

# **Green Lake, B.C. Lakeshore Survey**

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By

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## **ABSTRACT**

A lakeshore survey was completed for the North shore and South shore of Green Lake by motor boat on June 18<sup>th</sup> and 19<sup>th</sup> 2008 in preparation for a long-range community land and resource planning exercise and for future lakeshore analysis and water quality evaluations.

A photograph and video catalogue was created of the developed lakeshore on Green Lake to help better understand the nature of development on all lakeshore lands and foreshore areas and its effect on water quality. Particular attention was given to the riparian buffer zone left along the lakeshore, human-induced shoreline erosion from development and boating activity, the use of breakwaters and/or retaining walls, the setback distance of houses and outhouses from the lake, and the presence of imported sand, gravel, or treated wood structures. Overall the majority of developed lots on both the North and South shores of Green Lake showed suboptimal riparian buffers as reflected in the moderate or lower classifications, suggesting that the overall condition of the lakes riparian buffer needs improvement. Noticeable areas of concern included erosion, the presence of breakwaters and/or retaining walls, and building infringement. Also many of the new lakeshore developments were contributors to these areas of concern suggesting that this may become an increasing problem in the future.

In order to maintain and/or improve Green Lake's water quality, lakeshore lands, and foreshore areas it is important to continue educating lakeshore owners and/or developers on the importance of maintaining a natural vegetative riparian buffer zone and following proper lakeshore practices as outlined in the CRD Lakeshore Management Policy and the TNRD Lakeshore Development Guidelines. Continual observation should also be maintained to ensure that Green Lakes water quality, lakeshore lands, and foreshore areas are maintained for generations to come.

# **INTRODUCTION**

## **Green Lake Facts**

The Green Lake area is a land rich in history, wide open spaces, and abundant wildlife. Green Lake is known for its clear blue-green water and is located approximately 40km South of 100 Mile House (Appendix A). It is an oligotrophic lake, a lake with low primary productivity, resulting from low nutrient content. Its perimeter is 65.3km in length of which 36% is privately owned and 64% is crown land. It has a surface area of 2310ha, and a mean depth of 10.3m (CRD 2004). The North shore of Green Lake supports approximately 148 developed lots and the South shore of Green Lake supports approximately 273 developed lots both of which include summer cabins, permanent residences, RV parks, resorts, and public access parks, boat launches, and roads.

## **What is a Riparian Buffer Zone?**

A riparian buffer zone is a natural vegetation retention zone along the water's edge that is influenced by the water body and water table and plays a crucial role for many living things. When a shoreline is cleared and native vegetation removed along with any rocks, logs, root wads, and boulders the erosion risk increases. This can result in the physical loss of shoreline property, increased flood risk, pollution from runoff, changes in nutrient input, and destruction of fish and other wildlife habitat.

## **What is the Benefit of Having a Riparian Buffer Zone?**

The riparian buffer zone acts as an erosion protection device, flood control method, pollution prevention method, and fish and wildlife habitat and preservation area along the water's edge. The roots of a riparian buffer reinforce the soil and sand and help to hold them together preventing land loss by protecting the shoreline from slumping or being washed away. It is more desirable to have riparian species in the riparian zone versus

upland species (i.e. typical lawn grass) because riparian species have deeper rooting capabilities and better soil holding capacities making them more efficient at reducing erosion. The leaves and plants also reduce the energy of waves and currents, slow runoff, and reduce the force of falling rain protecting the shoreline from erosion.

Vegetation, rocks, logs and boulders slow down flood waters thus reducing damage to shoreline property. Vegetated riparian buffers can affect water quality by slowing down and retaining water, settling particles, and removing nutrients and other chemicals from runoff from yards, roads, fields, and septic systems before it reaches the lake water. If properly established, a full riparian buffer can remove at least:

- 50% of chemical fertilizers
- 60% of some bacteria
- 75% of sediment (Kipp and Callaway 2002).

The riparian buffer zone provides food, nesting cover, and shelter for fish and other wildlife. It is a connecting habitat corridor enabling wildlife to safely move from one area to another and provides cover and shade keeping the water cool for fish. Insects and litter from vegetation also provides food and nutrients for aquatic life.

A vegetated riparian buffer zone is vitally important to the lakes ecosystem. It provides shade in the summer, and protection in the winter, privacy from activities on the water and other residences, and protects lakeshore property and water quality. Overall a riparian buffer results in an increased quality of life for everyone involved.

