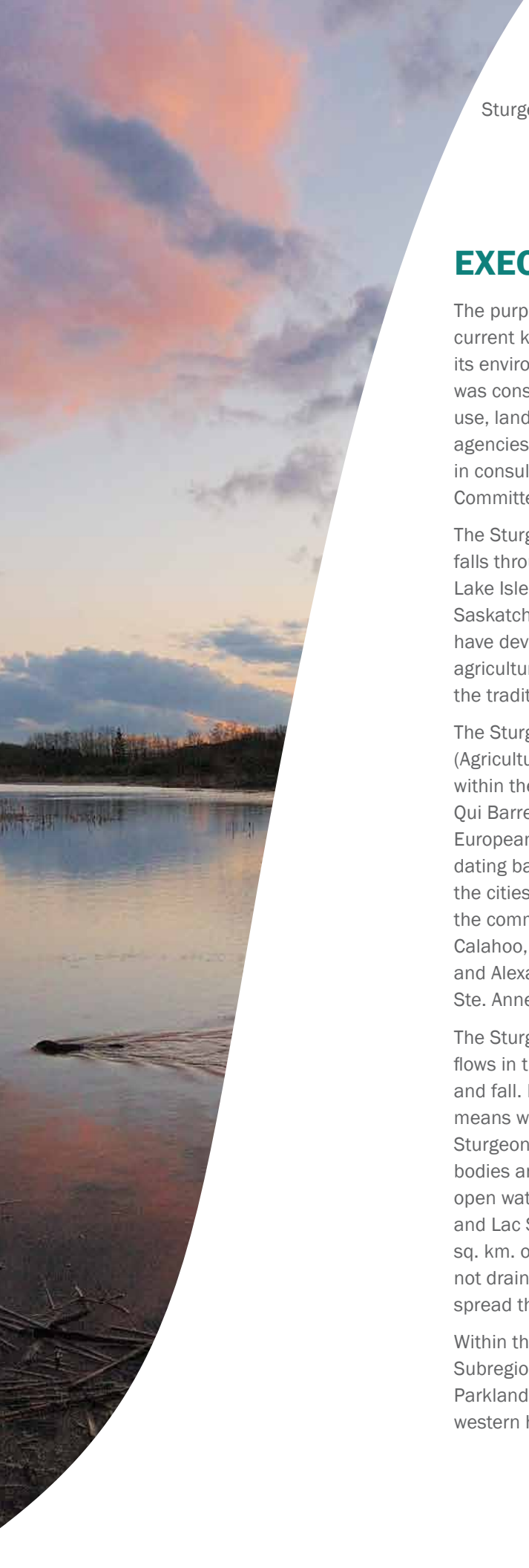
STURGEON RIVER
STATE OF THE WATERSHED REPORT
TECHNICAL REPORT | NOVEMBER 2012

City of St. Albert **Office of Environment**
Green by nature

City of St. Albert
Cultivate Life



EXECUTIVE SUMMARY

The purpose of this State of the Watershed Report is to summarize the current knowledge of the Sturgeon River Watershed and to comment on its environmental integrity. The data collected and used in this report was constrained to recent water quantity and water quality reports; land use, land cover and agricultural information from various governmental agencies; and select data pertaining to biological indicators, as determined in consultation with the City of St. Albert's Environmental Advisory Committee.

The Sturgeon River is a prairie river, fed only by the rain and snow that falls throughout the year. It starts at Hoople Lake, flowing east through Lake Isle, Lac Ste. Anne and Big Lake before emptying into the North Saskatchewan River at Fort Saskatchewan. Numerous cities and towns have developed along its journey. The river travels through fertile agricultural fields, open prairies, wooded forests and meanders through the traditional lands of First Nations communities.

The Sturgeon River Watershed covers 3,301 square kilometres (sq. km.) (Agriculture and Agri-Food Canada, 2008). The major water channels within the watershed are Toad Creek, Kilini Creek, Atim Creek, Rivière Qui Barre and Little Egg Creek. Along with First Nations communities, European settlements and missions were established along the watershed dating back to the 1800s. Today, the Sturgeon River Watershed includes the cities of St. Albert, Spruce Grove, the northwest corner of Edmonton, the communities of Bon Accord, Gibbons, Morinville, Onoway, Stony Plain, Calahoo, Villenueve, Spring Lake, the First Nations Reserves of Alexis 133 and Alexander 134, and portions of the County of Barrhead No. 11, Lac Ste. Anne County, Parkland County, Sturgeon County and Westlock County.

The Sturgeon River Watershed experiences high flow variability, with peak flows in the spring and extended periods of low flow during the summer and fall. Much of the watershed is believed to recharge groundwater, which means water flows on the surface contribute little to the groundwater. The Sturgeon River Watershed has approximately 179 sq. km. of open water bodies and approximately 1,380 km of permanent watercourses, with open water covering five per cent of the landscape. Wagner Bog, Big Lake and Lac Ste. Anne are notable bodies of water in the basin. There are 69.9 sq. km. of wetlands/saturated soils, and 353 sq. km. of land that does not drain out of the watershed. The non-contributing drainage areas are spread throughout the watershed.

Within the Sturgeon River Watershed there are three diverse Natural Subregion landscapes: Dry Mixedwood, Central Mixedwood and Central Parkland. The Dry Mixedwood Natural Subregion dominates in the western half of the watershed with rolling terrain, and the flatter terrain

of the Central Parkland Natural Subregion dominates the east. The upper west and north portions of the Sturgeon River Watershed have geological deposits on the surface underlying this terrain, dominated by glacial till. The Sturgeon River Watershed has little relief, with elevations ranging from 871 metres above mean sea level (amsl) in the headwaters to 600 m amsl where it joins the North Saskatchewan River in the east.

The Sturgeon River Watershed is located within the White Area (privately-owned lands) of the Province, though there are small areas of Crown-owned land. High quality soils contribute to the Watershed's primary use of agricultural production, with over 1,200 farms on 2,354 sq. km., or 71 per cent of the total land base either in crops or as pasture. Twenty per cent of the total land base consists of natural land cover classes such as scrub-shrub, forested lands and wetlands. Livestock densities in the watershed are considered moderate. An inventory carried out by Ducks Unlimited Canada found 6.8 per cent of the area included permanent and temporary wetlands. While little information is available on drained wetlands, we can assume losses of up to 71 per cent of wetlands with greater losses in urban areas. The area is impacted by urban development with more than three per cent of lands disturbed by linear developments.

Water quality was monitored at 85 sites within the Sturgeon River Watershed. These sites included: 14 along the Sturgeon River, 23 along tributaries, 45 on lakes and three on wetlands. Similar to other watersheds in the province, the primary pollutants of concern were nutrients (nitrogen and phosphorus), bacteria (both E. coli and total coliforms), and pesticides. In addition to these pollutant concentrations, sites with sufficient data were also analyzed for trends over time. Most of the parameters measured in the water quality monitoring program have not shown a consistent trend. However, bacteria, total phosphorus and total suspended solids increased, while nitrate-nitrite and total dissolved solids decreased. Unfortunately, for many of the parameters that remained steady, the concentrations were higher than the water quality guidelines. Nutrient concentrations in the Sturgeon River Watershed are similar to other North Saskatchewan River tributaries with similar land uses and agricultural intensities. Most of the problems with water quality may result from the over-application of fertilizers and road salt, combined with extensive impenetrable areas that do not allow these compounds to be absorbed by soils.

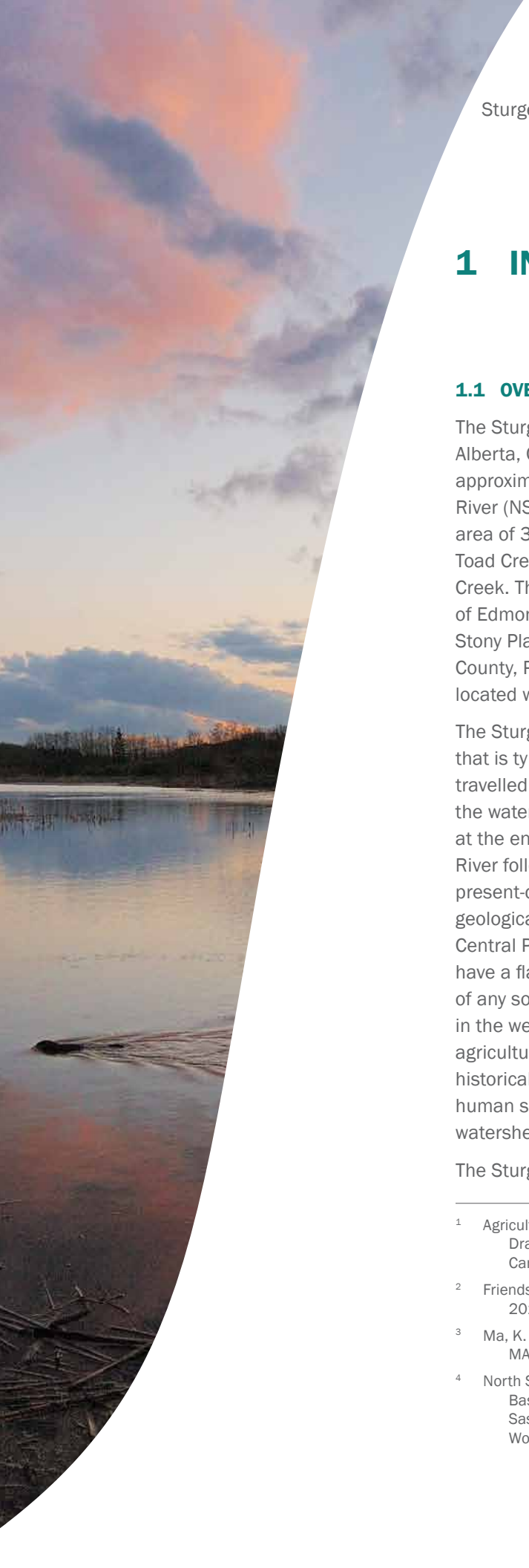
Overall, the health of the Sturgeon River Watershed is assessed as fair. This assessment is based on the average of 15 indicators, of which three were ranked as good, five were ranked as fair, and three were ranked as poor. Four of the indicators (Riparian Health, the Alberta Surface Water Quality Index, Aquatic Macrophytes and Benthic Invertebrates) had insufficient data. Nitrogen and Phosphorus, Fish and Vegetation Types were rated as poor. Due to a lack of in-depth watershed studies, considerable uncertainty surrounds the health based on the Wetland Inventory and Fish. However, much of the data indicates these two factors are in poor condition and at risk of further degradation due to a combination of both natural and anthropogenic causes, so a conservative approach was taken in their assessment.

The North Saskatchewan Watershed Alliance (NSWA) is actively seeking a sub-basin planning group for the Sturgeon River to undertake specific planning and on-the-ground initiatives for the basin. We recommend that a watershed group for the Sturgeon River be established immediately to oversee and undertake this work. Other municipal initiatives around planning and management for protection of wetlands and riparian buffers were also recommended.

CONTENTS

LIST OF FIGURES

LIST OF TABLES



1 INTRODUCTION

1.1 OVERVIEW OF THE STURGEON RIVER WATERSHED

The Sturgeon River is a non-glacial-fed prairie river located in central Alberta, Canada, flowing eastward from its headwaters near Hoople Lake approximately 260 km to its confluence with the North Saskatchewan River (NSR), near the City of Fort Saskatchewan. It has a total watershed area of 3301 sq. km.[1]. The major watercourses within the watershed are Toad Creek, Kilini Creek, Atim Creek, Rivière Qui Barre, and Little Egg Creek. The Cities of St. Albert and Spruce Grove and the northwest corner of Edmonton, the Towns of Bon Accord, Gibbons, Morinville, Onoway, and Stony Plain, and portions of County of Barrhead No. 11, Lac Ste. Anne County, Parkland County, Sturgeon County and Westlock County are all located within the Sturgeon River Watershed (Figure 1). [2]

The Sturgeon River Watershed is named after the Lake Sturgeon, a fish that is typically found in the North Saskatchewan River but historically travelled up the Sturgeon River to feed.[3] Much of the eastern portion of the watershed consists of ancient lake beds and river channels formed at the end of the last glaciation, with the current path of the Sturgeon River following the prehistoric valley of the North Saskatchewan River. The present-day physiography of the watershed is strongly determined by this geological history. In the eastern half of the watershed, the soils of the Central Parkland Natural Subregion formed on the glacial lake sediments have a flatter topography but some of the highest capability for agriculture of any soils in the province. The soils of the Dry Mixedwood Subregion in the west have a more rolling topography and lower (though still high) agricultural capability. This geological history is also reflected in the historical and present-day patterns of settlement and land use, with higher human settlement and agricultural densities in the eastern portion of the watershed.[4]

The Sturgeon River is a prairie river, fed only by snowmelt and seasonal

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1 Agriculture and Agri-Food Canada. 2008. PFRA Watershed Project - Incremental Gross Drainage Area. Prairie Farms Rehabilitation Administration, Agriculture and Agri-Food Canada. Regina, Saskatchewan.

2 Friends of Geographical Names of Alberta. 2011. Sturgeon River. Accessed February 18, 2011.

3 Ma, K. 2006. End to End: The State of the Sturgeon River and the Alberta Water Crisis. MA Thesis. Carleton University, Ontario, May 2006. 120 p.

4 North Saskatchewan Watershed Alliance (NSWA). 2009. North Saskatchewan River Basin: Overview of Groundwater Conditions, Issues, and Challenges. The North Saskatchewan Watershed Alliance Society, Edmonton, Alberta. Prepared by WorleyParsons, Edmonton, Alberta.

precipitation rather than the glaciers that contribute to some of the North Saskatchewan River's sub-watersheds further to the west. Therefore, it experiences naturally high variability in flows, with peak flows in the spring and extended periods of low flow during the summer and fall.[5] Much of the watershed is believed to be a groundwater recharge area, which means there is little contribution from groundwater to surface water flows. This combination of factors results in high variability in surface water supplies both within and between years, and also in the amount of water available to naturally recharge groundwater supplies. The potential for conflicting pressures on water quantity and quality, and increases in individual pressures due to population and economic growth, are a major driving force behind the need for watershed-level planning within the Sturgeon River. Effective planning requires a solid understanding of current conditions and their historic influences, which is the primary impetus for the creation of this State of the Watershed Report.

1.2 PURPOSE OF THE REPORT

A watershed or drainage basin is the area of land that catches precipitation and drains it to a single point, usually at the exit of the watershed, where it joins another body of water or watercourse, such as a wetland, lake, stream or river. Watersheds can range in size from a few hectares to thousands of square kilometres. Healthy, functioning watersheds can: provide clean and abundant water resources to agricultural, municipal, industrial and recreational users; help produce healthy crops and crop yields; support wildlife habitat; and control natural processes such as soil erosion and sedimentation. Healthy watersheds greatly contribute to the overall health of the environment. A state of the watershed report provides information on a wide variety of topics within a watershed, acting as a benchmark against which environmental changes and management practices will be assessed. [6]

A State of the Watershed Report is the first stage in Watershed Management Planning under the Province of Alberta's *Water for Life* strategy. [7] The *Water for Life* strategy was created by the Alberta Government in response to the often conflicting and increasing pressures on Alberta's water supplies. The three goals of the strategy are to preserve and maintain:

- safe, secure drinking water supplies
- healthy aquatic ecosystems
- reliable, quality water supplies for a sustainable economy

The strategy also recognizes that to meet these goals water and land management must be integrated at the watershed level. [8]

Watershed management is an adaptive, comprehensive and integrated multi-resource management

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[5] Golder Associates Ltd. 2009. Vermillion River Water Supply and Demand Study. Report prepared by Golder Associates Ltd. for the North Saskatchewan Watershed Alliance., Edmonton, Alberta. 140 p.

[6] Alberta Environment. 2008. Water for Life: A Renewal. Government of Alberta, Edmonton, Alberta.; Red Deer River Watershed Alliance (RDRWA). 2008. What is Watershed Management? Red Deer River Watershed Alliance, Red Deer, Alberta.; Aquality Environmental Consulting Ltd. 2009. Red Deer River State of the Watershed Report. Report prepared for the Red Deer River Watershed Alliance, Red Deer, Alberta, Canada.

[7] Alberta Environment. 2008. Handbook for State of the Watershed Reporting: A Guide for Developing State of the Watershed Reports in Alberta. Alberta Environment, Edmonton, Alberta.

[8] Alberta Environment. 2008. Indicators for Assessing Environmental Performance of Watersheds in Southern Alberta - ISBN 978-0-7785-7345-6 (online). 69 p.; Alberta Environment. 2009. Watershed Management Planning Opportunities for the Sturgeon River. Presentation by Andrew Schoepf, Senior Environmental Planner, at the Sturgeon River Watershed Initiative session on February 12, 2009.

planning process that seeks a balance of healthy ecological, economic and cultural/social conditions within a watershed.[9] Watershed management serves to integrate planning for land and water, accounting for ground and surface water flow, and recognizing and planning for the interaction of water, plants, animals and human land use within the physical boundaries of a watershed. Watershed management provides a framework for integrated decision-making to help:

- assess the nature and status of the watershed
- identify watershed issues
- define and re-evaluate short and long-term objectives, actions and goals
- assess benefits and costs
- implement and evaluate actions

Adopting a watershed approach is founded on the basis that Alberta's water resources must be managed within the capacity of individual watersheds and that Albertans recognize there are limits to the available water supply. What happens on the land and water in a watershed will affect the water supply that rivers provide. While land and water are closely linked, these resources have not historically been managed in a fully integrated manner. Focusing efforts at the watershed level provides a comprehensive understanding of local management needs, and encourages locally led management decisions. [10]

The purpose of this State of the Watershed Report is to summarize the current knowledge of the Sturgeon River Watershed pertaining to land-use, water quantity, water quality, fisheries and selected biological indicators and to comment on the environmental integrity of the Sturgeon River Watershed. This report has been created for the City of St. Albert for use by all stakeholders in the watershed including residents, regulators, policy makers, industry and non-governmental organizations. It provides the necessary information for a shared governance approach to watershed management decisions by regulators, policy makers, landowners and industrial users. This State of the Watershed Report is designed to answer the following questions:

- What is the current condition of the Sturgeon River Watershed, and how does this compare to conditions in the past?
- What are the cumulative impacts of land and water use on the health of the watershed?
- What are the critical or emerging environmental, economic or social issues?
- What are the data/knowledge gaps that need to be filled in?
- What indicators should be used to monitor and assess the health of the watershed?
- What mechanisms are in place or need to be in place to maintain and protect the health of the Sturgeon River Watershed?[11]

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9 Op. cit., RDRWA, 2008

10 Op. cit., RDRWA, 2008

11 City of St. Albert. 2010. Terms of Reference: State of the Sturgeon River Watershed Report. Report prepared by the City of St. Albert, Alberta, for the successful proponent.

1.3 SCOPE OF THE REPORT

The geographic scope of this report is the entire Sturgeon River Watershed (Figure 1). It includes all or portions of the boundaries of Bon Accord, Gibbons, Morinville, Onoway, Spruce Grove, St. Albert, Stony Plain, and portions of the County of Barrhead No. 11, Lac Ste. Anne County, Parkland County, Sturgeon County and Westlock County.

The scope of data collected and used in this report was constrained to recent water quantity and water quality reports; land use, land cover, and agricultural information from various governmental agencies; and select data pertaining to biological indicators, as determined in consultation with the City of St. Albert's Office of Environment and Environmental Advisory Committee. Trends over time, related to the biological indicators, are summarized and presented in this report. As such, this report includes historical and the most recent data that is available. Indicators of condition and risk were previously selected by North Saskatchewan Watershed Alliance (NSWA) experts to determine what variables would be summarized to gauge the State of the Watershed, and ultimately predict watershed health.

1.4 DESCRIPTION OF FORMAT AND CONTENT OF REPORT

The report consists of nine main sections:

1. Introduction
2. Public Perception and Concerns
3. Existing Legislation, Plans and Programs
4. Watershed Characteristics
5. Land Use and Social/Cultural Resources
6. Surface Water Quantity and Management
7. Surface Water Quality
8. Issues and Challenges
9. Conclusions, Recommendations and Stewardship Opportunities

Sections 2 to 7 summarize related data, reports, planning and other documents, and identify data gaps that may exist. Sections 8 and 9 summarize the overall state of knowledge about the Sturgeon River Basin, including the identification of data gaps, recommendations for future management activities, and further studies that may be required to maximize the benefit obtained from any future management plans.

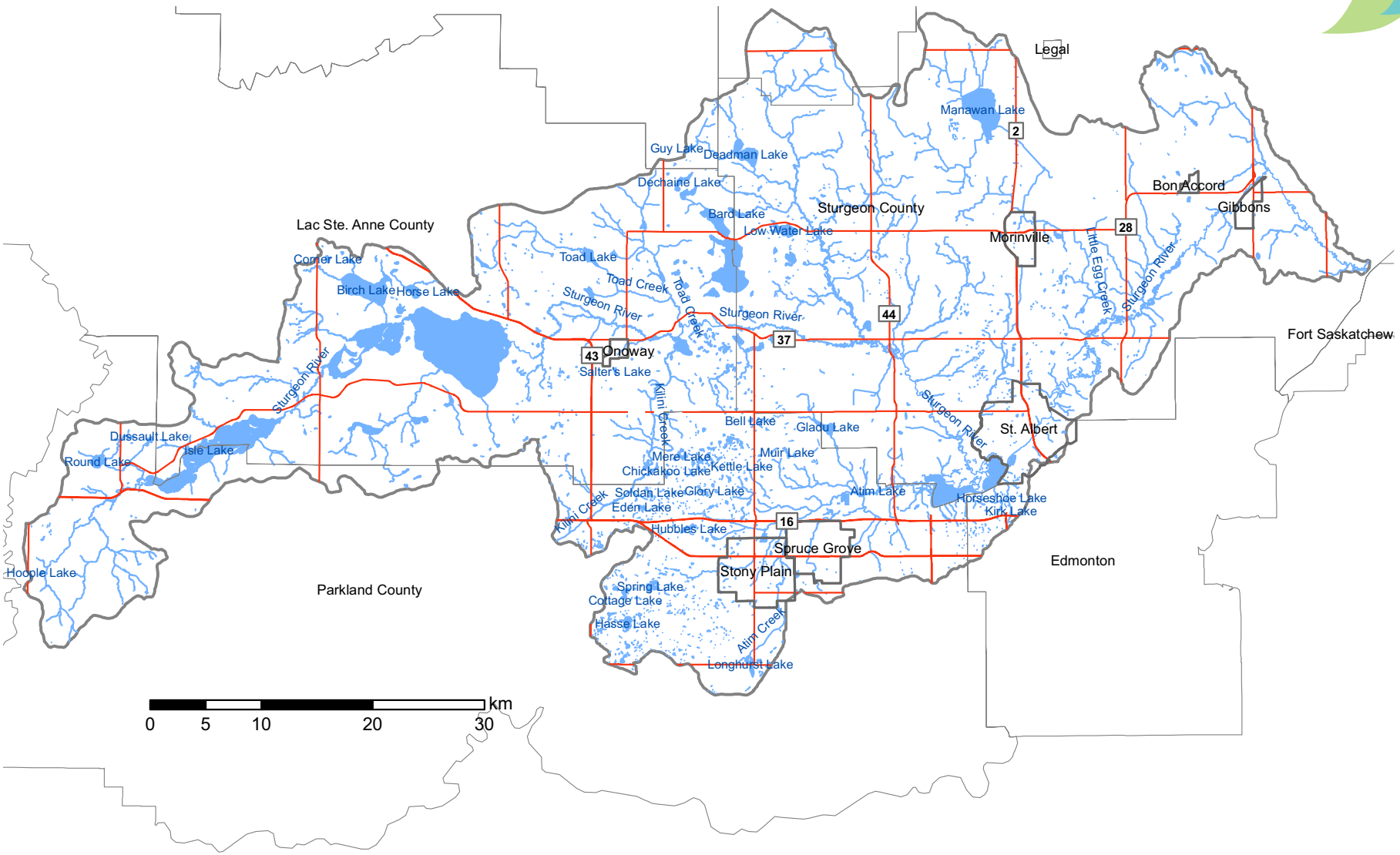

Figure 1. Sturgeon River Watershed geopolitical boundaries (Natural Resources Canada, 2009b; Natural Resources Canada, 2010).

2 PUBLIC PERCEPTION AND CONCERNS

Albertans in general are concerned about the environment and the impact our resource-extraction based economy may have on it. With continued economic and population growth, the demand for resources, such as water is also rising. Further, aquatic ecosystems are susceptible to small changes in water quality and quantity. The Province of Alberta has recently put a considerable amount of attention towards new legislation, strategies and policies directed towards more efficient use of our resources, such as the Land-use Framework, *Water for Life* and the *Alberta Wetland Policy*.

The Land-use Framework (LUF) recognizes that industrial activity, municipal development, infrastructure, recreation and conservation interests all compete to use the same piece of land, creating conflict and stressing the finite capacity of land, water, air and habitat.[12] LUF's purpose is to manage growth and sustain our growing economy while balancing these needs with social and environmental goals through seven basic strategies:

1. Develop seven regional land-use plans based on seven new land-use regions
2. Create a Land-use Secretariat and establish a Regional Advisory Council for each region
3. Manage the impacts of development on land, water and air at the regional level through cumulative effects management
4. Develop a strategy for conservation and stewardship on private and public lands
5. Promote efficient use of land to reduce the footprint of human activities on Alberta's landscape
6. Establish an information, monitoring and knowledge system to contribute to continuous improvement of land-use planning and decision-making
7. Include aboriginal peoples in land-use planning

Water for Life addresses the pressures of population growth, droughts, and agricultural and industrial development on available water supplies and the well-being of Albertans, the economy and aquatic ecosystems.[13]

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[12] Government of Alberta. 2008. Land-Use Framework. Government of Alberta, Edmonton, Alberta. 54p.

[13] Government of Alberta. 2002. Water for Life: Facts and Information on Water in Alberta 2002. Alberta Environment, Edmonton, Alberta. 48p.

As well, the Province of Alberta is no longer managing our resources in isolation, but has embraced a "shared governance"[14] approach of involving all Albertans in decision making, using a consensus decision-making approach.

A clear set of principles[15] emerged from the consultation process of *Water for Life*:

- All Albertans must recognize there are limits to available water supply.
- Alberta's watersheds must be managed within the capacity of individual watersheds.
- Citizens, communities, industry and government must share responsibility for water management in Alberta, and work together to improve conditions within their local watersheds.
- Knowledge of Alberta's water supply and quality is the foundation for effective decision-making.
- Albertans must become leaders of effective and efficient water usage and wise and responsible water use.
- Alberta must preserve the first-in-time, first-in-right principle for granting and administering water allocations, but water allocations will be transferable to ensure societal demands and needs can be met.
- Healthy aquatic ecosystems are vital to a high quality of life for Albertans and must be preserved.
- Groundwater and surface water quality must be preserved in pursuing economic and community development.
- Alberta will continue to be a leader in drinking water quality and standards to ensure Albertans have safe, secure drinking water.

From the above principles, the three goals or "pillars", of the water strategy became:

1. safe, secure drinking water supplies
2. healthy aquatic ecosystems
3. reliable, quality water supplies for a sustainable economy

In 2006, the strategy was reviewed by the Alberta Water Council to re-energize and refocus it. It became clear from the Alberta Water Council's 2006 Review Report[16] that the three goals of the strategy continue to be valid. However, from public and stakeholder input, two additional themes with three recommendations each emerged in the Council's Renewal Report:[17]

1. Safeguard our water sources
    a. address aquatic ecosystem degradation
    b. integrate land and water management
    c. create, enhance and use innovative tools and best practices

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[14] Alberta Water Council. 2008. Strengthening Partnerships: A Shared Governance Framework for Water for Life Collaborative Partnerships. Alberta Water Council, Edmonton, Alberta. 32p.

[15] Government of Alberta. 2003. Water for Life: Alberta's Strategy for Sustainability. Alberta Environment, Edmonton, Alberta. November 2003. 31 p.

[16] Alberta Water Council. 2006. Water for Life 2006 Review Report. Alberta Water Council, Edmonton, Alberta. 36p.

[17] Alberta Water Council. 2008. Water for Life: Recommendations for Renewal. Alberta Water Council, Edmonton, Alberta. 36p.

2. Accelerate action
    a. clarify roles, responsibilities and accountabilities
    b. enhance data collection, analysis and reporting
    c. expand public awareness programs and build shared commitment

2.1 PUBLIC CONSULTATIONS

he public's perceptions of, and concerns for the Sturgeon River are important as they provide direction and focus to this State of the Watershed Report and they identify areas that can be addressed. While public consultation was not undertaken as part of this report, public input was researched or solicited through various means, including past public consultations from the City of St. Albert with respect to developments such as area structure plans, master plans, and municipal development plans; surveys (at tradeshows) and letters to the editor from local newspapers. Public perceptions within the basin are often based on limited understanding of what a healthy prairie-type river should look. The basin has traditionally been dominated by agriculture but is now home to some of the fastest growing resource industries and urban communities in Alberta. This changing picture of land uses is reflected in the wide range of public concerns related to the Sturgeon River and watershed. Moving forward it will be important for collaborative partnerships like the Big Lake Task Force or the Sturgeon River Watershed Initiative to lead the way in any watershed based initiatives.

The following is a summary of some of the public consultations related to the Sturgeon River Watershed:

2.1.1 Sturgeon River Area Structure Plan

The earliest report containing documented public consultation is the Sturgeon River Valley Area Structure Plan, 1983. This plan was created at the request of the Town of Gibbons and the Municipal District (M.D.) of Sturgeon. The plan focused on developing specific land uses and recreation policies along the Sturgeon River within the Town of Gibbons and the surrounding area. Survey questionnaires were distributed to every household in Gibbons and within the study area. The majority of residents at that time stated they would like the area planned as a park, with some developed recreation, some natural and some undeveloped areas. Many of the residents were concerned about the fact that most of the river valley was privately owned and about funding additional development.

The Sturgeon Valley Area Structure Plan (ASP) was initiated in 1999 by Sturgeon County to help ensure land use policies that address the needs and values of residents, businesses and stakeholders, are in place to guide future growth and development. The ASP focuses on the land contained within the following boundaries: north of Edmonton and St. Albert city limits; east of Highway 28; south of Highway 37; and west of Range Road 253. Seventy-eight people participated in the public consultation either as part of a focus group or by interview. A summary of the public comments in regards to environmental protection is as follows:

- preserve environmentally sensitive areas
- use adequate setbacks
- dedicate adequate environmental and municipal reserves

- prohibit motorized vehicle use
- increase public education/interpretation centres
- restrict development in flood prone areas
- protect the Sturgeon River Valley

A review of the Sturgeon Valley Area Structure Plan was conducted in 2007 to determine if the goals set forth in the 1999 plan were still valid. The advisory committee, comprised of 11 members, and six developers/consultants active in the Sturgeon Valley completed a questionnaire.

Under Section 4.6 Environmental Protection, the 1999 ASP policy stated: "Environmental protection policies aim to protect environmentally sensitive areas and promote environmentally responsible development that can accommodate environmentally sustainable growth. These policies are designed to:

- protect environmentally sensitive areas;
- protect flood plain areas from inappropriate development;
- protect the environmental integrity of the Sturgeon River Valley; and
- protect wildlife habitat and the integrity of wildlife corridors."[18]

Nine respondents said the policy was still valid and their comments are summarized below:

- Prevent ad hoc development to preserve the valley environment.
- Preserve view corridors at scenic points that overlook the valley.
- Maintain public access to the Sturgeon River.
- Restrict motorized recreational vehicle activities in environmentally sensitive areas.
- Identify and protect historic barns and buildings and encourage their adaptive reuse – give the valley a 'sense of place' in the future by retaining elements of its farming past.
- Encourage the planting of trees and maintenance-free greenery to enhance the environment.
- Update the flood portion of the plan.
- Setbacks from bodies of water are too restrictive. Perhaps 30 m and 50 m setbacks could be identified as guidelines that are adjustable based on municipal needs and expert technical advice.

There have been other ASPs created for developments around the Sturgeon River Valley. They were reviewed but not included in this report because they did not contain specific environmental protection information but focused on trail and park development.[19]

2.1.2 Red Willow Park Master Plan Update

In September 2003, the City of St. Albert updated the Red Willow Park Master Plan, including two Vision Building Workshops as part of the public consultation process. The updated Plan's Vision recognized 'Red Willow Park and the Big Lake Natural Area is a means for the protection and conservation of the Big Lake and Sturgeon River environment with associated water bodies, shorelands, wetlands, forests and White Spruce stand.' [20]

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[18] Sturgeon Valley Area Structure Plan. 1999.

[19] Sturgeon River Valley Area Structure Plan. 1983. M.D. Sturgeon and the Town of Gibbons.

[20] Red Willow Park West Master Plan Update, page 57, Gibbs & Brown Landscape Architects Ltd., September 2003

2.1.3 City of St. Albert Environmental Master Plan

In August 2008, IMI Strategics of Edmonton completed a public consultation process for the City of St. Albert in support of the development of an environmental master plan. Six strategic directions were developed by the City's Internal Technical Committee and community-based Environmental Advisory Committee.[21] One of the strategies was to maintain and protect the Sturgeon River. Public input was obtained from the City's rain barrel contest entry forms, surveys and a series of six workshops. Workshop respondents ranked 'maintain and protect the Sturgeon River' as their third priority, whereas the rain barrel contest respondents ranked 'improving water quality in the Sturgeon River' as their fifth priority.

To maintain and protect the Sturgeon River, respondents were willing to:

1. switch to environmentally friendly fertilizers and pesticides (94 per cent)
2. participate in a river cleanup campaign (83 per cent)
3. support construction of water treatment devices for all water draining into the river from streets and roads (83 per cent)
4. support a ban on fertilizer/herbicide combination products, such as weed 'n feed (76 per cent)
5. support a ban on use of salts on driveways and sidewalks (72 per cent)
6. replace lawn with landscaping that uses less water (69 per cent)

Action themes included:

- control water quality
- protect habitat
- manage regionally or by watershed
- regulate
- educate

Specific actions included:

- cleaning up
- managing comprehensively
- increasing, protecting and enhancing habitat and riparian areas
- setting development standards
- educating
- providing incentives or disincentives[22]

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[21] Environmental Advisory Committee. 2010. Sturgeon River Overview. Presentation by the Environmental Advisory Committee, May 26, 2010.

[22] IMI Strategics. 2008. Public Consultation Phase 2 Summary: Guiding the City of St. Albert's Environmental Master Plan. Report prepared by IMI Strategies for the City of St. Albert, Alberta. 44 p.

2.1.4 Lac St. Anne County 2003 Gravel Management Plan

Gravel extraction along the North Saskatchewan River and its tributaries continues to be a contentious issue among local residents. In Lac Ste. Anne County, there has been much opposition to the 2003 Gravel Management Plan and citizen research states that Lac Ste. Anne County's process 'is widely questioned and contradicted by other municipalities, specifically as it relates to the gravel industry.'[23]

Citizens have written letters requesting revisions to the current bylaws that allow gravel extraction as close as three metres from residential properties; fail to protect sensitive areas; and has one set of generous bylaws for gravel companies, and another set of restrictive bylaws for all other developers, industries and residents (Lac Ste. Anne Community Group, 2012). The Onoway River Valley Conservation Association (ORVCA) echoes similar concerns.[24]

2.1.5 City of Edmonton Big Lake Neighbourhood Plan

Public consultation was undertaken between 2007 and 2010 for the Big Lake Neighbourhood plans that are located directly adjacent to the south shore of Big Lake and Lois Hole Provincial Park. Concerns raised by the public included:

- appropriate setbacks from Horseshoe Creek and the top of bank of Big Lake
- maintenance of water quality and quantity
- retention of existing vegetation
- creation of greenway links between natural areas

2.2 SURVEYS

At the 2009 and 2011 St. Albert Lifestyle Expos, the City of St. Albert undertook surveys related to the Sturgeon River. At the 2009 expo, people were asked to rate the health of the Sturgeon River, the greatest concerns affecting the river and additional initiatives the City should undertake to protect it. Of the 95 respondents, 59 per cent believed the Sturgeon River was unhealthy or very unhealthy; 31 per cent were neutral and five per cent felt it was healthy or very healthy. The three greatest concerns affecting the river were litter, pesticides and stormwater. Suggested initiatives for the City to undertake included dredging, cleaning up, building weirs to raise or maintain water levels, and education.

At the 2011 expo people were asked how they used the Sturgeon River and the river valley. Of the 118 respondents, 104 used the river valley trails for biking, running or walking; 42 used the river valley for bird watching or wildlife viewing; and 14 used the river for fishing.

Although these expo surveys may provide general trends regarding the public's perception of and concerns for the Sturgeon River, a more formal public consultation process is being investigated to solicit more accurate information.

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[23] Lac Ste. Anne Community Group website. Accessed April 23, 2012.

[24] Sturgeon River Watershed website. Accessed April 23, 2012.

2.3 BIG LAKE TASK FORCE

The Big Lake Task Force was a partnership of seven municipalities in the Sturgeon River Watershed that collaborated on the completion of a stormwater master plan for the basin. The main objectives of the plan were to:

- facilitate orderly development
- prevent flooding problems downstream of development areas
- protect the environment (water quality, drainage and flooding)
- plan for future generations

One of the major tasks of the plan was to discuss watershed issues with member municipalities and landowners and to provide interim results to the public through a series of public meetings and presentations to municipal councils.[25]

The following is a summary of the key issues that emerged from a review of previous studies, site visits, and stakeholder interviews:

- flooding and drainage issues are present in a number of locations in the basin, primarily in the area around Big Lake and Atim Creek
- concerns regarding the impacts of previous and future development, especially cumulative effects
- drainage/development guidelines are needed to facilitate orderly development in the basin
- concerns regarding water quality issues in Big Lake and the Sturgeon River
- concerns raised by landowners adjacent to Atim Creek regarding flooding

2.4 STURGEON RIVER WATERSHED INITIATIVE

One of the recommendations from the Big Lake Stormwater Master Plan was that a watershed management plan should be developed for the basin. The Sturgeon River Watershed Initiative (SRWI) was organized in 2007 as a non-profit society under the *Alberta Societies Act* to address this recommendation. It included a wider range of stakeholders including residents, First Nations, and agricultural, commercial, industrial, regulatory and municipal sectors. The group received funding from the Alberta Stewardship Network and the City of St. Albert to develop business and strategic plans.

The Sturgeon River Watershed Initiative's vision was for 'a watershed where ecological integrity is the foundation for environmental, cultural, social and economic decision-making, action and policies – resulting in the wise use and management of the Sturgeon River Watershed within Alberta.'[26] The group's mission is: 'Through partnerships among decision-makers and watershed users the SRWI will achieve its vision by gathering information on the watershed, facilitating shared learning/awareness among watershed users and engaging in collaborative watershed management planning.'[27] The

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[25] Associated Engineering. 2004. Big Lake Basin Task Force: Big Lake Stormwater Management Plan. Report prepared by Associated Engineering for the Big Lake Basin Task Force. 16 p.

[26] Sturgeon River Watershed Initiative Society. 2009. Sturgeon River Watershed Initiative Strategic Plan Review - March 12, 2009. St. Albert, Alberta, Canada.

[27] Ibid

SRWI's goals are:

1. To protect and restore the ecological integrity of the Sturgeon River Watershed
2. To promote awareness of the ecological, cultural, social and economic values of the Sturgeon River Watershed
3. To promote appropriate and effective public policies and management practices affecting the Sturgeon River Watershed
4. To provide an open forum to enable informed decision-making based on good scientific and cultural information
5. To develop a watershed management plan with a balanced and sustainable approach to managing land use in collaboration with other land use planning initiatives in the greater North Saskatchewan River Watershed
6. To build partnerships, develop collaboration and share human, information and financial resources[28]

The group raised issues with urban sprawl, aggregate mining, golf courses, feedlots, Big Lake infill, pesticides and water diversions in the Sturgeon River Watershed.[29] Unfortunately, the group was disbanded in 2009 when consensus could not be reached on the terms of reference for a state of the watershed report.[30] However, an organization such as the SRWI is critical in sustaining, enhancing and managing the Sturgeon River Watershed in a collaborative and environmental manner. The City of St. Albert may be prudent to initiate and promote the establishment of a similar watershed management group.

2.5 NEWSPAPERS

Submitted articles and letters to the editor, in the local newspapers, can be good sources of the public perceptions of, and concerns for, the Sturgeon River.

In June 2004, the *Saint City News* published an article by Derek Richmond, a 27-year resident in the Sturgeon River Basin, entitled "Is There Hope for the Sturgeon River?" The article gave an overview of the state of the Sturgeon River early in the 20th century, based on the experiences of former residents, the river's current condition, and some current efforts to improve and restore the watershed/river health.

In August 2005, the *St. Albert Gazette* published a series of three articles on the Sturgeon River by Kevin Ma. These articles were based on his research project for his Master's Degree in Journalism, entitled 'End to End – The State of the Sturgeon River and the Alberta Water Crisis." In his first article, Mr. Ma provided an overview of the state of the Sturgeon River at the turn of the 20th century and today. In his second article, he focused on the three largest economic impacts on the watershed – agriculture, rural subdivisions and the aggregate industry – and how good stewardship benefits big business. In his last article, Mr. Ma focused on the efforts underway to improve and restore the watershed/river health.[31]

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28 Ibid

29 Ibid

30 Ibid

31 Richmond, D. 2004. "Is There Hope for the Sturgeon River?" *Saint City News*, St. Albert, Alberta, 11 Jun 2004: 45,46.

In June 2011, the *St. Albert Gazette* published an anonymous editorial on the City's management of the Sturgeon River within the municipal boundaries. The author was highly critical of the perceived "inaction" on the part of the City in improving the health of the river, emphasizing the amount of time taken for the implementation of the recommendations of the 2004 Stormwater Master Plan and the installation of grit interceptors along the City's storm sewers. The author recognizes the benefits that have been reaped from the ones that have been installed, but states that the overall implementation of the plan has been "not good enough."[32]

In August 2011, the *St. Albert Gazette* published an article highlighting cleanup efforts on the Sturgeon River, including the City's annual "Clean Up the Sturgeon" event. In 2011, 475 individuals took part, surveying the banks of the Sturgeon and cleaning up trash as they went. The article suggests increasing awareness and participation in cleanup activities by Sturgeon watershed residents, with the increasing amounts of garbage collected resulting from a greater number of volunteers and a larger area covered, rather than deteriorating river health or greater amounts of garbage actually going into the river.[33]

In the Letters section of the Opinion page in the *St. Albert Gazette*, citizens are able to write letters and provide their comments on various issues and concerns they have regarding a number of topics. In a review of this section from August 2010 to February 2011, a number of letters and comments regarding the Sturgeon River were received. Below is a summary of the concerns raised over the river in the letters:

- lack of fish in the river, especially Sturgeon
- overall poor health of the river
- lack of oxygen in the river
- slumping of the riverbanks
- quality of the water from stormwater outfalls and the leachate from old dumps flowing into the river
- large amounts of garbage found in the river
- volume of sediment going into the river
- river water levels through the city
- lack of a watershed management plan with partners upstream
- developments along the riverbanks
- smell of the river
- presence of ice-free reaches along the river during the winter

From the review of articles and letters, it is apparent that St. Albert residents are concerned about the current state of the river. The small portion of the Sturgeon River that runs through St. Albert appears to have to the residents' attention.[34]

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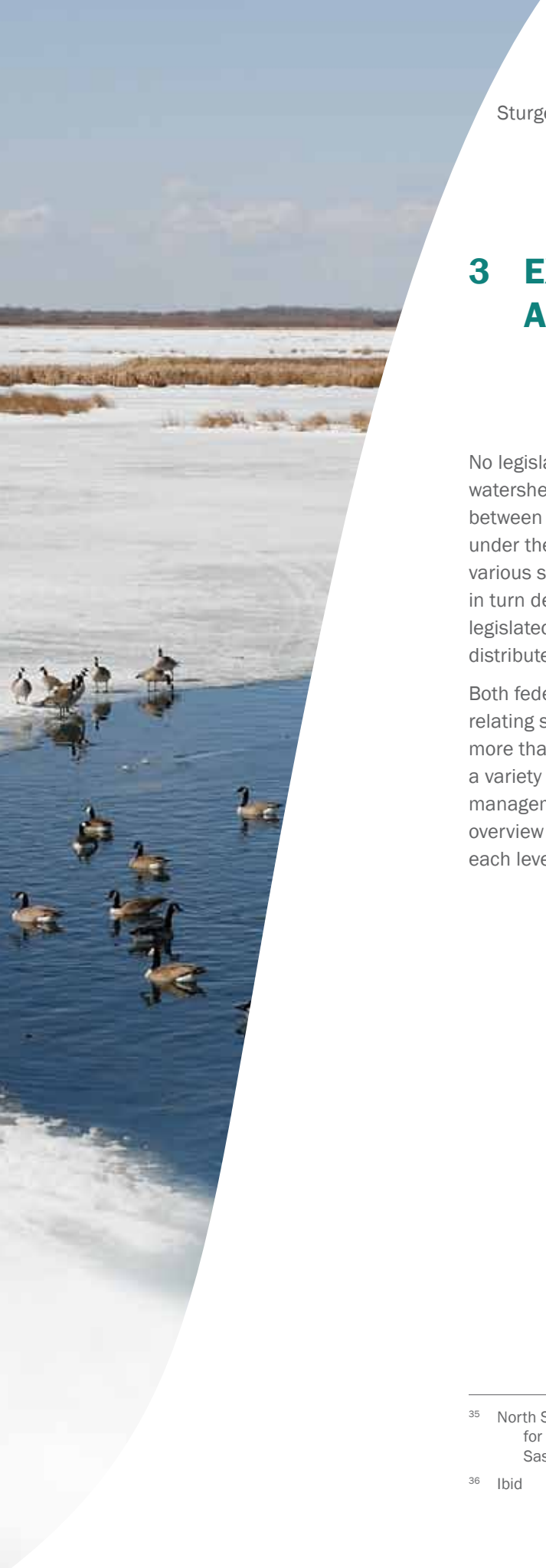
[32] Associated Engineering. 2004. City of St. Albert Stormwater Master Plan. Report prepared by Associated Engineering for the City of St. Albert, Alberta. 127 p.

[33] *St. Albert Gazette*. 2011. Sturgeon River. Accessed February 18, 2011.

[34] *St. Albert Gazette*. 2011. Sturgeon River. Accessed February 18, 2011.



3 EXISTING LEGISLATION, PLANS AND PROGRAMS

No legislation exists that assigns the responsibility of managing our watersheds to any one government. Instead this responsibility is shared between federal and provincial authorities through the powers designated under the *Constitution Act, 1867* and the responsibilities assigned through various statutes (acts), policies and regulations. Municipal powers are in turn delegated through a number of these statutes. Consequently, legislated responsibilities with the potential to impact watershed health are distributed widely across federal, provincial and municipal governments. [35]

Both federal and provincial governments have a number of responsibilities relating specifically to water (Table 1). Watershed management is much more than water management alone. It involves responsibilities for a variety of matters such as land use, natural area designation, and management and pollution prevention. This chapter provides a brief overview of the powers and watershed-related responsibilities assigned to each level of government.[36]

[35] North Saskatchewan Watershed Alliance (NSWA). 2006. Municipal Guide: Planning for a Healthy and Sustainable North Saskatchewan River Watershed. The North Saskatchewan Watershed Alliance Society, Edmonton, Alberta. 372 p.

[36] Ibid

Table 1. Division of legislative and regulatory responsibilities for water and watershed related issues [37]

Jurisdiction	Responsibilities
Federal	Responsibilities in areas that have the potential for significant national economic impact: navigation and fisheries
	Water on federal lands (e.g. national parks), in the territories and on the reserves of Canada's First Nations
	Boundary and transboundary waters
	Migratory Birds Convention Act
	Species at Risk (SARA)
Provincial	Primarily responsible for the management of water resources (surface and groundwater) that includes: flow regulation; inter-basin transfers; authorization of water use development; and authority to legislate areas of water supply, pollution control and thermal and hydroelectric power development
	Bed and shores (public lands)
Shared Federal and Provincial	Interprovincial water issues (fish habitat and fish protection)
	Agriculture
	Water Quality Guidelines (CCME)
Municipal	Land use planning, including protection of natural areas and floodplains
	Municipal Bylaws (drinking water supply, wastewater and stormwater)

These and other watershed-related legislative and regulatory responsibilities are governed by a number of legislations and policies. A summary of those legislations and policies most applicable to the Sturgeon River Watershed are summarized in Table 2 and are discussed below.

