43.00	35.00	80 (@ braided section/end of reach)
Bank Height (m)	2	2	1.5-5	2-5	3-10
Pool - Riffle Spacing (m)	>100	>100	100.00	>500	500.00
Bankful Depth (m)	2.00	1-4	2-6	2-4	1-4
Wetted Depth (m)	1.00	1-3	1-5	1-2	1-2.5
Entrenchment (m)	0 - 100	>100	0.00	>100	0->100
Bank Angle (Degrees) LEFT	30-90	30-90	30-90 (mostly steep)	30-90	30-90
Bank Angle (Degrees) RIGHT	30-90	30-90	30-90 (mostly steep)	30-90	30-90
Pool % Sand, Silt, or Clay	15.00	15.00	10.00	20.00	10.00
Pool % Gravel	10.00	10.00	10.00	20.00	20.00
Pool % Cobble	50.00	50.00	50.00	50.00	50.00
Pool % Boulder	25.00	25.00	20.00	10.00	10.00
Pool % Bedrock	NA	NA	20.00	NA	10.00

Site ID	reach 6	reach 7	reach 8	reach 9	reach 10
Riffle % Sand, Silt, or Clay	10.00	10.00	10.00	10.00	10.00
Riffle % Gravel	10.00	10.00	10.00	20.00	20.00
Riffle % Cobble	60.00	60.00	50.00	70.00	60.00
Riffle % Boulder	20.00	20.00	10.00	NA	NA
Riffle % Bedrock	NA	NA	20.00	NA	10.00
Sinuosity	sinuous	sinuous (more sinous than upstream reaches)	sinuous	sinuous	sinuous
Gradient	2.00	2.00	2.00	1.00	1.50
Dominant Bank Material	sandy loam	sand	sandy loam, b	sandy loam	sand, cobble, bedrock
Channel Hardening	no	yes (old riprap along apple orchard property)	yes (adjacent	yes	no
Bend Radius (m)	see maps	see maps	see maps	see maps	see maps
Woody Debris	minor	minor	minor	minor	major
Dominant Vegetation	mixed forest	mixed forest	mixed forest	mixed forest	mixed forest
% Channel Area Disturbed	0.00	10.00	10.00	0.00	0.00
Other Comments	Photos 581-602. Start @GPS pt 6. Water temp is 10.3 degrees C. Reach contains island (d/s of lodge). Right channel is dominant. Steep, not as wide as previous reach, large substrate.	Photos 602-669. Start @GPS pt 082. Stretch between island and rapids u/s of Portree. Very active channel. Evidence of headcutting in riffle section. Large substrate throughout. Actively eroding banks. Section mostly riffle. Some land clearing to river @ apple orchard.	Photos 669-683;687-694. water temp is 8.9 degrees C	Photos 696-739. water temp is 9.6 degrees C. Smaller substrate than upstream reaches. Section below bridge (upper end of this reach) is incised (consider separate reach for this section). Portree bridge possibly causing channel incision. Increasing sediment supply. Infilling of pools.	Photos 741-815. water temp is 11.5 degrees C. Substrate similar to previous reach. Stretch where channel used to split (old channel (dry) approx. 1 km long). Lots of cut faces on bars. One good pool d/s of high eroding bank. Bedrock throughout main channel. Lots of deposition @ end of reach where channels used to meet. Lots of braiding @ end.
