Healthy Lake Huron

Clean Water, Clean Beaches

Integrated Watershed Management Plan

Integrated Watershed Management Plan

PINE RIVER WATERSHED INITIATIVE NETWORK

SAUGEEN CONSERVATION

Ontario

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Acknowledgements

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A great deal of support was also provided by Cathy Farrell and Jim Armstrong of PRWIN who acted as secretary and PRWIN representative on the IWMP committee.

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Foreword

In 2000, a group of local concerned citizens contacted the Huron-Kinloss Council requesting support for the establishment of a committee focused upon making environmental improvements within the Pine River Watershed. The Pine River Watershed Initiative Network (PRWIN) became a committee of Council in 2005.

In February of 2008, PRWIN became an independent organization and established a constitution to govern its operation. PRWIN obtained charitable status and is incorporated in the Province of Ontario. PRWIN is a committee of volunteers, including land owners and residents along the Lake Huron shore within the watershed, who share the common vision of "Clean water and a healthy ecosystem within the Pine River Watershed". Various organizations have representatives sitting as non-voting members on the PRWIN committee as resource personnel, including Saugeen Valley Conservation Authority (SVCA), Lake Huron Centre for Coastal Conservation, Grey Bruce Health Unit, Bruce Resource Stewardship Network, the Municipality of Huron-Kinloss and Bruce County Federation of Agriculture.

Through the efforts of PRWIN's Directors, and the cooperation and support of the Municipality of Huron- Kinloss and SVCA, PRWIN projects have been very successful. The neighbouring conservation areas of Maitland Valley Conservation Authority and Ausauble Bayfield Conservation Authority are supporters of our efforts and the Lake Huron Southeast Shore Executive Steering Committee recognizes PRWIN as an organization that has demonstrated its capability to complete projects in the Pine River Watershed.

Over the years PRWIN has planted over 150,000 trees and built many kilometres of exclusion fencing, livestock water crossings and several alternate water sources. It has supported the research and evaluation of nitrate filters and initiated an educational outreach program for elementary school students.

PRWIN's major funding has come from Environment Canada through the Eco-Action program. PRWIN could not function as a committee without the funding from EC that pays the costs of getting the projects into the ground. Funds from other organizations such as the Municipality of Huron- Kinloss, Lake Huron Framework, Ontario Power Generation, Trillium, Ontario Community Environment Fund, Bruce Resource Stewardship Network, Beach Associations and private individuals, enables us to cover PRWIN's administration cost which includes negotiating with the land owners and planning the projects.

To date PRWIN has been able to hire a Project Co-ordinator on short term contracts. Sustainable, long term funding that covers more than one or two years would allow for a longer-term approach to project planning.

Moving into the future PRWIN plans to continue completing projects that will improve the environmental quality of the Pine River Watershed. The SVCA's 2008 Report Card on the Pine River Watershed will be used as a basis for measuring success. PRWIN plans to promote the creation of new wetlands and build on our support for nitrate filters. Plans also include the development of an education program for both students and adults, and seminars emphasizing good stewardship practices along the lakeshore. These are projects that will span more than one or two years and will require multi-year funding commitments to succeed.

J.K. Armstrong, Chairperson PRWIN

EXECUTIVE SUMMARY

The past 20 years has seen an increase in water quality issues, including nuisance algae and beaches posted as unsafe for swimming, in the Pine River Watershed and along the entire reach of the Southeast shores of Lake Huron. These problems are caused by a combination of nutrient and bacterial pollution from private septic systems, municipal wastewater, agriculture, and natural sources.

A team of dedicated environmental professionals have come together to coordinate actions that will improve overall water quality along the southeast shores of Lake Huron. This group, called the Lake Huron Southeast Shores Committee (the "Committee"), is leading the Healthy Lake Huron – Clean Water, Clean Beaches campaign.

Figure 1 - Map showing the Southeast shore of Lake Huron

The Committee identified the Pine River Sub-Watershed as one of the five priority areas for immediate action. The Committee works with local partners, such as the Pine River Watershed Initiative Network, to develop and support the implementation of watershed management plans, with specific targeted actions, as well as monitoring and research needs.

PRWIN has developed a strong education and outreach program at local events to promote the importance of land stewardship. The PRWIN logo is a common site across the landscape of Huron-Kinloss. PRWIN, its partners and volunteers continue to work together toward a goal of a cleaner river and cleaner Lake Huron[1]. Through the process of creating this plan, it has been determined that

[1] Healthy Lake Huron – Clean Water, Clean Beaches Newsletter. Summer, 2011

there are five critical areas of focus for the PRWIN in order to continue grow and succeed over the next five years.

1. Maintain organizational strength of PRWIN by maintaining strong relationships with
    a. Volunteers
    b. Landowners
    c. Funders and community partners
2. Increase capacity for water storage on landscape. Projects will include:
    a. Increase and protect all Wetland areas
    b. Tile shut off valves
    c. Increasing Meanders
    d. Increasing pool to riffle ratio in channels
3. Increasing Permanent or Semi-permanent vegetation on the Landscape focusing on:
    a. Increasing total Forest/Tree Cover
    b. Cover Crops
    c. Increasing Riparian Buffer strips
4. Education & Outreach
    a. School Programs
    b. Community Events
    c. Experiential Outdoor Education Centre
5. Increase erosion control mechanisms
    a. Bank Stabilization structures

Maintaining the strength of the PRWIN is listed as the number one priority because without the commitment of the volunteer board of directors, the continued support of funders and a strong network of landowners and volunteers, the other four areas are unachievable.

For PRWIN, the intent of this Plan is to build on PRWIN's success at completing projects within the Pine River Watershed and to show that much more can be done as we move into the future. It is all depends on sustainable funding. PRWIN, as independent incorporated organization with charitable status is completely dependent on funding it can apply for and successfully achieve. As PRWIN developed over the last few years it has become more evident that our costs of "doing business" can be split into two categories.

The first is the cost of putting projects into the ground. These costs include the cost of trees, fences and other infrastructures involved in completing projects. At present these costs are mainly covered by the Environment Canada Eco-Action program.

The second is the administration costs to support the existence of PRWIN. PRWIN has found that the position of a project coordinator under contract to PRWIN and a PRWIN office in the community is essential to be effective. It is the duty of the project coordinator, with the support of PRWIN Directors, to seek out landowners who are willing to participate in projects. Our outreach and education programs are run by the project coordinator. At present, funds to support the administration costs are coming from donations made by beach associations, private individuals and corporations located in the community and grants such as the Trillium Foundation. This source of funding, although welcomed and appreciated, is not secure for long range project planning.

As PRWIN moves into the future, although such projects as tree planting and exclusion fencing will continue to be important, more complex projects are planned. Projects to increase water storage on the landscape, land use, protection of wetland will require more organization, planning and cooperation with municipality and conservation areas, all taking more time, effort and funding to implement. The benefit to the watershed warrants the effort.

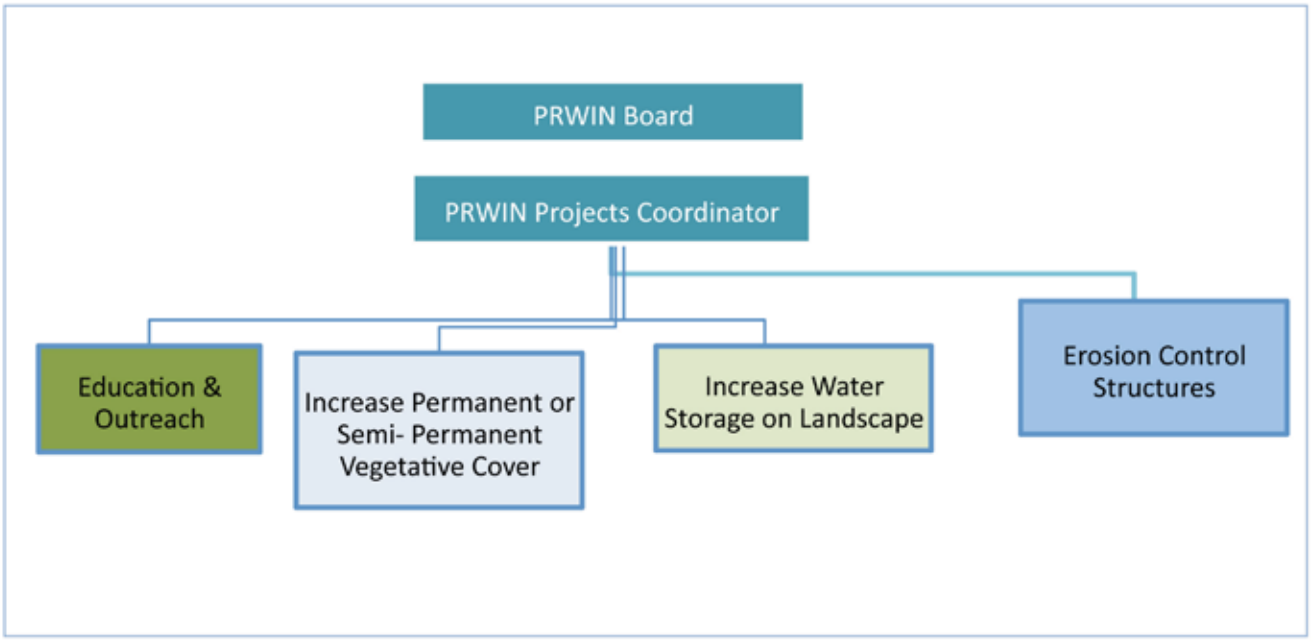
To be effective and efficient, independent groups like PRWIN, need sustainable funding in order to finance themselves and their projects into the future.

Governance

The Pine River Watershed Initiative Network consists of 12 directors that include representatives of the following stakeholder groups:

Agriculture 4 directors
At Large 4 directors
Bruce Beach Association
Lurgan Beach / Blair's Grove Association
Pine River Boat Club
Point Clark Beach Association
The following organizations may send Resource Representatives
Saugeen Valley Conservation Authority
Lake Huron Centre for Coastal Conservation
Bruce Grey Owen Sound Health Unit
Bruce Resource Stewardship Network
Bruce County Federation of Agriculture
Municipality of Huron Kinloss

PRWIN is the umbrella organization, contracting a Project Coordinator to oversee the administration of projects in the core areas: Education & Outreach, Vegetation Increase & Water Storage. Projects undertaken in these core areas may extend beyond the boundaries of the Pine River Watershed, but would fall under the PRWIN umbrella.



Goals

Embedded in PRWIN's constitution are the following Goals:

1. To research, organize and participate in projects designed to improve and preserve the environment as it relates to the Pine River Watershed and the Township of Huron-Kinloss.

2. To educate and increase the public's understanding of the Pine River Watershed and its importance by offering courses, seminars, conferences and meetings and by collecting and disseminating information on that topic.

3. To provide information to the public on existing or new programs and funding which can improve the Pine River Watershed.

4. To assist other like minded environmental groups where possible to achieve "clean water and a healthy ecosystem."

Achievements

Between the Years 2006 & 2011, PRWIN and Partners have:

- Planted 183 155 Trees
- Installed 9 km of fencing
- Constructed 4 cattle crossings
- 4 Nitrate filters installed
- Completed 68 ecological restoration projects
- Restored approximately 20 km of Riparian Buffer

Project Rationale

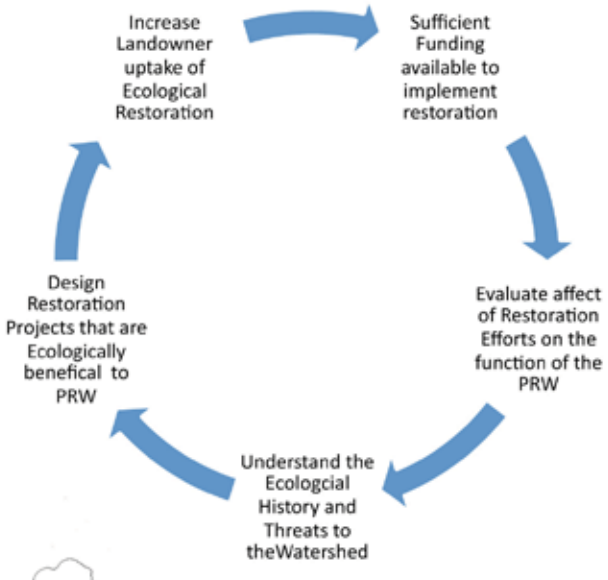
In January 2011 the Ministry of the Environment at a steering committee for the Southeast Shores Working Group endorsed the Pine River as a priority watershed and were willing to fund the development of an "Action Plan" to Identify priority areas to target for improvement measures over the next five years. PRWIN was assigned the task to develop this Integrated Watershed Management Plan to identify those areas of priority and outline a five year action plan for the improvement of the Pine River Watershed.

To date PRWIN has progressed through the years in its understanding of the Pine River Watershed. At its outset PRWIN was positioned for success as its founding members were longtime residents of the watershed's communities: Point Clark; Lurgan Beach; Blairs Grove; Ripley and the rural agricultural community. Most board members have lived through 5 to 6 decades of change in this landscape and have a personalized history of how the watershed's function has changed through time. A large volume of anecdotal evidence has been collected over time by PRWIN, charting agricultural trends typical of the "Green Revolution" of the late 1950's, as it affected the PRW, through to the present time. Many of the board members resided in the area before the shift away from semi-subsistence farming became a reality. It was based on the observations of many that the following prediction was made: The change in the size of agricultural fields has affected the removal of trees on the landscape: in islolated swamp forests, hedge rows and riparian buffers over the last several decades. Corresponding trends have been observed: higher amounts of topsoil erosion; fewer fish in streams; higher flow volumes in the spring freshette; greater presence of nuisance algae in the near shore. It was believed, during the formation of PRWIN that there was sufficient anecdotal evidence in the PRW and enough data gathered in other watersheds to link these two sets of trends and to actively begin restoring tree cover to try and combat deleterious water quality.

Through the group's successful decade of restoring ecological integrity to riparian buffer strips in the watershed, the PRWIN aligned itself with the municipality of Huron-Kinloss and SVCA to actively gather a detailed data set to measure total phosphorous and nitrate as well as *E. coli* levels in the watershed. Hence PRWIN now has a preliminary data set to begin analysing the watershed as a whole, in a quantitative as well as qualitative way. PRWIN has implemented positive environmental change in a multifaceted manner through working partnerships with local industry and volunteer groups, the MOE and Environment Canada. It is hoped that the evaluation of this quantitative data of environmental indicators, gathered for this report, will help to guide PRWIN in their efforts to exact further restoration of Pine River's water quality and ecosystem health.

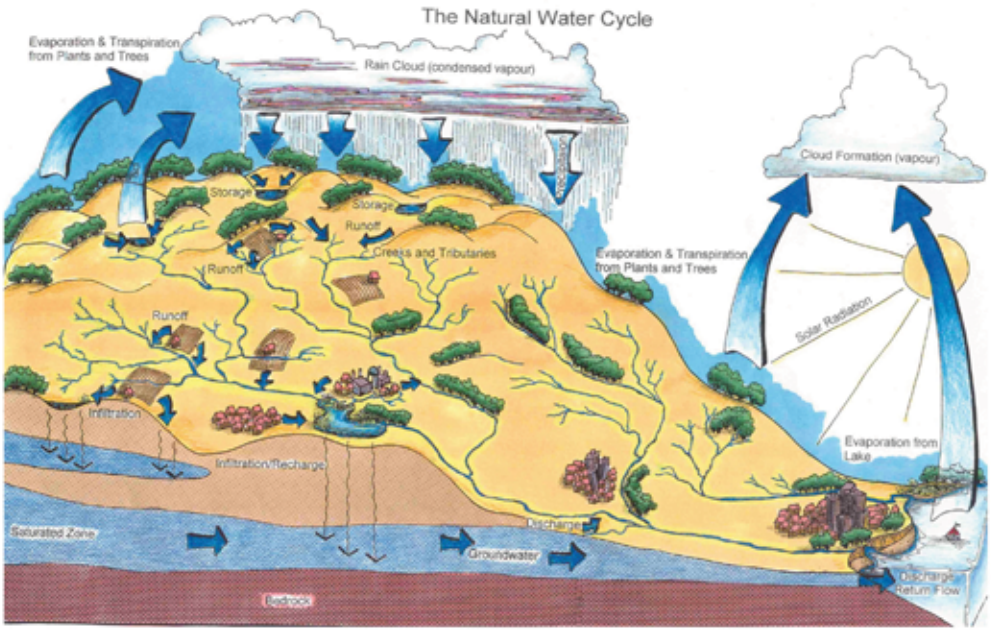
The PRWIN, along with various partners, have developed this Integrated Watershed Management Plan as an endeavor to fully address the problem of deleterious water quality in Pine River through consideration of the geological, hydrological, ecological, economic, and social environments of the Watershed. Recommendations have been designed to ultimately increase landowner uptake and funding of projects deemed beneficial to the health of the Pine River Watershed.

Figure 2 - Project Development Process



What is a watershed?

Figure 3 - A Watershed: Defined by hydrology



A watershed is an area of land that water flows across or through on its way to a particular water body, such as a stream, river, wetland or coast. [2]

Watersheds are important because they provide important habitat for both aquatic and terrestrial wildlife. They provide people, industries and animals with drinking water and support recreational uses of water such as swimming and boating.

Anything that occurs on land can directly affect streams, rivers, lakes and the groundwater. Contaminants can reach watercourses through sewers, drains, runoff, and infiltration.[3]

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[2] *Drinking Water Source Protection – Saugeen, Grey Sauble, Northern Bruce Peninsula Source Protection Region. http://www.waterprotection.ca/resources/r-download.htm on September 29, 2011.*

What is watershed management planning?

Watershed management planning is an integrated approach to management of environmental resources through the collaboration of all partners and stakeholders. The collaboration allows those involved in watershed protection to define and analyze risk towards a goal of resolving social and ecological challenges for the common good. This approach moves beyond conventional particular site or species management towards a consideration of the implications of species interactions, economic and demographic trends and parameters, habitat and ecosystem linkages, and cumulative effects.

There are five stages defined for the Integrated Watershed Management process, and each stage is intended to be a "big picture" approach to ensuring watershed health. The five stages include planning, implementation, monitoring and reporting, and review.

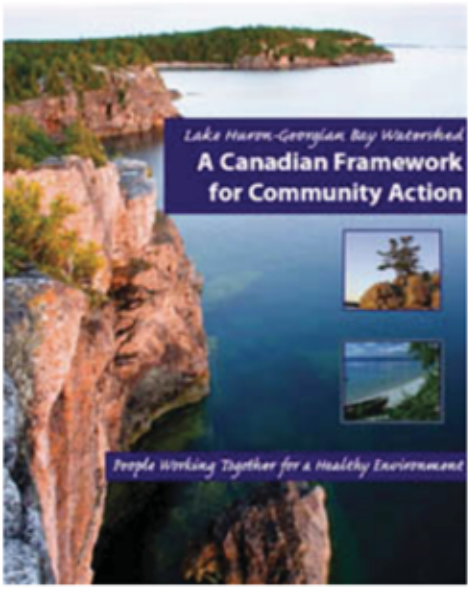

Figure 4 - Lake Huron Georgian Bay Watershed Planning Document

Through this process, project partners work together to:

- characterize the watershed system and its influences,
- scope the nature of environmental challenges within the watershed,
- set goals, objectives and working targets,
- develop and select preferred management alternatives and finalize targets,
- evaluate progress through implementation and monitoring plans. [4]

Lake Huron Framework for Community Action

The Lake Huron-Georgian Bay Watershed Canadian Framework for Community Action promote a people based approach to promote community action to respond to environmental issues across the watershed. It works on the belief that each individual, community and organization in the watershed operates independently, yet are united by the common cause of improving environmental health. The Framework is a watershed wide approach intended to connect the actions of government and non government organizations, raise awareness about common environmental issues and actions and builds upon the existing strengths and opportunities in our communities by:

- Encouraging active participation to identify common issues and resource stewardship:
- Promoting environmentally responsible decisions and activities throughout the watershed;
- Establishing a shared network of contact people and environmental information; and
- Promoting local restoration and protection initiatives that can be adopted and implemented.

Through the principles of the Framework, we will build awareness, support collaborative networks, and initiate pilot projects so that we may all learn and benefit from our efforts.[5]

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[3] All About Watersheds. Environment Canada. As viewed online at http://www.ec.gc.ca/geocache/default.asp?lang=en&n=065E5744-1 on September 29, 2011.

[4] Navigating Ontario's Future – Overview of Integrated Watershed Management in Ontario. Conservation Ontario. Newmarket, Ontario. 2010.

Where is the Pine River Watershed?

The Pine River is a sub-watershed of the larger Lake Huron Basin. The Pine River sub-watershed covers 160 km^2 and enters Lake Huron at Lurgan Beach. The Pine River Watershed Initiative Network, SVCA and the Municipality of Huron Kinloss often include the 30 km^2 Clark Creek Watershed in restoration and monitoring efforts, as this sub-watershed is directly adjacent to the PRW, within the same municipality and shares the same gammet of landuse practices and environmental concerns. In total Clark Creek and the Pine River Watershed encompass 190 km^2 of land, which also supports the sub-watershed of Jardine Creek . It is located in Bruce County, Township of Huron-Kinloss and includes the Village of Ripley, and the residential areas of Pine River, Point Clark, Lurgan Beach/Blairs Grove and Bruce Beach. The Pine River itself travels through 34 km of picturesque and agricultural land.[6]

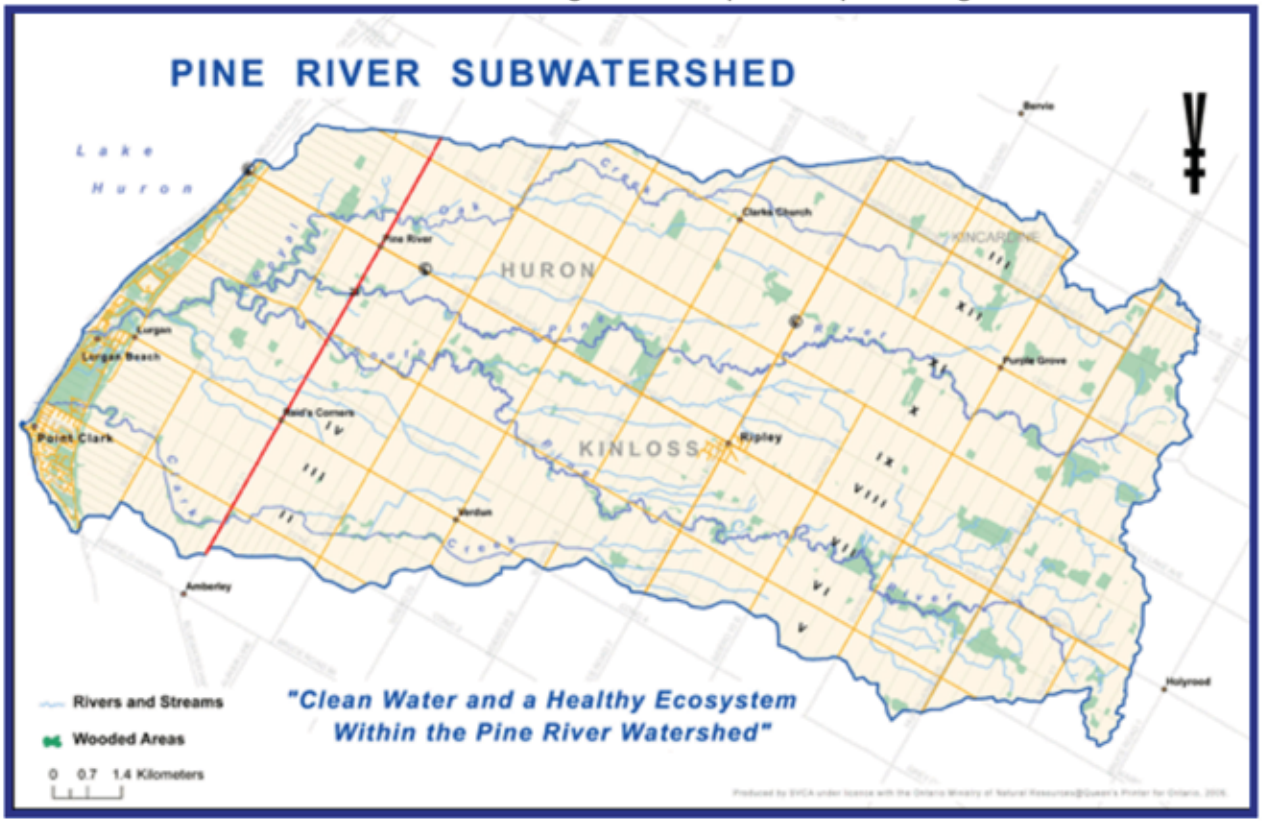

Figure 5 - The Pine River Watershed

It has been estimated that approximately 160 years ago over 50% of the Pine River watershed was covered with wetlands. Today the Pine River has less than 4% total wetland.[7] Wetlands are a mechanism of storing water on the landscape and their loss in the PRW means that when a drop of water hits the land in the Pine River watershed, it takes a number of hours rather than a number of weeks to find its way out to Lake Huron. The resulting impacts include increased drainage speed leading to more severe stream bank erosion as well as significant soil loss. Increased runoff of nutrients into tributaries and the Lake Huron basin leads to an increase in algae growth, an issue that is both unsightly and potentially harmful to human health.

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[5] Lake Huron – Georgian Bay Watershed – A Canadian Framework for Community Action. As viewed at http://www.lakehuroncommunityaction.ca/index.php?option=com_content&view=article&id=76&Itemid=113 on September 29, 2011.

[6] Sourcewater Protection Committee Assessment Report. 2011

[7] Harbinson, Jo-Anne, and Kleinecke, Rene. Saugeen Valley Conservation Authority

Ecological and Cultural History of the Pine River

Since the time of Lake Algonquin, humans have used the ecosystems of this landscape to provide sustenance, shelter, clean drinking water, and resources to support their various cultures. The early to late Woodlands cultures employed many evolving combinations of trade, based on locally available resources and finely honed artisan skills, hunting and gathering, and plant-based agriculture to sustain their communities. An analysis of artifacts found in seasonal hunting and fishing camps gives an insight into species make up of the watershed's ecosystems pre-contact.

Prior to the Treaty of 1836, the Pine River Watershed would have been part of the traditional territory of the Anishnabe People, who current land is held in Reserve in the Communities of Saugeen First Nations and Neyashingaming further North. Prior to and long after the official opening up of the "Queens bush" in 1852 to European settlement Metis and Anishnabe Peoples made use of the natural corridors along the Huron Fringe and Riparian Forests as seasonal camps, many of which had locations coinciding with important and abundant fish habitat. There are three Late Woodland sites registered around the mouth of Pine River. All were recorded in the 1950s -- not much known about them (especially their precise location), but collections are at the Canadian Museum of Civilization (Fitzgerald, 2011). It is assumed that excavations combined with Traditional Ecological Knowledge from the Anishnabe and Metis Peoples of Bruce County would give us an excellent snapshot of species composition of the PRW up to the early 1900's.

