APPENDIX 5

Draft Fish Habitat Compensation Plan (HADD)

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1.0 INTRODUCTION

Keltic Petrochemicals Inc. (Keltic) is proposing to construct and operate a Petrochemical and Liquefied Natural Gas (LNG) Facility in Goldboro, Nova Scotia. The primary facilities proposed include an LNG regasification facility, a petrochemical complex, a marginal wharf, a marine LNG Terminal, LNG storage, and an electric co-generation facility. Of particular interest in terms of this compensation plan is the construction of the marginal wharf and LNG marine terminal.

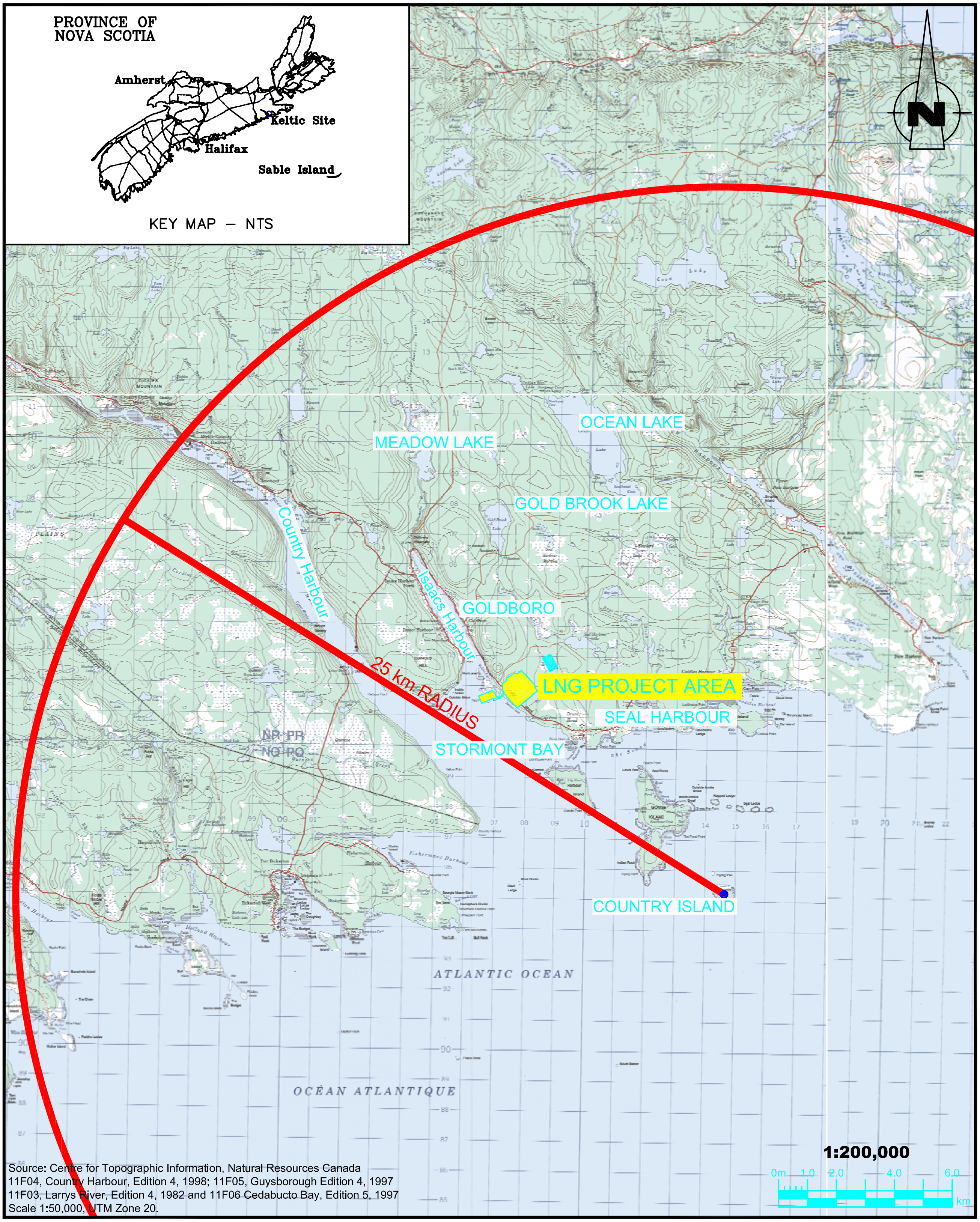
The marginal wharf area is required for receipt and shipment of products and by-products in support of the petrochemical plant and for receiving supplies and equipment during construction of the entire complex.

The wharf will extend off Red Head into Stormont Bay (Figure 1). Although adverse environmental effects have been addressed in the Comprehensive Study Report (CSR), the destruction of fish habitat is inevitable during the construction of the marginal wharf.

A two berth piled marine terminal will be connected to the marginal wharf facility by a piled jetty. This marine terminal will be used to receive and transfer product via LNG transfer lines along the jetty and marginal wharf facility to the LNG tanks where it is stored.

The Canadian Fisheries Act (Sections 35(1) and 35(2)) prohibits any work or undertaking that causes harmful alteration, disruption or destruction (HADD) of fish habitat unless authorized. Canada's "no net loss" policy requires, when authorization has been given, that the lost habitat is compensated for by creating new or increasing the productive capacity of existing habitat.

Keltic is proposing a habitat compensation plan (HCP) that both creates new habitat and enhances the productivity of existing locations. The plan also incorporates compensation in three different environments; marine, estuarine and freshwater.



