A Watershed Management Plan for the Winter River and Tracadie Bay

Prepared by the Winter River-Tracadie Bay Watershed Association

WINTER RIVER - TRACADIE BAY
WATERSHED ASSOCIATION

Finalized: April 2013

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1.0 Executive Summary

This plan was developed with input from residents from across the Winter River-Tracadie Bay watershed. It is intended to serve as a guide for the future development including environmental, social and economic sustainability. It attempts to identify concerns residents have, their visions of the future and to identify a course of action to address these issues and visions. The information gathered to prepare this document came from public meetings, a survey of residents and contacts with individuals between 2010 and 2012. We plan periodic reviews of the goals, objectives and strategies to keep them in line with current environmental and social conditions.

This plan must not be considered a final document on our watershed management, but as an ever changing plan, that can incorporate changes in the environment and changing wishes of residents. It serves as a summary of current situations, desires, goals and concerns, and identifies strategies to achieve these goals.

In initial meetings several years ago, a vision for the watershed was developed – "to protect and enhance the health and aesthetic qualities of the Winter River – Tracadie Bay watershed area."

At meetings and during discussions in 2011 numerous concerns were raised by watershed residents, and from these, goals, objective and strategies to meet them were developed. The greatest issue identified by residents was water, the quality and especially the quantity of water. A survey carried out in 2012 further identified concerns and visions

The goals for the watershed management plan emerging from these public consultations to meet the visions residents have for the watershed are:

1. Improve and protect quality of both surface water and groundwater
2. Protect the quantity of ground water - ensure extraction rate is sustainable
3. Enhance public understanding of water
4. Protect and enhance the health of bays and estuaries
5. Protect and enhance freshwater ecosystems
6. Improve agricultural practices to minimize negative impacts on the environment
7. Enhance forest management
8. Improve the management of shale pits/storage pits and associated activities
9. Enhance recreational opportunities and promote active living
10. Incorporate sustainability as a guiding principle in our approach to environmental, economic and social issues

2.0 Acknowledgements

The Winter River – Tracadie Bay Watershed Association Board of Directors provided countless hours in fostering the development of the organization, volunteering with summer work and most importantly guiding the development of this Watershed Management Plan. Board members included Cathy Corrigan (co-chair), Don Mazer (co-chair), George Coade (treasurer), Sarah Wheatley (secretary), Rod Dempsey (past secretary), John Hughes, Lowell Vessey and Ben Hoteling. Past members who also contributed in the early stages included Wayne Corrigan, Allan MacCormack (past treasurer) Darren Riggs, Luke Peters and John Dalziel.

Many others have made significant contributions in time and thought and have provided input into this document. Financial support, especially for summer work, but also for the development of this document has been provided by:

Government of Canada – Eco Action program
– Canada Summer Jobs

Government of PEI – Watershed Management Fund
– Greening Spaces program
– Rural Development Initiative
– Skills PEI, Community Mentorship program
– Skills PEI, Post secondary employment program
– Employment Development Program, Jobs for Youth

City of Charlottetown
Wildlife Conservation Fund
Atlantic Salmon Federation
Ducks Unlimited
PEI Wildlife Federation

3.0 Preface

The Winter River-Tracadie Bay Watershed Association (WRTBWA) has developed a watershed management plan that is intended to apply to the entire Winter River and Tracadie Bay area, with goals, objectives and strategies relevant for all of the tributaries running into Tracadie Bay. However, many of the specifics in this document relate to the Winter River watershed, which has been the main focus of our work during our first years. Our group has also done some work in the other tributaries running into the Tracadie Bay, and we have occasionally done work in conjunction with a long established environmental group in the Eastern Tracadie Bay area, the Tracadie Area Residents for Resource Protection (TARRP). One of the goals of the Winter River Management plan, Goal #10, is to extend our focus to include this Eastern Bay area and to conduct inventories, meet with residents and develop goals, objectives and strategies for the other watersheds which flow into Tracadie Bay. This plan is a “living document” and as actions are taken to address the tributaries of Tracadie Bay other than Winter River, these will be added

4.0 Introduction

Tracadie Bay and the Winter River Watershed are found on the north coast of PEI just east of the center of the province as shown in Figure 1. The Winter River watershed covers 7271.9 hectares. Agriculture and forestry are the predominant land use activities totalling 84% of the Winter River watershed.

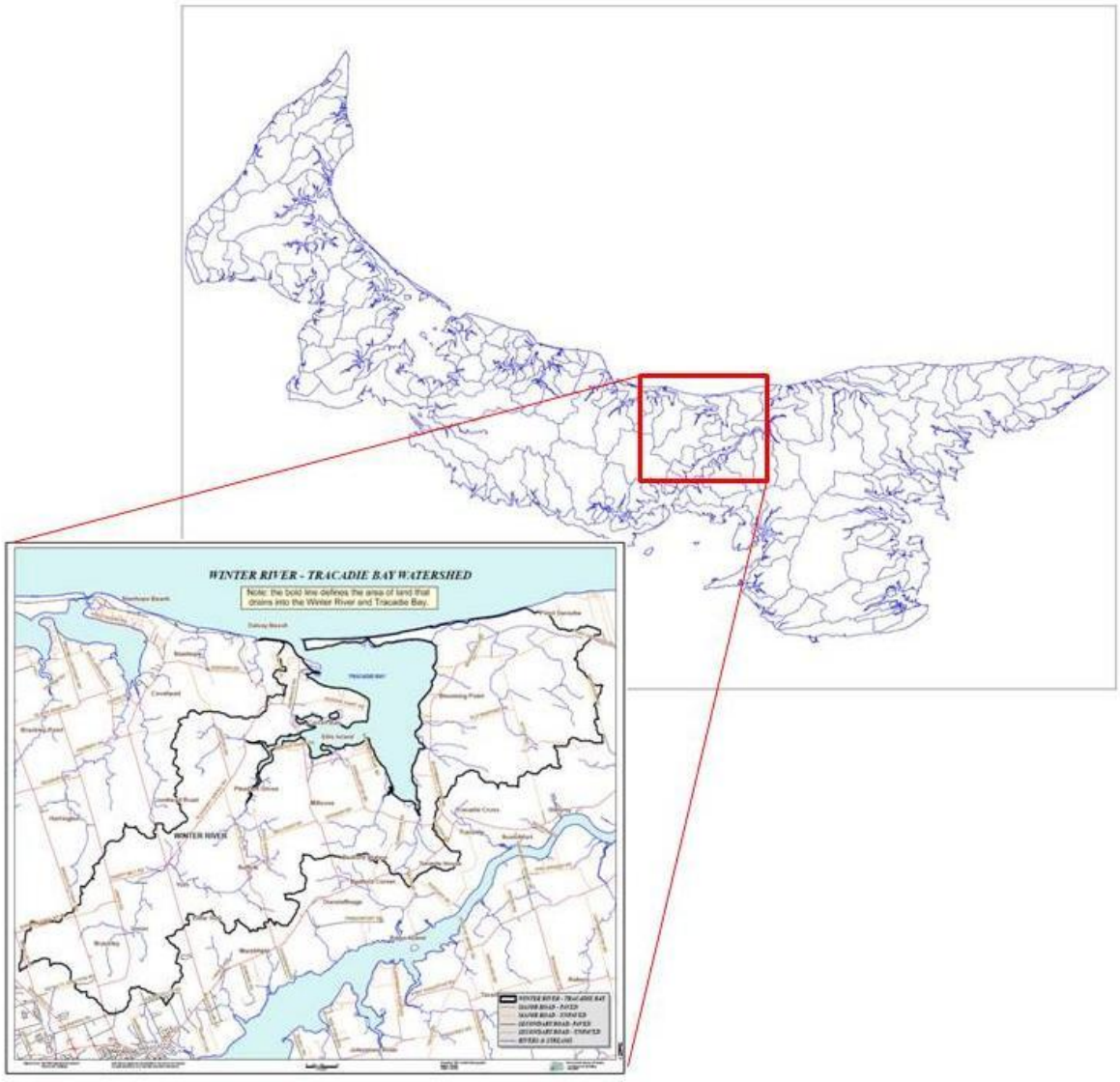

Figure 1: *Boundaries of watersheds on PEI, and detailed view of Winter River-Tracadie Bay watershed*

The watershed is somewhat unique in that it provides residences for many people who work in Charlottetown. These residents view the area as a residential location and are concerned about maintaining the environmental integrity of the area for recreation and relaxation, rather than being the site of their employment.

Those who work in the watershed would include farmers, tourism operators, fishers, shellfish aquaculturists and those involved in forestry. The mussel industry has become an important source of income over the last 30 years and has expanded so that current leases occupy about 75% of the estuary's 1700 hectares.

The use of water from the river has been a significant factor in the environment and the economy for decades. Beginning in the early 1800s, sawmills were operated at York and Suffolk. The York pond and mill was initially

established about 100 m upstream of the York Road-Pleasant Grove intersection, but moved to the current site of Hardy's Mill in 1856.

The groundwater from the watershed has supplied water to the residents of Charlottetown with the development of a pumping station in Brackley in 1930, a pumping station at Union Road in 1949 and a pumping station at Suffolk in 1994. This water extraction has had an impact on stream flow and springs. It was noted that when the pumping station in Union Road was constructed "the underground water pressure was so diminished, the flow of water was slowed through the mill, severely reducing its power", (Murray, 1993, p. 100). These three wellfields supply all of the water for Charlottetown, including both residential and industrial uses. An auxiliary pumping station on the Malpeque Road draws water from the Ellen's Creek watershed and has been used occasionally when Winter River wellfields might not be able to meet anticipated demands without exceeding permitted extraction levels.

Over the past 11 years, the average daily extraction rate has ranged between 17.5 and 19.6 million litres of water per day. However, there is higher extraction during the summer months when recharge is lower. Also during summer people use extra water for such activities as watering gardens and lawns, washing vehicles, and filling swimming pools. Additional water is used in summer by the cruise ships in the Charlottetown harbour.

The current extraction level (2011) is 88.9% of allowable extraction as permitted by the Province of PEI. Between 2000 and 2011, the combined extraction for all three pumping stations within the watershed ranged from 87-98% of what was permitted.[1] However, the extraction from the Brackley wellfields was above permitted values in 3 of the last 11 years. Similarly, extraction from the Union wellfield was over the permitted amount in 4 of the last 11 years. The near maximum overall extraction is of concern to the City as it may become a limiting factor in future growth. The City has undertaken conservation efforts to reduce existing consumption so that any increases for future development do not cause permitted levels to be exceeded. The City of Charlottetown has also initiated efforts to look at the development of another wellfield in a different watershed (Miltonvale Park).

Despite overall water extraction remaining within provincial guidelines, the amount extracted is far beyond the accepted standard for sustainable withdrawal, 50% of recharge from each wellfield. Consequently, springs flowing into the Winter River regularly dry up, large tributaries cease to flow and in 2001 portions of the river itself totally dried up. As can be seen in Figure 8 the extraction averages more than double the sustainable levels at the Brackley pumping station and more than 40% over for the Union Road station. In spite of being unsustainable on a wellfield or sub watershed basis, the extraction rarely exceeded the permitted levels as established by the Province of PEI.

5.0 Background Information

This portion of the document is intended to summarize actions which have impacted the watershed area since settlement by the Europeans. It summarizes activities by private individuals and the public in general to protect

[1] All figures related to permitted amount are based on the 2010 permit

this environment and details more recent activities by community environmental groups, first the Winter River Environmental Committee and currently the Winter River-Tracadie Bay Watershed Association.

5.1 **History of Tracadie Bay and the Winter River Watershed**

5.1.1 Estuary

Tracadie Bay has been an integral part of life on the Winter River-Tracadie Bay watershed since historical times. The area was used by the native community, as evidenced by the burial site found on the Blooming Point sand dune. It is known that the native people stayed on PEI seasonally to collect shellfish, and this was likely the case here. The estuary also served as a harbour to pursue the fishery in the Gulf of St. Lawrence. It served as a site for boat building, using wood from the surrounding forests. While cutting trees no doubt occurred in the watershed, most of the actual vessel construction, using these materials, took place at Mount Stewart as the sand bars associated with the Blooming Point and dune system may have made it difficult to launch and sail large vessels. Mount Stewart was a major boat building site in the mid 1800s. Tree species which were in demand for boat building include birch, beech, pine, spruce, maple and juniper.

The estuary provided an excellent harbour for the smaller boats that were used in the lobster fishery. Typically boats that were much smaller than those used today, often called shore boats, formed the basis of the lobster fishery (Figure 2). Where there currently is a limit on the number of traps that can be fished (300), in the past there was no limit due to the low state of technology. There was no serious impact on the stocks even without trap limits. Both fin fish and shellfish were in such abundance that almost any technique worked. Early finfish harvesting usually took place from sailing vessels, which had smaller boats associated with them. These smaller boats were capable of setting long lines with hooks or lobster traps. The vessels needed a safe harbour to return to at night and during storms which Tracadie Bay provided. The fishery was primarily based on cod, with the province serving as a base where the fish could be salted and dried. An advantage of PEI fishery over that of other provinces was that other forms of livelihood could be carried out in conjunction with the fishery, leading to a more satisfactory lifestyle. The lobster fishery, which is currently the backbone of the fishery, was historically not significant as lobsters were considered to have almost no value. They were so plentiful, that after major storms they could be found washed in on the beaches.

Figure 2: *Lobster fishing in the past*

The entrance into Tracadie Bay has been changing continuously over the last century. The 1880 Meacham's atlas and the 1924 atlas show three entrances into Tracadie Bay plus a large entrance at the west end of the sand dunes as well as an entrance through Deroche Pond. By 1935, aerial photos indicate the Blooming point sand dune system was a single Island and there was no access to the Gulf through Deroche Pond. In the winter of 2010 a large breach formed in the Blooming Point sand dunes once again showing the unstable nature of the dune system. This second entrance will certainly increase water exchange between the Gulf of St. Lawrence and the estuary. It is possible that the entrance into Tracadie Bay could change, with the old entrance closing over, or the breech may just be a temporary situation.

5.1.2 River and Ponds

The first order streams (branches) of Winter River, as well as the two primary ponds and three pumping stations are named and shown in Figure 3 below. The streams in the watershed have a total length of 42.75 km.

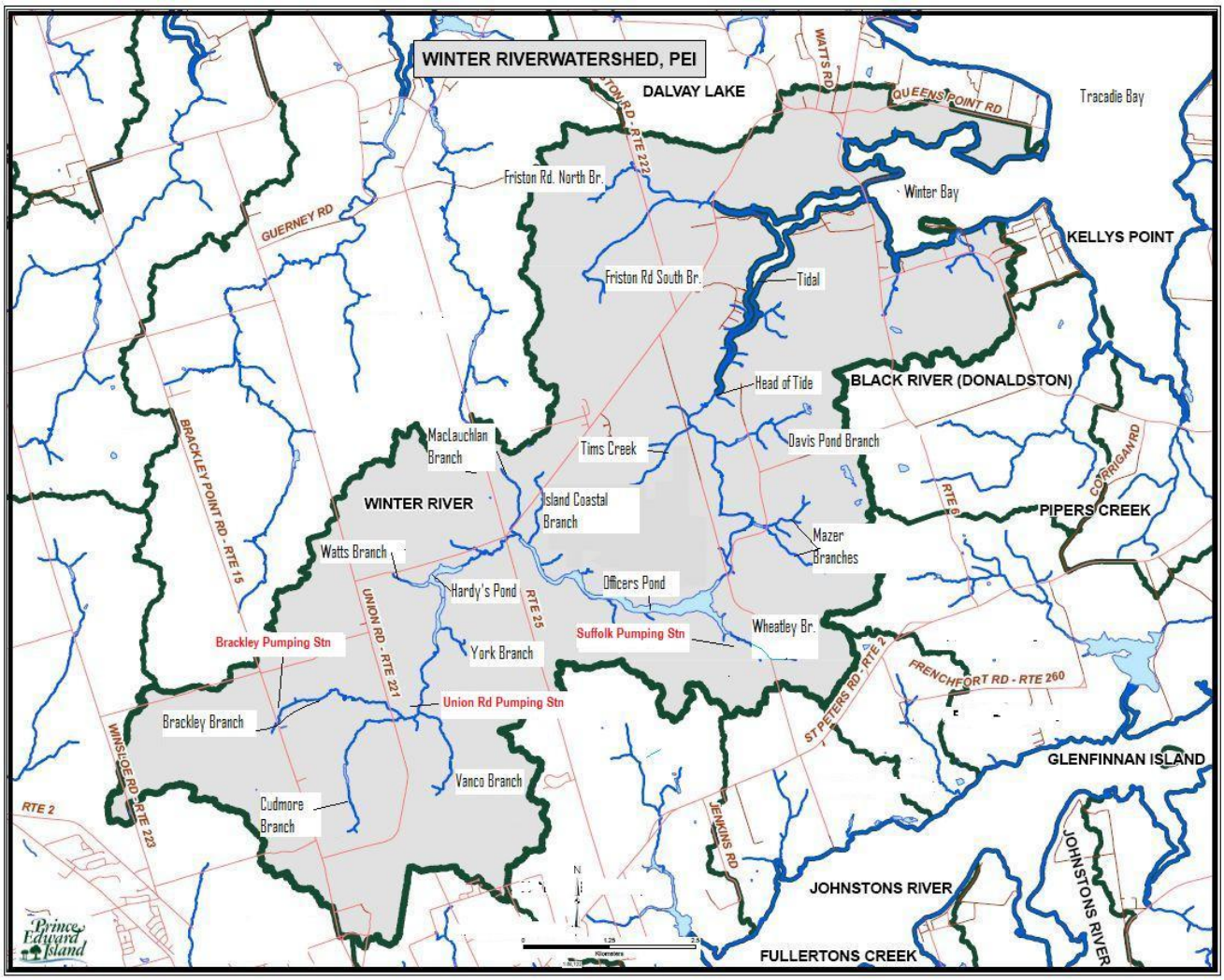

Figure 3: *Streams of the Winter River*

PEI has some of the best salmonid habitat in eastern North America. Since rivers and streams are spring fed, they are cooler in summer and warmer in winter than that found in other provinces. Under normal circumstances on PEI the stream flow is based on springs that flow more or less constantly all year round, with only a small runoff water occurring during spring. There normally isn't a significant decrease in flow rates in the summer. Both Nova Scotia and New Brunswick have much more variable flows. These ideal conditions have resulted in fish hatcheries on PEI supplying trout and salmon eggs to federal fisheries hatcheries throughout the Maritimes in past years. In the Winter River system, the relatively constant flow is not present, probably because of high extraction from the Brackley and Union Road pumping stations. The springs near these stations stop flowing in the summer, and this is reported to have been the case for years.