[37] Ibid

Sturgeon River State of the Watershed Report | Technical Report

Table 2. Legislation and policy involving water and watershed management

Jurisdiction	Regulatory Agency	Legislation/Policy	Description
FEDERAL	Environment Canada	*Canadian Environmental Protection Act*	Aims to prevent pollution and protect the environment and human health in order to contribute to sustainable development.
		Migratory Birds Convention Act	Aims to protect and conserve migratory birds, both as individuals and populations, as well as their nests (Canadian Wildlife Service).
		Canada Water Act	Aims to ensure water issues of national significance are conserved, developed and managed.
		Federal Policy on Wetland Conservation	Promotes wise use of wetlands and their protection through adequate consideration of wetland concerns in environmental assessments of development projects
		Canada Wildlife Act	Designed for the creation, management and protection of wildlife areas for wildlife research activities, or for the conservation or interpretation of wildlife.
		Species at Risk Act	Provides legal protection of wildlife species and the conservation of biological diversity.
	Fisheries and Oceans Canada	*Fisheries Act*	Section 35 regulates and enforces harmful alteration, disruption and destruction of fish habitat.
	Canadian Environmental Assessment Agency	*Canadian Environmental Assessment Act*	Requires federal departments, agencies and certain Crown corporations to conduct environmental assessments for proposed projects and activities before providing federal support to a project.
	Transport Canada	*Navigable Waters Protection Act*	Minimizes the interference of navigation on navigable waters throughout Canada.
PROVINCIAL	Alberta Environment and Water	*Water Act*	Governs the diversion, allocation and use of water. Regulates and enforces actions that affect water and water use management, the aquatic environment, fish habitat protection practices and in-stream construction practices.
		Environmental Protection and Enhancement Act	Manages stormwater, contaminated sites, storage tanks, landfill management practices, hazardous waste management practices and enforcement.
		Alberta Land Stewardship Act	A framework allowing the provincial government to give direction and to create policy that enables sustainable development through cumulative effects management.
		Wetland Policy (Interim)	Used to protect wetlands and mitigate wetland losses through a “No Net Loss” policy.
	Natural Resources Conservation Board	*Agricultural Operations Practices Act*	Regulates and enforces on confined feedlot operation and environment standards for livestock operations.
	Alberta Municipal Affairs	*Municipal Government Act*	Provides municipalities with authorities to regulate water on municipal lands, management of private land to control non-point sources, and authority to ensure that land use practices are compatible with the protection of aquatic environment.
	Alberta Sustainable Resource Development	*Public Lands Act*	Regulates and enforces activities affecting Crown-owned beds and shores of water bodies and some Crown-owned uplands that may affect nearby water bodies.
		Fisheries (Alberta) Act	Provides regulations governing declining fisheries, the number of fish that can be kept and where anglers can fish.
		Wildlife Act	Regulates and enforces the protection of wetland-dependent and wetland-associated wildlife, and endangered species (including plants).
	Alberta Municipal Affairs	*Provincial Safety Codes Act*	Regulates and enforces septic system management practices, including the installation of septic field and other subsurface disposal systems.
	Alberta Health	*Regional Health Authorities Act*	Regional Health Authorities have the mandate to promote and protect the health of the population in the region and may respond to concerns that may adversely affect surface and groundwater.
	Alberta Sustainable Resource Development & Alberta Community Development	*Provincial Parks Act*	Can be used to minimize the harmful effects of land use activities on water quality and aquatic resources in and adjacent to parks and other protected areas.
		Wilderness Areas, Ecological Reserves, Natural Areas and Heritage Rangelands Act	Can be used to minimize the harmful effects of land use activities on water quality and aquatic resources in and adjacent to parks and other protected areas.
MUNICIPAL	(municipality)	Municipal Development Plans	Adopted by Council as a municipal development plan pursuant to the *Municipal Government Act*.
		Area Structure Plans	Adopted by Council as a bylaw pursuant to the *Municipal Government Act* that provides a framework for future subdivisions, development, and other land use practices of an area, usually surrounding a lake.
		Land Use Bylaws	Bylaws that divide the municipality into land use districts and establish procedures for processing and deciding upon development applications. They set out rules affecting how each parcel of land can be used and developed, and include a zoning map.

3.1 FEDERAL GOVERNMENT

The *Constitution Act* (1867) empowers the Government of Canada to legislate on a number of issues that relate to or impact watersheds and watershed health. These explicitly granted powers include the following:[38]

- federal property
- trade and commerce
- revenue generation through taxation
- navigation and shipping
- seacoast and inland fisheries
- First Nations and lands reserved for them
- criminal law
- interprovincial works and undertakings (includes the regulation of pipelines and other means of interprovincial transportation)
- works for the general advantage of Canada
- the implementation of treaties entered into by Great Britain on behalf of Canada
- matters not specifically assigned to the provinces under the *Constitution Act, 1867*

The federal government has been granted additional powers by the courts to regulate the following environmental matters:[39]

- federal lands (e.g., national parks or other federal reserved lands) and all resources on these lands
- natural commercial, sport or recreational fishery habitat (whether on federal or non-federal lands or on privately owned or public lands)
- interprovincial waters
- migratory birds and, to a limited degree, migratory bird habitat (whether on federal or non-federal lands or on privately owned or public lands)
- regulation of toxic substances (as part of criminal law power)

All of the above listed powers have the potential to impact watershed health in some way, shape or form. For example, the federal government can use these powers to promote watershed health by: protecting ecologically important natural areas on federal lands, controlling the international trade of bodies of water, generating revenues to be spent on watershed stewardship initiatives or research, protecting bodies for navigation or fisheries and co-ordinating provincial management of interprovincial waters.[40]

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[38] Environmental Law Centre. 2003. The ABC's of Environmental Jurisdiction: An Alberta guide to federal, provincial and municipal responsibility. Environmental Law Centre, Edmonton, AB.; Op. cit., North Saskatchewan Watershed Alliance (NSWA). 2006.

[39] Ibid

[40] Op. cit., North Saskatchewan Watershed Alliance (NSWA). 2006.

The *Canadian Environmental Protection Act* (CEPA) is the primary federal legislation to protect the environment. With respect to water resources, CEPA empowers the federal government to create and enforce regulations controlling toxic substances, fuels and nutrients in lakes and surface bodies of water. CEPA enables the federal government to undertake environmental research, develop guidelines and codes of practice and establish agreements with provinces and territories. Environment Canada administers CEPA but assesses and manages the risk of toxic substances jointly with Health Canada.

Fisheries and Oceans Canada (FOC) has the authority to protect fish and fish habitat under the guidelines of the *Fisheries Act* and the *Species at Risk Act*. In Alberta, however, following a Memorandum of Understanding (MOU) with the federal government, FOC has jurisdiction only over the fish habitat, while the province maintains jurisdiction over the fish (*Fisheries (Alberta) Act*, 1997; see also Canada-Alberta Administrative Agreement for the Control of Deposits of Deleterious Substances under the *Fisheries Act*).[41] Fish habitat, by definition, includes spawning grounds and nurseries, rearing, food supply and migration areas which fish depend on to carry out their life processes. Fisheries and Oceans Canada's mandate is to preserve healthy marine and freshwater aquatic ecosystems in support of scientific, ecological, social and economic interests. The *Fisheries Act* prohibits any activity that results in the harmful alteration, disruption or destruction (HADD) of fish habitat, protects fish populations from pollution and recommends mitigation measures where loss of habitat is unavoidable. Work carried out near a fish-bearing watercourse must have Fisheries and Oceans Canada's approval, and failure to comply with the act may result in fines or imprisonment.

The *Canadian Environmental Assessment Act* (CEAA) is a federal statute requiring federal departments, agencies and certain Crown corporations to conduct environmental assessments for proposed projects and activities before providing federal support to a project. Environmental assessment is a planning tool used to identify the potential effects of a proposed project on the environment, which comprises air, water, land and living organisms, including humans. By eliminating or minimizing potential adverse environmental effects through the implementation of mitigation measures, project proponents can ensure that these effects are addressed, and thereby contribute to the goal of sustainable development. Environmental assessment provides decision-makers with the information required to make project-related decisions that are compatible with a healthy, sustainable environment for both present and future generations. The Canadian Environmental Assessment Agency administers the CEAA.

The *Migratory Birds Convention Act* (Canadian Wildlife Service of Environment Canada) protects migratory birds, their eggs and nests. Section 5(1) of the migratory bird regulation states that no person shall hunt a migratory bird except under authority of a permit. "Hunt" means chase, pursue, worry, follow after or on the trail of, lie in wait for, or attempt in any manner to capture, kill, injure or harass a migratory bird, whether or not the migratory bird is captured, killed or injured. Section 6 states that no person shall disturb, destroy or take a nest, egg, nest shelter, eider duck shelter or duck box of a migratory bird. Section 5.1 of the act prohibits the deposition of substances harmful to migratory birds in waters or areas frequented by migratory birds or in a place from which the substance may enter such waters or such an area.

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41 Environment Canada Website. Accessed April 23, 2012.

The Federal Policy on Wetland Conservation (Environment Canada) promotes the wise use of wetlands and protection through adequate consideration of wetland concerns in environmental assessments of development projects. The objective of this policy is to promote the conservation of Canada's wetlands to sustain their ecological and socio-economic functions, now and into the future. The policy goals promote the maintenance of the functions and values derived from wetlands throughout Canada, recognition of wetland functions in resource planning and economic decisions, enhancement and rehabilitation of wetlands in areas where continuing loss or degradation of wetlands or their functions have reached critical levels, and utilization of wetlands in a manner that enhances prospects for their sustained and productive use by future generations. Wetlands do not operate in isolation and adjacent upland habitats play an integral role in the maintenance of the functions of wetlands.

The *Navigable Waters Protection Act* (Transport Canada) minimizes the interference of navigation on navigable waters throughout Canada. It ensures a balance between the public right to navigate and the need to build works such as bridges, dams or docks in navigable waters. The act applies to any interference of navigation in, on, over, under, through or across Canadian navigable waterways. The Minister of Transport must approve major activities in major waters, such as construction in navigable waters, the removal of wreck and other obstacles to navigation, and the depositing of any material into navigable waters.

The *Canada Water Act* (Environment Canada) provides for the management of Canada's water resources, including research, and the planning and implementation of programs relating to conserving, developing and utilizing water resources.

The *Canada Wildlife Act* (Environment Canada) allows for the creation, management and protection of wildlife areas for wildlife research activities, or for the conservation or interpretation of wildlife. The purpose of wildlife areas is to preserve habitats that are critical to migratory birds and other wildlife species, particularly those that are at risk.

The *Species at Risk Act* (Environment Canada) was created: to prevent wildlife species in Canada from disappearing; to provide for the recovery of wildlife species that are extirpated (no longer exist in the wild in Canada), endangered, or threatened as a result of human activity; and to manage species of special concern to prevent them from becoming endangered or threatened.

3.2 PROVINCIAL GOVERNMENT

The *Constitution Act*, 1867 empowers provincial governments to legislate on a number of issues that relate to or impact watersheds and watershed health. As a result, the Government of Alberta can exert considerable influence on the state and management of watersheds within the province. These explicitly granted powers include the following:[42]

- the management of natural resources, including water
- the management and sale of provincial public lands, including timber and wood
- local works and undertakings
- property and civil rights in the province and local or private matters
- penalties for violating provincial law

Provincial governments have also been granted additional powers by the courts to regulate the following environmental matters:[43]

- provincially owned lands and all resources on those lands
- activities relating to the beds and shores of all naturally occurring watercourses and bodies of water, including permanent wetlands
- wildlife on private or public land anywhere in the province, except on federal land
- the conservation and management of non-renewable natural resources and forestry resources in the province

Through the powers stated above, the Province of Alberta can impact watershed health in a number of ways. The most apparent connection of the province to watershed health is through its ownerships of natural resources, including water. The Province has the power to deal with, or regulate, water as any private owner would, subject of course to federal law.[44] Other examples of provincial powers relating to watershed health include the Province's ability to protect environmentally significant natural areas on public lands, to conserve forests and to restrict activities around wetlands.

Initiated in 2003 and renewed in 2008, *Water for Life* is a Province-wide comprehensive strategy that identifies short-, medium- and long-term plans to effectively manage the quantity and quality of the Province's water systems and supply. The three main goals of the strategy are to ensure that Albertans have a safe and secure drinking water supply, healthy aquatic ecosystems and reliable, quality water supplies for a sustainable economy.[45] The *Water for Life* strategy is implemented by Alberta Environment and Water, and monitored by the Alberta Water Council, a non-profit society comprised of members from government, industry and non-governmental organizations.

A Province-wide *Wetlands Policy* has yet to be implemented, but "Recommendations for a New Alberta Wetland Policy" and recommendations for an "Alberta Wetland Policy Implementation Plan" were made to the government (2008). The goal of the policy is to maintain wetland areas in Alberta such that the ecological, social, and economic benefits wetlands provide are maintained following the principle of "no net loss." This would ensure Albertans have healthy watersheds that provide safe

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42 Op. cit., Environmental Law Centre, 2003; Op. cit., NSWA, 2006.

43 Ibid.

44 Op. cit., Environmental Law Centre, 2003.

45 Op. cit., Government of Alberta, 2003.

and secure drinking water supplies, healthy aquatic ecosystems, and reliable, quality water supplies for a sustainable economy. In recognition of the high rates of wetland loss in some watersheds, the policy also encourages Albertans to be proactive in restoring drained wetlands and enhancing existing wetlands.

The *Water Act* (Alberta Environment) supports the conservation and management of water, and allows for regional differences in water management to be reflected through the development of water management plans, as outlined in the *Framework for Water Management Planning*, released in 2002.

The *Environmental Protection and Enhancement Act* (Alberta Environment) is intended to support and promote the protection, enhancement and sustainable use of all aspects of the environment, from land to water. It covers conservation, reclamation, pesticide use, waste control and wastewater, and storm drainage.

Alberta Sustainable Resource Development is responsible for enforcing many acts that can be used in the protection of aquatic resources. These acts include the *Fisheries Act* (Alberta) and the *Wildlife Act*. The *Fisheries Act* (Alberta) provides regulations governing declining fisheries, the number of fish that can be kept and where anglers can fish. Anglers are responsible for understanding and following the regulations, which are published annually in the *Alberta Guide to Sportfishing Regulations*. Fines and penalties can be issued for violations, such as illegal harvesting of fish. The *Wildlife Act* governs the management of wildlife as a Crown resource, enables the hunting and trapping of wildlife, and addresses the conservation of species at risk (e.g. endangered or threatened). The *Public Lands Act* deals with the selling and transferring of public land, riparian rights, access to bed, shores and environmental reserves, as well as the management of rangeland and activities permitted on designated land.

The *Alberta Land Stewardship Act* (LSA), also administered by Alberta Sustainable Resource Development, provides a statutory framework that allows the provincial government to give direction with respect to the economic, environmental and social objectives of the Province and to create policy that enables sustainable development through cumulative effects management. The act is the foundation of Alberta's Land-use Framework (LUF), which was initially published in December 2008. Under the LSA and the LUF, development decisions are considered with respect to the overall impacts to the region. Cumulative effects considered under the act may include water withdrawals, land-based environmental impacts and overall habitat degradation.

The *Provincial Parks Act* and the *Wilderness Areas, Ecological Reserves, Natural Areas and Heritage Rangelands Act* ensures the preservation and conservation of natural areas as parks or reserves. These acts prohibit development and limit access to protected areas in order to preserve their natural state and ecological integrity.

The *Agricultural Operations Practices Act* (Alberta Agriculture) provides guidelines and regulations regarding environmental management in livestock operations. It allows the Province to be able to manage issues such as manure runoff, odour, noise, dust, smoke or other disturbances resulting from an agricultural operation, and provides clear manure management standards.

The *Safety Codes Act* applies to the construction, installation and maintenance of septic systems. It ensures that septic systems follow minimum engineering standards for manufacture and installation, and that their integrity is preserved through regular maintenance. Leaking septic systems are a

concern throughout the province. In particular, private septic systems operated at lakeside properties and recreational sites can cause contamination of groundwater and surface bodies of water.

The *Regional Health Authorities Act* ensures the preservation of the health and safety of Albertans, and can be used alongside the *Safety Codes Act* in ensuring water supplies are kept free of contamination of any kind.

3.3 MUNICIPAL GOVERNMENTS

Municipal governments are not directly granted any powers or authority under the *Constitution Act, 1967*; their powers are granted by delegation from the appropriate provincial government.[46] In Alberta, the powers are delegated by the Province to municipalities under the *Municipal Government Act* (MGA). However, these powers are not irrevocable or all-encompassing; the Government of Alberta retains the authority to extend, restrict, or vary powers granted under the MGA, to control and manage municipal growth through provincial Land Use Policies, to set policies regarding site condition evaluation and environmental assessment during the subdivision process, and to set priorities through funding decisions for municipal services or infrastructure projects.[47]

Under the *Municipal Government Act*, the purposes of a municipality are:

a. "To provide good governance,
b. to provide services, facilities or other things that, in the opinion of the council, are necessary or desirable for all or part of the municipality, and
c. to develop and maintain safe and viable communities."[48]

As noted in NSWA (2006), healthy, functioning watersheds may serve to provide many services and facilities that are desirable to communities and are an important characteristic of safe and viable communities. Municipalities are accepting significant responsibility or authority over maintaining and protecting healthy watersheds. Municipalities have been granted several specific powers and responsibilities related to watershed health under the *Municipal Government Act* and other acts, including:

- "natural person" power - permits municipalities to do anything a natural person may do (e.g. borrow money, lend money, buy land sell land and enter into leases without specific legislative authority) unless it conflicts with another statute
- control over numerous aspects of rivers, streams, lakes, and other natural bodies of water not specifically superseded by other provincial or federal legislation
- general powers to pass bylaws and a requirement to pass a land use bylaw
- municipal planning and development - the power to create statutory plans and land use bylaws and to make decisions on subdivision and development proposals
- conservation of natural areas – the MGA provides municipalities with many tools for conserving natural areas
- taxation

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46 Op. cit., Environmental Law Centre, 2003; Op. cit., NSWA, 2006.

47 Mallet, James S. 2005. Municipal Powers, Land Use Planning, and the Environment: Understanding the Public's Role. Environmental Law Centre, Edmonton, Alberta. 67 p.; Op. cit., Op. cit., NSWA, 2006.

48 Municipal Government Act, 2000. Alberta's Queen Printer.

- The *Environmental Protection and Enhancement Act* gives municipalities the power to accept, hold and enforce conservation easements
- *Historical Resources Act* gives municipalities the power to make designations or enter into agreements with landowners to protect historic resources including features of historic, cultural, natural, scientific or esthetic interest[49]

3.4 STATUTORY LAND USE DOCUMENTS

Of these powers, the three main instruments by which municipalities influence the health of watersheds include municipal development plans, area structure plans/land use plans and land use bylaws. A municipal development plan is a plan adopted by a council pursuant to the *Municipal Government Act*. It is a policy document clearly stating how land will be used and how future developments will be zoned. An area structure plan or land use plan is a plan adopted by Council as an area structure plan bylaw pursuant to the *Municipal Government Act* that provides a framework for future subdivisions and development of an area. Land use bylaws divide the municipality into land use districts and establish procedures for processing and determining development applications. These bylaws set out rules affecting how each parcel of land can be used and developed along with a zoning map.

3.5 ENVIRONMENTAL STRATEGIC PLANS

The City of St. Albert completed an Environmental Master Plan (EMP) in 2009 with the purpose of developing a long-term action plan to improve environmental performance and achieve tangible environmental outcomes for both the City and the community. The EMP is part of the City's Environmental Management Framework and is closely tied with the City's Environmental Management System to help reduce the environmental impacts of the city's daily activities. The EMP is presented in the context of air, land and water, and provides strategic goals, targets and initiatives for each. Across the three elements, eight goals are presented and each accompanied by strategic directions on reaching the targets in the next five-12 years. The eight goals are to: maintain air quality; reduce non-renewable energy consumption and greenhouse gas emissions; preserve and manage trees, parks and natural areas; reduce solid waste generation; reduce contamination by improving hazardous waste management; protect and maintain the Sturgeon River Watershed; and reduce water consumption. Specific targets related to the ecological health of the Sturgeon River include:

1. River water quality is maintained as it moves through St. Albert by 2020.
2. Capture 90 per cent of municipal winter road sanding materials by 2020.

Other targets, such as promoting higher development densities in new areas of development, preserving significant natural areas, and reducing municipal and residential pesticide use will also contribute to the improved ecological health of the watershed.

With input from the City's Environmental Advisory Committee, the EMP will be reviewed and updated on a five-year basis to ensure that changing trends and conditions are accurately considered.[50]

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[49] Op. cit., Environmental Law Centre, 2003; Op. cit., NSWA, 2006.

[50] City of St. Albert. 2009. Environmental Master Plan. Office of the Environment, City of St. Albert, Alberta. 40 p.

3.6 RESEARCH INITIATIVES IN THE WATERSHED

In 2004, Associated Engineering (with the collaboration of the Big Lake Task Force and Technical Advisory Committee) completed a comprehensive summary of work on the Big Lake Basin. The Big Lake Task Force and Technical Advisory Committee are members of the seven municipalities in the Big Lake Basin. From Summary: The group joined forces to investigate drainage problems in the Big Lake Basin and to develop a stormwater management plan that reduces the impacts that urban and agricultural developments have on our natural drainage systems. The Task Force and Technical Advisory Committee created a series of recommendations on flooding issues, stormwater management and floodplain management. The report summarized basin issues, presented a regional flood frequency analysis, and introduced models for analyzing the basin and its storm management ponds. Conclusions and recommendations were also proposed for flooding issues and stormwater and floodplain management. The report concluded the floodplain must be protected and preserved, and that when development occurs problems arise with flooding within the natural floodplain. Encroachment, infilling and development within the floodplain has and continues to occur (e.g. agriculture, recreation, roads). In addition, regional flood discharge rates for the 1:100 year flood were determined for drainage areas of 1, 10, 100, and 1000 sq. km. Stormwater management should be required for all forms of development in the basin (i.e., agricultural, recreational, roadways, rural and urban development). Stormwater management ponds should maintain a release rate of 2.5 L/s/ha to maintain a balance between the pond sizing and downstream impacts. Basin modeling indicated that flooding will occur along Atim Creek regardless of strategies to control runoff from urban development. Big Lake decreased flows from the Basin upstream of the lake and peak flood levels were not affected by urban development. However, flood levels could increase with sedimentation or encroachment into Big Lake's floodplain, or agricultural drainage improvements and acreage development conducted without stormwater management. Floodplains must be protected in the Basin though policies, regulations and standards for regulating land use and development. Land use bylaws and public awareness were stated to be vital tools in the protection of floodplains and the prevention of flooding.

Since 2006, the City of St. Albert has conducted annual studies of surface and stormwater quality within its boundaries to monitor long-term trends and address the potential impacts of stormwater from the city on the aquatic habitats of the Sturgeon River Watershed.[51] These studies extended Alberta Environment's previous monitoring of the Sturgeon River by including stormwater sampling and a greater number of sampling locations within the city's boundaries, and by providing a baseline for long-term studies of the health of the Sturgeon River within the city.

In 2010, staff and students from the Biological Sciences department of the Northern Alberta Institute of Technology (NAIT) initiated a study to examine habitat fragmentation and habitat quality in the Sturgeon River Watershed. This project established permanent sampling sites for assessing and monitoring fish habitat, water quality, flow rates and stream crossings, as well as providing NAIT students with research experience and the opportunity to be involved in long-term monitoring within the watershed. The project also included a significant educational component designed to complement the grade five wetland ecosystems curriculum to:

- increase students' awareness and understanding of water conservation issues in the Sturgeon River Watershed,

[51] Op. cit., Aquality Environmental Consulting Ltd., 2006-2010.

- increase environmental literacy
- teach students how to assess and maintain healthy aquatic ecosystems (consistent with the *Water for Life* strategy)

Through this educational program students: determine the concentrations of dissolved oxygen and other chemicals that may influence the health of the aquatic ecosystem of the Sturgeon River; collect and identify benthic invertebrates and categorize them as high or low-oxygen species; and conduct surveys of aquatic vertebrates and their habitats.[52]

3.7 STEWARDSHIP INITIATIVES IN THE WATERSHED

The Lac Ste. Anne and Lake Isle Water Quality Management Society was formed in 1999 and led to an Alberta Environment study of the two lakes entitled, "Water Quality Management in Lac Ste. Anne and Lake Isle: A Diagnostic Study." The report concluded high external nutrient loads were having a negative effect on water quality in the lakes.

The Onoway River Valley Conservation Association (ORVCA) was founded in 2001 by a group of concerned citizens from Lac Ste. Anne, Parkland, and Sturgeon Counties. Their mandate is "to ensure the bioregional sustainability of the ancient preglacial river valley known as the Onoway River channel."[53]

The Sandy Lake Restoration Society (SLRS) is a volunteer group that was incorporated in 1999. Their mission is "to restore and sustain the water quality of Sandy Lake and its watershed through ongoing research, coordination and education."[54]

The Big Lake Environment Support Society (BLESS) is a non-profit organization founded in 1991 by Dr. Fin Fairfield. The society's major purposes are "to help protect the natural wildlife habitat in and surrounding Big Lake; to promote awareness of the beauty of the area and increase interest in the outdoors through educational activities, bird watching, and various other projects and functions; and to liaise when possible, with various officials, groups, organizations and land owners in order to maintain these purposes of the Society."[55]

In 2005, the City of St. Albert partnered with BLESS, forming the River Edge Enhancement Project (REEP), to identify and execute changes in shoreline conditions at five reaches of the Sturgeon River within the city. The objectives of REEP are to increase or sustain both the natural biodiversity along the river's edge and the aesthetics of the park area, while reducing human disturbances and negative physical impacts (e.g. bank erosion). A 2.4 km reach of the Sturgeon River, extending from the Canadian National Railway train trestle bridge upstream to the Boudreau Bridge downstream, was studied. The project focused on the riparian zone of the river and the adjoining higher ground between the river and the paved walkway along the river. Observations, conclusions and recommendations at each of the five reaches included beaver controls, shrub plantings, flood

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52 Hunt, L. and Webb, D. 2011. Sturgeon River Watershed Project: One Year Summary. Department of Biological Sciences, NAIT, Alberta. 45 p.

53 Watershed Stewardship Alberta Directory. 2005. Alberta Environment. URL: http://www.landstewardship.org/media/uploads/Directory_of_Watershed_Stewardship_in_Alberta.pdf

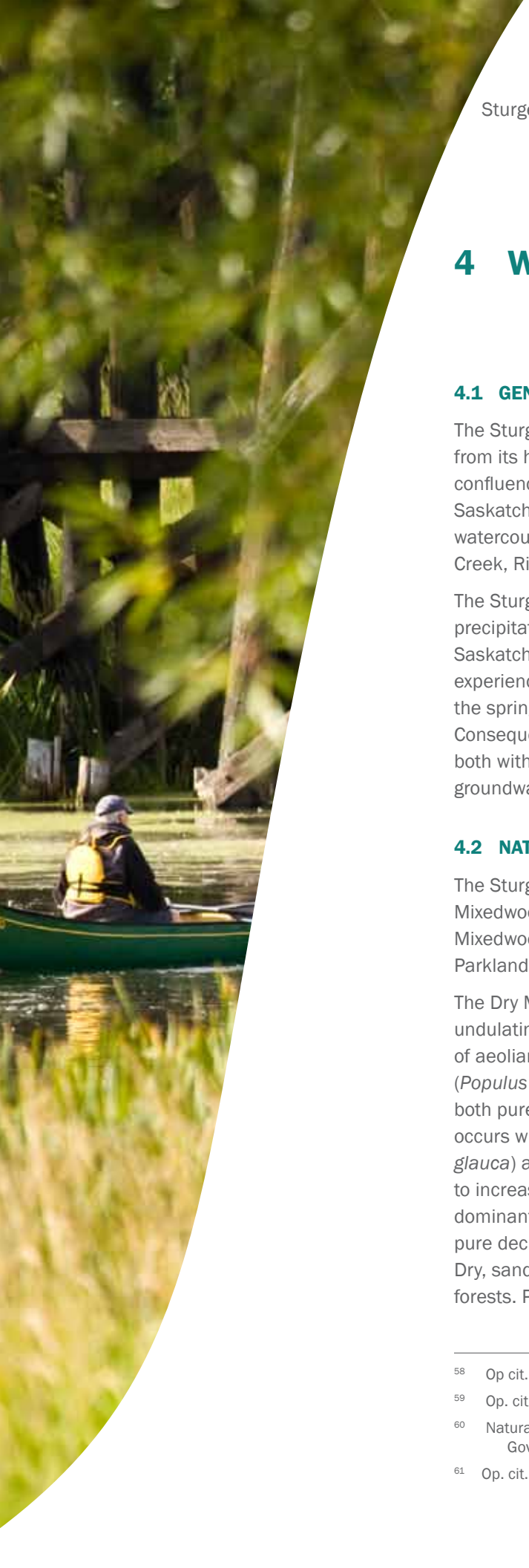
54 Land Stewardship Centre. 2011. Sandy Lake Restoration Society (SLRS). URL: http://www.landstewardship.org/resources/agency/183/

55 Big Lake Environment Support Society (BLESS) BLESS By-law.

prevention techniques, wire mesh maintenance on trees and shrubs, mowing strategies and weed control. Between 2005 and 2011, six planting events were held, with volunteers planting over 3,000 riparian plant species along the Sturgeon River. NAIT Biological Sciences students conducted an assessment and summary of riparian planting projects completed, and updated the report with the lessons learned. Some of the City of St. Albert's environmental stewardship activities are highlighted in a publication by the Alberta Stewardship Network.[56] The book describes REEP and its goal to attract the black-capped chickadee into the riparian areas along the Sturgeon River. The enhancement of Berrymore Flats is described as the pilot site for improvement.[57]

[56] Alberta Stewardship Network. 2007. Awareness to Action: A Showcase of Environmental Stewardship in Alberta. Edmonton, Alberta.

[57] City of St. Albert and BLESS (Big Lake Environmental Support Society). 2005. River Edge Enhancement Project: Sturgeon River - St. Albert. 80 p.



4 WATERSHED CHARACTERISTICS

4.1 GENERAL DESCRIPTION OF THE WATERSHED

The Sturgeon River is located in central Alberta, Canada, flowing eastward from its headwaters near Hoople Lake approximately 260 km to its confluence with the North Saskatchewan River (NSR), near the City of Fort Saskatchewan. It has a total watershed area of 3301 sq. km.[58] The major watercourses within the watershed are Toad Creek, Kilini Creek, Atim Creek, Rivière Qui Barre, Carrot Creek and Little Egg Creek.

The Sturgeon River is a prairie river, fed only by snowmelt and seasonal precipitation rather than the glaciers that contribute to many of the North Saskatchewan River's subwatersheds further to the west. Therefore, it experiences naturally high variability in flows, with elevated peak flows in the spring and extended periods of low flow during the summer and fall.[59] Consequently, a high variability in surface water supplies is experienced both within and between years. The basin is quite flat and largely groundwater fed and comparable to the Battle or Vermilion sub-basins.

4.2 NATURAL REGIONS

The Sturgeon River Watershed includes areas of Dry Mixedwood, Central Mixedwood, and Central Parkland Natural Subregions[60] (Figure 2). The Dry Mixedwood dominates in the western half of the watershed and the Central Parkland dominates the east.

The Dry Mixedwood Subregion is characterized by low relief and level to undulating terrain. Surficial materials are mostly glacial till with some areas of aeolian dunes (generated by wind) and sandy outwash plains. Aspen (*Populus* spp.) is an important tree species in the Subregion, occurring in both pure and mixed stands. Balsam poplar (*P. balsamifera*) frequently occurs with aspen on the moister sites. Over time, white spruce (*Picea glauca*) and, in some areas, balsam fir (*Abies balsamea*) can be expected to increase or replace aspen and balsam poplar (*P. balsamifera*) as the dominant species; however, frequent fire seldom permits this to occur, and pure deciduous stands are common in the southern part of the Subregion. Dry, sandy sites are usually occupied by jack pine (*Pinus banksiana* Lamb.) forests. Peatlands are common and may be extensive.[61]

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58 Op cit., AAFC, 2008

59 Op. cit., Golder, 2009

60 Natural Regions Committee. 2006. Natural Regions and Subregions of Alberta. Government of Alberta. Edmonton, Alberta.

61 Op. cit., Heritage Community Foundation, 2008

Surficial materials in the Central Mixedwood Subregion are predominantly till manifested as ground moraine and hummocky moraine landforms, with some areas of Aeolian dunes, sandy outwash plains and glaciolacustrine plains. The terrain has low relief and a level to undulating surface. The subregion includes much of the central and southeastern part of the Boreal Forest Natural Region Op. cit., Heritage Community Foundation, 2008 and is the largest subregion in Alberta. The vegetation of the Central Mixedwood Subregion is similar to that of the Dry Mixedwood Subregion. The differences are largely in the proportion of various vegetation types and other landscape features. Aspen (*Populus* spp.) is the characteristic forest species occurring in both pure and mixed stands, while balsam poplar (*P. balsamifera*) frequently occurs with aspen, especially on moister sites in depressions and along streams. Mixedwood forests, containing a mosaic of deciduous and coniferous patches with species typical of each, are widespread throughout the subregion and characteristic of upland sites. Jack pine (*Picea banksiana*) forests typically occupy dry, sandy upland sites. These may be quite open and have a prominent ground cover of lichens. Peatlands are also a common feature in this subregion.[62]

Surficial deposits in the Central Parkland Subregion range from intermediate-textured hummocky and ground moraines to fine-textured glaciolacustrine deposits and coarse outwash. Elevations range from 500–1,100 masl. Numerous permanent streams cut across the subregion, and lakes and permanent wetlands are scattered throughout. Many of the lakes and wetlands are naturally slightly to strongly alkaline. The vegetation changes from grassland with groves of aspen (*Populus* spp.) in the south to closed aspen forests in the north. The two major forest types in the subregion are trembling aspen (*Populus tremuloides* Michx.) and balsam poplar (*P. balsamifera*) on moister sites in depressions and in the northern part of the subregion. Both are characterized by a dense, lush, species-rich understories. The grassland vegetation of the parks is dominated by rough fescue (*Festuca campestris* Rydb.).[63]

In Alberta, the Central Parkland Subregion is one of the most productive waterfowl areas; however, only about two per cent of this landscape is formally protected in parks or other conservation areas. The area's deep, rich soils and reliable moisture have largely been converted to productive farmland. It is now the most heavily-impacted and fragmented eco-region in Alberta, with only about five per cent remaining in its natural state.[64]

4.3 TOPOGRAPHY, GEOLOGY AND SOILS

The Sturgeon River Watershed has little relief, with elevations ranging from 871 m above mean sea level (amsl) in the headwaters to just 600 m amsl where it joins the North Saskatchewan River in the east. The topography of the watershed is dominated by the surficial geology of the area, with rolling terrain in the west and flatter terrain in the east.

The surficial geological deposits underlying this terrain are dominated by glacial till throughout much of the upper portions of the watershed in the west and the north (Figure 4). The lower eastern portions of the watershed are dominated by lacustrine and fluvial deposits formed under glacial

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62 Ibid.

63 Ibid.

64 van Tighem, K. 1993. Alberta's endangered species: keeping the wild in the West. Borealis 4: 1–16.

lakes and outwash plains during the end of the last ice age,[65] and generally consist of somewhat stratified deposits with higher salinities than glacial deposits.

The bedrock geology of the watershed comprises primarily sedimentary Cretaceous formations, dominated by the Horseshoe Canyon Formation in the central portion of the watershed, the Belly River Group in the northeast, and the Upper Paskapoo and Scollard Foundations in the southwest (Figure 5). The Horseshoe Canyon formation consists of sandstones, mudstones, shales, ironstone, bentonite and minor limestone deposits. The Belly River Group consists mostly of sandstone with minor bentonite, shale and concretionary beds, and contains significant coal seams. In the Paskapoo formation, diverse sandstones, shales and siltstones/mudstones are present. The Scollard Formation consists of sandstone, mudstone and thick coal deposits.[66]

Soil development in the Sturgeon River Watershed is strongly influenced by topography and surficial geological deposits. In the east, where surficial deposits are primarily glacial till and the topography is more rolling than elsewhere in the watershed, soils tend to be dominated by Luvisols (Figure 6). In the west, where topography is flatter, soils formed on glacial deposits are dominated by Chernozems. Areas in the western portion of the watershed are dominated by lacustrine (lake-bed) deposits with elevated salinity and tend to form Solonetzic soils in the west. In areas with imperfect drainage, soils are dominated by organic soils (primarily in the western portion of the watershed) or Gleysols (primarily in the eastern portion of the watershed).[67] [68]

Luvisols are light-coloured soils commonly formed under deciduous or mixed forest types on imperfectly drained sites. [69] They have moderate capability for agriculture, but the organic matter's lower content in the upper horizons results in a less fertile soil than Chernozems. Chernozems are dark black soils that can form under xerophytic or mesophytic grassland or mixed grassland-forest communities.[70] Grasslands produce high organic matter content, resulting in nutrient-rich soils that hold up well to tilling and are rated as some of the best agricultural soils in the world.[71]

Solonetzic soils generally occur under the same conditions as Chernozems, forming primarily under grassland communities, except they develop from more saline parent materials.[72] They have an impermeable hardpan subsurface layer that restricts root growth and prevents water penetration into the soil, though recent advancements in soil preparation and management have resulted in improved yields.[73]

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65 Alberta Geological Survey. 2007. Quaternary Geology of Central Alberta – Deposits. Government of Alberta, Alberta Geological Survey. Edmonton, Alberta.

66 Ibid.

67 Agriculture and Agri-Food Canada. 2007. Soil Landscapes of Canada, version 3.1.1. Agriculture and Agri-Food Canada. Ottawa, Ontario.

68 Alberta Geological Survey. 2009. Geology of Alberta. Government of Alberta, Alberta Geological Survey. Edmonton, Alberta.

69 Agriculture and Agri-Food Canada (AAFC). 1998. Canadian System of Soil Classification, 3rd ed. Agriculture and Agri-Food Canada. Ottawa, Ontario.

70 Ibid.

71 IUSS Working Group WRB. 2006. World reference base for soil resources 2006. World Soil Resources Report 103. FAO, Rome, Italy.

72 Op. cit., AAFC, 1998.

73 Alberta Agriculture and Rural Development. 1993. Agri-Facts: Management of Solonetzic Soils. Government of Alberta, Alberta Agriculture and Rural Development. Edmonton, Alberta.

Gleysols and organic soils both form on imperfectly drained sites where water inputs tend to exceed outputs. Gleysols tend to occur in areas of periodic inundation such as seasonal wetlands, while organic soils tend to occur in areas of prolonged inundation.[74] Neither is particularly suited to agricultural activity without extensive management and reclamation.[75]

4.4 CLIMATE

The climate of the Dry Mixedwood Subregion is sub-humid, continental with short, cool summers and long, cold winters. The mean May–September temperature is about 13°C, and the growing season is about 90 days. Annual precipitation averages 350 mm, with June and July as the wettest months. Winters are relatively dry, with about 60 mm of precipitation. The climate of the Central Mixedwood Subregion is also sub-humid and continental with short, cool summers and long, cold winters. The growing season is slightly shorter than the Dry Mixedwood, with an average temperature from May–September of approximately 12°C and 85 days without frost. June and July are the wettest months, with an average of 380 mm annual precipitation. Winters tend to be relatively dry. Overall, the climate is more moist and cooler than the Dry Mixedwood Subregion with somewhat of a moisture deficit. The Central Parkland Subregion is slightly warmer and wetter than both the Dry and Central Mixedwood Subregions, with average temperature of 13°C between May and September and an average frost-free period of 95 days. The mean annual precipitation is about 350–450 mm, with 300 mm of precipitation in the May–September period.

A single Environment Canada weather station is located within the Sturgeon River Watershed (Edmonton-Stony Plain, Station ID 1870). Over the period from 1967 to 2010, the average temperature was 3.5°C, with an average of 503 mm of precipitation per year, slightly higher than any of the subregions that make up the watershed.[76]

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74 Op. cit., AAFC, 1998.

75 Op. cit., IUSS Working Group WRB, 2006.

76 Environment Canada. 2011a. Calculation of the 1971 to 2000 Climate Normals for Canada. Retrieved February 1, 2011, from National Climate Data and Information Archive.

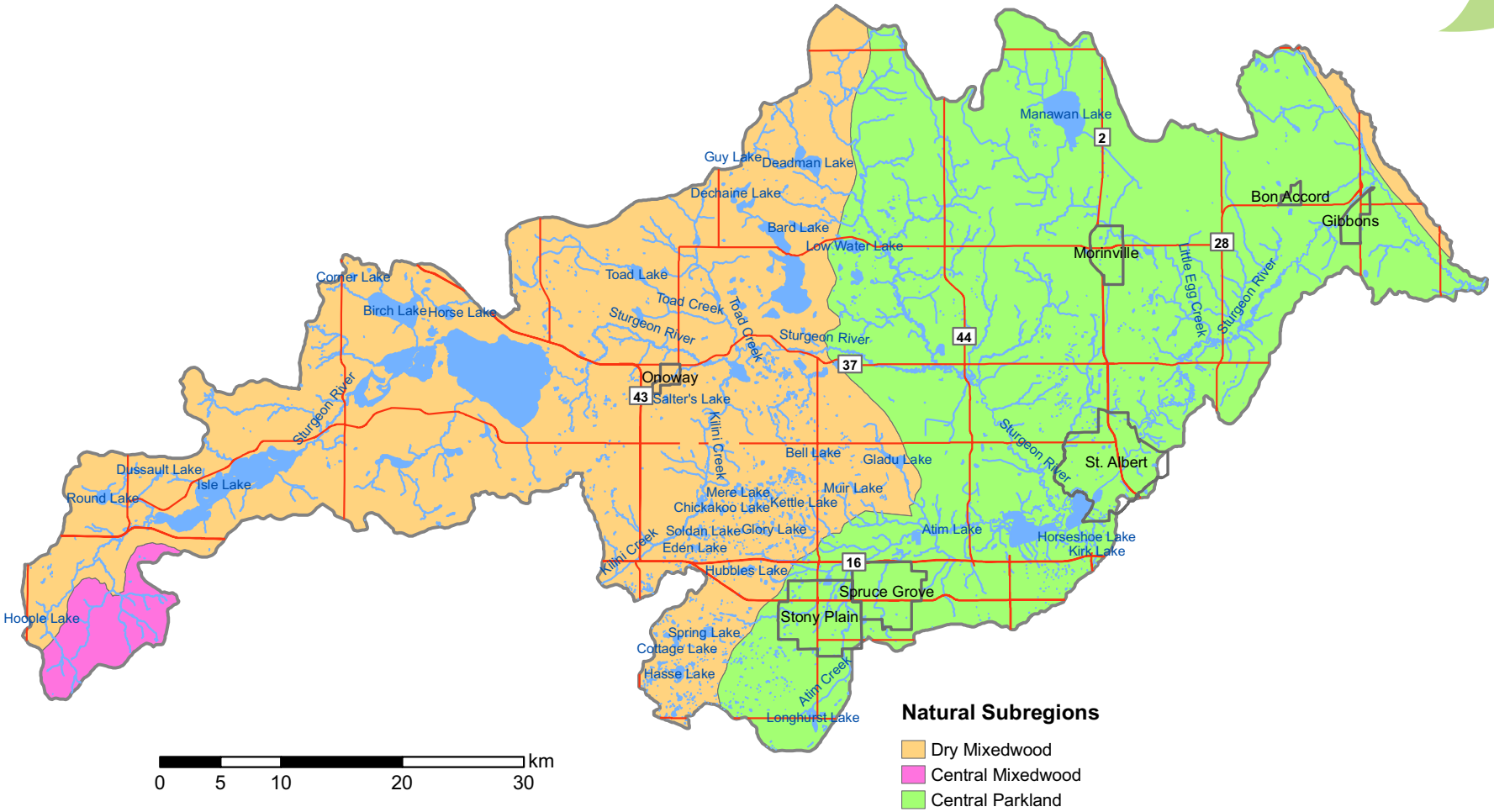

Figure 2. Natural subregions of the Sturgeon River Watershed (Natural Regions Committee, 2006).

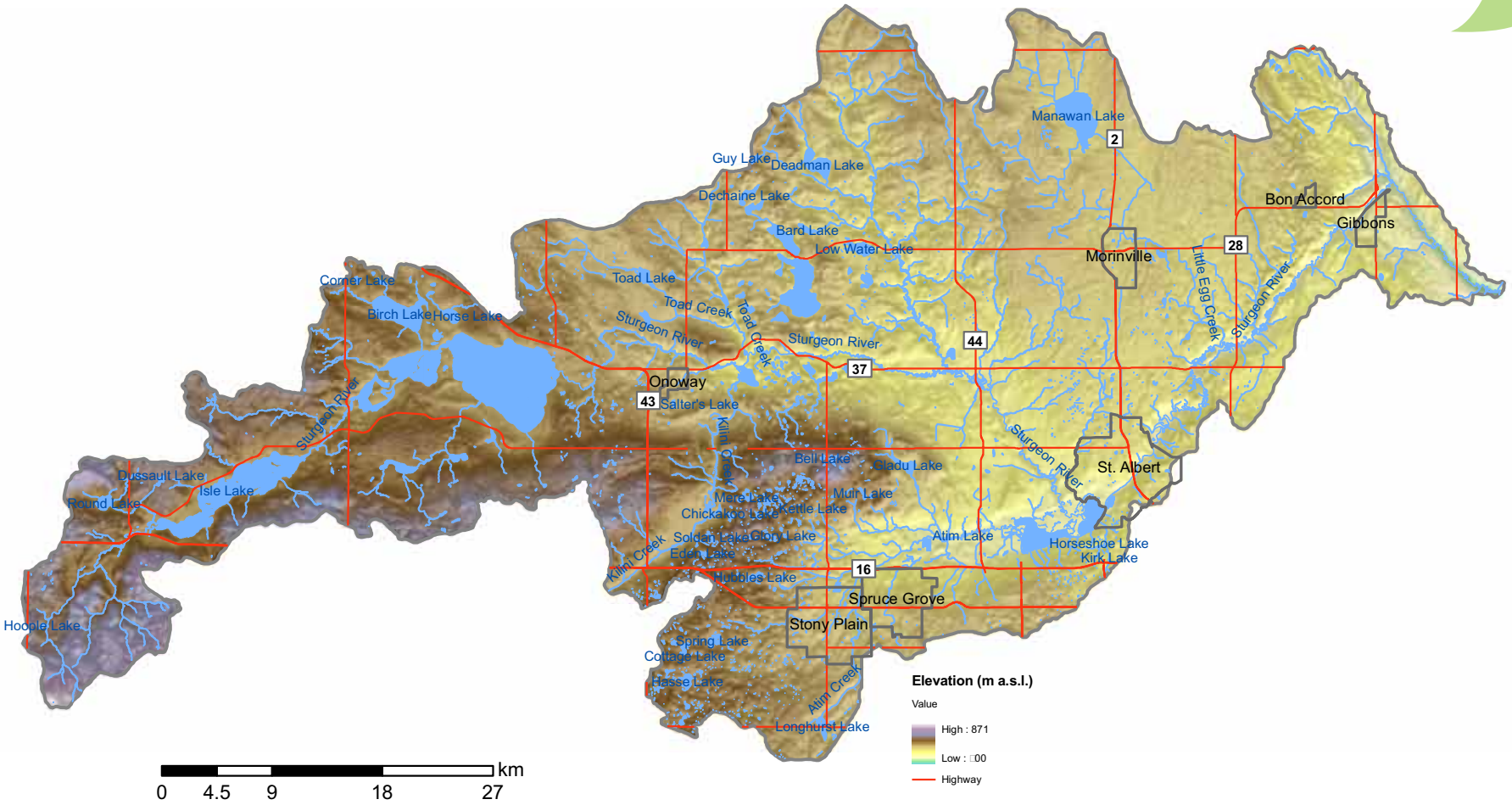

Figure 3. Topography and elevation of the Sturgeon River Watershed (Natural Resources Canada, 2002).

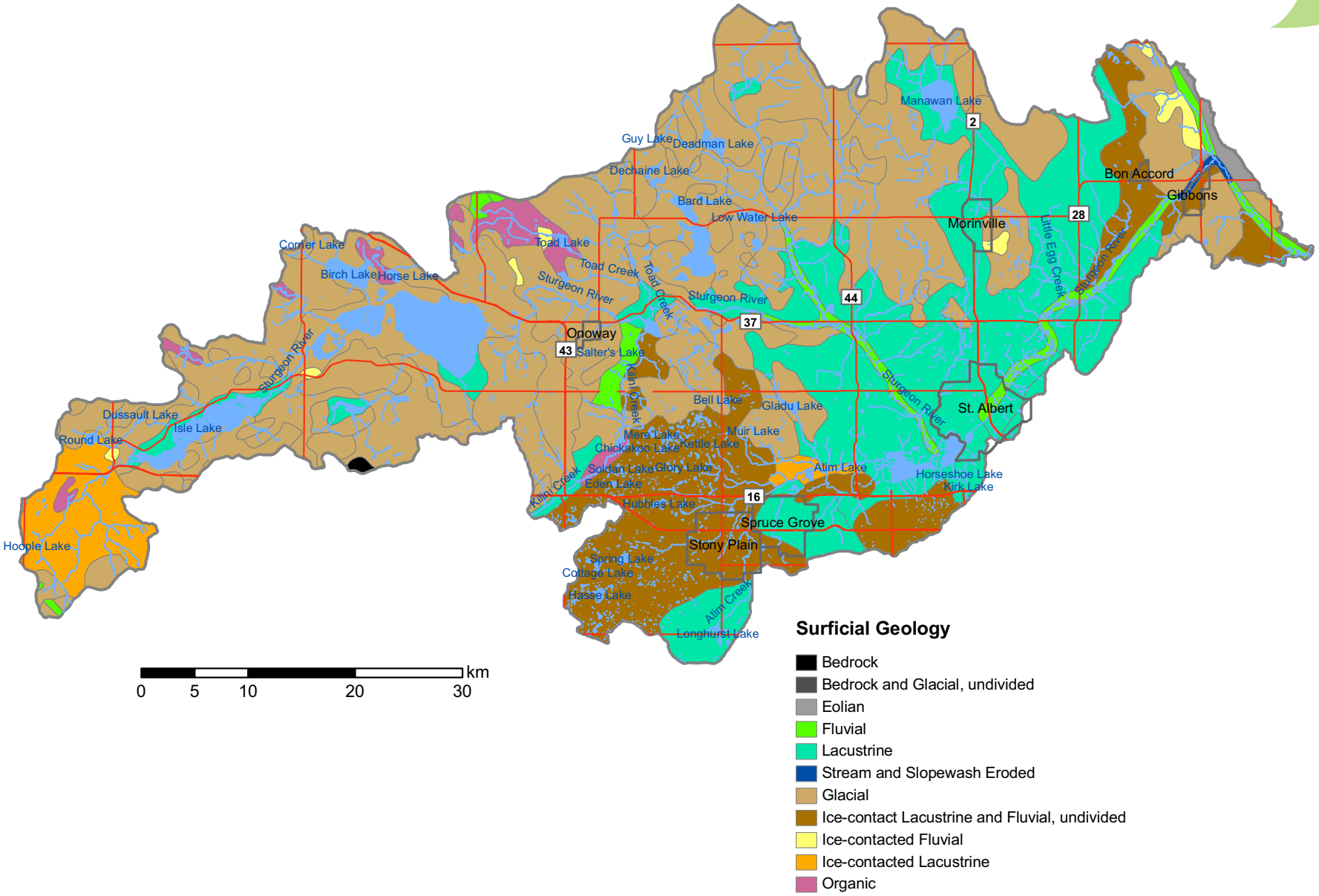

Figure 4. Surficial geology of the Sturgeon River Watershed (Alberta Geological Survey, 2007).