LEGEND

LNG Project Area

FIGURE No. 1

KELTIC PETROCHEMICALS INC.

PROJECT LOCATION AND REGIONAL SETTING

JUNE 2007

2.0 EXISTING ENVIRONMENT

2.1 PHYSICAL ENVIRONMENT

Stormont Bay and the surrounding areas offer a diversity of marine habitats that include freshwater, estuarial, nearshore, and deepwater environments.

Habitat types in the area have been mapped by several groups in the last 12 years, including:

- The Guysborough County Coastal Resources Mapping Project;
- Sable Offshore Energy Project;
- Encana's Deep Panuke Project;
- Canadian Seabed Research;
- Keltic; and
- Nova Scotia Department of Natural Resources and the Geological Survey of Canada.

These exercises have found that the near-shore marine habitat at Red Head, the site of the proposed marginal wharf, has a substrate of boulders, cobbles, and pebbles, with finer materials such as sand and gravel prevalent in more protected bays. A narrow band of coarser sediment with relatively sparse macro algae cover stretches from the shoreline seaward for approximately 50 m. Marine plants such as kelp are associated with rockier areas, while eelgrass beds occur on sandy substrates (Figure 2). These habitat variations are similar to what predominates in nearshore coastal areas elsewhere in Stormont Bay.

The total area of the marginal wharf is approximately 20.3 hectares (ha), calculated from the high water mark. The rock mattress that will support the concrete caissons will extend beyond the area of the wharf encompassing an additional .7 ha for a total habitat loss of 21.0 ha. The type of habitat that will be lost can be divided into three distinct types; rock and kelp, sand and silt, and eelgrass and sand. The most predominant habitat type in the footprint of the marginal wharf is rock and kelp, comprising approximately 55% (11.6 ha) of the total area. The remainder of the footprint is comprised of sand and silt and eelgrass and sand at 33% (7.0 ha) and 12% (2.5 ha) respectively (Figure 2).

2.2 BIOLOGICAL ENVIRONMENT

The marine vegetation of Stormont Bay and the Red Head area specifically is typical of the rocky intertidal zone of Nova Scotia's Atlantic shore. The intertidal zone is dominated by fucoids, namely rockweed (*Ascophyllum nodosum*) and bladder wrack (*Fucus* sp.). Seaweed growth is sparse in the area of the marginal wharf, mainly growing in the lower intertidal and subtidal areas. As discussed above, rock and kelp comprise the majority of the habitat in the footprint of the marginal wharf. Kelp and other subtidal seaweeds are generally abundant in all nearshore areas of Stormont Bay.

Several species of fish have been identified as occurring in the vicinity of the marginal wharf footprint in the CSR. The habitat being lost does not represent any limited or critical habitat for marine fish species in the area. This plan proposes the creation or enhancement of a variety of habitats, all which will benefit several fish species.

