Rapid City Beach

&

Reservoir Committee

April 12, 2018

Ms. Tracey Braun, M. Sc.

Director, Environmental Approvals

Sustainable Development

123 Main Street, Suite 160

Winnipeg, Manitoba, R3C 1A5

RE: PROJECT PROPOSAL FOR THE RESTORATION OF THE RAPID CITY RESERVOIR.

ENVIRONMENT ACT PROPOSAL SUBMISSION FOR A CLASS 2 DEVELOPMENT.

Dear Ms. Braun

On behalf of the Rapid City Beach and Reservoir Committee, Cando Contracting, and our main proponent, the RM of Oakview, please find attached our Environment Act Proposal submission for the above-mentioned project.

This application is for Environmental Approval to carry out the restoration of the Rapid City Reservoir by excavating the large amount of silt and debris that has accumulated over the last 20 years including the two major flood years of 2011 and 2014.

We trust that the enclosed application contains sufficient information for your staff to complete a licence for our project. Should the reviewer require any additional information or require any clarifications, please do not hesitate to contact myself.

Yours truly

Robert Christie

Project Manager/Rapid City Beach and Reservoir Committee

corganic@mymts.net

ENVIRONMENT ACT PROPOSAL

EXECUTIVE SUMMARY

The following Environment Act Proposal (EAP) is submitted on behalf of the Rural Municipality of Oakview (Main Proponent), Cando Contracting Ltd. And the Rapid City Beach and Reservoir Committee. The EAP is for a Class 2 Development Licence under the Manitoba's Environment Act for the restoration of the Rapid City Reservoir. This document provides the information required from Sustainable Development's Environment Act Proposal Report Guidelines.

Attached to this EAP is the Project Proposal : Rapid City Reservoir Restoration presented by the Rapid City Beach and Reservoir Committee. (Draft May 11/2018) and the Rapid City Dam Environment Assessment Screening Report/ Proposed Dredging of the Rapid City Reservoir (Prepared for Manitoba Infrastructure and Transportation by North/South Consultants of Winnipeg.) It is our hope that the proposal and screening report will contain sufficient information for your staff.

The Rapid City Reservoir is situated in the LUD of Rapid City, 30km north of Brandon, on the Little Saskatchewan River in southwestern Manitoba. The reservoir is within the little Saskatchewan River Conservation District and the Rural Municipality of Oakview (Section NW-20-13-19W). The Rapid City reservoir predates 1892 and was known then as the Mill Pond. In 1961 the Province of Manitoba reconstructed the Dam and at that time excavated (dredged) the reservoir. In 1992 Manitoba's first fish ladder was created so fish could pass upstream pass the dam to the reservoir. The reservoir was once widely used for recreational activities but that has diminished due to the large silt build-up.

Our Committee has partnered with the Rural Municipality of Oakview (Main proponent), Cando Contracting Ltd. Of Brandon (Construction specialists). Funding in the most part is from the Brandon and Area Community Foundation (Gord and Dianne Peters Fund). Other funding for this project will come from the Rapid City and District Wildlife Association (Chase the Ace Fund) and possibly from a Federated Coop Community Spaces grant. No government funding is anticipated for this project.

Environment Act Proposal Form

Manitoba
Sustainable Development

Name of the development:
Rapid City Reservoir Restoration

Type of development per Classes of Development Regulation (Manitoba Regulation 164/88):
Class 2 Development (9) Water development and Control

Legal name of the applicant:
Robert Christie

Mailing address of the applicant: PO Box 111

Contact Person: Robert Christie

City: Rapid City Province: Manitoba Postal Code: R0K 1W0

Phone Number: 204-826-2398 Fax: email: corganic@mymts.net

Location of the development: Rapid City Dam and Reservoir

Contact Person: Robert Christie

Street Address:

Legal Description: NW 20-13-19WPM

City/Town: Rapid City Province: Manitoba Postal Code: R0K 1W0

Phone Number: 204-826-2398 Fax: email: corganic@mymts.net

Name of proponent contact person for purposes of the environmental assessment:
RM. of Oakview c/o Diane Kuculym CMMA/CAO

Phone: 204-566-2146
Fax: 204-566-2126

Mailing address: PO Box 179 Oak River MB. R0K 1T0

Email address: oakviewcao@mymts.net

Webpage address:

Date: APRIL 17, 2018

Signature of proponent, or corporate principal of corporate proponent:
DIANE KUCULYM Diane Kuculym

Printed name: Diane Kuculym

PRINT RESET

Rapid City, Mb.

PROJECT PROPOSAL

Rapid City Reservoir Restoration

This is a project proposal for the restoration of the Rapid City Reservoir.

A part of our past.

A part of our future.

Presented by:
Rapid City Beach & Reservoir Committee

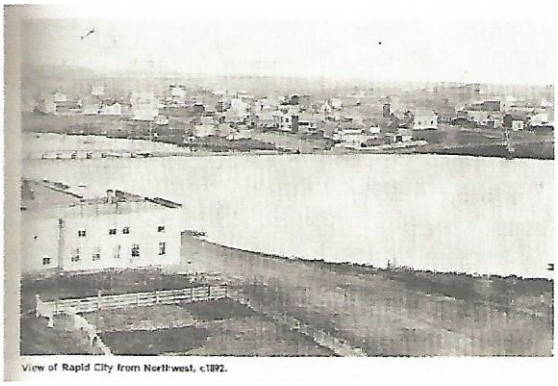
Table of Context

1.0 Introduction

This proposal has been prepared by the Rapid City Beach and Reservoir Committee in support of obtaining regulatory and funding approval for much needed improvements at the Rapid City Reservoir. This document provides a brief history of the Rapid City Dam and Reservoir, outlines the current and ongoing concerns with the condition of the reservoir, introduces the Rapid City Beach and Reservoir Committee and their goals and objectives, and details proposed improvements to the reservoir. Finally, the document outlines the specific support/funding/approval that the Rapid City Beach and Reservoir Committee is seeking.

2.0 Background (appendix A [2])

The Rapid City reservoir predates 1892 as shown here in these 2 photos.



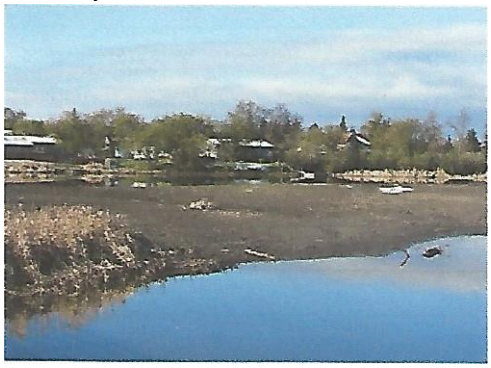
View of Rapid City from Northwest, c1892.

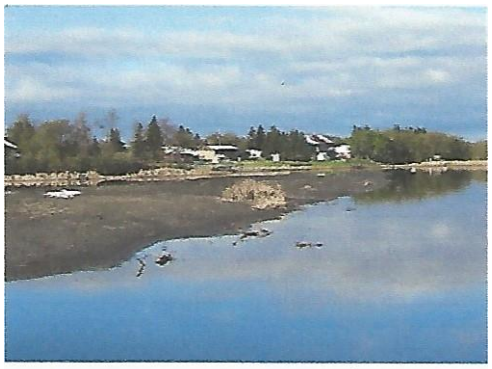
It was shown on many old maps as the "Mill Pond".

The reservoir was originally constructed for water storage for irrigation, drinking water, livestock watering and to help operate a lumber mill.

In 1961 the Province of Manitoba constructed the Rapid City Dam. The main purpose was for stock watering and water conservation. Presently the dam is owned by the province and operated by Manitoba Infrastructure (M.I.)

In 1992 Manitoba's first fish ladder was created so fish could pass upstream past the dam to the reservoir. The reservoir was once widely used for recreational activities but that has diminished due to a large silt & bulrush build-up. There have been 2 major flood events over the past 10 years that have contributed greatly to the silt and vegetation issue.





These 2 photos show the silt and vegetation build up when there was a partial drawdown of the reservoir. Controlling water levels for the dam & reservoir will be key to helping reduce the silt & vegetation accumulation during flood years. The reservoir's initial water capacity was 250,000 cubic metres(m^3) and has a present day volume of approximately 54,155 m^3. The reservoir is a big part of our whole beach complex which includes the campground, children's playground, pavilion & cenotaph. It has and will be a focal point for the community.

The RM of Oakview asked that a Committee be formed to research projects for the beach & reservoir restoration. The Rapid City Beach & Reservoir Committee was formed on June 16th, 2016 with a goal for the restoration of the beach & reservoir, in the Town of Rapid City, Mb. Our committee will work with all levels of Government on identifying problems, searching for solutions and looking at answers to reach our goal.

The Committee consists of members belonging to local service groups which include the Rapid City & District Wildlife Association, Lions Club of Rapid City, Rapid City & District Chamber of Commerce and councillors from the L.U.D. of Rapid City & RM of Oakview.

The committee's over all objectives is to restore the beach & reservoir back to a useable state and have a maintenance plan for the future.

The committee has broken the objectives into 2 projects.

- Project 1: Beach Restoration – COMPLETED
- Project 2: Reservoir Restoration & maintenance

Project 1: Beach Restoration - COMPLETED

- The committee was in contact with the Federal, Provincial & Municipal Governments and obtained approval for this project. This summer bulrush vegetation was removed in front of the beach as per conditions set by (M.I.) and a flood control berm is now under construction. Brush vegetation on the dam & bulrushes blocking the outtake to the fish ladder were removed by Manitoba Infrastructure (M.I.) The Placement of beach sand, sod & a swimmer's dock will be scheduled for spring of 2017 completing the beach restoration.

Project 2: Reservoir Restoration & Maintenance

- Restoration would include the removal of bulrush vegetation and silt that has accumulated over the past 20 years. A plan to implement the restoration & future maintenance of the reservoir will be outlined in this proposal.

3.0 KEY STAKEHOLDERS

In considering work on and adjacent to the Rapid City Reservoir, we have identified the following stakeholders:

- Cando Contracting
- Rapid City & District Wildlife Association
- Queens Hotel
- Rapid City Lions Club
- Taste Buds Restaurant and Catering
- Rapid City & District Chamber of Commerce
- Rapid City Co-op
- Valleyview Golf Club
- RM of Oakview
- L.U.D. of Rapid City
- Nails by Steff
- Rapid City Royal Canadian Legion
- Rapid City Legion Auxiliary
- Rapid City Nursery School
- Rapid City Memorials
- Evangel Worship Centre
- Rapid City Insurance
- Rapid City Regional Library
- R.C. Hairstyling
- Lil Bait n Tackle Shop
- Oakview Equipment
- Country Lane Sewing
- Rapid City Fire Department
- Hyndman Auctions
- Rapid City Agriculture Society
- Celtic Power

4.0 Goals/Objectives:

- To remove excess sedimentation and vegetation.
- To have a clear and unobstructed waterway for Manitoba's first fish ladder.
- To have a viable maintenance plan for the reservoir.
- To explore future projects like installing a low-level outlet on the dam to allow silt to be passed.
- To attract more tourism to the town which in turn will benefit our local businesses and campground.
- To have a recreational facility that all families may enjoy.
- To increase a healthier fish & wildlife population.
- To attract new families to reside in the town or surrounding community.

5.0 PROJECT DESCRIPTION

5.1 BACKGROUND AND PROJECT JUSTIFICATION (appendix A [1])

Significant sediment accumulation in the Rapid City Reservoir could cause a number of impacts, including, but not limited to:

i. Increased structural load on the Rapid City Dam, which could potential impact the stability of the structure

ii. Decreased storage capacity within the reservoir could result in reduced water supply for upstream users in periods of drought.

- Note this refers to individual users that draw water from the Little Saskatchewan River between the Rapid City and Minnedosa Dams; water supply for the Town of Rapid City is from groundwater wells.

iii. Impedence to migration of fish through the fish ladder

iv. Changes to native species habitat

v. Reduction in the quality of recreational activities on the reservoir

It is expected that addressing concerns related to items (i) through (iv) would be the primary objective of any dredging program proposed within the Rapid City reservoir, with (v) being a secondary consideration. Assessment of items (i) and (ii) require detailed structural and hydrologic studies, which were not completed at the time this document was issued. The current conditions in the reservoir, relative to items (ii) and (iv) are addressed below.

5.2 . NATURE OF THE PROJECT AND MAIN COMPONENTS

Excavation Phase:

- Reservoir drawdown
- Site access
- Site preparation
- Excavating and transport of excavated materials(see appendix D)

- Deposition of excavated materials. (see appendix D)

The post-excavation phase:

- Re-charge of the reservoir
- Monitoring

Excavation Phase

Using information obtained from the 2014 report (appendix A [1]) prepared for the Manitoba Government we estimate 57225 cubic yards of silt would need to be removed. It was concluded by our committee that after consultation with the Department of Sustainable Development (SD), excavating using backhoes and dump trucks was our best and only option. The work would have to be done when the frost settles into the silt and is able to accommodate the weight of the machinery and equipment. Draw-down of the reservoir would have to take place in the late fall prior to freeze-up.

Equipment access to the excavation zone is anticipated to occur across Municipal owned land. Access over private lands is not expected. Traffic control, fencing, and other measures would be established to protect public safety prior to and during excavation. A small staging area may need to be prepared to effectively coordinate movement of equipment and provide a location for fuel storage (if needed).

It is anticipated that the top 1.5-2 m of accumulated material would be removed and take 12 days to complete(see project cost breakdown on page10). Excavated material is expected to be transported by means of dump trucks to be deposited to selected deposition sites that are well away from any watercourses.(see appendix D)

Post-Excavation Phase:

- Following completed excavation, the reservoir will be restored to normal water levels (by operation of the Rapid City Dam).

6.0 SCOPE OF PROJECT

A description of each of the main Project components by Project phase is located in Table 6-1.

Table 6-1. Scope of Project – Summary Table (appendix A [1])

PROJECT PHASES/ COMPONENTS	DESCRIPTION
Excavation phase:	
Reservoir Drawdown	Includes operation of the dam to increase outflow of water from the reservoir and reduce the reservoir water level in order to expose the excavation areas. Expected drawdown from existing water surface elevation is from a range of 1-2 meters.
Site Access	Includes activities on land such as preparing an access route if required – e.g., preparing staging area for equipment access and limiting public access, traffic control (possible rerouting), preparing a fuel storage area, or other safety precautions as required.
Site Preparation	Includes activities on the waterway such as demarking the excavation zone and implementing associated best management practices (BMPs).
Excavation	Includes operation of excavation and transport equipment on the site and the excavating of the sediment.
Transport	Includes loading and transport of excavated materials to depositions site. (see appendix D)
Disposal	Includes disposal of excavated materials to selected sites. (see appendix D)
Post-Excavation phase:	
Reservoir Re-watering	Includes operation of the dam to restore water levels in the reservoir to the target water level.

7.0 BUDGET: Rapid City Reservoir Excavation Preliminary Cost Breakdown

- The Rapid City Dam Reservoir Environmental Assessment Screening Report (2014) Prepared for

Manitoba Infrastructure and Transportation by North/South Consultants Inc. was used to determine the areas to be excavated. (See attachments appendix B)

- The area A-C-D from the screening report was re-surveyed on November 18/2017 with a volume of 49,050.0 yds. for a depth 1.5 meters, and 65,400.0 yds. for depth of 2.0 meters. Thus an average of 57,225.0 yds. will be used for this cost breakdown.
- Using an estimated 2500 yds. / 12hr shift, This project would take approximately 24/12 shifts or 12 days

Protect Cost Breakdown (MHCR 2016 Equipment Rental Rates)

1-30 ton (Group 12) Excavator with twister bucket and ripper	1 X 12hrs. @ 276.90	$ 3322.80
1-45 ton (Group 14) Excavator with twister bucket and ripper	IX 12hrs. @ 399.10	$ 4789.20
4-30 ton (Group 3) Articulated Dump Truck	4 x 12hrs. @ 241.00	$ 11568.00
I-D6T (Group 6) Crawler Tractor with Hyd. 6 way	1 X 12hrs. @ 258.00	$ 3096.00
3-1/2 ton light trucks / worker transport	3 X 2hrs. @ 45.00	$ 270.00
1- Foreman/Supervisor with truck	1 X 12 hrs. @ 90.00	$ 1080.00
Daily Total	**= 24,126.00 x 24 Shifts**	**$ 579,024.00**

Water truck/ Home owner wells	North side of reservoir	Lump sum $ 5,000.00
Access roads onto reservoir	Possible 3 locations	Lump sum $ 5,000.00
Rig Mats for reservoir	15 mats, 5/day = 75.00 X 12 days	$ 900.00
Maintenance on RM/Town roads	300yd gravel @19.OO/yd	$ 5700.00
Maintenance on roads/ Motor Grader - Group 5	IOhrs @ 204.00	$ 2040.00
200 m reinforced silt fence @ 10.50m	200 @ 10.50	$ 2100.00
500m2 Erosion control blanket @ 4.00/m2	500m2 X 4/m2	$ 2000.00
500m2 Seeding @ 1.50m2	500m2 X 1.50/m2	$ 750.00
Survey - 4 visits @ 1500.00	4 x 1500.00	$ 6000.00
Mobilization-6 pieces@ 3360.00/jeep X 6	6 x 3360.00	$ 20160.00
Mobilization-I piece @3150.00/Tri bed	1 x 3150.00	3180.00
	Total	**$ 52,830.00**

Total:	**579,024.00 + 52,830.00 + 10% (contingency)**	**$ 695,039.00**

8.0 Evaluation

Representatives:

- The excavation contractor and the RM of Oakview will interact on what evaluation reports are needed prior to, during and after completion of the project.
- Copies of all evaluation reports would be made available to all funding partners.

9.0 Required Approvals, Permits & Licences

- (M.I.) Manitoba Infrastructure
- (S.D.) Department of Sustainable Development
- (D.F.O.) Federal Department of Fisheries & Oceans
- Environmental Licence

10.0 Reservoir Maintenance and Future Projects

- Closely working with the Little Saskatchewan River Conservation District (LSRCD) on identifying potential project locations upstream from the reservoir to help reduce the amount of erosion and silt being deposited during heavy rains and spring run-off periods.
- Communicating with (M.I.) on controlling water levels in the reservoir during the spring run-off and flood conditions.
- A yearly inspection and assessment of excess vegetation in the reservoir. Partial drawdown of the reservoir may be needed for vegetation cleanup from time to time.
- A study on installing a low-level outlet (slide gate). This could reduce the structural load on the dam & also help clean out the excess amount of silt that could build up during flood and spring run-off conditions.

11.0 Endorsements

- Please see (appendix C) for attached endorsements

12.0 SUMMARY

On behalf of the Town of Rapid City & surrounding community, the Rapid City Beach & Reservoir Committee is seeking your approval for the Restoration of the Rapid City Reservoir.

Our reservoir dates back to when the Town of Rapid City was conceived. It has and will play a big part of our past and future history. The Town of Rapid City is now starting to see a positive growth in new families taking up residency over the past few years. Making improvements to our infrastructure and restoration of our recreational facilities has been very important factors to those families looking to reside here. As it stands right now the reservoir is an eyesore and a hindrance for attracting potential home buyers. The reservoir creates space not only for recreational activities such as fishing, boating and swimming but a habitat for fish and wildlife. At the rate the reservoir is filling up with silt it will be only a few more years before it has completely lost its capacity to hold any water. The reservoir is essential to our beach & campgrounds survival and our tourism for the community. The restoration clean-up will have a positive impact for the whole community and any future growth.

Having all levels of governments approvals for this project will be a huge step in achieving our goal.

The Rapid City Beach & Reservoir Committee hope you will consider this proposal to restore our reservoir and bring back the pride we once had for this focal point of the community.

Please feel free to contact us if you require any additional information.

Contact Information:

Bob Christie

Project Manager

Rapid City Beach & Reservoir Committee

Box 111 Rapid City, Mb. R0K1W0

Email corganic@mymts.net

Phone (Home) 204 826-2398

Appendix A

Reference material

[1] Rapid City Dam Environmental Assessment Screening Report:

Proposed Dredging of the Rapid City Reservoir (by North/South Consultants Inc.)

[2] Rapid City and District OUR PAST FOR THE FUTURE

Published by: Rapid City Historical Book Society

Rapid City, Man. R0K 1W0

Appendix B

Attached pages 4, 14, 22 & 23 from The Rapid City Dam Reservoir Environmental Assessment Screening Report (2014)

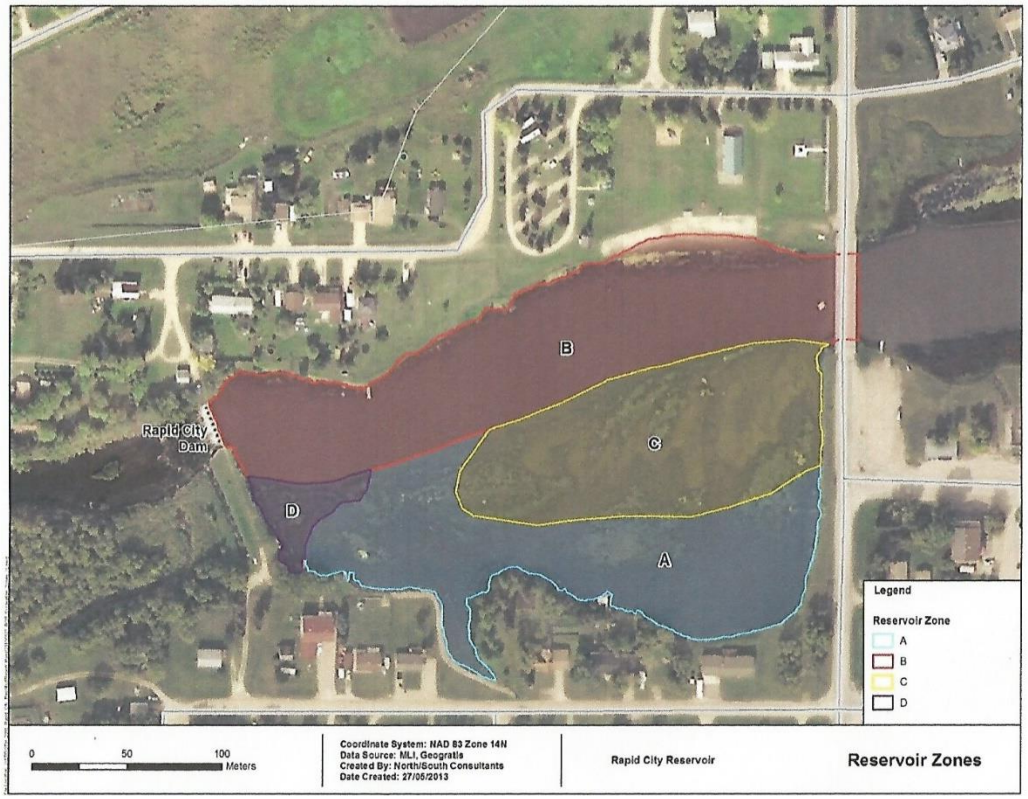

B
C
D
A
Rapid City Dam
Legend
Reservoir Zone
A
B
C
D
0
50
100
Meters
Coordinate System: NAD 83 Zone 14N
Data Source: MLI, Geogratis
Created By: North/South Consultants
Date Created: 27/05/2013
Rapid City Reservoir
Reservoir Zones

Figure 5-1. Large area of sedimentation outlined along the southern extent of the Little Saskatchewan River channel visible in a Quickbird high-resolution multispectral image from fall 2010 (O DigitalGlobe).

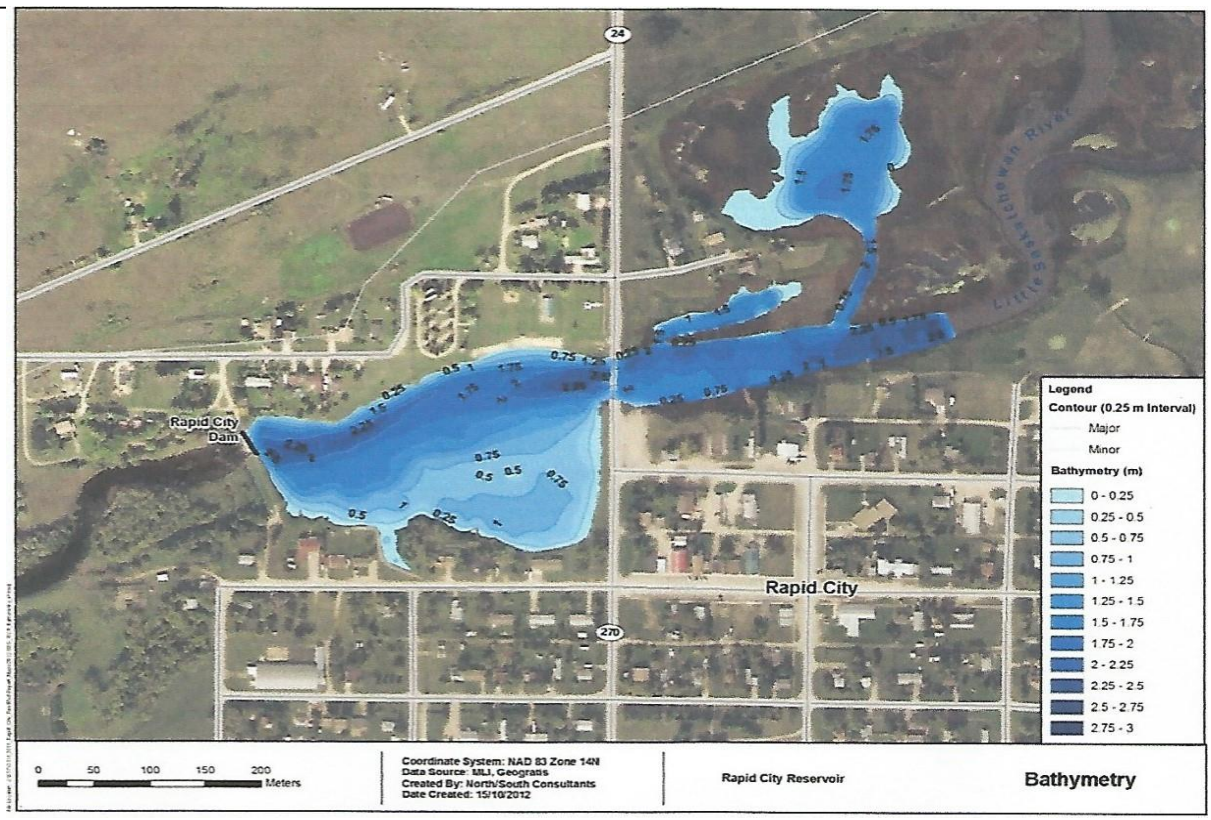


Figure 5-4. Bathymetric map of the Rapid City Reservoir from data collected May 18, 2012. The depth is relative to a water level of 479.75 m (CGVD28 HT2.O).

Table 5-4. Depth and volume statistics for Reach 3 and a portion of Reach 2 of the study area.

Reach	Maximum Depth (m)	Mean Depth (m)	Volume (m3)	Volume acre/ft
Reach 2	2.78	1.29	42654	34.6
Reach 3	2.98	1.15	54155	43.9
Total			96809	78.5

Reach 3 is deepest within Zone B, directly downstream of the PTH 24 bridge, which may be attributed to scour pools directly downstream of the bridge abutments. The other deep area in Zone B is immediately upstream of the dam. These areas approach depths of 3 m. The average depth in the reach is 1.15 m. A combination of long-term sediment deposition and the flooding of the flat valley of the Little Saskatchewan River upon the initial operation of the dam make this area of the reach shallow. Reach 3 has a present day volume of approximately 54,155 m or 43.9 acre/ft.

5.2.1.3.3 Substrate

Substrate mapping was conducted in a small portion of habitat Reach 2 upstream of the reservoir and in the reservoir itself (Reach 3) (Figure 5-5; Table 5-5). Reach 2 is dominated by silt/clay (mud) with organic debris substrate (54.7%) mainly in the backwatered wetland areas. The main channel of the Little Saskatchewan River is dominated by sand substrate (39.8%) with traces of larger sized sand and gravel. Silt/clay substrates found near shore are typically associated with cattail (Typha sp.) growth.

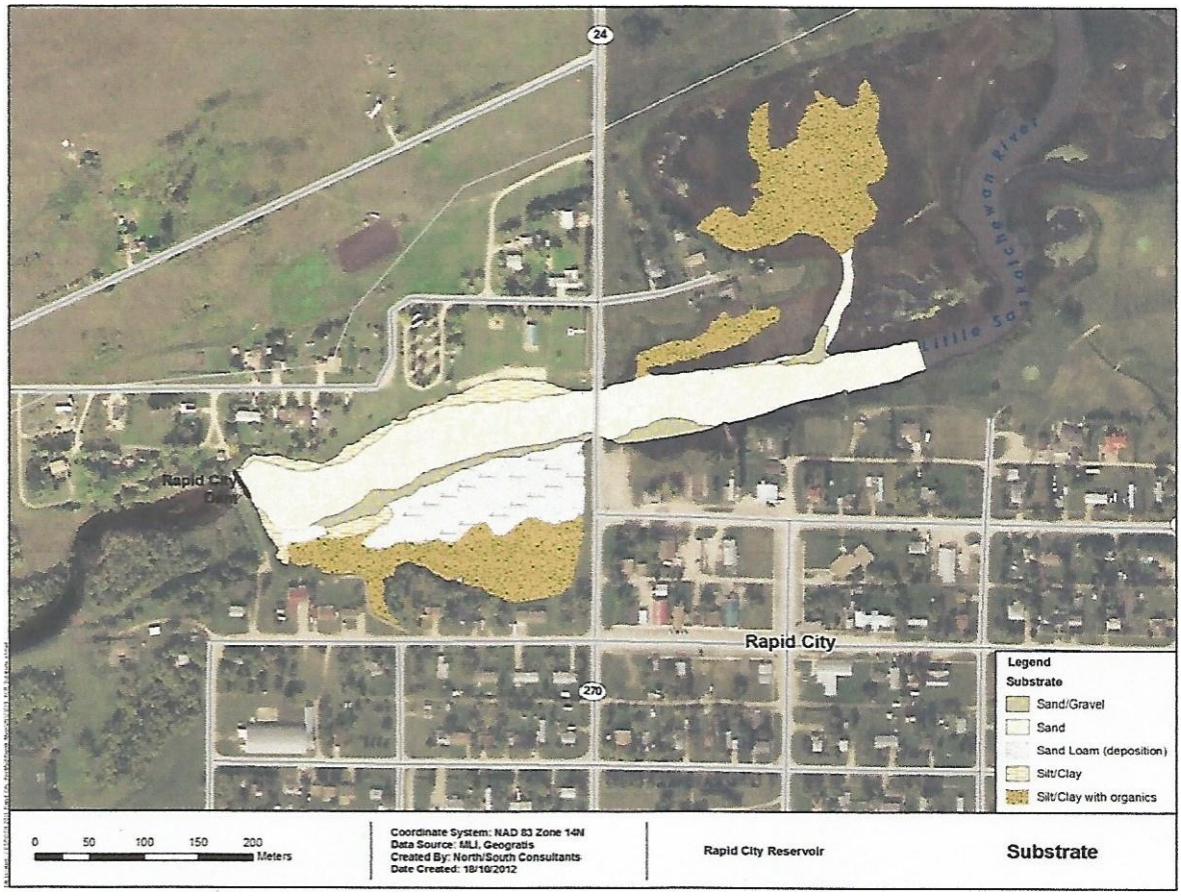


Figure 5-5. Substrate distribution map of the Rapid City Reservoir Study Area, data collected on May 18, 2012.

Appendix C

Attached Letter of Endorsement
Attached Endorsement Signatures

RE: RAPID CITY RESERVOIR RESTORATION PROJECT

To: The Rapid City Beach & Reservoir Committee

We whole heartedly endorse this project!

The slow decline of the reservoir has been a worrisome experience to watch. Organizations and volunteers have, in the past, put in countless hours and monies to make this a recreational facility to be admired and enjoyed by all. Campgrounds, washrooms, a covered pavilion (established by the Lions Club), children's playground and Cenotaph make up part of the beach complex.

The successful restoration of the beach last year was embraced by the community and visitors. The improvements to the beach volleyball court, adding a sodded berm, beach sand and a swimmer's dock was Phase 1 of the overall restoration project.

We as Businesses and Organizations look forward to seeing Phase 2 the restoration of the reservoir implemented. The outcome of the project will only attract more people to our community to enjoy and use the facility. This project will also greatly help in attracting prospective home buyers and new businesses to the community.

The more people we attract can only benefit our businesses and organizations here in the community.

Sincerely,

We the undersigned

We the undersigned, wholeheartedly approve of the Rapid City reservoir restoration and all it entails:

ORGANIZATION	TITLE	SIGNATURE
Rapid City Dist Wildlife	Sec-Tres	[illegible]
Rapid City Legion Aux.	Past-President	[illegible]
Garbutt Trucking Ltd	President	Steve Garbutt
Rapid City Golf Club	Vice-President	[illegible]
Rapid City Golf Club	Secretary	Colleen [illegible]
Rapid City NURSERY School	NURSERY School Aid	[illegible]
Tastebuds-Queens	Hotel Owner	[illegible]
Rapid City Chamber	Vice-President	Bryan Hall
[illegible] Contracting	Owner	[illegible]
[illegible]	Owner	O.P. Knox Ent.
Rustic Pirate	Owner	[illegible]
ItWorks by Chelsey	Owner	[illegible]
Wal-D Farm	Owner	Donald Waldon
Doug Reid	Owner.	Doug Reid
[illegible]	Owner	[illegible]
CL van Veen Carpentry Ltd	owner	C VanVeen
Lynne Miller Sutton Harrison Realty	owner	Lynne [illegible]
Durnin Honey Farm	owner	Susan Durnin
Ilsa Ballegeer	Owner	Ilsa Ballegeer
Kingdon Quilting	Owner	[illegible]
Mary Kay	Independent Consultant	[illegible]
Farmers Market	Owner	Glen Hyndman
Farmers Market	Owner	Dotty Hyndman
Silverline Construction	Owner	[illegible]
Valley View Ag	owner	[illegible]
Boyd Farms	Owner	[illegible]
Boyd Trucking	Owner	[illegible]
[illegible] Tire Service	owner	[illegible]
Lil Bait N Tackle	Owner	[illegible]
[illegible] Taxidermy	Owner	[illegible]
Bushnell's Trigger Effect	Owner	[illegible]
Little Valley Sewing	Owner	Mary [illegible]
Flowercraft	owner	S Evans
ROYAL CANADIAN LEGION	TREASURER	W Anderson

We the undersigned, wholeheartedly approve of the Rapid City reservoir restoration and all it entails:

ORGANIZATION	TITLE	SIGNATURE
Rapid City Lions	Secretary	[illegible]
Rapid City Library	SECRETARY	Dafydd Andrew
Rapid City + District Co-op	Manager	Hamish Bryce
Rapid City Memorials	Owner	[illegible]
Royal Cdn Legion Auxiliary	Treasurer	Shelley Meakin
Country Lane Sewing	Owner/operator	Bernice Finlay
Rapid City Fire Dept	Fire Chief	[illegible]
Resident	HYNDMAN AUCTIONS	Harold E. Hyndman
OAKVIEW EQUIPMENT	OWNER/OPERATOR	Doug Finley
RAPID CITY AG SOCIETY	PAST PRESIDENT	Doug Finley
Celtic Power & Machining	President	[illegible]
LUD RAPID CITY	COUNSLOR.	Ron Burnell.
RAPID CITY INSURANCE	STAFF	Irene McFarlin
RC HAIRSTYLING	OWNER	[illegible]

APPENDIX D

Attached:

1. Volume Calculations for disposal of reservoir material
2. Maps of disposal route and sites (Town of Rapid City Zoning Map)
3. Detail 'A' of Zoning Map

1. VOLUME CALCULATIONS FOR DESPOSAL OF RESERVOIR MATERIAL

Ball field West Plan 17, Block 47 area = 16,460.93m2 (16,400.00m2)

- 16,400.00 x 1.0m = 16,400.00m3
- 16,400.00 x 1.5m = 24,600.00m3
- 16,400.00 x 2.0m = 32,800.00m3

Ball field East Plan 17, Part of Block 49 = 3,011.00m2 (3,000.00m2)

- 3,000.00 x 1.0m = 3,000.00m3
- 3,000.00 x 1.5m = 4,500.00m3
- 3,000.00 x 2.0m = 6,000.00m3

Town Land South of PR#270 Part of Block 57 = 20,594.48m2 (20,000.00m2)

- 20,000.00 x 1.0m = 20,000.00m3
- 20,000.00 x 1.5m = 30,000.00m3
- 20,000.00 x 2.0m = 40,000.00m3

Town Land lagoon slopes = 9,930.00m2 (9,900.00m2)

- 9,900.00 x 1.0m = 9,900.00m3

Town Land Part of Block 56 = 4,737.35m2 (4,500.00m2)

- 4,500.00 x 1.0m = 4,500.00m3
- 4,500.00 x 1.5m = 6,750.00m3
- 4,500.00 x 2.0m = 9,000.00m3

Town Land Part of Block 37 = 12,376.97m2 (12,000.00m2)

- 12,000.00 x 1.0m = 12,000.00m3
- 12,000.00 x 1.5m = 18,000.00m3
- 12,000.00 x 2.0m = 24,000.00m3

Using an average depth of 1.5m for most areas except the lagoon slopes.

TOTALS

------24,600.00m3

------ 4,500.00m3

------30,000.00m3

-------9,900.00m3

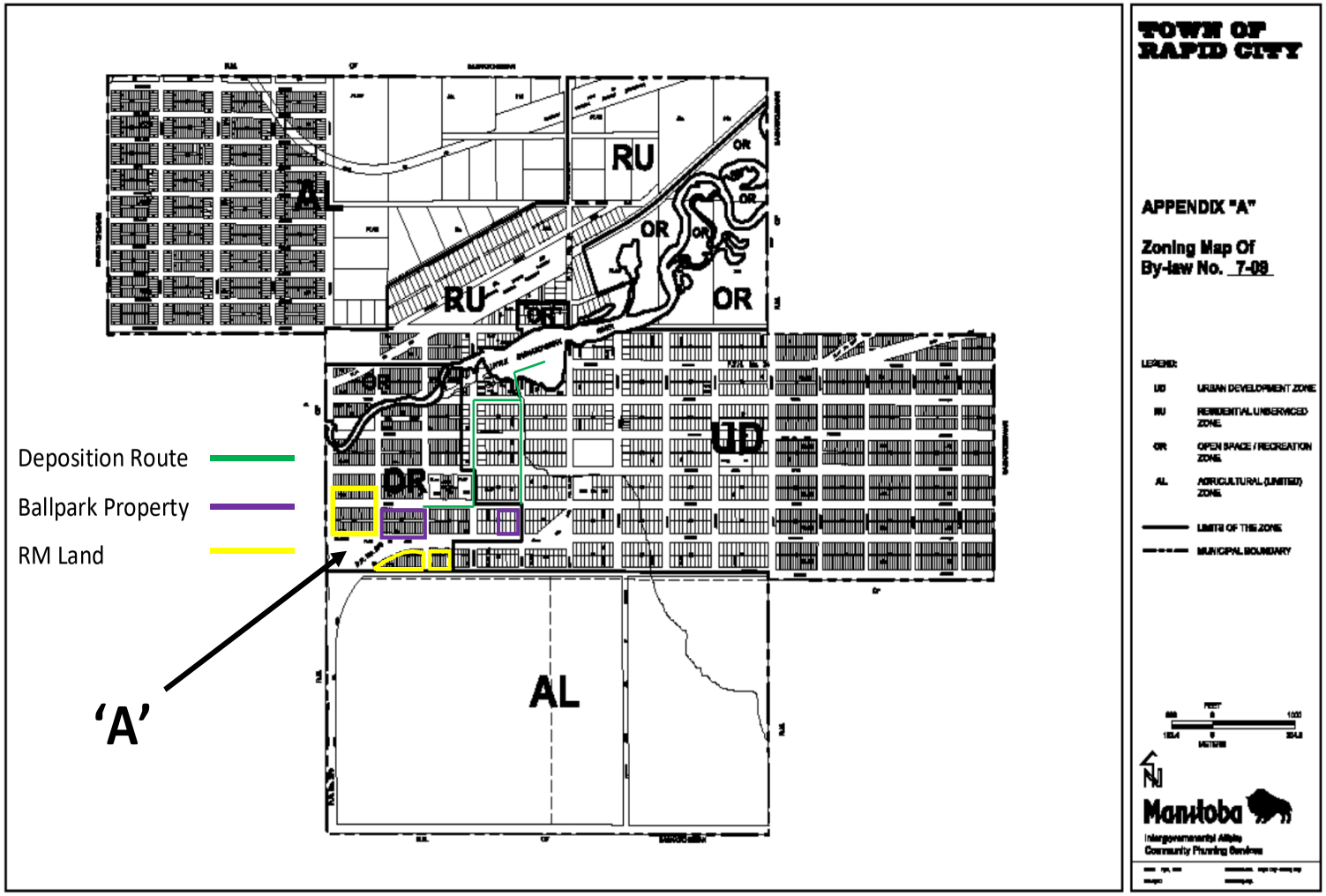
-------6,750.00m3

------18,000.00m3

93,750.00m3

Thus using the cost estimate volume of 65,400.00yds (50,000.00 m3) it appears that we have plenty of room for the reservoir material with an excess area to accommodate an extra 43,750.00m3 of material.

Robert Christie


TOWN OF RAPID CITY
APPENDIX "A"
Zoning Map Of By-law No. 7-09
LEGEND:
UD URBAN DEVELOPMENT ZONE
RU RESIDENTIAL UNSERVICED ZONE
OR OPEN SPACE / RECREATION ZONE
AL AGRICULTURAL (LIMITED) ZONE
LIMITS OF THE ZONE
MUNICIPAL BOUNDARY
Manitoba
Intergovernmental Affairs
Community Planning Services
RU
OR
UD
DR
AL
Deposition Route
Ballpark Property
RM Land
'A'


LITTLE SASKATCHEWAN
P.R. NO. 270

Rapid City Dam
Environmental Assessment Screening Report:
Proposed Dredging of the Rapid City Reservoir

REPORT

Prepared for Manitoba Infrastructure and Transportation
By North/South Consultants Inc. · 83 Scurfield Blvd. · Winnipeg, MB · R3Y 1G4

RAPID CITY DAM – ENVIRONMENTAL ASSESSMENT SCREENING REPORT:

PROPOSED DREDGING OF THE RAPID CITY RESERVOIR

April 2014

Prepared for

Manitoba Infrastructure and Transportation

By

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1.0 INTRODUCTION

The Rapid City Dam was constructed by the Province of Manitoba in 1961 with the capacity to store a reservoir of 250,000 cubic metres (m^3) of water, for the purposes of stockwatering and water conservation. The reservoir is currently used by the Town of Rapid City for recreation and sport fishing. In addition, a pool and riffle fish ladder was constructed in 1992 in order to allow fish passage between the reservoir and the Little Saskatchewan River downstream of the Dam.

Visual observations made by MIT and Town staff during a low water event in the reservoir, in 2009, indicate that sediment may have accumulated in some locations of the reservoir. Consequently, Manitoba Infrastructure and Transportation - Water Management and Structures (MIT-WMS) is undertaking investigations including survey, borehole drilling, structural stability analysis and this environmental assessment to determine the extent of sediment accumulation in the reservoir and the impact it may be having on the stability of the structure, performance of the reservoir and fish habitat/ migration.

An option that has been identified to address the sedimentation that may be occurring in the reservoir is to dredge (excavate) the areas of the reservoir where sediment accumulation is determined to be having a structural or environmental impact. However, MIT-WMS recognizes that dredging (excavation) in the reservoir would likely cause environmental concerns that would need to be addressed.

North/South Consultants Inc. was retained by MIT-WMS to gather information related to the existing environmental conditions at the site and prepare an Environmental Assessment Screening Report. This included assessing the potential environmental effects of the proposed dredging works (the Project), identifying mitigation measures, and designing monitoring and follow-up activities.

This environmental assessment screening report has been assembled to satisfy to the degree possible, the requirements stipulated for an Environmental Assessment Screening Report pursuant to the *Canadian Environmental Assessment Act* (*CEAA*). In instances where the assessment could not be completed in full compliance with CEAA, recommended courses of action are provided. This document includes information on the following:

- Project area and location
- Scope of the assessment
- Project description, including activities associated with the proposed dredging works
- Existing environmental conditions within the proposed Project area
- Assessment of the need for the Project (i.e. environmental and socio-economic impacts of the possible sediment accumulation in the reservoir)
- Potential environmental effects of the proposed Project Recommended mitigation measures to minimize or prevent potential environmental effects of the proposed Project
- Summary of residual effects.

2.0 PROJECT AREA AND LOCATION

The Rapid City Reservoir is situated in the Town of Rapid City (immediately downstream of PTH 24), 30 km north of Brandon, on the Little Saskatchewan River in southwestern Manitoba (Latitude 50°07'18.1", Longitude 100°02'30.66"; Figure 2-1). The reservoir is within the Little Saskatchewan River Conservation District and the Rural Municipality of Saskatchewan (Section NW-20, Township 013, Range 19W1; Figure 2-2).

The bounding UTM coordinates of the study area for this project, as defined by North/South and MIT-WMS, are as follows:

- northern limit – 14U 5,552,736.75 m ;
- southern limit – 14U 5,552,588.18 m;
- eastern limit – 14U 425,844.80 m; and
- western limit – 14U 425,525.67 m.

The total size of the study area was measured as 0.026 square kilometres (km2) or 2.58 hectares (ha).

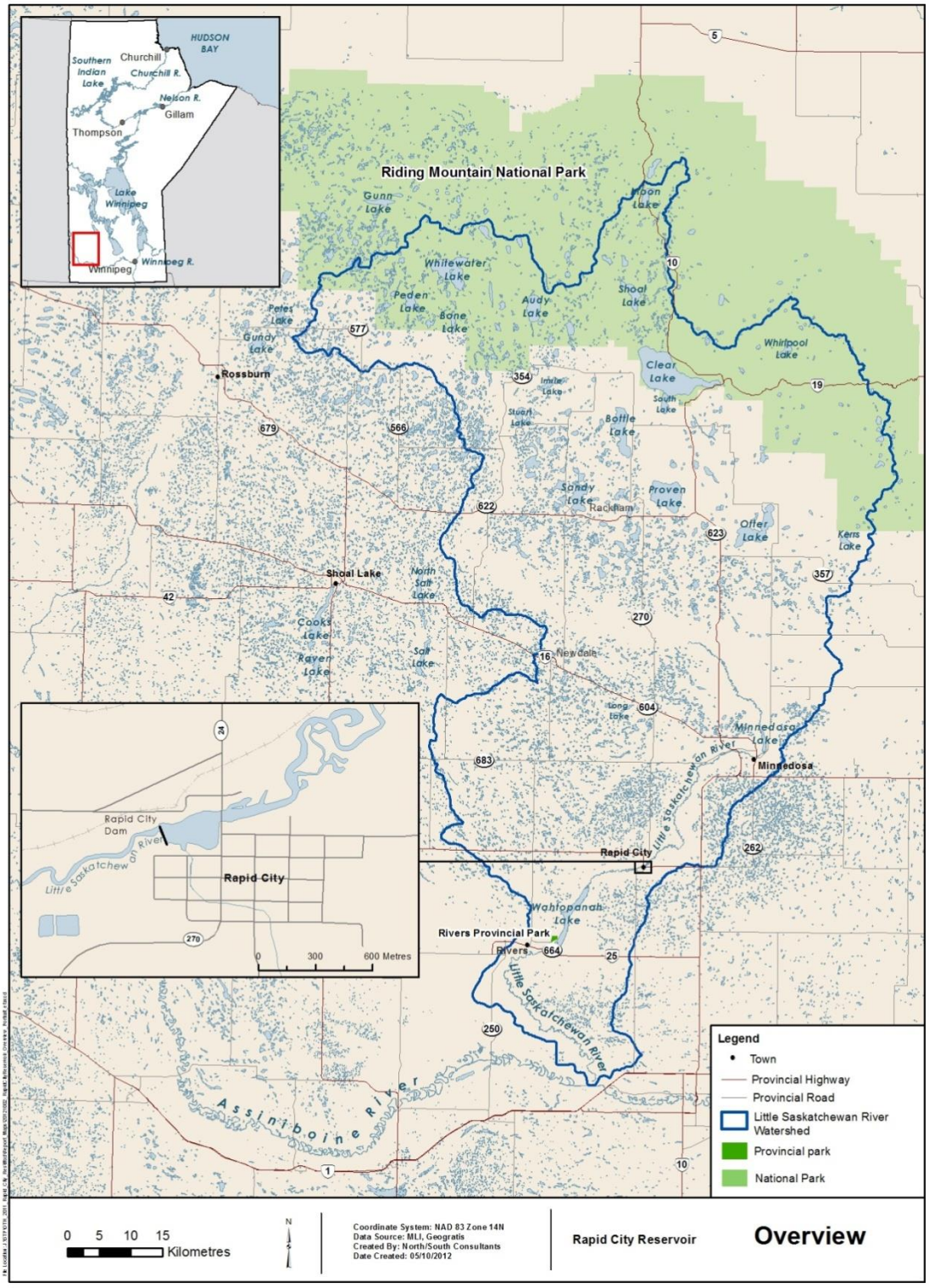

Figure 2-1. Map indicating the location of the Rapid City Reservoir Study Area within the Little Saskatchewan River Watershed.