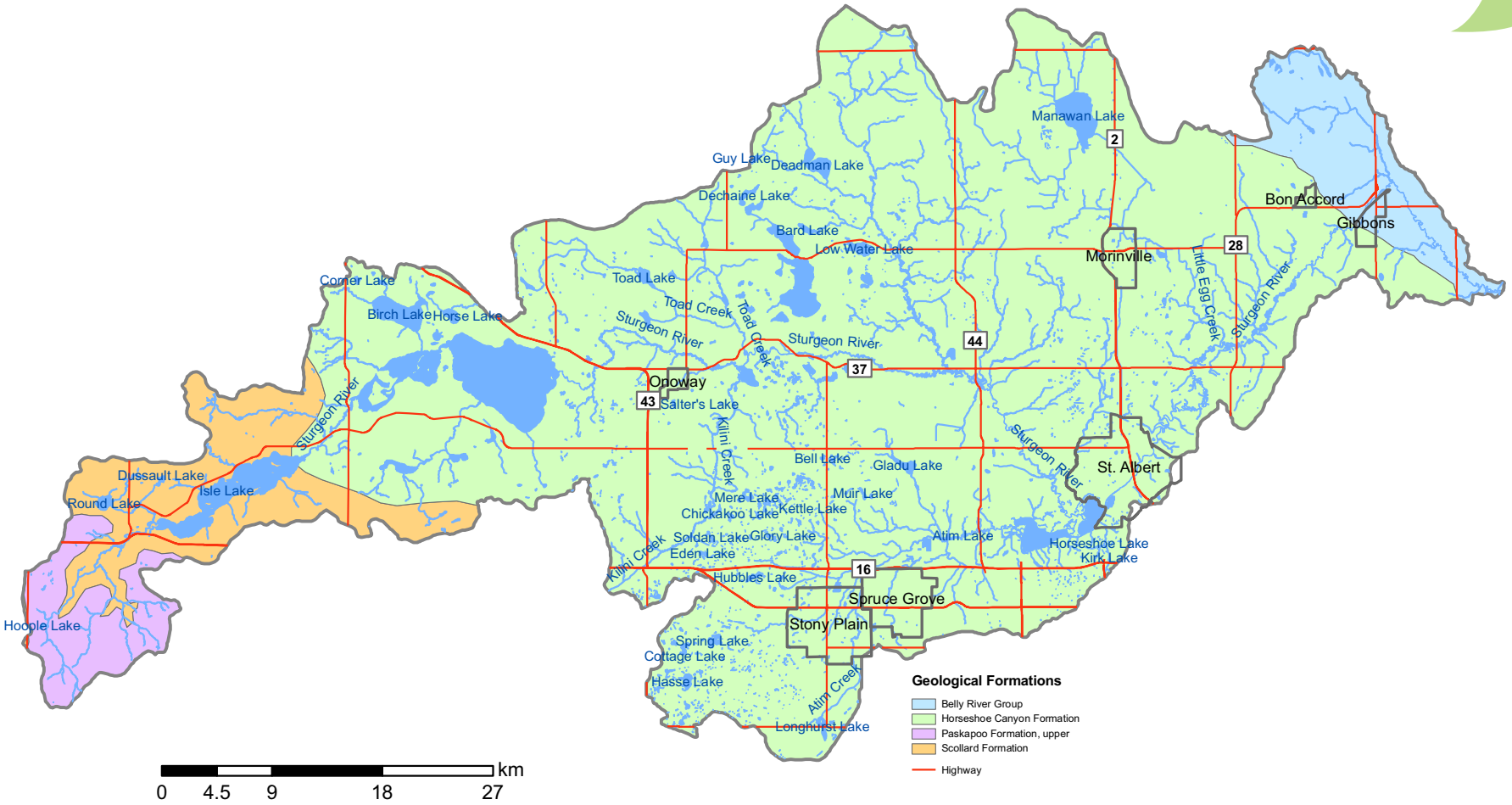

Figure 5. Bedrock geology of the Sturgeon River Watershed (Alberta Geological Survey, 2004).

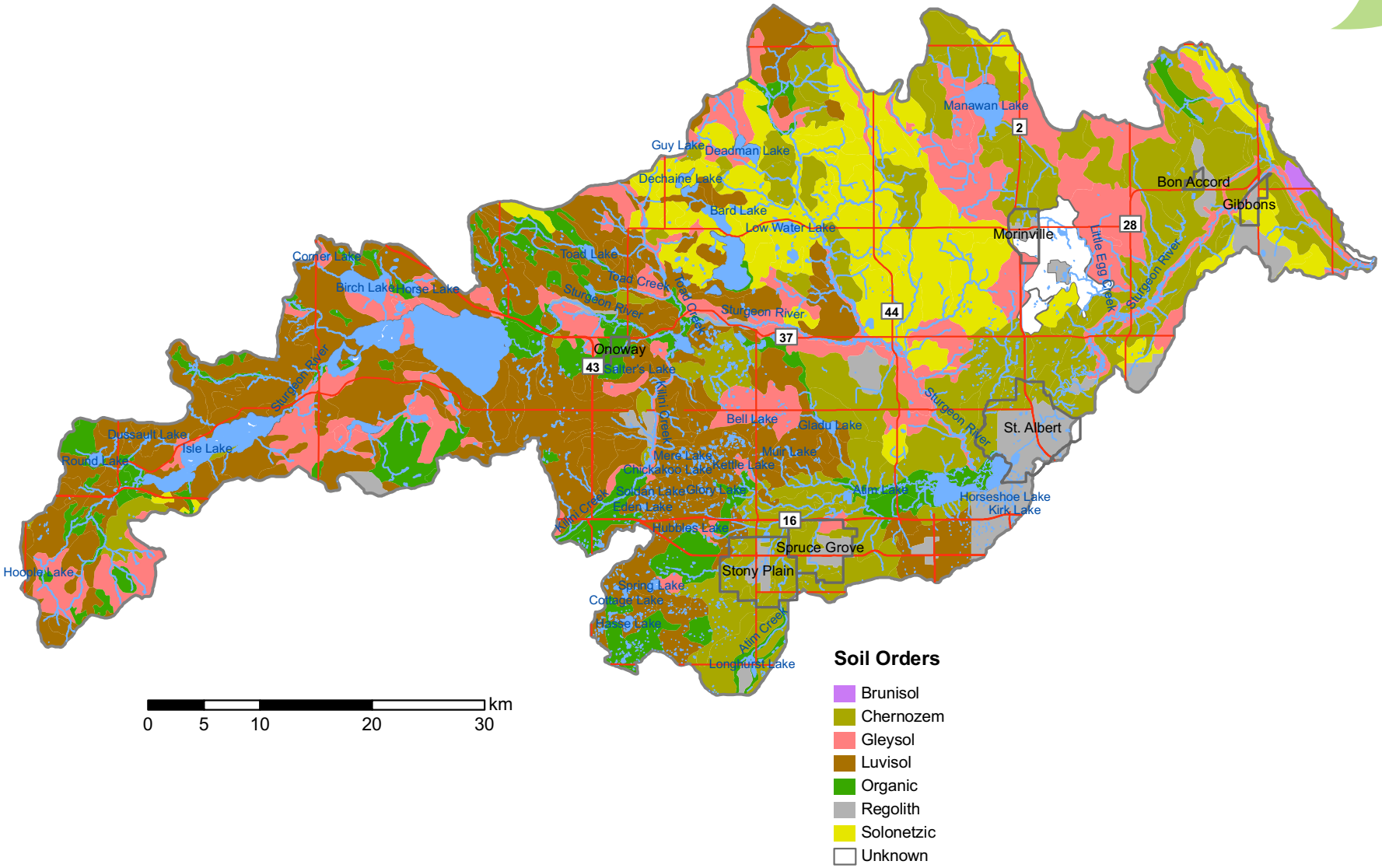

Figure 6. Major soil orders of the Sturgeon River Watershed (Canada - Alberta Environmentally Sustainable Agriculture, 2001).

4.5 LAND COVER AND USE

The Sturgeon River Watershed is located entirely within the White Area (privately-owned lands) of the Province, though there are small areas of Crown-owned land. The watershed has high quality soils and is dominated by agricultural production with 2354 sq. km., or 71 per cent of the total land base, currently in either cropland or pasture (Figure 7); only around 20 per cent of the total land base consists of natural land cover classes such as scrub-shrub, forested lands, and wetlands. [77] The area is impacted by urban development with more than three per cent of lands disturbed by linear developments. Water bodies cover approximately five per cent of the watershed. Livestock densities in the watershed are considered moderate. An inventory by Ducks Unlimited Canada found that 6.8 per cent of the area included permanent and temporary wetlands. While no accurate data for wetland loss exists for the sub-basin, we can assume losses of up to 71 per cent of wetlands in settled areas of the watershed like other areas of the White Area in Alberta with greater losses in urban areas.

The Big Lake Natural Area near the City of St. Albert is recognized as a globally significant bird habitat area because of the number and diversity of birds using it for breeding, staging, and migration.[78] Wagner Bog is a similarly important wetland area. Coarser-scale land cover/use information is available from 1966 (Figure 8) against which some comparisons of land use/cover change can be made (Table 3). Total cropland area in the watershed declined by approximately 39 per cent from 1966 to 2000 (from 1,742 to 1,071 sq. km.), while pasture increased by more than 50 per cent (from 849 to 1,283 sq. km.). The total amount of developed land more than tripled from 31 sq. km. to 144 sq. km. However, the total amount of natural vs. non-natural land cover has not changed over the same period; scrub-shrub, forested lands, and wetlands made up approximately 19.5 per cent of the land base in 1966, while they make up approximately 20.3 per cent of the land base in 2000.

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77 Natural Resources Canada. 1999. Canada Land Inventory Level-I Land Use (circa 1966). Government of Canada, Natural Resources Canada, The Canada Centre for Remote Sensing. Ottawa, Ontario.; Natural Resources Canada. 2009. Land Cover Classification circa 2000. Government of Canada, Natural Resources Canada, Earth Sciences Sector, Centre for Topographic Information. Sherbrooke, Quebec.

78 North Saskatchewan Watershed Alliance (NSWA). 2005. North Saskatchewan Watershed Report 2005 – A Foundation for Collaborative Watershed Management. Prepared by Aquality Environmental Consulting Ltd., Edmonton, Alberta.

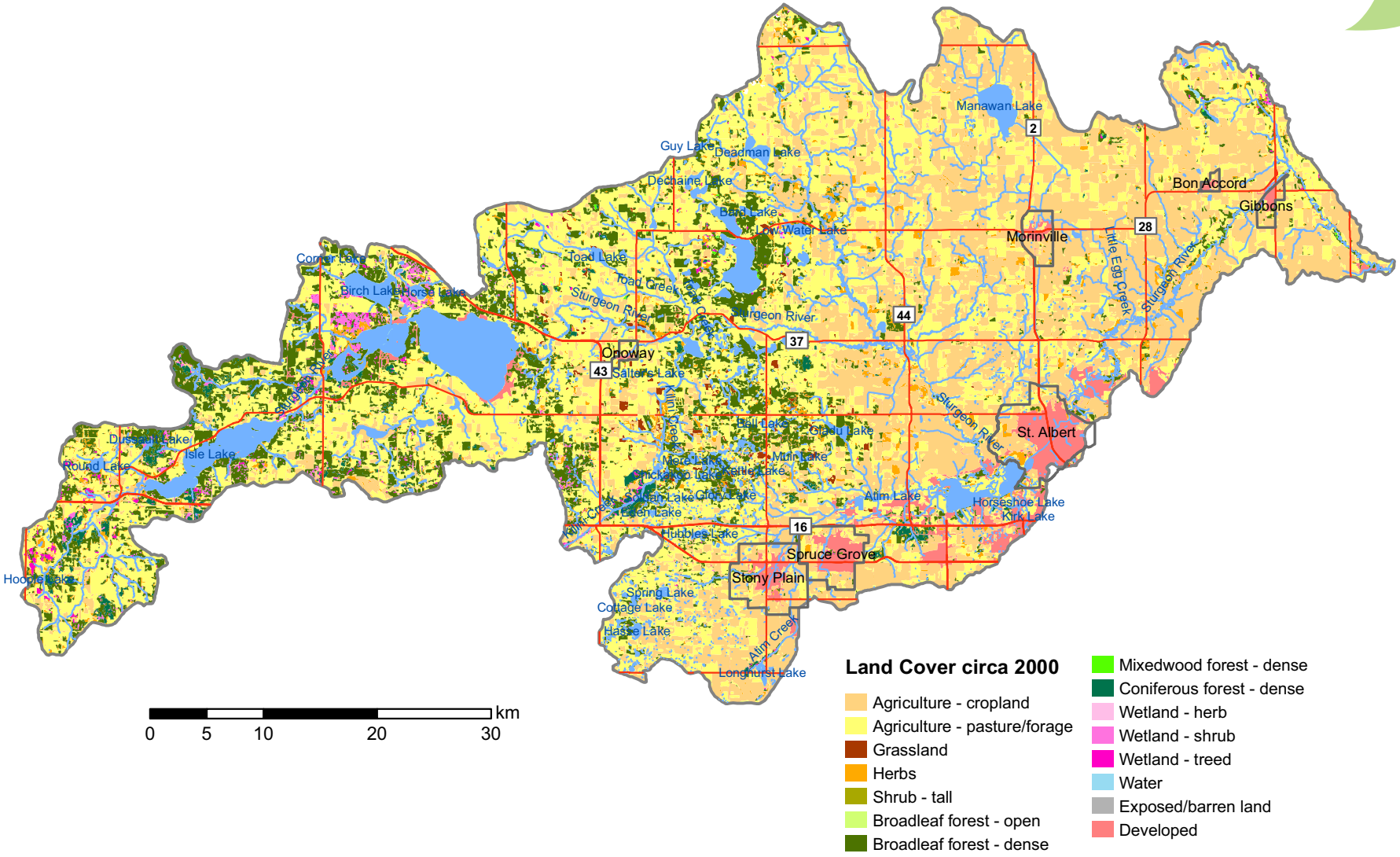

Figure 7. Land cover map, circa 2000 (Natural Resources Canada, 2009).

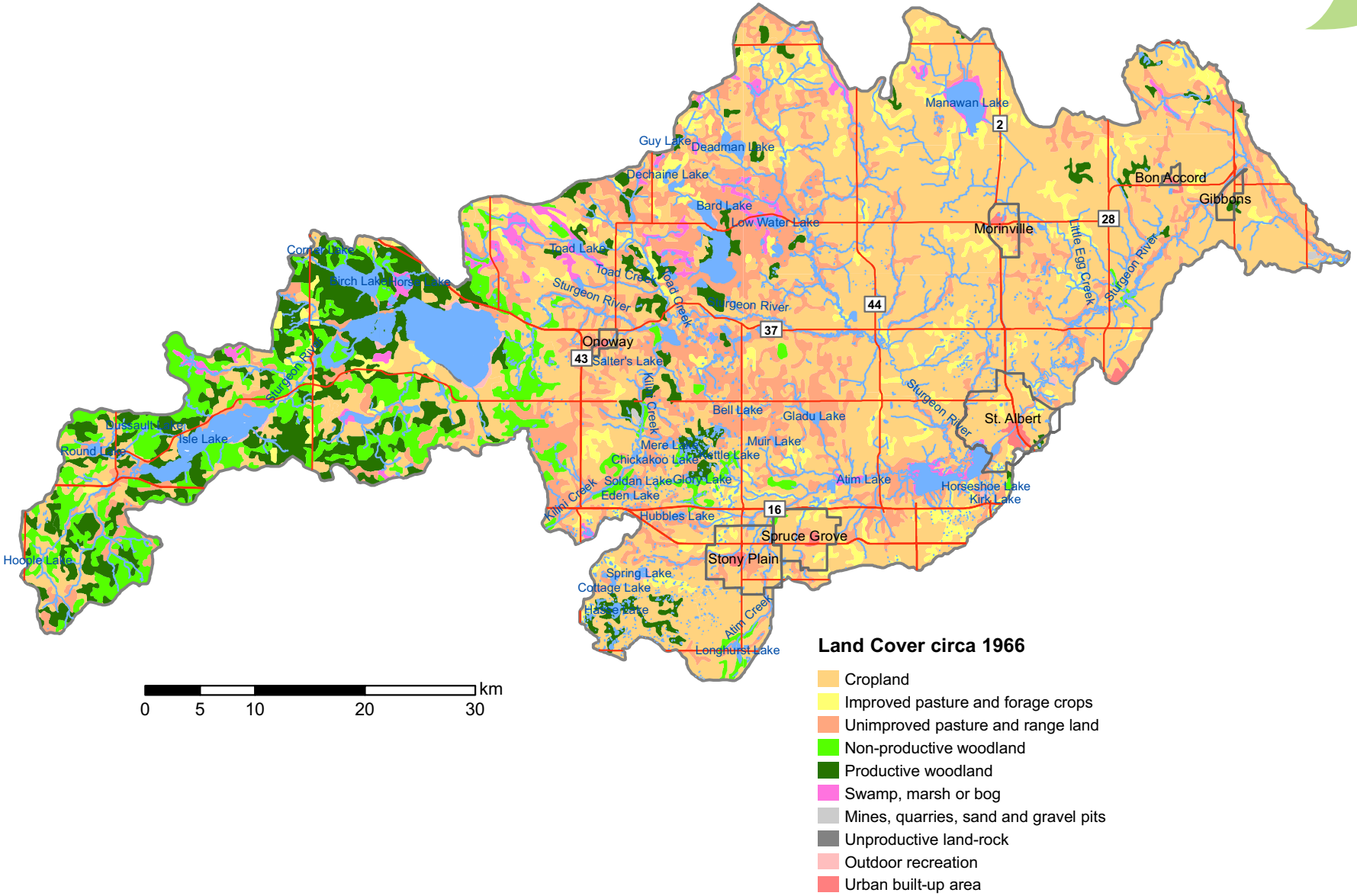

Figure 8. Land cover/use map, circa 1966 (Natural Resources Canada, 1999).

Table 3. Comparison of land cover/use total areas, circa 1966 and 2000 (Natural Resources Canada, 1999, 2009).

General Land Cover/ Use Class	1966		2000	
	Land Cover/Use Class*	Area (sq. km.)	Land Cover Class*	Area (sq. km.)
Scrub	**Total**	**253**	**Total**	**175**
	Non-productive woodland	253	Herbs	158
			Grassland	16
			Shrub - tall	1
Forested	**Total**	**305**	**Total**	**419**
	Productive woodland	305	Coniferous forest – dense	36
			Broadleaf forest – dense	381
			Broadleaf forest – open	1
			Mixedwood forest – dense	1
Cropland	**Cropland**	**1,742**	**Agriculture – cropland**	**1,071**
Pasture	**Total**	**849**	**Total**	**1,283**
	Unimproved pasture and rangeland	637	Agriculture - pasture/forage	1,283
	Improved pasture and forage crops	212		
Wetland	**Total**	**76**	**Total**	**42**
	Swamp, marsh or bog	76	Wetland – treed	17
			Wetland – shrub	24
			Wetland – herb	1
Developed	**Total**	**31**	**Total**	**144**
	Urban built-up area	13	Developed	144
	Outdoor recreation	17		
	Mines, quarries, sand and gravel pits	1		
Exposed	**Unproductive land-rock**	**3**	**Exposed/barren land**	**2**

*Land cover/use classes are not directly comparable between the two data sets; however, similar land cover types/uses have been grouped for comparison.

4.6 WILDLIFE RESOURCES

The Alberta Biodiversity Monitoring Institute (ABMI) maintains a network of monitoring sites across the province, including eight sites within the Sturgeon River Watershed. However, data on wildlife was not collected from these ABMI sites.

4.6.1 Birds

The Sturgeon River Watershed contains a number of important bird habitats, including Big Lake, Lac Ste. Anne, Isle Lake, Kirk Lake and Horseshoe Lake.[79] The Big Lake Natural Area/Lois Hole Centennial Park is one of the most important bird habitats within the Sturgeon River Watershed. This area has the largest amount of available information.[80] The area is a critical habitat for a large number of bird species and has been the focus of numerous bird studies and surveys. Two hundred and thirty-five bird species have been reported in various studies from the Big Lake area, of which 77 per cent are believed to be regularly or annually occurring. Just under half of the bird species found at Big Lake are native, breeding species with annual occurrences (Table 4).

Table 4. Summary of bird species occurrences at Big Lake Natural Area/Lois Hole Centennial Park (from AMEC, 2002).

Bird Group	Total Number of Species	Annually Occurring, Breeding Native Species
Loons and Grebes	6	5
Swans/Ducks/Geese	29	16
Other Water Birds	20	11
Shorebirds	32	10
Raptors (Diurnal)	14	7
Owls	8	2
Woodpeckers	7	6
Flycatchers	7	5
Vireos and Wood Warblers	25	8
Swallows and Martins	6	5
Crows and Allies	5	4
Sparrows and Allies	18	9
Blackbirds and Orioles	8	6
Finches	9	3
Others	41	15
Total	**235**	**112**

Several species in the Big Lake area may be potentially useful bio-indicators,[81] which can act as integrative yardsticks of conservation measures. Numerous species such as the Franklin's Gull, Eared Grebe, Yellow-Headed Blackbird, and American Bittern partition the habitats formed by emergent vegetation, and may provide integrated measures of wetland and riparian habitat integrity.

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79 Lane, B. 2000. Big Lake Important Bird Conservation Plan. Big Lake IBA Stakeholders Committee, St. Albert, Alberta; AMEC Earth and Environmental Limited. 2002. Big Lake Natural Area Management Plan Phase I:Phase I Report. Report prepared by AMEC Earth and Environmental in association with Richard Thomas, EDA Collaborative Inc. for Alberta Community Development Parks and Protected Areas Division, Lac La Biche, Alberta. 147 p.; Alberta Sustainable Resource Development and Alberta Conservation Association. 2006. Status of the western grebe (*Aechmophorus occidentalis*) in Alberta. Alberta Sustainable Resource Development, Wildlife Status Report No. 60. Edmonton, Alberta.

80 Op. Cit., Lane, 2000; Op. cit., AMEC, 2002

81 Op. cit., AMEC, 2002

Cavity-nesting species such as woodpeckers (especially the Pileated Woodpecker), and certain owl and duck species require intact mature forests and may be useful indicators of forest integrity and/or forest fragmentation.

4.6.2 Mammals

Much of the Sturgeon River Watershed has been cleared of naturally occurring habitat types, changing the collection and distribution of species, and restricting some species to a few critical wildlife habitats. Important wildlife areas within the watershed include the Big Lake Natural Area/Lois Hole Centennial Park and the Sturgeon River Valley, Horseshoe Lake and Kirk Lake.[82] A number of mammal species have been found in the Big Lake area,[83] and larger mammals could be restricted to the larger tracts of forests and ravines.[84] Moose have been sighted in the Big Lake area, but are not believed to have a viable population in the immediate area; it is likely they were found along corridor between habitats further to the west or along the North Saskatchewan River. The Big Lake Natural Area/Lois Hole Centennial Park and the Sturgeon River Valley (especially downstream of the City of St. Albert) form an important wildlife habitat and corridor,[85] providing both habitat and a means for mammal populations to migrate between different habitats within the watershed.

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82 Ibid.

83 Ibid.

84 Penner and Associates Ltd. 1998. Wildlife baseline report, Diavik Diamonds Project, Lac de Gras, N.W.T. Technical report prepared for Diavik Diamond Mines Inc. and Aber Resources. Available from Penner and Associates Ltd., 3-52059 Range Road 220, Sherwood Park, Alberta T8E 1B9, Canada. 220 p.; Armin A. Preiksaitis and Associates. 1999. Sturgeon Valley Area Structure Plan Bylaw 882/99. Prepared for Sturgeon County in association with Salloum and Associates Ltd Consulting Group. Associated Engineering Albert Ltd., and Gibbs and Brown Landscape Architects Ltd. Sturgeon County, Alberta.

85 AMEC Earth and Environmental Limited. 2002. Big Lake Natural Area Management Plan Phase I Literature Review. Report prepared by AMEC Earth and Environmental in association with Richard Thomas, EDA Collaborative Inc. for Alberta Community Development Parks and Protected Areas Division, Lac La Biche, Alberta. 147 p.; City of Edmonton. 2007. Natural Connections: City of Edmonton Integrated Natural Areas Conservation Plan. City of Edmonton, Edmonton, Alberta.

Table 5. Summary of mammal species occurrences at Big Lake Natural Area/Lois Hole Centennial Park (from AMEC, 2002).

Common Name	Scientific Name
Masked Shrew	*Sorex cinereus*
Arctic Shrew	*Sorex arcticus*
Little Brown Bat	*Myotis lucifugus*
Silver-Haired Bat	*Lasionycteris noctovaganas*
Big Brown Bat	*Eptesicus fuscus*
Northern Long-Eared Bat	*Myotis septentrionalis*
Snowshoe Hare	*Lepus americanus*
Northern Flying Squirrel	*Glaucomys sabrinus*
Northern Pocket Gopher	*Thomomys talpoides*
Beaver	*Castor canadensis*
Southern Red-Backed Vole	*Clethrionomys gapperi*
Meadow Vole	*Microtus pennsylvanicus*
Muskrat	*Ondatra zibethicus*
Meadow Jumping Mouse	*Zapus hudsonius*
Coyote	*Canis latrans*
Short-Tailed Weasel	*Mustela ermine*
Long-Tailed Weasel	*Mustela frenata*
White-Tailed Deer	*Odocoileus virginianus*
Moose	*Alces alces*

4.6.3 Amphibians and Reptiles

On the eastern edge of Big Lake surveys for amphibians were conducted.[86] These studies identified wood frogs (*Rana sylvatica*) and boreal chorus frogs (*Pseudacris maculata*) along the Sturgeon River near Big Lake. Other amphibian species known or suspected to occur within the watershed include the Canadian Toad (*Bufo hemiophrys*), Western Toad (Bufo boreas), Northern Leopard Frog (*Rana pipiens*), and Tiger Salamander (*Ambystoma tigrinum*). Most of the suitable habitat for these species is found along the marshy shorelines of the Sturgeon River and Big Lake, smaller wetlands in the area, and the spring-fed wetlands in the vicinity of Horseshoe Lake and Kirk Lake.[87] The latter two may be critical habitat for sensitive amphibian species.[88]

The Sturgeon River Watershed contains several Red-Sided Garter Snake hibernacula near Stony Plain. One of these hibernacula contained an estimated 8,500 individuals, and was the destination for a translocation program designed to remove snakes from a private lot and move them to a more

[86] IBI Group. 1996. City of St. Albert West Boundary Road Environmental Impact Assessment Study. Alberta, Canada.; Op. cit., AMEC, 2002.

[87] Biodiversity/Species Observation Database (BSOD). 2002. Observation Query Report. Alberta Conservation Association, Alberta Environment/Alberta Sustainable Resource Development. Edmonton, Alberta.; Op. cit., AMEC 2002

[88] Geowest Environmental Consultants Ltd., David M. Ealey Environmental Services, Schwabenbauer Ross, and Associates, Landscape Architects. 1993. Inventory of Environmentally Sensitive and Significant Natural Areas. City of Edmonton Technical Report, City of Edmonton.

protected location. [89] Since hibernacula rarely contain more than 5,000 individuals,[90] this location represents an important overwintering site for this and possibly other snake species in the area.[91] The decline of the snake population has been a concern, so this area may be critical in maintaining regional long-term population health.

4.6.4 Fish

The Sturgeon River Watershed includes several species of fish, as summarized in Table 6. Unfortunately, no Lake Sturgeon has been observed in the watershed recently. Rainbow Trout were only found in Salter's Lake, which may have been stocked.

Table 6. Summary of Fish Species Found in the Sturgeon River Watershed (Alberta Environment and Sustainable Resource Development (AESRD) Fish and Wildlife Management Information System, provided by AESRD February, 2011).

Common Name	Scientific Name
Walleye	*Sander vitreus*
Northern Pike	*Esox Lucius*
Rainbow Trout	*Oncorhynchus mykiss*
Lake Whitefish	*Coregonus clupeaformis*
Burbot	*Lota lota*
Yellow Perch	*Perca flavescens*
Brook Stickleback	*Culea inconstans*
Lake Chub	*Couesius plumbeus*
White Sucker	*Catostomus commersonii*
Fathead Minnow	*Pimephales promelas*
Iowa Darter	*Etheostoma exile*
Spottail Shiner	*Notropis hudsonius*
Pearl Dace	*Margariscus margarita*

4.6.5 Species at Risk

Alberta Agriculture and Rural Development has developed maps of the risk to biodiversity for the settled, agricultural regions of the Province, which include the Sturgeon River Watershed. Factors used in determining the risk to various species for a given area include the density of upland habitat, the density of wetland habitat, the density of waterways and species at risk distributions.[92] The risk to biodiversity is ranked from 0 (green) to 1 (red). Across the watershed the risk is high, but it is at its highest in the central portions of the watershed to the west of the City of St. Albert (Figure 9).

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89 Takats, L. 2002. Red-sided Garter Snake Relocation and Education Project: Final Report. Alberta Sustainable Resource Development Species at Risk Report No. 30, Edmonton, Alberta.

90 Koonz, W.H. 2001. Red-sided garter snake management plan. Manitoba Conservation, Wildlife Branch.

91 Gregory, P.T. 1984. Communal denning in snakes. In Seigal, R.A., Hunt, L.E., Knight, J.L., Maralet, L.A., and Zuschlag (eds.). Contributions to Vertebrate Ecology and Systematics: A Tribute to Henry S. Fitch. Museum of Natural History, The University of Kansas, Special Publication No. 10.

92 Alberta Agriculture and Rural Development. 2005. Agricultural Land Resource Atlas of Alberta - Groundwater Quality Risk for the Agricultural Area of Alberta. Government of Alberta, Alberta Agriculture and Rural Development. Edmonton, Alberta.

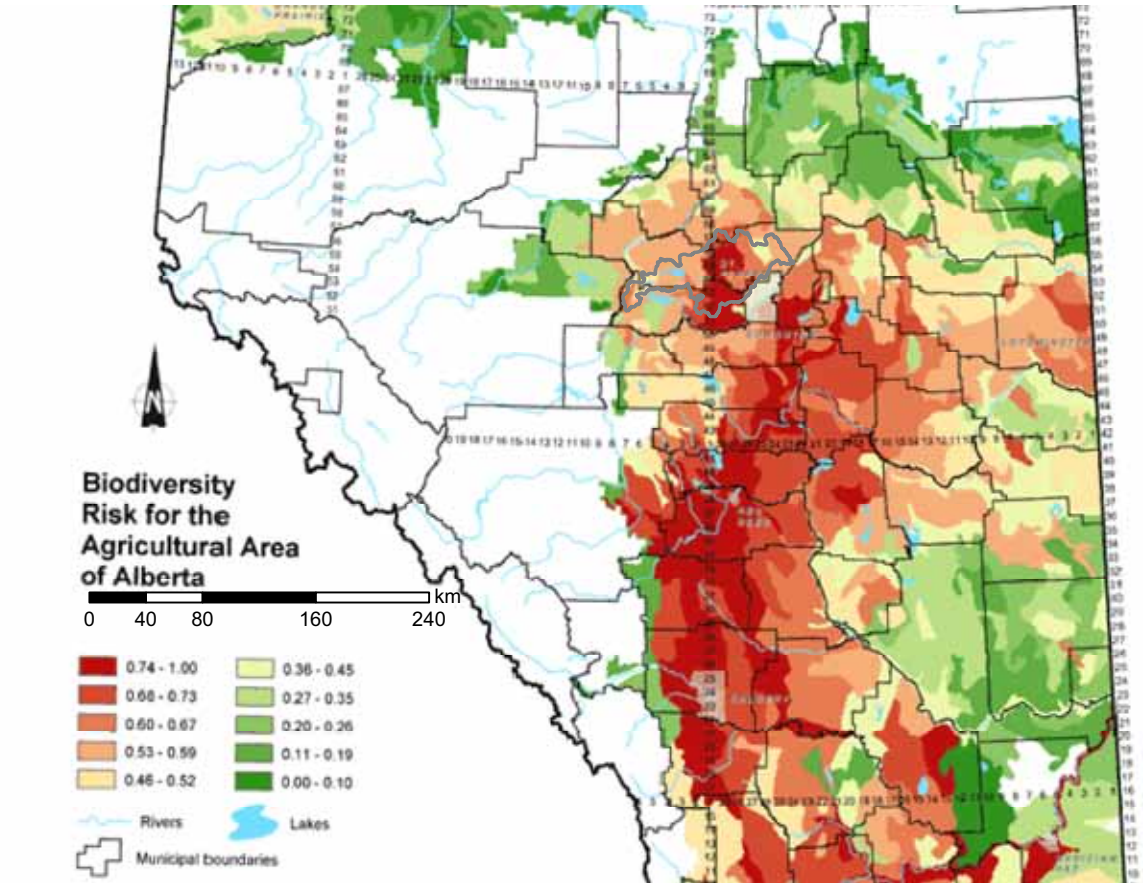

Figure 9. Biodiversity risk map for the agricultural region of Alberta (from Alberta Agriculture and Rural Development, 2005).

The Province of Alberta maintains and updates a list of species that may be at risk of population decline, extirpation or extinction within the province. Under the *Wildlife Act*, species may be legally designated as Threatened or Endangered in order to assist in management and conservation efforts and to provide specific legal protections. Alberta Sustainable Resource Development maintains ongoing reporting of the status of Alberta's wildlife species.

Under the *Wildlife Act*, currently 10 wildlife species (including fish and invertebrates) are listed as endangered, 12 as threatened, 14 as species of special concern, eight as data deficient, and five as in progress. There are currently no endangered species known to occur in the watershed, but there are three listed as threatened, five as species of special concern, three as data deficient, and two as in progress. An additional three bird species, not included in the species at risk short list are found in the Alberta Wildlife Status Report Series.

4.6.5.1 Birds

The Barred Owl (*Strix varia*) is listed as a species of special concern based on its requirement for large, continuous blocks of mature forest habitat that are disappearing throughout the province. It has a small, though stable, population size in the watershed.[93]

The status for the Bay-Breasted Warbler (*Dendroica castanea*) is currently listed as in process under the Wildlife Act, but it is listed as may be at risk due to concerns over habitat loss and declining population sizes in some areas of its range. Non-breeding birds have been found within the watershed, but breeding populations are not known to have ever existed in the surrounding area.[94]

The status for the Cape May Warbler (*Dendroica tigrina*) is currently listed as in process under the Wildlife Act, but it is listed as may be at risk due to concerns over habitat loss and declines in populations in some areas. There are known non-breeding occurrences in the Sturgeon River Watershed, but breeding populations are not known to have ever existed in the surrounding area.[95]

The Peregrine Falcon *anatum* subspecies (*Falco peregrinus anatum*) is listed as threatened, which is down from endangered in 2000, under the *Wildlife Act*, and as a species of special concern under the federal *Species at Risk Act*.[96] The falcon populations experienced significant declines due to the accumulation of organochlorine pesticides that caused their eggshells to weaken, reducing breeding success. The historical distribution of the *anatum* sub-species includes the Sturgeon River Watershed, with known occurrences both in the watershed and the surrounding areas. Populations are now recovering,[97] leading to their downlisting to Threatened status in 2000.[98]

Sprague's Pipit (*Anthus spragueii*) is listed as a species of special concern primarily due to population declines and loss of native grassland habitats. Its breeding range includes the Sturgeon River Watershed.[99]

The White-Winged Scoter (*Melanitta fusca deglandi*) is listed as a species of special concern due to declining populations. Its breeding range includes the watershed, which has also seen some of the area's most extreme population declines.[100]

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93 Alberta Sustainable Resource Development. 2005. Status of the barred owl (Strix varia) in Alberta. Alberta Sustainable Resource Development, Fish and Wildlife Division, and Alberta Conservation Association, Wildlife Status Report No. 56. Edmonton, Alberta.

94 Norton, M.R. 2001a. Status of Bay-breasted Warbler (Dendroica castanea) in Alberta. Alberta Environment, Fisheries and Wildlife Management Division, and Alberta Conservation Association, Wildlife Status Report No. 32. Edmonton, Alberta.

95 Norton, M.R. 2001b. Status of the Cape May Warbler (Dendroica tigrina) in Alberta. Alberta Environment, Fisheries and Wildlife Management Division, and Alberta Conservation Association, Wildlife Status Report No. 33. Edmonton, Alberta.

96 Alberta Endangered Species Conservation Committee. 2003. Peregrine Falcon. Alberta Endangered Species Conservation Committee. Edmonton, Alberta.

97 Rowell, P., and D. P. Stepnisky. 1997. Status of the Peregrine Falcon (Falco peregrinus anatum) in Alberta. Alberta Environmental Protection, Wildlife Management Division, Wildlife Status Report No. 8. Edmonton, Alberta.

98 Op. cit., Alberta Endangered Species Conservation Committee, 2003.

99 Prescott, DRC. 1997. Status of the Sprague's Pipit (Anthus spragueii) in Alberta. Alberta Environmental Protection, Wildlife Status Report No. 10. Edmonton, Alberta.

100 Alberta Sustainable Resource Development. 2002. Status of the White-winged Scoter (Melanitta fusca deglandi) in Alberta. Alberta Sustainable Resource Development, Fish and Wildlife Division, and Alberta Conservation Association, Wildlife Status Report No. 45. Edmonton, Alberta.

The Loggerhead Shrike (*Lanius ludovicianus*) is listed as a species of special concern due to long-term population declines; its range includes the watershed but observations of the species in the watershed are rare.[101]

The Trumpeter Swan (*Cygnus buccinator*) is listed as threatened due to population declines from habitat destruction and hunting. Populations of this species are now increasing in some areas. The breeding range includes the Sturgeon River Watershed and they have been occasionally spotted within the surrounding area.[102]

The Western Grebe (*Aechmophorus occidentalis*) is listed as a species of special concern due to sensitivity to human disturbances and habitat degradation, though data are somewhat limited. This species' breeding distribution includes the watershed, with Isle Lake and Lac Ste. Anne hosting regionally important populations.[103]

The Short-eared Owl (*Asio flammeus*) is listed as may be at risk under the General Status of Alberta Wildlife[104] due to population declines across Canada; its breeding range includes the Sturgeon River Watershed with a few known occurrences in the surrounding area.[105]

The status of the Northern Pygmy Owl (*Glaucidium gnoma californicum*) is currently listed as sensitive;[106] populations are being monitored due to loss of preferred older forest habitats. Its range includes the watershed with known occurrences in the surrounding area.[107]

The Brown Creeper (*Certhia Americana*) is listed as undetermined due to insufficient data on population trends;[108] however, populations are currently being monitored due to its requirement for older mixedwood forests and known negative effects of resource development on its population sizes. The Brown Creeper is present in the watershed and surrounding areas.[109]

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101 Prescott, D. R. C., and R. R. Bjorge. 1999. Status of the Loggerhead Shrike (*Lanius ludovicianus*) in Alberta. Alberta Environment, Fisheries and Wildlife Management Division, and Alberta Conservation Association, Wildlife Status Report No. 24. Edmonton, Alberta.

102 James, M. L. 2000. Status of the Trumpeter Swan (Cygnus buccinator) in Alberta. Alberta Environment, Fisheries and Wildlife Management Division, and Alberta Conservation Association, Wildlife Status Report No. 26. Edmonton, Alberta.

103 Alberta Sustainable Resource Development and Alberta Conservation Association. 2006. Status of the western grebe (Aechmophorus occidentalis) in Alberta. Alberta Sustainable Resource Development, Wildlife Status Report No. 60. Edmonton, Alberta.

104 Alberta Sustainable Resource Development. 2000. The General Status of Alberta Wildlife 2000. Alberta Sustainable Resource Development. Edmonton, Alberta.

105 Clayton, K. M. 2000. Status of the Short-eared Owl (Asio flammeus) in Alberta. Alberta Environment, Fisheries and Wildlife Management Division, and Alberta Conservation Association, Wildlife Status Report No. 28. Edmonton, Alberta.

106 Op. cit., Alberta Sustainable Resource Development, 2000.

107 Hannah, K. C. 1999. Status of the Northern Pygmy Owl (Glaucidium gnoma californicum) in Alberta. Alberta Environmental Protection, Fisheries and Wildlife Management Division, and Alberta Conservation Association, Wildlife Status Report No. 20. Edmonton, Alberta.

108 Op. cit., Alberta Sustainable Resource Development, 2000.

109 Alberta Sustainable Resource Development. 2003a. Status of the Brown Creeper (Certhia americana) in Alberta. Alberta Sustainable Resource Development. Wildlife Status Report No. 49. Edmonton, Alberta.

4.6.5.2 Amphibians

The Canadian Toad (*Bufo hemiophrys*) is listed as data deficient, although it was listed as may be at risk in the General Status of Alberta Wildlife[110] due to population declines and concerns over loss of wetland and associated upland habitats, both of which are required by this species. Its distribution includes the watershed, with numerous observations within the surrounding area.[111]

The Northern Leopard Frog (*Rana pipiens*) is listed as threatened due to severe population declines. The causes of these declines are not known, but habitat loss and extended droughts are suspected. It has historically been observed within the watershed.[112]

4.6.5.3 Mammals

The American Badger (*Taxidea axus*) is listed as data deficient, although it was listed as may be at risk in the Status of Alberta Wildlife[113] due to historical population declines resulting from trapping and habitat alteration. They have expanded their range due to clearing of wooded areas, with both their historic range and recent range expansions falling within the watershed.[114]

Northern myotis (*Myotis septentrionalis*) is listed as may be at risk due to lack of broad-scale data across its range. Its known distribution includes the Sturgeon River Watershed.[115]

4.7 SURFACE WATER RESOURCES

The Sturgeon River Watershed has approximately 179 sq. km. of open water bodies and approximately 1,380 km of permanent watercourses, with open water covering at least five per cent of the landscape. (Figure 10. Hydrological features, man-made hydrological entities, and non-contributing areas map (Natural Resources Canada, 2010).)[116] There are also 69.9 sq. km. of wetlands/saturated soils, and 353 sq. km. of non-contributing land that do not drain out of the watershed. The non-contributing drainage areas are spread throughout the watershed, as shown in Figure 10.

The drainage pattern of the watershed is dominated by the Sturgeon River itself, generally flowing west to east from its headwaters near Hoople Lake, to its confluence with the North Saskatchewan River at Fort Saskatchewan. Major tributaries to the Sturgeon River include Toad Creek, Kilini Creek, Atim Creek, Rivière Qui Barre and Little Egg Creek.

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110 Op. cit., Alberta Sustainable Resource Development, 2000.

111 Hamilton, IM, Skilnick, JL, Troughton, H, Russell, AP, and Powell, GL. 1998. Status of the Canadian Toad (Bufo hemiophrys) in Alberta. Alberta Environmental Protection and the Alberta Conservation Association, Wildlife Status Report No. 12. Edmonton, Alberta.

112 Op. cit., Alberta Sustainable Resource Development, 2003b

113 Alberta Environmental Protection. 1996. Prospects for Protection: The Foothills Natural Region of Alberta (Original manuscript). Protected Areas Report No. 10, Natural Resources Service, Recreation and Protected Areas Division, Edmonton, Alberta.. Alberta Environmental Protection. Edmonton, Alberta.

114 Scobie, D. 2002. Status of the American Badger (Taxidea taxus) in Alberta. Alberta Sustainable Resource Development, Fish and Wildlife Division, and Alberta Conservation Association, Wildlife Status Report No. 43. Edmonton, Alberta.

115 Alberta Sustainable Resource Development and Alberta Conservation Association. 2009., Status of the Northern Myotis (Myotis septentrionalis) in Alberta: Update 2009. Alberta Sustainable Resource Development. Wildlife Status Report No. 3 (Update 2009). Edmonton, Alberta.

116 Natural Resources Canada. 2010. CanVec digital data. Government of Canada, Natural Resources Canada, Earth Sciences Sector, Centre for Topographic Information. Sherbrooke, Quebec.

Water Survey of Canada (WSC) has three active hydrometric stations on the Sturgeon River:

- 05EA005 – Sturgeon River near Villeneuve
- 05EA002 – Sturgeon River at St. Albert
- 05EA001 – Sturgeon River near Fort Saskatchewan

The station near Fort Saskatchewan is virtually at the confluence with the North Saskatchewan River. It has a continuous record from 1914 to the present; however, except for the period from 1914 to 1931, only open water season flows (from March to October) were recorded. Similarly, the St. Albert station has a continuous record from 1976 to the present and, except for the years 2005-2008, only open water season flows were recorded. The Villeneuve station has a continuous record from 1968 to the present. However, in this case, it has complete records from 1971 onward. Based on the WSC's records, the mean annual flow for the Sturgeon River near Villeneuve is approximately 57 million cu. metres, while the mean annual open water season flow at Fort Saskatchewan is about 86 million cu. metres.

With a total area of 54.5 sq. km., Lac Ste. Anne is the largest body of water in the watershed. It drains an area of 619 sq. km., and has mean and maximum depths of 4.8 m and 9 m, respectively.[117] The lake is characterized as eutrophic, with algal blooms proliferating during the summer months, though it still supports populations of Northern Pike, Walleye and Yellow Perch. The Sturgeon River forms both the major inlet and outlet for the lake, with other minor inlets flowing only seasonally.

Isle Lake is the second largest water body in the watershed at 23 sq. km., and the Sturgeon River also forms its major inlet and outlet. It is hyper-eutrophic, experiencing frequent algal blooms and occasional summer- and winterkills.[118] Lake levels fluctuate from a minimum daily water level of 729.538 m to a maximum of 730.827 m Nevertheless, regulation of water levels was considered unfeasible.[119]

Sandy Lake is a shallow lake (2.4 m average depth) with a small drainage basin less than five times the lake area. It is hyper-eutrophic and experiences occasional summer- and winterkills.[120] Hubbles Lake is a small, deep lake (0.40 sq. km. with an average depth of 10.1 m), with a drainage basin over 20 times the area of the lake. It is a pothole lake, having no well-defined inlet or outlet, and groundwater flow likely provides a significant amount of incoming water.

Big Lake is a large lake and wetland ecosystem located along the Sturgeon River, at the northwest corner of Edmonton and the southwest corner of St. Albert. Parkland County is located to the south and Sturgeon County to the north of the lake. Big Lake is large – approximately eight kilometres long and three kilometres wide – but a shallow lake, covering an 840 ha area with depths varying from 0.3 to 4 m. Big Lake is recognized as an Important Bird Area by BirdLife International, as it has extensive nesting grounds and more than 235 species of birds have been recorded with 180 species, annually. Big Lake also provides important wildlife habitat. In 2005, Big Lake became part of the Lois Hole Provincial Park.

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117 Mitchell, P. and Prepas, E. 1990. Atlas of Alberta Lakes. The University of Alberta Press, Edmonton, Alberta.