Lobate Bar	no	no	no	no	yes
Coarse materials in riffles embedded	no	no	no	no	no
Siltation in pools	no	no	no	no	no
Mid-channel bars	no	yes	yes	yes	yes
Deposition on point bars	yes	yes	yes	yes	yes
Poor longitudinal sorting of bed materials	no	no	no	no	no
Soft, unconsolidated bed	no	yes	no	no	yes
Evidence of deposition in/around structures	no	no	no	no	no
Deposition in the overbank zone	yes	yes	yes	yes	yes
(AI) Sum of "NO"	7.00	5.00	6.00	6.00	4.00
(AI) Sum of "YES"	2.00	4.00	3.00	3.00	5.00
(AI) Factor Value	0.22	0.44	0.33	0.33	0.56

Site ID	reach 6	reach 7	reach 8	reach 9	reach 10
Channel worn into undisturbed overburden / bedrock	no	yes	yes	yes	yes
Elevated tree roots/root fans above channel bed	yes	yes	yes	yes	yes
Bank height increases	no	no	no	no	no
Absence of depositional features (no bars)	no	no	no	no	no
Cut face on bar forms	no	yes	yes	yes	yes
Head cutting due to knick point migration	no	yes	no	no	no
Suspended armour layer visible in bank	no	no	no	no	no
(DI) Sum of "NO"	6.00	3.00	4.00	4.00	4.00
(DI) Sum of "YES"	1.00	4.00	3.00	3.00	3.00
(DI) Factor Value	0.14	0.57	0.43	0.43	0.43
Fallen / leaning trees / fence posts / etc.	yes	yes	no	no	yes
Occurrence of large organic debris	no	no	no	no	yes
Exposed tree roots	yes	yes	yes	yes	yes
Basal scour on inside meander bends	no	no	no	no	yes
Toe erosion on both sides of channel through riffle	no	no	no	no	no
Steep bank angles through most of reach	no	no	no	no	no
Length of basal scour >50% through subject reach	no	no	no	no	no
Fracture lines along top of bank	yes	yes	no	no	yes
(WI) Sum of "NO"	5.00	5.00	7.00	7.00	3.00
(WI) Sum of "YES"	3.00	3.00	1.00	1.00	5.00
(WI) Factor Value	0.38	0.38	0.13	0.13	0.63
Formation of chute(s)	no	no	no	no	yes
Single thread channel to multiple channel	yes	yes	yes	yes	yes
Evolution of pool-riffle form to low bed relief form	no	no	no	no	no
Cut-off channel(s)	no	no	no	no	no
Formation of island(s)	yes	no	yes	yes	yes
Thalweg alignment out of phase meander form	no	no	no	no	no
Bar forms poorly formed / reworked / removed	no	no	yes	yes	yes
(PI) Sum of "NO"	5.00	6.00	4.00	4.00	3.00
(PI) Sum of "YES"	2.00	1.00	3.00	3.00	4.00
(PI) Factor Value	0.29	0.14	0.43	0.43	0.57
Stability Index	0.26	0.38	0.33	0.33	0.55
Condition	Transitional or Stressed	Transitional or Stressed	Transitional or Stressed	Transitional or Stressed	In Adjustment

Site ID	reach 11	reach 12	reach 13	reach 14	reach 15
Location	Reach 11 (between GPS pt.131-11)	Reach 12 (between GPS pt.11-12)	Reach 13 (between GPS pt.12-171)	Reach 14 (between GPS pt.171-181)	Reach 15 (between GPS pt.181-13)
Weather	Sunny 12 degrees C	Sunny 12 degrees C	Sunny 12 degrees C	Sunny 13 degrees C	Sunny 15 degrees C
Date Assessed	6/6/2017	6/6/2017	6/6/2017	6/6/2017	6/6/2017
Stream Name	NE Margaree River	NE Margaree River	NE Margaree River	NE Margaree River	NE Margaree River
Crew	AY NT	AY NT	AY NT	AY NT	AY NT
Recorder	AY	AY	AY	AY	AY
Channel Stability (0-11)	6.00	6.00	5.00	6.00	6.00
Scour/ Deposition (0-8)	6.00	5.00	4.00	6.00	6.00
Instream Habitat (0-8)	4.00	4.00	4.00	6.00	4.00
Water Quality (0-8)	6.00	6.00	6.00	6.00	6.00
Riparian Condition (0-7)	5.00	5.00	4.00	5.00	5.00
Biological Indicators (0-8)	6.00	6.00	6.00	6.00	6.00