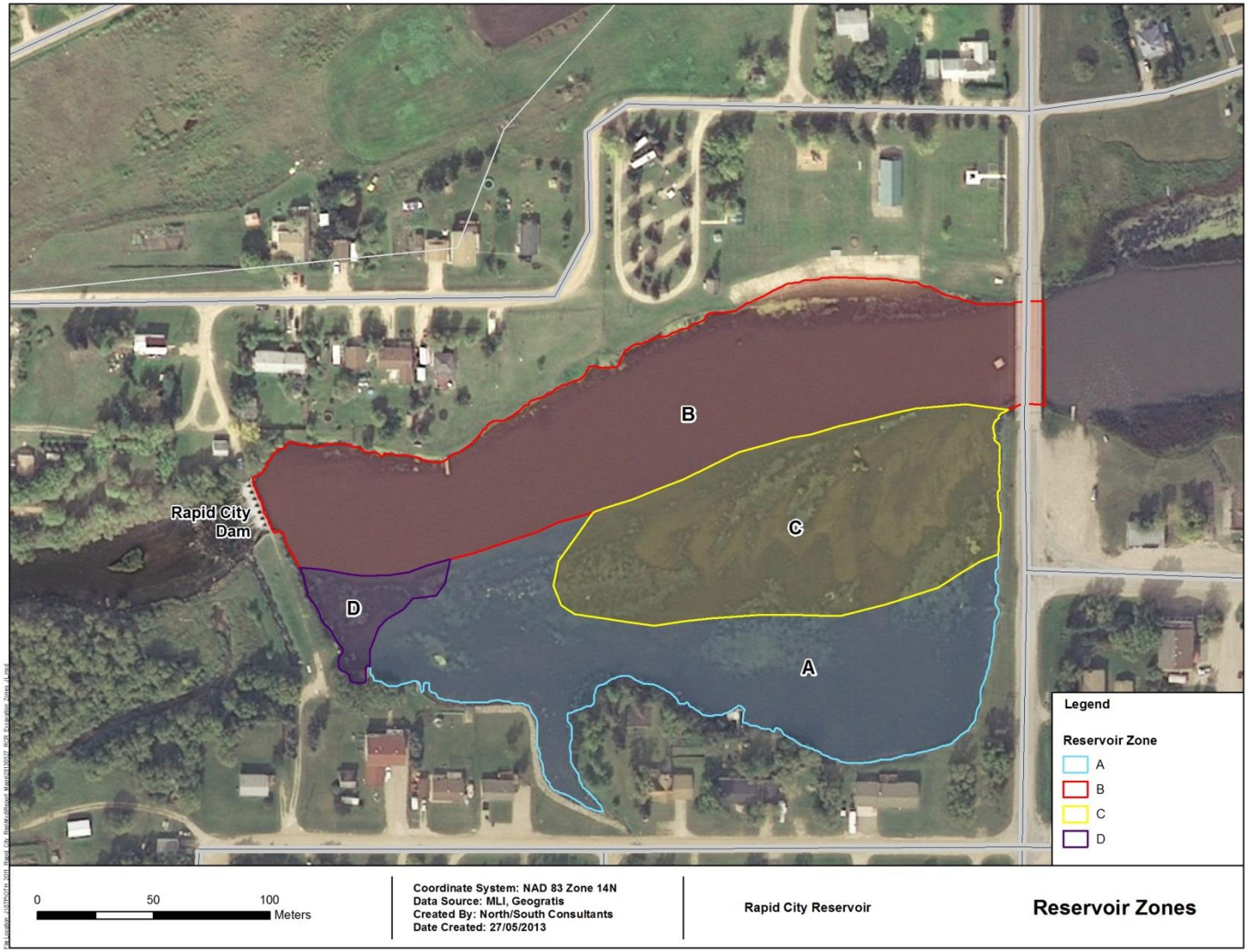

Figure 2-2. Project location and environmental assessment zones of the reservoir.

3.0 PROJECT DESCRIPTION

3.1 BACKGROUND AND PROJECT JUSTIFICATION

Significant sediment accumulation in the Rapid City Reservoir could cause a number of impacts, including, but not limited to:

i. Increased structural load on the Rapid City Dam, which could potential impact the stability of the structure
ii. Decreased storage capacity within the reservoir could result in reduced water supply for upstream users in periods of drought.
    - Note this refers to individual users that draw water from the Little Saskatchewan River between the Rapid City and Minnedosa Dams; water supply for the Town of Rapid City is from groundwater wells.
iii. Impedence to migration of fish through the fish ladder
iv. Changes to native species habitat
v. Reduction in the quality of recreational activities on the reservoir

It is expected that addressing concerns related to items (i) through (iv) would be the primary objective of any dredging program proposed within the Rapid City reservoir, with (v) being a secondary consideration. Assessment of items (i) and (ii) require detailed structural and hydrologic studies, which were not completed at the time this document was issued. The current conditions in the reservoir, relative to items (ii) and (iv) are addressed below.

3.2 NATURE OF THE PROJECT AND MAIN COMPONENTS

The Project can be divided into two main phases: the construction phase and post-dredging phase. The construction phase for these types of projects typically includes the following components:

- Reservoir drawdown
- Site access
- Site preparation
- Dredging and transport of excavated materials
- Deposition of excavated materials.

The post-dredging phase includes the following project components:

- Re-charge of the reservoir
- Monitoring

No project components have been identified for operation, decommissioning or abandonment phases.

Construction Phase

Prior to dredging, the reservoir would be drawn-down (by operation of the Rapid City Dam) in order to lower the water level and isolate the dredging zone from the main river channel. It is anticipated that this would be done just prior to freeze-up (late fall) to minimize the duration of draw-down conditions. Equipment access to the dredging zone is anticipated to occur across government owned land. Access over private lands is not expected. Traffic control, fencing, and other measures would be established to protect public safety prior to and during dredging. A small staging area may need to be prepared to effectively coordinate movement of equipment and provide a location for fuel storage.

It is anticipated that the top 1-2 m of accumulated sediment would be excavated. Dredging would take place during winter when the soils within the dredging zone are frozen. Sediment would be excavated using backhoes and deposited in trucks and hauled to a selected deposition site. Equipment would be operated on frozen ground to minimize the potential for soil compaction and/or erosion.

Excavated material is expected to be transported to and deposited on land that is well away from any watercourses.

Post-Dredging Phase

Following completed excavation, the reservoir will be restored to normal target water levels (by operation of the Rapid City Dam).

4.0 SCOPE

4.1 SCOPE OF PROJECT

A description of each of the main Project components by Project phase is located in Table 4-1. A specific schedule for Project activities has not yet been developed.

Table 4-1. Scope of Project – Summary Table

PROJECT PHASES/ COMPONENTS	DESCRIPTION
Construction phase:	
Reservoir Drawdown	Includes operation of the dam to increase outflow of water from the reservoir and reduce the reservoir water level in order to expose the dredging areas shown on Figure 2-2. Expected drawdown from existing water surface elevation has not yet been determined but is assumed to range from 1-2 m.
Site Access	Includes activities on land such as preparing an access route if required – e.g., preparing staging area for equipment access and limiting public access, traffic control (possible rerouting), preparing a fuel storage area, or other safety precautions as required.
Site Preparation	Includes activities on the waterway such as demarking the dredging zone and implementing associated best management practices (BMPs).
Dredging	Includes operation of dredging and transport equipment on the site and the dredging of the sediment.
Transport	Includes loading and transport of excavated materials to a deposition site.
Disposal	Includes disposal of excavated materials at a selected site (to be determined).
Post-Dredging phase:	
Reservoir Re-watering	Includes operation of the dam to restore water levels in the reservoir to the target water level.

4.2 SCOPE OF ASSESSMENT

The scope of the environmental assessment includes determining the impact the accumulated sediment is having on fish passage and species habitat in the reservoir, and the activities associated with the proposed dredging of the accumulated sediments that have the potential to affect environmental components (e.g., fish and fish habitat, wildlife) that occur in the vicinity of the Project. These activities include: reservoir drawdown; staging, access and use of dredging equipment; dredging and removal; and

deposition of the sediments from the Project area. Table 4-2 illustrates the potential Project–environment interactions.

The spatial extent of the assessment includes four river reaches assessed for the aquatic environment. The terrestrial and human environment study areas are broader, incorporating an area 1 km on each side of the Little Saskatchewan River and upstream and downstream extents 1 km larger than the aquatic environment.

The temporal scope of the Project was defined as the time required to prepare, conduct and complete the excavation works, as well as potential effects on fish habitat or water quality seasonally (i.e., spring freshet) or annually after the completed works.

The Rapid City Reservoir has been divided into four distinct zones for the purpose of this environmental assessment (Figure 2-2). These zones are:

A - Southern shallow water portion of the reservoir.

B - Little Saskatchewan River channel.

C – Depositional ridge of sediment along the southern edge of the river channel.

D – Area immediately upstream of the fish ladder mouth.

The existing environment and potential positive and negative effects of dredging these zones will be described and assessed as part of this environmental assessment screening report. MIT-WMS has indicated that Zone B will not be considered for dredging and is therefore not included in the zone-specific environmental effects assessment.

Because the project has not been defined in detail for scope or schedule by MIT-WMS, the assessment of potential effects must be considered preliminary and be reviewed following detailed design.

Table 4-2. Potential Project–Environment Interaction Matrix.

PROJECT PHASES / COMPONENTS	ENVIRONMENTAL COMPONENTS																										
	Direct Environmental Effect																			INDIRECT ENVIRONMENTAL EFFECTS						Other	
	Land				Water					Air			Natural Systems							Socio-Economic			Cultural				
	Terrain and Topography	Soil Quality	Erosion / Slope Stability	Other	Surface Water Quality	Surface Water Quantity	Sediment Quality	Groundwater Quality	Groundwater Quantity	Air Quality	Climate Change	Other	Vegetation	Wetlands	Species at Risk	Migratory Birds	Wildlife / Wildlife Habitat	Fish and Fish Habitat	Other	Human Health / Safety	Navigation Related	Land Use	Physical and Cultural heritage	Aboriginal Use	Historical / Archaeological site	Acoustic Environment	Vibration
Construction phase:																											
Reservoir Drawdown						x			?				x	x	x			x		x		x		?			
Site Access																				x		x		?			
Site Preparation																											
Dredging					x		x						x	x		x	x	x		x		x	?	?	?		
Disposal																						x	?		?		
Post-Dredging phase:																											
Re-Watering					x										x		x	x									

5.0 DESCRIPTION OF THE EXISTING ENVIRONMENT

5.1 DESCRIPTION OF THE PHYSICAL ENVIRONMENT

5.1.1 Climate

Climate characteristics for the Project Area were taken from the Canadian Climate Normals (1971-2000) (Environment Canada [EC] 2012). Temperature normals were not available for Rapid City and were obtained from the nearest climate normal (1971-2000) weather station at Minnedosa, Manitoba, approximately 20 northeast of Rapid City.

From 1971 to 2000, average annual air temperature was 1°C, with average daily temperatures ranging from -18.4°C in January to 17.3°C in July. Average daily maximum temperatures ranged from -12.4°C in January to 24.1°C in July while average daily minimum temperatures ranged from -24.2°C in January to 10.5°C in July. The hottest recorded temperature (42.2°C) was in June 1931 while the coldest recorded temperature (-46.7°C) occurred in January 1886 and February 1889.

For the period of record from 1971 to 2000, the area received an average of 336.9 mm of rain and 104.9 cm of snow per year. The highest average rainfall occurred in June (74.7 mm), while the highest average snowfall occurred in December (17.5 cm). The majority of the precipitation (64%) falls between the months of May and August.

5.1.2 Air Quality

Air quality in Manitoba is monitored by Manitoba Conservation under the National Air Pollution Surveillance (NAPS) Network at three locations: Winnipeg, Brandon and Flin Flon. The nearest NAPS station to the project area is in the industrial area of Brandon, Manitoba approximately 30 km south of Rapid City. From 2003 to 2008 air quality recorded at this station was in the “Good” range over 85% of the time (PSRAM 2009). The air quality in the Project Area is presumed to be that of a small town, rural community. Factors that contribute to air quality in the project area include vehicle emissions and road dust, exhaust resulting from using natural gas, diesel or wood to heat homes and buildings, the local sewage lagoon, and sources associated with agricultural practises. Some of these sources affecting air quality may include the dust generated during sowing and harvesting of crops or high winds, the seasonal application of fertilizers and pesticides, the presence of livestock on neighbouring land and seasonal burning of crops. In most years, the majority of the ”Fair” to “Very Poor” air quality events recorded at the Brandon station occurred between May and October, and was attributed to smoke from forest fires within Manitoba and adjacent provinces, burning of agricultural residue locally, and wind swept dust (PSRM 2009, Krawchuk and Snitowski 2008).

5.1.3 Noise

Noise levels in the Project Area should be typical of a small town and rural community. Expected sources of noise year round include local traffic on PTH 24 and surrounding residential neighbourhood, outdoor residential activities, recreational activities in the adjacent park, and on the river (boat motor/snowmobile). Seasonal sources of noise may include those associated with agricultural activities during the growing season, or on the river during the annual fishing derby held in February.

5.1.4 Geology, Hydrogeology, and Soils

Rapid City is located west of the Manitoba Escarpment. The underlying bedrock is part of the Riding Mountain Formation and is composed of mainly bentonitic and siliceous shale. The overlying surficial geology is dominated by calcareous clay diamicton, originating from the Mesozoic shale. It varies from 1 to 75 m thick depending on the hummocky terrain (Matile and Keller 2004). The clay till is covered discontinuously by thin veneers of glaciofluvial sediments. Sand and gravel deposits occur to the immediate southwest, belts with single or multiple esker ridges and kames, deposited in contact with glacial ice and meltwater. Steep slopes of the Little Saskatchewan River Valley upstream of the study area are dominated by colluvium materials resulting from landslide debris, eroded slopes and mass flow deposits associated with steep slopes (Matile and Keller 2004).

The Study Area resides in the Western Glaciated Plains physiographic region of the Manitoba Uplands. The primary bedrock aquifer is the Odanah Formation in the northern half of the drainage basin and some small discontinuous areas to the south. The Odanah formation sits above the Swan River Formation in most areas of the region, and its shale provides an aquitard between the two aquifers. In the direct vicinity of Rapid City, bedrock aquifers are discontinuous and are greater than 150 m deep. Sand and gravel aquifers of glacial and glacial-fluvial origin are widely distributed in the Western Glaciated Plains and are also common in the Study Area (Bethcher et al. 1995).

Soils in the region are dominated by Chernozems and Regosols. Variable textured alluvial Regosols are found primarily in the flat terrain of the Little Saskatchewan River valley. Clay and clay loam Black Chernozems dominate the landscape above the valley (Manitoba Conservation 2012; Podolsky 1988).

5.1.4.1 *Erosion*

The combination of Regosolic soils, rolling and sloped topography, and active agricultural channelization and drainage practices, make the Little Saskatchewan River Watershed one of the most highly susceptible watersheds to overland runoff erosion in Manitoba (Agriculture and Agri-food Canada 2012). The flood plain of the Little Saskatchewan River upstream of Rapid City has steeply sloped (30-45%) eroding banks composed of sand, clay, silt, and gravel alluvium, which are easily eroded due to water flow and/or gravity (colluvium). In addition, there are a number of glacial sand and gravel deposits located near Rapid City (Agriculture and Agri-food Canada 2012).

5.1.5 Surface Hydrology

The headwaters of the Little Saskatchewan River originate within Riding Mountain National Park, approximately 100 km north (Figure 2-1). They include water bodies such as Whitewater Lake and Lake Audy which is the Little Saskatchewan River's originating water body. There are three manmade reservoirs on the lower end of the Little Saskatchewan River, beginning with Lake Minnedosa, followed by Rapid City reservoir, and Lake Wahtopanah at the Town of Rivers. The Little Saskatchewan River flows into the Assiniboine River approximately 10 km upstream of the City of Brandon. The gross drainage area upstream of Rapid City is approximately 3,460 km^2 (Environment Canada 2012a).

Peak flows, associated with the spring freshet, occur between April and June, with minimum flows experienced in the winter months (Table 5-1). Using Environment Canada station 05MF001 as a proxy for over winter discharge, minimum flows approach zero in January through March and average 0.71 m^3/s during those same months (Table 5-2). On average, mean monthly discharge on the Little Saskatchewan River is 1.5 m^3/s higher at Rapid City than upstream of Lake Minnedosa.

Table 5-1. Monthly discharge records for the Little Saskatchewan River downstream of Rapid City.

Month	Little Saskatchewan River at Rapid City (05MF021) 1961-1978		
	Mean m^3/s	Maximum m^3/s	Minimum m^3/s
March	1.02	3.1	0.004
April	14.22	43.9	2.050
May	16.50	56.2	1.670
June	8.65	26.8	0.715
July	4.98	20.6	0.167
August	2.45	7.0	0.000
September	3.29	27.5	0.017
October	3.31	26.3	0.048
Mean Annual	6.80	56.2	0.584

Source: Environment Canada 2012a
Notes: m^3/s = cubic metres per second
Recorder discontinued in 1978

Table 5-2. Monthly discharge records for the Little Saskatchewan River upstream of Lake Minnedosa.

Month	Little Saskatchewan River Near Lake Minnedosa Discharge (05MF001) 1914-2010		
	Mean m^3/s	Maximum m^3/s	Minimum m^3/s
January	0.67	2.90	0.00
February	0.58	2.63	0.00
March	0.89	3.37	0.00
April	9.97	32.40	1.80
May	13.30	49.30	0.80
June	8.14	42.50	0.37
July	5.05	18.20	0.20
August	2.43	12.00	0.07
September	2.12	26.30	0.05
October	2.10	19.30	0.10
November	1.65	7.58	0.25
December	0.96	4.21	0.15
Mean Annual	4.02	9.26	0.82

Source: Environment Canada 2012b
Notes: m^3/s = cubic metres per second

5.1.5.1 *Sedimentation*

Typically, sediment inflow and outflow in most natural river reaches are balanced. Impoundment of a natural river reach alters this balance as a result of decreased flow velocity and efficient sediment trapping. The impounded river reach will lose storage capacity until this balance is returned, which normally occurs after the reservoir is in-filled (Morris and Fan 1998).

Due to the Little Saskatchewan River watershed's high susceptibility to overland erosion, transport and deposition of sediment in the Little Saskatchewan River is persistent. In addition to natural deposition of sediments on the inside bends of the Little Saskatchewan River, sedimentation also occurs simultaneously in all three reservoirs. A similar dredging activity was completed at the upstream end of Lake Minnedosa in 1998 (Manitoba Conservation 1998). Most sediment transport occurs during the spring freshet when higher river discharge and overland runoff flush large amounts of agricultural soils and floodplain alluvium downstream. Sedimentation occurs throughout the open water season as small-sized clay, silt, and sand particles fall out of suspension (suspended sediment load) where flow velocities permit. Large sand and small gravel particles may also move along the river bed (bed load) given high enough flow velocities. Figure 5-1 approximates the extent of sedimentation along the southern extent of the Little Saskatchewan River channel within the Rapid City reservoir (Zone C).

Figure 5-1. Large area of sedimentation outlined along the southern extent of the Little Saskatchewan River channel visible in a Quickbird high-resolution multispectral image from fall 2010 (© DigitalGlobe).

5.2 DESCRIPTION OF THE BIOPHYSICAL ENVIRONMENT

5.2.1 Aquatic Environment

5.2.1.1 *Water Quality*

5.2.1.1.1 Background

Manitoba Conservation and Water Stewardship (MWS) maintain a water quality monitoring station on the Little Saskatchewan River near Rivers, Manitoba (at the outlet of Lake Wahtopanah). Sampling has been done quarterly each year since 1973 and includes analysis of conventional water quality parameters (e.g., nutrients, pH, TSS), total metals, and pesticides. Eleven additional sites (including one at the Little Saskatchewan River near Rapid City) have been sampled historically in the area but the most recent sampling event occurred in 1994 and data are generally limited to bacterial analysis. As such, these data were not used for the assessment of current conditions in the region but the raw data was provided electronically to MIT-WMS.

Mean concentrations of routine parameters (e.g., pH), nutrients, total metals, and pesticides measured in the Little Saskatchewan River near Rivers, MB between 2002 and 2012 are provided in Appendix 1.

Between 1973 and 2012, total phosphorus (TP) concentrations measured in the Little Saskatchewan River near Rivers almost always exceeded the narrative Manitoba water quality guideline (0.05 mg/L) for the protection of rivers from the production of nuisance algal growth (MWS 2007). Trend analysis of data collected at this site also showed that TP concentrations increased approximately 40% between 1973 and 1996, but that total nitrogen (TN) concentrations decreased by almost 30% (Jones and Armstrong 2001). The increased load of phosphorus and sediments to the Little Saskatchewan River Watershed has resulted in "accelerated eutrophication and related problems (algae blooms, summer and winter fish kills)" in the watershed and has been attributed to inputs from point and non-point sources including municipal lagoons, poor agricultural practices, and bank erosion (Jones and Armstrong 2001; MWS 2007; MWS n.d.).

In addition to the TP exceedances noted in the region between 1973 and 2012, dissolved oxygen (season-specific objective), total suspended solids (TSS; site-specific objective), conductivity (season-specific objective), aluminum (0.1 mg/L), and iron (0.3 mg/L) occasionally exceeded the Manitoba water quality objectives and guidelines for protection of aquatic life or irrigation (MWS 2007; MWS 2011; MWS 2012). Iron and manganese concentrations also often exceeded the aesthetic objectives for drinking water (0.300 and 0.050 mg/L, respectively; MWS 2007; MWS 2011). All other parameters for which guidelines exist were within the respective thresholds (MWS 2007).

5.2.1.1.2 Field Surveys

In situ water quality parameters were measured on July 24 and 25, 2012 at each sediment quality sampling site prior to collection of the sediment cores. Parameters were measured using Analite, YSI-85, and YSI-63 water quality meters and included temperature, dissolved oxygen (DO), pH, turbidity, and specific conductance. Measurements were collected near the surface at each site; site WSQ-2 was also sufficiently deep to collect measurements at depth (i.e., 0.5m above the sediment-water interface). Manitoba water quality standards, objectives, and guidelines (MWQSOG) for the protection of aquatic life (PAL) exist for pH (lower limit of 6.5 and upper limit of 9.0) and dissolved oxygen (MWS 2011). DO guidelines vary according to the presence of cool- or cold-water aquatic life, the presence of mature or early life history stages of aquatic life, and duration of exposure. Both early and mature life stages were likely present during the sampling period, but the sampling frequency did not allow for determination of 7-day averages, minimal, or 30-day averages of DO concentrations; therefore, to be conservative, the most stringent objective (6.5 mg/L) was applied. No water chemistry samples were collected during the 2012 field surveys. Detailed results and sample locations are presented in Appendix 1.

In situ water quality was measured at three sites, one (WSQ-2) within Zone B, and two (WSQ-1 and WSQ-3) within Zone C. Slight differences in *in situ* water quality parameters were noted between sites, but measurements were similar across depth at site WSQ-2 (Table 5-3). DO and pH were lower at site WSQ-2 (surface: 6.64 mg/L and 8.24, respectively) than WSQ-1 or -3 (7.45-7.74 mg/L DO and 8.40-8.42 pH), but turbidity was slightly higher at site WSQ-1 near the mouth of the creek (8.50 NTU compared to 4.15-4.77 NTU) and specific conductance was lowest at site WSQ-3 (725 µS/cm). All *in situ* pH and DO measurements were within the MWQSOGs for PAL.

Table 5-3. *In situ* water quality parameters measured at three sites in the Rapid City Reservoir in July, 2012.

Site	Date	Time	Total Depth	Sample Depth	Temperature	pH	Dissolved Oxygen		Turbidity	Specific Conductance
			(m)	(m)	(°C)		(mg/L)	(%)	(NTU)	(µS/cm)
		MWQSOG[1]			-	6.5 - 9.0	6.5	-	-	-
WSQ-1	24-Jul-12	11:27	0.49	0.2	25.1	8.40	7.45	90.7	8.50	738
WSQ-2	24-Jul-12	16:10	1.7	0.2	24.9	8.24	6.64	80.3	4.77	743
				1.2	24.7	8.17	6.71	80.8	4.43	743
WSQ-3	25-Jul-12	10:55	0.33	0.2	23.9	8.42	7.74	92	4.15	713

[1] Manitoba Water Quality Standards, Objectives, and Guidelines for the Protection of Aquatic Life (MWS 2011).

5.2.1.2 *Sediment Quality*

5.2.1.2.1 Background

No historical data regarding sediment quality were located.

5.2.1.2.2 Field Surveys

Sediment quality was sampled on July 24 and 25, 2012 at three locations within the Rapid City Reservoir (Appendix 1) in order to determine particle size, sediment composition and sediment chemistry. Two of the three sediment quality sample sites were in Zone C (WSQ-1 and WSQ-3) and one was within Zone B (WSQ-2). Prior to the sampling event, all core tubes and glassware were cleaned using a laboratory-grade detergent, acid washed with 10% hydrochloric acid, and triple rinsed with de-ionized (DI) water. Cores of the sediment were collected using a hand corer and sediment was extruded at depths of 0-5 cm (i.e., surface sediment), 10-20 cm, and 25-35 cm (sites WSQ-1 and -3 only) into a clean Pyrex® dish. One triplicate sample and one homogenate duplicate sample were collected as quality assurance/quality control (QA/QC). Parameters measured in each sample include: particle size; carbon (total, total organic [TOC], and total inorganic [TIC]); total phosphorus (TP); nitrogen (nitrate, nitrite, and total Kjeldahl nitrogen [TKN]); total metals; polycyclic aromatic hydrocarbons (PAH); benzene, toluene, ethylbenzene and xylene (BTEX); and pesticides (organochlorine and organophosphate pesticides). All samples were processed at a Canadian Association for Laboratory Accreditation Inc. (CALA) approved laboratory (ALS Laboratories, Winnipeg, MB). Results of the quality assurance and quality control (QA/QC) samples are provided in Appendix 1.

In addition to sediment cores, particle size analysis of surface (0-5 cm) sediments was assessed at an additional ten sites (Appendix 1). Samples were collected using a petite Ponar and analysed for particle size and texture at ALS Laboratories.

All sediment data are compared to the Manitoba Interim Sediment Quality Guidelines (ISQG) and associated Probable Effects Levels (PELs) for arsenic, cadmium, chromium, copper, lead, mercury, zinc, and pertinent PAHs and pesticides (MWS 2011). Additional guidelines are also available from Ontario for iron, manganese, nickel, three PAHs [Benzo(k)fluoranthene, Benzo(g,h,i)perylene, and Indeno(1,2,3-cd)pyrene], and six pesticides (aldrin, alpha-BHC, beta-BHC, heptachlor epoxide, heptachlorobenzene, and mirex; Persaud et al. 1993). All applicable guidelines are presented with the data in Appendix 1.

Surface sediments in accessible areas of the reservoir were generally predominated by sand with localized areas of silt accumulation (Appendix 1). Laboratory and field observations also illustrated that the sediment samples were collected in two different depositional layers: surface and mid-depth strata were dominated by sand whereas the deeper strata was predominantly silt.

With few exceptions, most nutrients and metals were detected in all sediment samples and total carbon, TOC, TIC, TP, TKN, and most total metal concentrations increased with depth such that higher concentrations were typically reported in the 25-35 cm deep sediments than the 0-5 or 10-20 cm sections (Appendix 1). Nutrients and metals analysed in the surface sediments also tended to be higher at site WSQ-2 than WSQ-1 or WSQ-3. No BTEX or pesticides were detected in the sediment samples and

naphthalene was the only PAH detected (Appendix 1). Naphthalene was detected in most samples but was only slightly above the analytical detection limit. No pesticides were detected in the sediment cores (Appendix 1).

Arsenic and copper exceeded the Manitoba interim sediment quality guidelines (5.90 and 35.7 mg/kg, respectively) at site WSQ-3 in sediments below 10 and 25 cm depths, respectively. Exceedances of the Ontario guidelines were also noted for:

- TOC (LEL: 1%) in all sediment depths from sites WSQ-2 and -3 but only the deepest sediments (>25 cm) at site WSQ-1;
- TP (LEL: 600 mg/kg) in sediments deeper than 10 or 25 cm from sites WSQ-3 and -1, respectively, as well as surface sediment from sites WSQ-1;
- nickel (LEL: 16 mg/kg) in sediment deeper than 10 cm at site WSQ-3; and
- manganese (LEL: 460 mg/kg) in all sediment at every site, with the >10 cm and >25 cm sediments at sites WSQ-3 and -1 also exceeding the severe SEL guideline (1100 mg/kg).

Comparisons to the sediment guidelines for pesticides cannot be made as all analytical detection limits exceeded the guidelines; however, samples collected in future could be analysed at lower detection limits.

No other exceedances were noted for other metals or hydrocarbons where guidelines exist.

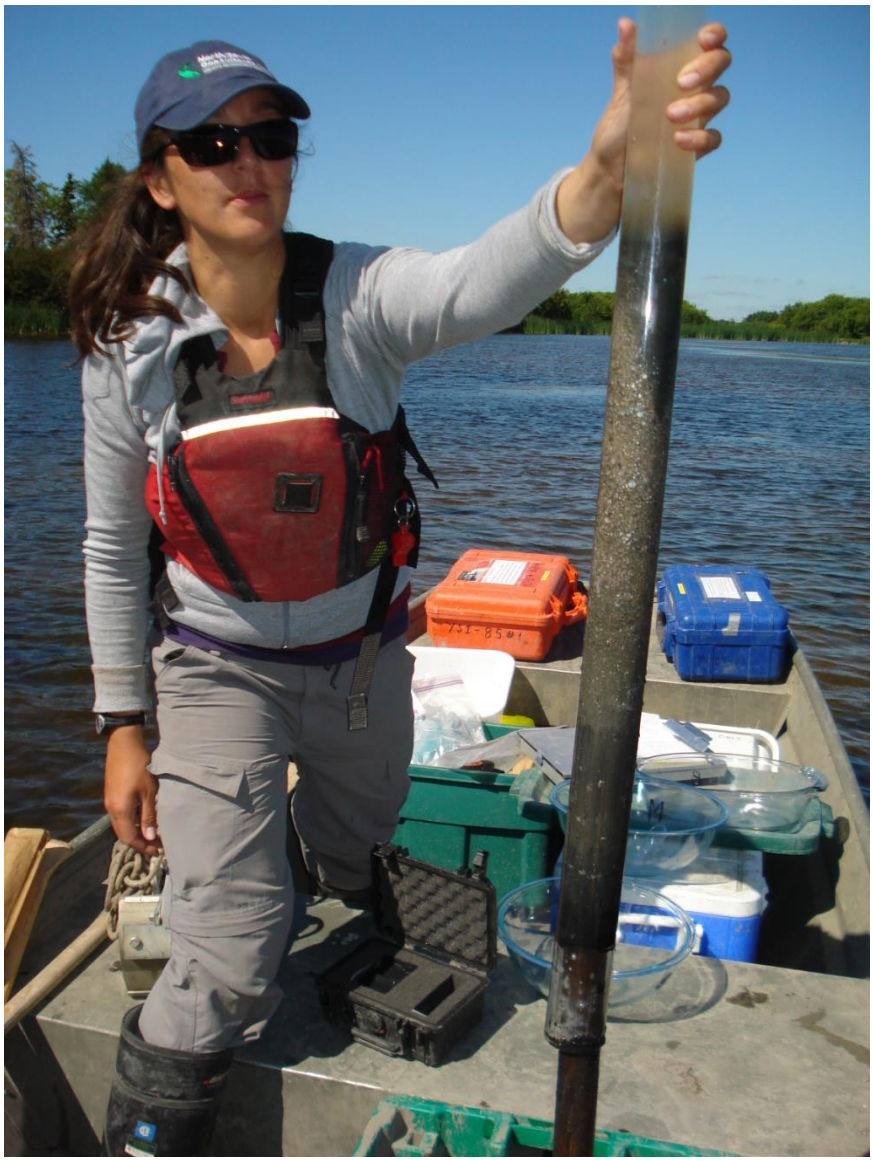

Figure 5-2. Sediment core collected in the Rapid City Reservoir showing: a dark surface layer; sandy mid-layer; and dark, silty deep layer.

5.2.1.3 *Aquatic Habitat*

Aquatic habitat surveys in support of this screening report were conducted in May 2012. See Appendix 2 for a complete description of methods.

5.2.1.3.1 Habitat Reaches

Four habitat reaches were identified along the Little Saskatchewan River at Rapid City for this environmental assessment (Figure 5-3). The general habitat characteristics of each reach are described below:

Reach 1 is a 500 m stretch of the Little Saskatchewan River upstream of the Rapid City Dam and has an estimated open water habitat area of 17,165 m^2. It has a low gradient, is moderately sinuous, with a gently meandering channel. It has a broad well-defined floodplain and healthy riparian vegetation dominated by grassland and deciduous forest.

Reach 2, downstream of Reach 1, meanders through a wetland uncharacteristic of the river's natural morphology. The adjacent wetland of this reach appears to be a result of the backwater effect caused by the construction of the dam and impoundment of the Little Saskatchewan River in 1961 at Rapid City. The reach has an estimated open water habitat area of 107,451 m^2.

Reach 3 is the Rapid City Reservoir reach. Here the river transitions from a predominantly lotic environment to a predominantly lentic environment over a short distance. The thalweg of the river runs along the north shore of the reservoir and has detectable flow throughout the year. The southern extent of the reservoir is susceptible to infilling where entrained sediments in the Little Saskatchewan River (sand, silt, clay) deposit due to the transition to a slow water (lentic) environment. This reach has an estimated open water habitat area of 47,222 m^2.

Reach 4 begins at the Rapid City Dam and extends downstream 1.5 km. The upper end of this reach has low sinuosity, with slightly faster moving water, and contains riffle habitat areas. The lower end of this reach is characterized by a highly sinuous low gradient channel with depositional alluvial soils on the inside bends. It also contains numerous oxbow lake formations along with additional riffle habitat. This reach has an estimated open water habitat area of 61,540 m^2.

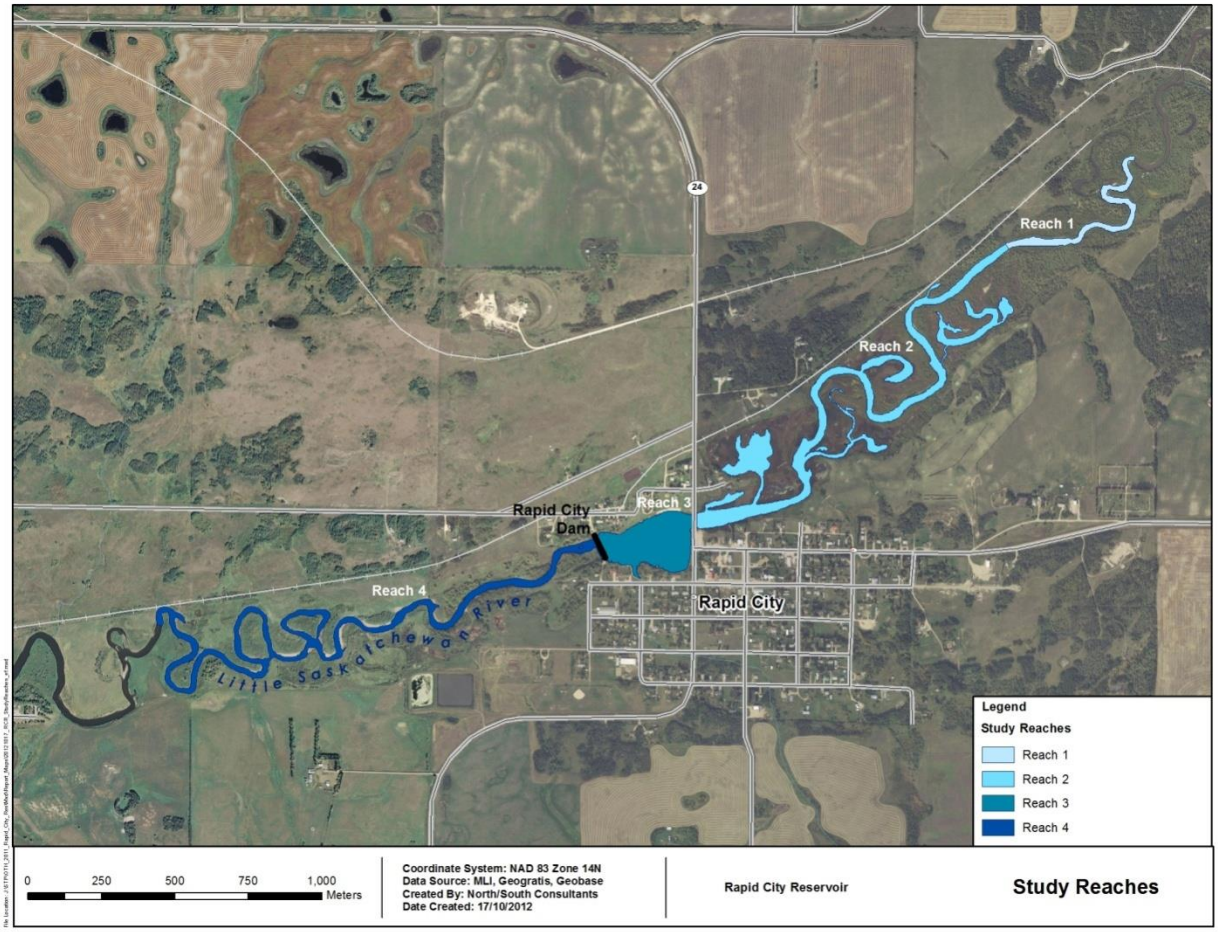

Figure 5-3. The four habitat reaches of the Little Saskatchewan River in the vicinity of the Rapid City reservoir.

5.2.1.3.2 Depth

The Little Saskatchewan River near Rapid City is generally quite shallow. With the exception of intermittent pools, the river maintains a shallow riverbed. Bathymetric surveys were conducted in Reach 2 and 3 in order to characterize aquatic habitat in the vicinity of the reservoir. The water level of the reservoir at the time of the survey was 479.75 m (CGVD28 HT2.0), which is close to normal operating level.

The downstream end of Reach 2 contains two shallow off-channel backwater habitats (Figure 5-4). The remainder of the surveyed reach is a broader form of what was the original river channel prior to impoundment. Reach 2 has an average depth of 1.29 m (Table 5-4) and a maximum depth of 2.78 m, which occurs in the furthest extent upstream. The total volume of the surveyed portion of Reach 2 is 42,654 m^3, or 34.6 acre/ft.

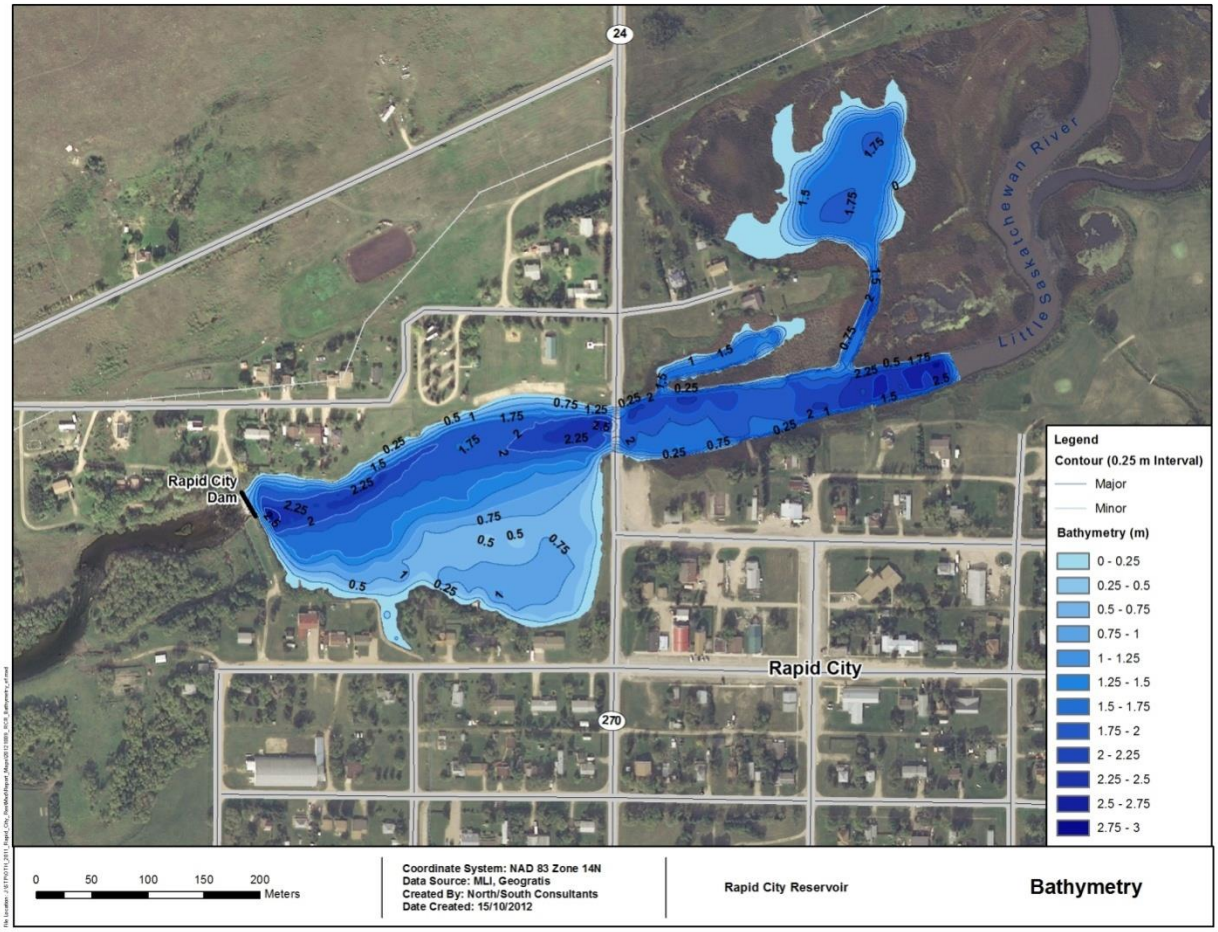

Figure 5-4. Bathymetric map of the Rapid City Reservoir from data collected May 18, 2012. The depth is relative to a water level of 479.75 m (CGVD28 HT2.0).

Table 5-4. Depth and volume statistics for Reach 3 and a portion of Reach 2 of the study area.

Reach	Maximum Depth (m)	Mean Depth (m)	Volume (m3)	Volume acre/ft
Reach 2	2.78	1.29	42654	34.6
Reach 3	2.98	1.15	54155	43.9
Total	-	-	**96809**	**78.5**

Reach 3 is deepest within Zone B, directly downstream of the PTH 24 bridge, which may be attributed to scour pools directly downstream of the bridge abutments. The other deep area in Zone B is immediately upstream of the dam. These areas approach depths of 3 m. The average depth in the reach is 1.15 m. A combination of long-term sediment deposition and the flooding of the flat valley of the Little Saskatchewan River upon the initial operation of the dam make this area of the reach shallow. Reach 3 has a present day volume of approximately 54,155 m^3 or 43.9 acre/ft.

5.2.1.3.3 Substrate

Substrate mapping was conducted in a small portion of habitat Reach 2 upstream of the reservoir and in the reservoir itself (Reach 3) (Figure 5-5; Table 5-5). Reach 2 is dominated by silt/clay (mud) with organic debris substrate (54.7%) mainly in the backwatered wetland areas. The main channel of the Little Saskatchewan River is dominated by sand substrate (39.8%) with traces of larger sized sand and gravel. Silt/clay substrates found near shore are typically associated with cattail (*Typha sp.*) growth.

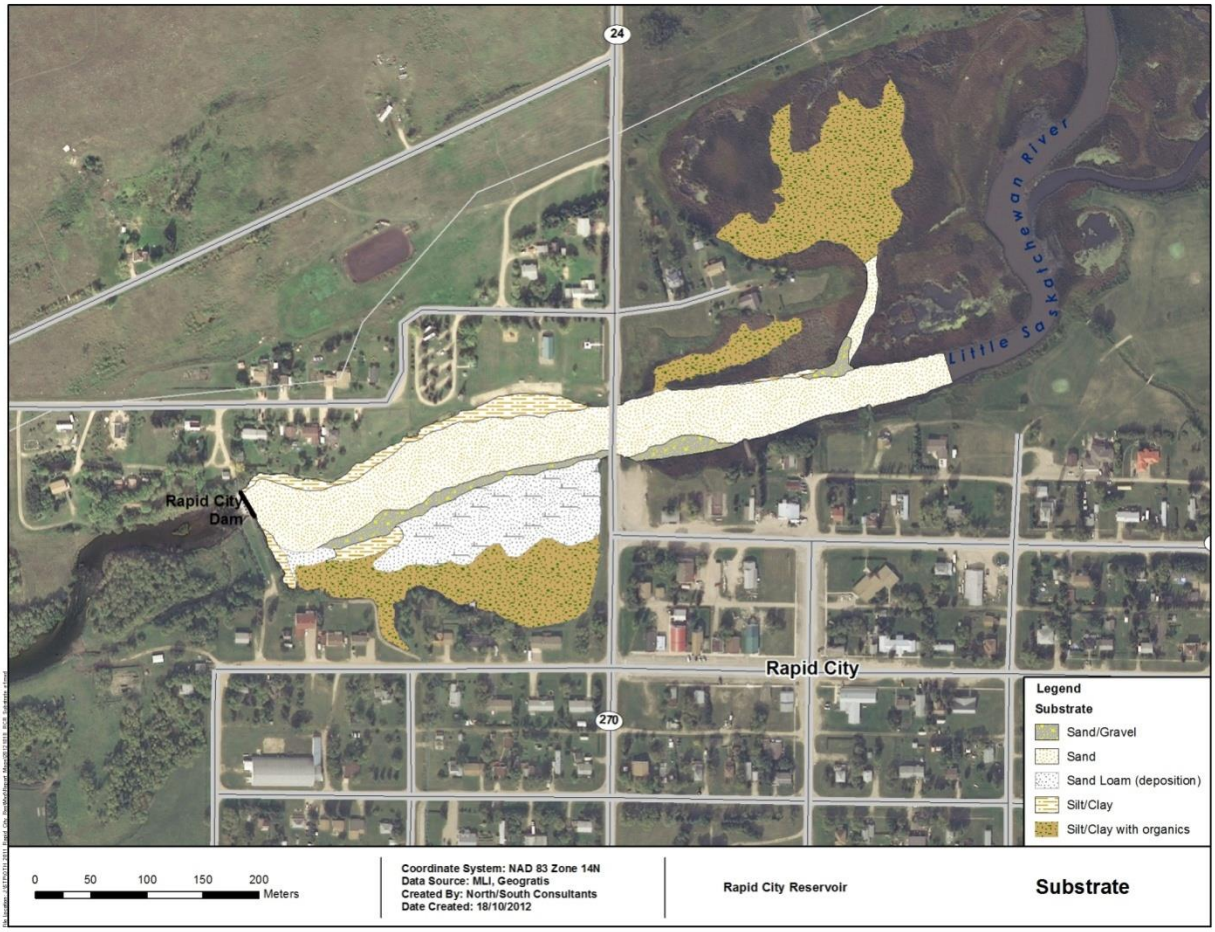

Figure 5-5. Substrate distribution map of the Rapid City Reservoir Study Area, data collected on May 18, 2012.

Table 5-5. Substrate class areas in Reaches 2 and 3 of the Study Area.

