St. Clair River Restoration Assessment Project Report

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April, 2007

Acknowledgments

The Great Lakes Sustainability Fund is a component of the Government of Canada's Great Lakes Program. The Sustainability Fund provides resources to demonstrate and implement technologies and techniques to assist in the remediation of Areas of Concern and other priority areas in the Great Lakes. The report that follows was sponsored by the Great Lakes Sustainability Fund and addresses habitat issues in the St. Clair River Area of Concern between Sarnia and Mitchell's Bay, Ontario. Although the report was subject to technical review, it does not necessarily reflect the views of the Sustainability Fund or the Government of Canada.

We would like to acknowledge the assistance and contributions of Municipalities, the County and private land owners for providing information and access to shoreline properties. Thanks to Scudder D. Mackey Ph.D. for providing the study methodologies, Assessment of Lake Michigan Shoreline Erosion Control Structures in Racine County and personal consulting throughout the project.

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In July 2006, St. Clair Region Conservation Authority as part of its commitment to the St. Clair River Area of Concern (AOC) and the Remedial Action Plan for the AOC, submitted an application to undertake the above noted project. Great Lakes Sustainability Fund approved the project in July of last year.

The project was to result in the following deliverables:

- Collect historic and current shoreline area photography and contour mapping of shoreline.
- Obtain current digital aerial photographs of the Canadian shoreline in the St. Clair River Area of Concern (AOC).
- Complete shore protection assessments and collect GPS data on all remaining shoreline properties in the Canadian side of the St. Clair River Area of Concern. The data to be collected will include (but no be limited to) the following: nearshore (water depth and type of substrate at various locations from the shore, moorings, etc); shore protection (type of protection, outfalls, toe protection, splash pad etc); and any on-shore structures.
- Construct GIS layer for the above data. Please submit an electronic and paper copy of these layers with your year end report.
- Begin the construction and integration of this collected data in a GeoDatabase. Submit a copy of the work completed by March 15th 2007 with the year end report.
- Conduct an assessment of the conditions at each site and identify potential opportunities for habitat restoration/enhancement. Produce a report summarizing this work including a map and unique site identifier and photographs of each location. Submit a copy of this report both electronically and paper with your year end report.

If you have any questions or require further information on any item within this document please contact Brian McDougall (bmcdougall@scrca.on.ca) at the St. Clair Region Conservation Authority, 205 Mill Pond Crescent, Strathroy, Ontario, N7G 3P9 or by phone at (519) 245-3710.

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1.0 Introduction

The St. Clair River flows south from Lake Huron to Lake St. Clair and is part of the boundary that separates Canada from the United States. Intensive urban and industrial development has resulted in shoreline hardening and alterations that affect fish habitat, shoreline processes, and water quality. In 1987 Environment Canada designated the St. Clair River as an Area of Concern (AOC) and identified shoreline habitat restoration as part of the de-listing criteria. This 87km stretch of shoreline is divided among private landowners, industrial companies and public works, within which are more than 800 shoreline protection structures. The modified shoreline has changed wave action, current direction and sediment erosion patterns which has subsequently created shoreline habitat unsuitable for many desirable species. In addition, erosion caused by sediment scour has resulted in many structures that are costly to maintain and providing minimal shoreline protection. The St. Clair Region Conservation Authority aims to encourage and assist landowners with the replacement of failing shoreline structures with soft shore engineering that would provide aquatic habitat, while improving erosion protection and aesthetics.

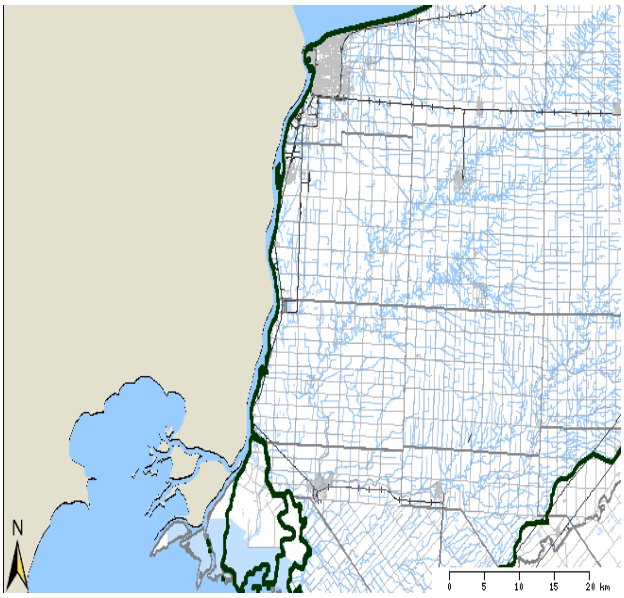


Figure 1.1 Map of the St. Clair River AOC

The St. Clair Region Conservation Authority in cooperation with Environment Canada's Great Lakes Sustainability Fund has created a shoreline structure database and a password protected GeoPortal to assist resource managers in identifying potential areas for improvement and rehabilitation. The database includes information on structure type, composition, condition, dimensions and elevation. Structure location and shape were captured using GPS equipment and linked to digital photographs taken onsite. The data collection methods have been adapted from the Assessment of Lake Michigan Shoreline Erosion Control Structures in Racine County, 2005 (Authored by Scudder D. Mackey, Ph.D.).

The purpose of this study is to provide landowners, resource managers and agencies with the knowledge and resources necessary to make environmentally friendly decisions concerning the location, design and construction of shore protection structures. This phase of the study has introduced the concept of "habitat friendly" shoreline designs to all residents and industries as well as proposed enhancement and restoration options. The foremost goal is to meet the de-listing criteria and contribute towards the rehabilitation of the St. Clair River AOC, while assisting landowners in protecting their property.

2.0 Methods

Prior to the commencement of field work, public awareness was gained through the local media with a newspaper article and news broadcasts. In addition, a detailed letter describing the study goals, procedures and benefits were delivered to shoreline residents. The Sarnia Lambton Environmental Association (SLEA) assisted with project awareness and access within the industrial sector. Refer to Appendix I for a copy of the news articles, public notice, letter to the editor, letter to residents, as well as, SLEA correspondence and 22/02/2007 presentation.

2.1 Field Protocols

The use of digital orthophotography and local maps aided in identifying areas where access may not be granted or where entrance may not be easily achievable. Maps were also beneficial in the field to identify drop off and pick up locations for the crew who were collecting data. Digital maps were also installed on the GPS unit for quality purposes and knowledge of property boundaries.

The field crew consisted of three personnel. A crew of two has been used in a similar project, but three were used to ensure quality and time management. While in the field one person operated the GPS unit collecting data points and digitally collecting information and measurements concerning the shoreline. A second person collected a hard copy of the same information, including measurements, as well as, digital photographs of the structure boundaries, docks, concern areas and anything relating to the project. The third person visited each residence along the river to remind landowners of the project and its goal, answered any questions they may have and asked permission to access the individually owned properties. When only two people were available the latter job was divided between the two. For safety reasons no one collected data alone.

Structure classification was the most important job in the data collection. An ID numbering system (ST0001-ST0891) was designed to sequentially number the primary structures along the river. The number represents the structure sequence, while the ST was used as an area code indicating the St. Clair River. Secondary structures were labeled using the following format: (secondary structure, structure type, and sequence) or (Sc. Dock 1).

The primary structures are numbered 0001 to 0891 starting North at Canatara Park and ending at Mitchell's Bay. The data is then collected regarding the individual structures. In terms of identifying these types of structures, the following definitions apply:

Primary Structure – A primary structure is either a single, stand-alone structure, or the "backbone" that connects and/or ties together a composite structure, placed to reduce or prevent erosion due to mass wasting processes and/or the action of wind, water or waves.

Most primary structures are shore parallel, however, some areas of shoreline may only be protected by a shore perpendicular groin, jetty or breakwater.

Secondary Structure – A secondary structure is generally a smaller structure or one of many attached appendages, such as; groins, jetties or docks. Docks were included as secondary structures because in combination with the associated ice breakers, both provide significant shore protection from ice scouring during the winter.

Where structures join one another to form a continuous zone of protection, subtle changes in the composition, size, shape, or other attributes can be used to distinguish individual structures for the purpose of identification. Even though many structures are defined by apparent property line boundaries, it is not uncommon to find structures that extend across multiple properties. An example of the ID numbering system can be seen below in Figure 2.1.

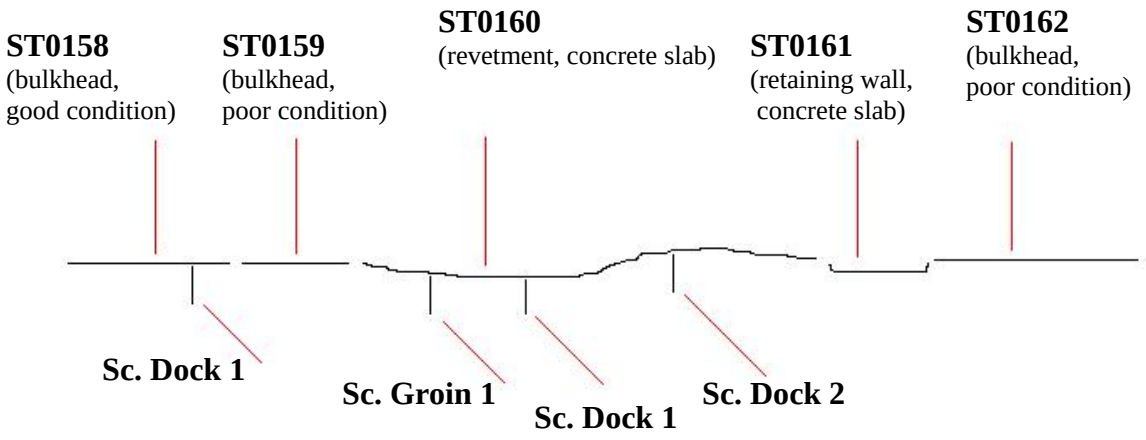


Figure 2.1 ID numbering system for primary and secondary structures

2.2 Field Data Collection

As a preliminary overview of the AOC, overlapping photographs and continuous video was taken by boat on November 6th and 7th, 2006. Field data was collected between November 17, 2006 and March 30, 2007, weather permitting.

2.2.1 Field Data Sheets

Attribute information for each of the structures was recorded on field data sheets. The information recorded includes: structure ID (File Name), date and time, Picture #, field crew, GPS positioning, land use, structure type, composition, condition, function, other attributes, dimensions (length, width, height of structure and distances), and an area for comments. The data sheet also provides a space for a sketch of the structure, and a cross-section sketch of both primary and/or secondary structures (if present). A copy of the Shore Structure Inventory data sheet is included in Appendix II of this report.

2.2.2 GPS and Data Acquisition

A Trimble GeoExplorer 2005 series handheld with a hurricane antenna was used to collect GPS data for individual structures and record attribute information. All positional data and horizontal coordinates were referenced to UTM system, Zone 17 North, Datum NAD 1983 (Canada). The GPS comes with Bluetooth capabilities for connection to an external Contour XLR Rangefinder which was used in the collection of GPS data for offshore or otherwise inaccessible structures.

The general shape and extent of structures (primary and/or secondary) were collected as a polyline feature. Single attributes, mostly outfalls were collected as points. Inaccessible areas were collected as point features using the Rangefinder and then converted to a polyline once in GIS. Data was collected along the centre point of most structures unless walking was difficult or it was a larger structure, in which case the outline was recorded with a polyline (eg. boat ramp). Attribute information was recorded on the GPS using a data dictionary specifically designed by the user for the particular study area. The St. Clair River data dictionary contains similar attribute data to the field data sheets. A copy of the data dictionary used is included in Appendix III of this report.

Data dictionary files were downloaded using Pathfinder Office Software and stored on the office GIS drive, which is backed up offsite. The location of each structure and attribute data was compared with field data sheets and digital photographs to ensure data integrity. Data dictionary files were converted to ESRI shape files in Pathfinder Office and then imported into ERSI ArcView. High resolution aerial photography was overlaid and the shoreline layer was edited to ensure precision and accuracy. Links were added to the final layer to include scanned data sheets and digital photographs for each

structure.

2.2.3 Digital Photography

Photographs were taken using an Olympus Stylus 6.0 Megapixel All-Weather camera. All primary and secondary structures were photographed at 2816 X2112 resolution and the photographs were saved in jpeg format. The number of pictures taken at each structure depended on the length, condition, and function. Additional photographs were taken of structures that covered a large distance or were in poor condition and had poor function.

After a day in the field, pictures were downloaded to a desktop PC using the Olympus software and were labeled accordingly using the datasheets as a reference. Each jpeg file would start with the structure name (eg. ST0024) and then would be numbered (eg. ST0024 01). Secondary structures were labeled using the primary structure name followed by the name of the secondary structure (eg. ST0024 DOCK 1). All photographs were stored on the company portal as well as on DVD's.

3. 0 Data Analysis

Shoreline data was collected along the St. Clair River AOC which included the Chenal Ecarte, and a small portion of Lake St. Clair. The study began at Canatara Park and ended at Mitchell's Bay, covering approximately 87 kilometers, where 869 primary shore protection structures were inventoried. In addition, 736 secondary structures consisting of docks, groins and boat ramps; as well as, 386 outfalls consisting of drain pipes, storm drains and river mouths were identified and mapped.

The most common types of shoreline structure encountered in this study were bulkheads/seawalls, which were given the same classification. They cover approximately 28 kilometers of the study area. Concerns have been raised that bulkheads and seawalls have led to artificial straightening and hardening of shorelines, and gradual infilling of waters along the St. Clair River, with a loss of valuable fish habitat and natural shoreline contours and landscapes. They are most often found along residential properties and in industrial areas, and are mainly composed of steel (Figure 3.0.2). Problems arise with bulkheads when water is able to penetrate through the structure. If the structure was not installed or designed correctly, erosion will occur behind the wall and will lead to flanking and failure of the toe.

As can be seen in Figure 3.1, 33% of the shoreline consists of Bulkheads, 29% is Dike and 21% is Revetment. Every reach of shoreline is given a structure ID number, including the 6.7 km of shoreline that has no protection in place. This 6.7km of shoreline is divided among 28 smaller sections of unprotected beach, bluff and wetland and falls within the "type other" category.

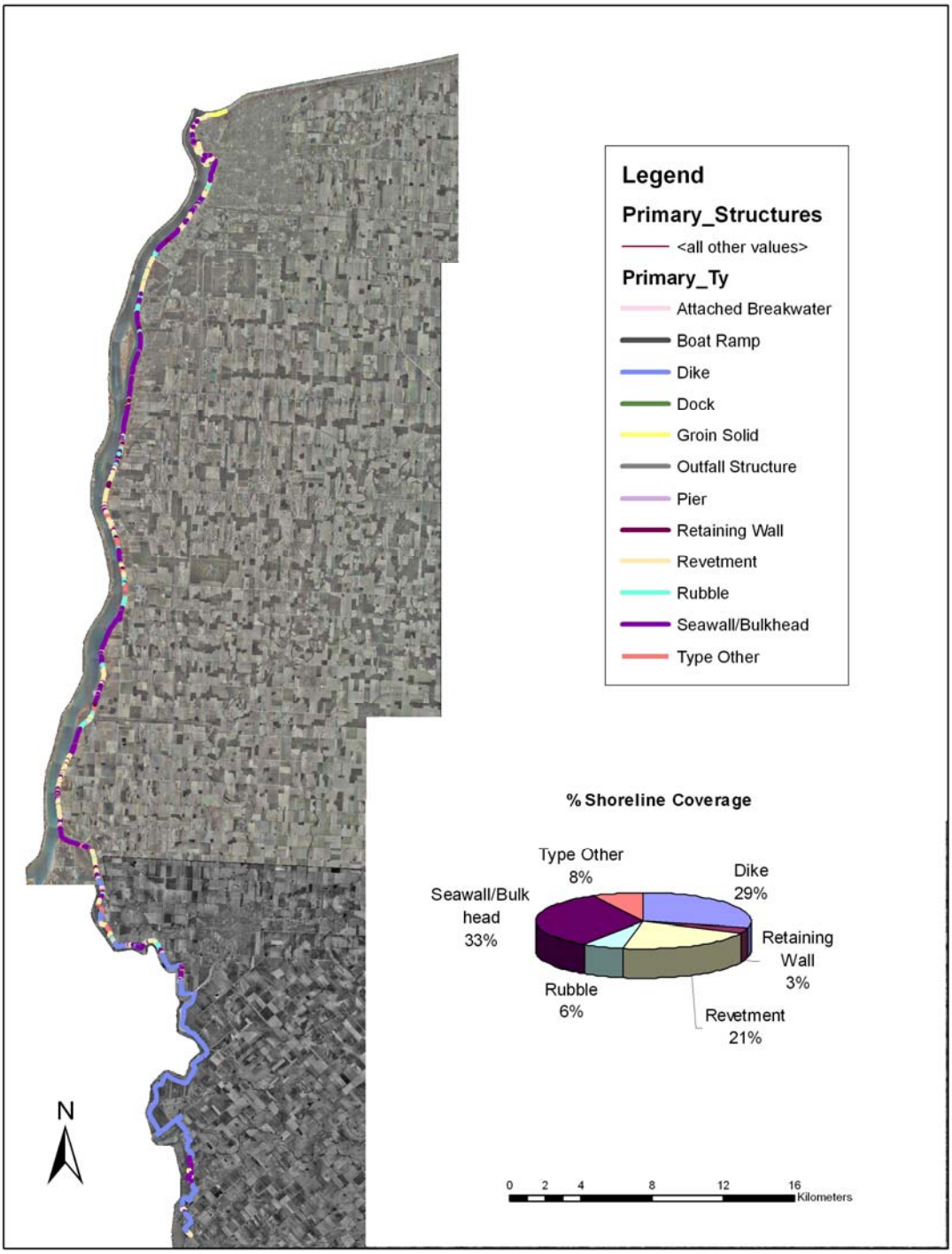


Figure 3.1 Primary structure distribution and % shoreline coverage

Dikes covered almost 30 % of the shoreline, found mainly along the Chenal Ecarte and the northern sections of Lake St. Clair. These were designed and constructed to prevent flooding of low lying lands during flood events. Although presently, the majority of them are in good condition, they have little to no bank protection on the slope facing the water which will decrease their life span. Mature trees and hazard trees are also concerns when looking at the longevity of these dike systems.

Over 18 km of shoreline is protected by revetments. These sloping structures consist of layers of stone or concrete placed along a shoreline. Rip rap is used to prevent erosion in the same way a bulkhead, but has the advantage of dissipating the wave energy. Environmentally, rip rap is favored over bulkheads made of wood, steel and concrete because it creates habitat for aquatic organisms. It also has a long life span that prevents the shoreline habitat from being disrupted from ongoing repairs and reconstruction of structures. It is the goal of this study to promote this type of soft shore protection and increase aquatic habitat along the St. Clair River Area of Concern.

Figure 3.2 shows 29% of the shoreline is composition other, 30 % of structures consists of steel, 21 % of concrete rubble, 16 % were stone and the remaining 3% consisted of fill and timer crib/piling.

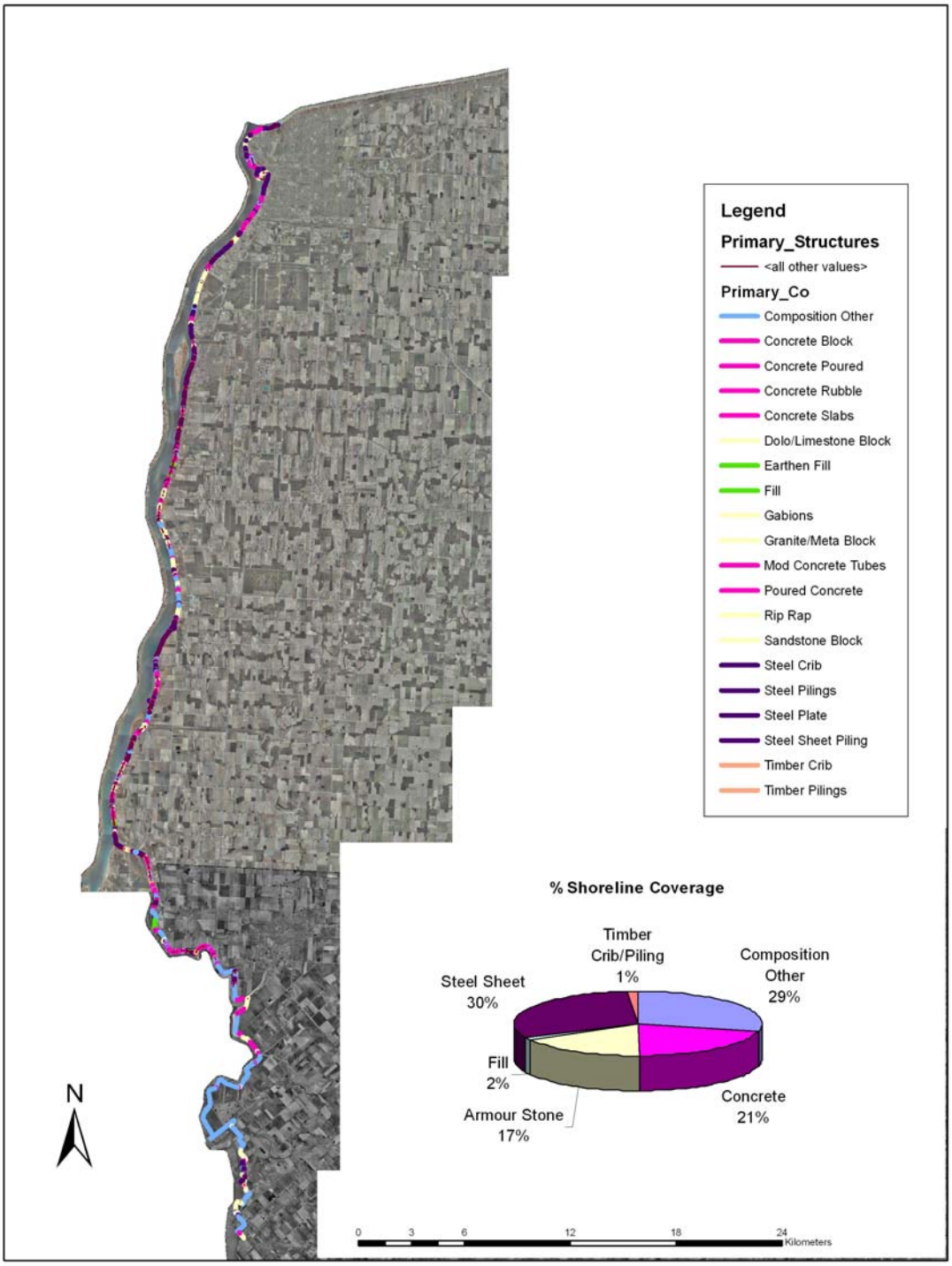


Figure 3.2 Shoreline structure composition and % shoreline coverage

Bulkheads composed of steel and revetments composed of concrete dominate the shoreline from Point Edward to Port Lambton. Dikes are clearly the most abundant structure through Chanel Ecarte and Mitchell's Bay, with other structure types protecting some sort of housing development.

