RIDEAU VALLEY CONSERVATION AUTHORITY

SHORELINE CLASSIFICATION PROJECT

2003 REPORT

Prepared by Brad Stephens

May 2004

TABLE OF CONTENTS

1.0	INTRODUCTION	1
2.0	BACKGROUND	1
	2.1 WATER QUANTITY AND QUALITY	1
	2.2 LAND USE	2
	2.3 HABITAT	3
	2.4 EROSION	4
	2.5 SHORELINE STRUCTURES	4
3.0	METHODS	6
	3.1 MAPS	6
	3.2 FIELD SHEETS	10
	3.3 PHOTOS	10
	3.4 CLASSIFICATION CRITERIA	11
4.0	ANALYSIS	13
5.0	SHORELINE ATTRIBUTES	14
	5.1 CLASSIFICATION	14
	5.2 AQUATIC VEGETATION	16
	5.3 WATER QUALITY	19
	5.4 EROSION	23
6.0	RECOMMENDATIONS	25
7.0	CONCLUSION	26
8.0	RESOURCES	26
9.0	GLOSSARY OF TERMS	27
10.0	LITERATURE CITED	29

LIST OF FIGURES

Figure 2.3.1	Painted turtle (*Chrysemys picta*) making use of a downed tree	3
Figure 3.1.1	2003 Rideau River Shoreline Classification Project Study Area	7
Figure 3.1.2	Surveyed Shorelines of Rideau River Flood Risk Maps 1 to 13	8
Figure 3.1.3	Surveyed Shorelines of Rideau River Flood Risk Maps 16 to 38	9
Figure 3.4.1	Representation of a Property with a 'Degraded' Classification	11
Figure 3.4.2	Representation of a Property with an 'Ornamental' Classification	11
Figure 3.4.3	Representation of a Property with a 'Regenerative' Classification	12
Figure 3.4.4	Representation of a Property with a 'Natural' Classification	12
Figure 5.1.1	Shoreline Classification Percent Frontage for Rideau River 2003	14
Figure 5.2.1	Submergent Aquatic Vegetation Cover by Map for Rideau River 2003	17
Figure 5.2.2	Emergent Aquatic Vegetation Cover by Map for Rideau River 2003	18
Figure 5.2.3	Floating Aquatic Vegetation and Algae Cover by Map for Rideau River 2003	18
Figure 5.3.1	Land Use Percent Frontage for Rideau River 2003	19
Figure 5.3.2	Average Property Frontage by Land Use for Rideau River 2003	20
Figure 5.3.3	Percent Shoreline Canopy Cover by Map for Rideau River 2003	21
Figure 5.3.4	Percent Shoreline Canopy Cover by Land Use for Rideau River 2003	22
Figure 5.3.5	Shoreline Shrub Layer Composition for Rideau River 2003	22
Figure 5.4.1	Percent Shoreline Erosion by Map for Rideau River 2003	23
Figure 5.4.2	Percent Erosion Frontage by Type by Map for Rideau River 2003	24

LIST OF TABLES

Table 5.1.1	Shoreline Classification Frontage by Map for Rideau River 2003	15
Table 5.2.1	Aquatic Plant Species on Rideau River 2003	16

APPENDICES

APPENDIX A: FIELD SHEETS

Property Description Form Side 1 of 2
Property Description Form Side 2 of 2
Offshore Floating Objects Description Form
Public Notice

APPENDIX B: LAND USE DEFINITIONS

Acknowledgements

Thank you to:

- The Centre for Sustainable Watersheds and Human Resources Development Canada for their roles in providing staffing and administrative resources for the 2003 project.
- Micheal Kostiuk and Luke Chagnon for their roles in protocol refinement and data collection.
- Martin Czarski, Rideau Valley Conservation Authority Watershed Ecologist, for his role in managing the 2003 project.
- Simon Lunn and Parks Canada for their support with project finances and design.
- Hurst Marina for providing a boat, motor and trailer for daily use.
- Ewan Hardie, Rideau Valley Conservation Authority GIS Specialist, for his great help with data analysis and management.

1.0 INTRODUCTION

In 2003, the Shoreline Classification Project continued upstream along the Rideau River towards Smiths Falls from Kars, surveying and mapping the natural and human-made features of the shoreline. The Three Year Plan for the project involves surveying Rideau River to Smiths Falls and continuing on to Kemptville Creek. In support of the Rideau Valley Conservation Authority's (RVCA) long term vision for watershed habitats, this project will provide a framework where changes to shorelines over time can be monitored and reported. The collection of baseline data will assist in rehabilitation and planning and regulations issues within the Rideau Valley Watershed. In the future, less labour and time intensive methods for reassessing the shoreline will be developed. Detection of change will then be possible.

Data sharing with other organizations in Eastern Ontario is a significant part of this project. The ability of RVCA to compare data with other agencies in other jurisdictions will allow for relative health of watercourses to be determined. Parties that will benefit from data sharing include member municipalities of the Conservation Authority, Parks Canada, adjacent Conservation Authorities and other non-governmental organizations that share a common concern about the health of the Rideau River. When combined with other monitoring data, the overall health of the watercourses within the Rideau Valley Watershed can be assessed.

2.0 BACKGROUND

In a natural state, shorelines provide diverse terrestrial and aquatic habitat and perform many hydrologic functions, significantly contributing to the overall health of a waterbody. Riparian zone vegetation benefits river ecology in many ways. Vegetation improves water quality and temperature, nutrient and sediment content in runoff, bank stability, terrestrial and aquatic habitat, biodiversity and species richness (Belsky *et al* 1999; Johnson *et al* 2001). These factors are each extremely important in contributing to the health of a watercourse. Richards *et al* (1996) stated that "…the proportion of permanent vegetation in a catchment was vital for mediating other land use impacts on stream habitats". The following sections outline the importance of riparian and aquatic vegetation to various aspects of watercourse and watershed health.

2.1 WATER QUANTITY AND QUALITY

Through the uptake and physical filtering of water, vegetation moderates flow of water through the riparian zone (Eubanks and Meadows 2002). This lowers watercourse flow rates during precipitation and spring snowmelt events. Stresses on channel systems are reduced and flow management through human-made structures, such as dams and dykes, is easier. Through this process, water with high nutrient content is impeded from flowing directly into the watercourse. This is extremely significant in areas where fertilizers are used for lawn or agricultural applications and older septic systems are present and possibly leaking. Eutrophication of a watercourse through nutrient loading can result in large vegetation blumes (as observed in certain areas of the Rideau River in August

2003). The decomposition of these vegetation masses lowers dissolved oxygen levels and aquatic organisms (including fish) suffer as a result.

The impacts of runoff water quality characteristics, including nutrient content, acidity, salinity and contamination can be reduced by vegetation buffering (Crowder *et al*, 1996). Variability in discharge, temperature and sedimentation increases when vegetation is removed from the riparian zone (Wohl and Carline 1996).

2.2 LAND USE

All natural systems within a watershed are linked in some way. Water connects the entire watershed through overland, drain, ground water and watercourse flow. Therefore, what happens to the water on land directly affects the composition of ground water and surface water stores. Community species composition is significantly affected by land use (Richards *et al* 1996).

Agriculture has significant ecological impact on adjacent watercourses. If allowed into the riparian zone, livestock seek out surface water, moisture rich vegetation, and cooler temperatures (Belsky *et al* 1999). This leads to trampling and overgrazing of shoreline vegetation. Any habitat that riparian shrubs were providing is diminished. Many exotic plant species thrive in disturbed areas such as this. Local extinction of native species may occur as a result.

Livestock have relatively small hooves with high PSI values. Hooves sink into shoreline soils, disrupting existing, stabilizing root systems. This results in increased erosion rates, causing silting, which degrades fish and invertebrate habitat.

Riparian vegetation slows runoff flow, allowing water to infiltrate into the soils. This water slowly reaches the channel, resulting in more steady water levels. The lack of vegetation in a riparian zone allows runoff to flow directly into the watercourse from the floodplain. A lower water level results and riparian plant species are left high and dry, only to be replaced by upland species that are better suited to drier conditions (Belsky *et al* 1999).

On cropland adjacent to watercourses, fertilizer application and use of heavy machinery for planting, harvesting and tilling can have great impacts. Sedimentation, runoff water quality and flow change significantly in areas used for row-crop production (Richards *et al* 1996).

In residentially developed areas, the impacts of riparian degradation are not unlike those in agricultural areas. However, ecological differences are more significant when comparing forested and unforested shorelines rather than when comparing urban and non-urban shorelines (Johnson *et al* 2001). The widespread disturbance of water quantity and quality in densely populated urban reaches can lessen the benefits of ecological restoration.

2.3 Habitat

Overhanging trees in riparian areas provide shade for the littoral zone. Cooler temperatures increase dissolved oxygen levels and improve aquatic habitat. Fallen logs and woody debris from shoreline trees provide habitat for aquatic and terrestrial species (Eubanks and Meadows 2002; Richards *et al* 1996; Stauffer *et al* 2000). For example, painted turtles (*Chrysemys picta*) need warming sites to aid in digestion (Figure 2.3.1) (Nature 2002). Downed trees provide a site for this. Fish utilize logs for protection, shade and spawning purposes. Organic material of all types is retained by large logs by reducing local flow rates. Litter from riparian vegetation is a significant energy (i.e. food) source for aquatic invertebrates (Eubanks and Meadows 2002; Stauffer *et al* 2000).

Figure 2.3.1: Painted turtle (*Chrysemys picta*) making use of a downed tree.

Vegetation provides a good base for terrestrial wildlife habitat. Within tree and shrub strata, animals and birds can nest, forage and hunt for food and hide from predators. A riparian buffer can provide a continuous wildlife corridor that can allow for animal movement from place to place under protective cover (Hannon *et al* 2002). This can improve a population's genetic diversity and ability to respond to environmental changes (i.e. natural disasters, development).

Riparian vegetation protection and restoration benefits fish communities (Eubanks and Meadows 2002; Stauffer *et al* 2000). Aquatic substrate composition is affected by sediment inputs from adjacent lands. Vegetation buffers filter sediment to provide protection for fish spawning grounds and invertebrate habitat. Terrestrial invertebrates can reach aquatic food webs via overhanging riparian vegetation (Allan *et al* 2003). This is an important food source for aquatic species.