Reach	Substrate Class	Area (m^2)	Area of Reach (%)
Reach 2	sand	13110.4	39.8
	sand/gravel	1613.6	4.9
	silt/clay	207.8	0.6
	silt/clay with organics	18024.1	54.7
	Total	**32955.8**	**100.0**
Reach 3	sand	16322.0	34.6
	sandy loam (deposition)	11890.0	25.2
	sand/gravel	2386.8	5.1
	silt/clay	4505.8	9.5
	silt/clay with organics	12117.8	25.7
	Total	**47222.4**	**100.0**
Total		**80178.1**	**100.0**

The thalweg of the Little Saskatchewan River in Reach 3 (Zone B) is dominated by sand substrate, which comprises 34.6% of the total substrate in the reach; there is a sand and gravel bar along the south bank of the channel directly downstream of the PTH 24 bridge. The southern portion of the reservoir is dominated by silt/clay (mud) (25.7%) containing varying amounts of decayed plant matter in areas where submergent and emergent aquatic plants persist (Zone A). The large depositional infill area south of the river channel (Zone C) is comprised mainly of sandy loam substrates [(dominant sand, smaller contributions of silt and clay sized material) see Section 5.2.1.2 for the PSA results]. Silt/clay substrates primarily along the shoreline and associated with emergent aquatic plant growth make up the remainder of substrates in the reach.

5.2.1.3.4 Macrophytes

Aquatic plants support various life stages of numerous fish species. They provide refuge, spawning grounds, and food sources. An estimate of aquatic plant occupation was produced in support of this screening document. Figure 5-6 shows the estimated distribution of aquatic vegetation in the study area. Emergent vegetation was found to be largely comprised of cattail (*Typha spp.*). Submergent aquatic vegetation was primarily composed of, (but not limited to): Canada water weed (*Elodea canadensis*), pond weed (*Potamogeton spp.)*, water milfoil (*Myriophyllum* sp.), and traces of aquatic bryophytes.

Reach 2 contains small contributions of emergent (1,319 m^2) and submergent (310 m^2) vegetation. The river channel is dominated by sand and flowing water, which are generally not conducive to plant growth. The open water backwater areas are covered mid-summer by duck weed and various algal communities (categorized as 'other').

The reservoir environment of Reach 3 is conducive to aquatic plant growth. It is a shallow well protected, slow-water environment with nutrient rich substrates. The large shallow depositional bed on the south side of the reservoir contains sporadic pockets of cattail and is dominated by submergent vegetation (10,520 m^2) (Figure 5-7 and 5-8). The shorelines of Reach 3 are dominated by emergent vegetation (3,867 m^2). The north shore of Reach 3 is primarily composed of cattails (Figure 5-9); however, submergent vegetation can also be found growing intermittently in this area.

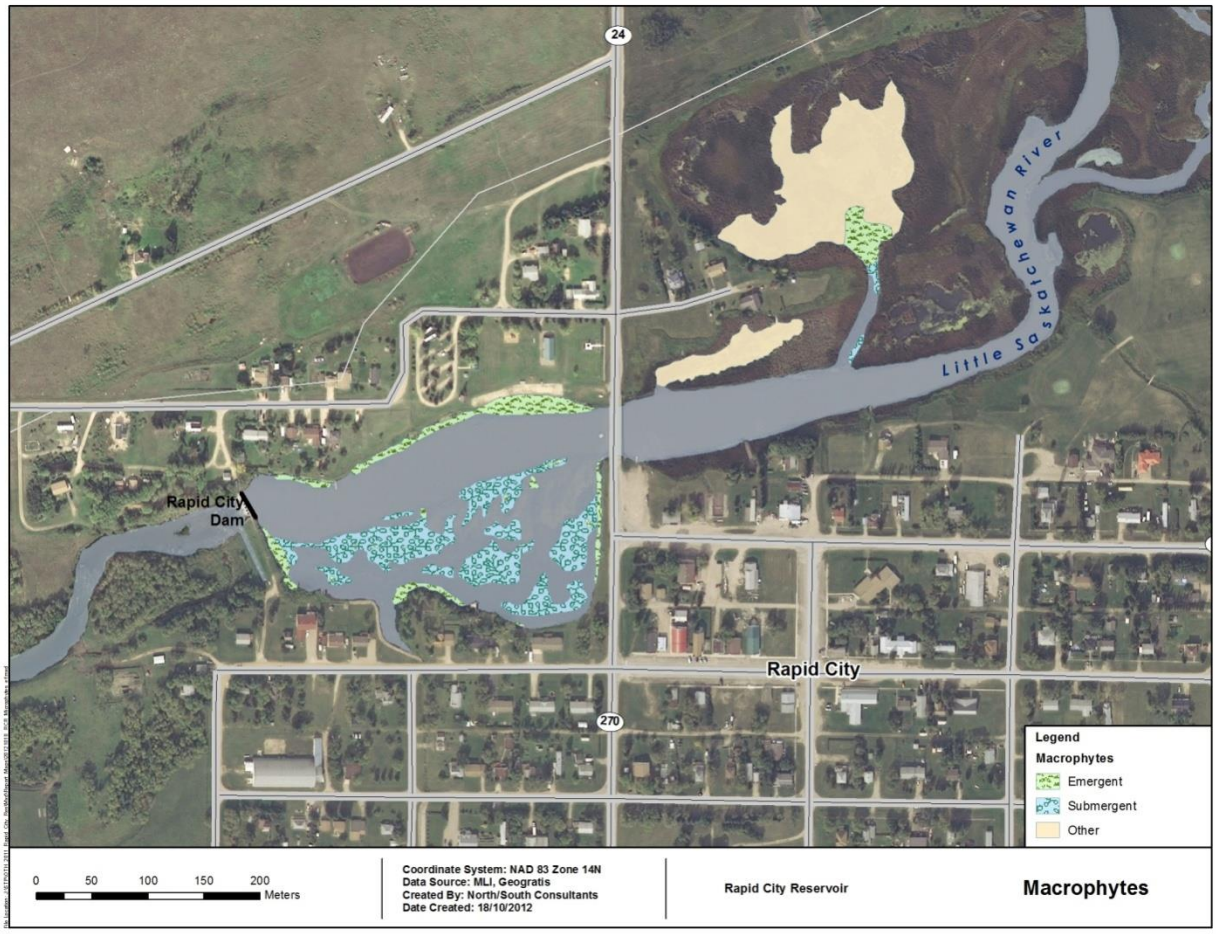

Figure 5-6. Map illustrating emergent and submergent vegetation distribution in Reaches 2 and 3 of the Project Area. Data collected on May 18, 2012

Figure 5-7. View of the south-western shoreline of the reservoir and the emergent vegetation on the depositional area in the center of the reservoir (Reach 3), taken from the PTH 24 bridge, August 2012.

Figure 5-8. Submergent vegetation on the depositional area in the center of the reservoir (Zone C, Reach 3), August 2012.

Figure 5-9. View of the northern shoreline of the reservoir (Reach 3) from the channel showing emergent vegetation along the banks, August 2012.

5.2.1.4 *Lower Trophic Levels*

No historical data regarding lower trophic levels were located and field studies were not included as part of this assessment. However, the following provides a description of lower trophic levels based on habitat and geography of the site.

Lower trophic levels form the basis of the food web and, therefore, are important to higher trophic levels such as fish. Aquatic lower trophic level organisms include bacteria, algae (large filamentous algae and microscopic phytoplankton), large rooted plants (aquatic macrophytes), and invertebrates (zooplankton, aquatic insects, shellfish). In particular, aquatic invertebrates are noted for their ecological significance as a dietary item for fish.

Aquatic invertebrates are defined as those living organisms that lack a spinal cord and are associated with the aquatic environment in one or more of their life stages. Aquatic invertebrates can be divided into two main categories; microinvertebrates (those indistinguishable by the naked eye) and macroinvertebrates (those that can be distinguished without the aid of magnification). Microinvertebrates are widespread throughout the Study Area and are broadly classified as zooplankton. Zooplankton will not be described further in the existing environment. Macroinvertebrates include a wide range of organisms such as water mites, insects, worms, mollusks, and crayfish, etc. Benthic invertebrates are macroinvertebrates living at/in the river bottom sediments (aka benthos). Some macroinvertebrates live in the water column, because these invertebrates spend at least a portion of one of their life stages in benthos, all will be considered benthic invertebrates.

Aquatic benthic invertebrates within the Study Area inhabit a variety of lentic (still or slow moving water) and lotic (fast moving water) environments (Table 5-6). Most of the main channel of the Little Saskatchewan River likely contains lotic species, and the back-bay/pond areas directly attached to the river likely contains lentic species. In Reach 3, the main channel of the river is lotic, whereas the assumed dredging area is lentic.

Species distribution, diversity, and relative abundance throughout the area are influenced by differences in water depth, water current, substrate type, vegetation, water chemistry, and climate. Although parameters can be broadly characterized, it is the compounding effects of these parameters that directly influence the suitability of water bodies for benthic invertebrate communities. Within individual water bodies, invertebrates utilize various habitat types based on physiological constraints (e.g., temperature), feeding habits (e.g., filter feeders versus carnivores), trophic interactions (e.g., predator and prey relationships), and physical constraints (e.g., flow regimes). Some types of invertebrates spend their entire life cycle within the aquatic environment while others utilize this medium only during particular life stages (e.g., egg or larval stages with larvae eventually emerging from the water as a terrestrial adult).

Aquatic benthic invertebrates occupy valuable ecological roles; serving as food sources for higher trophic levels (including fish species), recycling organic materials and nutrients, and removing toxic substances from the water column. Aquatic invertebrates can also serve as valuable bio-indicators of environmental change. Invertebrate responses at the individual, species, or community level can be observed and linked to short- and long-term environmental stresses (Hodkinson and Jackson 2005, Rosenberg et al. 2005).

Table 5-6. Aquatic macroinvertebrates occurring or suspected to occur in the Study Area.

Taxonomic Class	Common Name	Occupied Habitat	Aquatic Life Stage	Trophic Relationship[1]
Annelida				
Oligochaeta	Segmented worms	Lotic/Lentic	Egg/Immature/Adult	Collectors
Hirudinea	Leeches	Lotic/Lentic	Egg/Immature/Adult	Predators/Parasites
Crustacea				
Amphipoda	Scuds	Lotic/Lentic	Egg/Immature/Adult	Collectors
Gammaridae[2,3]	N/A	Lotic/Lentic	Egg/Immature/Adult	Collectors
Hyalellidae	N/A	Lotic/Lentic	Egg/Immature/Adult	Collectors
Decapoda[3]	Crayfish	Lotic/Lentic	Egg/Immature/Adult	Collectors/Predators
Arachnida				
Acari	Mites	Lotic/Lentic	Egg/Immature/Adult	Predators/Parasites
Mollusca				
Bivalvia	Freshwater clams	Lotic/Lentic	Egg/Immature/Adult	Collectors/Parasites
Gastropoda	Snails	Lotic/Lentic	Egg/Immature/Adult	Scrapers
Insecta				
Odonata	Dragonflies/Damsel flies	Lotic/Lentic	Egg/Immature	Predators
Coleoptera	Beetles	Lotic/Lentic	Egg/Immature/Adult	Shredders/Collectors/Scrapers/Predators
Hemiptera	True Bugs		Egg/Immature/Adult	Collectors/Scrapers/Predators
Corixidae	Water boatman	Lotic/Lentic	Egg/Immature/Adult	Collectors/Macrophye Piercers/Predators
Ephemeroptera	Mayflies	Lotic/Lentic	Egg/Immature	Shredders/Collectors/Scrapers/Predators
Baetidae[2]	N/A	Lotic/Lentic	Egg/Immature	Collectors/Scrapers
Caenidae	N/A	Lentic	Egg/Immature	Collectors/Scrapers
Ephemeridae	N/A	Lotic/Lentic	Egg/Immature	Collectors/Scrapers/Predators
Heptageniidae	N/A	Lotic	Egg/Immature	Collectors/Scrapers/Predators
Leptophlebiidae	N/A	Lotic	Egg/Immature	Collectors/Scrapers
Plecoptera	Stoneflies	Lotic	Egg/Immature	Shedders/Predators
Trichoptera	Caddisflies	Lotic/Lentic	Egg/Immature	Shredders/Collectors/Scrapers/Predators
Hydropsychidae[2]	Net-spinning caddisflies	Lotic	Egg/Immature	Shredders/Collectors/Scrapers/Predators
Leptoceridae	Long-horn caddisflies	Lotic/Lentic	Egg/Immature	Shredders/Collectors/Scrapers/Predators
Limnephilidae	Northern caddisflies	Lotic/Lentic	Egg/Immature	Shredders/Collectors/Scrapers/Predators
Diptera	Flies	Lotic/Lentic	Egg/Immature	Shredders/Collectors/Scrapers/Predators/Parasites
Ceratopogonidae	Biting midges	Lentic	Egg/Immature	Collectors/Scrapers/Predators
Chironomidae[2]	Midges	Lotic/Lentic	Egg/Immature	Shredders/Collectors/Scrapers/Predators/Parasites
Culicidae	Mosquitoes	Lentic	Egg/Immature	Collectors/Predators
Simuliidae[2]	Blackflies	Lotic	Egg/Immature	Collectors
Tipulidae	Craneflies	Lotic/Lentic	Egg/Immature	Shredders

Habitat, lifestage, and trophic relationships are based on Peckarsky et al. (1990) and Merritt and Cummins (1996).
[1]Trophic Relationships based on Merritt and Cummins (1996) classifications, filterers are included in collectors.
[2]Invertebrates collected on Little Saskatchewan River in 1990 by McCulloch (1994).
[3] invertebrates observed during field work in 2012, unmarked invertebrates are suspected to occupy the study area.

5.2.1.5 *Bivalves*

A detailed literature review describing available published information with respect to freshwater mussels and mussel habitat within the Rapid City reservoir and associated waterbodies was conducted. To supplement the literature review, qualitative mussel surveys were conducted by NSC staff in the Project Area on site visits in April, May, July and August 2012. The presence of mussels was evaluated using methods adapted from the "Guidelines for Sampling Freshwater Mussels in Wadable Streams" (Wisconsin Department of Natural Resources 2005) and the "Protocol for the Detection and Relocation of Freshwater Mussel Species at Risk in Ontario-Great Lakes Area (OGLA) (Mackie et al. 2008). These methods included: visual observations along the shorelines in Reaches 3 and 4; mussel raking in wadable waters (< 1 m); and ponar grabs throughout Reach 3. Incidental observations and captures during the course of supplemental field surveys were also noted. Specimens were identified *in situ* by a qualified NSC biologist. Details on methods, site locations, habitat information and catch can be found in Appendix 3.

The most recent published mussel survey, which included the Little Saskatchewan River (LSR), occurred in 1995 and 1996. In this survey of the Assiniboine River and its tributaries, Watson (2000) found 11 species of freshwater mussel, nine of which were found in the Little Saskatchewan River (Table 5-7). Only species historically recorded upstream of the Rivers dam are included in the list of potential species for the Project Area as the Rivers dam is impassable to fish and would act as a barrier to upstream movement (Carney 2004). Of the nine, Fatmucket, White Heelsplitter, Creek Heelsplitter, Giant Floater and Creeper were found between Rivers and Minnedosa, at a site approximately one mile upstream of Lake Wahtopanah, well downstream of the Rapid City dam. Upstream of the Minnedosa dam, White Heelsplitter, Giant Floater and Fatmucket were recorded (Clarke 1973, Watson 2000). Mapleleaf Mussel, not found in Watson's survey, is purported to have been identified in the Little Saskatchewan River prior to 1992 (COSEWIC. 2006d). No other records for the Little Saskatchewan River were found.

Five species of mussel were reported during field surveys in the Project Area in the spring and summer of 2012. These included Fatmucket, Giant Floater, White Heelsplitter, Plain Pocketbook, and Fingernail Clams (family Sphaeriidae). Only four living specimens were found; two Fatmucket on the northern side of the depositional bar (Reach 3) in sandy/loam and gravel substrate, and two Giant Floaters captured in a gill net in the same area. Searchers reported empty shells of Giant Floater, White Heelsplitter, and numerous Fatmucket along the northern side of the bar closest to the channel, while empty shells of Fatmucket and Giant Floater were in abundance along the southern side of the bar where sandy loam substrate transitioned to silt/clay and submerged macrophytes. Fingernail Clam shells were also abundant in these same areas. Empty shells of all species, with the exception of the Fingernail Clam, were also found along the shoals/islands (50 – 100 m) downstream of the dam (Reach 4). The northern shoreline downstream of the PTH 24 bridge (Reach 3) was generally devoid of mussels, with the exception of a single dead Giant Floater captured while raking. The substrate along this shoreline was described as soft, mainly bare silt and clay to two meters from the shoreline transitioning to emergent and submergent vegetation. Incidental catches in gill nets sets within the main river channel also included a single Fatmucket. Since so few mussels were found alive, it is likely the abundance of empty valves can be attributed to transportation downstream from upstream habitats. The apparent lack of

living mussels in the reservoir is not unexpected, as reservoirs are known to have the potential to be detrimental to mussel communities. Changes to substrate, channel morphology, sedimentation or siltation, diversion of water flows, and periodic water draw-downs are often associated with reservoirs (Watson 2000, Samad and Stanley 1986). It has been noted, however, that provided the reservoir is shallow and productive, the substrate appropriate, and the appropriate host fish species present, mussels can recolonize (Watson 2000, Kelner and Davis 2002).

Table 5-7. Mussel species historically recorded in the Little Saskatchewan River (LSR) and those found in the NSC 2012 survey of the Project Area.

Common Name	Scientific Name	Clarke (1973) LSR	Watson (2000) LSR	COSEWIC (2006)	NSC 2012 Field Studies Project Area
Wabash Pigtoe	*Fusconaia flava*		x		
Threeridge	*Amblema plicata*		x		
White Heelsplitter*	*Lasmigona complanata*	x	x		x
Creek Heelsplitter*	*Lasmigona compressa*		x		
Giant Floater*	*Pyganodon grandis*	x	x		x
Creeper*	*Strophitus undulatus*		x		
Black Sandshell	*Ligumia recta*		x		
Fatmucket*	*Lampsilis siliquoidea*		x		x
Pocketbook	*Lampsilis cardium*		x		x
Fingernail Clam	*Sphaeridae* (family)				x
Mapleleaf Mussel	*Quadrula quadrula*			x	

* Species found between Rivers and Minnedosa dams, at the only site in this stretch of river, just upstream of the Rivers Dam.

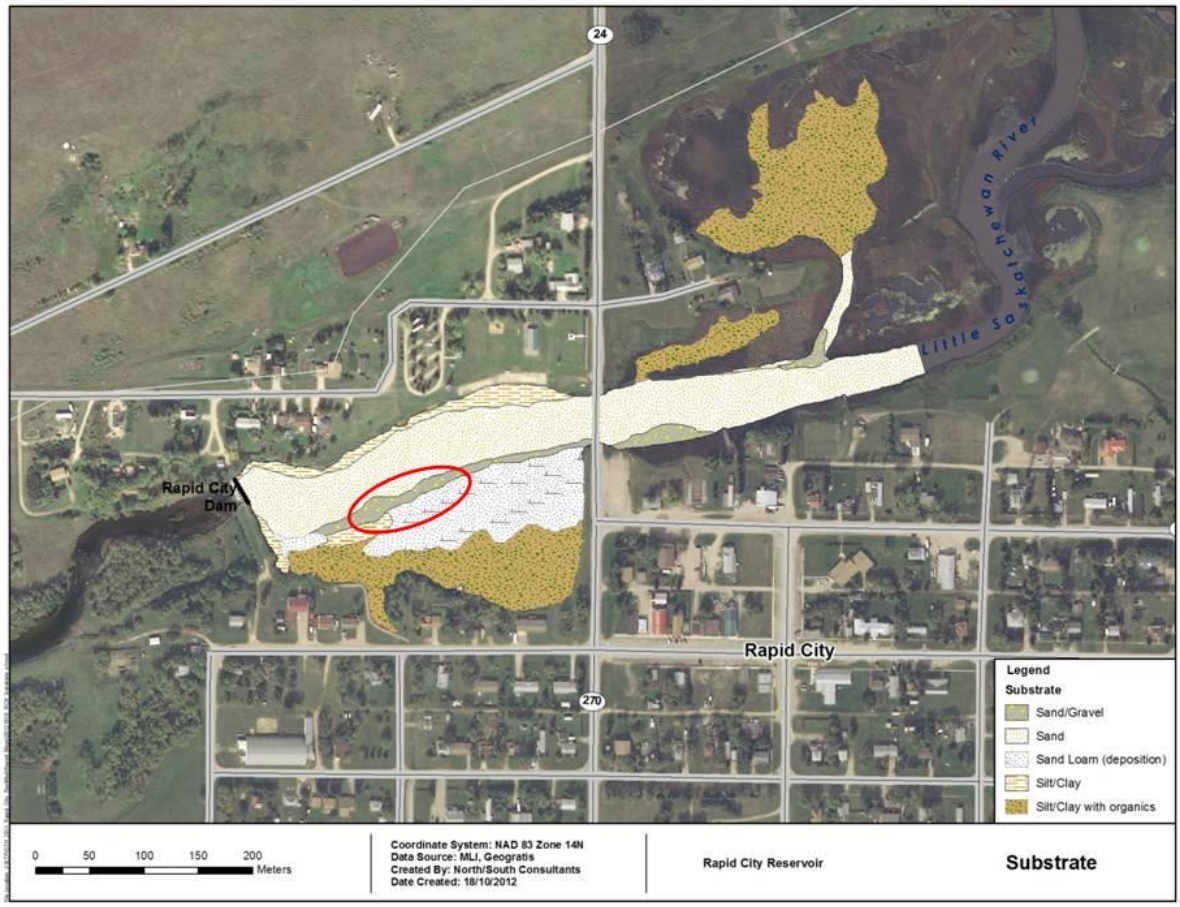

Figure 5-9. Location in which live mussels (Fat Mucket and Giant Floater) were found during spring and summer field surveys of 2012.

5.2.1.6 *Fish*

A detailed literature review describing available published information with respect to fish and fish habitat within the Rapid City Dam Reservoir and associated waterbodies was conducted. Existing information was supplemented with the results of a field study conducted by NSC in the spring and summer of 2012. Methods used in the field study included gill-netting, electrofishing and incidental observations. Site details, methodology and capture data are available in Appendix 4.

Twenty-two species of fish reportedly exist in the Little Saskatchewan River (Table 5-8). However, little is known about the fish community in the project area, particularly small-bodied fishes. The field surveys and fish ladder data confirm that Northern Pike, Shorthead Redhorse, White Sucker, Rock Bass, Walleye and Quillback are present in the reservoir in the spring. Quillback and Walleye were not captured in July. Nonetheless, inferences can be made based on the available habitat types. Some of these species may be transient in the reservoir using upstream spawning beds, whereas others may be residents year round.

The main habitat types in the project area include: the shallow water zones supporting aquatic vegetation; the sandy loam and gravel bar separating the channel from the shallow bay to the south; riffle/run/pool habitat; and the river channel. Shallow areas (< 2 m deep) with emergent and submergent aquatic vegetation provide cover and an abundant supply and variety of food for fish, particularly in their juvenile stage (Wilcox and Meeker 1992, Casselman and Lewis 1996, Lane et al. 1996, Parks 2006). This type of habitat occurs within the study area in the wetland on the north side of the river in Reach 2, the shallow bay (Zone A) and the periphery of the reservoir (Reach 3) (Figure 5-6). Young-of-the-year (YOY) of numerous fish species found in the reservoir are moderately to highly associated with these types of habitats (Table 5-9). Species such as Fathead Minnow and Brook Stickleback may use these vegetated zones year round (Klinger et al. 1982, Parks 2006); whereas Northern Pike tend to move towards less dense vegetation and deeper waters as they age (Casselman and Lewis 1996); and Walleye tend to prefer deeper, macrophyte free water throughout their life cycle.

In the winter months, Fathead Minnows and Brook Stickleback are the only species likely to be found in the shallow zones of the study area as it does not necessarily freeze fully to the sediment surface. Over the winter, shallow water bodies are prone to becoming oxygen deficient, resulting in fish kills (Klinger et al. 1982). Morphological, physiological and behavioural adaptations allow these species to survive overwintering in shallow waters such as the isolated ponds of coastal marshes, near shore areas and prairie pothole lakes (Klinger et al. 1982, Magnuson et al. 1985, Peterka 1989, Parks 2006). However, given the opportunity they will migrate to deeper or better oxygenated waters (Klinger et al. 1982) with other species less tolerant of low oxygen conditions, such as Northern Pike, suckers and Walleye. In the winter only the river channel itself is not frozen to the bottom (B. Bruederlin, pers. comm.), and as such likely harbours several species of fish, although only Walleye and Northern Pike have been reported being captured during the annual fishing derby in the waters upstream of the PTH 24 bridge (B. Bruederlin, pers. comm.).

Although an electrofishing survey in May of 2012 of the riffle and run habitats within 200 m downstream of the dam (Reach 4) captured no fish, several of the species listed are commonly associated with this habitat type. Described as having moderate flow and a sandy bottom, mixed with cobble and boulders, it is habitat commonly associated with juvenile Burbot, shiners, darters, dace and stonecats, as well as suitable substrate for the spawning of larger bodied fish such as suckers and Walleye (Scott and Crossman 1973, Stewart and Watkinson 2004).

The depositional bar in the reservoir may be good habitat for a few species of fish, which may use it either for foraging or spawning. The substrate consists of a band of sand and gravel on the northern side closest to the channel, and a sand-loam mixture on the southern side. Johnny Darter, noted in the spring/summer survey in 2012, are often found over sand and gravel substrates in exposed areas, devoid of vegetation throughout the open water season (Stewart and Watkinson 2004). Burbot may use the northern edge to spawn. Burbot spawn under the ice over sand and gravel substrates, often behind depositional bars, in low velocity areas of main channels and in side channels as early as December in the Red and Winnipeg rivers, and as late as March in northern Manitoba (Sorokin 1971, Breeser et al. 1988, Stewart and Watkinson 2004). Although there was no evidence found of their presence in the

2012 survey, the ammoceote larvae of Chestnut Lamprey are known to burrow in firm sand-mud substrates in fast-flowing water (Scott and Crossman 1979, Stewart and Watkinson 2004).

Table 5-8. Fish species known to occur in the Little Saskatchewan River and may occur in the Project Area, and fish that were found in the Project Area during the field surveys in 2012.

Common Name	Systematic Name	Erickson (2001)	FIHCS (2005)	Field Studies (2012)
Bigmouth Shiner*	*Notropis dorsalis*			
Blackside Darter	*Percina maculataq*	x		
Brook Stickleback	*Culaea inconstans*	x	x	
Burbot	*Lota lota*	x		
Channel Catfish	*Ictalurus punctatus*	x	x	
Chestnut Lamprey*	*Icthyomyzon castaneus*			
Common Shiner	*Luxilus cornutus*	x		
Creek Chub	*Semotilus atromaculatus*	x		
Fathead Minnow	*Pimephales promelas*	x		
Johnny Darter	*Etheostoma nigrum*	x		x
Longnose Dace	*Notropis longirostris*	x		
Northern Pike	*Esox lucius*	x	x	x
Quillback	*Carpiodes cyprinus*	x	x	
River Darter	*Percina shumardi*	x	x	
Rock Bass	*Ambloplites rupestris*	x	x	x
Sand Shiner	*Notropis stramineus*	x		
Shorthead Redhorse	*Moxostoma macrolepidotum*	x		x
Silver Chub*	*Macrhyobopsis storeriana*			
Stonecat	*Noturus flavus*	x		
Trout Perch	*Percopsis omiscomaycus*	x	x	
Walleye	*Sander vitreus*	x	x	x
White Sucker	*Catostomus commersonii*	x	x	x
Yellow Perch	*Perca flavescens*	x	x	

*Species either reported via pers. comm. or known to occur in the Assiniboine River Drainage Basin.

Table 5-9. Strength of association with vegetation and water depth by young-of the-year fishes, potentially present in the Project Area. A dash (-) indicates a lack of information. This list adapted from Table 1 in Lane et al. 2006.

Species	Submergent/Emergent Aquatic Macrophytes	Water depth < 2 m spring	Water depth < 2 m no specific seasonality
Bigmouth Shiner	-	-	-
Blackside Darter	medium		x
Brook Stickleback	medium	x	
Burbot	-	x	
Channel Catfish	low	-	-
Chestnut Lamprey	-	-	-
Common Shiner	medium		x
Creek Chub	-	-	-
Fathead Minnow	medium		x
Johnny Darter	medium		x
Longnose Dace	-	-	-
Northern Pike	high	x	
Quillback	medium		x
River Darter	-		x
Rock Bass	high		x
Sand Shiner	medium		x
Shorthead Redhorse	-	-	-
Silver Chub	low	-	-
Stonecat	low		x
Trout Perch	-	x	
Walleye	low	x	
White Sucker	high		x
Yellow Perch	medium	x	

5.2.1.6.1 Fish Ladder

Manitoba Conservation and Water Stewardship monitored use of the fish ladder until as recently as 2007, documenting upstream spring migration of fish into the Rapid City Reservoir (Appendix 5). Therefore, detailed field studies of fish use and movements through the fish ladder were not undertaken in this study. However, in response to concerns over siltation of the fish ladder intake (reservoir side) by Manitoba Conservation and Water Stewardship (B. Bruederlin pers. comm.) an inspection was carried out in the spring of 2012 by NSC.

On April 25, 2012, 10 White Sucker and one Walleye were observed ascending the pool and riffle fish ladder. Two White Sucker were captured, both males in spawning condition. At the reservoir side of the fish ladder a drop of 0.3 m was noted between the reservoir and the inside of the fish ladder culvert (see

Appendix 5 for photos). This elevation differential is not considered an impediment to fish movements (B. Bruederlin pers. comm.). From the inlet (reservoir side) of the fish ladder, the reservoir was surveyed by wading into the reservoir. Although cattail growth persists in the area, water depth was 0.75 to 1.0 m with no apparent obstructions to fish movements into the reservoir.

5.2.1.7 *Species at Risk*

A search of the MB Conservation Data Centre (CDC) database for known occurrences of aquatic plant and animal species listed under the *Species at Risk Act* (SARA) or the Manitoba *Endangered Species Act* (MB ESA) was performed. In addition, species listed under SARA or MB ESA that, based on species distributions and habitat preferences, may occur in the Study Area were identified. The potential for these species to be found within the Project Area was then assessed.

Of the mussel species known to occur in the Little Saskatchewan River, only the Creeper was listed as a species of concern under the Manitoba Conservation Data Center (MB CDC), although it has not yet been assigned a rank. The Creeper is not listed under either COSEWIC, SARA or MB ESA. The MB CDC also lists the Mapleleaf Mussel as a species of concern in the greater Aspen Parkland eco-region in which the Little Saskatchewan River is found. The Mapleleaf Mussel is considered rare in Manitoba and may be vulnerable to extirpation (MB CDC). It is listed as endangered under both SARA and the MB ESA (Table 5-10). While historical records, prior to 1992 suggest that the Mapleleaf Mussel did at one time occur in the Little Saskatchewan River (COSEWIC 2006d), there have been no records of it since. Recent mussel distribution studies of the Assiniboine River and its tributaries have shown that this species is restricted primarily to the lower portion of the Assiniboine River below the City of Brandon (Carney 2003, COSEWIC 2006d, North/South 2009) having been found only in the Assiniboine River itself and none of its tributaries (Watson 2000). However, channel catfish, the host species for the glochcidium of this species are reported to be in Lake Minnedosa and preclude the possibility that they may still be present.

Three fish species were listed as species of special concern under the MBCDC for the Aspen Parkland region, in which the Little Saskatchewan River occurs. These include the Silver Chub, Bigmouth Shiner, and the Chestnut Lamprey. Listed as species of special concern (Schedule 3) under SARA (not including the Silver Chub), these three species are currently designated as not at risk or non-active under COSEWIC (Table 5-10). A review of the literature found no validated records of these species occurring in the reaches comprising the Project Area. However, Bigmouth Shiner and Chestnut Lamprey may be present because habitat therein is suitable to both species for at least part of their lifecycle and there have been reports of their presence between the dams at Rivers and Minnedosa, situated downstream and upstream of the Project Area.

Found mainly in the lower reaches of the Assiniboine River tributaries, a single Bigmouth Shiner was identified at a site immediately upstream of the Rivers Dam (McCulloch and Franzin 1996, Stewart and Watkinson 2004). This species is commonly associated with riffles, runs, and pools below riffles (Stewart and Watkinson 2004), similar to the habitat found below the Rapid City dam in Reach 4.

Common in most lakes and streams in southern Manitoba, Chestnut Lamprey move upstream to spawn in mid- to late June, their ammoceote larvae burrowing in firm sand-mud substrates in fast-flowing

water, while the adults will migrate to larger waterways (Scott and Crossman 1973, Stewart and Watkinson 2004). Chestnut Lamprey may be present in the Project Area as they were identified at the Rivers Dam downstream, upstream at the Minnedosa fish-way attached to other fish and are believed to occur in Lake Minnedosa (Mazur 2006). Although the specimens near Minnedosa were not positively identified, they were thought to be Chestnut Lampreys as no other lamprey species are known to occur in the Little Saskatchewan River (Mazur 2006).

Of the three species of concern, the Silver Chub is the least likely to occur in the Study Area. It is strongly associated with the mainstem of the Red and Assiniboine Rivers and the lowest portions of their tributaries, preferring slow moving water over soft substrates (Stewart and Watkinson, 2004), a habitat type not generally associated with the upper reaches of the Little Saskatchewan River.

Table 5-10. Fish and Bivalve species listed as being at risk under COSEWIC, SARA, MBESA, or MBCDC which may be found in the project area.

Species	Scientific Name	COSEWIC	SARA		MBESA	MBCDC		Habitat	Potential to be in the Project Area
			Schedule	Status		Global	Provincial		
Fish									
Chestnut Lamprey	*Icthyomyzon castaneus*	non-active	3	Special Concern	-	G4	S3S4	small streams up to 12 m wide, 1 m deep, often in riffles and runs; substrate is commonly sand and gravel, but combinations with shale and boulders were also observed (COSEWIC 2003)	high
Silver Chub	*Macrhyobopsis storeriana*	not at risk as of 2012	-	-	-	G5	S3	mainstems of large rivers, preferring slow moving water over soft substrates	low
Bigmouth Shiner	*Notropis dorsalis*	not at risk as of 2003	3	Special Concern	-	G5	S3	riffles, runs and pools located below riffles (0-15 cm/s water velocity, 35-100 cm water depth) (Stewart and Watkinson, 2004)	moderate
Mussels									
Creeper	*Strophitus undulates*	-	-	-	-	G5	SNR	small to medium sized streams in mud, sand, or gravel	high
Mapleleaf Mussel	*Quadrula quadrula*	Endang.	1	Endang.	Endang.	G5	S2	medium to large rivers, slow to moderate current, shallow lake and deep river impoundments over mud, sand and fine gravel (COSEWIC 2006d)	low

COSEWIC - Committee on the Status of Endangered Wildlife in Canada -http://www.cosewic.gc.ca/

SARA - Species At Risk Act - http://www.sararegistry.gc.ca

Schedule 3 - status determined prior to 1999; due for re-evaluation prior to receiving protection under Schedule 1

MBESA - Manitoba Endangered Species Act - http://www.gov.mb.ca/conservation/wildlife/sar/sarlist.html

MBCDC - Manitoba Conservation Data Center - http://www.gov.mb.ca/conservation/cdc http://www.gov.mb.ca/conservation/cdc/ecoreg/aspen.html

SNR - A species not ranked. A rank has not yet assigned or the species has not been evaluated

5.2.2 Terrestrial Environment

A review of information on the terrestrial environment was conducted from published literature, grey literature, various government sources, and habitat cover class information. Federal and provincial legislation and sources, including SARA, MBESA, and the MBCDC, were used to identify at-risk species with distribution ranges within the Project Study Area. Assessment and status reports from COSEWIC were utilized where available for species of interest. Literature examining the potential impacts of activities associated with and relevant to the Project was also reviewed.

The terrestrial environment surrounding the Project reservoir was examined using desktop analysis of a 1 km buffer (Figure 5-10). Desktop analysis included the evaluation of land cover classifications extending 1 km from the shore of the reservoir, and identification of species that may be present within the area. Information and incidental observations obtained during the course of field investigations of the aquatic environment (Section 5.2.1) were also used in describing the terrestrial existing environment within the 1 km Study Area buffer.

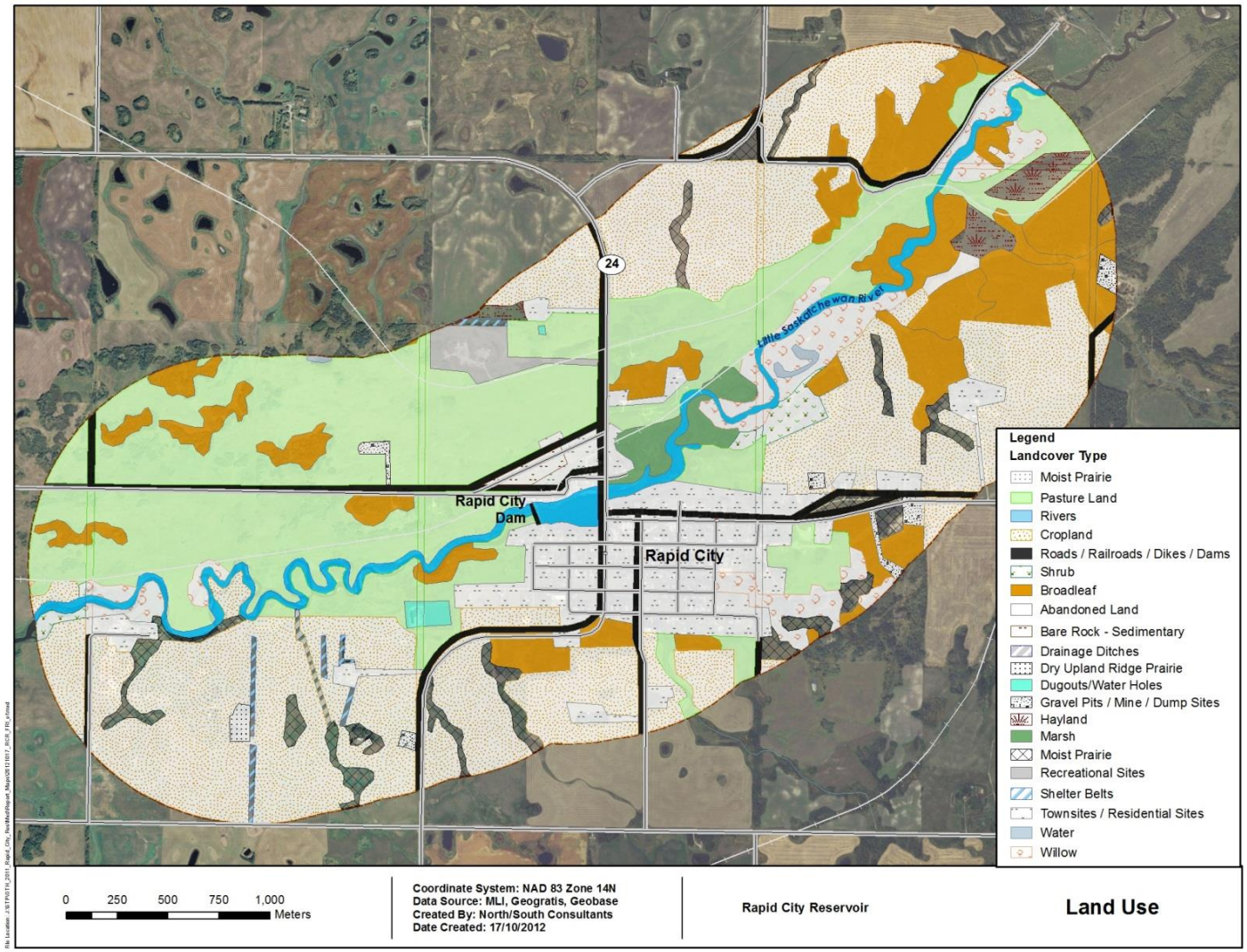

Figure 5-10. Landcover within the Rapid City Project 1 km terrestrial Study Area, as determined using provincial Forest Resources Inventory (FRI) data.

5.2.2.1 *Habitat and Plants*

5.2.2.1.1 Landscape

The Study Area is located within Manitoba's Aspen Parkland Ecoregion of the Prairie Ecozone, demarked by the Manitoba Escarpment at the eastern-most boundary (Manitoba Conservation 2001, Smith et al. 1998). The Aspen Parkland Ecoregion is underlain by Upper Cretaceous shale sediments, and is covered by calcareous glacial till, with significant areas of lacustrine and hummocky to ridged fluvioglacial deposits (Ecological Stratification Working Group 1995). This ecoregion is considered the transitional area between the boreal forest to the north and the grasslands to the south (Ecological Stratification Working Group 1995).

In general, the Aspen Parkland Ecoregion slopes gently eastward, and is drained by the Souris, Assiniboine, Qu'Appelle and Pembina Rivers (Smith et al. 1998). The Study Area is situated on the Little Saskatchewan River, with downstream connectivity to the Lake Wahtopanah and continuing downstream to the Assiniboine River (Government of Manitoba 2008).

5.2.2.1.2 Vegetation

The Aspen Parkland Ecoregion is characterized as having a transitional grassland eco-climate (Ecological Stratification Working Group 1995), home to both wetlands and grasslands. It is characterized by trembling aspen, mixed tall shrubs on moist sites, and bur oak and grassland communities in drier sites (Smith et al. 1998). Dominant grasses include fescues (*Festuca* spp), wheat grasses (*Agropyron* spp), Junegrass (*Koeleria* spp) and Kentucky bluegrass (*Poa pratensis*), as well as a host of deciduous shrubs and herbs. Poorly drained sites typically support slough grasses (*Beckmannia* spp), marsh reed grass (*Calamagrostis* spp), sedges (*Carex* spp), cattails (*Typha* spp), and shrubby willows (Smith et al. 1998). A list of plant species of concern within the Aspen Parkland Ecoregion is presented in Appendix 6. A description of ranking codes is presented in Appendix 7.

Favourable climate and fertile warm black soils within the Aspen Parkland Ecoregion have resulted in conversions from the natural state of this ecoregion to farmland. This ecoregion, with some of the most productive agricultural land on the prairies, is now predominated by a wide variety of pasture, hayed, and cropped areas (Ecological Stratification Working Group 1995).

Landcover within the Project Study Area 1 km buffer was determined using the provincial Forest Resource Inventory (FRI).The 1 km Study Area is dominated by cropland (representing 32% of the area) and pasture land (representing 27.8% of the area). Broadleaf habitat (11.8%) and townsite/residential (9%) also constitute a relatively large portion of the 1 km Study Area; all other land covers are found covering 3.9% or less of the 1 km Study Area (Table 5-11). Field investigations found the terrestrial vegetation immediately adjacent to the Study Area reservoir to be townsite/residential habitat, highly disturbed and largely consisting of buildings and manicured lawn, unlikely to contain any remnant native vegetation communities (See Appendix 7). Some specialized habitat does exist within the 1 km terrestrial Study Area; moist Prairie (3.1%) and Dry Upland Ridge Prairie (0.1%) are present upland, within the 1 km Study Area, while marsh habitat (1.1%) is present along the Little Saskatchewan River immediately upstream of the

reservoir (Appendix 6). Field investigations found abundant cattail and marsh habitat present near the lake inlet, and on the east side of the bridge (Section 5.2.1.3.4).

Table 5-11. Terrestrial habitat cover types present within the terrestrial environment Rapid City Study Area, based on the Forest Resource Inventory land cover database (1971).

Cover Type	Area (ha)	Total (%)
Abandoned Land	2.1	0.2
Bare Rock – Sedimentary	3.1	0.3
Broadleaf	141.6	11.8
Cropland	383.6	32.0
Drainage Ditches	1.4	0.1
Dry Upland Ridge Prairie	1.7	0.1
Dugouts/Water Holes	2.9	0.2
Gravel Pits / Mine / Dump Sites	6.6	0.5
Hayland	12.3	1.0
Marsh	13.2	1.1
Moist Prairie	36.9	3.1
Pasture Land	333.0	27.8
Recreational Sites	10.7	0.9
Rivers	35.3	2.9
Roads / Railroads / Dikes / Dams	46.2	3.9
Shelter Belts	4.1	0.3
Shrub	8.1	0.7
Townsites / Residential Sites	107.5	9.0
Water	1.5	0.1
Willow	47.0	3.9
TOTAL	1198.9	100.0

5.2.2.2 *Birds*

The Prairie Ecozone and associated Aspen Parkland Ecoregion contain numerous wetlands that provide major breeding, staging, and nesting habitat for various species of migratory waterfowl (Ecological Stratification Working Group 1995). Other bird species found in the Aspen Parkland Ecoregion include various raptors such as red-tailed and American Kestrel (Smith et al. 1998). Mourning Dove, Black-Billed Magpie, Red-Winged Blackbird, Killdeer, and Meadowlark are also common to this Ecoregion (Ecological Stratification Working Group 1995, Smith et al. 1998). A list of birds found in south-western Manitoba and species observed during field studies is presented in Appendix 6.

5.2.2.3 *Mammals*

Species widespread in the Aspen Parklands Ecoregion include White-Tailed Deer, Coyote, Red Fox, Ground Squirrel, Cottontail Rabbit, Striped Skunk, Redback Vole and Deer Mice (Smith et al. 1998). Additional species include Snowshoe Hare, Northern Pocket Gopher, and Franklin's Ground Squirrel (Ecological Stratification Working Group 1995). Semi-aquatic species include Muskrat, Beaver and American Mink. In general, most species of mammals are year-round residents of these areas.

A list of mammals found within the Aspen Parkland Ecoregion of Manitoba is presented in Appendix 6. Mammals identified during the course of field investigations within the Study Area include Muskrat and American Mink. Both species were seen along the north shore of the reservoir.

5.2.2.4 *Amphibians and Reptiles*

The Prairie Ecozone and associated Aspen Parkland Ecoregion contain numerous wetlands that provide major breeding habitat for various species of anurans, and food sources for other species such as snakes. A list of amphibians and reptiles found within Manitoba and potentially overlapping the Study Area is presented in Appendix 6.

In total, there are 12 anuran species that may occur in the Project Study Area, including the Canadian toad, Cope's Gray Treefrog, Northern Leopard Frog, Wood Frog and Boreal Chorus Frog. In general, many of these frog species are common to this ecoregion (Smith et al. 1998). Of the four salamander species found within Manitoba, only the Barred Tiger Salamander has a distribution that overlaps the Project Study Area. All species potentially overlapping the Study Area are reliant on wetland or riparian habitats (Preston 1982).

There are six reptile species that have distribution ranges overlapping the Project Study Area. Both the Common Snapping Turtle and the Western Painted Turtle potentially occur within the Project Study Area. Four snake species have distribution ranges overlapping the Project Study Area. They inhabit uplands and include the Smooth Greensnake, Northern Redbelly Snake, Plains Garter Snake, and Red-Sided Garter Snake. In general, the Red-Sided and Western Plains Garter Snakes are common to the Ecoregion overlapping the Project Study Area (Smith et al. 1998).

Amphibians and reptiles identified during the course of field investigations within the Study Area are presented in Appendix 6, and include the Northern Leopard Frog and the Western Painted Turtle. Northern Leopard Frog observations included 18 individuals from the north shore and 20 individuals observed during the course of mussel surveys (Figure 5-11). Painted Turtle observations included two along the south shore, and one during the course of gill netting as part of the fish component of the field investigations.

Figure 5-11. Northern Leopard Frog observed on north shore during mussel survey at Transect 1, August 2012.

5.2.2.5 *Species at Risk*

5.2.2.5.1 Habitat and Plants

There are 126 plant species and five plant assemblages of conservation concern documented by the MBCDC, seven of which are listed either provincially or federally (Appendix 6). All seven listed species are associated with wet meadows, remnant prairies, or sandy soils of various degrees of stabilization, and although suitable habitat is present (i.e. moist prairie, dry upland ridge prairie, Table 5-11), distribution ranges of these species do not overlap the Study Area.

5.2.2.5.2 Terrestrial Invertebrates

There is one species of terrestrial invertebrates listed under either federal or provincial species at risk legislation that has a known distribution and suitable habitat within or in close proximity to the project study area. The Monarch Butterfly is listed as a species of Special Concern by COSEWIC and under SARA. It is not listed under MBESA or by the MBCDC. The Monarch Butterfly is associated with its host plant milkweed, found in meadows of farmland, roadsides, ditches, open wetlands, dry sandy areas, short and tall-grass prairies, river banks, irrigation ditches, arid valleys, south-facing hillsides, and gardens (COSEWIC 2010c). Threats include herbicide and pesticide use. Furthermore, milkweed, the butterflies' sole food during the caterpillar stage, is listed under *The Noxious Weeds Act* in Manitoba (COSEWIC 2010c).