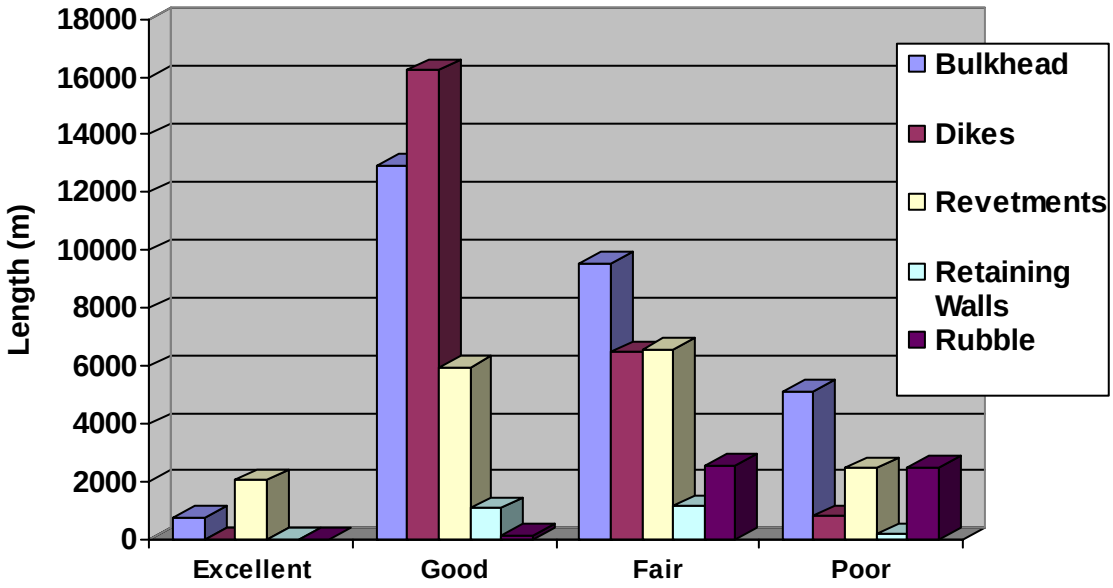


Figure 3.3 Shoreline length (m) of each type of shoreline structure in excellent, good, fair, and poor condition.

Condition represents the structures vertical and horizontal alignment, as well as, its aesthetic appearance. The most consistent structure in fair-poor condition is rubble. This was to be expected because rubble is indicative of a lack of engineering or merely remnants of a structure that once existed. This type of structure can be in fair-good condition because in combination with tree roots and phragmites, they sometimes have a reasonable appearance and show no signs of erosion. Revetments and bulkheads are fair-good for the most part, but with 1479m and 1131m respectively in poor condition, many enhancement opportunities still exist.

Structures in poor condition require immediate attention, repair and/or replacement within the next 5 years. Structures in fair condition have a lifespan of roughly 10-15years, at which point they would be classified as poor. This would result in a 39940m of shoreline needing repair or replacement within the next 15years.

Structure function represents its ability to protect the embankment or property from erosion due to wind, current and waves. This is determined by slumping or holes behind the structure. Structure function is often very similar to structure condition. In general, there are more structures in poor condition than poor function. This is a result of structures losing their ability to retain land before they lose their alignment and appearance. This could be due to poor design or improper materials at the time of construction.

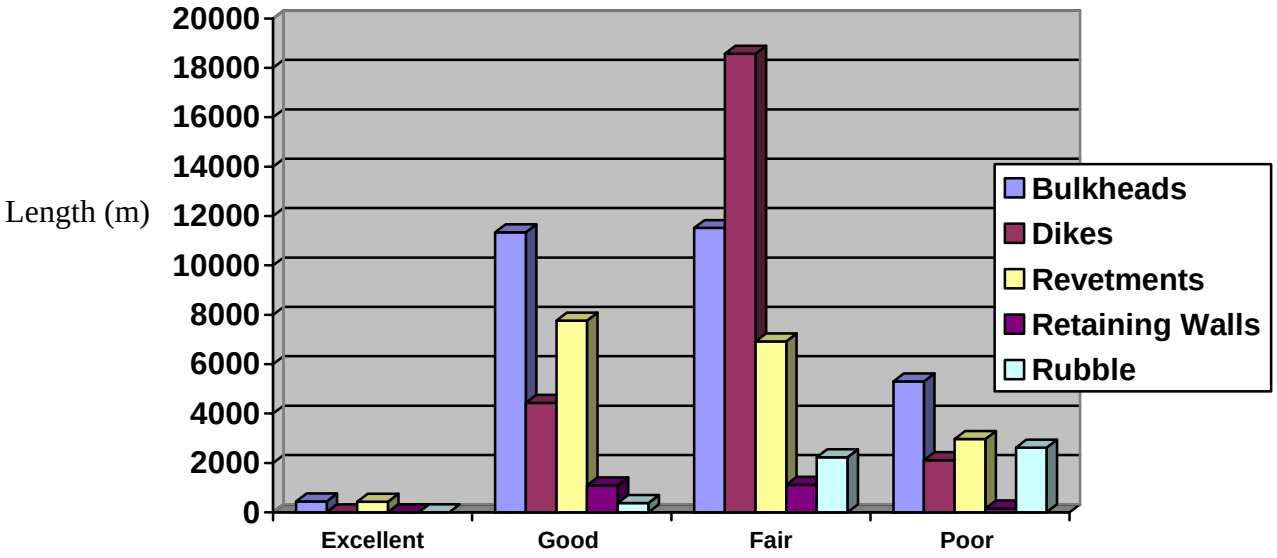
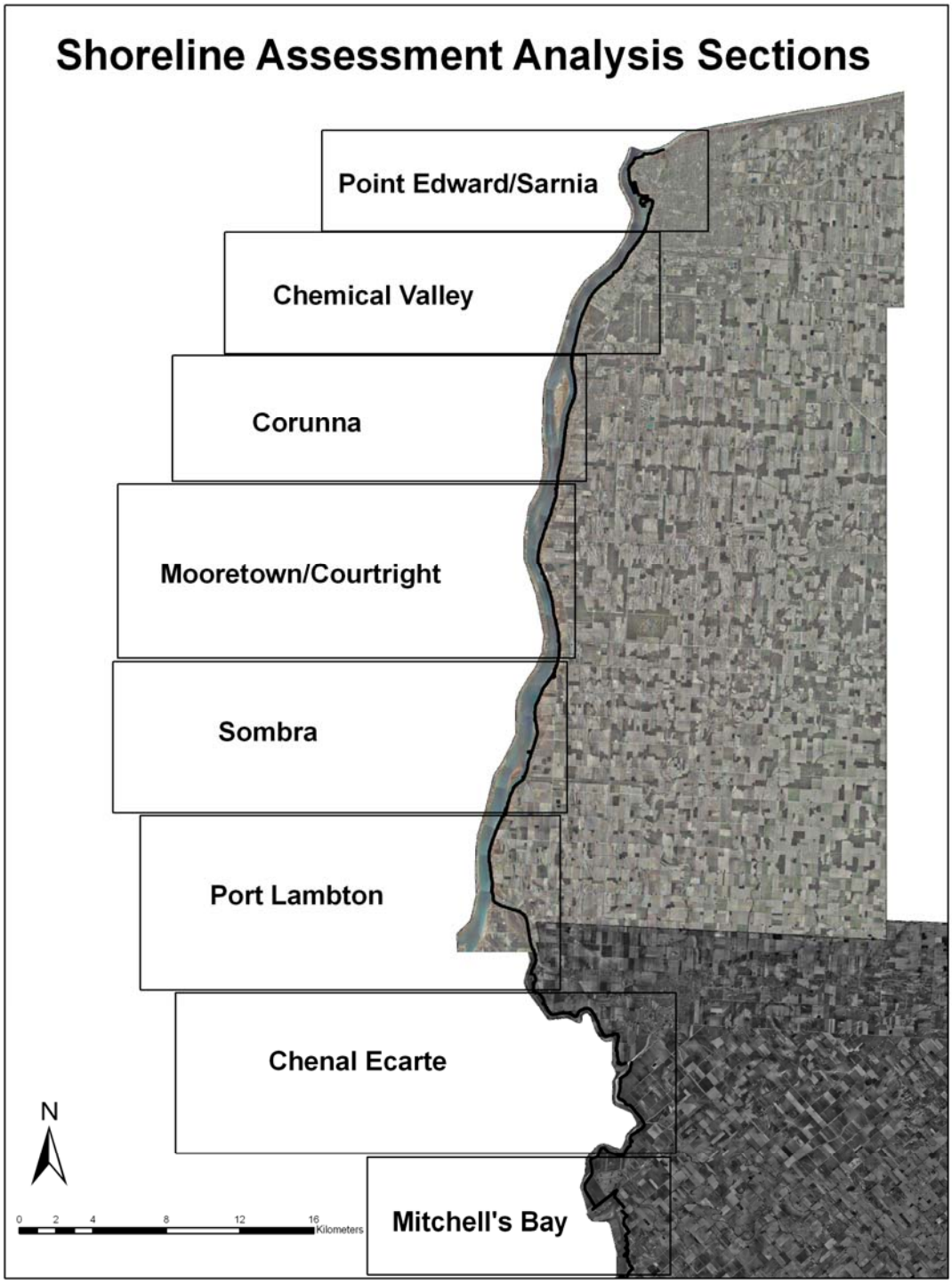


Figure 3.0.4 Shoreline length (m) of each type of shoreline structure with excellent, good, fair, and poor function.

The main difference between the two figures is the amount of shoreline in fair-good condition compared to function. Figure 3.0.4 has more structures in fair function than figure 3.0.3 has in fair condition. This further illustrates the previously mentioned point that structures retain their condition longer than their functioning ability. This is especially true for steel sheet bulkheads and dikes, but is not nearly as relevant for revetments of stone or concrete. In fact, for revetments this trend is reversed to a small degree. This may suggest that revetments have better longevity than bulkheads, however, structure age and design must also be considered.

The study area was broken down into 8 smaller sections for a more detailed analysis. The sections were chosen by land usage and to include main communities along the river shoreline. The purpose of the following analysis is to assess the possibility of shoreline enhancement at various locations based on structure type, condition and on-shore structures. The individual sections are outlined below:


Shoreline Assessment Analysis Sections
Point Edward/Sarnia
Chemical Valley
Corunna
Mooretown/Courtright
Sombra
Port Lambton
Chenal Ecarte
Mitchell's Bay
N
0 2 4 8 12 16
Kilometers

3.1 Section 1

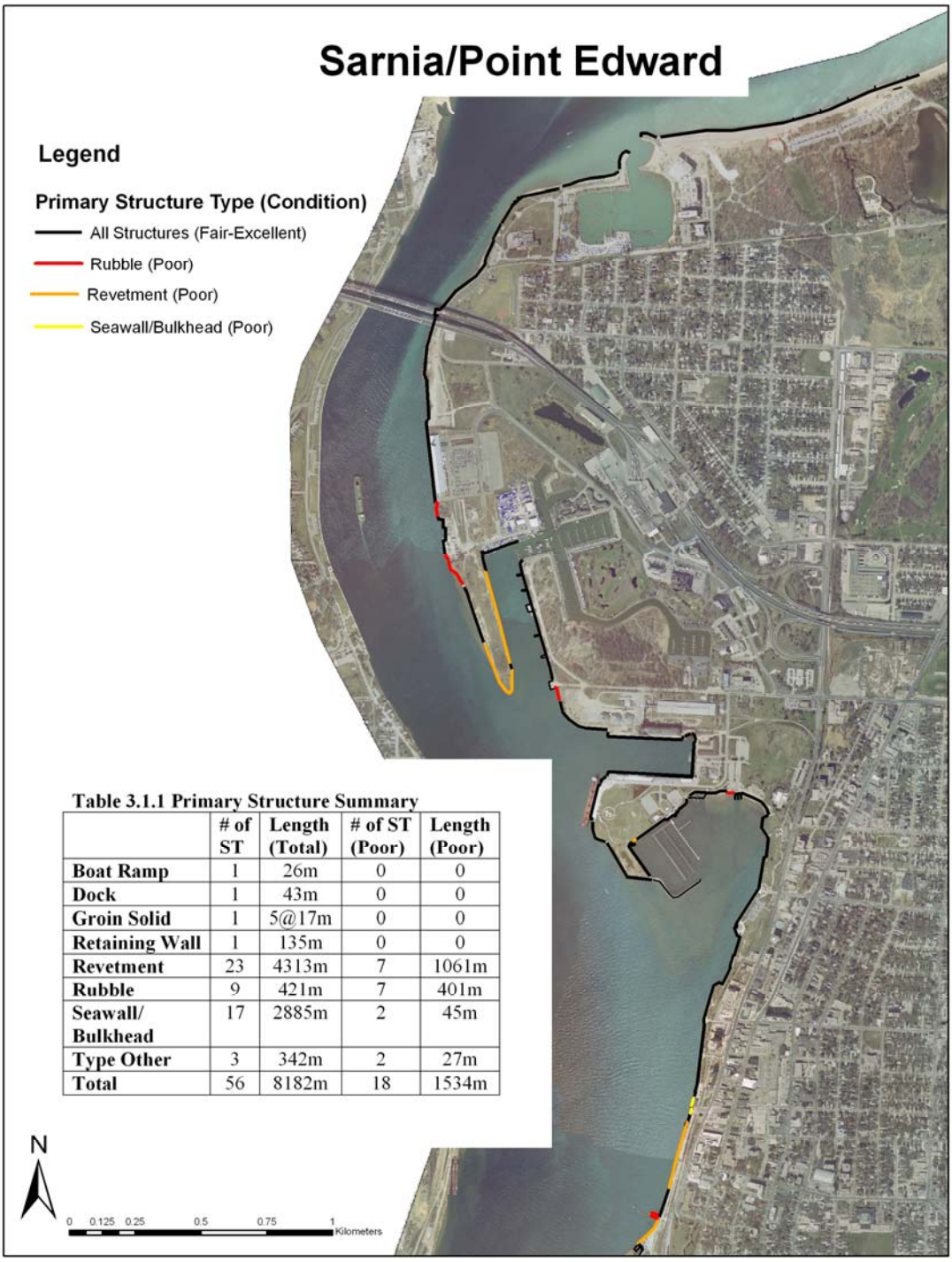


Table 3.1.1 Primary Structure Summary

	# of ST	Length (Total)	# of ST (Poor)	Length (Poor)
Boat Ramp	1	26m	0	0
Dock	1	43m	0	0
Groin Solid	1	5@17m	0	0
Retaining Wall	1	135m	0	0
Revetment	23	4313m	7	1061m
Rubble	9	421m	7	401m
Seawall/ Bulkhead	17	2885m	2	45m
Type Other	3	342m	2	27m
Total	56	8182m	18	1534m

3.1.1 Overview

Section 1 begins at Canatara Park, which is located on Lake Huron, near the mouth of the St. Clair River. It includes Point Edward, Sarnia Bay and ends on the former CN lands north of the concrete plant. This section consists predominantly of municipally owned parks, marinas, industries and no residential housing.

This section is home to a number of endangered mussel species, all of which are listed in Table 3.1.2. Their range is from Point Edward down to Mooretown or for the purposes of this report, from Section 1 to Section 4.

Table 3.1.2 Mussel species at risk

Species	Status
Kidney shell	Endangered
Northern Riffleshell	Endangered
Rayed Bean	Endangered
Round hickorynut	Endangered
Round pigtoe	Endangered
Salamander Mussel	Endangered
Snuffbox	Endangered
Wavyrayed Lampmussel	Endangered

Taken from the DFO Referral Review Tool for Projects Affecting Aquatic Species at Risk.

3.1.2 Historical

Shoreline modifications in Sarnia and Point Edward were assessed using project documents and aerial photography from 1972, 1992 and 2003. Point Edward was the site of a significant erosion protection project that began in 1995 and was completed by 2007. This project consists of a stepped and slopped armour stone shoreline protection system that stretches from the Lambton Area Water Supply System (LAWSS) Treatment Plant to the Point Edward Charity Casino. The 1972 aerial photography shows no major changes in shoreline shape; however the new protection shows an immense improvement over the concrete rubble and steel sheet that preceded it. The Point Edward Charity Casino opened in 2000 and has re-built the steel wall that previously existed at that location.

The land approximately 300m south of the casino has experienced changes in land use and subsequent shoreline modifications over the last 35 years. In 1972 it appeared to be relatively unprotected and inconsistent in shape. The 1992 aerial photography shows the spit being used for aggregate storage and the shoreline altered into a uniform shape with some sort of protection in some areas. Currently it has no apparent land use and is in poor condition, with a scattered concrete slab and rubble shoreline.

The piece of land between Sarnia Harbour and Sarnia Bay has also undergone significant changes over the last 35 years. What is now Sarnia Bay Park off Seaway Road, has been altered in shape since 1972 and is now protected by a 250m armour stone revetment and a 230m armour stone breakwater. It is difficult to determine the former shoreline composition from aerial photography; however, the general shape has changed dramatically.

3.1.3 Current Analysis

This section consists of 56 primary structures covering 8182m of shoreline, refer to Table 3.1.1. Greater than 50% of these structures are in good-excellent condition, 31% are in fair condition and 19% are in poor condition. The shoreline composition is roughly 32% concrete (2608m), 36% steel (2904m) and 20% armour stone (1663m) with the remaining 12% composed of timber pilings, fill and composition other.

Of 26 revetments, there are 3 dolomite/limestone block, 6 rip rap and 1 sandstone block; leaving the remaining 16 composed of some form of concrete. Revetments composed of stone are mainly in good-excellent condition (Figure 3.1.1), whereas, revetments and/or rubble composed of concrete are typically in poor-fair condition (Figure 3.1.2). Most revetments composed of concrete are in some form of "bluff dump" where any scrap materials, usually concrete is simply dumped over an embankment to prevent erosion. Concrete rubble and slabs are most commonly used for revetments of this nature, where concrete block usually signifies an attempt to engineer or design a shoreline protection structure.

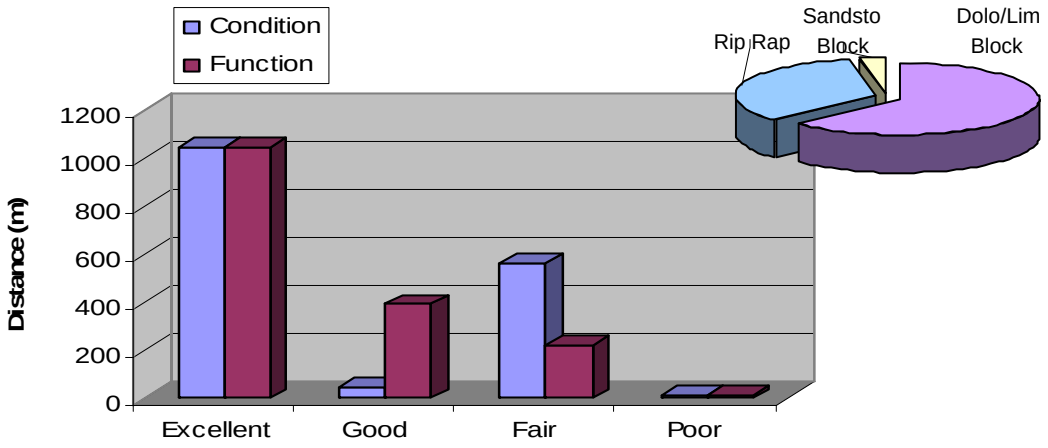


Figure 3.1.1 Condition, function and distribution of stone shoreline protection structures in Sarnia and Point Edward, 2007.