## **METHODS**

The North shore of Green Lake was surveyed by motor boat on June 18, 2008 and the South shore on June 19, 2008. A photograph and video catalogue (Appendix C) was created for both of Green Lakes developed shorelines and foreshore areas to help better understand the nature of all lakeshore development. Particular attention was given to the

riparian buffer zone left along the lakeshore, human-induced shoreline erosion from development and boating activity, the use of breakwaters and/or retaining walls, the setback distance of houses and outhouses from the lake, and the presence of imported sand, gravel, or treated wooden structures in or near the water. The method used is summarized below:

- A photograph was taken of each development, including public accesses, Crown land and parks;
- Notes were taken regarding riparian buffer classification, building infringement, visible erosion, and any questionable land uses such as erosion control methods, visible pipes, artificial beaches, and treated wood structures in or near the water, and the excessive removal of vegetation;
- Video footage was taken of the entire foreshore to determine general shoreline condition and to ascertain the proportion of developed land.

Lakeshore survey guidelines (Appendix B) were developed based on the Cariboo Regional Districts Shoreland Management Policy, the Thompson Nicola Districts Lakeshore Development Guidelines and Interior Health information. They were then used to classify the riparian buffer zones of each developed property on the lakeshore. In addition all visible areas of concern such as erosion, breakwaters and/or retaining walls, visible pipes, artificial beaches, and treated wood structures in or near the water were noted for each site. The data collected was then categorized and analyzed to provide an indication of the nature of current development on the Green Lake lakeshore lands and foreshore areas. From this information some conclusions and recommendations were made to improve and/or maintain the quality of these areas both for now and the future.

The information gathered by the study will also be used by the Cariboo Regional District and the Thompson Nicola Regional District as baseline data to assist with policy

development in conjunction with the Watch Lake, Green Lake, 70 Mile House and Area Official Community Planning exercise.

## RESULTS

### Green Lake Data

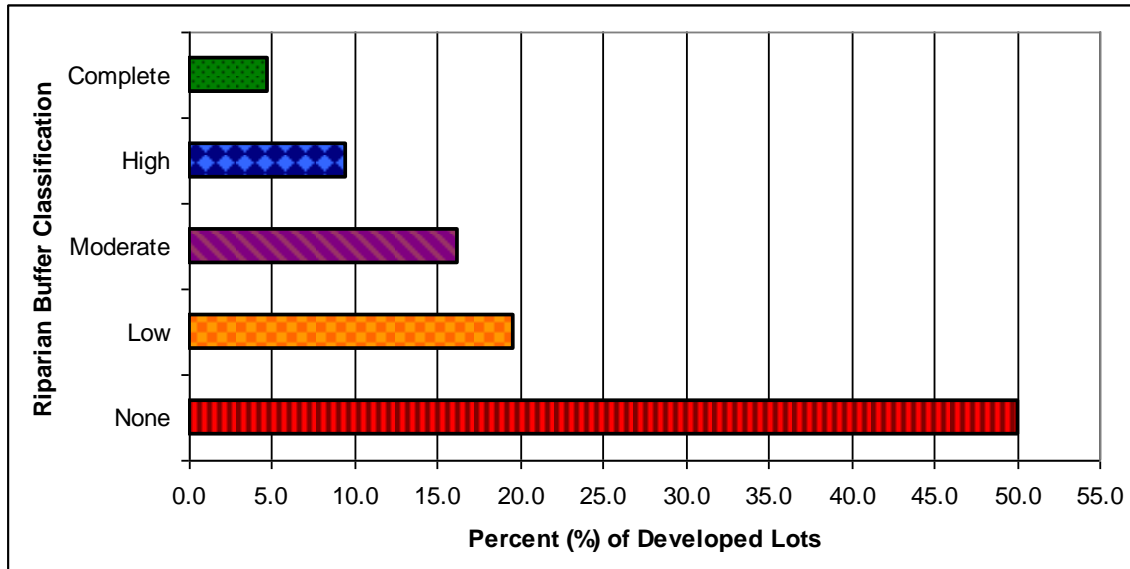
<b>Location:</b>	40km South of 100 Mile House		
<b>Ownership:</b>	36% - private and 64% - crown land		
<b>Developed Lots:</b>	approx. 421 lots	<b>Surface area:</b>	2310ha
<b>Elevation:</b>	1069m	<b>Mean depth:</b>	10.3m
<b>Perimeter:</b>	65.3km	<b>Flushing period:</b>	Unknown