Three factors have had the greatest impact on salmonid populations. The first is sediment from fields. PEI was settled early in Canada's colonization and by the mid 1800s agriculture was a major industry. By the 1870s until the 1920s almost 90% of the land suitable for farming on PEI was cultivated, the natural forest cover almost eradicated. With the loss of tree cover it would be anticipated that erosion and the resulting sedimentation would be a factor in filling in fish habitat. Fields were much smaller in the early farming days and hedgerows common which minimized erosion. Because horses and oxen supplied most of the power, land had to be used to grow grain and hay as feed for these animals which would have ensured crop rotations and reduced

potential potato production. Erosion would have been minimal when compared to today's situation. The sediment released from agriculture would have covered fish habitat, initiating the first stress on fish populations.

The second factor would have been the construction of dams. Because rivers in PEI, including Winter River, were relatively small they were ideal for damming. The water flow through water wheels could be used to drive machinery for grinding grain into flour, making rolled oats, or cutting logs into lumber. The ponds would have provided habitat for fish to live, but access to spawning areas, especially by sea run Brook Trout and Atlantic salmon might have been jeopardized, depending on the water management in the pond. Older residents have reported that Officers Pond had a high elevation difference and it was unlikely that fish made it around or over the dam structure. In 1982, with the support of Ducks Unlimited, a new dam with water control structure and fishway was constructed. Hardy Mill Pond, initially known as the Deanston Mill Pond, was considered a very viable mill with great water power. A newspaper article (Murray, 1993, p. 100) notes "Captain Eldridge Hardy is doing an extensive business this spring. On March 6 and 7 no less than 80 loads of lumber were left at the mill to be manufactured into boards, shingles etc." In 1942 the dam washed out. It was rebuilt by Reg Barwise who built a "higher dam". No figures are available but if the dam was higher, fish passage would have been even less likely. The dam once again washed out in the late 1970s. The land was acquired by the Provincial government and with support of Ducks Unlimited a new dam and fishway was constructed. Fish passage through each of the fish ways was monitored in 1988 and again in 1993. No salmon were observed at either of these ponds.

The third factor impacting fish would be water quality and quantity. Brook trout ideally live at temperatures below 20°C. They can tolerate higher temperatures for short periods of time, but must then move to springs where the water is cooler. In these springs, where fish numbers become concentrated, there is an increased opportunity for disease transmission and for predation by cormorants, Great Blue Herons, raccoons, mink and larger fish. As well when temperatures rise, the ability of water to contain oxygen is diminished and once the level of oxygen drops below 5 mg/L the fish must search for areas with higher levels of dissolved oxygen. High water temperatures can result from shallow areas where the water heats up from sunlight. The other factor affecting water temperature and water quantity is the reduced flow rates from springs. If the water table drops, springs may slow or they may stop. With reductions of cool water, the stream temperatures will rise. If a sufficient number of springs stop flowing, the stream will dry up. The level of the water table depends on precipitation and the amount of water extraction. The sustainable extraction level of 50% of recharge is a generally agreed upon established value to maintain sustainable stream flow. If water is extracted at double the sustainable level as it is in the Brackley branch, it is not surprising that the springs stop flowing. When streams dry up, all non mobile aquatic life is lost. In 2001 the main branch went dry, in 2011 the Brackley branch went dry and in 2012 both the Brackley Branch and the Cudmore branch went dry (see Figure 3).

In the 1960s, Winter River was well known as a great place to go angling. In studies carried out in 1994, Officers Pond and Hardy Mill Pond were considered two of the best ponds on PEI in terms of fish habitat (UPEI and ASE Consultants, 1994). In 2010 temperatures in Officers went to 25°C on many occasions and anglers reported trout were almost absent. Trout could not have stayed in the pond unless they found springs. Anecdotal reports suggest that sites on the Winter River which are now less than 30 cm deep were deep enough for swimming during the 1960s.

5.1.3 Uplands - Agriculture

Prior to the arrival of Europeans, PEI was covered with forests except where sand dunes or wetlands limited tree growth. Soon after settlers arrived on PEI, their primary task was to convert forest land to fields. Initially trees were cut and crops planted between the stumps. In some cases trees were cut down and the wood used to construct buildings but in many cases the trees were burned to remove their presence. Because there was a lack of mechanized equipment field sizes were relatively small. The land was well suited for agriculture, as rocks were not nearly as abundant as in New Brunswick or Nova Scotia. Agriculture expanded, with farming hitting a peak in terms of land farmed in the early 1900s when 90% of the land was farmed (McAskill, 1987). When the fertility of the land became depleted, it was conditioned with mussel mud which was primarily oyster shells. As farms became more mechanized and efficiency became more important, the sizes of fields became larger and hedgerows were removed. With larger fields, wind and water erosion have become important factors. Wind erosion, especially in the winter, blows away the topsoil from larger fields which devoid of windbreaks. Without windbreaks to slow water flow, water is able to build up speed and create water erosion even though the slope may not be very great.

5.1.4 Uplands - Forests

When PEI was first settled by Europeans, the forest covered 97% of the Island and was made up of stands of large trees comprising the “Acadian Forest”, including sugar maple, yellow birch, beech, red oak, with scattered white pine, red spruce, red oak, white ash and hemlock. Doug Sobey (2007) suggested that prior to cutting by Europeans a significant component of the hardwoods, consisted of American beech. These beech trees had large quantities of seeds which were used by many wildlife species and farm animals in early settlement days. In wetter areas there were black spruce and larch.

The size of the trees was truly impressive. For example, the masts for sailing vessels needed to be 30 m high with the size at the small end being 30 cm. This height is 25% higher than the Delta hotel, and trees of this size are just not seen anymore. Dan McAskill (1987) makes reference to records showing ships built on PEI with masts from trees that must be 45 to 50 m high. The initial forests were cut to provide shelter, log cabins, and to provide land for cropping. To the initial settlers the forests were the opposition, something to be overcome, but soon the trees were cut to supply lumber. Some trees were cut and used for construction of buildings, while others were burned just to remove them. Forests in the Winter River watershed would likely have been typical PEI forests with similar harvesting.

But in the early 1800s, an industry began to flourish based on ship building and shipping wood to England. The best of the wood from the long lived Acadian forest was harvested. The large quality and quantity resulted in a major ship building industry. The Winter River-Tracadie Bay Watershed was not left out of this initiative and although there are no records to indicate that boats were built along the shores of Tracadie or Winter Bay, the lumber was taken to nearby Mount Stewart where there were several shipyards and a large number of boats built.

The land was then either converted to agriculture or allowed to regenerate, usually in white spruce. Because of the demand for timber and the need for farmland in the late 1800s and early 1900s almost all of the Acadian Forest was cut. The mills at Hardy Mill Pond and Officers Pond were both used to saw lumber for boat building as well as other forms of construction. While initially this cutting and sawing was done by human power, soon rivers were dammed and water wheels were used to turn saw blades to cut the timber.

These ponds had an impact on fish movements and changed the habitat for many species. Unfortunately it was usually the genetically inferior trees, those that were misshapen that were left and these provided the seeds for successive trees. The composition of the forest changed as well. Much of the forest now found on PEI, and the Winter River-Tracadie Bay watershed, was agricultural land which has been abandoned and allowed to grow up in trees. Some small patch cuts or thinning of the Acadian forest regenerated with the original species, but often and especially in recent years, forests were clear cut and trees were allowed to regenerate. The regenerating trees in this situation were exposed to full sunlight and usually consisted of white spruce, balsam fir, red maple, white birch, poplar and pin cherry. The same type of forest regenerated from the abandoned farmland.

The Acadian Forest species were mostly shade tolerant, being adapted to having young trees grow up in the shadow of older trees. These species were totally missing from the cut over forest community. This also changed the mammalian and avian community. The new forests have included primarily white birch, poplar, red maple, alder and white spruce. The softwoods were usually cut for lumber and pulp while the hardwoods were cut for firewood.

The forest was further impacted by massive forest fires which burned entire counties. As land became overworked and could not be used for agriculture it usually reverted to forest consisting primarily of white spruce which was cut every 60 to 80 years for saw logs or pulp. Today on PEI, about 48% of the land is covered in forest. The short rotation white spruce stands also gave landowners a relatively quick turn around on their investment. The forest component for the Winter River watershed is slightly less than the average for PEI. It can be assumed that the Winter River watershed probably went through this same transition away from Acadian Forest.

5.2 **History of Enhancement Efforts and Community Partnership**

5.2.1 Winter River-Tracadie Bay Watershed Association Inc., the Organization

The current group known as the Winter River–Tracadie Bay Watershed Association (WRTBWA) was established in 2008 with the goal of protecting and enhancing the health and aesthetic qualities of the Winter River-Tracadie Bay watershed. But there have been people concerned about the health of the Winter River and Tracadie Bay for over 130 years. A group was organized to oppose a starch factory in 1881, and it is stated that the factory did not operate very long; “Perhaps the disagreeable effluence entering the Winter River caused consternation among the residents who enjoyed an occasional walk to the old fishing hole” (Murray, 1993, p. 249).

Between approximately 1998 and 2007 a group called the Winter River Environmental Committee was active in carrying out environmental enhancement. As a result of several factors, including an inability to secure funding and at the request of the provincial government, in the fall of 2008 a group of people met to try to revitalize activities to restore, enhance and protect the Winter River and Tracadie Bay. This group became the Winter River-Tracadie Bay Watershed Association and was incorporated under that name. At the urging of government, the new organization was asked to include the entire Tracadie Bay watershed. There were discussions with another group that was active at the time, the Tracadie and Area Residents for Resource Protection (TARRP) who wanted to continue their work addressing issues on the eastern side of Tracadie Bay. Consequently, WRTBWA has focused on the Winter River and western Tracadie Bay area to date, with fewer

activities being carried out on the east side. With the cooperation of TARPP, our future work will inventory all tributaries and to develop plans to address the issues and concerns in the eastern Tracadie Bay area.

5.3 **Physical Description and Current Land Use**

5.3.1 General Description

Tracadie Bay and the Winter River watershed are found on the north coast of PEI, just east of the center of the province of PEI as shown on the Figure 1. The watershed covers about 7000 hectares. Figure 4 shows the breakdown of land use, with agricultural lands and forests, each at about 40%, totalling 80% of the surface area. The rest of the land use consists of wetlands (2.8%), roads (4.4%), residential (4.2%) and pits/storage sites/industrial (1.1%). Figure 5 provides a map showing where the activities take place in the watershed.

Although technically not part of the watershed, which normally only includes land and fresh water, the bay forms a vital part of the community and occupies about 1700 hectares. About 80% of the bay is used for off bottom aquaculture, primarily for mussels. In 2010 a bar which had formed across the channel above the Corran Ban Bridge was dredged to achieve better water flow and reduce anoxic conditions.

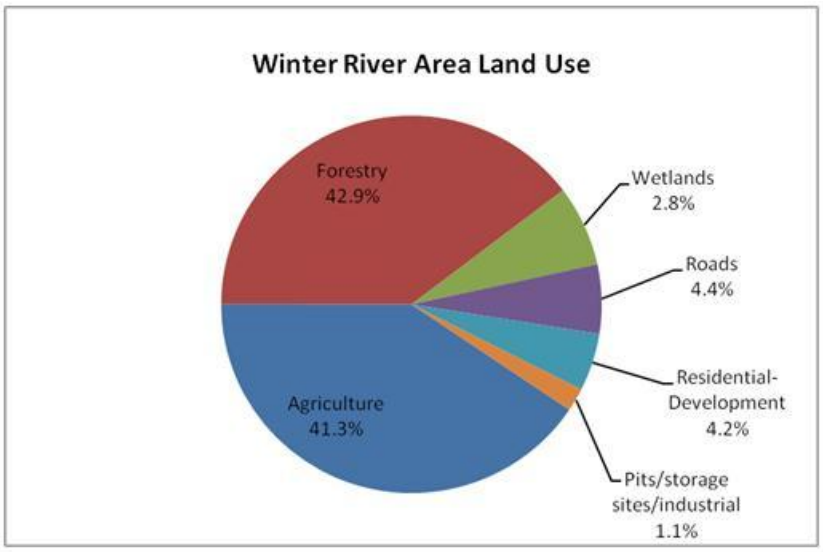

Figure 4: *Land use in the Winter River Area*

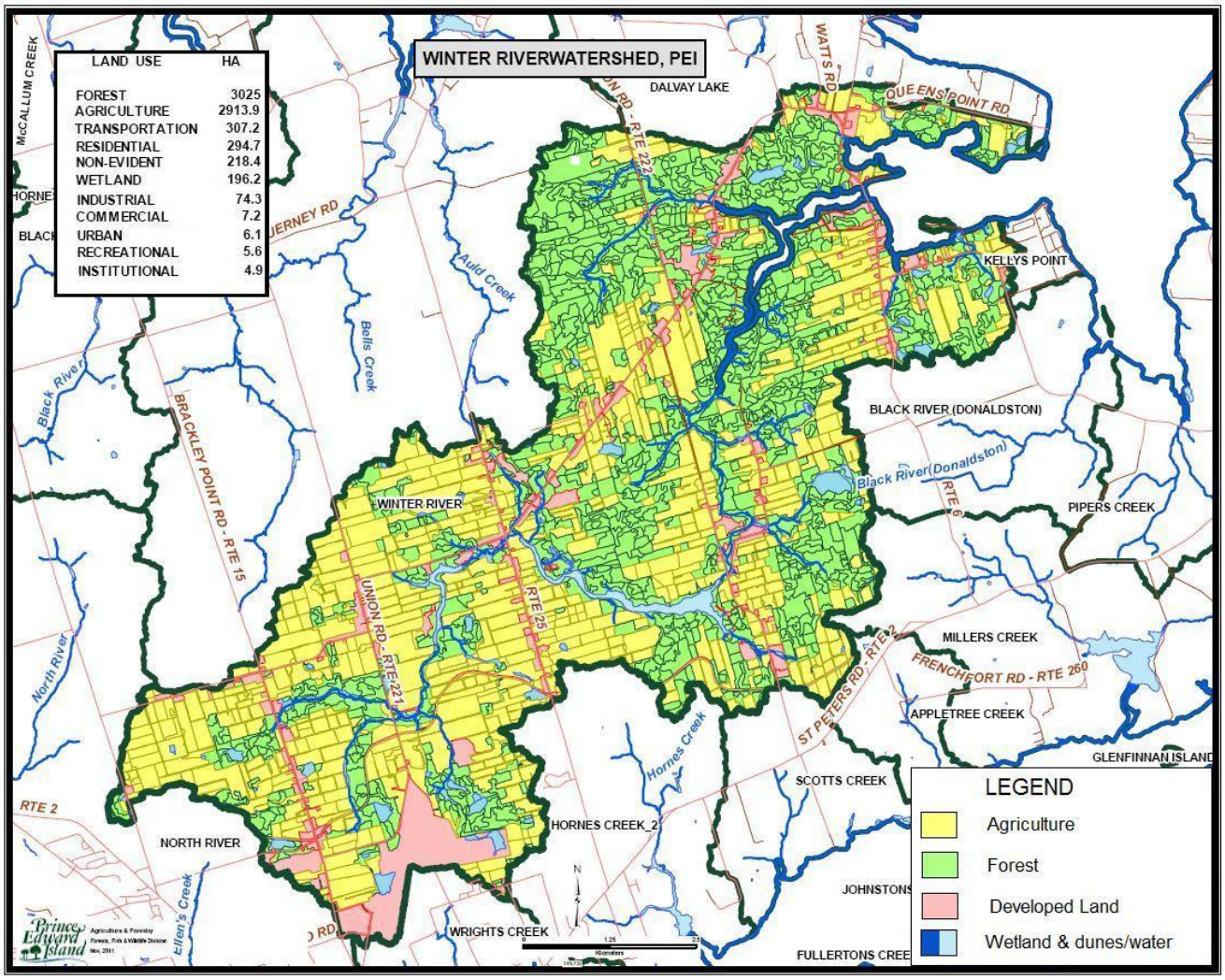

Figure 5: *Map of land use activities in the Winter River watershed*

5.3.2 Topography

The topography of the watershed is one of rolling hills with streams in the valleys. The maximum elevation near Suffolk is about 50 m. The river valley with very steep sides downstream from the Suffolk Road is unique and rare on PEI. Unlike many other watersheds, there is little agricultural land with significant slopes in excess of 9%. The level lands are largely farmed. Several of the higher sloping areas are being mined for shale, or are owned by construction companies for future excavation work.