Beginning around the 1830s, a commercial fishing operation began in the Goderich area, whose main catch included lake trout and lake sturgeon as a by-catch. Clearing the land for agriculture and settlement resulted in the loss of the majority of forested land contributing to a population crash in these stocks within a period of roughly 50 years(Coastal Centre Conference, 2010). In 1852, Huron Township became open for European Settlement and was settled primarily by People from the Isle of Lewis in Scotland. In order to ascertain your rights as a settler and to hold claim over your land one had to clear the landscape rapidly and erect at least one or two structures. During this period the lumber industry boomed in this area of southern Bruce County. However the rapid clear cutting left many piles of dry branches across the country side and many largescale forest fires affected this area during the late 1800's. With the last of the fires came the last of the lumber industry, mills closed down and agriculture became the

Above left: Figure 6 - Points found at Lurgan Site in Pine River Watershed. (Cale, 2011)
Above right: Figure 7 - A Metis camp (Perhaps late summer) near the bridge at Lurgan Beach over the Pine River in 1918 (Photo courtesy of Bill Fitzgerald)

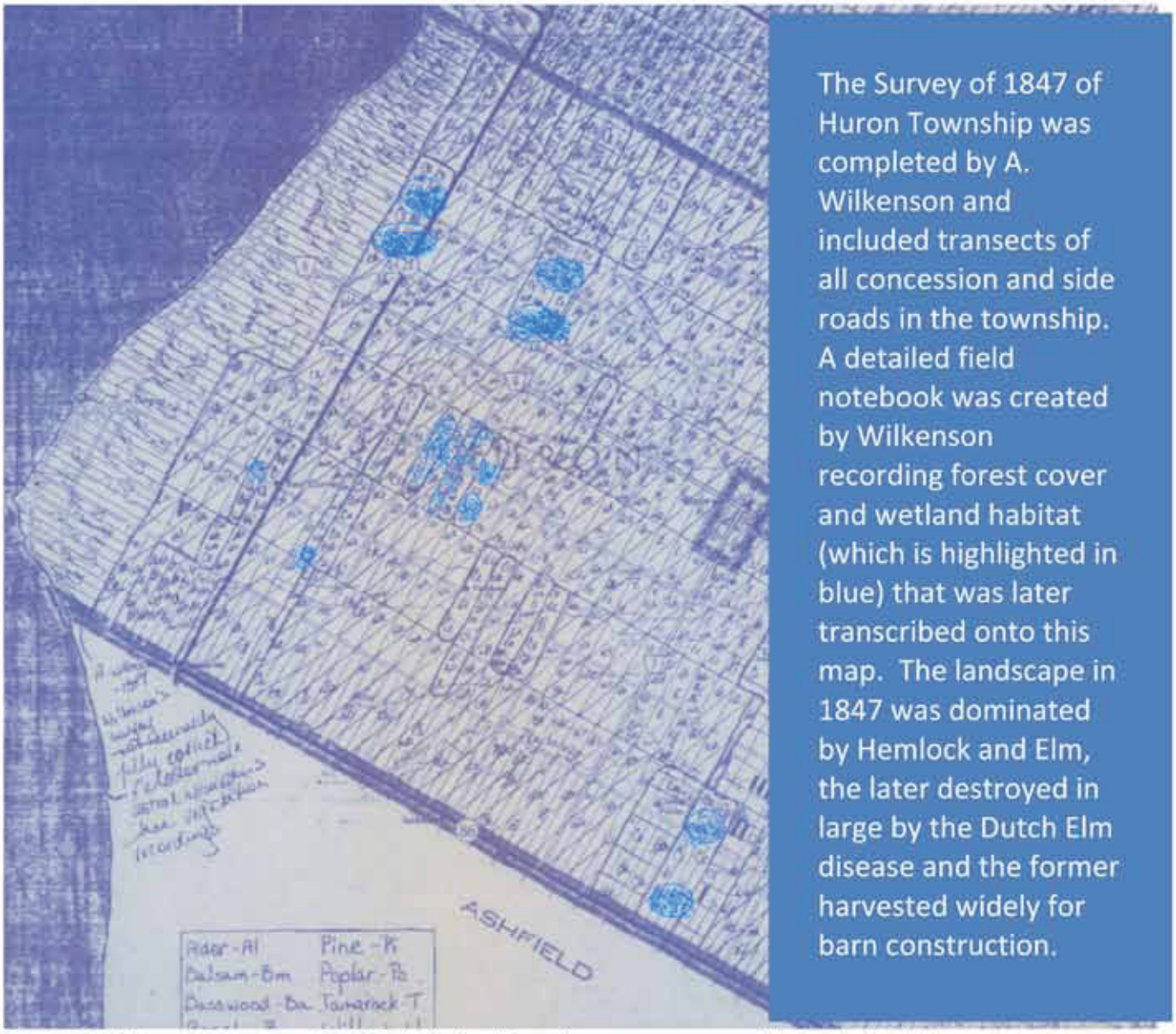

Figure 8 - The survey map of 1847 depicting historic ecosystems and hydrological clues

dominant way of life. At least 3 saw mills and one grist mill were at work in the Pine River watershed and it is possible to calculate the historical rates of base flow in branches of the PR and compare these to concurrent land use practices, to develop a historic water budget. With shipping being the main route of exporting, land locked Ripley homesteaders were mainly subsistence farmers by necessity, due to the horrible condition most roads were in at this time. With the opening of the Wellington Grey and Bruce Railway in 1873 farms were able to focus on higher levels of production for export, hence the initial birth of cash crop farming in Huron Township. Road conditions eventually improved and with the onset of the Green Revolution affecting this area as late as the 1960's, large scale agriculture, increasingly became the norm in most of the western areas of Huron Township.

Topography and Surficial Geology

There are a number of physiographic regions that make up the Pine River, although the majority is comprised of the Huron Slope Region. The outlet of the Pine River is part of the Huron Fringe. The Huron Slope Region has a uniformly gentle gradient towards the Lake Huron shoreline with an estimated slope of approximately 1%[8]. This grade of slope is associated with high sinuosity and pool to riffle ratios in a 'natural' system. However, in the 24 sample sites measured during the field work in the fall 2010, by Gazendam et al, only 4 sites had a sinuosity value higher than 1.05, suggesting the straightening of waterways in the PRW as a result of anthropogenic drainage[9].

The Huron Slope is a clay plain modified by a narrow strip of sand, believed to have been deposited and shaped by wave action along the shoreline of Lake Warren (the predecessor of present day Lake Huron, during the recession of the Wisconsin glacier). This clay plain is a result of a lacustrine deposition, and is rarely more than 1 m in depth. There is an area between Point Clark and Ripley that consists of clay more than 1 m in depth and increased silt content. This lacustrine clay deposit essentially isolates the surface water features from the ground water resulting in, for the most part a perched water table.

There is also a sand plain located 2 km inland, and approximately parallel to the Lake Huron shoreline, which overlies the clay deposits within the Huron Slope physiographic region.

The Algonquin Bluff provides a distinct boundary between the Huron Slope and the Huron Fringe regions, due to a 10 – 30 m near vertical drop. Large and small surface water streams, including the Pine River itself, have cut deep gullies in the area reaching the outlet.

Below the bluff is the narrow Huron Fringe region, comprised in general of wave-cut terraces produced by glacial lakes with their boulders and sand dunes. In the north half of the sub-watershed, there is little terracing below the Algonquin Bluff. However, the south half is wider due to an accumulation of sands around Point Clark and sand dunes at Lurgan Beach, which is a zone of accumulation in the nearshore Lake Huron.[10]

[8] Pine River Study, Ecologistics, 1990
[9] Waters Edge Environmental Solutions Team. Pine River Watershed Initative Network Fluvial Geomorphological Characterization Report. September 6, 2011.
9 Pine River Study, Ecologistics, 1990.

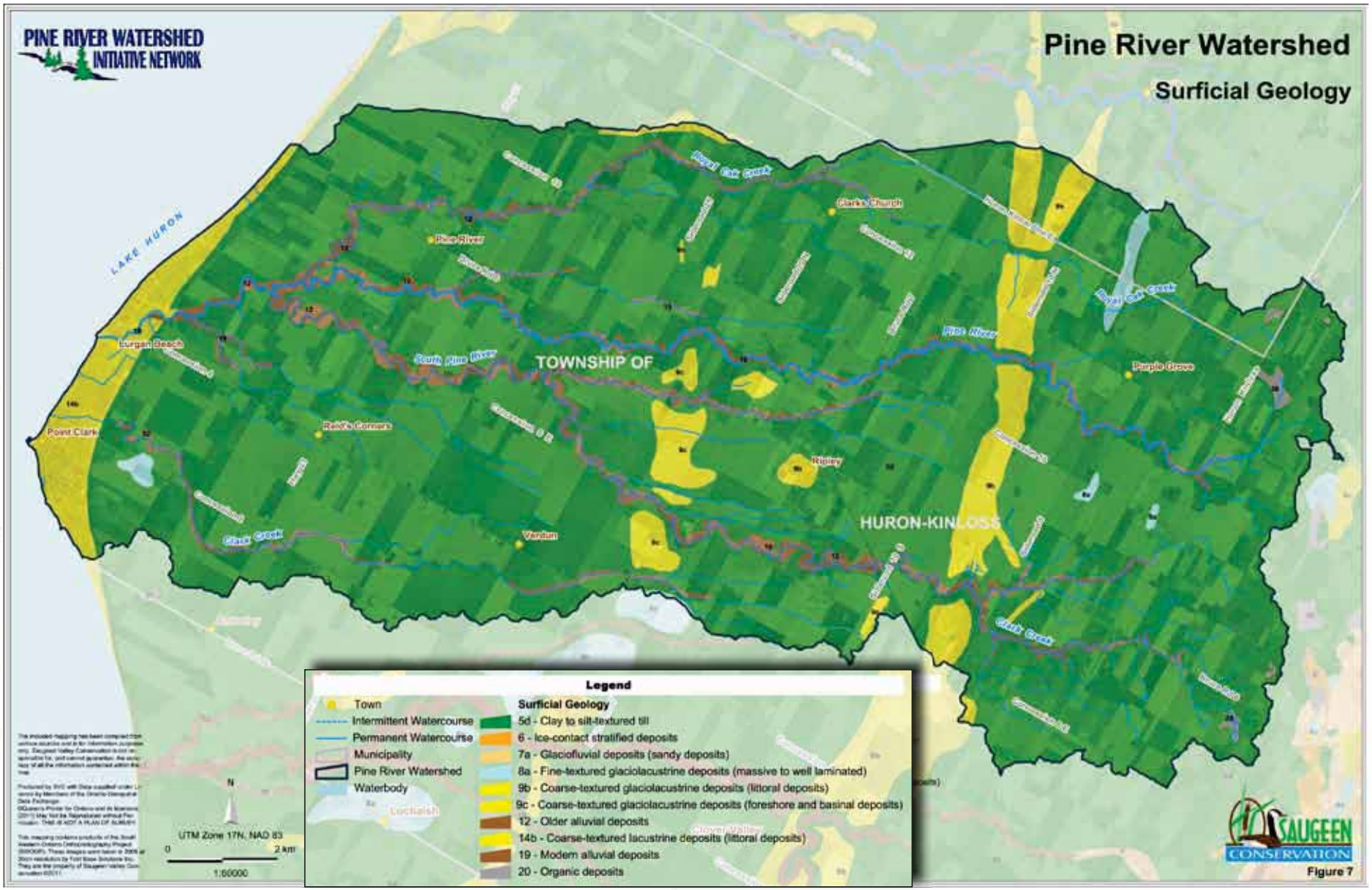

Figure 9 - The Surficial Geology of the PRW has been formed by ancient glacial lakes and rivers and chemical precipitation of limestone bedrock layers.

Soil Resources and Agricultural Capability

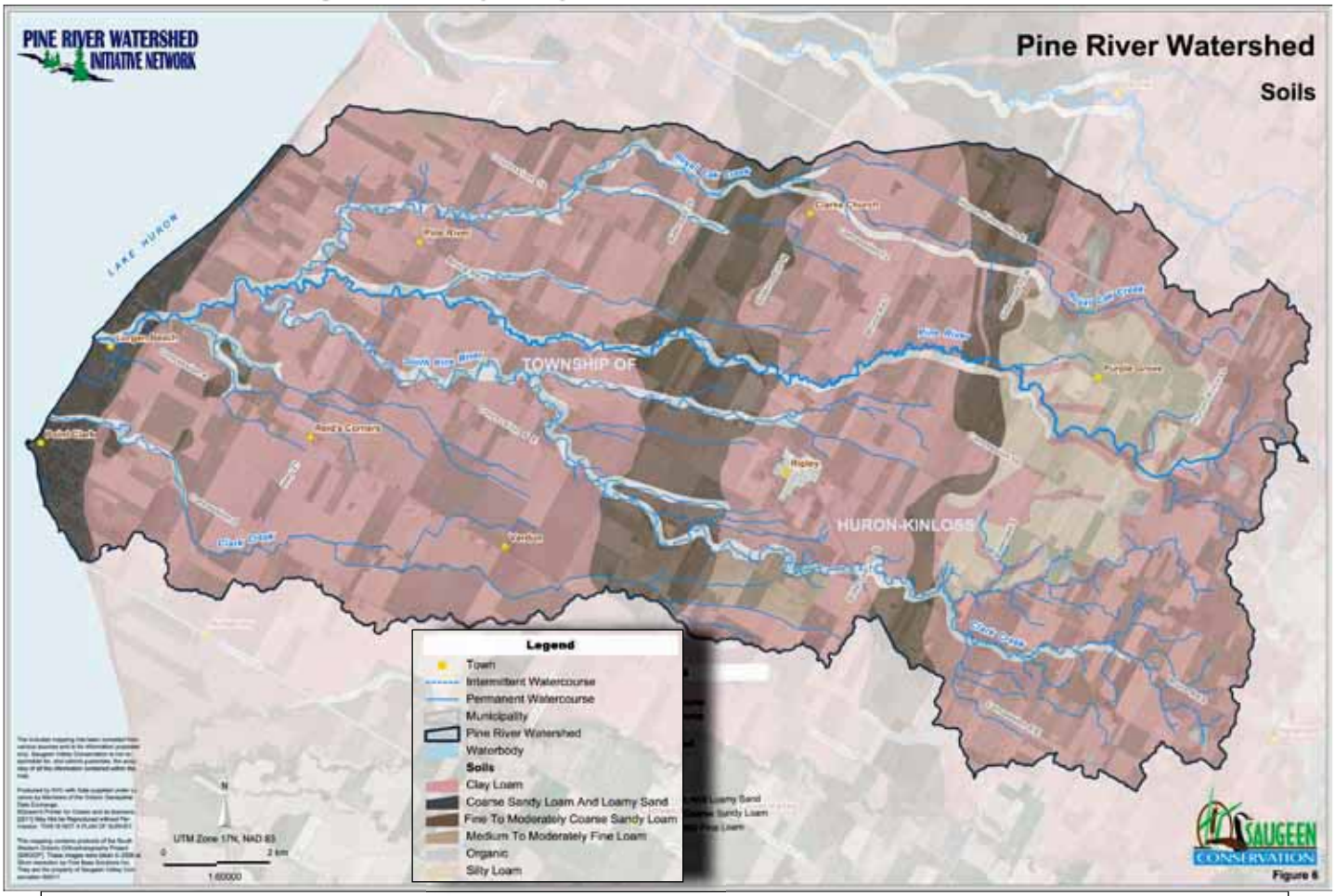

Figure 10 - The topsoil which is essential for agriculture is informed by PRW surficial geology.

The Canada Land Inventory classification system of land capability for agriculture groups mineral soils into seven classes according to their potential and limitation for agricultural use for common field crops. Common field crops include corn, oats, wheat, barley, and perennial forage crops such as alfalfa, grasses and birdsfoot trefoil. The best soils with no significant limitations for crop use are designated as Class 1. Soils designated as Class 2 to 6 have decreasing capability for agriculture and Class 7 soils have no agricultural potential.

Within the watershed, Class 1, 2 and 3 are the dominant agricultural capabilities. Class 5 land occupies the floodplain and valley complexes adjacent to the streams and water courses within the watershed.

Class 1 soils have no significant limitations in use for crops. These soils are level to very gently sloping, deep, well-to imperfectly drained, and hold moisture and plant nutrients well. They can be managed and cropped without difficulty. Under good management, they are moderately high to high in productivity for common field crops.

Class 2 soils have moderate limitations that restrict the range of crops, or require moderate conservation practices. These soils are deep, and may not hold moisture and nutrients as well as Class 1 soils. The limitations are moderate, and the soils can be managed and cropped with little difficulty. Under good management, they are moderately high to high in productivity for common field crops.

Class 3 soils have moderately severe limitations that restrict the range of crops, or require special conservation practices. The limitations are more severe than for Class 2 soils. They affect one or more of the following practices – timing and ease of tillage; planting and harvesting; choice of crops; and methods of conservation. Under good management, they are fair to moderately high in productivity for common field crops.

Class 5 soils have very severe limitations that restrict their capability to produce perennial forage crops. Improvement practices are feasible. The limitations are so severe that the soils are not capable of use for sustained production of annual field crops. The soils are capable of producing native or tame species of perennial forage plants, and may be improved by the use of farm machinery. The improvement practices may include clearing of bushes, cultivating, seeding, fertilizing, or water control.

There are no Class 4, 6 or 7 soils identified in the Pine River Watershed.

The following summary of the soil resources found within the Pine River watershed study area uses information contained within the Agricultural Soil Survey Upgrade Bruce/Huron Area for Ontario Hydro Report (Gartner Lee Associates, 1985) and accompanying 1:50 000 soils map. Nine soil types (series) are found within the study area. The following is map provides a visual description of each soil type, class and location.[11]

Organic Soils have developed in partially to well decomposed organic materials that are greater than 40 cm thick. These soils are very poorly drained and occur on level slopes with level surface expression. The Canada Land Inventory Agricultural rating system does not apply to these soils.

Bottomland Soils are mapped adjacent to the river and stream courses within the watershed. These soils include the flat alluvial floodplain deposits and the relatively steep valley walls. In addition to the organic soils mentioned above these soils have great variability in the textures of the materials deposited and are usually flood prone. These soils have low agricultural value due to inundation and adverse topography limitations. It is these soils, that have the capacity to hold water and provide the potential within the PRW to develop a series of offline wetlands that will hold water back on the landscape during times of peak precipitation events and during the spring freshette. These bottomland soils follow the hazard land or Class 5 agricultural land zoning in the following figure and thus new developments are prohibited from locating in these areas in order to prevent damage to life, property and social disruption as deemed by the Huron-Kinloss Official Plan and comprehensive zoning by-law. This restriction in turn provides an element of protection to the environmentally sensitive land in these regions.

[11] This section is copied from the previous Watershed Study completed in 1991. Ecologistics Limited. Pine River Watershed Study. January, 1991. p. 17 - 19

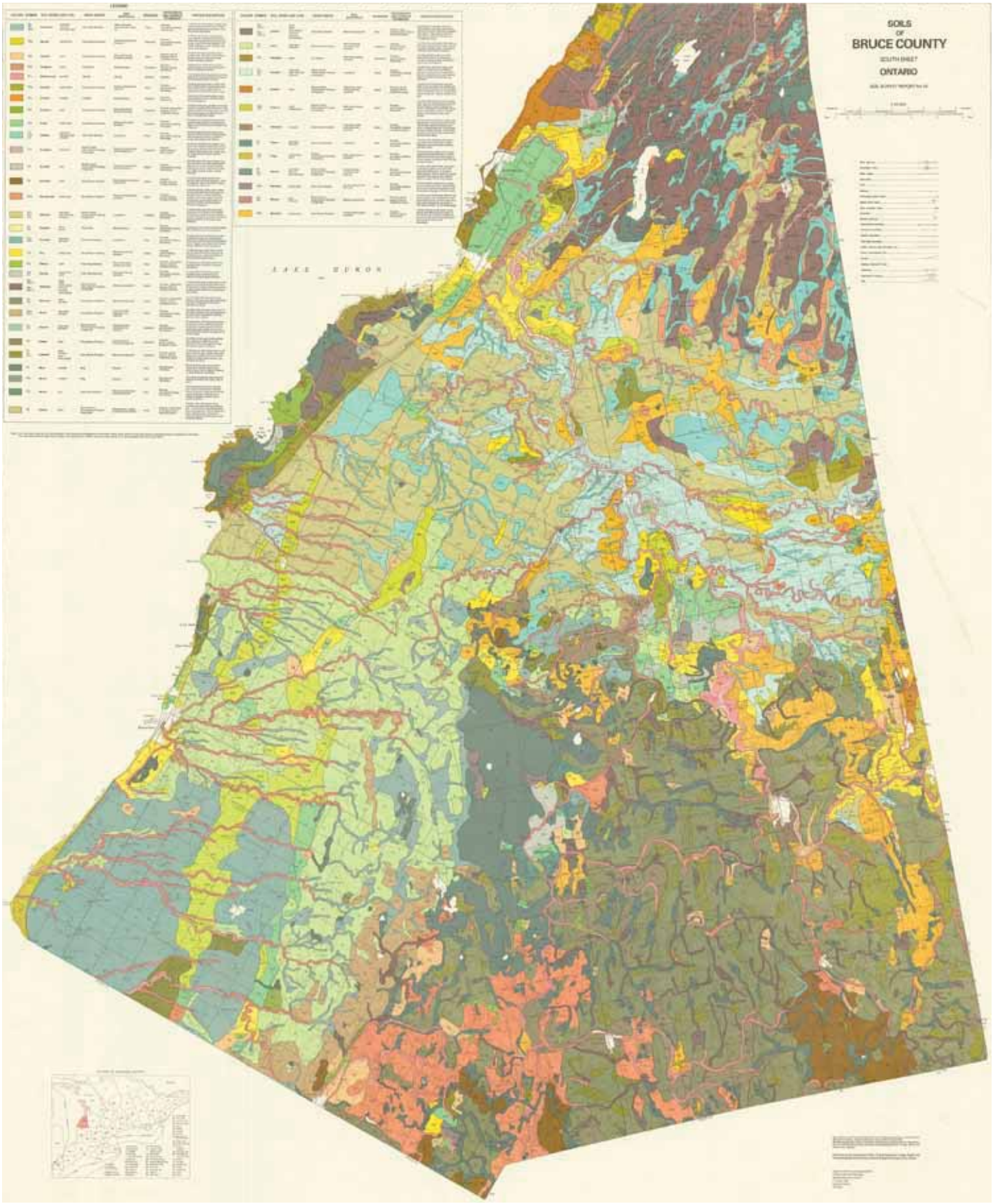

Figure 11 - Soil Map highlighting soil types for PRW

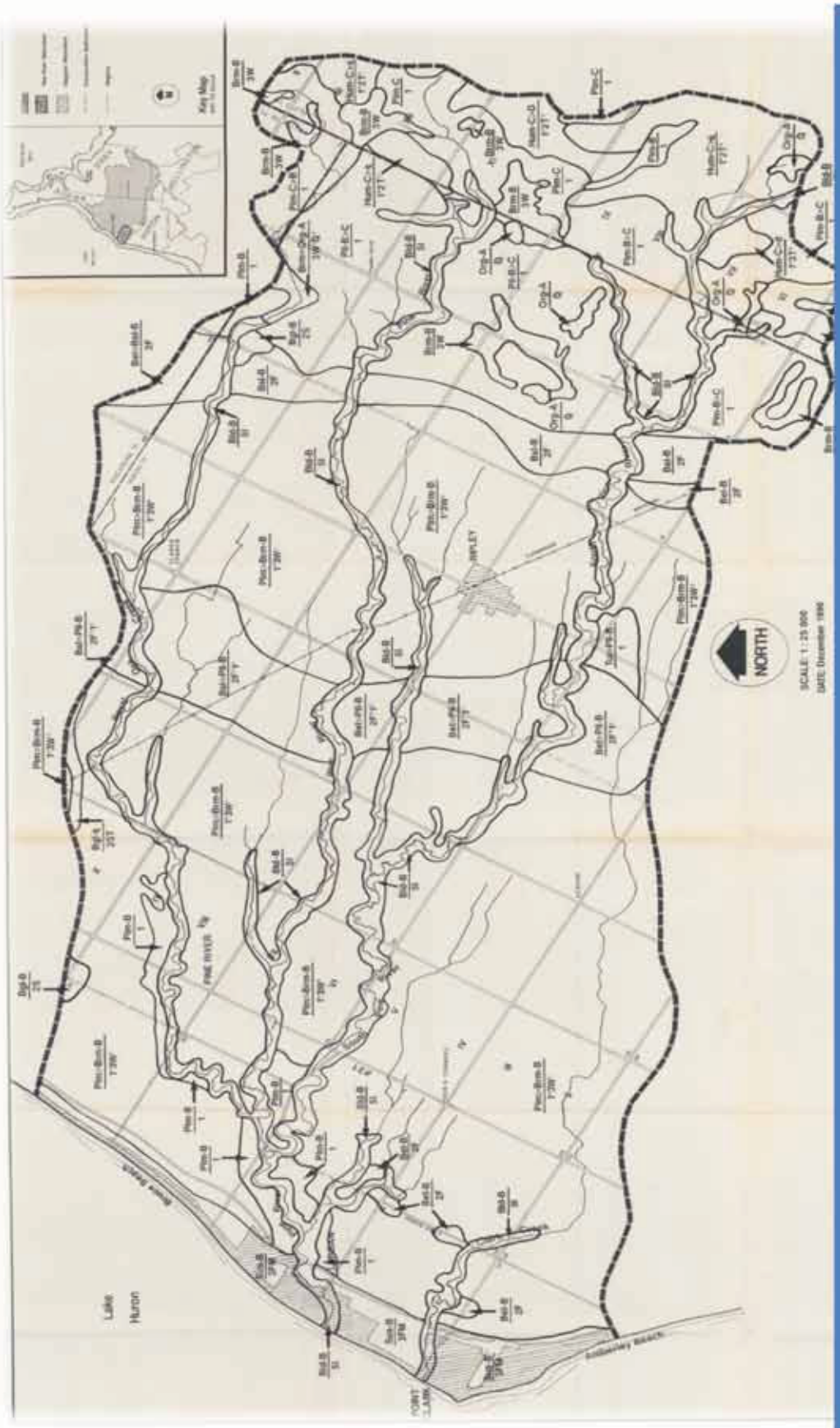

Figure 12 - Landuse planning map from Ecologistics 1991 study

This soil map provides an underlying basis for PRWIN's recommendations for ecological restoration. Any soils classified 1-3 in this watershed are economically valuable agricultural land, whereas Environmental Protection or Class 5 soils represent areas protected against certain development in the Huron-Kinloss planning document. These same areas represent the matrix of land that is economically and socially viable in regards to restoration site selection. Fortunately the lands zoned Environmental Protection follow the majority of the riparian areas and contains organic soils, which provides suitability to 2 of our 12 Targets: To Increase Wetland Cover
And
To Increase Riparian Buffer Vegetation.

Wetlands

The Pine River sub-watershed consists of 5.4 km^2 of wetlands[12]. In terms of a percentage of subwatershed covered by wetlands, the Pine River is the lowest among all the rivers in the Saugeen Valley Source Protection Area.[13] According to Ducks Unlimited, Huron Township was covered by 54.15 % wetlands in the pre-settlement period of the 1800s. By 2002, this number had been reduced to 0.7%.[14] of MNR evaluated wetlands and under 3.4%[15] unevaluated wetland cover.

In the Pine River watershed, wetlands are rare and more likely a consequence of topography and poor surface drainage than groundwater discharge to the surface[16]. This is because the clay plain in the Pine River area restricts groundwater flow, and is therefore not considered a significant groundwater recharge area. Agricultural drainage water is the dominant groundwater source for streamflow. Only two springs have been identified in the watershed, one near the mouth of the Pine River and the other in the headwater reach of the South Branch of the Pine River. [17]

Natural Habitat and Wildlife

White-tailed deer is one of the big game species found in the area. The range of deer within the study area is primarily confined to the narrow Huron Fringe physiographic region, situated adjacent to the Lake Huron shoreline. The valley lands associated with the waterways and the woodlots present at the back of many farm properties provide the potential for developing increased connectivity on the landscape for wildlife movement. The continued pressures of cottage development, however, restrict the area suitable for deer habitat.

Other animal species found in the area include rabbit, red fox, opossum, coyote, raccoon, red squirrel, chipmunks and field mouse (Ecologistics, 1990). These species are common in the study area and seem to prefer the Huron Fringe, but the scattered, small woodlots throughout the watershed may provide some suitable habitat.

Twenty seven species of fish were identified in the Pine River, during an electrofishing survey done as part of the Ecological Monitoring of the Pine River by SVCA in partnership with MOE and Ed Gazendam[18]. This general species richness appears greater than the family grouped survey done in 1987 and highlighted in the Ecologistics report, however methodology and classification level make this an incongruous comparison. Anecdotal evidence from PRWIN board members suggests that by large fish populations, specifically of Chub and Suckers have been greatly reduced since the 1960's.

The entire study area is rated as having severe limitations to the production of waterfowl. The South Pine River, and the mouths of the Pine River and Clark Creek, produce waterfowl. However, these areas are severely limited by the reduced marsh edge and free-flowing water (CLI for Waterfowl, 1970).

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[12] Kleinecke, Rene. Saugeen Valley Conservation Authority. This figure includes the evaluated wetlands identified by MNR, and the unevaluated wetlands.
[13] Saugeen Valley Source Protection Area. Proposed Assessment Report. June 15, 2011. p. 26
[14] Southern Ontario Wetland Conversion Analysis. Ducks Unlimited. Final Report. March, 2010. As viewed online at http://www.ducks.ca/aboutduc/news/archives/prov2010/pdf/duc_ontariowca.pdf on October 14, 2011
Waters Edge Environmental Solutions Team. P. 4
[15] GIS evaluation, completed 2011 by SVCA specialist Rene Klieneke
[16] Source Water Protection , Watershed Evaluation, 2010
[17] Pine River Study, Ecologistics, 1990
[18] Ecological Monitoring of the Pine River and Clark Creek, SVCA, 2011

One hundred and eight bird species are known to breed in and around the Pine River watershed.[19] Nesting habitats were identified for each species based on Cadman et al (1987). Forest interior specialists prefer to nest within the interior of larger woods and avoid edges. Forest interior-edge specialists prefer to nest within mature woods but also use forest edges. Edge-field specialists are birds that have a diversity of habitat requirements including those species that nest in wooded borders in the margins or interiors of forests, but require open fields for foraging. Riparian specialists include species that breed and nest in areas immediately adjacent to rivers or streams. The water treatment lagoons, directly adjacent to the Lewis Cemetery walking trail is an excellent site for viewing migratory water birds in the spring and fall.