**TABLE 1.1** – Summary of Data for the North Shore of Green Lake\*

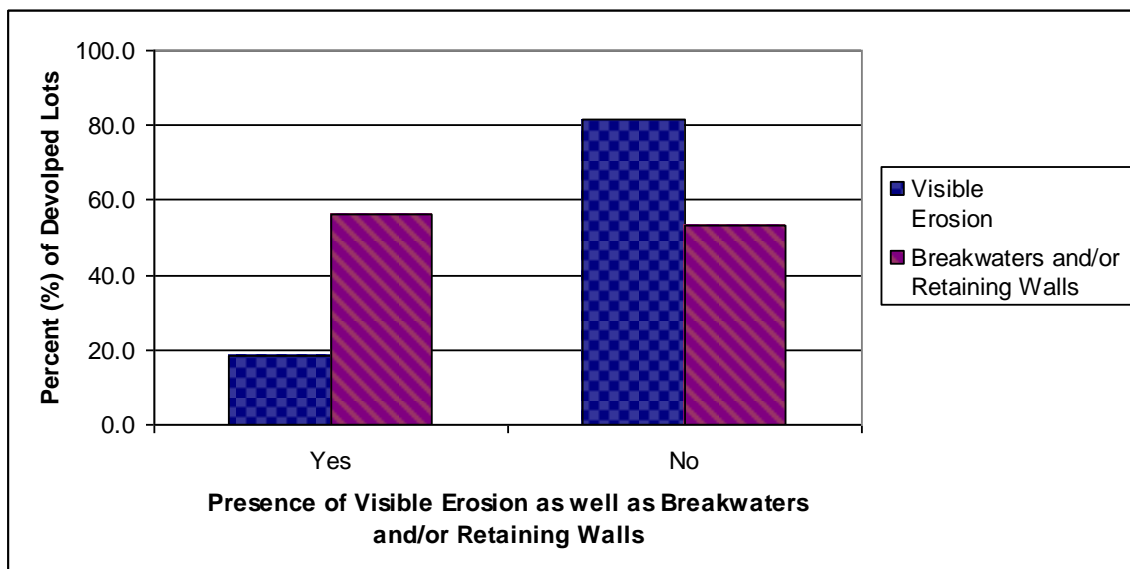
<b>DEVELOPMENT</b>	<b>TOTAL # of Developed Lots</b>	<b>% of Developed Lots</b>
Total Number of Developed Lots	148.0	100
Building Infringement	105.0	70.9
Outhouse Infringement	6.0	5.7
<b>BUFFER CLASSIFICATION</b>	<b>TOTAL # of Developed Lots</b>	<b>% of Developed Lots</b>
No Riparian Buffer	74.0	50.0
Low Riparian Buffer	29.0	19.6
Moderate Riparian Buffer	24.0	16.2
High Riparian Buffer	14.0	9.5
Complete Riparian Buffer	7.0	4.7
<b>OTHER</b>	<b>TOTAL # of Developed Lots</b>	<b>% of Developed Lots</b>
Visible erosion	27.0	18.2
Breakwaters/Retaining walls	83.0	56.1
Treated wood structures	34.0	23.0
Visible Pipes in water	36.0	24.3

\* The data compiled in this summary is the result of field data obtained by boat that has been electronically entered from field data sheets (Appendix B) and analyzed yielding the above results. Thus it may not be completely accurate when compared with current lot maps and lot numbers.

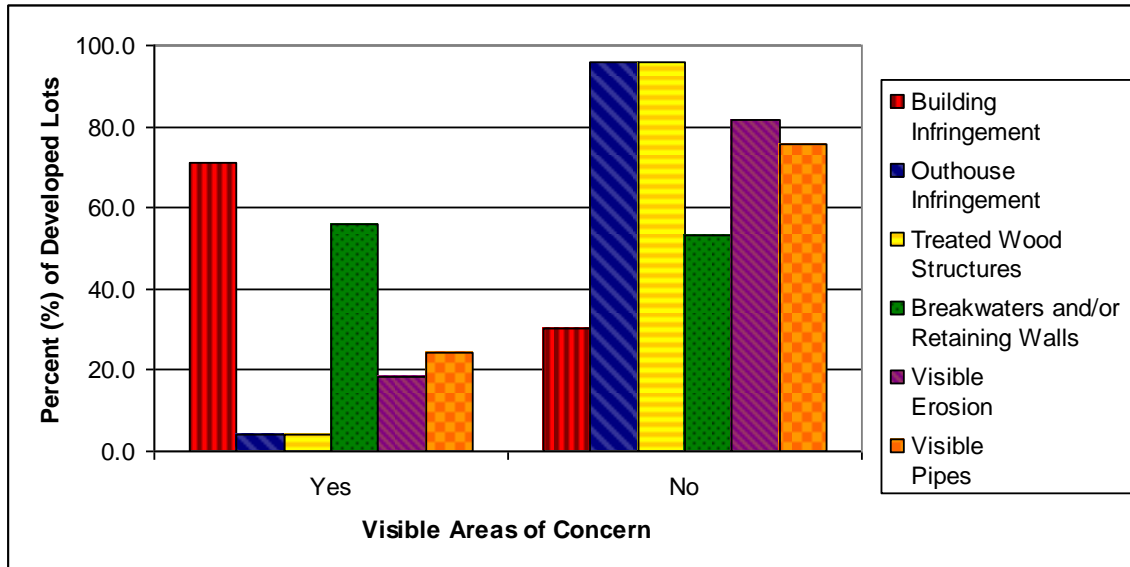
\*Setback distances for buildings and outhouses are based on the lakeshore survey guidelines (Appendix B)



**FIGURE 1.1** – A comparison of riparian buffer classification showed that the majority of the developed lakeshore on Green Lakes North shore was within the moderate riparian buffer classification and lower. 16.2% Moderate, 19.6% Low, and 50.0% None, the classifications were based on the lakeshore survey guidelines (Appendix B).