Aquatic plants, rooted or floating, emergent or submergent, are also known as macrophytes. They are concentrated in shallow areas of a watercourse where light can penetrate enough to establish life. Habitats provided by these plants are vital to the survival of many fish and invertebrate species (Randall *et al* 1996). Just as trees and shrubs provide cover and protection on land, macrophytes provide cover and protection underwater. Invertebrate species diversity and richness increases as macrophyte cover increases (Randall *et al* 1996). Along with aquatic vegetation providing habitat and cover, fish benefit from high invertebrate concentrations as a source of food. This results in higher fish species richness and biomass in vegetated areas. Macrophytes are used as spawning substrate by many of the 30 fish species found in the Rideau River (Nature 2002).

2.4 EROSION

Erosion is a natural process where natural forces of water and wind move soil and rock material. Rate of erosion is a function of bank height ratio (stream bank height/maximum bankfull depth), ratio of vegetation rooting depth/bank height, rooting density, per cent surface area of bank protected by natural or human-made means, bank angle, number and location of various soil composition layers in the bank, and bank material composition (Rosgen 2001). Natural river flow causes erosion. However, the addition of boat traffic and development increases erosion forces.

Deep rooting shrubs and trees provide bank stabilization. Grasses, especially groomed, ornamental varieties have weak, shallow root systems. They are simply not good enough at stabilizing shoreline soils. With roots that can penetrate soils to depths of 24 inches, the presence of shrubs in the riparian zone is vital for protection from erosion.

Native shrub species to the Rideau Valley Watershed, that grow well along shorelines include Red-Osier Dogwood (*Cornus stonolifera*), Sweet Gale (*Myrica gale*), and Virginia Creeper (*Parthenocissus quinquefolia*). On a larger scale, overstory trees can protect large areas of shoreline against erosion. However, there is still a need for the high root densities that shrubs can offer below dominant trees to stabilize pockets of soil between larger roots.

2.5 SHORELINE STRUCTURES

There are many ways that humans alter shorelines to better suit their needs. Be it residential, agricultural or industrial applications, any developments in the riparian and littoral zones can have significant impacts on existing ecosystems.

Retaining Walls

The most popular method for addressing erosion problems involves the construction of some sort of retaining wall. Materials used in construction of these structures include wood, steel, concrete blocks and pipes, poured concrete, gabion baskets and loose rock or rip rap. Vertical retaining walls do not allow any movement of wildlife between the riparian zone and the watercourse. Much of the habitat value to small mammals, reptiles, amphibians and birds is therefore lost (Hannon *et al* 2002). As waves and boat wakes impact a vertical wall the energy is not dissipated (Ford 1999). It is deflected upwards and downwards. These forces can undercut an expensive wall, ruining it in just a few years. These high energy deflected waves remove any vegetation trying to become established in such a harsh environment. In winter, ice flows can easily heave and damage vertical walls.

A low loose rock or rip rap wall at a 25 to 45 degree angle is ideal for stabilizing a shoreline. The low angle can easily dissipate wave forces and promote movement of shoreline organisms. A native shrub buffer can secure the rock barrier. Any large impacts or movement of rocks by ice in winter is easily responded to by the deep roots of native shrubs.

Decks and Boathouses

Onshore decks and boathouses severely degrade onshore habitat. Where a structure of this type is present there is no chance for onshore vegetation to survive and contribute to watercourse health. The only way to minimize the impacts of decks and boathouses is to construct them on stilts in areas where exposed bedrock already exists.

Docks and Boat Lifts

The impact of docks on aquatic habitat varies with dock type. Popular dock types include floating, cantilever, post, and crib.

From an ecological standpoint, docks can be good and bad. They can offer cover and shade to aquatic organisms. But, they can also completely remove habitat from the littoral area they are covering. Cantilever and floating docks offer the least amount of habitat impact because they do not touch the watercourse floor. The area disturbed by post docks is kept to a minimum. Older crib docks offer no positives and only degrade or completely remove existing habitat.

Boat lifts generally resemble post docks in design. As a result, they have the same ecosystem impacts.

Boat Ramps

Boat ramps have a significant impact on river ecology. Construction of a concrete ramp removes any aquatic habitat. Even if gravel is used instead of concrete, the constant use of a ramp impedes any species from using the area. Run-off rich in nutrients, salt and contaminants has a direct route into the water from roadways, parking lots, and adjacent lawns and gardens.

3.0 METHODS

3.1 MAPS

The 2003 study started at the Kars Bridge and moved upstream to end approximately 5 km upstream of Merrickville (Figure 3.1.1). Rideau River Flood Risk maps were used as the main point of reference for the entire 2002 study and the majority of the 2003 study. The 1:5000 flood maps were used from Kars Bridge to Burritts Rapids and 1:6000 maps provided by Parks Canada were used to complete the 2003 study. Building location and shape were not provided on these maps, but they did provide sufficient information to complete the study.

All data and photos were stored on a map by map basis. Each map was surveyed upstream along the north bank to its limit and downstream along the south bank to the limit of the previous map. Some properties covered more than one map. Figures 3.1.2 and 3.1.3 show the specific location of each map and the corresponding shorelines classified within them.

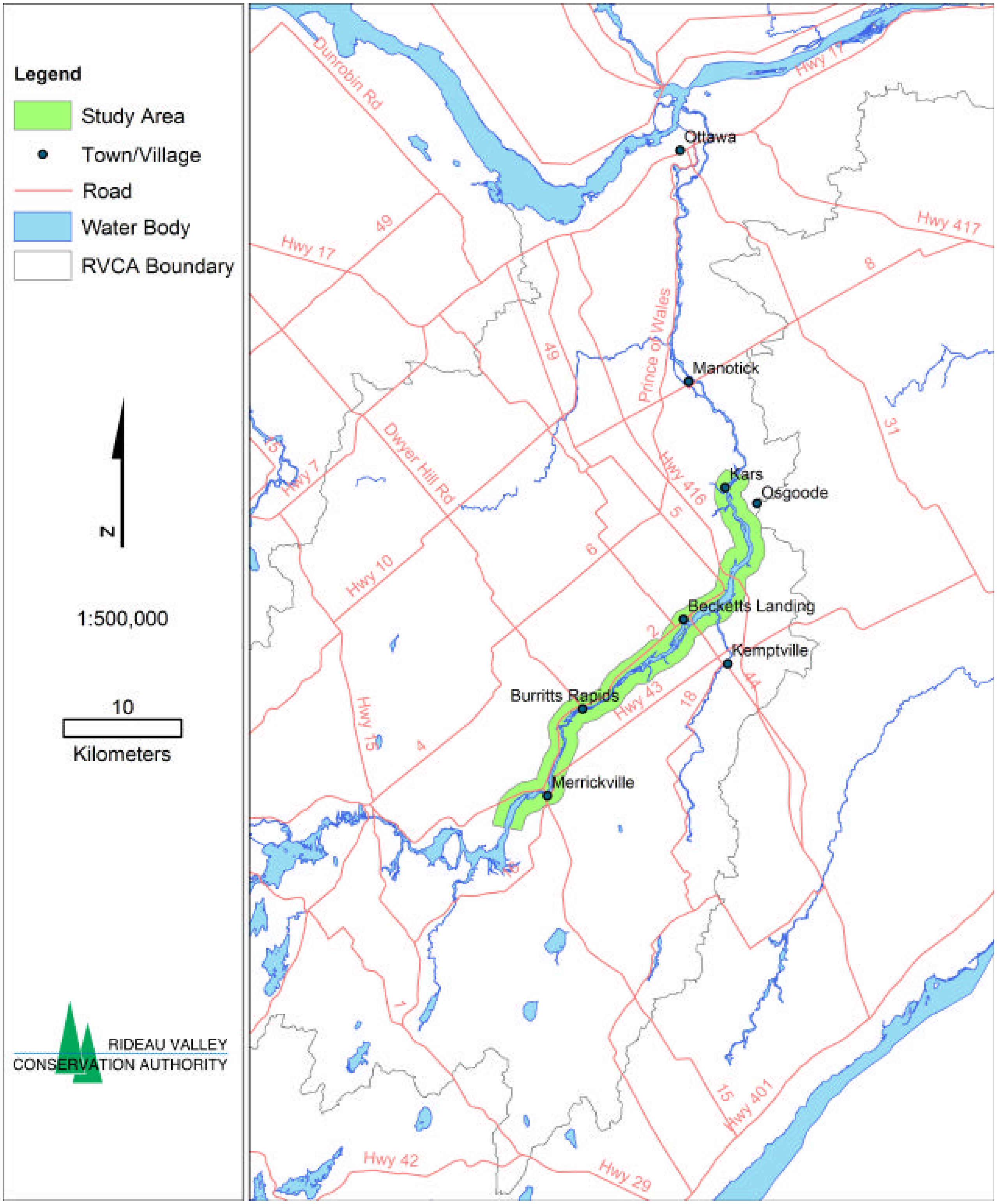

Figure 3.1.1: 2003 Rideau River Shoreline Classification Project Study Area.