118 Ibid.

119 Op. cit., Alberta Environment, 1980; as cited in Prepas and Mitchell, 1990.

120 Op. cit., Prepas and Mitchell, 1990.

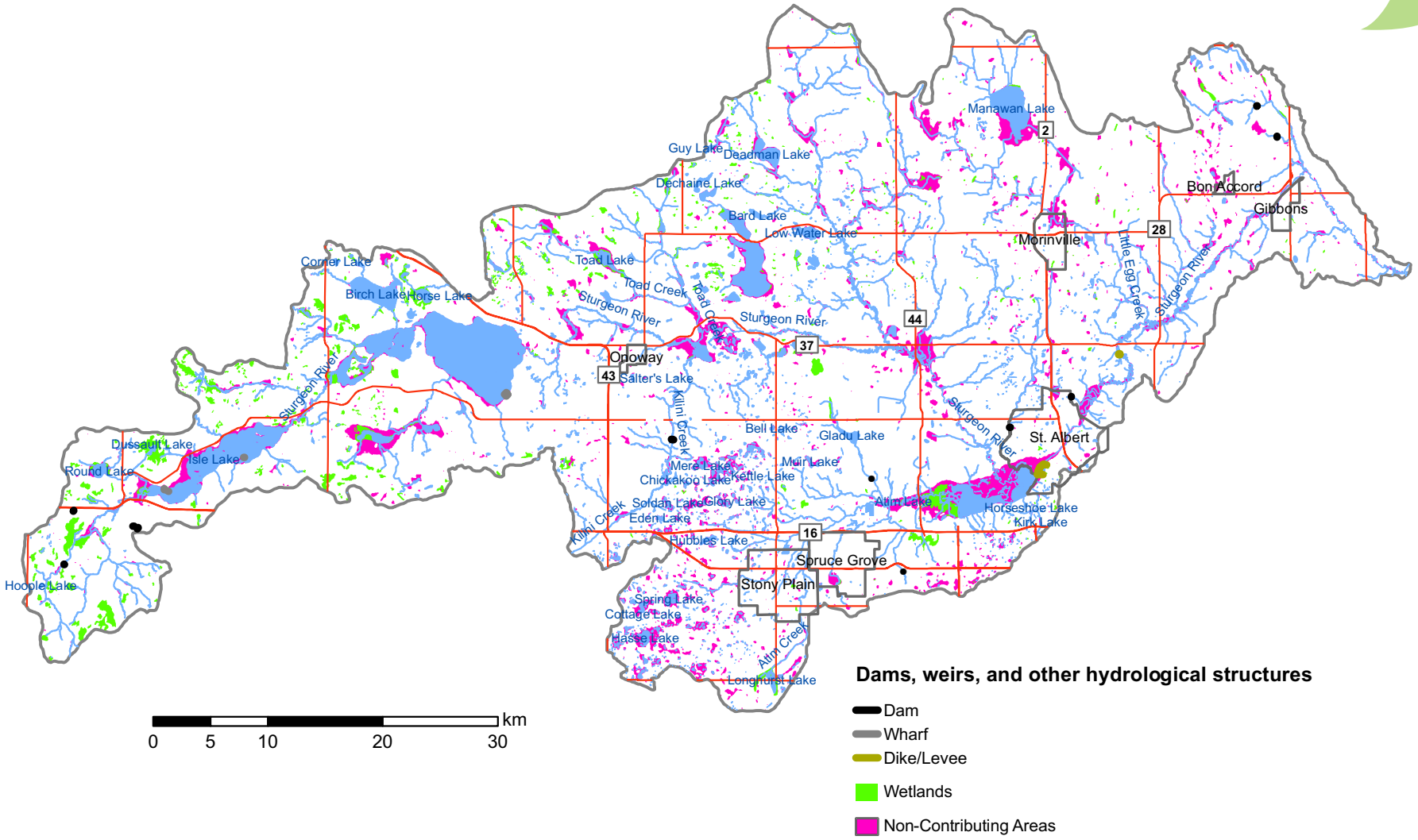

Figure 10. Hydrological features, man-made hydrological entities, and non-contributing areas map (Natural Resources Canada, 2010).

4.8 GROUNDWATER RESOURCES/AQUIFERS

Hydrogeological studies were completed for the Sturgeon River Watershed on a county-by-county basis. The vast majority of the Sturgeon River Watershed's land base is believed to be a groundwater recharge area,[121] meaning groundwater contributes little to surface water flows, suggesting a high risk for groundwater contamination and emphasizing the importance of wetlands in this region. Alberta Agriculture and Rural Development (2005) carried out broad scale assessments of groundwater risk that show elevated groundwater risk in parts of the watershed (Figure 11). One notable groundwater discharge area within the watershed is located in the Wagner Natural Area; the area is a rich fen with vegetative characteristics that agree with the alkaline waters expected in a groundwater discharge area. Horseshoe Lake, Kirk Lake and their associated wetlands are also believed to be groundwater fed to some extent.[122]

The Horseshoe Canyon Formation, Scollard Formation, and Paskapoo Formation, which dominate the underlying geology across all but the western-most regions of the watershed, have good potential as aquifers.[123] The underlying topography of the basin includes the Onoway buried valley, much of which is currently occupied by the present-day path of the Sturgeon River.[124] The presence of surficial glacial till deposits across much of the watershed results in high variability in the chemical composition of the groundwater; groundwater from areas with lower permeability clays are generally typified by very high mineral and sulfate contents, with high iron also occurring in some areas.[125] An older study on groundwater in the region found nitrate concentrations in excess of the former drinking water quality guidelines.[126] These elevated concentrations were believed to be derived from human and animal waste, with improved management practices expected to improve water quality. This reiterates the elevated potential risk to groundwater in much of the watershed.

Approximately 9.5 million cu. m. of groundwater has been allocated for use on an annual basis. Consumptive use is almost 3.4 million cu. m. and return flows total over 5.5 million cu. m, which are discharged to surface watercourses or bodies of water. The remaining 0.6 million cu. m. is designated as losses.

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121 Hydrogeological Consultants Ltd. 1998a-c, 2000, 2001. County of Barrhead No. 11., Lac Ste Anne County, Parkland County, Westlock County, Sturgeon County. Prepared in conjunction with Agriculture and Agrifood Canada. Edmonton, Alberta.

122 Op. cit., AMEC 2002.

123 Op. cit., WorleyParsons, 2009.

124 Carlson, VA. 1967. Bedrock topography and surficial aquifers of the Edmonton District, Alberta. Research Council of Alberta Report 66-3, Edmonton, Alberta.

125 Op. cit., WorleyParsons, 2009.

126 Stein, R. 1976. Hydrogeology of the Edmonton area (northeast segment), Alberta. Edmonton. Research Council of Alberta Report 76-1, Edmonton, Alberta.

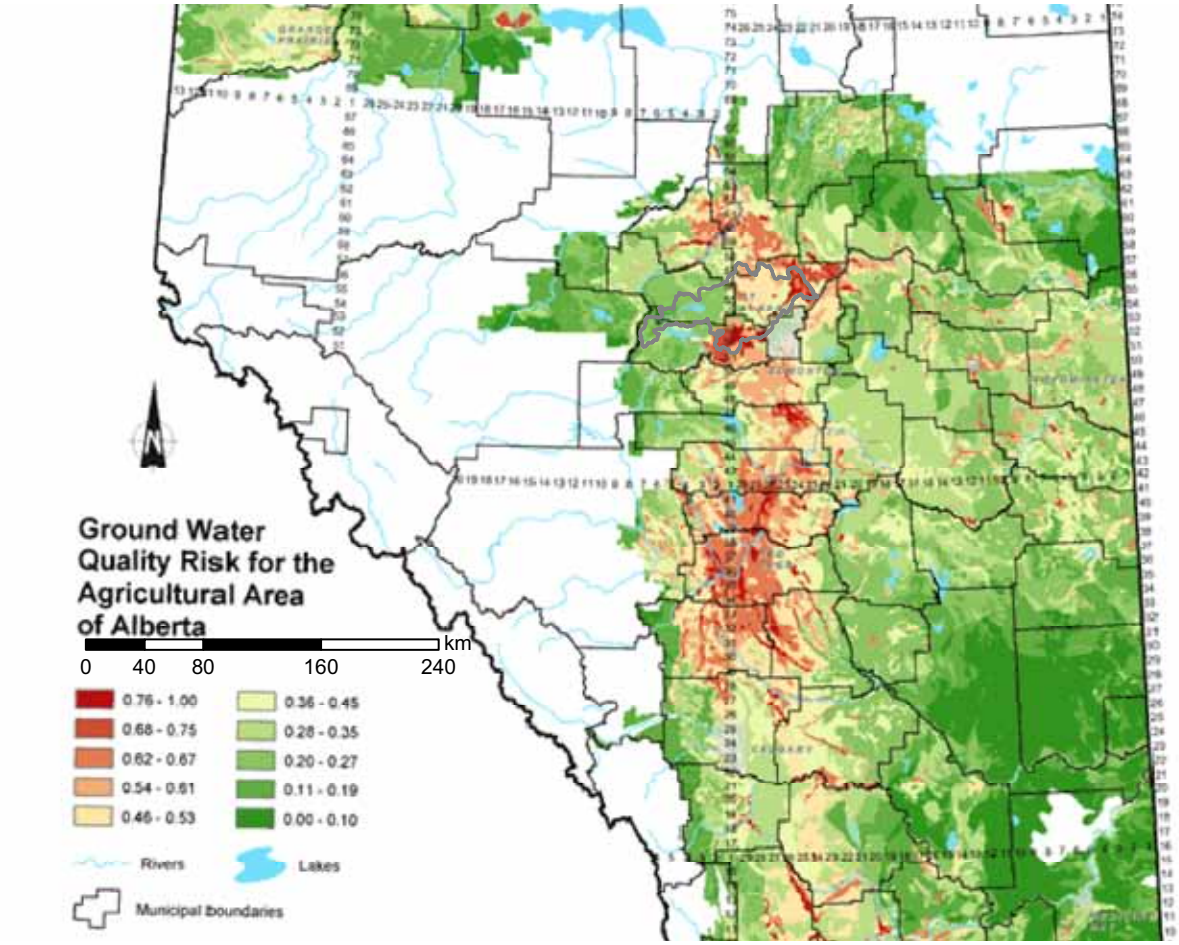
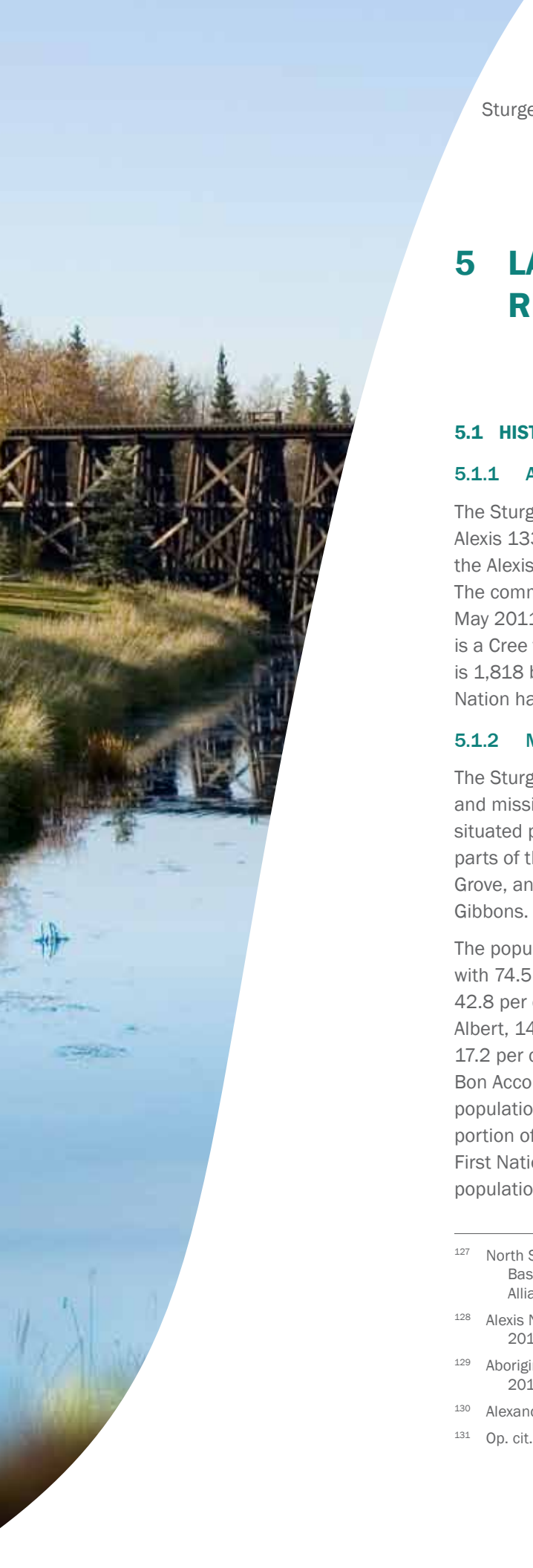


Figure 11. Groundwater risk map for the agricultural region of Alberta (from Alberta Agriculture and Rural Development, 2005a).



5 LAND USE AND SOCIAL/CULTURAL RESOURCES

5.1 HISTORY OF HUMAN SETTLEMENT

5.1.1 Aboriginal communities

The Sturgeon River Watershed includes two First Nations communities – Alexis 133 and Alexander 134.[127] Alexis 133 is comprised of members of the Alexis Nakota Sioux Nation (Stoney) and is a member of Treaty 6.[128] The community reported a population of 1,723 registered residents as of May 2011 on 6,175 hectares (ha) of land.[129] The Alexander First Nation is a Cree tribe and signed Treaty 6 in 1876. The community's population is 1,818 but only half reside on the reserve. In total, the Alexander First Nation has over 23,000 ha of land.[130]

5.1.2 Major communities in the watershed

The Sturgeon River Watershed has a long history of European settlements and missionaries dating back to the 1800s. The major urban centers are situated primarily in the south and east part of the watershed and include parts of the City of St. Albert and the City of Edmonton, the City of Spruce Grove, and the Towns of Morinville, Stony Plain, Onoway, Bon Accord and Gibbons.

The population of the Sturgeon River Watershed is predominantly urban, with 74.5 per cent of the people found in urban centres. The majority, 42.8 per cent, of the watershed's population resides within the City of St. Albert, 14.5 per cent reside in the City of Spruce Grove, and a combined 17.2 per cent reside in the Towns of Stony Plain, Morinville, Gibbons and Bon Accord. A small, but ever increasing, percentage of the watershed's population reside in one of the watershed's nine summer villages, a small portion of the City of Edmonton, and the Alexis 133 and Alexander 134 First Nation Reserves. The remaining 20.4 per cent of the watershed's population live in rural areas.[131]

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127 North Saskatchewan Watershed Alliance (NSWA). 2010. North Saskatchewan River Basin: Socio-Economic Profiles, 2006. 266 pp. The North Saskatchewan Watershed Alliance Society, Edmonton, Alberta. Prepared by Watrecon Consulting.

128 Alexis Nakota Sioux Nation. 2011. Alexis Nakota Sioux Nation website. Accessed 1 June 2011.

129 Aboriginal Affairs and Northern Development Canada. 2008-12-11. p. 1-10 on April 23, 2012.

130 Alexander First Nation. 2011. Alexander First Nation website. Accessed 1 June 2011.

131 Op. cit., North Saskatchewan Watershed Alliance, 2006

The City of Edmonton has a population of 782,439 as of April 2009, and was incorporated as a city in 1904. European settlement began with the fur trade by the Hudson's Bay Company. Father Albert Lacombe founded St. Albert in 1861. St. Albert is the oldest, non-fortified community in Alberta and was the largest agricultural settlement west of Winnipeg. In 1900, St. Albert was incorporated as a village, followed by town status in 1904 and it officially became a city in 1977. As of May 2010, the population of St. Albert was 60,138. St. Albert has placed in the top five of the "Most Wealthy Cities in Canada" based on average net income per citizen, since 2000.

French and Scottish families settled Spruce Grove in 1891. In 1955, Spruce Grove was incorporated as a village, as a town in 1971 and as a City in 1986. In September 2010, its population was reported to be 24,646; making it the 11th largest city in Alberta. Stony Plain was settled in 1881 and is dominated by agriculture and resource industries. The town has a population of 14,177 as of April 2010. Bon Accord was established in 1896 and has a population of 1,584. Morinville has a population of 8,504 as of the 2011 municipal census. As of April 2010, the Town of Gibbons has a population of 2,848 and serves as a major agricultural centre for the surrounding area. The town was settled between 1889 and 1894 by William R. Gibbons and became a town in 1977. Onoway has a population of 1,021 and is supported by a large number of country residential subdivisions and summer villages. It became a town in 2005.

5.1.3 Population Growth, Structure and Socio-Economic Status

Population growth in the Sturgeon River Watershed is extremely high, especially in the City of St. Albert, the City of Spruce Grove and the Town of Stony Plain. All major communities in the watershed experienced rapid growth from 1970 to the 1990s, but growth has continued or accelerated in these three communities (Figure 12). Since 1990, the population of these seven communities has increased from 70,159 to 112,000 (Alberta Municipal Affairs, 1960 – 2010). The pattern reflects an ongoing trend of urbanization in Alberta, with populations in smaller, mostly rural communities remaining steady or declining somewhat, while populations in larger urban centres growing rapidly. Overall, population growth in the Sturgeon River Watershed from 2001 to 2006 was 10.9 per cent, higher than the overall average for both the North Saskatchewan River basin (9.6 per cent) and the province as a whole (10.6 per cent).[132]

[132] Op. cit., North Saskatchewan Water Alliance, 2006.

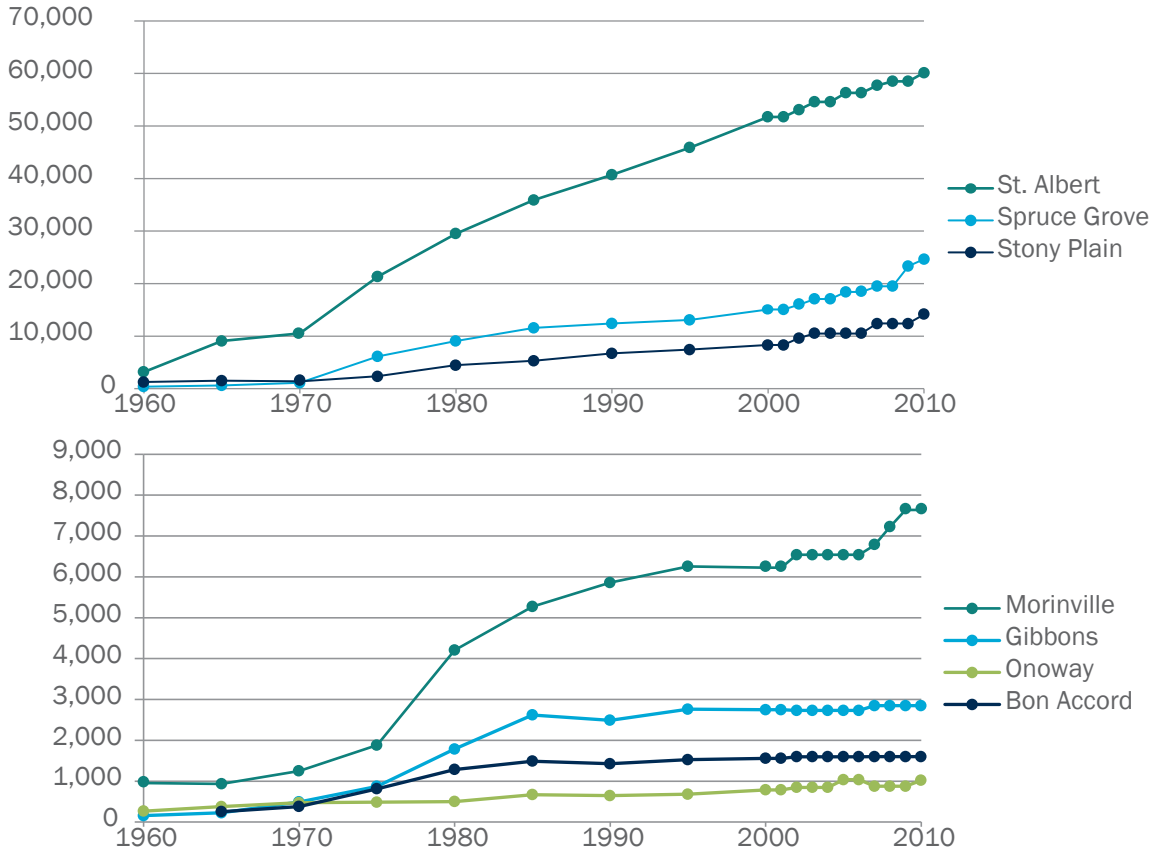

Figure 12. Population growth for major communities in the Sturgeon River Watershed. Data from Alberta Municipal Affairs (1960 – 2010).

The age-structure of the population of the Sturgeon River Watershed shows an interesting pattern, with a higher proportion of young people (under the age of 20) and older adults (ages 40 to 69), with relatively few young adults (ages 20 to 39) and very old people (over 70 years of age) (Figure 13).[133] This distribution differs from the pattern seen in the rest of the North Saskatchewan River Basin and Alberta as a whole.

[133] North Saskatchewan Watershed Alliance (NSWA). 2010. Proposed Site-Specific Water Quality Objectives for the Main stem of the North Saskatchewan River. The North Saskatchewan Watershed Alliance Society, Edmonton, Alberta. 28 p.

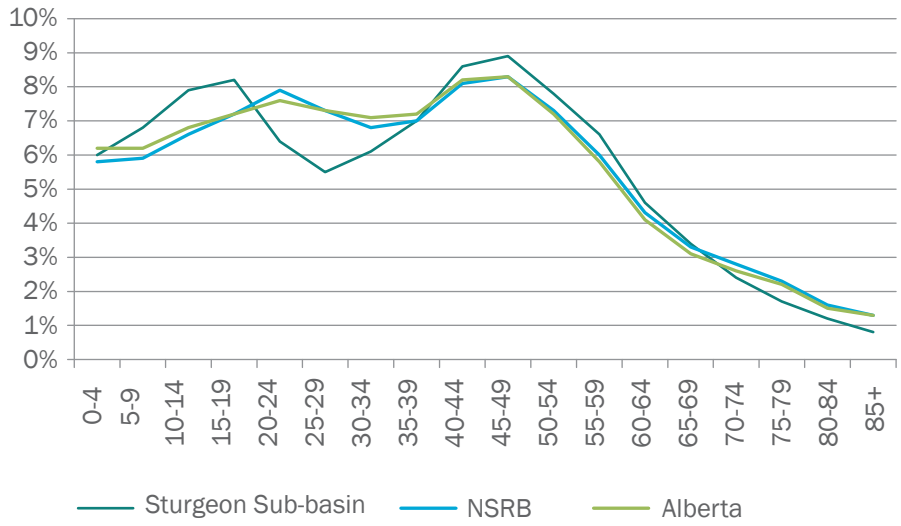

Figure 13. Age composition of the Sturgeon River Watershed (as of 2006; from NSWA, 2010).

Employment earnings in the basin are higher than the average from the rest of the North Saskatchewan River Basin, with the highest average earnings found in Bon Accord and the City of St. Albert, and the lowest in the Alexis 133 and Alexander 134 Reserves.[134] Average family incomes in the Sturgeon watershed were substantially higher than the average for the North Saskatchewan River basin ($85,407 vs. $73,823).[135]

5.1.4 Historical Resources

Alberta Culture and Community Spirit maintains a Listing of Historic Resources across the province.[136] Historic Resource Values are assigned to Resources based on the criteria outlined in Table 7.

Table 7. Criteria for the listing of resources under the Alberta Listing of Historical Resources (Alberta Culture and Community Spirit, 2011a).

Historic Resource Value	Description/Criterion	# of sites
1	Afforded to lands that have been designated under the Historic Resources Act as Provincial Historic Resources	9
2	Designated under the Historic Resources Act as a Municipal or Registered Historic Resource	3
3	Contains a significant historic resource that will likely require avoidance	1
4	Contains a historic resource that may require avoidance	26
5	Believed to contain a historic resource	45
	Total	80

134 Ibid.

135 North Saskatchewan River Basin Socio-Economic Profile. 2006. North Saskatchewan Watershed Alliance.

136 Alberta Culture and Community Spirit. 2011a. Listing of Historic Resources. Alberta Culture and Community Spirit, Edmonton, Alberta.

As noted in Table 7, a total of 80 sites are listed within the Sturgeon River Watershed (Figure 14). The majority of the Provincial, Municipal, or Registered Historic Resources relate to the history of European settlement in the area, the history of religious institutions and to the historical importance of agricultural activity in the watershed. The twelve sites that are ranked as 1 or 2 within the Sturgeon River Watershed are listed in Table 8.

Table 8. Historic Resources Listed under the Alberta Register of Historic Places (Historic Resource Values 1 or 2; Alberta Culture and Community Spirit, 2011a, 2011b).

Resource	Resource Type*	Date Registered	Municipality	Location
Bishop's Palace	PHR	15/02/1977	St. Albert	W4-25-54-4
Father Lacombe Church	PHR	02/06/1983	St. Albert	W4-25-54-4
Alberta Grain Company Grain Elevator	PHR	19/01/2007	St. Albert	W4-25-54-5
Alberta Wheat Pool Grain Elevator	PHR	19/01/2007	St. Albert	W4-25-54-5
Poundmaker Lodge	PHR	06/10/1983	Sturgeon County, near St. Albert	W4-25-54-11
Notre Dame Convent	PHR	21/08/1978	Morinville	W4-25-55-33
St. Jean Baptiste Church And Rectory	PHR	20/11/1979	Morinville	W4-25-55-33
Stony Plain Multicultural Heritage Centre	PHR	04/05/1983	Stony Plain	W5-1-52-25
Sharman House	PHR	03/07/2007	County of Lac Ste. Anne	W5-2-53-34
Sturgeon River Mill	RHR	09/07/1976	Sturgeon County, near Bon Accord	W4-23-55-32
Bruin Inn, The	RHR	08/01/1999	St. Albert	W4-25-54-4
Little White School	MHR	27/04/2009	St. Albert	W4-25-54-4

**PHR = Provincial Historic Resource; RHR = Registered Historical Resource; MHR = Municipal Historic Resource*

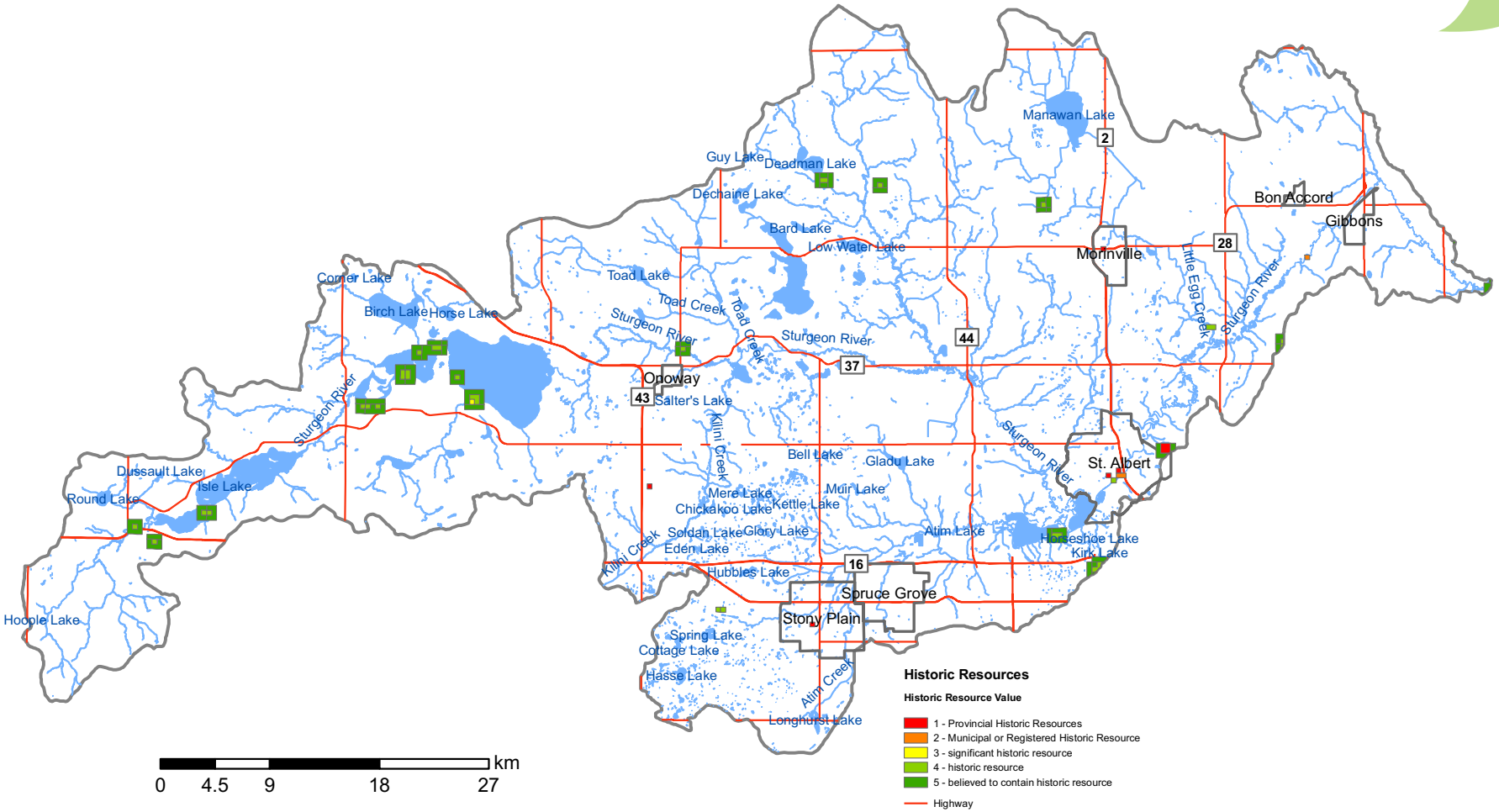

Figure 14. Locations of Historic Resources within the Sturgeon River Watershed (Alberta Culture and Community Spirit, 2011a).

5.2 WATER SUPPLY AND WASTEWATER SYSTEMS

In the Sturgeon River Watershed, the following communities receive their treated water supply from the Edmonton Waterworks System from the North Saskatchewan River (EPCOR): St. Albert, Gibbons, Spruce Grove (with the Capital Region Parkland Water Services Commission), Stony Plain (with the Capital Region Parkland Water Services Commission and an additional surface water source), Rivière Qui Barre, Villeneuve, Morinville, Sturgeon W4 Industrial Park (in addition to a groundwater source), Sturgeon Valley, Bon Accord, Hewitt Estates and Valley Vista Estates, Acheson/Big Lake Industrial Park (with Capital Region Parkland Water Services Commission). The Onoway, Alcomdale and Busby Waterworks Systems use a groundwater source.[137]

Alberta Environment does not regulate private wells and water systems. Surface water sources and shallow groundwater sources used for drinking water are treated by (at a minimum): chemically assisted filtration and disinfection or slow sand filtration and disinfection. Additional treatment may be required, depending on the quality of the water supply. Deep groundwater sources (i.e. aquifers) usually don't require filtration but need disinfection treatment.[138]

Wastewater treatment in the watershed is provided by exporting effluent to regional treatment plants, through the Alberta Capital Region Wastewater Commission (ACRWC) as shown in Figure 15. Wastewater from St. Albert is transported through the regional wastewater transmission network to the ACRWC facilities, near Fort Saskatchewan. Onoway maintains its own wastewater treatment system, comprised of four anaerobic digestion ponds and two detention ponds that are released into the Sturgeon River.[139]

Figure 15. Alberta Capital Region Wastewater Commission transmission network. Image from Alberta Capital Region Wastewater Commission (2012).

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137 Alberta Environment. 2011. Alberta river water quality index. Government of Alberta, Alberta Environment. Edmonton, Alberta.

138 Ibid.

139 Town of Onoway. 2011. Town of Onoway website. Town of Onoway, Alberta.

5.3 LAND USE

5.3.1 Land Resources Overview

The vast majority of the Sturgeon River Watershed is under agricultural development, with only limited areas of forested land present. As the vast majority of lands are privately held, there are no Forest Agreement Management Areas,[140] though logging may occur, at a smaller scale on private woodlots. Several areas have protected or semi-protected status (Provincial Parks, Provincial Recreation Areas, and Natural Areas; Figure 16).

Within the Sturgeon River Watershed Basin there are eight provincially environmentally significant areas (ESAs) and one international ESA listed in the Environmentally Significant Areas Provincial Update 2009[141] and as shown in Table 9.

To classify an area as an ESA it must meet at least one of the following criteria by containing:

- elements of conservation concern
- rare or unique landforms
- important wildlife habitat
- large natural areas
- sites of recognized significance

Table 9. Environmentally Significant Areas within the Sturgeon River Watershed (Environmentally Significant Areas of Alberta Volumes 1-3, 1997).

ESA ID	Natural Subregions	Location	Designation	ESA Criteria Met
422	Central Parkland	Big Lake	International	• rare or unique landforms • important wildlife habitat • sites of recognized significance
441	Dry Mixedwood/ Central Mixedwood	Isle Lake	Provincial	• elements of conservation concern • important wildlife habitat
443	Dry Mixedwood	Eden Lake/ Soldan Lake area	Provincial	• elements of conservation concern • rare or unique landforms
445	Dry Mixedwood	Dawn Valley/ Kettle Lake area	Provincial	• important wildlife area
447	Dry Mixedwood/ Central Parkland	east of Calahoo	Provincial	• important wildlife area
449	Dry Mixedwood	Matchayaw Lake	Provincial	• elements of conservation concern

[140] Allen, T., Maslen, L. and Melton, S.J. 2008. Fisheries Challenges associated with Ray Gibbon Drive at Riel Pond and the Sturgeon River in St. Albert, Alberta. AltaLIS, Calgary, Alberta.

[141] Fiera Biological Consulting. 2009. Environmentally Significant Areas: Provincial Update 2009. Government of Alberta, Edmonton, Alberta.

ESA ID	Natural Subregions	Location	Designation	ESA Criteria Met
450	Dry Mixedwood	Lac Ste. Anne	Provincial	• elements of conservation concern
451	Dry Mixedwood	East of Sandy Lake	Provincial	• important wildlife area
452	Dry Mixedwood	Birch Lake	Provincial	• elements of conservation concern

Big Lake is located northwest of the City of Edmonton and west of the City of St. Albert, within Sturgeon County. The Sturgeon River drains into Big Lake from the north. Two smaller creeks, Atim and Carrot also drain into Big Lake from the west and northeast respectively. Big Lake was recognized as an international environmentally sensitive area because of the diverse regional wildlife and the use by species at risk. Over 220 species of birds have been observed at the site, including Trumpeter and Tundra Swans during their migrations. The Big Lake Natural Area, with an area of 1,119 ha, was designated as part of the Special Places program in May 1999.[142] In April 2005, the Province of Alberta established the Lois Hole Centennial Provincial Park, which incorporates the Big Lake Natural Area and an additional 302 ha, resulting in a total of 1,421 ha.

Big Lake is recognized as an important waterfowl molting (shed feathers) and staging site and it has been designated as one of the 20 most important waterfowl habitat units in Alberta. Most of the waterfowl consist of dabbling and diving ducks, but large numbers of Tundra Swans are also present during the last few weeks of October. In addition to its importance for staging waterfowl, Big Lake also supports a large colony of nesting Franklin's Gulls in the west bay of the lake. Nesting colonies of Eared Grebes and Black Terns are also present. In years when water levels are low, a variety of migrating shorebirds can also be observed, including yellowlegs, dowitchers, Pectoral Sandpipers, American Avocets, and a variety of small sandpipers. On June 5, 2001 the lake became an Important Bird Areas site.[143]

[142] Alberta Tourism, Parks and Recreation. 2011. Lois Hole Centennial Provincial Park. Government of Alberta, Edmonton, Alberta.

[143] IBA (Important Bird Areas). Site Listing for Big Lake St. Albert.

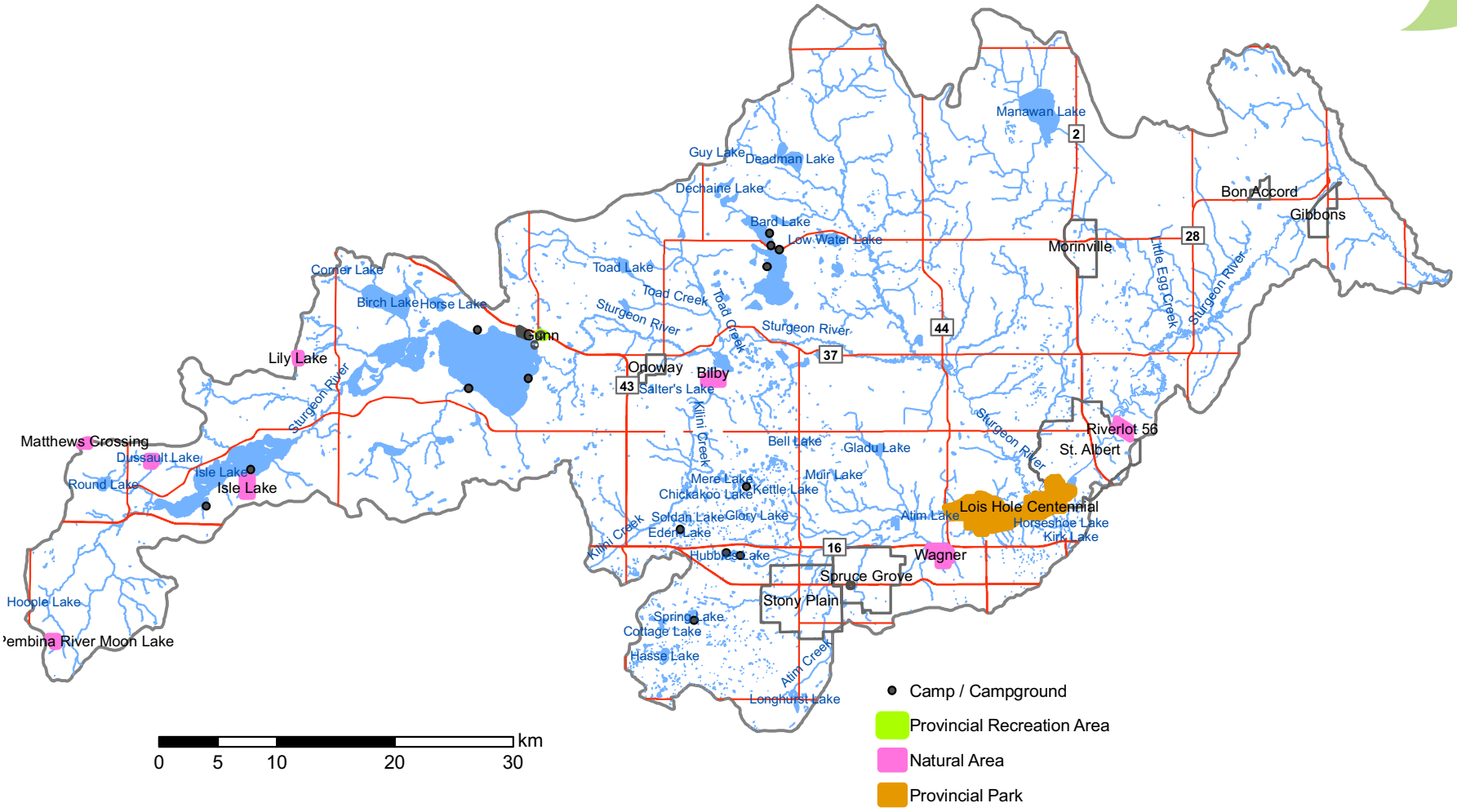

Figure 16. Provincial Parks, Provincial Recreation Areas, Natural Areas, campgrounds, and other recreational resources in the Sturgeon River Watershed (Natural Resources Canada, 2010).

5.3.2 Agricultural Resources

Agricultural land use and associated data are taken from the Census of Agriculture.[144] The Census is carried out every five years, with the most recent complete data available from 2006; agricultural data from the 2011 census is scheduled to be completed and released in 2013. The smallest-scale at which data are generally available corresponds to the Soil Landscapes of Canada dataset.[145] Because the boundaries of that dataset do not line up with those of the watershed, some data have been interpolated.

Approximately 71 per cent of the total land base within the Sturgeon River Watershed is taken up by agricultural operations including cropland (46 per cent), and improved and unimproved pasture, involving over 1,200 farms (Figure 17).[146] The highest percentage of agricultural land use occurs in the central and eastern portion of the watershed, with a lower (though still high) percentage in the western portion (Figure 18). The percentage of lands under crop cultivation follows a similar pattern, with approximately a quarter of the lands in the western portion of the watershed under cultivation and with more than half of the lands in the eastern portion of the watershed under cultivation (Figure 19).

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144 Statistics Canada. 2008. 2006 Census. Statistics Canada, Ottawa, Ontario; Agriculture and Agri-Food Canada. 2005. Soil Landscapes of Canada v3.0. Agriculture and Agri-Food Canada, Soil Landscapes of Canada Working Group. Ottawa, Ontario.

145 Op. cit., Agriculture and Agri-Food Canada, 2005.

146 Op. cit., Statistics Canada, 2008; Op. cit., Agriculture and Agri-Food Canada, 2005.

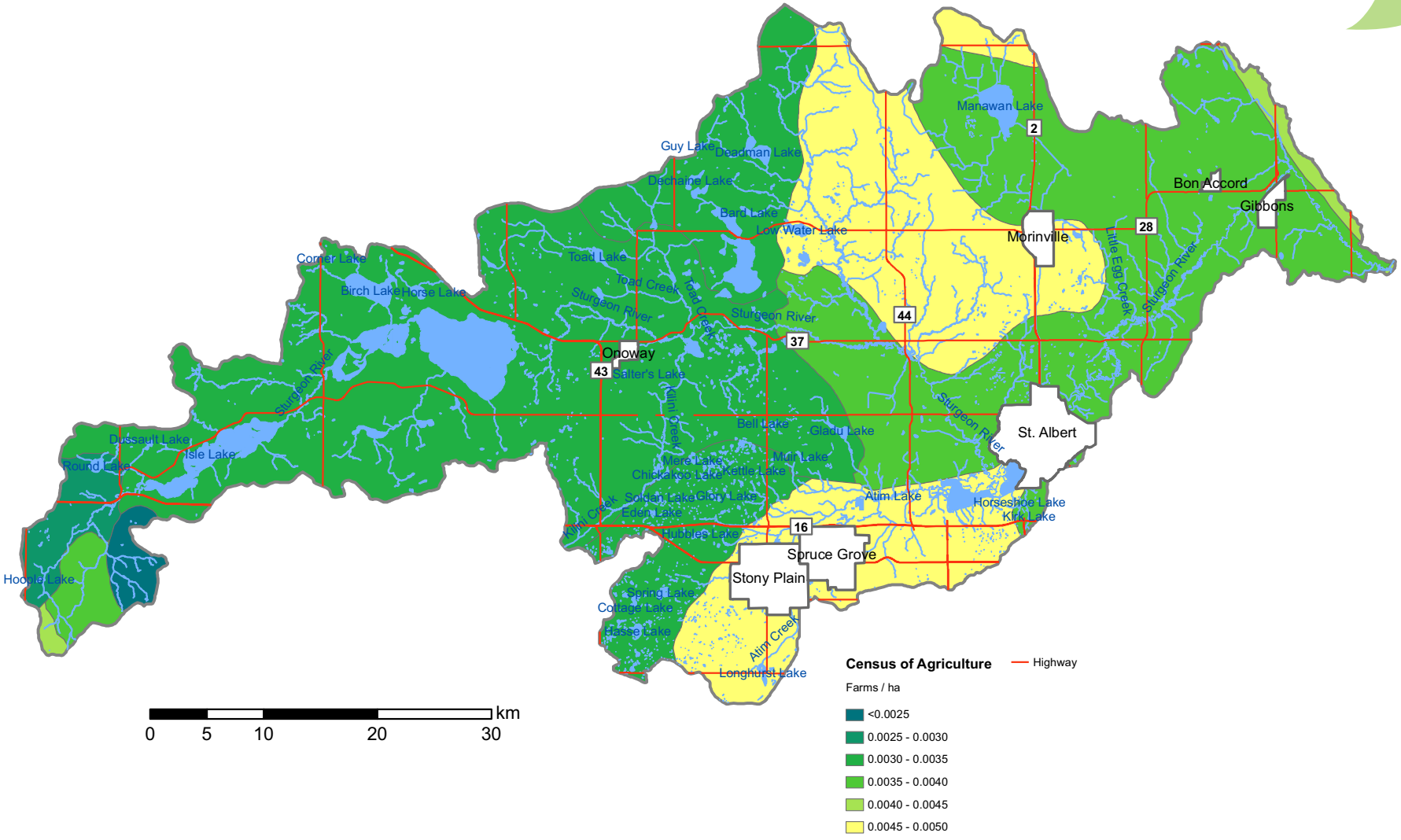

Figure 17. Density of farms in the Sturgeon River Watershed (Statistics Canada, 2008 and Agriculture and Agri-Food Canada, 2005).

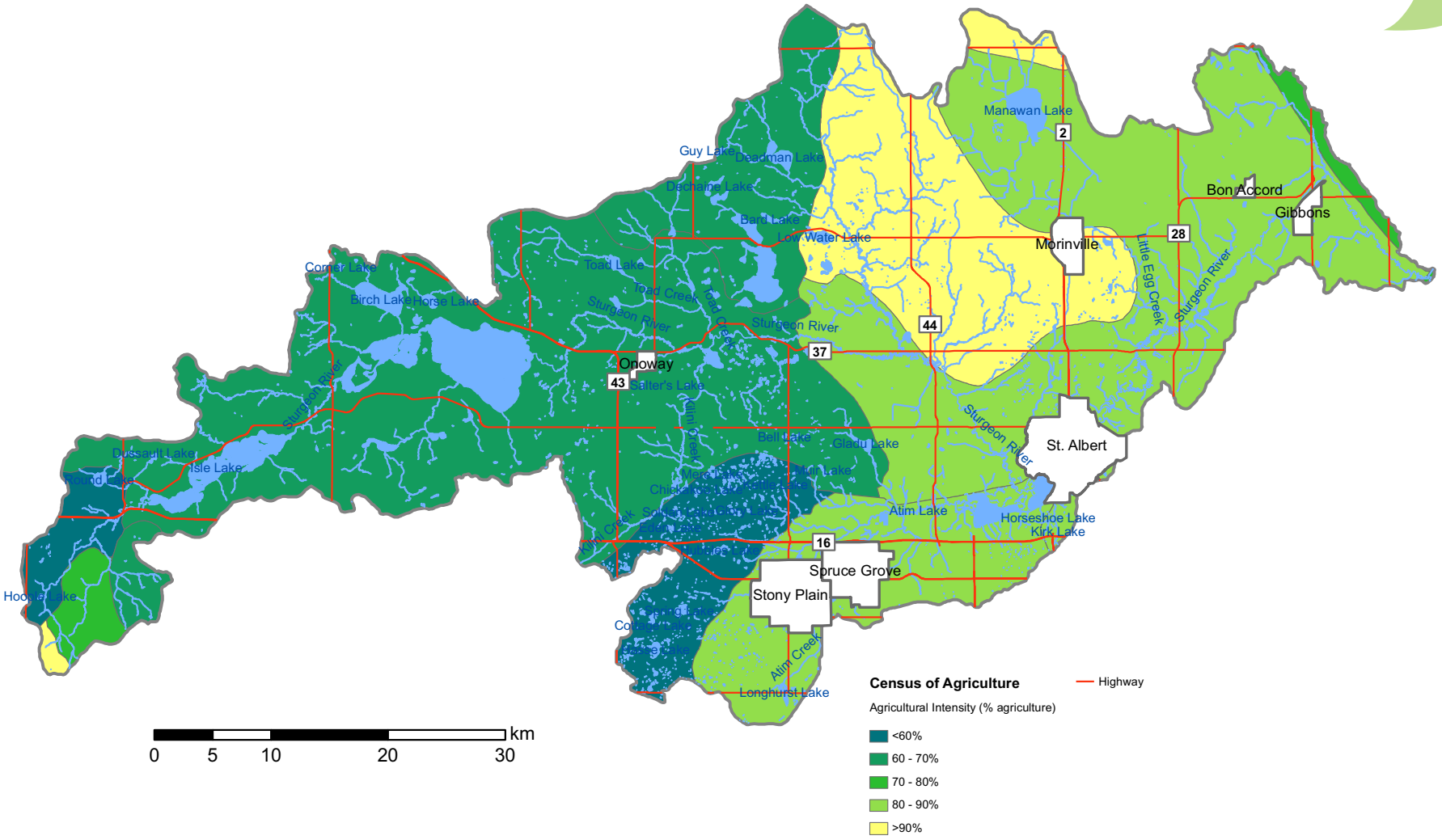

Figure 18. Agricultural intensity in the Sturgeon River Watershed, expressed as the percentage of total land used for all agricultural activities (Statistics Canada, 2008 and Agriculture and Agri-Food Canada, 2005).