5.2.2.5.3 Birds

Bird species of concern found within the Aspen Parkland Ecoregion are presented in Appendix 6. Of those species, suitable grassland habitats for grassland birds such as Sprague's Pipit, Baird's Sparrow and Grasshopper Sparrow are found within the project study area (Table 5-11). However, because the project study area lies at the northern extent of these species range, the potential for such grassland birds to occur in the study area is low. The Least Bittern, provincially endangered and listed as threatened by SARA nests in marshes in the south-central and south-eastern portion of the province. The Project Study Area lies at the western extent of its range and considering that this species is not known from the Project Study Area, the potential for it to be found in the area is low.

5.2.2.5.4 Mammals

A list of at-risk mammal species found within the Aspen Parkland Ecoregion of Manitoba is presented in Appendix 6. Two listed mammal species have distributions overlapping the Study Area, the Long-Tailed Weasel and the Mule or Black-Tailed Deer. The Long-Tailed Weasel is listed as G5 (i.e. globally widespread), S3 (i.e. provincially uncommon) by the MBCDC; it was removed from the endangered list by COSEWIC in 1993, and is not listed under SARA or MBESA. Habitat includes open grasslands, aspen parklands, and rivers, preferably near water (Banfield 1974).

The Mule Deer is also listed as G5 (i.e. globally widespread), S3 (i.e. provincially uncommon) by the MBCDC. It is listed as threatened under MBESA, but is not listed by COSEWIC. Habitat includes open coniferous forests, aspen parklands, and river valleys. The Mule Deer tends to avoid open prairie and deep coniferous forests (Banfield 1974).

5.2.2.5.5 Amphibians and Reptiles

A list of amphibian and reptile species of concern within Manitoba's Aspen Parkland Ecoregion is presented in Appendix 6. One at risk amphibian species has a distribution range that overlaps the Project Study Area, the Northern Leopard Frog.

The Northern Leopard Frog has a distribution range overlapping the southern two thirds of the province, and the Project Study Area. It is listed as Special Concern under SARA. It is not listed by the MBCDC or under MBESA. This species utilizes three different habitat types annually. Overwintering occurs in well-oxygenated waterbodies that do not freeze to the bottom. Breeding occurs in pools, ponds, marshes and lakes, and occasionally in slow moving streams and creeks. During the summering stage and for movement, the Northern Leopard Frog utilizes grasslands, riparian areas and ponds (COSEWIC 2009f). In the 1970s, the Northern Leopard Frog had been subject to large-scale declines. This species has since seen a recovery, but not to the same geographical extent. Threats include habitat conversion (including wetland drainage and eutrophication), game fish introduction, harvesting, pesticide contamination, and habitat fragmentation. This species is also susceptible to emerging diseases (COSEWIC 2009f).

The Common Snapping Turtle is the only reptile species considered at risk that may be found in the Study Area. This turtle is ranked as G5T5 (i.e. globally widespread), S3 (i.e. provincially uncommon) by MBCDC and as a species of special concern under SARA (Appendix 6). It is not listed under MBESA. The Common

Snapping Turtle inhabits slow-moving water with a soft-mud bottom and dense aquatic vegetation, including ponds, sloughs, shallow bays, river edges, and/or slow streams (COSEWIC 2008d). Females generally nest on sand and gravel banks along waterways. Hibernation occurs in streams, lakeshores, and muddy sites (COSEWIC 2008d).

5.3 DESCRIPTION OF THE SOCIO-ECONOMIC AND CULTURAL ENVIRONMENT

5.3.1 Human Environment

5.3.1.1 *Study Area*

The Socio-economic Study Area encompasses an area that extends 1 km on either side of the Little Saskatchewan River and 1 km upstream and 1 km downstream on either side of the Aquatic Study Reaches. This Study Area encompasses areas expected to be directly and indirectly affected by the project (Figure 5-12).

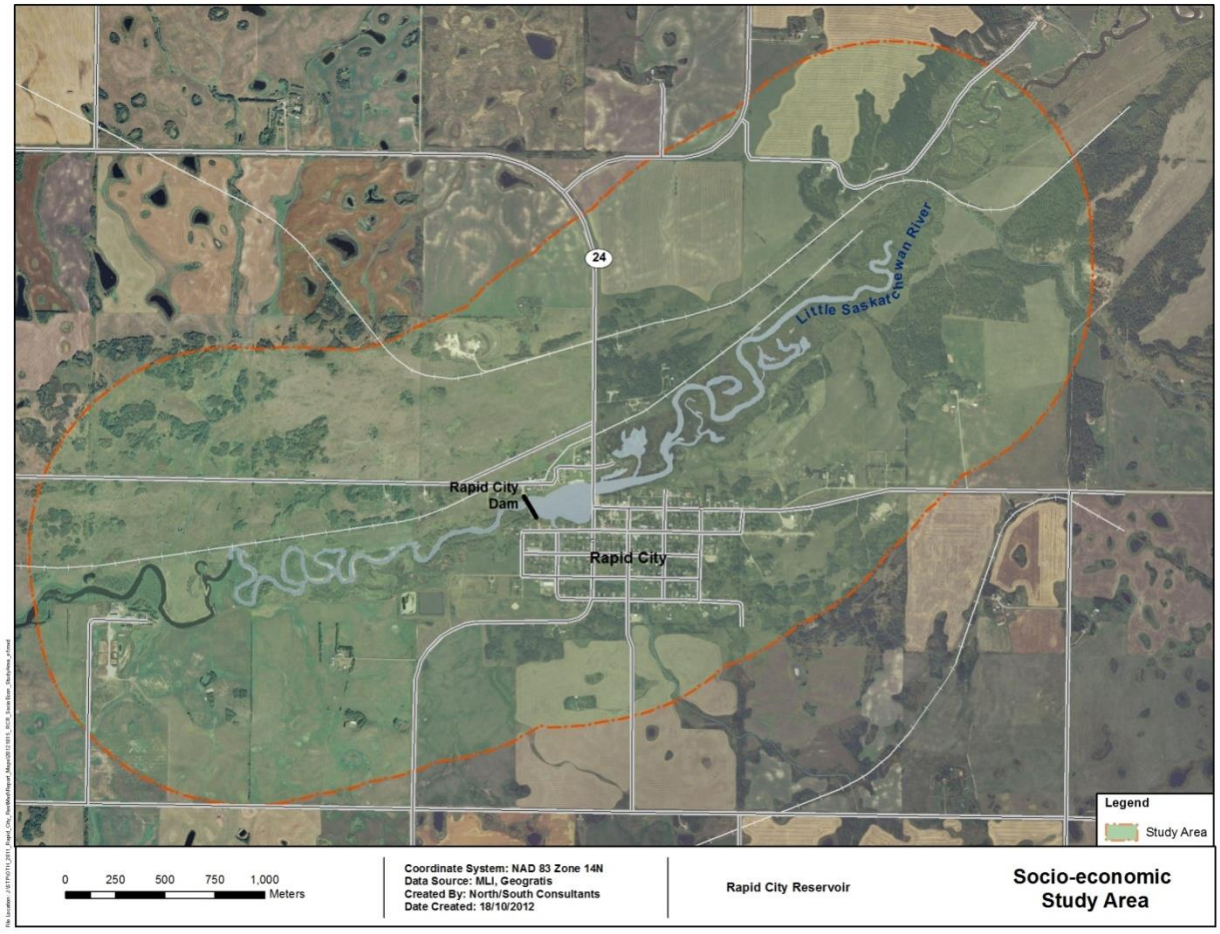

Figure 5-12. The Socio-Economic Study Area.

5.3.1.2 *Aboriginal Lands and Resource Use*

Aboriginal communities surrounding Rapid City include the Rolling River First Nation (RRFN) located near Erikson 38 km to the north of the Project with a 318 on-reserve population (Aboriginal Affairs and Northern Development Canada [AANDC] 2012). The Sioux Valley Dakota Nation (SVDN) occupy Federal Reserve lands 44 km to the southwest of the Project close to Griswold, Manitoba on which 1,461 SVDN members reside (AANDC 2012). Swan Lake First Nation (SLFN) Reserve No. 7A is located 65 km to the southeast of the Project, south of Carberry and adjacent to Spruce Woods Provincial Park. The SLFN on-reserve population is located on the main reserve (Reserve 7) further to the southeast (AANDC 2012). Aboriginal lands are shown on Figure 5-13.

Community Interest Zones (CIZ) are temporary areas of protection adjacent to the main reserves of Entitlement First Nations (EFNs[1]). The intent of CIZs are to protect an area 30 km from the exterior boundaries of EFN reserve lands while a First Nation is involved in selection and acquisition of reserve lands. Rolling River First Nation's CIZ intersects the Project Study area though does not overlap the reservoir (Figure 5-13). However, CIZs apply to deposition of Crown lands and are therefore not affected by the Project.

According to the 2006 census profile, of the 415 residents of Rapid City, 55 or 13% identified as North American Indian (10[2] individuals) or Metis (50 individuals) (Manitoba Bureau of Statistics 2008). With respect to the Metis, it should be noted that a recent press release (Province of Manitoba 2012a) (September 29, 2012) announced the legal recognition of Metis Natural Resource Harvesting rights, including domestic fishing and hunting, in parts of Manitoba including the Rapid City area (see Province of Manitoba 2012b). Regulations are expected to be developed and refined in the coming months.

No literature was located describing land and resource use by Aboriginal or Metis people for subsistence purposes. To date, Aboriginal and Metis consultation has not been conducted.

5.3.1.3 *Other Land and Resource Use*

A review of existing literature was conducted to understand land and resource use patterns.

The area surrounding Rapid City is comprised primarily of annual cropland (producing spring wheat, oilseed and canola) and, secondarily, forage lands (cattle) (Little Saskatchewan River Conservation District 2008). Agriculture is an important contributor to the local economy (Ingles and Jackson 2010).

Tourism is considered a growing industry in Rapid City with ice fishing, snowmobiling, swimming and boating being popular recreational activities on the Little Saskatchewan River (Ingles and Jackson 2010). A campsite and beach are present on the north shore of the reservoir above the dam and west of the

[1] See the Manitoba Treaty Land Entitlement Framework Agreement, 1999.
[2] Random data rounding (either up or down) to a multiple of 5 is standard practice to protect confidentiality within small population samples. In this instance, totals do not add up.

PTH 24 bridge (Rapid City 2012). The beach has been reported to be no longer usable due to silt deposition in the reservoir (Sopuck 2012).

Fishing is permitted on the Little Saskatchewan River including the Rapid City Reservoir year-round except from April 1 to, and including, May 31. A catch limit of four Walleye/Sauger is permitted except those between 45 and 70 cm, which must be released (Manitoba Conservation and Water Stewardship 2012a). It is a violation for all fishers (including Aboriginal fishers) to fish within 25 yards (23 m) of a fishway or fish ladder (Manitoba Conservation and Water Stewardship 2009; 2012b). Actual fishing activity is unknown; however, based on informal conversations with local residents; the reservoir is fished occasionally by local residents, targeting Northern Pike and Walleye.

Active winter ice fishing is conducted annually and an ice-fishing derby is held on the Rapid City Reservoir in February upstream of the PTH 24 bridge (Bruederlin pers. comm. 2012).

Snowmobile tracks have been observed on the reservoir and upstream of the PTH 24 bridge from satellite imagery. Based on a visual assessment of this imagery, access by snowmobile appears to be via the small inlet off 3rd Avenue and 6th Street. Access to the water/ice upstream of the PTH 24 bridge, appears to occur on the southwest side of the PTH bridge.

Hunting activity likely does not occur in the Project area due to the Project being situated within a municipality where rifles, firearms and shotguns may not be discharged (see Manitoba Conservation and Water Stewardship 2012c).

5.3.1.4 *Navigation and Access*

Based on informal information sources, limited and local navigation is undertaken by boat on the reservoir from local private docks. Observation made during field studies included one small-motorized boat (electric motor) and five private docks within the reservoir. A public boat launch is located on the south shore of the Little Saskatchewan River upstream of the PTH 24 bridge. The dam structure is an effective downstream barrier to navigation and low clearance under the PTH 24 bridge structure limits navigation by boat from upstream.

As discussed in section 5.3.1.3, winter access to the reservoir appears to be conducted by snowmobile from the small inlet off 3rd Avenue and 6th Street and at the upstream location noted above.

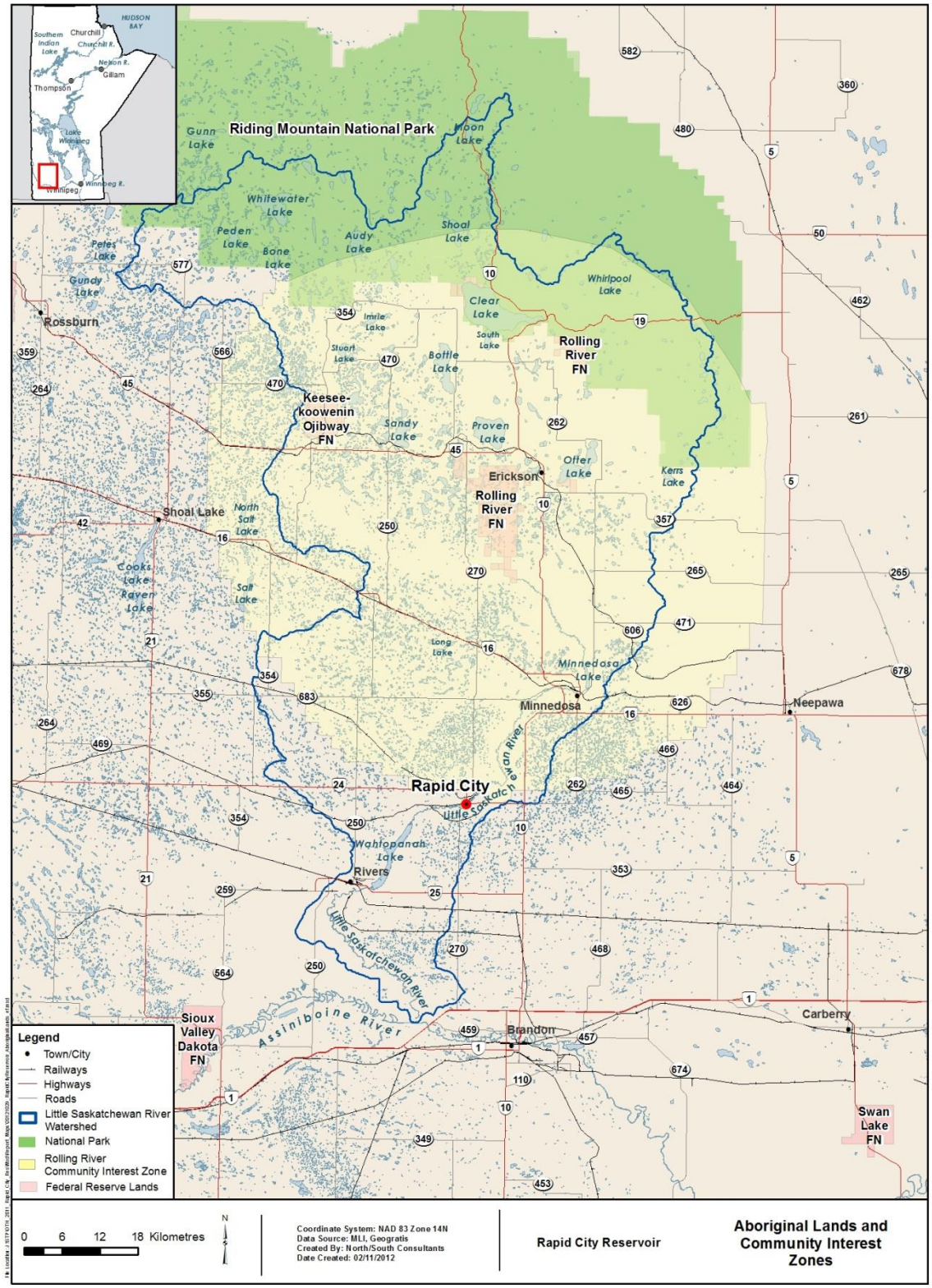

Figure 5-13. Aboriginal Lands within the area adjacent to Rapid City in western Manitoba.

5.3.1.5 *Human Health and Safety*

This section focuses on quantity and quality of drinking water.

The Rapid City public water treatment plant serves a population of approximately 425, residing on the south side of the Little Saskatchewan River from three wells (Little Saskatchewan River Conservation District 2008). Residents located on the north side of the Little Saskatchewan River draw their water from private wells.

Drinking water susceptibility rating is part of a standardized methodology that has been adopted for the province of Manitoba, which allows for relative comparison of susceptibility of drinking water sources across the province. One of the key factors that affects drinking water quality is the quality of the water at the intake location (Little Saskatchewan River Conservation District 2008). A high susceptibility rating is an indicator (though not a determinant) of the potential for drinking water quality to be affected by pollution introduced as a result of human activities (see Table 5-12 for the Rapid City public well susceptibility rating). It is likely, though unconfirmed, that private wells in the vicinity also would be subject to the same susceptibility rating. Rapid City municipal water has a high susceptibility rating.

Table 5-12. Drinking Water Susceptibility.

Well[3]	Well Type	Susceptibility Rating	Factors Impacting Susceptibility Rating
East Well	Unconfined	High[4]	Disturbance, highway, wastewater treatment lagoons, unconfined aquifer in management zone
West Well	Unconfined	High	
Back-up Well	Unconfined	High	

Source: Little Saskatchewan River Conservation District (2008).

Rapid City's water supply is managed under a municipal system (Manitoba Conservation and Water Stewardship 2012c).

5.3.1.6 *Protected Areas*

A review of the Manitoba Land Initiative spatial database (Government of Manitoba 2012), the federal Geogratis spatial database (Canadian Council on Geomatics 2012) and existing literature was conducted to identify federal, provincial or privately protected areas or areas proposed for protection (i.e., Areas of

[3] The primary drinking water well is currently not known.
[4] It is important to recognize that a high susceptibility rating does not mean that water from these sources is unsafe.

Special Interest) in and around the Project Area. Protected areas, lands with special designation and federal and provincial Crown Lands are shown on Figure 5-14.

Riding Mountain National Park is located at the headwaters of the Little Saskatchewan River watershed approximately 65 km to the north. Rivers Provincial Park is located on the southwestern shores of Lake Wahtopanah offering seasonal camping sites and recreational activities such as boating and fishing (Manitoba Conservation and Water Stewardship 2012e).

To the northwest, Minnedosa Lake Wildlife Refuge provides important game bird prairie pothole habitat (Bouffard 1982). Ducks Unlimited Canada has also acquired private land for protection of similar habitat in areas surrounding the Project, the closest of which is located approximately 7 km from the Reservoir. Conservation lands in the region also are held by various owners such as the Manitoba Habitat Heritage Corporation, the Manitoba Naturalists Society and the Manitoba Wildlife Federation. The closest conservation land parcel (legal description SE1-14-20W) is held by Ducks Unlimited Canada approximately 5 km distant from the reservoir. Provincial Crown Lands surround Lake Wahtopanah.

No protected areas, federal or provincial Crown Lands or lands with special designation are located within the Socio-Economic Study Area. Assuming deposition of excavated materials will be avoided on lands that are protected, are proposed for protection or have special interests (i.e., conservation lands), no Project effects are expected.

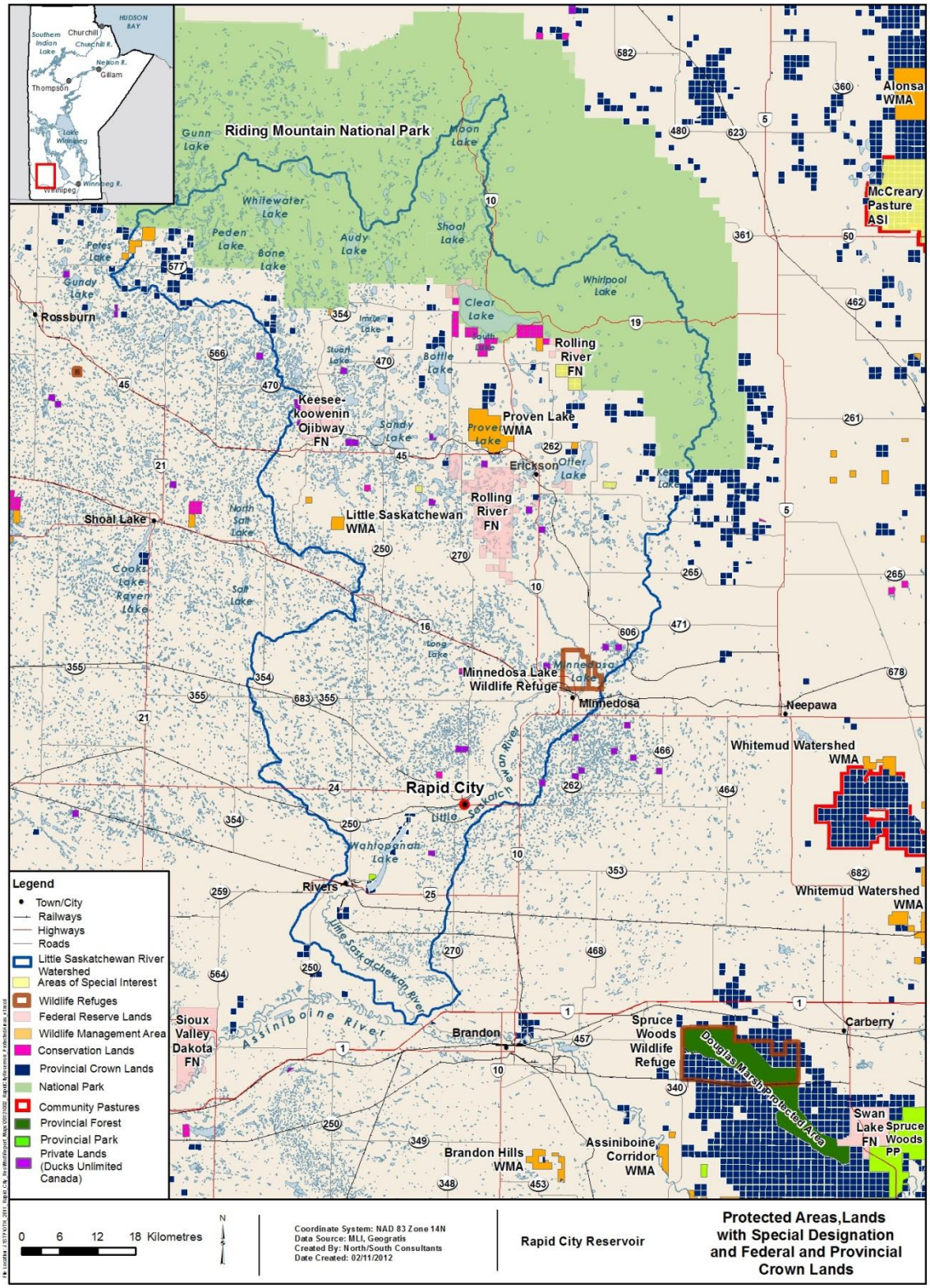

Figure 5-14. Protected areas, lands with special designation and federal and provincial Crown Lands.

5.3.2 Heritage Resources

A formal request was made to the Historic Resources Branch of Manitoba Culture, Heritage and Tourism on July 23, 2012 to determine if a heritage resources impact assessment (HRIA) was required for the proposed Project Area. A request was made for a listing of known and recorded heritage resources within the Socio-Economic Study Area. One archeological site, an infilled stone basement, is present just outside the Study Area and adjacent to PTH 24 (Table 5-13)

Table 5-13. Archeological sites in or adjacent to the Study Area.

Borden No.	Site Type	Features	Cultural Affiliation	Distance from Project (m)
EaMa-9	Public	Stone Basement	Late Historic	1,600

Source: Manitoba Culture, Heritage and Tourism (2012).

Two plaques are located within the Study Area and one centennial farm is located just outside the Study Area (Table 5-14). No provincial or municipal designated sites are present within the Study Area (Docking *pers. comm.* 2012).

Table 5-14. Heritage Resources in or adjacent to the Study Area.

Site ID	Site Type	Site Name	Distance from Project (m)
PLAQ96	Plaque	Rapid City Agricultural Society Centennial	131
PLAQ49	Plaque	Grove, Frederick Philip	225
309	Centennial Farm	Findlay Family Farm	2,800

Source: Manitoba Culture, Heritage and Tourism (2012).

6.0 ENVIRONMENTAL EFFECTS AND MITIGATION MEASURES

The following section provides a description of potential environmental effects resulting from the project and recommended mitigation and environmental protection measures to minimize the corresponding potential effects. Only those environmental components that are considered susceptible to potential effects from the project were included. Where effects were variable with specific zones of the reservoir (as described in section 4.2), the effects were described for the specific zone(s). A summary of the beneficial and adverse effects for each zone is presented in Table 6-1.

6.1 ENVIRONMENTAL EFFECTS ON PHYSICAL COMPONENTS

6.1.1 Geology, Hydrogeology, and Soils

The potential effects of the project on the geology, hydrogeology and soils within the Project Area include:

- Disturbance to soils and terrain with the Project Area;
- Potential for the contamination of soil and/or groundwater resources as a result of accidental or incidental petroleum spills; and
- Potential release of hazardous materials resulting from accidents or equipment malfunctions.

The potential effects to geology, hydrogeology and soils can be mitigated through implementation of the following measures:

- Construction to occur under frozen ground conditions;
- Access points reclaimed to pre-construction conditions following completion of works;
- The contractor will comply with any permitting requirements with respect to storage and handling of petroleum and allied products as per the Dangerous Goods Handling and Transportation Act Regulation 188/2001 and the CCME Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products (2003). These may include but may not be limited to:
    - Construction crews will be adequately trained in spill prevention and containment procedures;
    - An on-site emergency response and containment plan will be developed;
    - Emergency spill clean-up kits will be on site at all times; and
    - All vehicles, machinery, and construction materials will arrive on site clean and free of leaks.

6.1.2 Surface Hydrology

The proposed reservoir drawdown will result in changes to water level elevation in the reservoir and upstream.

Mitigation to minimize the potential effects to surface hydrology include:

- Restricting the time period reservoir drawdown occurs.

6.2 ENVIRONMENTAL EFFECTS ON BIOPHYSICAL COMPONENTS

6.2.1 Aquatic Environment

6.2.1.1 *Water Quality*

Potential effects of dredging on water quality in the Study Area include:

- Deterioration of water quality during rewatering and/or freshet as a result of resuspension of sediment; and
- Increases in nutrients, metals, hydrocarbons, and pesticides in the water column due to exposure to sediment of different quality.

As construction activities will occur in the dry during winter, no impacts to water quality are anticipated during the construction phase. Rather, suspension of newly exposed surficial sediments may increase turbidity and concentrations of suspended solids (TSS) and some nutrients and metals (e.g., aluminum and iron) during re-watering (presumably during freshet). The freshet normally coincides with increases of these compounds due to inputs of erosive materials; however, these particulates tend to settle out of the water column within days to weeks following ice-off.

Nutrient and metal concentrations in the existing reservoir sediments were higher at depth (0.35 m) than at the surface and, to be conservative, it is assumed that the newly exposed sediment (i.e., approximately 2.0 m) will have similar or higher concentrations to those already measured. The potential for increases in concentrations of these compounds in the water column are considered minimal as long as the dredging depth of the southern portion of the reservoir does not exceed 2 m. Specifically, a post-dredging depth of approximately 2.5 m in the southern portion of the reservoir should not cause stratification or associated oxygen depletion and release of nutrients and metals from the sediment.

Pesticides were not detected in sediments at 0.35 m, but historic use of these compounds suggests that concentrations in sediments may be higher at depth. If so, pesticide concentrations in the water column may increase subsequent to dredging.

Potential effects to water quality can be mitigated by:

- Gradually re-watering the dredging area to avoid a sudden disturbance of the substrate, thereby re-introducing the sediment to the water column;
- Implementation of an erosion and sediment control plan; and
- Adhering to the safety guidelines for the storage and handling of hydrocarbons.

6.2.1.2 *Sediment Quality*

Potential effects of dredging on sediment quality in the Study Area include:

- Increases in nutrients, metals, hydrocarbons, and pesticides in surficial sediments.

As sediment sampling was completed to a depth of 0.35 m, the quality of sediment at a depth of up to 2 m is not known. Diagenetic processes typically cause the migration of nutrients and metals from deeper sediments to the surface; therefore, these compounds are expected to be relatively low in newly exposed sediment. However, it is possible that higher concentrations of hydrocarbons and pesticides may occur in deeper strata, i.e., the new surface sediment, as a result of historic use of these compounds.

To mitigate the potential impacts to sediment and water quality, a long core of sediment should be collected prior to dredging and analysed at low analytical detection limits to determine the concentrations of hydrocarbons and pesticides in different strata as well as the depth to which dredging could safely be completed.

6.2.1.3 *Aquatic Habitat*

Potential effects of water level drawdown, removal of the sand/loam substrates and subsequent deepening of the basin on the aquatic habitat include:

- Changes to the community composition of submergent macrophytes along the riverbanks and in the wetland adjacent to the river in Reach 2 due to water level drawdown;
- Increased water depth, most notably in the shallow zones (A and C);
- Long-term alteration of the established community composition of emergent and submergent macrophytes in the excavated area (throughout zones A and C, and along the shoreline of zone D);
- Extant emergent macrophytes will be removed and will be restricted to shallow water zones along the periphery of the zones; and
- Altered community composition of submergent macrophytes due to the changed depth profile and substrate type (less organics).

Although the drawdown will occur during their natural period of senescence and dormancy, the damaging effects of freezing substrates on below-ground plant structures may cause a die-off of macrophytes intolerant of such conditions. Species of shallow water emergent vegetation will likely be unaffected as they are able to tolerate frozen substrate conditions. However, submergent macrophytes that do not experience frozen substrate under typical conditions may be less tolerant of freezing and may die off, resulting in a change in the community composition and overall structure in the following growing season (Kantrud et al. 1989, Wilcox and Meeker 1991, YEC 1998, Fazakas and Kroeker 2004, McGowen et al. 2005).

The effect of dewatering of macrophyte beds is anticipated to be short in duration. A winter drawdown is not necessarily negative as water level fluctuations and periodic disturbances are an important factor in maintaining a diverse, species rich shallow water ecosystem and are not uncommon in the prairie

region (McGowen et al. 2005). Additionally, both winter and summer drawdowns are commonly used as an effective and inexpensive means of controlling the community structure and biomass of submergent vegetation (Madsen 2000).

Aquatic macrophytes are known to re-colonize quickly from the 'natural' seed bank, plant fragments, or from outside sources in a single season (Silver et al. 1986, Strand and Weisner 1991, McGowen 2005). They may even re-colonize at a greater biomass than pre-drawdown levels. A 2.5 fold increase in the biomass of aquatic macrophytes, with a significant increase in the abundance of *Potamogeton pectinatus* was observed following an experimental winter long drawdown of Buffalo Pound Lake, SK, a shallow impoundment lake.

Within the excavated area, provided there is enough photosynthetically active radiation available to allow for germination (as in clear water), submergent macrophytes can recolonize and thrive, even in water 2.5 m deep (Silver et al 1986). Additionally, over time, fine sediments will be deposited and organic matter will accumulate.

Mitigation other than that in section 6.1 is not prescribed to offset the effects of drawdown and substrate removal on the aquatic habitat.

6.2.1.4 *Lower Trophic Levels*

Potential effects of the project on the benthic invertebrate communities within the Project Area include:

- Changes in the benthic invertebrate community composition due to habitat alterations within the affected area, particularly where an invertebrate species lives in association with certain macrophyte species;
- Stranding or beaching of aquatic benthic invertebrates in small shallow pools or on land during the drawdown period, resulting in mortality due to freezing and/or dessication;
- Short term changes in species composition within the dewatered area due to desiccation and reduced food availability;
- Direct mortality during dredging of sediments; and
- Alteration of benthic invertebrate habitat within the dredging area.

When depositional sediments are removed from the dredging area, surviving invertebrates will likely relocate to other more suitable habitats, until a layer of depositional substrates accumulates in this same area. However, dredging can cause significant changes in channel topography/flow rates and substrate conditions that may not recover to pre-dredging conditions until after a longer period of time (Harvey and Lisle 1998). In the long term, food resources within the de-watered area will likely recover over time and sites with similar habitat conditions should have similar invertebrate communities (Fowler 2004).

Potential effects of the Project can be mitigated by:

- Restricting the drawdown and construction period to the shortest duration feasible.

6.2.1.5 *Bivalves*

Potential effects of the Project on the Bivalve communities in the Study Area include:

- Direct loss of habitat in the dredging area;
- Direct mortality from dredging;
- Exposure to freezing conditions during the drawdown period; and
- Exposure to deleterious substances such as elevated concentration of suspended sediments and associated compounds, and petroleum products originating from dredging machinery as water levels rise.

Suitable mussel habitat is limited to zone C, the depositional area and to a lesser extent zone B.

Mitigation to offset the potential effects from exposure to deleterious substances are described in sections 6.1 and 6.2.1. No other mitigation measures are prescribed.

6.2.1.6 *Fish*

Potential effects of the Project on fish communities include:

- Permanent alteration of the fish habitat within the dredging zone;
- Stranding of fish in the natural basin located in the dredging zone during de-watering;
- Temporary reduction or elimination of the overwintering habitat in the river channel within some or all reaches during the drawdown and construction phase; and
- Introduction of deleterious substances such as suspended solids and associated compounds, and hydrocarbons to the water column during re-watering.

Potential effects to fish specific to the four zones are as follows:

Zone A:

This shallow water zone supports species that rely on shallow water habitat with abundant submergent macrophytes including small-bodied fish as well as possibly spawning and rearing by Northern Pike. Dredging will change the majority of this zone from shallow to deeper (>2m) water, limiting the shallow water area to the immediate shoreline. The deeper water will be less suitable for Northern Pike spawning and rearing but will provide suitable habitat for adult pike foraging. This area may be used by pike and suckers for foraging throughout the open water period and possibly through a portion of the winter. Overall, dredging of this zone is expected to increase fish species diversity by providing a greater range of habitats (shallow littoral to deep water), but will reduce the amount of pike spawning and rearing habitat.

Zone C:

Removal of the depositional area will result in the loss of potential spawning and/or foraging habitat for species of fish that prefer sand/gravel substrate for spawning (e.g., Johnny Darter); however these species may find alternative habitat (e.g., gravel/cobble/boulder) outside the Project Area along the edges of the river and in established riffle habitats. Although potential spawning habitat may be lost, dredging may provide species such as Walleye additional deeper, non-vegetated and/or off-current zones during the open water season, in addition to an expanded overwintering area (Stewart and Watkinson 2004). Provided conditions permit, the submergent macrophyte community may re-establish in portions of the excavated area.

Zone D:

The area in front of the fish ladder inlet is relatively shallow with depths up to 1 m, and includes emergent macrophyte along the shore with small amounts of submergent macrophytes. Although it does not appear that fish passage from the fish ladder outlet into the reservoir is impeded, dredging this area would enhance water depths and the corridor for fish movement.

The proposed drawdown will have temporary effect on overwintering areas within Reaches 2 and 3 and may affect habitat both upstream and downstream of these reaches. A drawdown of 1.5 m from the spring levels (to 478.25 masl) will reduce overwintering habitat to three semi-isolated pools with a maximum water depth of 1.5 m (ice free) in a few small areas (Figure 6-1). However, between the pools the water depth would be less than 0.5 m. Prior to drawdown, hydrologic modelling should be undertaken to ensure flow and water depth is maintained in the river channel.

Potential project effects on fish communities can be mitigated by:

- Completing the drawdown prior to fish becoming established in their normal overwintering areas, fish may move outside the project area to deeper water within the river channel, upstream to Lake Minnedosa or downstream to Lake Wahtopanah;
- Ensuring the duration of the drawdown period be kept as short as possible to avoid fish stranding or winter kill in existing pools;
- Maintaining continuous flow to prevent dewatering downstream of the Project Area and potential ice jams caused by substrate-bound ice;
- Conducting a fish salvage within the dredging area prior to freeze up and as soon as the natural basin becomes isolated;
- Adherence to DFO Timing Windows Operational Statement for in-water works;
- Gradually re-watering the dredging area to avoid a sudden disturbance of the substrate, thereby re-introducing the sediment to the water column;
- Adhering to the safety guidelines for the storage and handling of hydrocarbons; and
- Implementation of an erosion and sediment control plan.

6.2.1.7 *Species at Risk*

Potential effects of the Project on species at risk are restricted to the Bigmouth Shiner and Chestnut Lamprey and include:

- Stranding of Lamprey in the natural basin during de-watering; and
- Introduction of deleterious substances such as suspended solids and associated compounds, and hydrocarbons to the water column during re-watering.

The Bigmouth Shiner and Chestnut Lamprey may be found within the Project Area. However, the preferred habitat of Lamprey ammoceotes and Bigmouth Shiner (e.g., riffle and run over sand and gravel) does not occur within the reservoir. Suitable habitat is located downstream of the reservoir in the Little Saskatchewan River.

Potential Project effects on species at risk can be mitigated by:

- Completing the drawdown prior to Lamprey becoming established in their normal overwintering areas, Lamprey may move outside the Project Area to deeper water within the river channel, upstream to Lake Minnedosa or downstream to Lake Wahtopanah;
- Ensuring the duration of the drawdown period be kept as short as possible to avoid Lamprey stranding or winter kill in existing pools;
- Monitoring existing overwintering pools for dissolved oxygen concentrations and re-oxygenation by aeration if necessary;
- Maintaining continuous flow to prevent dewatering downstream of the Project Area and potential ice jams caused by substrate-bound ice;
- Gradually re-watering the dredging area to avoid a sudden disturbance of the substrate, thereby re-introducing the sediment to the water column;
- Monitoring turbidity/TSS in the main channel prior to, during, and after construction activities; This measure will ensure that SS concentrations do not exceed CCME guidelines;
- Adhering to the safety guidelines for the storage and handling of hydrocarbons; and
- Implementation of an erosion and sediment control plan.

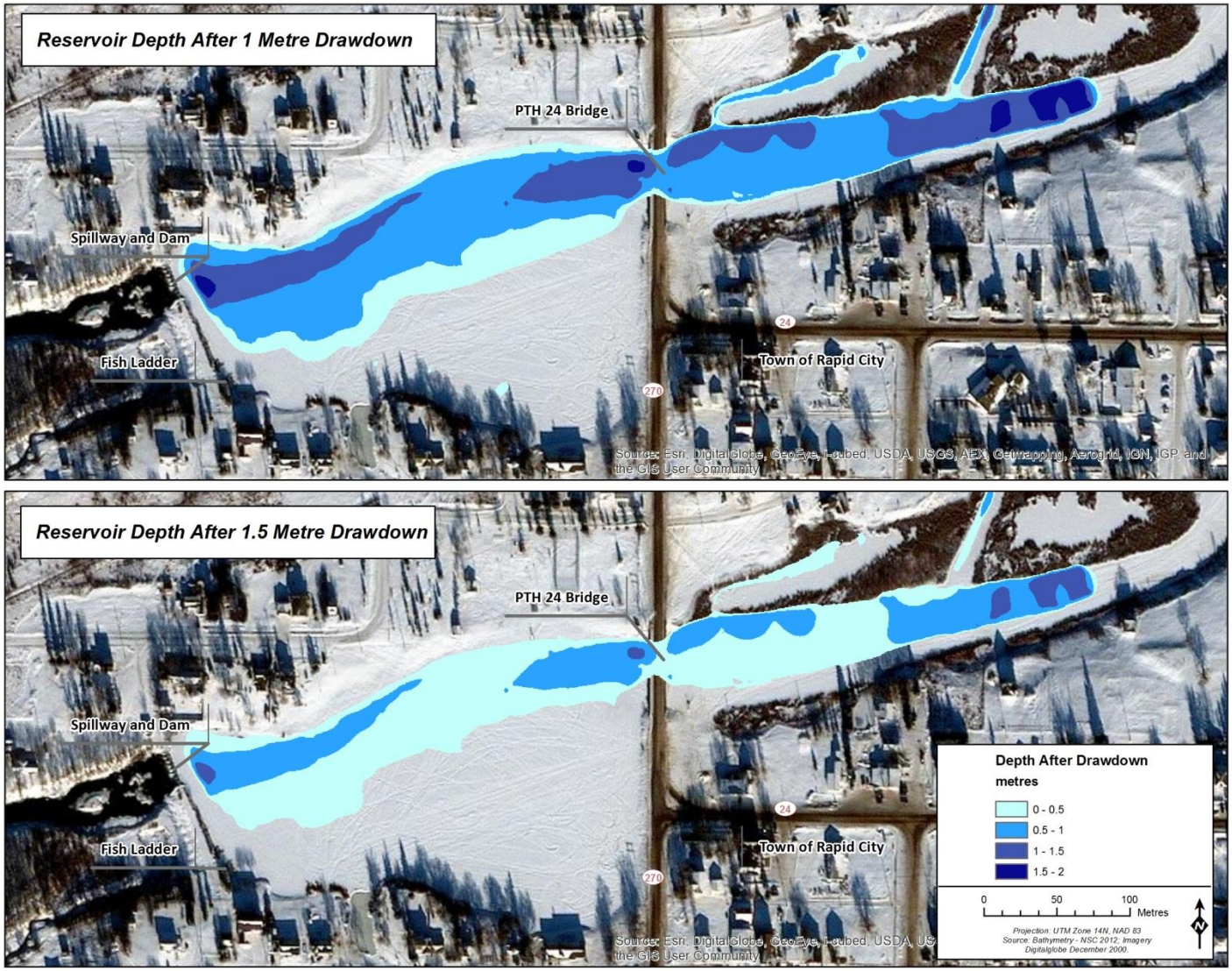

Figure 6 -1. Projected water depth profile of Reaches 2 and 3 after a drawdown of 1 m and 1.5 m relative to spring 2012 water levels of 479.75 masl.

6.2.2 Terrestrial Environment Effects and Mitigation

6.2.2.1 *Habitat and Plants*

The Project is not expected to affect upland terrestrial habitat and associated vegetation, as Project-related activities are expected to be limited to the reservoir and surrounding area. Where access points and upland deposition of excavated materials occurs, avoidance of uncommon habitat types frequently associated with at-risk plant species is recommended. These habitat types include: dry upland ridge prairie, marsh, and moist prairie.

6.2.2.2 *Terrestrial Invertebrates*

The Project is not expected to affect terrestrial invertebrates, as Project-related activities are expected to be limited to the reservoir and surrounding area. Where access points, construction traffic, and upland deposition of excavated materials occurs, avoidance of uncommon habitat types frequently associated with terrestrial invertebrate species at risk is recommended. These habitat types include: dry upland ridge prairie, marsh, and moist prairie.

6.2.2.3 *Birds*

The primary effects of the Project on birds relate to habitat alteration and loss within the Project Area, including:

- Temporary loss of nesting habitat for some bird species due to loss of emergent vegetation (e.g., cattail) along reservoir margins; and
- Loss of shorebird foraging habitat on the deposition ridge in zone C.

The cattail margin, where effected by the Project, is expected to recolonize quickly.

No mitigation is prescribed to offset potential effects to birds.

6.2.2.4 *Mammals*

Semi-aquatic animals, such as the Muskrats and Beavers, have the greatest potential to be affected by Project activities, as they depend on access to water beneath the ice. The potential impacts to these species include:

- Loss of access to water beneath the ice during the drawdown period, resulting in the abandonment of lodges or burrows, and potential increase in winter mortality.

Project effects on mammal species that utilize the aquatic environment can by mitigated by:

- Completing the drawdown prior to muskrat/beavers becoming established in their normal overwintering areas.

Following re-watering, both species are expected to re-colonize the area from adjacent populations.

6.2.2.5 *Amphibians*

For amphibian species that utilize the aquatic environment within the Project Study Area, potential Project effects include:

- Loss of anuran breeding habitat in the dredging areas;
- Reduction of egg survival as a result of re-suspension of sediment in the spring following winter dredging;
- Loss of overwintering habitat for Northern Leopard Frogs during the drawdown period; and
- Direct mortality of overwintering Northern Leopard Frogs due to reduced dissolved oxygen levels and/or exposure to freezing conditions during drawdown.

Numerous Leopard Frogs were found within the Study Area during the course of surveys, indicating that the area is used by this species for at least some of their life stages. The Northern Leopard Frog is the only frog species within the Study Area that utilizes aquatic habitat during the winter; it overwinters in cold, well-oxygenated waters that do not freeze to the bottom and may potentially utilize the river channel portion of the reservoir as an overwintering site (zone B). A drawdown of 1.0 to 1.5 m will result in average reservoir levels ranging from 0 to 1.0 m. Although relatively shallow, this area represents the river channel where flow will continue through winter and is not expected to freeze to the bottom. The risk to Leopard Frog exists where they select areas to overwinter that will become exposed under drawdown conditions.

Potential effects to amphibians specific to the reservoir zones are as follows:

Zone A:

The shallow water with abundant submergent macrophytes provides suitable breeding and foraging habitat for a number of anurans including Northern Leopard Frog. Dredging of this zone and the resulting deeper water would make most of this zone unsuitable breeding and foraging habitat for anuran species. The shoreline area would remain shallow and provide suitable breeding habitat.

Zone B:

Amphibian habitat in zone B includes the shallow area along the north shoreline for breeding and foraging by anurans including Northern Leopard Frogs, as well as the main river channel that is suitable overwintering habitat for Northern Leopard Frogs. Potential effects within this zone are limited to those associated with overwintering frogs as described above.

Zone C:

Suitable amphibian habitat within zone C includes areas of macrophytes in shallow water that occur sporadically throughout the zone. This habitat is suitable for breeding and foraging by a number of anuran species. Dredging of this zone and the resulting deeper water would make most of this zone unsuitable breeding and foraging habitat for anuran species.

Zone D:

Other than the shoreline area, water depths in this zone are too deep to support amphibian breeding or foraging. The immediate shoreline may be used by anurans for breeding and foraging, but habitat of higher quality exists in the adjacent zone A. Dredging of this zone would have little effect on amphibians due to the absence of high quality habitat.

Project effects on amphibian species that utilize the aquatic environment can by mitigated by:

- Installing barriers to keep Northern Leopard Frogs from entering the drawdown area to overwinter;
- Completing the drawdown prior to anurans becoming established in their normal overwintering areas;
- Ensuring the duration of the drawdown period be kept as short as possible to avoid winter kill of individuals in existing pools;
- Monitoring of existing overwintering pools for dissolved oxygen concentrations; and
- Gradually re-watering the dredging area to avoid a sudden disturbance of the substrate, thereby re-introducing sediment to the water column.

6.2.2.6 *Reptiles*

The potential effects of the Project on reptiles are limited to turtle species that use the reservoir for overwintering. These potential effects include:

- Temporary loss of overwintering habitats resulting in direct mortality to overwintering turtles during the drawdown due to low water levels and freezing of the water column.

Mitigation recommendations for the fish community of the Project Study Area will aid in minimizing effects on the turtle community, including:

- Completing the drawdown prior to turtles becoming established in their normal overwintering areas;
- Ensuring the duration of the drawdown period be kept as short as possible to avoid winter kill of individuals in existing pools;
- Monitoring of existing overwintering pools for dissolved oxygen concentrations; and
- Gradually re-watering the dredging area to avoid a sudden disturbance of the substrate, thereby re-introducing sediment to the water column.

6.3 ENVIRONMENTAL EFFECTS ON THE SOCIO-ECONOMIC AND CULTURAL COMPONENTS

6.3.1 Human Environment

The Project has the potential to affect the human environment through the following pathways:

- Disruption of fishing activities by Aboriginal or Metis peoples during the construction period;
- Increased water depths enhancing recreational use of the reservoir;
- Reservoir drawdown affecting recreational activities during the construction period; and

- Reservoir drawdown affecting water supply quantity during construction periods.

Potential effects on Aboriginal or Metis domestic resource use cannot be determined at this time. Consultations with Aboriginal or Metis have not been conducted to date. The Crown has a legal duty to consult with Aboriginal groups, where it contemplates conduct that might adversely impact any potential or established Aboriginal and Treaty rights. Consultations with Aboriginal and Metis residents of Rapid City and nearby communities may be warranted to understand their use of resources on and around the reservoir. It should be noted, however, that effects on domestic hunting activities is not expected due to restrictions with respect to discharging firearms within municipal bounds (see section 5.3.1.3). The potential to affect domestic fishing activities is expected to be of low magnitude due to the short-term nature of disruption (construction period), the limited geographic extent of the disruption (reservoir), and the season of the disruption (late fall and early winter) when fishing for food is typically less common (as opposed to spring).