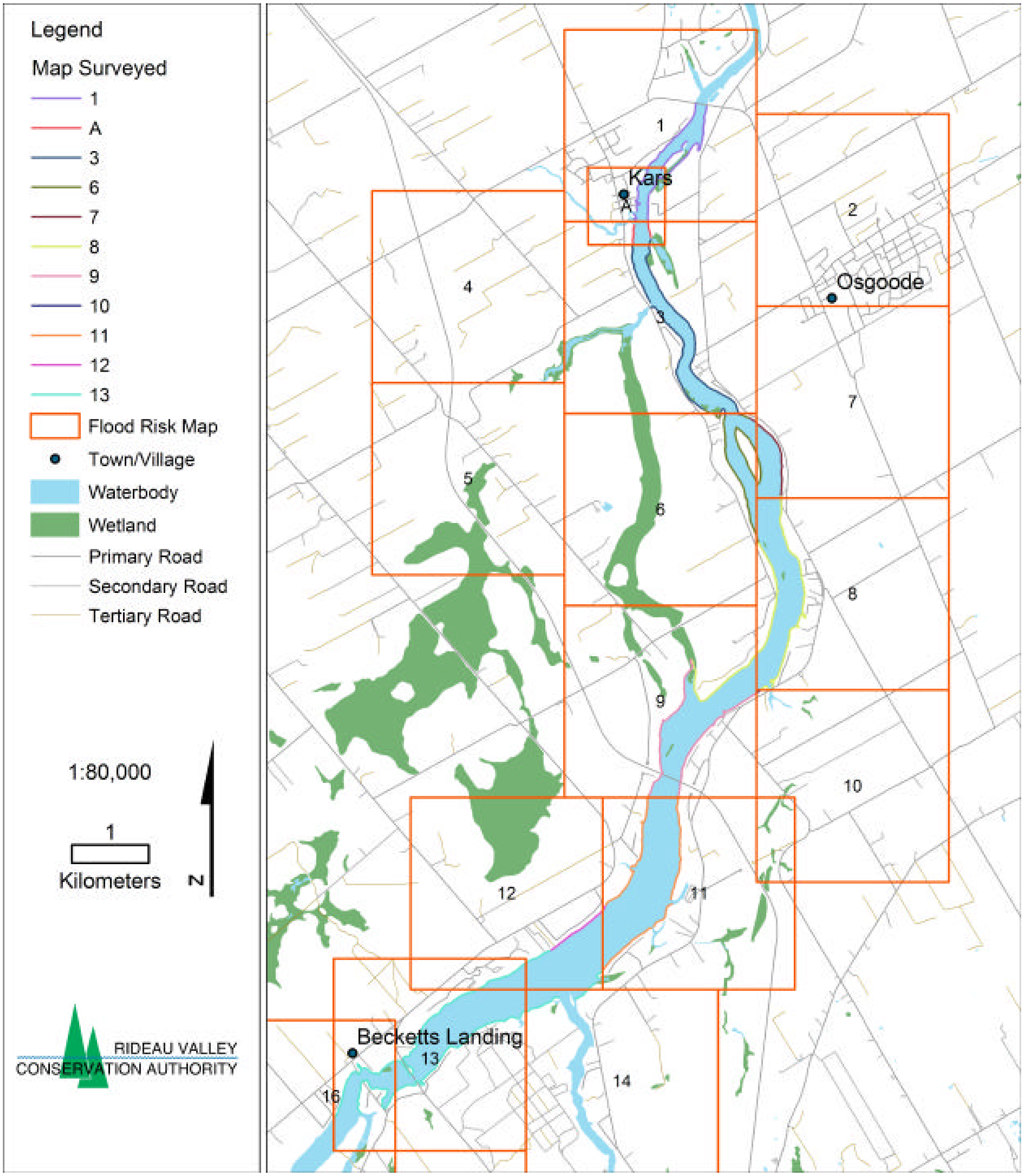

Figure 3.1.2: Surveyed Shorelines of Rideau River Flood Risk Maps 1 to 13.

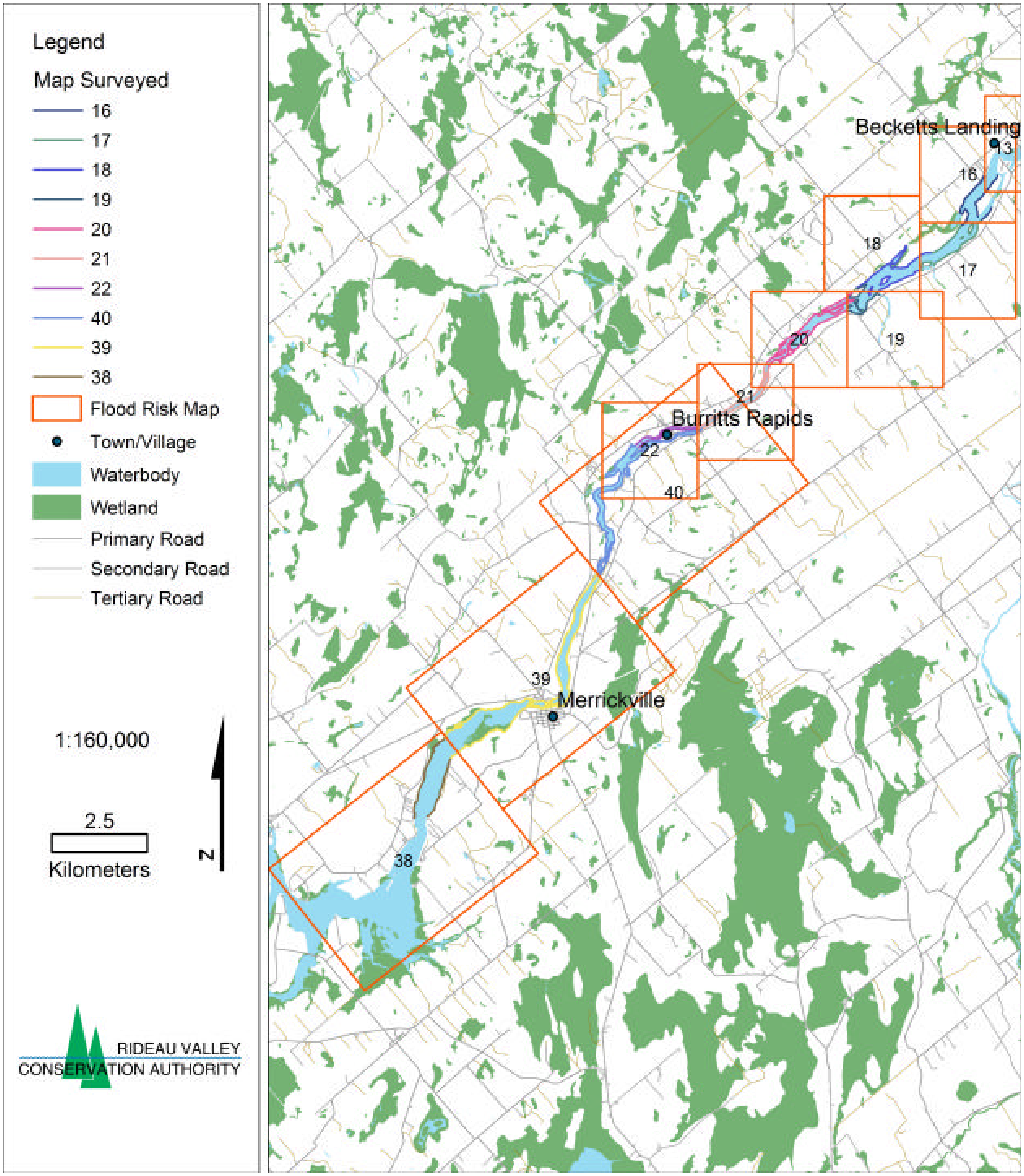

Figure 3.1.3: Surveyed Shorelines of Rideau River Flood Risk Maps 16 to 38.

3.2 FIELD SHEETS

For 2003, the survey method and field sheet (Appendix A) received revisions, just as it did in 2002. Through conversation with RVCA staff, the necessary changes were made to better identify the biophysical features from property to property. Most revisions were made to terrestrial and aquatic vegetation analysis and aquatic substrate composition. For example, shoreline vegetation and its roles in erosion and runoff control were addressed in the survey methods. Shoreline canopy percent cover and composition was also included. At the shrub layer, percent cover of shrubs versus groomed grass was deemed important to assess.

Six different types of aquatic vegetation were surveyed: Onshore Emergent (E.g. Common Cattail), Offshore Emergent (E.g. Flowering Rush), Floating (E.g. Yellow Pond Lily), Algae, Submergent Leafy (E.g. Common Waterweed) and Submergent Grasses (E.g. Tape Grass). Percentage cover was based on the total possible coverage of each vegetation type, adjacent to the shore or within the littoral zone.

Features that provide good aquatic habitat, including downed trees and woody debris were added to the aquatic substrate section of the field sheet. The inclusion of two or more Global Positioning System (GPS) points for each property allowed for more useful data analysis. The description and plan view sketch were moved to the reverse side of the field sheet (Appendix A). This was then scanned into a PDF file for each map. This provides comments on significant features and the exact locations of features such as retaining walls, overstory trees and docks.

A specific field sheet for each offshore floating object observed (Appendix A) was produced showing the exact location and type of object.

A public notice was prepared to help explain the Shoreline Classification Project to any property owners encountered during the survey (Appendix A). Also, when conversing with the public, referrals were always made to the LandOwner Resource Centre (LRC) in Manotick. The LRC offers accurate, impartial, user-friendly information on forestry, agriculture, wildlife, water, soil and any land management issues. It houses many resources containing educational information about managing and protecting shorelines.

3.3 PHOTOS

At least one digital photo was taken per property. Additional photos were taken if the property was relatively large and could not fit into one photo, or if there was a feature of significance that warranted another photo. These features included areas showing erosion, extremely large man-made structures, such as boat houses, docks, and retaining walls or examples of good wildlife habitat.

3.4 CLASSIFICATION CRITERIA

All properties were classified as Degraded, Ornamental, Regenerative or Natural. These four classifications were derived from the Mutual Association for the Protection of Lake Environment (MAPLE) *Shoreland Inventory and Classification Program*. In many cases more than one classification could apply to a single property. Therefore classification was determined on a percent frontage basis.

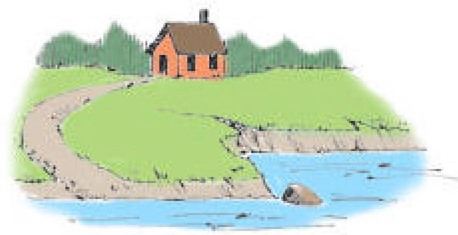

Figure 3.4.1: Representation of a Property with a 'Degraded' Classification.

Degraded

Degraded areas are areas where restoration is needed as soon as possible. Development with little consideration for river ecology or impacts from boat wakes can result in areas where erosion is present, runoff from roads and driveways flows directly into the water, and/or garbage and debris is polluting the shoreline habitat (Figure 3.4.1).

Figure 3.4.2: Representation of a Property with an 'Ornamental' Classification.