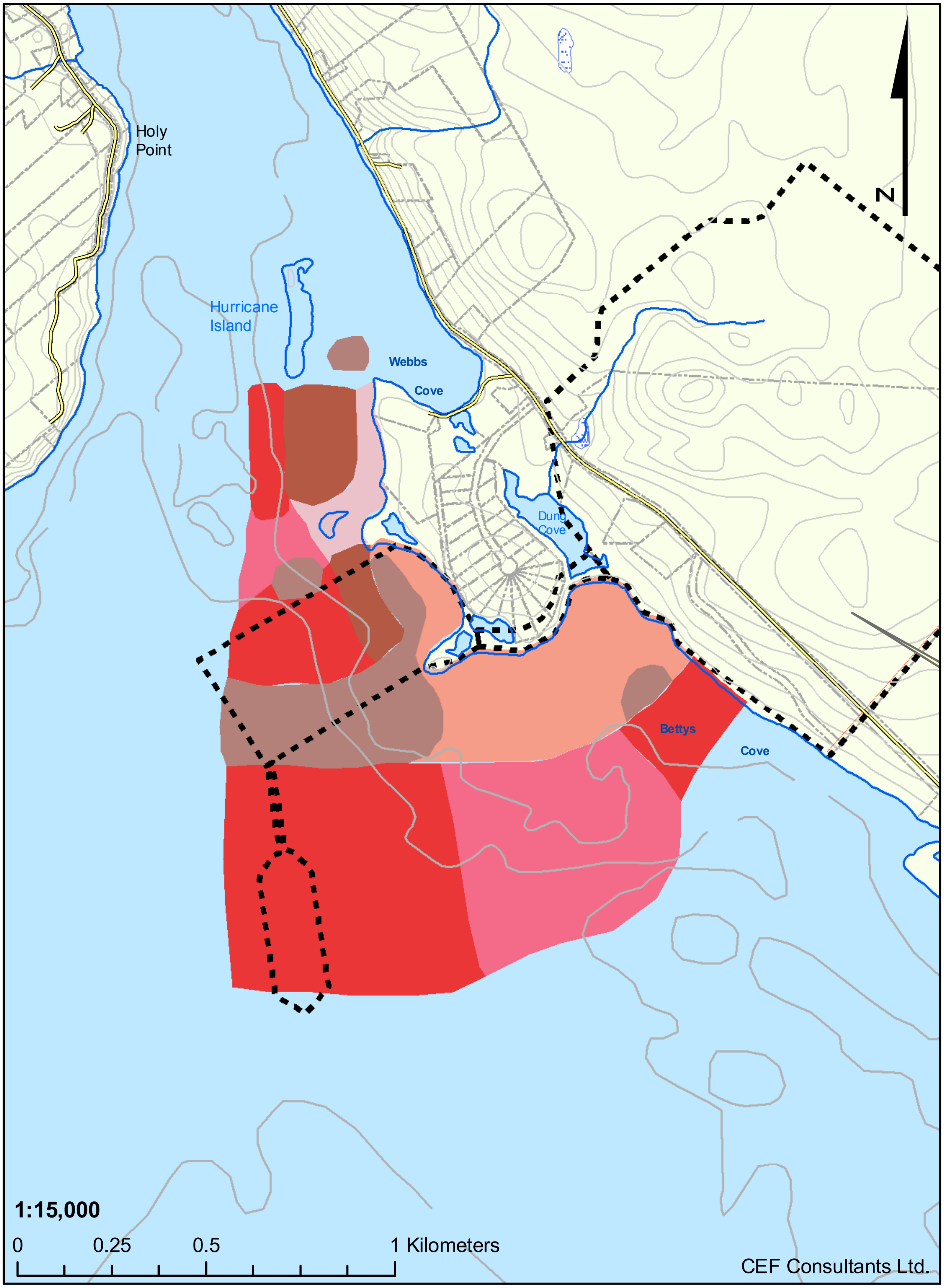


FIGURE No. 2

KELTIC PETROCHEMICALS INC.

FISH HABITAT IN THE VICINITY OF KELTIC FACILITIES

June 2007

Legend

- CSR Project Area
- Approximate Rock and Kelp Area
- Approximate Sand and Silt Area
- Inferred Sand and Silt Area
- Approximate Eelgrass and Sand Area
- Inferred Eelgrass and Sand Area
- Inferred Rock and Kelp Area

The footprint of the marginal wharf encompasses habitat that is desired by invertebrates, namely lobster, rock crabs, and sea urchins. Lobster and rock crab adults often seek out areas with cover, either rocky habitats with algal growth or eelgrass beds. Post larval and juvenile lobsters prefer rocky habitats with tunnels and crevices for protection from predation. Sea urchins feed on algae so they seek out areas with rocky bottoms that can sustain the growth of marine vegetation.

3.0 PROPOSED HABITAT COMPENSATION PLAN (HCP)

The proposed HCP addresses both the creation of and enhancements to habitat in different ecosystems that will address a variety of habitats and species.

3.1 MARINE

DFO has a preference for habitat compensation to be of a similar type and in the same general area as that lost. Construction of additional habitat within the bay is not practical because of the large area required and the presence of already suitable habitat in all nearshore areas. A search was undertaken to find a suitable area consisting of predominantly sand near the outer entrance to the bay.

The largest habitat creation area is located in Fisherman's Harbour between two shoal areas which protrude at low tide. Depths range from 10 to 14 metres (m) within the area, and substrate is consistently silty-sand. The only fauna present currently are sand dollars.

The area does not serve as a navigation channel for the ports of Port Bickerton, Country Harbour, or Isaac's Harbour. Following habitat creation, water depths would be reduced by less than one metre.

Additional sandy bottom sites have been identified seaward of Dung Cove and in a sheltered area behind Harbour Island. Habitat structures may also be placed along the periphery of existing habitat in Stormont Bay (Figure 3).

The habitat creation methodology proposed is the construction of an artificial reef within the described area in Fisherman's Harbour. The design, described below, is based on successful laboratory (Miller et al, 2006) and field (G. Sharp, pers. comm.) trials that have been undertaken in Nova Scotia.

Miller et al (2006) conducted experiments that showed juvenile lobster preferred artificial habitats built on sandy bottoms with gravel sizes less than 3 cm. The type of rock that showed the most success was large flat rocks that allowed larger crevices under the rock. The experimental work has been scaled up to field trials in the Sambro, NS area (G. Sharp, pers. comm.). The reefs that have been constructed are now inhabited by juvenile crabs, juvenile urchins, and juvenile fish. Marine vegetation has started to establish on the rocks, creating additional habitat for juvenile and adult fish. To date, lobsters have not established themselves at the location but the researchers are confident they will (G. Sharp, pers. comm.).

To create a series of artificial reefs for juvenile lobsters (carapace length (CL) 50-79 millimetres), rock will be dumped in small piles by a crane fixed with a grab. Flat quarry rock measuring approximately 25 to 50 centimetres (cm) (with the greatest length more than four times the depth) will be dumped by a grab in a random pattern on the sea bottom.