Total	33.00	32.00	29.00	35.00	33.00
Stability Ranking	Moderate	Moderate	Moderate	Moderate	Moderate
Bankful Width (m)	45.00	>100	>100 (split into 3)	38 (bridge at end is 40)	43.00
Wetted Width (m)	45.00	40.00	50 (35 for main channel)	38.00	30.00
Bank Height (m)	3	3-15	1-3	1-5	4
Pool - Riffle Spacing (m)	>500	>500	>500	>500	>500
Bankful Depth (m)	3-5	3-5	2-4	2-5	1.5-3
Wetted Depth (m)	1-4	1-4	1-3	1-4	1-2
Entrenchment (m)	0->100	0->100	0->100	0->100	>100
Bank Angle (Degrees) LEFT	30-90	30-90	30-90	30-90	30-90
Bank Angle (Degrees) RIGHT	30-90	30-90	30-90	30-90	30-90
Pool % Sand, Silt, or Clay	10.00	10.00	20.00	20.00	30.00
Pool % Gravel	20.00	15.00	30.00	30.00	30.00
Pool % Cobble	50.00	30.00	40.00	40.00	40.00
Pool % Boulder	10.00	5.00	0.00	0.00	0.00
Pool % Bedrock	10.00	40.00	10.00	10.00	0.00

Site ID	reach 11	reach 12	reach 13	reach 14	reach 15
Riffle % Sand, Silt, or Clay	10.00	10.00	10.00	10.00	20.00
Riffle % Gravel	20.00	20.00	30.00	30.00	40.00
Riffle % Cobble	60.00	50.00	50.00	50.00	40.00
Riffle % Boulder	NA	NA	NA	NA	NA
Riffle % Bedrock	10.00	20.00	10.00	10.00	NA
Sinuosity	sinuous	sinuous	sinuous	sinuous	sinuous
Gradient	1-2	2	1-2	2	1
Dominant Bank Material	sand, loam, bedrock	sand, loam, bedrock	sand, loam, bedrock	sand, loam, bedrock	sandy loam
Channel Hardening	yes	no	no	yes @ bridge	no
Bend Radius (m)	see maps	see maps	see maps	see maps	see maps
Woody Debris	major	minor	major	minor	minor
Dominant Vegetation	mixed forest	mixed forest	mixed forest	mixed forest	mixed forest
% Channel Area Disturbed	10.00	5.00	0.00	10.00	10.00
Other Comments	Photos 816-848. water temp is 11.9 degrees C. Only one pool in entire reach. GPS shows 2 channels @ end but no evidence of splitting (just one main channel). Similar substrate as previous reach. Relatively straight section. Man-made restoration structures in place (weir and tree revetments). Reach ends @ high eroding bank adjacent to road. Bedrock influence at end with nice pool. Channel eroding over top of riprap @ end.	Photos 849-890. water temp is 12.7 degrees C. relatively straight stretch for 800m. Largely bedrock controlled. Channel widens in middle section of reach. Substrate similar to previous reach. Crib-log weirs installed @ end just u/s of hatchery.	Photos 890-921. water temp is 12.8 degrees C. Hatchery to WSC station. Good confluence pool where ingram brook comes in. Leonard mentioned Ingram Brook as a cold water system. Very active downstream of brook confluence. Channel splits 3 ways (main channel is far right looking downstream). Major deposition and wood debris.	Photos 921-929. relatively stable section between wsc station and crowdis bridge. Major bedrock control. And high eroding bank and rock wall.	Photos 929-962. water temp is 13 degrees C. conductivity spike from avg 80-90us in upper reaches to 200us at this location (gps pt 13). No good pools in this reach. Straight section between crowdis bridge and rivertrail cottages. Section of rapids at start of reach. wide and shallow. bank erosion throughout. tree revetments installed. deposition opposite rivertrail property pushing river into property.
Lobate Bar	no	no	yes	no	no