Ornamental

Ornamental areas are areas where development has focused on shoreline aesthetics and industry. No significant buffer exists along the shoreline. Construction of retaining walls, onshore structures and docks has significantly impacted wildlife habitat and the ability of the shoreline to slow runoff inputs of nutrients and pollution (Figure 3.4.2).

Figure 3.4.3: Representation of a Property with a 'Regenerative' Classification.

Regenerative

Regenerative areas are areas where there have been significant efforts made to restore the shoreline to a pre-development state. Presence of native vegetation is vital to regeneration. This would consist of a thick shrub buffer, developing canopy and diverse aquatic vegetation. The ability of the property to control erosion and runoff is good (Figure 3.4.3).

Figure 3.4.4: Representation of a Property with a 'Natural' Classification.

Natural

Natural areas are areas where human disturbance on land or in the river is minimal. Vegetation is established at all strata providing habitat for various organisms. Ecological health of the river depends on natural areas (Figure 3.4.4).

The above mentioned classifications are broad in scope. They provide a basic framework from which more specialized analysis can take place. Beyond these classifications, other data was recorded regarding other biophysical features of each property. This additional information will allow for differences between properties that fall within the same classification to be identified and analyzed. For example, agricultural and residential properties with no riparian buffer fall under the ornamental classification even though their land use is significantly different.

4.0 ANALYSIS

All collected data were entered into an Excel spreadsheet by flood risk map number. Each file was then converted into a format (i.e., a .dbf file extension) that could be used in a database format. Between the Kars overpass and the study limit, upstream of Merrickville, 948 properties were surveyed and 1499 photos were taken. Surveyed shoreline totaled 120.4 kilometres.

Database files were imported into the RVCA's Geographic Information System (GIS) software ArcMap. The corresponding GPS points were then used to determine property frontage in metres. In many cases the aquatic vegetation was too dense to navigate the boat close to the shoreline. Therefore a splitter had to be programmed that could produce a line directly to shore from GPS points. The intersection of that line and the shoreline was then identified as the property boundary. Property frontage was then determined using Ontario Ministry of Natural Resources provincial data layers. Total length, in metres, of attributes that were recorded as percent shoreline cover could then be calculated. These included tree canopy, retaining walls, shoreline structures, erosion, classification, etc. Total frontage and percent frontage on a map by map or study area scale could then be determined for all of the attributes collected.

5.0 SHORELINE ATTRIBUTES

Beyond the shoreline classifcations described in Section 3.4, analysis of the additional data collected will provide more insight into the health of the Rideau River. The Rideau River Biodiversity Project (Nature 2002) found that the river is in relatively good health. However, the natural systems that are in place are fragile.

Waterfront property owners on the Rideau River responded to a questionnaire mailed out by the Lower Rideau Watershed Strategy (LRWS - a set of strategies, created by various management agencies, aiming to use an ecosystem approach to managing the Lower Rideau River and its corridor). Thirty percent of the 2200 residents that received the questionnaire responded (Billington 2003). They identified weed (aquatic vegetation) growth, water quality and erosion as the top three problems on the Rideau River. Parameters closely linked to these problems were recorded in the 2003 Shoreline Study.

5.1 CLASSIFICATION

Shoreline classification percentages are represented in Figure 5.1.1. Ornamental and regenerative designations were close at 37.97% and 40.95% respectively. This is a drop in ornamental frontage percent from 61% in the 2002 study between Mooney's Bay and the Kars Bridge. It is evident that development pressures are less intense, as one moves upstream (away from the heart of the City of Ottawa) along the Rideau River, which is reflected in these figures.

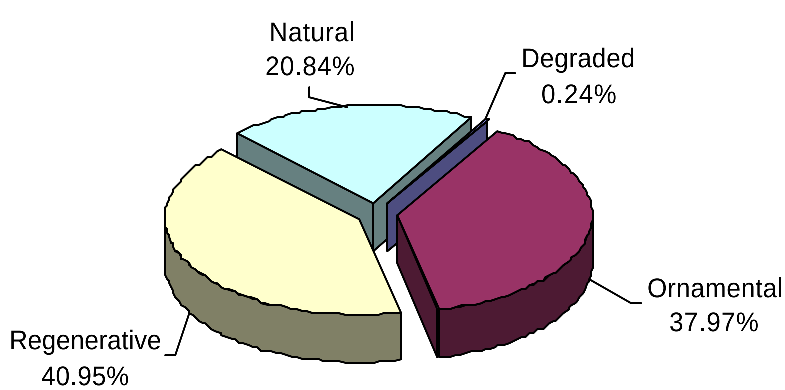

Figure 5.1.1: Shoreline Classification Percent Frontage for Rideau River 2003.

Table 5.1.1 shows the classification frontages, in metres, by map. Regenerative totals exceeded ornamental totals more frequently the further upstream the study progressed. For example, Maps 17, 20, 22 and 40 show much more regenerative frontage than ornamental. This contrasts Maps A, 3, 6 and 9 which follow trends identified in the 2002 study.

Table 5.1.1: Shoreline Classification Frontage by Map for Rideau River 2003.

Map	Degraded Frontage (m)	Ornamental Frontage (m)	Regenerative Frontage (m)	Natural Frontage (m)	Total Frontage (m)
A	0.00	442.52	0.00	0.00	442.52
1	0.00	1767.46	66.56	2646.28	4481.30
3	0.00	3354.07	1366.28	924.32	5647.67
6	0.00	1388.09	216.61	2222.11	3832.81
7	0.00	332.53	223.27	644.95	1207.75
8	0.00	3532.93	1854.14	869.29	6264.36
9	5.15	1858.12	349.41	1678.22	3899.90
10	0.00	75.50	0.00	0.00	85.50
11	0.00	1884.69	1748.41	790.91	4435.01
12	0.00	833.30	124.68	18.15	988.13
13	0.00	4795.37	3080.27	1517.71	9406.35
16	0.00	1154.71	1061.09	1586.24	3818.04
17	38.79	1239.10	2637.59	540.79	4473.27
18	0.00	3005.61	2057.24	1300.64	6381.49
19	33.55	765.87	2717.66	0.00	3536.08
20	0.00	2268.35	8861.87	896.99	12047.21
21	178.15	2999.11	3195.73	0.00	6393.99
22	0.00	1168.80	1799.23	683.73	3673.76
38	0.00	1238.71	188.07	2836.82	4301.60
39	27.53	7840.69	8220.25	2140.82	18268.29
40	7.43	3786.09	9553.21	3797.23	17183.96
Total (m)	290.60	45731.62	49321.57	25095.20	120438.99

5.2 AQUATIC VEGETATION

As mentioned in Section 3.2, macrophytes provide vital habitat for fish and other aquatic organisms. Table 5.2.1 shows dominant macrophyte species observed at the five strata specified in the field sheet and methods. Flowering rush, an invasive, exotic species, was the only species identified in the offshore emergent strata. Poulin had similar findings in water deeper than 1 m in the observations carried out for the Rideau River Biodiversity Project (2001).

Table 5.2.1: Aquatic Plant Species on Rideau River 2003.

Strata	**Species (common name)**	**Species (scientific name)**
Onshore Emergent	Common Cattail	*Typha latifolia*
	Broad-leaved Arrowhead	*Sagittaria latifolia*
	Stiff Arrowhead	*Sagittaria rigida*
	Pickerelweed	*Pontederia cordata*
Offshore Emergent	Flowering Rush	*Butomus umbellatus*
Floating	Yellow Pond Lily	*Nuphar variegatum*
	Fragrant White Water Lily	*Nymphaea odorata*
	European Frogbit	*Hydrocharis morsus-ranae*
	Lesser Duckweed	*Lemna minor*
	Columbia Watermeal	*Wolffia columbiana*
	Dotted Watermeal	*Wolffia borealis*
Algae	There are more than 300 species in Rideau River	
Leafy	Northern Water Milfoil	*Myriophillum sibiricum*
	Eurasian Water Milfoil	*Myriophillum spicatum*
	Bracted Water Milfoil	*Myriophillum verticillatum*
	Common Waterweed	*Elodea canadensis*
	Common Bladderwort	*Utricularia vulgaris*
	Coontail	*Ceratophyllum demersum*
	Common Water Starwort	*Callitriche hermaphroditica*
	Richardson's Pondweed	*Potamogeton richardsonii*
Grass	Tape Grass	*Vallisneria americana*

Figures 5.2.1, 5.2.2, and 5.2.3 show percent littoral zone cover of aquatic vegetation at different strata. Maximum values for littoral zone cover were observed within Map 7 for all vegetation types with the exception of offshore emergents and grasses. The majority of map 7 is on a shoal where slope between the shoreline and the main water channel is relatively low. This agrees with Poulin who found that more gradual slopes provided more suitable macrophyte habitat (2001). Current speed was extremely low in Map 7. Poulin found that species diversity increases as watercourse velocity decreases.

Tape grass cover values were relatively high for most maps. Macrophyte cover, for the entire 2003 study area, was greatest for Grass with a value of 56.38% littoral zone cover. Leafy vegetation values followed with 42.27% cover.