The majority of bird species in this area breed in edge and field-edge habitats. The study area has an abundance of edge habitats. Few of the species observed in the area prefer forest interior habitats. This indicates the lack of large, undisturbed forests within the study area. Most of the riparian specialists were probably found outside of the watershed itself.[20]

Species at Risk

A "*species at risk*" is any naturally-occurring plant or animal in danger of extinction or of disappearing from the province. Once classified as "at risk", they are added to the Species at Risk in Ontario (SARO) List.[21] As soon as a species is listed as extirpated, endangered or threatened, it is automatically protected from harm.

Also immediately upon listing, the general habitats of endangered and threatened species are automatically protected from damage or destruction.

Figure 13 - Burrowing Crayfish (Mason, 2011)

Recovery strategies identifying steps to protect and restore populations are developed within one year for endangered species and within two years for threatened species. Management plans are also prepared for special concern species within five years of being listed, outlining ongoing population monitoring as well as future recovery and research goals.

Some of the Species at Risk that have been known to be found in Pine River are Clamp-tipped Emerald, Tulip Tree Silk Moth, Beaked Spike-rush, and Blue-Leaved Willow. Listed species found in the Pine River Watershed include Great Lakes Sand Reed Grass, and the Blue-Leaved Willow. Great Lakes Wild Rye and the burrowing Chimney Crayfish species are listed as 'vulnerable' and are also found in some areas of the PRW. The entirety of the listed species, however, have been found within the Lake Huron Fringe Forest below the Lake Algonquin ridge and in the dune ecosystems found within this region of the PRW.

[19] Christmas and breeding bird count 1986-1989
[20] Pine River Study, Ecologistics, 1990
[21] Ministry of Natural Resources. As viewed online at http://www.mnr.gov.on.ca/en/Business/Species/index.html on October 11, 2011.

Biodiversity

Biodiversity is the variety of life on Earth. It includes all living things and the ways in which they interact with one another and their environment. Simply put biodiversity is life and is about being connected. Biodiversity can be thought about in three levels. Genetic diversity, this describes the variety of genetic information contained in individual plans, animals and micro-organisms. The second level of biodiversity speaks to species diversity or the variety of species. And lastly, the third level of biodiversity is ecosystem diversity which includes the variety of habitats, ecological communities and ecological processes. Conserving our biodiversity is important because healthy ecosystems support healthy people and a healthy economy. The benefits we derive from ecosystems biodiversity include food, fibre and medicines, clean air and water and outdoor recreation.

Some of the main threats to biodiversity in southern Ontario and the Pine River watershed are habitat loss, invasive alien species, population growth, pollution, unsustainable use and climate change. Acting together these threats can produce a much greater negative effect than on their own.[22]

A great many species, including keystone species, such as the wolf, have been extirpated from the area surrounding the Pine River Watershed through anthropogenic change over the last two to three centuries.[23] The population of beaver have dropped increasingly over the last century within the watershed as well due to trapping and overall destruction of their habitat. The loss of these species as well as a plethora of other flora and fauna has greatly changed the nature of the Pine River's ecosystems and associated ecological functions.

Figure 14 - Eastern Gray Tree Frog (Mason, 2011)

The importance of biodiversity is a growing field of study, in the text Mycelium Running [24]the author Paul Stamets suggests that the intentional presence of mychorrizal fungi- of which 99% of plants require a symbiotic partnership with in order to flourish- in a reforestation site can increase the rate of natural succession towards a more diverse community and the ability of that buffer strip to absorb nutrients present in runnoff. A more diverse community has greater resilience to threats on many levels. Higher diversity in the plant community also provides greater fodder for a wider community of fauna and arguably human uses as well. Utilizing the information gathered from the Ecological, Cultural and Geological history of the watershed, an additional database is being developed as to the native plants that could and have been supported by the landscape in the PRW. (See appendix 1: Analog Forestry)

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[22] Ontario Biodiversity Council. 2011. Ontario's biodiversity Strategy, 2011: Renewing Our Commitment to What sustains Us, Peterborough ON

[23] Fitzgerald, W. 2003. Inverhuron Provincial Park: Cultural Resources and their Management. Ontario Ministry of Natural Resources, Ontario Parks,

[24] Stamets, Paul, 2005 Mycelium Running: how mushrooms can help save the world, Colourcraft ltd., Hong Kong

Ecological monitoring has been completed in the PRW to investigate benthic macroinvertebrates using the Ontario Benthic Biomonitoring Network protocol, breeding and Christmas bird surveys, as well as electrofishing surveys. Further ecological monitoring utilizing the Marsh Monitoring protocol, Environmental Monitoring and Assessment Network butterfly count among others, is being planned, as part of our outreach and education programming, to increase awareness of the natural beauty of our watershed and create a database that can be used to track changes on the landscape associated with restoration efforts.

Figure 15 - 1966 Aerial Photo

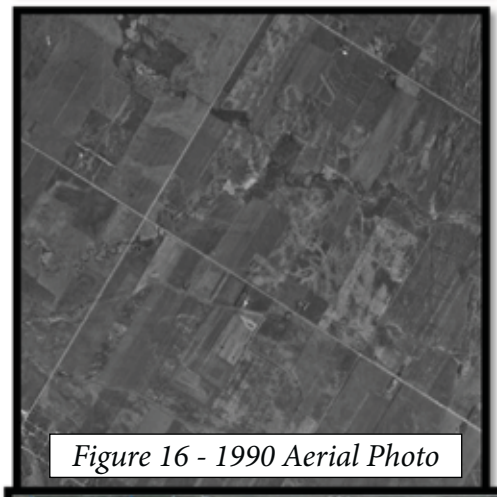


Figure 16 - 1990 Aerial Photo

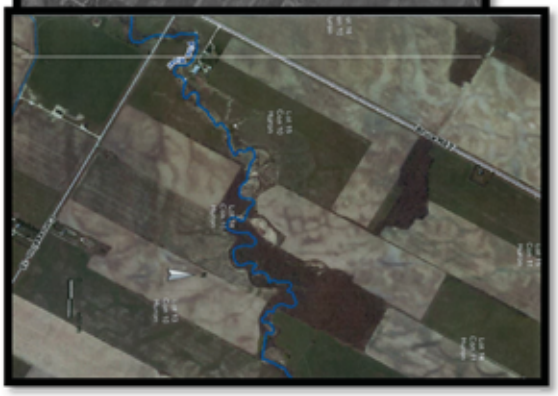
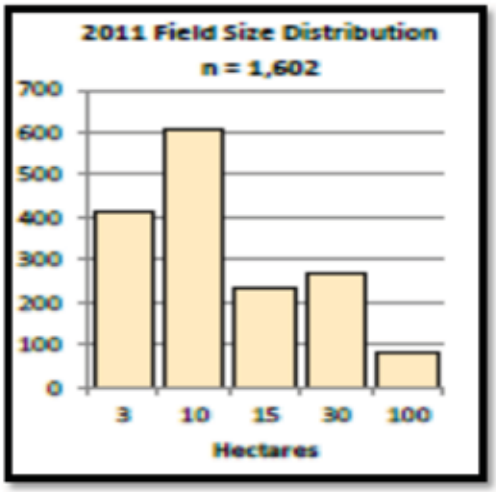


Figure 17 - 2010 Aerial Photo

Comparison of Cropping Patterns. The photo on the top is from 1966, and the photo in the middle is the same area in 1990, note the larger field sizes in the bottom 2010 photo[25]

The same area can again be compared in 2010 aerial photography with reference to extensive 'windshield' surveys carried out by OMAFRA to find that increase in field size has continued, at the expense of windbreaks, small forest stands and unevaluated wetlands, in some areas. This shift from smaller fields coincides with a watershed wide reduction in pasture and hay fields and an increase in row cropped fields.

This figure[26], created by OMAFRA, following the field season of 2010, shows the relative size of fields in the Pine River Watershed. There appears to be a qualitative trend towards increasing field size, as farm equipment and farm size becomes larger[27]. This has both a negative and positive effect on tree cover in the watershed; negative, as existing tree cover between smaller fields may be removed to enhance the perceived efficiency of tillage, spraying and harvest; the positive is that in oddly



Above: Figure 18 - OMAFRA Field Size Data

[25] JoAnne Harbinson. Saugeen Valley Conservation Authority.

[26] OMAFRA, 2011, Resources Information and Business Services Unit of the Environmental Management Branch ©2011 Queen's Printer for Ontario

[27] Informal communications with long-term residents and farmers in the Pine River Watershed, Mason, 2012.

shaped corners of these larger fields, where large equipment cannot turn, farmers often allow these areas to be restored with seedlings. The following map represents a snapshot of current crop rotation and landuse practices documented in 2010 through windshield surveys conducted by OMAFRA staff.

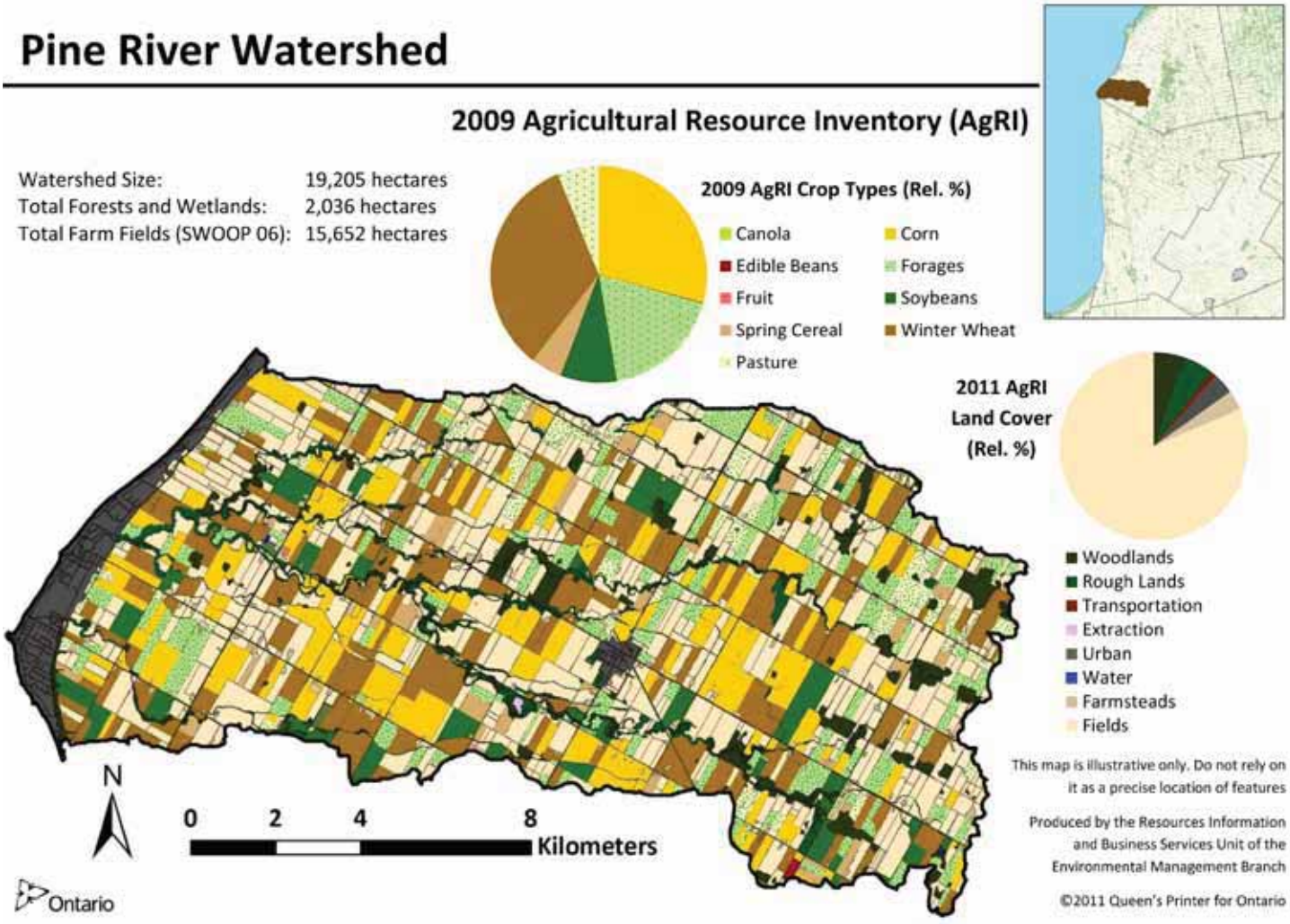


Figure 19 - OMAFRA's landuse inventory for the PRW for the 2009 growing season

Hydrology of the Pine River

On average, it takes 16 hours for rain from a precipitation event to travel from the top end of the watershed to the mouth at Lurgan Beach. [28] This lack of retention time greatly reduces the environment's ability to filter any contaminants from point and non-point sources before entering the waters of Lake Huron. A comparison can be made between the historic water budget for the Pine River watershed and the current water budget for PRW, linking the shifting variables of land use change and climate change to the change in PR hydrographs. In regards to a historic hydrograph an amount of further supposition is required, linking the data sets available in regards to 19th century precipitation and baseflow models necessary for the function of the 4 mills present on the water courses. (see appendix 2)

[28] Pybus, David. Saugeen Valley Conservation Authority.

The following chart shows precipitation and corresponding water levels in the lower end of the PRW that act as a preliminary hydrograph and are contributing data for further developing a water budget for the Pine River Watershed. This data was taken from the Environment Canada gauge at Lurgan Beach by staff at SVCA. In a hydrograph from a resilient watershed there is a shallower curve in the response time for water level in stream following a precipitation event.

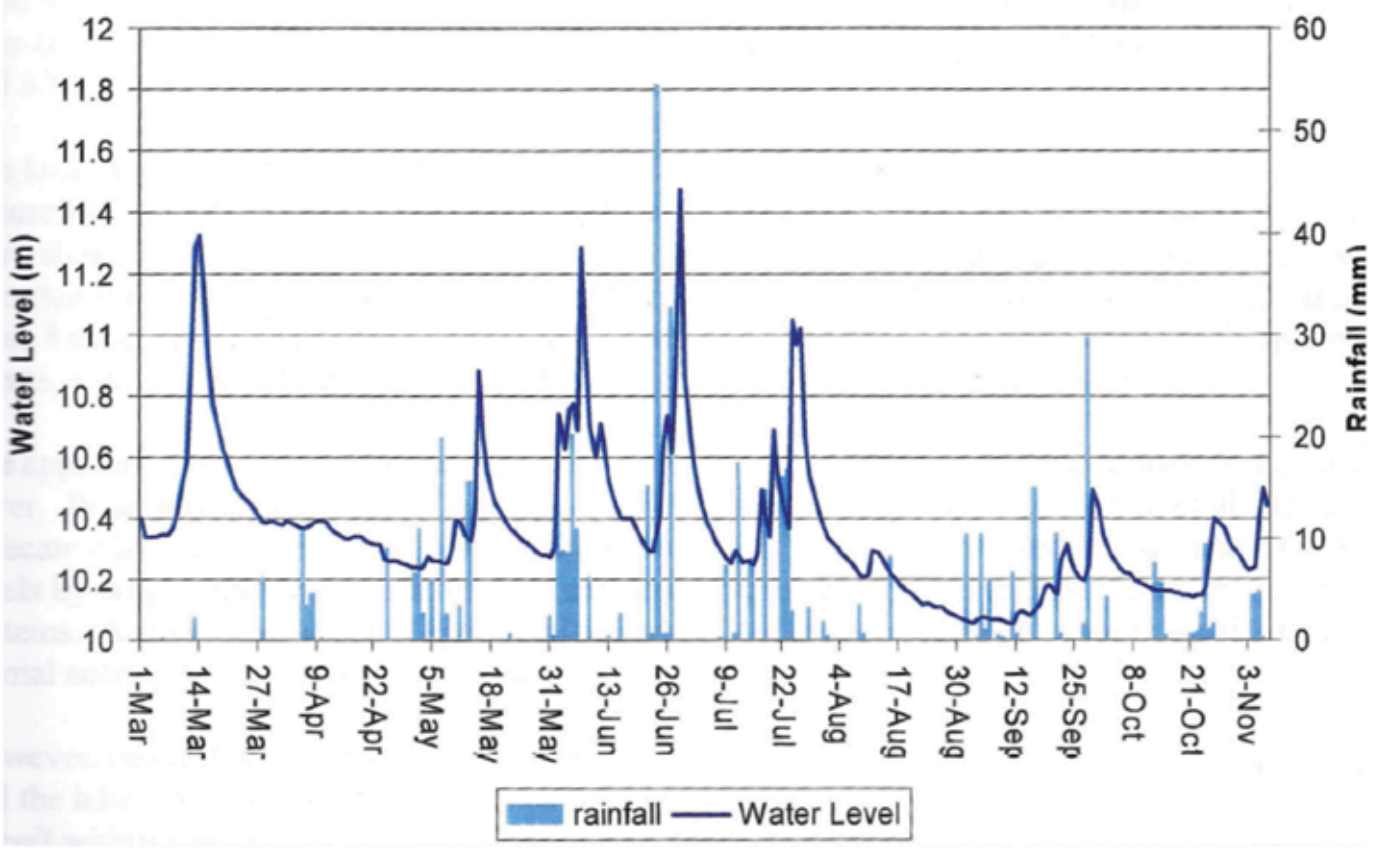


*Figure 20 - The Hydrograph of Discharge at Lurgan Gauge describes a "flashy system" that has little remaining natural resilience in the face of storm events *[29]*

Climate Change as it Affects the Pine River Watershed

"Climate change will greatly affect composition, structure, and function of ecosystems in Ontario. In some areas, new ecosystems will develop, altering the existing ecosystems now found both on land and in the water. It is estimated that about 10% of the world's known species will be at an increasingly higher risk of extinction for every 1°C rise in temperature"[30].

In reference to International Panel on Climate Change, models and trends observed in MVCA and extrapolated from raw data gathered at the Lurgan gauge in Pine River, extreme precipitation events

[29] BMROSS Township of Huron-Kinloss Pine River Water Quality Monitoring Program 2010 Annual Report, January 2011

[30] MNR. http://www.web2.mnr.gov.on.ca/mnr/Climate_change/Climate_Change_Biodiversity_en.pdf Accessed: Nov 4th 2011

are increasing in the PRW, which will compound the effect of vegetation loss on the already prevalent problems of soil erosion in the PRW.

Table 1 Potential Impacts of Climate Change on Watersheds

Trend	Potential Impact	Affected Areas
Increased total Precipitation	Increased Flooding	Entire Watershed – storm water management, rural stormwater management
		Urban areas in Till Plains (Harriston, Listowel)
		Lakeshore Area – increased lake-effect snowfall, highway closures
	Increased Erosion	Entire Watershed – actively eroding river valleys
		Lakeshore gullies – actively eroding gullies
Increased Precipitation Intensity	Increased Flooding	Entire Watershed – storm water management, rural stormwater management, flood forecasting system
		Urban areas in Till Plains (Harriston, Listowel)
	Increased Erosion	Entire Watershed – actively eroding river valleys
		Lakeshore gullies – actively eroding gullies
Increased Temperatures	Increased energy consumption	Entire Watershed
	Crop inputs	Entire Watershed
	Longer, more frequent heat waves	Entire Watershed
Shorter frozen -period, more frequent thaws	Road Maintenance cost increases	Entire Watershed
	Increased bluff destabilization	Lake Huron Bluff, Lake Shore Gullies and Streams, Maitland River Valley

[31]

The above table comes from the report produced by Huron Geoscience for effects of climate change on Saugeen Source Protection Region. These trends are in keeping with some of the modeling predictions of the IPCC for the Great Lakes Region.

The precipitation data from Goderich Station and the discharge data that has been gathered by Environment Canada and SVCA at the Lurgan station, show visual trends of increased rainfall intensity in the spring and fall with decreased precipitation in the Summer and Winter. This is a trend that has been strengthened by the observations of long term residents of Huron Township and suggests keen attention be focused on the effects that flooding, drought and increased erosion may have in the PRW.

Groundwater

Although PRW has a perched watershed, in regards to the fluvial nature of its rivers, it is important to recognize the protection of the underlying aquifer, specifically around the zones of influences surrounding the Municipal wells and the non-demarcated zones of influence around private wells.

[31] Huron Geosciences, 2011. Climate Trends in the Saugeen, Grey Sauble, Northern Bruce Peninsula Source Protection Region. Unpublished Report.

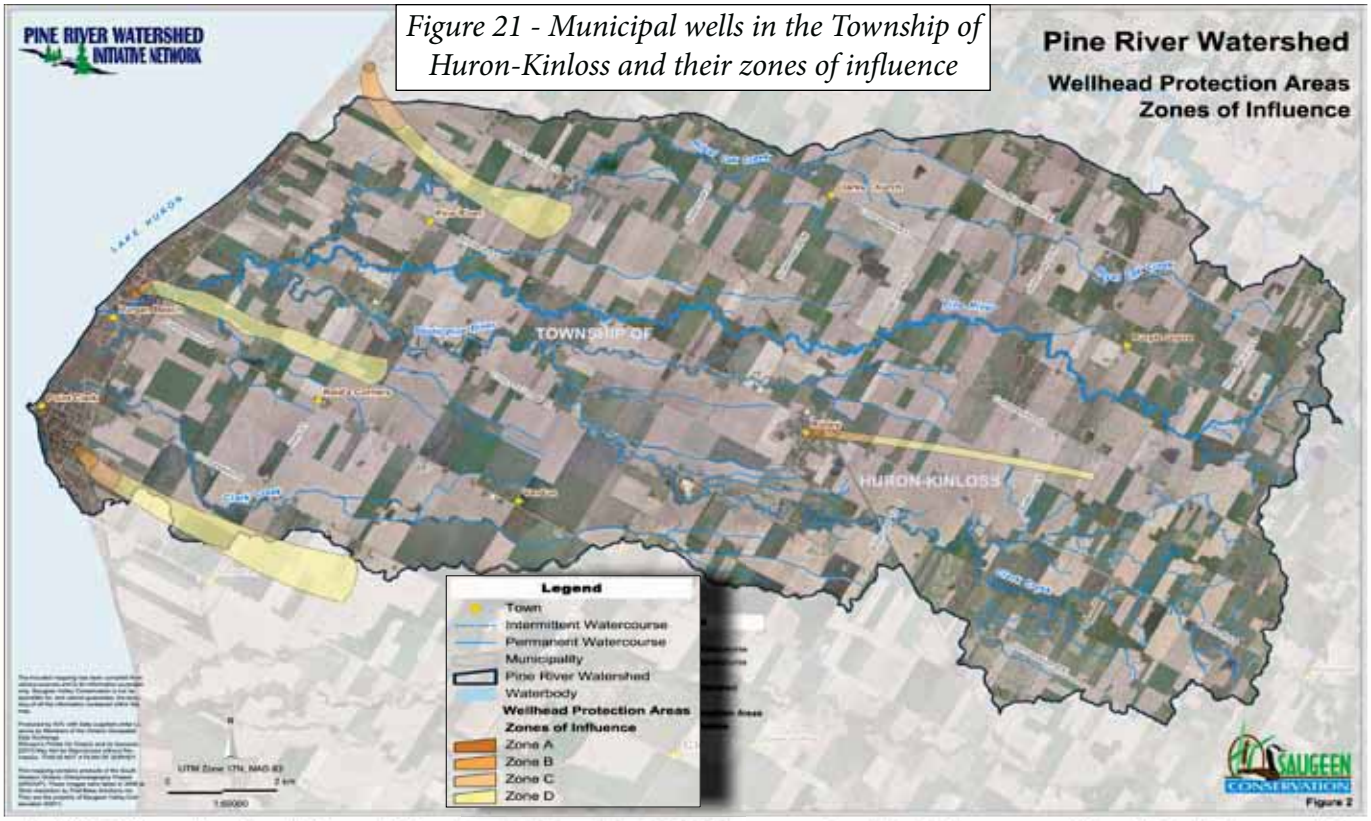


Figure 21 - Municipal wells in the Township of Huron-Kinloss and their zones of influence

In SVCA's watershed Report Card, published in 2008 it was noted that the overall health of the aquifers underlying the PRW was in excellent condition, however to maintain this health, decommissioning of wells no longer in use should be done in accordance to recommendations outlined in the Source Water Protection Act. Furthermore to support the health of the ground water and surface water interface present in the Huron Fringe area of the watershed, a continuation of the award winning Septic Re-inspection Program, led by BM ROSS and Huron-Kinloss Township, should prevail.

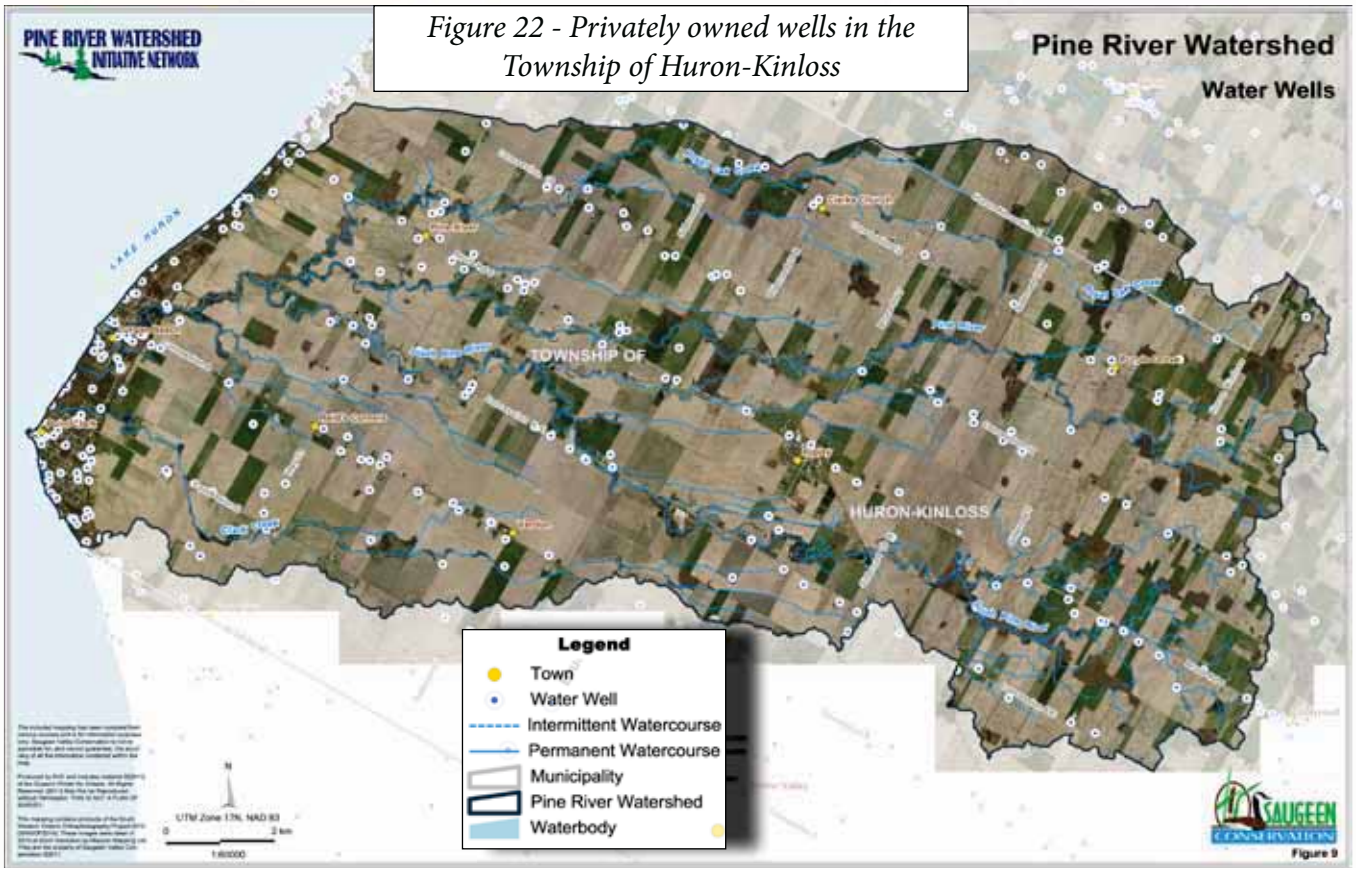


Figure 22 - Privately owned wells in the Township of Huron-Kinloss

Soil Erosion

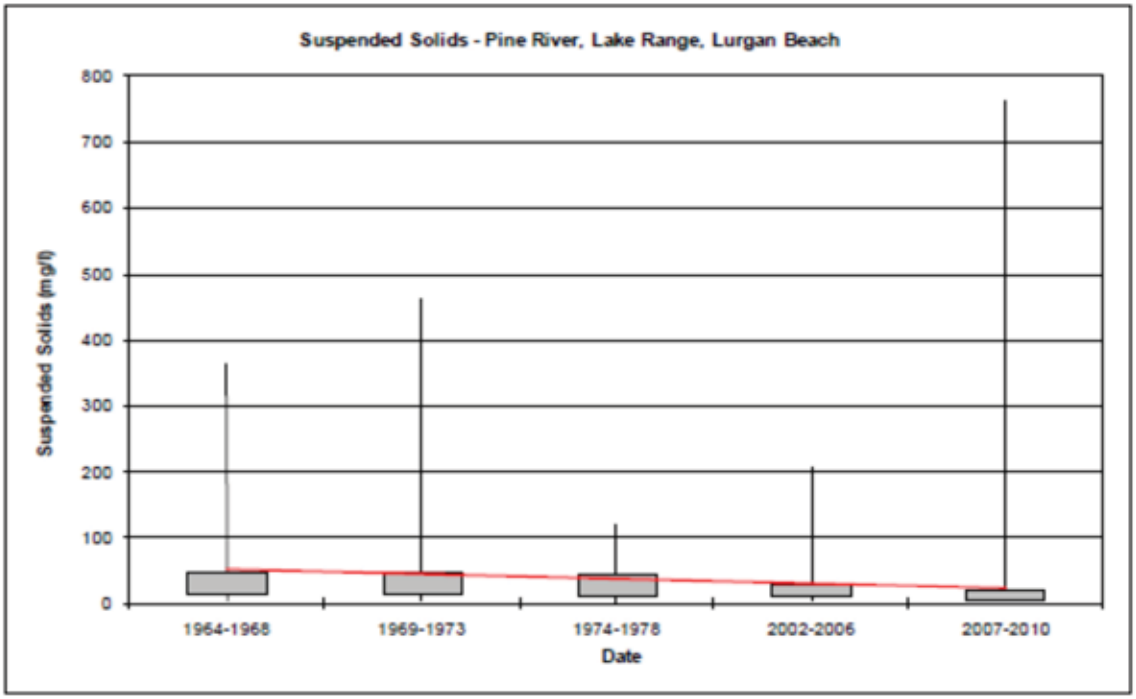


Figure 22 - Decreasing Trend of Total Suspended Solids measured at the Lurgan PR-1 station (32)

According to the Canadian Council of Ministers of the Environment (1999) the guideline for maintaining conditions that support healthy levels of total suspended sediment in stream is no higher than 25 mg/L over historical levels. This is difficult to determine given the lack of historical turbidity data. The data set is sparse, but visual observations of the Pine River support the findings that sediment loading in the Pine River is a serious environmental problem. Most samples were captured during the spring and fall, which are the most critical times of year for soil conservation, as most traditionally tilled cash crop fields are devoid of cover during these months, allowing for the mobilization of soil particles. However, this total sediment loading comes from three mechanisms of non-point source pollution: wind erosion, surface / sheet erosion and bank erosion.