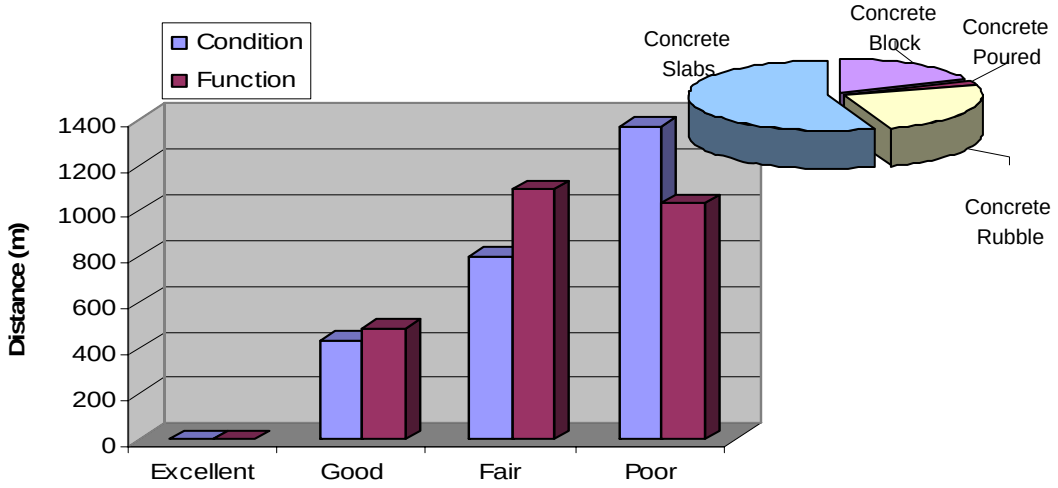


Figure 3.1.2 Condition, function and distribution of concrete shoreline protection structures in Sarnia and Point Edward, 2007.

The vast majority of bulkheads are steel sheet piling, 1% of which are in poor condition (Figure 3.1.3). These bulkheads are in very good condition, which is directly related to the adjacent land use. The largest continuous reach of steel sheet piling is in a series of Sarnia owned parks, including; Centennial Park, Bayshore Park, Mackenzie Park and Seaway Park. These parks are well maintained and the shoreline protection is in very good condition. Other stretches of steel sheet wall belong to the LAWSS Treatment Plant, Point Edward Charity Casino and Transport Canada. All of which have enough financial resources and motivation due to aesthetics to maintain reasonable shoreline protection.

Photo 3.1.1 ST0045, Bayshore Park, Sarnia

Figure 3.1.3 Condition and function of steel shoreline protection structures in Sarnia and Point Edward, 2007.

3.1.4 Future Opportunities

Due to the condition of most structures and the associated land use there is little opportunity to replace and/or enhance any steel sheet wall in this section. These walls are in very good condition and were built to provide easy access to the water and docking of large industrial vessels. However, there are two good opportunities to enhance sections of concrete rubble and debris which span a total of 1396m.

The spit of land 300m south of the casino presents an interesting opportunity for enhancement. There is 676m of continuous shoreline that could be enhanced with no apparent land use to restrict construction designs. This piece of land is used primarily by the public for walking and fishing, however, a development proposal does exist. The proposed residential development would likely require replacement or restoration of the existing shore protection. The shoreline consists of mostly concrete slabs, undermined by erosion and is clearly ineffective.

Photo 3.1.2 ST0016, Sarnia 2007

The potential for fish habitat enhancement is also interesting due the position of the spit and nearby water depth. Winter Harbour which lies on the inland side of the spit and is protected from current, major waves and is quite deep right off shore. However, this area does receive high boat traffic due to Bridgeview Marina and docking for Transport Canada.

Ferry Dock / Former CN Lands have already been identified as a potential area for rehabilitation. Draft plans for an armour stone/rip rap revetment have been drawn and a Class Environmental Assessment is currently underway to obtain required permits and to support requests for funding. This section is 720m long and consists of concrete rubble and slabs with a poured concrete slush cap. Erosion is quite evident and will clearly continue without replacement and/or enhancement.

Photo 3.1.3 ST0052, Sarnia 2007

3.2 Section 2

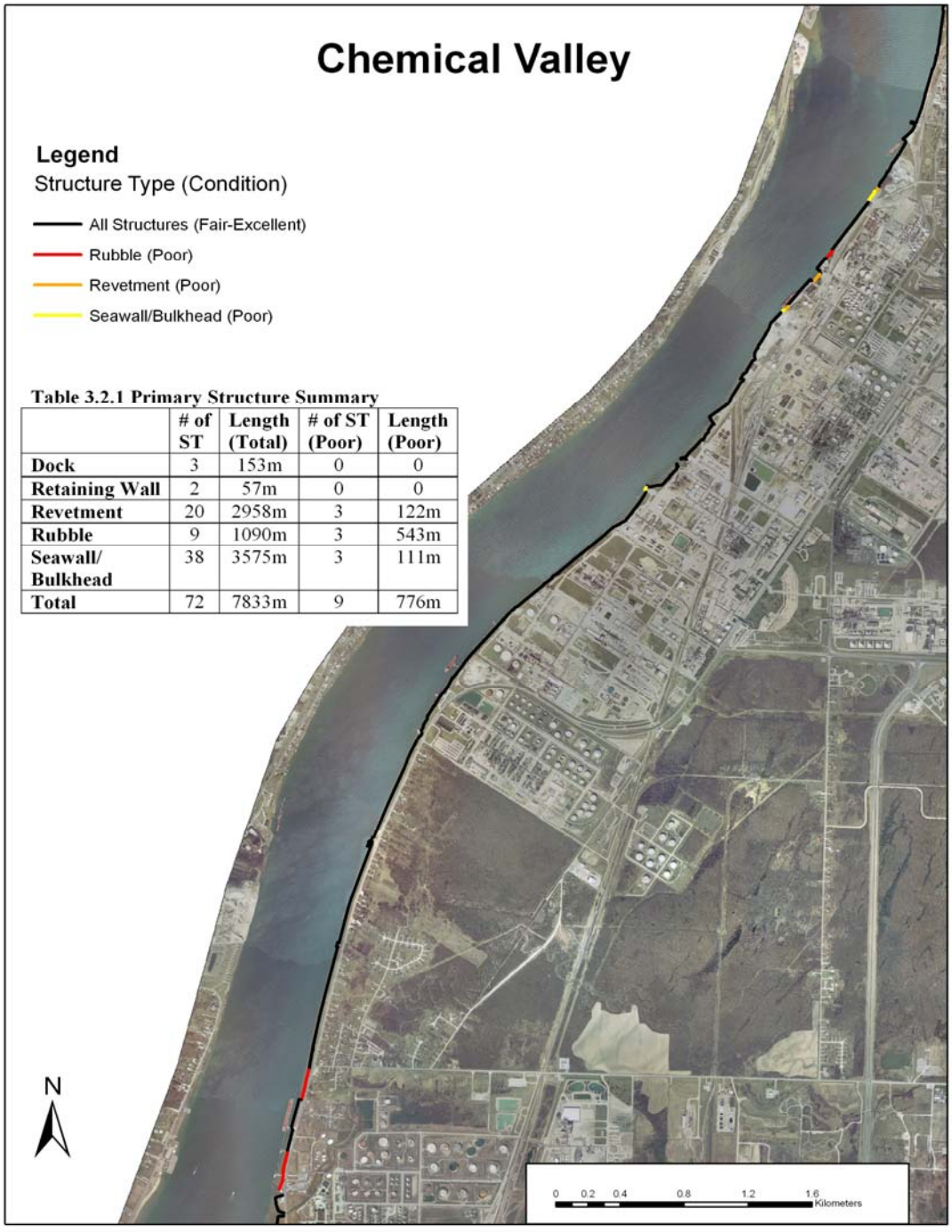


Table 3.2.1 Primary Structure Summary

	# of ST	Length (Total)	# of ST (Poor)	Length (Poor)
Dock	3	153m	0	0
Retaining Wall	2	57m	0	0
Revetment	20	2958m	3	122m
Rubble	9	1090m	3	543m
Seawall/ Bulkhead	38	3575m	3	111m
Total	72	7833m	9	776m

3.2.1 Overview

Section 2 begins at the Concrete Plant south of the Former CN Lands and continues south; including Chippewa's of Sarnia First Nation (Aamjiwnaang) and ends just north of Guthrie Park in Corunna. With exception to First Nation land, this section is entirely owned by industry. Shoreline usages such as docking and water exchange limit the possibilities for enhancement within this region.

3.2.2 Historical

Shoreline modifications in chemical valley (Sarnia's industrial sector) were assessed using aerial photography from 1972, 1992 and 2003. There have been only minor changes in shoreline shape and structure since 1972. No changes were evident between 1992 and 2003. Within the section of Chemical Valley from Talfourd Street to the North end of Chippewa's of Sarnia First Nation (Aamjiwnaang) there are no major shoreline alterations visible by aerial photography.

Ranging from the Chippewa's of Sarnia First Nation (Aamjiwnaang) to just north of Guthrie Park there are few minor changes in shoreline composition. The shoreline immediately across from the First Nation was heavily vegetated in 1972 and is now a bare armour stone revetment. At the base of LaSalle Line, the 1972 aerial photography shows some sort of hard structure, likely a seawall or bulkhead. This has since been converted into an armour stone revetment. In addition, North of Guthrie Park across from Church Street, a bulkhead (380m) was built to dock large industrial vessels. This area appears to be relatively unprotected in 1972 aerial photography.

3.2.3 Current Analysis

This section consists of 69 primary structures covering 7832.6m of shoreline (Table 3.2.1). Greater than 55% of these structures are in good-excellent condition, 37% are in fair condition and only 3% are in poor condition. Chemical Valley shoreline is composed of 29% concrete (2115m), 34% stone (2434m) and 36% steel sheet piling (2971.3m).

With approximately 2115m of concrete shoreline, 604m or 29% is in the form of poured concrete seawalls and 52% or 1099m is in the form of concrete slab or rubble revetments (Figure 3.2.1). Only 400m of concrete shoreline is in poor condition, which is reasonable considering concrete is typically representative of poorly designed and/or disarticulated shorelines.

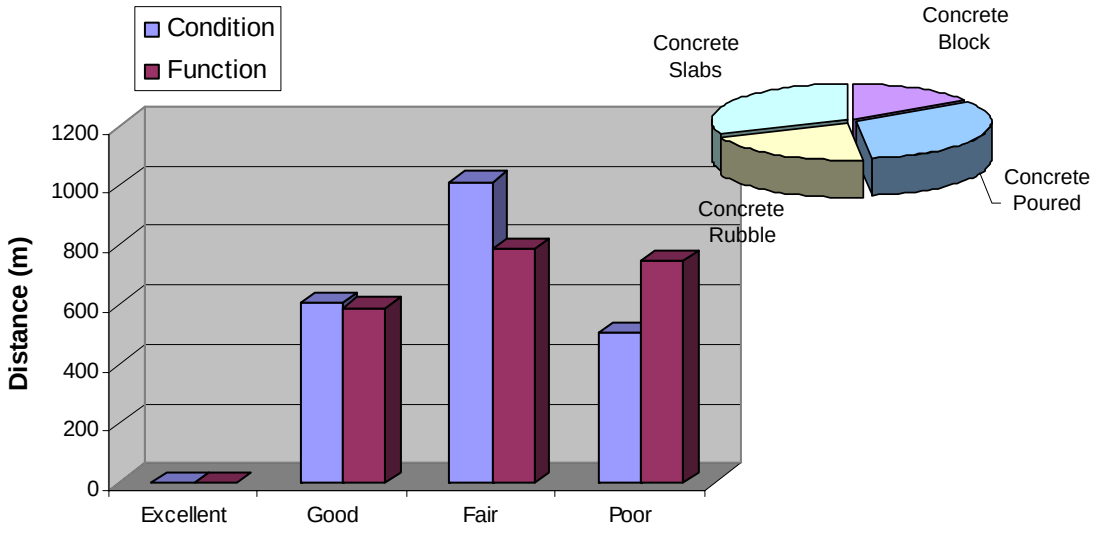


Figure 3.2.1 Condition, function and distribution of concrete shoreline protection structures in Chemical Valley, 2007.

Roughly 90% of revetments are made of dolomite/limestone block and rip rap. They make up 2434m of shoreline and are in fair-excellent condition with fair-excellent function. Stone structures are 74% dolomite/limestone blocks and 24% rip rap (Figure 3.2.2). In general, revetments of this composition and structure type appear to be more recently constructed than bulkheads or seawalls and concrete structures.

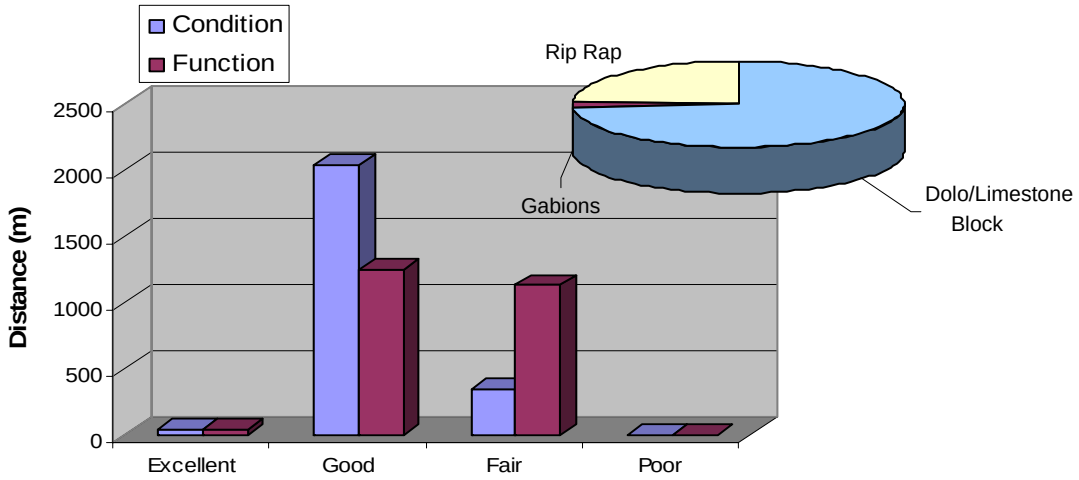


Figure 3.2.2 Condition, function and distribution of stone shoreline protection structures in Chemical Valley, 2007.

Steel sheet piling is very common throughout Chemical Valley. In most cases it was constructed to provide easy access to the water and therefore has been kept in reasonable condition to meet required operational needs. Of the 2971m of steel shoreline, 13m is steel plate and the rest is steel sheet piling. As can be seen in Figure 3.2.3, no steel walls are in poor condition and as a result there are no real opportunities to replace this type of structure within Chemical Valley.

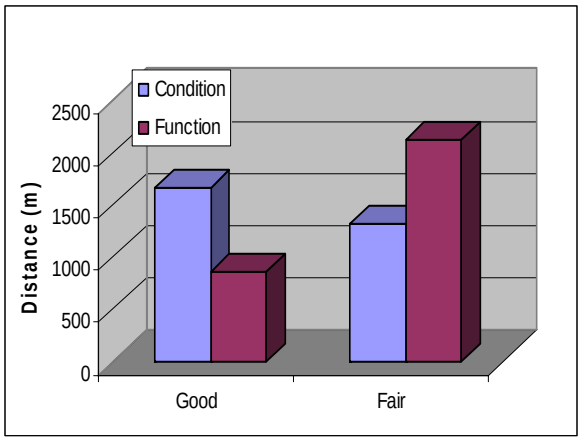


Figure 3.2.3 Condition and function of steel shoreline protection structures in Chemical Valley, 2007

3.2.4 Future Opportunities

There is little potential for enhancement within chemical valley because of the land use and shoreline condition. The shoreline within this section serves a purpose, either docking or water exchange. In most cases where steel sheet piling is present, it is the only shore protection that will work. In addition, most structures have been kept in fair-excellent condition. Furthermore, 85% of revetments have been constructed of dolomite/limestone block, rip rap or gabions, which suggests the use of concrete and/or "bluff dumps" is rare in this section. However, there are two opportunities for rehabilitation.

The north end of Chemical Valley has a few potential areas for rehabilitation. There are four structures, one 115m and 3 @ 58m; each separated by an average of 225m. The longest one (115m) is a concrete seawall in ruins and is in need of immediate attention. The land adjacent to the structure is used for aggregate storage, but no permanent structure is in place. It is difficult to assess the amount of erosion because the nearby aggregates could easily be masking any visual effects.

Photo 3.2.1 ST0840, Sarnia 2007

The other 3 structures are located a good distance from roads and buildings, but at only 58m per structure, they do not offer significant potential for large scale shoreline enhancement.

The south end of chemical valley has two structures which offer little protection and have potential for enhancement. They are very similar reaches, one 249m (18m to road) and one 232m (8m to road), totaling 481m. They are mostly concrete rubble, with other forms of debris, such as re-bar, scrap metal and tires. Both have very little protection and show numerous signs of erosion. Although the road is nearby, it is uphill and the potential for rehabilitation still exists. Some brush and trees are helping to retain the shoreline, however, under higher water levels it is clearly insufficient protection.

Photo 3.2.2 ST0064, Corunna 2007

3.3 Section 3

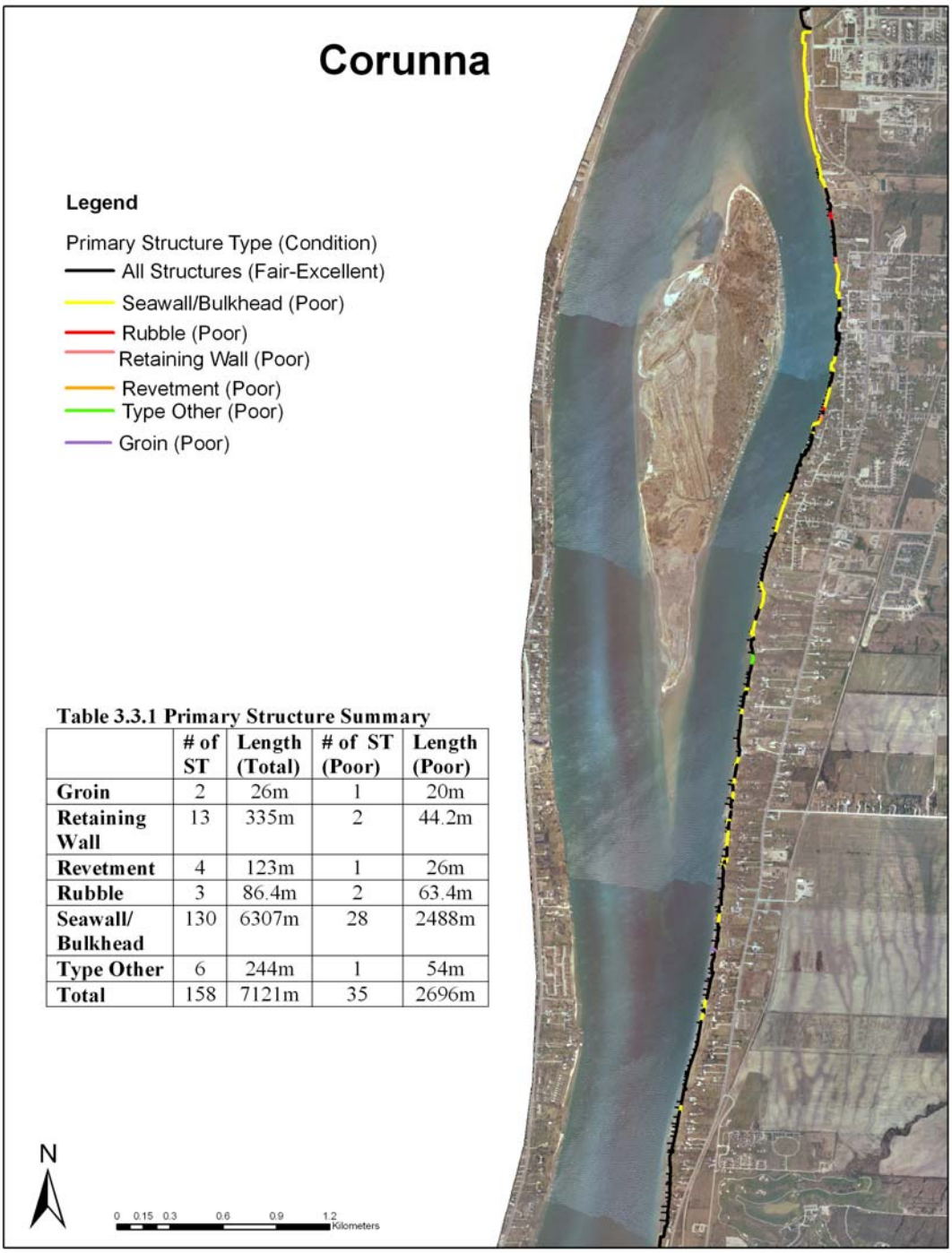


Table 3.3.1 Primary Structure Summary

	# of ST	Length (Total)	# of ST (Poor)	Length (Poor)
Groin	2	26m	1	20m
Retaining Wall	13	335m	2	44.2m
Revetment	4	123m	1	26m
Rubble	3	86.4m	2	63.4m
Seawall/ Bulkhead	130	6307m	28	2488m
Type Other	6	244m	1	54m
Total	158	7121m	35	2696m

3.3.1 Overview

Section 3 begins north of Corunna at Guthrie Park and ends north of Mooretown Centennial Park. This area is almost entirely residential, with a few parks owned by the Township of St. Clair.

3.3.2 Historical

Shoreline modifications in Corunna were assessed using project documents and aerial photography from 1972, 1992 and 2003. There are very few visible changes over the last 35 years. Most of the current bulkheads appear to be in place by 1972, however, the amount of shoreline tree cover in 1972 makes interpreting aerial photographs quite difficult in this region.