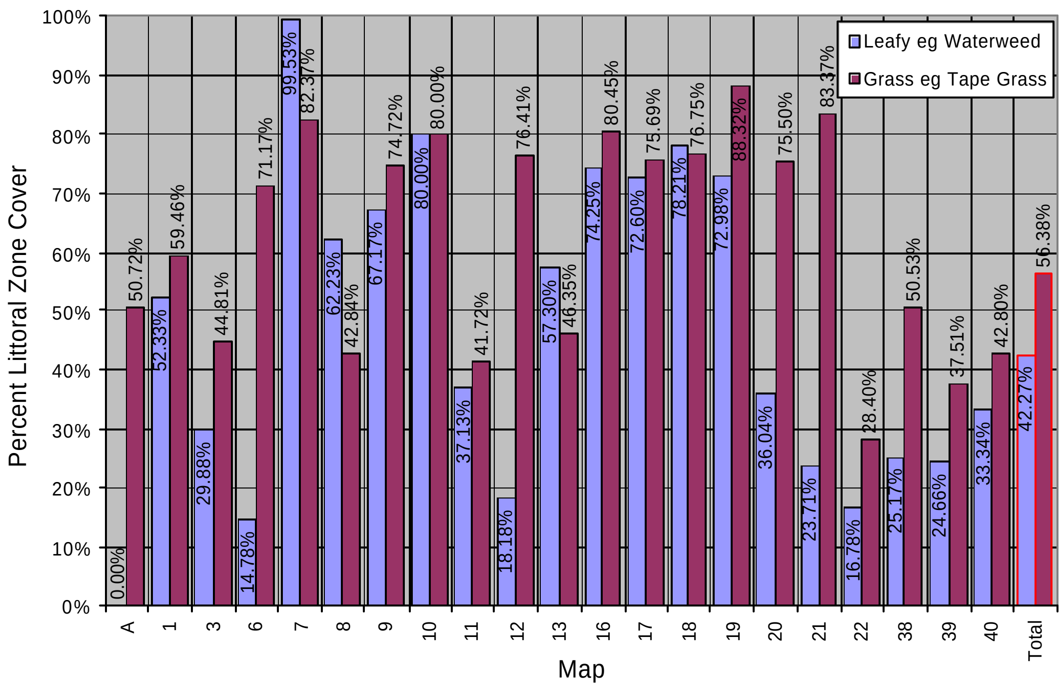

Figure 5.2.1: Submergent Aquatic Vegetation Cover by Map for Rideau River 2003.

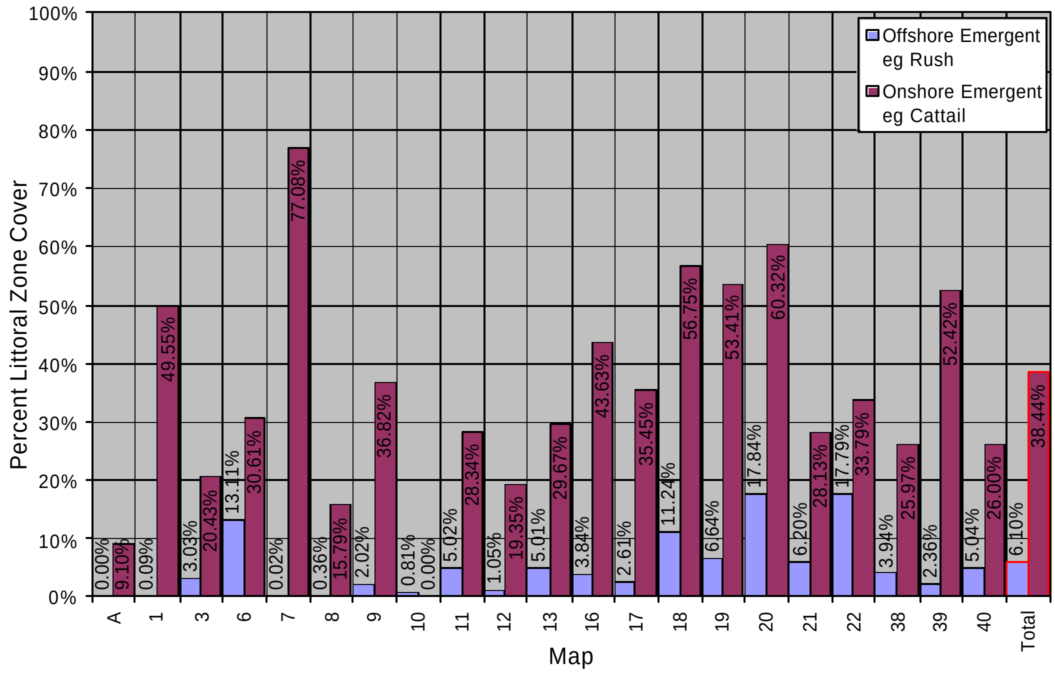

Figure 5.2.2: Emergent Aquatic Vegetation Cover by Map for Rideau River 2003.

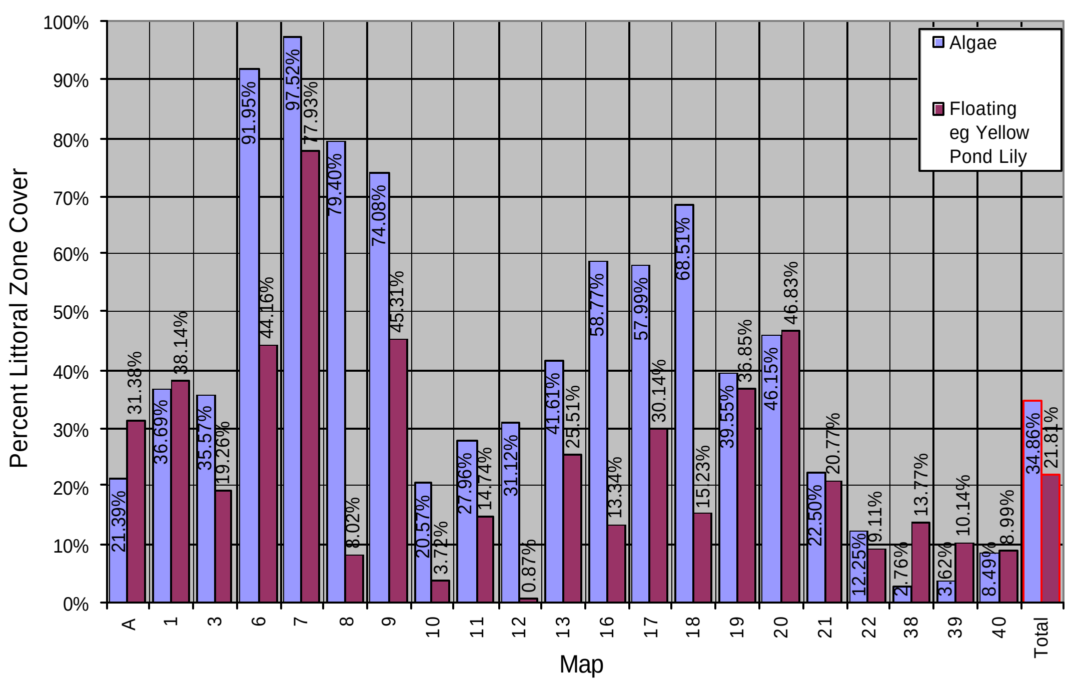

Figure 5.2.3: Floating Aquatic Vegetation and Algae Cover by Map for Rideau River 2003.

Large submergent vegetation and algal blooms were observed in many locations within the 2003 study area. Vegetation growth in deeper waters, closer to the main channel, were recorded near Baxter Conservation Area, the highway 416 bridge, Kemptville Creek, and Rideau River Provincial Park. In all cases, the local residents mentioned that the vegetation growth in these areas was greater than in years past.

There are many ecological reasons why such growth is occurring in these areas. Residential/cottage properties and agricultural lands could have significant nutrient-loading impacts. Also, recent increases in water clarity could change the depth at which submergent vegetation are present. Reasons for changes in location and density of these blooms could be determined through more comprehensive water quality and biodiversity research.

5.3 WATER QUALITY

Data collected that have some sort of impact on water quality include land use and land cover (i.e., terrestrial vegetation). As mentioned in the background section, these attributes have significant impacts on runoff composition. Concerning land use, Figure 5.3.1 shows percent frontage for each land use defined in Appendix B. Natural environment was the dominant land use at 40.95% of total shoreline frontage. The largest contributors to this were natural peninsulas and islands witin Maps 16 to 20 and Map 40. Figure 5.3.2, in part, explains the dominance of natural environment where individual property frontages, on average, were 576.38m. This is much higher than village land use with an average frontage of 47.7m. With the exception of Map 38, properties identified as village were concentrated, closer to Ottawa, into clusters downstream from Becketts Landing. Village land use represents the second highest percentage of total frontage with a value of 22.85%. This was possible at such a small average frontage because there were 544 village properties identified during the field survey out of a total of 948.

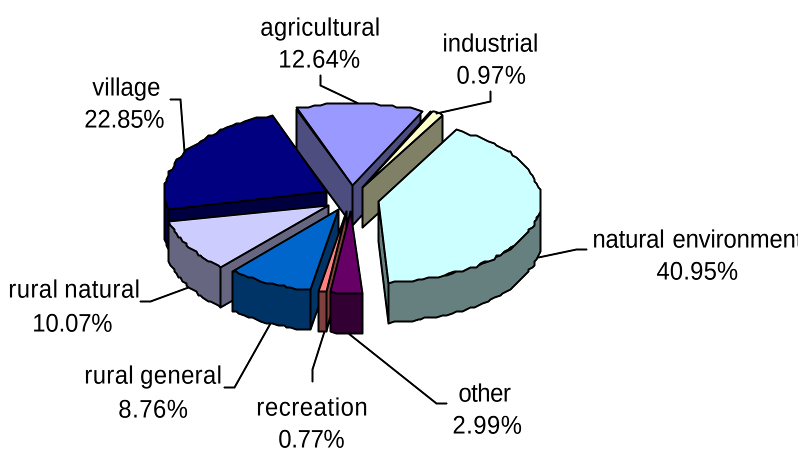

Figure 5.3.1: Land Use Percent Frontage for Rideau River 2003.