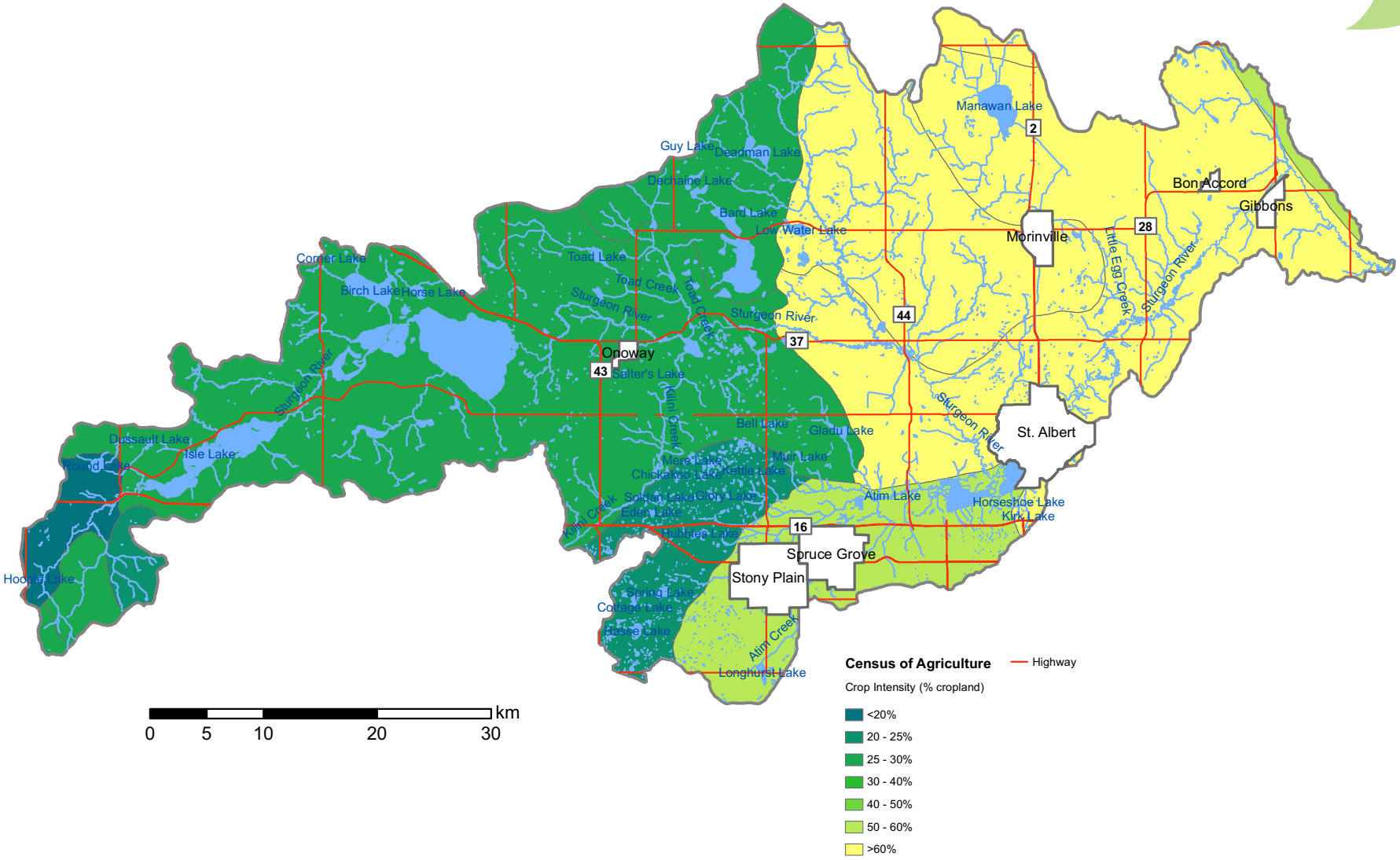

Figure 19. Crop intensity in the Sturgeon River Watershed, expressed as the percentage of total land used as cropland (Statistics Canada, 2008 and Agriculture and Agri-Food Canada, 2005).

Grains, alfalfa and various oil seeds dominate crop production in the watershed (Table 10). Intensive agricultural practices are common, with nearly 100,000 ha fertilized and over 80,000 ha treated with herbicides each year (Table 11). Only a minor proportion of the total cropland uses practices such as applying green manure and no-till seeding. The total area of fertilized land in the watershed has remained mostly steady since the 1980s (Figure 20), while the total area of land to which herbicide is applied has shown a very slight increasing trend (Figure 21). However, the intensity of application of both fertilizers and herbicides (either total amount or frequency of application) and the types of herbicides used are not reported.

Table 10. Crop densities in the Sturgeon River Watershed (Statistics Canada, 2008 and Agriculture and Agri-Food Canada, 2005).

Crop	Crop area (ha)	Number of Farms
Grains	64,019	555
Alfalfa	35,020	564
Oilseeds	34,811	251
Pulses or legumes	1,742	27
Vegetables and fruits	158	58
Total	135,750	1455

Table 11. Summary of areas under select agricultural practices within the Sturgeon River Watershed (Statistics Canada, 2008 and Agriculture and Agri-Food Canada, 2005).

Agricultural practice	Total area (ha)	Percent
Fertilizer application	99,413	41.7
Herbicide use	82,029	34.4
No-till seeding	30,349	12.7
Manure application	11,936	5.0
Fungicide use	8,682	3.6
Insecticide use	5,579	2.3
Irrigation	314	0.13
Chemical weed control of summer fallow crops	248	0.10
Green manure crops for plowdown	97	0.04

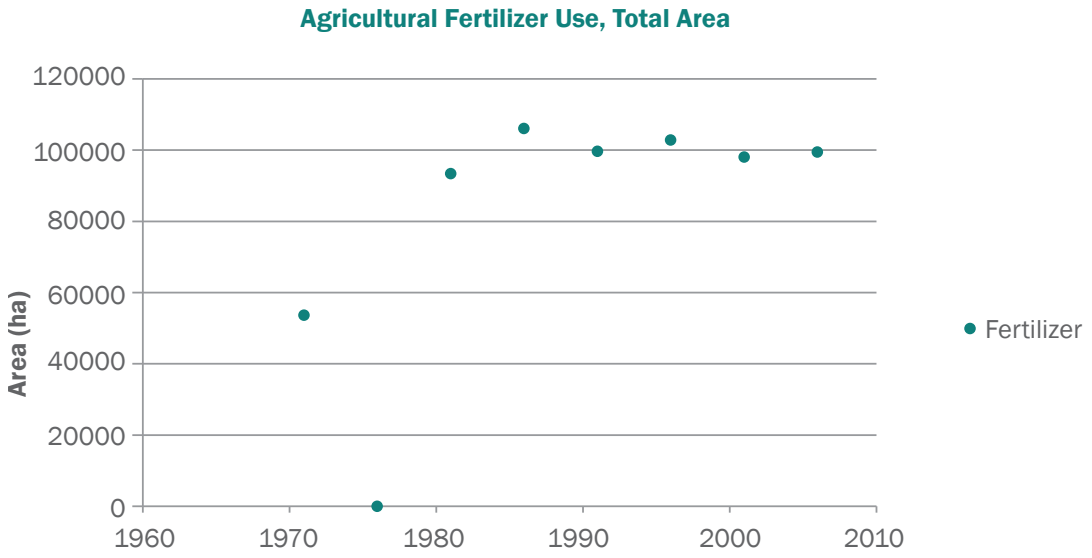

Figure 20. Total area of agricultural fertilizer application in the Sturgeon River Watershed (Statistics Canada, 2008 and Agriculture and Agri-Food Canada, 2005). No data are available from 1976.

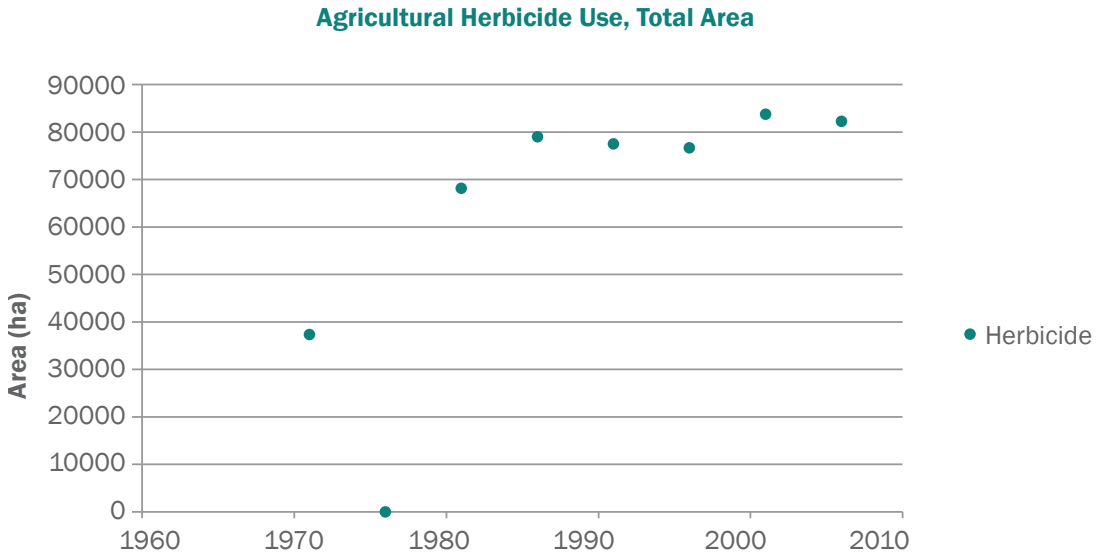

Figure 21. Total area of agricultural herbicide application in the Sturgeon River Watershed (Statistics Canada, 2008 and Agriculture and Agri-Food Canada, 2005). No data are available from 1976.

The estimated total numbers of livestock within the watershed is summarized in Table 12. The distribution of livestock within the Sturgeon River Watershed varies by species. Cattle densities are the highest in the western portions of the watershed (Figure 22), pigs' densities are the highest in the north-central portion of the watershed (Figure 23), and sheep densities are the highest in the central portion of the watershed (Figure 24). Poultry production is highest in the eastern portion of the watershed (Figure 25). Manure is produced at an average annual rate of approximately 2,500 kg/ha across the entire watershed, with the highest rates of production (of over 3,000 kg/ha per year) in the central-northern portion of the watershed, where the highest densities of cattle, pigs, and sheep overlap (Figure 26). Data on manure production are calculated as part of the Census of Agriculture by Statistics Canada and Agriculture and Agri-Food Canada, based on average rates of manure production by each livestock species.[147]

Table 12. Total estimated numbers of livestock in the Sturgeon River Watershed (Statistics Canada, 2008 and Agriculture and Agri-Food Canada, 2005).

Livestock	Total number	Number of Farms
Cattle	80,038	639
Poultry	672,091	113
Pigs	19,005	33
Sheep	7,464	58
Goats	922	35

[147] Op. cit., Statistics Canada, 2008; Op. cit., Agriculture and Agri-Food Canada, 2005

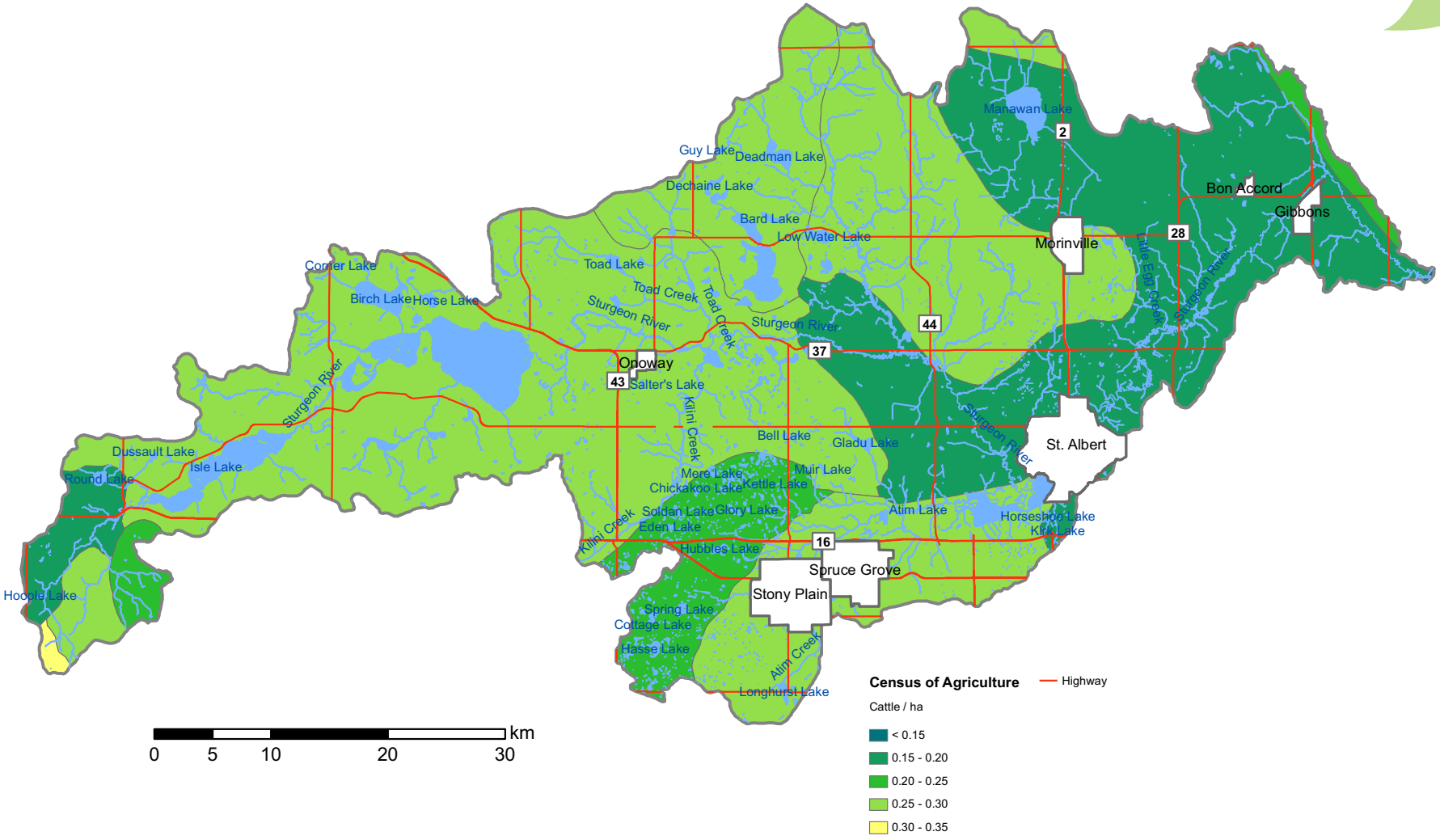

Figure 22. Cattle density in the Sturgeon River Watershed (Statistics Canada, 2008 and Agriculture and Agri-Food Canada, 2005).

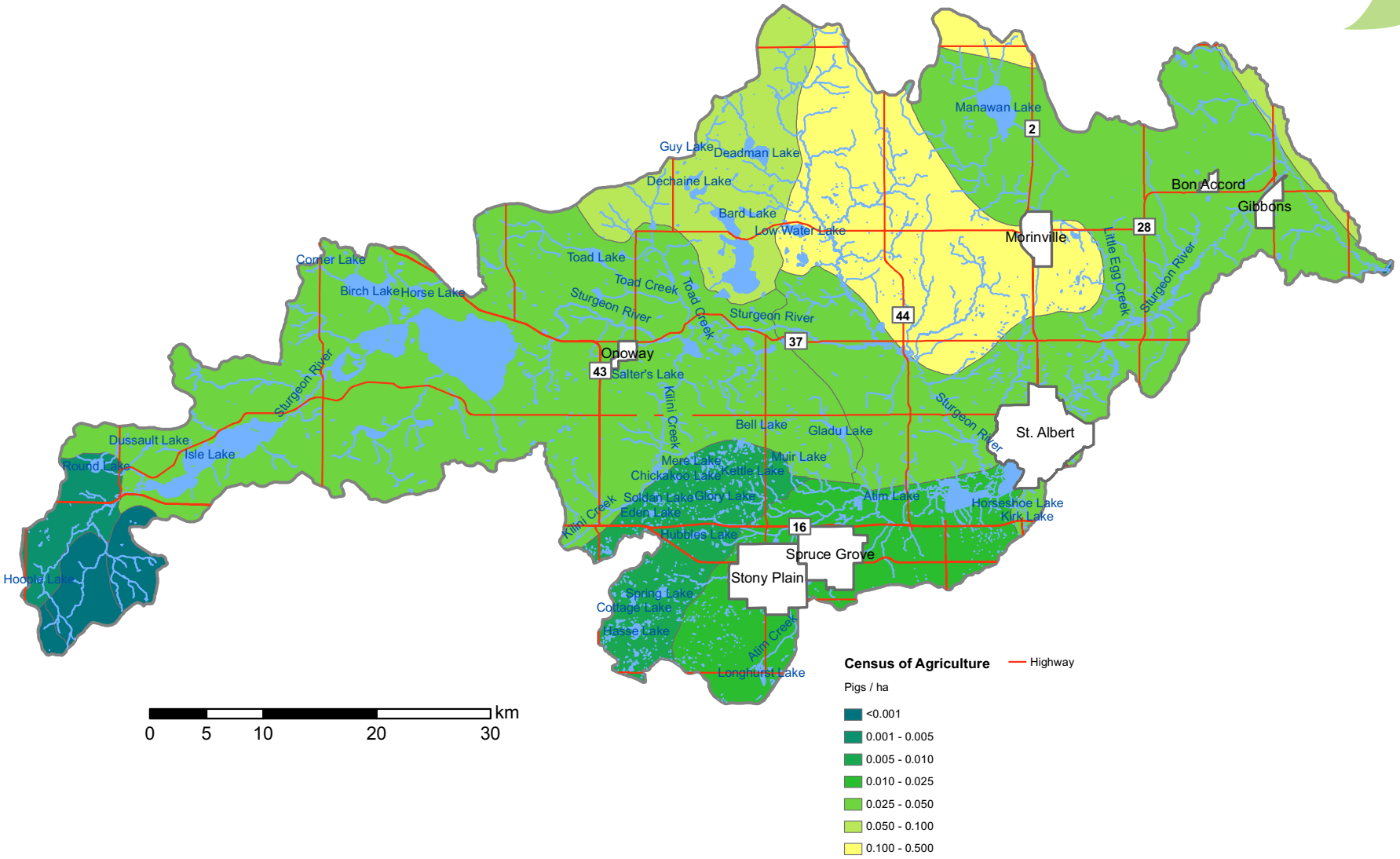

Figure 23. Pig density in the Sturgeon River Watershed (Statistics Canada, 2008 and Agriculture and Agri-Food Canada, 2005).

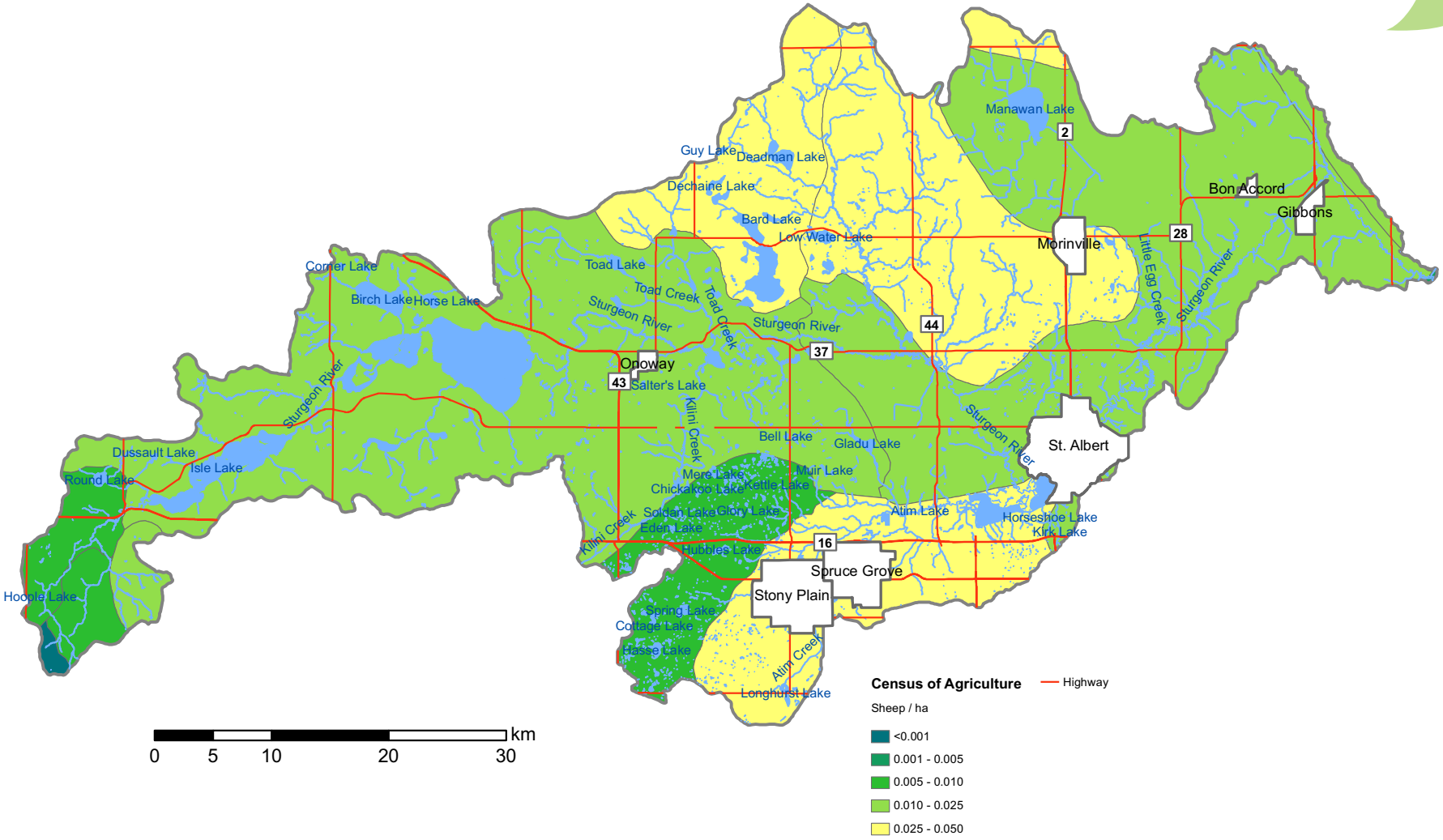

Figure 24. Sheep density in the Sturgeon River Watershed (Statistics Canada, 2008 and Agriculture and Agri-Food Canada, 2005).

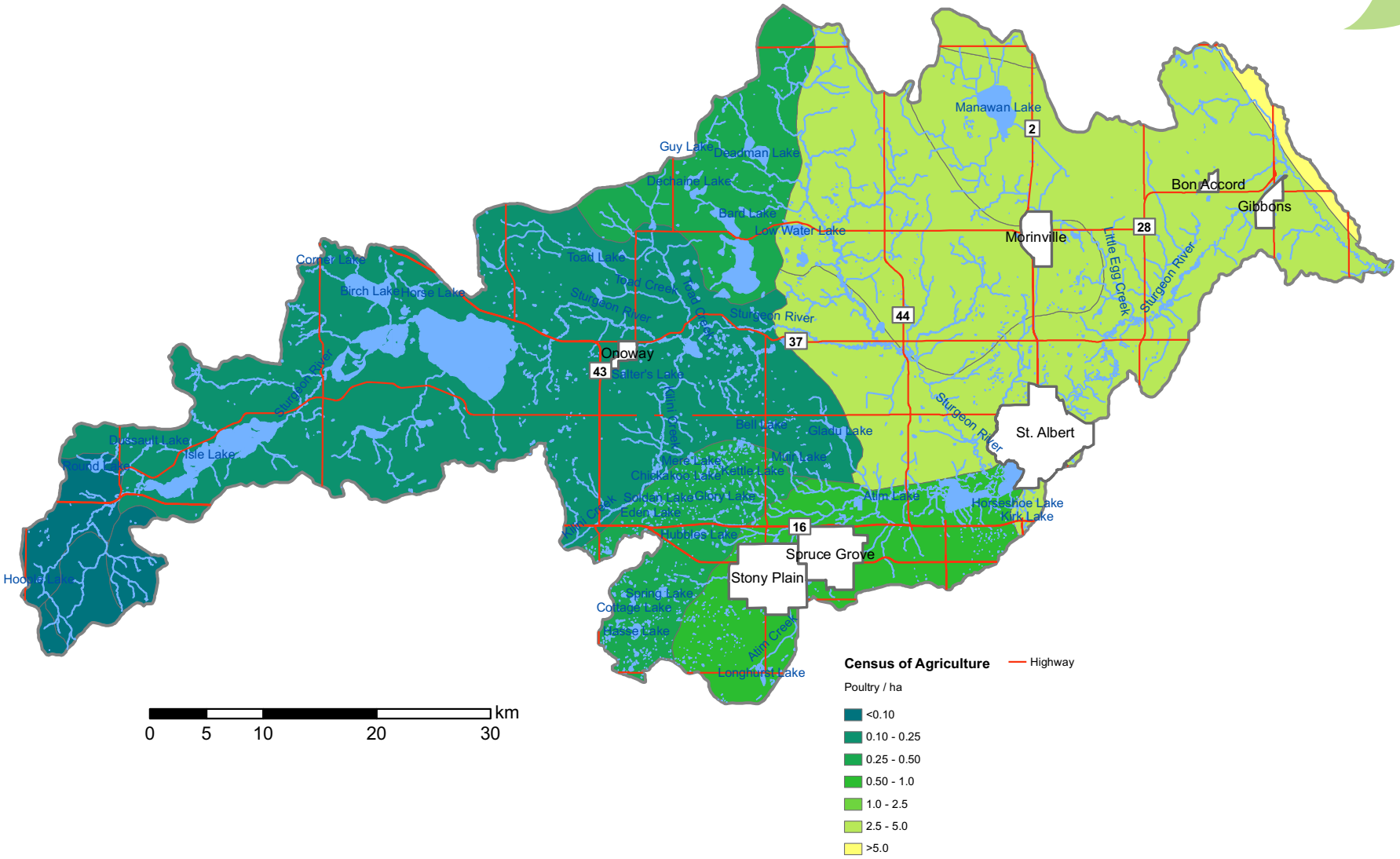

Figure 25. Poultry density in the Sturgeon River Watershed (Statistics Canada, 2008 and Agriculture and Agri-Food Canada, 2005).

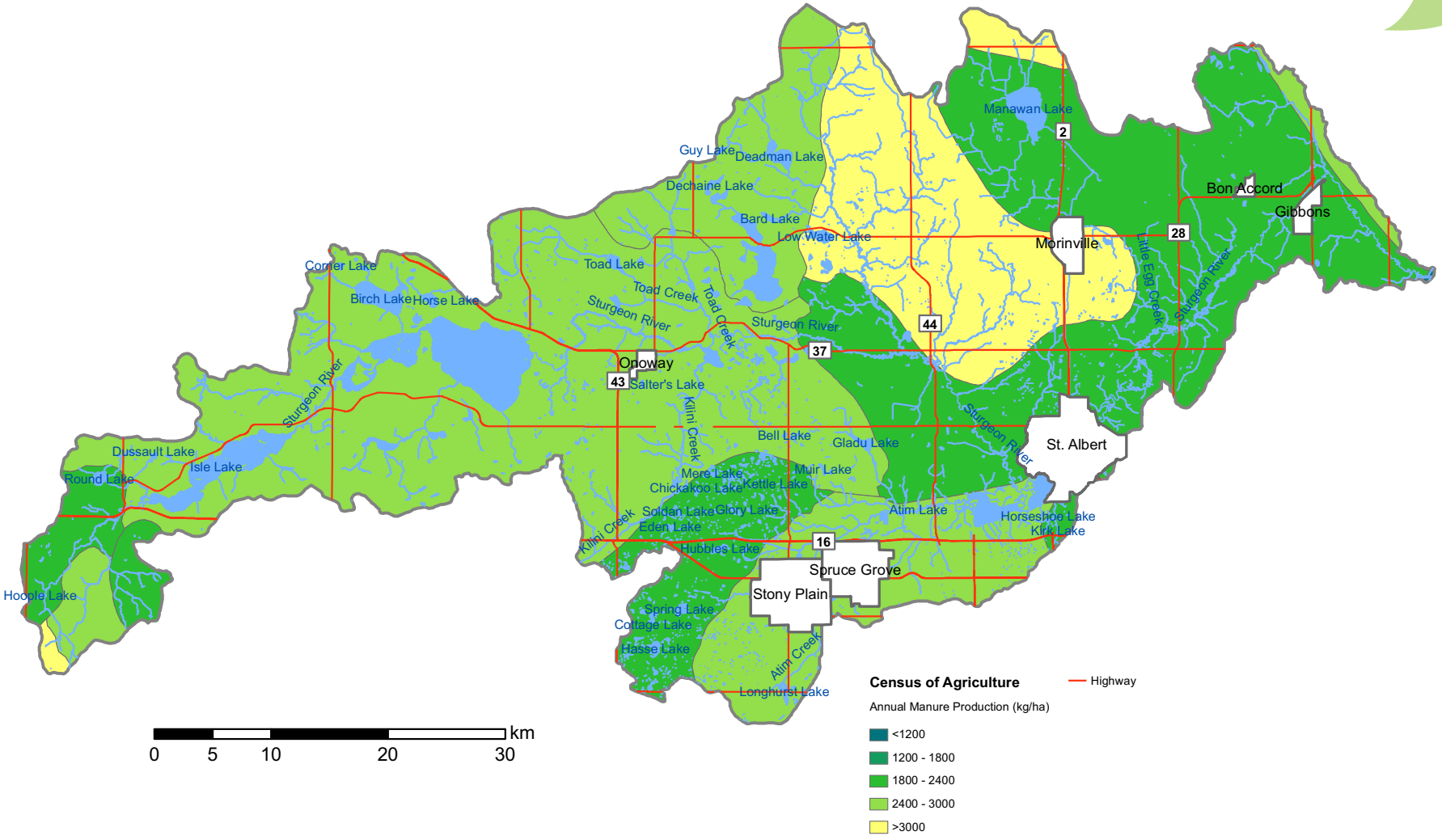

Figure 26. Manure density in the Sturgeon River Watershed (Statistics Canada, 2008 and Agriculture and Agri-Food Canada, 2005)

5.3.3 Recreational Resources

There are eight Natural Areas, one Provincial Recreation Area, and one Provincial Park in the watershed, as listed in Table 13 and shown in Figure 16. There are also a total of 18 camps and campgrounds and two picnic spaces in the watershed.

Table 13. Recreational resources within the Sturgeon River Watershed.

Recreational Resource	Location	Area (ha)
Lois Hole Centennial Provincial Park	Big Lake (Parkland County, Sturgeon County, City of St. Albert, City of Edmonton)	1421
Lily Lake Natural Area	County of Lac Ste. Anne	172
Bilby Natural Area	Sturgeon County	126
River Lot 56 Natural Area	Sturgeon County	108
Matthews Crossing Natural Area	County of Lac Ste. Anne	311
Isle Lake Natural Area	Lake Isle (County of Lac Ste. Anne	106
Wagner Natural Area	Parkland County	219
Pembina River Moon Lake Natural Area	Lac Ste. Anne	98
Dussault Lake	Lac Ste. Anne	56
Gunn Provincial Recreation Area	Lac Ste. Anne	Closed

Summer villages have been established on Lac Ste. Anne, Lake Isle and Sandy Lake. There are six summer villages around the lakeshore of Lac Ste. Anne: Castle Island, Ross Haven, Sunset Point, Val Quentin, West Cove and Yellowstone.[148] Two public camping facilities operate on Lac Ste. Anne. The first, at the village of Alberta Beach, has a campground with 100 sites, a beach and a boat launch. The second campground is located by Gunn and has 25 campsites.[149] Lake Isle has two summer villages, Silver Sands and South View,[150] and the hamlet of Gainford on the southwest shore. There are several campgrounds operating on Lake Isle. The campground near Gainford has eight campsites, the Kokomoko Recreation Area has 10 campsites and a boat launch, and Camp He-Ho-Ha on the southern shore is a recreational camp for the disabled. Two-quarter sections south of Camp He-Ho-Ha were preserved as a Natural Recreation Area in 1971.[151] On the shores of Sandy Lake are two summer villages (Sandy Beach and Sunrise Beach) and a country residential subdivision (Pine Sands). There are no public campgrounds on Sandy Lake, but several commercial campgrounds exist, with a total of 212 campsites. Also, a Girl Guide Camp is located on Sandy Lake on the north basin's east side.[152]

Summer villages in the watershed are all members of the Association of Summer Villages of Alberta. Many have land use bylaws, municipal development plans and sustainability plans to deal with development and expansion of the communities in order to maintain the integrity and character of their villages. The population of summer villages can expand 10-fold in the summer months and the

148 Summer Villages. 2012. Alberta Summer Villages.

149 Op. cit. Mitchell, P. and Prepas, E. 1990.

150 Summer Villages. 2012. Alberta Summer Villages.

151 Op. cit. Mitchell, P. and Prepas, E. 1990.

152 Ibid

demand for new developments of homes and cottages are increasing. The adherence to a municipal development plan is a vital tool for village council members to use to protect their beloved lakes.

Environmental Reserve (ER) on a lakeshore is intended to provide a buffer between the lake and human activities surrounding it. As outlined in the Municipal Government Act (1994), an ER buffer between the lake and human activity must be no less that 6m wide. The Alberta Summer Villages Association (ASVA) has adopted ER as part of their lake stewardship plan and encourages all members to follow the ER guidelines. Like ER, the incorporation of Municipal Reserves (MR) is encouraged by the ASVA. Each summer village may demand up to 10 per cent of land slated for development to be maintained as MR. This land can be kept in its natural state and, therefore, act as a buffer to protect the lake.

5.3.4 Other Human/Industrial Influences, Developments, and Disturbances

Because the Sturgeon River Watershed is located within the settled region of the province, there are numerous sources of human disturbance on the landscape. One of the most common types of disturbance is linear developments, such as roadways, rail lines and rights-of-way associated with transmission lines and pipelines (Figure 27). A total of 5,263 km of linear developments exist within the Sturgeon River Watershed. Assuming the widths of these disturbances, as used by the North Saskatchewan Watershed Alliance (2005), this yields a total area of 79.2 sq. km. of linear developments, or 2.3 per cent of the total land base (Table 14). When petroleum well pads are included in this area (Figure 28), this total rises to 86.4 sq. km. or 2.6 per cent of the total land base, assuming a well pad size of one hectare.

Table 14. Lengths and areas of linear developments in the Sturgeon River Watershed at the 1:50,000 scale (Natural Resources Canada, 2010). Assumed development widths follow North Saskatchewan Watershed Alliance (2005).

Development Type	Total Length (km)	Width (m)	Area (sq. km.)
Roadways	4,249	15	63.7
Pipeline	446	15	6.7
Railway	260	15	3.9
Transmission line	127	30	3.8
Forest cutline	163	6	1.0
Trail	18	6	0.1
Total	**5,263**		**79.2**

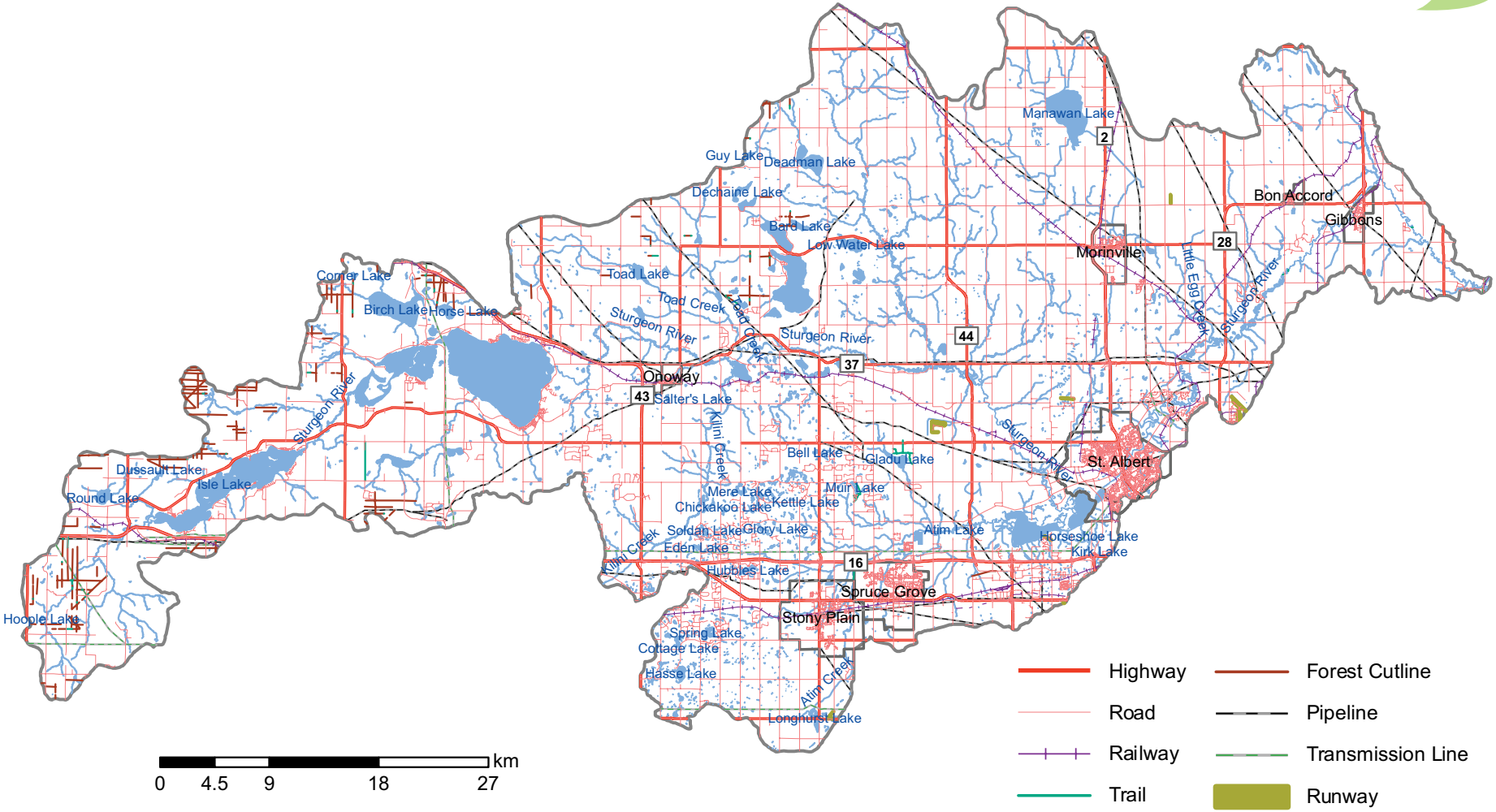

Figure 27. Linear developments and impervious features in the Sturgeon River Watershed (Natural Resources Canada, 2010).

The petroleum and energy sector accounts for another large proportion of disturbance in the Sturgeon River Watershed, with a total of 718 petroleum wells, 19 other petroleum-related facilities or structures, and 13 transformer stations (Figure 28).

There are a number of other rural commercial/industrial developments in the watershed, including 62 mines or pits (including coal mines and aggregate extraction areas), four operating domestic/residential waste facilities (landfills), seven automobile wreckers and one lumberyard (Figure 29).[153] Commercial and industrial developments found within cities or towns are not enumerated in this dataset.

Hunt and Webb (2011) are currently conducting a study on water quality impacted by bridges and river crossings in the Sturgeon River Watershed. The study examined 101 crossings of permanent rivers and streams, including 20 culverts and 81 bridges (Figure 30). The study did not find any of the culverts to be hanging, but did find incidences of debris jams and beaver dams blocking crossings (in 35 per cent of culverts and 22 per cent of bridge crossings) and sedimentation (in 15 per cent of culverts and 80 per cent of bridge crossings). Based on a spatial analysis of the intersections of the watercourse features with maps of roadways,[154] 866 potential crossings of unknown classifications were found (Figure 30). These potential crossings include those on both permanent and transitory watercourses, and may not feature culverts or other crossing structures to facilitate the flow of water and passage of fish.

[153] Op. cit., Natural Resources Canada, 2010

[154] Op. cit., Natural Resources Canada, 2010

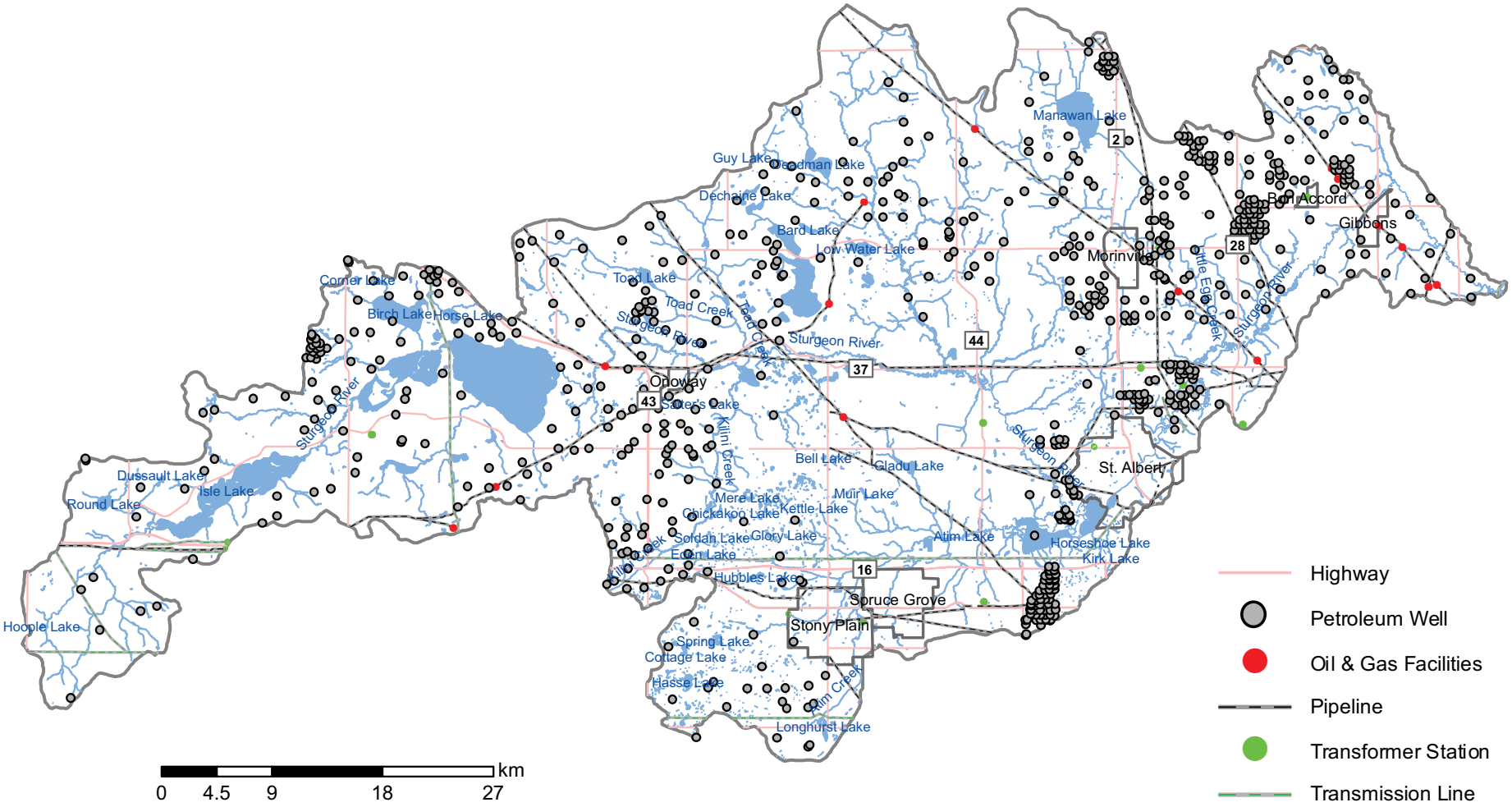

Figure 28. Petroleum and other energy facilities/developments in the Sturgeon River Watershed (Natural Resources Canada, 2010).

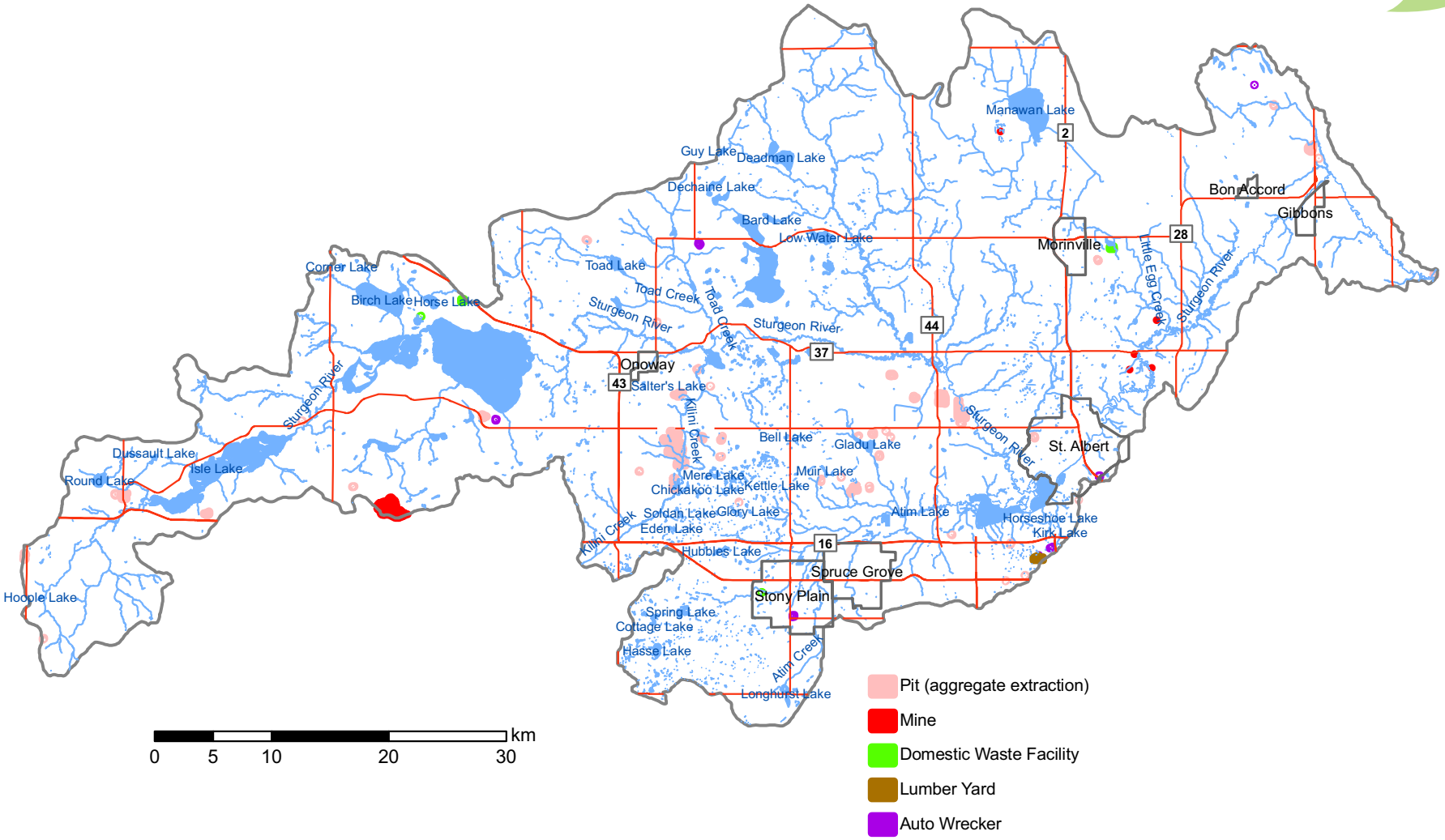

Figure 29. Rural industrial/commercial developments in the Sturgeon River Watershed (Natural Resources Canada, 2010).

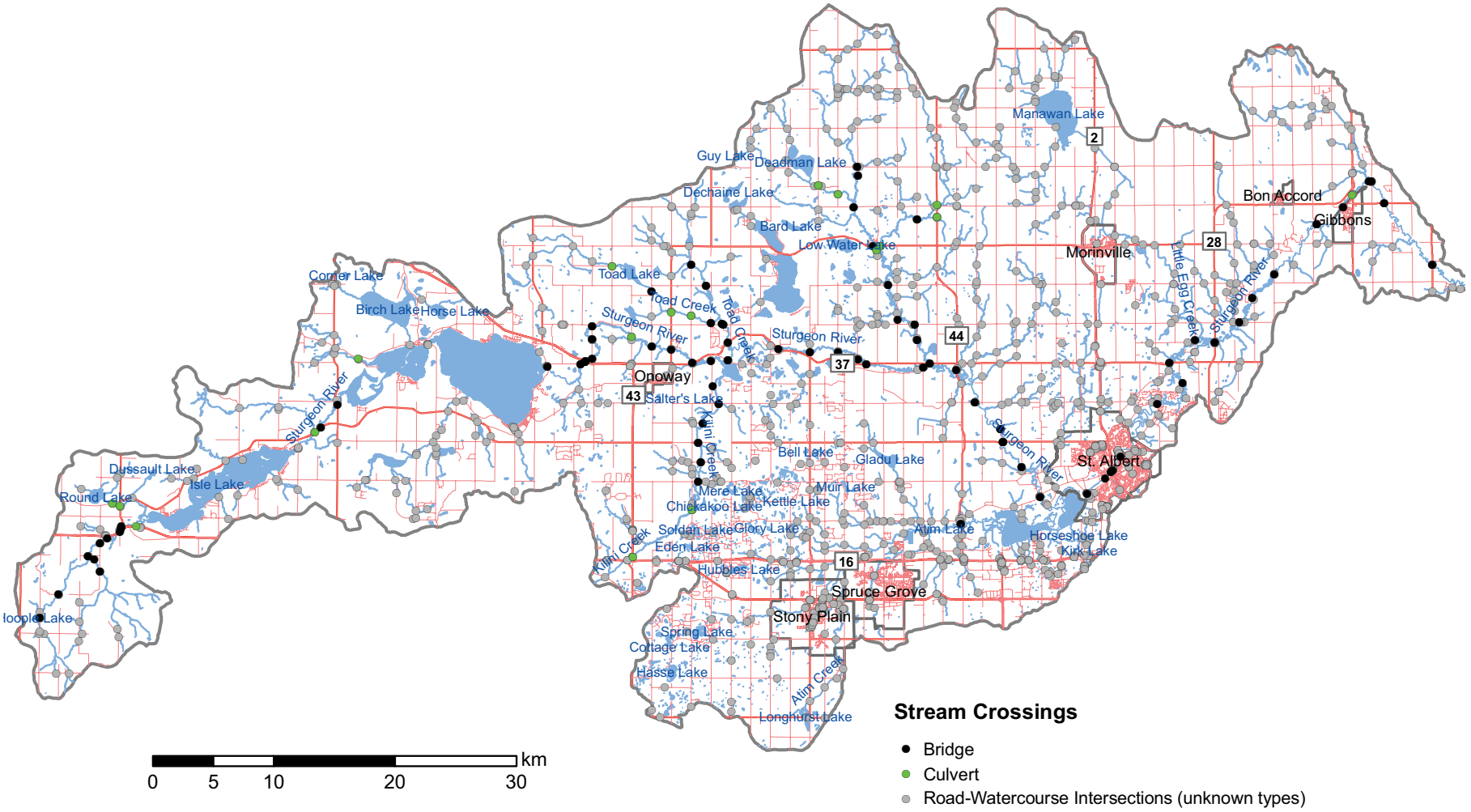

Figure 30. Watercourse crossings in the Sturgeon River Watershed. Bridge and culvert crossings from Hunt and Webb (2011); Other/unknown crossing types derived from Natural Resources Canada (2010).