5.3.3 Climate

PEI is considered part of the "wet Atlantic Maritime Hydrological zone" by the Water Survey of Canada. It is considered to be in the 5b zone of plant hardiness by the Federal Department of Agriculture. The mean January temperature is -7.6°C while the mean July temperature is 18.8°C. PEI annually receives about 1000 mm of precipitation, although it is a little higher near the Winter River-Tracadie Bay Watershed where the average is 1173 mm as indicated in Table 1. There are between 100 and 160 frost free days per year.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL
Monthly rainfall (mm)	42	30	39	59	94	93	86	87	95	105	87	63	880
Monthly snowfall (cm)	71	60	53	29	4	0	0	0	0	3	23	68	311
Monthly precipitation (mm)	106	86	92	88	98	93	86	87	95	109	111	123	1173

Table 1: *Precipitation at Charlottetown airport (adjacent to Winter River Watershed)*

5.3.3.1 *Climate Change*

Climate change could have a significant impact on PEI, especially the estuarial portions of the Winter River-Tracadie Bay watershed. The shoreline along Tracadie Bay is already under considerable stress. The area is heavily subdivided into small cottage lots. Predictions are for increased water levels, increased intensity of storms and higher temperatures in the winter when ice would provide protection from wave action (Richards and Daigle, 2011). For the last 70 or more years Blooming Point has consisted of one long sand bar, however, in 2010 a major storm caused a breach in the sand dune system. This enhanced water exchange in the estuary resulting from this new opening into the Gulf is a positive factor for the shellfish industry, but if there are additional breaches there would be increased exposure of the coastline of the bay to storm damage.

5.3.4 Habitats

5.3.4.1 *Streams*

Streams and associated riparian habitat areas are critical to many species of fauna on PEI. Winter River has a total length of 42.75 km of freshwater streams. Unlike most rivers in Nova Scotia and New Brunswick, PEI rivers are all fed by groundwater and are relatively short. Rivers in Nova Scotia and New Brunswick have high flows in the spring resulting from snow melt and there may be little flow in the summer. Since rivers in PEI originate from springs which flow at 7°C year round, the rivers are relatively warm in the winter and cool in the summer. Brook Trout spawn in the warm and relatively silt-free water in the springs, which allows earlier hatching than in the main body of the river. In the past, Winter River was well known for its excellent angling opportunities. Salmon were a sought after species that was present. In the 1990s, a survey of impoundments of PEI identified Officers Pond and Hardy Mill Pond as having some of the best salmonid habitat on PEI. As with most ponds on PEI, these two ponds became in-filled with silt, largely originating from agricultural land, but also from roads, both public and private and ditches. The sediment originating from agricultural land was fertile topsoil which resulted in a great deal of aquatic vegetation, shallower water and water movement obstructed by weeds, which all resulted in waters warmed by sunlight. This was further complicated by less cold water flowing from springs, due to the high levels of water extraction at the pumping stations. In 2001 there was so little water flow that the fishway at Hardy Mill Pond stopped functioning, the pond lost all oxygen (became anaerobic) and the stream disappeared between Hardy Mill Pond and the York Road. This would have resulted in the death of all aquatic life including fish if they were not able to move to habitat elsewhere in the system. It has been noted by anglers in Officers Pond that from mid July to late August, when the temperatures are highest, there is very little fishing success.

There are also problems with obstructions in the stream preventing fish movement. Most blockages, which consist of debris, stumps and alders which had fallen in the water, have been removed. A total of about 35 km of stream was cleared of all blockages in the summers of 2010, 2011 and 2012. Blockages are also important in reducing the quality of fish habitat because the obstructions prevent the stream from building up enough energy to flush the silt. In the past, cattle were given access to streams to drink and agriculture took place right

to the stream bank resulting in destabilization of the stream bank and increased movement of sediment into the watercourse. When regulations requiring buffer zones, first of 10 m and then 15 m, were implemented and land use practices changed, there was much less silt but alders became abundant. Often the alders collapsed into the streams under the weight of the snow and they would root in the stream. Thus streams including tributaries of the Winter River became much wider and shallower and large amounts of silt were trapped. The silt filled in holes that provided fish cover and covered spawning areas.

To trap the silt two in-stream silt traps were constructed in 2010. These were excavated holes in the bottom of the stream which measured about 2 m wide and 2 m deep and had a length of about 25 m. Because the water slows when it enters these traps, the silt drops out. When the traps became full they were re-excavated in 2012. As well, to remove silt from Hardy's Pond it was drained in 2012 and left dry for three months, with the hope that silt would be washed downstream. In order to trap the silt a large bypass pond silt trap was constructed. It measured about 20 m wide, 40 m long and 2 m deep.

An effective and inexpensive technique to trap silt involves constructing piles of brush, which are at specific locations to accelerate and encourage the deposition of silt. 195 of these brush mats were constructed in 2011 and 2012.

Over the last three years, the Winter River-Tracadie Bay Watershed Associate staff and volunteers planted almost 8000 trees to provide shade for the stream and to consolidate the banks. It is hoped that the newly planted, longer-lived native tree species will restore the natural forest in the riparian zone along the stream. The species planted, which were typical of the Acadian Forest, include white ash, green ash, eastern cedar, larch, white pine, red spruce, eastern hemlock, red maple, red oak, sugar maple and yellow birch.

There is a blockage to fish passage at the Union Road highway culvert on the Cudmore Branch and at the triple culvert on the access road to the City's Union Road pumping station. Repairing the highway culvert is a priority item with the Department of Transportation and Infrastructure Renewal so it is hoped that that the culvert will be repaired and fish passage is restored in the near future.

In order to address the high water temperatures in Officers Pond, in 2011 the pond was operated at a level 15 cm lower than usual. In order to address the problems in Hardy Mill Pond, the pond was drained for a three month period from March to June 2012, to dry out and hopefully set back or kill the pondweed. While the pond was down and the bottom dried out, silt was removed from several areas in order to provide deeper water. It was noted there were active springs which if flowing will provide cooler water. The re-growth of vegetation and infilling of excavated areas will be monitored to assess the effectiveness of this portion of the initiative. Temperature recorders were installed to determine the impact of these actions

A Recreational Fisheries Management Policy is being developed.

5.3.4.2 *Wetlands*

Rivers often do not have much wetland habitat and therefore limited of limited benefit to wetland species, but this is countered on Winter River by the construction of two man-made ponds. Officers Pond and Hardy Mill Pond and their associated wetlands cover approximately 30.4 and 14.2 hectares respectively. Beavers have also created several small wetlands. Because of impact of beaver dams on temperature and water flow, a Beaver Management Policy for Winter River is being developed to balance the positive and negative impact of additional blockages and wetlands on the ecosystem.

5.3.5 Wildlife Populations

Wildlife populations found in the Winter River-Tracadie Bay Watershed are typical of those found elsewhere in the province. Waterfowl numbers have been enhanced by the construction of Officers Pond and Hardy's Mill Pond. The ponds were not initially constructed to enhance waterfowl or other wetland species, but these species benefitted from the construction of the ponds to power mills that ground grains, made starch or sawed timber.

Ponds sometimes had a negative impact on migratory fish species because fish are not able to navigate the faster water conditions created by dams. Centuries ago the flow regime associated with operating the mills, sometimes prevented fish movement. Most ponds did not have fish passage facilities but in the 1970s and 1980s there was a major initiative by the Province of PEI and Ducks Unlimited Canada to construct fishways. Fishways were constructed at both Hardy Mill Pond and Officers Pond. However, the fishways were not perfect, as they did not pass smelts and the percentage of Gaspereau migrating upstream is questionable.

Beaver are one of the few species that create their own desired habitat, wetlands. At the time of early settlement beaver were not present. They were either never native to PEI or had been exterminated. There were short lived introductions prior to 1910 and an introduction in the 1930s but these animals were all trapped. They were successfully reintroduced in the 1960s and strict laws were established to protect the beaver until a sustainable harvest could be established. Beavers build dams and lodges that provide protection and make it easier to float branches down to the lodge for direct consumption or storage and consumption over the winter.These ponds provide habitat for many wetland species. The dams can prevent fish migration both upstream and downstream. The dams also hold shallow water which allows it to become warm. Further, the dams flood out forested riparian zones which may take a great many years or decades to return to native forest habitat.

In order to assess fish populations, or at least numbers of migrating fish, a fish trap was operated in 2011 at both Hardy Mill Pond and Officers Pond. The information shows 386 fish using the fishway at Hardy Mill Pond between June and November and 300 fish using the fishway at Officers Pond. This is less than 25% of the fish using the facility in 1988 and 1993. Data on the number of Brook trout caught and numbers released was also kept by members of the Officers Pond Club. This showed numbers in 2011 at about 50% of the level of numbers in 1999.

5.3.6 Status of Groundwater - Quantity

PEI has an abundance of groundwater based on recharge from rainfall. Annual rainfall for PEI averages about 1 m per year. As indicated on the water cycle diagram below (Figure 6) some rainfall runs into streams and eventually into the ocean. Other water percolates into the ground and eventually into aquifers. It is from these aquifers that all PEI residential and industrial water is drawn. It is generally accepted that extraction of up to 50% of recharge is sustainable. Although the aquifers below watersheds are connected, water movement through the Island's sandstone bedrock is very slow. When water is pumped from an aquifer below a watershed, almost all that water has penetrated the ground from directly above. In virtually all aquifers on PEI, water quantity is not a problem. Almost all water in streams originates from springs which flow from groundwater in the aquifer. All domestic and industrial water comes from wells connected to aquifers but most extracted amounts, coming from wells, are sustainable. Water that is extracted is replaced by precipitation flowing back into the aquifer. The Winter River Watershed and associated aquifer is an exception, as water in

some of wellfields is being pumped out at an unsustainable rate. Almost all of the water used by the City of Charlottetown is being withdrawn from the Winter River watershed aquifer, with about 18 million litres of water per day being extracted. In normal conditions within a watershed, waste water goes into septic systems and is largely returned to the ground water, but when water is pumped to Charlottetown the waste water goes to Charlottetown estuary, and is unavailable to recharge the water supply.

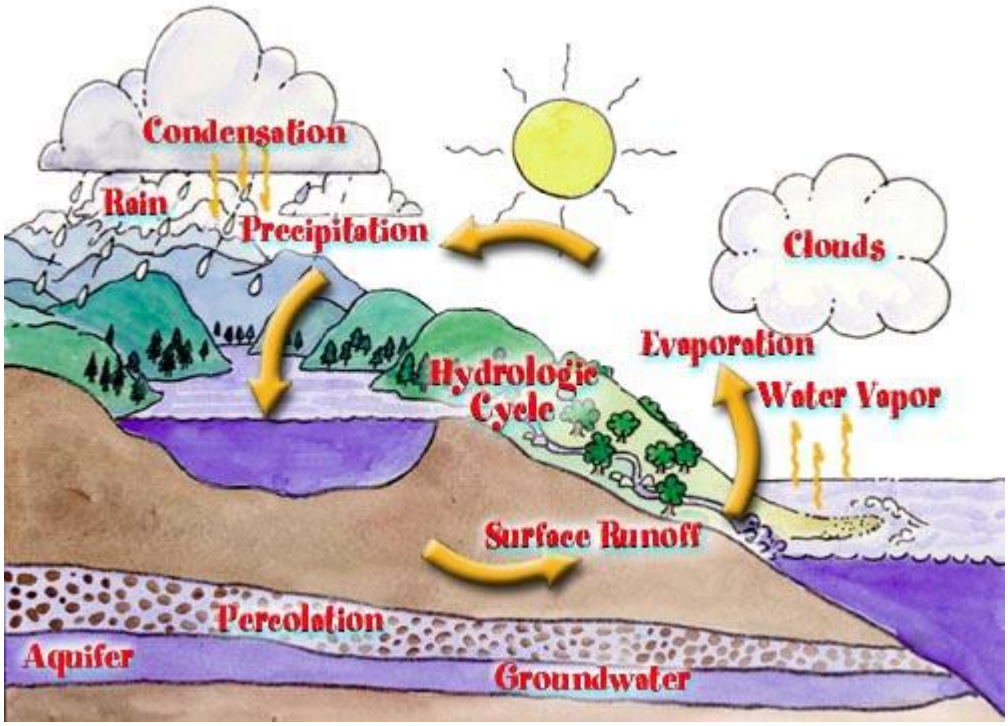

Figure 6: *Water Cycle*

The City of Charlottetown currently has the three wellfields (in Brackley, Union and Suffolk), comprising a total of 13 wells. The city pumps water based on a permit issued by the Province of PEI in 2010. Water extraction from these stations is indicated on Figure 7 as a percentage of permitted extraction. Extraction from the Winter River watershed aquifer is about 93% of the amount permitted by the province, based on the average of the 2001-2011 data from all wellfields.

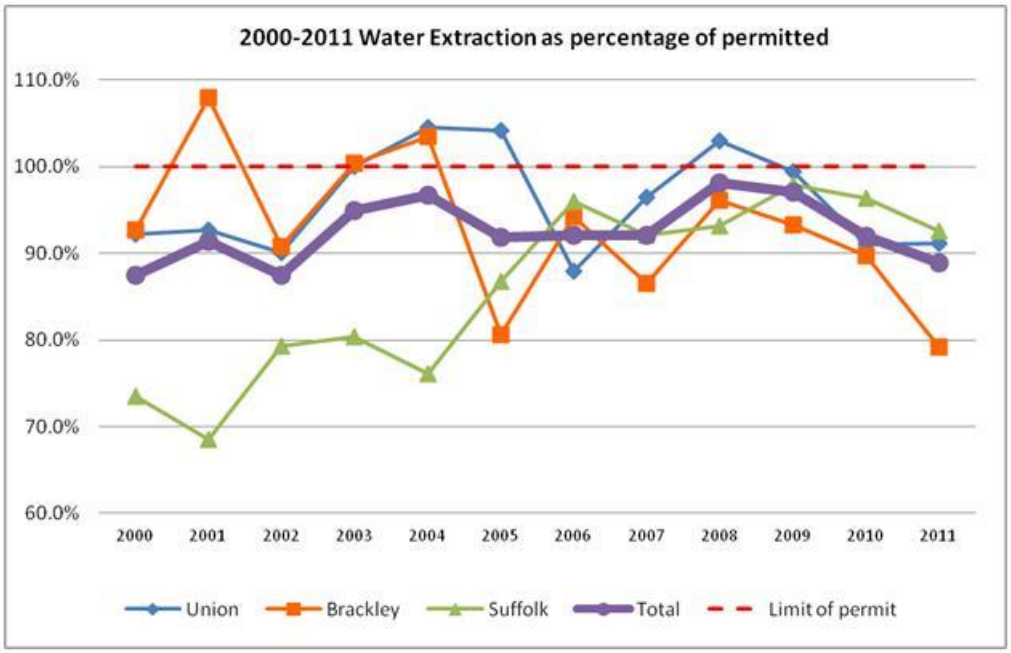

Figure 7: *Water extraction as a percentage of permitted*

Figure 8 and Figure 9 show water extraction as a percentage of recharge. When we examine individual wellfields, the average extraction rate at Brackley has been 100.3% of recharge, 71.3% for the Union Road pumping station and 37.9% for the Suffolk pumping station. With the exception of Suffolk, these figures are far above the generally accepted standard of sustainability of 50% of recharge at each wellfield.