FIGURE 3 Proposed Habitat Creation Area – Fisherman's Harbour

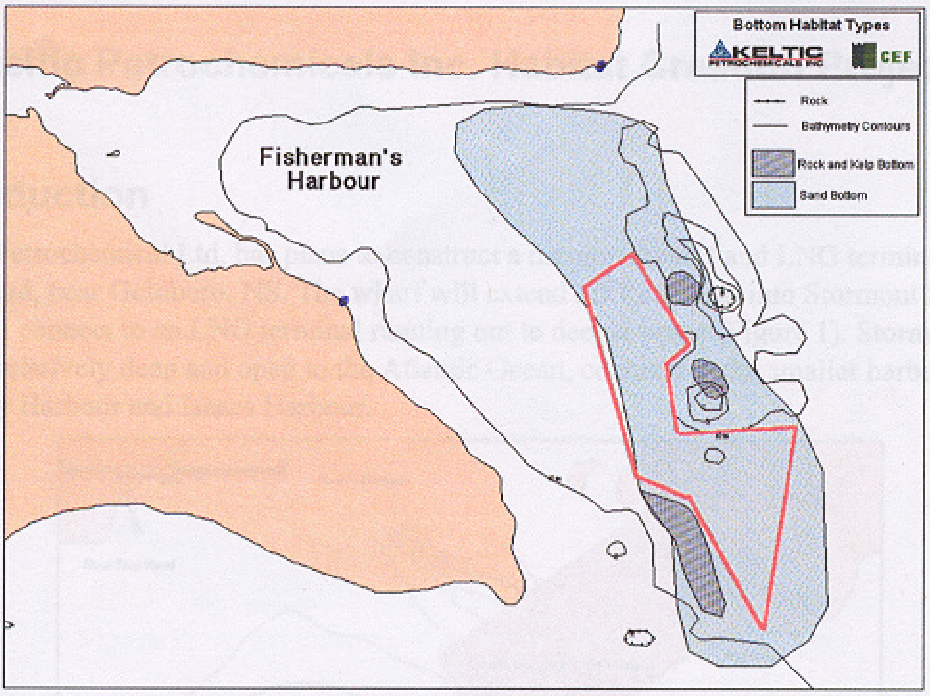
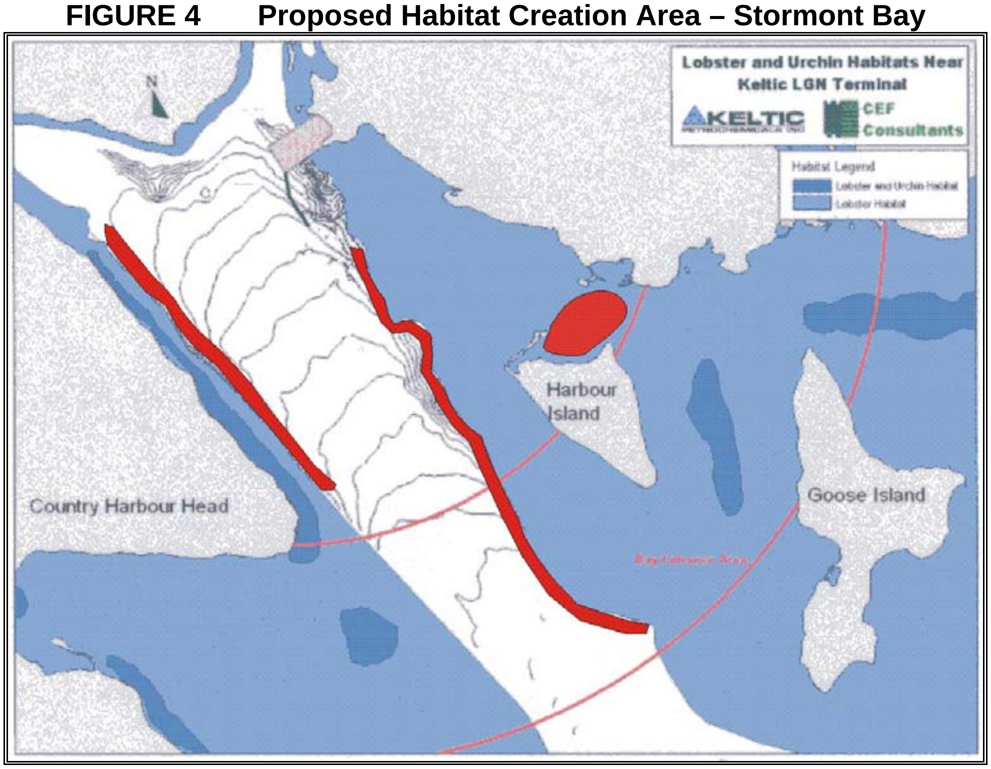


Figure 3: Area Proposed for Habitat Creation

FIGURE 4 Proposed Habitat Creation Area – Stormont Bay



The piles need to be only a few rocks in height as the laboratory trials showed that lobsters tend to dig into the substrate under the rocks and are not interspersed among the crevices (Miller et al, 2006).

The rock size used in the experiment is approximately 55% larger than what would be predicted based on a regression presented by Wahle (1992, in Miller et al, 2006). As such, rock sizes for larger adult lobster (average of 140 mm CL) would be roughly 75 cm long. Reefs of variable rock sizes will establish lobster habitat for several sizes and life stages. As noted above, it can be expected that these reefs will also be used by juvenile crabs, urchins, and fish. The depth in Fisherman's Harbour is excessive for many marine plants to establish but kelp are known to grow in deeper water and it can be hypothesized that some will establish here. Structures placed in shallower areas can be expected to provide habitat for a wider variety of marine plants.

As noted, successful colonization of artificial rock reefs has been seen and is a more cost effective methodology when compared with other methods such as reef balls (G. Sharp, pers. comm.).

Monitoring by remote operated vehicle (ROV) or divers should be completed prior to the placement of any rock structures in order to obtain baseline information. Following the installation of the artificial reefs monitoring should be undertaken at 3, 6, and 12 month periods for the first year and annually thereafter for 5 years. The monitoring should focus on the integrity of the structures, including possible sedimentation and the presence or absence of colonizing individuals.

The total area encompassed by these proposed sites would create additional habitat of approximately 200 ha throughout the Stormont Bay area.

3.2 ESTUARINE

Keltic is proposing to support the Mulgrave and Area Lakes Enhancement Association (MLEA) in their initiative to restore the inter-tidal river pools at St. Francis Harbour, Nova Scotia. The background information and project description are borrowed from the plan developed by Thaumus Environmental Consultants Ltd. on behalf of the MLEA.