5.4 RIPARIAN HEALTH ASSESSMENTS

Riparian areas are an important transition zone between uplands and aquatic systems. These areas act as buffers, protecting water quality, attenuating floods and providing habitat for a diverse community of aquatic, semi-aquatic and terrestrial organisms. Contaminants are absorbed onto sediment particles, assimilated by vegetation and transformed by soil microbes into less harmful forms. They are effective in reducing nutrients, sediments and other anthropogenic pollutants that enter surface waters via overland and subsurface flow.

The Alberta Riparian Habitat Management Society completed a single riparian health assessment on Sandy Lake. Homogeneous subsets of shoreline were delineated and representative sections were assessed, with a total of 4.88 out of 35 km assessed. The study found 36 per cent of the shoreline was surveyed to be healthy, 27 per cent was healthy but with problems, and 36 per cent was unhealthy.[155] No broad assessment of riparian health has been completed across the watershed.

5.5 WETLAND INVENTORY

Several sources of data are available on wetland density across the Sturgeon River Watershed. Based on the 1:50,000 scale base features for the watershed, wetlands make up 69.9 sq. km. (2.1 per cent) of the land base of the Sturgeon River Watershed (Figure 10);[156] this increases to 249.1 sq. km. (7.5 per cent) when open water bodies are included (as they are under many wetland classification systems). Under the 2000 Land Cover Classification System, 1.3 per cent of the land base is made up of wetlands, though this is a coarser scale and excludes smaller and temporary wetlands (Figure 7).[157] An inventory carried out by Ducks Unlimited Canada (DUC) found 6.8 per cent of the Sturgeon River Watershed land base to be composed of permanent and temporary wetlands;[158] however, much of the watershed lies outside of DUC's current areas of focus, so little information on drained wetlands is available. The relatively high density of Gleysols on the landscape (525 sq. km., or approximately 16 per cent of the watershed area), including areas under agricultural development, suggests that a much higher proportion of the land base consisted of wetlands at some point in history, and is in line with province-wide estimates of historical wetland densities of 18 per cent. [159]

In addition to existing inventories, there are several ongoing projects related to wetland distributions, such as Alberta Wet Areas Mapping Initiative[160] and the Canada Wetland Inventory project.[161]

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155 Cows and Fish. 2007. Riparian Health Inventory Final Report – Sandy Lake. Cows and Fish, Alberta Riparian Habitat Management Society. Lethbridge, Alberta.

156 Op. cit., Natural Resources Canada, 2010.

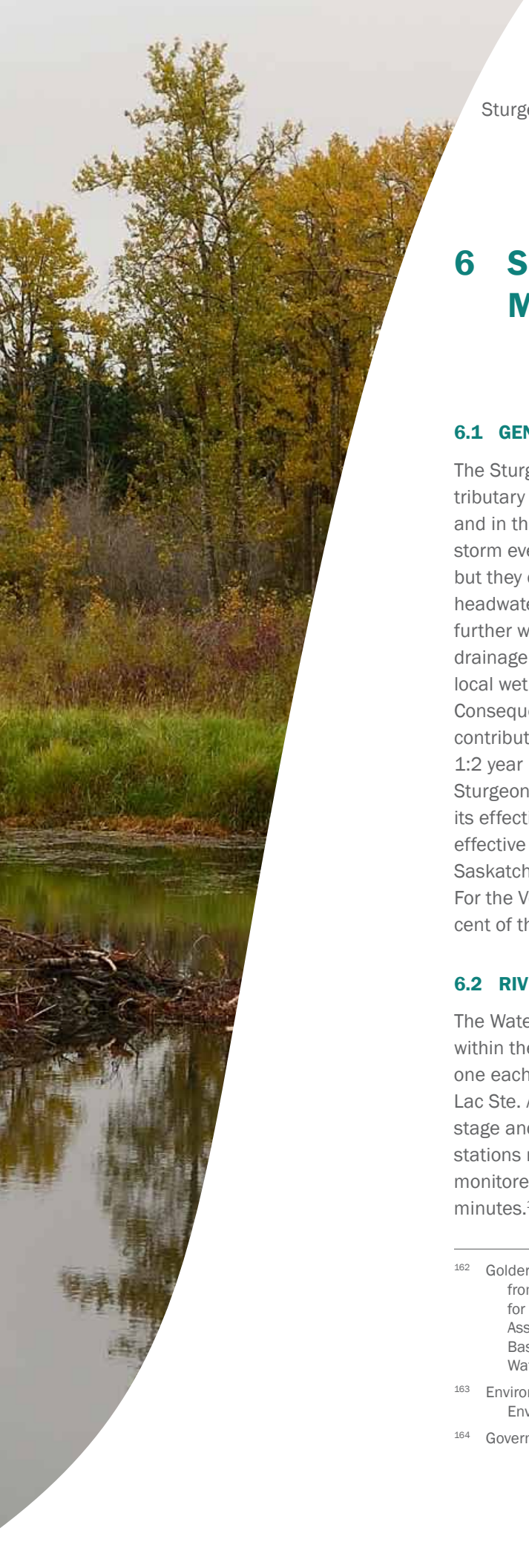
157 Op. cit., Natural Resources Canada, 2009.

158 North Saskatchewan Watershed Alliance (NSWA). 2005. Canadian Heritage Rivers System Background Study North Saskatchewan River Alberta. Prepared by the North Saskatchewan Watershed Alliance Society, Edmonton, Alberta. 252 p.

159 Alberta Water Council. 2008b. Recommendations for a New Alberta Wetland Policy. Alberta Water Council. Edmonton, Alberta.

160 Haag, J.J., Logan, M., Thormann, M., and White, J.S. 2011. City of St. Albert Sturgeon River Water Quality Monitoring 2010. Report prepared by Aquality Environmental Consulting Ltd. for the City of St. Albert, Alberta. 68 p.

161 Ducks Unlimited Canada. 2011. Canada Wetland Inventory. Stonewall, Manitoba.



6 SURFACE WATER QUANTITY AND MANAGEMENT

6.1 GENERAL HYDROLOGY OF THE STURGEON RIVER WATERSHED

The Sturgeon River is a prairie river, meaning it is a non-glacier fed tributary of the North Saskatchewan River. Most of the flow in the river and in the watershed occurs during the spring snowmelt period. Summer storm events contribute a much smaller proportion of total discharge, but they can result in significant flood events. Since the Sturgeon River's headwaters are on the prairies, rather than in the mountainous regions further west, topographic relief is limited, resulting in relatively slow drainage and significant internal drainage (i.e. drainage into lakes, local wetlands or sloughs rather than direct discharge through rivers). Consequently, the Sturgeon River Watershed's effective drainage or contributing drainage area – that drainage area that contributes to the 1:2 year runoff event – is smaller than the gross drainage area. The Sturgeon River gross drainage area is approximately 3,250 sq. km. and its effective drainage area is approximately 2,320 sq. km. However, its effective drainage area is significantly greater than in those of other North Saskatchewan tributaries further to the east, such as the Vermillion River. For the Vermilion River, the effective drainage area is approximately 30 per cent of the gross drainage area.[162]

6.2 RIVER FLOWS AND LAKE LEVELS

The Water Survey of Canada (WSC) maintains eight hydrometric stations within the Sturgeon River Watershed.[163] Four are on the Sturgeon River, one each on Carrot Creek and Atim Creek, and one each on Lake Isle and Lac Ste. Anne (Table 15). Alberta Environment and Water reports the flow stage and estimated volume in the Sturgeon River for the hydrometric stations near Villeneuve and in the City of St. Albert. These stations are monitored using remote equipment with measurements taken every 15 minutes.[164]

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[162] Golder Associates Ltd. 2008. Assessment of Climate Change Effects on Water Yield from the North Saskatchewan River Basin. Report prepared by Golder Associates Ltd. for the North Saskatchewan Watershed Alliance., Edmonton, Alberta. 57 p; Golder Associates Ltd. 2008. Water Supply Assessment for the North Saskatchewan River Basin, Alberta. Report prepared by Golder Associates Ltd. for the North Saskatchewan Watershed Alliance., Edmonton, Alberta. 37 p.; Op. cit., Golder Associates, 2009.

[163] Environment Canada. 2011b. Water Survey of Canada Archived Hydrometric Data. Environment Canada, Water Survey of Canada. Fredericton, New Brunswick.

[164] Government of Alberta. 2011b. Alberta's River Basins. Accessed on March 30, 2011.

Table 15. Hydrometric stations in the Sturgeon River Watershed.

Station Number	Station Name/Location	Data available from:
WSC 05EA001	Sturgeon River Near Fort Saskatchewan	1914 - 2010
WSC 05EA002*	Sturgeon River at St. Albert	1913 - 2010
WSC 05EA005*	Sturgeon River near Villeneuve	1914 - 2010
WSC 05EA006	Lac Ste. Anne at Alberta Beach	1933 - 2010
WSC 05EA008	Isle Lake at Eureka Beach	1972 - 2010
WSC 05EA010	Sturgeon River near Magnolia Bridge	1981 - 2010
WSC 05EA011	Carrot Creek near The Mouth	2005 - 2010
WSC 05EA012	Atim Creek at Century Road	2005 - 2010

**Alberta Environment and Water uses to report real-time hydrometric data*

Lake Isle historic water levels vary considerably, but a 1980 study determined lake stabilization was unfeasible.[165] Water levels have declined significantly from 1972 to 2010 (linear regression, $p<0.001$, $r2 = 0.200$), with an approximate 11 mm drop in water levels per year (Figure 31). The wettest year on record was 1974, and since this occurred so close to the beginning of recording water levels, this decline may in fact represent a return to more normal levels.

Water levels in Lac Ste. Anne show a declining trend over a longer period from 1933 to 2010. This trend is significant but negligible, with an approximate two millimetres drop in water levels per year over the entire period (linear regression, $p<0.001$, $r2 = 0.014$). This result may have been influenced by both the high variability in levels as well as the lack of complete records prior to 1974. Since 1974, when records were more complete, the decline in water levels has been significant and more substantial (linear regression, $p<0.001$, $r2 = 0.385$), with an approximate 14 mm drop in water levels per year (Figure 32). 1974 was an especially wet year, so this recent decline may also represent a return to more normal levels.

[165] Op. cit., Alberta Environment, 1980, as cited in Prepas and Mitchell, 1990.

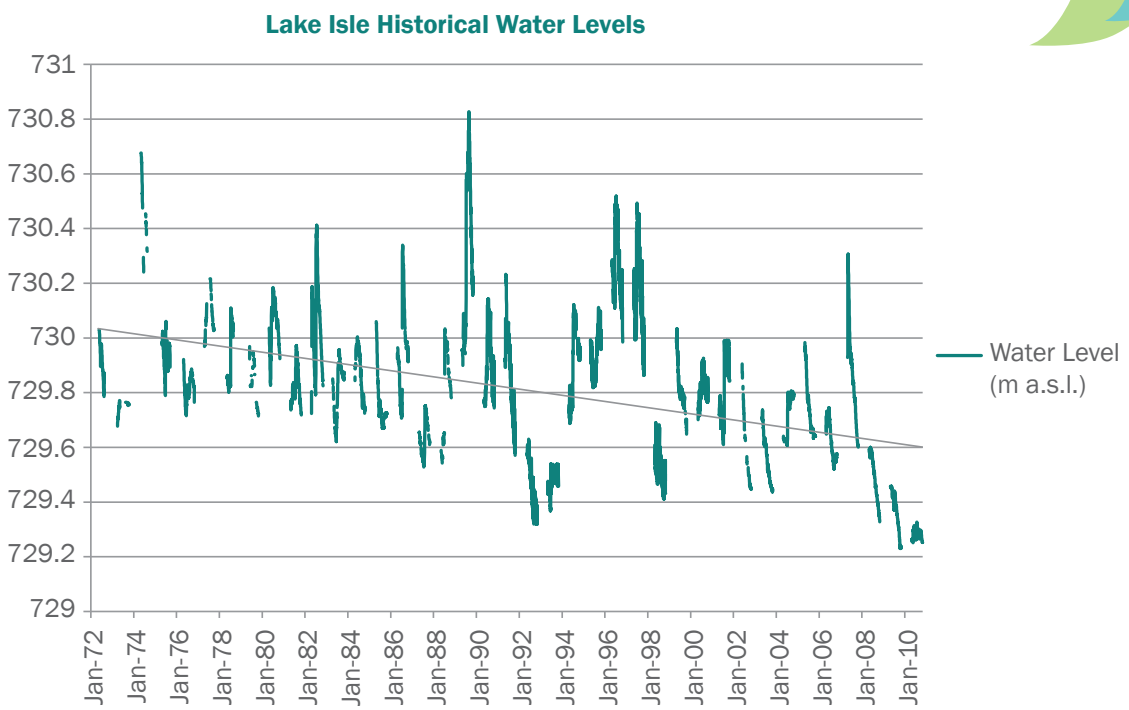

Figure 31. Historical (1972-2010) water levels for Lake Isle (hydrometric station 05EA008; Environment Canada, 2011b).

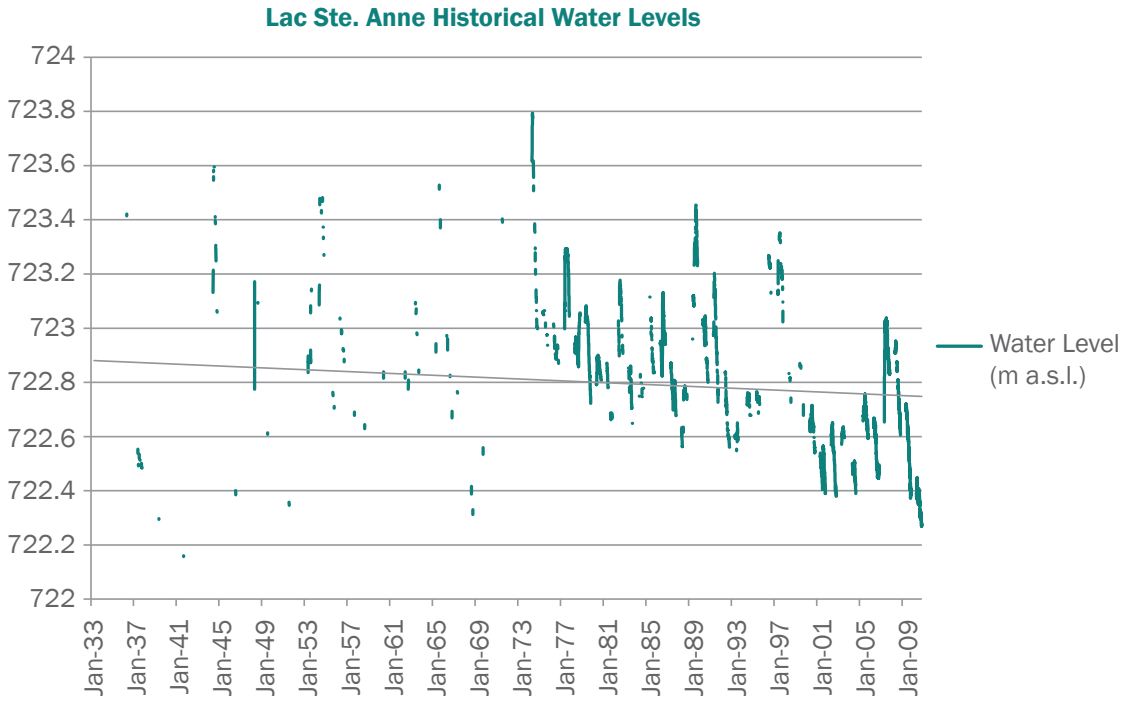

Figure 32. Historical (1933-2010) water levels for Lac Ste. Anne (hydrometric station 05EA006; Environment Canada, 2011b).

The total average flow volume in the Sturgeon River near its confluence with the North Saskatchewan River is approximately 79 million cu. m. per year, compared to 52 million cu. m. per year for the Vermilion River and 7,510 million cu. m. for the North Saskatchewan River at the Saskatchewan border.[166] Flow volumes in the Sturgeon River vary, both in terms of average volume and peak flows (Figure 33), typical of prairie streams. This variability is primarily due to the various amounts of precipitation received in any given year and other climatic conditions. Both average and May to September flow volumes in the last decade have been lower than in previous years, with lower peak discharges that occur earlier in the year, and lower sustained summer flows (Figure 34). Although both of these reductions in flows are highly significant, with average flows over the last decade down 58 per cent from their historical values (t-test, $p < 0.001$) and May to September flows down 69 per cent (t-test, $p < 0.001$), they may be attributed primarily to the drought conditions experienced since the turn of the century.

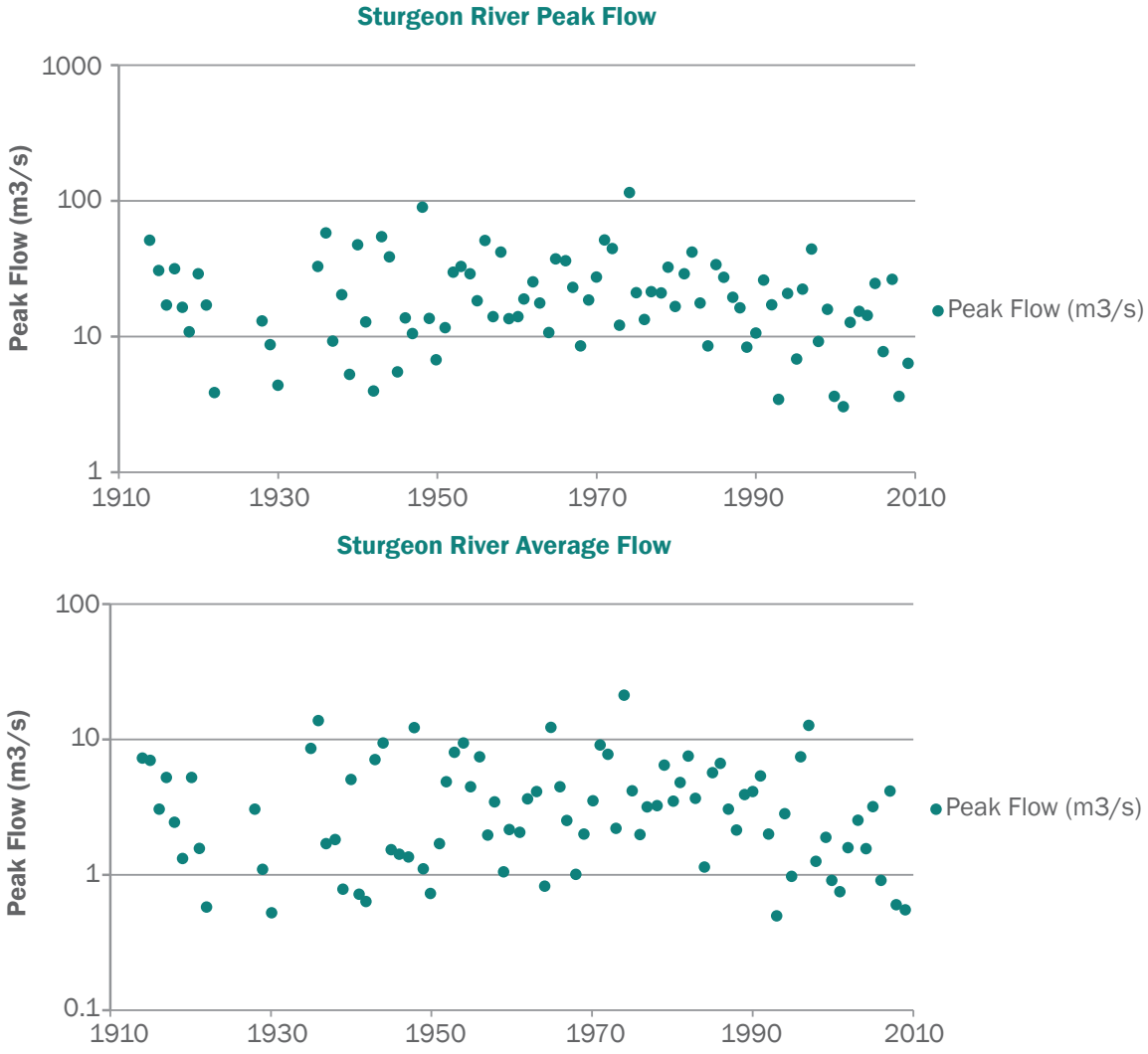

Figure 33. Discharge volumes of the Sturgeon River near Fort Saskatchewan for the period of record 1914-2010 (hydrometric station 05EA001; Environment Canada, 2011b). Top: annual peak flow; bottom: annual average flow.

166 Op. cit., Golder Associates, 2008, 2009.

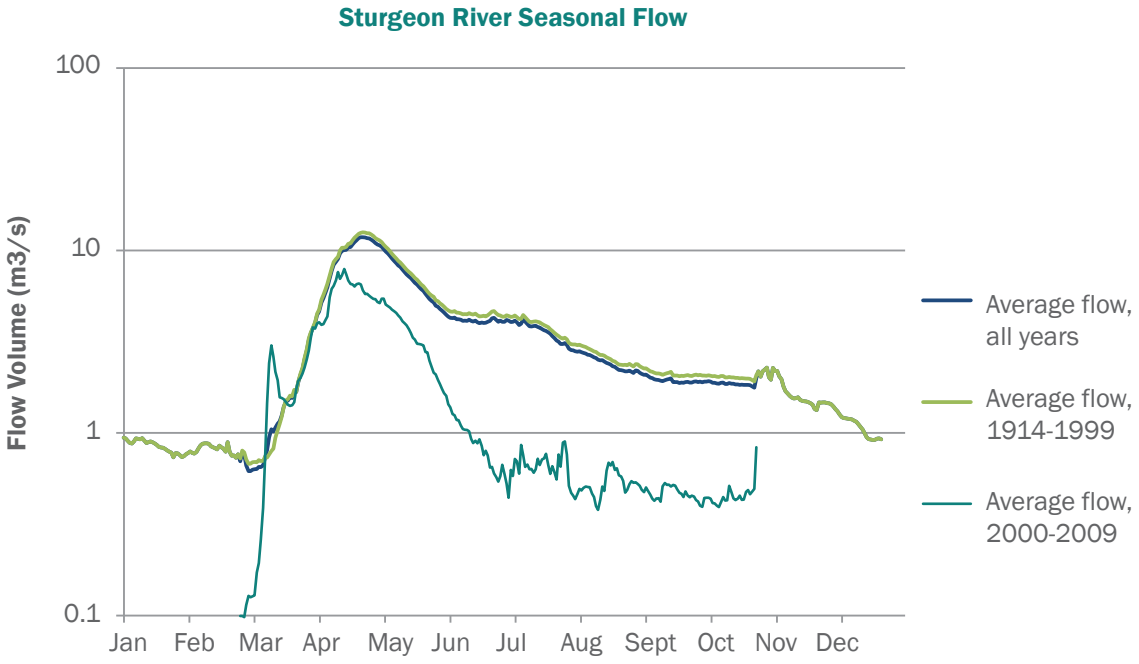

Figure 34. Seasonal instantaneous discharge volumes of the Sturgeon River near Fort Saskatchewan (hydrometric station 05EA001; Environment Canada, 2011b), for the entire period of record (1914-2009) and for the periods 1914-1999 and 2000-2009.

Current consumptive water use estimates were detailed in a report completed by MPE Engineering in 2004. The mean annual precipitation in the Sturgeon River Watershed ranges from 450 to 500 mm, of which the mean annual rainfall is between 300 and 400 mm. The mean annual evapotranspiration ranges from 365 to 425 mm.[167] Thus, evapotranspiration can exceed summer precipitation by as much as 125 mm, creating a water deficit. As a result, water levels on bodies of water in the Sturgeon River Watershed will fluctuate over the course of the open-water season and, if water deficits are experienced over a number of consecutive years, the water levels may drop significantly. The fluctuation in water levels may also be impacted by groundwater. If groundwater discharges into the lake, water levels may be higher and if the lake discharges into groundwater, levels may be lower. For comparison, mean annual precipitation in the Vermilion River Watershed ranges from 400 to 450 mm, of which mean annual rainfall is between 300 and 360 mm. Mean annual evapotranspiration may be in excess of 400 mm.[168] Thus, water deficits experienced in the Sturgeon River Watershed may be more severe than those experienced in the Vermilion River Watershed.[169]

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167 Op. cit., Golder Associates, 2008.

168 Op. cit., Golder Associates, 2008

169 MPE Engineering. 2004. Sturgeon River Basin Current Consumptive Water Use Estimates. Alberta Environment. Edmonton, Alberta.

The Province of Alberta is currently developing an integrated surface and groundwater model for the Sturgeon River Watershed. A detailed investigation was conducted on the Sturgeon River Basin[170] to prepare a characterization report as the first part of model development, but the report have not yet been released and the model is still in the process of being developed and refined. Once finalized, the model should provide significant insight into the dynamics and interactions of surface and groundwater within the watershed.

6.3 1969 MASTER AGREEMENT ON APPORTIONMENT

In 1969 the governments of Canada, Alberta, Saskatchewan and Manitoba entered into a Master Agreement on Apportionment for sharing the waters of eastward flowing interprovincial streams. Under this agreement, Alberta is required to pass along one-half of the natural flow in each of the rivers and streams to Saskatchewan. In Schedule E of the agreement, the provinces have also agreed on water quality guidelines for the water transferred downstream.[171] Although the Sturgeon River does not flow into Saskatchewan, it is a tributary of the North Saskatchewan River, which flows into Saskatchewan and is, therefore, subject to the 1969 Agreement on Apportionment. Thus, in determining the volumes of flow in the North Saskatchewan River that Alberta has to pass downstream to Saskatchewan, the Sturgeon River flows are included.

In 1951, a broad-crested weir was constructed on the Sturgeon River at the Lac St. Anne outlet (NE 35 TWP 54 RR 3 W5M) to stabilize the lake levels. No authorization was issued for the weir. The Municipal District of Lac St. Anne removed the weir in 1952, as they deemed it ineffective to the point where natural conditions prevailed. Remnants of the weir are still visible today.

6.4 WATER ALLOCATIONS, WITHDRAWALS AND CONSUMPTION

Water allocations, withdrawals and consumption are regulated by Alberta Environment under the *Water Act* (1999). Data presented below (Figure 35) has been provided by Alberta Environment. Within the Sturgeon River basin a total (surface water and groundwater) annual maximum of 33.5 million cu. m. of water is allocated. A total of 13.6 million cu. m. of water is allocated as a consumptive use. The total annual return to the basin is only 39 per cent (13 million cu. m.) of the total maximum allocated. The remaining 6.9 million cu. m. is categorized as losses.

Overall, including both surface and groundwater sources, the number of licensed water allocations in the Sturgeon River Watershed account for approximately one per cent of the total licensed allocations in the North Saskatchewan River Watershed.[172] However, in terms of actual water use, the Sturgeon River Watershed accounts for 11 per cent of total use in the North Saskatchewan River Watershed, and only the Modeste and Beaverhill sub-watersheds have greater actual water use.[173]

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170 Komex International Ltd. 2004. Development of a Sturgeon River Basin Groundwater Flow Model. Prepared for Alberta Environment. Edmonton, Alberta.

171 Government of Alberta. 2011. Master Agreement on Apportionment (1969). Accessed on March 30, 2011.

172 AMEC Earth and Environmental Limited. 2007. Current and Future Water Use in the North Saskatchewan River Basin, Alberta. Report prepared by AMEC for the North Saskatchewan Watershed Alliance, Edmonton, Alberta. 30 p.

173 Bibby, R. 1974. Hydrogeology of the Edmonton Area (Northwest Segment). Research Council of Alberta Report 74-10 Alberta. Edmonton.

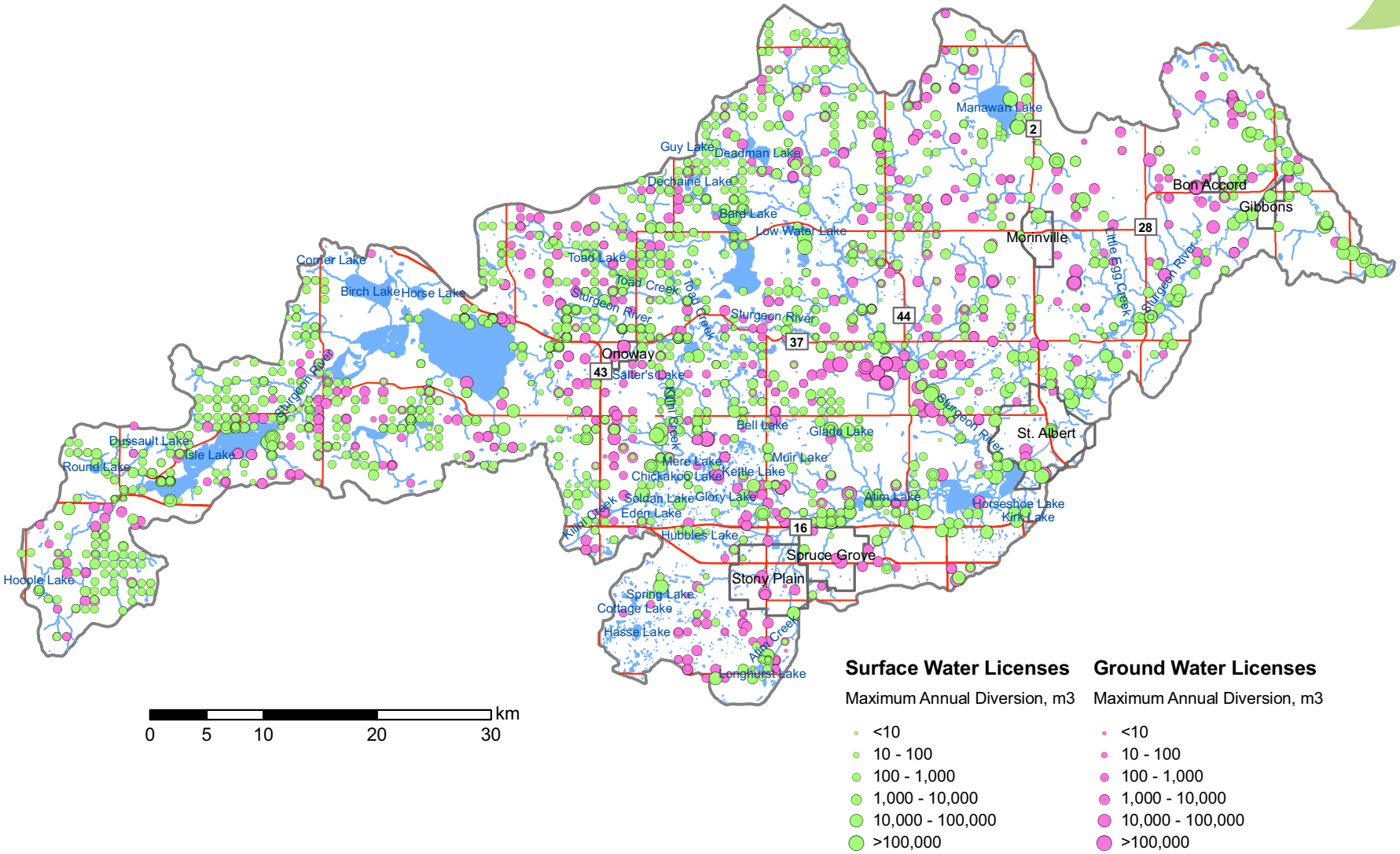

Figure 35. Location and maximum diversion volumes (dam3) for surface water and groundwater licences in the Sturgeon River Watershed (Alberta Environment 2011).

6.4.1 Surface Water Licenses

From 1912 to 2010, a total of 1,682 surface water licences were issued in the basin with a total maximum annual water allocation of 24 million cu. m. of water. The total consumptive use was 10.3 million cu. m. of water a year (Figure 37). Only 31 per cent (7.5 million cu. m.) of the annual allocated water was reported as being returned to the basin. Thus, approximately 30 per cent of the mean annual flow for the Sturgeon River has been allocated but only 13 per cent is actually used. The four highest allocations were assigned to aggregate washing (9.2 million cu. m.), crops (3.1 million cu. m.), lake stabilization (2.0 million cu. m.), and towns (1.9 million cu. m.), while the four highest consumptive users were crops (3.0 million cu. m.), aggregate washing (1.9 million cu. m.), S other (1.1 million cu. m.), and gardens (1.1 million cu. m.) (Figure 37).

From 1912 to 2001, the number of surface water licences issued ranged from zero to 16 per year (Figure 36). In 2002 alone, 692 licences were issued. From 2003 to 2010, the number of licences issued ranged from 31 to 183. The high number of licences issued in 2002 can be attributed to the Traditional Agricultural Use registrations. A traditional agricultural user is defined under the *Water Act* as: a person who owns or occupies land to which a registration is appurtenant, and that adjoins a river, stream, lake, natural watercourse or body of water, or under which groundwater exists, has the right to divert water from the authorized sources to raise animals or apply pesticides to crops, as part of a farm unit, as authorized by the registration. Before January 1, 1999, these users were exempt from applying for a water allocation of up to a maximum diversion of 6,250 cu. m. of water per year. From 1999 to 2001 and extended to 2002 Alberta Environment set up a registration program to allow the traditional agricultural users to register their water use. Registrations had to be submitted to Alberta Environment by December 31, 2001. As specified in the Water Act, during a drought, water consumption is allocated based on a first-in-time, first-in-right protocol based on the date the water licence was issued. Before January 1, 1999, traditional agricultural users were not allocated water rights during a drought because they did not possess a water licence. From 1912 to 2010, 50 per cent of the licences issued have been from the “Registry” use category (Figure 38).

From 1912 to 2010, 50 per cent of the licences issued have been from the registry use category (Figure 38). Based on the most recent estimates, surface water use exceeds the licensed allocation, with total use exceeding licensed use by approximately 200 per cent.[174]

The s other category includes any allocation specified by the Director of the Environment that does not fit into any other more specific categories. Commercial other includes any commercial allocation that does not fit into the specific commercial categories. Municipal other includes any municipal allocation that does not fit into any of the more specific municipal categories. The registry use category is used for traditional agricultural users that are defined by the Water Act as: a person who owns or occupies land to which a registration is appurtenant, and that adjoins a river, stream, lake, natural watercourse or body of water, or under which groundwater exists, has the right to divert water from the authorized sources to raise animals or apply pesticides to crops, as part of a farm unit, as authorized by the registration.

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174 Op. cit., AMEC, 2007

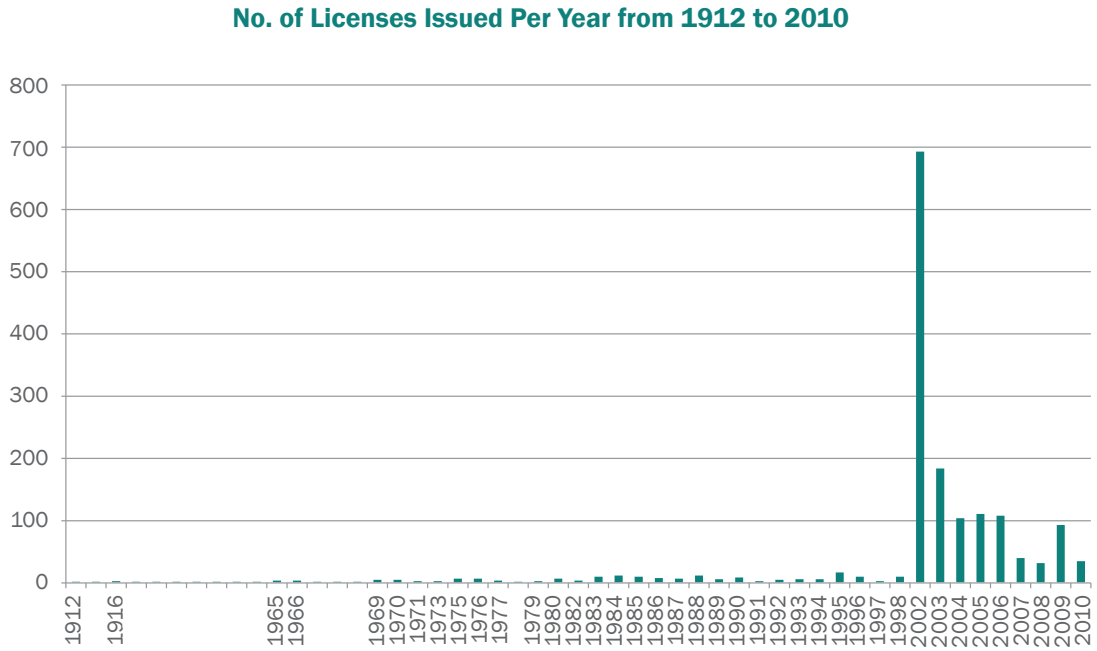

Figure 36. Number of surface water licences issued in the Sturgeon River Watershed from 1912 to 2010. (Source: Alberta Environment)

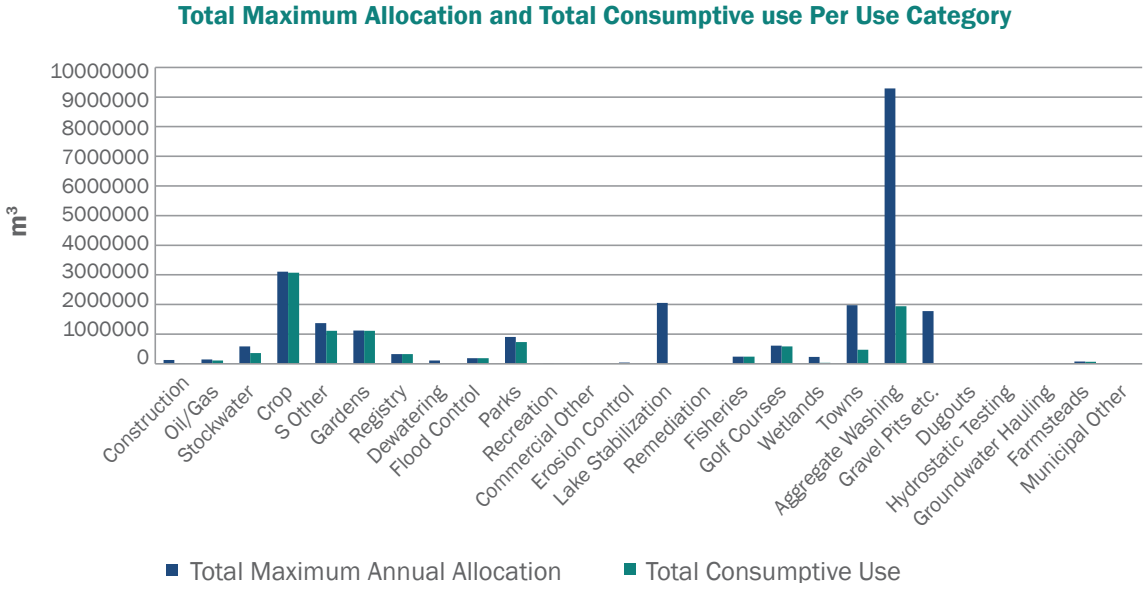

Figure 37. Total maximum allocation and total consumptive use by sector in the Sturgeon River Basin from 1912 to 2010. (Source: Alberta Environment)

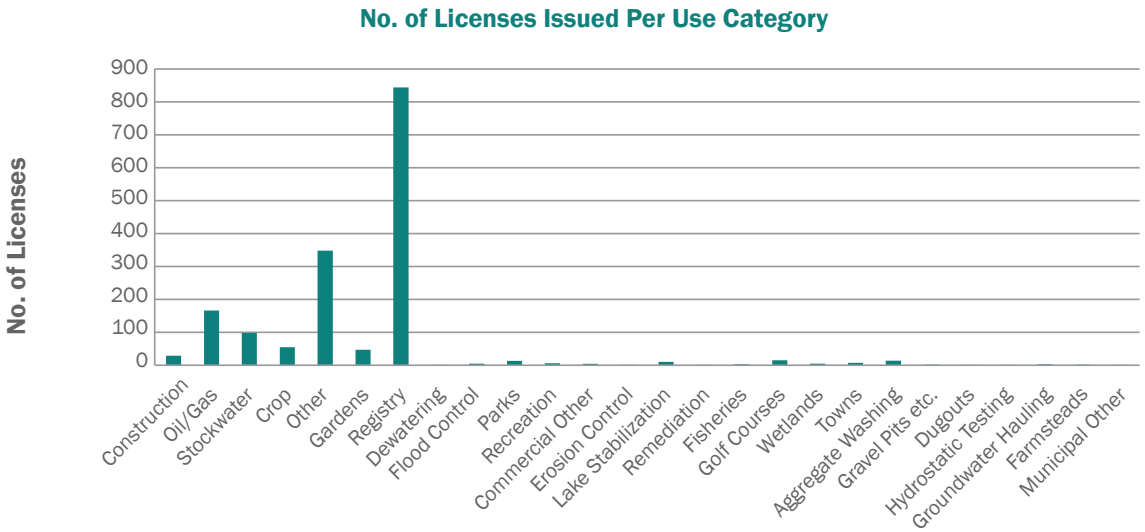

Figure 38. Number of surface water licences issued for each sector in the Sturgeon River Basin from 1912 to 2010. (Source: Alberta Environment)

6.4.2 Groundwater Licenses

From 1900 to 2011, a total of 959 groundwater licences were issued with a total maximum annual allocation of 9.5 million cu. m. of water from the Sturgeon River Watershed (Figure 39). The total consumptive use is 3.3 million cu. m. (35 per cent) per year. The reported return is 5.5 million cu. m. (58 per cent) of water to the basin annually. The remaining 0.7 million cu. m. is categorized as losses. As observed in Figure 40 the three highest combined allocations were assigned to dewatering (5.1 million cu. m.), aggregate washing (1.6 million cu. m.) and registry (679 thousand cu. m.). The three highest consumptive sectors were aggregate washing (1.3 million cu. m.), registry (679 thousand cu. m.) and stockwater (459 thousand cu. m.).

Figure 39 shows that from 1900 to 2001, the number of groundwater licences issued ranged from 0 to 35 per year. In 2002, 538 groundwater licences were issued. From 2003 to 2011, the number of groundwater licences issued ranged from 1 to 102. The increase in groundwater licences can be attributed to the same registration program of traditional agricultural users mentioned above. From 1900 to 2011, 725 (76 per cent) of the groundwater licences issued have been traditional agricultural use registrations (Figure 41).

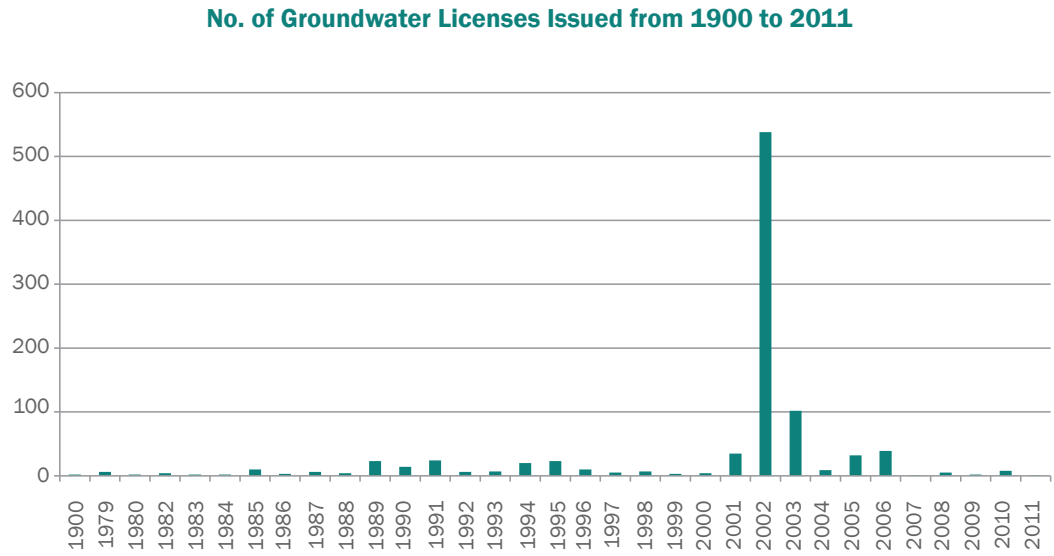

Figure 39. No. of groundwater licences Issued per year from 1990 to 2011. (Source: Alberta Environment)

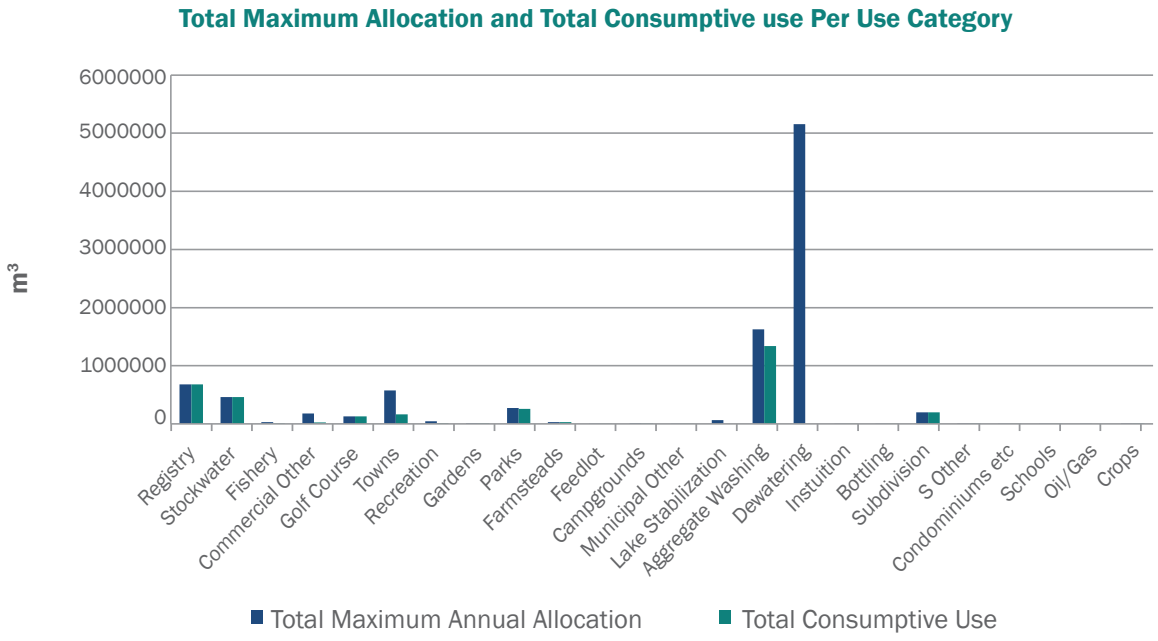

Figure 40. Total Maximum Allocation and Total Consumptive Use Per Use Category for Groundwater Licenses in the Sturgeon River Basin from 1900 to 2010. (Source: Alberta Environment)

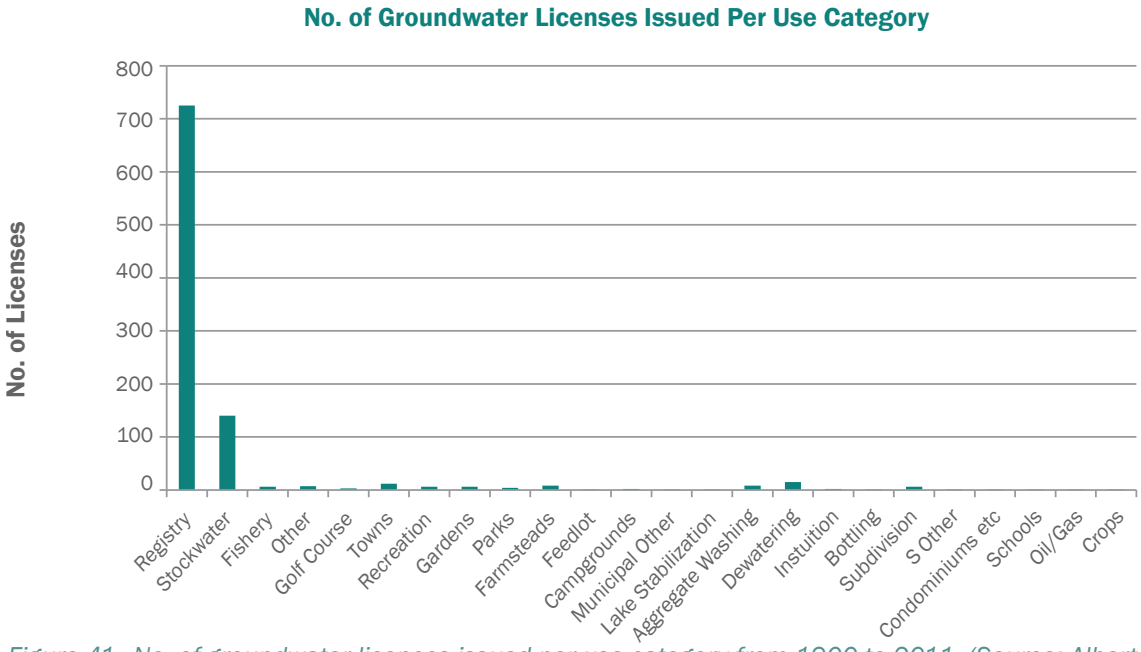

Figure 41. No. of groundwater licences issued per use category from 1900 to 2011. (Source: Alberta Environment).