In 1994, SCRCA and the former Moore Township commissioned a study in 1994 on the slope stability along 6km of shoreline from Corunna to Mooretown. Although slope slippage has occurred from north of Corunna to south of Mooretown, it is particularly evident in the Beresford Street Area. Many residents have reported house cracking and foundation problems. The 1994 study suggests this problem is directly associated with filling for house construction and failing retaining walls along the shoreline (Terraprobe ltd, 1994). Slope movement can cause bowing of the steel sheet walls. A comparison between the 1994 photographic log and 2007 photographs show evidence of significant repairs to bulkheads in few locations. This ongoing issue makes estimating shore protection lifespan and repair status difficult, and the proximity of houses makes restoration and/or enhancement difficult and more expensive.

3.3.3 Current Analysis

This section consists of 122 structures, 87 or 83.9% of which are composed of steel sheet piling (Table 3.3.2). There are 8 structures made of stone, 14 made of concrete and 7 made of timber. Timber structures are generally in the form of bulkheads or seawalls and are generally in poor condition.

Table 3.3.2 Number, length (m) and % of shoreline structures by composition, 2007

Structure Composition	No.	Length (m)	%
Concrete Block	6	48.0	0.7
Concrete Poured	2	45.0	0.6
Concrete Rubble	2	107.4	1.5
Concrete Slabs	4	90.2	1.3
Dolo/Limestone Block	3	203.7	2.9
Gabions	3	72.0	1.0
Rip Rap	2	63.0	0.9
Steel Plate	2	46.0	0.6
Steel Sheet Piling	**87**	**5977.0**	**83.9**
Timber Crib	3	63.0	0.9
Timber Pilings	4	197.0	2.8
Composition Other	4	209.7	2.9
Total	**122**	**7122.0**	**100**

The greatest percentage of steel sheet piling is in poor condition, which suggests this section may have great potential for enhancement. Nearly 2500m of shoreline are lined with steel sheet piling in poor condition and 1500m are in fair condition. Assuming the lifespan of walls in fair condition is around 10 years; compared to 0-5 years for walls in poor condition, that would provide 4000m of potential enhancement within the next 10 years. Due to the large amount of steel sheet pile, which is our target structure for replacement, this area should be targeted as a high priority area.

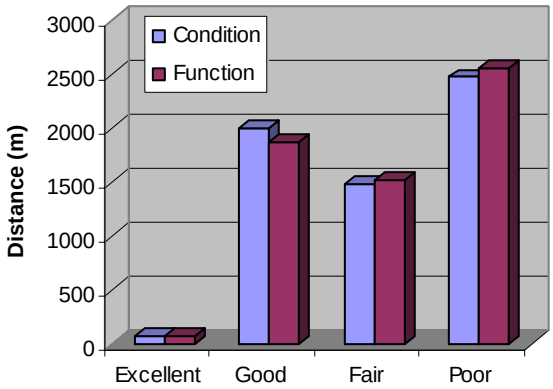


Figure 3.3.1 Steel structure condition and function 2007.

There are no on-shore constraints to shoreline development for 5064m of shoreline (Table 3.3.3). Of the 957.2m of shoreline with on-shore structures within 10m, most are in a continuous string of structures in the Beresford St. area. Unfortunately many of the walls in this area are in drastic need of replacement.

Table 3.3.3 Number of steel sheet pile walls with on-shore structures within 10m, 10-20m, 20-50m and over 50m.

	0-10	10-20	20-50	>50
Excellent	50.2	0	0	27
Good	464	186	638	580.7
Fair	106	178	458	782
Poor	337	300	526	1388
Total	957.2	664	1622	2777.7

3.3.4. Future Opportunities

This section provides one of the greatest opportunities for shoreline enhancement. Not only is it almost entirely composed of steel sheet pile, but significant stretches are in poor condition. There are 10 structures which span multiple properties that total 1927m and have a minimum individual length of 80m. Although they are not all adjacent to one another, they represent a significant portion of the shoreline. More importantly, enhancement in this area would promote soft-shore engineering in an urban area that will see a lot of shoreline replacement over the next 10, 20 and even 30 years.

Guthrie Park is located north of Corunna and is the first structure found in this section. It is owned by the Township of St. Clair and represents the single largest opportunity for shoreline enhancement in this section, with a length of 764m. It has already been identified as a potential area for enhancement and draft designs for new protection are being undertaken. This site would be ideal because of its length, composition and proximity to numerous residential homes with steel walls. This site would act as an example of soft-shore engineering and will help encourage residents to switch to this type of protection.

Photo 3.3.1 ST068, Corunna 2007

There is no other single property or structure that stands out as a candidate for enhancement or replacement, but there are a collection of potential sites of equal importance. The photo to the left is simply a typical bulkhead in this area that is representative of all potential sites for enhancement and will need repair or replacement as soon as possible. Specific sites for enhancement will likely come down to the willingness of the individual landowners. Potential candidate sites were assessed based on the following criteria: a minimum length of 80m, no on-shore structures within 10m and currently in poor condition (Table 3.3.4).

Photo 3.3.2 ST0080, Corunna 2007

Table 3.3.4 Candidate sites structure number and length (m).

ST #	0069	0080	0092	0095	0104	0112	0120	0144	0176
Length	125m	169m	115m	114m	82m	233m	105m	89m	132m

3.4 Section 4

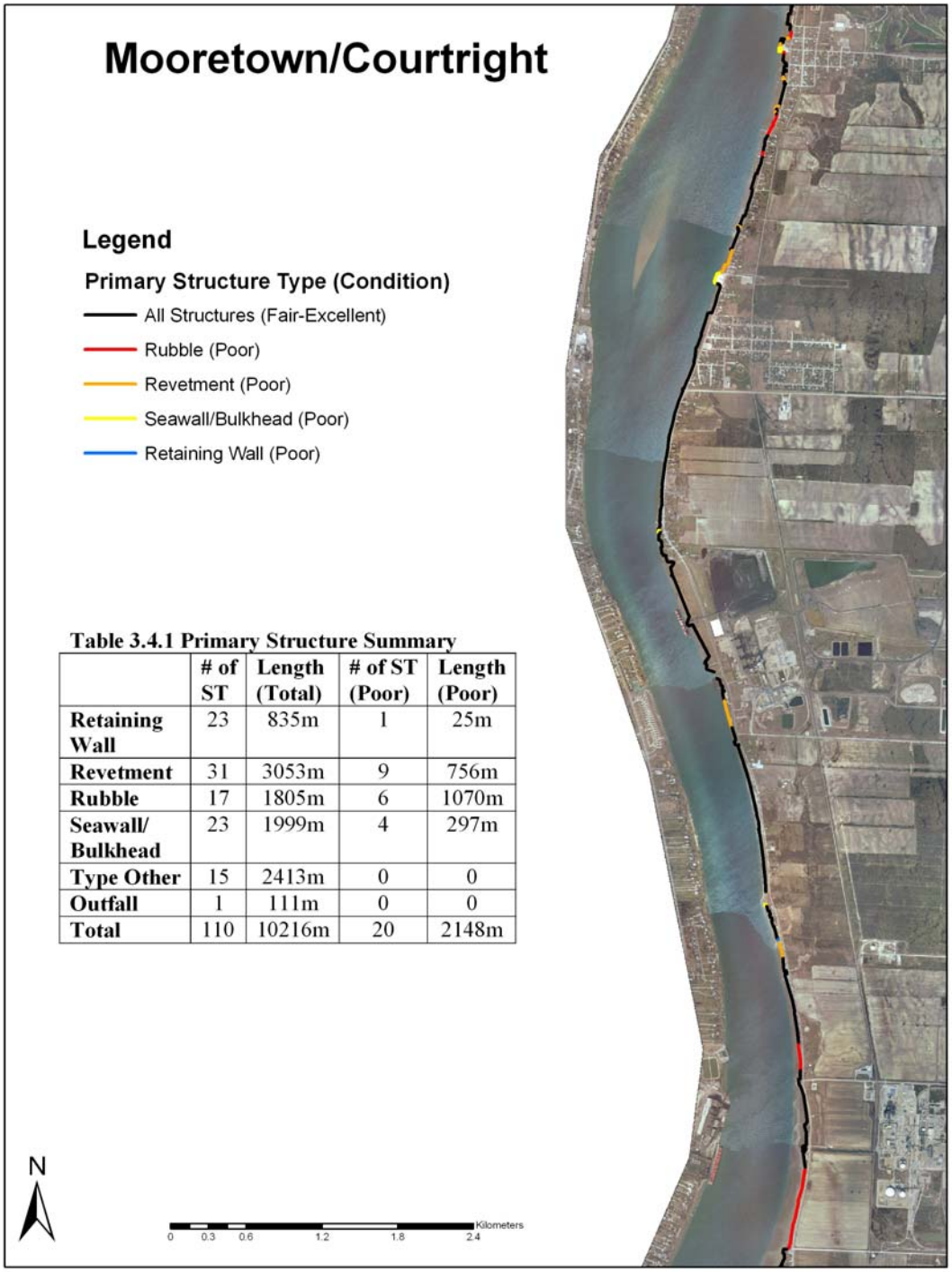


Table 3.4.1 Primary Structure Summary

	# of ST	Length (Total)	# of ST (Poor)	Length (Poor)
Retaining Wall	23	835m	1	25m
Revetment	31	3053m	9	756m
Rubble	17	1805m	6	1070m
Seawall/ Bulkhead	23	1999m	4	297m
Type Other	15	2413m	0	0
Outfall	1	111m	0	0
Total	110	10216m	20	2148m

3.4.1 Overview

Section 4 includes the areas from Centennial Park in Mooretown, just off Victoria Street to the road allowance at Stanley Line south of Courtright. This section covers 10.4 kilometres of the St. Clair River shoreline and includes a variety of protection. A great deal of this area is residential and many of the structures in place were constructed to protect personal property. The southern section of this area contains a naturalization project done by Terra International to help enhance fish and wildlife habitat. This project covers approximately 1.35 kilometres of shoreline from Oil Springs Line to Stanley Line.

3.4.2 Historical

While referencing documents from 1973 and 1976, slight shoreline modifications were found. In Environment Canada's "Great Lakes Shore Damage Survey" no damaged steel sheet piling was noted in this section of river. In the St. Clair-Huron Waterfront Study, the composition was recorded as limestone rip rap or unprotected. As the condition of the shoreline declined and as shoreline protection became necessary, it was evident that landowners began to use concrete rubble and fill to protect their shoreline.

Based on the comparisons of aerial photography from 1955, 1972, 1992 and 2003, three areas have noticeable alterations. The first area is Mooretown Centennial Park. It is clear from the aerial photographs that this area was not designated a park until after 1955. The existing steel sheet pile wall was only installed between the years of 1972 and 1992. The area for the park could be identified in 1972; however steel sheet pile walls are only evident in the 1992 aerial photography.

Photo 3.4.1 - Mooretown Centennial Park, 2007

The second major difference is the water levels south of Courtright. Many landowners along the St. Clair River have commented on the lowering water levels and in reviewing photographs from 1955 to 2003, it is evident that the water levels have in fact declined significantly.

The third change noted is the construction of the Ontario Power Generation plant south of Courtright. There is no evidence of the plant prior to 1955; however, by 1972 its appearance was similar to that of current aerial photography.

3.4.3 Current Analysis

As can be seen in Figure 3.4.1, the most common type of protection is revetment. This is due to the location of the St. Clair Parkway and the limited amount of shoreline available for protection. Where revetments are in place, most often the houses are built on the opposite side of the road. These revetments often contain a mixture of concrete slab, rubble, brick and man made structures created as a last resort to protect the shoreline.

This section of shoreline also contains a great deal of bulkhead and unprotected shoreline noted as 'type other'. Bulkhead is very common in residential areas where the houses are built adjacent to the shoreline and where erosion of the bank is at risk. Bulkheading accounts for 30% of the entire St. Clair River shoreline, while this section is only comprised of 20% bulkheads. The 'type other' composition of Courtright contains a great deal of beach area and unprotected banks which have been left to naturalize through Terra International's Naturalization program.

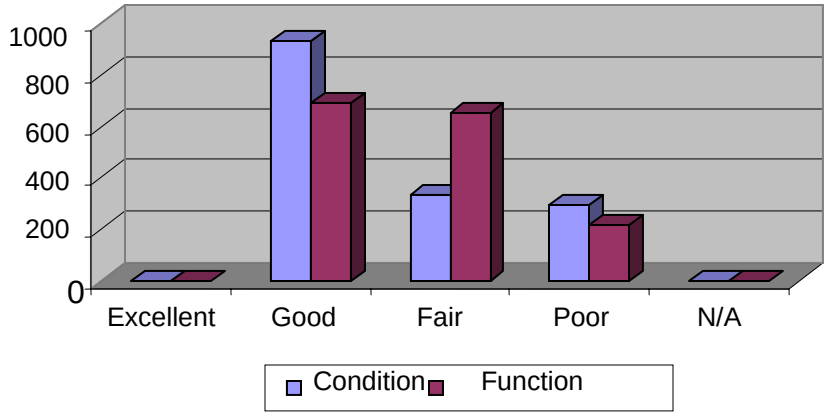


Figure 3.4.2 – Condition and Function of steel protection structures in Courtright and the surrounding area, 2007.

Based on Figure 3.4.2 it appears that most of the steel sheet piling in Courtright is in fair to good condition and is not in immediate need of repair. However the section of poor conditioned shoreline accounts for 20% (2148m), whether it is steel wall or any type of shoreline. The poor conditioned areas are important areas for rehabilitation and some are mentioned in the Future Opportunities section. The concrete structures are in worse condition that the steel sheet pile bulkheads and therefore are a greater priority for restoration (Figure 3.4.3).

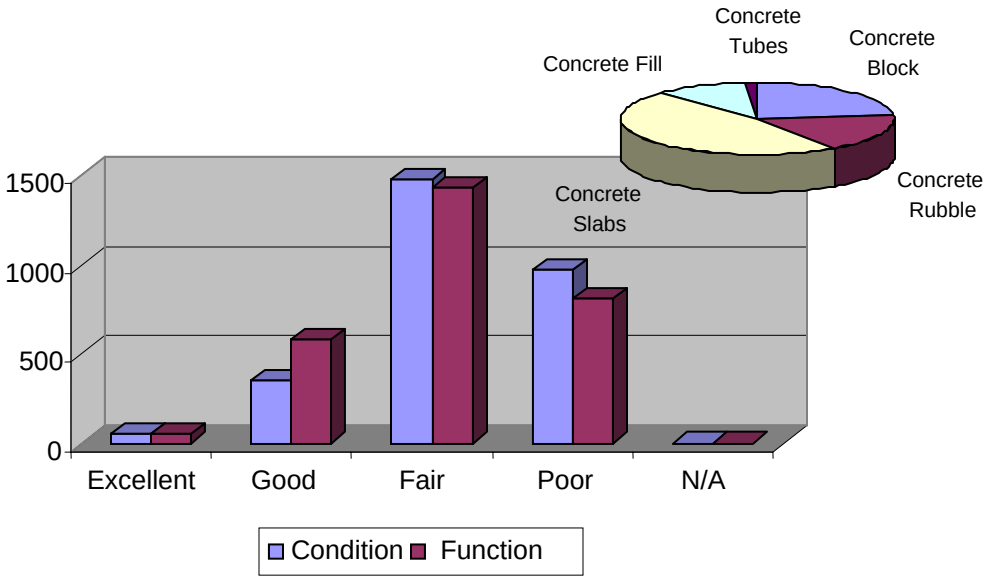


Figure 3.4.3 – Condition, Function and Distribution of concrete shoreline protection structures in Courtright and the surrounding area, 2007.

Of the 2148 metres in poor condition, some structures do not offer restoration possibilities because of the distance from the structure to the nearest building. If a building is less than 10 meters away from the shoreline, it is all but impossible to replace the structure with the ideal rip rap or armour stone. In some cases where a narrow revetment/rubble is in place, the existing protection could be replaced with a 2-1 rip rap slope. Based on the chart below, 388 meters of the shoreline have limited fish habitat and water quality restoration possibilities, while 293 meters have a great opportunity for improvement.

Table 3.4.2 – Distance of shoreline within areas from structures.

Distance to Shore	Meters in Length
1-10m	388
10-50m	1467
>50m	293

3.4.4 Future Opportunities

Possible areas of restoration can be identified as a small section within the community of Mooretown, north of Courtright and north of the Ontario Power Generation area.

The first photo shows concrete slab dumped into the water to protect the shoreline. This slab has a great deal of re-bar protruding from the recycled concrete. The use of this concrete is dangerous to human and wildlife safety. This type of rubble is common along this section of river and would be an excellent location to promote shoreline enhancement. This area of shoreline, due to it's proximity to roadway and its slope would best be replaced with a rip rap revetment. The recycled concrete shown in photo 3.4.2 stretches over 342 meters and consists of a mixture of concrete rubble, slabs, and steel sheet piling all in very poor condition. The possible construction is limited due to the adjacent gravel dock and the distance between the water and the road.

Photo 3.4.2 – ST0196, Mooretown, 2007.

Photo 3.4.3 shows a steel sheet pile wall that is in need of repair. This protection has begun to slant in the centre and flank at the ends. A great deal of soil has been used to fill erosion areas and is adding to the weight and force against one side without the equal amount of force from water energy or toe protection. By removing the steel wall, there would be a great deal of property loss by creating the slope, but the slopped revetment would benefit aquatic habitat. The evidence of the rocks near the bottom of the wall indicates that the slope would not have to be too slanted and would still allow for some green space.

Photo 3.4.3 – ST0283, south of Courtright, 2007

3.5 Section 5

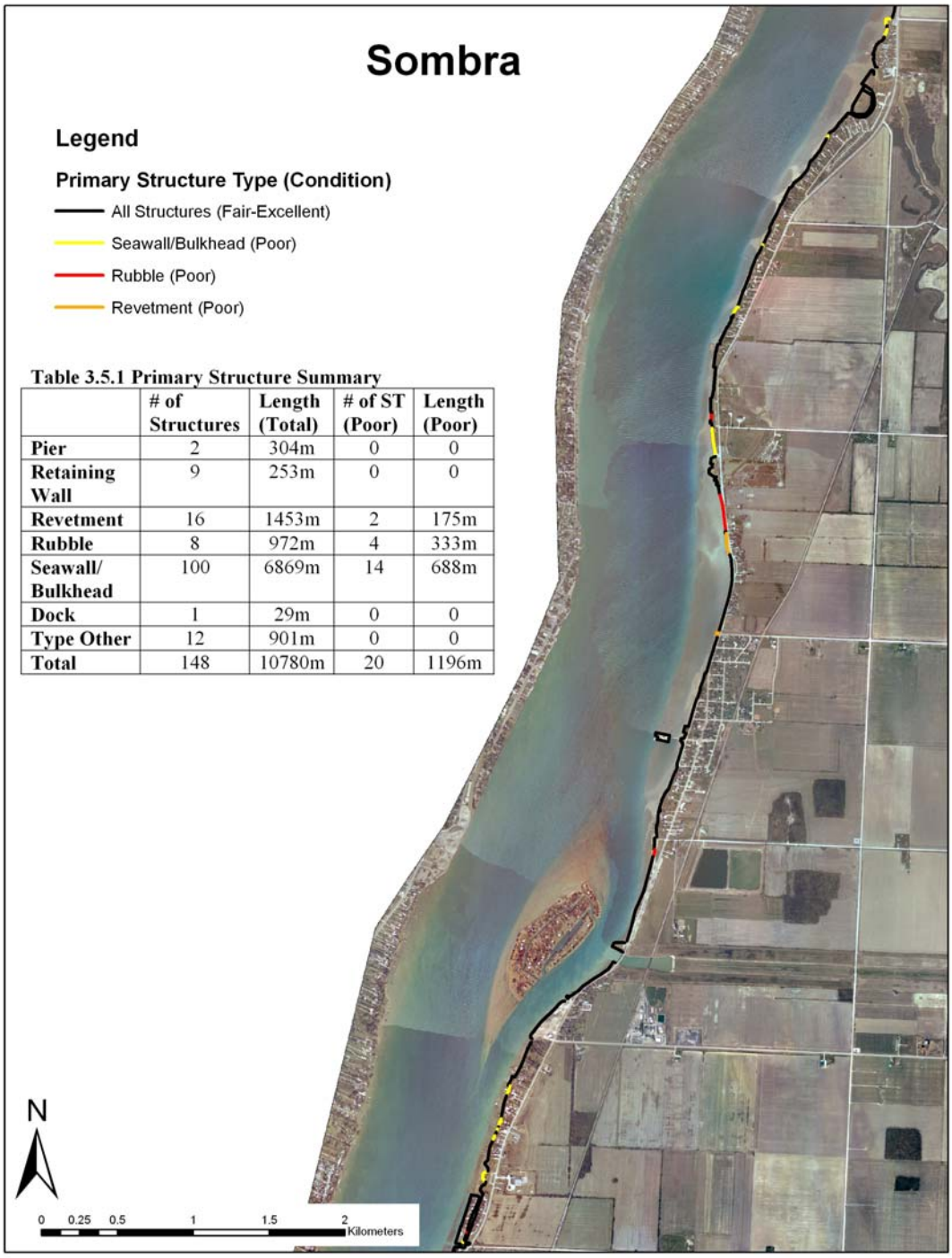


Table 3.5.1 Primary Structure Summary

	# of Structures	Length (Total)	# of ST (Poor)	Length (Poor)
Pier	2	304m	0	0
Retaining Wall	9	253m	0	0
Revetment	16	1453m	2	175m
Rubble	8	972m	4	333m
Seawall/ Bulkhead	100	6869m	14	688m
Dock	1	29m	0	0
Type Other	12	901m	0	0
Total	148	10780m	20	1196m

3.5.1 Overview

Section 5 begins at the road allowance at Stanley Line just north of Sombra to the road allowance at French Line south of the McKeough Floodway. This area covers 10.7 kilometres of shoreline and contains 148 structures. Within this section, there is only one community, but we see a great deal of residential and commercial use of the shoreline.