Recreational activities (described in section 5.3.1.3), such as ice fishing or snowmobiling, involving use of the reservoir are expected to be restricted during the construction and post-dredging periods of the Project. Access will be restricted during both periods for safety purposes. To protect public safety, mitigation may involve erecting fencing to limit access to the reservoir from the small inlet off 3rd Avenue and 6th Street and possibly along the west side of the PTH 24 bridge (though limited access appears to occur there). Changes in ice conditions (thickness or stability) may occur upstream of the PTH 24 bridge in association with reestablishing reservoir levels following dredging may have the potential to affect the February fishing derby conducted there. Ice will need to be tested for suitable thickness and stability prior to conducting the fishing derby. Downstream, effects on fishing are not expected to occur as sediment transport is expected to be limited with mitigation identified (see section 6.2.1.1) and this is not expected to affect open water recreational fishing.

As discussed in section 5.3.1.5, the groundwater under the direct influence of surface water (GUDI) classification suggests hydrological linkages between reservoir levels and well-water levels, meaning that there is a possibility that reservoir drawdown may affect the municipal water supply and possibly, local wells on the north side of the reservoir (quantity). Hydrological study will clarify Project effects (if any) on water supply quantity. Water supply for fire protection during the reservoir drawdown period is not expected to be affected due water storage in a self-contained cistern for this purpose. Changes in drinking water quality are not expected under normal conditions as dredging is not expected to increase the concentration of organic matter in drinking water source intakes (wells) (excluding accidents and malfunctions – see section 6.4).

Potential effects to the human environment specific to the reservoir zones are as follows:

Zone A, C and D:

Dredging and resulting deepening of these zones would enhance the ability to operate small boats in the reservoir.

Mitigation recommendations for the human environment component of the Project will aid in minimizing effects on fishing activities, recreation and water quantity, including:

- Ensuring the duration of the drawdown period be kept as short as possible;
- Gradually re-watering the dredging area to avoid a sudden disturbance of the substrate, thereby re-introducing sediment to the water column;
- Undertaking hydrological studies to identify the relationship between surface and groundwater with subsequent management recommendations;
- Restricting public access to equipment staging areas and the reservoir for safety purposes during construction; and
- Testing ice thickness and stability following reservoir re-watering on the reservoir and upstream of the PTH 24 bridge prior to resuming recreational activities such as snowmobiling and ice fishing.

6.3.2 Heritage Resources

Project effects on heritage resources cannot be determined at this time. Information presented in section 5.3.2 pertains to currently known and recorded heritage resources within the area of the request and does not necessarily indicate the potential of the area to contain additional heritage sites. Therefore, this information cannot be used to obtain heritage clearance for the Project. All development proposals must be approved directly by the Historic Resources Branch Archaeological Assessment Services Unit (Docking *pers. comm.* 2012). Information required would include a finalized deposition site or a set of deposition site options for excavated materials as part of a finalized Project description.

Following approval and, in the event that heritage resources (including but not limited to pre-European aboriginal artifacts, fur-trade related items, homestead remains, human burial remains, etc.) are encountered during Project activities, work should be suspended and the Impact Assessment Archaeologist from the Historic Resources Branch at Manitoba Culture, Heritage and Tourism should be contacted to determine an appropriate course of action to mitigate impacts to resources.

Table 6-1. Summary of long-term potential positive and negative effects from dredging of each of the three assessment zones (zone B not considered a potential dredge zone).

Effect	Zone		
Positive	**A**	**C**	**D**
Increased deep water habitat (>2m)	X	X	X
Increased fish species diversity and period of fish use	X	X	
Enhanced movement corridor from reservoir to fish ladder inlet			X
Increased water depth for recreation	X	X	X
Negative			
Decrease in the amount of shallow water macrophyte dense habitat suitable for pike spawning and rearing	X	X	X
Decrease in the amount of freshwater mussel (bivalve) habitat		X	
Decrease in the amount of Northern Leopard Frog breeding habitat	X	X	
Decrease in breeding habitat (cattail) for wetland birds	X	X	X
Loss of shorebird foraging habitat		X	

7.0 SUMMARY OF RESIDUAL EFFECTS

The predicted effects of the Project following the application of prescribed mitigation were assessed following the significance framework "Reference Guide for the *Canadian Environmental Assessment Act*" including the identification of beneficial and adverse environmental effects, followed by the determination of the significance. These residual effects are summarized below and in Table 7-1.

7.1 GEOLOGY, HYDROGEOLOGY AND SOILS

7.1.1 Construction Phase

Soil Disturbance and Hazardous Materials

With the application of proven mitigation measures and conduct of construction during winter, the residual effects of the disturbance to soils and terrain and potential release of hazardous materials will be of low magnitude, confined to the Project Site, of short duration, continuous during dredging, and fully reversible. The environmental effects of dredging on geology, hydrogeology and soils are, therefore, predicted to be "not significant".

7.1.1 Post-Dredging Phase

Post-dredging effects were not identified.

7.2 SURFACE HYDROLOGY

7.2.1 Construction Phase

Water Level Changes

With the application of mitigation measures, the residual effects of temporary reduction of water levels in the reservoir will be of low moderate magnitude, confined to the Project Site, of short duration, continuous during dredging, and fully reversible. The environmental effects of dredging on surface hydrology are, therefore, predicted to be "not significant".

7.2.2 Post-Dredging Phase

Post-dredging effects were not identified.

7.3 WATER QUALITY

7.3.1 Construction Phase

Dredging of Sediment

With the application of proven mitigation measures and conduct of construction during winter, the residual effects of sediment dredging on water quality in the Rapid City Reservoir and Little Saskatchewan River will be of low magnitude, confined to the Project Site, of short duration, continuous

during dredging, and fully reversible. The environmental effects of dredging on water quality are, therefore, predicted to be “not significant”.

7.3.2 Post-Dredging Phase

Resuspension of sediment

The application of proven mitigation measures will minimize the release of resuspended sediments to the main channel of the Rapid City Reservoir and Little Saskatchewan River. Therefore, residual effects will be of low magnitude and moderate extent, duration, and frequency but will be fully reversible and “not significant”.

7.4 SEDIMENT QUALITY

7.4.1 Construction Phase

Construction phase effects were not identified.

7.4.2 Post-Dredging Phase

Exposure of Pesticides

The implementation of soil testing will define dredging depth and avoid exposure of pesticides to the main channel of the Rapid City Reservoir and Little Saskatchewan River. Therefore, residual effects will be of low magnitude and low extent, duration, and frequency but will be fully reversible and “not significant”.

7.5 AQUATIC HABITAT

7.5.1 Construction Phase

Exposure of Macrophytes

Aquatic macrophyte abundance will be reduced due to exposure and freezing during drawdown. This effect will be of moderate magnitude, low extent, moderate duration, low frequency and is reversible and therefore “not significant”.

Dredging of Sediment

The dredging of the shallow areas (zones A, C or D) will result in an increase in water depth and change in aquatic macrophyte community. This effect will be moderate in magnitude, with an increase in water depth to approximately 2 m or more. The effect will be most pronounced in zones A and C as these areas consist of the relatively uniform shallow water (<1 m depth). The effect of dredging any of the zones will be moderate in magnitude, low extent, moderate duration, low frequency and reversible. Similar shallow water macrophyte dense habitats exist within the study area in Reach 2. Therefore the described effects considered “not significant”.

7.5.2 Post-Dredging Phase

Post-dredging effects were not identified.

7.6 LOWER TROPHIC

7.6.1 Construction Phase

Exposure of Benthic Invertebrates

Benthos will be exposed to freezing during drawdown with predicted mortality. With mitigation implemented this effect will be of moderate magnitude, low extent, moderate duration, low frequency and is reversible and therefore “not significant”.

Dredging of Sediment

The residual effects of sediment dredging and macrophyte removal on benthic invertebrates in the Rapid City Reservoir will be of moderate magnitude, confined to the Project Site, of moderate duration, restricted to the dredging period, and reversible. The environmental effects are therefore predicted to be “not significant”.

7.6.2 Post-Dredging Phase

Post-dredging effects were not identified.

7.7 BIVALVES

7.7.1 Construction Phase

Exposure of Bivalves

Bivalves are likely to be exposed to freezing during drawdown with predicted mortality. Following the application of mitigation, this effect will be of moderate magnitude, low extent, moderate duration, low frequency and is reversible and therefore “not significant”.

Dredging of Sediment

Suitable bivalve habitat was restricted to the depositional area of the reservoir, zone C, and therefore effects of dredging sediment of bivalves will only occur if this zone is dredged. The residual effects of sediment dredging on bivalves in the Rapid City Reservoir will be of moderate magnitude, confined to the Project Site, of moderate duration, restricted to the dredging period, and reversible. The environmental effects are therefore predicted to be “not significant”.

7.7.2 Post-Dredging Phase

Resuspension of Sediment and Deleterious Substances

The application of mitigation measures will minimize the release of resuspended sediments and deleterious substances to the main channel of the Rapid City Reservoir and Little Saskatchewan River.

Therefore, residual effects will be of low magnitude and moderate extent, duration, and frequency but will be fully reversible and "not significant".

7.8 FISH

7.8.1 Construction Phase

Introduction of Suspended Sediments

With the isolation of the dredging area, sediments will not be introduced to the Little Saskatchewan River during construction. Residual effects will be of low magnitude, confined to the Project Site, of short duration, continuous during dredging, and fully reversible. The environmental effects will be "not significant".

Dredging of Sediment

The residual effects of sediment dredging and macrophyte removal on fish in the Rapid City Reservoir will result in a change to fish habitat through an increase in water depth and change to associated macrophyte communities. This effect will be most pronounced is zones A and C and to a lesser extent observed in zone D.

Specifically, in zone A, the majority of the shallow water habitat will be changed to deeper water and this will represent a loss of suitable spawning and rearing habitat for Northern Pike. Similar shallow, macrophyte dense habitat will remain along the shoreline of zone A. The deeper water habitat that results from dredging, although less suitable for spawning and rearing by Northern Pike, will provide suitable foraging and possibly wintering habitat for pike and other species of fish. In context of the study area, similar shallow water habitat to that in zone A is available in the upstream Reach 2. The effects of dredging sediment in zone A will be of moderate magnitude, confined to the Project Site, of moderate duration, restricted to the dredging period, and reversible. The environmental effects are therefore predicted to be "not significant".

Dredging of zone C, the depositional area will result in the loss of shallow water habitat with sand/gravel, sand/silt and silt/clay substrate and sparse macrophytes. Similar habitat exists within the study area upstream in Reach 1 and downstream in Reach 4. The environmental effects of dredging zone C will be moderate magnitude, confined to the Project Site, of moderate duration, restricted to the dredging period, and reversible. The environmental effects are therefore predicted to be "not significant".

Dredging of the relatively small area of zone D will result in a deepening of shallow areas and an enhancement of fish travel corridor to the fish ladder opening. The environmental effects of dredging zone D will be moderate magnitude, confined to the Project Site, of moderate duration, restricted to the dredging period, and reversible. The environmental effects are therefore predicted to be "not significant".

Stranding of Fish

With the application of mitigation measures the residual effects of drawdown on fish stranding in the Little Saskatchewan River will be of low magnitude, confined to the Project Site, of short duration, continuous during dredging, and fully reversible. The environmental effects of dredging on fish stranding are therefore predicted to be "not significant".

7.8.2 Post-Dredging Phase

Resuspension of sediment

The application of proven mitigation measures will minimize the release of resuspended sediments to the main channel of the Rapid City Reservoir and Little Saskatchewan River. Therefore, residual effects will be of low magnitude and moderate extent, duration, and frequency but will be fully reversible and "not significant".

7.9 SPECIES AT RISK

7.9.1 Construction Phase

Stranding of Lamprey

With the application of mitigation measures the residual effects of drawdown on Lamprey stranding in the Little Saskatchewan River will be of low magnitude, confined to the Project Site, of short duration, continuous during dredging, and fully reversible. The environmental effects of dredging on Lamprey stranding are therefore predicted to be "not significant".

7.9.1 Post-Dredging Phase

Resuspension of sediment

The application of proven mitigation measures will minimize the release of resuspended sediments to the main channel of the Rapid City Reservoir and Little Saskatchewan River. Therefore, residual effects will be of low magnitude and moderate extent, duration, and frequency but will be fully reversible and "not significant".

7.10 BIRDS

7.10.1 Construction Phase

Loss of Breeding Habitat

Drawdown is expected to result in a loss of cattail breeding habitat for some species. The residual effects on such habitat will be of low magnitude, confined to the Project Site, of moderate duration, and fully reversible. The environmental effects of dredging on bird breeding habitat are therefore, predicted to be "not significant".

Dredging of sediment

The dredging of the depositional ridge, zone C, will result in the loss of shorebird foraging habitat and the residual effects will be of moderate magnitude, confined to the Project Site, of moderate duration, continuous during dredging, and fully reversible. The environmental effects are therefore, predicted to be "not significant".

7.10.2 Post-Dredging Phase

Post-dredging effects were not identified.

7.11 MAMMALS

7.11.1 Construction Phase

Isolation of Lodges/Burrows

With the application of mitigation measures, the residual effects of drawdown on mammals in the Rapid City Reservoir and Little Saskatchewan River will be of moderate magnitude, confined to the Project Site, of short duration, continuous during dredging, and fully reversible. The environmental effects are therefore, predicted to be "not significant".

7.11.2 Post-Dredging Phase

Post-dredging effects were not identified.

7.12 AMPHIBIANS

7.12.1 Construction Phase

Dredging of Sediment

The residual effects of sediment dredging and macrophyte removal on amphibians, including the Northern Leopard Frog in the Rapid City Reservoir will result in a reduction in breeding habitat limited to zones A and C.

Shallow macrophyte dense habitat in zone A will be changed to deeper water and this will represent a loss of suitable breeding habitat for amphibians. Similar shallow, macrophyte dense habitat will remain along the shoreline of zone A. In context of the study area, similar shallow water habitat to that in zone A is available in the upstream Reach 2. The effects of dredging sediment in zone A will be of moderate magnitude, confined to the Project Site, of moderate duration, restricted to the dredging period, and reversible. The environmental effects are therefore predicted to be "not significant".

Dredging of zone C, the depositional area is comprised primarily of sand/gravel, sand/silt and silt/clay substrate with only sparse macrophyte beds. These macrophyte areas provide suitable amphibian breeding habitat where they occur within the zone. The environmental effects of dredging zone C will be moderate magnitude, confined to the Project Site, of moderate duration, restricted to the dredging period, and reversible. The environmental effects are therefore predicted to be "not significant".

Overwintering Leopard Frogs

With the application of mitigation measures the residual effects of drawdown on Leopard Frogs in the Little Saskatchewan River will be of low magnitude, confined to the Project Site, of short duration, continuous during dredging, and fully reversible. The environmental effects of dredging on frog stranding are therefore, predicted to be “not significant”.

7.12.1 Post-Dredging Phase

Resuspension of sediment

The application of proven mitigation measures will minimize the release of resuspended sediments to the main channel of the Rapid City Reservoir and Little Saskatchewan River. Therefore, residual effects will be of low magnitude and moderate extent, duration, and frequency but will be fully reversible and “not significant”.

7.13 REPTILES

7.13.1 Construction Phase

Overwintering Turtles

With the application of mitigation measures the residual effects of drawdown on reptiles in the Little Saskatchewan River will be of low magnitude, confined to the Project Site, of short duration, continuous during dredging, and fully reversible. The environmental effects of dredging on reptile stranding are therefore, predicted to be “not significant”.

7.13.2 Post-Dredging Phase

Post-dredging effects were not identified.

7.14 HUMAN ENVIRONMENT

7.14.1 Construction Phase

Recreational Use

With the application of mitigation measures, the residual effects of construction on recreational use of the Rapid City Reservoir and Little Saskatchewan River will be of moderate magnitude, confined to the Project Site, of short duration, continuous during dredging, and fully reversible. The environmental effects of dredging on water quality are therefore, predicted to be “not significant”.

Water Supply

With the application of mitigation measures, the residual effects of construction on water supply in the Rapid City Reservoir will be of low magnitude, confined to the project site, of short duration, continuous during dredging, and fully reversible. The environmental effects of dredging on water quality are therefore, predicted to be “not significant”.

7.14.2 Post-Dredging Phase

Post-dredging effects were not identified.

Table 7-1. Environmental Effects Analysis for each environmental component and project phase.

Environmental Components	Project Phase or Component	Description of Potential Environmental Effects	Significance of the Effect*	Recommended Mitigation Measures or Best Management Practices (BMPs)	Residual Effect	Significance of Residual Effect*	Monitoring	Follow-Up
Geology, Hydrogeology, Soils	Construction	Disturbance to soils and terrain with the Project Area.	ME	Construction to occur under frozen ground conditions and access points will be reclaimed to pre-construction conditions.	None	NS	NA	NA
	Construction	Potential for the release of hazardous materials and contamination of soil and/or groundwater resources as a result of accidental or incidental petroleum spills.	S	Appropriate storage, refuelling and setback distances for fuels and chemicals will be adhered to.	None	NS	NA	NA
Surface Hydrology	Construction	Change in water level in the reservoir.	ME	Restrict the drawdown and construction period to the shortest duration feasible.	None	NS	NA	NA
Surface Water Quality	Construction	Dredging of soils in the reservoir can reduce the quality of surface water in downstream areas through the suspension of soil particles.	ME	Dredging will be performed in the dry during winter.	Minor risk of introduction of sediments and associated compounds to the reservoir and river channel.	NS	M	NA
	Construction/ Post-Dredging	Excavated material may be reintroduced to waterways.	ME	Excavated materials will be deposited on agricultural fields distant from waterways and at an elevation above the high water mark.	None	NS	NA	NA

Environmental Components	Project Phase or Component	Description of Potential Environmental Effects	Significance of the Effect*	Recommended Mitigation Measures or Best Management Practices (BMPs)	Residual Effect	Significance of Residual Effect*	Monitoring	Follow-Up
	Post-Dredging	Dredging of soils in the reservoir can reduce the quality of surface water in downstream areas through the suspension of soil particles.	ME	Gradual refilling of the reservoir will reduce downstream sediment transport.	Minor risk of introduction of sediments and associated compounds to the reservoir and river channel.	NS	M	NA
	Post-Dredging	Sediments exposed after dredging could release hydrocarbons and pesticides to the water column.	S	Test the sediment prior to dredging in order to determine the depth to which dredging could safely be completed.	None.	NS	M	F
Sediment Quality	Post-Dredging	Sediments exposed after dredging could have concentrations of pesticides above the guidelines for the protection of aquatic life.	S	Test the sediment prior to dredging in order to determine the depth to which dredging could safely be completed.	None.	NS	NA	F
Aquatic Habitat	Construction	Exposure and die-off of shallow water vegetation during water drawdown.	NS	None	Temporary loss of macrophytes; expect rapid re-colonization of aquatic macrophytes.	NS	NA	NA
	Construction	Habitat alteration by removing the sediment: deepening of the reservoir.	ME	None	Alteration of habitat resulting in deeper water.	NS	NA	NA
Lower Trophic	Construction	Changes in the benthic invertebrate community.	ME	None	Changes to the benthic invertebrate species composition.	NS	NA	NA

Environmental Components	Project Phase or Component	Description of Potential Environmental Effects	Significance of the Effect*	Recommended Mitigation Measures or Best Management Practices (BMPs)	Residual Effect	Significance of Residual Effect*	Monitoring	Follow-Up
	Construction	Mortality of aquatic benthic invertebrates during the drawdown period.	ME	Restrict the drawdown and construction period to the shortest duration feasible.	Temporary loss of benthic invertebrate abundance.	NS	NA	NA
	Construction	Direct mortality during dredging of sediments.	ME	None	Temporary loss of benthic invertebrate abundance.	NS	NA	NA
	Construction	Alteration of benthic invertebrate habitat within the dredging area.	ME	None	Alteration of habitat resulting in deeper water.	NS	NA	NA
Bivalves	Construction	Direct loss of habitat in the dredging area (zone C).	ME	None	Alteration of habitat resulting in deeper water.	NS	NA	NA
	Construction	Direct mortality from dredging.	ME	None	Temporary loss of bivalve abundance.	NS	NA	NA
	Construction	Exposure to freezing conditions during the drawdown period.	ME	Restrict the drawdown and construction period to the shortest duration feasible.	Temporary loss of bivalve abundance.	NS	NA	NA
	Post-Dredging	Exposure to deleterious substances during re-watering.	ME	Gradual re-watering of excavated area to reduce re-suspension of fine sediment.	None	NS	NA	NA
Fish	Construction	Elevated levels of suspended sediment particles can be detrimental to the health of fish overwintering in the channel.	ME	Water level drawdown to below the level of dredging, and dredging of frozen materials	None	NS	M	NA

Environmental Components	Project Phase or Component	Description of Potential Environmental Effects	Significance of the Effect*	Recommended Mitigation Measures or Best Management Practices (BMPs)	Residual Effect	Significance of Residual Effect*	Monitoring	Follow-Up
	Construction	Drawdown for the duration of construction could result in the stranding of fish in overwintering pools that could become anoxic resulting in winter kill, within the Project Area.	ME	Drawdown prior to the fish moving into their overwintering areas; assurance of continuous water flow or the monitoring; fish salvage of the de-watered dredging zone.	Minor risk of fish stranding and water becoming anoxic.	NS	M	NA
	Construction	Dredging will remove existing shallow water habitat.	ME	None.	Change in depth of water and substrate.	NS	NA	NA
	Post-Dredging	Re-suspended sediment and associated compounds from the dredging area during re-watering and the spring freshet may result in the siltation of spawning beds immediately downstream of the dam and compromise the health of fish.	ME	Gradual re-watering of excavated area to reduce re-suspension of fine sediment.	None	NS	NA	NA
Species at Risk	Construction	Stranding of Lamprey in the natural basin located in the dredging zone during de-watering	ME	Drawdown prior to the Lamprey moving into their overwintering areas; assurance of continuous water flow or the monitoring; fish salvage of the de-watered dredging zone.	Minor risk of Lamprey stranding and water becoming anoxic.	NS	NA	NA
	Post-Dredging	Introduction of deleterious substances during re-watering.	ME	Gradual re-watering of excavated area to reduce re-suspension of fine sediment.	None	NS	NA	NA
Birds	Construction	Temporary loss of nesting habitat in cattail margin.	ME	None	None	NS	NA	NA
	Construction	Loss of shorebird foraging habitat on the depositional ridge (zone C).	ME	None	None	NS	NA	NA

Environmental Components	Project Phase or Component	Description of Potential Environmental Effects	Significance of the Effect*	Recommended Mitigation Measures or Best Management Practices (BMPs)	Residual Effect	Significance of Residual Effect*	Monitoring	Follow-Up
Mammals	Construction	Isolation of Muskrat/Beaver from lodges and burrows during drawdown.	ME	Complete the drawdown prior to Muskrat/Beavers becoming established in their normal overwintering areas.	Temporary displacement of individual Muskrat/Beaver	NS	NA	NA
Amphibians	Construction	Loss of anuran breeding habitat in the dredging areas (zone A and C).	ME	None	Reduction in amount of breeding habitat.	NS	NA	NA
	Construction	Loss of overwintering habitat for Northern Leopard Frogs during the drawdown period.	ME	Install barriers to keep Northern Leopard Frogs from entering the drawdown area to overwinter.	Temporary reduction in the amount of overwintering habitat.	NS	NA	NA
	Construction	Direct mortality of overwintering Northern Leopard Frogs due to reduced dissolved oxygen levels and/or exposure to freezing conditions during drawdown.	S	Complete the drawdown prior to anurans becoming established in their normal overwintering areas. Install barriers to keep Northern Leopard Frogs from entering the drawdown area to overwinter. Ensure the duration of the drawdown period be kept as short as possible. Monitor of existing overwintering pools for dissolved oxygen concentrations.	Minor risk of mortality to overwintering Northern Leopard Frogs.	NS	M	NA
	Post-Dredging	Reduction of egg survival as a result of re-suspension of sediment in the spring following winter dredging.	NS	Gradual re-watering the dredging area to reduce re-suspension of sediment.	Minor risk of increase in suspended sediments.	NS	NA	NA

Environmental Components	Project Phase or Component	Description of Potential Environmental Effects	Significance of the Effect*	Recommended Mitigation Measures or Best Management Practices (BMPs)	Residual Effect	Significance of Residual Effect*	Monitoring	Follow-Up
Reptiles	Construction	Temporary loss of overwintering habitats resulting in direct mortality to overwintering turtles.	S	Complete the drawdown prior to anurans becoming established in their normal overwintering areas. Ensure the duration of the drawdown period be kept as short as possible. Monitor of existing overwintering pools for dissolved oxygen concentrations.	Minor risk of mortality to overwintering turtles.	NS	M	NA
Human Environment	Construction	Reservoir drawdown affecting recreational activities during the construction period	ME	Ensure the duration of the drawdown period be kept as short as possible.	Minor disruption to winter recreation.	NS	NA	NA
	Construction	Reservoir drawdown affecting water supply quantity during construction periods.	S	Undertaking hydrological studies to identify the relationship between surface and groundwater with subsequent management recommendations.	Further mitigation to be implemented following studies with no effects to water supply.	NS	M	F

* Different methods/criteria can be used to define the Significance of the effect (or the significance of residual effect).

S: Significant adverse environmental effect

ME: Minor Adverse Effect/ Mitigable Effect (Not Significant)

NS: Not significant adverse environmental effect

M: Monitoring required

F: Follow-up required

NA: Not required or not applicable

8.0 PUBLIC PARTICIPATION

8.1 PUBLIC AND COMMUNITY ENGAGEMENT

Based on the preliminary and tentative status of the Project, public and community engagement has not occurred.

8.2 ABORIGINAL ENGAGEMENT

Based on the preliminary and tentative status of the Project, Aboriginal engagement has not occurred as part of this assessment.

9.0 MONITORING REQUIREMENTS

9.1 WATER QUALITY

Water quality monitoring of turbidity, total suspended solids (TSS), polyaromatic hydrocarbons (PAHs), and oil and grease should be conducted prior to and during the construction phase. Monitoring should include sites located approximately 100 m upstream of the construction area (i.e., background) and at various distances up to approximately 1.5 km downstream of the control structure to determine the extent of sediment dispersion.

Water quality monitoring of the routine parameters (e.g., turbidity, TSS, pH), nutrients, metals, PAHs, and pesticides should be conducted during the spring freshet. Monitoring should include sites located approximately 100 m upstream of the construction area (i.e., background) and at various distances up to approximately 1.5 km downstream of the control structure. Monitoring will also ensure that hydrocarbons and pesticides are not being released from the sediments.

Results of all water quality monitoring could be compared to the MWQSOGs for PAL, recreation, and irrigation

9.2 FISH COMMUNITY

Overwintering pools should be monitored for dissolved oxygen concentrations content during the drawdown and construction phase.

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11.0 PERSONAL COMMUNICATIONS

Bruederlin, Bruno, Regional Fisheries Biologist, Manitoba Conservation and Water Stewardship. Email correspondence with Kurt Mazer, Senior Biologist, North/South Consultants Inc. April 4, 2012.

Docking, Heather, Heritage Resources Registrar, Historic Resources Branch, Manitoba Culture, Heritage and Tourism. Email correspondence with Gaylen Eaton, Environmental Researcher, North/South Consultants Inc. July 25, 2012.

12.0 APPENDICES

APPENDIX 1. WATER AND SEDIMENT QUALITY

Table A1-1. Mean water quality parameters measured at the MWS long-term monitoring site located on the Little Saskatchewan River near Rivers, MB (site MB05MF098) from January 2002 to April 2012. Values in bold exceed the Manitoba Water Quality Standards, Objectives, and Guidelines (MWQSOG) for the Protection of Aquatic Life (PAL).

Parameter	Unit	Concentration	MWQSOG
Routine Parameters			
Total Alkalinity	mg/L	3.77	-
Hydroxide	mg/L	<0.5	-
Calcium Carbonate	mg/L	266	-
Bicarbonate	mg/L	317	-
Total Suspended Solids (TSS)	mg/L	5	-
Turbidity	NTU	3.1	-
True colour	CU	27	-
pH	pH units	8.11	6.5-9.0
Conductivity (at 25c)	µS/cm	770	-
Dissolved Oxygen (field)	mg/L	8.47	Varies by
Biochemical Oxygen Demand	mg/L	2.8	-
Total Dissolved Solids (TDS)	mg/L	538	-
Chlorophyll *a*	µg/L	49.3	-
Pheophytin *a*	µg/L	5.7	-
Escherichia coli	CFU/100	15	-
Fecal coliforms	CFU/100ML	25	-
Nutrients			
Ammonia	mg/L	0.144	Site specific
Nitrate/nitrite	mg/L	0.224	2.93
Total Kjeldahl Nitrogen	mg/L	1.3	-
Total Acid Reactive Phosphorus	mg/L	0.167	-
Ortho-phosphorus	mg/L	0.087	-
Total Dissolved Phosphorus	mg/L	0.141	-
Particulate Phosphorus	mg/L	0.036	-
Total Phosphorus	mg/L	**0.178**	**0.05**
Total Inorganic Carbon	mg/L	62.3	-
Total Organic Carbon	mg/L	16	-
Total Carbon	mg/L	78	-
Total Metals			
Hardness	mg/L	351	-
Aluminum	mg/L	0.060	0.100
Antimony	mg/L	0.0003	-

Table A1-1 Continued.

Parameter	Unit	Concentration	MWQSOG
Arsenic	mg/L	0.0026	0.150
Barium	mg/L	0.046	-
Beryllium	mg/L	<0.0002	0.100
Bismuth	mg/L	<0.0002	-
Boron	mg/L	0.13	1.50
Cadmium	mg/L	<0.00004	Site specific
Calcium	mg/L	75.6	-
Cesium	mg/L	<0.0001	-
Chloride - dissolved	mg/L	10.1	-
Chromium	mg/L	<0.001	-
Cobalt	mg/L	0.0003	-
Copper	mg/L	0.0016	Site specific
Iron	mg/L	0.17	0.300
Lead	mg/L	0.00037	Site specific
Lithium	mg/L	0.065	-
Magnesium	mg/L	39.6	-
Manganese	mg/L	0.241	-
Molybdenum	mg/L	0.0020	0.073
Nickel	mg/L	0.0018	Site specific
Potassium	mg/L	8.27	-
Rubidium	mg/L	0.0027	-
Selenium	mg/L	<0.001	0.001
Silicon	mg/L	8.75	-
Silver	mg/L	<0.0001	0.0001
Sodium	mg/L	35.9	-
Strontium	mg/L	0.29	-
Sulphate - dissolved	mg/L	157	-
Tellurium	mg/L	<0.0002	-
Thallium	mg/L	<0.0001	0.0008
Thorium	mg/L	<0.0001	-
Tin	mg/L	<0.0006	-
Titanium	mg/L	0.0026	-
Tungsten	mg/L	<0.001	-
Uranium	mg/L	0.0022	0.015
Vanadium	mg/L	0.0013	-
Zinc	mg/L	0.003	Site specific
Zirconium	mg/L	<0.002	-
2,4,5-TP	µg/L	<0.05	-
2,4-DB	µg/L	<0.05	-
2,4-D	µg/L	<0.05	-
Alachlor	µg/L	<0.2	-
Alpha BHC	µg/L	<0.1	-

Table A1-1 Continued.

Parameter	Unit	Concentration	MWQSOG
AMPA(Aminomethylphosphonic Acid)	µg/L	1.81	-
Atrazine Desethyl	µg/L	<0.1	1.8
Atrazine	µg/L	<0.1	1.8
Azinphos Methyl	µg/L	<1	-
Beta BHC	µg/L	<0.1	-
Bromacil	µg/L	<0.2	5
Bromoxynil	µg/L	<0.02	5
Captan	µg/L	<10	1.3
Carbofuran	µg/L	<0.2	1.8
Carboxin (Carbathin)	µg/L	<0.1	-
Chlordane-cis	µg/L	<0.01	-
Chlordane-trans	µg/L	<0.01	-
Chlorothalonil	µg/L	<0.06	-
chlorpyrifos-ethyl (Dursban)	µg/L	<0.1	0.0002
Cyanazine	µg/L	<0.5	2.0
Delta BHC	µg/L	<0.1	-
Deltamethrin	µg/L	<0.04	0.0004
Diazinon	µg/L	<0.03	-
Dicamba (Banvel)	µg/L	<0.02	10
Dichloroprop(2,4-DP)	µg/L	<0.05	-
Diclofop-Methyl	µg/L	<0.1	6.1
Dimethoate (Cygon)	µg/L	<0.2	6.2
Dinoseb	µg/L	<0.05	0.05
Eptam	µg/L	<0.2	-
Ethalfluralin (Edge)	µg/L	<0.02	-
Fenoxaprop	µg/L	<0.1	-
Glyphosate (Roundup)	µg/L	3.3	65
imazamethabenz-Methyl	ng/L	27	-
Lindane(Gamma-BHC)	µg/L	<0.1	0.01
Malathion	µg/L	<0.2	-
Mcpp (Mecoprop)	µg/L	<0.05	2.6
Methoxychlor (P,P'-Methoxychlor)	µg/L	<0.04	-
Metribuzin	µg/L	<0.2	1
Metsulfuron-Methyl	µg/L	<0.01	-
Parathion Ethyl	µg/L	<0.2	-
Parathion Methyl	µg/L	<0.2	-
Picloram (Tordon)	µg/L	<0.2	29
Propachlor	µg/L	<0.2	-
Propanil	µg/L	<0.2	-
Propoxur	µg/L	<0.2	-
Quizalofop	µg/L	<0.1	-
Simazine	µg/L	<0.1	10

Table A1-1 Continued.

Parameter	Unit	Concentration	MWQSOG
Tebuthiuron	µg/L	<2	1.6
Terbufos	µg/L	<0.5	-
Thifensulfuron Methyl	µg/L	<0.01	-
Triallate (Avadexbw)	µg/L	<0.1	0.24
Tribenuron	µg/L	<0.01	-
Triclopyr	µg/L	<0.05	-
Trifluralin (Treflan)	µg/L	<0.03	0.20

Table A1-2. Location of sites sampled in the Rapid City Reservoir for water and sediment quality as well as particle size analysis. Samples collected by North/South Consultants Inc. July 24 and 25, 2012.

	UTM Location (14U)	
Site	Easting	Northing
Water and Sediment Quality Sites		
WSQ-1	425630	5552642
WSQ-2	425684	5552748
WSQ-3 (*in situ*)	425761	5552649
WSQ-3 (sediment)	425751	5552642
Particle Size Analysis Sites		
PSA-1	425833	5552759
PSA-2	425776	5552761
PSA-3	425757	5552713
PSA-4	425655	5552669
PSA-5	425575	5552637
PSA-6	425641	5552619
PSA-7	425780	5552649
PSA-8	425596	5552657
PSA-9	425658	5552702
PSA-10	425706	5552750

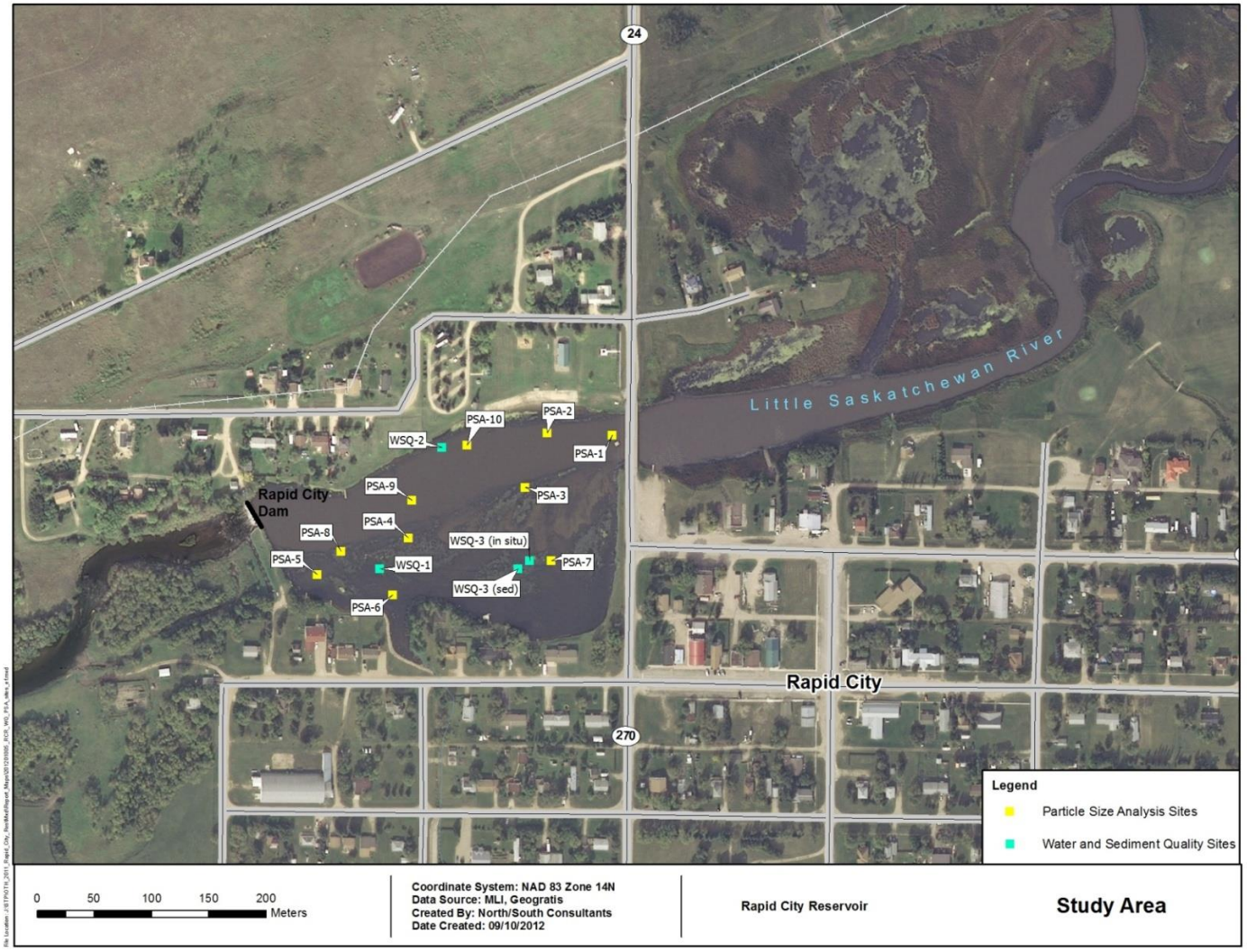

Figure A1-1. Location of sites sampled for water and sediment quality (WSQ) and particle size analysis (PSA) in the Rapid City Reservoir, July 24 and 25, 2012.

Table A1-3. Routine sediment quality variables measured in sediment cores collected from the Rapid City Reservoir on July 24 and 25 2012 by North/South Consultants Inc. Values highlighted exceed the respective guidelines.

Site ID	ALS ID	Date Sampled	Moisture Analysis			Particle Size Analysis			Texture
			Moisture (%)	Dry (g)	Total (g)	% Sand (%)	% Silt (%)	% Clay (%)	
		Method Detection Limit	0.1	1	1	0.1	0.1	0.1	n/a
		Ontario LEL [2]	-	-	-	-	-	-	-
		Ontario SEL [3]	-	-	-	-	-	-	-
WSQ-1 - S	L1184946-1	24-Jun-12	30	884.5	1260	80.8	13.1	6.17	Loamy sand
WSQ-1 - M	L1184946-2	24-Jun-12	27.7	1823.6	2520	84.1	11.3	4.59	Loamy sand
WSQ-1 - B	L1184946-3	24-Jun-12	44.7	1106.9	2000	28.7	67.5	3.84	Silt loam
WSQ-2 - S	L1184946-4	24-Jun-12	45.4	690	1260	41.5	57.6	0.91	Silt loam
WSQ-2 - M*	L1184946-5	24-Jun-12	42.2	1025.9	1780	25.8	69.8	4.42	Silt loam
WSQ-3 - S	L1184946-8	25-Jun-12	36.6	771.6	1220	79.5	17.1	3.43	Loamy sand
WSQ-3 - M	L1184946-9	25-Jun-12	50.1	583.2	1170	30.5	61.9	7.59	Silt loam
WSQ-3 - B**	L1184946-11	25-Jun-12	58.9	336.2	818.5	6	90.75	3.225	Silt

Table A1-3 Continued.

Site ID	Alkalinity (%)	Total (%)	Inorganic (%)	Total Organic (%)	Total (mg/kg)	Nitrate/ (mg/kg)	Nitrate- (mg/kg)	Nitrite- (mg/kg)	Total Kjeldahl (%)
Detection Limit	0.8	0.1	0.1	0.1	50	2	2	0.4	0.02
Ontario LEL [2]	-	-	-	1	600	-	-	-	
Ontario SEL [3]	-	-	-	10	2000	-	-	-	
WSQ-1 - S	12.3	2.3	1.48	0.80	408	3.4	3.4	<0.40	0.081
WSQ-1 - M	11.4	1.8	1.36	0.48	351	<2.0	<2.0	<0.40	0.068
WSQ-1 - B	16.1	4.2	1.94	2.31	658	<2.0	<2.0	<0.40	0.234
WSQ-2 - S	14.4	4.3	1.73	2.54	624	<2.0	<2.0	<0.40	0.240
WSQ-2 - M*	16.7	4.4	2.01	2.39	585	<2.0	<2.0	<0.40	0.235
WSQ-3 - S	11.5	2.5	1.37	1.08	537	<2.0	<2.0	<0.40	<0.020
WSQ-3 - M	15.7	4.5	1.88	2.58	688	<4.0	<4.0	<0.80	0.241
WSQ-3 - B**	23.8	6.2	2.86	3.35	679	<4.0	<4.0	<0.80	0.351

[1] by combustion
[2] Ontario Lowest Effect Level (Persaud 1983)
[3] Ontario Severe Effect Level (Persaud 1983)
* mean of triplicates
** mean of homogenate duplicates

Table A1-4. Composition and texture of sediment samples collected using a Ponar from the Rapid City Reservoir. Samples collected by North/South Consultants Inc. on July 24 and 25, 2012.

Site ID	Lab ID	Date Sampled	Total Depth (m)	% Moisture (%)	Dry Weight (g)	Total Weight (g)	% Sand (2.0mm - 0.05mm) (%)	% Silt (0.05mm - 2um) (%)	% Clay (<2um) (%)	Texture
	Method Detection Limit				1	1	0.1	0.1	0.1	n/a
PSA-1	L1184946-12	25-Jun-12	2.3	57.4	882.3	2070	64.7	32.6	2.67	Sandy loam
PSA-2	L1184946-13	25-Jun-12	1.9	31.1	819.6	1190	71.8	25.7	2.52	Sandy loam
PSA-3	L1184946-14	25-Jun-12	1.1	56.0	623.8	1420	34.9	59.7	5.45	Silt loam
PSA-4	L1184946-15	25-Jun-12	1.1	48.8	779.4	1520	42.6	53.4	3.97	Silt loam
PSA-5	L1184946-16	25-Jun-12	0.8	34.4	726.0	1110	81	15.7	3.27	Loamy sand
PSA-6	L1184946-17	25-Jun-12	0.9	66.8	546.7	1650	6.55	67.5	26	Silt loam
PSA-7	L1184946-18	25-Jun-12	0.3	29.2	760.0	1070	89.3	7.46	3.21	Sand
PSA-8	L1184946-19	25-Jun-12	1.2	46.6	449.0	841	39	54.5	6.48	Silt loam
PSA-9	L1184946-20	25-Jun-12	1.6	44.0	1104.7	1970	73.7	23.1	3.19	Sandy loam / Loamy sand
PSA-10	L1184946-21	25-Jun-12	1.7	44.8	870.5	1580	63.8	33.2	3.01	Sandy loam

Table A1-5. Total metal concentrations measured in sediment cores collected from the Rapid City Reservoir in July 2012. Values highlighted exceed the respective guidelines.

Site ID	ALS ID	Date Sampled	Aluminum (mg/kg)	Antimony (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Beryllium (mg/kg)	Bismuth (mg/kg)	Boron (mg/kg)	Cadmium (mg/kg)	Calcium (mg/kg)
		Method Detection Limit	5	0.1	0.1	0.5	0.1	0.02	10	0.02	100
		ISQG [1]	-	-	5.90	-	-	-	-	0.600	-
		PEL [2]	-	-	17	-	-	-	-	3.5	-
WSQ-1 - S	L1184946-1	24-Jun-12	4160	<0.10	2.22	64.1	0.25	0.051	<10	0.136	40100
WSQ-1 - M	L1184946-2	24-Jun-12	5170	0.11	3.66	65.5	0.33	0.114	10	0.120	49000
WSQ-1 - B	L1184946-3	24-Jun-12	9340	0.18	5.20	133	0.49	0.126	21	0.348	67000
WSQ-2 - S	L1184946-4	24-Jun-12	8340	0.17	4.16	96.9	0.38	0.128	19	0.321	50800
WSQ-2 - M*	L1184946-5	24-Jun-12	8653	0.18	4.92	105	0.43	0.119	20	0.342	64567
WSQ-3 - S	L1184946-8	25-Jun-12	5370	<0.10	2.64	72.6	0.30	0.059	11	0.174	43400
WSQ-3 - M	L1184946-9	25-Jun-12	10200	0.22	6.24	140	0.49	0.138	24	0.393	63600
WSQ-3 - B**	L1184946-10	25-Jun-12	11900	0.23	7.32	171	0.68	0.176	26	0.497	94100

Table A1-5. Continued.

Site ID	Cesium (mg/kg)	Chromium (mg/kg)	Cobalt (mg/kg)	Copper (mg/kg)	Iron (mg/kg)	Lead (mg/kg)	Magnesium (mg/kg)	Manganese (mg/kg)	Mercury (mg/kg)	Molybdenum (mg/kg)	Nickel (mg/kg)
Detection Limit	0.02	1	0.02	1	25	0.2	10	0.5	0.05	0.02	0.5
ISQG [1]	-	37.3	-	35.7	-	35.0	-	460 [3]	0.170	-	16 [3]
PEL [2]	-	90	-	197	-	91.3	-	1100 [4]	0.486	-	75 [4]
WSQ-1 – S	0.424	8.9	3.54	4.6	7830	3.28	8420	574	<0.050	0.184	6.67
WSQ-1 – M	0.559	10.6	4.43	4.5	9920	3.88	7660	572	<0.050	0.201	7.43
WSQ-1 – B	0.612	17.9	7.04	13.0	16300	7.64	14100	1280	0.058	0.534	14.8
WSQ-2 – S	0.542	16.4	6.33	12.1	13500	8.40	14200	887	0.065	0.458	13.9
WSQ-2 - M*	0.601	16.9	6.78	13.1	13867	8.48	14567	909	0.070	0.673	14.5
WSQ-3 – S	0.496	10.9	4.26	5.8	9420	4.19	8270	568	<0.050	0.288	8.35
WSQ-3 – M	0.667	19.7	7.74	14.8	17500	9.37	14000	1360	0.058	0.672	16.9
WSQ-3 - B**	0.613	21.9	8.34	20.5	19600	16.6	12700	2340	0.077	1.13	20.7

Table A1-5. Continued.

Site ID	Phosphorus (mg/kg)	Potassium (mg/kg)	Rubidium (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)	Sodium (mg/kg)	Strontium (mg/kg)	Sulfur (mg/kg)	Tellurium (mg/kg)	Thallium (mg/kg)	Tin (mg/kg)	Titanium (mg/kg)
Detection Limit	100	25	0.02	0.5	0.1	10	0.1	5	0.1	0.1	5	0.5
ISQG [1]	-	-	-	-	-	-	-	-	-	-	-	-
PEL [2]												
WSQ-1 - S	450	846	7.83	<0.50	<0.10	140	52.4	2340	<0.10	<0.10	<5.0	126
WSQ-1 - M	360	1220	9.71	<0.50	<0.10	202	58.2	2920	<0.10	<0.10	<5.0	85.8
WSQ-1 - B	740	1880	16.5	0.71	<0.10	240	107	1260	<0.10	0.20	<5.0	124
WSQ-2 - S	690	1630	15.0	0.67	0.10	223	72.7	424	<0.10	0.20	<5.0	123
WSQ-2 - M*	690	1703	15.7	0.56	0.12	247	99.3	3087	<0.10	0.21	<5.0	147
WSQ-3 - S	540	1170	10.2	0.55	<0.10	201	65.8	2970	<0.10	0.12	<5.0	117
WSQ-3 - M	800	2090	18.0	0.85	<0.10	314	100	1760	<0.10	0.23	<5.0	129
WSQ-3 - B**	780	2420	19.8	1.03	0.18	347	181	6060	<0.10	0.27	<5.0	94.4

Table A1-5. Continued.