To lure anchor industries to the Strait of Canso, in 1959 the province of Nova Scotia dammed the outflow from the three Goose Harbour lakes, creating an 865 ha water impoundment that would later supply the Stora Enso paper mill with fresh water for paper making.

It was recognized that this would reduce river flows and change the size and frequency of flood flows in the St. Francis Harbour River. These changes have altered the meander pattern, changing the location of pools and riffles, and over-widening the river in many reaches. The result has been an increase in the bed load movement of gravel. This gravel has been deposited at the head of tide and combined with the change in meander length has filled in the pools in the inter-tidal section of the river.

These projects will be the latest in a series of successful improvements made to the St. Francis Harbour River over the last number of years. These improvements have included

- Construction of a fish passage over the dam;
- Habitat improvements including constructing pools and riffles;
- Installation of in-stream habitat improvement structures to create deeper pools;
- Installation of a siphon over the dam to increase water flow through the main channel; and,
- Stabilization of the outer channel bank of the estuary.

The restoration of pools in the St. Francis River (Figure 5) is important for migrating fish as they change from salt to freshwater habitats. Work in the winter of 2007 restored the outlet chaneel through the barrier beach. The re-establishment of the outlet channel in the estuary has restored the full tidal range and brought the tide further up the river. This has exposed a greater length at low tide providing the opportunity to establish several in river pools and greatly increasing the fish holding capacity of the inter-tidal river pools.

The changes in the river resulted in the loss of the natural run of Alewife (*Alosa pseudoharengus*) lowering the quality of the food supply in the estuary for sea trout and migrating grilse and adult salmon. With fish passage at the dam and effective migration habitat in the barrier beach the only significant impediment to restoring the run is the staging pools in the estuary. Stocking of adult Alewife for a five year period would restore this run and the associated habitat food supply productivity. Alewife will also contribute to the bait fishery along this coast.

The compensation/ restoration project will restore the thalweg and pools in the inter-tidal section of the St. Francis Harbour, Guysborough County, Nova Scotia (Figure 6).

Work is proposed for the summer of 2007 when site access roads are dry and will handle the heavy trucks and equipment with a minimum of disruption. The site can be accessed by a private dirt road parallel to the river then walk down a trail adjacent to a nearby home.

The work involves the installation of deflectors and associated bank stabilization. The design width of the river at this location is 18 m with a meander length of approximately 108 m.

There is a bedrock outcrop at the upper end with a well-established right hand pool (looking downstream).

The first deflector structure will be placed on the right bank approximately 108 m below the head of the pool above. It will extend into the watercourse at bank height to a point 20 m from the opposite bank. This left bank will be rocked to bank height for approximately 40 m. This will give an 18 m finished stream width.

FIGURE 5 Section of Topographical Chart 11f/6 Showing the Project Location

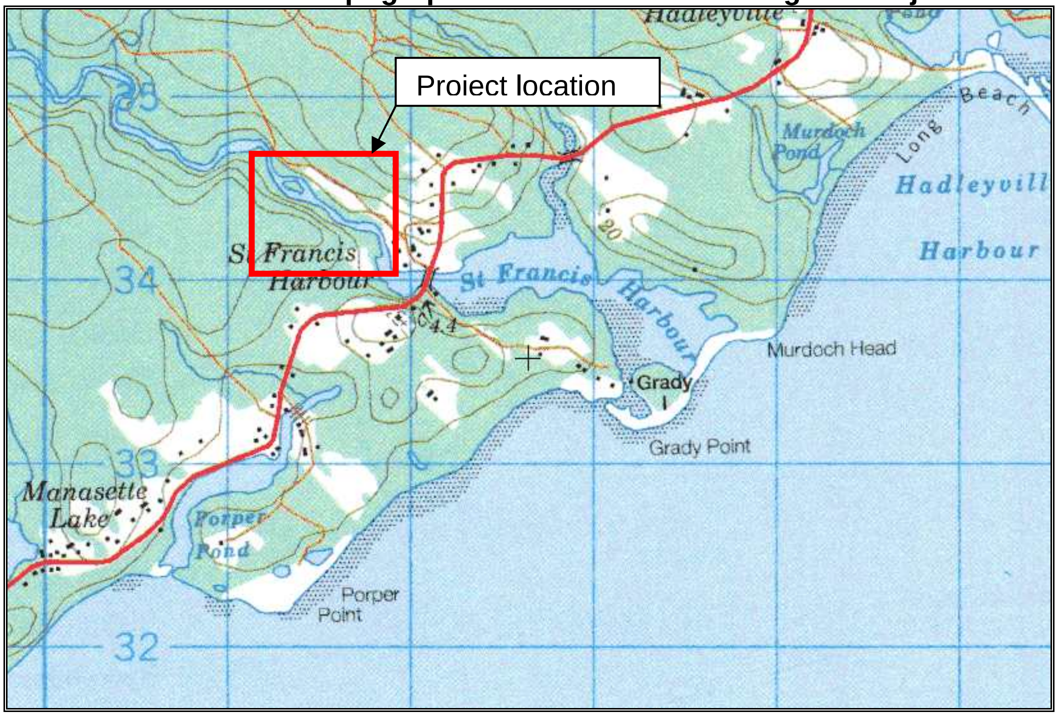


FIGURE 6 Aerial Photograph of St. Francis River Proposed Pool Sites

From air photo 9700-141-500 TN - Service Nova Scotia

The second deflector structure will be located on the left bank approximately 108 m downstream and extend into the watercourse at bank height to a point 18 m from the rock outcrop on the right bank. The left bank upstream of this site will be rocked as needed including the side channel that cuts off to the left.