It is estimated, using methods developed by Ecologistics in 1991 (see appendix 3), that areas of the Pine River experience topsoil loss, due to wind erosion at rates as high as **3.3 tons/acre/year.** The median rate of topsoil loss for areas in the Pine River as analysed by Ecologistics was **0.4 tons/acre/year.** The largest type of land use, by percentage cover, in the PRW in 2011, is intensive row cropping using traditional tillage practices, which plow under crop residue and leave exposed soil for the average period of October- June. The conversion of grass and pasture farms to cash crop production during the period of 1960-to present has contributed to a net loss of permanent vegetation on the landscape of the PRW, which again has contributed to the overall amount of exposed topsoil. The conversion of small to large fields to accommodate larger equipment and larger farm operations, has resulted in a net

[32] Saugeen Conservation Water Quality Data Summary Report, SVCA, March 2010

loss of windbreaks, hedge rows and small forest patches, that historically broke up the agricultural landscape and reduced wind speed over the cropland. [33]

Drainage

We drain land to remove *surplus* moisture, and to fit it for tillage and rotation of crops and possible horticulture. [34]

Over 85% of the entire PRW has been tile drained. A great deal of money has been invested in this drainage and the result, for farmers, has been an increase in yield for cash crops due to the longer accessible growing season. Tile drainage can cut down on surface top-soil erosion by guiding water down through soil layers instead of overtop, however the tile does not stop this top-soil erosion entirely. This Agricultural drainage water is the dominant source for streamflow in the Pine River Watershed at this time. Only two springs have been identified in the watershed, one near the mouth of the Pine River and the other in an upstream reach of the South Pine River. [35]

This map highlights the different types of drainage and waterways in the PRW. The red tributaries that are highlighted have been buried and are now subsurface drainage. The green watercourses are the open ditches, classified as drains under the Drainage Act. The blue waterways are the only sections in the PRW that are still classified as natural waterways. This distinction is important to recognize as stream bank and wetland restoration is pursued as there are different regulatory bodies presiding over the different classifications of watercourse. For example the natural waterways are governed by the

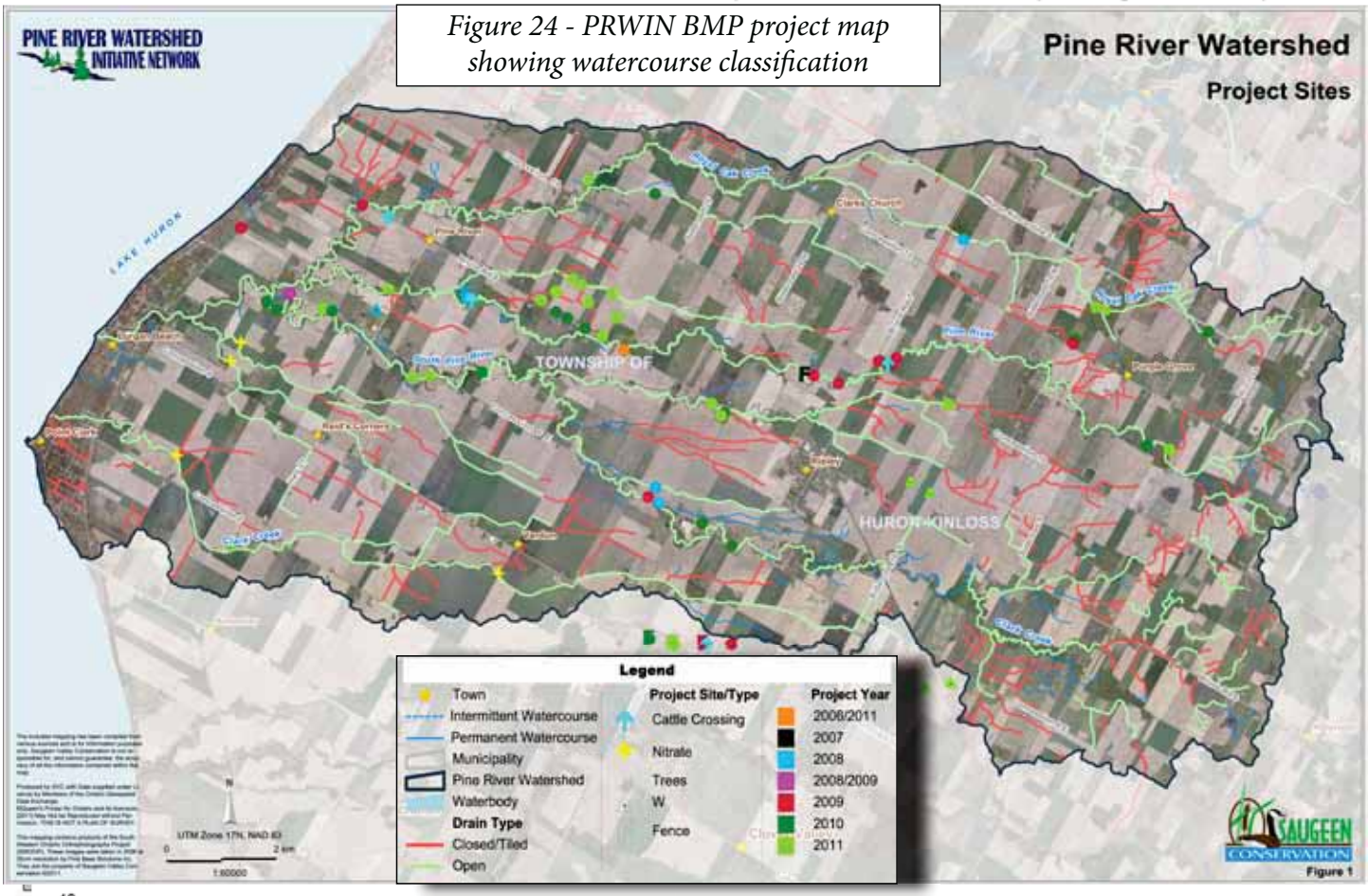


Figure 24 - PRWIN BMP project map showing watercourse classification

[40] Wilkenson, A., Transcribed Survey Notes, County of Bruce, Ministry of Transportation and Communications, circa 1847.

SVCA whereas the drains are governed by the Drainage Act, Superintendant and Municipality. Other bodies that come into regulating work on these watercourses are the Department of Fisheries and Oceans and the Ministry of the Environment.

As one approaches Lake Huron in the Pine River Watershed there is a compounding problem, the drains increase in size to allow for a greater amount of water to exit the watershed at once, which encourages high flow volume and velocity. This means that there is greater force present in the main channels of the watershed, which can be deleterious to fish, and invertebrate species (Vannote et al, 1984)[37] and can contribute to higher rates of bank erosion. However, for the last several centuries this has been deemed a necessity by both agriculturalist and drainage engineers, as a means to modern food production. Naturalized channel design takes its cues from natural stream systems, yet employs engineered slopes to accommodate flow necessary for maintaining agricultural practices; a compromise between the landscape and its users.

Figure 25 - Topsoil erosion in tile drain

Figure 26 - Municipal Drain that has been 'cleaned out'

The majority of municipal drainage works were completed in the 1960s – 1970s. There have only been 2 new municipal drains installed in Huron Township since 1983 however there is one proposed in the headwaters of the Main Branch of the Pine River. Drain maintenance is common today. Tile drainage was completed primarily during the years of 1965 – 1986, but systematic drainage of fields continues today, making greater than 85% of the agricultural land in the Pine River artificially drained. The soil's imperfect or poor drainage characteristics make tile drainage important from an agricultural standpoint. [38]

Flooding rarely occurs, and the last recorded event was a 1:100 year storm event in 1986. When flooding does occur, it is usually the result of culvert blockages, and this encourages regular drain maintenance.[39] Increased flooding during the spring freshette and extreme precipitation events has increased soil erosion on farm fields and higher rates of flow associated with decreased levels of

[37] Vannote et al, 1984 The River Continuum Concept

[38] Pine River Watershed Study, Ecologistics Limited. 490 Dutton Drive, Suite A1 Waterloo, Ontario N2L 6H7, 1991.

[39] Pine River Watershed Study, Ecologistics Limited. 490 Dutton Drive, Suite A1 Waterloo, Ontario N2L 6H7, 1991.

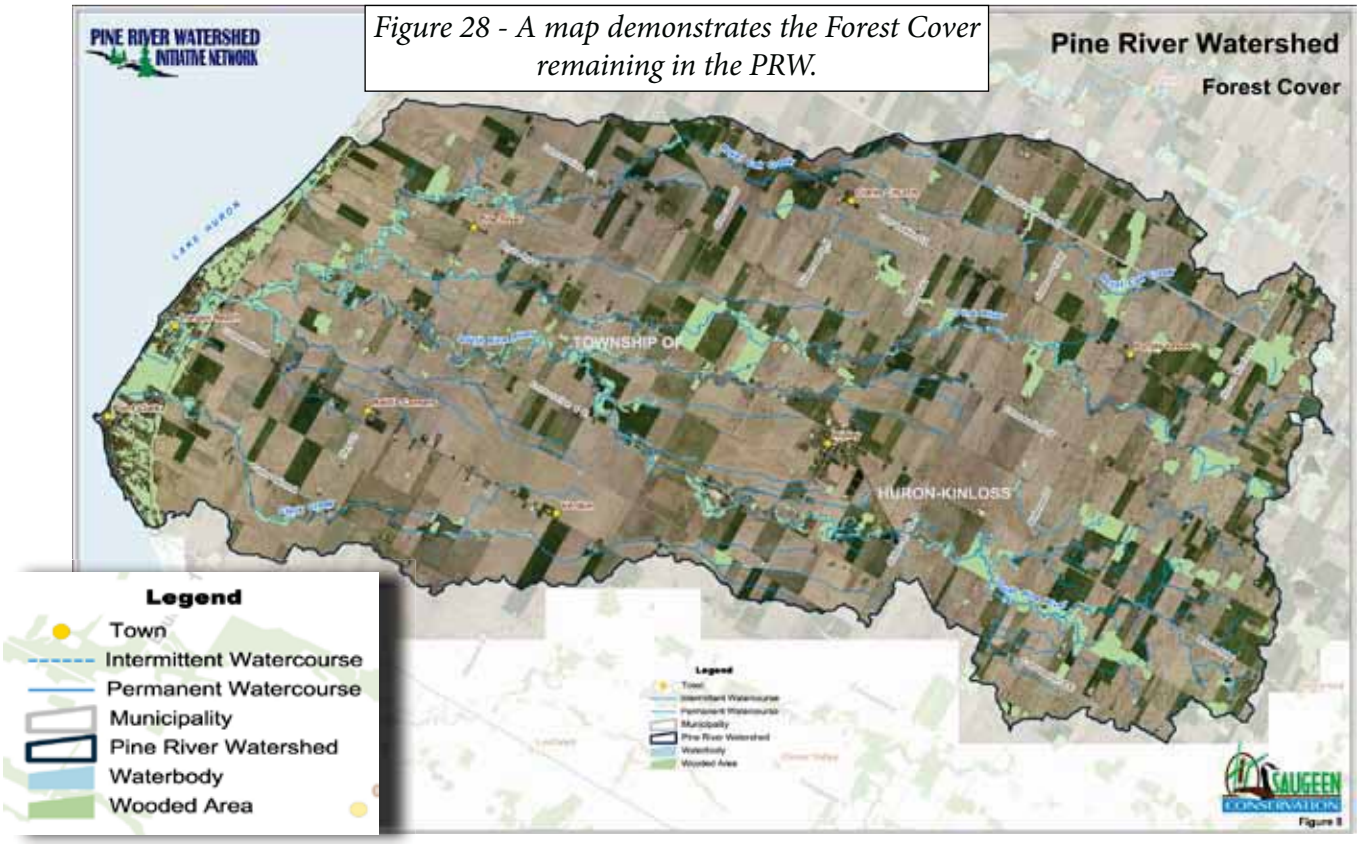
sinuosity and pool to riffle ratio in channels within the Pine River has led to bank erosion becoming a critical issue at many sites along the PRW, especially the culturally significant site of the Anglican church in Lurgan Beach where bank erosion is threatening the integrity of a pioneer cemetery.

Forest Cover

Figure 27 - A cedar log eroded from the banks of the Pine during the spring freshette of 2011

Historically the PRW was over 90% forested. This forest was likely split between dry upland forest consisting of a old growth mixed deciduous and coniferous forest containing large stands of White Pine, Alder, White Ash, Cherry, Birch and Elm and lowland mixed swamp forests of White Cedar, Willow, Hemlock, Basswood, Black Ash and Balsam fir. The tree cover has been reduced to merely 5% cover of the watershed to date in 2011, in response to settlement practices, the timber industry, forest fires, subsistence and commercial agriculture, current residential land clearing, storm events, road widening and installation of amenities. PRWIN has restored over 150,000 seedlings to the PRW over the last 6 years, however the loss of mature trees has still progressed. PRWIN historically has focused its tree planting efforts in riparian areas using traditional Canadian Reforestation practices, but these methods require landowners to completely stop all agricultural activities in this section of their property. It is proposed that while continuing to focus primarily on traditional reforestation, working with Landowners to develop working agro-forestry buffer strip, as outlined by the diagram produced in Chesapeake Bay, may actually increase the overall width and possible effectiveness of these buffer strips. One mechanism for actualizing working buffer strips is through the process of Analog Forestry, which links the environmental benefits to the possible economic benefits of the landowner and in turn watershed (please see appendix 1 for details regarding Analog Forestry).

Figure 28 - A map demonstrates the Forest Cover remaining in the PRW.



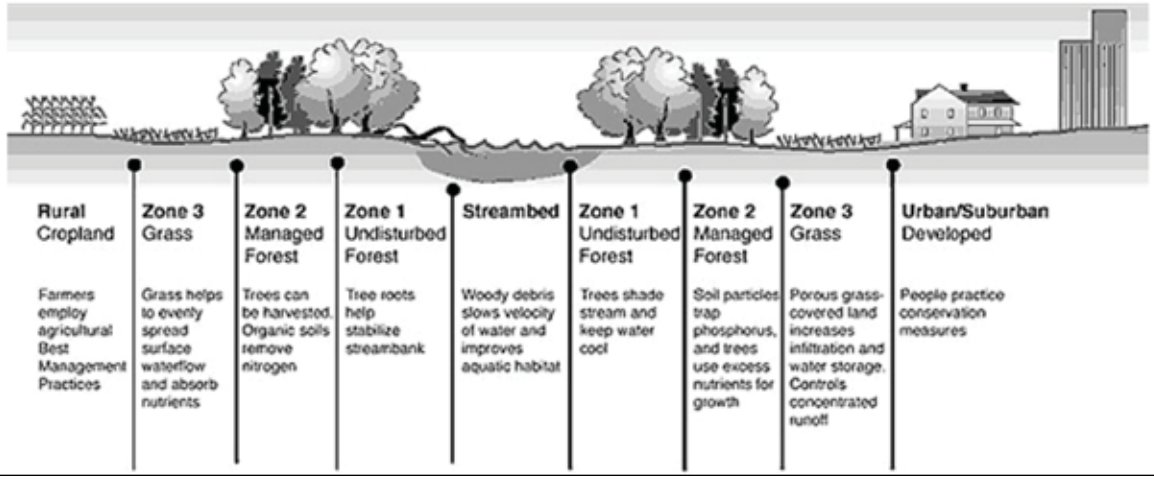


Figure 29 - A working buffer strip concept from the Cheasapeake Bay Study that incorporates a wide buffer strip that benefits both the landowner economically and the watershed ecologically

Riparian Buffers

To date PRWIN, in partnership with many funding and community based volunteer groups has planted a total of 183 155 trees in the PRW, which represents 69 total hectares and approximately 20 km of stream bank reforestation. This planting took place during the years of 2006- 2011. In the Pine River Watershed Report Card, published in 2008 by SVCA, the amount of riparian buffer was estimated to cover 37% or 191km of all banks in the watershed. The total bank length in the PRW is roughly 516 km, which is a composite of the lengths of both open ditch (214 km) and watercourse (44 km) multiplied by 2. This leaves an estimated 305 km of un-forested stream bank in the PRW. Environment Canada recommends that 75% of streambanks have 30 metres of forested buffer strips to promote high water quality. However this is in opposition to regular drainage maintenance that requires one side of a drain be untreed. In the PRW this would require 214 km of untreed bank. These opposing recommendations are antagonistic and without a purposeful resolution water quality is likely to remain at risk in the PRW.

It is hoped that by partnering with the Drainage Superintendant that a compromise can be made around the reforestation of some drain banks, whereas this still leaves 91 km of watercourse or single sided drain to be buffered, which would increase the amount of forested buffer to approximately 58% of the total banks in the watershed. It is estimated that the cost of treeing 20 km of streambank in the PRW to an average width of only 7m, with the inclusion of cattle exclusion fencing, alternative water sources, livestock crossings, and project administration cost an estimated $200 000. It is projected that the remaining 91 km of untreed stream bank require an additional $900 000 to reforest using traditional reforestation practices.

Nutrient Loading

The Pine River is routinely monitored as part of the Provincial Water Quality Monitoring Network (PWQMN) at Lurgan Beach by the Saugeen Valley Conservation Authority. Historical water quality monitoring results are available for most parameters for 1964-1978 and 2002-present. The Township of Huron-Kinloss also routinely monitors water quality in the Pine River as a part of their Water Quality Monitoring Program in partnership with BMROSS. The monitoring program was established in 2001 to measure levels of nitrate, total phosphorus and *E.coli* in the surface water. The purpose of the

Township's monitoring program is to establish and maintain a data base of water quality information that will assist in the future evaluation of development proposals, track changes over time and to allow the Township to make decisions to protect the water resources and the beach resources.

In late spring of 2008, a local resident brought to the attention of the Ministry of the Environment (MOE) concerns over water quality in the Pine River, specifically at the outlet to Lake Huron. The Pine River was thought to be contributing to abundant algae and detritus along the lakeshore due to possible nutrient loading. Numerous photos were sent to the MOE depicting the accumulation at the Lake. The Ministry's Environmental Monitoring and Reporting Branch (EMRB) communicated these concerns with Southwest Regional and Owen Sound District MOE staff and a field program was set up to determine if the impacts were localized or watershed wide (point source or non-point source).

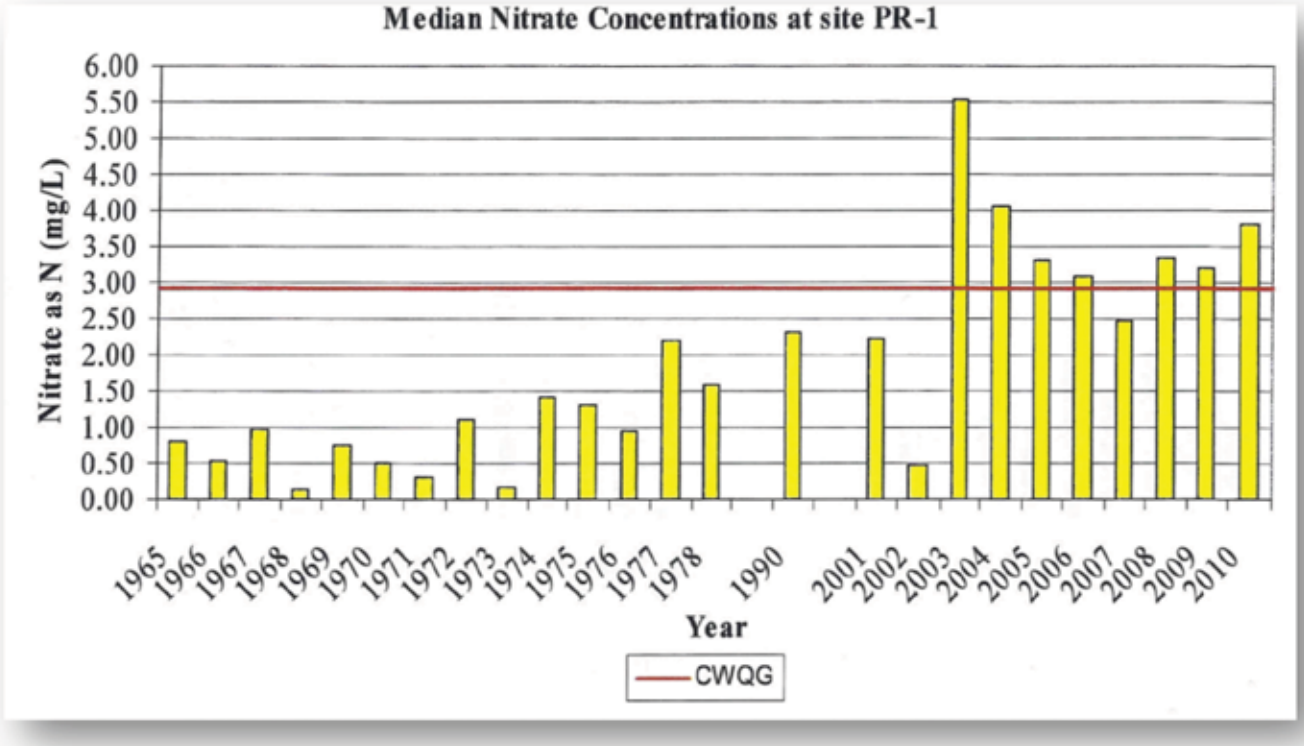


Figure 30 - A decided increase in nitrate levels has been measured at PR-1 since about 2004. PR-1 is the confluence of all branches of the Pine River (41)

[41] B.M. Ross and Associates Limited, "Township of Huron-Kinloss Pine River Water Quality Monitoring Program, 2010 Annual Report, 2010.

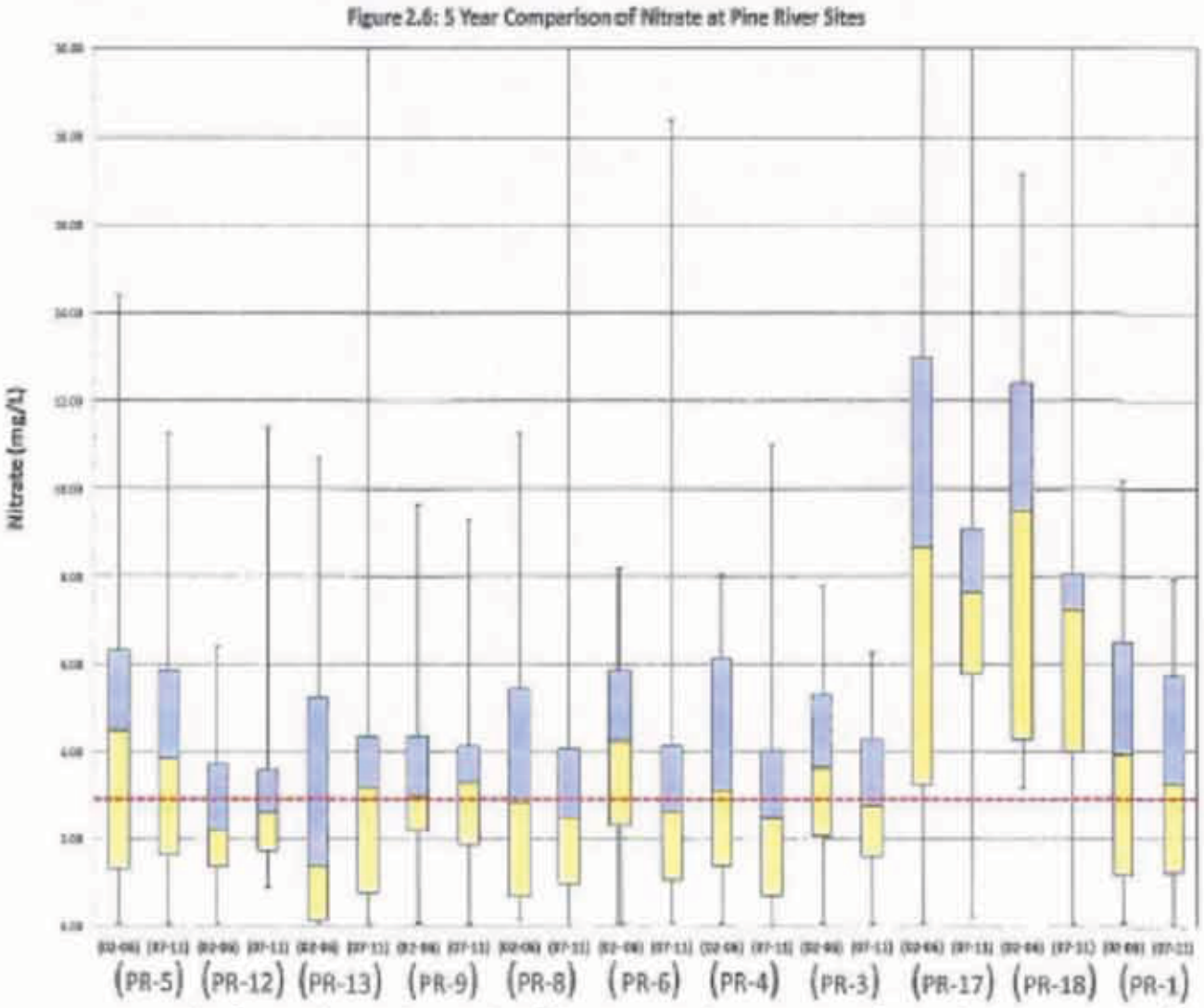


Figure 31 - This figure shows the results of the Mann-Whitney test performed on a 5 year set of samples taken from 11 sites on the Pine River. Standing apart are the results from PR-17 and P-18 with elevated nitrate leves. The PR-17 site also has an extremely elevated level of total phosphorus recorded over this same time period. The landowners on these reaches of stream will be contacted during 2012 by the Municipality of Huron-Kinloss about participation in BMP projects. (42)

[42] BMROSS Pine River Watershed Water Quality Monitoring Program 10 Year Statistical Review, January 2012

2010 Nitrate Results for Nitrate Filter Sites in the Pine River Water Quality Monitoring Program (in mg/L)

Date Sampled	PR7 - Upstream	PR7 - Outlet	PR17 - Upstream	PR17 – Outlet	PR18 – Upstream	PR18 – Outlet	PR19 – Upstream	PR19 – Outlet
March 29	4.71	n/s	8.74	n/s	n/s	n/s	n/s	n/s
April 26	2.23	0.05	4.97	n/s	3.98	2.33	2.80	0.05
June 01	28.2	n/s	37.7	n/s	27.4	n/s	23.1	n/s
June 22	4.19	0.05	15.2	n/s	13.6	10	9.34	n/s
July 5	7.28	0.05	n/s	n/s	14.3	10	n/s	n/s
July 20	2.89	1.54	6.02	n/s	6.81	3.81	3.49	n/s
August 17	0.05	0.05	0.21	n/s	0.06	0.05	0.05	n/s
September 14	0.05	0.05	0.88	n/s	dry	dry	0.05	n/s
October 13	1.83	0.05	1.33	n/s	0.63	0.05	1.52	n/s
November 9	4.9	2.44	7.39	n/s	7.53	4.94	7.44	n/s

Figure 32 - A comparison between upstream and outlet levels of instream nitrate shows a strong reduction in functioning filters. (42)

Dr. Will Robertson of the University of Waterloo has set up four nitrate filters in the Pine River Watershed, which consist of a 50 meter long trench filled with woodchips, covered by filter cloth, p-stone and river sediment. These trenches intake water upstream and act as denitrifying bioreactors under the stream bed in four reaches of the PRW. They are cost effective filters that have been found to remove 98% of nitrate from effected water in flow conditions that exceed 25 L/min. [43]

2010 Results of Hydrogen Sulphide Analysis for Pine River Water Quality Monitoring program (in mg/L)

Date Sampled	PR7 - Upstream	PR7 - Outlet	PR17 - Upstream	PR17 - Outlet	PR18 - Upstream	PR18 - Outlet	PR19 - Upstream	PR19 - Outlet
April 26	<0.02	0.43	<0.02	n/s	<0.02	0.48	<0.02	0.39
June 21	<0.02	1.71	<0.02	n/s	<0.02	0.037	<0.02	n/s
July 5	<0.02	4.39	n/s	n/s	<0.02	0.02	n/s	n/s
July 20	0.02	3.53	n/s	n/s	0.02	0.02	0.02	n/s
August 17	<0.02	6.13	n/s	n/s	0.09	3.3	n/s	n/s
September 14	<0.02	7.4	n/s	n/s	dry	dry	n/s	n/s
October 13	<0.02	<0.02	n/s	n/s	<0.02	0.08	n/s	n/s
November 9	<0.02	0.04	n/s	n/s	<0.02	<0.02	n/s	n/s

Figure 33 - Hydrogen Sulphide levels analyzed upstream and at the outlet of the nitrate filters. (42)

It has been found during sampling in 2010 by BM Ross and by PRWIN in 2011, in flow conditions under 25 L/min the nitrate filters H_2S gas can be produced in low concentrations. H_2S is lethal to humans in concentrations of 500 ppm in the air. During 2010 "a portable gas meter was brought to the nitrate filter sites and readings were always under the detectable limit of 0.01 ppm"(BMROSS, 2011). In the river H_2S is converted to HS and S, which can be affect fish and invertebrate health at concentrations of 15 ppb - 10 ppm. On more than one occasion throughout both sampling years technicians observed minnow species close to the filter outlet. Furthermore the filters use anaerobic decomposition under optimal flow conditions, but in low flow conditions aerobic decomposition can begin, which depletes oxygen levels in the out-flowing water. Measurements taken downstream of the outlet showed that D.O. returned to upstream levels within one metre of the filter outlet. It is thought that the presence

[43] BMROSS Township of Huron-Kinloss Pine River Water Quality Monitoring Program 2010 Annual Report, January 2011

and effects of H2S reduced D.O. are minimal and that the effects of removing nitrate from the surface water out way the risks, at present.