6.5 INSTREAM FLOW NEEDS AND WATER CONSERVATION OBJECTIVES

In 2004, Alberta Environment conducted an instream flow needs (IFN) study on the Sturgeon River.[175] The objectives of the report were to:

- review and summarize existing data
- identify potential gaps necessary for completing an IFN evaluation
- provide a work plan for completing any additional field work necessary for the development of an IFN determination for the Sturgeon River
- propose a flow evaluation framework for assessing year-round instream flow needs with consideration of including public involvement throughout the process where possible

The report focused on seven ecosystem components:

- hydrology
- channel morphology
- ice processes
- water quality
- benthic invertebrates
- riparian ecosystems
- fish and fish habitat

[175] Golder Associates Ltd. 2004. Final Report, Sturgeon River Instream Flow Needs Scoping Study. Submitted to Alberta Environment, Central Region, Stony Plain, Alberta. 164 pp. June 2004.

Results from the data review found that there were substantial data gaps for the seven components listed above to complete an IFN study at that time. Findings identified in the report included:

- Hydrology data at that time was not sufficient. At that time, AEW was modeling naturalized flows and creating a synthetic flow time series. Once AEW's information is complete, it should provide enough hydrology data to complete an IFN study.
- Water quality issues may be problematic (numerous parameters exceeded the guideline criterion) and water quality issues should be resolved prior to a detailed IFN.
- Substantial gaps in benthic invertebrates and fisheries data would prohibit a complete IFN study.

In order for a successful IFN study to be completed, the report outlined a number of recommendations:

- a public advisory group and an IFN technical committee should be established
- resolve microhabitat issues prior to a detailed habitat modeling exercise
- AEW to develop naturalized and synthesized recorded flow time
- additional water quality monitoring
- focus on the development of a habitat map
- entry of all available fisheries data into FMIS
- collection of additional baseline data for fisheries, benthic invertebrates, and riparian ecosystems
- complete habitat modeling [176]

Water Conservation Objectives (WCO) within the Sturgeon River Watershed have not been defined. To date, no WCO agreements have been executed for the Sturgeon River Watershed or the North Saskatchewan River Watershed. The North Saskatchewan Watershed Alliance (NSWA) released a Discussion Paper for the development of an Integrated Watershed Management Plan (IWMP) for the North Saskatchewan River and its tributaries on January 14, 2011. Their intent is to complete an Integrated Watershed Management Plan between 2012 and 2019.[177]

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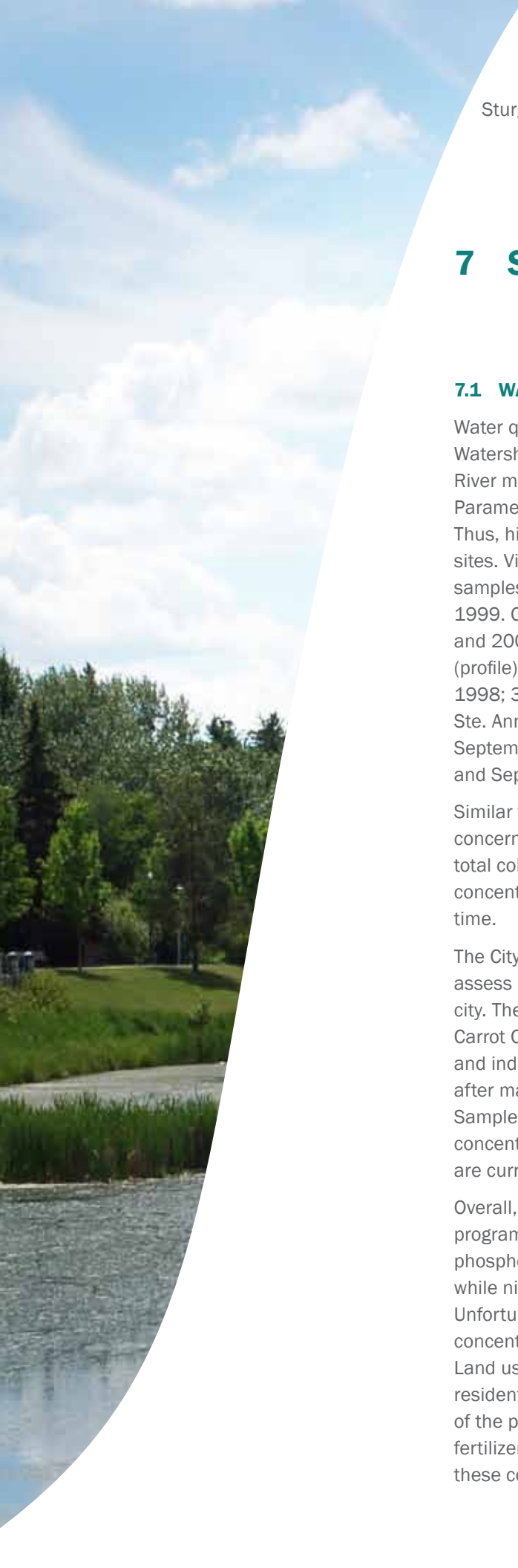
176 Stantec Consulting Ltd. 2005. Alberta Environment Naturalized Flow Study North Saskatchewan River, Alberta. Prepared by Stantec Consulting Ltd. for Alberta Environment. 169 p.

177 North Saskatchewan Watershed Alliance (NSWA). 2011. Discussion Paper for the Development of an Integrated Watershed Management Plan for the North Saskatchewan River Watershed in Alberta. The North Saskatchewan Watershed Alliance Society, Edmonton, Alberta.



7 SURFACE WATER QUALITY

7.1 WATER QUALITY PARAMETERS

Water quality has been monitored at 85 sites within the Sturgeon River Watershed, as shown in Figure 42. The sites include 14 along the Sturgeon River main stem, 23 along tributaries, 45 on lakes and 3 on wetlands. Parameters sampled and the frequency of sampling varies at all the sites. Thus, historical information is only available intermittently at the majority of sites. Virtually no data was collected prior to 1970. Since then, over 3100 samples have been analyzed with over 50 per cent done between 1990 and 1999. Only 6 per cent (188) of the samples were analyzed between 2000 and 2009. The site most frequently sampled is the Lac Ste. Anne east side (profile) with 494 samples analyzed between April 1984 and September 1998; 333 of the samples were taken between 1990 and 1998. The Lac Ste. Anne west side (profile) was sampled 395 times between April 1984 and September 1998 and Lake Isle was sampled 388 times between May 1983 and September 1998. No site was sampled in all four decades.

Similar to other watersheds in the province, the primary pollutants of concern are nutrients (nitrogen and phosphorus), bacteria (both E. coli and total coliforms), and pesticides. In addition to watershed-wide pollutant concentrations, sites with sufficient data were also analyzed for trends over time.

The City of St. Albert initiated a water quality monitoring program in 2006 to assess long-term water quality conditions of the Sturgeon River within the city. The program includes five sites along the Sturgeon River, five sites along Carrot Creek and ten stormwater outfalls that drain residential, commercial and industrial areas of the city. Samples are collected during spring runoff, after major summer rain events, and in the fall, under low flow conditions. Samples are tested for bacteria, pesticides, nutrients, solids, metals and salt concentrations. The last year for which data are available is 2010; 2011 data are currently being analyzed.

Overall, most of the parameters measured in the water quality monitoring program have not shown a consistent trend. However, bacteria, total phosphorus, and total suspended solids have shown increasing trends, while nitrate-nitrite and total dissolved solids have shown decreasing trends. Unfortunately, for many of the parameters that have remained steady, the concentrations are well in excess of their associated water quality guidelines. Land use may explain a large part of this pattern, given the high densities of residential areas and roadways in St. Albert. This pattern suggests that most of the problems with water quality may result from the over-application of fertilizers and road salt, combined with extensive impervious areas that allow these compounds to runoff rather than be absorbed by soils.

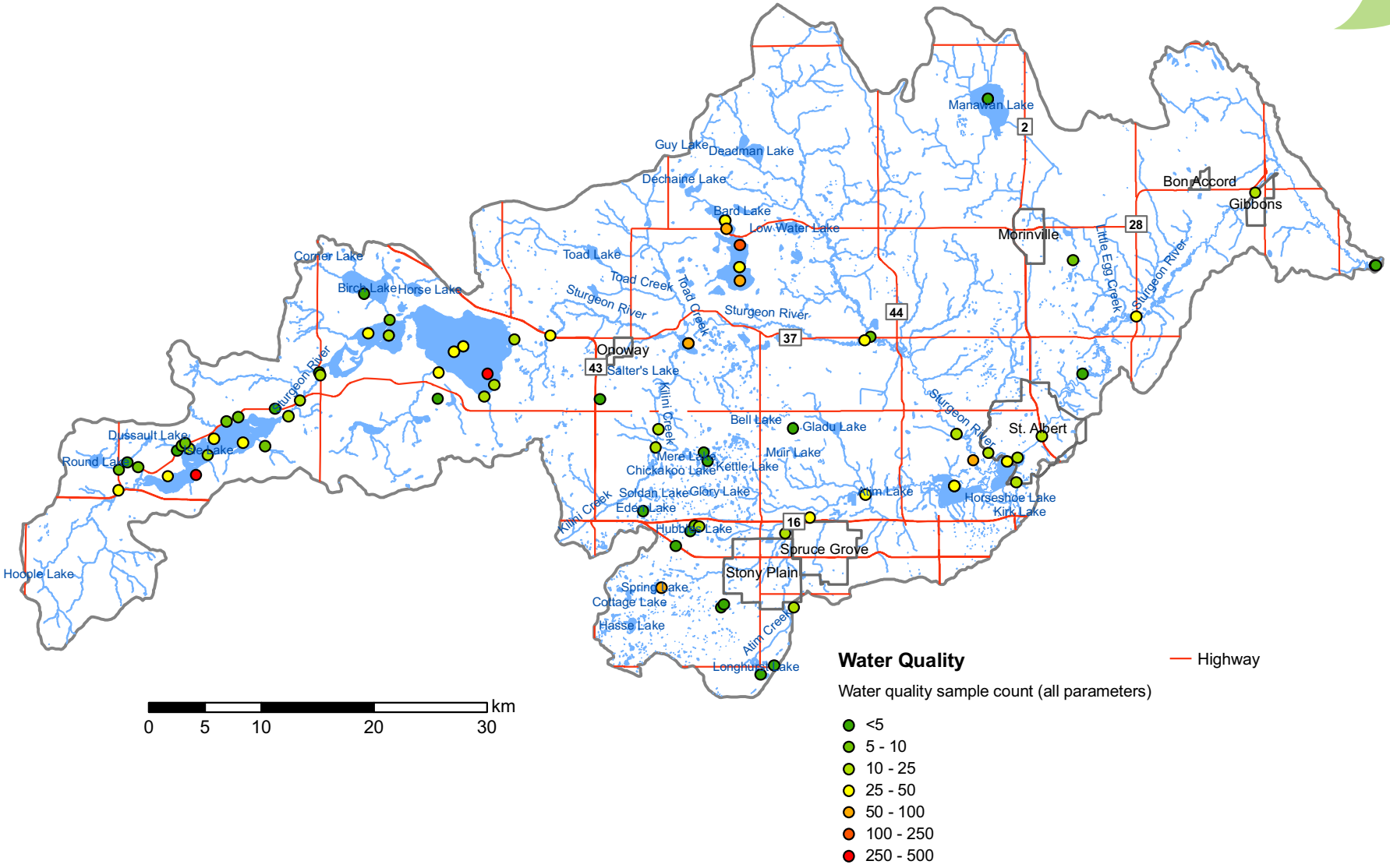


Figure 42. Surface water quality monitoring map, number of sampling events per site by Alberta Environment (2010)

7.1.1 Nutrient Concentrations

7.1.1.1 Watershed-wide Patterns

Average total nitrogen concentrations at the majority of sample locations across the watershed exceed the Alberta Surface Water Quality Guideline for the Protection of Aquatic Life (ASWQG-PAL) of 1.0 mg/L.[178] Sites on Sandy Lake and in the Big Lake area have higher-than-average total nitrogen concentrations.[179] Although all the lakes within the watershed are naturally eutrophic, no consistent spatial trend in concentrations is apparent (Figure 43).

Average total phosphorus concentrations at the majority of sampling locations across the watershed exceed the ASWQ PAL Guideline of 0.05 mg/L (Figure 44). No strong spatial trend is apparent for these concentrations, although sites along the Sturgeon River downstream of Big Lake and in the vicinity of Lake Isle and Lac Ste. Anne tend to have the highest total phosphorus concentrations.

Due to the nature of prairie rivers and the soils within the watershed, we can expect to have higher nutrient concentrations than from glacial-fed streams originating in the Rocky Mountains. Nutrient concentrations in the Sturgeon watershed are similar to other North Saskatchewan River sub-basins with similar land uses and agricultural intensities.

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178 Alberta Environment. 1999. Surface water quality guidelines for use in Alberta. Alberta Environment, Environmental Assurance Division, Science and Standards Branch. Edmonton, Alberta.

179 Alberta Lake Management Society. 2006b. Lakewatch Sandy Lake2006 Report. 11 p. Edmonton, Alberta.

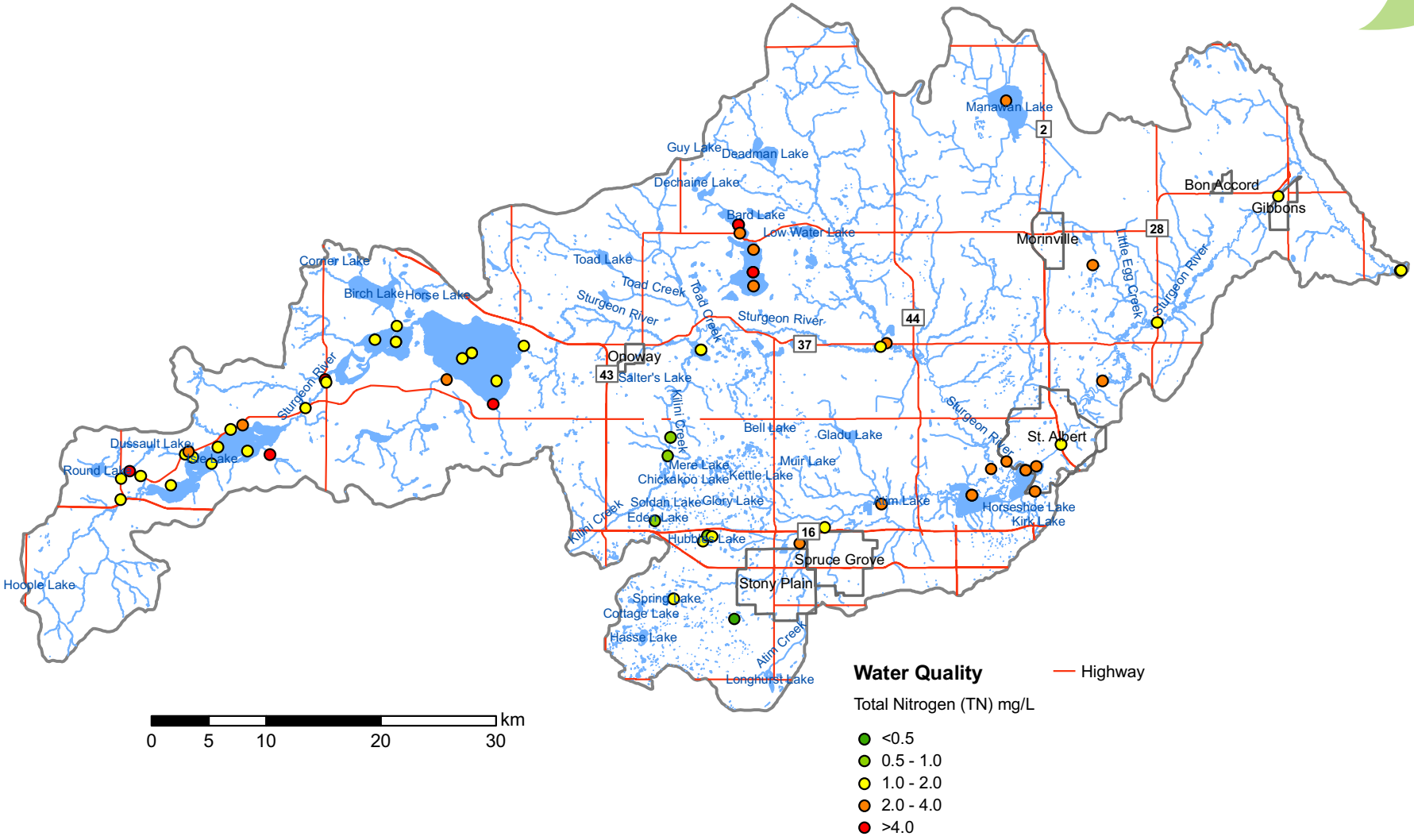


Figure 43. Average total nitrogen concentrations at locations sampled in the Sturgeon River Watershed (Alberta Environment, 2010). The ASWQ PAL Guideline for total nitrogen is 1.0 mg/L

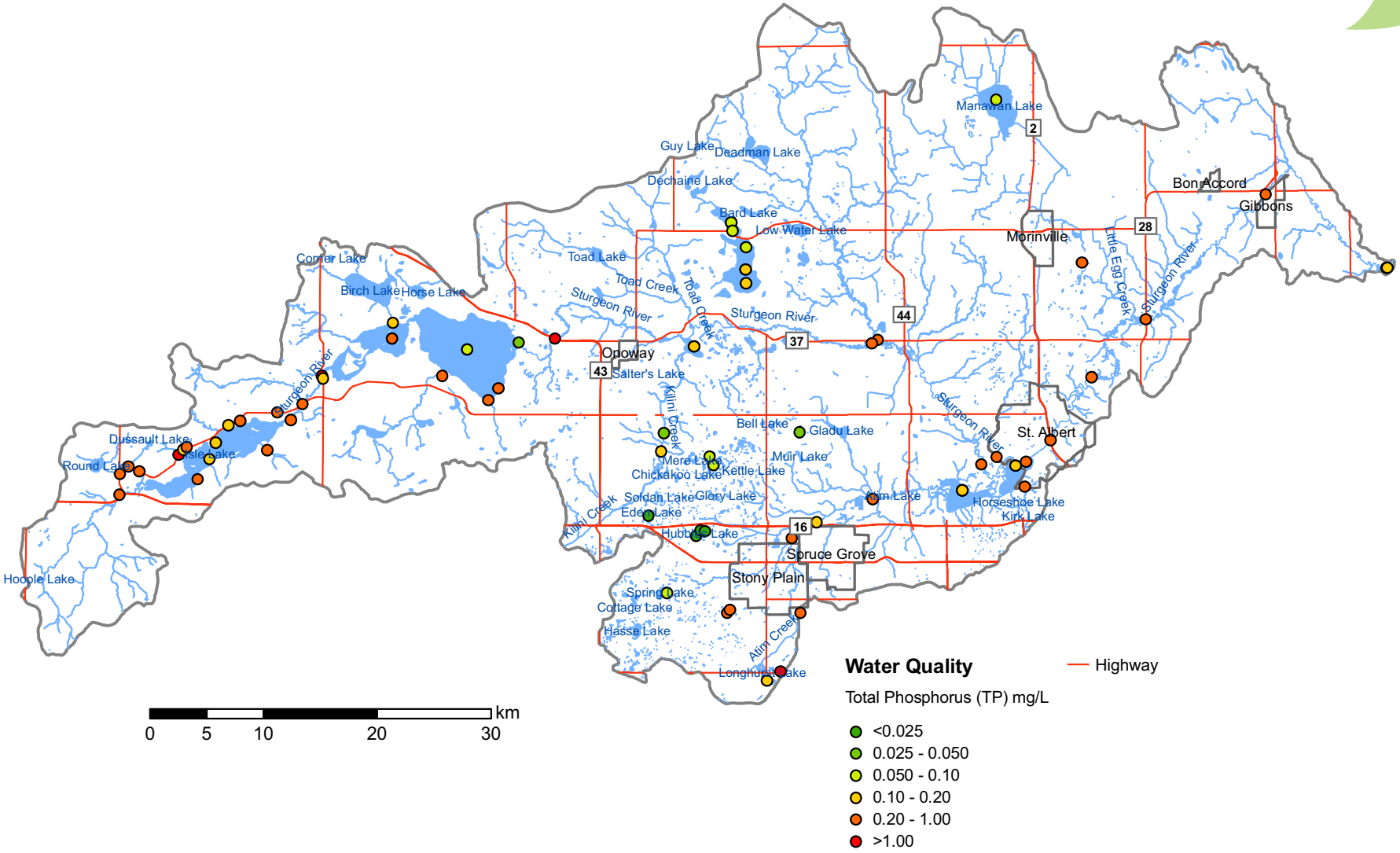


Figure 44. Average total phosphorus concentrations at locations sampled in the Sturgeon River Watershed (Alberta Environment, 2010). The ASWQ PAL Guideline for total phosphorus is 0.05 mg/L.

7.1.1.2 Sturgeon River – Spatial Trends

No clear trend is apparent in either total phosphorus or total nitrogen concentrations along the main stem of the Sturgeon River (Figures 45 and 46). Total nitrogen concentrations peaked upstream of Big Lake and the City of St. Albert, while total phosphorus concentrations peaked downstream of the City of St. Albert. Concentrations for both total phosphorus and total nitrogen were at their lowest in the Sturgeon River at the Alberta Beach Bridge.

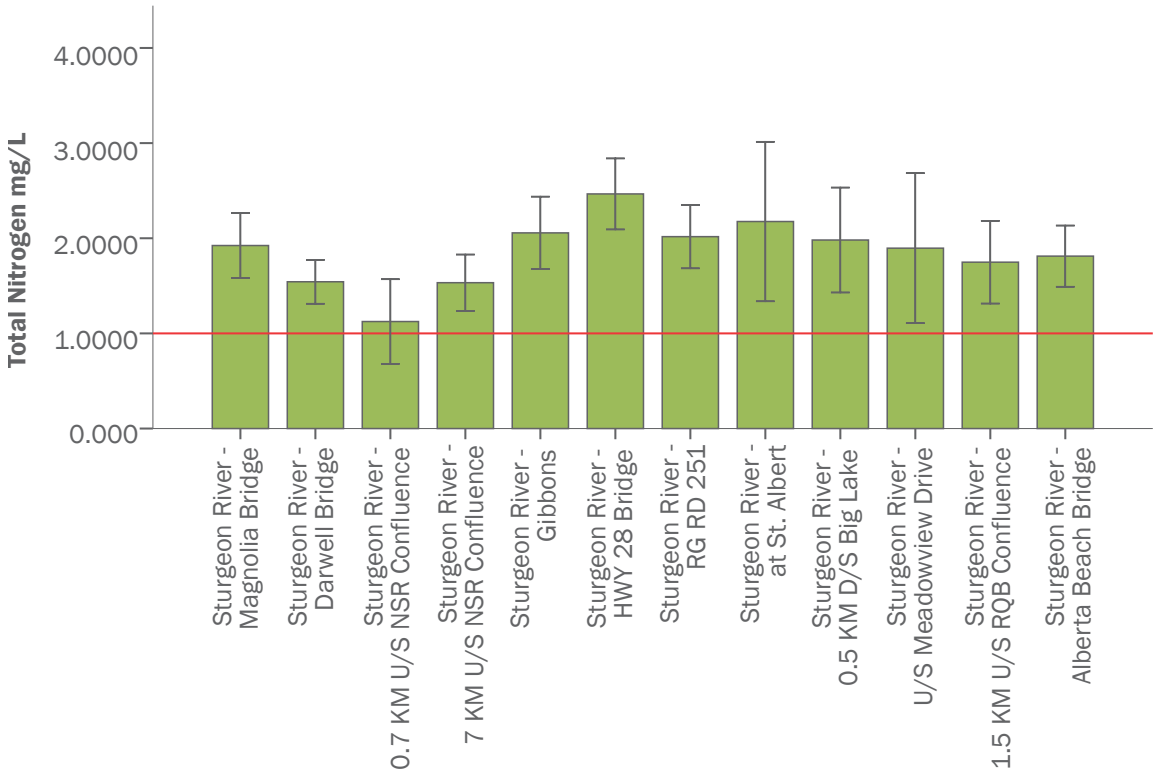


Figure 45. Total nitrogen concentrations at sampling locations on the Sturgeon River main stem. Sites are ordered in an upstream to downstream direction from left to right. The red line represents the Alberta Surface Water Quality Guideline for the Protection of Aquatic Life (ASWQG-PAL) of 1.0 mg/L. Data from Alberta Environment (2010) and Aquality Environmental Consulting (2006-2010).

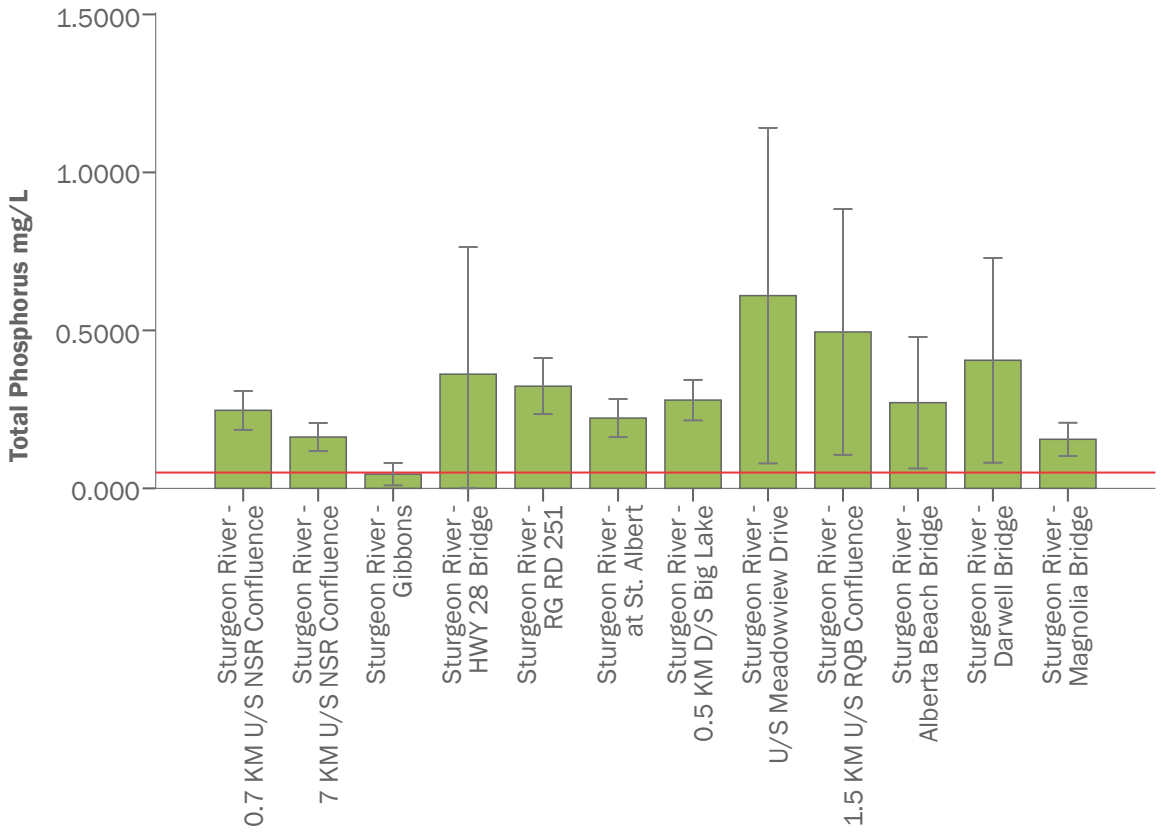
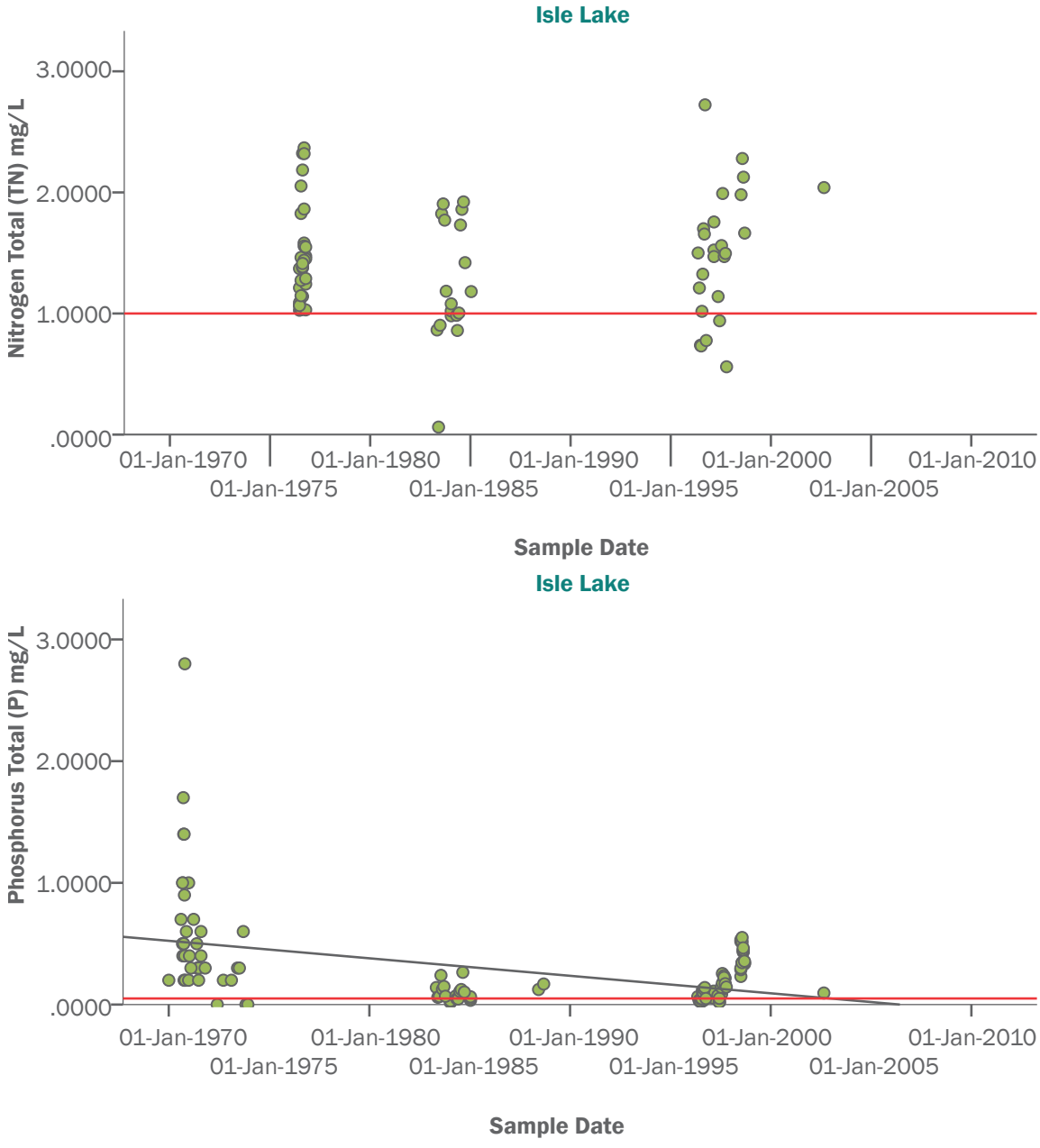


Figure 46. Total phosphorus concentrations at sampling locations on the Sturgeon River main stem. Sites are ordered in an upstream to downstream direction from left to right. The red line represents the Alberta Surface Water Quality Guideline for the Protection of Aquatic Life (ASWQG-PAL) of 0.05 mg/L. Data from Alberta Environment (2010) and Aquality Environmental Consulting (2006-2010).

7.1.1.3 Temporal Trends

Sufficient data were available to examine trends in nutrient concentrations over time for a selection of water bodies in the watershed, though in some cases recent data have not been collected, so current conditions and possible recent changes are unknown.

Total nitrogen concentrations at Isle Lake have not shown a consistent trend over time (linear regression; p=0.655), while total phosphorus concentrations have shown a significant decreasing trend (linear regression; p<0.001) (Figure 47).



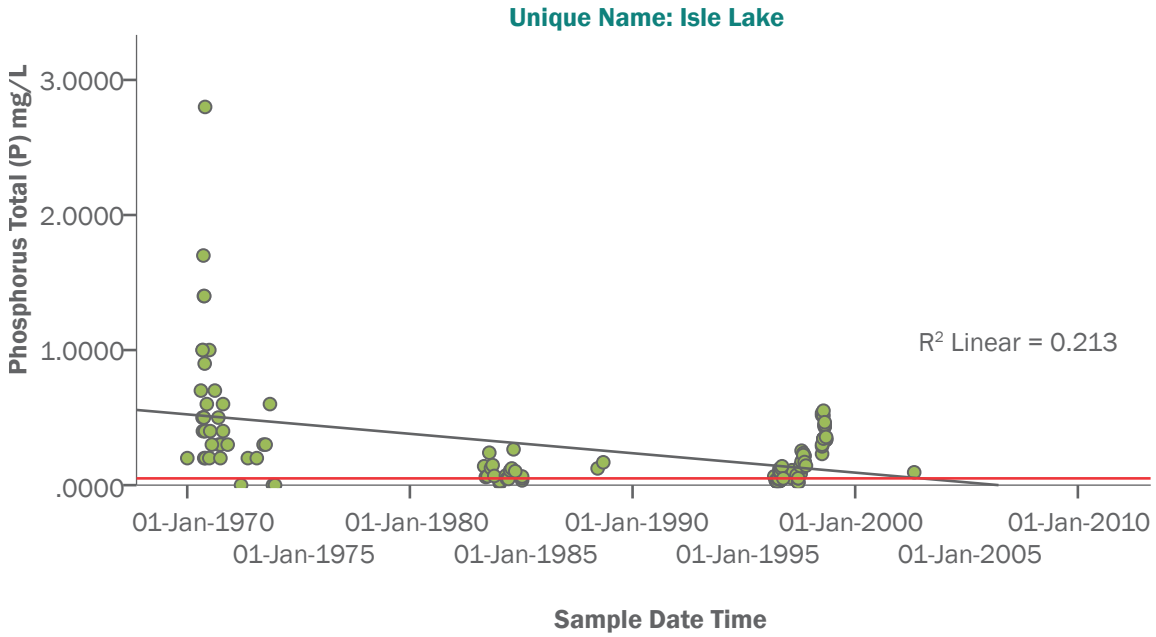


Figure 47. Isle Lake - historical total nitrogen (top) and total phosphorus (bottom) concentrations. The red lines represent the Alberta Surface Water Quality Guideline for the Protection of Aquatic Life (ASWQG-PAL) of 1.0 mg/L (TN) and 0.05 mg/L (TP) (Alberta Environment 1999). Data from Alberta Environment, 2010.

Total nitrogen concentrations at Lac Ste. Anne have shown a significant (though weak) increasing trend over time (linear regression; p=0.039), while total phosphorus concentrations have not shown a consistent trend (linear regression; p=0.649) (Figure 48).

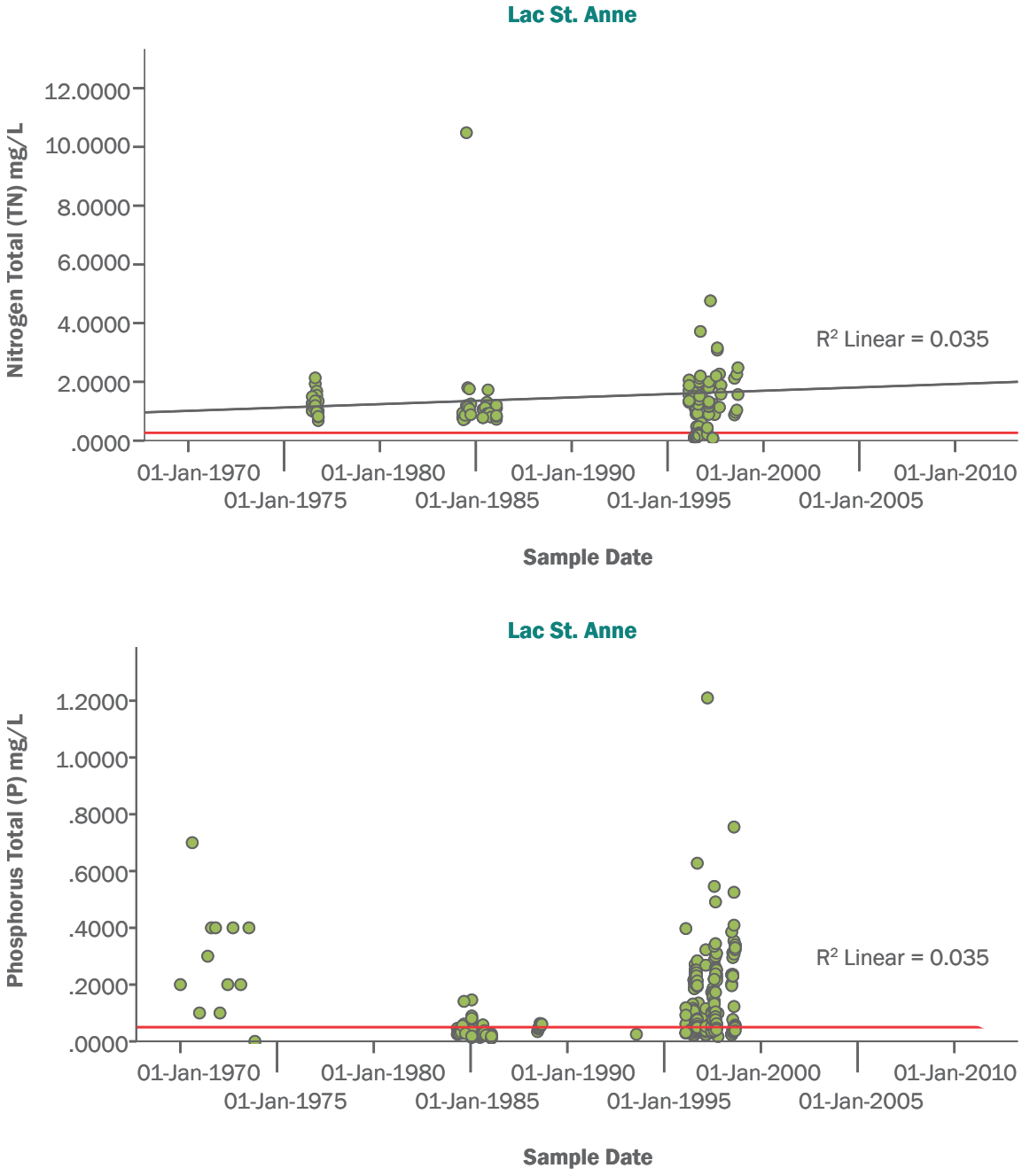


Figure 48. Lac Ste. Anne - historical total nitrogen (top) and total phosphorus (bottom) concentrations. The red lines represent the Alberta Surface Water Quality Guideline for the Protection of Aquatic Life (ASWQG-PAL) of 1.0 mg/L (TN) and 0.05 mg/L (TP) (Alberta Environment, 1999). Data from Alberta Environment, 2010.

Total nitrogen concentrations at Sandy Lake have shown a significant increasing trend over time (linear regression; $p<0.001$), while total phosphorus concentrations have not shown a consistent trend (linear regression; $p=0.067$) (Figure 49).

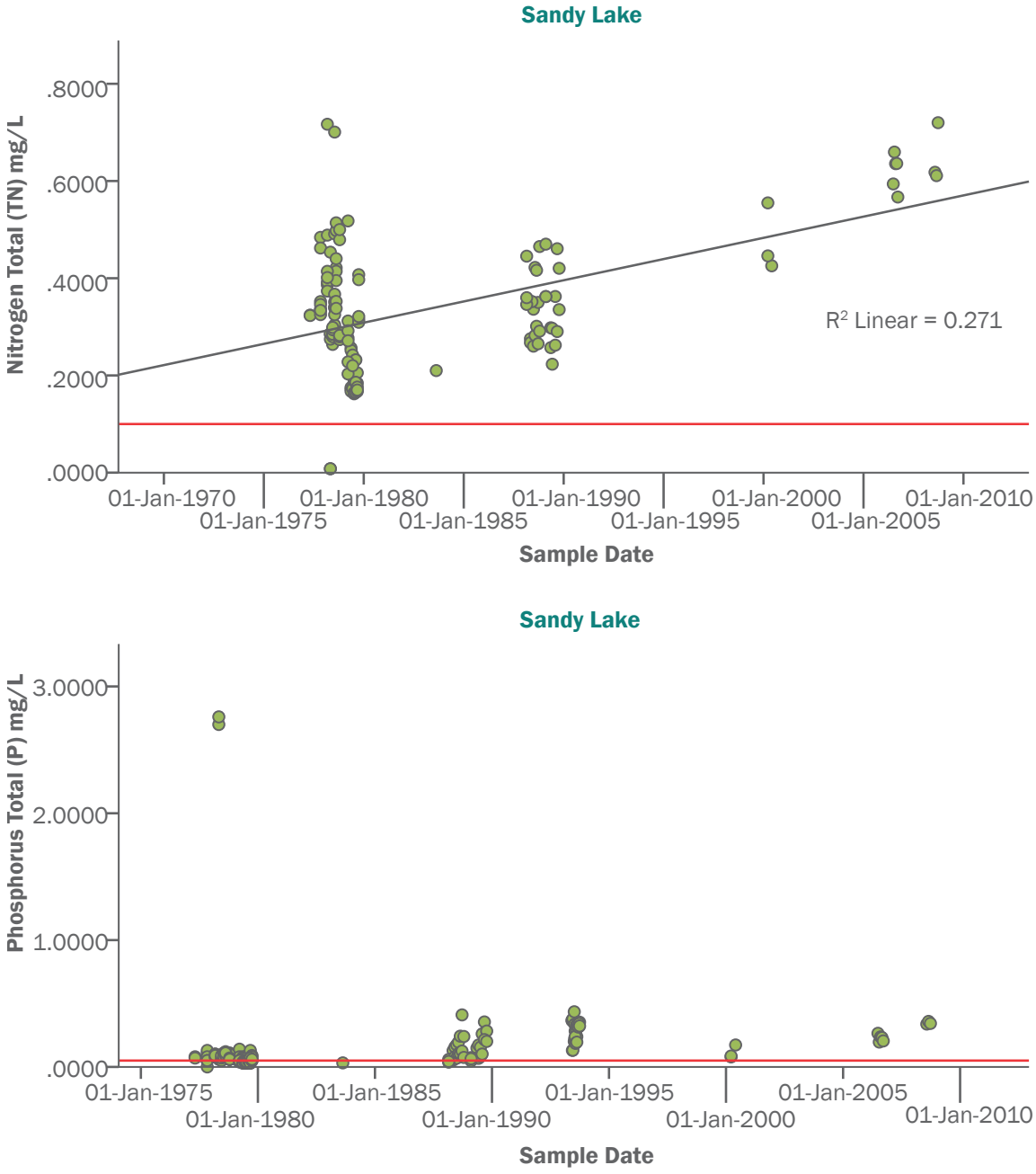


Figure 49. Sandy Lake - historical total nitrogen (top) and total phosphorus (bottom) concentrations. The red lines represent the Alberta Surface Water Quality Guideline for the Protection of Aquatic Life (ASWQG-PAL) of 1.0 mg/L (TN) and 0.05 mg/L (TP) (Alberta Environment, 1999). Data from Alberta Environment 2010.

On the Sturgeon River just downstream of Big Lake, near the Ray Gibbon Drive Bridge (Alberta Environment and Water monitoring site AB05EA 1590) no consistent trend is apparent over time for either total nitrogen or total phosphorus (linear regression; p=0.286 and p=0.910, respectively) (Figure 50).

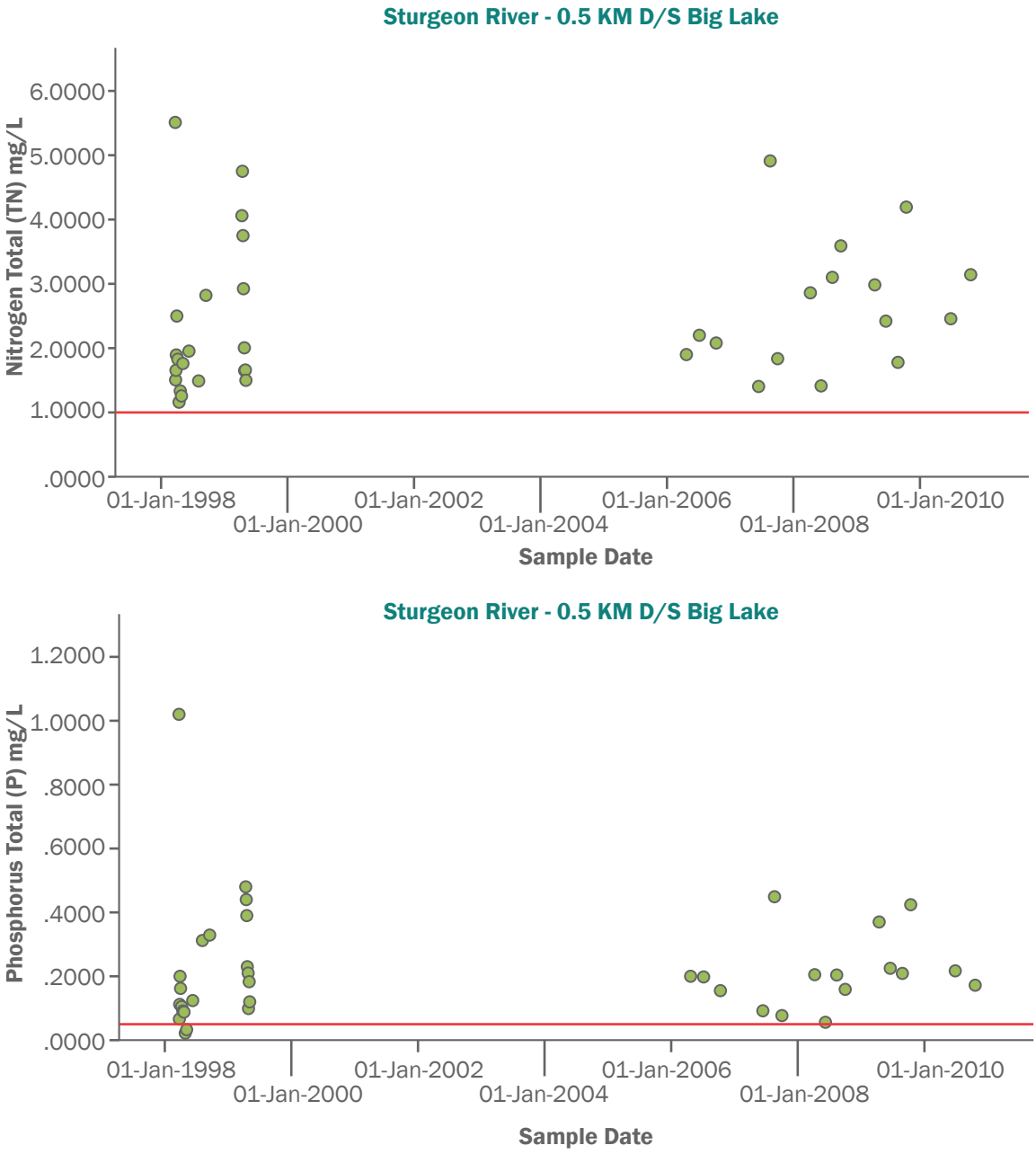


Figure 50. Sturgeon River downstream of Big Lake - historical total nitrogen (top) and total phosphorus (bottom) concentrations. The red lines represent the Alberta Surface Water Quality Guideline for the Protection of Aquatic Life (ASWQG-PAL) of 1.0 mg/L (TN) and 0.05 mg/L (TP) (Alberta Environment, 1999). Data from Alberta Environment, 2010.

Further downstream on the Sturgeon River, just upstream of the confluence with the North Saskatchewan River, no trend was apparent in total nitrogen concentrations (linear regression; p=0.129), but total phosphorus concentrations showed a significant decreasing trend (linear regression; p=0.023) (Figure 51).