The third deflector structure will be on the right bank approximately 108 m downstream and will extend into the river to a point 18 m from the opposite bank at a height equal to or greater than the one in two year bank full channel. The right bank will be rocked downstream of this structure to tie into a second deflector 18 m further downstream. These paired deflectors on the right bank will steer the channel across the existing over widened section toward the left pool below.

A fourth deflector will be on the left bank approxinmately 108 m downstream just below the small tributary. This deflector will direct the flow toward a centre pool.

This work will restore 4 pools and restore the thalweg to five sections of river. The excess gravel will be deposited by river and tidal flows on the point bar areas and will not move further into the estuary.

The improvement made by rocking the bank and installing deflectors for the development of migration pools and allowing the currents to deepen the channel will improve the overall productive capacity of the river. The Alewife restocking program will improve the productive capacity by improving the diversity of the estuary and improving the food supply for larger forage fish. The total area that will see an increase in its productive capacity is approximately 13 ha.

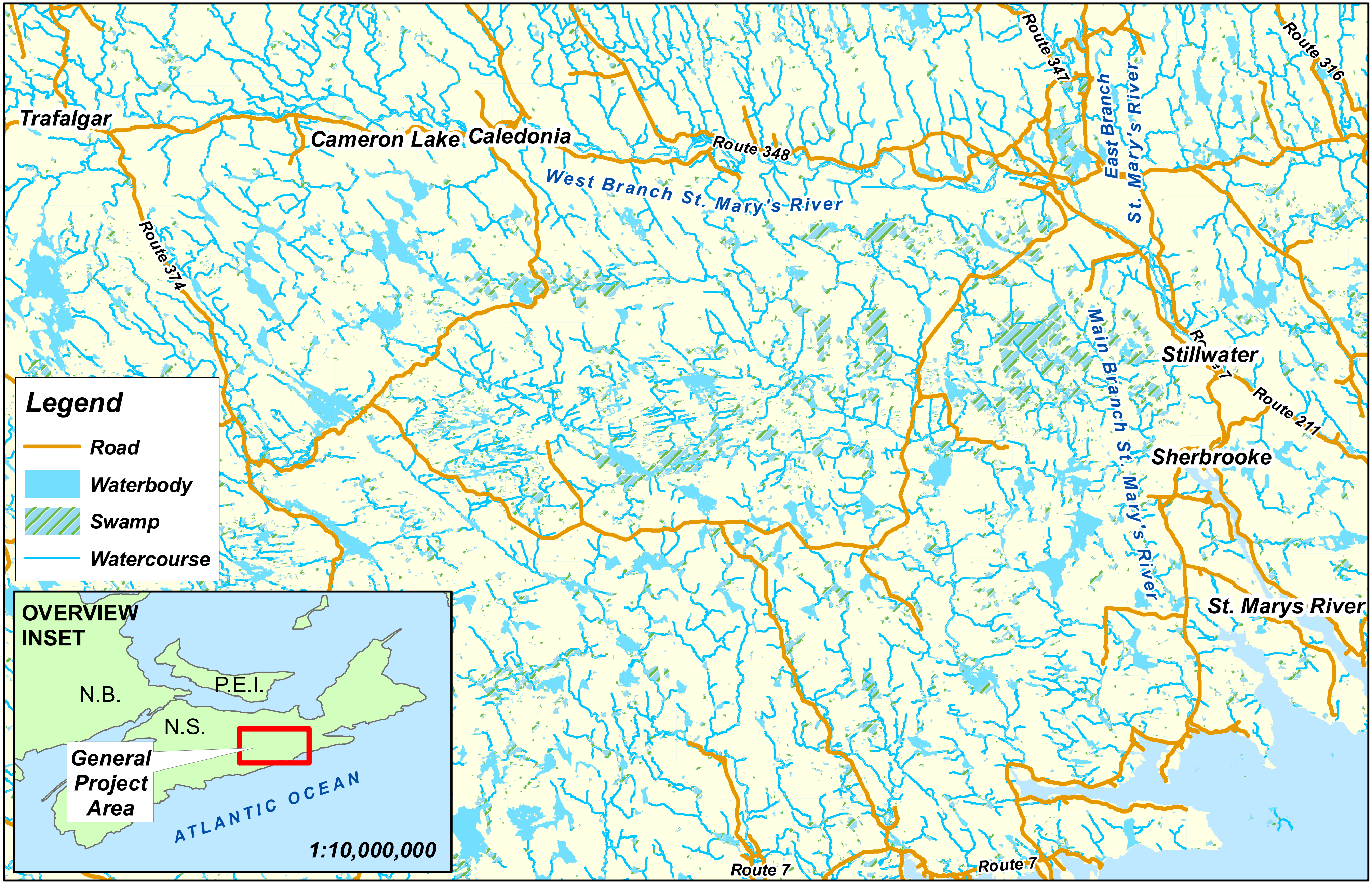
3.3 FRESHWATER

Keltic is proposing to support the St. Mary's River Association (SMRA) in their initiative to restore the fish habitat in three branches (West, East, and Main) of the St. Mary's River. The background information and project description are borrowed from the plan developed by Bob Rutherford of the Nova Scotia Salmon Association Adopt-A-Stream Program.