Coarse materials in riffles embedded	no	no	yes	no	no
Siltation in pools	no	no	no	no	no
Mid-channel bars	yes	no	yes	no	no
Deposition on point bars	yes	yes	yes	yes	yes
Poor longitudinal sorting of bed materials	no	no	no	no	no
Soft, unconsolidated bed	yes	yes	yes	yes	yes
Evidence of deposition in/around structures	no	yes	no	no	no
Deposition in the overbank zone	yes	yes	yes	yes	yes
(AI) Sum of "NO"	5.00	5.00	3.00	6.00	6.00
(AI) Sum of "YES"	4.00	4.00	6.00	3.00	3.00
(AI) Factor Value	0.44	0.44	0.67	0.33	0.33

Site ID	reach 11	reach 12	reach 13	reach 14	reach 15
Channel worn into undisturbed overburden / bedrock	yes	yes	yes	yes	no
Elevated tree roots/root fans above channel bed	yes	yes	yes	yes	yes
Bank height increases	no	no	no	no	no
Absence of depositional features (no bars)	no	no	no	no	no
Cut face on bar forms	yes	yes	yes	no	yes
Head cutting due to knick point migration	no	no	no	no	no
Suspended armour layer visible in bank	no	no	no	no	yes
(DI) Sum of "NO"	4.00	4.00	4.00	5.00	4.00
(DI) Sum of "YES"	3.00	3.00	3.00	2.00	3.00
(DI) Factor Value	0.43	0.43	0.43	0.29	0.43
Fallen / leaning trees / fence posts / etc.	yes	yes	yes	yes	yes
Occurrence of large organic debris	no	yes	yes	no	yes
Exposed tree roots	yes	yes	yes	yes	yes
Basal scour on inside meander bends	no	no	no	yes	yes
Toe erosion on both sides of channel through riffle	yes	no	no	no	no
Steep bank angles through most of reach	no	no	no	no	no
Length of basal scour >50% through subject reach	no	no	no	no	no
Fracture lines along top of bank	yes	yes	yes	yes	yes
(WI) Sum of "NO"	4.00	4.00	4.00	4.00	3.00
(WI) Sum of "YES"	4.00	4.00	4.00	4.00	5.00
(WI) Factor Value	0.50	0.50	0.50	0.50	0.63
Formation of chute(s)	no	no	yes	no	no
Single thread channel to multiple channel	yes	no	yes	no	no
Evolution of pool-riffle form to low bed relief form	no	no	no	no	no
Cut-off channel(s)	no	no	yes	no	no
Formation of island(s)	no	no	yes	no	no
Thalweg alignment out of phase meander form	no	no	no	no	no
Bar forms poorly formed / reworked / removed	yes	yes	yes	yes	yes
(PI) Sum of "NO"	5.00	6.00	2.00	6.00	6.00
(PI) Sum of "YES"	2.00	1.00	5.00	1.00	1.00
(PI) Factor Value	0.29	0.14	0.71	0.14	0.14
Stability Index	0.41	0.38	0.58	0.32	0.38
Condition	In Adjustment	Transitional or Stressed	In Adjustment	Transitional or Stressed	Transitional or Stressed

Site ID	reach 16	reach 17	reach 18	reach 19	reach 20	reach 21	reach 22
Location	Reach 16 (between GPS pt.13-211)	Reach 17 (between GPS pt.211-Cranton Bridge)	Reach 18 (between GPS pt.231 (Cranton Bridge) and 14)	Reach 19 (between GPS pt. 14 and 281)	Reach 20 (between GPS pt. 281-15)	Reach 21 (between GPS pt. 15-16)	Reach 22 (between GPS pt. 16-311)
Weather	Sunny 20 degrees C	Sunny 20 degrees C	Sunny 20 degrees C	Sunny 20 degrees C	Sunny 20 degrees C	Sunny 20 degrees C	Sunny 20 degrees C
Date Assessed	6/6/2017	6/6/2017	6/7/2017	6/7/2017	6/7/2017	6/7/2017	6/7/2017
Stream Name	NE Margaree River	NE Margaree River	NE Margaree River	NE Margaree River	NE Margaree River	NE Margaree River	NE Margaree River
Crew	AY NT	AY NT	AY NT	AY NT	AY NT	AY NT	AY NT
Recorder	AY	AY	AY	AY	AY	AY	AY
Channel Stability (0-11)	6.00	5.00	4.00	4.00	4.00	4.00	4.00