**FIGURE 1.2** – 18.2% of developed lots on the North shore of Green Lake showed signs of erosion. This could be due in part to 56.1% of developed lots having breakwaters and/or retaining walls. The presence of a breakwater and/or retaining wall can promote erosion on neighbouring lots due to the deflection of waves and water currents from one shore onto another increasing the erosion risk.



**FIGURE 1.3** – An overview of the visible areas of concern clearly showed that the most visible concerns were building infringement and the presence of breakwaters and/or retaining walls. 70.9% of the buildings on the North shore were less than 15m from the high water mark. The setback distances are based on the lakeshore survey guidelines (Appendix B). 56.1% of developed lots had breakwaters and/or retaining walls which can promote erosion on neighbouring lots due to the deflection of waves and water currents from one shore onto another increasing the erosion risk.

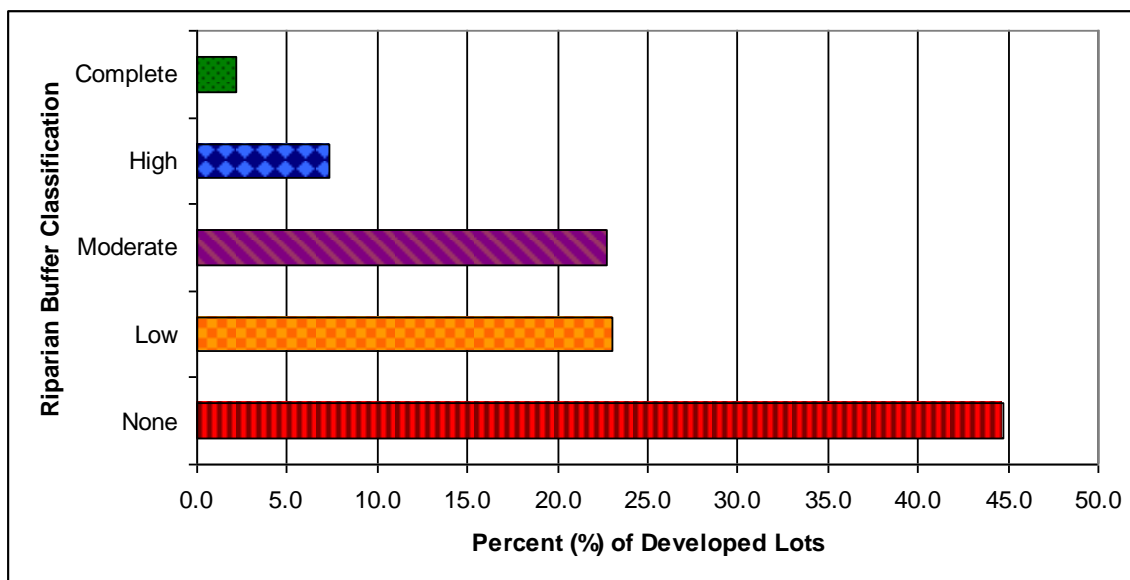
**TABLE 2.1** – Summary of Data for the South Shore of Green Lake\*

DEVELOPMENT	TOTAL # of Developed Lots	% of Developed Lots
Total Number of Developed Lots	273.0	100
Building Infringement	215.0	78.8
Outhouse Infringement	9.0	3.3
BUFFER CLASSIFICATION	TOTAL # of Developed Lots	% of Developed Lots
No Riparian Buffer	122.0	44.7
Low Riparian Buffer	63.0	23.1
Moderate Riparian Buffer	62.0	22.7
High Riparian Buffer	20.0	7.3
Complete Riparian Buffer	6.0	2.2
OTHER	TOTAL # of Developed Lots	% of Developed Lots
Visible erosion	40.0	14.7
Breakwaters/Retaining walls	199.0	72.9
Treated wood structures	37.0	13.6
Visible Pipes in water	57.0	20.9