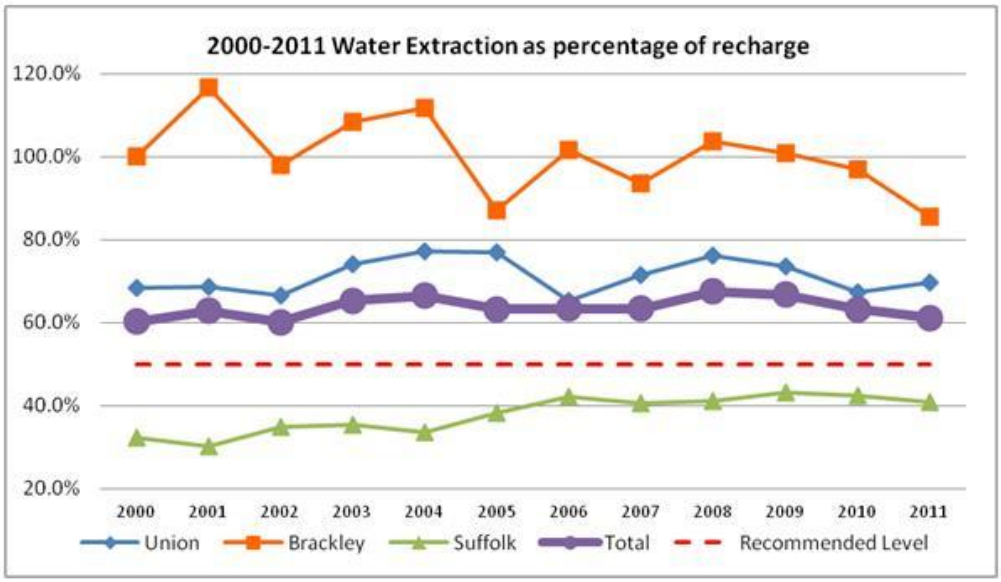

Figure 8: *Water extraction as a percentage of recharge*

	UNION		BRACKLEY		SUFFOLK	
	Actual Use (L)	% recharge	Actual Use (L)	% recharge	Actual Use (L)	% recharge
2000	2,755,354,400	68.3%	2,214,588,200	100.1%	1,404,917,700	32.3%
2001	2,767,827,700	68.6%	2,578,877,000	116.6%	1,308,648,300	30.1%
2002	2,688,787,600	66.6%	2,169,568,800	98.1%	1,514,999,600	34.9%
2003	2,987,655,000	74.0%	2,398,194,000	108.4%	1,535,741,000	35.3%
2004	3,120,873,000	77.3%	2,470,971,000	111.7%	1,454,105,000	33.5%
2005	3,109,545,000	77.0%	1,924,398,000	87.0%	1,658,621,000	38.2%
2006	2,628,341,000	65.1%	2,250,320,000	101.7%	1,834,247,000	42.2%
2007	2,880,886,000	71.4%	2,068,310,680	93.5%	1,760,156,900	40.5%
2008	3,074,652,000	76.2%	2,296,702,000	103.8%	1,781,565,000	41.0%
2009	2,968,391,000	73.5%	2,229,340,000	100.8%	1,871,640,000	43.1%
2010	2,719,791,000	67.4%	2,143,189,000	96.9%	1,840,764,000	42.4%
2011	2,815,187,000	69.7%	1,891,309,000	85.5%	1,770,993,000	40.8%
AVERAGE		71.3%		100.3%		37.9%

Figure 9: *Volumes of water extracted and percentage of recharge*

The City wells are very deep which ensures a continuous flow of good quality water. When wells were being maintained or refurbished they were often deepened. While direct cause-and-effect relationships are difficult to prove, when the Suffolk wells were established and when the Brackley wells were deepened, local private wells went dry and had to be drilled deeper. As well it was noted (Murray, 1993, p. 100) that the Mill at Hardy's Pond remained very productive until a well was drilled at Union Road to supply the city of Charlottetown, "the underground pressure was so diminished, the flow of water through the mill, severely reducing its power."

High extraction rates which reduce spring flow, has caused surface water problems. In 2001 the Winter River dried up below Hardy Mill dam. In 2011 the entire Brackley branch dried up for a few days and in 2012 the Cudmore Branch dried up for a few days and the Brackley Branch dried up for over a month (see Figure 10). More details on the impact of the streams drying up are described under section 5.3.4 regarding fish habitat.

Figure 10: *Dry Brackley branch, summer 2012*

5.3.7 Status of Groundwater Quality

There are two general problems associated with ground water on PEI, salt and nitrates. Salt water is generally found in aquifers located under surface salt water. There are locations where the salt has intruded into the aquifers under land, but such situations are relatively rare. These "salt water wells" are often in demand for aquaculture and fish processing facilities, but are a problem for domestic consumption. It is postulated that when there is a high amount of fresh water extraction near salt water, that a "vacuum" is created and salt water from adjacent areas will move inland, into the aquifer and make groundwater there salty. Such situations are rare, but there is concern that this could happen anywhere that too much water is extracted too fast. This is of particular concern on PEI where many wells are located close to salt water.

The presence of nitrates in groundwater and hence in well water is a major problem on PEI. The nitrates can be traced largely to the application of fertilizers. PEI soils are known to be excellent for the growing of potatoes and other crops, but the soil acts as a medium, rather than as a source of nutrients. In order to maximize crops, nutrients or soil amendments are applied. For almost a century, until about 1945 mussel mud, composed largely of oyster shells, supplied the lime and nutrients for farm fields. Digging and applying mussel mud was a time consuming and back breaking job. Fields which had the mussel mud, reaped benefits for 15-20 years as the oyster shells gradually decomposed. With the advent of chemical fertilizers it was easier to apply chemicals, but it was also easy to over apply. Unused nitrogen/nitrates flowed through the soil and into the aquifers. The Canadian Drinking Water Standards recommend the upper level for human consumption be 10 ppm, although there has been recent consideration of reducing this level to 5 ppm. The level for wildlife is set at 3 ppm. Many residences in high volume potato growing areas have well water with nitrate levels above 12 and even 15 ppm. The recent major increases in the costs of fertilizer make over fertilizing expensive may help alleviate the problem. Careful nutrient management and farming practices by farmers can reduce the unneeded fertilizer applications and reduce the level of nitrates entering the ground water. It has been postulated that it takes a lengthy period of time, 2-50 years for water to enter the aquifer, so it would take a long time before decreased nitrate levels in waters would be seen. However, if no decrease in the level of surplus nutrients occurs, the problem will only get worse. Surveys of nitrate levels in private wells were conducted by the WRTBWA and by the provincial government. In general, the Winter River is not an area with high contamination, having an average of 2-3 ppm, but there were individual wells exceeding the standard of 10 ppm as the maximum level for human consumption. The levels found in the deep wells operated by the City were 4.6 ppm for the Brackley wellfield, 4.23 ppm for the Union wellfield and 1.65 ppm for the Suffolk wellfield (Charlottetown Water and Sewer Utility, 2012)

5.3.8 Agriculture

In the last part of the 19th century and the first part of the 20th century, agriculture on PEI occupied about 80% of the land, with forests, wetlands and dunes making up the balance. It is probable that this figure would also apply to the Winter River Watershed. Streams were important as they allowed cattle to have water for drinking, which resulted in removing most of the vegetation from the riparian zone. The fronts of the farms were often cropped while a portion of the farm was often left wooded to supply firewood and the wood needed for building repairs, construction and firewood. Agricultural land use on PEI has reverted from 90% to approximately 50% with the unused land growing up in forest, usually white spruce. In the last half of the 20th century the farming has become much more specialized on each farm. There is a general division between row

crop production, mainly potatoes and corn, and the dairy industry, which involves hay, pasture and grains. Currently agriculture occupies approximately 42% of the land in the Winter River watershed.

5.3.8.1 *Row Crop production*

Potatoes have formed the core of the PEI agriculture industry for decades. While initially fields were relatively small, 5 to 10 acres, there has gradually been an increase in the size of the fields to achieve greater efficiency. Greater efficiency has come mainly through the use of larger tractors and minimizing unproductive headlands by having much larger fields. The larger fields were mainly achieved through joining fields through the removal of hedgerows.

The larger fields resulted in two primary environmental problems, wind erosion and water induced erosion, both resulting in the loss of topsoil. Topsoil is the key growing component which provides nutrients and retains moisture needed for the crops. In order to maintain long term agricultural productivity the rate of erosion should not be greater than the rate of soil formation.

Topsoil is gradually built up each year, with estimates that it takes 300-500 years to create 2.5 cm of topsoil. The level of sustainable topsoil loss has been calculated as about 7 tonnes/hectare (3 tons/acre). A field losing 4 mm (0.16 inches) of soil by erosion loses a total quantity of 50 tonnes/hectare (22 tons/acre). Thus while a 4 mm loss over a period of one year may not appear to be a serious problem, projected over a period of ten years, 4 cm of topsoil would be lost which has taken 500-800 years to create. This is not sustainable.

With the reduction of hedgerows, wind was able to travel a longer distance without being blocked by trees and speeds were able to increase, thereby carrying away increased amounts of topsoil, especially over the winter. A second form of erosion is that caused by water. Water can carry topsoil away from the field. This is most prominent in fields that have a high slope or fields that have a long run, in which the water can build up speed. The loss of hedgerows greatly exacerbated the problem by increasing slope length. Fields which are left bare over the winter, such as those used to grow potatoes and corn, are prone to both wind and water erosion. Initiatives such as planting a cover crop were effective in reducing both forms of erosion over the winter.

Lack of organic content can be a significant problem in row crop production. The organic content acts like a sponge, holding water that can be released in times of drought. With the inclusion of a year with hay in a crop rotation, which is incorporated into the ground, the organic content is maintained. If there is a two year rotation with only grain and potatoes, or when potato crops were planted several years in succession, which was more common in the past, the amount of organic material will be diminished. When organic material is not present, moisture can't be retained, which can lead to the need for irrigation. It is strongly recommended that any potato rotation include a forage crop such as hay.

Nitrate leaching into the groundwater can also be a problem with row crops, such as potatoes or corn. Both of these crops require added nutrients, in the form of chemical fertilizers and/or manure to achieve optimum growth. One of the components in fertilizers is nitrogen, in the form of nitrates. The amount of fertilizer spread by farmers is a very exact science, and if too much is spread, the plants do not use it all and the remainder leaches down into the groundwater. Programs have been and are being developed to help farmers apply only what is needed. Other programs have looked at cost/benefit analyses of applying high levels of fertilizers. As fertilizers are primarily applied during the row crop year of a crop rotation, the PEI Commission on Nitrates in Groundwater (2008) recommended that row crops be permitted only one year in three, rather than one year in

two, thus decreasing the frequency of the fertilizer application. Farmers are encouraged to participate in the development of nutrient management plans for their lands.

5.3.8.1.1 Restorative/Preventative Programs

Government has initiated a mandatory three year crop rotation for row crop production. Exceptions can occur when there is an approved farm plan, which usually exists for low slope fields where water erosion is minimal and organic content is maintained. The two year rotation row production, which occurs on about 25% of the potato fields on PEI, does not address concerns about nitrate leaching as a two year rotation increases the frequency of the application of the nitrogen based fertilizers.

5.3.8.2 *Dairy production*

The operation of a farm for dairy purposes offers a very different impact on the environment. A significant amount of the land is in pasture and hay production. This land is usually only broken about one year in five to replant a forage crop. The land is not left bare over the winter so that erosion is much reduced. Some dairy farmers do grow some grain or corn which can lead to erosion problems, but there is generally not a large amount of fertilizers applied to the soil. The spreading of manure which is applied both as a method of disposing of a product and as a nutrient for the soil is high in organic content which is eventually incorporated into the soil.

The spreading of manure can present a problem if not done at the right time of the year and in the right location. Usually the manure is stock piled and then spread over an entire field as a fertilizer. Provided this is done when the ground is not frozen, ideally when vegetation is growing, and the land is not too steep, the nutrients will be readily taken up by the vegetation. If the manure is spread when ground is frozen, or at a time when there is not much vegetative e growth the nutrients cannot be absorbed and if there is a heavy rain or rapid snow melt, the manure and water will flow over the surface and into to a watercourse where it result in over enrichment, called eutrophication, of the stream.

In the past, livestock have had access to streams, which lead to many problems including destroying the stream bank and stream bottom, which impact fish habitat, and enrichment of the stream with cattle feces. Recent Federal fish habitat legislation has required cattle to be fenced out of streams on PEI because cattle feces have been determined to be a deleterious substance which is prohibited from entering the stream. All farmers on the Winter River have complied with this legislation.

5.3.8.3 *Alternative Land Use Service (ALUS) program*

The ALUS program provides funding for farmers to help with initiatives to enhance the environment or at least minimize the negative impacts of agricultural activities. When streams become laden with silt, there is a loss of aquatic habitat, a loss of wildlife, and hence a loss of value to society, as wildlife, including fish, belong to the public. Under this program when farmers take measures to protect the environment above that which is required by law, they can be compensated for the extra effort involved in these measures. The funding provides compensation for such activities as planting trees, leaving more than the required buffer zones along streams, retiring high slope lands from cropping, planting cover crops following potato harvesting, and refraining from fall ploughing to maintain a hay crop over the winter prior to planting potatoes in the spring.

5.3.9 Forestry

The forests currently found on most of the Winter River are typical of most forests on PEI. Largely they are the remnants of agricultural land which was not productive, perhaps because of loss of nutrients. Old sketches from the mid to late 1800s show almost no forest, and foresters have suggested that 90% of PEI was under cultivation. Thus the current forest is made up largely of low to moderate shade tolerant species, usually white spruce, balsam fir, poplar, pin cherry, white birch, with eastern larch and red maple in wetter areas. This is often referred to as “old field succession”. Lack of specific forest management until recent times has resulted in a forest made up of white spruce and balsam. The trees have been allowed to regenerate naturally and after 50-80 years the area is clear cut. In recent years, planting has included a mixture of species to create a more diversified forest community which is less prone to diseases or pests.

There are a few individual properties which have stands of Acadian forest in the Winter River Watershed. This is especially true along the riparian zone of the river downstream of the Suffolk Road. Because there was a steep bank, which extends up 20-30 m in height with a very steep slope, it was very difficult to harvest the timber, and the stream was not wide enough to float the logs if the trees were cut. These stands have magnificent specimens of white pine, hemlock, red spruce yellow birch and red oak often being 1m or more in diameter. These areas also have unique species of wildlife that are not found in the white spruce forests such as barred owls.

The original forests would have bordered the rivers and streams. Because the rivers served as the primary means of transportation, this is where settlers built houses and conducted farming. Cattle were given access to the streams to drink but they also grazed on the young trees, shrubs and grasses and created considerable erosion. Laws now require cattle be fenced from the water, which provides an opportunity to reforest these riparian zones which are critical to many species of wildlife.

Over the last two decades there has been an intensive effort by the two environmental groups in the watershed to reforest the riparian zone with Acadian Forest species. The have included primarily white and green ash, red maple, eastern larch and eastern cedar with lesser numbers of yellow birch, sugar maple and red oak. Planting efforts peaked when in 2011 the Winter River-Tracadie Bay Watershed Association staff planted about 4500 trees in an attempt to restore some of the Acadian Forest species. To date almost 8000 trees have been planted. The City of Charlottetown owns considerable land in the watershed. As part of a wellfield protection initiative, this could be managed to restore a more stable Acadian forest community.

Forests benefit the environment because they improve water quality, increase filtering capacity, create and support wildlife and wildlife habitats, help prevent the transport of sediment, fertilizers and toxic material from entering waterways, stabilize land with deep rooted trees and shrubs, reduce runoff and erosion, allow for more recharging of the ground water supply, offer recreational opportunities and provide economic opportunities.

5.3.10 Aquaculture

There has been intensive interest in shellfish and finfish aquaculture in Tracadie Bay. Beginning in the early 1980s experimentation began with various fish species and growing techniques. Initially there were entrepreneurs who explored growing finfish in land-based facilities and cages in the bays but super-chilled water and ice reduced the economic potential of these ventures.

Shellfish aquaculture ventures of shellfish, especially with oysters and Blue mussels, proved much more successful. The limiting factor for mussel operators was a limited surface area of adequate depth for growing sites. Growers apply to the Federal Department of Fisheries and Oceans to lease both surface water and the bottom for aquaculture production. The map in Figure 11 below shows the current leases. Because shellfish growers want as large an acreage as possible, most of the bays were divided into leases. Concern about food availability for the shellfish, has led to discussions about the maximum amount of product that can be grown. In the case of mussels, a limit on the number of socks per acre of lease was developed. There is currently a moratorium on any further shellfish leasing to ensure there was sufficient food present for existing shell fish leases.

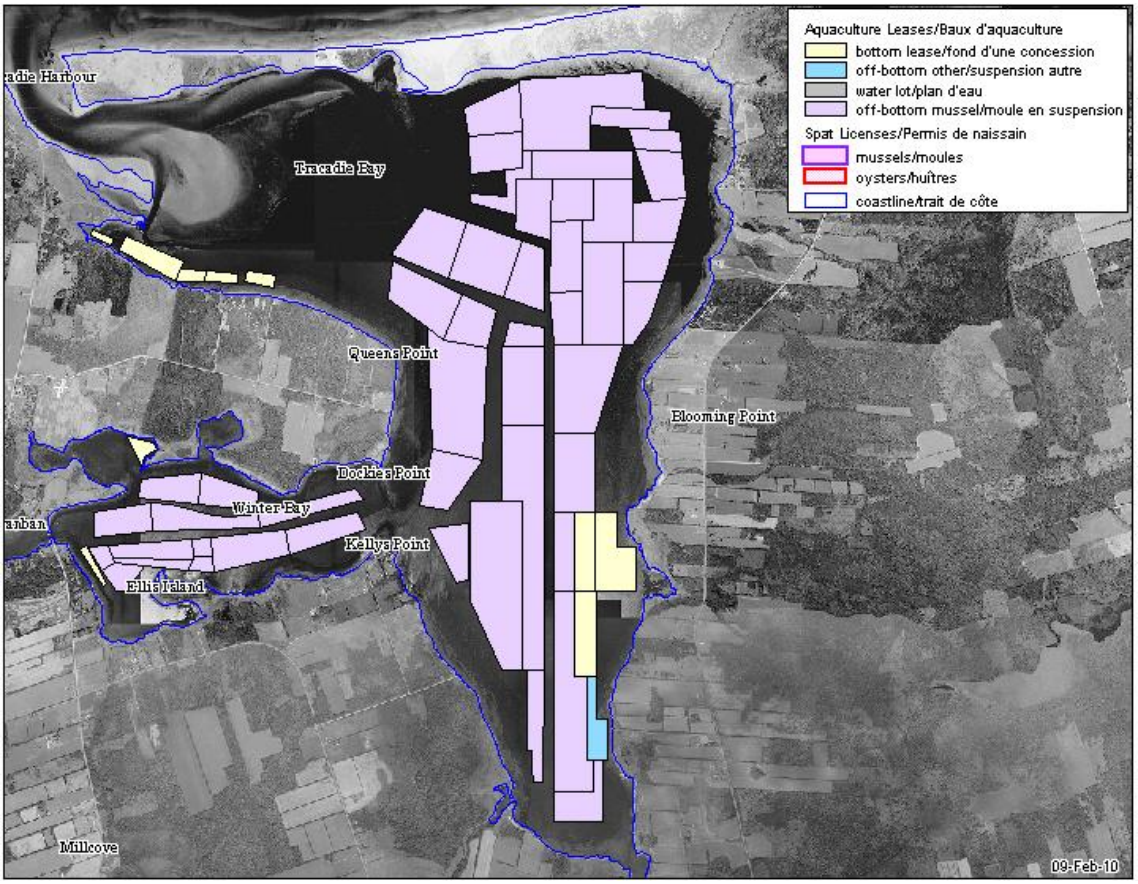

Figure 11: *Aquaculture leases in Tracadie Bay*

The individual species of shellfish grown are discussed below.