Site ID	Tungsten (mg/kg)	Uranium (mg/kg)	Vanadium (mg/kg)	Zinc (mg/kg)	Zirconium (mg/kg)
Detection Limit	0.05	0.02	0.5	10	0.1
ISQG [1]	-	-	-	123.0	-
PEL [2]				315.0	
WSQ-1 – S	<0.050	0.883	22.1	24	2.21
WSQ-1 – M	<0.050	0.712	31.9	27	3.71
WSQ-1 – B	<0.050	1.51	46.2	56	4.14
WSQ-2 – S	<0.050	1.37	40.0	50	3.95
WSQ-2 - M*	<0.050	1.60	42.6	53	4.41
WSQ-3 – S	<0.050	1.07	30.3	30	2.68
WSQ-3 – M	<0.050	1.78	50.2	60	3.32
WSQ-3 - B**	<0.050	2.03	56.3	80	3.93

[1] Manitoba Interim Sediment Quality Guideline (MWS 2011).
[2] Manitoba Probably Effects Level (MWS 2011).
[3] Ontario Lowest Effect Level (Persaud 1993).
[4] Ontario Severe Effect Level (Persaud 1993).
* mean of triplicates.
** mean of homogenate duplicates.

Table A1-6. Hydrocarbon concentrations measured in sediment cores collected from the Rapid City Reservoir in July 2012. Values highlighted exceed the respective guidelines.

Site ID	ALS ID	Date Sampled	BTEX						
			Benzene	Toluene	Ethyl benzene	o-Xylene	m+p-Xylenes	Xylenes	4-Bromofluorobenzene (Surrogate)
			(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(%)
		Method Detection Limit	0.005	0.05	0.015	0.05	0.05	0.1	0.0005
		ISQG [1]	-	-	-	-	-	-	-
		PEL [2]	-	-	-	-	-	-	-
WSQ-1 – S	L1184946-1	24-Jun-12	<0.0050	<0.050	<0.015	<0.050	<0.050	<0.10	105.5
WSQ-1 - M	L1184946-2	24-Jun-12	<0.0050	<0.050	<0.015	<0.050	<0.050	<0.10	94.5
WSQ-1 - B	L1184946-3	24-Jun-12	<0.0050	<0.050	<0.015	<0.050	<0.050	<0.10	93
WSQ-2 - S	L1184946-4	24-Jun-12	<0.0050	<0.050	<0.015	<0.050	<0.050	<0.10	82.5
WSQ-2 - M*	L1184946-5	24-Jun-12	<0.0050	<0.050	<0.015	<0.050	<0.050	<0.10	95.5
WSQ-3 - S	L1184946-8	25-Jun-12	<0.0050	<0.050	<0.015	<0.050	<0.050	<0.10	91.5
WSQ-3 - M	L1184946-9	25-Jun-12	<0.0050	<0.050	<0.015	<0.050	<0.050	<0.10	82
WSQ-3 - B**	L1184946-10	25-Jun-12	<0.0050	<0.050	<0.015	<0.050	<0.050	<0.10	92.0

Table A1-6. Continued.

Site ID	F1 (C6-C10) (mg/kg)	F1-BTEX (mg/kg)	F2 (C10-C16) (mg/kg)	F2-Naphth (mg/kg)	F3 (C16-C34) (mg/kg)	F3-PAH (mg/kg)	F4 (C34-C50) (mg/kg)	Total Hydrocarbons (C6-C50) (mg/kg)	1-Methyl Naphthalene (mg/kg)	2-Methyl Napht (mg/kg
Detection	10	10	10	10	50	50	50	50	0.01	0.01
ISQG [1]	-	-	-	-	-	-	-	-	-	0.0202
PEL [2]	-	-	-	-	-	-	-	-	-	0.201
WSQ-1 - S	<10	<10	<10	<10	<50	<50	<50	<50	<0.010	<0.010
WSQ-1 - M	<10	<10	<10	<10	<50	<50	<50	<50	<0.010	<0.010
WSQ-1 - B	<10	<10	<10	<10	<50	<50	<50	<50	<0.010	<0.010
WSQ-2 - S	<10	<10	<10	<10	<50	<50	<50	<50	<0.010	<0.010
WSQ-2 - M*	<10	<10	<10	<10	<50	<50	<50	<50	<0.010	<0.010
WSQ-3 - S	<10	<10	<60	<60	<300	<300	<300	<300	<0.010	<0.010
WSQ-3 - M	<10	<10	<10	<10	<50	<50	<50	<50	<0.010	<0.010
WSQ-3 - B**	<10	<10	<20	<20	<100	<100	<100	<100	<0.010	<0.010

Table A1-6. Continued.

Site ID	Acenaphthene (mg/kg)	Acenaphthylene (mg/kg)	Acridine (mg/kg)	Anthracene (mg/kg)	Benzo(a)-anthracene (mg/kg)	Benzo(b&j)-fluoranthene (mg/kg)	Benzo(b)-fluoranthene (mg/kg)	Benzo(b+j+k)-fluoranthene (mg/kg)	Benzo(k)-fluoranthene (mg/kg)
Detection Limit	0.005	0.005	0.01	0.004	0.01	0.01	0.01	0.014	0.01
ISQG [1]	0.00671	0.00587	-	0.0469	0.0317	-	0.0319	-	0.240 [3]
PEL [2]	0.0889	0.128	-	0.245	0.385	-	0.782	-	1.340 [4]
WSQ-1 – S	<0.0050	<0.0050	<0.010	<0.0040	<0.010	<0.010	<0.010	<0.014	<0.010
WSQ-1 – M	<0.0050	<0.0050	<0.010	<0.0040	<0.010	<0.010	<0.010	<0.014	<0.010
WSQ-1 – B	<0.0050	<0.0050	<0.010	<0.0040	<0.010	<0.010	<0.010	<0.014	<0.010
WSQ-2 – S	<0.0050	<0.0050	<0.010	<0.0040	<0.010	<0.010	<0.010	<0.014	<0.010
WSQ-2 - M*	<0.0050	<0.0050	<0.010	<0.0040	<0.010	<0.010	<0.010	<0.014	<0.010
WSQ-3 – S	<0.0050	<0.0050	<0.010	<0.0040	<0.010	<0.010	<0.010	<0.014	<0.010
WSQ-3 – M	<0.0050	<0.0050	<0.010	<0.0040	<0.010	<0.010	<0.010	<0.014	<0.010
WSQ-3 - B**	<0.0050	<0.0050	<0.010	<0.0040	<0.010	<0.010	<0.010	<0.014	<0.010

Table A1-6. Continued.

Site ID	Benzo(g,h,i)-perylene (mg/kg)	Benzo(a)-pyrene (mg/kg)	Chrysene (mg/kg)	Dibenzo(a,h)-anthracene (mg/kg)	Fluoranthene (mg/kg)	Fluorene (mg/kg)	Indeno(1,2,3-cd)-pyrene (mg/kg)	Naphthalene (mg/kg)	Phenanthrene (mg/kg)
Detection	0.01	0.01	0.01	0.005	0.01	0.01	0.01	0.01	0.01
ISQG [1]	0.170 [3]	0.0319	0.0571	0.00622	0.111	0.0212	0.200 [3]	0.0346	0.0419
PEL [2]	0.320 [4]	0.782	0.862	0.135	2.355	0.144	0.320 [4]	0.391	0.515
WSQ-1 -	<0.010	<0.010	<0.010	<0.0050	<0.010	<0.010	<0.010	0.012	<0.010
WSQ-1 -	<0.010	<0.010	<0.010	<0.0050	<0.010	<0.010	<0.010	<0.010	<0.010
WSQ-1 -	<0.010	<0.010	<0.010	<0.0050	<0.010	<0.010	<0.010	0.014	<0.010
WSQ-2 -	<0.010	<0.010	<0.010	<0.0050	<0.010	<0.010	<0.010	0.013	<0.010
WSQ-2 -	<0.010	<0.010	<0.010	<0.0050	<0.010	<0.010	<0.010	0.012	<0.010
WSQ-3 -	<0.010	<0.010	<0.010	<0.0050	<0.010	<0.010	<0.010	0.013	<0.010
WSQ-3 -	<0.010	<0.010	<0.010	<0.0050	<0.010	<0.010	<0.010	0.016	<0.010
WSQ-3 -	<0.010	<0.010	<0.010	<0.0050	<0.010	<0.010	<0.010	0.013	<0.010

Table A1-6. Continued.

Site ID	Pyrene	Quinoline	Acenaphthene d10	Chrysene d12	Naphthalene d8	Phenanthrene d10	B(a)P Total Potency	Index of Additive Cancer Risk
	(mg/kg)	(mg/kg)	(%)	(%)	(%)	(%)	(mg/kg)	(mg/kg)
Detection Limit	0.01	0.01	1	1	1	1	0.02	0.15
ISQG [1]	0.0530	-	-	-	-	-	-	-
PEL [2]	0.875	-	-	-	-	-	-	-
WSQ-1 – S	<0.010	<0.010	92.2	109.9	79.8	87.1	<0.020	<0.15
WSQ-1 – M	<0.010	<0.010	88.2	108.1	79.1	82.7	<0.020	<0.15
WSQ-1 – B	<0.010	<0.010	97.5	116.3	87.1	92.8	<0.020	<0.15
WSQ-2 – S	<0.010	<0.010	85.2	93.3	79.4	82.3	<0.020	<0.15
WSQ-2 - M*	<0.010	<0.010	91.3	100.9	80.5	87.8	<0.020	<0.15
WSQ-3 – S	<0.010	<0.010	91.1	90.7	79.1	85.9	<0.020	<0.15
WSQ-3 – M	<0.010	<0.010	91.8	98.3	78.7	86.2	<0.020	<0.15
WSQ-3 - B**	<0.010	<0.010	99.9	95.0	88.5	101.7	<0.020	<0.15

Table A1-7. Pesticide concentrations measured in sediment cores collected from the Rapid City Reservoir in July 24 and 25 2012.

			Organochlorine Pesticides							
Site ID	ALS ID	Date Sampled	Aldrin (mg/kg)	alpha-BHC (mg/kg)	beta-BHC (mg/kg)	delta-BHC (mg/kg)	a-chlordane (mg/kg)	g-chlordane (mg/kg)	op-DDD (mg/kg)	pp-DDD (mg/kg)
		Method Detection Limit	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
		ISQG [1]	0.002 [3]	0.006 [3]	0.005 [3]		0.0045 [5]		0.00354 [6]	
		PEL [2]	8 [4]	10 [4]	21 [4]		0.0087 [5]		0.00851 [6]	
WSQ-1 – S	L1184946-1	24-Jun-12	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
WSQ-1 – M	L1184946-2	24-Jun-12	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
WSQ-1 – B	L1184946-3	24-Jun-12	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
WSQ-2 – S	L1184946-4	24-Jun-12	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
WSQ-2 - M*	L1184946-5	24-Jun-12	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
WSQ-3 – S	L1184946-8	25-Jun-12	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
WSQ-3 – M	L1184946-9	25-Jun-12	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
WSQ-3 - B**	L1184946-10	25-Jun-12	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30

Table A1-7. Continued.

Site ID	Organochlorine Pesticides										
	o,p-DDE (mg/kg)	pp-DDE (mg/kg)	op-DDT (mg/kg)	pp-DDT (mg/kg)	Dieldrin (mg/kg)	alpha-Endosulfan (mg/kg)	beta-Endosulfan (mg/kg)	Endosulfan Sulfate (mg/kg)	Endrin (mg/kg)	Endrin Aldehyde (mg/kg)	Heptachlor (mg/kg)
Detection Limit	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
ISQG [1]	0.00142 [6]		0.0019 [6]		0.00285				0.00267		0.00060
PEL [2]	0.00675 [6]		0.00477 [6]		0.00667				0.0624		0.00274
WSQ-1 - S	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
WSQ-1 - M	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
WSQ-1 - B	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
WSQ-2 - S	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
WSQ-2 - M*	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
WSQ-3 - S	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
WSQ-3 - M	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
WSQ-3 - B**	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30

Table A1-7. Continued.

Site ID	Organochlorine Pesticides										
	Heptachlor Epoxide (mg/kg)	Hexachloro-benzene (mg/kg)	Lindane (mg/kg)	Methoxychlor (mg/kg)	Mirex (mg/kg)	Oxychlordane (mg/kg)	2-Fluoro-biphenyl (%)	d14-Terphenyl (%)	Alachlor (mg/kg)	Ametryn (mg/kg)	Atrazine (mg/kg)
Detection Limit	0.2	0.1	0.2	0.2	0.2	0.2	Surrogate	Surrogate	0.05	0.05	0.05
ISQG [1]	0.005 [3]	0.02 [3]	0.00094		0.007 [3]						
PEL [2]	5 [4]	24 [4]	0.00138		130 [4]						
WSQ-1 - S	<0.20	<0.10	<0.20	<0.20	<0.20	<0.20	102	99.6	<0.050	<0.050	<0.050
WSQ-1 - M	<0.20	<0.10	<0.20	<0.20	<0.20	<0.20	94.1	85.8	<0.050	<0.050	<0.050
WSQ-1 - B	<0.20	<0.10	<0.20	<0.20	<0.20	<0.20	96.3	89.9	<0.15	<0.050	<0.050
WSQ-2 - S	<0.20	<0.10	<0.20	<0.20	<0.20	<0.20	94.1	87	<0.050	<0.050	<0.050
WSQ-2 - M*	<0.20	<0.10	<0.20	<0.20	<0.20	<0.20	95.9	96	<0.060	<0.050	<0.050
WSQ-3 – S	<0.20	<0.10	<0.20	<0.20	<0.20	<0.20	97.7	92.5	<0.050	<0.050	<0.050
WSQ-3 – M	<0.20	<0.10	<0.20	<0.20	<0.20	<0.20	95	89.4	<0.065	<0.050	<0.050
WSQ-3 - B**	<0.30	<0.15	<0.30	<0.30	<0.30	<0.30	95.2	99.9	<0.090	<0.075	<0.075

Table A1-7. Continued.

Site ID	Azinphos-methyl (mg/kg)	Bendiocarb (mg/kg)	Benzo(a) pyrene (mg/kg)	Carbaryl (mg/kg)	Carbofuran (mg/kg)	Chlorpyrifos (mg/kg)	Cyanazine (mg/kg)	Diazinon (mg/kg)	Dimethoate (mg/kg)	Atrazine Desethyl (mg/kg)	Parathion (mg/kg)
Detection Limit	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
ISQG [1]											
PEL [2]											
WSQ-1 - S	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
WSQ-1 - M	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
WSQ-1 - B	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
WSQ-2 - S	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
WSQ-2 - M*	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
WSQ-3 - S	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
WSQ-3 - M	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
WSQ-3 - B**	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075

Table A1-7. Continued.

Site ID	Malathion (mg/kg)	Diclofop-methyl (mg/kg)	Methyl Parathion (mg/kg)	Metolachlor (mg/kg)	Metribuzin (mg/kg)	Phorate (mg/kg)	Prometon (mg/kg)	Prometryne (mg/kg)	Propazine (mg/kg)	Simazine (mg/kg)	Temephos (mg/kg)
Detection Limit	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.075
ISQG [1]											
PEL [2]											
WSQ-1 - S	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.10
WSQ-1 - M	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.10
WSQ-1 - B	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.10
WSQ-2 - S	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.10
WSQ-2 - M*	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.10
WSQ-3 - S	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.10
WSQ-3 - M	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.10
WSQ-3 - B**	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075	<0.10

Table A1-7. Continued.

Site ID	Terbufos (mg/kg)	Terbutryn (mg/kg)	Triallate (mg/kg)	Trifluralin (mg/kg)	2-Fluorobiphenyl (%)	d14-Terphenyl (%)
Detection Limit	0.05	0.05	0.05	0.05	Surrogate	Surrogate
ISQG [1]						
PEL [2]						
WSQ-1 - S	<0.050	<0.050	<0.050	<0.050	107.7	115.7
WSQ-1 - M	<0.050	<0.050	<0.050	<0.050	97.2	100.2
WSQ-1 - B	<0.050	<0.050	<0.050	<0.050	100.4	107.6
WSQ-2 - S	<0.050	<0.050	<0.050	<0.050	100.5	108.2
WSQ-2 - M*	<0.050	<0.050	<0.050	<0.050	101	102
WSQ-3 - S	<0.050	<0.050	<0.050	<0.050	99.8	104.5
WSQ-3 - M	<0.050	<0.050	<0.050	<0.050	107.1	95.7
WSQ-3 - B**	<0.075	<0.075	<0.075	<0.075	105	97.5

[1] Manitoba Interim Sediment Quality Guideline (MWS 2011).
[2] Manitoba Probably Effects Level (MWS 2011).
[3] Ontario Lowest Effect Level (Persaud 1993).
[4] Ontario Severe Effect Level (Persaud 1993).
[5] Manitoba sediment guidelines are provided for chlordane
[6] Guidelines for DDD, DDE, and DDT are a sum of the respective o,p- and p,p-compounds.
* mean of triplicates.
** mean of homogenate duplicates.

Table A1-8. Routine sediment quality variables measured in QA/QC sediment samples collected from the Rapid City Reservoir, July 2012. Percent relative standard deviations (PRSD) and relative percent mean difference (RPMD) were calculated for triplicate and duplicate samples, respectively; values greater than 18 and 25%, respectively, are indicated in red.

Site ID	ALS ID	Date Sampled	Moisture Analysis			Particle Size Analysis			Texture
			Moisture (%)	Dry (g)	Total (g)	% Sand (%)	% Silt (%)	% Clay (%)	
		Method Detection Limit	0.1	1	1	0.1	0.1	0.1	n/a
Triplicate									
2 - M1	L1184946-5	24-Jun-12	41.7	989.9	1700	23.9	73.6	2.51	Silt loam
2 - M2	L1184946-6	24-Jun-12	41.8	935.5	1610	27.2	68.5	4.30	Silt loam
2 - M3	L1184946-7	24-Jun-12	43.1	1152.3	2030	26.2	67.4	6.44	Silt loam
		Mean	**42.2**	**1025.9**	**1780**	**25.8**	**69.8**	**4.42**	**Silt loam**
		SD	**0.78**	**112.79**	**221.1**	**1.69**	**3.31**	**1.968**	**-**
		PRSD	**2**	**11**	**12**	**7**	**5**	**45**	**-**
Homogenate Duplicate									
3 - B1	L1184946-10	25-Jun-12	58.9	366.7	893	5.79	92.3	1.90	Silt
3 - B2	L1184946-11	25-Jun-12	58.9	305.7	744	6.21	89.2	4.55	Silt
		Mean	**58.9**	**336.2**	**818.5**	**6**	**90.75**	**3.225**	**Silt**
		RPMD	**0**	**18**	**18**	**7**	**3**	**82**	

Table A1-8. Continued.

Site ID	Alkalinity (%)	Total (%)	Inorganic (%)	Total Organic (%)	Total (mg/kg)	Nitrate/ (mg/kg)	Nitrate- (mg/kg)	Nitrite- (mg/kg)	Total Kjeldahl (%)
Detection Limit	0.8	0.1	0.1	0.1	50	2	2	0.4	0.02
Triplicate									
2 - M1	17.3	4.2	2.08	2.17	578	<2.0	<2.0	<0.40	0.226
2 - M2	16.7	4.3	2.01	2.28	590	<2.0	<2.0	<0.40	0.227
2 - M3	16.2	4.7	1.94	2.71	588	<4.0	<4.0	<0.80	0.251
Mean	**16.7**	**4.4**	**2.01**	**2.39**	**585**	<2.0	<2.0	<0.40	**0.235**
SD	**0.55**	**0.26**	**0.07**	**0.285**	**6.4**	**-**	**-**	**-**	**0.014**
PRSD	**3**	**6**	**3**	**12**	**1**	**-**	**-**	**-**	**6**
Homogenate Duplicate									
3 - B1	23.8	6.1	2.85	3.27	674	<4.0	<4.0	<0.80	0.352
3 - B2	23.8	6.3	2.86	3.42	683	<4.0	<4.0	<0.80	0.349
Mean	**23.8**	**6.2**	**2.86**	**3.35**	**679**	**<4.0**	**<4.0**	**<0.80**	**0.351**
RPMD	**0**	**3**	**0**	**4**	**1**	**-**	**-**	**-**	**1**

Table A1-9. Total metal concentrations measured in QA/QC sediment samples collected from the Rapid City Reservoir, July 2012. Percent relative standard deviations (PRSD) and relative percent mean difference (RPMD) were calculated for triplicate and duplicate samples, respectively; values greater than 18 and 25%, respectively, are indicated in red.

Site ID	ALS ID	Date Sampled	Aluminum (mg/kg)	Antimony (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Beryllium (mg/kg)	Bismuth (mg/kg)	Boron (mg/kg)	Cadmium (mg/kg)	Calcium (mg/kg)	Cesium (mg/kg)
		Method Detection Limit	5	0.1	0.1	0.5	0.1	0.02	10	0.02	100	0.02
Triplicate												
2 - M1	L1184946-5	24-Jun-12	9120	0.17	4.66	108	0.41	0.120	23	0.338	63700	0.661
2 - M2	L1184946-6	24-Jun-12	8630	0.18	4.95	104	0.45	0.113	20	0.330	64000	0.586
2 - M3	L1184946-7	24-Jun-12	8210	0.20	5.15	102	0.42	0.125	18	0.357	66000	0.555
		Mean	**8653**	**0.18**	**4.92**	**105**	**0.43**	**0.119**	**20**	**0.342**	**64567**	**0.601**
		SD	**455.4**	**-**	**0.246**	**3.1**	**-**	**0.006**	**-**	**0.0139**	**1250.3**	**0.0545**
		PRSD	**5**	**-**	**5**	**3**	**-**	**5**	**-**	**4**	**2**	**9**
Homogenate Duplicate												
3 - B1	L1184946-10	25-Jun-12	11900	0.24	7.42	174	0.62	0.180	26	0.500	95300	0.606
3 - B2	L1184946-11	25-Jun-12	11900	0.22	7.22	168	0.74	0.172	26	0.494	92900	0.619
		Mean	**11900**	**0.23**	**7.32**	**171**	**0.68**	**0.176**	**26**	**0.497**	**94100**	**0.613**
		RPMD	**0**	**-**	**3**	**4**	**18**	**5**	**-**	**1**	**3**	**2**

Table A1-9. Continued.

Site ID	Chromium (mg/kg)	Cobalt (mg/kg)	Copper (mg/kg)	Iron (mg/kg)	Lead (mg/kg)	Magnesium (mg/kg)	Manganese (mg/kg)	Mercury (mg/kg)	Molybdenum (mg/kg)	Nickel (mg/kg)	Phosphorus (mg/kg)	Potassium (mg/kg)
Detection Limit	1	0.02	1	25	0.2	10	0.5	0.05	0.02	0.5	100	25
Triplicate												
2 - M1	17.5	6.57	12.7	13900	8.09	14900	879	0.054	0.613	14.0	690	1790
2 - M2	16.8	6.79	12.7	13700	8.16	14500	900	0.073	0.618	14.6	680	1690
2 - M3	16.4	6.99	13.8	14000	9.19	14300	948	0.083	0.788	14.8	700	1630
Mean	**16.9**	**6.78**	**13.1**	**13867**	**8.48**	**14567**	**909**	**0.070**	**0.673**	**14.5**	**690**	**1703**
SD	**0.56**	**0.210**	**0.64**	**152.8**	**0.616**	**305.5**	**35.4**	**-**	**0.0996**	**0.42**	**10.0**	**80.8**
PRSD	**3**	**3**	**5**	**1**	**7**	**2**	**4**	**-**	**15**	**3**	**1**	**5**
Homogenate Duplicate												
3 - B1	22.1	8.50	20.8	20000	16.8	12900	2360	0.073	1.16	21.9	790	2430
3 - B2	21.7	8.18	20.1	19200	16.4	12500	2320	0.081	1.09	19.5	770	2410
Mean	**21.9**	**8.34**	**20.5**	**19600**	**16.6**	**12700**	**2340**	**0.077**	**1.13**	**20.7**	**780**	**2420**
RPMD	**2**	**4**	**3**	**4**	**2**	**3**	**2**	**-**	**6**	**12**	**3**	**1**

Table A1-9. Continued.

Site ID	Rubidium (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)	Sodium (mg/kg)	Strontium (mg/kg)	Sulfur (mg/kg)	Tellurium (mg/kg)	Thallium (mg/kg)	Tin (mg/kg)	Titanium (mg/kg)	Tungsten (mg/kg)	Uranium (mg/kg)	Vanadium (mg/kg)
Detection Limit	0.02	0.5	0.1	10	0.1	5	0.1	0.1	5	0.5	0.05	0.02	0.5
Triplicate													
2 - M1	16.4	<0.50	0.12	250	98.9	2770	<0.10	0.21	<5.0	170	<0.050	1.57	45.0
2 - M2	15.4	0.53	0.12	247	99.0	2780	<0.10	0.20	<5.0	142	<0.050	1.53	42.5
2 - M3	15.2	0.89	0.13	244	100	3710	<0.10	0.21	<5.0	130	<0.050	1.70	40.3
Mean	**15.7**	**0.56**	**0.12**	**247**	**99.3**	**3087**	**<0.10**	**0.21**	**<5.0**	**147**	**<0.050**	**1.60**	**42.6**
SD	**0.64**	**-**	**-**	**3.0**	**0.61**	**539.8**	**-**	**-**	**-**	**20.5**	**-**	**0.089**	**2.35**
PRSD	**4**	**-**	**-**	**1**	**1**	**17**	**-**	**-**	**-**	**14**	**-**	**6**	**6**
Homogenate Duplicate													
3 - B1	19.8	1.23	0.17	345	184	6260	<0.10	0.27	<5.0	95.1	<0.050	2.07	56.3
3 - B2	19.7	0.82	0.18	348	178	5860	<0.10	0.27	<5.0	93.6	<0.050	1.99	56.3
Mean	**19.8**	**1.03**	**0.18**	**347**	**181**	**6060**	**<0.10**	**0.27**	**<5.0**	**94.4**	**<0.050**	**2.03**	**56.3**
RPMD	**1**	**-**	**-**	**1**	**3**	**7**	**-**	**-**	**-**	**2**	**-**	**4**	**0**

Table A1-9. Continued.

Site ID	Zinc (mg/kg)	Zirconium (mg/kg)
Detection Limit	10	0.1
Triplicate		
2 - M1	52	4.74
2 - M2	52	3.99
2 - M3	55	4.50
Mean	**53**	**4.41**
SD	**1.7**	**0.383**
PRSD	**3**	**9**
Homogenate Duplicate		
3 - B1	83	3.91
3 - B2	77	3.95
Mean	**80**	**3.93**
RPMD	**8**	**1**

Table A1-10. Hydrocarbon concentrations measured in QA/QC sediment samples collected from the Rapid City Reservoir, July 2012. Percent relative standard deviations (PRSD) and relative percent mean difference (RPMD) were calculated for triplicate and duplicate samples, respectively; values greater than 18 and 25%, respectively, are indicated in red.

Site ID	ALS ID	Date Sampled	Benzene (mg/kg)	Toluene (mg/kg)	Ethyl (mg/kg)	o- (mg/kg)	m+p- (mg/kg)	Xylenes (mg/kg)	4- (%)
		Method Detection Limit	0.005	0.05	0.015	0.05	0.05	0.1	0.0005
Triplicate									
2 - M1	L1184946-5	24-Jun-12	<0.0050	<0.050	<0.015	<0.050	<0.050	<0.10	97.0
2 - M2	L1184946-6	24-Jun-12	<0.0050	<0.050	<0.015	<0.050	<0.050	<0.10	96.5
2 - M3	L1184946-7	24-Jun-12	<0.0050	<0.050	<0.015	<0.050	<0.050	<0.10	93.0
		Mean	**<0.0050**	**<0.050**	**<0.015**	**<0.050**	**<0.050**	**<0.10**	**95.5**
		SD	**-**	**-**	**-**	**-**	**-**	**-**	**2.18**
		PRSD	**-**	**-**	**-**	**-**	**-**	**-**	**2**
Homogenate Duplicate									
3 - B1	L1184946-10	25-Jun-12	<0.0050	<0.050	<0.015	<0.050	<0.050	<0.10	87.5
3 - B2	L1184946-11	25-Jun-12	<0.0050	<0.050	<0.015	<0.050	<0.050	<0.10	96.5
		Mean	**<0.0050**	**<0.050**	**<0.015**	**<0.050**	**<0.050**	**<0.10**	**92.0**
		RPMD	-	-	-	-	-	-	**10**

Table A1-10. Continued.

Site ID	F1 (mg/kg)	F1- (mg/kg)	F2 (mg/kg)	F2- (mg/kg)	F3 (mg/kg)	F3- (mg/kg)	F4 (mg/kg)	Total (mg/kg)	1-Methyl (mg/kg)	2-Methyl (mg/kg)
Detection Limit	10	10	10	10	50	50	50	50	0.01	0.01
Triplicate										
2 - M1	<10	<10	<10	<10	<50	<50	<50	<50	<0.010	<0.010
2 - M2	<10	<10	<10	<10	<50	<50	<50	<50	<0.010	<0.010
2 - M3	<10	<10	<10	<10	<50	<50	<50	<50	<0.010	<0.010
Mean	**<10**	**<10**	**<10**	**<10**	**<50**	**<50**	**<50**	**<50**	**<0.010**	**<0.010**
SD	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
PRSD	-	-	-	-	-	-	-	-	-	-
Homogenate Duplicate										
3 - B1	<10	<10	<20	<20	<100	<100	<100	<100	<0.010	<0.010
3 - B2	<10	<10	<20	<20	<100	<100	<100	<100	<0.010	<0.010
Mean	**<10**	**<10**	**<20**	**<20**	**<100**	**<100**	**<100**	**<100**	**<0.010**	**<0.010**
RPMD	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

Table A1-10. Continued.

Site ID	Acenaphthene (mg/kg)	Acenaphthylene (mg/kg)	Acridine (mg/kg)	Anthracene (mg/kg)	Benzo(a)- (mg/kg)	Benzo(b&j)- (mg/kg)	Benzo(b)- (mg/kg)	Benzo(b+j+k)- (mg/kg)	Benzo(k)- (mg/kg)	Benzo(g,h,i)- (mg/kg)
Detection Limit	0.005	0.005	0.01	0.004	0.01	0.01	0.01	0.014	0.01	0.01
Triplicate										
2 - M1	<0.0050	<0.0050	<0.010	<0.0040	<0.010	<0.010	<0.010	<0.014	<0.010	<0.010
2 - M2	<0.0050	<0.0050	<0.010	<0.0040	<0.010	<0.010	<0.010	<0.014	<0.010	<0.010
2 - M3	<0.0050	<0.0050	<0.010	<0.0040	<0.010	<0.010	<0.010	<0.014	<0.010	<0.010
Mean	**<0.0050**	**<0.0050**	**<0.010**	**<0.0040**	**<0.010**	**<0.010**	**<0.010**	**<0.014**	**<0.010**	**<0.010**
SD	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
PRSD	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Homogenate Duplicate										
3 - B1	<0.0050	<0.0050	<0.010	<0.0040	<0.010	<0.010	<0.010	<0.014	<0.010	<0.010
3 - B2	<0.0050	<0.0050	<0.010	<0.0040	<0.010	<0.010	<0.010	<0.014	<0.010	<0.010
Mean	**<0.0050**	**<0.0050**	**<0.010**	**<0.0040**	**<0.010**	**<0.010**	**<0.010**	**<0.014**	**<0.010**	**<0.010**
RPMD	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

Table A1-10. Continued.

Site ID	Benzo(a)- (mg/kg)	Chrysene (mg/kg)	Dibenzo(a,h)- (mg/kg)	Fluoranthene (mg/kg)	Fluorene (mg/kg)	Indeno(1,2,3-cd)- (mg/kg)	Naphthalene (mg/kg)	Phenanthrene (mg/kg)	Pyrene (mg/kg)
Detection Limit	0.01	0.01	0.005	0.01	0.01	0.01	0.01	0.01	0.01
Triplicate									
2 - M1	<0.010	<0.010	<0.0050	<0.010	<0.010	<0.010	0.012	<0.010	<0.010
2 - M2	<0.010	<0.010	<0.0050	<0.010	<0.010	<0.010	0.014	<0.010	<0.010
2 - M3	<0.010	<0.010	<0.0050	<0.010	<0.010	<0.010	0.011	<0.010	<0.010
Mean	**<0.010**	**<0.010**	**<0.0050**	**<0.010**	**<0.010**	**<0.010**	**0.012**	**<0.010**	**<0.010**
SD	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
PRSD	-	-	-	-	-	-	-	-	-
Homogenate Duplicate									
3 - B1	<0.010	<0.010	<0.0050	<0.010	<0.010	<0.010	0.012	<0.010	<0.010
3 - B2	<0.010	<0.010	<0.0050	<0.010	<0.010	<0.010	0.014	<0.010	<0.010
Mean	**<0.010**	**<0.010**	**<0.0050**	**<0.010**	**<0.010**	**<0.010**	**0.013**	**<0.010**	**<0.010**
RPMD	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

Table A1-10. Continued.

Site ID	Quinoline (mg/kg)	Acenaphthene (%)	Chrysene (%)	Naphthalene (%)	Phenanthrene (%)	B(a)P Total (mg/kg)	Index of Additive (mg/kg)
Detection Limit	0.01	1	1	1	1	0.02	0.15
Triplicate							
2 - M1	<0.010	91.2	97.3	80.3	87.1	<0.020	<0.15
2 - M2	<0.010	92.7	100.7	84.1	87.1	<0.020	<0.15
2 - M3	<0.010	90.1	104.8	77.0	89.1	<0.020	<0.15
Mean	**<0.010**	**91.3**	**100.9**	**80.5**	**87.8**	**<0.020**	**<0.15**
SD	**-**	**1.31**	**3.76**	**3.55**	**1.15**	**-**	**-**
PRSD	**-**	**1**	**4**	**4**	**1**	**-**	**-**
Homogenate Duplicate							
3 - B1	<0.010	109.5	110.5	95.5	117.8	<0.020	<0.15
3 - B2	<0.010	90.3	79.4	81.5	85.6	<0.020	<0.15
Mean	**<0.010**	**99.9**	**95.0**	**88.5**	**101.7**	**<0.020**	**<0.15**
RPMD	**-**	**19**	**33**	**16**	**32**	**-**	**-**

Table A1-11. Pesticide concentrations measured in QA/QC sediment samples collected from the Rapid City Reservoir, July 2012. Percent relative standard deviations (PRSD) and relative percent mean difference (RPMD) were calculated for triplicate and duplicate samples, respectively; values greater than 18 and 25%, respectively, are indicated in red.

Site ID	ALS ID	Date Sampled	Aldrin (mg/kg)	alpha-BHC (mg/kg)	beta-BHC (mg/kg)	delta-BHC (mg/kg)	a-chlordane (mg/kg)	g-chlordane (mg/kg)	op-DDD (mg/kg)	pp-DDD (mg/kg)
		Method Detection Limit	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Triplicate										
2 - M1	L1184946-5	24-Jun-12	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
2 - M2	L1184946-6	24-Jun-12	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
2 - M3	L1184946-7	24-Jun-12	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
		Mean	**<0.20**	**<0.20**	**<0.20**	**<0.20**	**<0.20**	**<0.20**	**<0.20**	**<0.20**
		SD	-	-	-	-	-	-	-	-
		PRSD	-	-	-	-	-	-	-	-
Homogenate Duplicate										
3 - B1	L1184946-10	25-Jun-12	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
3 - B2	L1184946-11	25-Jun-12	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
		Mean	**<0.30**	**<0.30**	**<0.30**	**<0.30**	**<0.30**	**<0.30**	**<0.30**	**<0.30**
		RPMD	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

Table A1-11. Continued.

Site ID	o,p-DDE (mg/kg)	pp-DDE (mg/kg)	op-DDT (mg/kg)	pp-DDT (mg/kg)	Dieldrin (mg/kg)	alpha-Endosulfan (mg/kg)	beta-Endosulfan (mg/kg)	Endosulfan Sulfate (mg/kg)	Endrin (mg/kg)	Endrin Aldehyde (mg/kg)
Detection Limit	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Triplicate										
2 - M1	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
2 - M2	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
2 - M3	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Mean	**<0.20**	**<0.20**	**<0.20**	**<0.20**	**<0.20**	**<0.20**	**<0.20**	**<0.20**	**<0.20**	**<0.20**
SD	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
PRSD	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Homogenate Duplicate										
3 - B1	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
3 - B2	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Mean	**<0.30**	**<0.30**	**<0.30**	**<0.30**	**<0.30**	**<0.30**	**<0.30**	**<0.30**	**<0.30**	**<0.30**
RPMD	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

Table A1-11. Continued.

Site ID	Heptachlor (mg/kg)	Heptachlor Epoxide (mg/kg)	Hexachloro-benzene (mg/kg)	Lindane (mg/kg)	Methoxychlor (mg/kg)	Mirex (mg/kg)	Oxychlordane (mg/kg)	2-Fluoro-biphenyl (%)	d14-Terphenyl (%)	Alachlor (mg/kg)
Detection Limit	0.2	0.2	0.1	0.2	0.2	0.2	0.2	Surrogate	Surrogate	0.05
Triplicate										
2 - M1	<0.20	<0.20	<0.10	<0.20	<0.20	<0.20	<0.20	94.6	91.5	<0.050
2 - M2	<0.20	<0.20	<0.10	<0.20	<0.20	<0.20	<0.20	97.7	108.7	<0.060
2 - M3	<0.20	<0.20	<0.10	<0.20	<0.20	<0.20	<0.20	95.3	89.1	<0.050
Mean	**<0.20**	**<0.20**	**<0.10**	**<0.20**	**<0.20**	**<0.20**	**<0.20**	**95.9**	**96**	**<0.060**
SD	**-**	**-**	-	**-**	**-**	**-**	**-**	**1.6**	**10.7**	**-**
PRSD	**-**	**-**	-	**-**	**-**	**-**	**-**	**2**	**11**	**-**
Homogenate Duplicate										
3 - B1	<0.30	<0.30	<0.15	<0.30	<0.30	<0.30	<0.30	94.6	86.4	<0.090
3 - B2	<0.30	<0.30	<0.15	<0.30	<0.30	<0.30	<0.30	95.7	113.3	<0.080
Mean	**<0.30**	**<0.30**	**<0.15**	**<0.30**	**<0.30**	**<0.30**	**<0.30**	**95.2**	**99.9**	**<0.090**
RPMD	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**27**	**-**

Table A1-11. Continued.

Site ID	Ametryn (mg/kg)	Atrazine (mg/kg)	Azinphos-methyl (mg/kg)	Bendiocarb (mg/kg)	Benzo(a) pyrene (mg/kg)	Carbaryl (mg/kg)	Carbofuran (mg/kg)	Chlorpyrifos (mg/kg)	Cyanazine (mg/kg)	Diazinon (mg/kg)	Dimethoate (mg/kg)
Detection Limit	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Triplicate											
2 - M1	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
2 - M2	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
2 - M3	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Mean	**<0.050**	**<0.050**	**<0.050**	**<0.050**	**<0.050**	**<0.050**	**<0.050**	**<0.050**	**<0.050**	**<0.050**	**<0.050**
SD	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
PRSD	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Homogenate Duplicate											
3 - B1	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075
3 - B2	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075
Mean	**<0.075**	**<0.075**	**<0.075**	**<0.075**	**<0.075**	**<0.075**	**<0.075**	**<0.075**	**<0.075**	**<0.075**	**<0.075**
RPMD	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

Table A1-11. Continued.

Site ID	Atrazine Desethyl (mg/kg)	Parathion (mg/kg)	Malathion (mg/kg)	Diclofop-methyl (mg/kg)	Methyl Parathion (mg/kg)	Metolachlor (mg/kg)	Metribuzin (mg/kg)	Phorate (mg/kg)	Prometon (mg/kg)	Prometryne (mg/kg)	Propazine (mg/kg)
Detection Limit	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Triplicate											
2 - M1	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
2 - M2	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
2 - M3	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Mean	**<0.050**	**<0.050**	**<0.050**	**<0.050**	**<0.050**	**<0.050**	**<0.050**	**<0.050**	**<0.050**	**<0.050**	**<0.050**
SD	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
PRSD	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Homogenate Duplicate											
3 - B1	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075
3 - B2	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075
Mean	**<0.075**	**<0.075**	**<0.075**	**<0.075**	**<0.075**	**<0.075**	**<0.075**	**<0.075**	**<0.075**	**<0.075**	**<0.075**
RPMD	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

Table A1-11. Continued.

Site ID	Simazine (mg/kg)	Temephos (mg/kg)	Terbufos (mg/kg)	Terbutryn (mg/kg)	Triallate (mg/kg)	Trifluralin (mg/kg)	2-Fluorobiphenyl (%)	d14-Terphenyl (%)
Detection Limit	0.05	0.075	0.05	0.05	0.05	0.05	Surrogate	Surrogate
Triplicate								
2 - M1	<0.050	<0.10	<0.050	<0.050	<0.050	<0.050	109.6	115.9
2 - M2	<0.050	<0.10	<0.050	<0.050	<0.050	<0.050	91.9	89.3
2 - M3	<0.050	<0.10	<0.050	<0.050	<0.050	<0.050	102.7	99.9
Mean	**<0.050**	**<0.10**	**<0.050**	**<0.050**	**<0.050**	**<0.050**	**101**	**102**
SD	**-**	**-**	**-**	**-**	**-**	**-**	**8.9**	**13.4**
PRSD	**-**	**-**	**-**	**-**	**-**	**-**	**9**	**13**
Homogenate Duplicate								
3 - B1	<0.075	<0.10	<0.075	<0.075	<0.075	<0.075	108	99.7
3 - B2	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075	102	95.2
Mean	**<0.075**	**<0.10**	**<0.075**	**<0.075**	**<0.075**	**<0.075**	**105**	**97.5**
RPMD	**-**	-	**-**	**-**	**-**	**-**	**6**	**5**

APPENDIX 2. AQUATIC HABITAT METHODS

DATA COLLECTION

The habitat surveys were conducted on May 18, 2012 from a small 12-foot Jon boat equipped with a 15 HP Mercury outboard motor. A Quester Tangent Corporation (QTC) Series V scientific grade echosounder coupled to a Trimble R8 RTK GPS rover receiver were used to collect acoustic bathymetric and bottom-type data. The GPS receiver was positioned approximately 2 metres directly above the echosounder's transducer on an aluminum mounting pole. The transducer was positioned approximately 0.6 m below the surface of the water. Sonar depths were collected and recorded at a frequency of 50 kHz at 1 second intervals.

A Trimble R8 GNSS real-time kinematic (RTK) survey-grade base station and rover receiver were used in order to obtain centimetre-accuracy x, y and z coordinates throughout the survey (Figure A2-1). The Trimble R8 GNSS real-time kinematic (RTK) survey-grade global positioning system (GPS) base receiver tripod was setup on the north shore beach at the Rapid City reservoir. Approximate coordinates were used for the base station location. This method is used where adequate survey monuments are not found nearby or are not known to be nearby. The base receiver information is then sent post-survey to Natural Resources Canada's Precise Point Positioning (PPP) service, where accurate X,Y,Z coordinates for the base are returned. Elevations associated with this system are those based on the 1928 adjustment of the national levelling networks - Canadian Geodetic Vertical Datum 1928 (CGVD28 HT2.0). This base station location was used for the duration of the acoustic survey: 425744.97 m Easting, 5552791.91 m Northing (CSRS NAD83), 480.18 m CGVD28 (HT2.0). Table A2-1 lists the field coordinates and post-processed corrected water level taken during the survey was 479.75 m (CGVD28 HT2.0).

The survey consisted of longitudinal transects approximately at the centre of the river and was filled in by transects oriented bank to bank and spaced approximately 20 m apart (Figure A2-2) throughout the entire Study Area, with transects spaced more closely in the vicinity of the confluence with the Little Churchill River. A total of 2,487 soundings were collected, providing information on depth, bottom hardness (soft to hard bottom types), and bottom complexity (smooth to rough bottom types). Acoustic bottom-type surveys in the immediate area of the infill zone were limited due to shallow water. Supplemental hand sonar measurements and substrate observations were made in this area (Figure A2-3).

Bottom-type validation was conducted using a Ponar dredge deployed at random locations in correspondence with QTC survey tracks throughout the Study Area. Samples were documented and described according to visual texture analysis and photographed. Samples were classified *in situ* according to a modified Wentworth (1922) particle size scale. Coordinates were recorded using a hand-held GPS receiver (Table 1; Figure 3). Core samples were also taken in support of the water and sediment quality studies in July of 2012, a particle sediment size analysis was conducted by ALS (Winnipeg). The results of which were also used to validate the acoustic habitat surveys. Observations of submergent and emergent plants were recorded throughout the 2012 surveys. An extensive focused inventory of plants and/or terrestrial vegetation was not conducted.

ANALYSIS AND MAPPING

Habitat Reaches

Four habitat reaches were delineated and mapped using the Manitoba Land Initiative's (MLI) 2009 colour orthophotography database of the area. The date of the imagery was determined to be September 16, 2009. Shorelines for the habitat reaches were digitized from the imagery using ArcGIS 10.1 (ESRI) software. The reaches were then segmented based on interpreted reach breaks. Reach 1 and 4 had natural riverine characteristics for the area, Reach 2 and 3 were the manmade reservoir at Rapid City and its upstream wetland habitat reach. Areas for each reach were then calculated within the GIS software.

Bathymetry

Elevations and depths collected in the field were first preprocessed using QTC IMPACT software. The data were exported to a Microsoft Excel format for further processing. Depths were corrected for transducer depth below the water surface. These corrected depths along with their x and y coordinates obtained via RTK GPS were then placed in a spatial interpolation algorithm to produce a 0.5 m pixel resolution continuous surface of depth in raster format for each island dataset. In areas that lacked sufficient coverage due to limited boat access, manually retrieved depths were added to the interpolation procedure. The *Topo to Raster* spatial interpolation method in ArcGIS allows multiple inputs including shorelines and spot elevations, allowing for the creation of a realistic model of lake bed terrain. Depth and volume statistics were then calculated within the GIS.

Bottom Typing

QTC Impact software is used to classify the acoustic bottom-type data collected in the field into discrete acoustic classes related to substrate size, bottom hardness, and bottom roughness. Acoustic signals vary according to the bottom type and can therefore be classified based on these attributes recorded in the field. The software processes the 166 acoustic variables (related to surface roughness, and hardness) recorded by the QTC View software in the field into 3 principal component variables that are used to cluster (K-means) the individual sonar records into a user-specified number of unsupervised acoustic classes. The classified acoustic records were then exported and labeled post-hoc in the GIS according to their spatial correspondence with the physical validation samples collected at intermittent intervals along the acoustic data tracks. Five acoustic classes were validated as being: sand/gravel, sand, sand loam (depositional), silt/clay, and silt/clay with high organic content. ArcGIS was used to delineate substrate polygons based on breaks between the acoustically validated substrate classes. Finally, the GIS was used to map and calculate total area for each class.

Macrophytes

Emergent and submergent aquatic plant distributions were mapped using the MLI's 2009 colour imagery. Submerged beds were delineated through tonal variation recognition between the underlying substrate (brighter) and plant beds themselves (darker). Emergent shoreline vegetation was also

apparent in the imagery due to the time of year, the dominant cattail vegetation had already senesced to a light brown and was discriminated from surrounding green vegetation (grasses, sedges, etc.) The species were cross referenced with field observations recorded during the 2012 surveys.

References

Wentworth, C.K., 1922, A scale of grade and class terms for clastic sediments: Journal of Geology, v. 30, p. 377-392.

Table A2-1. Field and post-processed coordinates used to determine base station location and water levels during the course of the acoustic habitat surveys. Note: all x,y coordinates are relative to UTM Zone 14 (NAD83 CSRS), all elevations are relative to CGVD28 HT2.

Site		Field Coordinates			PPP Correction Offset			Corrected Coordinates		
Survey Id	Description	Easting	Northing	Elevation(m)	Easting Offset	Northing Offset	Elevation Offset	Easting	Northing	Elevation
BM01	Bench Mark	425744.014	5552790.469	480.345	0.953	1.438	0.168	425744.967	5552791.907	480.177
WL01	Water Level	425745.294	5552780.805	479.923	0.953	1.438	0.168	425746.247	5552782.243	479.755
WL02	Water Level	425745.668	5552780.819	479.914	0.953	1.438	0.168	425746.621	5552782.257	479.746

Table A2-2. Sample sites for manual depth readings and validation of bottom type from Ponar grab samples.