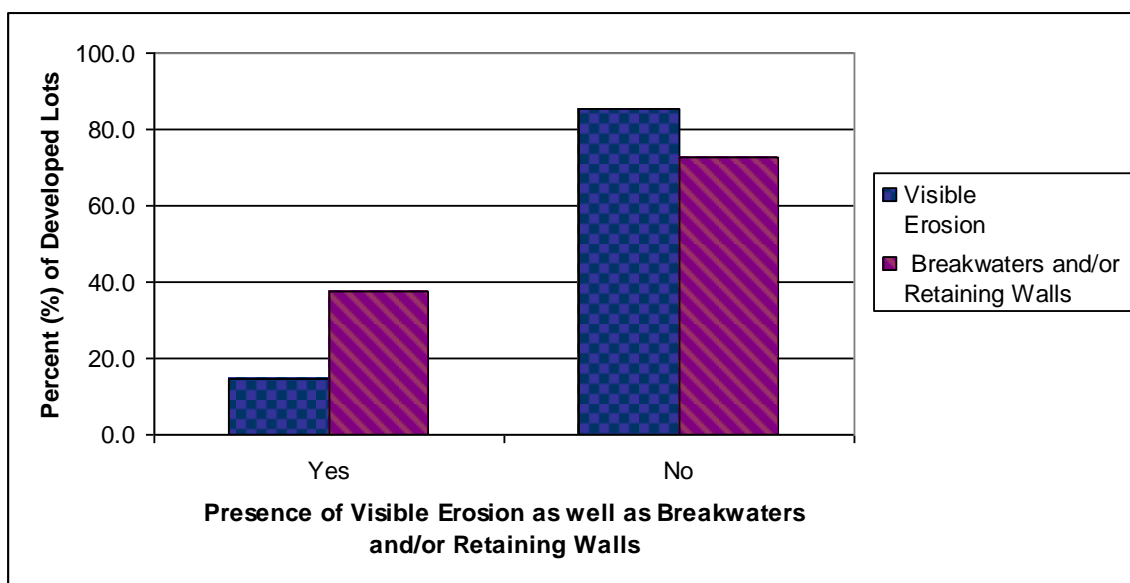
\* The data compiled in this summary is the result of field data obtained by boat that has been electronically entered from field data sheets (Appendix B) and analyzed yielding the above results. Thus it may not be completely accurate when compared with current lot maps and lot numbers.

\*Setback distances for buildings and outhouses are based on the lakeshore survey guidelines (Appendix B)

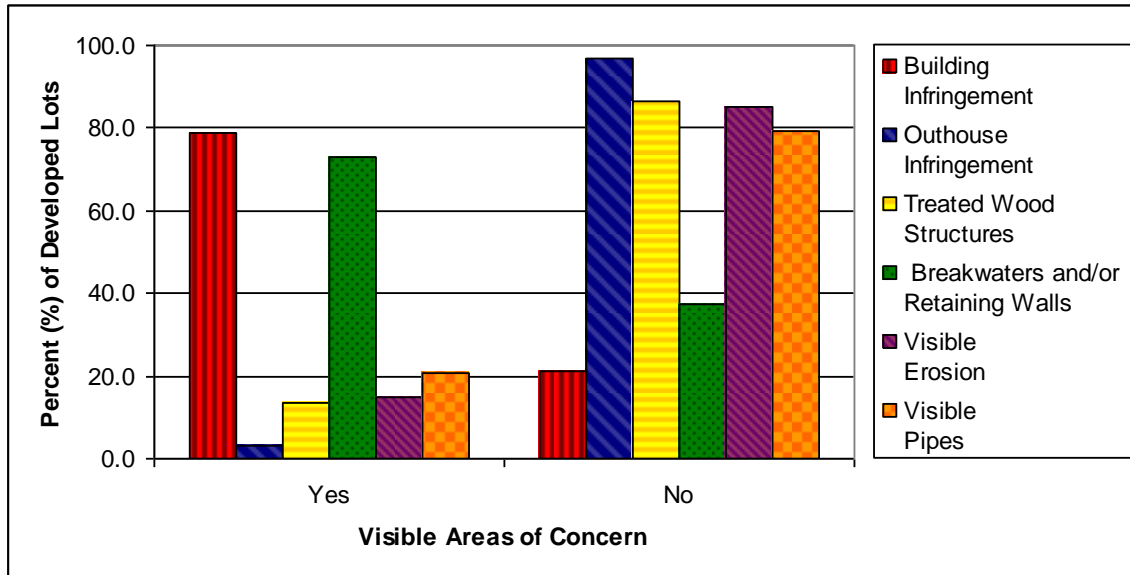




**FIGURE 2.1** – A comparison of riparian buffer classification showed that the majority of the developed lakeshore on Green Lakes South shore was within the moderate riparian buffer classification and lower. 22.7% Moderate, 23.1% Low, and 44.7% None, the classifications were based on the lakeshore survey guidelines (Appendix B)



**FIGURE 2.2** – 14.7% of developed lots on the South shore of Green Lake showed signs of erosion. This could be due in part to 37.4% of developed lots having breakwaters and/or retaining walls. The presence of a breakwater and/or retaining wall can promote erosion on neighbouring lots due to the deflection of waves and water currents from one shore onto another increasing the erosion risk.