Scour/ Deposition (0-8)	5.00	4.00	4.00	4.00	4.00	4.00	4.00
Instream Habitat (0-8)	5.00	4.00	4.00	4.00	5.00	5.00	5.00
Water Quality (0-8)	6.00	5.00	5.00	5.00	5.00	5.00	5.00
Riparian Condition (0-7)	5.00	5.00	4.00	4.00	4.00	4.00	4.00
Biological Indicators (0-8)	6.00	6.00	5.00	5.00	5.00	5.00	5.00
Total	33.00	29.00	26.00	26.00	27.00	27.00	27.00
Stability Ranking	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Bankful Width (m)	40.00	>100	80.00	60.00	40.00	40.00	70.00
Wetted Width (m)	40.00	40.00	30.00	25.00	35.00	35.00	30.00
Bank Height (m)	3	3-5	4	4	4	4	4
Pool - Riffle Spacing (m)	>500	approx 1 km	>500	>500	100.00	100.00	100.00
Bankful Depth (m)	2-5	1-4	2-4	2-5	2-6	2-6	2-6
Wetted Depth (m)	1-4	.5-3	1-3	1-4	1-4	1-4	1-5
Entrenchment (m)	>100	0->100	>100	0->100	0->100	0->100	0->100
Bank Angle (Degrees) LEFT	30-90	30-90	30-90	30-90	30-90	30-90	30-90
Bank Angle (Degrees) RIGHT	30-90	30-90	30-90	30-90	30-90	30-90	30-90
Pool % Sand, Silt, or Clay	30.00	30.00	30.00	30.00	30.00	20.00	30.00
Pool % Gravel	30.00	30.00	30.00	30.00	30.00	30.00	30.00
Pool % Cobble	40.00	40.00	40.00	40.00	40.00	40.00	40.00
Pool % Boulder	0.00	0.00	0.00	0.00	0.00	NA	NA
Pool % Bedrock	0.00	0.00	0.00	0.00	0.00	10.00	NA

Site ID	reach 16	reach 17	reach 18	reach 19	reach 20	reach 21	reach 22
Riffle % Sand, Silt, or Clay	20.00	20.00	20.00	20.00	20.00	10.00	20.00
Riffle % Gravel	40.00	30.00	30.00	30.00	30.00	30.00	30.00
Riffle % Cobble	40.00	50.00	50.00	50.00	50.00	50.00	50.00
Riffle % Boulder	NA	NA	NA	NA	NA	NA	NA
Riffle % Bedrock	NA	NA	NA	NA	NA	10.00	NA
Sinuosity	sinuous	sinuous	sinuous	sinuous	sinuous	sinuous	sinuous
Gradient	1-2	1-2	2	2	2	2	2
Dominant Bank Material	sandy loam	sand	sand, loam	sand, loam	sand, loam	sand, loam	sand, loam
Channel Hardening	yes	yes	yes	yes	yes	no	no
Bend Radius (m)	see maps	see maps	see maps	see maps	see maps	see maps	see maps
Woody Debris	major	major	major	major	major	major	major
Dominant Vegetation	mixed forest	mixed forest	mixed forest	mixed forest	mixed forest	mixed forest	mixed forest
% Channel Area Disturbed	0.00	10.00	10.00	10.00	10.00	0.00	0.00
Other Comments	Photos 962-997 (Nile Brook 998-1016). Rivertrail cottages to Nile Brook confluence. Sinous, shallow, large point bars. Fallen trees on eroded outer bend. Good confluence pool @ Nile Brook. Mouth of Nile Brook is very aggraded, active.	Photos 1016-1068. Hardly any pools. Long bends and large point bars. Section is mostly rapids.	Photos 1069-1133. very wide turns, section from cranton bridge to rock wall. huge gravel bars, not very good pool habitat. Very active channel	Photos 1133-1156. similar to previous section. Largely bedrock controlled. few deep pools. rip rapped bank with still water behind it. active channel	Photos 1156-1186. deep pools, good habitat. Channel very active. Riprap throughout section. High gravel bars.	Photos 1186-1192. straight section upstream of big brook. good pools, large pool along rock wall.	Photos 1192-1197. very active channel at confluence with big brook. channel comes in close to road (rock wall). channel is wide coming in then constricts at wall. lots of depositions. Very shallow just upstream of wall.