The St. Mary's River is Nova Scotia's largest river system with a watershed that spreads over five counties and drains an area approximately 135,000 ha. The river system is composed of the West Branch (56 kilometres (km)), the East Branch (35 km) and the Main Branch (14 km) (Figure 7). The East and West Branches are home to genetically unique Atlantic salmon populations. The watershed habitat has degraded over the past two centuries due to impacts from mining, agriculture, forestry, road construction, and human settlement.

Despite these impacts the river is still largely intact, and although salmon runs have declined significantly it has only been over the last 15 years. The SMRA believes that the river can, with the proper rehabilitation, be restored with a corresponding rebound in depleted salmon runs.

A preliminary assessment of both historical and current impacts on the watershed has been undertaken. Historically impacts from mining, agriculture, forestry, road construction, and human settlement have been detrimental to the health of the ecosystem. This is mainly due to nonexistent or poor practices when putting infrastructure in place. These impacts have been highly reduced today because of tighter environmental controls over work being done in and around a water course. Current impacts can be narrowed down to site-specific sewage issues



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June 6, 2007
Drawn by S. Turner
Projection: NAD83 UTM Zone 20
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Figure 7
General Project Area
St. Mary's River

and climate change. Climate change has caused a decrease in the number of summer storms affecting the area. This has resulted in short duration, high intensity storms that are prone to cause flash floods and negative impacts on the physical nature of the river. These climate change issues have been taken into account in the design for the restoration plan so the work undertaken will be effective for years to come.

This plan focuses mainly on the West and Main Branches of the river. Further plans will be developed to rehabilitate the East Branch and intertidal areas of the river. The restoration project has targeted seven parameters that need to be addressed in order to properly bring the river back to a more productive state.

Pools

Properly developed pools provide cover, help regulate water temperature, aid in fish passage, and are refuges for juvenile fish during low flow periods. A lack of pools is a clear indicator that something is wrong in the watershed.

There are extensive areas of this watershed that do not have this level of pool development particularly in the main river and the West branch below Trafalgar. All of the tributaries crossed by a highway are impacted for 500m to 1500m both upstream and downstream.

Thalweg

The thalweg is the deepest part in a cross-section of the main channel of a waterway; it provides fish passage, maintains a minimal water depth during low flow periods to keep the water cool, and provides habitat for juvenile salmon and insects. There are many sections of the West and Main Branch that have a highly degraded thalweg.

Cover

Shallow water depths limit the density and size of fish that can use and be supported by the habitat. Due to decreased water depths the amount of cover available is reduced and larger parr and adults are forced to move to the pool areas where there is limited cover making them vulnerable to predation.

Embeddedness

The spaces between rocks and boulders in a streambed are essential habitat for aquatic invertebrates and they form the base of many key food chains and cover for small fish. Therefore, it is important that cobble, rocks, and boulders are minimally embedded (set in sand and silt).

The shifting channels and eroding banks have set much of the bed material in sands and silts. This has limited secondary productivity reducing the food supply of the fish and suitable cover for the juveniles.

Bank Stability

Bank erosion usually means the watercourse is unstable and realigning itself to adjust to changes in flow volumes or other disturbances. Its presence is a clear indicator that something is wrong in the watershed. Bank erosion is a major contributor of silt that can lead to high embeddedness in a stream.

Bank erosion is a major problem on the Main River, West branch below Trafalgar, and the lower sections of the East branch. This of course provides silt to the river infill in interstitial spaces in the gravel thus lowering overall insect productivity and damaging spawning beds and over wintering habitats.

Bank Vegetation

Bank vegetation is important for cover, nutrient input, bank stability etc. It has been observed that in many sections of the watercourse the vegetation is being under cut and falling in due to ice scour and erosion having proceeded at a pace faster than the vegetation can recover.

Water Quality

The higher the water quality in a watercourse the higher the potential for success for any fish population. The pH is low in some tributaries due to acid rain and geology that lacks buffering capacity. Temperatures are a problem in the main and west branches due to shallow over widened sections and warm dry summers.

Water quality in the St. Mary's River is rated as marginal for the protection of aquatic life. Water quality consistently failed the guideline for pH, frequently exceeded the guideline for copper and occasionally exceeded it for aluminum, lead, and iron.

It is believed that with the improvements being proposed to restore the watercourse, the water quality will improve.

The plan for the restoration of the St. Mary's River is presented below, first with comments on the general habitat needs and then focusing on particular sections of the watercourse.

General Habitat Needs

There is a need to improve the fish passage in the main river, the lower part of the West Branch and the lower parts of the West Branch tributaries. The intent is to get spawners into the river early and as far up the system as possible before spawning. The plan includes holding and resting pools and a thalweg designed to concentrate the low flows. Concentrating the low flow will improve water quality by moderating the summer temperatures, reduce the development of ice that leads to bank souring and erosion, and preventing damage to physical habitats by ice scouring. The pool development will provide refuge for parr in extreme conditions and over winter habitat for pre smolts.

The channel size and shape for the thalweg low flow channel can be designed based on the one in two year mean daily flood flows and the summer low flows expected in an average year. This calculation would be made for each section of river/stream to be restored and sited in the river based on existing locations of pools and riffles. The creation of the channel for migration also creates the conditions for spawning and good juvenile habitats. The latter may require some fine-tuning on a site-specific basis or some adjustment to make a good angling pool but the fundamentals are the same.

To create these conditions in low flow periods the shape of the channel needs to be changed so that summer flows are collected in one channel that has the optimum depth and flow characteristics for fish migration and rearing.