Waypoint	Easting (m)	Northing (m)	Zone	Altitude (m ASL)	Depth (m)	Substrate Class
11	425814	5552633	14	481	0.8	n/a
12	425792	5552642	14	479	1	n/a
13	425730	5552636	14	472	0.81	n/a
14	425712	5552635	14	473	0.66	n/a
15	425687	5552636	14	474	0.54	n/a
16	425658	5552638	14	475	0.64	n/a
17	425635	5552635	14	473	0.78	n/a
18	425609	5552623	14	475	0.9	n/a
19	425627	5552614	14	475	0.83	n/a
20	425643	5552590	14	478	0.72	n/a
21	425652	5552569	14	478	0.62	n/a
22	425658	5552625	14	476	1.25	n/a
23	425694	5552620	14	477	1.36	n/a
24	425717	5552611	14	474	0.94	n/a
25	425738	5552605	14	475	1.07	n/a
26	425759	5552596	14	476	1.08	n/a
27	425786	5552589	14	477	0.78	n/a
28	425807	5552596	14	478	0.78	n/a
30	425825	5552659	14	475	0.87	n/a
31	425814	5552666	14	476	0.66	n/a
32	425805	5552661	14	476	0.44	n/a
33	425787	5552654	14	477	0.89	n/a
34	425764	5552655	14	475	0.32	n/a
35	425733	5552659	14	475	0.36	n/a
36	425712	5552665	14	475	0.49	n/a
37	425678	5552664	14	477	0.63	n/a
40	425777	5552720	14	478	1.2	Sand Gravel
41	425685	5552707	14	470	1.6	Sand Gravel
42	425615	5552703	14	472	1.8	Sand
43	425558	5552675	14	472	2.1	Sand Gravel
44	425596	5552642	14	472	0.9	Sand
45	425743	5552604	14	471	1.2	Clay
46	425786	5552645	14	471	0.8	Clay
47	425898	5552781	14	476	2	Sand
48	426122	5552794	14	472	2.1	Sand Gravel

Figure A2-1. Photograph showing the setup of the real-time kinematic (RTK) GPS based acoustic habitat survey.

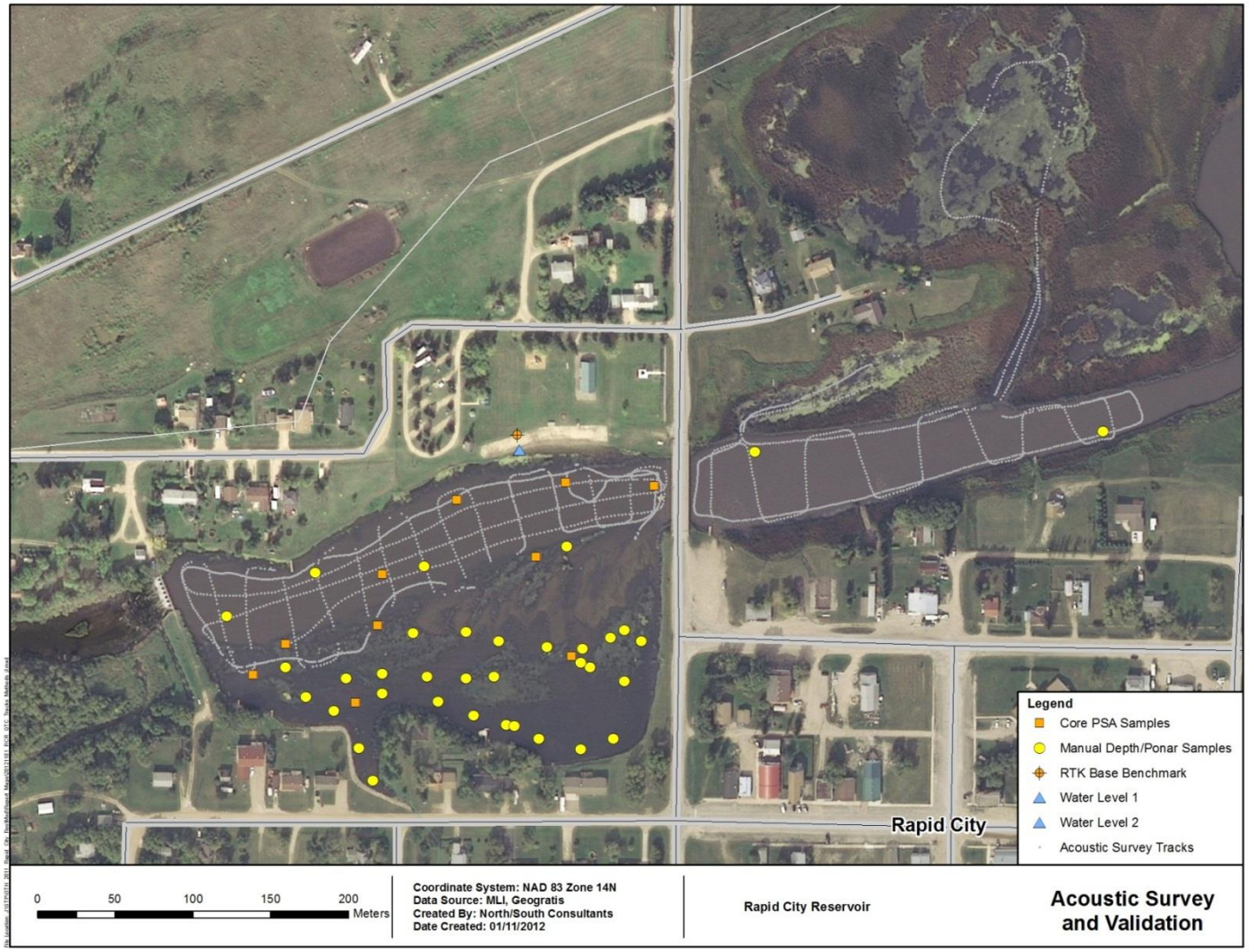

Figure A2-2. Map indicating location of acoustic survey tracks, manual depth validation and ponar bottom-type validation sites, May 18, 2012.

APPENDIX 3. BIVALVE FIELD STUDIES

Methods

Qualitative mussel surveys were conducted by NSC staff in the Project Area on site visits in April, May, July and August 2012. Several sampling methods were used to evaluate the presence of mussels using methods adapted from the "Guidelines for Sampling Freshwater Mussels in Wadable Streams" (Wisconsin Department of Natural Resources 2005) and the "Protocol for the Detection and Relocation of Freshwater Mussel Species at Risk in Ontario-Great Lakes Area (OGLA) (Mackie et al. 2008). These methods included visual observations along the shorelines and in the river, mussel raking and ponar grabs. Incidental observations and captures during the course of other field surveys were also noted. Specimens were identified *in Situ* by a qualified NSC biologist. Details of site locations, effort and catches available in Table A4-1.

Visual Surveys

Visual surveys were conducted on foot for any indication of the presence of mussel species on 25 April 2012. Two areas were searched: the northern shoreline just downstream of the PR 270 bridge - in the same area as mussel raking transect MS-1; and the southern shoreline immediately downstream of the dam – in approximately the same area as mussel raking transect MS-4 (Figure A3-1). Each search was 30 minutes in duration and conducted by a single searcher.

Mussel Raking

Wadable areas were sampled 02 August 2012. Using a mussel rake on a 2 m long pole, the searcher waded to water depths of approximately 1 m and raked the substrate within their reach, to a maximum depth of approximately 2 m deep where conditions allowed (Figure A3-2). Three transects were sampled upstream of the fish ladder and dam, one along the northern shore and two along either side of the sand bar currently downstream of the PR 270 bridge (Figure A3-1). The fourth transect was located downstream of the Rapid City dam along the southern shoreline and around the islands in the center of the river (Figure A3-1 and A3-3). Samples collected with the rake were sorted by hand and visually inspected for the presence of mussels (Figure A3-2). Sediment type (sand/silt/clay/gravel/boulders/organics), the ranged of water depth raked, time, and site coordinates were recorded. Surveys of the transects lasted between 20 and 40 minutes.

Benthic Ponar Grabs

Benthic samples were collected within Reach 3 using a Ponar benthic grab (0.023 m^2; Figure A3-4). Three ponar grabs were collected at each of ten sites within the reservoir (Figure A3-5). Maximum water depth at each site was recorded, as well as the approximate depth of penetration and substrate type per grab. Samples were sorted by hand and visually inspected for the presence of mussels.

Results

Five species of mussel were found in the project area in the spring and summer of 2012. These included Fatmucket, Giant Floater, White Heelsplitter, Plain Pocketbook, and Fingernail Clams (family Sphaeriidae). Only four living specimens were found; two Fatmucket on the northern side of the depositional bar (Reach 3) in sandy/loam and gravel substrate, and two Giant Floaters captured in a gill net in the same area. Searchers reported empty shells of Giant Floater, White Heelsplitter, and numerous Fatmucket along the northern side of the bar closest to the channel, while empty shells of Fatmucket and Giant Floater were in abundance along the southern side of the bar where sandy loam substrate transitioned to silt/clay and submerged macrophytes. Fingernail Clam shells were also abundant in these same areas. Empty shells of all species, with the exception of the Fingernail Clam, were also found along the shoals/islands (50 – 100 m) downstream of the dam (Reach 4) (Figure A3-3). The northern shoreline downstream of the PTH 24 bridge (Reach 3) was generally devoid of mussels, with the exception of a single dead Giant Floater captured while raking.

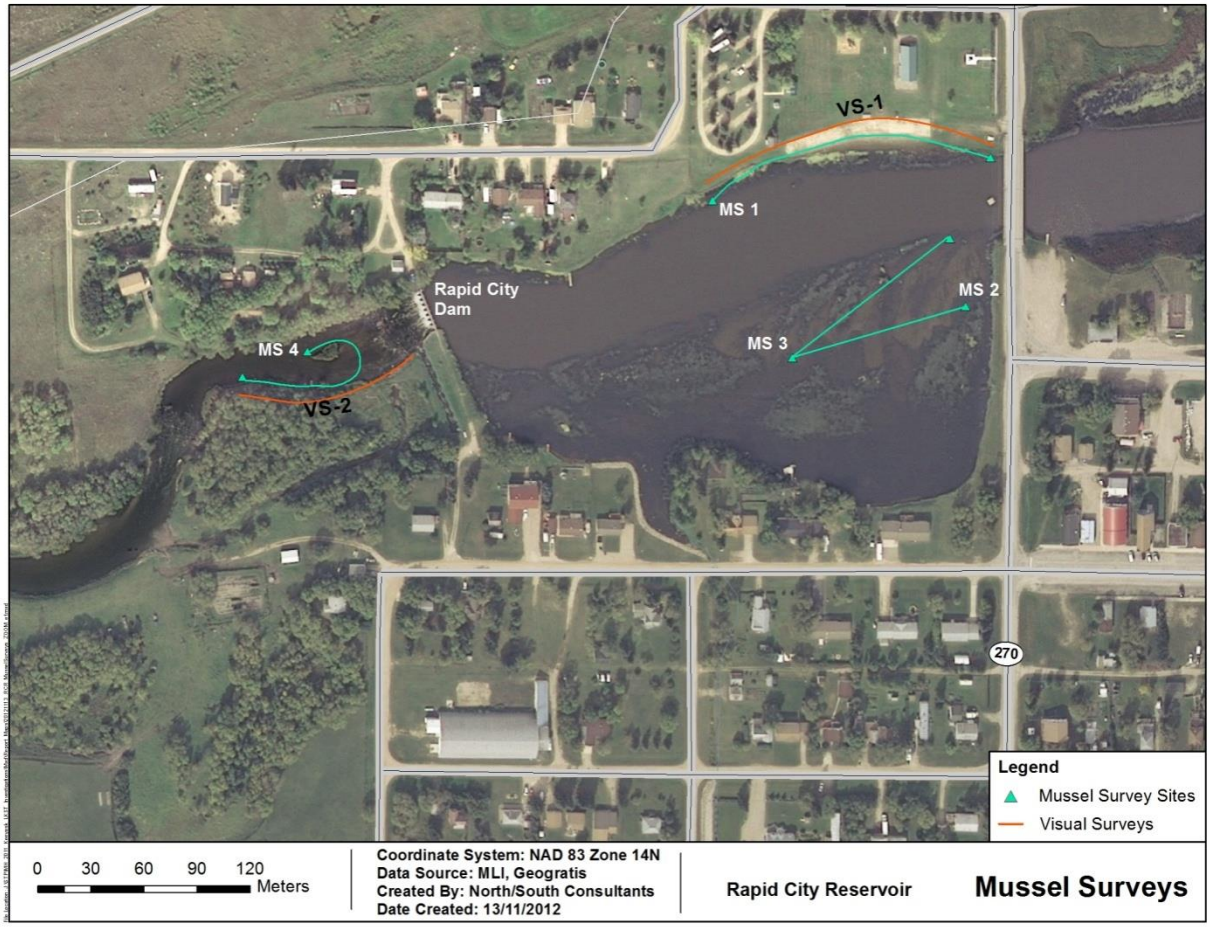

Figure A3-1. Visual Survey routes and Mussel Raking transects searched 25 April and 02 August 2012.

Figure A3-2. Searcher with mussel rake and a sample of sediment collected while mussel raking along the northern shore of the reservoir (transect MR-1).

Figure A3-3. View of the area sampled for mussels (transect MR-4) downstream of the Rapid City dam (Reach 4), May 2012.

Figure A3-4. Searcher using the ponar grab to sample sediment in the reservoir, July 2012.

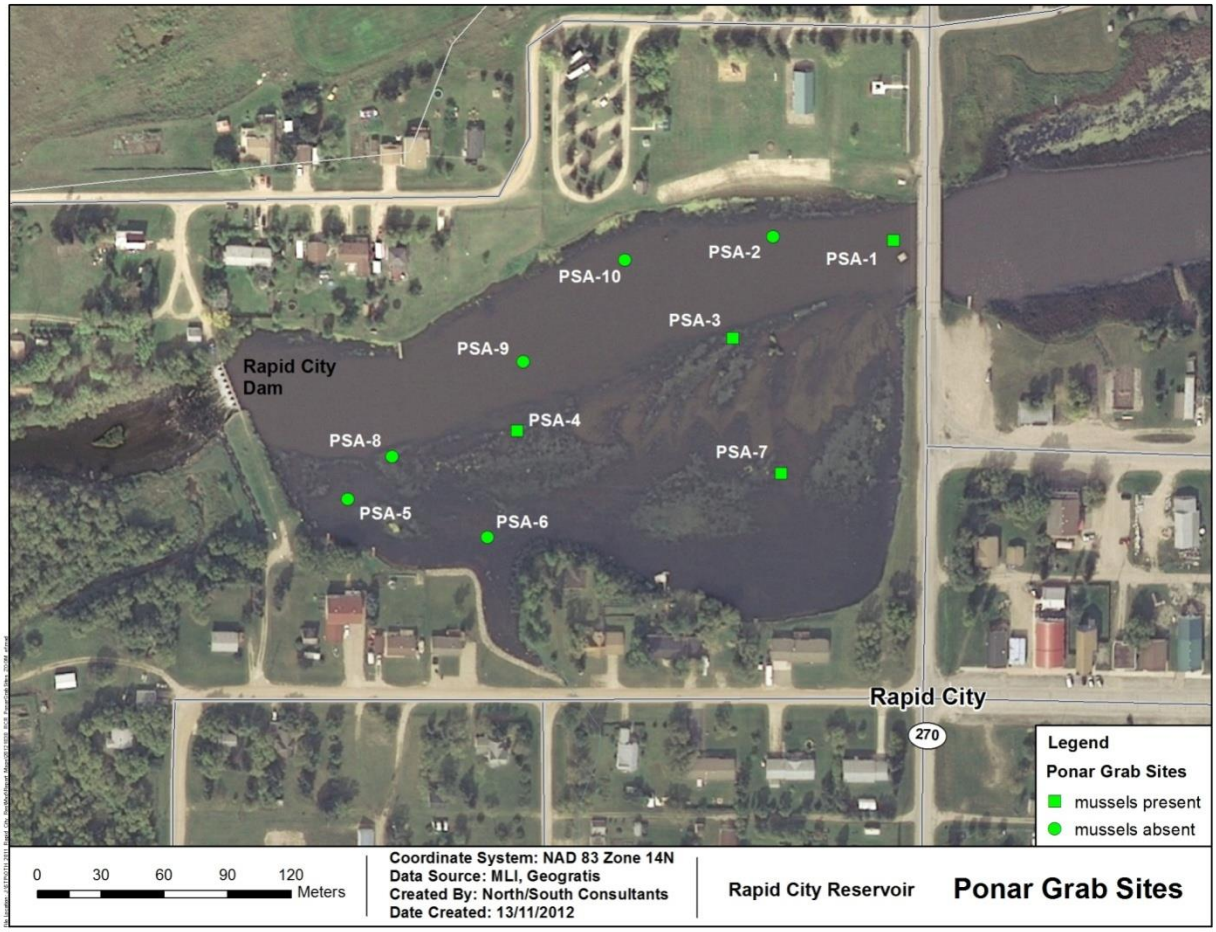

Figure A3-5. Ponar benthic grab sites in the Project Area (Reach 3) on the Little Saskatchewan River, July 25, 2012.

Table A3-1. Site and capture data for mussels in the Project Area in the spring and summer of 2012.

	Elapsed Time (min)	Date	Location Description	Start (zone 14U) Easting	Start (zone 14U) Northing	End (zone 14U) Easting	End (zone 14U) Northing	Common Name	#	Alive or Dead	Substrate
Visual Survey											
VS-1	30	25-Apr-12	downstream of fish-way along the river; at the MR-4 site	425674	5552768	425840	5552781	Fatmucket	-	-	sand with boulders and cobble
								Giant Floater	-	-	
								Plain Pocketbook	-	-	
								White Heelsplitter	-	-	
VS-2	30	24-Jul-12	along the north shore from the bridge to west end of the park; at the MR-1 site	425501	5552656	425415	5552649	-	-	-	silt/clay
Mussel Raking											
MR-1	40	2-Aug-12	along north shore d/s of the bridge, u/s of the dam	425674	5552768	425840	5552781	Giant Floater	1	-	silt/clay
MR-2	20	2-Aug-12	sand bar near bridge, south side	425823	5552692	425725	5552663	Giant Floater	14	Dead	sand with small gravel
								Fatmucket	10	Dead	
								Fingernail Clams	-		
MR-3	30	2-Aug-12	sand bar near bridge, north side	425725	5552663	425814	5552730	Fatmucket	2	Alive	sand transition to silt/clay
								Fatmucket	19	Dead	
								Giant Floater	3	Dead	
								White heelsplitter	4	Dead	

Table A3-1. Continued

	Elapsed Time (min)	Date	Location Description	Start (zone 14U) Easting	Start (zone 14U) Northing	End (zone 14U) Easting	End (zone 14U) Northing	Common Name	#	Alive or Dead	Substrate
MR-3											
		2-Aug	shoreline and river 50-75 m downstream of MR-4					White Heelsplitter	4	Dead	boulder/sand
Ponar Grabs											
PSA-1	-	25-Jul	channel	425833	5552759	-	-	Fingernail clams	-	Dead	sand
PSA-2	-	25-Jul	channel	425776	5552761	-	-	-			sand or silt/sand
PSA-3	-	25-Jul		425757	5552713	-	-	Giant Floater	-	Dead	sand/loam with gravel
PSA-4	-	25-Jul		425655	5552669	-	-	Fingernail clams	-	Dead	silt/sand/gravel
PSA-5	-	25-Jul		425575	5552637	-	-	-			silt over sand
PSA-6	-	25-Jul		425641	5552619	-	-	-			organics
PSA-7	-	25-Jul		425780	5552649	-	-	Fingernail Clams	-	Dead	sand/loam or silt/clay and organics
PSA-8	-	25-Jul		425596	5552657	-	-	-	-	-	silt/sand
PSA-9	-	25-Jul	channel	425658	5552702	-	-	-	-	-	silt/sand
PSA-10	-	25-Jul	channel	425706	5552750	-	-	-	-	-	silt/sand
Incidental											
	-	18-May	SIG-May					Fatmucket	1	-	-
	-	24-Jul	WQS-1					"shells"		Dead	-
	-	25-Jul	SIG-July; 2, 1.5 mesh					Giant Floater	2	Alive	-
	-	25-Jul	WQS-3					Fatmucket	1	Dead	-

APPENDIX 4. FISH FIELD STUDIES

Field studies to gather qualitative information on the fish species using the reservoir (Reach 3) and area immediately downstream of the Rapid City Dam and Project Area were conducted by NSC in the spring and summer of 2012. Methods used included gill netting, electrofishing and incidental observations. Site details and methodology are presented here.

Backpack Electrofishing

A Smith-Root Model 11 A or Lr-24 backpack electrofisher was used at five sites of wadeable depth (< 1 m) on 18 May 2012 (Figure A4-1, Figure A4-2). Electrofishing sites were chosen to cover a variety of shallow habitats, including riffles/runs/pools and vegetated areas. The start and end of each transect was marked using a handheld GPS.

Gill Netting

On 16 May and 24 July, 2012, a single standard index gill net (SIG) gang was used to gather qualitative information on the fish species found in the main channel of the reservoir (Reach 3). Gill net gangs consisted of six 22.9 m long by 1.8 m deep twisted nylon or monofilament panels of 1.5, 2.0, 3.0, 3.75, 4.25, and 5.0 inch (38, 51, 76, 95, 108, and 127 mm, respectively) stretched mesh. To the 1.5 inch panel of each SIG gang a Swedish gill net (12 mm stretch mesh; 20 m long by 1.8 m deep) was attached. Each gill net gang was set on the bottom of the channel in the afternoon and retrieved the following day. The location and depth of the ends of each gang were determined using a hand-GPS and a handheld depth sounder, respectively. Details of their deployment and retrieval are available in Table A4-2 and Figure A4-1. Captured fish were identified, enumerated and measured for length (± 1mm) and weight (± 10 g) (Table A4-3).

Results

Eight Northern Pike, three White Suckers and one Rock Bass were captured in May. Eleven Northern Pike, two White Suckers, four Shorthead Redhorse and three Rock Bass were captured in June. No fish were captured while electrofishing.

Table A4-1. Gill net site and set details for field studies in the Rapid City Reservoir, 2012.

Site	Set Date	Set Time	Duration	Start (zone 14U)		End (zone 14U)		Start Depth (m)	End Depth (m)	Description
		(24 hr)	(hrs:min)	Easting	Northing	Easting	Northing			
SIG May	17-May-12	17:04	16:16	425596	5552696	425749	5552728	1.4	1.4	Start: 5.0" end of SIG; End: 12 mm
SIG July	24-Jul-12	20:31	12:50	425602	5552661	425780	5552749	0.8	2.0	Start: 12 mm; End: 5.0" end of SIG

Table A4-2. Fish captured in Standard Index Gill net gangs + 12 mm panel in the Rapid City Reservoir (Reach 3) in 2012.

Site	Species	Fork Length (mm)	Weight (g)	Comments
SIG-May*				
	Northern Pike	427	550	partially consumed
		437	550	
		455	750	partially consumed
		502	1100	
		509	-	partially consumed
		560	-	
		675	2700	
		-	-	
	Rock Bass	126	100	
	White Sucker	150	-	partially consumed
		402	950	
		440	1500	
SIG-July**				
	Northern Pike	192	-	
		350	371	
		395	400	
		448	600	
		450	650	
		466	700	
		499	950	
		508	900	
		548	1200	
		608	1500	
		700	364	
	Rock Bass	120	-	
		122	-	
		146	-	
	Shorthead Redhorse	350	275	
		392	800	
		434	1200	
		460	1100	
	White Sucker	252	200	
		460	1200	

* 1 Fatmucket captured

* 2 Giant Floaters and 1 Painted Turtle captured

Table A4-3. Electrofishing sites and effort in the Rapid City Reservoir (Reach 3) and the riffle habitats immediately downstream of the Rapid City Dam (Reach 4), 18 May,2012.

			Start (zone 14 U)		End (zone 14U)					
Site	**Location**	**Time (24 hr)**	**Easting**	**Northing**	**Easting**	**Northing**	**V**	**Power**	**Amps**	**Duration (s)**
EF Site 1	S shore of shallow area	10:31	425710	5552607	425832	5552649	100	140	1.5	771
EF Site 2	perimeter of shallow bay on S side of reservoir; 0.3-0.5 m depth	10:52	425832	5552649	425748	5552634	100	140	1.5	374
EF Site 3	N shore from upstream of dam to bridge from boat	14:10	425611	5552710	425791	5552782	100	140	1.5	541
EF Site 4	100 m d/s from bridge, run with boulders/sand/gravel and cobble	12:50	425420	5552649	n/a	n/a	n/a	n/a	n/a	325
EF Site 5	run/rapid/riffle	13:30	425391	5552633	n/a	n/a	101	n/a	n/a	349

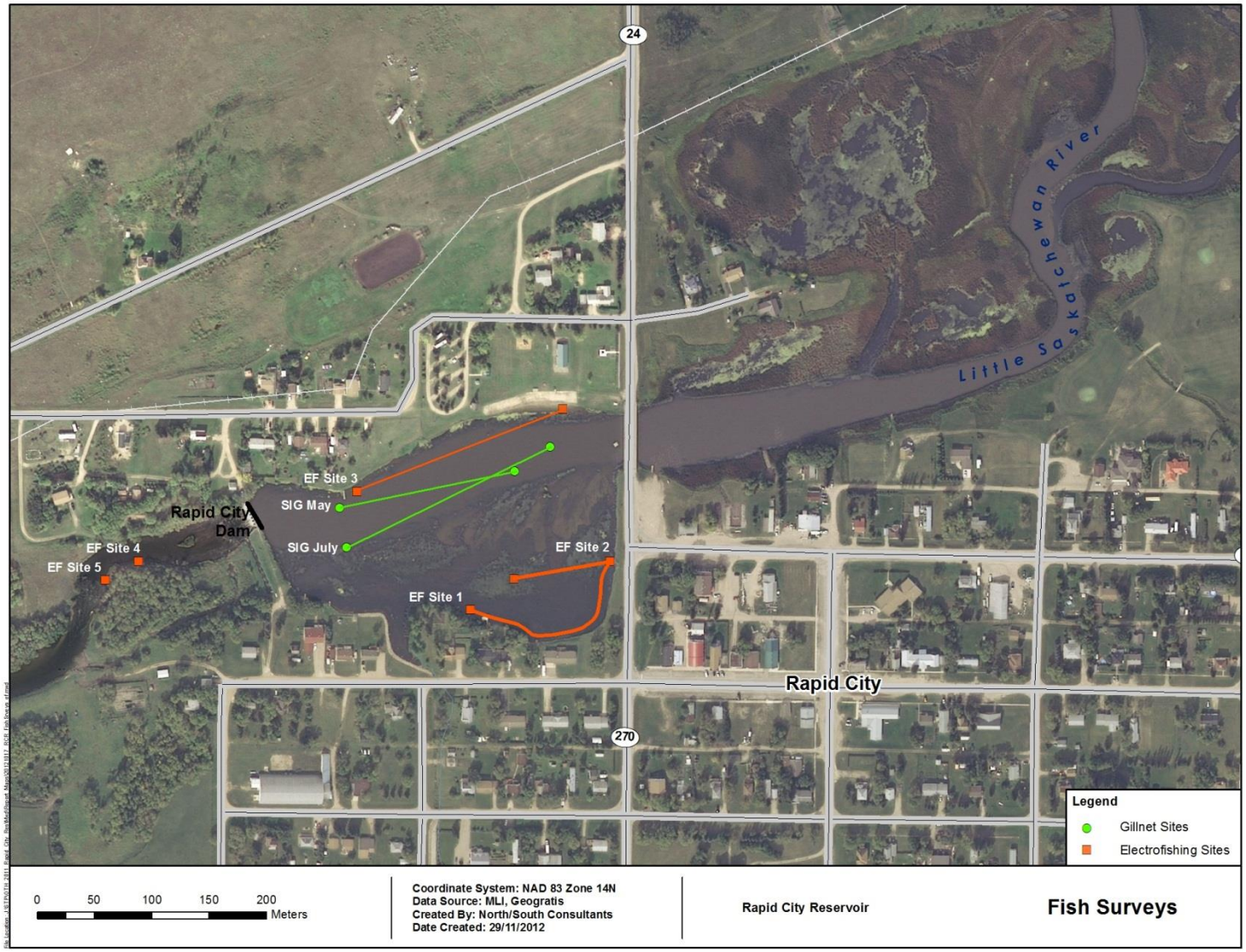

Figure A4-1. Gill net and electrofishing sites in Reaches 3 and 4 of the Project Area on the Little Saskatchewan River, 2012.

Figure A4-2. Searcher using the backpack electrofisher to capture fish in a riffle/pool habitat downstream of the Rapid City Dam, May 2012.

APPENDIX 5. FISH LADDER DATA

EVALUATION OF RAPID CITY FISH LADDER

A large 4 hoop trap net was attached to the fish ladder oriface in an attempt to evaluation species utilization. There is that school of thought that the Rapid City fish ladder is removing all the large walleye from Lake Wahtopanah. These walleye are assumed to pass up through the ladder to spawn and are assumed not to return to Lake Wahtopanah again.

The trap net was postioned on April 14, 1998 and checked once daily after that time til May 05, 1998.

Trap net checked by Friends of Rivers Lake (*)
Trap net checked by Eco Odessey students (#)

DATE	WATER TEMP oC	SPECIES CAUGHT
14	5.5	NIL
15	4.7	NIL
16	5.5	NIL
17	5.8	20 WS
18 *	5.7	365 WS 1 NP
19 *	5.2	2 WS
20 #	7.2	192 WS 5 NP
21 #	8.2	435 WS 2 SHR
22 #	10.0	1 SHR 35 WS
23 #	12.3	3 NP 72 WS
24 #	11.0	35 WS 1 SHR 1 NP
25 *	?	NIL
26 *	?	NIL

(ORIFACE ON LADDER WAS SHUT OFF AND LADDER WAS DE WATERED)

27	14.0	2 WS 1 NP
28	15.0	14 WS 6 SHR
29	?	26 WS 17 SHR
30	?	8 SHR 60 WS 1 NP
01	?	16 WS 13 SHR
02	?	NIL
03	?	NIL
04	?	1 SHR
05	15.1	NIL
TOTAL		1274 WS 12 NP 49 SHR

Removed trap on May 05, 1998, water temperature was 15.1 oC. Observed two shorthead redhorse (SHR) in lower pond.

133

1274
'49

1274
'49

EVALUATION OF RAPID CITY FISH LADDER 1999

In an attempt to evaluation species utilization of the Rapid City fish ladder, an expanded metal mesh trap was temporaily attached to the discharge. There is that school of thought that the Rapid City fish ladder is removing all the large walleye from Lake Wahtopanah. These walleye are assumed to pass up through the ladder to spawn and are assumed return to Lake Wahtopanah again.

The trap was postioned on April 12, 1999 and checked twice daily by a local individual that lives in the town. Fish ladder evalutation terminated on May 31, 1999.

- Unfortunately, the individual did not separately count the different species of suckers. White suckers, shorthead redhorse and quillbacks were all counted as just suckers (S).
- Northern Pike (NP)
- Walleye (W)
- Rock Bass (RB)

DATE	WATER TEMP oC	SPECIES CAUGHT
12	2.5	NIL
13	4.0	1 - NP
14	3.0	NIL
15	2.0	NIL
16	2.0	NIL
17	0.0	NIL
18	2.0	NIL
19	1.5	1 - NP
20	3.0	NIL
21	7.0	2 - NP 42 - S*
22	9.0	5 - S
23	7.0	1 - NP
24	10.0	1 - NP

25	11.0	3 - NP 223 - S
26	12.0	3 - NP 7 - W 432 - S
27	12.0	1 - NP 155 - S
28	12.0	1 - NP 1 - W 261 - S
29	10.0	4 - NP 76 - S
30	12.0	2 - NP 1 - W 111 - S
01	14.0	2 - NP 70 - S
02	15.0	36 - S
03	14.0	3 - NP 52 - S
04	13.0	42 - S
05	13.0	3 - NP 224 - S
06	12.0	20 - S
07	12.0	24 - S 1 - NP
08	10.0	1 - NP
09	10.0	NIL
10	6.0	NIL
11	6.0	NIL
12	8.0	NIL
13	10.0	1 - S 1 - NP

14	8.0	NIL
15	10.0	3 - NP 143 - S
16	11.0	3 - NP 90 - S
17	10.0	2 - S
18	10.0	140 - S
19	11.0	96 - S
20	14.0	5 - S 2 - NP
21	14.0	2 - S 2 - NP 1 - W
22	14.0	1 - NP
23	14.0	1 - S 1 - NP
24	14.0	2 - S
25	14.0	1 - S 1 - RB
26	15.0	1 - S 1 - NP
27	17.0	2 - NP 2 - RB 1 - S
28	17.0	6 - S 3 - RB
29	17.0	6 - S
30	15.0	2 - S
31	15.0	NIL

S (white sucker, shorthead redhorse + quillbacks) ——— 2271

NP (pike ——— 45

EVALUATION OF RAPID CITY FISH LADDER 2000

In a continuing attempt to evaluate species utilization of the Rapid City fish ladder, an expanded metal mesh trap was temporaily attached to the discharge. There is that school of thought that the Rapid City fish ladder is removing all the large walleye from Lake Wahtopanah. These walleye are assumed to pass up through the ladder to spawn and are assumed return to Lake Wahtopanah again.

The trap was postioned on April 04, 2000 and checked twice daily by a local individual (Doug Reid 826-2536) that lives in the town. Fish ladder evalutation terminated on May 31, 2000.

- Unfortunately, the individual did not separately count the different species of suckers. White suckers, shorthead redhorse and quillbacks were all counted as just suckers (S).
- Northern Pike (NP)
- Walleye (W)
- Rock Bass (RB)

DATE	WATER TEMP oC	SPECIES CAUGHT
APRIL		
04	2.5	NIL
05	6.0	NIL
06	1.0	NIL
07	2.0	1 NP
08	2.0	NIL
09	1.0	NIL
10	1.5	NIL
11	2.0	NIL
12	2.0	NIL
13	----	----
14	----	----
15	----	----
16	----	-----

17	8.0	NIL
18	6.0	6 NP 52 S
19	6.0	2 NP
20	----	----
21	6.0	6 NP 37 S
22	8.0	5 NP 37 S
23	10.0	6 NP 97 S
24	12.0	2 NP 166 S
25	11.0	9 NP 217 S
26	10.0	105 S
27	11.6	6 NP 57 S
28	9.0	1 NP
29	10.0	NIL
30	10.0	4 NP 7 S
MAY 01	10.0	3 NP 84 S
02	12.0	2 NP 52 S
03	13.0	147 S
04	14.0	1 NP 22 S
05	12.0	NIL
06	11.0	NIL
07	15.0	47 S

08	13.0	NIL
09	12.0	NIL
10	14.0	NIL
11	----	----
12	----	----
13	----	----
14	----	----
15	----	----
16	----	----
17	11.0	NIL
18	----	----
19	----	----
20	----	----
21	16.0	8 S 1 RB
22	----	----
23	----	----
23	----	----
24	----	----
25	----	----
26	----	----
27	----	----
28	----	----
29	----	----
30	----	----
31	16.0	TRAP REMOVED

Totals for the 2000 monitoring period were:

Northern Pike	54
Suckers	1135
Rock Bass	1
Totals	1190

EVALUATION OF RAPID CITY FISH LADDER 2001

In a continuing attempt to evaluate species utilization of the Rapid City fish ladder, an expanded 4' x 6' metal mesh trap was temporaily again attached to the discharge. This is the fifth year the fish ladder has been evaluated. Sampling years have been 1994, 1998, 1999, 2000 and 2001.

The trap was postioned on April 23, 2001 and checked twice daily by a local individual (Doug Reid 826-2536) that lives in the town. Fish ladder evaluation terminated on May 28, 2001.

Extremely high water levels on the Little Saskatchewan River this spring, submerged the fish trap and made monitoring the fish movement impossible. The lid of the fish trap was simply left open and the fish could just swim through. The water flows at the fish ladder discharge appeared to be to fast to facilitate any fish passage.

- The sampling individual recorded the different species of suckers present at the fish ladder,(White suckers, shorthead redhorse and quillbacks) as just suckers.

- Suckers (S)
- Northern Pike (NP)
- Walleye (W)
- Rock Bass (RB)

DATE	WATER TEMP oC	SPECIES CAUGHT
APRIL		
23	5	fish trap installed
24	5	nil
25	6	nil
26	6	nil
27	7	nil
28	9	211 S 1 NP 1 W
29	12	280 S 1 W 2 NP

30	11	151	S
		1	NP
May			
01	12	304	S
		13	NP
02	12	25	S
03	FLOODED	NIL	
04	FLOODED	NIL	
05	15	2	W
		1	S
		1	NP
06	FLOODED	NIL	
07	FLOODED	NIL	
08	10	1	S
09	10	5	W
		6	S
		5	NP
10	10	17	NP
		43	S
11	11	15	NP
		58	S
12	10	4	NP
		151	S
13	14	82	S
		18	NP
14	15	234	S
		9	NP
15	13	169	S
		9	NP
		2	RB
16	13	143	S
		18	NP
		5	RB
17	15	12	S
		1	NP

18	14	18	NP
		71	S
19	14	27	S
		6	NP
		1	RB
20	11	4	NP
21	10	NIL	
22	10	NIL	
23	10	NIL	
24	10	7	NP
25	14	5	NP
		1	RB
26	14	NIL	
27	14	5	NP
		2	S
28	14 **(TRAP REMOVED)**	1	NP

Totals for the 2001 monitoring period were:

Walleye	9
Northern Pike	163
Suckers	1971
Rock Bass	9
Totals	2152

EVALUATION OF RAPID CITY FISH LADDER 2004

In a continuing attempt to evaluate the fish species utilization of the Rapid City fish ladder, an expanded 4' x 6' expanded metal mesh trap was again temporaily attached to the upstream side of the pipe that passed through the dam. This is the sixth year the fish ladder has been evaluated. Sampling years have been 1994, 1998, 1999, 2000, 2001 and 2004.

The trap was installed on April 19th, 2004 and checked by a local individual (Doug Reid 826-2536) that lives in the town. Fish ladder evaluation terminated on May 17th, 2004.

Extremely low and fluctuating water levels and temperatures on the Little Saskatchewan River this spring, had a huge impact on fish movements. Initially, a northern pike tagging program was proposed but was cancelled due to the lack of fish.

- White Suckers (WS)
- Northern Pike (NP)
- Walleye (W)
- Rock Bass (RB)
- Short Head Redhorse (SHRH)

DATE	WATER TEMP °C	SPECIES CAUGHT
APRIL 19	5.9	nil
April 20 to May 04	2.0 - 5.9	nil
May 05	10.0	12 WS
May 09	13 1	27 WS 1 SHRH
May 17	14	TRAP REMOVED

Totals for the 2004 monitoring period were:

Walleye	0
Northern Pike	0
Whit Sucker	39
Rock Bass	0
Short Head Redhorse	1
Total	40

RAPID CITY FISH LADDER – COUNT 2007

FISH TRAP INSTALLED APRIL 20, 2007

DATE	WATER TEMPERATURE	~~SAUGER~~ walleye	PIKE
APRIL 21	7 C		
22	8 C		
25	10 C	10	1
26	10 C	5	1
27	14 C	1	1
28	13 C	107	8
29	15 C	22	10
30	14 C	23	5
MAY 1	15 C	11	5
2	15 C	3	2
3	15 C	2	1
9	16 C	1	
10	14 C	3	
TOTALS		188	34

FISH TRAP REMOVED MAY 15

Figure A5-1. View of the pool and riffle structure of the Rapid City fish ladder, April 25, 2012.

Figure A5-2. View of the 0.3 m water level differential between the inside of the fish ladder culvert and the Rapid City Reservoir, April 25, 2012.

Figure A5-3 View of the fish ladder inlet on the Rapid City Reservoir side with small area of cattail immediately in front of the opening, April 25, 2012.

APPENDIX 6. TERRESTRIAL ENVIRONMENT

Table A6-1. List of plant species of concern within Manitoba's Aspen Parkland Ecoregion and their respective status under: 1) Manitoba Conservation Data Centre (MBCDC); 2) The Committee on the Status of Endangered Wildlife in Canada (COSEWIC); 3) Species at Risk Act (SARA); and 4) Manitoba Endangered Species Act (MBESA).

Species	Common Name	MBCDC Global Rank	MBCDC Provincial Rank	COSEWIC Status	SARA Status	MBESA Status
VASCULAR PLANT						
Agalinis aspera	Rough Purple False-foxglove (aka Rough Agalinis)	G5	S1S2	Endangered (April 2006)	Endangered (Schedule 1)	Endangered
Alisma gramineum	Narrow-leaved Water-plantain	G5	S1	--	--	--
Ambrosia acanthicarpa	Sandbur	G5	S1S2	--	--	--
Andropogon hallii	Sand Bluestem	G4	S2S3	--	--	--
Aristida purpurea var. longiseta	Red Three-awn	G5T5?	S1	--	--	--
Arnica fulgens	Shining Arnica	G5	S2	--	--	--
Artemisia cana	Silver Sagebrush	G5	S2	--	--	--
Asarum canadense	Wild Ginger	G5	S3S4	--	--	--
Asclepias lanuginosa	Hairy Milkweed	G4?	S2	--	--	--
Asclepias verticillata	Whorled Milkweed	G5	S3	--	--	--
Asclepias viridiflora	Green Milkweed	G5	S3	--	--	--
Astragalus gilviflorus	Cushion Milkvetch	G5	S1	--	--	--
Astragalus pectinatus	Narrow-leaved Milkvetch	G5	S2S3	--	--	--
Atriplex argentea	Saltbrush	G5	S2	--	--	--
Bidens amplissima	Beggar-ticks	G3	SNA	--	--	--
Boltonia asteroides var. recognita	White Boltonia	G5T3T5	S2S3	--	--	--
Botrychium campestre	Prairie Moonwort	G3G4	S1	--	--	--
Botrychium multifidum	Leathery Grape-fern	G5	S3	--	--	--
Bouteloua curtipendula	Side-oats Grama	G5	S2S3	--	--	--

Table A6-1. Continued.

Species	Common Name	MBCDC Global Rank	MBCDC Provincial Rank	COSEWIC Status	SARA Status	MBESA Status
VASCULAR PLANT						
Bromus porteri	Porter's Chess	G5	S3?	--	--	--
Bromus pubescens	Canada Brome Grass	G5	SNA	--	--	--
Bouteloua dactyloides	Buffalograss	G4G5	S1	Special Concern (Nov 2011)	Threatened (Schedule 1)	Threatened
Calamagrostis montanensis	Plains Reed Grass	G5	S3	--	--	--
Callitriche heterophylla	Larger Water-starwort	G5	S2	--	--	--
Carex bicknellii	Bicknell's Sedge	G5	SH	--	--	--
Carex cryptolepis	Northeastern Sedge	G4	S1	--	--	--
Carex gravida	Heavy Sedge	G5	S1	--	--	--
Carex hallii	Hall's Sedge	G4?Q	S3	--	--	--
Carex hystericina	Porcupine Sedge	G5	S3?	--	--	--
Carex parryana	Parry's Sedge	G4	S3?	--	--	--
Carex prairea	Prairie Sedge	G5?	S4?	--	--	--
Carex sterilis	Dioecious Sedge	G4	S2	--	--	--
Carex supina var. spaniocarpa	Weak Sedge	G5T3T5	S2?	--	--	--
Carex tetanica	Rigid Sedge	G4G5	S2	--	--	--
Carex torreyi	Torrey's Sedge	G4	S4	--	--	--
Carex tribuloides	Prickly Sedge	G5	SNA	--	--	--
Carex xerantica	White-scaled Sedge	G5	S3?	--	--	--
Celtis occidentalis	Hackberry	G5	S1	--	--	Threatened
Chamaesyce geyeri	Prostrate Spurge	G5	S1	--	--	--
Chenopodium subglabrum	Smooth Goosefoot	G3G4	S1	Threatened (April 2006)	Threatened (Schedule 1)	Endangered

Table A6-1. Continued.

Species	Common Name	MBCDC Global Rank	MBCDC Provincial Rank	COSEWIC Status	SARA Status	MBESA Status
VASCULAR PLANT						
Circaea lutetiana ssp. canadensis	Large Enchanter's-nightshade	G5T5	S2	--	--	--
Clematis ligusticifolia	Western Virgin's-bower	G5	S1	--	--	--
Clematis virginiana	Virgin's-bower	G5	S2	--	--	--
Coreopsis tinctoria	Common Tickseed	G5	SH	--	--	--
Corispermum americanum var. americanum	American Bugseed	G5?T5?	S2S3	--	--	--
Corispermum hookeri var. hookeri	Hooker's Bugseed	G4G5T4T5	S1	--	--	--
Corispermum pallasii	Pallas' Bugseed	G4?	SU	--	--	--
Corispermum villosum	Hairy Bugseed	G4?	S1S2	--	--	--
Cornus alternifolia	Alternate-leaved Dogwood	G5	S3	--	--	--
Cryptotaenia canadensis	Honewort	G5	S2	--	--	--
Cycloloma atriplicifolium	Winged Pigseed	G5	S2	--	--	--
Cymopterus acaulis	Plains Cymopterus	G5	S2S3	--	--	--
Cyperus houghtonii	Houghton's Umbrella-sedge	G4?	S2	--	--	--
Cyperus schweinitzii	Schweinitz's Flatsedge	G5	S2	--	--	--
Cypripedium candidum	Small White Lady's-slipper	G4	S2	Endangered (May 2000)	Endangered (Schedule 1)	Endangered
Dalea villosa var. villosa	Silky Prairie-clover (aka Hairy Prairie-clover)	G5T5	S2S3	Special Concern (Nov 2011)	Threatened (Schedule 1)	Threatened
Desmodium canadense	Beggar's-lice	G5	S2	--	--	--
Dichanthelium linearifolium	White-haired Panic-grass	GNR	S2	--	--	--

Table A6-1. Continued.

Species	Common Name	MBCDC Global Rank	MBCDC Provincial Rank	COSEWIC Status	SARA Status	MBESA Status
VASCULAR PLANT						
Dichanthelium wilcoxianum	Sand Millet	G5	S2	--	--	--
Drosera anglica	Oblong-leaved Sundew	G5	S3	--	--	--
Eleocharis engelmannii	Engelmann's Spike-rush	G4G5	S1	--	--	--
Elymus hystrix	Bottle-brush Grass	G5	S2	--	--	--
Eragrostis hypnoides	Creeping Teal Love Grass	G5	S4	--	--	--
Erigeron caespitosus	Tufted Fleabane	G5	S2	--	--	--
Festuca hallii	Plains Rough Fescue	G4	S3	--	--	--
Festuca subverticillata	Nodding Fescue	G5	S1	--	--	--
Galium aparine	Cleavers	G5	SU	--	--	--
Hackelia floribunda	Large Flowered Stickseed	G5?	SU	--	--	--
Helianthus nuttallii ssp. rydbergii	Tuberous-rooted Sunflower	G5T5	S2	--	--	--
Heliotropium curassavicum	Seaside Heliotrope	G5	SH	--	--	--
Hypoxis hirsute	Yellow Stargrass	G5	S4	--	--	--
Juncus interior	Inland Rush	G4G5	S1	--	--	--
Krascheninnikovia lanata	Winterfat	G5	S2	--	--	--
Leersia oryzoides	Rice Cutgrass	G5	S3?	--	--	--
Lemna turionifera	Duckweed	G5	SU	--	--	--
Leucophysalis grandiflora	Large White-flowered Ground-cherry	G4?	S3	--	--	--
Linum sulcatum	Grooved Yellow Flax	G5	S3	--	--	--
Lomatium foeniculaceum	Hairy-fruited Parsley	G5	S3	--	--	--
Lomatium macrocarpum	Long-fruited Parsley	G5	S3	--	--	--

Table A6-1. Continued.