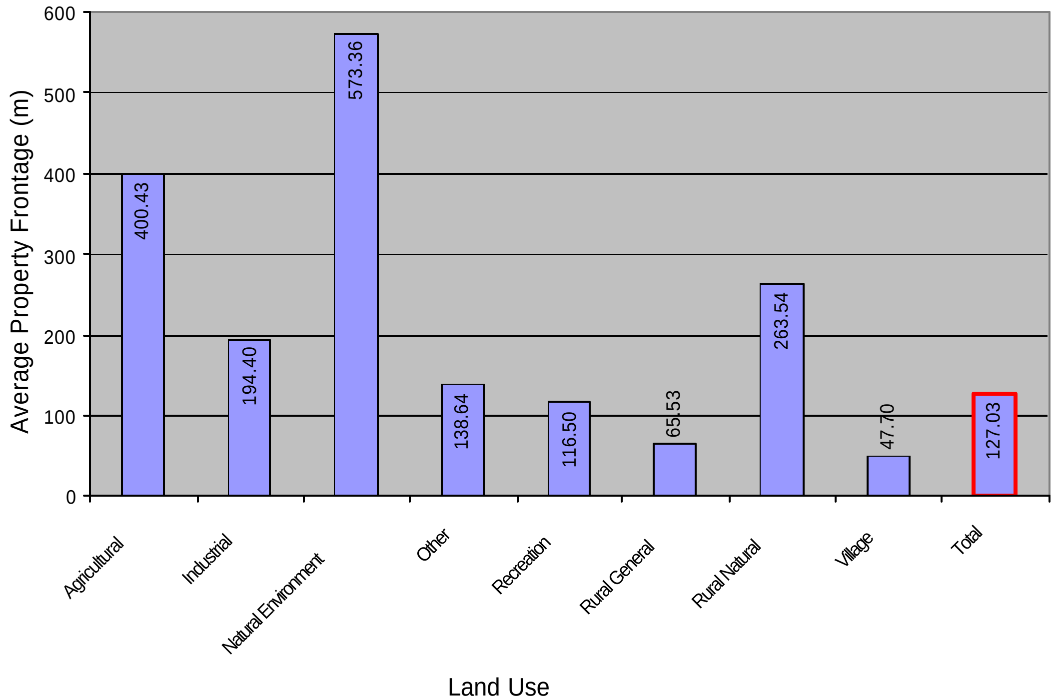

Figure 5.3.2: Average Property Frontage by Land Use for Rideau River 2003.

Agricultural land use represented 12.64% of the 2003 study area. The majority of these properties were concentrated into the area between Burritts Rapids and Becketts Landing. Within the 38 agricultural properties, livestock were observed in the river in 3 locations. A total of 6 properties showed evidence of livestock accessing the river. In all instances a complete lack of riparian plants and signs of widespread erosion were present.

Terrestrial vegetation and its affect on water quality and quantity are outlined in Section 2.1. Canopy coverage, by map, is represented in Figure 5.3.3. No map stands out as having extremely high cover relative to the rest of the study area. Total percent cover for deciduous and coniferous trees combined is 62.74%. However, combinations in some maps of high canopy cover values for one section of the map and extremely low values for another section result in average values for the map as whole. A significant frontage of that map has virtually no canopy. A good example of this is Map 9. The natural environment property immediately upstream from Baxter Conservation Area accounts for 43.13% of the total frontage of Map 9. With 100% canopy coverage on that property, the remaining 57 properties provide another 18.29% canopy cover. Therefore, values for Map 9 as a whole are average however there is fragmentation of wildlife corridors.

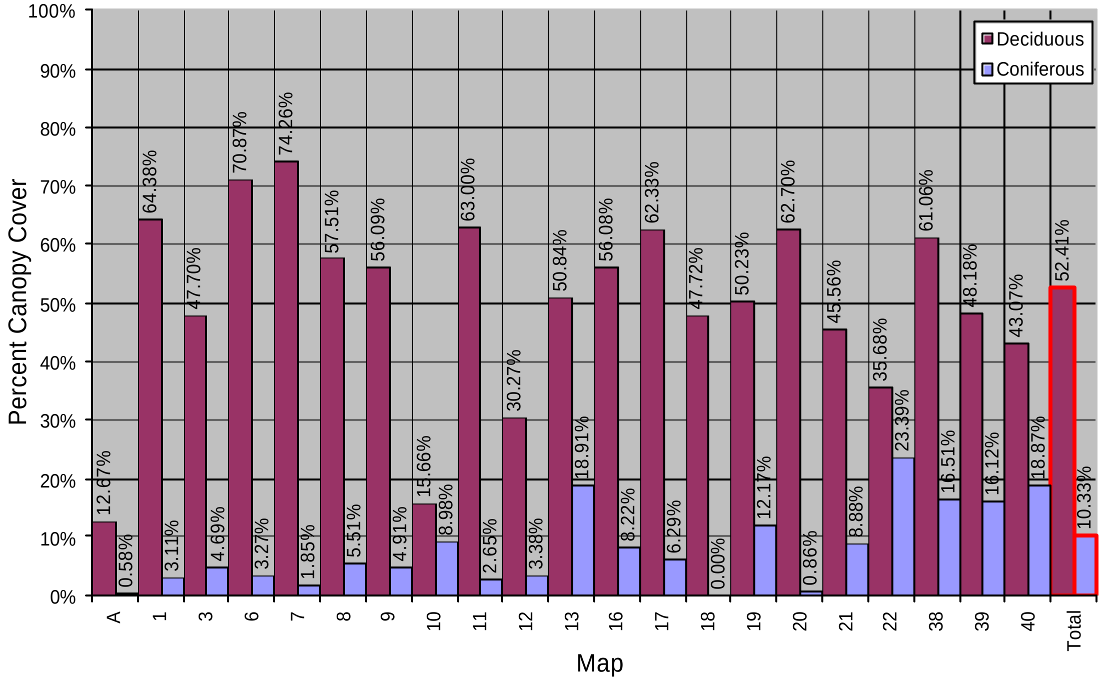

Figure 5.3.3: Percent Shoreline Canopy Cover by Map for Rideau River 2003.

Canopy cover versus land use is shown in figure 5.3.4. Natural Environment, the dominant land use above Becketts Landing, showed the highest values at 82.95% canopy cover. The dominant land uses downstream from Becketts Landing, village and rural general show canopy cover values at 40.28% and 43.20% respectively. This is well below cover for the entire 2003 study area at 62.74%. This helps explain why fragmentation occurs when mixing residential (village and rural general) and natural environment properties.

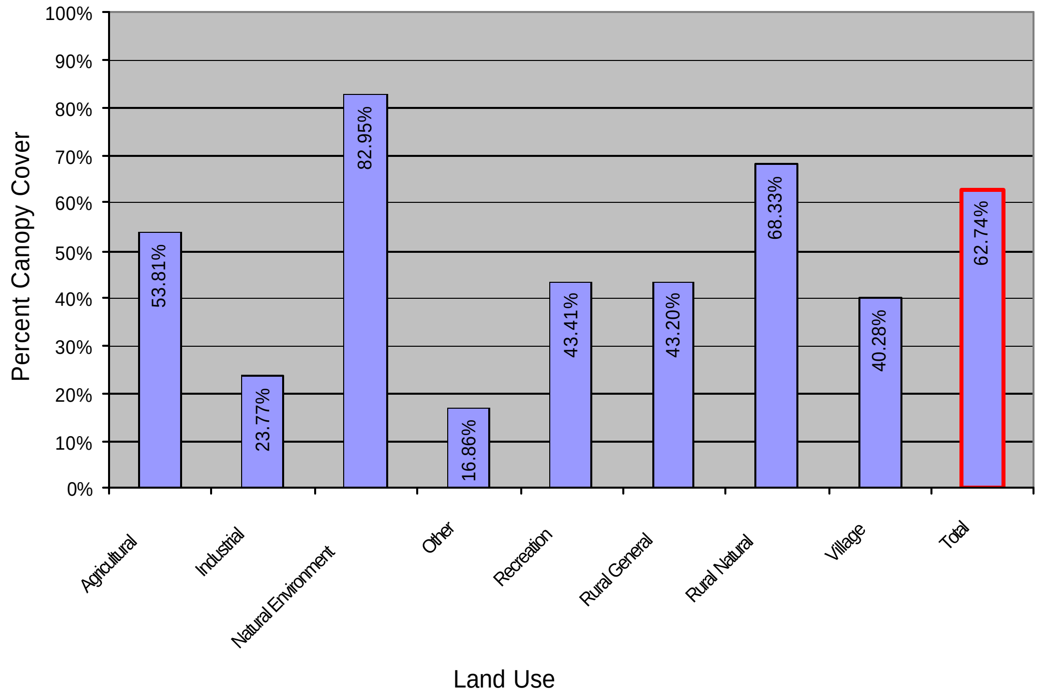

Figure 5.3.4: Percent Shoreline Canopy Cover by Land Use for Rideau River 2003.

Shrub layer composition is represented in Figure 5.3.5. Shrubs dominate this layer with 76.63% shoreline cover. However, by querying the GIS database, it was identified that the majority of the properties with greater than 90% shrub cover were upstream from Becketts Landing. Further queries showed that in this stretch of river 83.86% of the surveyed shoreline had shrub cover. Whereas downstream from Becketts Landing (closer to the City of Ottawa) shrub cover was 55.66%. In the same areas, groomed grass cover was 12.39% and a much higher 29.80%. Queries of the residential land uses, village and rural general, showed shrub cover as 53.01% and groomed grass cover as 43.69%.

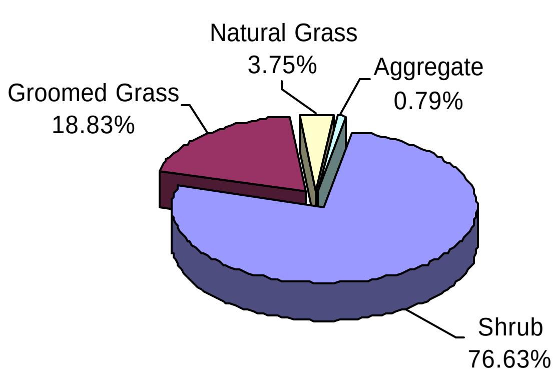

Figure 5.3.5: Shoreline Shrub Layer Composition for Rideau River 2003.

5.4 EROSION

For the entire 2003 study area, 149 properties showed erosion, representing 5.52% of the shoreline. This is shown in Figure 5.4.1. Map A shows the highest value at 24.22%. All of the properties within Map A are classified as ornamental with village land use. Map 3 shows the second most erosion with 15.32%.