3.5.2 Historical

Presently this section is over 75% residential. While comparing the aerial photography from 1955, 1972, 1992 and 2003, there are noticeable shoreline alterations which have occurred over this time span. There are seven areas of visible changes along the river in this timeframe.

The area between Stanley Line and Wilkesport Line is the first area of major development in this fifty year span. In 1955, this area shows houses scattered from road to road. By 2003, this section has houses infilling to capacity. In reviewing the 1992 photography, it can be noted that a great deal of trees previously seen in photos were removed and shoreline hardening becomes evident. Most of the houses along the St. Clair Gardens have been built since 1955.

Photo 3.5.1 – Cathcart Park, Sombra, 2007.

Cathcart Park just north of St. Clair Gardens has also been developed since 1955. At that time there were no campgrounds or trails in the area. By 1972, there is evidence of shoreline straightening and more trails are identified. By 1992 the campgrounds are defined and the majority of the trees are removed from the park. The adjacent photo is taken facing east (looking inland) and exemplifies a loss of trees and shows the complete hardening of the park.

The 1955 air photo of Fawn Island shows the area to be covered with trees and virtually undeveloped. By 1972, the waterways are created and development has been on-going.

The McKeough Floodway was created in 1984 and therefore only present on the 1992 and 2003 air photos, however, a drain can be seen in the previous photos where the floodway is today. Another area of recent development is the gravel yard north of Holt

Line. This development was noticed in the 1972 photos but had expanded to its present day size by 1992.

The residential section between Holt Line and French Line has been developed slightly in the fifty year timeframe; however, the most notable difference is the decline in trees along the shoreline. As the trees decreased, more evidence of shoreline hardening was noticed.

The final major shoreline modification is the creation of the island north of French Line. In 1955 the area now occupied by a small island was a shallow beach area along the St. Clair Parkway. By 1972, this area was filled and zoned for development. Two roads, one along the Parkway, Leeland Drive, and one on the island, Seaway Road were created. At this time houses were only built along Leeland Drive, but lots were created for future development on Seaway Road. By 1992 all the lots on both roads were developed.

3.5.3 Current Analysis

While looking at Table 3.5.1, it is evident that the majority of the shoreline protection is a bulkhead structure. This indicates that 64 percent of the shoreline is hardened. The amount of bulkhead used in this section is due to the location of the St. Clair Parkway and the location of the numerous houses along the river. Bulkheading is frequently used to ensure the maximum amount of property protection. In areas where houses are less then 30 meters from shore, protection is crucial to keep soil movement from disrupting the structural integrity of the houses.

Based on Figure 3.5.2, it is evident that the majority of the steel walls are in good to fair condition and may not need to be replaced in the near future. The ones in poor to fair condition are often restored and maintained by tightening the tighbacks. Although it would be ideal to remove as much steel wall from the shoreline, it is not always possible or the best solution depending on the existing development.

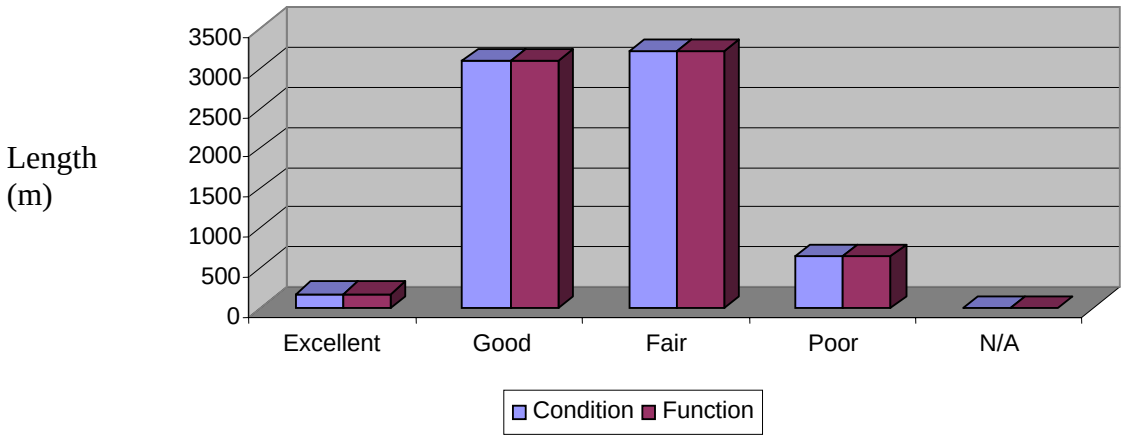


Figure 3.5.2 - Condition, Function and Distribution of steel shoreline protection structures in Sombra and the surrounding area, 2007.

The condition and function of concrete structures differs greatly from the steel structures. For the most part, the concrete structures are either in fair or poor condition and may need to be replaced. The percentage of concrete structures is 18% whereas steel structures take up 66% of the total Sombra area. When looking at the map of the Sombra area, it is evident that the amount of bulkhead in need of repair outweighs the poor conditioned rubble or revetment. It is positive to note that out of the 10.7 kilometres of this area; only 12.8% (1195m) is in poor condition and in need of repair. Despite the low number of poor structures, only 1.7% (181.9m) of the Sombra shoreline is in excellent condition and all of that is steel sheet pile wall.

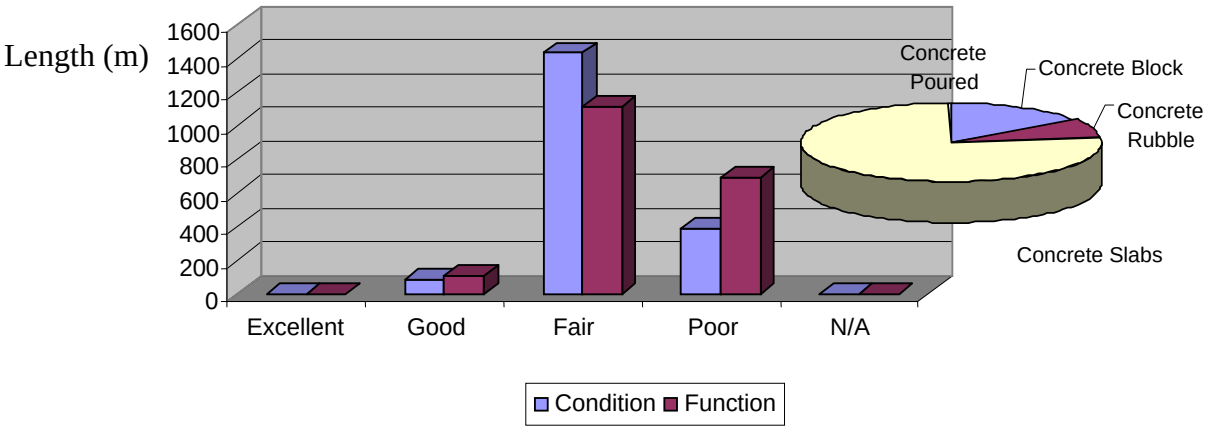


Figure 3.5.3 - Condition, Function and Distribution of concrete shoreline protection structures in Sombra and the surrounding area, 2007.

Table 3.5.2 outlines the condition of the shoreline in Sombra and the surrounding area. The bulk of the collected data was recorded to be in good and fair condition and may not need as much repair on the whole, as other sections of the river.

Table 3.5.2 – Overall condition of the shoreline protection in Sombra, 2007.

	Condition of Shoreline Protection		
	# of Structures	% of Shoreline	Length
Excellent	6	1.69	181.9
Good	60	32.80	3528.2
Fair	50	44.64	4973.6
Poor	19	12.84	1195.9
Not Applicable	13	8.04	900.5

Of the 1195.9 meters of poor conditioned shoreline, 483.6 meters have limited opportunity for improvement, while only 153 meters have the ideal distance (Table 5.5.3). Working with the 559.3 meters of shoreline is possible, but will require detailed plans and drawings of the proposed construction.

Table 3.5.3 - Distance from shoreline to nearest on-shore structures.

Distance to Shore	Meters in Length
1-10m	483.6
10-50m	559.3
>50m	153

3.5.4 Future Opportunities

Already there are property owners in this section who are planning restoration projects within the next few years to improve habitat and water quality. Some other areas of potential restoration can be located north of Sombra and between French Line and Holt Line.

Photo 3.5.2 shows an area of concrete slab randomly placed along the shoreline. Beneath the concrete are large holes indicating erosion. Due to the gaps in the concrete and the absence of filter cloth behind the structure, the soil is easily eroded away. To repair this shoreline, a possibility would be to replace the concrete slabs with rip rap stone and slope the revetment slightly to decrease the potential wave energy against the shoreline. Before any rip rap stone would be laid, a filter cloth would be used to decrease any possible erosion.

Photo 3.5.2 – ST0359, Sombra, 2007.

Photo 3.5.3 is a bulkhead made from plywood and timber pilings. The wall is vertical, however, due to its composition; it may not remain this way. Due to the water level, the property owner will begin to notice the wall erode and begin to fail. Due to the distance between the house and the shoreline it may be impossible to replace the current protection with the rip rap revetment that SCRCA is encouraging.

Photo 3.5.3 – ST0314, Sombra, 2007.

Some possible solutions would be to install a steel sheet piling wall similar to its neighbours or replace the wood with stepped gabion baskets or stepped armour stone and install a toe of rip rap to provide fish and benthic habitat with any of the protection they choose.

The three photos of the steel sheet piling walls all show a common problem associated with this type of protection. The crack shown will permit soil loss which will in turn decrease the stability of the adjacent sheets of steel. The white rock/brick in the photo indicates that the property owner has noticed erosion and has done what he/she can do to prevent any more loss. The replacement of the soil can become costly if repairs are not done to the wall. In this case, the wall could either be replaced by a new steel wall or repaired. This would also be a beneficial area to remove and replace with an armour stone revetment depending on the distance between the shoreline and the nearest structure.

Photo 3.5.4 - ST0416, Sombra, 2007.

Photo 3.5.5 shows a wall that is clearly undermined. Because the water level has decreased there is minimal force against the wall maintaining its vertical alignment. The soil behind the wall has slumped and has pushed out the bottom of the wall. In order to prevent this, there must be equal pressure against both sides of the wall. These pressures can be in the form of toe protection or higher water levels.

Photo 3.5.5 – ST0338, Sombra, 2007.

Photo 3.5.6 shows a wall that is in ruins and in desperate need of repair. The problems associated with this property are due to age of the wall and lack of equilibrium on either side of the structure. This wall is ideal for habitat restoration. On one side of the property is a natural shoreline and the other is a steel sheet piling wall unattached to this one.

Photo 3.5.6 – ST0301, Sombra, 2007.

Section 6

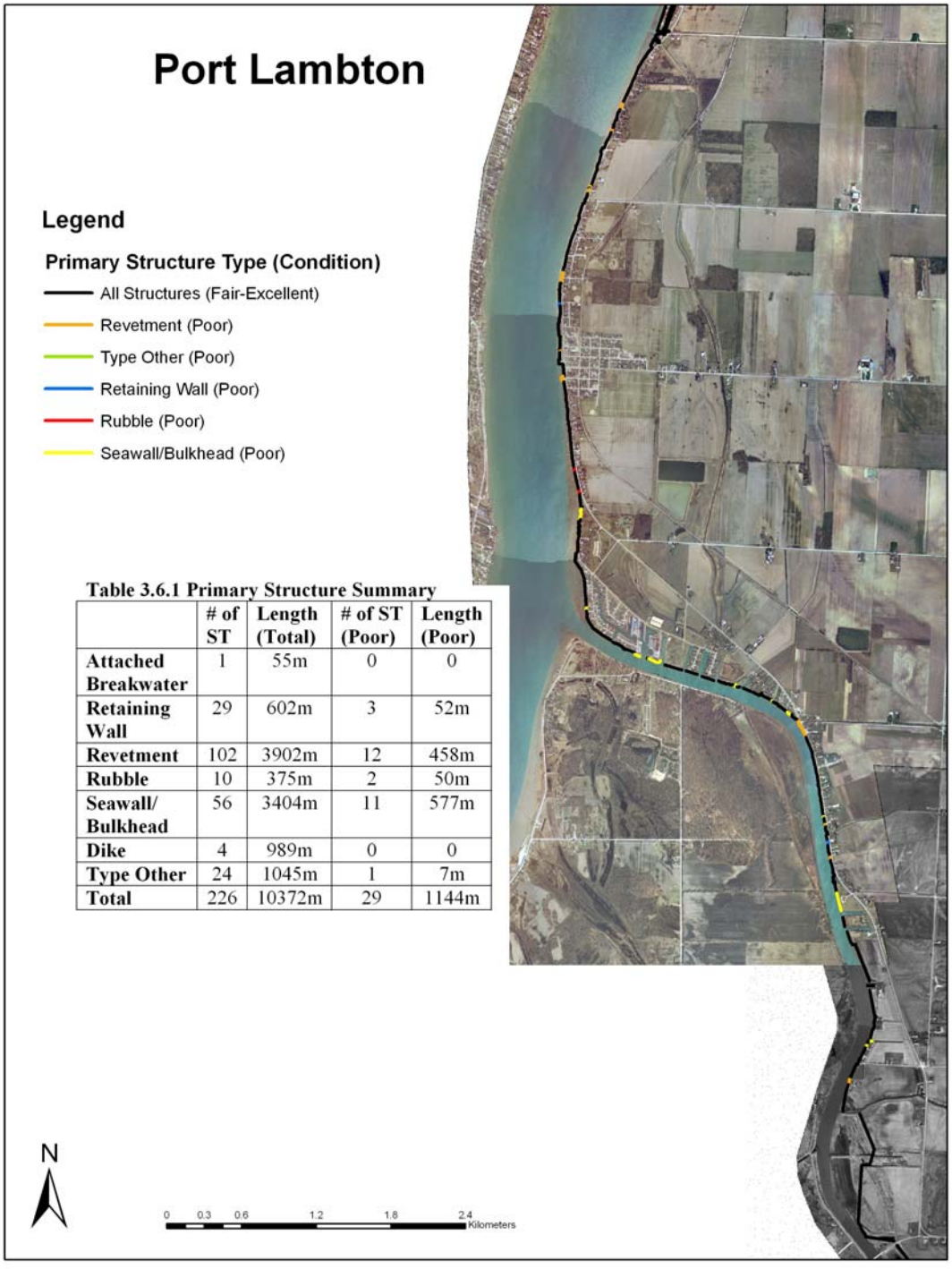


Table 3.6.1 Primary Structure Summary

	# of ST	Length (Total)	# of ST (Poor)	Length (Poor)
Attached Breakwater	1	55m	0	0
Retaining Wall	29	602m	3	52m
Revetment	102	3902m	12	458m
Rubble	10	375m	2	50m
Seawall/ Bulkhead	56	3404m	11	577m
Dike	4	989m	0	0
Type Other	24	1045m	1	7m
Total	226	10372m	29	1144m

Overview

Section 6 covers the areas of Port Lambton and the shoreline outside of Wallaceburg from French Line to Dufferin Line. Within this section there are 226 structures covering 10.8 kilometres of shoreline. The survey follows Chanel Ecarte south to Mitchell's Bay rather then following the St. Clair River through Walpole Island. The majority of this section is residential and is in good to fair condition.

Historical

After reviewing the aerial photography from 1955, 1972, 1992, and 2003 there is no change observed along the St. Clair River shoreline, however, the Chanel Ecarte has seen a great deal of shoreline modifications in the past fifty years.

In 1955, there were many areas of natural pasture lands or marshy areas that have been converted to residential homes. This development has caused many wetland and marshy areas to be filled. The area between Stewart Line and Dufferin Road is key area, as well as the corner where Chanel Ecart meets the St. Clair River. The first area between Stewart and Dufferin is a marshy area that turned to agriculture which later was separated into areas distinctly wetland or pasture. By 1972, the second area (photo 3.6.1), had been zoned for development. Cuts were made in the shoreline and steel wall was installed. There was some noticeable development in 1972, but by 1992 a great deal of this area was developed for both residential and commercial purposes.

Photo 3.6.1 – Corner of St. Clair River and Chanel Ecart, Port Lambton, 2003.

In many areas there are cuts of the shoreline removed. The purpose of these cuts is to provide recreational access to a greater number of properties or is a result of cut and fills. Many of the areas established along the shoreline are built on fill and would be protected by steel sheet piling or a rip rap revetment. This fill would be taken from areas along the shoreline that created these cuts. Areas where this type of change is noticed, and mostly between 1955 and 1972, are at the corner of the river and the chanel, above Whitebread Line and below Langstaff Line.

Bishop Road near Stewart Line is the area that has seen the most development. This development was most notable from 1955 to 1972 with less development between 1972 and 1992.

Current Analysis

As mentioned previously, the Port Lambton section of this report covers a section of the St. Clair River and the Chanel Ecarte. These areas differ in the history and usage, but the shoreline protection is very similar in composition. The graph below shows the differences between the two sections.

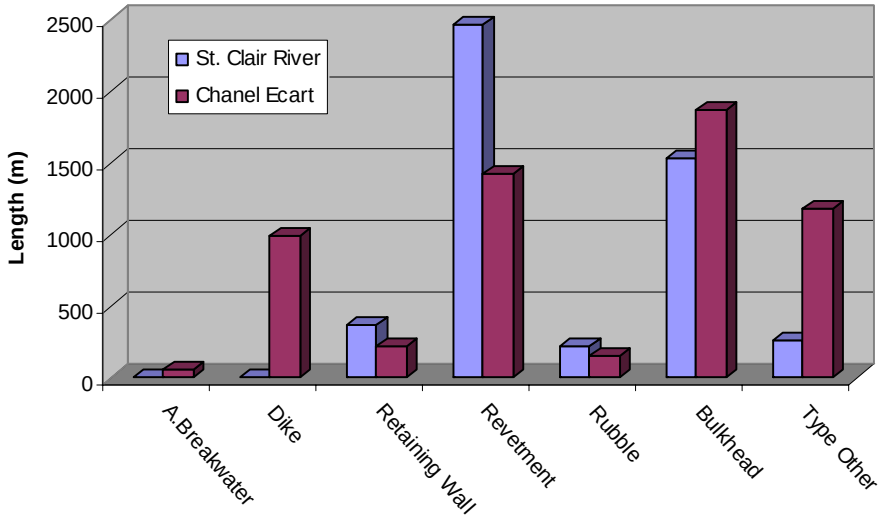


Figure 3.6.1 – Composition of shoreline structures in Port Lambton separated by the river and channel.

This section consists of 226 structures covering 10.8km of shoreline. Only 1% of this reach is in excellent condition while only 10% is in poor condition. The greatest percentages are in good and fair condition.

Based on the following three graphs the majority of the structures are in good to fair condition and it appears there are few structures that will need to be replaced. The function is worse for both the stone and concrete structures due to age and improper installation. A great deal of the development since 1955 has created steel sheet pile walls and the stone and concrete used may predate this time.

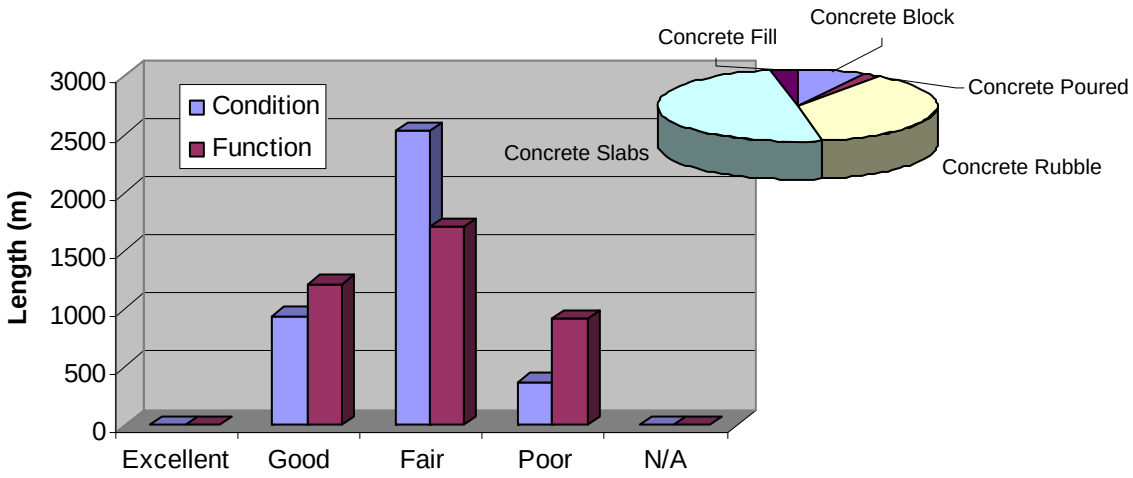


Figure 3.6.2 – Condition, function and composition of concrete protection structures in Port Lambton and the surrounding area, 2007.