Species	Common Name	MBCDC Global Rank	MBCDC Provincial Rank	COSEWIC Status	SARA Status	MBESA Status
VASCULAR PLANT						
Lomatium orientale	White-flowered Parsley	G5	S1	--	--	--
Lomatogonium rotatum	Marsh Felwort	G5	S2S3	--	--	--
Lotus unifoliolatus	prarie trefoil	G5	S2S3	--	--	--
Malaxis monophyllos	White Adder's-mouth	G5	S2?	--	--	--
Malaxis paludosa	Bog Adder's-mouth	G4	S1	--	--	--
Mentzelia decapetala	Gumbo-lily	G5	SH	--	--	--
Mertensia lanceolata	Tall Lungwort	G5	S2	--	--	--
Mimulus glabratus	Smooth Monkeyflower	G5	S1	--	--	--
Mimulus glabratus var. jamesii	Smooth Monkeyflower	G5T5	S1	--	--	--
Musineon divaricatum	Leafy Musineon	G5	S2	--	--	--
Myosurus minimus ssp. minimus	Least Mousetail	G5T5	S1	--	--	--
Nassella viridula	Green Needle Grass	G5	S3	--	--	--
Orobanche ludoviciana	Louisiana Broom-rape	G5	S2	--	--	--
Osmorhiza claytonii	Wooly or Hairy Sweet Cicely	G5	S2	--	--	--
Ostrya virginiana	Hop-hornbeam	G5	S2	--	--	--
Oxytropis sericea	Early Yellow Locoweed	G5	S1	--	--	--
Parietaria pensylvanica	American Pellitory	G5	S4	--	--	--
Penstemon nitidus	Smooth Blue Beard-tongue	G5	S2	--	--	--
Penstemon procerus	Slender Beard-tongue	G5	S1?	--	--	--
Phlox hoodii	Moss Pink	G5	S3	--	--	--
Phryma leptostachya	Lopseed	G5	S3	--	--	--
Plagiobothrys scouleri var. scouleri	Scouler's Allocarya	G5TNR	S1	--	--	--

Table A6-1. Continued.

Species	Common Name	MBCDC Global Rank	MBCDC Provincial Rank	COSEWIC Status	SARA Status	MBESA Status
VASCULAR PLANT						
Plantago elongata ssp. elongata	Linear Leaved-plantain	G4T4	S2	--	--	--
Platanthera orbiculata	Round-leaved Bog Orchid	G5	S3	--	--	--
Poa arida	Plains Blue Grass	G5	S4	--	--	--
Poa cusickii	Mutton-grass	G5	S2?	--	--	--
Poa fendleriana	Mutton Grass	G5	S2	--	--	--
Polanisia dodecandra ssp. dodecandra	Clammyweed	G5T5?	S1	--	--	--
Polanisia dodecandra ssp. trachysperma	Clammyweed	G5T5?	S1	--	--	--
Polygala verticillata	Whorled Milkwort	G5	S2	--	--	--
Polygala verticillata var. isocycla	Whorled Milkwort	G5T5	S2	--	--	--
Potamogeton amplifolius	Large-leaved Pondweed	G5	S2?	--	--	--
Potamogeton illinoensis	Illinois Pondweed	G5	S2	--	--	--
Potentilla plattensis	Low Cinquefoil	G4	S2	--	--	--
Ranunculus cymbalaria var. saximontanus	Seaside Crowfoot	G5T5	S1S2	--	--	--
Rhynchospora alba	White Beakrush	G5	S3?	--	--	--
Rhynchospora capillacea	Horned Beakrush	G4	S2	--	--	--
Sanguinaria canadensis	Blood-root	G5	S2	--	--	--
Schedonnardus paniculatus	Tumble-grass	G5	S2	--	--	--
Shinnersoseris rostrata	Annual Skeletonweed	G5?	S1S2	--	--	--
Sisyrinchium campestre	White-eyed Grass	G5	SU	--	--	--
Sporobolus neglectus	Annual Dropseed	G5	S3?	--	--	--
Thermopsis rhombifolia	Golden Bean	G5	S2	--	--	--

Table A6-1. Continued.

Species	Common Name	MBCDC Global Rank	MBCDC Provincial Rank	COSEWIC Status	SARA Status	MBESA Status
VASCULAR PLANT						
Townsendia exscapa	Silky Townsend-daisy	G5	S2	--	--	--
Tradescantia occidentalis	Western Spiderwort	G5	S1	Threatened (Nov 2002)	Threatened (Schedule 1)	Threatened
Uvularia sessilifolia	Small Bellwort	G5	S2	--	--	--
Verbena bracteata	Bracted Vervain	G5	S3	--	--	--
ASSEMBLAGE						
Andropogon scoparius-bouteloua spp. (curtipendula, gracilis)-carex filifolia herbaceous vegetation	Little Bluestem-grama Grass (Blue, Side-oats)-thread-leaved Sedge/Herbaceous Vegetation	GNR	S3	--	--	--
Fraxinus pennsylvanica-(ulmus americana)-acer negundo forest	Green Ash-(American Elm)-manitoba/Maple Forest	GNR	S3	--	--	--
Juniperus horizontalis/andropogon scoparius dwarf-shrubland	Creeping Juniper/little Bluestem//Dwarf Shrubland	GNR	S3?	--	--	--
Quercus macrocarpa/amelanchier alnifolia/aralia nudicaulis-carex assiniboinensis forest	Bur Oak/saskatoon//Serviceberry/sarsaparilla-assiniboia//Sedge Forest	GNR	S3?	--	--	--
Stipa comata-bouteloua gracilis-carex filifolia herbaceous vegetation	Needle-and-thread-blue/Grama-thread-leaved Sedge/Herbaceous Vegetation	GNR	S3	--	--	--

Figure A6-1. Park on north side of the Rapid City Reservoir, May 17, 2012.

Figure A6-2. North shoreline of the Rapid City Reservoir, August 2, 2012.

Figure A6-3. North shoreline of the Rapid City Reservoir, August 2, 2012.

Table A6-2. Bird species found within south-western Manitoba. Adapted from Manitoba Breeding Bird Atlas (2012), species names updated based on ITIS.

Order	Scientific Name	Common Name	Species CODE
Anseriformes	*Aix sponsa*	Wood Duck	WODU
	Anas acuta	Northern Pintail	NOPI
	Anas americana	American Wigeon	AMWI
	Anas clypeata	Northern Shoveler	NSHO
	Anas crecca	Green-winged Teal	GWTE
	Anas discors	Blue-winged Teal	BWTE
	Anas platyrhynchos	Mallard	MALL
	Anas strepera	Gadwall	GADW
	Aythya affinis	Lesser Scaup	LESC
	Aythya americana	Redhead	REDH
	Aythya collaris	Ring-necked Duck	RNDU
	Aythya valisineria	Canvasback	CANV
	Branta canadensis	Canada Goose	CAGO
	Bucephala albeola	Bufflehead	BUFF
	Bucephala clangula	Common Goldeneye	COGO
	Lophodytes cucullatus	Hooded Merganser	HOME
	Mergus merganser	Common Merganser	COME
	Oxyura jamaicensis	Ruddy Duck	RUDU
Galliformes	*Perdix perdix*	Gray Partridge	GRPA
	Bonasa umbellus	Ruffed Grouse	RUGR
	Gavia immer	Common Loon	COLO
	Meleagris gallopavo	Wild Turkey	WITU
	Phasianus colchicus	Ring-necked Pheasant ¤ ‡	RIPH
Gaviiformes	*Tympanuchus phasianellus*	Sharp-tailed Grouse	STGR
Podicipediformes	*Aechmophorus clarkii*	Clark's Grebe †	CLGR
	Aechmophorus occidentalis	Western Grebe §	WEGR
	Podiceps auritus	Horned Grebe ¤	HOGR
	Podiceps grisegena	Red-necked Grebe §	RNGR
	Podiceps nigricollis	Eared Grebe §	EAGR
	Podilymbus podiceps	Pied-billed Grebe	PBGR
Suliformes	*Phalacrocorax auritus*	Double-crested Cormorant §	DCCO
Pelecaniformes	*Ardea sumatrana*	Great Blue Heron §	GBHE
	Botaurus lentiginosus	American Bittern	AMBI
	Bubulcus ibis	Cattle Egret ¤ ‡	CAEG
	Egretta caerulea	Little Blue Heron †	LBHE
	Nycticorax nycticorax	Black-crowned Night-Heron §	BCNH
	Pelecanus erythrorhynchos	American White Pelican §	AWPE
	Plegadis chihi	White-faced Ibis ¤ ‡	WFIB

Table A6-2. Continued.

Order	Scientific Name	Common Name	Species CODE
Accipitriformes	*Accipiter cooperii*	Cooper's Hawk	COHA
	Accipiter gentilis	Northern Goshawk	NOGO
	Accipiter striatus	Sharp-shinned Hawk	SSHA
	Buteo jamaicensis	Red-tailed Hawk	RTHA
	Buteo platypterus	Broad-winged Hawk	BWHA
	Buteo regalis	Ferruginous Hawk †	FEHA
	Buteo swainsoni	Swainson's Hawk	SWHA
	Cathartes aura	Turkey Vulture	TUVU
	Circus cyaneus	Northern Harrier	NOHA
	Haliaeetus leucocephalus	Bald Eagle	BAEA
	Pandion haliaetus	Osprey ‡	OSPR
Falconiformes	*Falco columbarius*	Merlin	MERL
	Falco peregrinus	Peregrine Falcon ¤ ‡	PEFA
	Falco sparverius	American Kestrel	AMKE
Gruiformes	*Coturnicops noveboracensis*	Yellow Rail ¤	YERA
	Fulica americana	American Coot	AMCO
	Grus canadensis	Sandhill Crane	SACR
	Porzana carolina	Sora	SORA
	Rallus limicola	Virginia Rail	VIRA
Charadriiformes	*Actitis macularius*	Spotted Sandpiper	SPSA
	Bartramia longicauda	Upland Sandpiper	UPSA
	Charadrius melodus	Piping Plover †	PIPL
	Charadrius vociferus	Killdeer	KILL
	Chlidonias niger	Black Tern §	BLTE
	Chroicocephalus philadelphia	Bonaparte's Gull ‡	BOGU
	Gallinago delicata	Wilson's Snipe	WISN
	Hydroprogne caspia	Caspian Tern §	CATE
	Larus argentatus	Herring Gull §	HERG
	Larus delawarensis	Ring-billed Gull	RBGU
	Leucophaeus pipixcan	Franklin's Gull	FRGU
	Limosa fedoa	Marbled Godwit	MAGO
	Phalaropus tricolor	Wilson's Phalarope	WIPH
	Recurvirostra americana	American Avocet	AMAV
	Scolopax minor	American Woodcock	AMWO
	Sterna forsteri	Forster's Tern	FOTE
	Sterna hirundo	Common Tern	COTE
	Tringa semipalmata	Willet	WILL
Columbiformes	*Columba livia*	Rock Pigeon	ROPI
	Zenaida macroura	Mourning Dove	MODO
Cuciliformes	*Coccyzus erythropthalmus*	Black-billed Cuckoo	BBCU

Table A6-2. Continued.

Order	Scientific Name	Common Name	Species CODE
Strigiformes	*Aegolius acadicus*	Northern Saw-whet Owl	NSWO
	Asio flammeus	Short-eared Owl ¤	SEOW
	Asio otus	Long-eared Owl ¤	LEOW
	Athene cunicularia	Burrowing Owl †	BUOW
	Bubo virginianus	Great Horned Owl	GHOW
	Caprimulgus vociferus	Whip-poor-will ¤	WPWI
	Chordeiles minor	Common Nighthawk ¤	CONI
	Megascops asio	Eastern Screech-Owl	EASO
	Strix nebulosa	Great Gray Owl ¤	GGOW
	Strix varia	Barred Owl ¤	BDOW
	Surnia ulula	Northern Hawk Owl ¤	NHOW
Apodiformes	*Archilochus colubris*	Ruby-throated Hummingbird	RTHU
	Chaetura pelagica	Chimney Swift ¤	CHSW
Coraciiformes	*Megaceryle alcyon*	Belted Kingfisher	BEKI
Piciformes	*Colaptes auratus*	Northern Flicker	NOFL
	Dryocopus pileatus	Pileated Woodpecker	PIWO
	Melanerpes erythrocephalus	Red-headed Woodpecker ¤	RHWO
	Picoides arcticus	Black-backed Woodpecker	BBWO
	Picoides dorsalis	American Three-toed Woodpecker	ATTW
	Picoides pubescens	Downy Woodpecker	DOWO
	Picoides villosus	Hairy Woodpecker	HAWO
	Sphyrapicus varius	Yellow-bellied Sapsucker	YBSA
Passeriformes	*Contopus cooperi*	Olive-sided Flycatcher ¤	OSFL
	Contopus virens	Eastern Wood-Pewee	EAWP
	Empidonax alnorum	Alder Flycatcher	ALFL
	Empidonax flaviventris	Yellow-bellied Flycatcher	YBFL
	Empidonax minimus	Least Flycatcher	LEFL
	Empidonax traillii	Willow Flycatcher ¤ ‡	WIFL
	Sayornis phoebe	Eastern Phoebe	EAPH
	Sayornis saya	Say's Phoebe ¤ ‡	SAPH
	Myiarchus crinitus	Great Crested Flycatcher	GCFL
	Tyrannus tyrannus	Eastern Kingbird	EAKI
	Tyrannus verticalis	Western Kingbird	WEKI
	Lanius ludovicianus	Loggerhead Shrike †	LOSH
	Vireo flavifrons	Yellow-throated Vireo	YTVI
	Vireo gilvus	Warbling Vireo	WAVI
	Vireo olivaceus	Red-eyed Vireo	REVI
	Vireo philadelphicus	Philadelphia Vireo	PHVI
	Vireo solitarius	Blue-headed Vireo	BHVI
	Cyanocitta cristata	Blue Jay	BLJA
	Perisoreus canadensis	Gray Jay	GRAJ
	Pica hudsonia	Black-billed Magpie	BBMA
	Corvus brachyrhynchos	American Crow	AMCR
	Corvus corax	Common Raven	CORA
	Eremophila alpestris	Horned Lark	HOLA
	Progne subis	Purple Martin §	PUMA

Table A6-2. Continued.

Order	Scientific Name	Common Name	Species CODE
Passeriformes	*Tachycineta bicolor*	Tree Swallow	TRES
	Stelgidopteryx serripennis	Northern Rough-winged Swallow	NRWS
	Petrochelidon pyrrhonota	Cliff Swallow §	CLSW
	Riparia riparia	Bank Swallow §	BANS
	Riparia riparia	Barn Swallow	BARS
	Poecile atricapillus	Black-capped Chickadee	BCCH
	Sitta canadensis	Red-breasted Nuthatch	RBNU
	Sitta carolinensis	White-breasted Nuthatch	WBNU
	Certhia americana	Brown Creeper	BRCR
	Troglodytes aedon	House Wren	HOWR
	Troglodytes troglodytes	Winter Wren	WIWR
	Cistothorus palustris	Marsh Wren	MAWR
	Cistothorus platensis	Sedge Wren	SEWR
	Regulus calendula	Ruby-crowned Kinglet	RCKI
	Regulus satrapa	Golden-crowned Kinglet	GCKI
	Sialia currucoides	Mountain Bluebird ‡	MOBL
	Sialia sialis	Eastern Bluebird	EABL
	Catharus fuscescens	Veery	VEER
	Catharus guttatus	Hermit Thrush	HETH
	Catharus ustulatus	Swainson's Thrush	SWTH
	Dumetella carolinensis	Gray Catbird	GRCA
	Sturnus vulgaris	European Starling	EUST
	Toxostoma rufum	Brown Thrasher	BRTH
	Turdus migratorius	American Robin	AMRO
	Anthus spragueii	Sprague's Pipit ¤ ‡	SPPI
	Bombycilla cedrorum	Cedar Waxwing	CEDW
	Vermivora celata	Orange-crowned Warbler	OCWA
	Vermivora chrysoptera	Golden-winged Warbler ¤ ‡	GWWA
	Vermivora peregrina	Tennessee Warbler	TEWA
	Vermivora ruficapilla	Nashville Warbler	NAWA
	Dendroica coronata	Yellow-rumped Warbler	YRWA
	Dendroica pensylvanica	Chestnut-sided Warbler	CSWA
	Dendroica petechia	Yellow Warbler	YWAR
	Dendroica tigrina	Cape May Warbler	CMWA
	Mniotilta varia	Black-and-white Warbler	BAWW
	Seiurus aurocapilla	Ovenbird	OVEN
	Seiurus noveboracensis	Northern Waterthrush	NOWA
	Setophaga ruticilla	American Redstart	AMRE
	Oporornis agilis	Connecticut Warbler	CONW
	Oporornis philadelphia	Mourning Warbler	MOWA
	Geothlypis trichas	Common Yellowthroat	COYE
	Pipilo erythrophthalmus	Eastern Towhee	EATO
	Ammodramus bairdii	Baird's Sparrow †	BAIS
	Ammodramus leconteii	Le Conte's Sparrow	LCSP
	Ammodramus nelsoni	Nelson's Sparrow	NSTS
	Ammodramus savannarum	Grasshopper Sparrow ¤ ‡	GRSP

Table A6-2. Continued.

Order	Scientific Name	Common Name	Species CODE
	Chondestes grammacus	Lark Sparrow	LASP
	Pooecetes gramineus	Vesper Sparrow	VESP
	Spizella pallida	Clay-colored Sparrow	CCSP
	Spizella passerina	Chipping Sparrow	CHSP
	Melospiza georgiana	Swamp Sparrow	SWSP
	Melospiza lincolnii	Lincoln's Sparrow	LISP
	Melospiza melodia	Song Sparrow	SOSP
	Passer domesticus	House Sparrow	HOSP
	Passerculus sandwichensis	Savannah Sparrow	SAVS
	Zonotrichia albicollis	White-throated Sparrow	WTSP
	Junco hyemalis	Dark-eyed Junco	DEJU
	Calcarius ornatus	Chestnut-collared Longspur ¤ ‡	CCLO
	Passerina cyanea	Indigo Bunting	INBU
	Pheucticus ludovicianus	Rose-breasted Grosbeak	RBGR
	Piranga olivacea	Scarlet Tanager ¤	SCTA
	Dolichonyx oryzivorus	Bobolink	BOBO
	Sturnella neglecta	Western Meadowlark	WEME
	Agelaius phoeniceus	Red-winged Blackbird	RWBL
	Euphagus cyanocephalus	Brewer's Blackbird	BRBL
	Xanthocephalus xanthocephalus	Yellow-headed Blackbird	YHBL
	Quiscalus quiscula	Common Grackle	COGR
	Molothrus ater	Brown-headed Cowbird	BHCO
	Icterus galbula	Baltimore Oriole	BAOR
	Icterus spurius	Orchard Oriole	OROR
	Carpodacus mexicanus	House Finch	HOFI
	Carpodacus purpureus	Purple Finch	PUFI
	Loxia curvirostra	Red Crossbill †	RECR
	Loxia leucoptera	White-winged Crossbill ¤	WWCR
	Carduelis pinus	Pine Siskin	PISI
	Carduelis tristis	American Goldfinch	AMGO
	Coccothraustes vespertinus	Evening Grosbeak	EVGR

† and ¤ rare species in Manitoba; ‡ a regionally rare species; § a colonial species.

Table A6-3. Bird species identified during the course of field investigations within the Rapid City Project Study Area, April through July 2012.

Date	Time	Common Name	Scientific Name	Location	Comments
25-Apr-12		American crow	*Corvus brachyrhynchos*	near fish ladder	
25-Apr-12		Song sparrow	*Melospiza melodia*	near fish ladder	
25-Apr-12		Ring-billed Gull	*Larus delawarensis*	Sandbar	numerous on the sandbar
17-May-12	9:30	Ruby-crowned Kinglet	*Regulus calendula*	Eastern shoreline	
17-May-12	9:30	Red-winged Blackbird	*Agelaius phoeniceus*	Eastern shoreline	
17-May-12	9:30	Tree Swallow	*Tachycineta bicolor*	Eastern shoreline	
17-May-12	9:30	Barn Swallow	*Riparia riparia*	Eastern shoreline	
17-May-12	9:30	Purple Martin	*Progne subis*	Eastern shoreline	2 on NW shore
17-May-12	9:30	Common Grackle	*Quiscalus quiscula*	Eastern shoreline	
17-May-12	9:30	American Robin	*Turdus migratorius*	Eastern shoreline	
17-May-12	9:30	Mallard	*Anas platyrhynchos*	Eastern shoreline	
17-May-12	9:30	Northern Flicker	*Colaptes auratus*	Eastern shoreline	
17-May-12	9:30	American crow	*Corvus brachyrhynchos*	Eastern shoreline	
17-May-12	9:30	Least Flycatcher	*Empidonax minimus*	Eastern shoreline	
17-May-12	9:30	House Sparrow	*Passer domesticus*	Eastern shoreline	
17-May-12	9:30	Killdeer	*Charadrius vociferus*	Eastern shoreline	
17-May-12	9:30	Chipping Sparrow	*Spizella passerina*	Eastern shoreline	
17-May-12	9:30	Black-billed Magpie	*Pica hudsonia*	Eastern shoreline	
17-May-12	9:30	Yello Warbler	*Dendroica petechia*	Eastern shoreline	
17-May-12	9:30	Yellow-bellied Sapsucker	*Sphyrapicus varius*	Eastern shoreline	
17-May-12	9:30	Tennessee Warbler	*Vermivora peregrina*	Eastern shoreline	recent name change to *Oreothlypis*
17-May-12	9:30	Brewer's Blackbird	*Euphagus cyanocephalus*	Eastern shoreline	
17-May-12	9:30	Blue-winged Teal	*Anas discors*	Eastern shoreline	
17-May-12	9:30	Willet	*Tringa semipalmata*	mud bar	
17-May-12	15:02	Canada Goose	*Branta canadensis*	marsh in little bay on north side upstream of PTH24 Bridge	multiple, nesting

Table A6-3. Continued.

Date	Time	Common Name	Scientific Name	Location	Comments
24-Jul-12	9:50	Killdeer	*Charadrius vociferus*		
24-Jul-12	9:50	Cliff Swallow	*Petrochelidon pyrrhonota*		
24-Jul-12	9:50	Cedar Waxwing	*Bombycilla cedrorum*		
24-Jul-12	9:50	House Sparrow	*Passer domesticus*		
24-Jul-12	9:50	American Goldfinch	*Carduelis tristis*		
24-Jul-12	9:50	Greater Yellowlegs	*Tringa melanoleuca*		
24-Jul-12	9:50	Lesser Yellowlegs	*Tringa flavipes*		
24-Jul-12	9:50	Red-winged Blackbird	*Agelaius phoeniceus*		
24-Jul-12	9:50	Common Grackle	*Quiscalus quiscula*		

Table A6-4. List of mammal species found within Manitoba's Aspen Parkland Ecoregion. Adapted from The Mammals of Canada (1974). Species names updated based on ITIS, accessed October 2012 (http://www.itis.gov).

Family	Scientific Name	Common Name
Soricidae	*Sorex arcticus*	Arctic Shrew
	Sorex cinereus	Masked Shrew
	Sorex hoyi	Pygmy Shrew
	Sorex palustris	Water Shrew
	Blarina brevicauda	Northern Short-tailed Shrew
Talpidae	*Condylura cristata*	Star-nosed Mole
Vespertilionidae	*Myotis lucifugus*	Little Brown Bat
	Myotis keenii	Keens' Myotis
	Lasiurus borealis	Red Bat
	Lasiurus cinereus	Hoary Bat
	Lasionycteris noctivagans	Silver-haired Bat
	Eptesicus fuscus	Big Brown Bat
Leporidae	*Sylvilagus floridanus*	Eastern cottontail
	Lepus americanus	Snowshoe Hare
	Lepus townsendii	White-tailed Jackrabbit
Sciuridae	*Tamias minimus*	Least Chipmunk
	Tamias striatus	Eastern Chipmunk
	Marmota monax	Woodchuck/Groundhog/Marmot
	Spermophilus richardsonii	Richardson's Ground Squirrel
	Spermophilus franklinii	Franklin’s Ground Squirrel
	Spermophilus tridecemlineatus	Thirteen-lined Ground Squirrel
	Sciurus carolinensis	Eeastern Gray Squirrel
	Tamiasciurus hudsonicus	Red Squirrel
	Glaucomys sabrinus	Northern Flying Squirrel
	Thomomys talpoides	Northern Pocket gopher
Heteromyidae	*Perognathus fasciatus*	Olive-backed Pocket Mouse
Geomyidae	*Castor canadensis*	American Beaver

Table A6-4. Continued.

Family	Scientific Name	Common Name
Muridae	*Peromyscus maniculatus*	Deer Mouse
	Onychomys leucogaster	Northern Grasshopper Mouse
	Clethrionomys gapperi	Southern Red-backed Vole
	Phenacomys intermedius	Heather Vole
	Microtus ochrogaster	Prairie Vole
	Microtus pennsylvanicus	Meadow Vole
	Ondatra zibethicus	Muskrat
	Synaptomys borealis	Northern Bog Lemming
	Mus musculus	House Mouse
	Rattus norvegicus	Norway Rat
Dipodidae	*Zapus hudsonius*	Meadow Jumping Mouse
Erethizontidae	*Erethizon dorsatus*	North American Porcupine
Canidae	*Canis latrans*	Coyote
	Canis lupus	Wolf
	Vulpes vulpes	Red Fox
	Urocyon cinereoargenteus	Gray Fox
Ursidae	*Ursus americanus*	Black Bear
Procyonidae	*Procyon lotor*	Raccoon
Mustelidae	*Martes americana*	American Marten
	Martes pennanti	Fisher
	Mustela erminea	Ermine
	Mustela frenata	Long-tailed Weasel
	Mustela nivalis	Least Weasel
	Neovison vison	American Mink
	Taxidea taxus	American Badger
	Mephitis mephitis	Striped Skunk
	Lontra canadensis	River Otter
Felidae	*Puma concolor*	Puma/Cougar
	Lynx canadensis	Lynx
	Lynx rufus	Bobcat
Cervidae	*Odocoileus hemionus*	Mule Deer
	Odocoileus virginianus	White-tailed Deer
	Alces alces	Moose

Table A6-5. A list of mammal species identified during the course of field investigations within the Rapid City Project Study Area, May through August 2012.

Date	Time	Common Name	Scientific Name	Location
17-May-12	9:30	muskrat	*Ondatra zibethicus*	north shore
18-May-12	~11:00	American mink	*Neovison vison*	north shore at park
2-Aug-12	11:00	muskrat	*Ondatra zibethicus*	north shore near bridge

Table A6-6. List of amphibian and reptile species found in Manitoba. Adapted from Preston (1982), with updated taxonomy based on ITIS, accessed October 2012 (http://www.itis.gov).

Class	Order	Scientific Name	Common Name	Distribution Range Overlapping Study Area
Amphibia	Anura (frogs & toads)	*Anaxyrus americanus americanus*	Eastern American Toad	NO
		Anaxyrus cognatus	Great Plains Toad	NO
		Anaxyrus hemiophrys	Canadian Toad	YES
		Hyla chrysoscelis	Cope's Gray Treefrog	YES
		Hyla versicolor	Gray Treefrog	NOT LIKELY
		Lithobates clamitans	Green Frog	NO
		Lithobates pipiens	Northern Leopard Frog (western boreal/prairie population)	YES
		Lithobates septentrionalis	Mink Frog	NO
		Lithobates sylvaticus	Wood Frog	YES
		Pseudacris crucifer	Spring Peeper	NO
		Pseudacris maculata	Boreal Chorus Frog	YES
		Spea bombifrons	Plains Spadefoot	POSSIBLE
	Caudata (Salamanders)	*Ambystoma laterale*	Blue-Spotted Salamander	NO
		Ambystoma tigrinum	Eastern Tiger Salamander	NO
		Ambystoma mavortium	Barred Tiger Salamander	YES
		Necturus maculosus maculosus	Common Mudpuppy	NOT LIKELY
Reptilia	Testudines	*Chelydra serpentina serpentina*	Common Snapping Turtle	YES
		Chrysemys picta bellii	Western Painted Turtle	YES
	Squamata (lizards & snakes)	*Plestiodon septentrionalis septentrionalis*	Northern Prairie Skink	NO
		Heterodon nasicus nasicus	Plains Hognose Snake	NO
		Opheodrys vernalis	Smooth Greensnake	YES
		Storeria occipitomaculata occipitomaculata	Northern Redbelly Snake	YES
		Thamnophis radix	Plains Garter Snake	YES
		Thamnophis sirtalis parietalis	Red-sided Garter Snake	YES

Table A6-7. A list of amphibian and reptile species identified during the course of field investigations within the Rapid City Project Study Area, May through August 2012.

Date	Time	Common Name	Scientific Name	Location	Comments
17-May-12	9:30	Painted Turtle	*Chrysemys picta bellii*	south shore on dock	
17-May-12	~13:00	Painted Turtle	*Chrysemys picta bellii*	south shore	picture taken
24-Jul-12	9:50	Northern Leopard Frog	*Lithobates pipiens*	north shore at the playground	18 observed; may breed, rear and winter in the reservoir, channel deep for winter, margins suitable for breeding and rearing
25-Jul-12	9:21	Painted Turtle	*Chrysemys picta bellii*	GN-1	Alive
2-Aug-12	11:00	Northern Leopard Frog	*Lithobates pipiens*	T1 of mussel survey; near bridge	17 Adults and 3 YOY
2-Aug-12	12:45	Northern Leopard Frog	*Lithobates pipiens*	T4 of mussel survey	

Table A6-8. List of bird species of concern within Manitoba's Aspen Parkland Ecoregion and their respective status under 1) Manitoba Conservation Data Centre (MBCDC), 2) The Committee on the Status of Endangered Wildlife in Canada (COSEWIC), 3) Species at Risk Act (SARA), and 4) Manitoba Endangered Species Act (MBESA) and the potential occurrence of these species in the Project Study Area.

Species	Common Name	MBCDC Rank	COSEWIC Status	SARA Status	MBESA Status	Habitat	Potential to Occur in Project Area
Accipiter cooperii	Cooper's Hawk	G5, S4S5B	Not at Risk (April 1996)	--	--	open forest; forest edge, oak and riparian[1]	High
Aechmophorus occidentalis	Western Grebe	G5, S4B	--	--	--	marshes, lakes, rivers and vicinity, sandspits, mudlfats, ponds, and rocky or sandy seashores & coastal habitats[1]	Low
Ammodramus bairdii	Baird's Sparrow	G4, S1B	Special Concern (May 2012)	No Status (no schedule)	Endangered	mixed-grass prairies or lightly razed pastures, occasionally in hayfields, fallow fields, or cropland[2]	Low
Ammodramus savannarum	Grasshopper Sparrow	G5, S2B	--	--	--	open landscapes, including grasslands; grasslands with scattered trees[1]	Low

Table A6-8. Continued.

Species	Common Name	MBCDC Rank	COSEWIC Status	SARA Status	MBESA Status	Habitat	Potential to Occur in Project Area
Anthus spragueii	Sprague's Pipit	G4, S2B	Threatened (April 2010)	Threatened (Schedule 1)	Threatened	grassland habitat; prefers to nest in open native grasslands with no or low shrub density; rarely found in cultivated lands, less abundant in native grasslands with introduced grasses; may breed in tame forages[3]	Low
Ardea herodias	Great Blue Heron	G5S4S5B	--	--	--	marshes, lakes, rivers and vicinity, sandspits, mudlfats, ponds[1]	Moderate
Asio flammeus	Short-eared Owl	G5, S2S3B	Special Concern (April 2008)	Special Concern (Schedule 1)	Threatened	open habitats: unforested, including grasslands, sand-sage, peat-bogs, marshes, fallow pastues, & occasionally fields planted with row-crops & agricultural fields[3]	Moderate
Athene cunicularia	Burrowing Owl	G4, S1B	Endangered (April 2006)	Endangered (Schedule 1)	Endangered	flat/gently rolling treeless pastureland & prairie, with abandoned burrows; also seen nesting in ditches, cropland, golf course & lawns[2]; open, sparsely vegeatted grasslands with excavated burrows[3]	Low
Bubulcus ibis	Cattle Egret	G5, S1S2B	--	--	--	grassland with scattered trees, marshes & swamps[1]	Low
Buteo regalis	Ferruginous Hawk	G4, S2B	Threatened (April 2008)	Threatened (Schedule 1)	Endangered	natural grasslands[3]; open areas dominated by native grasses & scattered trees or shrubs[2]	Low
Calamospiza melanocorys	Lark Bunting	G5, S1B	--	--	--	open landscapes such as grasslands; areas of scrub vegetation; grasslands with scattered trees[1]	Low
Calcarius ornatus	Chestnut-collared Longspur	G5, S1S2B	Threatened (Nov 2009)	Threatened (Schedule 1)	Endangered	native prairie grasslands, typically breeding in recently grazed or mowed, arid, short- or mixed-grass prairie[3]	Low

Table A6-8. Continued.

Species	Common Name	MBCDC Rank	COSEWIC Status	SARA Status	MBESA Status	Habitat	Potential to Occur in Project Area
Chaetura pelagica	Chimney Swift	G5, S2B	Threatened (April 2007)	Threatened (Schedule 1)	Threatened	near waterbodies; associated with urban & rural areas with chimneys[3]	Moderate
Charadrius melodus	Piping Plover	G3, S1B	Endangered (May 2001)	Endangered (Schedule 1)	Endangered	lakeshores & river sandbars, nesting on gravel shores of shallow, saline lakes & of sandy shores or larger prairie lakes[2]	None
Chlidonias niger	Black Tern	G4, S4B	Not at Risk (April 1996)	--	--	open landscapes, including grasslands & coastal ponds; lakes, irvers, mudflats & ponds; marshes; open seas & rocky or sandy seashores[1]	High
Chordeiles minor	Common Nighthawk	G5, S3B	Threatened (April 2007)	Threatened (Schedule 1)	Threatened	nests in open, vegetation-free habitats including dunes, beaches, forest clearings, burnt-over areas, logged areas, rocky outcrops, rocky barrens, grasslands, pastures, peat bogs, marshes, lakeshores, and river banks; also inhabitats mixed & coniferous forests[3]	High
Contopus cooperi	Olive-sided Flycatcher	G4, S3S4B	Threatened (Nov 2007)	Threatened (Schedule 1)	--	open areas (forest clearings, forest edges near natural openings like rivers, bogs or swamps, or logged areas, burned forests or old-growth gaps) containing tall live trees or snags for perching[3]	Low
Coturnicops noveboracensis	Yellow Rail	G4, S3S4B	Special Concern (Nov 2009)	Special Concern (Schedule 1)	--	marshes dominated by sedges, true grasses & rushes with little or no standing water (1-12 cm)& saturated substrate throughout summer; damp fields & meadows, river & stream floodplains, bog herbaceous vegetation, & at upper levels of estuarine & salt marshes[3]	Moderate

Table A6-8. Continued.

Species	Common Name	MBCDC Rank	COSEWIC Status	SARA Status	MBESA Status	Habitat	Potential to Occur in Project Area
Dolichonyx oryzivorus	Bobolink	G5, S4B	Threatened (April 2010)	No Status (no schedule)	--	nesting in forage crops (hayfields & pastures dominated by a variety of species such as clover, Timothy, Kentucky Bluegrass & broadleaved plants), & various grassland habitats including wet prairie, graminoid peatlands & abandoned field dominated by tall grasses, prairie remnants, no-till cropland, small-grain fields, restored surface mining sites, & irrigated fields in arid regions[3]	High
Empidonax traillii	Willow Flycatcher	G5, S2S3B	--	--	--	brushland, shrubs, thickets & undergrowth; marshes; lakes, rivers & vicinity, sandspits, mudflats, ponds[1]	Low
Eremophila alpestris	Horned Lark	G5, S3B	--	--	--	open landscapes, including grasslands & coastal ponds; grasslands with scattered trees[1]	High
Falco peregrinus	Peregrine Falcon	--	Special Concern (April 2007)	Special Concern (Schedule 1)	Endangered	open habitats such as grassland & marshes; nesting: on cliff edges or crevices, sometimes on ledges of tall buildings or bridges, usually near wetlands[2,3]	Low
Grus americana	Whooping Crane	--	Endangered (April 2010)	Endangered (Schedule 1)	Endangered	overwinters in Texas & breeds in unique wetland complex in Wood Buffalo National Park near Alberta/NWT border consisting of substantial amount of open water[3]	None

Table A6-8. Continued.

Species	Common Name	MBCDC Rank	COSEWIC Status	SARA Status	MBESA Status	Habitat	Potential to Occur in Project Area
Ixobrychus exilis	Least Bittern	--	Threatened (April 2009)	Threatened (Schedule 1)	Endangered	breeds in marshes dominated by emergent vegetation interspersed with areas of open water[3]	Low
Lanius ludovicianus e xcubitorides	Loggerhead Shri ke	G4T4, S2B	Threatened (May 2004)	Threatened (Schedule 1)	Endangered	native prairie and pastureland habitats; wide variety of open habitats including grasslands, sagebrush stands, pastures, agricultural or open areas and thinly wooded areas with small trees and shrubs[3]	Low
Melanerpes erythrocephalus	Red-headed Woodpecker	G5, S2B	Threatened (April 2007)	Threatened (Schedule 1)	Threatened	variety of habitats, including open oak & beech forests, grasslands, forest edges, orchards, pastures, riparian forests, roadsides, urban parks, golf courses, cemeteries, & along beaver ponds & burms[3]	Moderate
Numenius americanus	Long-Billed Curlew	--	Special Concern (May 2011)	Special Concern (Schedule 1)	Extirpated	breeding in extensive, flat areas of short native grassland[3]	None
Nycticorax nycticorax	Black-crowned Night-heron	G5, S3S4B	--	--	--	freshwater marshes & swamps; lakes, rivers & vicinity, sandspits, mudflats, ponds; forest edge, oak & riparian[1]	High
Phalacrocorax auritus	Double-crested Cormorant	G5, S5B	Not at Risk (April 1978)	--	--	lakes, rivers & vicnity, sandspits, mudflats, ponds; rocky & sandy seashores; rocky places or cliffs[1]	Low
Podiceps auritus	Horned Grebe	G5, S3B	Special Concern (April 2009)	No Status (no schedule)	--	nests in freshwater (occasionally brackish) on small permanent or semi-permanent ponds which last until autumn; also uses marshes & shallow bays on lake borders; breeding: open water & emergent vegetation beds[3]	Moderate

Table A6-8. Continued.

Species	Common Name	MBCDC Rank	COSEWIC Status	SARA Status	MBESA Status	Habitat	Potential to Occur in Project Area
Podiceps nigricollis	Eared Grebe	G5, S4S5B	--	--	--	freshwater marshes & swamps; lakes, rivers & vicinity, sandspits, mudflats, ponds[1]	Moderate
Sayornis saya	Say's Phoebe	G5, S2S3B	--	--	--	areas of scrub vegetation; open landscapes (grasslands & coastal ponds); grassland with scattered trees; semidesert; desert[1]	Low
Sterna forsteri	Forster's Tern	G5, S4B	Data Deficient (April 1996)	--	--	freshwater marshes & swamps; open landscapes (grasslands & coastal ponds); lakes, rivers & vicinity, sandspits, mudflats, ponds; rocky or sandy seashores[1]	Moderate
Strix varia	Barred Owl	G5, S3S4B	--	--	--	forest: coniferous, broadleaf, tempertae; forest edge, oak or riparian; freshwater marshes[1]	Moderate
Tympanuchus cupido	Greater Prairie-Chicken	--	Extirpated (Nov 2009)	Extirpated (Schedule 1)	Extirpated	native prairies[3]	None
Vermivora chrysoptera	Golden-winged Warbler	G4, S3B	Threatened (April 2006)	Threatened (Schedule 1)	Threatened	areas of early successional scrub surrounded by mature forests; found in dry uplands, swamp forests & marshes; RoWs, field edges, recently logged areas, beaver marshes & areas that are burned or intermittently farmed[3]	Low
Wilsonia canadensis	Canada Warbler	G5, S4B	Threatened (April 2008)	Threatened (Schedule 1)	Endangered	variety of forest types, butmost abundant in mixed forest with a well-developed shrub layer; riparian shrub forest on slopes,in ravines; in regenerating stands[3]	Low

[1]Alsop II, F.J. 2002. Birds of Canada.

[2]Manitoba Conservation Species at Risk brochure. Wildlife and Ecosystem Protection Branch. Winnipeg, MB.

[3]COSEWIC reports

Table A6-9. List of mammal species of concern within Manitoba's Aspen Parkland Ecoregion and their respective status under 1) Manitoba Conservation Data Centre (MBCDC), 2) The Committee on the Status of Endangered Wildlife in Canada (COSEWIC), 3) Species at Risk Act (SARA), and 4) Manitoba Endangered Species Act (MBESA) and the potential occurrence within the Project Study Area.

Species	Common Name	MBCDC Rank	COSEWIC Status	SARA Status	MBESA Status	Habitat	Potential to Occur in the Project Study Area
Antilocapra americana	Pronghorn	n/a	not listed	not listed	Extirpated	plains, steppes, deserts & foothills[1]	None
Bison bison bison	Plains Bison	n/a	not listed	not listed	Extirpated	historically, across prairies, including grasslands, shrublands & some woodland areas, in suitable grassland & meadow habitat[2]	None
Mustela frenata	Long-tailed Weasel	G5, S3	Not at Risk (April 1993)	not listed	--	open grasslands, aspen parklands, & river bottom lands; prefers the vicinity of water[1]	High
Odocoileus hemionus	Mule or Black-tailed Deer	G5, S3	not listed	not listed	Threatened	open coniferous forests, subclimax brush, aspen parklands, steep broken terrain, & river valleys; avoids open prairie & deep coniferous forests[1]	Moderate
Ursus arctos	Grizzly Or Brown Bear	n/a	not listed	not listed	Extirpated	open areas of alpine tundra & subalpine forests[1]	None
Vulpes velox	Kit or Swift Fox	n/a	not listed	not listed	Extirpated	short- or mixed-grass prairie on level terrain or gently rolling hills[2]	None

[1]Banfield, A.W.F. 1974. The Mammals of Canada
[2]COSEWIC reports

Table A6-10. List of amphibian and reptile species of concern within Manitoba's Aspen Parkland Ecoregion and their respective status under 1) Manitoba Conservation Data Centre (MBCDC), 2) The Committee on the Status of Endangered Wildlife in Canada (COSEWIC), 3) Species at Risk Act (SARA), and 4) Manitoba Endangered Species Act (MBESA) and the potential occurrence within the Project Study Area.

Species	Common Name	MBCDC Rank	COSEWIC Status	SARA Status	MBESA Status	Habitat	Potential to Occur in the Project Study Area
AMPHIBIA							
Bufo cognatus	Great Plains Toad	G5, S2	Special Concern (April 2010)	Special Concern (Schedule 1)	Threatened	associated with native grasslands; shallow, clean, clear, temporary pools & ditches of spring melt- & rainwater[1]	None
Lithobates pipiens	Northern Leopard Frog	--	Special Concern (April 2009)	Special Concern (Schedule 1)	--	Overwintering: well oxygenated waterbodies that don't feeze to bottom; Breeding: pools, ponds, marshes & lakes; Summering: moist upland meadows & native prairie[1]	High
Spea bombifrons	Plains Spadefoot	G5, S2S3	Not at Risk (May 2003)	--	--	grasslands, generally in areas of sandy or light-textured soils[2]	Low
REPTILIA							
Chelydra serpentina serpentina	Common Snapping Turtle	G5T5, S3	Special Concern (Nov 2008)	Special Concern (Schedule 1)	--	slow-moving water with a soft-mud bottom and dense aquatic vegetation[1]	High
Plestiodon septentrionalis	Northern Prairie Skink	G5, S1	Endangered (May 2004)	Endangered (Schedule 1)	Endangered	mixed grass prairies with sandy soil[1]	None
Heterodon nasicus	Western Hognose Snake	G5, S1S2	--	--	Threatened	grasslands, preferring sandy soil habitat[2]	None
Storeria occipitomaculata	Northern Redbelly Snake	G5, S3S4	--	--	--	open areas & in marshes or meadows, found hibernating in ant hills[2]	High

[1]COSEWIC reports

[2]Preston, W. 1982. The Amphibians and Reptiles of Manitoba.

APPENDIX 7. AT RISK SPECIES RANK CODES

Table A7-1. Ranks and codes used by the Manitoba Conservation Data Centre to denote global and provincial status for species of conservation concern.

Rank/Code	Definition
1	Very rare throughout its range or in the province (5 or fewer occurrences, or very few remaining individuals). May be especially vulnerable to extirpation.
2	Rare throughout its range or in the province (6 to 20 occurrences). May be vulnerable to extirpation.
3	Uncommon throughout its range or in the province (21 to 100 occurrences).
4	Widespread, abundant, and apparently secure throughout its range or in the province, with many occurrences, but the element is of long-term concern (>100 occurrences).
5	Demonstrably widespread, abundant, and secure throughout its range or in the province, and essentially impossible to eradicate under present conditions.
U	Possibly in peril, but status uncertain; more information needed.
H	Historically known; may be rediscovered.
X	Believed to be extinct; historical records only, continue search.
SNR	A species not ranked. A rank has not yet assigned or the species has not been evaluated.
SNA	A conservation status rank is not applicable to the element.
G#G# S#S#	Numeric range rank: A range between two of the numeric ranks. Denotes range of uncertainty about the exact rarity of the species.
T	Rank for subspecific taxon (subspecies, variety, or population); appended to the global rank for the full species, e.g. G4T3.
B	Breeding status of a migratory species. Example: S1B,SZN - breeding occurrences for the species are ranked S1 (critically imperilled) in the province, nonbreeding occurrences are not ranked in the province.
N	Non-breeding status of a migratory species. Example: S1B,SZN - breeding occurrences for the species are ranked S1 (critically imperilled) in the province, nonbreeding occurrences are not ranked in the province.
Q	Taxonomic questions or problems involved, more information needed; appended to the global rank.
T	Rank for subspecific taxon (subspecies, variety, or population); appended to the global rank for the full species.
#	A modifier to SX or SH; the species has been reintroduced but the population is not yet established.
?	Inexact or uncertain; for numeric ranks, denotes inexactness.

Table A7-2. Ranks and codes used by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) to denote status for species of conservation concern.

Rank/Code	Definition
Extinct	A species that no longer exists.
Extirpated	A species that no longer exists in the wild in Canada, but exists elsewhere.
Endangered	A species facing imminent extirpation or extinction.
Threatened	A species that is likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction.
Special Concern	A species that may become threatened or endangered because of a combination of biological characteristics and identified threats.
Data Deficient	A category that applies when the available information is insufficient (a) to resolve a species' eligibility for assessment or (b) to permit an assessment of the species' risk of extinction.
Not at Risk	A species that has been evaluated and found to be not at risk of extinction given the current circumstances.

Table A7-1. Ranks and codes used by the Manitoba Endangered Species Act to denote status for species of conservation concern.

Rank/Code	Definition
Extinct	A species formerly indigenous to Manitoba that no longer exists either in Manitoba or elsewhere.
Extirpated	A species formerly indigenous to Manitoba that no longer exists in the wild in Manitoba but exists elsewhere.
Endangered	A species indigenous to Manitoba that is threatened with imminent extinction or with extirpation throughout all or a significant portion of its Manitoba range.
Threatened	A species indigenous to Manitoba that is likely to become endangered or is, because of low or declining numbers in Manitoba, particularly at risk if the factors affecting its vulnerability do not become reversed.

APPENDIX 8. SIGNIFICANCE DETERMINATION

The significance approach framework is guided by the "Reference Guide for the *Canadian Environmental Assessment Act*" and includes the identification of adverse environmental effects, followed by the determination of the significance and likelihood of the residual adverse effects as outlined in the tables below.

Environmental Component	EFFECT	Significance Criteria						Significance
		Magnitude	Geographic Extent	Duration	Frequency	Permanence / reversibility	Ecological Context	

S: Significant adverse environmental effect

NS: Not significant adverse environmental effect

ME: Minor Adverse Effect/ Mitigable Effect (Not Significant)

UN: Uncertain/ Unknown Effect

Significance Criteria Definitions

Criterion	Low	Moderate	High
Magnitude (of the effect)	• Effect is evident only at or nominally above baseline conditions.	• Effect exceeds baseline conditions however is less than regulatory criteria or published guideline values.	• Effect exceeds regulatory criteria or published guideline values.
Geographic Extent (of the effect)	• Effect is limited to the project site/footprint.	• Effect extends into areas beyond the project site/footprint boundary.	• Effect is trans-boundary in nature.
Duration (of the effect)	• Effect is evident only during the construction phase of the project.	• Effect is evident during construction and/or the operational phase of the project.	• Effects will be evident beyond the operational life of the project.
Frequency (of conditions causing the effect)	• Conditions or phenomena causing the effect occur infrequently (i.e. < once per year).	• Conditions or phenomena causing the effect occur at regular intervals although infrequent intervals (i.e. < once per month).	• Conditions or phenomena causing the effect occur at regular and frequent intervals (i.e. > once per month).
Permanence (of effect)	• Effect is readily reversible over a short period of time (i.e. one growing season).	• Effect is not readily reversible during the life of the project.	• Effect is permanent.
Ecological Context (of effect)	• Evidence of environmental effects by human activities. Effect results in minimal disruption of ecological functions and relationships in the impacted area.	• Relatively pristine area. Effect results in some disruption of non-critical ecological functions and relationship in the impacted area.	• Pristine area / not affected by human activity. Effect results in disruption of critical ecological functions and relationship in the impacted area.