Below the Stillwater Bridge to the Main River Estuary

The actual width of the main river at the Stillwater Bridge is 55 to 60 m which is the natural width for this section of river, based on flow data at Stillwater. Normally the pools would be located approximately every six channel widths or 330 m apart but the bedrock outcroppings restart this pattern so the pools would be located immediately below the 15 major bedrock gradient controls then 330 m downstream if another control has not been reached. Within this channel there should be a thalweg channel approximately 25 m wide and 0.5 m deep as a riffle/run between the pools. This channel would have near optimum flow and depth characteristics from June through October during all flows except the lower quartile (lowest 25%) of the flows in August and September. During these months passage would be possible but without optimum depths and velocities. Rearing habitats would still be in the optimum range. Currently good migration conditions do not exist for the period July through October except in above median flows in June and October and top quartile flows in July, August and September. This may require the placement of pools into the bedrock.

Main River above the Stillwater Bridge to the confluence of the East and West Branches

The area around the Stillwater Bridge is fine and appears to be a favourable holding area.

Upstream, the river needs to be stabilized using rip rap rock to create gradient controls that will realign the riffles and re-establish pools. These structures will normally be rock sills but in some cases will be combined with deflectors or deflectors used on their own. They will also direct the flows to establish a single main channel and thalweg. Additional rocking will be required at most of the pools. Again the natural channel width is 55 m with pools on alternate sides approximately 330 m apart. The work will be designed to establish this channel with a low flow thalweg with a width of approximately 25 m within a 55 m wide normal flow channel with a low flood plain extending to the existing banks to carry high flows. There are 22 estimated sites of this sort in this section.

West Branch to Caledonia / Chisholm Brook

The lower half of this section is very wide and as stated before it does not appear to have enough material for the gradient controls and deflectors to work to restore a proper channel and flood plain. Since little elevation change is required between the channel and the flood plain it is proposed that gradient controls be tried with a lower than normal profile on the flood plain area. If the channel scours to bedrock in the pool areas without forming proper pools then they will have to be built by excavating the bedrock. It is likely that holding pool locations will have to be selected based on the depth of cobble over the bedrock or specifically built into the bedrock. At Archibald Brook, just above the confluence with the East Branch, the natural channel width is

30 m (with pool spacing of approximately 180m). This is just under half of the current width of 76 m. The natural channel will narrow at each tributary as you move up stream, narrowing to approximately 20 m at Chisholm brook, which is close to the current width. There are an estimated 246 sites starting at the lower end.

West Branch above Caledonia / Chisholm Brook

This area is not as over widened as the lower area but does have areas of braided channels and diagonal bars. Standard techniques of gradient controls and deflectors can be designed to improve this section of the river. In braided areas, the low flows can be directed into one channel where there is a channel of adequate size to handle the flows without erosion which appears to be the case at all sites.

Above the Community of Trafalgar

These tributaries have not been surveyed due to a lack of easy access but from a preliminary assessment revealed good habitat. Restoration work would be local sites and of low priority at this time.

West Branch Tributaries

Some sections of the tributaries can be restored using standard techniques including digger logs but many have streambeds armoured with rocks too big for the stream flows to move. These streams need to be shaped by hand to provide the thalweg and pools in the over widened and degraded areas. This methodology has worked very well in some streams with very large rock but still needs some fine-tuning in streams like these tributaries that have a mixture of substrate sizes.

The priority is to do the sections impacted by past road construction but longer sections could be done in log driven streams.

East Branch and Tributaries

Generally the East Branch habitat is in much better shape. Work on this branch is site specific and a more detailed survey is needed to specify the site locations and extent of the work needed. Spot checks have noted some over widened sections but generally the width is what you would expect. Siltation is serious in some sections but it is site specific.

The restoration plan proposed for the St. Mary's River is to take place along approximately 150 km of the river and encompasses 300 ha of habitat (Table 1). These estimates are strictly for the direct restoration work and do not account for the improved access to habitats further up the watershed. The estimates of area of the East Branch and the West Branch above Trafalgar are based on work that needs to be completed in association with substandard road crossings.

TABLE 1 Approximate Area Available for Restoration in the St. Mary's River

Section	Estimated Length (m)	Average Estimated Width (m)	Habitat Area available for restoration (ha)
Below the Stillwater Bridge to the Main River estuary	4,550	55	24.75
Above the Stillwater Bridge to the confluence of the East and West Branch	7,200	55	39.60
West Branch to Caledonia / Chisholm Brook	37,000	25	92.50
West Branch above Chisholm Brook	24,000	15	36.00
Above Trafalgar (site specific)			5.00
West Branch Tributaries (51 in total)	76,500	5	38.25
East Branch (site specific)			64.00
Total	**149,250**		**300.10**

4.0 CONCLUSIONS

In conclusion, Keltic proposes a three pronged approach to the compensation required for the HADD as a result of the construction of the marginal wharf. This document presents plans to address compensation in three different areas; marine, estuarine, and freshwater. The total area proposed for compensation measures approximately 513 ha (Table 2) which represents an area 24 times that which is being removed.

TABLE 2 Total Compensation Area Presented in this Plan

Ecosystem	Total Area (ha)
Marine	200
Estuarine	13
Freshwater	300
Total	**513**

REFERENCES

Miller, J.A., Sharp, G.J., and O'Brien, E.M. 2006. Laboratory Experiments on Artificial Reefs for American Lobsters. Journal of Crustacean Biology. Volume 26, Issue 4. Pg 621-627