Lobate Bar	no	no	no	no	no	no	yes
Coarse materials in riffles embedded	no	no	yes	yes	yes	yes	yes
Siltation in pools	no	no	no	no	no	no	no
Mid-channel bars	no	yes	yes	yes	no	no	yes
Deposition on point bars	yes	yes	yes	yes	yes	no	yes
Poor longitudinal sorting of bed materials	no	no	yes	yes	yes	yes	yes
Soft, unconsolidated bed	yes	yes	yes	yes	yes	yes	yes
Evidence of deposition in/around structures	no	no	no	no	no	no	no
Deposition in the overbank zone	yes	yes	yes	yes	yes	yes	yes
(AI) Sum of "NO"	6.00	5.00	3.00	3.00	4.00	5.00	2.00
(AI) Sum of "YES"	3.00	4.00	6.00	6.00	5.00	4.00	7.00
(AI) Factor Value	0.33	0.44	0.67	0.67	0.56	0.44	0.78

Site ID	reach 16	reach 17	reach 18	reach 19	reach 20	reach 21	reach 22
Channel worn into undisturbed overburden / bedrock	no	no	no	yes	no	no	no
Elevated tree roots/root fans above channel bed	yes	yes	yes	yes	yes	yes	yes
Bank height increases	no	no	no	no	no	no	no
Absence of depositional features (no bars)	no	no	no	no	no	no	no
Cut face on bar forms	yes	yes	yes	yes	yes	no	yes
Head cutting due to knick point migration	no	yes	no	no	no	no	no
Suspended armour layer visible in bank	yes	yes	no	no	no	no	no
(DI) Sum of "NO"	4.00	3.00	5.00	4.00	5.00	6.00	5.00
(DI) Sum of "YES"	3.00	4.00	2.00	3.00	2.00	1.00	2.00
(DI) Factor Value	0.43	0.57	0.29	0.43	0.29	0.14	0.29
Fallen / leaning trees / fence posts / etc.	yes	yes	yes	yes	yes	yes	yes
Occurrence of large organic debris	yes	yes	yes	yes	yes	yes	yes
Exposed tree roots	yes	yes	yes	yes	yes	yes	yes
Basal scour on inside meander bends	yes	yes	yes	yes	yes	no	yes
Toe erosion on both sides of channel through riffle	no	no	no	no	no	no	no
Steep bank angles through most of reach	no	no	no	no	no	no	no
Length of basal scour >50% through subject reach	no	no	no	no	no	no	no
Fracture lines along top of bank	yes	yes	yes	yes	yes	yes	yes
(WI) Sum of "NO"	3.00	3.00	3.00	3.00	3.00	4.00	3.00
(WI) Sum of "YES"	5.00	5.00	5.00	5.00	5.00	4.00	5.00
(WI) Factor Value	0.63	0.63	0.63	0.63	0.63	0.50	0.63
Formation of chute(s)	no	no	no	no	no	no	yes
Single thread channel to multiple channel	no	yes	yes	yes	no	no	yes
Evolution of pool-riffle form to low bed relief form	no	no	no	no	no	no	no
Cut-off channel(s)	no	no	no	no	no	no	no
Formation of island(s)	no	no	no	no	no	no	no
Thalweg alignment out of phase meander form	no	no	no	no	no	no	no
Bar forms poorly formed / reworked / removed	yes	yes	yes	yes	yes	yes	yes
(PI) Sum of "NO"	6.00	5.00	5.00	5.00	6.00	6.00	4.00
(PI) Sum of "YES"	1.00	2.00	2.00	2.00	1.00	1.00	3.00
(PI) Factor Value	0.14	0.29	0.29	0.29	0.14	0.14	0.43
Stability Index	0.38	0.48	0.47	0.50	0.40	0.31	0.53
Condition	Transitional or Stressed	In Adjustment	In Adjustment	In Adjustment	Transitional or Stressed	Transitional or Stressed	In Adjustment

Site ID	reach 23	reach 24	reach 25	reach 26	reach 27	reach 28
Location	Reach 23 (between GPS pt. 311-321)	Reach 24 (between GPS pt. 321-341)	Reach 25 (between GPS pt. 341-17)	Reach 26 (between GPS pt.17-381) Doyle's Bridge to SW Margaree confluence	Reach 27 (between GPS pt.381-18) SW Margaree confluence to island	Reach 28 (between GPS pt.18 to "out")
Weather	Sunny 20 degrees C	Sunny 20 degrees C	Sunny 20 degrees C	Sunny 20 degrees C	Sunny 20 degrees C	Sunny 20 degrees C