**FIGURE 2.3** – An overview of the visible areas of concern clearly showed that the most visible concerns were building infringement and the presence of breakwaters and/or retaining walls. 78.8% of the buildings on the North shore were less than 15m from the high water mark. The setback distances are based on the lakeshore survey guidelines (Appendix B). 72.9% of developed lots had breakwaters and/or retaining walls which can promote erosion on neighbouring lots due to the deflection of waves and water currents from one shore onto another increasing the erosion risk.

## DISCUSSION

Approximately 148 developed lots on the North shore of Green Lake and 273 lots on the South shore of Green Lake were surveyed by motor boat during the Green Lake lakeshore survey on June 18<sup>th</sup> and 19<sup>th</sup> 2008. Particular attention was given to the riparian buffer left along the lakeshore, human-induced shoreline erosion from development and boating activity, the use of retaining walls and/or breakwaters, the setback distance of houses and outhouses from the lake, and the presence of imported sand, gravel, or treated wooden structures in or near the water.

The following percentage of developed lots and respective riparian buffer classification was observed on the North shore: 50.0% None, 19.6% Low, 16.2% Moderate, 9.5% High, and 4.7% Complete (Figure 1.1). A similar trend was observed on the South shore

which had the following percentage of developed lots and respective riparian buffer classifications: 44.7% None, 23.1% Low, 22.7% Moderate, 7.3% High, and 2.2% Complete (Figure 1.1). Overall the majority of developed lots on both shores showed riparian buffer classifications of moderate or lower suggesting that the overall condition of the lakes riparian buffer needs improvement.

Shoreline erosion was visible on 27 (18.2%) of the developed lots along the North shore of Green Lake (Figure 1.2) and 40 (14.7%) of the developed lots along the South shore of Green Lake (Figure 2.2). In most cases the erosion was due to the complete lack of a riparian buffer and in some cases a combination of steep slopes and lack of a riparian buffer. The roots of a riparian buffer reinforce the soil and sand and help to hold them together preventing land loss by protecting the shoreline from slumping or being washed away thus without one the risk of erosion increases greatly.

An overview of the visible areas of concern on the North shore (Figure 1.3) and on the South shore (Figure 2.3) clearly shows that the most visible areas of concern were building infringement and the appearance of breakwaters and/or retaining walls. 105 (70.9%) of the developed lots on the North shore and 215 (78.8%) of the developed lots on the South shore had buildings that were less than 15m from the high water mark as is the recommended distance according to the CRD Shoreland Management Policy and the TNRD Lakeshore Development Guidelines. Infringing buildings are problematic because they leave insufficient room for a natural vegetated riparian buffer zone and adequate distance between septic systems and the lake. This can result in the physical loss of property, increased flood risk, pollution from runoff, destruction of fish and other wildlife habitat, and changes to nutrient input affecting water quality. Breakwaters and/or retaining walls were visible on 83 (56.1%) of the developed lots on the North shore (Figure 1.2) and 199 (72.9%) of the developed lots on the South shore (Figure 2.2). The

presence of a breakwater and/or retaining wall can promote erosion on neighbouring lots due to the deflection of waves and water currents from one shore onto another increasing the erosion risk. This is especially true when hard breakwaters and/or retaining walls are used such as concrete and other solid walls because less of the waves and currents are absorbed and more is deflected increasing the risk of erosion on neighbouring shorelines. Soft natural methods such as planting native vegetation and using native rocks and logs help stabilize the shoreline while absorbing the energy of waves and currents, slowing runoff, and reducing the force of falling rain thus protecting the shoreline from erosion.

Outhouse infringement was also observed on six (5.7%) of the developed lots on the North shore and nine (3.3%) of the developed lots on the South shore where outhouses were closer than 30m from the high water mark as is the recommended distance according to Interior Health. This can result in the contamination of the lake water with disease-causing parasites, harmful strains of bacteria, and nutrient rich sewage. Also of concern were 34 (23.0%) of the developed lots on the North shore and 37 (13.6%) of the developed lots on the South shore that had treated wood structures in or near the water. The use of treated wood should always be avoided where possible to reduce the risk of introducing toxic preservative chemical leachate into the lake water. It was also observed that 36 (24.3%) of the developed lots on the North shore and 57 (20.9%) of the developed lots on the South shore had pipes going into the lake. It appeared that most if not all of the pipes were water intake pipes as opposed to effluent discharge pipes which are not permitted into the lake. This assumption was made based on the small diameter of the pipes and the presence of pumps or pump houses from which the pipes often ran to or from.