5.3.10.1 *Oysters*

There has been an interest in harvesting shellfish since it was carried out by native people who came to PEI seasonally to collect various bivalves. There is a long standing industry in harvesting oysters which continues today. The oysters are carefully managed on the bottom to obtain optimum shape, as the shape plays a major role in determining the value of the oyster. Some growers have experimented with growing oysters in cages off the bottom. By doing so there is better water flow around the oyster, so more food is available with consequent increase in growth. By having the oysters off the bottom their shape is better. Some growers experimented with growing the oysters in Vexar bags on racks placed on the bottom in shallow areas. Others suspended Vexar bags from the surface.

5.3.10.2 *Mussels*

Prior to the mid 1970s there was no mussel aquaculture on PEI. Older residents and stories reported the mussels to be poisonous. Experiments took place in eastern PEI with initial success and aquaculturists in Tracadie Bay began establishing leases. The success was so great that virtually all of the surface water in the estuary was divided into leases. Current landings average about 425,000 kg of mussels with a landed value to fishers of about $535,000. In addition there is value added as the mussels are processed and as well significant quantities of mussel seed are harvested. With the large number of leases and mussels, it soon became evident that there was insufficient food as the length of time for mussels to reach maturity became significantly longer. Research was carried out on food availability in Tracadie Bay by the Department of Fisheries and Oceans and Dalhousie University. As the results showed a lack of available food, an agreement was reached among the fishers to limit the number of socks and hence the volume of mussels being grown in the estuary. There was limited success in this venture. In the early months of 2010 a hole was breached through the dunes in Blooming Point during a major storm. This allows much greater tidal exchange which appears to bring greater food availability for the mussels. The size of the breach in the sand dune system continues to expand (Figure 12).

While aquaculture is a very important activity that provides a source of income for watershed residents, the estuary is now almost exclusively used for aquaculture. Initial plans were to retain routes to provide access between leases but the area for these channels is minimal. There has been concern that the large number of leases precludes other recreational opportunities. As well there has been concern about the impact of shellfish consuming most of the plankton found within the water column. Careful monitoring of estuarial biota was recommended.

Figure 12: *Breach in Blooming Point sand dune system*

There were experimental trials with growing Bay Scallops and Quahogs but there is little work currently being carried out in Tracadie Bay with these species.

5.3.11 Land Development

5.3.11.1 *Residential Development*

As noted elsewhere, many of the residents of the Winter River-Tracadie Bay Watershed work in Charlottetown. The watershed serves as a "bedroom" community with quality of life in non-working time being of importance. Residences with larger lots and nearby outdoor recreation opportunities are important factors to living in rural settings found in the watershed. Residences all need to be able to dispose of sewage and grey water by having septic systems. While these facilities are important in that they return water to the ground water, they also add nitrates and nutrients to the groundwater. To date there have been few restrictions to development, resulting in much strip development within the watershed. Some residents feel that this strip development detracts from the rural nature of the landscape. Some multi-lot subdivisions have been developed as well, with recent activity to capitalize on certain desired environmental features, such as proximity to the river. Since many communities within the watershed are unincorporated, there are no opportunities for community reviews of such development.

Along Tracadie Bay there have been many subdivisions with cottage lots several rows deep. In many cases the cottage lots are small, or more importantly shallow. Erosion is reducing the depth of shore front cottage lots. Some owners have resorted to expensive erosion control techniques, while others will eventually lose their cottages. Again these small lots and associated large number of cottages, each with individual sewage systems release nitrates which soon find their way into Tracadie Bay.

5.3.11.2 *Commercial Development - Shale pits, storage sites and transportation routes*

Shale is a needed commodity for road building and other construction initiatives on PEI. The proximity of the Winter River-Tracadie Bay Watershed to Charlottetown makes mining shale a viable initiative. Sites where shale has been mined are also used to store construction materials such as sand, culverts, pieces of concrete and asphalt. Mining activities related to the operation of pits are controlled by provincial legislation. Mining shale, storing materials and transportation to sites of use requires the use of large equipment and trucks. Concern has been expressed about the presence of large trucks on roads which have a significant number of residences on them. There are currently five active shale pits located in the Winter River-Tracadie Bay Watershed but the number varies from year to year depending on demand. Others have been mined out and restored. The WRTBWA has undertaken a more active restoration initiative of the Vanco pit near Union Road. An educational program was developed for students at L.M. Montgomery and Sherwood Schools and students planted a variety of tree species. Bird nest boxes have been erected. Some land especially where there are high slopes, is owned by construction companies, perhaps for developing future pits.

Shale pits can have a deleterious impact on the environment. Because the soil surface is exposed there is susceptibility to water erosion and the movement of sediment to streams, but this can be minimized with proper mitigation techniques. Some pit owners have expended considerable effort to minimize the amount of sediment leaving the site. There has also been concern expressed about chemicals leaching into the groundwater from material stored on shale sites.

Pit operators are required to restore the terrain following cessation of mining. This has consisted primarily of levelling the pit. Because there is little topsoil, vegetation growth often takes a significant period of time.

Roads can contribute sediment to watercourses, both on public roads and private driveways. Some roads which are not paved can have considerable erosion from the road surface, but there can be even more erosion in the ditches. If the ditches are steep, as the water passes through them water erosion will occur. Public roads are usually the ones that present the greatest erosion problems because they are long and straight. This allows water speed to build up. The Department of Transportation and Infrastructure Renewal has made great efforts to install check dams or rock dams in ditches to slow water. As the water slows, sediment settles out and can be removed, which the department has been carrying out. As well, where unpaved road surfaces are near a watercourse crossing, asphalt millings have been applied to the road surface to reduce erosion which would not have a chance to settle out in the ditch.

There have been significant erosion problems on the unpaved portion of the Suffolk Rd. The Department of Transportation and Infrastructure Renewal (T&IR) has placed milled asphalt on the road surfaces near stream crossings. The banks of the ditches are very steep and erosion has occurred on these surfaces. Erosion has cut into the road surface in places. Check dams were installed by T&IR and cleaned out when full but the movement of sediment into the stream has continued. It is hoped that discussions by WRTB board members with a land owner where much of the sediment and water is originating, will result in changes which will reduce the problem.

5.3.12 Liaison with City of Charlottetown.

Charlottetown has recognized the critical and tenuous status of its water supply in the Winter River watershed. The City has endorsed a policy of environmental sustainability and recognized the need to conserve water. A Water Conservation Officer was hired in 2010 to initiate a water conservation program with public education and school education being critical components. The City has implemented programs to monitor and reduce water consumption, including the following activities completed so far:

a) Requiring all industrial users to have water meters.
b) Requiring all multi-unit dwellings to have water meters.
c) Requiring all new residences to be equipped with water meters.
d) Initiating public education measures to make residents aware of water conservation opportunities,
e) Providing a subsidy program for low flow toilets and other water saving devices to encourage house owners to replace high water usage toilets, faucets and showerheads with low flow versions.
f) Coordinating with various groups and especially the Sierra Club and the Winter River-Tracadie Bay Watershed Association to present in class presentations, followed by on-site tours.
g) Introducing water use restriction guidelines during the dry summer of 2012. These guidelines were changed to bylaws in September, 2012.

There has also been considerable discussion with the city about implementing measures designed to reduce the rate of extraction from Winter River. This has included requests by the Winter River - Tracadie Bay Watershed Association for the city to perform the following activities:

a) Accept the new standard that water extraction from any wellfield should not exceed the sustainable rate, which is 50% of the rate of recharge.

b) Establish annual targets and timetables for reduction in water usage with the aim of meeting the sustainability level for each wellfield.
c) Initiate metering of all water usage so that individual home owners become aware of their usage.
d) Develop a program to urge conservation by large users.
e) Establish "tiered" water rates based on use, with higher rates as more is used.
f) Consider sustainable water use in issuing permits in any new developments.
g) Participate and cooperate with educational campaigns to reduce water usage, such as the "Save some water for me" campaign initiated by the WRTBWA in the summer of 2012.
h) Complete all necessary preparations so that when funding becomes available from the federal government, work can occur immediately to establish an additional wellfield at Miltonvale.
i) Reduce water extraction from the Brackley and Union wellfields when Miltonvale pumping station water becomes available, so that water extraction can be brought down to sustainable levels.

Perhaps most importantly, our watershed group works toward developing an ongoing relationship with the City through meetings with the City Council, the Water and Utilities Commission and Committee, and the City Councillor responsible for water to present our concerns and to discuss options to reduce water consumption from the Winter River Watershed aquifer. We are developing regular meetings to ensure cooperation between staff and managers of the Water and Sewage and Utilities Commission, the City Water Conservation Officer, and the Winter River-Tracadie Bay Watershed Association.

6.0 Watershed Planning Process

Cooperation between all residents and sectors is essential to the development of a plan that everyone can support. While stream enhancement has taken place for almost two decades, it has been over the last few years that an effort was made to secure public input and develop an agreed upon plan to guide our work in future years. Meetings were held to secure public input and a survey was sent to watershed residents. The information provided by these activities has been used to develop this plan.

6.1 Public Awareness and Understanding of Various Topics

A series of public presentations were made to familiarize residents with aspects of the watershed during the fall of 2010 and spring of 2011. Presentations included:

- Agriculture, Agricultural Practices and Opportunities: presented by Shawn Hill, Alternative Land Use Service, Province of PEI; Erica MacIsaac, PEI Department of Agriculture; and Jennifer Roper, PEI Federation of Agriculture.
- Groundwater Management: Yefang Jiang, Hydrogeologist, Province of PEI
- Wetlands: Allie MacLennan, Wetlands Technician, Province of PEI
- Aquaculture: Dr. Jon Grant, Marine Biologist, Fisheries and Oceans and Dalhousie University
- Streams and Recreational Fishing: Rosie MacFarlane, Recreational Fisheries Biologist, Province of PEI
- Climate Change, General: Erin Taylor, Climate Change Coordinator, Province of PEI
- Climate Change, Impact on PEI Forests: Michael Montigny, Forester, Province of PEI

6.2 Opportunity for Public Discussions and Planning

There were two primary opportunities for public input. The first was a meeting on November 23, 2011 which consisted of concurrent sessions which addressed issues that had been brought to the attention of the Winter River-Tracadie Bay Watershed Association Board. Brief presentations were made on five general topics, which were followed by discussions. The general topics included: tidal waters and aquaculture, groundwater and City of Charlottetown use of Winter River groundwater, development and land use, fresh water and freshwater habitats, and agriculture and forestry. Participants had an opportunity to attend sessions on three different topics. Following these sessions, there was a discussion involving all participants to review the items that had been brought forward. The items discussed in each of the sessions were recorded on flip charts which were taped to the walls for the combined session. Those present participated in an activity to establish priorities by providing each person with five stickers to identify topics which they thought most important of those listed on the flip charts. About 40 residents participated in the meeting. The items that participants marked at the public meeting were grouped into general categories, and the results are summarized on the pie chart below (Figure 13) with the specifics discussed under section 7.0, Issues and Concerns.

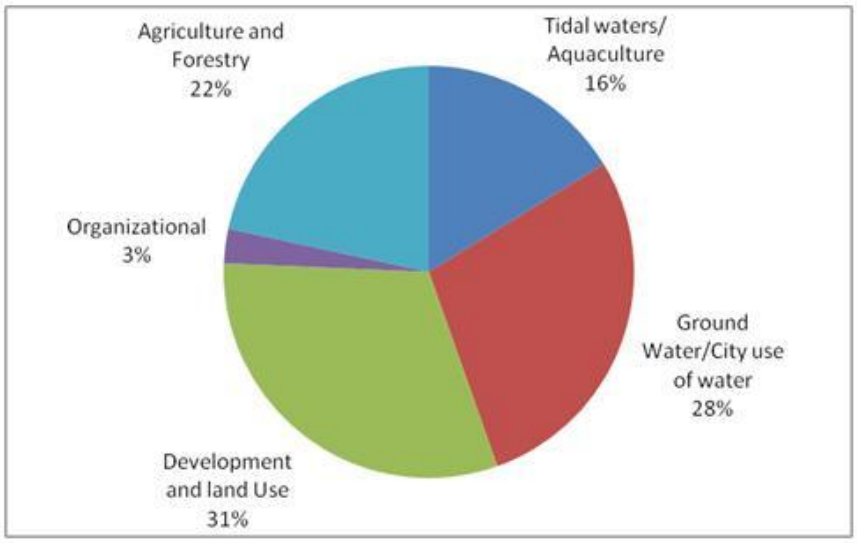

Figure 13: *Identified issues of importance during public meeting*

6.3 **Survey of Residents**

Based on the discussions at the November public meeting, a survey for residents was developed by members of the Board and staff to get additional input from a broader sample of residents and to get more details on interests, hopes and concerns. Approximately 800 residents were contacted via a post card and asked to complete a questionnaire which was posted on the Winter River-Tracadie Bay Watershed Association website. By having a questionnaire which could be completed at home the participants had more time to consider responses and not feel any peer pressure which would have been present at a public meeting. 64 residents participated in the survey. Data from the survey has been summarized in the form of the following graphs and tables. These responses, along with the input from the public meeting, were used to develop the goals, objectives and strategies as identified in section 8.0 of this plan.

Figure 14 summarizes some key characteristics of the respondents. A number made their living in the watershed through tourism (11%) farming (10%), aquaculture (8%) and commercial fishing (3%). Some were involved in more than one sector. Eleven percent indicated they owned a business in the watershed.

I am a year-round resident	92%
I am a land owner	81%
I am a walker/hiker	79%
I have children and/or grandchildren	62%
I enjoy bird watching	60%
I canoe/kayak	41%
I am a recreational fisher	30%
I own a woodlot or forested land	30%
I am involved in tourism	11%
I own a business based in the watershed	11%
I am a farmer	10%
I am involved in aquaculture	8%
I am a commercial fisher	3%
I am a seasonal resident	3%

Figure 14: *Breakdown of residents' activities as a percentage of respondents*

The responses also show that the large majority of the respondents were landowners and year round residents who had had lived in the watershed for ten years or longer (Figure 15).

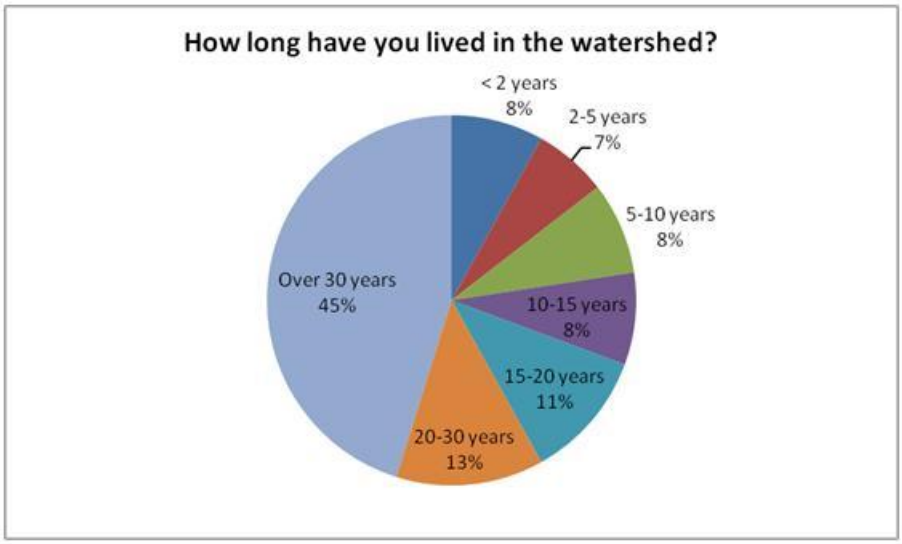

Figure 15: *Years of residency for survey respondents*

Respondents were asked to rank their top three concerns or issues from a list of 11 topics (Figure 16). Water quality, removal of water by the City of Charlottetown and health of bays and streams were the issues most often selected as the top three issues by residents. Water quality and removal of water by the City were most often selected as the most important issue, in each case by over 20% of the residents.