Date Assessed	6/7/2017	6/7/2017	6/7/2017	6/8/2017	6/8/2017	6/8/2017
Stream Name	NE Margaree River	NE Margaree River	NE Margaree River	NE Margaree River	Margaree River	Margaree River
Crew	AY NT	AY NT	AY NT	AY NT	AY NT	AY NT
Recorder	AY	AY	AY	AY	AY	AY
Channel Stability (0-11)	4.00	6.00	6.00	6.00	6.00	5.00
Scour/ Deposition (0-8)	4.00	5.00	5.00	5.00	6.00	4.00
Instream Habitat (0-8)	5.00	5.00	5.00	5.00	6.00	5.00
Water Quality (0-8)	5.00	5.00	5.00	6.00	5.00	5.00
Riparian Condition (0-7)	4.00	4.00	4.00	5.00	4.00	5.00
Biological Indicators (0-8)	5.00	5.00	5.00	6.00	6.00	6.00
Total	27.00	30.00	30.00	33.00	33.00	30.00
Stability Ranking	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Bankful Width (m)	50.00	60.00	60.00	50.00	60.00	60.00
Wetted Width (m)	45.00	45.00	45.00	50.00	60.00	60.00
Bank Height (m)	4	4	4	3->5	3-6	2-6
Pool - Riffle Spacing (m)	100.00	100.00	>500	>500	>500	>500
Bankful Depth (m)	2-5	2-5	2-5	2-5	3-5	2-6
Wetted Depth (m)	1-4	1-4	1-4	1-4	1-4	.5-3
Entrenchment (m)	0->100	0->100	0->100	0->100	0->100	>100
Bank Angle (Degrees) LEFT	30-90	30-90	30-90	30-90	30-90 (mostly steep)	30-90 (mostly steep)
Bank Angle (Degrees) RIGHT	30-90	30-90	30-90	30-90	30-90 (mostly steep)	30-90 (mostly steep)
Pool % Sand, Silt, or Clay	30.00	30.00	30.00	35.00	35.00	35.00
Pool % Gravel	30.00	30.00	30.00	30.00	30.00	30.00
Pool % Cobble	40.00	40.00	40.00	35.00	35.00	35.00
Pool % Boulder	NA	NA	NA	NA	NA	NA
Pool % Bedrock	NA	NA	NA	NA	NA	NA

Site ID	reach 23	reach 24	reach 25	reach 26	reach 27	reach 28
Riffle % Sand, Silt, or Clay	20.00	20.00	20.00	25.00	25.00	25.00
Riffle % Gravel	30.00	30.00	30.00	30.00	30.00	30.00
Riffle % Cobble	50.00	50.00	50.00	45.00	45.00	45.00
Riffle % Boulder	NA	NA	NA	NA	NA	NA
Riffle % Bedrock	NA	NA	NA	NA	NA	NA
Sinuosity	sinuous	sinuous	sinuous	sinuous	sinuous	sinuous
Gradient	2	2	2	1-2	1-2	1
Dominant Bank Material	sand, loam	sand, loam	sand, loam	sand, loam	sand, loam	sand, loam
Channel Hardening	no	no	no	yes (lots)	yes (riprap)	yes (riprap)
Bend Radius (m)	see maps	see maps	see maps	see maps	see maps	see maps
Woody Debris	major	major	major	major	major	major
Dominant Vegetation	mixed forest	mixed forest	mixed forest	mixed forest	mostly shrubs (lots of pasture land)	mixed forest, shrubs, open fields
% Channel Area Disturbed	0.00	0.00	0.00	40.00	10.00	10.00
Other Comments	Photos 1197-1213. eroding sections of bank, high gravel bars, good pool habitat. Lots of sand.	Photos 1213-1231. water temp 14 degrees C. groundwater inputs (spring) on rb. Erosion on lb at end. channel is wide and shallow. Conductivity spiked from 200 to 300us	Photos 1231-1248. water temp 15 degrees C. straight section to just u/s of Doyle's Bridge. Good fldpl access. Shallow. No pools, wide channel.	Photos 1248-1287. water temp 12 degrees C. Torvane = 1. Straight, wide, shallow, lots of rip rapped banks.	Photos 1287-1313. water temp 13 degrees C. Torvane = 1.5. Straight, wide, shallow, lots of bank erosion. Channel is turbid (coming from SW?), conductivity hasn't spiked (still around 200), not estuary yet. Lots of Gaspereau running (hundreds).	Photos 1313-1355. water temp 13 degrees C. Conductivity still 300us. Channel splits, multiple threads. Lots of bank erosion. Channel is still turbid.