## **CONCLUSION**

Overall the majority of developed lots on both the North and South shores of Green Lake showed riparian buffer classifications of moderate or lower suggesting that the overall condition of the lakes riparian buffer needs improvement. 196 (46.6%) of the developed lots on Green Lake's lakeshore had no riparian buffer zone and 320 (76.0%) of the developed lots had buildings that were closer than 15m. Many of the new lakeshore developments are contributors to these statistics suggesting that this may become an increasing problem in the future.

## **RECOMMEDATIONS**

In order to maintain and/or improve Green Lake's water quality, lakeshore lands, and foreshore areas it is important to continue educating lakeshore owners and/or developers on the importance of maintaining a natural vegetative riparian buffer zone and following proper lakeshore practices. Some examples of available educational information include the following:

- TNRD Lakeshore Development Guidelines, available online at [www.tnrd.bc.ca](http://www.tnrd.bc.ca)
- CRD Shoreland Management Policy, available online at [www.crd.bc.ca](http://www.crd.bc.ca)
- CRD Protecting Water Quality and Shorelines brochure, available online at [www.crd.bc.ca](http://www.crd.bc.ca)
- Interior Health Privy (outhouse) and Vault Privy Information, available at your nearest Interior Health office
- On the living Edge: Your Handbook to Lakeshore Living, by Sarah Kipp and Clive Callaway
- Waterfront Living information and brochure, available at [www.livingbywater.ca](http://www.livingbywater.ca)

Current developments should be encouraged to improve their current riparian buffer zones as much as possible. This can be accomplished by planting/replanting natural vegetation and using soft natural water break methods as opposed to hard retaining walls and imported breakwaters.

New development should continue to be encouraged to correspond with the CRD Shoreland Management Policy and TNRD Lakeshore Development Guidelines. District lot sizes should consistently be large enough to support adequate septic systems and riparian buffer zones.

Continual observation should be maintained to ensure that the quality of Green Lake's water, lakeshore lands, and foreshore areas is maintained for generations to come.

## **REFERENCES**

Cariboo Regional District, 2004. Shoreland Management Policy, [www.crd.bc.ca](http://www.crd.bc.ca), CRD, Williams Lake, B.C.

Cariboo Regional District, 2004. Protecting Water Quality and Shorelines, [www.crd.bc.ca](http://www.crd.bc.ca), CRD, Williams Lake, BC.

Environment Canada, Waterfront Living, [www.livingbywater.ca](http://www.livingbywater.ca)

Kipp, S., and Callaway, C., 2002. On the Living Edge: Your Handbook for Waterfront Living. BC ed. FBCN, Canada.

Interior Health, 2006. Privy and Vault Privy Information, Health Protection, Canada, BC

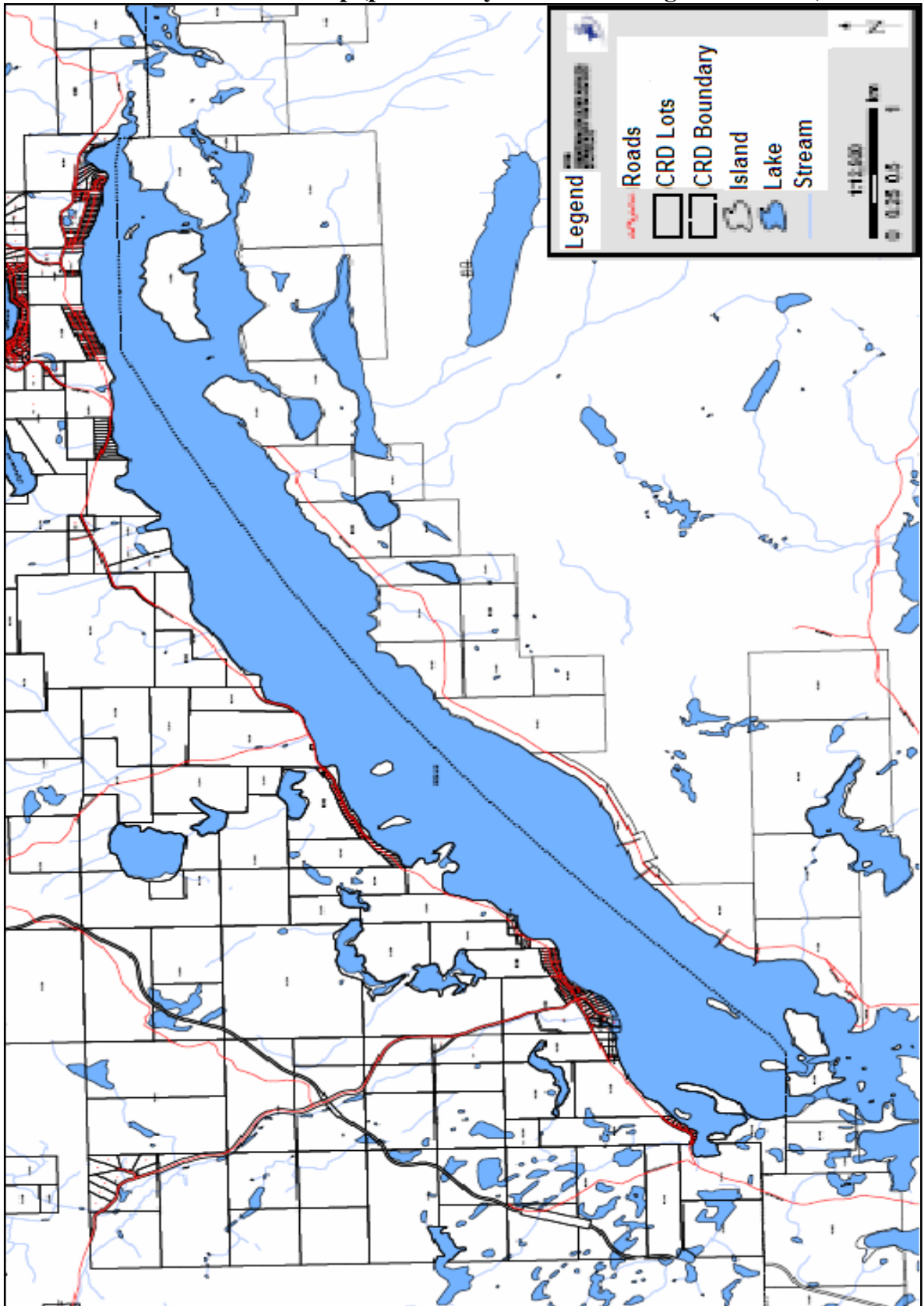
Thompson Nicola Regional District, 2004. Lakeshore Development Guidelines, [www.tnrd.bc.ca](http://www.tnrd.bc.ca), TNRD, Kamloops, BC.