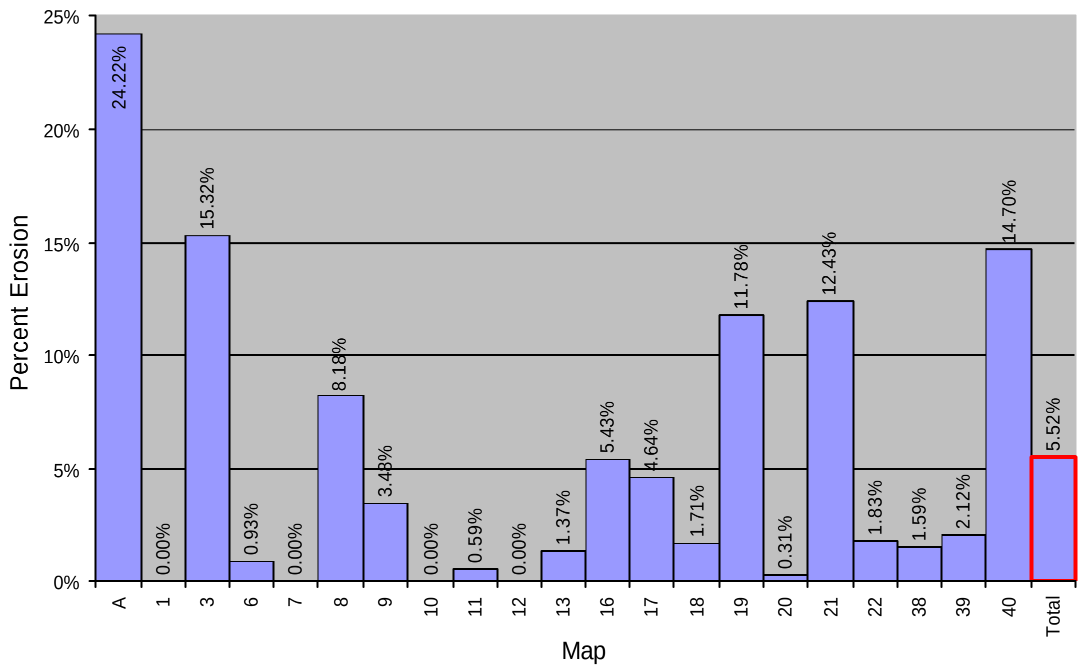

Figure 5.4.1: Percent Shoreline Erosion by Map for Rideau River 2003.

Figure 5.4.2 shows that all erosion observed in Maps A and 3 is toe erosion. However, the map that shows the third highest values, Map 40, has more mass wasting erosion. The volume of sediment that is eroded through mass wasting is much more significant than that associated with toe erosion.

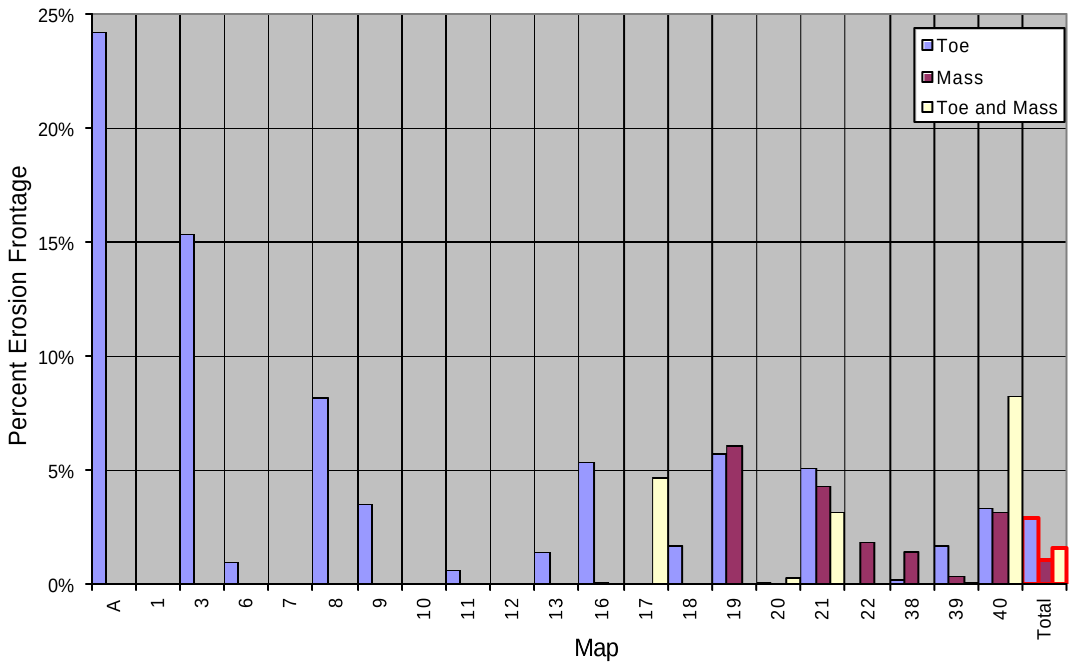

Figure 5.4.2: Percent Erosion Frontage by Type by Map for Rideau River 2003.

Toe erosion is present throughout the 2003 study area. Mass wasting is only present from Map 16, at Becketts Landing, upstream to the limit of study, in Map 38. The relationship between slope and erosion type becomes apparent when comparing slope values on a property by property basis. Slopes between Map 1 and Map 13 have a mean slope of 1:0.12. Those between Map 16 and Map 38 have a mean slope of 1:0.35. Properties with toe erosion have a mean slope of 1:0.24. Those with mass wasting have a much higher mean slope of 1:0.97. Further, properties with both toe erosion and mass wasting have a mean slope of 1:1.15.

6.0 RECOMMENDATIONS

The 2003 Study Area can be split into two distinct reaches. Becketts Landing splits these two stretches. Land use, terrestrial vegetation, and erosion show significant differences upstream and downstream from this location.

One could characterize the reach closer to Ottawa (Maps 1 to 13) as being heavily developed with relatively small, residential properties. Slope is lower and there is much more groomed grass cover than along the upper stretch. There are many properties below Becketts Landing that provide good habitat through diverse terrestrial and aquatic vegetation cover. However, clusters of residential properties fragment these examples of good habitat. This removes continuity in valuable wildlife corridors.

Above Becketts Landing (Maps 16 to 38) the properties become larger, slopes increase and land uses change. Agricultural properties are concentrated into this reach.

General recommendations, derived from the 2003 study results, are different for the above mentioned reaches, upstream and downstream from Becketts Landing. Closer to the City of Ottawa, river health initiatives should focus on residential properties, whereby landowners in this area are provided with further information about improving the ecological viability of their shoreline properties and the health of the Rideau River. Informing landowners and facilitating change in shoreline practices and attitudes will benefit both the watercourse and its shoreline landowners. The LRC, accessible in Manotick and on the internet, offers extensive resources for ecological waterfront property management. The LRWS Questionnaire results showed the use of available brochures and self help methods for naturalization as the most likely action to be taken by landowners (Billington 2003).

Further upstream, the scale of river health initiatives needs to be much larger. The erosion problems associated with increased slopes and agricultural land uses reach across many properties. Livestock accessing the river, for watering purposes, is another issue concentrated in this reach. Both the City of Ottawa and Rideau Valley Rural Clean Water Programs are designed to assist landowners with on-site erosion control and water quality projects. Grants and technical assistance are offered to qualifying landowners. The overall health of the watershed depends on programs such as these. Continued funding and implementation will give landowners the help they need to minimize land use impacts in water quality and increase shoreline habitat viability.

7.0 CONCLUSION

The issues raised in this paper will provide a background for further analysis of the data set created in 2003. Relationships between the different parameters observed may offer some clues for other indicators of river health and what protective/mitigative measures should be considered to conserve and improve the diverse aquatic and terrestrial habitats in and along the shoreline of the Rideau River.

The 2003 study managed to refine the Shoreline Classification Protocol to achieve a higher level of detail in areas deemed significant by RVCA and Parks Canada staff. As the study moves further upstream towards Smiths Falls and possibly into some of the main tributaries of the Rideau River, it is inevitable that there will be some additional refinements to the protocol. This will ensure the collected data are usable and sharable for planning and regulatory purposes, as well as resource management activities along the Rideau River.

8.0 RESOURCES

Much of the 2003 Shoreline Classification data is accessible on the RVCA Watershed Information System website
(RVCA WIS – www.rideauvalley.on.ca/watershed/index.html)

The LandOwner Resource Centre (www.lrconline.com) in Manotick, Ontario has endless resources for the individual looking to improve the ecological integrity of their shoreline property. Specifically, Ontario Ministry of Natural Resources Extension Notes (www.lrconline.com/EN_splash.html) are available in hard copy or PDF format.

Caring for Shorelines (www.caringforshorelines.ca)

Living By Water Project (www.livingbywater.ca)

Mutual Association for the Protection of Lake Environment in Ontario Inc.
(MAPLE Inc. - www.rideauvalley.on.ca/maple)

Rideau River Biodiversity Project (www.nature.ca/rideau/index-e.html)

Incentive Programs:

Rideau Valley Rural Clean Water Program
(www.rideauvalley.on.ca/programs/rcwp/rvca_rcwp.html)

City of Ottawa Rural Clean Water Program
(www.rideauvalley.on.ca/programs/rcwp/ottawa_rcwp.html)

Some specific publications include:

The Dock Primer – Max Burns, Cottage Life and Fisheries and Oceans Canada (www.dfo-mpo.gc.ca/canwaters-eauxcan/infocentre/guidelines-conseils/guides/dock-primer/dock1_e.asp)

The Shore Primer – Ray Ford, Cottage Life and Fisheries and Oceans Canada (www.dfo-mpo.gc.ca/canwaters-eauxcan/infocentre/guidelines-conseils/guides/shore-primer/shore1_e.asp)

Working Around Water - Fact Sheet Series – Conservation Ontario, Ontario Ministry of Natural Resources, Fisheries and Oceans Canada and Parks Canada (www.fish-habitat.com/waw/index_e.html)

9.0 GLOSSARY OF TERMS

Biodiversity – Index of number of different species in a community or ecosystem and the relative abundance of each.

Cantilever Dock – A dock that hangs over the shoreline, never touching the water. Great efforts must be made to secure this type of dock to the shoreline.

Crib Dock – The dock is built on a box, constructed of wood or metal, that is filled with rocks and debris to keep it in place. A Solid Crib supports the full length of the dock. A Span Crib has open space between two or more supports.

Detritus - Small pieces of dead and decomposing plants and animals. E.g. leaves, twigs.

Erosion - The removal, transport and deposition of soil and rock particles by natural forces such as water and wind.