The areas of poor conditioned walls are sparse. While looking at the photo of the section, there are only scattered areas of possible restoration with the greatest length being 136m of continuous restoration possibilities. Only 10.6 % (1143.6 meters) is rated poor. Of that, 4.3 % (462.9 meters) are found in the St. Clair River half and 6.3% (680.7) are found in the Chanel Ecarte half.

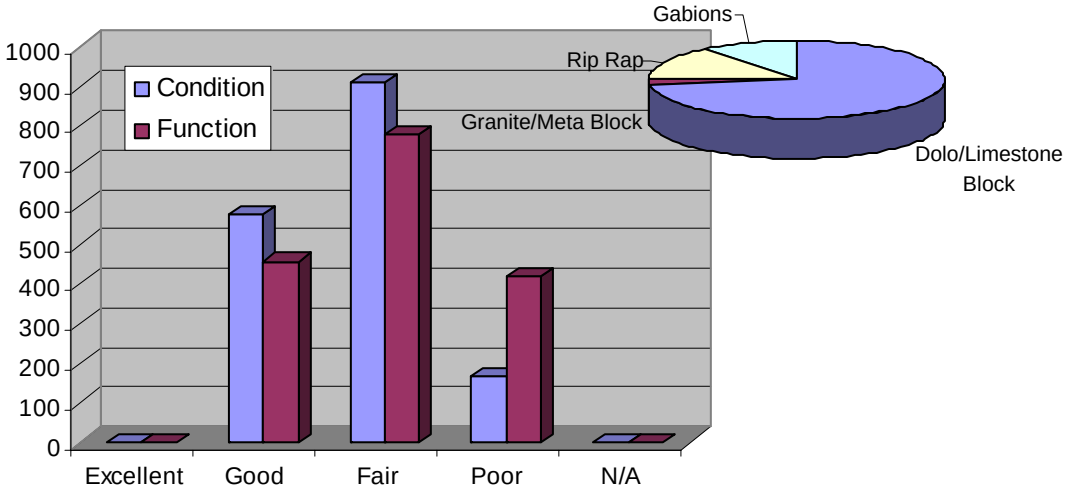


Figure 3.6.3 – Condition, function and composition of stone structures in Port Lambton and the surrounding area, 2007.

Comparing these three composition types, we can see that the majority of concrete structures are in fair condition. When concrete is used, it is most often used as a last resort to prevent any further erosion. Concrete is used very similar to stone revetments; a major difference is the use of a design and the installation method. The stone structures are in better condition than the concrete structures, but in worse condition than the steel sheet piling, which we see as having a greater length in good condition than stone and concrete combined.

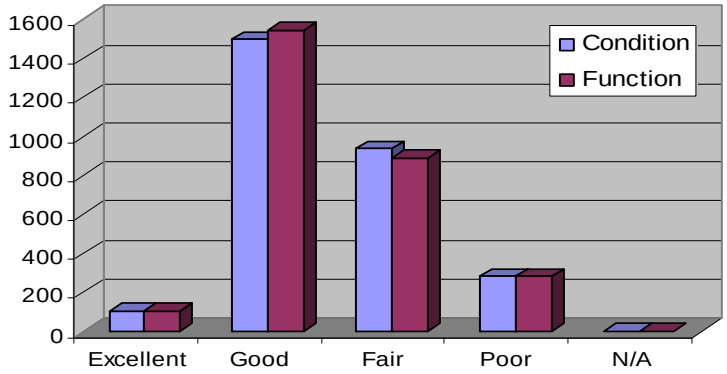


Figure 3.6.4 – Condition and function of the Steel Sheet Pile walls in Port Lambton and the surrounding area, 2007.

Future Opportunities

The future opportunities are limited in this section due to the type of structures and the length of possible restoration. The steel sheet pile walls are relatively new and the sloping and disarticulating issues that are commonly associated with this type of wall are not as prevalent as they may be in other areas along the river.

Photo 3.6.2 – ST0592, Port Lambton, 2007.

The steel sheet pile wall in photo 3.6.2 is in need of repair due to the rusted areas shown here. This is caused by fluctuating water levels causing oxidation to occur and weakening the steel. This type of problem is uncommon in most steel walls because water levels fluctuate less than the water levels do in this area, meaning that the wall is either consistently above the water or below. This wall will see a great deal of soil loss and may fail if not repaired.

A possible solution is to replace the wall with another steel wall or remove it and replace it with a revetment. The Chanel Ecarte is shallow enough to sustain a rip rap revetment and not used as industrially as the St. Clair river allowing for a longer lifespan of the revetment.

Other areas of possible restoration include two wooden cribs, one found in MacDonald Park along the Chanel Ecarte and another in Port Lambton across from Moore Street. Both photos indicate a great loss of soil. Photo 3.6.3 shows a concrete slab protection behind the timber piles attempting to prevent property loss.

Photo 3.6.3 – ST0531, Port Lambton, 2007.

The area in Port Lambton should be repaired as soon as possible to maintain property and control erosion and enhance aesthetic and recreational uses of the site. Due to the distance between the shoreline and roadway, a beneficial revetment can be installed with the appropriate slope.

The shoreline of MacDonald Park has been renovated since our visit. The works included installing gabion baskets to replace the ruins of timber wall. The stacks of gabions baskets will create a wall limiting the soil loss and provide stone creating benthic and fish habitat. MacDonald Park is a public park and will provide a good example of restoration opportunities along the river system.

Photo 3.6.4 – ST0648, McDonald Park, Port Lambton, 2007.

Section 7

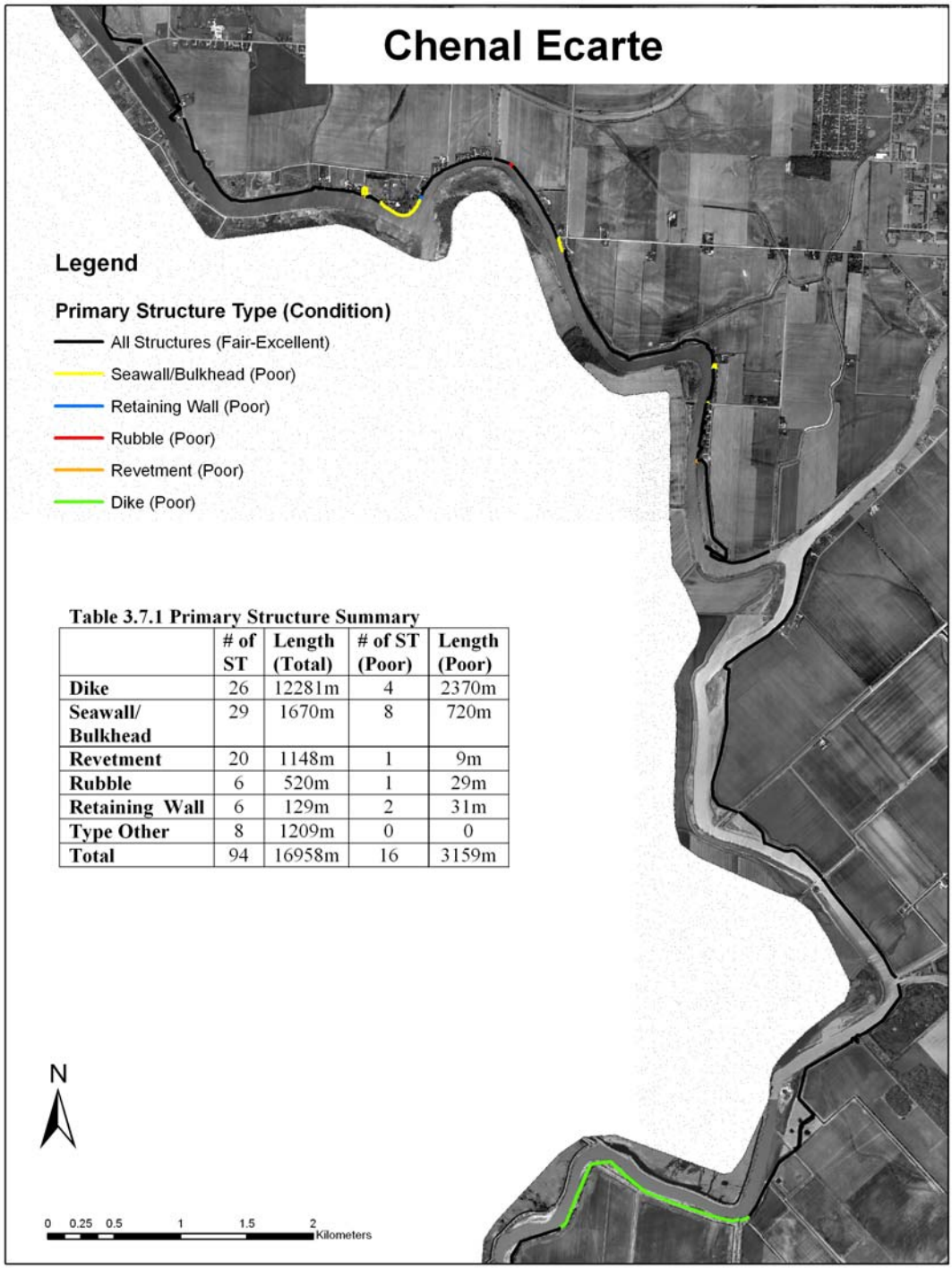


Table 3.7.1 Primary Structure Summary

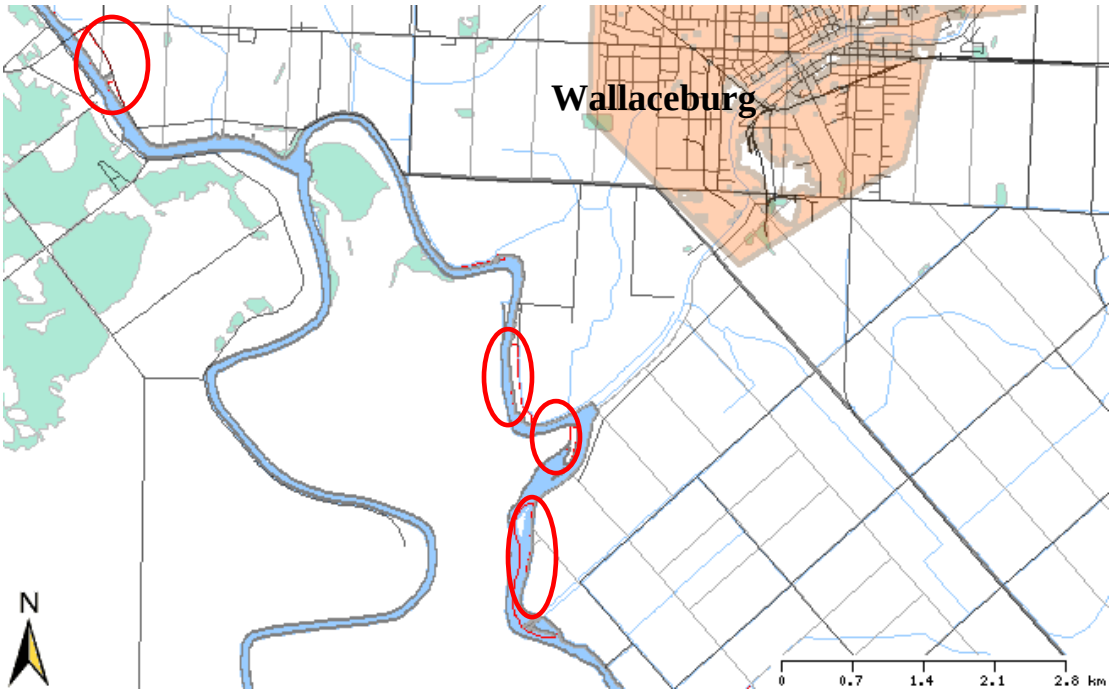
	# of ST	Length (Total)	# of ST (Poor)	Length (Poor)
Dike	26	12281m	4	2370m
Seawall/ Bulkhead	29	1670m	8	720m
Revetment	20	1148m	1	9m
Rubble	6	520m	1	29m
Retaining Wall	6	129m	2	31m
Type Other	8	1209m	0	0
Total	94	16958m	16	3159m

Overview

Section 7 starts just South of Port Lambton and ends as the Chenal Ecarte reaches Lake St. Clair. It is mainly agricultural fields and wetlands that surround this watercourse with a few scattered residential developments. Much of this shoreline runs parallel to the east side of Walpole Island or St. Anne's Island. Adjacent wetland areas are popular for breeding populations of waterfowl and wading birds and have been designated as Environmentally Sensitive. It is also habitat for threatened and endangered mussel and fish species.

Historical

Upon reviewing aerial photographs, the most visible changes in the past 30 to 50 years are the wetlands. Many of the marshy areas, at one time, were protected by dike systems built to protect valuable farmland. These dikes stopped erosion and allowed these wetland areas to retain moisture. Throughout the years, these dikes have gradually eroded away due to flooding and wave action derived from boats and wind, leaving the wetlands vulnerable. The map below indicates wetland areas that have changed significantly in the past few decades.



This loss of wetland habitat has resulted in a significant decrease in specific fish and mussel populations. Now, the following species are listed as endangered or threatened in this area.

Fish Species at Risk

Species	Status
Channel Darter	Threatened
Eastern Sand Darter	Threatened
Lake Chubsucker	Threatened
Northern Madtom	Endangered
Pugnose Shiner	Endangered

Mussel Species at Risk

Species	Status
Mapleleaf	Threatened
Rainbow	Endangered

Structure ST0675 is located directly south of the bridge that connects Walpole Island with the main land and is a perfect example how these wetlands have changed over the last fifty years. Before the bridge was built, this wetland area was protected by a dike measuring a distance of approximately 800 metres. By the 1970's, the dike was undermined and the wetland area behind it showed signs of becoming drier. Presently there are only remnants of the dike and the wetland has been taken over by a field of phragmites.

Left: Side view of ST0675

Below: View of wetland from shoreline

The bank of the Chenal Ecarte has seen very little change in residential growth in the past 30 years. Bluewater Line, Wren Line and Island View still remain the most populated areas with only a few new developments over the years.

Current Analysis

Section 7 is comprised of 94 structures and is dominated by dike systems covering 12.3 km in this 17 km stretch.

The majority of these dikes border agricultural fields and drains, and as shown in Figure 3.7.1, 9000 m have a natural vegetated slope as protection. Concrete was the second most popular form of shoreline protection and stone was a distant third. (Figure1).

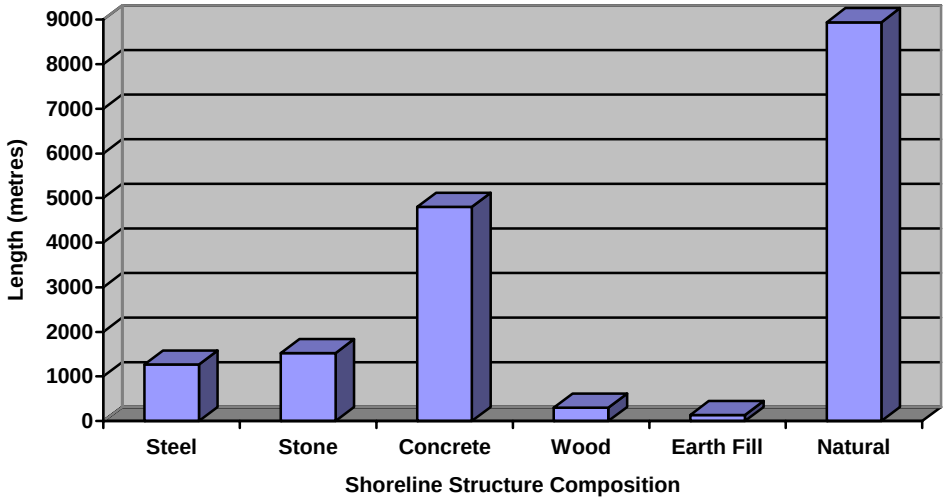


Figure 3.7.1 Composition of Shoreline Structures

When the dikes were located by residential properties and along roadways, additional protection would be in place, in the form of bulkheads and revetments.

Photograph of Bluewater Line, where the road has been built on top of the dike.

The houses, roads and other on-shore structures were also frequently closer to the water in these areas with distances as close as 1 metre. This would make enhancing shoreline protection in this area difficult with very little room to work with.

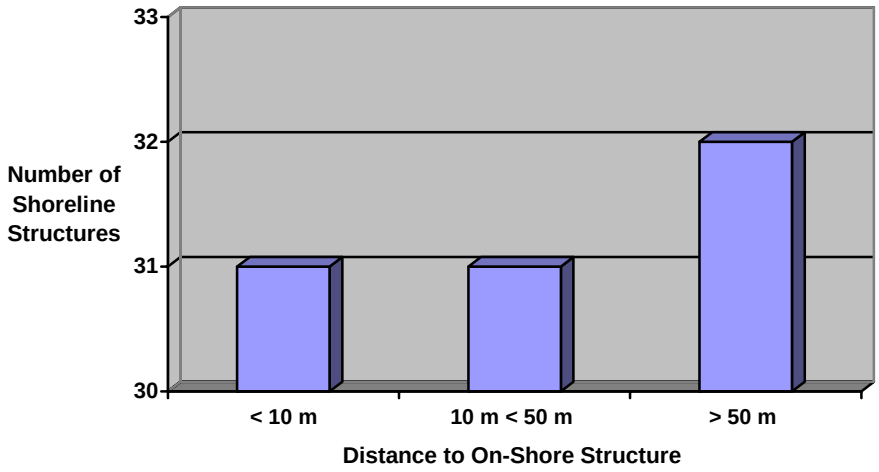


Figure 3.7.2 Distance to Closest On-Shore Structure

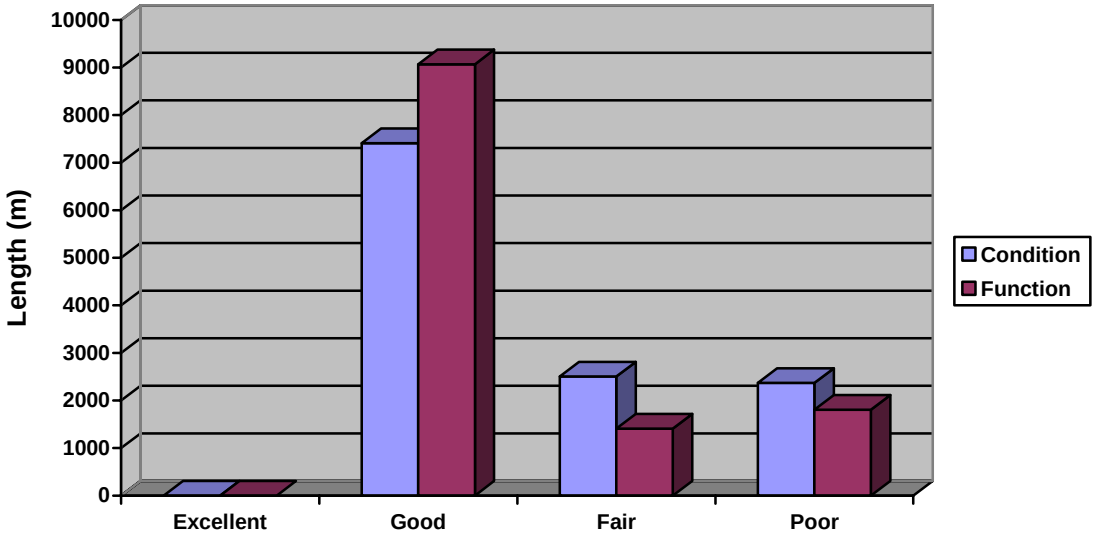


Figure 3.7.3 Condition and Function of Dike Structures

60 % of the dikes were found to be in good condition and 74% were functioning well. There was only 2.37 km of dike in poor condition as a result of bank erosion, hazard trees, and rodent burrows.

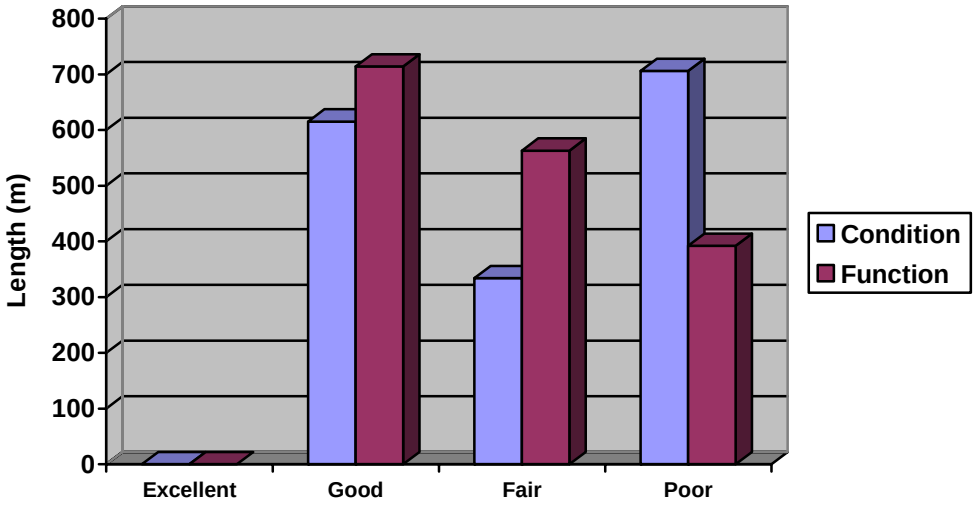


Figure 3.7.3 Condition and Function of Bulkheads/Seawalls

Bulkheads and seawalls cover 1.67 km of this reach which is about 9 %. Over 700 metres of the bulkheads in this section are in poor condition (42%) and 400 m are functioning poorly.