(iii) Green Lake District Lot Map (provided by the Cariboo Regional District)



## APPENDIX B

### (i) Lake Shore Survey Guidelines

<b>Lakeshore Survey Guidelines for Riparian Buffer Classification</b>		
<b>Riparian Buffer Classification</b>	<b>Description</b>	
None	Mowed lawn or exposed ground to shoreline. Few if any trees or shrubs present on lawn.	
Low	Some tall grasses/shrubs in sparse patches along <30% of shoreline or in a very narrow strip <b>OR</b> mowed lawn with some interspersed trees or shrubs, not necessarily directly along the shoreline.	
Moderate	Strip of trees or shrubs several meters wide along >30% of shoreline <b>OR</b> when a high level of vegetation is retained on the property, but the proximity of the house to the water does not leave room for a sufficient buffer <b>OR</b> when the entire lawn has been left un-mowed, allowing the generation of tall grasses, but few or no shrubs and trees are present along the shoreline.	
High	Densely vegetated strip of trees and/or shrubs and herbaceous plants at least several meters wide along 70% (TNRD), 75%(CRD), or all of shoreline with small amounts of clearing for access and view.	
Complete	<b>TNRD*</b>	<b>CRD*</b>
	Minimum <b>15m, from streams, and 30m, from lakes</b> , of vegetation in its natural state along entire shoreline, including trees as well as shrub and herbaceous understorey. <b>Only 30%</b> clearing to allow for access or view.	Minimum <b>15m</b> of vegetation in its natural state along entire shoreline, including trees as well as shrub and herbaceous understorey. <b>Only 25%</b> clearing to allow for access or view.
<b>Encroachment Distances from Lakeshore*</b>		
<b>Structure</b>	<b>Minimum Distance from Lakeshore</b>	
	<b>TNRD*</b>	<b>CRD*</b>
Boathouse	Allowed at any distance at a size $\leq$ 25% of lots water frontage	Allowed at any distance
Outhouse	30m	30m
Any Structure Excluding Boathouse/Outhouse	30m	7.5m
Septic Field	100m, if <100m property owner must consult a qualified professional)	35m
<i>*(TNRD) Thompson Nicola Regional District</i>		
<i>*(CRD) Cariboo Regional District</i>		
<i>*Distances according to the TNRD Lakeshore Development Guidelines and the CRD Lakeshore Management Policy</i>		
<i>*Distances from Lake for outhouses according to Interior Health Recommendations</i>		
<b>Methods</b>		
<ul style="list-style-type: none"> <li>• A photograph will be taken of each residence or developed area</li> <li>• Notes will be taken regarding riparian buffer classification, building/outhouse infringement, visible erosion, and any questionable land uses such as erosion control methods, effluent-type pipes, artificial beaches, treated wood structures in/near the water, and excessive removal of vegetation.</li> <li>• Panoramic photographs will be taken of the lakeshore to determine general shoreline condition and proportion of developed land.</li> </ul>		