Lobate Bar	yes	no	no	no	no	no
Coarse materials in riffles embedded	no	yes	yes	yes	yes	yes
Siltation in pools	yes	no	no	no	yes	yes
Mid-channel bars	yes	no	no	yes	no	yes
Deposition on point bars	yes	no	no	yes	yes	yes
Poor longitudinal sorting of bed materials	no	yes	no	no	no	no
Soft, unconsolidated bed	no	yes	yes	yes	yes	yes
Evidence of deposition in/around structures	yes	no	no	no	no	no
Deposition in the overbank zone	no	no	no	yes	yes	yes
(AI) Sum of "NO"	4.00	6.00	7.00	4.00	4.00	3.00
(AI) Sum of "YES"	5.00	3.00	2.00	5.00	5.00	6.00
(AI) Factor Value	0.56	0.33	0.22	0.56	0.56	0.67

Site ID	reach 23	reach 24	reach 25	reach 26	reach 27	reach 28
Channel worn into undisturbed overburden / bedrock	yes	no	no	yes	no	no
Elevated tree roots/root fans above channel bed	yes	yes	yes	yes	yes	yes
Bank height increases	no	no	no	no	no	no
Absence of depositional features (no bars)	no	no	no	no	no	no
Cut face on bar forms	no	no	no	no	no	no
Head cutting due to knick point migration	no	no	no	no	no	no
Suspended armour layer visible in bank	no	no	no	no	no	yes
(DI) Sum of "NO"	5.00	6.00	6.00	5.00	6.00	5.00
(DI) Sum of "YES"	2.00	1.00	1.00	2.00	1.00	2.00
(DI) Factor Value	0.29	0.14	0.14	0.29	0.14	0.29
Fallen / leaning trees / fence posts / etc.	yes	yes	yes	yes	yes	yes
Occurrence of large organic debris	yes	yes	yes	yes	yes	yes
Exposed tree roots	yes	yes	yes	yes	yes	yes
Basal scour on inside meander bends	yes	yes	no	no	no	no
Toe erosion on both sides of channel through riffle	no	no	no	no	no	no
Steep bank angles through most of reach	no	no	yes	no	no	yes
Length of basal scour >50% through subject reach	no	no	no	no	no	no
Fracture lines along top of bank	yes	yes	yes	yes	yes	yes
(WI) Sum of "NO"	3.00	3.00	3.00	4.00	4.00	3.00
(WI) Sum of "YES"	5.00	5.00	5.00	4.00	4.00	5.00
(WI) Factor Value	0.63	0.63	0.63	0.50	0.50	0.63
Formation of chute(s)	no	no	no	no	no	no
Single thread channel to multiple channel	no	no	no	yes	no	yes
Evolution of pool-riffle form to low bed relief form	no	no	no	no	no	no
Cut-off channel(s)	no	no	no	no	no	no
Formation of island(s)	no	no	no	no	no	yes
Thalweg alignment out of phase meander form	no	no	no	no	no	no
Bar forms poorly formed / reworked / removed	yes	yes	yes	yes	yes	yes
(PI) Sum of "NO"	6.00	6.00	6.00	5.00	6.00	4.00
(PI) Sum of "YES"	1.00	1.00	1.00	2.00	1.00	3.00
(PI) Factor Value	0.14	0.14	0.14	0.29	0.14	0.43
Stability Index	0.40	0.31	0.28	0.41	0.34	0.50
Condition	Transitional or Stressed	Transitional or Stressed	Transitional or Stressed	In Adjustment	Transitional or Stressed	In Adjustment

APPENDIX D

POOL AND EROSION COORDINATES

Name	POINT_X	POINT_Y
POOL	-60.9216	46.44407
POOL	-60.9286	46.4389
POOL	-60.9216	46.45427
POOL	-60.9409	46.43259
POOL	-61.0792	46.36184
POOL	-60.974	46.38876
POOL	-61.0211	46.33099
POOL	-60.9618	46.41319
POOL	-60.9786	46.37844
POOL	-61.0216	46.32526
POOL	-60.9637	46.40389
POOL	-60.977	46.37831
POOL	-61.0304	46.3211
POOL	-60.965	46.40271
POOL	-60.9695	46.37463
POOL	-61.0317	46.32141
POOL	-60.9706	46.37267
POOL	-61.033	46.32278
POOL	-60.9769	46.3634
POOL	-61.049	46.32602
POOL	-60.9813	46.34991
POOL	-61.0767	46.32818
POOL	-60.9654	46.39925
POOL	-61.0186	46.33445
POOL	-61.0924	46.33718
EROSION	-60.9646	46.40773
EROSION	-60.9672	46.39893
EROSION	-60.9881	46.35049
EROSION	-60.9792	46.38834
EROSION	-60.9734	46.3722
EROSION	-60.9816	46.34869
EROSION	-61.0018	46.3405
EROSION	-61.0397	46.31995
EROSION	-61.0819	46.36302