Revetments covered approximately 1.15 km of this shoreline and 99% were in good to fair condition.

Future Opportunities

Being an area with endangered and threatened species, any opportunity to enhance shoreline habitat of the Chenal Ecarte should be considered.

There may be opportunities to rehabilitate the poorest areas, where the old timber piling shoreline protection is in ruins and there is ample space to introduce a soft shore revetment.

ST0738 Chenal Ecarte, 2007

Other sites include a site where a landowner has a combination of failing structures. The first section has an old concrete slab wall that is beginning to crumble, followed by a flanked timber piling bulkhead. The property ends with a concrete wall in ruins with most of the shoreline exposed and eroding. This property has limited space with an average of 10-12 m to the nearest on-shore structure

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ST0726 Bluewater Line, 2007

ST0724 Bluewater Line,2007

ST0725 Bluewater Line, 2007

Section 8

Table 3.8.1 Primary Structure Summary

	# of ST	Length (Total)	# of ST (Poor)	Length (Poor)
Seawall/ Bulkhead	34	5081.2	4	448
Retaining Wall	2	937	0	0
Dike	17	11845	0	0
Groin	1	34	0	0
Revetment	8	2598	1	117
Rubble	1	1405	0	0
Pier	1	121	0	0
Type Other	3	149	2	102
Total	67	22170	7	667

Overview

Section 8 begins at Mud Creek Line and continues until the end of the St. Clair Region Conservation Authority's watershed boundary north of Marsh Line. At Mud Creek Line, the Chenal Ecarte empties into Lake St. Clair. Similar to Section 7, agriculture is the main land-use with much of the shoreline consisting of dikes bordering agricultural fields and drains. There is however more residential development in this area. Mitchell's Bay is a small community of 350 year-round residents. This shoreline community is a popular destination for outdoor enthusiasts with great camp grounds and excellent fishing. Wetlands in this area are popular for breeding populations of waterfowl and wading birds. It is also habitat for threatened and endangered mussel and fish species.

Historical

Very little change in land-use has occurred in the Northeast corner of Lake St. Clair. Most of the dikes are still in place, except one area where a new dike has been built further inland and the outer dike has disappeared.

Upon reviewing aerial photographs, the most visible changes of this section occur in Mitchell's Bay. Since the 1950's this area has expanded significantly to accommodate tourism. Campgrounds, numerous seasonal cottages, and a marina are the main commercial shoreline additions. Numerous homes have been built and even more continue to be built along this shoreline which is encroaching on wetland areas. Additional dikes have been constructed along the campgrounds and the new subdivisions to protect from flooding events. Further south, the same dikes are still present and are in good condition.

This loss of wetland habitat has resulted in a significant decrease in mussel populations. Now, the following species are listed as endangered in this area.

Table 1 Mussel Species at Risk in Section 8

Species	Status
Kidney Shell	Endangered
Northern Riffleshell	Endangered
Rayed Bean	Endangered
Round Hickory Nut	Endangered
Round Pigtoe	Endangered
Salamander Mussel	Endangered
Snuffbox	Endangered
Wavyrayed Lampmussel	Endangered

Taken from the DFO Referral Review Tool for Projects Affecting Aquatic Species at Risk.

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Current Analysis

There are 64 primary structures in Section 8, which measure a length of 15.1 km. Over 75% of this section of shore protection is a series of dike systems.
The majority off these dikes border agricultural fields and drains and over 7864 m have a natural vegetated slope as protection. When the dikes were located by residential properties additional protection was found to be in place, in the form of bulkheads and revetments.

Bulkheads and Seawalls compose a little over 12 % of the shoreline protection and covered 1.7 km of this section. There were 378 metres of shoreline with revetments and only 140 m of rubble structures.

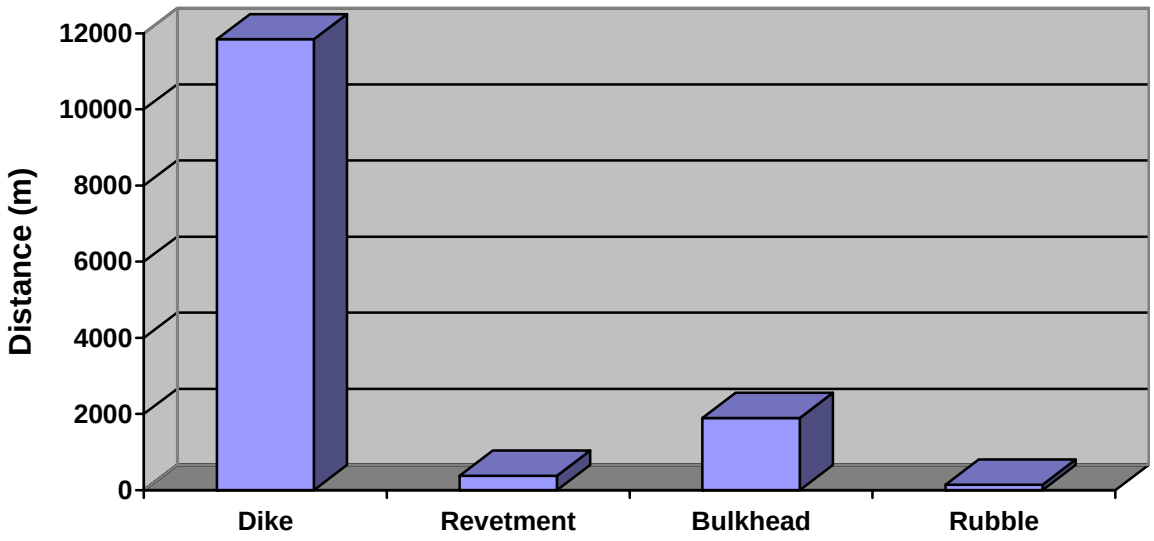

Figure 3.8.1 Distribution of Erosion Control Structures in Section 8.

Figure 2 shows the distance from the shoreline structure to the nearest on-shore structure. Close to 25 % of structures have an onshore structure that is less than 10 metres away from the shore protection. Being so close to the shore, it decreases the options available to repair existing protection or constructing a new structure.

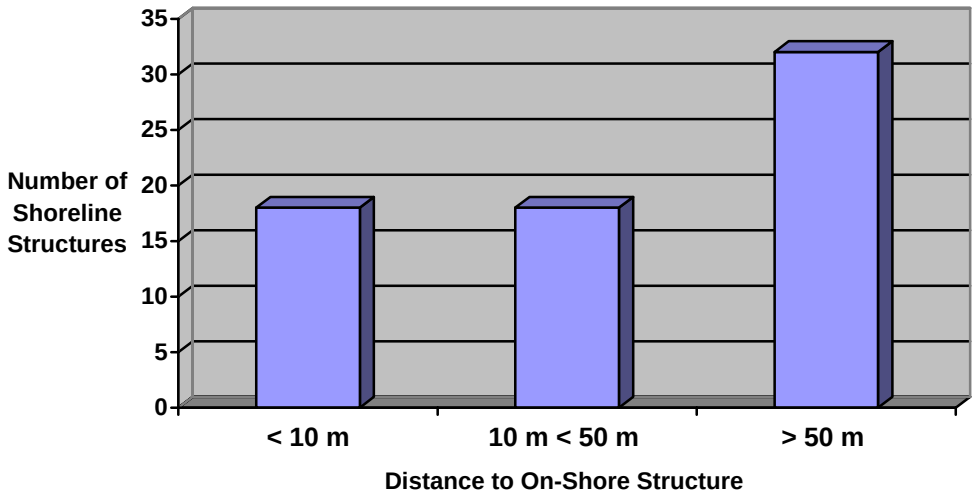

Figure 3.8.2 Distances to Closest On-Shore Structure

View of a dike that is also functioning as a road. The stone revetment has been placed for added protection.

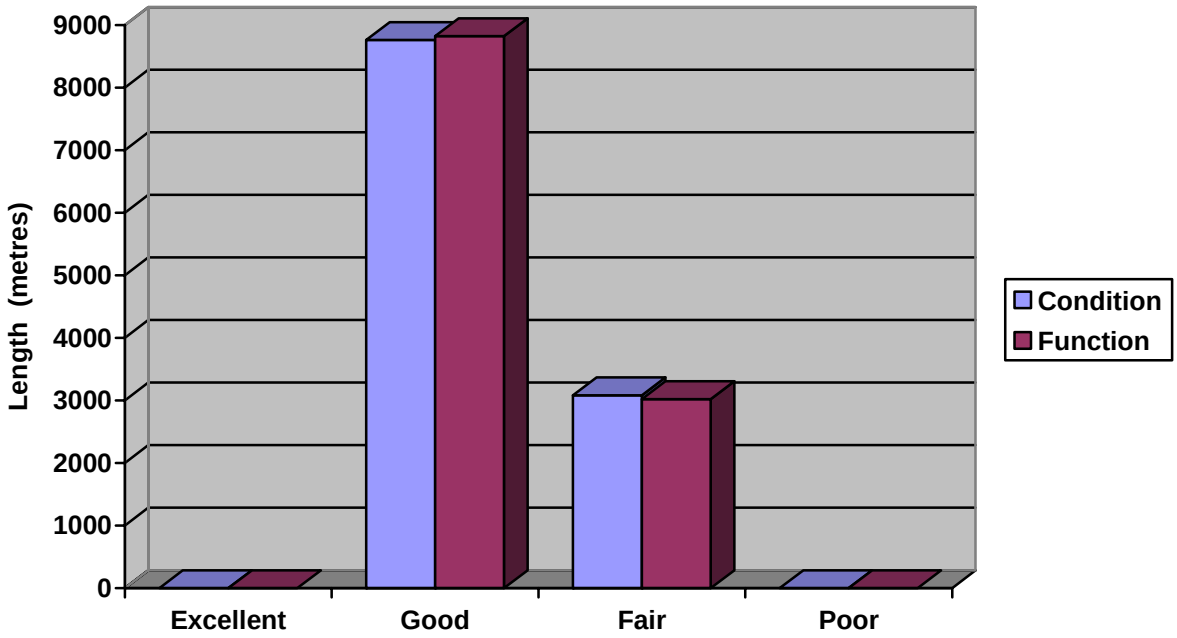

Figure 3.8.3 Condition and Function of Dikes

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The majority (75%) of these dikes were in good condition and were functioning well.

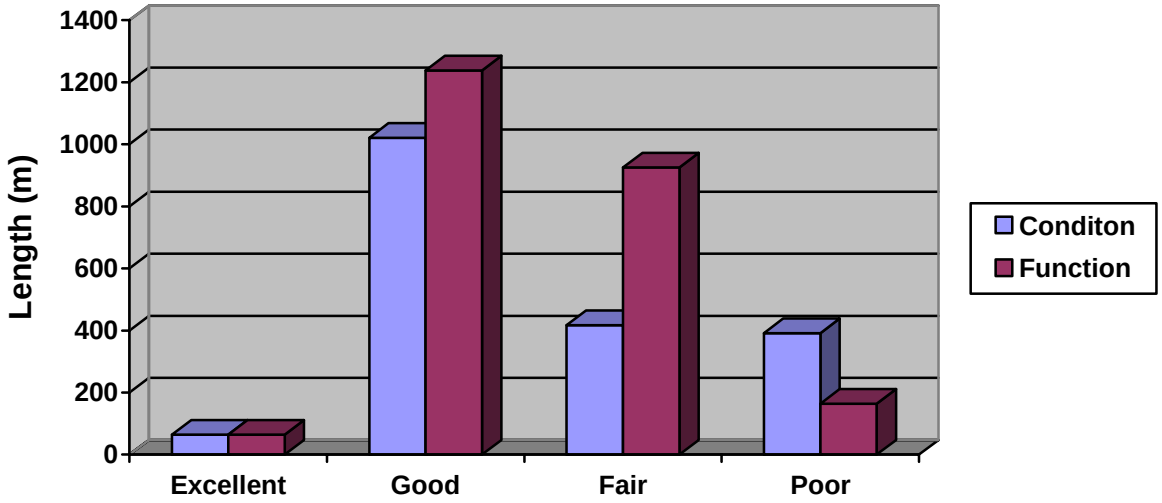

Figure 3.8.4 Condition and Function of Bulkheads and Seawalls

Bulkheads/Seawalls were in good condition and functioning well in this section with 80 % being categorized from Excellent to Fair condition. Revetments represented a small area in section 8 with only 593 m.

Future Opportunities

Since this area has several endangered mussel species, any opportunity to enhance shoreline habitat along Section 8 should be considered.

Two parks in particular that are located close to the Marina and Wharf would be excellent candidates for shoreline rehabilitation. In both areas, the shoreline protection that is in place is failing. and as a result valuable parkland is being lost. Restoring these areas would stabilize the shoreline as well as making it more aesthetically pleasing.

ST00775, Marine Park 2007

Erosion along dike and flanked steel walls at Marine Park

ST0778, Marine Park 2007

Park located next to Mitchell's Bay Wharf has very little protection in place and substantial soil is being lost.

ST0793, Mitchell's Bay 2007

ST0794, Mitchell's Bay 2007

4.0 Conclusions

With the completed assessment of the St. Clair River shoreline, the SCRCA has prepared an extensive GIS database and included supporting documentation that enables resource managers to target potential key areas for restoration and enhancement. This database can be used as a base layer for the collection of more comprehensive fisheries and aquatic data. This would provide the SCRCA and St. Clair River AOC partners with a tool valuable to assess and analyze the St. Clair River AOC now and in the future.

With regard to erosion protection, bulkheads composed of steel sheet piling (33%) and revetments of various compositions (21%) are the most common structures along the St. Clair River shoreline. Dominant materials used for revetment construction are concrete scraps such as rubble or large slabs, as well as, armour stone in the form of rip rap or large dolomite/limestone blocks. Dikes, which make up 33% of the total length are all found in the southern reach from Port Lambton to Mitchell's Bay and rarely have protected banks in the form of stone, concrete or steel. With slightly over 50% of all structures in poor-fair condition the possibilities for restoration and enhancement over the next 5-15 years is quite extensive.

With the emphasis being placed on the removal of steel sheet pile walls, other areas have been identified that if corrected could make gains towards the de-listing of the St. Clair River AOC. These restoration possibilities are in the form of a variety of materials from wooden piling to concrete slabs. Both types of protection have negative impacts on water quality and shoreline habitat. Steel sheet piling has been found to disrupt the wave action and current direction which results in sediment scouring, erosion and lost shoreline habitat (Edsall, T., 1996). Concrete revetments or "bluff dumps" are continuously in need of added material and the suspended solids during dumping and altered circulation patterns have negative affects on the local habitat and water quality (DOTA, 1995). The proposed armour stone revetments would dissipate wave energy, reduce wave reflection, as well as, provide more diverse and stable habitat fish and aquatic organisms (DOTA, 1995).

The next step in the delisting process is to create demonstration sites for the residential communities and nearby industry. The Point Edward erosion protection project completed in 2007 displays the concept of soft shore engineering and provides an example to the public of alternative shore protection. Another demonstration project planned for 2007 is Guthrie Park, an area just north of Corunna that is experiencing a erosion due to failing steel sheet pile wall shore protection. Guthrie Park is an excellent site for restoration due to its condition and public accessibility. The Corunna area is the single largest zone of residential steel sheet pile wall and provides the greatest opportunity for enhancement and restoration. As more landowners are exposed to the benefits of alternative shoreline protection, they may be more inclined to replace their failing bulkheads with more environmentally friendly protection.

To encourage landowners interested in shoreline restoration, the SCRCA is developing a program to provide funding incentives for up to 50% of the total cost of restoring their shoreline. These funds are to encourage the removal of bulkheads and hardened shoreline with soft shore engineering. For more information on potential projects or funding requirements please contact Brian McDougall at SCRCA.

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Glossary of Terms

Erosion - The gradual wearing away or removal of land or sediment by wind, water, wave attack, and/or mass wasting processes.

Structure ID – The unique site/structure identifier. (eg: ST0368) = the 368th shore protection structure.

ST – When on its own this abbreviation stands for structure.

Structure Type (Primary or Secondary) – What design or type of structure is present

Revetment - A sloped structure of stone or concrete designed to protect a bluff or bank from erosion and wave attack. Usually oriented parallel to shore.

Rubble – Concrete or rock debris of varying sizes placed or dumped along the shore to provide protection. Broken concrete debris or slabs are dumped over the bluff edge as a form of expendable shore protection ("bluff dump"). Wave action may shift debris into an imbricate pattern that armors the beach face and toe of the bluff. Usually oriented parallel to shore.

Groin - A shore protection structure built (usually perpendicular to the shoreline) to trap sand and retard erosion of the shore. Structure is normally solid and is impermeable to water and sediment. Usually oriented perpendicular to shore.

Bulkhead - A vertical structure, usually made of concrete, steel or wood beams, designed to protect a bluff or bank from erosion and wave attack. Usually oriented parallel to shore.

Retaining Wall – A vertical structure, usually made of concrete, steel, rock, or wood beams, designed to resist the lateral pressure of the material behind it and to prevent the downslope movement of material on a slope. May serve to protect bluff or bank from erosion. Usually oriented parallel to shore.

Pier - A pier may constructed as part of a breakwater, groin, or other structure used to protect a harbor or shore, or may be an elevated structure on pilings designed to provide access to the water and/or a landing place for vessels. Usually oriented perpendicular to shore.

Dock - A dock is a wharf or pier, generally shorter than a pier and typically located in protected waters (i.e. behind a jetty or breakwater). May be oriented either parallel or perpendicular to shore.

Boat Ramp - A gently sloping hard surface used for launching boats from trailers. Usually oriented perpendicular to shore.

Outfall Structure – A structure or pipe designed to release or discharge water (or other fluids) into a body of water. May include small stream mouths or channels. Usually oriented perpendicular to shore.

Dike - A wall or mound built around a low-lying area to prevent flooding. May be oriented either parallel or perpendicular to shore.

Composition (Primary or Secondary) – What material the structure is composed of

Dolomite/Limestone Block - Cut or blasted blocks of dolomite and/or limestone, typically rectangular or angular in shape and individually placed.

Rip Rap – Cut or blasted rocks of dolomite and/or limestone typically less than 20cm in diameter.

Sandstone Block – Cut or blasted blocks of sandstone, typically rectangular or angular in shape and individually placed.

Granite/Metamorphic Block – Cut or blasted blocks of granite or metamorphic rock, typically rectangular or angular in shape and individually placed.

Concrete Block - Large poured concrete blocks that are placed in a regular pattern. May be notched, pinned, or cabled together.

Concrete Slabs - Cut slabs of concrete, roadway or sidewalk sections, typically associated with concrete rubble. May be placed or dumped to provide shore protection.

Concrete Rubble - Construction rubble and broken concrete debris placed or dumped, to provide shore protection.

Concrete Poured - Concrete poured into a form on site to control its shape.

Concrete Module - A module is a concrete structural component, a number of which when joined together create an integrated structure.

Concrete Cone and Wedge – Two-pieced form of interlocking pre-cast concrete modules for shore protection

Concrete Bags or Tubes - Bags and/or tubes filled with poured concrete.

Concrete Rings - Large diameter concrete pipe sections.

Concrete Slabs - Cut slabs of concrete; typically roadway sections or sidewalks.

Concrete Cubes - Cube shape form-poured concrete modules.

Steel Sheet Piling - Long, heavy sections of metal driven or jetted into the earth or seabed to serve as a support or protection.

Steel Piling – Cylinder poles driven into the earth or seabed to serve as support to protection or docks.

Steel Plate - Flat sheets of steel positioned to provide protection.

Steel Crib - A bin-type retaining wall consisting of interlocking steel used to stabilize slopes.

Gabions - Specially designed containers, cylinders, or boxes of corrosion-resistant wire used to hold coarse rock or concrete aggregate that may be used to form a groin, seawall, or bulkhead.

Timber Crib - A bin-type retaining wall consisting of interlocking wood used to stabilize slopes.

Timber Pilings - Long, heavy sections of wood driven or jetted into the earth or seabed to serve as support or protection.

Earthen Fill - Soil, sand, gravel, or rock typically placed behind an engineered structure and/or placed along the shore as an expendable form of shore protection.

Shape (Primary or Secondary)

Shore Parallel (||) – Structure runs parallel to the shoreline.

Shore Perpendicular (_|_) – Structure is perpendicular to the shoreline.

Segmented - An attribute of the structure where the structure has significant changes in composition, condition, or dimension but is not inventoried as a separate structure.

Uniform - An attribute of the structure where the structure is relatively consistent in composition, dimension and condition.

T or L shaped - An attribute of the structure where a structure has the shape of a letter "T" or "L".

Drainage Attributes – Materials that assist or change the drainage pattern of water through or above a shore protection structure.

Slush Cap (Splash Pad) - Concrete that has been poured onto small objects to collectively act as a bigger object.

Splash Apron - The hard material placed above the main structure and out of direct wave attack to reduce erosion above the structure due to water splashing on the native material. This can be a drain-splash apron or a solid splash apron depending on material and design.

Toe Attributes - Material that has been placed adjacent to, but lakeward, of the structure to protect the base of the structure from direct wave attack. These materials may be partially or completely submerged. This can be in the form of any composition material mentioned above.

Condition - The horizontal and vertical alignment of the structure, as well as, it's overall aesthetic appearance.

Excellent – Brand new in appearance and shows no sign of stress or wear.