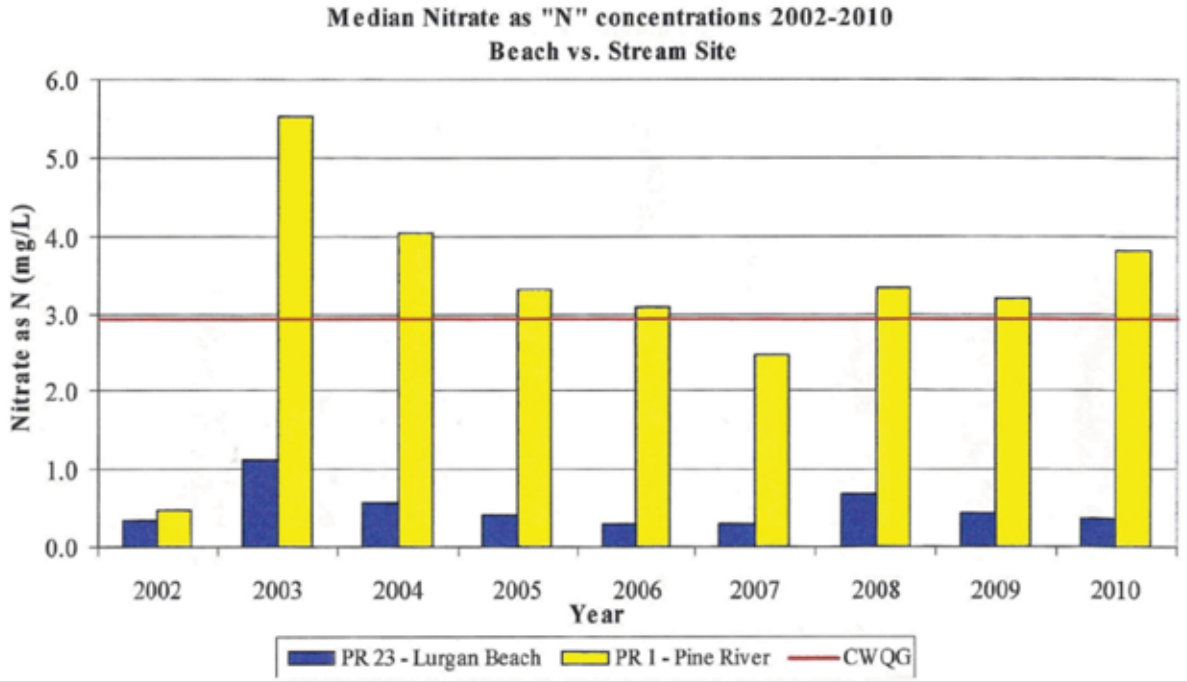


Figure 34 - Nitrates sampled upstream at the Lurgan gauge as compared to samples taken at the Lurgan beach nearshore Lake Huron site. A visual correlation can be detected given the presented data. (44)

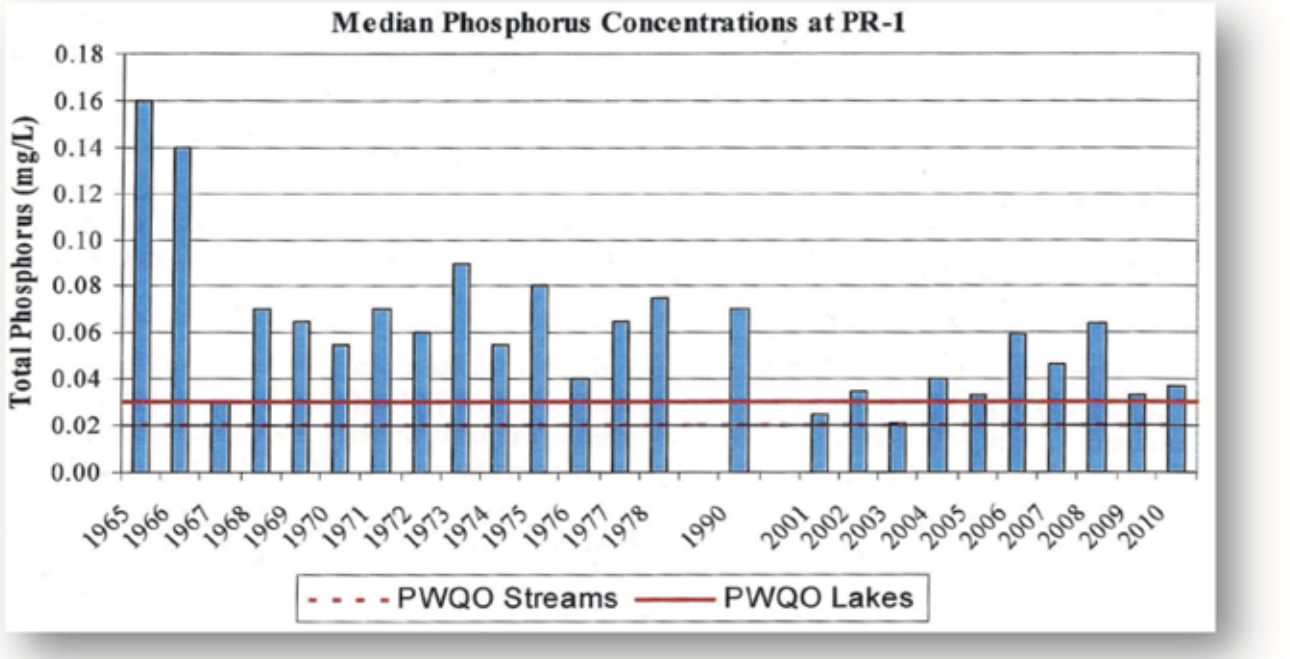


Figure 35 - Median phosphorus levels have been reduced since the mid 1960's in the PRW. (43)

[44] B.M. Ross and Associates Limited, "Township of Huron-Kinloss Pine River Water Quality Monitoring Program, 2010 Annual Report, 2010.

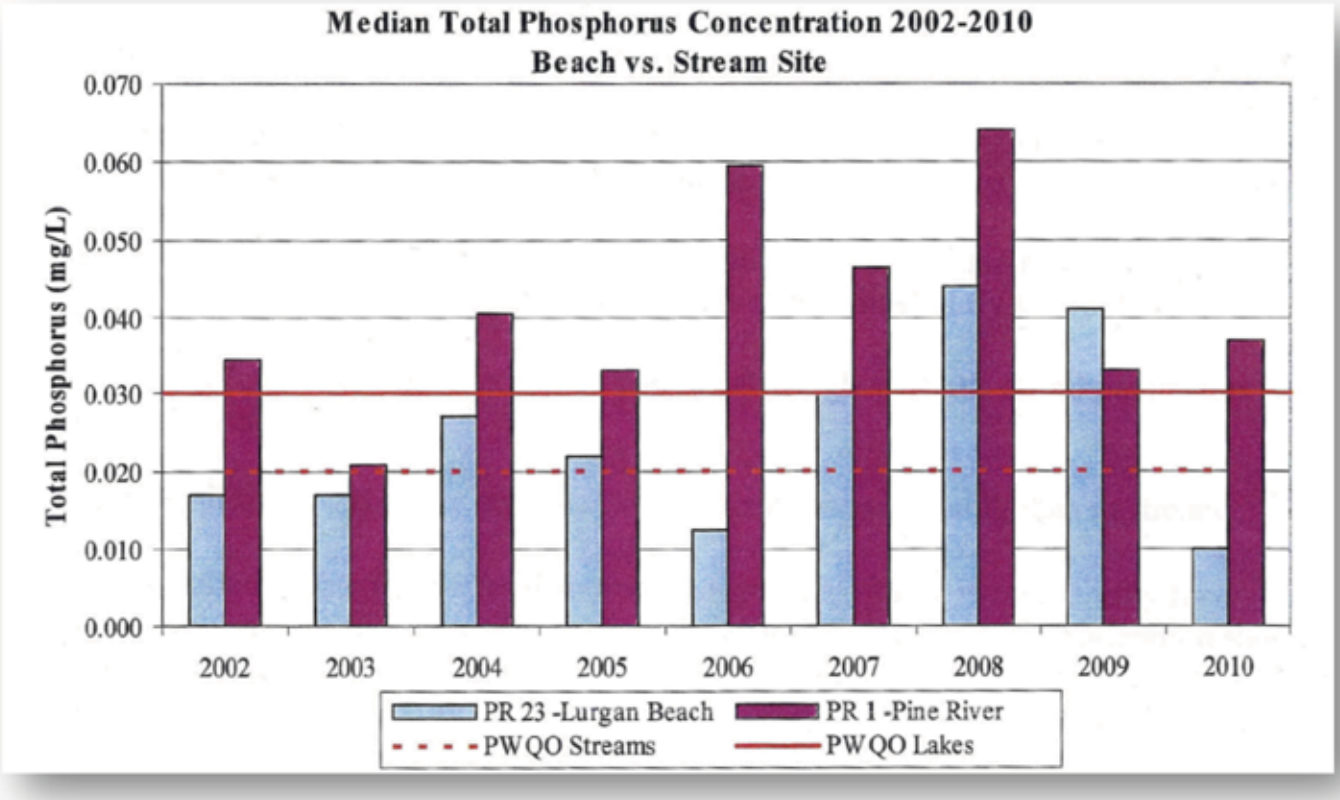


Figure 36 - Total phosphorus in stream at PR-1 as compared to Nearshore Lake Huron at PR-23. A stronger correlation is noticed between stream phosphorus levels and nearshore levels as compared to nitrates. There is also a stronger relationship between the occurrence of nuisance algae in the presence of soluble phosphate. (45)

Total phosphorus levels have fluctuated during this recent period of monitoring by BMRoss and can be compared to other historic records kept by SVCA for the watershed.

Monitoring and Sampling

There are a number of data sets available from various sources for the Pine River Watershed. Part of this report has been to consolidate them. Saugeen Valley Conservation Authority, in partnership with Environment Canada, collect data on rainfall, storm events, nutrients, benthic invertebrates and operates a groundwater monitoring well, west of Ripley. BM ROSS has a contract with Huron-Kinloss Township to collect data on nitrate, *E. coli*, and total phosphorus in surface water. Todd Howell of the MOE has been collecting nearshore data in regards to conductivity and nuisance algae and nutrient levels. OMAFRA has been collecting land use information and there has been considerable work done by the Landowners within the watershed with respect to soil testing and nutrient application. The PRWIN wants to continue to work with these agencies, both private and public to build on the water quality data that has been collected over the past decade.

[45] B.M. Ross and Associates Limited, "Township of Huron-Kinloss Pine River Water Quality Monitoring Program, 2010 Annual Report, 2010.

PRWIN will focus on the headwaters sub-watershed of the main branch of the Pine River in terms of implementation of BMPs and the continuation of several sampling stations within this reach. The main parameters that will be targeted for monitoring will be turbidity and rate of flow at the sample station, as well as total phosphorus and nitrate data that will continue to be gathered in this reach of stream by BMROSS and SVCA. This branch of the Pine River has had several Riparian Buffer Restoration projects implemented over the last 5 years and several other projects to implement Best Management Practices (BMPs) have been proposed for the next 2 years. To date data limited data set has been created charting total suspended solids or soil erosion statistics for this reach of the PRW and we see the loss of top-soil and the subsequent total phosphorus loading that occurs to be of key interest to PRWIN in terms of the effectiveness of our work with Riparian Buffer Strip restoration.

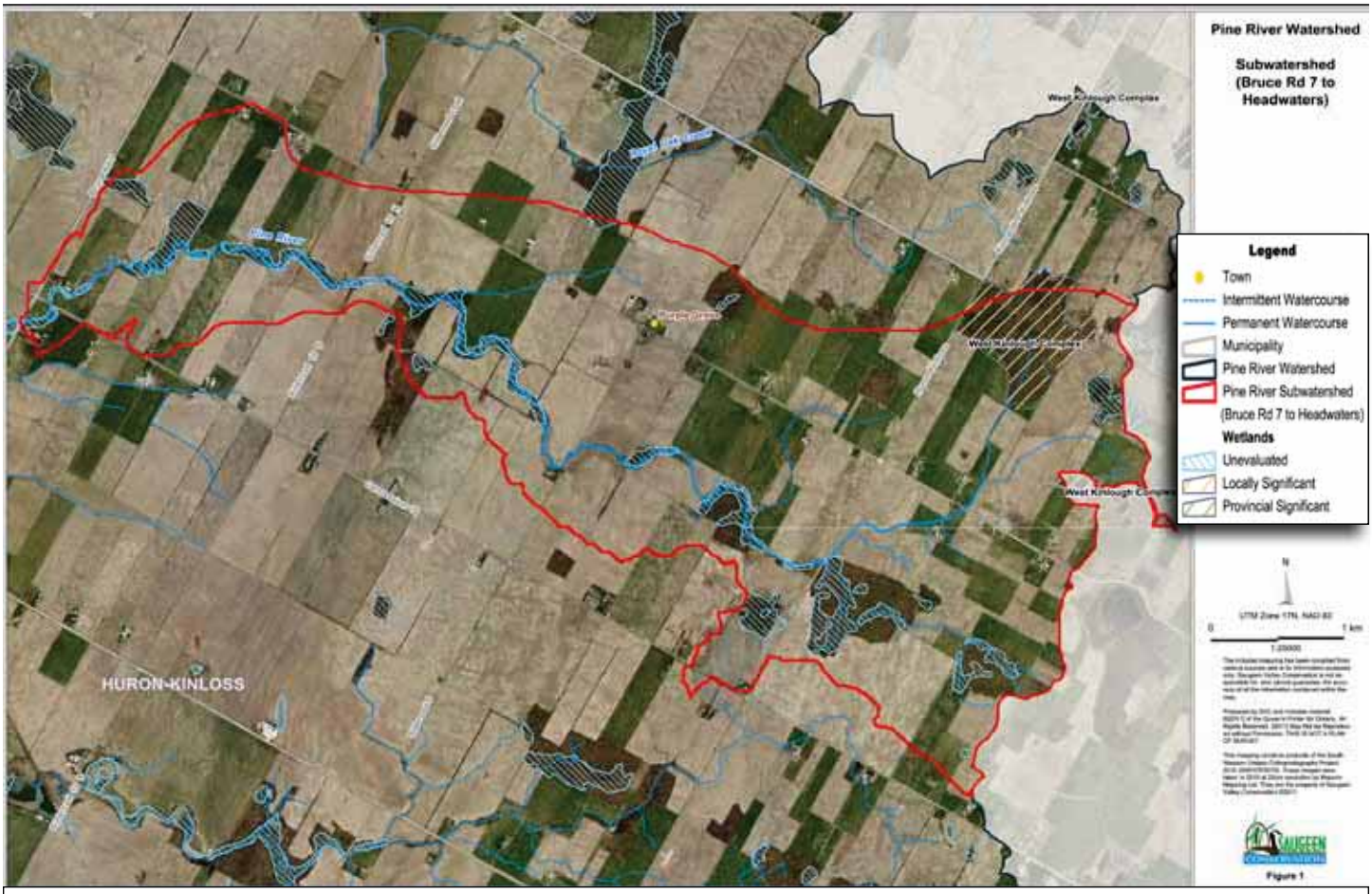


Figure 37 - Diagram outlining sub-watershed of interest with proposed sampling site in orange. This represents a roughly 12 km reach of the Main Branch of the Pine River.

It is hoped that additional qualitative data can be gathered from the local communities as to sites of environmental concern that are eligible from the landowner's perspective for restoration. This data will be gathered primarily through diffuse and informal communication channels, which has been the primary method of site selection for PRWIN over the last decade. Some formal surveys will be posted for response on our website to further this qualitative research, as well as further work with GIS specialists to monitor change on the landscape.

Furthermore the application of this integrated watershed management plan will be studied on an ongoing basis by PRWIN. It is hoped that through the implementation of the recommendations of this plan, that positive change on the social, economic, biological, chemical or hydrogeological scale will be

observed. It is intended that this integrative watershed management plan be a living document. The very word integrative implies the idea of transdisiplinarism; to truly 'manage' a watershed one must know what a watershed truly is, and to know that one must know about all of the aspects, variables and players who make up this functioning geography. For to study in isolation the movement of ground and surface water over the bedrock, surficial geology, soils and plant communities of past and present along with water chemistry and biota, we leave out perhaps the most important variable the dominant species within this ecosystem; the People. Who are these people, why did they stay or settle in the Pine River Watershed (PRW) and how do they affect its function? In turn how does the health of the PRW affect these people? These are questions that PRWIN will explore in hopes of informing the future decision making capacity towards the mandate of "Clean Water and a Healthy Ecosystem in the Pine River Watershed".

Currently, the nutrient monitoring data gathered over the last decade by BM Ross and the Township of Huron-Kinloss, has highlighted monitoring sites PR 17 and PR 18 (please see appendix 6) for elevated levels of nitrate. During the summer of 2012 landowners along this reach of stream will be approached to see whether they will be amenable to the implementation of a series of BMPs designed to reduce nutrient loading. In the spring of 2011 a report[46] was produced by a group of engineering students with the University of Guelph in partnership with the SVCA and Ed Gazendam of Water's Edge consulting firm that selected a section of Royal Oak Creek that was deemed as being most impaired across a series of measured parameters. This 1 km section was then designed to meet an ideal channel naturalization schematic that incorporated meanders and riffle to pool ratios that would still function as a ditch to move water from the surrounding agricultural landscape.

Nearshore Water Quality

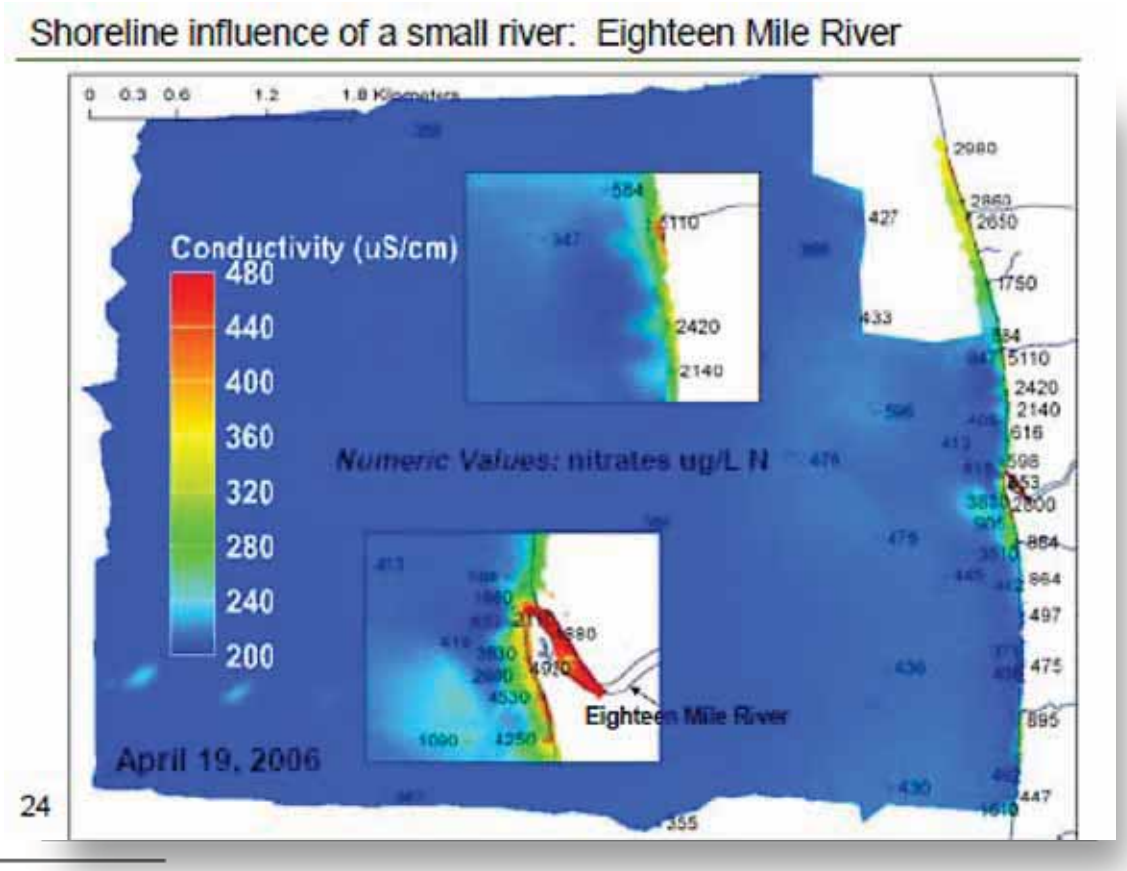


Figure 38 - Figure showing conductivity as a measure of total suspended solids, from a power point presentation made by Todd Howell.

[46] Miles, O, Fraser, T., Murihead, J., Stream Restoration of a Rural Ontario Watercourse: Royal Oak Creek, ENGG 4150, University of Guelph, 2011

In a study led by Prof. Todd Howell an analysis of the nearshore environment of Lake Huron has interpolated the relationship of total suspended solids, as measured by conductivity in relation to total nitrate levels and the presence of nuisance algae. This study hopes to elucidate the relationship of landuse practices with nearshore water quality and it is hoped that PRWIN can assist in the process of this study.

Shoreline Management

The Lake Huron Centre for Coastal Conservation prepared a Beach Stewardship Guide for the Township of Huron-Kinloss in 2007. The guide was prepared to present a set of Best Stewardship Practices for the coastal portion of the municipality. While the guide is still valid and presents the details for implementing sound coastal stewardship, developing a set of recommendations that tie in to the Pine River watershed plan will help to underscore the importance of coastal stewardship to water quality outcomes at the lake.

The section of the report will focus on specific recommendations that relate to water quality and beach health, as it pertains to the area west of the Algonquin Bluff (the traditional physical division between agriculture and cottage related activities in the municipality), referred to as the Huron Fringe. As identified in the Beach Stewardship Guide, there are several topics that will affect beach and water quality in this area. The shoreline specific recommendations have been singled out in their own section as they are a unique set of management issues that pertain to an primarily to the Huron Fringe region of the watershed:

Dune conservation and its implications for beach and water quality

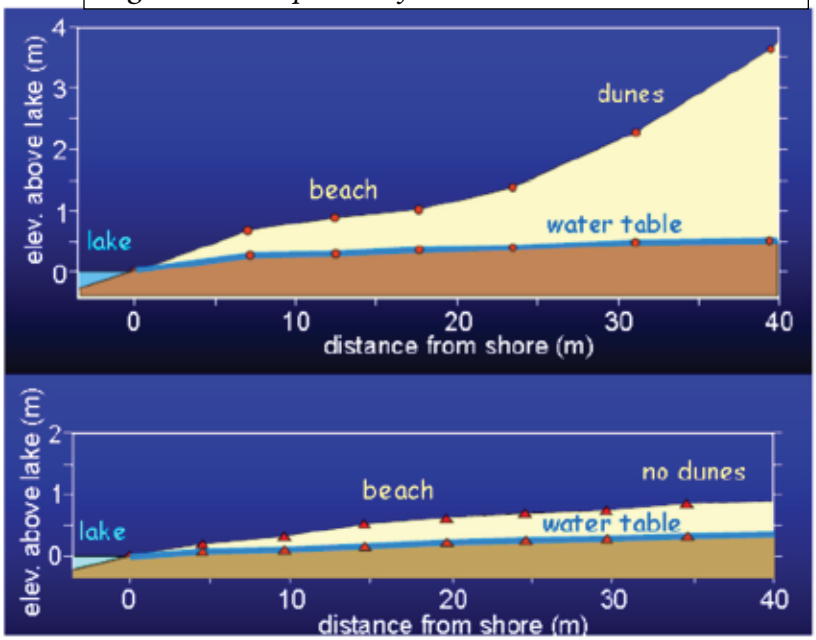
Recent research on Lake Huron has concluded that degraded dune areas can create the conditions that lead to elevated bacterial pollution in the sand from groundwater below beaches (Crowe, 2005). Removal of dunes and dune vegetation and the erosion of beach sand by wind leads to a shallow depth to the water table, which in turn promotes wet or damp sand on the beach, the invasion and growth of non-native beach plants including turf grass. As more sand is eroded from the surface of the beach, the distance to the water table beneath the beach decreases. As the water table comes closer to the surface, the sand will become wetter and in some cases springs will form as the water table intersects the beach surface. When combined with input of water and nutrients from beachfront residences, this leads to a wet and nutrient-rich environment favourable for plants such as cattails and sedge grass, but not favourable for natural shore vegetation such as dune grasses and shrubs (Crowe, 2005).

High concentrations of bacteria can be found in the swash zone of beaches, where the sand tends to be wet, but little is found in the dry parts of the beach (From Crowe 2011)

It is possible to restore the beach to dry sandy conditions by raising the surface of the beach (i.e., greater depth to the water table). This requires residents to protect and restore the sand dunes and dune vegetation.

Intact dune systems also provide a corridor or buffer between the beach and cottage development. This buffer can aid in filtering pollutants from surface and shallow groundwater flowing toward the lake.

Figure 39 - Comparison of beaches with and without dunes



Comparison of a dry beach (top) with wet beach (bottom). Wet beaches can be formed when dunes have been removed, where the beach sand blows off the active shore zone and the beach profile deflates over time.

Beaches with dunes retain the sand cycling characteristics and sand is not lost from the active shore system.[47]

Recommendation: Promote beach and dune conservation for the ecological benefits, as well as the water quality benefits that healthy dune systems can provide. The municipality should work with local beach associations and the Coastal Centre to promote and encourage dune naturalization and dune restoration programs.