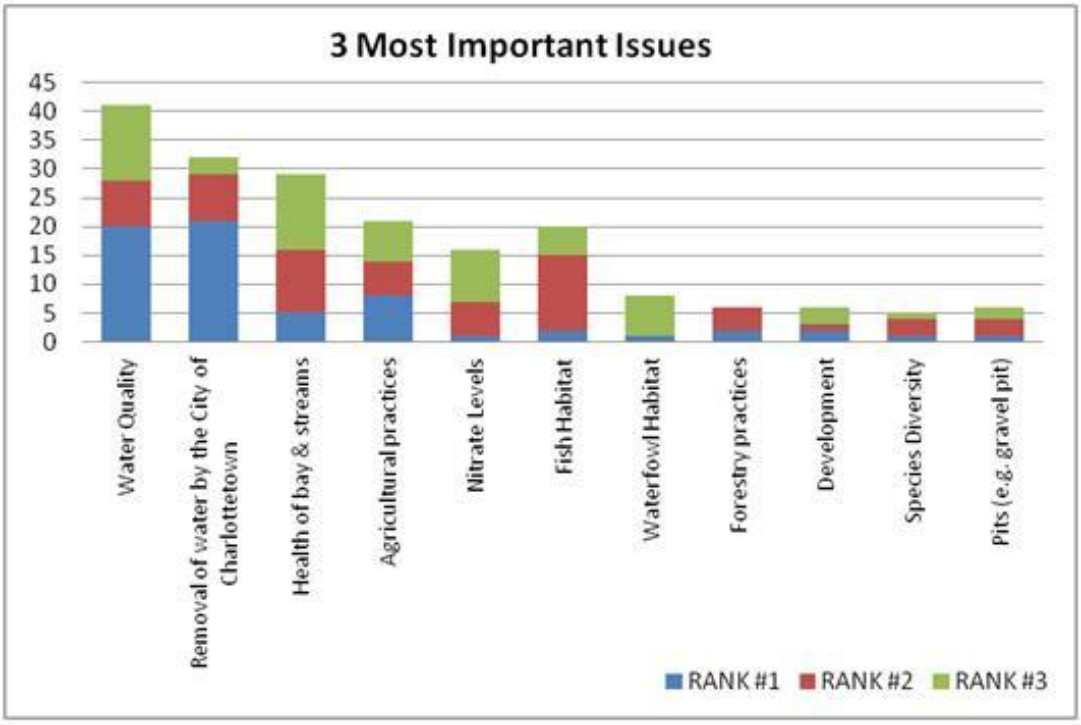

Figure 16: *Important issues identified in survey*

Respondents were asked to rank their three most important visions for the watershed from a list of 11 topics (Figure 17). Sustainable communities, sustainable forestry and walking trails were most frequently endorsed among the top three visions of the respondents. Individually the most important visions identified were organic agriculture (12%) and sustainable communities (10%). The most utilized walking trail in the watershed is the Winter River trail developed by Island Trails, starting at the PEI Wildlife Federation property at Suffolk as shown below in Figure 18.

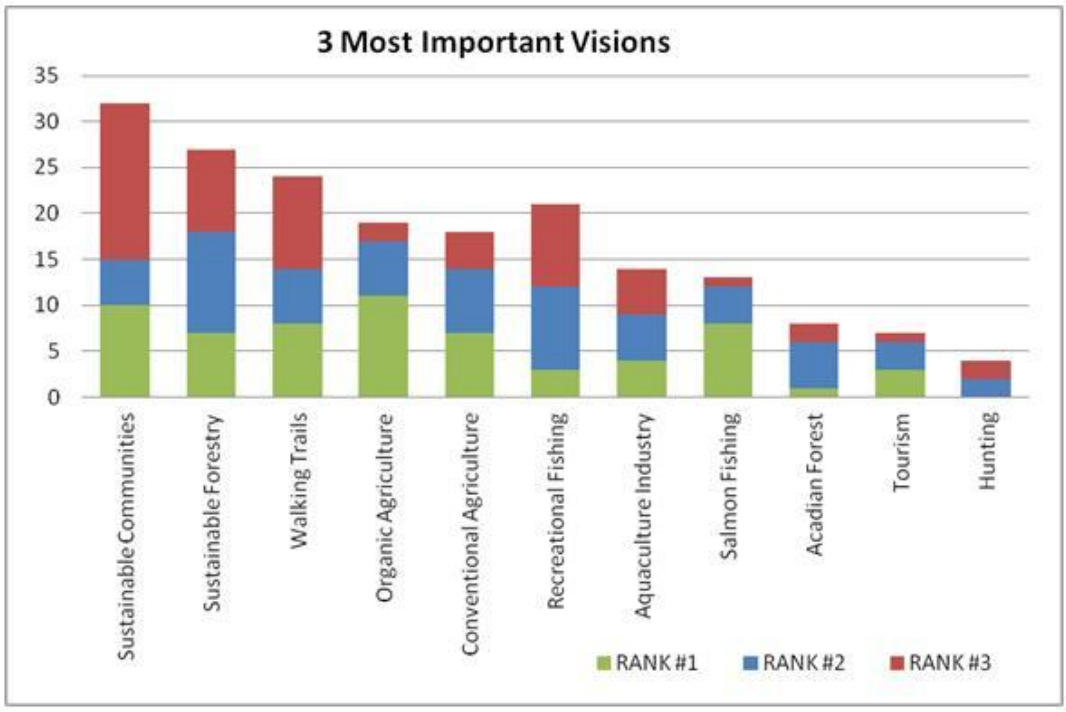

Figure 17: *Visions identified during survey.*

Figure 18: *Map of Winter River Suffolk trail system*

7.0 Issues and Concerns

The details of issues and concerns discussed below have been summarized primarily from the public meeting and the survey results. They are presented in order of their relative priorities to the residents. The visions served as the goals for developing a plan for the watershed. These issues and visions served as the basis for the development of the implementation portion of this document as they were used to develop the goals,

objective to reach the goals and the specific actions or strategies to achieve the goals and objectives which form the basis of section 8.0 of this document.

7.1 Quality of Water

Two related items were identified as concerns. The first is the presence of chemicals in groundwater and drinking water, particularly nitrates. The nitrates originate mainly from fertilizers used in agriculture. The water from wells of some residents is above Canadian Drinking Water Standards. Measures must be taken to reduce the amount of nitrates entering the groundwater.

Groundwater has an impact on surface water as the surface water originates from springs. The concerns about surface water quality are related to temperature and water volume. These concerns in turn are related to a lack of flow of cold water from springs. There is concern that the low flow and high temperatures are negatively impacting fish.

7.2 Quantity of Groundwater - Water Extraction for Charlottetown

There is concern that water extraction by the City of Charlottetown is not sustainable and is impacting the Winter River aquatic environment. This is exemplified by springs not flowing, by one major tributary drying up in 2011 and two drying up in 2012 and by the main channel of the river itself drying up in 2001. In order to reduce extraction from the Winter River, water conservation measures must be expanded in the City of Charlottetown. Action must be taken to reduce demand to an environmentally sustainable level. This will include education, developmental policies and likely the establishment of a new wellfield. Educating the citizens of Charlottetown about water and water conservation was identified as a necessary action.

7.3 Health of Bays and Streams

There is concern about anoxia, or a lack of oxygen in the water, which kills all marine life that cannot move from the zone. Dredging was carried out above the Corran Ban Bridge in 2010, but the effectiveness of this action is not yet known. In 2011 and 2012 there were still anoxic events above the Corran Ban Bridge, which extended downstream, almost into the shellfish leases. The water quality of Tracadie Bay depends on water coming in from the Gulf as well as water coming down from tributaries, of which Winter River is the largest.

It is important for marine health and especially for shellfish propagation that the water flowing into the estuary be a good as possible. The new breach in the sand dune system was thought to be a positive development, as it will increase the mixing of Gulf of St. Lawrence water which contains needed nutrients with the waters of the bay.

It is important, that scientific studies be carried out to inventory the species and numbers of fish, shellfish and other animals in the river and estuary, and to study the long term impact of intensive mussel aquaculture in the estuary, and to study the overall health of Tracadie Bay.

7.4 Agricultural Practices

At the public meeting there was strong concern about runoff from agricultural fields and the effectiveness of buffer zones. It was suggested that current buffer zones and management practices were not preventing silt from getting into the watercourses. There was concern about a lack of enforcement of buffer zone legislations. There was also strong concern about the impact of agricultural activities on groundwater and that there should be increased efforts to work with farmers to implement “best management practices”. In the survey, views

were solicited to determine more details about the scale of agricultural efforts that should be identified in a management plan. The results of the survey indicate that the top three agricultural issues with which our watershed group should be involved are controlling erosion, enhancing buffer zone and reducing nitrate contamination of the ground water (Figure 19). Because of the impact on nitrate leaching and reduction in organic content, as identified by the report of the Commission on Nitrates in Groundwater, some residents suggested that three year rotations should be mandatory with no exceptions, while others believed exceptions could be made with an accepted farm plan. The other two topics which respondents felt were important included making an effort to reduce the application of pesticides and fertilizers through organic farming and increased support for smaller more diversified farms with smaller fields.

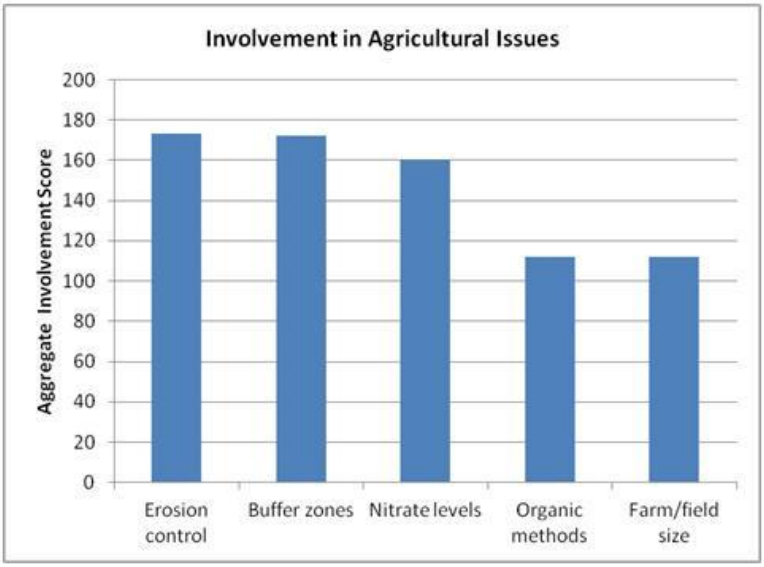

Figure 19: *Suggested involvement level of WRTBWA in agricultural issues*

7.5 **Fish Habitat**

There was concern about the long term degradation of fish habitat. This has included significant infilling by sediments, compounded by the replacement of original riparian zone forests by alders. The alder collapse into the stream causing barriers, slowing the water which in turn causes the silt to accumulate. All of these actions seriously reduce the quality of the fish habitat. A second concern was water quality and quantity in the streams. The lack of a sufficient quantity of cool water increases stream temperatures, and lowers oxygen levels to the point that the river cannot support Brook Trout populations. The lack of flowing springs limit spawning opportunities for Brook Trout. What was once one of the best fishing locations on PEI has been severely compromised.

7.6 **Other Issues**

7.6.1 Waterfowl/Wetland Habitat

Wetland habitat which has been developed as part of a pond initiative must be monitored. While the man-made marshes can increase waterfowl production, as they age they can have a negative impact on water quality for fish. Activities to rejuvenate ponds should be considered, especially if the amount of water extraction can be reduced.

7.6.2 Forestry Practices

Concern was expressed about the level of clear cutting. It was suggested that alternate methods be promoted. It was noted there were no regulations against clear cutting, which yields short term gain but not an enhanced forest community. An incentive program for longer lived forest species and wildlife communities would benefit all Islanders.

7.6.3 Shale Pits

There was concern expressed about shale pits. There was concern about the impact on the environment though run-off into surrounding watercourses and possible water contamination of ground water under storage sites. There was also a concern expressed about noisy industrial activity in an area that has become more residential. The presence of large trucks hauling the shale from pits or materials to pits for storage in a primarily residential area was noted. It was noted that there appeared to be little or no monitoring of pits by government unless a complaint was reported. The development of watershed based municipality was suggested to address development. Such a Watershed based municipality might be able to better integrate development and the environment with overall community wishes.

7.6.4 Species Diversity

It was noted that for many species and especially larger raptors, the changes to the forest communities have made it difficult for them to survive. Tree cavity nesting birds such as Kestrels and barred owls have problems finding nesting sites. Restoring old growth forests and building nest boxes for appropriate species was suggested. PEI's only endangered bird species, the Piping Plover has nested on the Blooming Point sand dune system. Activities to protect the nesting birds should be taken.

7.6.5 Climate Change

While little action can be taken by residents of the Winter River-Tracadie Bay Watershed to have a meaningful effect on the changing climate, there are activities that can be taken to minimize the impact. With more frequent heavy storms generating conditions to increase agricultural erosion, farming practices must be encouraged to minimize this erosion. For coastal areas, erosion is a problem and planning should take place for erosion mitigation, i.e. sufficient setbacks for building construction so that there is a 50 or 75 year buffer before the buildings or associated infrastructure are affected.

8.0 Goals, Objectives and Strategies

Based on the public meetings and survey identified in section 6.0 and the issues and concerns identified in section 7.0, a series of goals, objectives to address these goals, and specific strategies to meet the objectives have been developed. These are listed below in a relative order of priority. Based on the strategies, especially

those categorized as immediate, an operational plan will be developed on an annual basis to address the issues and to guide our work each year.

8.1 **Goal # 1: Improve and Protect Surface Water and Groundwater Quality**

8.1.1 Objective # 1: Reduce the impact of land management practices related to farm practices on surface and ground water quality

8.1.1.1 *Strategies – Immediate (1-3 years)*

- 8.1.1.1.1 Conduct annual surveys of the watercourses to identify sources of silt associated with agriculture and develop solutions to the problems.
- 8.1.1.1.2 Encourage farmers to crop in a way that minimizes soil loss, especially at problem sites. See also 8.6.1.
- 8.1.1.1.3 Develop a program to recognize farmers on the Winter River-Tracadie Bay watershed who exhibit care for the environment through improved farming practices.
- 8.1.1.1.4 Encourage cooperation with agricultural organizations, commodity boards and government departments.
- 8.1.1.1.5 Investigate sudden presence of sediment, red water, to identify source of the problem and develop mitigation. See also 8.5.1.1.7.
- 8.1.1.1.6 Encourage the planting of grasses, shrubs and trees which most effectively utilize excess nutrients.
- 8.1.1.1.7 Monitor groundwater quality and especially nitrates to establish base line levels.
- 8.1.1.1.8 Work with key farmers so that other farmers have peer information available on nutrient management. See also 8.6.2.1.1.
- 8.1.1.1.9 Encourage government to put more emphasis on nutrient management and reward farmers who implement nutrient management plans.

8.1.1.2 *Strategies - Short term (4-6 years)*

- 8.1.1.2.1 Encourage famers to participate in best management programs, Environmental Farm Plans and Alternative Land Use Support (ALUS), which will help reduce nitrate loading of the ground water. See also 5.3.8.3.
- 8.1.1.2.2 Encourage farmers to participate in a nutrient management program. See also 8.6.2.
- 8.1.1.2.3 Monitor groundwater quality and especially nitrates to establish base line levels.
- 8.1.1.2.4 Work with farmers to develop nutrient management plans to minimize over fertilization and leaching of nitrates into the ground water. See also 8.6.2.

8.1.1.2.5 Work with key farmers so that other farmers have peer information available on nutrient management. See also 8.6.2.1.1.

8.1.1.2.6 Encourage government to put more emphasis on nutrient management and reward farmers who implement nutrient management plans.

8.1.1.2.7 Encourage all potato farmers to operate on at least a 3 year potato rotation. See also 8.6.3.2.1

8.1.2 Objective # 2: Reduce the impact of land management practices related to transportation activities on surface and ground water quality

8.1.2.1 *Strategies – Immediate (1-3 years)*

8.1.2.1.1 Carry out yearly inspections of all road crossings to identify sources of surface water problems (silt) associated with roads.

8.1.2.1.2 Work with Department of Transportation and Infrastructure Renewal, especially the Environmental section to address problems of road surfaces contributing sediment to surface water.

8.1.2.1.3 Work with Transportation and Infrastructure Renewal to place hard surface material at all watercourse crossing.

8.1.2.1.4 Work with Charlottetown Airport staff to ensure that the possibility of an aviation fuel spill, which could have very serious implications to the headwaters of Winter River, is minimized.

8.1.3 Objective #3: Reduce the impact of the use and storage of all hazardous materials, by residents, landowners and land users on surface and groundwater quality

8.1.3.1 *Strategies – Immediate (1-3 years)*

8.1.3.1.1 Encourage all residents, landowners and land users to exercise the highest level of care in the use and storage of all hazardous materials (e.g. fuel and heating oil, farm and cosmetic pesticides etc.).

8.1.4 Objective 4: To enhance buffer zones

8.1.4.1 *Strategies – Immediate (1-3 years)*

8.1.4.1.1 Plant buffer zones long lived species of trees and shrubs native to the Acadian forest. These species are also beneficial to wildlife. See also 8.5.1.1.4, 8.7.6.1.1.