Good- Good appearance and alignment, but may appear to be over 5 years old.

Fair- Some minor bowing or alignment issues, minor cracks with reasonable appearance. Expected lifespan: 10-15 years.

Poor- Major bowing, collapsing, flanking or large cracks. Expected lifespan: 0-5years.

Function – The ability of the structure to retain the soil, land or property that it is protecting.

Excellent- Absolutely no on-land issues with regard to erosion or sinking.

Good- no visible on-land issues with regard to erosion or sinking, but evidence of possible filling or repair at some time.

Fair- The presence of a few minor holes or sunken land that appear at small sections along the structure.

Poor- Major holes or sinking that appear at small sections along the structure and/or minor holes or sinking that appear along the majority of the structure.

D to Structure – Distance from the most in-land side of the shore protection structure to the nearest on-shore permanent structure, such as: houses, roads and parking lots.

Structure Type- What type of on-shore permanent structure it is.

D shore to Structure – Distance from the shore side of the shore protection structure to the waters edge.

Dimensions

Primary Length – Length of the primary structure following the structure centre line.

Primary Width - Width of the primary structure including attributes.

Primary Height – Height of the primary structure above water level or ground level (if structure is set back from the shoreline).

Secondary Length – Length of the secondary structure following its centre line.

Secondary Width – Width of the secondary structure nearest to the shoreline.

Secondary Height – Height of the secondary structure above water level.

Notes - This is a place to record any unique information about the structure or site that cannot be described in any other section.

Appendix Ia. Newspaper notice, articles and editorials

Observer Nov 11 06

Notice to St. Clair River Residents Re: Shoreline Protection Assessments

This fall and winter, the St. Clair Region Conservation Authority will be conducting a study on the St. Clair River. The study requires the collection of data regarding the state of shore protection from Canatara Park to the northern section of Mitchell's Bay.

The goal of this study is to obtain information on public and private lands regarding the type and current status of shore protection along the river. This information will be used to quantify the types of shore protection that exist along the river and to provide background to support applications for funding to improve shoreline protection and increase fish and wildlife habitat on the St. Clair River.

Conservation Authority staff will begin the review of the shoreline later this month. Residents are asked to watch their mail for a letter containing more detailed information regarding the study.

For more information contact:

Brian McDougall, Director of Watershed Services
St. Clair Region Conservation Authority
(519) 245-3710 ext 36
bmcdougall@scrca.on.ca

Sarnia Observer November 9 0

St. Clair shoreline surveyed

STEEL WALLS MAY BE DAMAGING FISH HABITAT

By SHAWN JEFFORDS
The Observer

A vast stretch of the St. Clair River shoreline will be surveyed to gather evidence of damage done to fish and habitat by failing steel walls.

The St. Clair Conservation Authority will begin the in-depth inspections early next week from Canatara Park to Mitchell's Bay.

The survey is the first step in persuading the government to commit funding to restore the natural shoreline habitat of the river and protect native fish species, said Brian McDougall, director of watershed services for the authority.

"This is a precursor to a larger application," said McDougall. "We have to put what we have on paper. That will give us more ammunition ... to work on improvements to shore protection."

It's believed the steel walls that line much of the Canadian side of the St. Clair prevent a number of native fish species from flourishing.

The authority would eventually like to restore some of the shoreline to its original state with shoals, rocky outcroppings and shallow pools.

A three-person crew will work its way up the river taking photos and video footage for a report.

The survey is being paid for with a $60,000 federal grant and will take about three months to finish, depending on how harsh the winter is, said McDougall.

Letters will be delivered to property owners informing them of the survey. If they don't want to take part they can contact the authority by phone or e-mail. But McDougall hopes there aren't many opt-outs.

"I don't feel we really have to sell this because it's a positive project," said McDougall.

"We could put their mind at ease if nothing else. This is a very exciting project to be involved in. We're looking forward to assisting landowners and making improvements."

To opt out of the survey contact McDougall at 1-519-245-3710 ext. 36 or by e-mail at bmcdougall@scrca.on.ca.

Shoreline protection a key issue for home owners

Observer Nov 18 06

Sir: I am writing in response to your editorial "How costly is this plan" (The Observer, Nov. 10, 2006), regarding the study being completed by the St. Clair Region Conservation Authority to document shore protection along the St. Clair River.

To clarify, this inventory of shoreline properties will assist landowners by providing them with an assessment of their shore protection and will help resource managers in assessing the overall health of the St. Clair River shoreline. We are not proposing to remove functioning shore protection or to leave the shoreline unprotected for the purpose of creating fish habitat. Should a steel wall fail and replacement is required, there are designs that can provide the same level of protection at a greatly reduced cost (as compared to a steel wall), while at the same time providing improved fish habitat.

The result would be a savings for landowners along the river.

The Conservation Authority is working with partners to create one or two demonstration projects so that landowners can evaluate for themselves if alternate shore protection methods work for their properties.

The Conservation Authority will continue to look for grants for landowners who wish to pursue this option. A shoreline that provides protection from erosion and flooding and improves habitat is addressing one of the key issues in the St. Clair River Remedial Action Plan designed to delist the St. Clair River as an Area of Concern.

Brian McDougall
Director of
Watershed Services
St. Clair Region
Conservation Authority
Strathroy

Sarnia Observer

November 10 06

EDITORIAL

How costly is this plan?

A plan to remove steel seawalls along the Ontario side of the St. Clair River shoreline should raise eyebrows from Sarnia to Mitchell's Bay.

The St. Clair Region Conservation Authority plans to conduct a survey to gather evidence of damage being done to fish and habitat by failing steel walls.

The probe will be the first step in persuading the government to commit funding to restore the natural shoreline habitat of the river and protect native fish species.

It's an ambitious plan. In fact, the survey alone will cost $60,000, with taxpayers picking up the tab through a federal government grant. And that could be just the beginning.

If steel walls are to be removed, it will cost money. Probably a lot of money.

That isn't to say this is a bad idea. It's believed the walls that line much of the Canadian side of the international waterway prevent a number of native fish species from flourishing. The authority would eventually like to restore some of the shoreline to its original state with shoals, rocky outcroppings and shallow pools.

But before this scheme goes too far, a number of questions need to be answered.

The walls were put in to protect the shoreline from severe erosion problems. Water levels are down now, but are they going to stay down? If we remove the steel walls will some properties be washed away a few years from now?

And more to the point, how much will it cost to remove the walls? Will private property owners be expected to foot the bill, or will there be government help?

If the government does plan to foot the bill, how will it do so? Will it cut funding for social programs or increase the deficit?

In other words, we need to know whether we can afford this plan.

Appendix Ib. Letter to shoreline residents

November 8, 2006

Attn: St. Clair River Shoreline Owners – Re: Shoreline Assessment

Dear Residents;

The St. Clair Region Conservation Authority (SCRCA) is very pleased to have received a grant from the Great Lakes Sustainablity Fund to undertake a study on the St. Clair River to document and assess the current conditions of the shoreline.

Considerable progress has been made over the last two decades with industry, municipalities, government agencies and individuals working together to improve the condition of the St. Clair River. Shoreline restoration has been identified as a priority and it was recommended that an inventory be undertaken to assess the type, condition and longevity of the present shoreline protection structures and identify the potential for enhancement at these locations.

This is a great opportunity for the SCRCA to work with landowners to not only improve the condition of the St. Clair River, but enhance the aesthetic appearance of their property as well. Shoreline designs which incorporate armour stone or rip rap provide habitat for aquatic organisms and refuge for small fish from predators. The use of armour stone and rip rap in the shore protection also minimizes sediment scouring and dissipates wave energy, both of which cause erosion. In addition, these types of shoreline protection are less expensive then replacing the existing steel walls.

The assessments will be completed during the fall and winter months with a crew of three Authority Staff collecting information regarding the shoreline protection in place. These assessments will provide the Conservation Authority with the information needed to support grant applications for landowners who are interested in improving their shoreline protection.

We ask your support by allowing staff to undertake a brief on site assessment of your shoreline property. All data gathered will be kept strictly confidential and only be used for the purpose of this study.

If you have any questions or require further information please contact Jon Nodwell, Sybil Kyba, Martha Loewen or the undersigned at your convenience.

Yours truly,

Brian McDougall
Director of Watershed Services

Jon Nodwell – *jnodwell@scrca.on.ca*
Sybil Kyba – *skyba@scrca.on.ca*
Martha Loewen – *mloewen@scrca.on.ca*

Appendix Ic. Letter to SLEA and power point presentation

Sarnia Lambton Environmental Association
Suite 111 265 N. Front Street
Sarnia, ON N7T 7X1
November 1, 2006

To Whom It May Concern:

As previously mentioned by Brian McDougall, the St. Clair Region Conservation Authority (SCRCA) has begun a study on the St. Clair River to improve the current conditions of the shoreline. We would like to gain access to your member companies' shoreline property and your assistance would be much appreciated.

The Sarnia-Lambton Environmental Association has had a positive influence on the major companies within the St. Clair River and with your assistance we feel they will be more supportive. By using your ties to the member companies the information will reach the appropriate individual who has the authority to grant us permission to access the property shorelines.

The shoreline assessment and proposed enhancement would benefit these companies by protecting their properties from erosion due to wind and waves. In addition, shoreline enhancement would be good publicity and be beneficial to the company's image within the community. A committee will review any proposed rehabilitation plans and will award grants to projects approved by the authority.

The assessments of the St. Clair River shoreline will occur during the fall and winter with a crew of three collecting data regarding the bank and the type of protection used along the shorelines. The assessments will provide research on future enhancements opportunities of habitat restoration and bank stabilization as well as methods of improving the area of concern. By gaining approval from the industries along the bank we will have a greater sense of what could be done for improvement and better key point problem areas.

For more information or concerns please contact one of the people listed below.

Jon Nodwell – *jnodwell@scrca.on.ca*
Sybil Kyba – *skyba@scrca.on.ca*
Martha Loewen – *mloewen@scrca.on.ca*
Shoreline Assessment Technicians
Brian McDougall- (519) 245 – 3710x36
Director of Watershed Serices

St. Clair River Shoreline Restoration Assessment

Identifying Restoration Opportunities along the St. Clair River

February 20, 2007

Brian McDougall
Director of Watershed Services

St. Clair Region Conservation Authority

- Located west of London
- Watershed basis
- 4,100 km²
- Population 162,000
- In place to reduce the risk to life and property from flooding and erosion; water and land stewardship; forestry; wildlife habitat creation and outdoor recreation

St. Clair River Area of Concern

AOC includes all areas that drain directly into the St. Clair River

Reasons for designation:
- Loss of fish and wildlife habitat
- Restrictions on and quality of drinking water
- Degradation of aesthetics

St. Clair River Area of Concern

Our goal:
- Take a cooperative approach
- Make continual progress
- Improve areas of the shoreline that were identified as a priority
- Encourage soft-shore engineering to replace shoreline hardening

Phase 1 of Study:

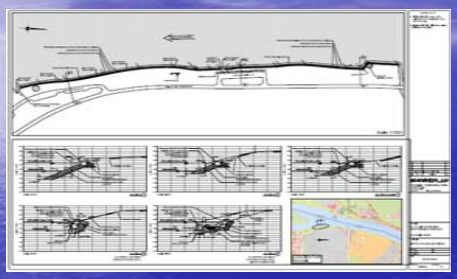
- Studied public lands on the shoreline of the St. Clair River
- Created a catalogue of all publicly owned shoreline properties in the St. Clair River AOC
- Recorded type and status of existing shore protection
- Assessed the feasibility of improving or enhancing the aquatic and/or riparian habitat if and when the existing shore protection requires repair or replacement

Phase 1 of Study:

- Two sites are being looked at as possible demonstrations

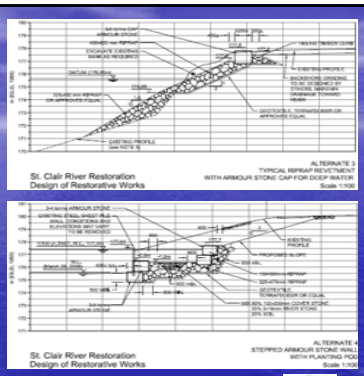
Phase 1 of Study:

- Habitat friendly designs were created for the two sites



Phase 1 of Study:

- Six general cross sectional designs were created
- Habitat friendly protection types
- Cost comparison with other types of protection



Phase 1 of Study:

- Municipal partners were very positive and supportive
- Class Environmental Assessment has commenced for Guthrie Park near Corunna in St. Clair Township

Phase 1 of Study:

- A Class Environmental Assessment has commenced on the former CN Lands near the south end of Sarnia Bay
- These two potential projects could combine for almost a kilometer of rehabilitated, habitat friendly shore protection

Phase 2 of Study:

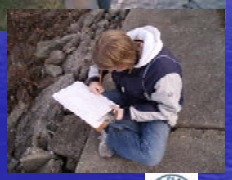
- Expanded project to include all properties

Study – Phase 2

- Properties to date include all residential, commercial, and agricultural.

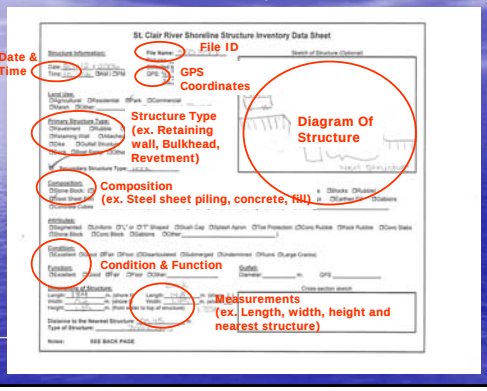
Phase 2 of Study

- Process includes:
  - Measuring existing shoreline structure (width, height, condition, function, etc)
  - Creating a catalogue of all shoreline properties from Canatara Park to Mitchell's Bay
  - Taking GPS readings of the location and shape of the shoreline
  - Taking digital photography for indication of erosion or potential rehabilitation sites



Phase 2 of Study:

- Inventory Data Sheet used



Phase 2 of Study:

Crew will be using a GPS unit with a backpack and antenna

Phase 2 of Study

- The cataloguing of the structures will take place in a GeoDatabase used with GIS software. The catalogue will use the digital aerial photography to show the current conditions of the shoreline and outline areas for potential restoration work

- This will provide the baseline information needed for any future planning

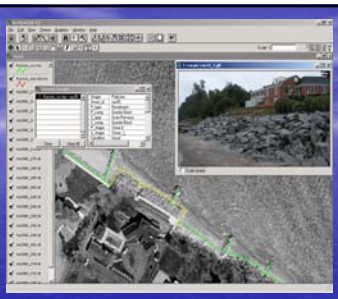
Phase 2 of Study:

Some photos taken

Phase 2 of Study:

After the field work is completed and the entire shoreline is assessed the study will include:

- Comparing aerial photographs from the 1950's, 1970's and 1990's to identify changes over five decades



- Long term planning for rehabilitating shoreline properties
- Tracking improvements that have been made
- And writing a final report analyzing the change in shoreline structures and types used along the river

Phase 2 of Study

Results

- Baseline data on shore protection
- Target specific areas where repairs are required and where habitat improvements are feasible
- Develop a plan to access grants to assist landowners in undertaking improvements
- Web accessible, password protected GIS based data resource for all St. Clair AOC resource managers
- All results work toward the goal of delisting the St. Clair River

Current Status

- Assessment team currently approximately 8 km from the Mitchell's Bay (south boundary)
- 740 structures assessed to date

Next Steps

- In order to complete the assessment we are seeking access to the industrial properties on the shoreline
- The assessments will be identical to those completed to date
- Phase III of the projects will be providing grants to landowners to replace existing failing protection with soft, habitat friendly shore protection

St. Clair River Shoreline Restoration Assessment

Identifying Restoration Opportunities along the St. Clair River

February 20, 2007

Brian McDougall
Director of Watershed Services

St. Clair River Shoreline Structure Inventory Data Sheet

Appendix II - Structure Information **File Name:** _____

Pictures: _____

Date:_____/_____/_____ Collected by:_____

Time:_____:_____ ❒AM / ❒PM GPS: _____

_____

Sketch of Structure (Optional)

Land Use:

❒Agricultural ❒Residential ❒Park ❒Commercial
❒Marsh ❒Other: _____

Primary Structure Type:

❒Revetment ❒Rubble ❒Groin ❒Bulkhead ❒Jetty
❒Retaining Wall ❒Attached Breakwater ❒Offshore Breakwater
❒Dike ❒Outfall Structure ❒Stream Mouth ❒Pier
❒Dock ❒Boat Ramp ❒Other:_____

❒ **Secondary Structure Type**:_____

Composition:

❒Stone Block: (❒ Dolo/Limestone ❒Granite/Metamorphic ❒Sandstone) ❒Concrete: (❒ Poured ❒Slabs ❒Blocks ❒Rubble)
❒Steel Sheet Piling ❒Steel Plate ❒Steel Crib ❒Fill (Waste) ❒Timber Crib ❒Timber Pilings ❒Earthen Fill ❒Gabions
❒Concrete Cubes Concrete Modules: (❒Cone & Wedge ❒Bags and Tubes ❒Rings ❒Slabs)
❒Other:_____

Attributes:

❒Segmented ❒Uniform ❒"L" or ❒"T" Shaped ❒Slush Cap ❒Splash Apron ❒Toe Protection: (❒Conc Rubble ❒Rock Rubble ❒Conc Slabs
❒Stone Block ❒Conc Block ❒Gabions ❒Other:_____)

Condition:

❒Excellent ❒Good ❒Fair ❒Poor: (❒Disarticulated ❒Submerged ❒Undermined ❒Ruins ❒Large Cracks)
Other:_____

Function:

❒Excellent ❒Good ❒Fair ❒Poor ❒Other:_____

Outfall:

Diameter:_____ m. GPS _____

Dimensions of Structure:

Length:_____m. (shore ll) Length:_____m. (shore _|_)
Width: _____m. (shore ll) Width: _____m. (shore _|_)
Height:_____m. (from water to top of structure)

Cross-section sketch

Distance to the Nearest Structure: _____ m.
Type of Structure: _____

Appendix III - TRIMBLE PATHFINDER DATA DICTIONARY

Shore Structure – Polyline feature – St. Clair River Shore Structure
Structure ID – Structure Identification Number (e.g. ST0001, ST0002, ST0003…)

Primary Type - Type of Shore Structure	**Primary Comp - Dominant Composition of Shore Structure**
Revetment, default Rubble Groin Solid Groin Pervious Seawall/Bulkhead Retaining Wall Jetty Attached Breakwater Offshore Breakwater Pier Dock Boat Ramp Intake Structure Outfall Structure *Stream Mouth* Dike Type Other	Dolo/Limestone Block, default Sandstone Block Granite/Meta Block Concrete Block Concrete Slabs Concrete Rubble Concrete Poured Mod Concrete Cubes Mod Concrete Rings Mod Concrete Tubes Mod Cone & Wedge Mod Campbell Mod Other Steel Sheet Piling *Steel Pilings* Steel Plate Steel Crib Gabions Timber Crib Timber Pilings Earthen Fill Composition Other Rip Rap
Secondary Type - Secondary Type of Shore Structure	**Secondary Comp – Dominant Composition of Shore Structure**
None, default Revetment Rubble Groin Solid Groin Pervious Seawall/Bulkhead Retaining Wall Jetty Attached Breakwater Offshore Breakwater Pier Dock Boat Ramp Intake Structure Outfall Structure *Stream Mouth* Dike Type Other	Dolo/Limestone Block, default Sandstone Block Granite/Meta Block Concrete Block Concrete Slabs Concrete Rubble Concrete Poured Mod Concrete Cubes Mod Concrete Rings Mod Concrete Tubes Mod Cone & Wedge Mod Campbell Mod Other Steel Sheet Piling *Steel Pilings* Steel Plate Steel Crib Gabions Timber Crib Timber Pilings

	Earthen Fill Composition Other Rip Rap
Primary Shape - Primary Structure Shape Shore ||, default Shore _|_ T Shaped L Shaped Shape Other	**Secondary Shape - Secondary Structure Shape** None, default Shore || Shore _|_ T Shaped L Shaped
Toe Attributes - Structure Shape and Features None, default Toe Concrete Rubble Toe Rock Rubble Toe Rock/Conc Block Toe Concrete Slabs Toe Poured Concrete Toe Gabions Toe Other	**Drainage Attributes - Structure Shape and Features** None, default Bluff Drainage Splash Apron Drain_Splash Apron Drainage Other Not Applicable
Condition - Structural Integrity Excellent Good, default Fair Poor Disarticulated Poor Submerged Poor Undermined Poor Ruins Poor Large Cracks Poor Flanked Poor Other Condition Other *Not Applicable*	***Function - Structure Functionality*** Excellent Good, default Fair Poor *Not Applicable*
|| Length (m) - Shore Parallel Length (ft) **|| Width (m) - Structure Shore Parallel Width (ft)** **|| Elev (m) - Elevation above Lake Level (ft)**	**_|_ Length (m) - Shore Perpendicular Length (ft)** **_|_ Width (m) - Perpendicular Width (ft)** **_|_ Elev (m) - Perpendicular Elevation (ft)**
D Shore to Structure – Distance from shore structure to water's edge **D to Structure – Distance from land side of shore structure to nearest permanent on-land structure.** **Structure – Type of on-land structure (eg: house, road)** **Outfall Diameter - Pipe Diameter of Outfall Structure**	**Field Team - Last Name Field Team** **Inventory Date - Field Inventory Date** **Inventory Time - Field Inventory Time**