Water Conservation

Changes in development from traditional cottages to seasonal and permanent homes has meant a change in the way people use water. Where in past, cottages may have had one washroom and kitchen sink, many now have multiple washrooms, dishwasher, shower/bath facilities. Increased water use leads to greater amounts of effluent, making septic maintenance especially important to nearshore water quality. It is important minimize water use in order to keep solids well settled on the bottom of the tank. Septic systems are designed to hold wastewater long enough to allow solids to settle to the bottom forming a sludge layer and oil and grease to float to the top forming a scum layer. This process of settling and separating achieves primary treatment. If too much water is flowing into the septic tank, wastewater is pushed out into the drainfield before the settling and separating process has time to occur. The solids will be pushed out into the drainfield and can cause clogged pipes and clogged soil. In addition, older septic systems were designed when cottagers used less water.

Water conservation will lessen the load on the system, which lowers pumping frequency and reduces malfunctions.

Recommendation: The municipality should work with the Coastal Centre, Saugeen Conservation and others to promote cottager water conservation practices for the purposes of reducing amounts of septic effluent, which ultimately flows toward the lake.

[47] Crowe, A. June 2011. "Caring for Our Beaches: The science of good beaches and good water quality", presentation delivered to Beach Processes Seminar, Friends of Sauble Beach, June 10, 2011

Water Quality and Wildlife

In Huron-Kinloss there have been local resident populations of Canada Geese with nests situated along the lakeshore. These birds can be a source of bacteria and nutrients to beaches and should be discouraged. Conventional cottage landscaping often resorts to plants that are not native to the coast. Lawns and turf grass, in particular, attracts geese. Dune grasses and shrubs can act as a deterrent, as they are not attracted to these plants for food, and trees and shrubs obstruct access.

***Recommendation*:** Encourage the use of native dune plants in gardening and restoration, and discourage the use of turf grass in beach/dune areas. This issue is most obvious in and around the Point Clark lighthouse area.

Water Testing

There is some confusion amongst cottage residents about the state of beach safety and whether or not it is safe to swim in the lake within the Township. The Grey Bruce Health Unit no longer undertakes water testing in Huron-Kinloss. The monitoring station at Point Clark was abandoned in 2009, despite the beach meeting public beach criteria of having washroom facilities and parking for visitors. While the Township conducts an annual water monitoring program and does undertake some beach sampling, these samples are not intended to provide information for making public health decisions.
In the absence of data and/or adequate public information on safe swimming, some cottagers have reported that they no longer allow family to swim in the lake based on this uncertainty.

Recommendation: Beach monitoring should be resumed by the public health authority in Huron-Kinloss. There is an element of accountability on the part of the public health authority to provide an effective public education program to educate beach-goers about safe swimming conditions (beyond posting information on their website). Safe Swimming awareness could be promoted through partnership promotion between the Health Unit, Municipality, the Coastal Centre and Saugeen Conservation.

Cottage Landscaping and Retention of Huron Fringe forest

Forested lands contribute less sediment and nutrient runoff pollution than any other land use. Riparian buffers have the ability to filter water that is often comparable to wetlands. In Huron-Kinloss the largest forested area occurs in the Huron Fringe corridor within the cottage community. However, that 'forest' label is deceiving in that the understory is gradually being diminished by development (roads, cottage development).

More and more of the forest lands is being lost to development. In addition, the understory is being converted to urbanized landscapes. Encouraging tree retention, and naturalized landscapes would help to promote better water filtration in the coastal corridor. The Coastal Centre has developed a guide for cottagers who can participate in smaller scale initiatives to help reduce stormwater. It will be necessary to build local knowledge and capacity to implement the restoration measures for the naturalization of buffers in dune grassland areas. The "Dune Planting Guide" can help people select suitable species for naturalized buffers in the coastal zone.

Stormwater and Beaches

Dealing with stormwater (precipitation runoff) is a challenging issue for municipalities and can be particularly challenging when the drain outlet flows onto a beach. Stormwater from storm drains has

the effect of creating channels on the beach, which can occupy large expanses of beach depending on how the channel mouth is moved by alongshore currents. Stormwater can also transport pollutants to the beach elevating bacteria and nutrient levels. Past practices have encouraged the fast removal of stormwater from the land and convey water to the lake through culvert systems. At the beach, stormwater has been typically left to empty onto the beach where it creates a channel to the lake. During low flows, the beach sand may have some capacity to filter nutrients and pathogens from the water, but high flows will result in direct inputs to the nearshore waters. Local impairments of beaches can result, including elevated bacteria and algae occurrences.

Recent research in the neighboring Maitland River Watershed reviewed climate data from 1950 to 2006 identifies some trends with serious implications for stormwater management design in the coastal zone. Precipitation data over the study timeframe indicated that total annual precipitation was increasing, and that most of those increases were coming in the fall, winter and spring seasons. Intensity of precipitation was noted to be increasing by 10 to 30%.

Implications for the Pine River watershed could have implications for stormwater and sediment/nutrient contributions to the lake. From the Maitland report, the author notes that *"In particular, those areas that are dynamically eroding due to surface water flow may be particularly susceptible to increases in erosion due to increased runoff. Notably, the small streams and gullies which drain directly into Lake Huron within the Huron Slope area may be particularly vulnerable, due to their actively eroding gullies, less competent geology and clayrich soils. These areas also tend to be extensively drained, further accentuating any potential erosion issues by increasing total runoff."*[48]

Increased snowbelt activity resulting from an open, ice-free lake coupled with winter thaw events from increased winter temperatures could overload current stormdrain systems.

Recommendation: Water storage on the land, and riparian buffering, will be necessary to prevent increased erosion and higher stormwater flows resulting from climate changes. The municipality is encouraged to consider using 'green' infrastructure to minimize stormwater impacts to beaches. Rain gardens, bio-retention cells, infiltration swales, green parking lot/driveway design, rain barrels, are examples of technologies that are intended to address stormwater quality and quantity issues. While stormwater management on the broad scale is a municipal responsibility, individual property owners can get creative with functional landscaping, that helps to keep our nearshore clean!

Pine River Environmental Issues

The environmental issues facing the Pine River Watershed are best illustrated as a web, which begins to highlight their interrelationship as it affects the ecosystems of the Pine River.

[48] Luinstra B., 2009. Climate Trends and Impacts in the Maitland Valley Conservation Authority Jurisdiction. Unpublished report. 131pp.

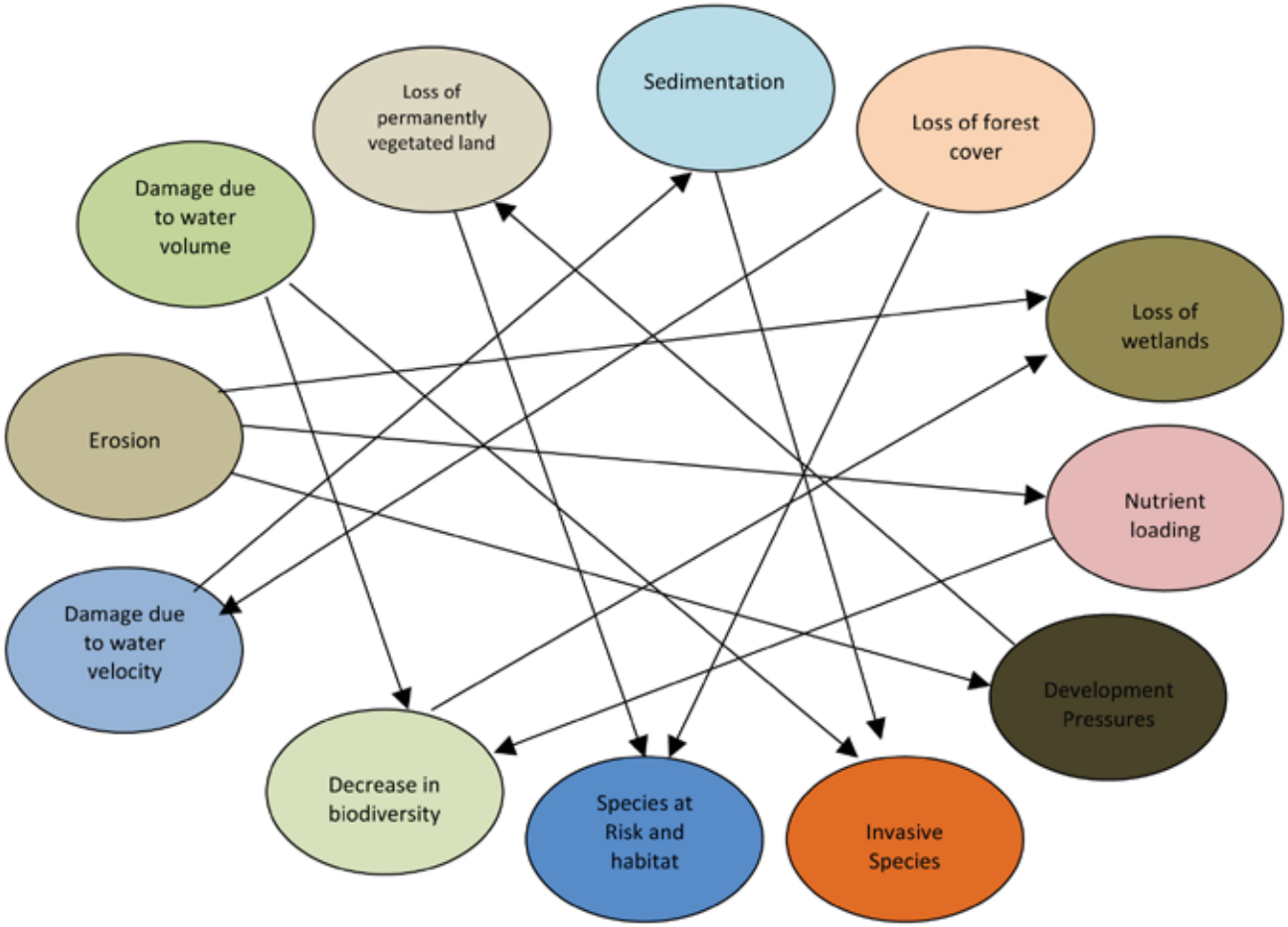


Figure 40 - The Environmental Issues that face the PRW are all interconnected and interdependent

Erosion was identified as being a high priority resource management issue by PRWIN. The cause of erosion in the PRW can be grouped into three general categories:

- surface water sheet runoff and wind erosion
- soil instability
- streamflow forces causing stream bank erosion

In order to achieve successful remediation of erosion problems, the nature and cause of erosion at each individual site must be determined and a work plan developed with the landowner to address them.

Surface water sheet runoff and wind erosion are two separate causes of erosion, however they both originate from the lack of permanent or semi-permanent vegetative cover on the landscape. The large expanses of exposed topsoil allow for long runs of surface water to occur in fields and carry topsoil down slope. These large fields of exposed topsoil are also vulnerable to wind forces that are not checked by any barriers other than ditches or water bodies which act as catchments for topsoil particles. The topsoil is then transported downstream via the watercourses. Wind breaks,

shelterbelts, cover cropping, low -till or no-till tillage practices, and riparian buffer strips can alleviate the severity of this environmental issue.

Soil instability is an environmental issue that cannot be fundamentally changed in the PRW as the clay soils have an inherent instability and are vulnerable to erosion.

Streambank erosion is more serious in the lower reaches of the local watercourses, downstream of Sideroad 30. This is primarily caused by the increased rate of flow present in this reach of the watershed during heavy precipitation events as well as due to naturally occurring, steep, high bank, combined with the meandering nature of the stream itself. All branches of the Pine River now experience bank slumping, sloughing, and undermining processes however the South Pine River and the upper reaches of Royal Oak Creek are most seriously affected.

Damage due to water velocity results in a high amount of streambank erosion, including pulling trees from the bank and threatening the integrity of the Lurgan Anglican Church pioneer cemetary. High water velocity is also deletorious to fish and macroinvertebrate populations who may be flushed out of the watercourses during heavy precipitation events.

Decrease in biodiversity**:** The environmental problems associated with a decrease in biodiversity are outlined further in the Biodiversity section.

Species at Risk and habitat**:** The loss of habitat and species at risk can be compared to the analogy of the "canary in the coalmine". Species at risk are often the most vulnerable, unique and therefore specialized to a specific habitat and with habitat degradation are usually the first animals or plants to become threatened. However it is likely they are an early warning system for the totality of the ecosystem being at risk.

Invasive Species**,** such as *Phragmites australis,* Garlic Mustard and Quagga mussels cause added pressure to ecosystems that are threatened from many sides and therefore already have decreased resiliency to threats. Invasive species come from distant parts of the world and thus do not have any natural checks and balances that would have evolved in a native ecosystem, in the form of predators, parasites or viruses. Thus they are able to grow widely and rapidly, often creating monocultures of themselves, and displacing already vulnerable native species.

Development Pressures**:** In the Pine River watershed there are two development trends that currently threaten the environmental integrity of the Huron Fringe and Dune Ecosystems located below the Lake Algonquin ridge and the river, forest and wetland ecosystems located above it. One is a trend towards the larger developments of permanent and semi-permanent homes along the lakeshore and subsequent deforestation and draining of coastal wetlands; the other is a trend towards the development of larger farm fields associated with growing agribusinesses and related deforestation and draining of unevaluated wetlands.

Nutrient loading**:** Soluble phosphate and nitrate are the primary nutrients that have been linked to the problem of Nuisance Algae in the nearshore environment at the outlet of the Pine River and Clark Creek. These nutrients enter the watercourses through two separate mechanisms, surface or sheet runnoff; and via the tile outlets.

***Loss of wetlands*:** The majority of the historic wetlands documented in the Pine River Watershed have already been drained. The remaining wetlands are threatened by continuing systematic drainage of the landscape, especially the wetlands that have not been evaluated by MNR as there are fewer regulations for conservation placed on these sites. One of the most serious threats to these wetlands is a misunderstanding of their importance, most people still view wetlands as an impediment to human development as opposed to a benefit.

***Loss of forest cover*:** Again most of the historic forest cover has been removed from the watershed, however a net loss of mature trees continues to occur annually. Please see section on Forest Cover for further information.

Sedimentation is a result of the erosion process as it affects the water course. The topsoil eroded from the landscape enters the streams and rivers and is deposited as silt along the bottom of the riverbed. This is extremely detrimental to fish spawning and the metabolic needs of the benthic macroinvertebrates, that form the basis of the aquatic food web.

Loss of permanently vegetated land affects the amount of precipitation that can be absorbed and stored on the landscape, which increases the amount of water entering a watercourse during a precipitation event.

Damage due to water volume: The large amount of water entering the watercourses of the Pine River very rapidly during heavy precipitation events, which are increasing in intensity as a result of global climate change, causes localized flooding in some fields and puts increased pressure on the drainage systems making 'improvement' necessary. This improvement results in deepening drainage channels which then increases the rate of flow in the entire system.

Many of these topics have developed into environmental issues over decades and have now compounded into major environmental problems such as the loss of summer baseflow in the PRW and the presence of nuisance algae in the nearshore environment. Although each issue can be addressed separately, it is the purpose of this plan to encourage a systems approach to address the milieu of environmental issues as a whole.

The "Economy" in so far as it affects the Ecological Restoration of the PRW

In developing an environmental plan, one has to understand the economic drivers within the community. The success (or failure) of these economic drivers either enables greater implementation of stewardship activities, or grinds it to a halt.

One of the largest industry sectors in Canada, agri-food contributes 8.1% of GDP, and one in eight jobs. Grey and Bruce Counties are historically agricultural communities. The counties have some of the best growing conditions in Canada. Agricultural production in the counties are managed by nearly 5,000 farms taking advantage of the fertile soil base and growing season. Over 62% of Bruce County's land is dedicated to the agriculture industry with 63% of farms being family-owned.[49]

[49] "Agriculture" Bruce County, http://www.brucecounty.on.ca/agriculture.php (Accessed: Oct. 8, 2009)

The regional economy is largely driven by agriculture and related businesses, providing employment for over 6,800 residents (7.5% of the labour force) and generating over $600 million in farm revenues are employed in the Grey and Bruce Counties Agriculture Sector.

Agriculture and agri-businesses in Ontario are being transformed by technology and consumer demand, contributing to the growth of processed food and consumer-oriented food products. The counties are adapting to these changes by actively promoting and attracting agri-business operations. The loyal and skilled labour and competitive business costs make it the ideal location for smaller farms and companies to flourish.

The most common farming types of operation in Grey and Bruce Counties are beef cattle ranching and farming (1,946 farms), hay farming (559 farms), and dairy cattle and milk production (366 farms).[50]

	Bruce	Grey	Total	Percent
Dairy cattle and milk production	197	169	366	7%
Beef cattle ranching and farming	899	1047	1946	39%
Hog and pig farming	86	56	142	3%
Poultry and egg production	38	35	73	1%
Sheep and goat farming	80	131	211	4%
Oilseed and grain farming	400	123	523	11%
Vegetable and melon farming	22	24	46	1%
Fruit and tree-nut farming	12	83	95	2%
Green- house, nursery and floriculture production	27	75	102	2%
Other types	498	944	1442	29%
Total	2259	2687	4946	100%

Number of census farms classified by industry (OMAFRA, 2008)

The Developing 'Green Sector' and how it could affect the restoration of the Pine River Watershed

PRWIN participated in a survey completed by the mid-western regional green jobs strategy during the growing season of 2011. "All businesses who are currently involved in or anticipating transition into new renewable energy, energy efficiency or climate change adaptation products and services have the opportunity to participate" (MWOGJS, 2011)[51] in a survey designed to elucidate limitations to growing "green sector" jobs.

According to the Scott Farm economic analysis over the years of 1974 to present a notable net increase in profit from the 100 acre managed forest on their farm property in comparison to the greater acreage left in cash crop.

"This analysis does not attempt to place a monetary value on the many other woodlot benefits such as site protection, contributions to water quality or groundwater recharge, opportunities for recreational

[50] Agriculture Profiles. Investing Grey Bruce. As viewed online at http://www.investingreybruce.com/en/introduction-to-grey-bruce/36.html on October 6, 2011.

[51] MWOGJS, Ontario Green Jobs Survey, 2011

use, etc. It is typically more difficult to place a dollar value on these benefits, although in some locations landowners are charging for access or leasing hunting and fishing rights." (Roulston, 2004)

Another promising field of the green sector is in energy production through manipulating algae in vitro to create ethanol. In the PRW we have an excess amount of *Chladophora* algae, several dump truck loads, per week during a bloom in summer, and an ethanol plant in the neighboring township that is open to new research and production projects! The economics of other niche crop and energy crop markets are being explored by PRWIN through a partnership with an Analog Forestry technician and an organic cash crop landowner.

Demographics

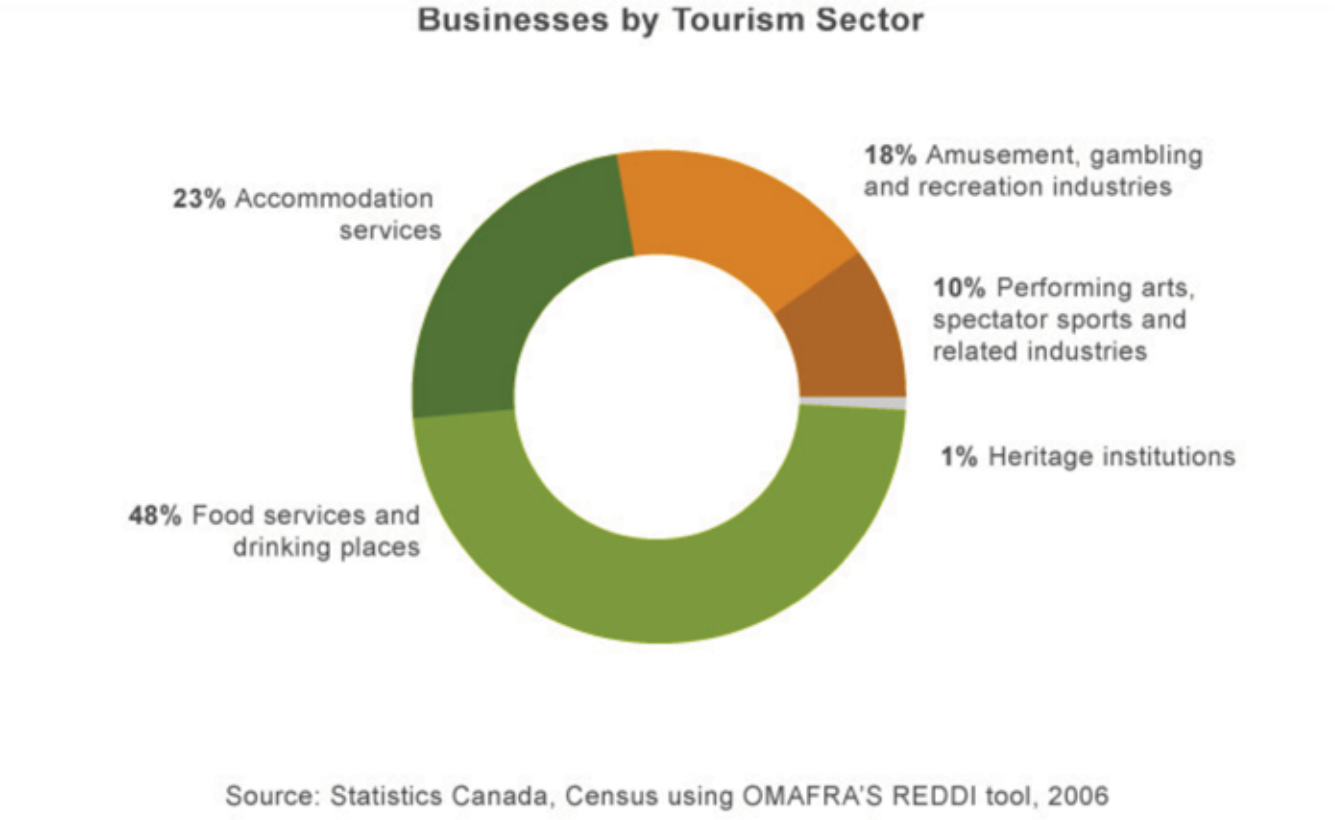
Grey Bruce currently has significant energy assets which it continues to build on. With a base of nuclear power, Grey Bruce is also leading the way in Canada's green energy sector. Nearly 5400 residents (6.0% of the labour force) are employed in this sector. The sector's main employer is the Bruce Nuclear Power Plant in Tiverton, Ontario, and another is Westario Power in Walkerton, Ontario.[52]

3 Labour Force by Industry, % Share	
Utilities	12.9%
Retail trade	12.1%
Manufacturing	9.2%
Agriculture, forestry, fishing and hunting	9.1%

5 Target Industry Growth, 2006 - 2010	
Value-added Agriculture	10.1%
Energy & Environment	11.3%
Advanced Manufacturing	9.5%
Tourism	33.6%
Retail	8.9%

Along with agriculture and energy, the third pillar of the Huron-Kinloss economy is tourism. Tourism is the second largest industry employing 1 in 7 of the working population within Bruce County.[53] The Grey Bruce tourism sector includes the arts, entertainment and recreation industries, accommodation and food services. Over 8,500 residents (13.4% of the labour force) are employed in this sector of the economy.[54]

[52] Energy and Environment. Investing Grey Bruce. As viewed at http://www.investingreybruce.com/en/invest-in.html on October 6, 2011.
[53] "Tourism" Bruce County, http://www.brucecounty.on.ca/tourism.php (Accessed: Oct. 8, 2009)
[54] www.investingreybruce.com Tourism Profiles as seen October 27,2011



Source: Statistics Canada, Census using OMAFRA'S REDDI tool, 2006

COMPETING USER NEEDS

Given that there are such a variety of users that benefit from the PRW, it is understandable that the needs of these different user groups would clash. Since all of these groups need to be engaged in the restoration of the PRW, it is important to understand the issues between groups. The following chart shows competing user needs for the agricultural and recreational groups in the PRW.

Agricultural	Recreational
property values, increase in size of homes and type of usage, change from seasonal residence to permanent homes	increase in farm size, change in type of farming operation

There are three distinct user groups who benefit economically, socially and environmentally from the PRW: farmers/agribusiness; cottage/lakeshore home owners and recreational water users; and environmental organizations. In the case of all three, what benefits one ie, drainage tile to increase yield on farm land – can have a negative impact on the others, tiled fields increase runoff carrying fertilizers into watershed resulting in poorer water conditions in lake. In order to maintain its success the PRWIN will need to remain the glue that brings these user groups together to work towards a common goal of rehabilitating the PRW so that it continues to be a benefit to all.

Moving forward to benefit all user groups

According to the Bruce County Federation of Agriculture, the average age of the Ontario farmer is approximately 55. As these farmers retire and move out of the rural landscape, it is likely that the land

will be purchased by the operators of larger farm enterprises. In other areas of the province, this has resulted in the consolidation of livestock, and larger acreages being farmed by single operators.

The north western parts of the PRW have seen an increase in the creation of Mennonite/Old Order Amish farms, which encompass more mixed farming, including horticulture, than specialized operations. This community is culturally distinct in many ways and will require different outreach and communication strategies that are appropriate. It will be important to work with this community as many of their farms lie in the headwater region of the PRW.

Along the lakeshore, development of permanent, year-round residences has increased, while seasonal residences have decreased. This is a function of the cost of properties along the lakeshore, which is at a premium. As a result, there is more interest in municipal water and sewage works, although development continues mainly through private services.

Recognizing the contribution that faulty septic systems make to nutrient loading, The Municipality of Huron-Kinloss has been at the forefront of the development of a mandatory septic system inspection program in partnership with BMROSS, an engineering firm and in the fall of 2011 received the prestigious award at the State of the Lakes Ecosystem Conference (SOLEC) for their efforts.

Environmental Farm Plans (EFP) are assessments voluntarily prepared by farm families to increase their environmental awareness in up to 23 different areas on their farm. Through the EFP local workshop process, farmers highlight their farm's environmental strengths, identify areas of environmental concern, and set realistic action plans with time tables to improve environmental conditions. Environmental cost share programs are available to assist in implementing projects.

Bruce County has historically been within the top three counties in Ontario for the number of farmers who have completed Action Plans for their farm, and for the amount of grant dollars spent, matched by farmers, on stewardship projects.[55] With continued funding from federal and provincial sources, it is anticipated that the willingness of Bruce County farmers to participate in the programs will continue.

COMMUNICATION, EDUCATION AND OUTREACH

One of the primary goals of the education and outreach associated with this IWMP is to create 2 short videos that can be posted on Youtube and linked to our website to summarize the contents of this plan into an accessible format for the public. This medium of education and outreach will have the ability to reach hundreds or thousands of individuals in the privacy of their own homes at a level of understanding that will be informative yet not overwhelming.

There are many particular groups whose support is critical to the continued success of the PRWIN in their efforts in the PRW. They include: the municipal through federal government; local and more widely based environmental, conservation groups, user groups, such as boaters, hikers, hunters, fishermen; and local landowners. Respectively, they have interests in protecting the environment and the watershed, using the watershed for their particular activity, and protecting their private property rights. In order for the PRWIN to continue to thrive as an organization, it needs to continue to propose

[55] Deitrich, Jayne. Ontario Soil and Crop Improvement Association Field Representative. Personal Communication. October 15, 2011.

projects that cover a wide range of activities-riparian buffer strip rehabilitation, stream bank stabilization, erosion control, wetland rehabilitation and installation of nitrate and possible phosphate filter systems and water storage mechanisms. These activities, coupled with education and outreach, are also aimed at providing private landowners with cost-effective techniques and information to assist them with stewardship and management of the watershed. A comprehensive Stewardship and Management booklet is currently being developed to give to each landowner that completes a project. They then can take the opportunity to continue to improve their own property for water quality and ecosystem values.

PRWIN is also developing an Environmental Studies Area on privately owned property adjacent to the Ripley Elementary school that will be used to showcase restoration pilot projects and involve students in biomonitoring and other outdoor education. A series of interpretive trails will be completed on this property, meandering through a constructed wetland, scheduled to be completed during the summer of 2012 and several areas that have been reforested in different periods. Students will be engaged in experiential education on this site where they will actively participate in restoration and monitoring activities.