8.1.4.1.2 Plant buffer zones with shrubs and trees that will be beneficial to wildlife.

8.1.4.1.3 Ensure that all landowners, not just farmers, are aware of the regulations relating to the requirement to preserve buffer zones. See also 8.1.3.1.1

8.1.4.1.4 Liaise with the City to encourage the development of forest management plans to best protect wellfields and water quality. See also 8.7.2.1.1.

8.1.4.2 *Strategies – Short Term (4-6 years)*

8.1.4.2.1 Encourage land owners to have enlarged buffer zones that will allow increased planting of natural vegetation such as shrubs and trees. See also 8.6.1.1.2.

8.1.4.2.2 Explore opportunities to encourage allowable revenue generating activities, which will in turn encourage larger buffer zones (e.g., ecotourism, alternate species with harvestable nuts or berries).

8.1.4.2.3 Develop initiatives which will allow restoration and enhancement of buffer zones without conflicting with regulations. See also 8.7.1.1.3.

8.2 **Goal # 2: Protect Groundwater Quantity**

8.2.1 Objective 1: To work toward reducing the City of Charlottetown's water extraction from the Winter River watershed to sustainable levels[2] within 5 years.

8.2.1.1 *Strategies – Immediate (1-3 years)*

8.2.1.1.1 Work with city to:

8.2.1.1.1.1 Accept the goal of sustainable extraction and develop criteria of sustainable extraction for each well field.

8.2.1.1.1.2 Develop and implement yearly water reduction targets to achieve sustainable extraction within this time frame.

8.2.1.1.1.3 Encourage the development and operation of alternate wellfields outside the Winter River watershed to reduce extraction from the Winter River.

8.2.1.1.1.4 Encourage the development of a longer term regional water development plan so that once

[2] At the time of preparation of this document, the acknowledged standard of sustainable extraction was 50% of recharge at each wellfield. In December, 2012, after we had prepared a draft of this document that was the basis of public consultations we held in November, 2012, the Department of the Environment informed us that they were in the process of developing new criteria of sustainability related to percentage of stream flow. Presumably, this new standard will have implications for the permitted level of extraction from the different wellfields in our watershed.

While we await the development of the new criteria for sustainability (% of stream flow), we will continue to frame our objectives and strategies in this document in terms of the recharge criteria (i.e. 50% of recharge at each wellfield). Once the new criteria for sustainable extraction become operative, we will modify our objectives and strategies to reflect this change. But our ongoing 'objective' is to reduce water extraction to sustainable levels, however it is defined, and to work with the City, and the province to achieve this end.

Miltonvale is operational there is sufficient lead time planning so that extraction from the existing watersheds is not compromised.

8.2.1.1.1.5 Encourage universal metering and tiered rate structures as measures to reduce extraction.

8.2.1.1.1.6 Liaise with the City water conservation officer to raise awareness about limited water supplies and promote water conservation programs.

8.2.1.1.1.7 Ensure that sustainable water use is considered in all new development permits.

8.2.1.1.2 Work with the provincial government to:

8.2.1.1.2.1 Endorse the standard of sustainable extraction for each wellfield.

8.2.1.1.2.2 Require City water extraction to be based on the standard of sustainability at each well field.

8.2.1.1.2.3 Encourage the sustainable extraction levels be met within five years.

8.2.1.1.2.4 Develop water extraction targets with timelines to meet sustainable extraction levels.

8.2.1.1.2.5 Encourage the provincial government to convert all water using devices to low flow/low usage in all provincial buildings in Charlottetown.

8.2.1.1.2.6 Encourage the Province to coordinate with City to facilitate the development of an alternate wellfield outside the Winter River watershed so that extraction from Winter River can be reduced.

8.2.1.1.3 Work with all levels of government to ensure all necessary action has taken place to ensure that action to develop the new Miltonvale wellfield takes place as soon as funding is available.

8.2.1.1.4 Develop programs that encourage all water users to reduce their water use.

8.2.1.1.5 Develop a “Friends of the Winter River” program to recognize leadership in water conservation with particular attention to businesses and institutions that are “large users”.

8.2.1.1.6 Promote the “Save Some Water for Me” campaign.

8.2.1.1.7 Encourage the city officials to work with federal and provincial representatives to initiate the development of the Miltonvale wellfield as soon as possible.

8.2.1.2 *Strategies – Short term (4-6 years)*

8.2.1.2.1 Monitor city water reduction targets toward achieving the sustainability standard within this time frame.

8.2.1.2.2 Encourage the province to make changes to the building codes and other acts related to water consumption to mandate changes that will require the use of such things as low-flow toilets and reduced flow shower heads.

8.2.2 Objective 2: To participate more actively in policy and decision making about the use of water from the Winter River watershed

8.2.2.1 *Strategies – Immediate (1-3 years)*

8.2.2.1.1 Maintain close cooperation and discussions with staff and managers of the Charlottetown Sewer and Water Utility.

8.2.2.1.2 Encourage the development of a regional body to look at the long term water requirements for the City of Charlottetown so that there will not be a need to increase water extraction from any wellfield above sustainable levels.

8.2.2.1.3 To work toward being included in such a regional body, and in creating its policies and participating in the decision making process.

8.3 **Goal # 3: Raise Public Awareness of the Importance of Water**

See also 8.11.2, 8.11.5.1.2

8.3.1 Objective 1: Develop and deliver activities to educate adults on the importance of water (including water conservation, idea of watersheds, uses of water)

8.3.1.1 *Strategies – Immediate (1-3 years)*

8.3.1.1.1 Liaise with city to co-ordinate the development and delivery of water awareness activities.

8.3.1.1.2 Conduct a literature search to identify and summarize the water awareness activities (e.g., pamphlets, videos, field trips) being delivered in other jurisdictions.

8.3.1.1.3 Identify the water awareness activities most feasible to deliver in the short term.

8.3.1.1.4 Evaluate the success of delivered activities to change or improve future activities.

8.3.2 Objective 2: Develop and deliver activities to educate students on the importance of water (including water conservation, idea of watersheds, uses of water)

8.3.2.1 *Strategies – Immediate (1-3 years)*

8.3.2.1.1 Liaise with educators and other environmental groups to identify and assess water awareness programming currently being delivered in the school system.

8.3.2.1.2 Identify opportunities for additional programming (as necessary) with the possibility of including field trips to Winter River.

8.3.2.1.3 Liaise with youth groups within the City and the watershed for the purposes of identifying, developing and delivering water awareness programming.

8.3.2.2 *Strategies – Short Term (4-6 years)*

8.3.2.2.1 Work with educators to have presentations about water made in classrooms at various grade levels followed by field trips to Winter River.

8.3.2.2.2 Work with educators to have water identified as a more important item in the curriculum.

8.4 **Goal # 4: Protect and Enhance the Health of Bays and Estuaries**

8.4.1 Objective 1: Protect health of the estuary

8.4.1.1 *Strategies – Immediate (1-3 years)*

8.4.1.1.1 Ensure that buffer zones are being implemented to reduce the flow of chemicals and silt into streams, which generates eutrophication and anaerobic conditions in the estuary. See also 8.1.4 and 8.7.1.1.3.

8.4.1.1.2 Work with farmers to minimize the addition of nutrients to surface and ground water which eventually leads to anaerobic conditions in the estuary. See also 8.6.2, and 8.1.1.2.2.

8.4.1.1.3 Monitor stream conditions to identify and minimize impacts on the estuary. See also 8.1.3.1.1, 8.5.1.1.9, 8.5.1.1.11, 8.5.1.1.12, 8.5.2 and 8.5.4.2.1.

8.4.1.1.4 Encourage government and post secondary institutions to initiate monitoring research to identify changes in the estuarial ecosystem.

8.4.1.1.5 Have information on estuarial conditions, especially levels of anoxia, collected by provincial and federal staff available on the WRTBWA web site.

8.4.1.1.6 Examine space allocation for aquaculture and recreational opportunities.

8.4.1.1.7 Work with local aquaculture fishers and aquaculture organizations to reduce wastes from growing activities from washing up on the beaches.

8.5 **Goal # 5: Protect and Enhance the Freshwater Ecosystem**

8.5.1 Objective 1: Enhance in-stream aquatic habitat

8.5.1.1 *Strategies – Immediate (1-3 years)*

- 8.5.1.1.1 Clean springs to encourage water flow.
- 8.5.1.1.2 Conduct annual maintenance to remove debris and fallen trees from stream.
- 8.5.1.1.3 Construct and maintain brush mats and silt traps to trap silt.
- 8.5.1.1.4 Plant long lived native trees in the riparian zone. See also 8.1.4.1.1.
- 8.5.1.1.5 Drain and dredge ponds as funding permits.
- 8.5.1.1.6 Work with City to prevent tributaries from going dry. See also 8.2.
- 8.5.1.1.7 When "red water" is seen, survey the river to identify the source of the silt. See also 8.1.1.1.5.
- 8.5.1.1.8 Develop mitigation measures when sources of silt are found.
- 8.5.1.1.9 Conduct electrofishing surveys to establish benchmark population levels and to monitor changes.
- 8.5.1.1.10 Conduct an assessment of fish habitat and determine the need for in-stream structures such as digger logs, cover logs and deflectors.
- 8.5.1.1.11 Establish a temperature monitoring system using thermo recorders.
- 8.5.1.1.12 Establish a protocol to monitor oxygen levels in ponds and stream.

8.5.1.2 *Strategies – Short Term (4-6 years)*

- 8.5.1.2.1 Monitor fish populations at fish traps at regular intervals, for example, once every 3 or 5 years. See also 8.5.2.1.1.
- 8.5.1.2.2 Develop pond management plans for Officers Pond and Hardy Mill Pond.
- 8.5.1.2.3 Enhance spawning opportunities by improving access to springs and enhancing spring habitat where appropriate.
- 8.5.1.2.4 Explore techniques to monitor silt load and turbidity in the main tributaries.
- 8.5.1.2.5 Develop a beaver management plan for Winter River which will identify beaver dam free zones to ensure access to spawning habitat for all native species.

8.5.1.3 *Strategies – Long Term (7-15 years)*

- 8.5.1.3.1 Use media, local newsletter and web sites to promote the importance of a healthy stream and riparian zone.

8.5.2 Objective 2: To monitor and enhance fish populations

8.5.2.1 *Strategies – Short Term (4-6 years)*

8.5.2.1.1 Operate a fish trap at both Officers Pond and Hardy Mill Pond fishways at 3-5 year intervals to monitor populations of fish moving through the fishway. See also 8.5.1.2.1.

8.5.2.1.2 Develop index sites which could be assessed every five years using an electrofisher to identify numbers, species and sizes of resident fish.

8.5.2.2 *Strategies – Long Term (7-15 years)*

8.5.2.2.1 Explore opportunities to re-establish populations of fish species which have been extirpated from the river such as Atlantic salmon.

8.5.3 Objective 3: To enhance fish passage

8.5.3.1 *Strategies – Immediate (1-3 years)*

8.5.3.1.1 Work with Transportation and Infrastructure Renewal to correct fish passage problems at road culverts.

8.5.3.1.2 Work with landowners to permit the construction of check dams on private property to provide fish access to culverts.

8.5.3.1.3 Conduct surveys every two months to ensure no beaver dams have been built in the beaver dam free area.

8.5.3.1.4 Initiate a study to determine the effectiveness of the Officers Pond fishway to pass Gaspereau.

8.5.3.2 *Strategies – Short Term (4-6 years)*

8.5.3.2.1 Have all watercourse crossings (culverts) capable of fish passage.

8.5.3.3 *Strategies – Long Term (7-15 years)*

8.5.3.3.1 Work with the Department of Fisheries and Oceans and Ducks Unlimited to evaluate the effectiveness of the two fishways on the Winter River in passing Alewife and Blue-back Herring (Gaspereau).

8.5.4 Objective 4: To enhance wetland habitat without jeopardizing water quality

8.5.4.1 *Strategies– Immediate (1-3 years)*

8.5.4.1.1 In conjunction with the owners and/or managers, develop plans which will maximize benefits to waterfowl but minimize negative impacts to fish.

8.5.4.1.2 Develop a beaver management plan.

8.5.4.2 *Strategies – Short Term (4-6 years)*

8.5.4.2.1 Review the beaver management plan on a biannual basis, to make sure it continues to address the situation.

8.5.4.2.2 Conduct bathymetric survey to monitor sediment infilling every 3 or 5 years.

8.5.4.3 *Strategies – Long Term (7-15 years)*

8.5.4.3.1 Review programs to remove silt from ponds, which may include draw downs, excavation and possible removal of one pond.

8.6 **Goal # 6: Improve Agricultural Practices to Minimize Negative Impacts on the Watershed**

8.6.1 Objective 1: To modify agricultural practices to reduce soil erosion

8.6.1.1 *Strategies – Immediate (1-3 years)*

8.6.1.1.1 Encourage management practices as identified by the PEI Department of Agriculture "Best Management Practices" guidelines.

8.6.1.1.2 Encourage use of the Provincial Department of Agriculture and Forestry "Alternative Land Use Services" program, which pays farmers for environmentally beneficial activities beyond those that are required by legislation. See reference for P.E.I. Department of Agriculture and Forestry.

8.6.1.2 *Strategies – Short Term (4-6 years)*

8.6.1.2.1 Develop a program with farmers, so that all farmers can become familiar with alternate techniques.

8.6.2 Objective 2: To modify agricultural practices to reduce excessive nutrient loads

8.6.2.1 *Strategies – Immediate (1-3 years)*

8.6.2.1.1 Develop nutrient management programs with willing farmers. See also **Error! Reference source not found.**.

8.6.2.2 *Strategies – Short Term (4-6 years)*

8.6.2.2.1 Extend nutrient management to more farmers.

8.6.2.2.2 Work with farmers to develop nutrient management demonstration sites, possibly involving those who participated in the pilot program.

8.6.2.3 *Strategies – Long Term (7-15 years)*

8.6.2.3.1 Develop farm tours so the public can gain a better understanding of the challenges faced by farmers.

8.6.3 Objective 3: Change of cropping practice to minimize environmental damage

8.6.3.1 *Strategies – Immediate (1-3 years)*

8.6.3.1.1 Identify problem locations where most damage is occurring and most work needs to be done.

8.6.3.2 *Strategies – Short Term (4-6 years)*

8.6.3.2.1 Work with farmers to encourage a change in practices, such as evaluating crop rotation practices and phasing out rotations that are most damaging. See also 8.1.1.2.7.

8.6.3.3 *Strategies – Long Term (7-15 years)*

8.6.3.3.1 Encourage farmers to try other farming techniques such as organic agriculture.

8.6.4 Objective 4: Develop an list of watershed health indicators

8.6.4.1 *Strategies – Immediate (1-3 years)*

8.6.4.1.1 Examine organic content of soil tests to determine soil health

8.6.4.2 *Strategies – Short term (4-6 years)*

8.6.4.2.1 Develop a compilation of soil information to help farmers assessing nutrient management and to serve as an indicator of watershed health. Changes would be recorded and would help in validating government developed models.

8.6.4.3 *Strategies – Long Term (7-15 years)*

8.6.4.3.1 In conjunction with the Forest, Fish and Wildlife Division, post-secondary educational institutions and other watershed groups, develop a list of animal and plant species which would serve as indicators of watershed health.

8.7 **Goal # 7: Enhance Forest Management**

8.7.1 Objective 1: To make landowners of forests aware of management options

8.7.1.1 *Strategies – Immediate (1-3 years)*

8.7.1.1.1 Encourage landowners to consider forest management program opportunities offered by the Forest, Fish and Wildlife division of the PEI government which allows management plans to be prepared by consultants and contractors, and informs landowners about how they can apply and qualify for funding.

8.7.1.1.2 Have public tours of sites that are being managed using improved techniques that illustrate the environmental and economic benefits of sustainable forestry management.

8.7.1.1.3 Develop initiatives which will support the restoration and enhancement of buffer zones without conflicting with regulations. See also 8.6.1.1.2.

8.7.1.1.4 In conjunction with the Forest, Fish and Wildlife Division, work with landowners to encourage the development of forest management plans for each property. Emphasis should be on sustainable forest harvesting and restoration of the Acadian Forest as well as alternate income generating activities.

8.7.1.2 *Strategies – Short Term (4-6 years)*

8.7.1.2.1 Work with government to have financial benefits available to those using improved long term forest management in the same manner that ALUS operated.

8.7.2 Objective 2: Target environmentally sensitive lands (wellfields, flood plains, steep slopes, headwaters stream sides) for forest management, conservation and restoration

8.7.2.1 *Strategies – Immediate (1-3 years)*

8.7.2.1.1 Liaise with City to identify goals for forest management and further planting on City owned lands. See also 8.1.4.1.4

8.7.2.1.2 Liaise with pit owners to identify goals for restoration activities. See also 8.8.2.

8.7.2.1.3 Liaise with Forest, Fish and Wildlife Division and encourage landowners to seek out qualified consultants and contractors who will prepare sustainable forest management plans. See also 8.7.1.2.1.

8.7.3 Objective 3: Develop forest management plans for overly mature short lived forests

8.7.3.1 *Strategies – Immediate (1-3 years)*

8.7.3.1.1 To encourage landowners to develop a forest management plan based on periodic site assessments of tree growth (known as performance based assessments), which will be delivered by a qualified consultant and/or contractor as approved by the Government of PEI. See also 8.7.2.1.3.

8.7.3.1.2 Obtain educational material to assist landowners with information to identify forest management opportunities and to participate in field days and tours. See also 8.7.1.1.2.