Eutrophication – Increases in the concentration of nutrients in a watercourse result in the stimulation of aquatic vegetation growth. The decomposition of this plant material depletes dissolved oxygen needed by fish and other organisms.

Fragmentation - The breaking up of a continuous habitat, ecosystem, or land-use type into smaller fragments. This represents a major threat to biodiversity and the health of ecosystems.

Gabion Basket – Rectangular basket made of steel wire mesh, filled with stones. Used for retaining wall construction and erosion control.

Littoral Zone. The onshore area of body of water, extending from the shore to the limits of rooted aquatic plants.

Macrophyte - Aquatic plants, growing in or near water that are either emergent, submergent, or floating.

Mass Wasting Erosion - Once a bank has been undercut by toe erosion, gravity can cause a large mass of the shoreline to slide or slump. This can expose large areas of the shoreline. Erosion forces then have less difficulty removing the remaining exposed material further.

Mitigation - Measures added to a project to reduce, prevent, or correct its impact.

Overstory – Also known as the canopy, trees at this level are taller than all others in the same vegetation community.

Rip Rap – Loose fragments of broken rock used for bank stabilization and channel lining material.

Riparian Zone - The physical and biological environment adjacent to a river or stream that significantly influences, and/or is significantly influenced by, the watercourse. These zones provide functional linkages between terrestrial and aquatic ecosystems through organic matter input, bank stability, water temperature regulation, sediment and nutrient flow regulation, and maintenance of unique wildlife habitat.

Species (Taxa) Richness - The number of species present in a community or ecosystem.

Substrate – The material that lines the floor of a watercourse.

Toe Erosion - The flow of water at the base of a shoreline removes material and eventually causes an unstable, overhanging bank.

Wildlife Corridor – Areas along which animals can travel, plants can propagate, genetic interchange can occur, populations can move in response to environmental changes and natural disasters, and threatened species can be replenished from other areas.

10.0 LITERATURE CITED

Allan, J.D., M.S. Wipfli, J.P. Caouette, A.Prussian, and J. Rodgers. 2003. Influence of streamside vegetation on inputs of terrestrial invertebrates to salmonid food webs. Can. J. Fish. Aquat. Sci. **60**: 309–20

Belsky, A.J., A. Matzke, and S. Uselman. 1999. Survey of Livestock Influences on Stream and Riparian Ecosystems in the Western United States. J. of Soil and Wat. Cons. **54**: 419-31.

Billington, C. 2003. Shoreline Landowner Questionnaire Results. Lower Rideau Watershed Strategy.

Crowder, A.A., J.P. Smol, R. Dalrymple, R. Gilbert, A. Mathers, and J. Price. 1996. Rates of natural and anthropogenic change in shoreline habitats in the Kingston Basin, Lake Ontario. Can. J. Fish. Aquat. Sci. **53**(Suppl. 1): 121–35.

Eubanks, C.E., and D. Meadows. 2002. A Soil Bioengineering Guide for Streambank and Lakeshore Stabilization. U.S. Dept of Agriculture and Forest Service. http://www.fs.fed.us/publications/soil-bio-guide.

Ford, R.. 1999. The Shore Primer. Cottage Life and Fisheries and Oceans Canada.

Hannon, S.J., C.A. Paszkowski, S. Boutin, J. DeGroot, S.E. Macdonald, M. Wheatley, and B.R. Eaton. 2002. Abundance and species composition of amphibians, small mammals, and songbirds in riparian forest buffer strips of varying widths in the boreal mixedwood of Alberta. Can. J. For. Res. **32**: 1784–1800.

Johnson T.E., W.C. Hession, D.F. Charles, R.J. Horwitz, D.A. Kreeger, B.D. Marshall, J.D. Newbold, J.E. Pizzuto, and D.J. Velinsky. 2001. An Interdisciplinary Study of the Ecological Benefits of Riparian Reforestation in Urban Watersheds. In: D. Phelps, and G. Sehlke (eds), Proceedings of the World Water and Environmental Resources Congress, May 20-24, 2001, Orlando, FL. American Society of Civil Engineers.

Nature. 2002. The Nature of the Rideau River. Rideau River Biodiversity Project. http://www.nature.ca/rideau (25 February 2004).

Poulin, M. 2001. A Multidisciplinary, Community-Based Study of the Environmental Health of the Rideau River: Final Report. Canadian Museum of Nature.

Randall, R.G., C.K. Minns, V.W. Cairns, and J.E. Moore. 1996. The relationship between an index of fish production and submerged macrophytes and other habitat features at three littoral areas in the Great Lakes. Can. J. Fish. Aquat. Sci. **53**(Suppl. 1): 35-44.

Richards, C., L.B. Johnson, and G.E. Host. 1996. Landscape-scale influences on stream habitats and biota. Can. J. Fish. Aquat. Sci. **53**(Suppl. 1): 295–311.

Rosgen, D.L. 2001. A Practical Method of Computing Streambank Erosion Proceedings of the Seventh Federal Interagency Sedimentation Conference. **2**: pp. II - 9-15, March 25-29, 2001, Reno, NV.

Stauffer, J.C., R.M. Goldstein, and R.M. Newman. 2000. Relationship of wooded riparian zones and runoff potential to fish community composition in agricultural streams. Can. J. Fish. Aqaut. Sci. **57**: 307–16.

Wohl, N.E. and R.F. Carline. Relations among riparian grazing, sediment loads, macroinvertebrates, and fishes in three central Pennsylvania streams. Can. J. Fish. Aquat. Sci. **53**(Suppl. 1): 260–6.

APPENDIX A: FIELD SHEETS

Property Description Form (Field Sheet) Side 1 of 2

Property Number Digital Photo Reference Number	Municipal Address	Tax Roll #
% Classification: Degraded [ ] Ornamental [ ] Regenerative [ ] Natural [ ]	GPS UTM (NAD83) E [ ] N [ ] E [ ] N [ ]	
Embankment - Depth (horizontal distance from shore — metres) [ ] - Frontage (metres) [ ] - Slope Angle (percentage) [ ]	Retaining Wall (Height in metres): [ ] - Type: Concrete Block [ ] Poured Concrete [ ] Concrete pipe [ ] Riprap [ ] Gabion Basket [ ] Loose Rock [ ] Steel [ ] Wood [ ] Other ( ) [ ] Percentage of frontage: [ ]	
% Shoreline Cover (Natural) VEGETATION: - Canopy [ ] - Trees (C) [ ] - Bedrock[ ] - Trees (D) [ ] - Boulder [ ] - Shrubs [ ] - Rock [ ] - Grasses Groomed [ ] - Sand [ ] - Grasses Natural [ ] - Silt [ ] - Other( ) [ ] - Clay [ ]	Erosion - Toe [ ] Mass Wasting [ ] - Percentage of lot frontage affected [ ] Dock Type: D1 [ ] D2 [ ] D3 [ ] D4 [ ] D5 [ ] Other ( ) [ ]	
% Aquatic Vegetation Cover - Emergents: On-Shore [ ] Off-Shore [ ] - Floating: Lily-Type plants [ ] - Submergents: Algae [ ] Leafy [ ] Grass [ ]	Land Use Agricultural [ ] Natural Environment[ ] Recreation [ ] Rural General [ ] Rural Natural[ ] Village[ ] Industrial [ ] Other ( ) [ ]	
Aquatic Substrate/Cover: Bedrock [ ] Boulders [ ] Rubble [ ] Gravel [ ] Sand [ ] Silt [ ] Clay [ ] Muck [ ] Detritus [ ] Downed Trees [ ] Woody debris [ ] Other ( ) [ ]	% Shoreline Cover (Built) Deck [ ] Boat Lift [ ] Boat Ramp [ ] Boat Slip [ ] Boathouse [ ] Buildings [ ]	
Surveyed by Survey Date:		

Property Description Form (Field Sheet) Side 2 of 2

Description:
Plan View:
Profile:

Offshore Floating Objects Description Form
(Field Sheet)

Nearest Property Number(s)	Municipality
Photo Reference Number	GPS UTM (NAD83) E N
Floating Object Type:	Nearby Aquatic Vegetation Emergent: (Cattail [ ] Rush [ ] Submergent / Floating [ ]
Description	
Sketch Plan View	Profile
Surveyed by	Survey Date

2003 Public Notice

RIDEAU VALLEY CONSERVATION AUTHORITY
SHORELINE CLASSIFICATION PROJECT

Purpose:	To map the natural and human-made features of the shoreline of the Rideau River and to classify the shoreline into categories based on degrees of degradation and health.
Where:	All shoreline information from Mooney's Bay to Smith Falls will be mapped.
What:	All information to human-made features such as buildings, retaining walls or other stabilizing structures, docks, boat houses, beaches, storm sewer outlets, swim rafts etc. will be mapped. Land use will be determined (Agricultural, Natural Environment, Rural, Industrial, Recreational and Village). A photo will be taken of each property included in the study.
Why:	The information collected will be used by planning and regulations staff of both the RVCA and Parks Canada, Rideau Canal Office to assist with planning regulation issues. This information will allow prompt accurate responses to development applications. This study will also indicate areas where shoreline erosion or degradation has occurred and can be used to identify areas for rehabilitation. This classification will contribute towards the Lower Rideau River Watershed Study.

Contact Information:

Project Manager:

Technicians:

APPENDIX B: LAND USE DEFINITIONS

Agricultural	Land that is primarily used for the production of crops and livestock.
Industrial	Land that is used for industry and commercial applications. This includes manufacturing, repair and storage.
Natural Environment	Land that has a high level of natural community and/or species diversity. Vegetative communities are large enough to provide high quality terrestrial and aquatic habitat and perform important hydrologic functions.
Other	Land that does not fall within the other provided definitions. An example of this would be the many lock stations within the 2003 study area.
Recreation	Also referred to as Open Space, this is common land that is used by the public. A public municipal park would be an example of this.
Rural General	Land that has less resource potential than other parts of the surrounding rural area. Waterfront use of this land is primarily residential. Frontages are larger than properties identified as village.
Rural Natural	Land that is currently going through succession back to a natural environment state from agricultural or developed land use.
Village	Land that is used for residential development along the shoreline. Property frontage is the smallest of all land uses.