Figure 41 - Experiential Outdoor Education has always been a strong focus of PRWIN

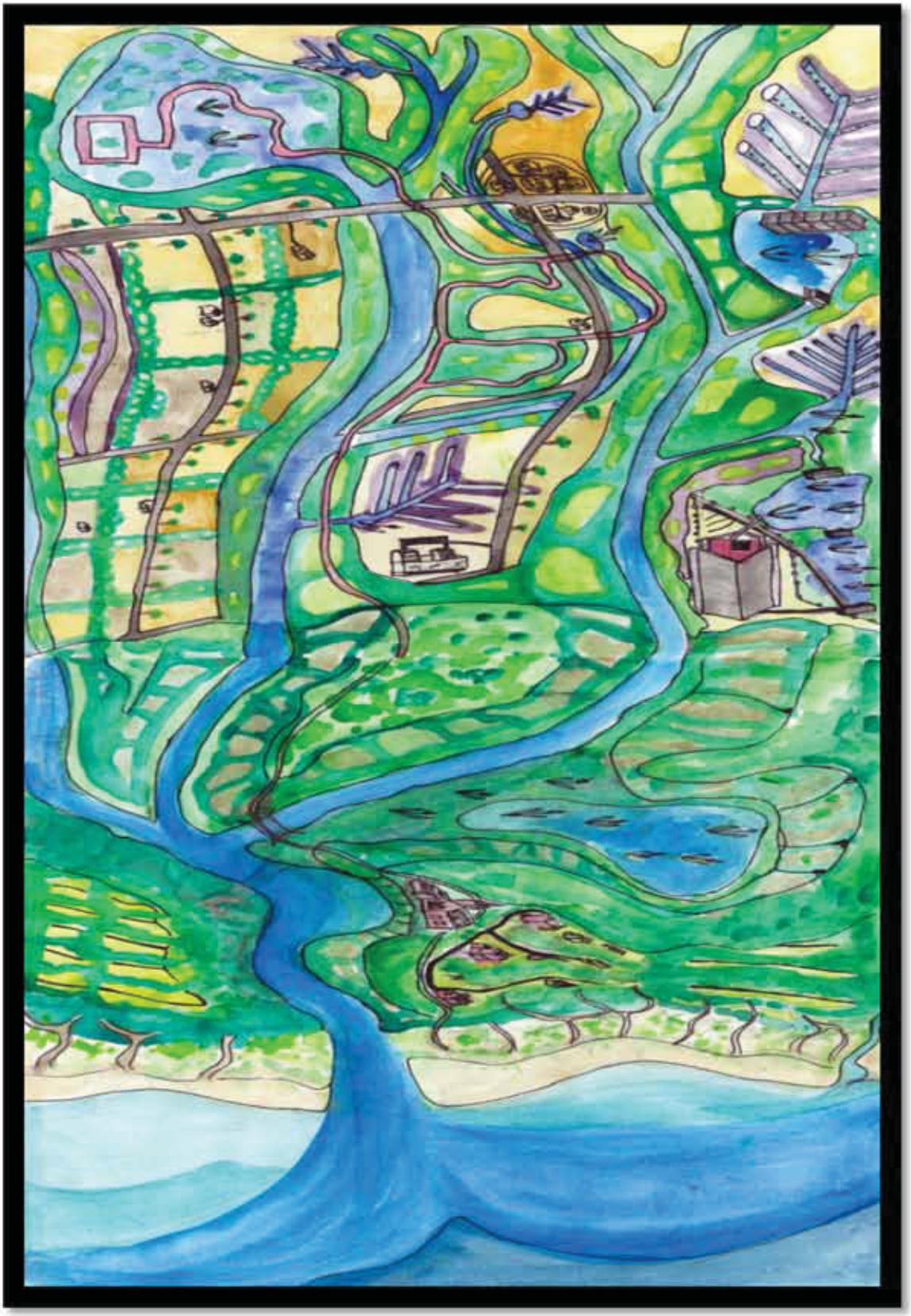


Figure 42 - Figure showing a vision of the Pine River in 2050 (painted by Adrienne Mason, 2011)

A Vision of the Pine River in the year 2050

The water in the Pine River Watershed has returned to a quality that meets all federal and provincial standards, which have increased in their stringency since the year 2011, for levels of nitrate, phosphate, total suspended solids and E. Coli. Forested Swamps have replaced some low lying areas in agricultural fields, where soil erosion and seasonal flooding had caused low returns on cash cropping fields. These deciduous trees contribute leaf matter to the first order streams, which fosters a diverse community of macroinvertebrates, these in turn support various feeder fish. Chub and White Suckers have returned to the 2nd Order Reaches of the three branches of the Pine River. This return coincided with the increased water storage on the landscape in regards to tile shutoff valves and online structures to holdback water in drainage ditches and the restoration of wetlands that was focused at tile outlets and in lowland swamp forests. This increased water storage on the landscape resulted in a return of summer baseflow even during the increasingly hot summers of the 2020's through 2040's.

A system of forested strips is flourishing between productive agricultural fields that have utilized soil conservation techniques, including cover cropping and crop rotation consistently for the last four decades. These vegetated strips perform four beneficial tasks for the agricultural industry: they provide habitat for native pollinator insects which suffered near extinction in the early 2020's; they provide habitat for beneficial insects such as parasitic wasps; they host an economically lucrative agriforestry industry; and they act as successful windbreaks and surface runoff buffers. The agriforestry strips produce nut crops, fruit crops, medicinal plants, artisanal products and areas for al fresco painting, wild edibles and timber based forest products. These products are harvested, processed and marketed by a local labour force that navigates a privately owned system of buffer strips through a profit sharing partnership with the involved landowners.

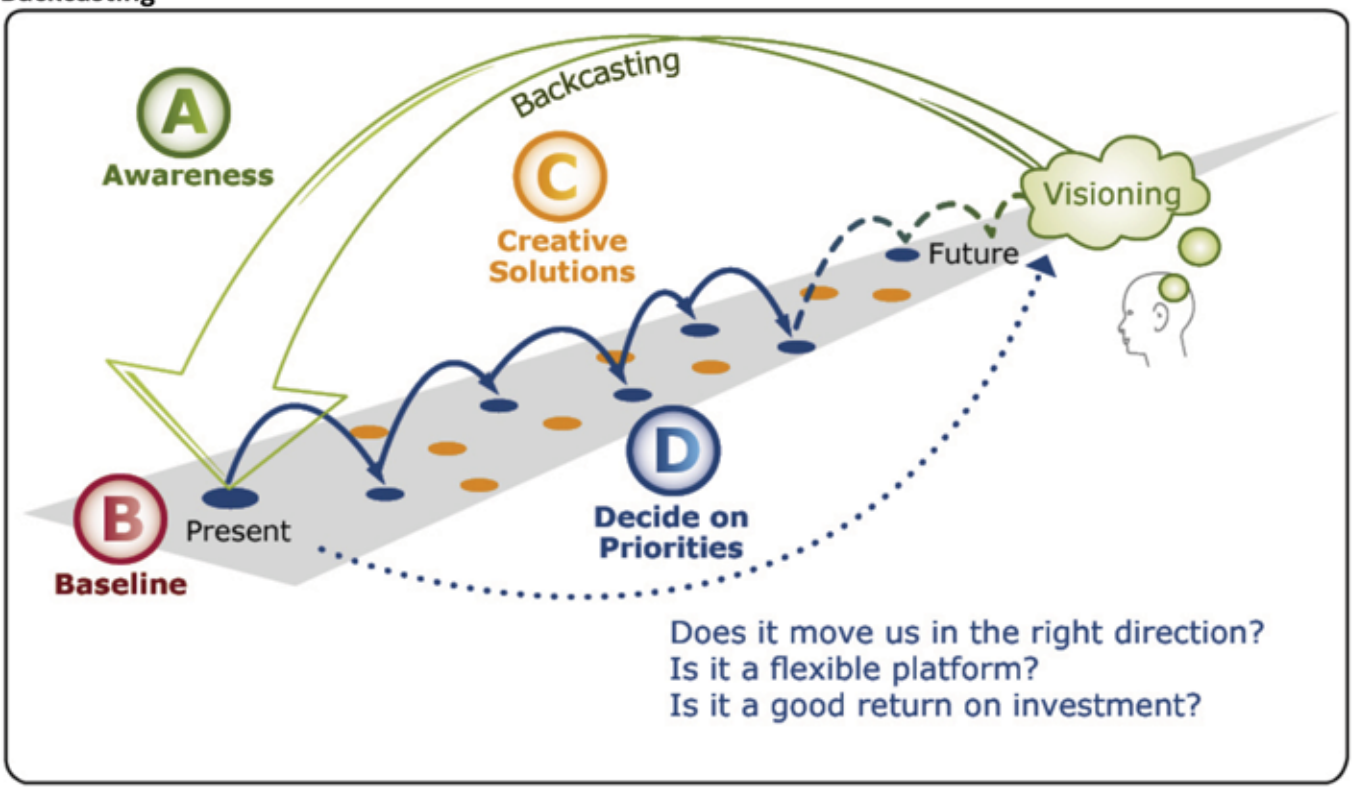
The nearshore environment has returned to conditions that haven't been observed in the PRW since the 1950's. The nuisance algae, that spurred the actions of the Southeast Shores Working Group at the turn of the century, has all but become a thing of the past. The period of 2015 to 2035 was required for the full maturation of the forested buffer strips into effective mechanisms for absorption of soluble phosphate from surface runoff entering the water courses. During this 20 year period, as the nearshore responded by warming in response to Climate change, decreased nutrient discharge into the nearshore (made possible by soil testing and GPS applied commercial fertilizers; treatment wetlands; and riparian buffer strips) still fostered the growth of nuisance algae, however the occurance rates declined with the maturation of the buffer strips. The township formed a partnership with PRWIN to administrate the monies gained from the production of bioethanol produced along riparian strips to support a flurry of restoration activity in the PRW as well as forming the seed money for the development of the subsequent agriforestry strips and industries.

The agriforestry strips extend towards the forests being managed towards the historical climax communities associated with the various landforms in the watershed that have been situated next to the watercourses. The corridors of developing old-growth forests represent connectivity on the landscape for the movement of wildlife and to provide a picturesque location for the Pine River trail, a highly popular destination for ecotourists, agri-tourists and artists alike. The Pine River Trail runs through the Experiential Educational Centre that remains paired with the Bluewater School Board and provides meaningful outdoor education through wildlife observation and identification. Bird and mammal edge specialists continue to thrive in the PRW and some species that prefer forest interiors

have been encouraged to return through the construction of specialized nesting structures present in the fairly large continuous Huron Fringe forest. Populations of native herpetiles have increased and stabilized congruent with the restored and buffered wetland habitats.

Through the rise in fuel costs that were experienced during the early 2020's many farms reverted fields from large scale commercial agribusiness towards locally produced and marketed organic agriculture to meet the growing issue of food security in the locality of the PRW. This trend reversal helped to; retain the agricultural heritage of the region; promote and sustain the local economy ; increased the 20-30 year old demographic; decrease the amount of commercial fertilizers, pesticides and herbicides released into the PR; and increase the amount of semi-permanent vegetation on the landscape due to increased demand for hay and pasture.

Backcasting



The creation of the vision for the Pine River Watershed of the future allows for a process to occur entitled backcasting, outlined in the above diagram. From the vision statement and our research defining the current and historic state of the watershed we can develop a system of recommendations for action over the next five years to help move towards our eventual goals. The specific areas for implementing this work is outlined in part in the map highlighting soil classification, namely in the class 5, hazard land. The recommendations for action follow.

Recommendations:

Protect ...	*Restore ....*	*Encourage ...*
Protect Unevaluated Wetlands	Increase water storage on the landscape through the creation of new wetlands	Continue to promote, develop and operate experiential learning opportunities such as workshops, field trips and guided tours.
Secure stable funding for the PRWIN, to ensure consistent administration of stewardship programs and to continue with success of marketing and education initiatives	Increase water storage on the landscape through the implementation of a pilot project utilizing tile shut-offs or other means of retaining water	Work with partners involved in the Environmental Farm Plan program to increase participation in stewardship programs
Develop a stewardship plan for the management of existing tree plantations, to move them from a monoculture towards a more diverse forest community	Increase water storage on the landscape through the creation of erosion control structures such as berms and grassed waterways	Work with landowners on cost-sharing programs to increase the implementation of stewardship initiatives
Continue sampling and monitoring, and the sharing of data sets to understand natural processes in Pine River	Innovative measures of improving water quality in the Pine River watershed	Promote the economic benefits of environmental stewardship through green job creation for local residents
Use the ISCO sampler to collect data on turbidity and sediment loading and soluble phosphate	Connectivity and linkages between natural areas	Continue to use the PRWIN logo and signage to encourage adoption of BMPs
Protect the fragile dune ecosystem through education and outreach, and the implementation of Dune Grass planting projects	Natural channel designs in drainage projects through partnerships with drainage practitioners, municipal officials and landowners, especially in Royal Oak Creek sub-watershed	Encourage the education of rural non-farming residents on environmental BMPs, especially those related to water conservation and septic system maintenance, through the Rural Landowner Stewardship Guide and the Cottage Owners Stewardship Guide, and the Green Ribbon program
Use native trees and plants in all stewardship projects, to increase the natural biodiversity in Pine River habitats, especially in the Huron Fringe area	Continue to expand on the tree planting programs in the Pine River watershed with a focus on Riparian buffer zone vegetation	Maintain working relationships with agencies that assist in technical expertise, monitoring, funding, research and development or promotion, such as the Saugeen Valley Conservation Authority, MNR, OMAFRA, MOE, etc.
Protect water quality through implementation of livestock fencing and water crossing projects	Replace turf grass in lakeshore areas with native plants and trees	Continued communications with the Township of Huron-Kinloss municipal officials and landowners on the importance of natural areas
Existing wetlands should be protected through a variety of methods (legislative, planning tools, grants, etc)	Restore river bank stability with appropriate erosion control measures	Encourage municipalities and landowners to maintain or enlarge riparian buffers to at least 5 m or more
Protect soil health and soil resources through the promotion of agricultural BMPs, such as cover crops, tillage practices, and cropping practices	**Linkages between natural areas through the restoration of green corridors**	**Educate and encourage the use of cover crops over winter to reduce soil erosion**

TARGETS

As part of a 5 year plan supported by this document PRWIN would like meet the following targets to further our work towards improved water quality and a healthy ecosystem in the Pine River Watershed:

1. Maintain the rate of planting approximately 40 000 trees per year
2. Increase wetland cover by 0.5 acres per year
3. Maintain the level of landowner uptake at the rate of at least 10 restoration projects per year
4. Increase the amount and level of experiential education programming
5. Complete an interpretive trail system at the Experiential Education Centre in the watershed
6. Initiate 2 streambank stabilization projects on sites identified as vulnerable to erosion by Landowners
7. Initiate one watercourse naturalization project in partnership with drainage superintendant and engineering firm
8. Work with the nursery on the 12th Concession of Huron Township to establish a working partnership and connection to the Mennonite community, Maple Leaves Forever and the Township of Huron Kinloss to plant hedge rows and tree rows along side and concession roads.
9. Design and implement and monitor a series of 2 soluble phosphate filters
10. Work with OMAFRA staff to implement an onfield berm to hold back water for 24 hours
11. Continue to monitor nitrate filters and design and implement 2 additional nitrate filters
12. Work with landowners and municipality to maintain and increase natural dune and Huron fringe vegetation at the Lakeshore

These targets align with the long term (20 year timeline) goals outlined in the report -How Much Habitat is Enough?(Environment Canada, 2004) and the corresponding assessment completed in the Watershed Report Card by Saugeen Valley Conservation Authority in 2008.

***Riparian Buffer Zones**: 299 km of Pine River's Banks are treed (representing 58% of total banks, please refer to Riparian Buffer Zone section for more details)*

***Wetland Cover**: 10% of the PRW covered in wetland would require the construction of an additional 1260 Ha of wetland*

***Total Tree Cover**:30% of the PRW covered in Forest would require the planting of an additional 9 669 600 trees*

MEASUREMENT AND ACCOUNTABILITY

The Board of Directors of PRWIN will be most directly accountable for the continued success of the project. They, in turn, will hold the coordinator responsible for activities within their authority that they've been assigned. Reporting will be completed for all restoration, education and monitoring projects undertaken by PRWIN to the public and associated partners.

1) Measures of Restoration: Measures of success of restoration treatments will be based on determining attainment or progress towards attainment of desired future ecosystem conditions. More specifically, we will focus on restoring both ecosystem structure (e.g., species composition, biodiversity, age-class distribution, woody debris) and function (e.g., nutrient and hydrologic cycles, viable populations of native species and habitats) towards conditions outlined in the vision of future conditions.

2) Measures of Preservation: Preservation will be defined in terms of management options (including no treatment) required to maintain the condition of ecosystems in their desired state. Monitoring will be required to detect changes in ecosystem structure and function and will be used to dictate the timing and location of treatments.

3) Water Quality Measures: One of the research emphasis will be to develop meaningful, yet realistic measures of water quality to be used as monitoring variables. A key component of this research will be to link easily measured variables, such as sediment load, stream chemistry, bacteria, and flow with functional characteristics of the watershed. This cause and effect approach will increase the rigour of the monitoring and be scientifically defensible as a tool to evaluate success or failure of restoration activities.

4) Watershed Health: Watershed health or resilience is a hotly debated term, but can be defined in terms of the ability of the watershed to resist disturbance, such as storm runoff events, and the ability to recover quickly from disturbance. Measures of recovery include rates of nutrient cycling, estimates of biological diversity, and sustainable productivity. Again, the key organizing principle in watershed ecosystem restoration is attainment of a desired future condition or conditions across the landscape.

These goals can only be achieved and sustained by:

- Early and continued involvement of key groups and individuals
- Continued monitoring and measurement of the health of the PRW
- Working with user groups to identify problem areas and possible solutions
- Identify potential sources of funding and alternative methods for solving watershed problems.

As the PRWIN has gained recognition through the completion of successful projects, the community partners have continued to widen to include outside environmental groups, residents, youth groups, schools, Municipal Government, Provincial ministries, and a host of other Non-Governmental Organizations and corporations. These partners want to participate in projects that contribute to the obvious improvements being made in the watershed, improved economic values for agriculture, tourism and recreation, and educational tools that can be used widely across all age groups. Continuing to implement projects on the ground, that provide demonstrable, visible, measurable outcomes will be the key to the sustainability of the PRWIN organization.

Another key to success will be continued communication to the public through public meetings, presentation to municipal council, sponsor recognition signage, events and awards and regular updating of the website.

One of the strongest tools the Pine River has is its "brand". This sign is well known throughout the area as a sign of environmental initiatives. The goals of the Communication Plan are to increase the visibility of the logo, and use its brand-appeal to increase participation in projects.

Full development of a communication plan and its implementation will continue to be a primary duty of the PRWIN Coordinator and should be reviewed on an annual basis.

A Communications Plan has been developed to:

- ensure that the limited resources of PRWIN are maximized
- focus on increasing participation in BMPs and stewardship programs
- communicate the focussed areas of emphasis identified in this watershed management plan to the appropriate stakeholders

The steps to further develop the Communication Plan are:

- Identify the partners
- Their role in stewardship activities advocated by PRWIN
- List their communication needs
- Identify the method of communicating and the frequency of communication
- Timing of each communication

Partner	Role of the Partner	Communication Needs	Method of Communication	Frequency of Communication
Board of Directors	Provide direction on resource allocation to staff and volunteers Be financially accountable to funding agencies Develop the key messages for PRWIN	Staff Reports Financial reports Watershed Report Cards	Presentation at Board meetings	Monthly
Farming landowners	Develop stewardship plans for their individual farm properties Implement stewardship plans Provide inkind assistance Tell other farming landowners about the program	Technical advice related to BMP implementation Grant and funding opportunities that offset costs Information to understand the importance of stewardship on a watershed scale	One-on-one meetings Workshops Webcasts or Podcasts Conversation	Seasonally to match cropping season and construction season Meet with the landowners with significant amounts of land or in significant locations (wetlands, headwaters)
Youth or New	Consider stewardship practices when taking over	Technical advice related to BMP	Webcasts or podcasts	

Farmers - Farming	the family farms or buying new Incorporate remediation measures into business plans Consider stewardship practices or potential environmental implications when changing commodities or farming practices	implementation Grant and funding opportunities that offset costs	Twitter Facebook	Seasonally
Non-farming rural landowners	Promote awareness of the stewardship initiatives underway Financial support through donations Letters of support for PRWIN initiatives	Maps and pictures (particularly before and after) Key Messages about areas targeted for remediation	Emails and newsletters Watershed report cards	Monthly or seasonally
Youth (general)	Encourage their families to adopt stewardship practices Increase awareness of the PRWIN practices	Promote PRWIN principles of basic stewardship	School presentations and workshops Fairs	Seasonally
Funding agencies	Providing financial support for PRWIN initiatives	Focussed restoration plan for Pine River Performance measures Monitoring data	Grant applications Letters of support Budget	Seasonally
Municipalities, SVCA, NGOs	Provide technical expertise Assist in obtaining funding through partnerships	Goals and Objectives	Regular meetings	As required
PRWIN Website	Linked to PRWIN Website	Summary of the Watershed Management Goals Highlights of Stewardship Projects PRWIN projects	You Tube Videos	On going

PARTNERSHIPS

The community stakeholders that would potentially be interested in watershed restoration projects includes federal and provincial agencies, local government, universities, conservation and environmental groups, and youth groups. A list of potential partners and collaborators is attached as Appendix 4.

These groups and individuals all have an interest in improving the health of the PRW for environment, economic or social reasons. As project partners they can be counted on to provide funding but more often, they provide hundreds of hours of labour, materials and equipment use. Other groups and individuals can make available critical data, educational, and scientific tools within their particular areas of expertise. Success in partnership can be measured by the variety of partners along with the depth and length of the relationship. Does the partnership extend beyond the length of an individual project? Success can also be measured by extension of PRWIN projects and efforts beyond the PRW borders. If the PRW is to be viewed as a model watershed, the projects, structure and partnerships undertaken by the PRWIN should be easily duplicated in other watersheds.

OPERATIONAL PLAN

In order to meet the 12 targets outlined on page 55 the table on page 60 displays the tentative cost of projects anticipated over the next 5-year period. These timelines, projects, and costs must be flexible to allow the Board of Directors to take advantage of new ideas that develop during the process. Some projects may be dropped and replaced by new projects developed during the 3-5 year timeline as a result of new funding opportunities and partnerships.

The PRWIN has seen a tremendous amount of growth since a full time coordinator has been in place. In order to maintain and build on the success of the PRWIN, it is a priority of the PRWIN to maintain this position at the current level and continue to seek funding for part-time project assistance as required.

The benefits of these actions will include a significant improvement in water quality and the long-term health of the watershed. The outreach and partnership that the PRWIN undertakes has created permanent relationships that extend beyond the life of any one project. The PRWIN feels that it has been the success of its collaboration with individuals and organizations that should become a model for other watersheds and is one of the primary outcomes they hope to realize.

Table 2 PRWIN Annual Work Plan

Project Activities	Timeframe
1) Educational Outreach programming including the children's Water and Forest Festivals 2) Project Proposals Submitted to Funding Sources 3) implement aspects of our Maintenance, Monitoring and Biodiversity Strategy 4) Follow up with landowners regarding long term stewardship agreements, to see if any maintenance on fence lines or trees or wetlands is necessary for next spring 5) Increase presence in the community through informal and formal outreach programming	November-December
1) Design, schedule and deliver Educational Outreach programming in community schools and volunteer groups 2) prepare to implement projects on in targeted areas of the watershed that might yield the highest level of water quality improvement	January-March
1) Tree planting and cattle exclusion fencing farmsteads 2) a) Machine Tree planting at accessible farmsteads b) Hand Planting at farmsteads where machinery is inhibited 3) Tree spraying will be completed at all sites, with the exception of the organic farmsteads and areas too near water, to allow trees to out compete aggressive grass species during first year of growth 4) Mulching 5) Emails, meetings and phone calls with landowners and contractors. 6) Project site visits. 7) Post-project observations (pictures, growth progress, etc.) 8) Monitoring and Sampling of project sites with volunteers 9) Implement Outdoor aspect of the educational outreach programming 10) Implementation of our Maintenance, Monitoring and Biodiversity Strategy 11) Initiating monitoring of groundwater and rain water and flow data for proposed wetland construction and restoration sites	April-June

1) Post-project observations (pictures, growth progress, etc.) for tree planting and exclusion projects 2) Ripley Fall fair - workshops and presentations 3) Implementation of our Maintenance, Monitoring and Biodiversity Strategy 4) Monitoring and Sampling of project sites with volunteers 5) Implement any near or in water work such as excavating wetlands, livestock crossings, instream nitrate or phosphate filters or alternative water sources	July-September
1) Monitoring and Sampling of project sites with volunteers 2)Prepare yearend financial statements for PRWIN	October
Communication Activities	**Timeframe**
Press will be contacted after educational workshops and for project updates when the planting has occurred	ongoing

RISKS AND ASSUMPTIONS

The greatest risks associated with the success of the implementation of the Pine River Watershed Integrated Watershed Management Plan are likely to be as follows:

- Loss of project funding
- Loss of key board members/employees/staff
- Change of provincial leadership and/or direction
- Insufficient coordination/communication between the board of directors, and coordinator
- Loss of landowner cooperation on project uptake

Behaviours that will reduce these risks include:

- Develop detailed timelines for funding requirements early on
- Create a board recruitment policy
- Document successful implementation of projects and notify key partners
- Clarify what projects are priority.
- Hold people accountable
- Schedule regular coordination meetings
- Seek flexibility in projects and dollars to be carried over to the next year if not implemented in year planned
- Involve and engage early on in the identification, planning, and design of projects.

FINANCIAL PLAN

In order to achieve these goals of restoring the Pine River Watershed towards a state of resiliency and health PRWIN has created a financial plan that highlights a five year budget period that quantifies in dollars the costs associated with the recommended restoration work.

Table 3 Financial Forecasting: 5 year budget to activate IWMP

	Year 1	Year 2	Year 3	Year 4	Year 5
1. Maintain organizational strength of PRWIN by maintaining strong relationships with **a. Volunteers** **b. Landowners** **c. Funders and community partners**	Admin Budget $65K	Admin Budget $65K	Admin Budget $65K	Admin Budget $65K	Admin Budget $65K
2. Increase capacity for water storage on landscape. Projects will include: **a. Wetlands** **b. Tile outlet wetlands/ valves**	$200,000	$200,000	$200,000	$200,000	$200,000
3. Channel Naturalization through: **a. Buffers** **b. Meanders** **c. In ditches**	$200,000	$200,000	$200,000	$200,000	$200,000
4. Best Management Practices on the Landscape focusing on: **a. Forest/Tree Cover** **b. Cover Crops**	$20,000	$20,000	$20,000	$20,000	$20,000
5. Education & Outreach **a. School Programs** **b. Community Events** **c. Experiential Outdoor Ed Centre**	$10,000	$10,000	$10,000	$10,000	$10,000
Total	**$430,065**	**$430,065**	**$430,065**	**$430,065**	**$430,065**

References

Agriculture Profiles. Investing Grey Bruce. As viewed online at http://www.investingreybruce.com/en/introduction-to-grey-bruce/36.html on October 6, 2011.

All About Watersheds. Environment Canada. As viewed online at http://www.ec.gc.ca/geocache/default.asp?lang=en&n=065E5744-1 on September 29, 2011.

B.M. Ross and Associates Limited, "Township of Huron-Kinloss Pine River Water Quality Monitoring Program, 2010 Annual Report, 2010.

Brock, H, A. Gutteridge and M. Veliz. 2010. Management Plan for the Bayfield North Watersheds. Ausable Bayfield Conservation Authority. Exeter, Ontario. 47 pp.

Caldwell, W., Kraehling, P., Medeiros, J., Mechanisms to Build Community Adaptation/Mitigation Measures to Climate Change/Peak Oil While Creating Jobs in Midwestern Ontario –Midwestern Ontario Regional Job Strategy, University of Guelph, 2011.

Clements. Nature and Structure of the Climax, Journal of Ecology 24:252-284, 1936.
Alliance for the **Chesapeake Bay** White Paper: **Riparian** Forest Buffers

Conservation Ontario. Navigating Ontario's Future – Overview of Integrated Watershed Management in Ontario. 2010. 118 pp.

Conservation Ontario. Navigating Ontario's Future – Water Management Framework. 2010. 31 pp.

Crowe, A. June 2011. "Caring for Our Beaches: The science of good beaches and good water quality", presentation delivered to Beach Processes Seminar, Friends of Sauble Beach, June 10, 2011.

Crowe, A., June 2005. Federation of Ontario Cottagers' Association, Lake Stewardship Newsletter

Deep Geologic Repository, OPG, April 2010, 170 pages www.cea.gr/050/documents_staticpo

Deitrich, Jayne. Ontario Soil and Crop Improvement Association Field Representative. Personal Communication. October 15, 2011.

Drinking Water Source Protection – Saugeen, Grey Sauble, Northern Bruce Peninsula Source Protection Region. As viewed at http://www.waterprotection.ca/resources/r-download.htm on September 29, 2011.

Environment Canada, 2004. How Much Habitat Is Enough? A Framework for Guiding Habitat Rehabilitation in Great Lakes Areas of Concern. Second Edition. www.on.ec.gc.ca/wildlife/publications-e.html

Environment Canada. Integrated Watershed Management. As viewed online on September 27, 2011, at http://ec.gc.ca/eau-water/default.asp?lang=En&n=13D23813-1&printerversion=true

Evensom, R and Golli, D. Assessing the Impact of the Green Revolution, 1960 to 2000. Science 2. Vol. 300 no. 5620 pp. 758-762. May 2003.

Farrell, Amanda. Business Plan for the Pine River Watershed Initiative Network. September, 2011.