8.7.4 Objective 4: Promote forest stewardship and endorse the connection that forests have on the health of people, land, soil, water quality and habitat.

8.7.4.1 *Strategies – Immediate (1-3 years)*

8.7.4.1.1 Include articles in WRTBWA newsletter and/or website about opportunities for enhanced forest stewardship and forest management initiatives.

8.7.5 Objective 5: To raise public aware about the importance of forested areas in the long term, low cost protection of water supplies

8.7.5.1 *Strategies – Immediate (1-3 Years)*

8.7.5.1.1 Develop and deliver information for watershed residents about the importance of forests in the long term, low cost, protection of water supplies. See also 8.3.

8.7.6 Objective 6: To enhance forest habitat in the riparian zone

8.7.6.1 *Strategies – Immediate (1-3 years)*

8.7.6.1.1 Continue planting riparian zone with trees and shrubs to benefit wildlife and restore an Acadian forest using student and volunteer labour. See also 8.1.4.1.1.

8.8 **Goal # 8: Improve Management of Shale Pits/Storage Pits and Associated Activities**

8.8.1 Objective 1: To minimize environmental degradation at shale pits.

8.8.1.1 *Strategies– Immediate (1-3 years)*

8.8.1.1.1 Work with landowners to ensure material does not escape from the site.

8.8.2 Objective 2: To maximize restoration of habitat at pits

8.8.2.1 *Strategies – Immediate (1-3 years)*

8.8.2.1.1 Work with landowners to secure permission to encourage cooperation in restoration initiatives by having volunteers, staff and students restore the site though vegetation planting.

8.9 **Goal # 9: Enhance Recreational Opportunities and Promote Active Living**

8.9.1 Objective 1: Encourage activities that promote and utilize the features of the watershed

8.9.1.1 *Strategies - Immediate (1-3 Years)*

8.9.1.1.1 Evaluate currently available outdoor recreational activities.

8.9.1.1.2 Work with currently active groups to promote physical activities (ex. go!PEI, Island Trails).

8.9.1.1.3 Encourage the development of new groups to promote additional outdoor opportunities.

8.9.1.1.4 Develop events that will encourage people to be outdoors.

8.9.1.1.5 Initiate community based activities such as skating parties, orienteering events, snowshoeing, hikes and fly fishing introductions.

8.9.1.1.6 Work with the City of Charlottetown to have all city property open for non motorized recreational activities.

8.9.1.2 *Strategies – Short Term (4-6 years)*

8.9.1.2.1 Develop and promote the existing recreational fishery.

8.9.1.2.2 Develop brochures and other materials to promote outdoor activities.

8.9.1.2.3 Work with City of Charlottetown to develop recreational opportunities such as hiking trails on their land.

8.9.1.3 *Strategies – Long Term (7-15 years)*

8.9.1.3.1 Initiate a partnership with government and recreational groups to host events in the watershed.

8.9.1.3.2 Work with fishing groups to develop an annual family fishing initiative.

8.10 **Goal # 10: Develop Goals, Objectives and Strategies to Address Environmental Issues for Other Watersheds Flowing into Tracadie Bay.**

8.10.1 Objective 1: To identify issues affecting watersheds flowing into Tracadie Bay from the southern and easterly directions.

8.10.1.1 *Strategies – Immediate (1-3 years)*

8.10.1.1.1 Conduct surveys of other tributaries to identify environmental problems.

8.10.1.1.2 Develop plans to address environmental problems.

8.10.1.1.3 Meet with residents of that area to review plans.

8.10.1.2 *Strategies – Short Term (4-6 years)*

8.10.1.2.1 To develop management plans for some of the other watersheds in this area.

8.10.1.3 *Strategies – Long Term (7-15 years)*

8.10.1.3.1 To complete management plans for all watersheds that flow into Tracadie.

8.11 Goal # 11: Incorporate Sustainability as a Guiding Principle in our Approach to Environmental, Economic and Social Issues within the Watershed

8.11.1 Objective 1: Develop a community endorsed definition of "sustainable community"

8.11.1.1 *Strategies – Immediate (1-3 years)*

- 8.11.1.1.1 Review literature and approaches to sustainable communities and report on these findings.
- 8.11.1.1.2 Hold public meetings to obtain community input for this definition.

8.11.2 Objective 2: Provide public education about sustainability in diverse areas

8.11.2.1 *Strategies – Immediate (1-3 years)*

- 8.11.2.1.1 Present a series of public talks related to sustainability on such topics as sustainable agriculture, forestry, aquaculture, business and development, tourism, consumption, etc.
- 8.11.2.1.2 Develop materials that will encourage sustainable and ecologically friendly approaches and "best management practices" in these areas.

8.11.3 Objective 3: Promote and facilitate the development of sustainable and environmentally supportive ways of living and making a living within the watershed

8.11.3.1 *Strategies – Immediate (1-3 years)*

- 8.11.3.1.1 Distribute materials related to sustainability widely within the watershed community.

8.11.3.2 *Strategies – Short term (4-6 years)*

- 8.11.3.2.1 Develop a means of recognizing and "certifying" sustainable enterprises and businesses with the watershed, similar to the "Friends of the Winter River" program.
- 8.11.3.2.2 Develop and promote farm tours as an income generating activity as well as an educational activity.

8.11.3.3 *Strategies – Long term (7-15 years)*

- 8.11.3.3.1 Facilitate the planning for long term sustainable development in conjunction with different groups (e.g., agriculture, aquaculture, tourism) that make a living in the watershed.

8.11.4 Objective 4: Encourage the development of government programs in support of sustainability

8.11.4.1 *Strategies – Immediate (1-3 years)*

8.11.4.1.1 Encourage government programs to base rewards, incentives and support on sustainable practices in business, agriculture, etc.

8.11.5 Objective 5: Reduce the "ecological footprint" within the watershed community to more sustainable levels, including both carbon and water footprints.

8.11.5.1 *Strategies – Immediate (1-3 years)*

8.11.5.1.1 Review literature related to these footprints.
8.11.5.1.2 Develop materials for public education.
8.11.5.1.3 Develop and administer a survey to obtain baseline data within the watershed.
8.11.5.1.4 Collaborate with the provincial Climate Change coordinator to develop a Winter River-Tracadie Bay Watershed climate change plan.

8.11.5.2 *Strategies – Short Term (4-6 years)*

8.11.5.2.1 Reduce our 'footprints' by a "significant amount" (identified through literature review and public consultation).
8.11.5.2.2 Implement and monitor the watershed climate change plan.

8.11.5.3 *Strategies – Long Term (7-15 years)*

8.11.5.3.1 Continue to reduce our footprint to achieve an agreed upon 'high standard' of sustainability consistent with the practice of the most sustainable communities.
8.11.5.3.2 Continue to educate residents about the ecosystem and aesthetic impacts of litter on watershed habitat.

9.0 Implementation

The watershed management plan reviews the watershed, identifies problems and concerns of residents and proposes goals, objectives and strategies to address these problems and achieve the visions of the residents. The strategies have time lines associated with them in order to guide initiatives. As the environment within the watershed changes, as actions outside the watershed, which impact the watershed, change, and the wishes of residents change it will be necessary to modify and update this document. The document on its own will not make improvement, but will serve to guide the residents and those associated with the Winter River- Tracadie Bay Watershed Association. Residents, both those who have lived on the watershed all their lives and have chosen to stay there, and residents who have more recently chosen to live in the watershed, have a common bond, a love for the watershed. All residents are encouraged to contact member of the Winter River-Tracadie Bay Watershed Association with recommendations for improvements to the plan, or to help with the implementation of the various strategies contained within the plan.

10.0 Annotated Glossary

ALUS Program The Alternative Land Use Service program, operated by the provincial government, which provides financial incentives to farmers to pay for environmentally beneficial activities. These activities usually involve the use of Best Management Practices.

Anaerobic Without oxygen. Anaerobic conditions in streams involve water without oxygen. Normally in streams, decomposition takes place in the presence of oxygen and material breaks down without much smell. With anaerobic decomposition there is often a smell, sometimes like rotten eggs when sulphur is involved. *See also Anoxia.*

Anoxia A condition characterized by an absence of oxygen. Low oxygen in water often results from eutrophication. Nutrient loading accelerates plant growth, then too much vegetation uses up the available sunlight (by shading the vegetation below), causing some vegetation to die and rot which also uses up oxygen. Decomposition in anaerobic conditions can create bad odours. Many Island estuaries become anoxic annually, turning milky white and killing all biota caught within the area. This is often called an anoxic event. See also Anaerobic.

> *Further note on Anaerobic/Anoxia: Anoxic conditions can be worst at night when photosynthesis, in which plants use sunlight to create food and oxygen, is not occurring. This is particularly the case on ponds with abundant algae, which turns the water a green colour. During the day the algae produce oxygen, sometimes making the water super saturated with oxygen, while at night the oxygen level may drop below 5 mg/L making the site lethal to fish. Anoxic events on Winter River usually take place in the estuary but have taken place in Hardy's Pond during very low flow water conditions. In an estuary, when anoxic conditions occur, there is often a milky colour on the bottom and clams and oysters die. If the anaerobic conditions expand to the whole water column turns white and other sedentary marine organisms may suffer. Fish usually move away from the area.*

Aquifer An underground layer of water-bearing permeable rock or material from which water can be extracted. The top border of the aquifer is the water table. Well water, which provides all PEI domestic and industrial water, is extracted from aquifers. Aquifers fill very slowly.

Bacterial Contamination The presence of unacceptable levels of bacteria. The presence of bacteria can render water unusable for drinking, aquaculture or even swimming. The bacteria usually come from faecal coliform. While some bacterial contamination can be traced to faulty septic systems, the presence of cattle in or near streams or runoff from manure piles can contribute to the problem.

Beaver Management Plan A plan to manage the beaver population in a watershed. Beaver have positive and negative impacts to other wildlife. The plan serves to balance these positive and negative impacts.

Beneficial Management Practices (BMP) An agricultural management practice designed to meet crop and/or livestock production, while at the same time promoting environmental quality and sustainability. Now referred to as Better Management Practices.

Buffer zone A protective region next to an area of ecological importance. Buffer zones on PEI are most often related to water-bodies. Current legislation thoroughly restricts activity within 15 m of a body of water. Legislated buffer zones regulate agricultural and forestry activities to protect the riparian zone habitat and water quality.

Brush Mats An assemblage of branches and boughs fastened to stream edges where sediment will naturally settle out. The brush mats will trap the silt, and can eventually form a new stream bank. The mats also serve to

narrow the stream. Because sediment in the watercourse is one of the biggest problems facing fish habitat, this cheap and effective technique to remove or stabilize migrating silt is used extensively by most fish habitat enhancement projects.

Dissolved Oxygen (DO) The amount of oxygen dissolved in water. Cold water can contain much higher amounts of oxygen than warm water. Most fish species require dissolved oxygen levels of 5 mg/L or more to survive. Low dissolved oxygen can occur during warm summer weather, when vegetation is decomposing (following eutrophication). Low DO can occur when ice and snow restrict the movement of oxygen between the air and the water. Ice and snow also limit sunlight which aquatic plants need for oxygen generating photosynthesis.

Erosion The action of water, wind and ice that moves soil. Usually refers to soil and associated chemicals moving from fields into nearby water bodies. Moving water is the primary cause of erosion, which is increased by highly sloped land and/or long uninterrupted fields which allow water to build up speed. Erosion is particularly important in reference to sediment filling in streams, fertilizer runoff causing eutrophication and loss of topsoil. Erosion is worst from late fall to spring when there is little or no groundcover. This is common when potatoes are harvested late in the fall, after the time when ground cover can be established.

Eutrophication A process by which a water body becomes enriched with excessive dissolved nutrients. This may lead to excess plant growth, possibly leading to anoxic conditions when the plants die.

Fecal Coliform A group of bacteria including some that are contained in the excrement of warm blooded animals, such as E. coli. Acceptable levels have been set, above which certain activities such as drinking, aquaculture or bathing are not permitted.

Fish Habitat Locations in water bodies with appropriate conditions for supporting various stages of fish life, including spawning grounds, juvenile rearing areas, adult holding areas, and overwintering areas, all with proper cover. Fish must be able to move between these various habitat locations.

Ground water Water below the surface of the earth. On PEI all water for human consumption comes from ground water, brought to the surface by wells. Ground water, found in aquifers, may be very old, sometimes having been present for centuries in that aquifer. Springs originate from ground water, where the water table is at the surface. If the water table is lowered by the extraction of water from the aquifer, the springs will cease to flow.

Hydrologic (Water) Cycle A description or depiction which describes the continuous movement of water on, above and below the surface of the earth. It includes precipitation, evaporation, groundwater flow, stream flow, etc.

Nitrate (NO_3) Nitrate is a water soluble form of nitrogen, and is a primary nutrient needed for plant production. It is one of three main chemicals needed for maximum productivity, listed first in naming the concentration of fertilizers, e.g. 40-20-20.Nitrates are highly water soluble and can leach into ground water, emerging later from springs. Health Canada has established maximum recommended concentrations in drinking water for humans at 10 mg/L. Some well water samples in the Winter River area exceed 15 mg/L. High levels of nitrates contribute to eutrophication. It is considered one of the most serious chemical contaminants to ground water on PEI.

Nitrite (NO_2-) A form of nitrogen. It can be created from ammonia (NH_3) and can turn into nitrate (NO_3-). It can also form nitric acid which causes the soil to be more acidic.

Nutrient Enrichment An increase in available nutrients. Fertilizers increase the chemical nutrients in soil and allow increased yields. Excess nutrients not used by plants can end up in streams via erosion or groundwater via leaching. Extra nutrients in water bodies can cause excess vegetative growth. See also eutrophication.

Nutrient Management Plan An agricultural management plan developed to supply enough nutrients to maximize plant growth, while minimizing unused nutrients which can cause eutrophication.

Phosphorous It is one of three main chemicals found in fertilizers. It is the second number of the three found in the naming of fertilizers e.g. 17-17-17. Its chemical symbol is P. It is not very soluble in water but binds with soil particles and moves into watercourses via erosion. High levels of phosphorous contribute to eutrophication of water bodies, especially in fresh water. Is a primary limiting factor in fresh water plant production, so when found in ponds, it will accelerate vegetative growth and can cause eutrophication.

Potassium It is one of the three essential chemicals found in fertilizers without which crop production may be limited. It is the third number of the three found in the naming of fertilizers e.g. 17-17-17. Its chemical symbol is K. It does not leave fields as readily as the Nitrogen or Phosphorous and therefore is less of an issue for water quality.

Recharge The process of replacing water in an aquifer with rain water. This is usually calculated on a watershed basis and can be used to determine the amount of water that can be extracted. It is generally accepted that extracting a volume equal to 50% of the total rainfall in an area is sustainable.

Riparian Zone This is the interface between the land and a river or stream. The width is not defined. The zone includes the upland areas adjacent to and nearby a watercourse. Riparian areas can include stream and river banks or lakeshores and are associated with all types of watercourses including swamps, wetlands, tributaries, side channels and intermittently wetted areas. The area is very important for wildlife. In the past riparian zones were often damaged by cattle drinking from streams, but since this is no longer permitted, restoration efforts such as tree planting are common in these areas.

Sediment The material which is eroded from exposed surfaces such as fields, roads and ditches. It is made up of soil, often topsoil, and includes organic material and chemical nutrients such as phosphorous. The movement of sediments is one of the important factors in destroying habitat, for fish, other aquatic vertebrates and invertebrates. Sediments can destroy critical fish habitat as well as asphyxiate fish eggs by covering fish redds (nests).

Silt trap A depression in a watercourse into which silt (sediment) is naturally deposited. To artificially trap silt from stream ecosystems, holes can be dug into which silt will settle as it moves down the watercourse. There are two main types: bypass ponds and in stream silt traps.

> Bypass ponds are one form of silt trap. These are large holes dug next to a stream into which water is temporarily diverted. Water slows down in the pool allowing suspended silt to settle. After the pool has filled with silt, the water is diverted back into the original stream bed and the silt is then excavated. Bypass ponds are preferred over in-stream silt traps as there is less disturbance of the stream and less sediment is released.
>
> In-stream silt traps involve the removal of all fish from a site during construction, then a hole is dug in the stream bed. Silt fences are established to minimize the movement of silt during construction. The area of the trap is larger than the old stream bed, so the water slows down and silt settles out. When the hole has filled with sediment, it is then re-excavated. When first constructed, in-stream silt traps serve as artificial pools for fish.

Watershed An area of land from which all surface water drains into one river system. Thus all of the land where rain falls and eventually makes its way into the Winter River is considered the Winter River watershed. Also known as a drainage basin.

Wellfield A group of wells in an area. These groups can draw more water collectively than could be drawn by one larger well. There are three well fields, each having between 4 and 6 individual wells, in the Winter River area which supply the City of Charlottetown. These wellfields are located in Brackley, Union Road, and Suffolk.

Wellfield Protection Additional safeguards for the area immediately surrounding wellfields which supply a public water system. Well fields provide significant quantities of water for human consumption. If contaminants enter the aquifer, the water that is pumped may be unfit for human consumption. In order to reduce the possibility of contaminating the area, only limited activities are permitted. This often means acquiring the land to manage its use. Examples of contaminants could be chemicals such as petroleum products or pesticides.

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