Grey & Bruce Counties Groundwater Studies Final Report, MOE 264 pages www.grey.ca/media/files/Final_Report.pdf

Harris, P. J., 1995. Water quality impacts from on-site waste disposal systems to coastal areas through groundwater discharge, in Environmental Geology vol. 26,pp.262-268

Healthy Lake Huron – Clean Water, Clean Beaches Newsletter. Summer, 2011

Hydrology of Southern Ontario 395 pages second edition April 2003 www.ontario.ca/drinkingwater/stel01|_049392.pdf

Killins, Kari. 2008. A Management Plan for the Old Ausable Channel Watershed. Ausable Bayfield Conservation Authority. Exeter, Ontario.125 pp.

Lake Huron Biodiversity- Importance of Native Plants, Lake Huron Center for Coastal Conservation, 2003

Lake Huron – Georgian Bay Watershed – A Canadian Framework for Community Action. As viewed at http://www.lakehuroncommunityaction.ca/index.php?option=com_content&view=article&id=76&Itemid=113 on September 29, 2011.

Luinstra B., 2009. Climate Trends and Impacts in the Maitland Valley Conservation Authority Jurisdiction. Unpublished report. 131pp.

Making Drains Work Backwards, can pay off in Ontario's Southwestern Counties- Better Farming, March 2004

Miles, O., Fraser, T., Muirhead, J., Stream Restoration of a Rural Ontario Watercourse: Royal Oak Creek, ENGG 4150, University of Guelph, 2011.

MWOGJS, Ontario Green Jobs Survey, 2011

Ontario Biodiversity Council. 2011. Ontario's Biodiversity Strategy, 2011: Renewing Our Commitment to Protecting what Sustains Us. Ontario Biodiversity Council, Peterborough, ON

Ostergren, R.C. Wisconsin Land and Life, University of Wisconsin Press, 1930 Monroe St. Madison Wisconsin 53711, 1997

Peach, Geoff. Beach Stewardship Guide for the Township of Huron Kinloss,Lake Huron Centre for Coastal Conservation.

Pennsylvania State University, 2005. Water Conservation--How Much Water and Money Could You Save? College of Agricultural Sciences Cooperative Extension factsheet, 6pp.

Pine River Watershed Initiative Network Analog Forestry Plan 2011 – 2012. September, 2011

Pine River Watershed Study, Ecologistics Limited. 490 Dutton Drive, Suite A1 Waterloo, Ontario N2L 6H7, 1991.

Rideau Valley Conservation Authority. May, 2002. Tay River Watershed Management Plan. 32 pp.

Roulston, K., Brethour, C., 2004 Building a case for sustainable management of private woodlands Case Study: Murray Scott, OMNR, Maitland Watershed Partnership Initiative, Huron Perth Chapter of the Ontario Woodlot Association, Huron Stewardship Council, George Morris, Ontario Stewardship Opportunity. Fund

Sanderson, D. Eighteen Hundred and Sixty One census: Huron Township, Bruce County Canada West. 2006, Ontario Genealogical Society. Bruce and Grey Branch 78 pages Dewey: 929/.371321 22 -1901 census included

Saugeen Valley Source Protection Area. Proposed Assessment Report. June 15, 2011 As viewed online at http://www.waterprotection.ca/UAR/svspa-uar.htm on September 29, 2011

Southern Ontario Wetland Conversion Analysis. Ducks Unlimited. Final Report. March, 2010. As viewed online at http://www.ducks.ca/aboutduc/news/archives/prov2010/pdf/duc_ontariowca.pdf on October 14, 2011

Spring 2011 Farmland Values Report. Farm Credit Canada. As viewed online on October 14, 2011 at http://www.fcc-fac.ca/en/Products/Property/FLV/Spring2011/index.asp#on

SVCA, Saugeen Conservation Water Quality Data Summary Report, March 2010

Watershed Characterization- Grey Sauble Source Protection Area- 2010 www.waterprotection.ca/par/qsspa/txt/
- sustainable forest management Pine and Penetangore

Waters Edge Environmental Solutions Team. Pine River Watershed Initiative Network Fluvial Geomorphological Characterization Report. September, 2011.

Water Quality Stress Assessment Chapter 3 July 2010, 80 pages www.waterprotection.ca/par/suspa/txt

Appendix 1

Analog Forestry

Introduction

Whereas, and even catering to, the needs of surrounding local populations that may otherwise provoke forest degradation and contamination of natural ecosystems. There has been, in effect, a shifting paradigm away from a focus on preservation, which is seen as both impractical and potentially previous conservation efforts have been focused on protecting lands from human intrusion, a shift in attitudes now demand balance between social, economic and environmental realms. The success of these efforts, as a result of these attitude shifts, relies on recognition of the importance of integrating detrimental to local economies, towards integrated conservation and development projects that address both socio-economic and environmental concerns.

This Integrated Watershed Management Plan, prepared for the Pine River Watershed Initiative Network, represents an integrated conservation method that focuses on the demands called for by these attitude shifts, which has already demonstrated successfully applications on suitable lands around the world, This technique, called Analog Forestry (AF), seeks to restore degraded forest lands, often replacing inefficient conventional agriculture or cattle ranching, with highly productive and biologically diverse regenerated forests capable of meeting the extractive needs of local populations (e.g. firewood, fodder, fruits, nuts, subsistence crops, timber) while supplying them with a supplemental income and an ecologically stable environment. This information includes the activities to be developed over the course of the next year and suggested dates by which to implement these activities.

A training program for use at PRWIN will be suggested in order to strengthen the capacity of the PRWIN so that this organization can be a Centre of Excellence in Analog Forestry, which would be the first at this level in Canada. With proper application of the methodological manner of the AF process, this technique of reforestation can be replicated and demonstrated throughout the pine river watershed with the objective to demonstrate how the restoration of suitable lands in the Pine River area (model forests, degraded areas, etc.) can be synonymous with dynamic economic benefits at the local level.

For the Pine River Watershed area, the application of this new method in the areas in question, in particular degraded farmlands, is a **reto** because it can become a very effective reforestation tool to change the economic value of our forests. In order to enjoy the goals and benefits of the AF method, it is necessary to involve the people who live in these areas and identify most with these forests (ie. Farmers, home owners, etc). It is these people who receive the most benefits of capacitation and as such, can become a great inspiration and motivation for all who plant trees.

Pine River Watershed Issues and Needs

Current forest issues go beyond timber production. In order to successfully run integrated conservation and development projects, many international conventions emphasize the importance of addressing needs of:

- Biodiversity
- Soil conservation- water filtration and
- Long-term forest sustainability

These become important considerations in planning reforestation in the Pine River Watershed area.

Biodiversity

As a result of heavy agricultural processes in the pine river watershed area, land has been degraded and diversity of plant species is low. Because the diversity of plant species in a forest community helps maintain stable forest ecosystems, recuperation of biodiversity is essential. Insect outbreaks, a large risk of reforestation projects in this area, can be greatly reduced because the forests contain a full complement of the predators and parasites that provide pest control services.

Soil conservation and-water filtration

With no natural forests or biodiversity on these former agricultural areas, the productivity from ecological services from these areas remains limited because they will require more input from external sources in the form of fertilizers, artificial irrigation, and insect repellents than they are able to produce. If biodiversity can be restored, ecological services of soil improvement, production of fresh water, and regulation of the flow of our rivers and streams can be enjoyed.

Long term forest sustainability:

Restoring old growth forest is fundamental to ensuring long term sustainability of reforested ecosystems. Mature trees produce millions of seeds that produce the next generation of trees. Snags and fallen trees provide source of food for insects, animals and birds and create an important structure for nesting and shelter. The presence of a mature forest ensures the forest can provide the full suite of ecosystem services we require from soil building to flood control, and supply the habitat necessary to support the full diversity of wildlife native to the *** forest. Old growth forests host great diversity of wetlands that contributes in maintaining the quality of the watershed.

Native plants will be important to incorporate in reforestation programs of this area because they are the plants evolved in the local ecosystem and will insure resiliency to disturbance like epidemic. They grow well in our soils and contribute in building that same soil. They play an important role when alive and after they die as dead wood on the forest floors.

In order to ensure success of the project itself within the PRWIN organization, it is important to recognize that application of an AF project incorporates and fulfils the primary goals of the PRWIN:

1: "To research, organize and participate in projects designed to improve and preserve the environment as it relates to the Pine River Watershed"

The primary principles of the Analog forestry system require research of the land where AF will be applied, as well as organization of a perspective reforestation plan that is appropriate to these areas.

2. "To educate and increase the public's understanding of the Pine River Watershed and its importance by offering courses, seminars, conferences and meetings and by collecting and disseminating information on that topic"

Capacitating of the land owners and support teams on the important actions necessary to complete an AF project is vital in order to establish a multidisciplinary knowledge base that becomes the toolkit for all those involved.

3. To provide information on existing or new programs and funding which can improve the Pine River Watershed to the public.

Incorporating AF projects into the PRWIN strategies to improve the areas within the Pine River Watershed, the land owners will become key players in implementation of the planning behind these projects. Their involvement is essential and as such, communication of AF related materials must be initiated and maintained.

Definition and Benefits of Analog Forestry Program

Definition:

Analog Forestry is a system of forest management that seeks to establish a tree-dominated ecosystem analogous in architectural structure and ***ecological function*** *to the original climax or sub climax vegetation community.*

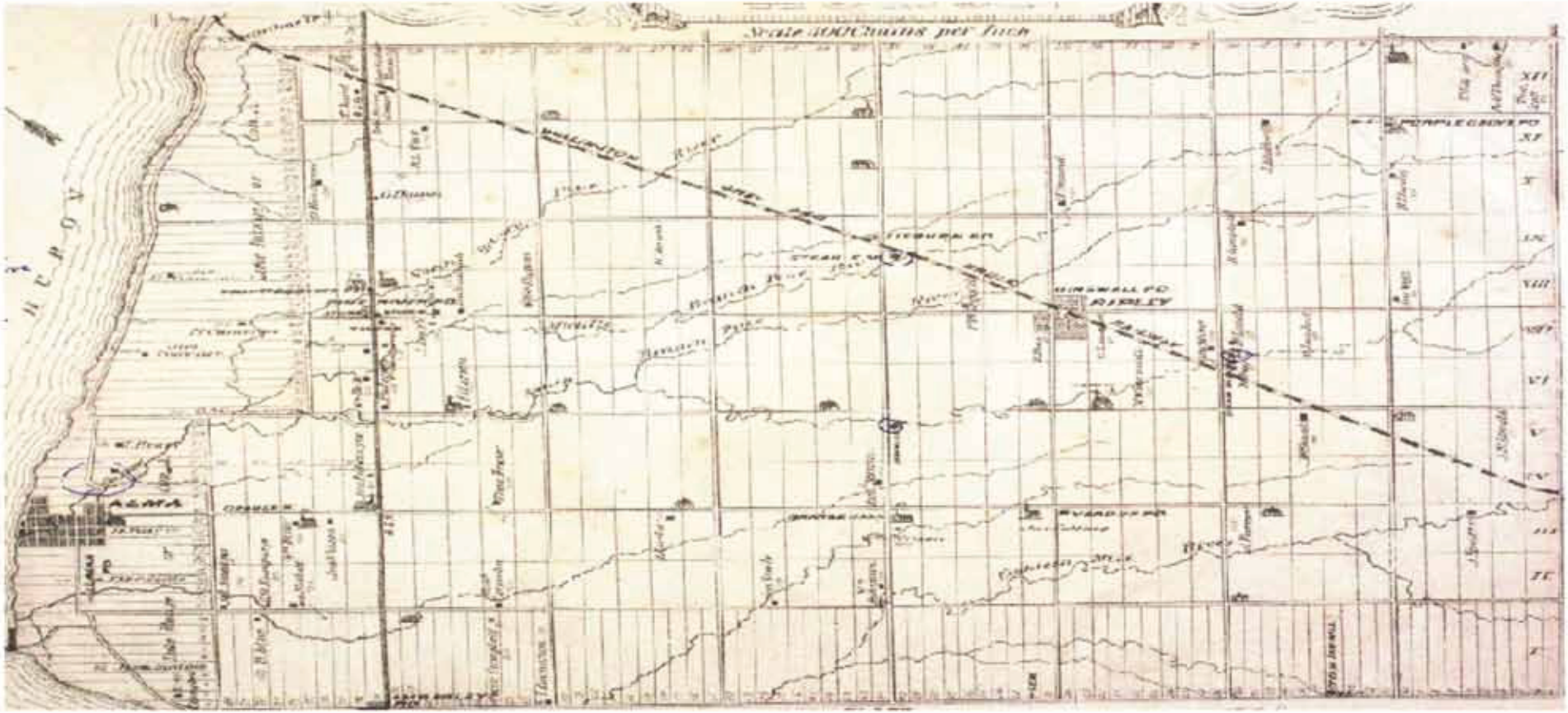
Analog Forestry seeks to empower rural communities both socially and economically, through the use of species that provide marketable products. Analog Forestry is a technology recognized by the International Meeting of Scientists on Biological Diversity in Mexico City (1994) as the most promising technology to address these needs and more

*Analog forestry, different from the focus of silviculture, does not derive benefits from only timber Wood species, but also includes non timber species, forming 90-95% of the forest biological diversity being constituted by non-tree components. The functions of an analog forest can be used as a tool in a variety of ways, providing micro habitats, cleaning water and stabilizing an environment. The design of the activities on the land areas in question is the most effective manner by which to apply the 12 principles of AF (**refer to AF Principles) and reverse the loss of biodiversity, deforestation and recuperate soil, because the application of these techniques are individualized for each location.*

Benefits

- *Environmental*
- *Soil enrichment (top soil)*
- *Surface water filtration*
- *Erosion prevention*
- *Air purification*
- *Promotion of biodiversity (through biological corridors, increased habitat)*
- *Carbon "sink" creation*
- *Social*
- *Farmers have access to a diversity of perennial crop products*
- *This decreases their market dependence and risk of crop failure*
- *Within an analog forestry plot, farmers can manage certified forest gardens*

Appendix 2



Appendix 3

TECHNIQUE FOR ESTIMATING ANNUAL WIND EROSION LOSSES WITHIN THE PINE RIVER WATERSHED

STEPS

A) FROM FIELD OBSERVATION

1. Determine if there is a soil loss or crop damage problem.
2. Determine crops to be grown in sequence.
3. Determine the average length of the field of concern, in an east-west direction (Note that most fields in the Pine River watershed are planted with a north-south orientation. Consequently, the east-west length can be more appropriately called the field width). This measurement must start at a stable border such as a fence row, a hay or pasture field or a tree windbreak. If no stable border exists along the field's western edge (ie. the windward side) continue westward until a stable border is located. Measure the field length in an east-west direction from this point.
4. If a windbreak exists on the west side of the field (eg. a woodlot) determine its height.
5. Determine the type of and percent residue cover on the soil surface.
6. Determine SURFACE ROUGHNESS of field (smooth, semi-ridged, ridged).
7. Determine the soil type.

B) OFFICE CALCULATIONS

8. Multiply value obtained in step 3 (above) by 2.0.
9. Determine the effective barrier height (if one exists) by multiplying the value obtained in step 4 (above) by 10.
10. Subtract the result from step 9 (above) from the value obtained in step 8 (above) to obtain the UNSHELTERED DISTANCE. Convert to units of feet.
11. Convert the percent residue cover to a residue weight (lbs/acre) using Figure C-1.
12. Convert residue weight to an EQUIVALENT FLAT SMALL GRAIN RESIDUE BY WEIGHT (lbs/acre) using the appropriate Figure (C-2 through C-8).
13. If soil type from step 7 (above) is Sullivan Sand, use Table C-1 to estimate annual wind erosion losses. Otherwise, use Table C-2 to estimate wind erosion losses.

Note: The technique outlined here is customized for the Pine River watershed and cannot be extrapolated to other watersheds.

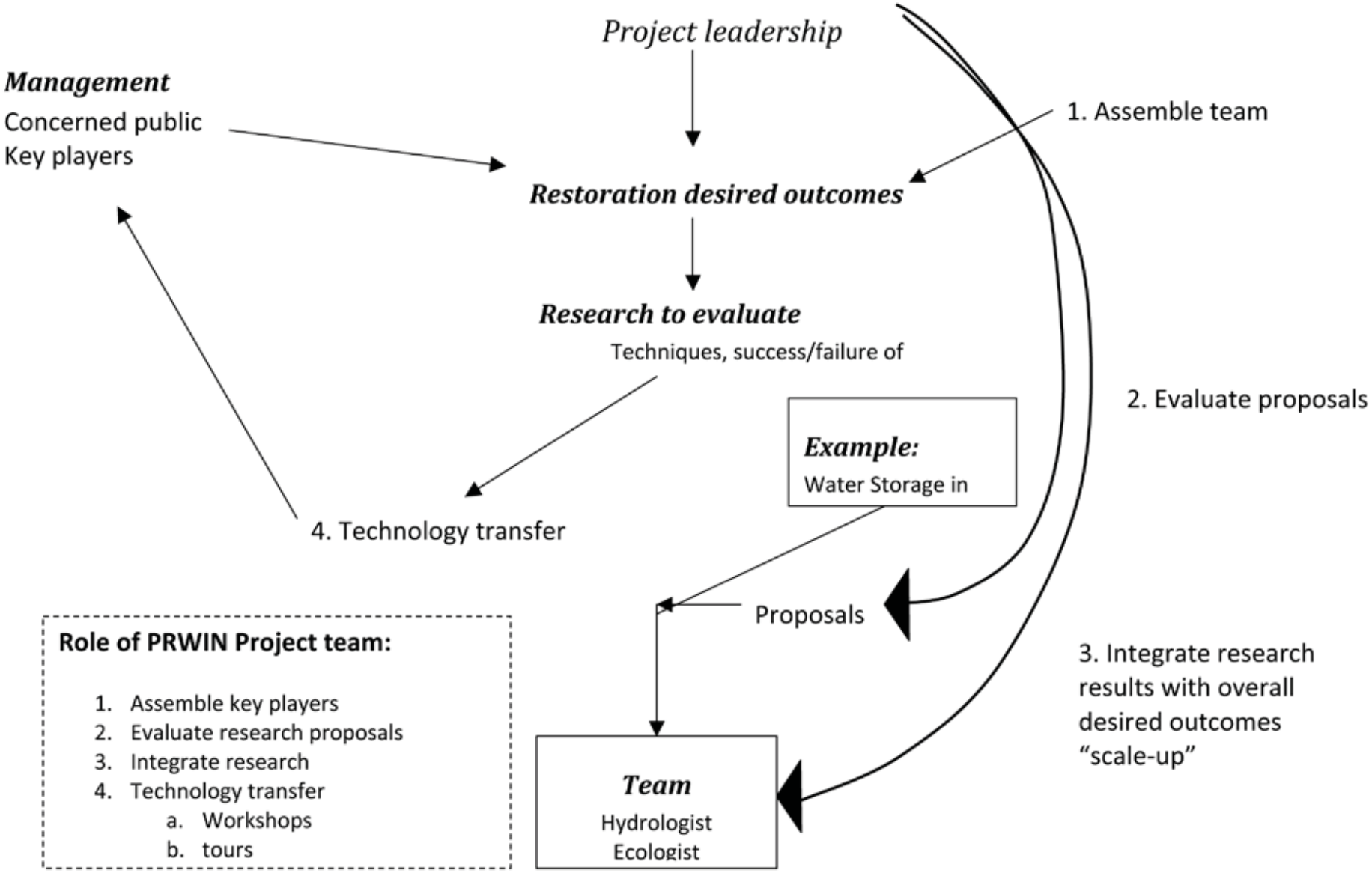
Appendix 4

Pine River Watershed Initiative Network
List of Supporters and Collaborators

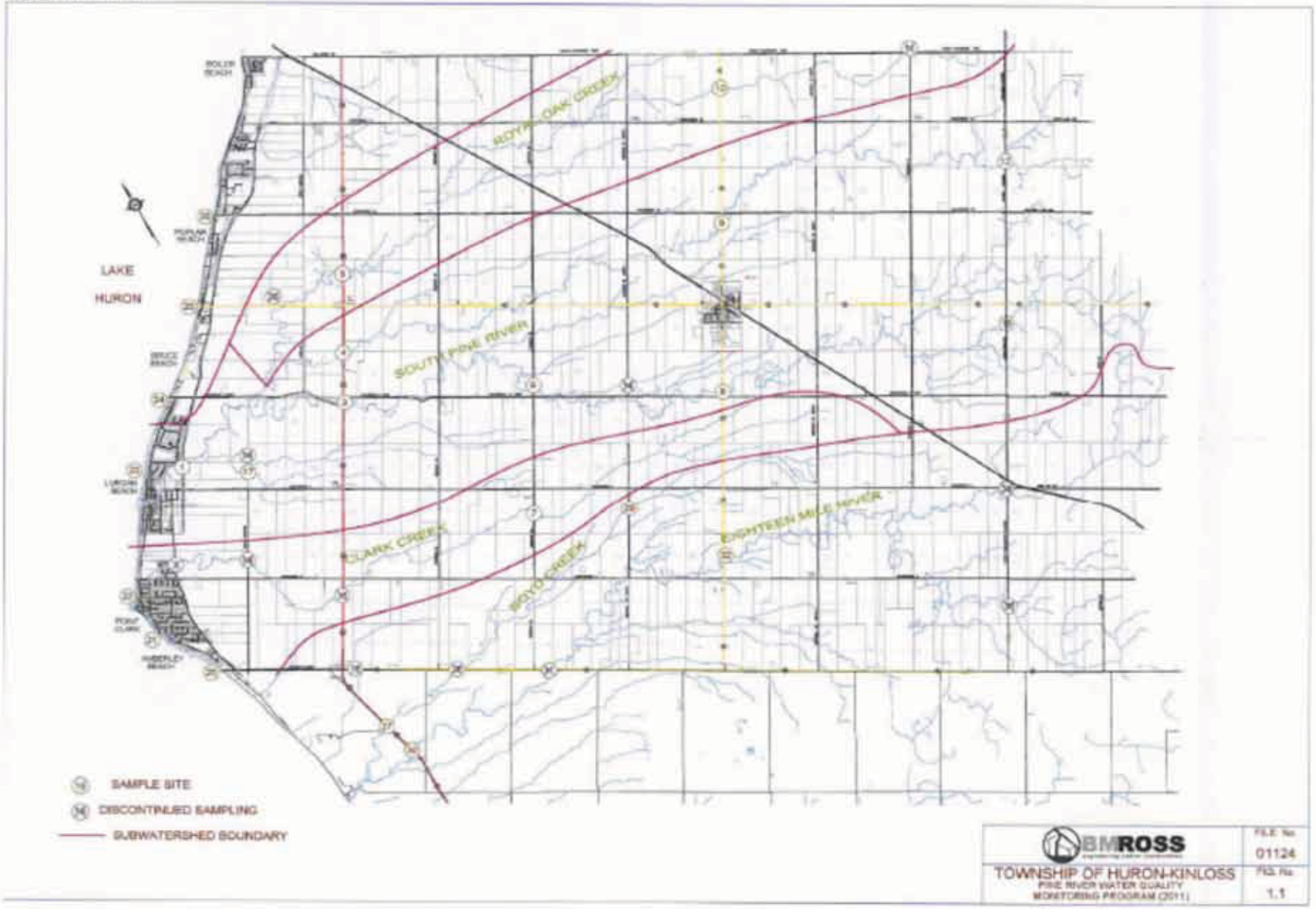
Benefits

- *Local landowners*
- *Beach Associations*
- *Ontario Power Generation*
- *Bruce Power*
- *Bruce Resource Stewardship Network*
- *Pine River Boat Club*
- *Twp. Of Huron Kinloss*
- *Saugeen Valley Conservation Authority*
- *Environment Canada's EcoAction & Adopt-A- Watershed Programs*
- *Bruce County Fed. Of Agriculture*
- *Ripley 4-H Clubs*
- *Lake Huron Coastal Centre*
- *Ontario Federation of Anglers and Hunters*
- *Ministry of the Environment*
- *Ontario Ministry of Agriculture, Food and Rural Affairs*
- *Ontario Trillium Fund*
- *Lake Huron Framework for a Healthy Lake Huron*

Appendix 5


Project leadership
Management
Concerned public
Key players
1. Assemble team
Restoration desired outcomes
Research to evaluate
Techniques, success/failure of
2. Evaluate proposals
Example:
Water Storage in
4. Technology transfer
Proposals
Role of PRWIN Project team:
1. Assemble key players
2. Evaluate research proposals
3. Integrate research
4. Technology transfer
a. Workshops
b. tours
3. Integrate research results with overall desired outcomes "scale-up"
Team
Hydrologist
Ecologist

Appendix 6


LAKE
HURON
SOUTH PINE RIVER
CLARK CREEK
BOYD CREEK
EIGHTEEN MILE RIVER
SAMPLE SITE
DISCONTINUED SAMPLING
SUBWATERSHED BOUNDARY
BMROSS
FILE No.
01124
TOWNSHIP OF HURON-KINLOSS
PINE RIVER WATER QUALITY
MONITORING PROGRAM (2011)
FIG. No.
1.1

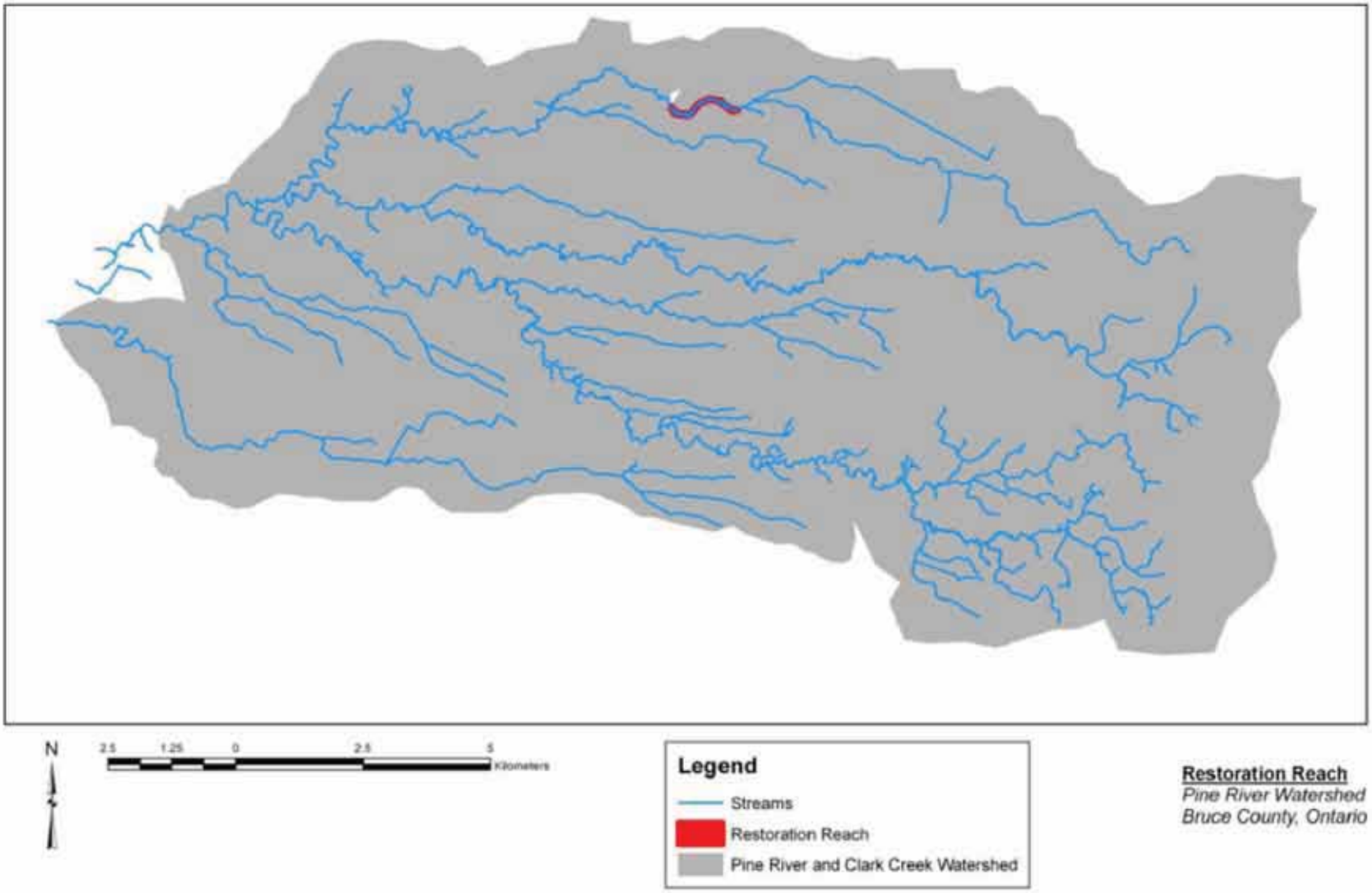


Figure 7: Royal Oak Creek Restoration Reach

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