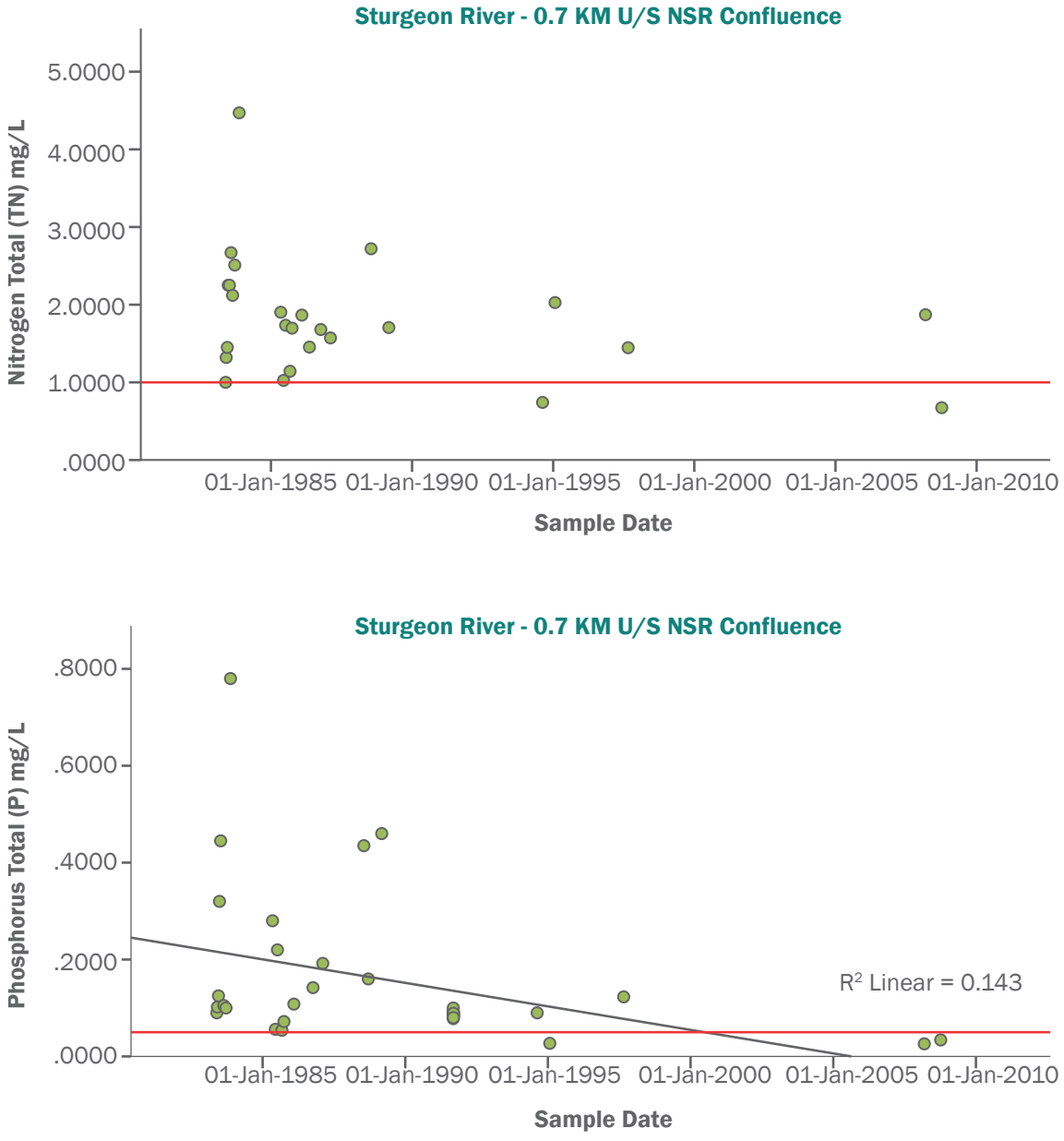


Figure 51. Sturgeon River just upstream of the North Saskatchewan River confluence - historical total nitrogen (top) and total phosphorus (bottom) concentrations. The red lines represent the Alberta Surface Water Quality Guideline for the Protection of Aquatic Life (ASWQG-PAL) of 1.0 mg/L (TN) and 0.05 mg/L (TP) (Alberta Environment, 1999). Data from Alberta Environment, 2010.

7.1.1.4 Other Bodies of Water

The majority of the water bodies in the Sturgeon River Watershed have concentrations of nutrients that exceed their respective ASWQ Guidelines (Table 16). Of those bodies of water with sufficient data to analyze, only two had average total nitrogen concentrations below the ASWQ PAL guideline of 1.0 mg/L, and only two had average total phosphorus concentrations below the ASWQ PAL guideline of 0.05 mg/L.

Table 16. Summary of nutrient parameters for water bodies within the Sturgeon River Watershed. Data from Alberta Environment (2010).

Location (Lakes)		**NH_3 mg/L**	**NO_3-NO_2 mg/L**	**TN mg/L**	**TP mg/L**	**TDP mg/L**
Guideline		**1.37-2.20***	**N/A**	**1.0**	**0.05**	**N/A**
Big Lake	Mean	0.04296	0.043296	1.84478	0.12989	0.064785
	N	25	27	27	27	27
Isle Lake	Mean	0.41401	0.074671	1.43223	0.25203	0.10171
	N	101	161	73	149	104
Lac St. Anne	Mean	0.0755	0.054995	1.43915	0.12659	0.086451
	N	104	196	121	280	255
Matchayaw Lake	Mean	0.431111	0.091357	1.71622	0.12028	0.075545
	N	9	14	9	24	11
Sandy Lake	Mean	0.177414	0.033121	3.37916	0.16423	0.031196
	N	128	140	132	159	73
Spring Lake	Mean	0.102556	0.007889	1.26567	0.03786	0.012567
	N	9	9	9	9	9
Location (Sturgeon River main stem sites)		**NH_3 mg/L**	**NO_3-NO_2 mg/L**	**TN mg/L**	**TP mg/L**	**TDP mg/L**
Sturgeon River - 1.5 Km U/S Rqb Confluence	Mean	0.169231	0.123077	1.53286	0.36143	
	N	13	13	7	7	
Sturgeon River - 7 Km U/S Nsr Confluence	Mean	0.579394	0.115	1.7485	0.40546	
	N	33	33	10	22	
Sturgeon River - Alberta Beach Bridge	Mean	0.092308	0.136286	1.12467	0.045	0.017
	N	13	14	6	8	1
Sturgeon River - At St. Albert	Mean	0.445061	0.2504	2.01675	0.27937	0.118367
	N	33	30	24	26	18
Sturgeon River - Darwell Bridge	Mean	0.208237	0.091778	1.5427	0.16244	0.10139
	N	38	54	43	48	41
Sturgeon River - Gibbons	Mean	0.335714	0.424286	1.89571	0.27125	
	N	14	14	7	8	
Sturgeon River - Hwy 28 Bridge	Mean	0.519286	0.317857	1.98143	0.495	
	N	14	14	7	8	

Table 16 con't

Location (other water courses and tributaries)		NH_3 mg/L	NO_3-NO_2 mg/L	TN mg/L	TP mg/L	TDP mg/L
Guideline		**1.37-2.20***	**N/A**	**1.0**	**0.05**	**N/A**
Sturgeon River - Magnolia Bridge	Mean	0.164778	0.13334	1.92351	0.24702	0.158487
	N	36	50	39	43	39
Sturgeon River - Rge Rd 251	Mean	1.092308	0.297692	2.17571	0.61	
	N	13	13	7	7	
Sturgeon River - U/S Big Lake At Meadowview Drive	Mean	0.23125	0.319423	2.05644	0.32335	0.190868
	N	56	52	45	46	38
Atim Creek - D/S Stony Plain	Mean	0.914615	0.053846	2.56857	0.45143	
	N	13	13	7	7	
Atim Creek - North Of Hwy 16x	Mean	0.209025	0.2886	1.4901	0.15098	0.080174
	N	40	40	40	40	23
Atim Creek - W Of Big Lake	Mean	0.35256	0.43	2.21158	0.36911	0.086833
	N	25	25	19	19	12
Birch Lake Creek	Mean	0.0875	0.005429	1.106	0.16871	0.110429
	N	6	7	2	7	7
Carrot Creek - U/S Big Lake	Mean	0.570063	1.32175	3.74925	0.33288	0.18325
	N	16	16	16	16	16
Isle Lake Tributary - Hofmann Beach	Mean	0.083143	0.024857	1.74067	0.15314	0.081
	N	7	7	3	7	7
Isle Lake Tributary - Horne Beach	Mean	0.118833	0.0965	3.777	0.42713	0.368
	N	6	8	4	8	8
Isle Lake Tributary - Marigold Bridge	Mean	0.1714	0.086714	4.31867	0.57243	0.448286
	N	5	7	3	7	7
Isle Lake Tributary - West Of Darwell	Mean	0.045667	0.066091	1.85029	0.24236	0.183273
	N	9	11	7	11	11
Isle Lake Tributary 11a - 2km North Of Hwy 16 On Hwy 757	Mean	0.148111	0.0771	1.93871	0.2071	0.1217
	N	9	10	7	10	10
Isle Lake Tributary 11c - 1.2km East Of Hwy 757 On Hwy 634	Mean	0.210222	0.0966	1.947	0.2307	0.1379
	N	9	10	6	10	10
Isle Lake Tributary 8 - Hwy 633	Mean	0.038	0.12	1.7345	0.16617	0.110333
	N	5	6	2	6	6
Isle Lake Tributary 9 - 0.6km East Of Isle Trib 8 On Hwy 633	Mean	0.04875	0.199	2.2825	0.39267	0.323
	N	4	6	2	6	6
Kilini Creek	Mean	0.0596	0.0085	0.6765	0.0812	0.0362
	N	10	10	10	10	10

Table 16 con't

Location (other water courses and tributaries)		NH_3 mg/L	NO_3-NO_2 mg/L	TN mg/L	TP mg/L	TDP mg/L
Guideline		**1.37-2.20***	**N/A**	**1.0**	**0.05**	**N/A**
Kirk Lake Creek	Mean	0.243	1.095938	2.88281	0.25906	0.127313
	N	16	16	16	16	16
Little Egg Creek	Mean	0.1	0.4	3.2	0.35	
	N	6	6	2	2	
Matchayaw Lake	Mean	0.431111	0.091357	1.71622	0.12028	0.075545
	N	9	14	9	24	11
Mission Creek	Mean	0.25352	0.180595	2.30484	0.28224	0.205784
	N	25	37	32	37	37
Riviere Qui Barre	Mean	0.188889	0.1	2.588	0.704	
	N	9	9	5	5	
Val Quentin Creek	Mean	0.816333	0.636889	4.65671	0.55133	0.467556
	N	12	18	14	18	18

** 1.37 mg/l at pH 8.0, 100C; 2.20 mg/l at pH 6.5, 100C,*

7.1.2 Bacteria

7.1.2.1 Watershed-wide Patterns

Coliform bacteria are found in the aquatic environment, soil and on vegetation, and are present in large numbers in the feces of humans and animals. The presence of coliform bacteria is used as an indicator of other pathogenic organisms of fecal origin that may cause serious illness in humans. Escherichia coli (E. coli) are coliform bacteria of fecal origin and are commonly used as an indicator of fecal contamination. Sources of coliform bacteria within the Sturgeon River Watershed include runoff from urban centres, runoff from feedlots and farms with livestock, and bodies of water where wildlife and waterfowl gather in large numbers.

E. coli concentrations are low to moderate across the Sturgeon River Watershed, with the majority of sites falling below the ASWQ PAL Guideline of 100 CFU/100 ml and the higher Canadian Council of Ministers of the Environment (CCME) guideline for Recreation and Aesthetics of 200 CFU/100 mL (Figure 52). No strong spatial trend to concentrations is apparent, though the highest average concentrations were found on tributaries to Isle Lake, Lac Ste. Anne, and Big Lake. Only two sites on the Sturgeon River main stem had average concentrations exceeding ASWQ PAL guidelines, at Magnolia Bridge and upstream of Rivière Qui Barre.

Total coliform concentrations are generally low in the watershed, falling below the ASWQ PAL guideline of 1000 CFU/100 mL, with the exception of the site immediately downstream of Big Lake (Figure 53); this may be a result of the high densities of waterfowl and slow flows at that site.

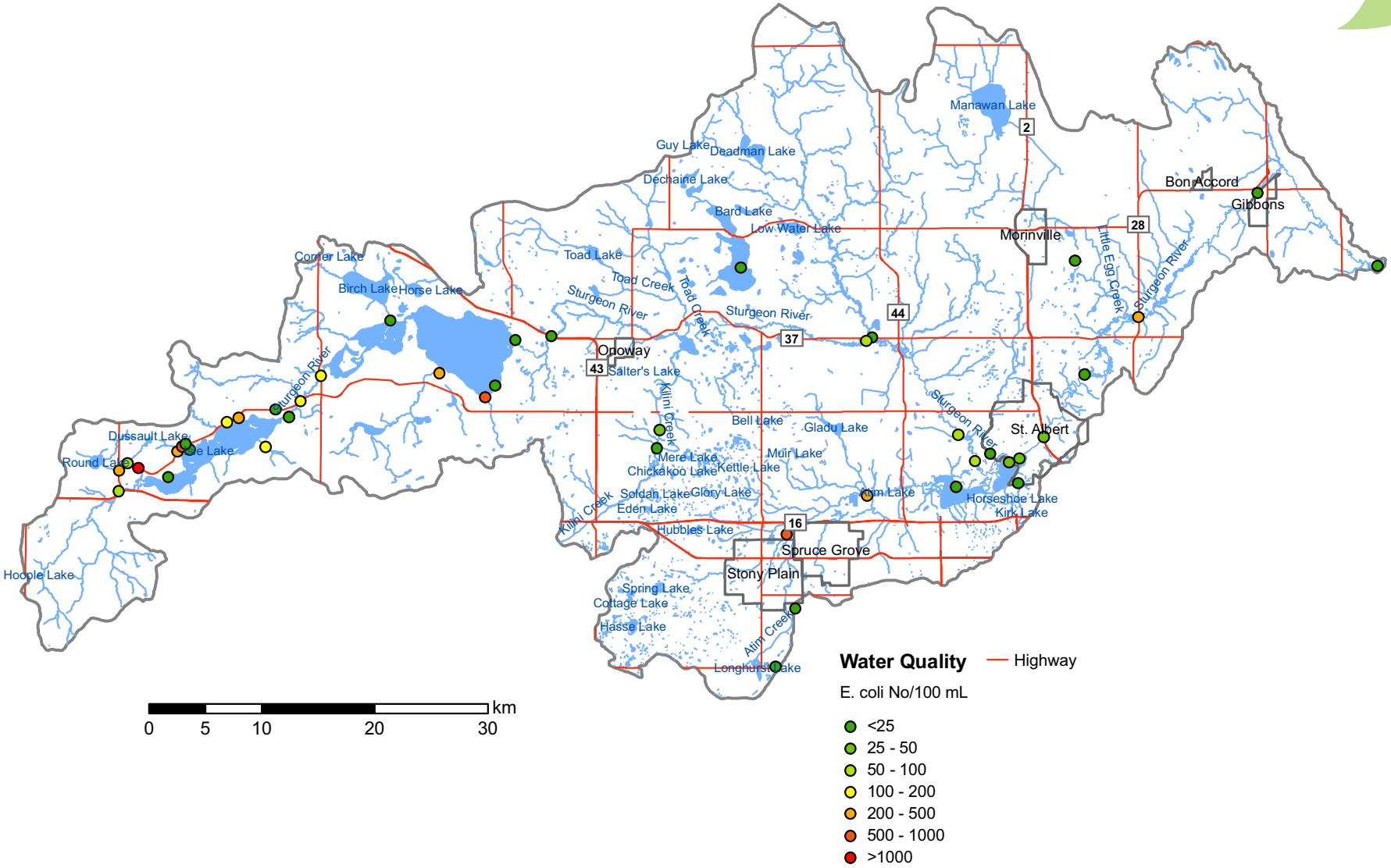


Figure 52. Average E. coli concentrations at all sample locations in the Sturgeon River Watershed (Alberta Environment, 2010). ASWQ PAL Guideline is 100 CFU/100 mL.

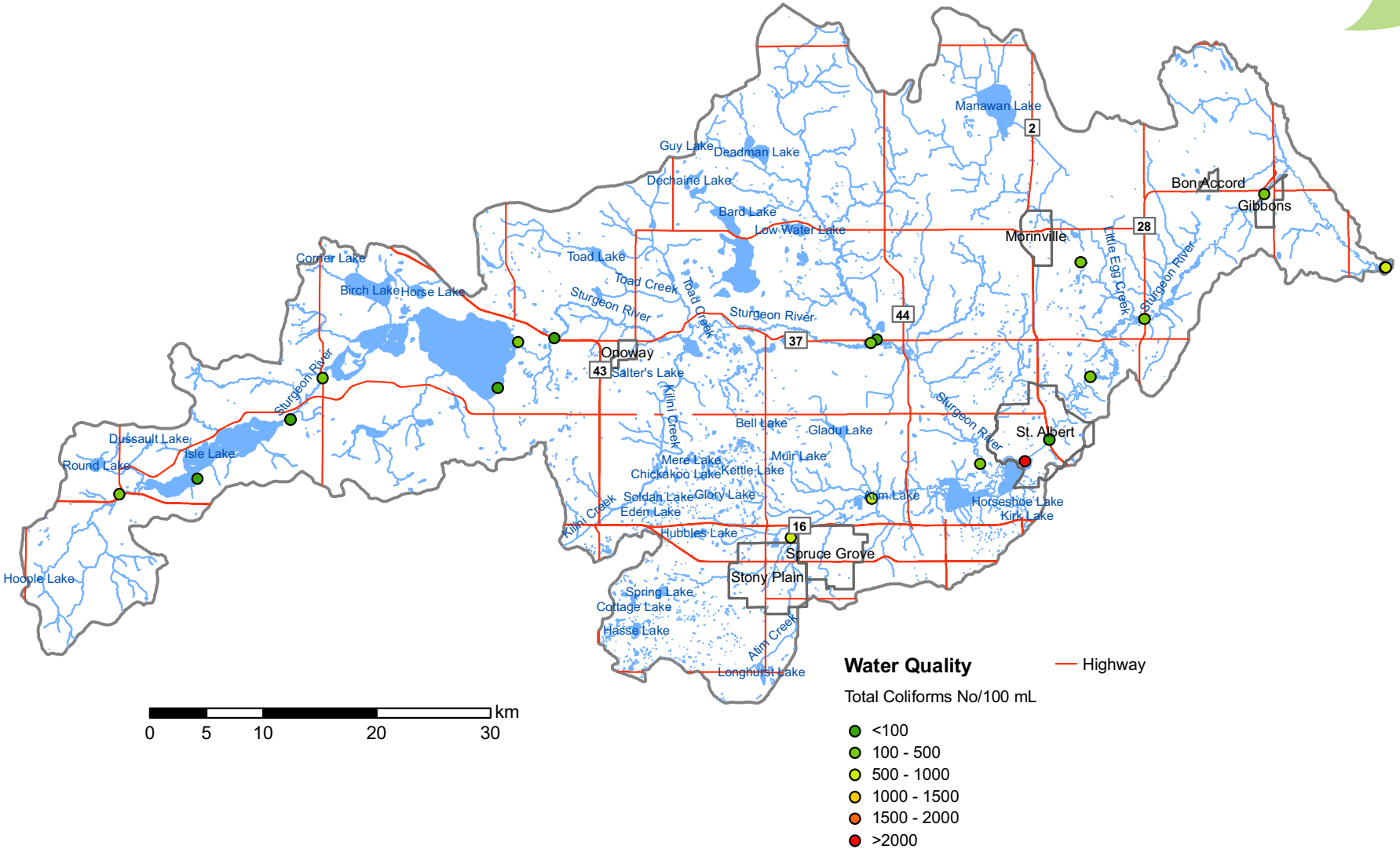


Figure 53. Average total coliform concentrations at all sample locations in the Sturgeon River Watershed (Alberta Environment, 2010). ASWQ PAL Guideline is 1,000 CFU/100 mL.

7.1.2.2 Sturgeon River – Spatial Trends

E. coli concentrations along Sturgeon River main stem are generally low, with average concentrations at all but two sites falling below the ASWQ PAL Guideline of 100 CFU/100 ml and all but one falling below the Canadian Council of Ministers of the Environment (CCME) guideline for Recreation and Aesthetics of 200 CFU/100 mL (Figure 54). There appears to be a generally decreasing trend in E. coli concentrations from upstream to downstream along the Sturgeon River, with the highest concentrations found in the upper reaches and lower concentrations downstream of Big Lake and the City of St. Albert.

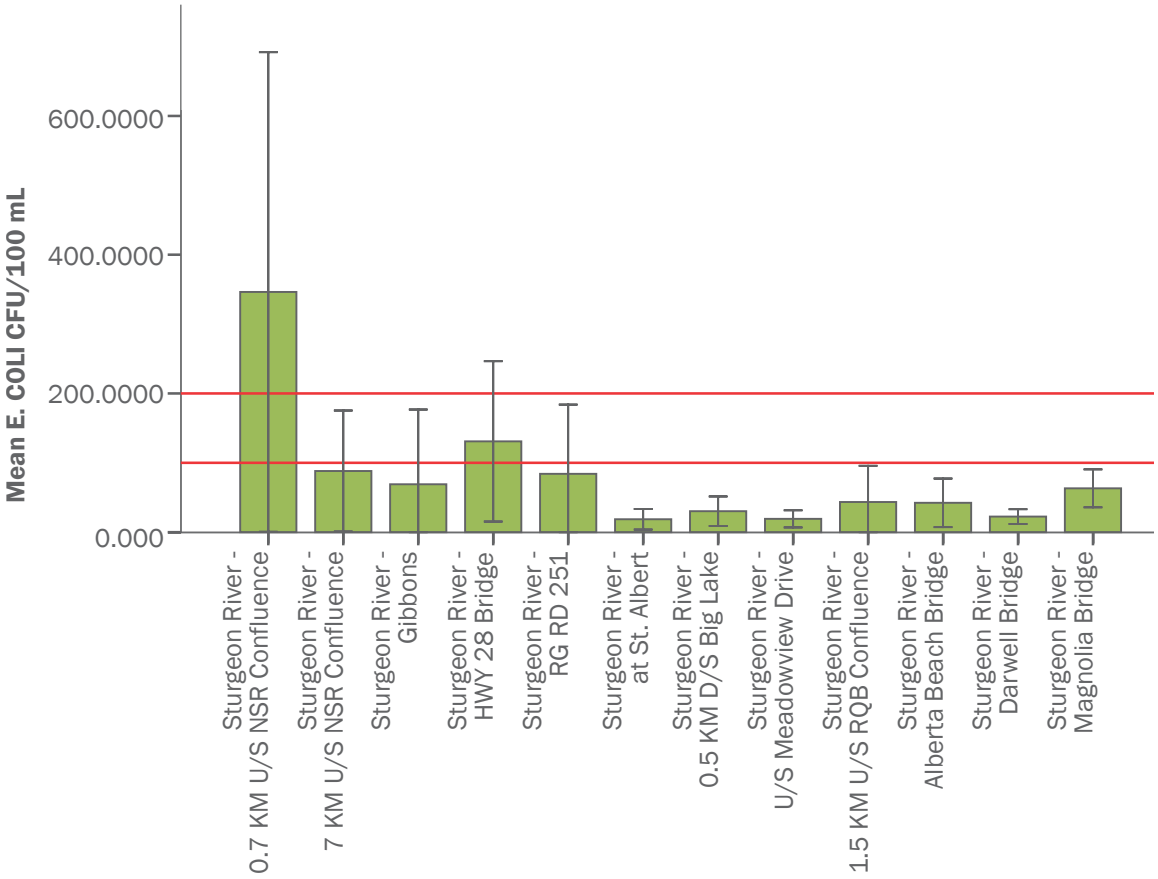


Figure 54. E. coli concentrations at sampling locations on the Sturgeon River main stem. Sites are ordered in an upstream to downstream direction from left to right. The red lines represent the Alberta Surface Water Quality Guideline for the Protection of Aquatic Life (ASWQG-PAL) of 100 CFU/100 mL (lower) and the CCME guideline for Recreation and Aesthetics of 200 CFU/100 mL (upper). Data from Alberta Environment (2010) and Aquality Environmental Consulting (2006-2010).

Total coliform concentrations along the Sturgeon River main stem are also generally low, with average concentrations at only one site downstream of Big Lake exceeding the ASWQ Guideline of 1000 CFU/100 mL. However, the spatial pattern of concentrations follows a different pattern from E. coli, with the highest concentrations found in the vicinity of Big Lake (Figure 55). Slightly elevated concentrations are also seen at the site just upstream of the confluence with the North Saskatchewan River.

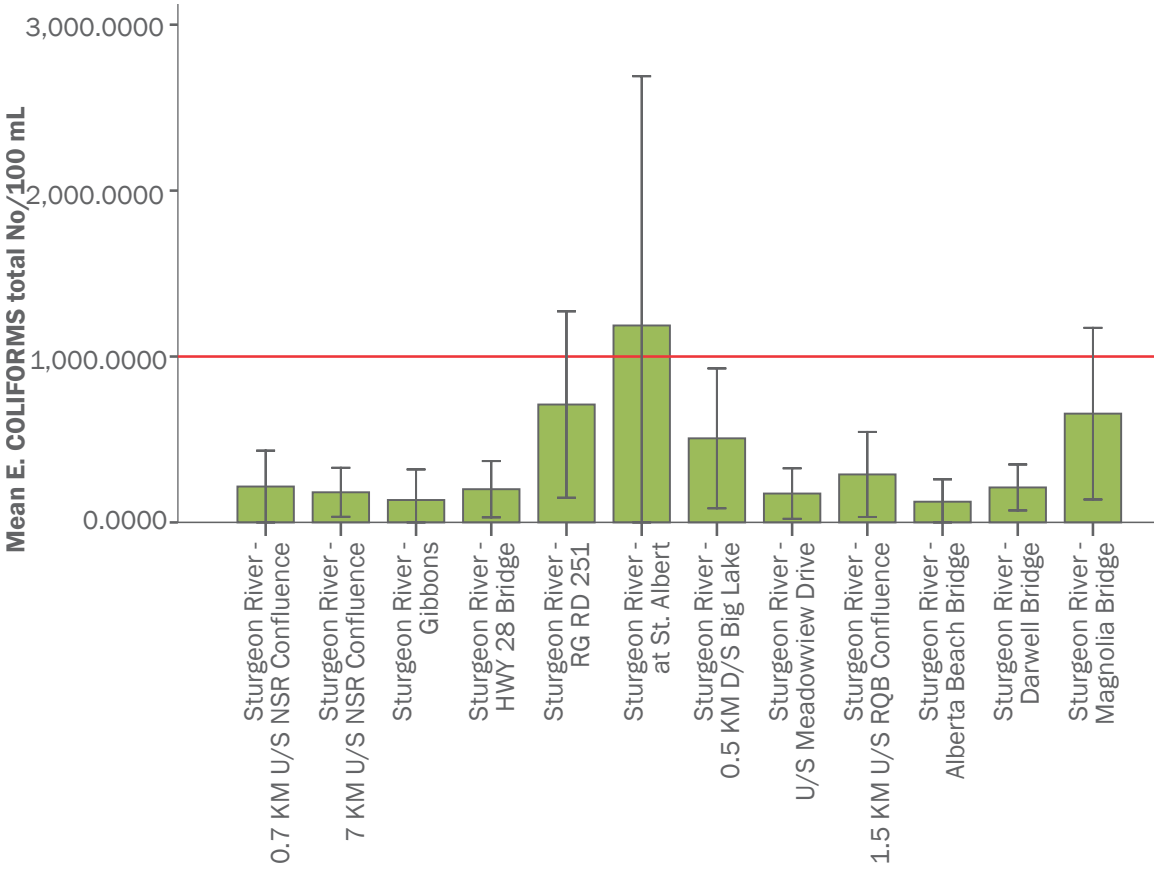


Figure 55. Total coliform concentrations at sampling locations on the Sturgeon River main stem. Sites are ordered in an upstream to downstream direction from left to right. The red line represents the Alberta Surface Water Quality Guideline for the Protection of Aquatic Life (ASWQG-PAL) of 1000 CFU/100 mL. Data from Alberta Environment (2010) and Aquality Environmental Consulting (2006-2010).

7.1.2.3 Temporal Trends

Concentrations of E. coli at a reference site on the Sturgeon River at upstream of Big Lake are generally below the ASWQ PAL Guideline of 100 CFU/100 ml and all fall below the Canadian Council of Ministers of the Environment (CCME) guideline for Recreation and Aesthetics of 200 CFU/100 ml. No significant trend in concentrations over time is apparent (linear regression, p=0.268) (Figure 56). Concentrations of total coliforms at the same site fall for the most part below the ASWQ PAL Guideline of 1000 CFU/100 mL, but also show a significant increasing trend over time, with a greater proportion of samples exceeding the guideline in recent years (linear regression, p=0.41) (Figure 57).

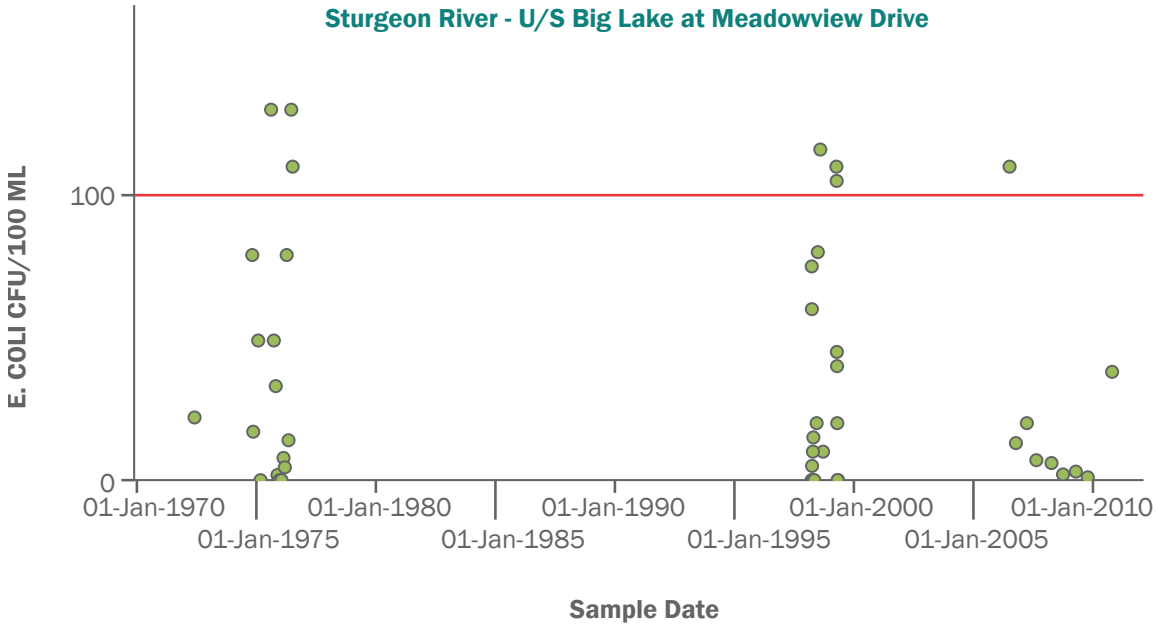


Figure 56. E. coli concentrations on the Sturgeon River at Meadowview Drive, just upstream of Big Lake. The red line represents the Alberta Surface Water Quality Guideline for the Protection of Aquatic Life (ASWQG-PAL) of 100 CFU/100 mL. Data from Alberta Environment (2010) and Aquality Environmental Consulting (2006-2010).

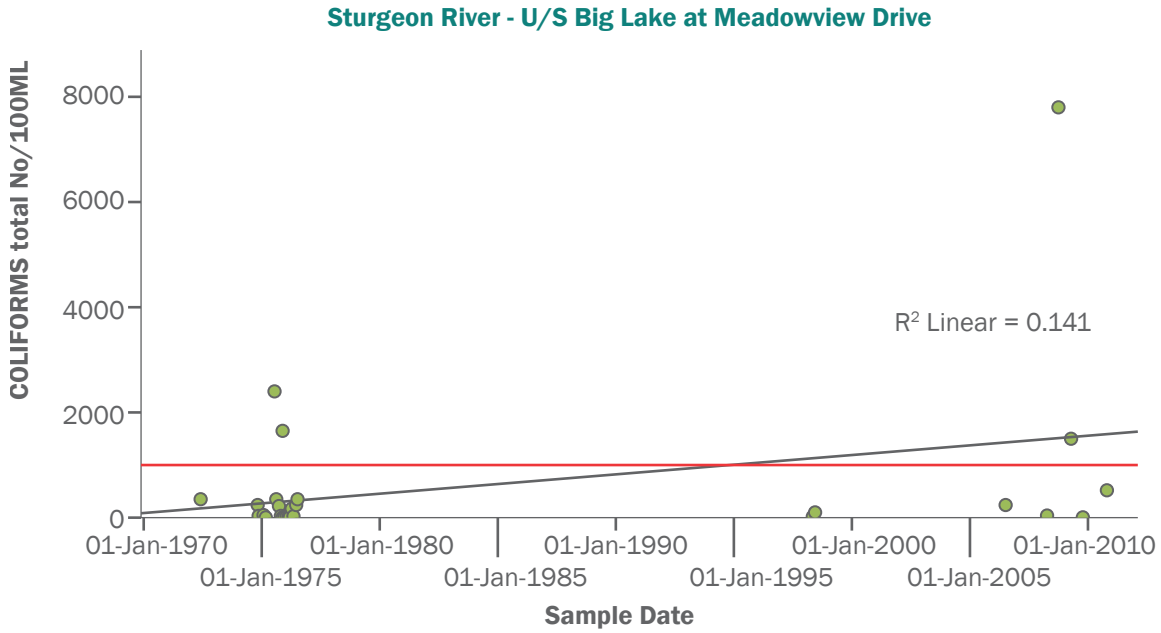


Figure 57. Total coliform concentrations on the Sturgeon River at Meadowview Drive, just upstream of Big Lake. The red line represents the Alberta Surface Water Quality Guideline for the Protection of Aquatic Life (ASWQG-PAL) of 1000 CFU/100 ml. Data from Alberta Environment (2010) and Aquality Environmental Consulting (2006-2010).

7.1.3 Pesticides

A number of pesticides and other organic compounds of anthropogenic origin have been detected in water bodies in the Sturgeon River Watershed (Table 17), with samples collected from the mid-1990s onwards. MCPP, MCPA, and 2,4-D are the most prevalent, and were detected in the greatest number of water bodies. These three compounds showed high frequencies of detection in some water bodies, being frequently found (in 8 to 25 per cent of samples collected) in Atim Creek, Carrot Creek, and Kirk Lake Creek. These three water bodies had the highest frequencies of pesticide detections, while the Sturgeon River main stem had the greatest number of different compounds detected. However, all concentrations of pesticides fell below their respective CCME PAL guideline.

Along the Sturgeon River main stem, pesticides were most frequently detected at the furthest downstream sampling location, just upstream of the confluence with the North Saskatchewan River (Figure 58). Since pesticides may persist in the environment for extended periods in transit downriver, this likely indicates an accumulation of different types of pesticides over the course of the river's length.

Sturgeon River State of the Watershed Report | Technical Report

Table 17. Frequency of pesticide and other organic compound detections in named bodies of water in the Sturgeon River Watershed.*

Water body	2,4-D µg/l	Atrazine µg/l	bis(2-ethylhexyl) phthalate µg/l	Carbathiin µg/l	Clopyralid µg/l	Dicamba µg/l	Di-n-butyl phthalate µg/l	Diuron µg/l
Isle Lake	0	0		0	0	0		0
Mission Creek	0	0		0	0	0		0
Lac Ste. Anne	0.01	0		0	0	0		0
Atim Creek	0.2	0.04	0	0	0.08	0.04	0.08	0
Kirk Lake Creek	0.16	0	0	0.04	0	0	0.08	0
Carrot Creek	0.188	0	0.063	0	0.188	0.063	0.125	0
Big Lake	0.047	0	0	0	0.024	0.012	0	0
Sturgeon River u/s of N. Sask.	0.025	0	0.003	0	0.006	0.003	0.006	0.003

Table 17, cont'd.

Water body	Ethalfluralin µg/l	Imazamethabenz-methyl µg/L	Imazethapyr µg/L	MCPA µg/L	MCPP µg/L	Picloram µg/L	Triallate µg/L	Trifluralin µg/L
Isle Lake	0	0		0	0	0	0	0
Mission Creek	0			1	0	0	0	0
Lac Ste. Anne	0	0		0.04	0	0	0	0
Atim Creek	0	0.04	0	0.16	0.2	0.12	0.04	0
Kirk Lake Creek	0	0	0	0.08	0.16	0	0	0
Carrot Creek	0	0.1875	0.125	0.1875	0.25	0.25	0.125	0
Big Lake	0	0	0	0.036	0.036	0.012	0	0
Sturgeon River u/s of N. Sask.	0.003	0.003	0.003	0.011	0.011	0.014	0.006	0.003

** Data from Alberta Environment (2010). Only those bodies of water with at least one positive detection are included; empty cells indicate that the parameter was not sampled in that water body.*

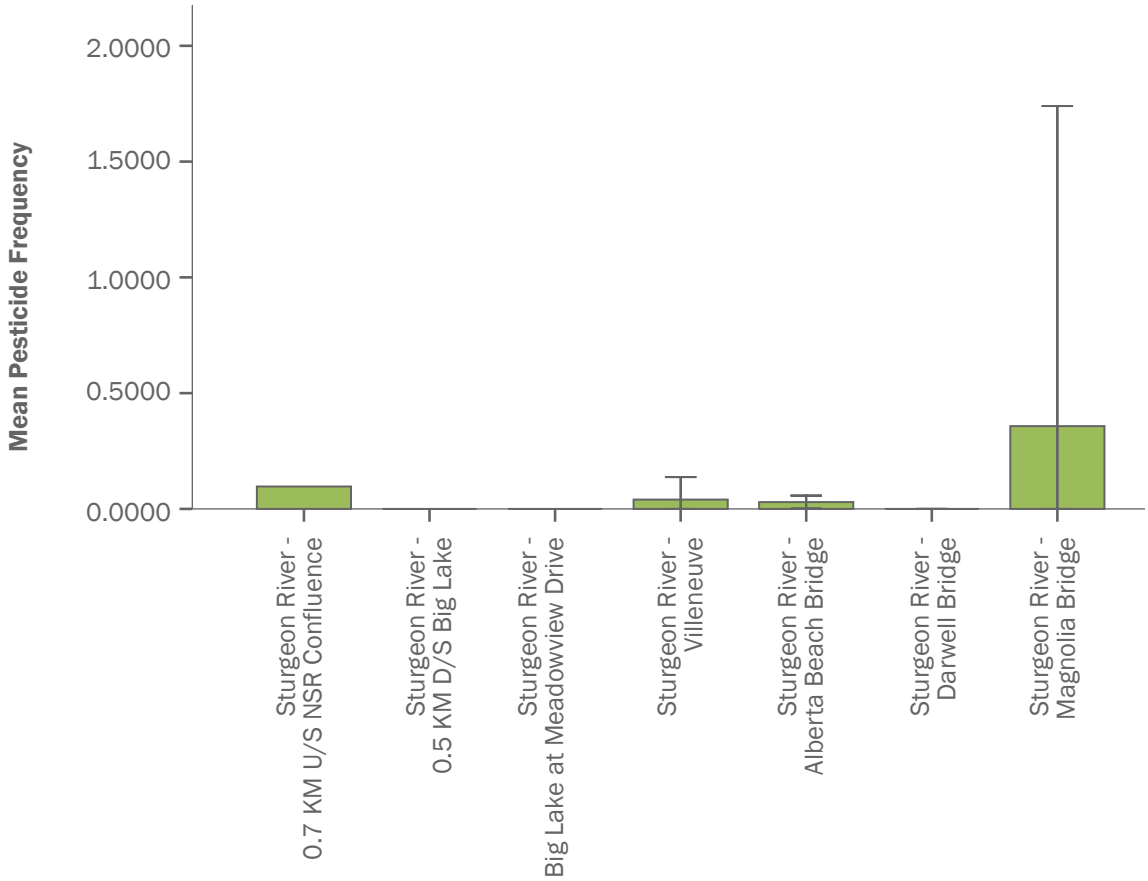


Figure 58. Frequency of pesticide detection at sampling locations along the Sturgeon River main stem. Detection frequency is calculated as (Number of detected pesticides) / (Number of tested pesticides) (Alberta Environment, 2010).

7.1.4 Other Water Quality Parameters

The water bodies in the Sturgeon River Watershed generally have hard, slightly alkaline water, as indicated by: the pH and alkalinity parameters; high concentrations of basic ions such as magnesium, calcium, and iron; and high conductivities and concentrations of dissolved solids (Table 18). Although most of these parameters may be influenced by human-caused erosion and practices such as road salting, the dominant soils and surficial geological features suggest these results may be a predominantly natural occurrence.

Sturgeon River State of the Watershed Report | Technical Report

Table 18. Summary of ions and routine water quality parameters for water bodies within the Sturgeon River Watershed. Data from Alberta Environment (2010). Only water bodies for which at least 4 samples were available are included in the table.

Water Body (Sturgeon River main stem)		pH	Alkalinity mg/L	Calcium mg/L	Chloride mg/L	Hardness mg/L	Magnesium mg/L	Potassium mg/L	Sodium mg/L	pecific cond. (uS/cm)	TDS mg/l
CCME guideline		6.5 – 9.5	N/A	100	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Sturgeon River - Magnolia Bridge	Mean	7.7461	157.59	30.98	5.29	132.187	11.25	7.17	22.72	337.03	199.94
	N	41	32	12	32	32	23	23	32	32	32
Sturgeon River - Darwell Bridge	Mean	7.9328	143.57	32.01	3.69	116.000	8.77	7.06	15.69	290.81	167.20
	N	45	35	11	36	36	24	24	36	36	35
Sturgeon River - Alberta Beach Bridge	Mean	8.0771	163.21		1.59	124.071	9.46	7.26	15.21	292.71	184.29
	N	14	14		14	14	13	13	14	14	14
Sturgeon River - 1.5 Km U/S RQB Confluence	Mean	8.1615	225.69		3.46	175.615	13.69	7.57	38.08	452.77	288.54
	N	13	13		13	13	13	13	13	13	13
Sturgeon River - U/S Big Lake At Meadowview Drive	Mean	7.8832	192.21	38.06	5.79	178.105	13.13	7.77	37.85	553.52	279.11
	N	50	39	22	40	55	40	39	39	52	38
Sturgeon River - 0.5 Km D/S Big Lake	Mean	8.1227	159.29	47.90	17.94	200.294	15.37	8.55	35.19	590.23	298.29
	N	31	21	20	21	34	21	21	21	32	21
Sturgeon River - At St. Albert	Mean	8.2294	243.00	36.00	7.71	205.452	17.68	7.94	48.06	580.45	340.94
	N	17	17	1	17	31	17	17	17	29	16
Sturgeon River - Rge Rd 251	Mean	8.3231	257.38		5.69	223.385	18.23	8.01	54.46	554.77	383.69
	N	13	13		13	13	13	13	13	13	13
Sturgeon River - Hwy 28 Bridge	Mean	8.1000	267.50	136.00	10.57	269.643	23.07	8.48	60.07	700.36	449.31
	N	14	14	1	14	14	14	14	14	14	13
Sturgeon River - Gibbons	Mean	8.0500	250.14	56.00	5.86	291.286	24.21	7.50	49.85	667.86	471.54
	N	14	14	1	14	14	14	13	13	14	13
Sturgeon River - 7 Km U/S NSR Confluence	Mean	7.9767	254.33	68.50	7.00	309.000	26.03	8.00	53.14	718.63	710.83
	N	30	30	12	30	24	30	29	29	30	24
Sturgeon River - 0.7 Km U/S NSR Confluence	Mean	8.0020	237.40	71.72	10.25	320.830	23.96	7.92	41.02	583.90	406.14
	N	40	23	23	38	14	23	23	37	40	23

Sturgeon River State of the Watershed Report | Technical Report

Table 18 cont'd. – Other water courses and tributaries:

Water Body (other water courses and tributaries)		pH	Alkalinity mg/L	Calcium mg/L	Chloride mg/L	Hardness mg/L	Magnesium mg/L	Potassium mg/L	Sodium mg/L	pecific cond. (uS/cm)	TDS mg/l
CCME guideline		**6.5 – 9.5**	**N/A**	**100**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
Isle Lake Tributary - West Of Darwell	Mean	7.5333	89.67	25.53	1.73	91.833	6.80	6.80	2.67	201.17	107.50
	N	6	6	6	6	6	6	6	6	6	6
Mission Creek	Mean	7.6270	126.89	35.83	4.32	124.833	8.72	10.01	7.44	293.19	156.78
	N	28	18	9	18	18	9	9	18	18	18
Val Quentin Creek	Mean	7.4681	109.20	30.90	10.86	125.429	7.84	16.96	5.29	330.14	178.86
	N	13	7	5	7	7	5	5	7	7	7
Kilini Creek	Mean	7.8350	291.80		10.96	270.700		4.62	55.31	721.10	454.35
	N	10	10		10	10		10	10	10	10
Atim Creek - D/S Stony Plain	Mean	8.1308	372.00		5.38	352.385	30.46	5.43	46.23	798.08	504.69
	N	13	12		13	13	13	13	13	13	13
Atim Creek - North Of Hwy 16x	Mean	7.8374	356.33	79.97	10.80	302.000	24.83	3.93	36.67	761.33	423.33
	N	27	3	3	3	3	3	3	3	3	3
Atim Creek - W Of Big Lake	Mean	7.8952	284.96	82.48	15.97	323.440	26.03	7.20	36.84	726.27	454.36
	N	26	25	12	25	25	25	25	25	26	25
Riviere Qui Barre	Mean	7.8556	161.11		3.67	120.889	9.67	7.03	26.78	327.78	205.11
	N	9	9		9	9	9	9	9	9	9
Carrot Creek - U/S Big Lake	Mean	7.4834	102.38	52.57	48.19	210.062	19.17	10.67	54.06	664.16	408.25
	N	16	16	16	16	16	16	16	16	16	16
Kirk Lake Creek	Mean	7.7263	127.25	84.89	28.12	313.813	24.75	9.91	26.44	695.31	457.50
	N	16	16	16	16	16	16	16	16	16	16
Little Egg Creek	Mean	8.0500	157.17		4.83	228.167	17.83	13.33	36.67	523.33	391.17
	N	6	6		6	6	6	6	6	6	6

Table 18 cont'd. – Lakes:

Water Body (Lakes)		pH	Alkalinity mg/L	Calcium mg/L	Chloride mg/L	Hardness mg/L	Magnesium mg/L	Potassium mg/L	Sodium mg/L	pecific cond. (uS/cm)	TDS mg/l
CCME guideline		**6.5 – 9.5**	**N/A**	**100**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
Isle Lake	Mean	8.4329	144.55	29.48	2.84	111.247	8.82	6.18	17.40	289.44	160.50
	N	443	159	39	159	154	119	119	135	419	124
Lac St. Anne	Mean	8.3123	149.74	32.47	2.44	117.815	10.10	7.12	16.56	297.60	165.24
	N	855	191	87	191	189	164	165	187	849	180
Matchayaw Lake	Mean	8.1833	244.47	39.58	10.06	176.118	16.62	6.80	64.44	659.41	351.50
	N	103	17	13	17	17	13	16	17	102	16
Spring Lake	Mean	8.1889	186.00	34.57	.29	255.286	41.14	10.40	23.86	590.69	361.00
	N	63	7	7	7	7	7	7	7	63	6
Sandy Lake	Mean	8.8942	308.42	11.76	3.88	71.980	9.91	12.53	107.59	614.70	339.68
	N	296	138	45	138	138	135	138	138	385	138
Big Lake	Mean	8.9224	158.00	45.22	18.69	189.520	19.42	8.01	39.19	524.57	317.36
	N	72	25	22	25	25	22	25	25	72	25

Bodies of water within the watershed have been sampled for metals at varying intervals, and for different suites of metals. A summary of the results of these studies is presented in Table 19. Only metals with positive detections are included, and only sites with at least four samples collected for at least one metal are included. In records from Alberta Environment (in 2010), the only metals to exceed either the respective ASWQ or CCME guidelines include aluminum, iron, mercury, and zinc, with aluminum and iron found above guidelines at many of the sites examined. Aluminum and iron both exhibit toxic effects on aquatic life, through both direct and indirect pathways.[180] Other recent studies within the basin have also found levels of chromium, cadmium, manganese, and copper at concentrations that may cause damage to aquatic life, but these studies have been restricted to sites within the City of St. Albert.[181] Whether issues with these metals are widespread within the watershed is unknown.

7.1.5 Groundwater Quality

A discussion around groundwater quality was beyond the scope of the current project; however, an excellent overview of groundwater conditions, users, issues and challenges was recently completed for the North Saskatchewan Watershed Alliance.[182] The 12 basins of the North Saskatchewan River were broken into western, central and eastern basins.

The Sturgeon sub-basin was represented in the central basin, along with White Earth, Strawberry and Beaverhill. Information on topography, relief, geology, hydrogeology and formations within the basin are well discussed. Groundwater quantity usage statistics, such as supply, use, vulnerability and threats to groundwater are also quantified. For example, the Wagner Natural Area, located west of Edmonton, is a local groundwater discharge area. Within the fen is a rich peatland supporting dozens of unusual species of plants and lichen, along with insects, frogs, and birds. Without the consistent supply of groundwater at a relatively constant temperature, the specific conditions making the fen and supporting the unique ecology would not exist.[183]

Approximately 50 wells of the Provincial Ambient Groundwater Quality (PAGQ) Monitoring Program are located in the North Saskatchewan River basin. Currently, data regarding the provincial groundwater monitoring network and general groundwater information are available through three primary sources. Temporal water level trend hydrographs are available through an Alberta Environment website. Quality and level data are available through the provincial Groundwater Information Centre. Visit www.envinfo.gov.ab.ca/GroundWater for more information. Water well drilling records are also available through the Groundwater Information Centre. Specific information about PAGQ wells, such as available chemistry data, borehole geology, or completion details, are available from Alberta Environment by request only. While large amounts of data are available, no single point of data access exists. Also, no province- or watershed-wide institutional framework exists to interpret the hydrogeological data gathered over the past 50 years and to evaluate its significance.[184]

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180 Linton, T.K., Pacheco, M.A.W., McIntyre, D.O., Clement, W.H., and Doodrich-Mahoney, J. 2007. Development of bioassessment-based benchmarks for iron. Environmental Toxicology and Chemistry 26: 1291-1298.; Dalzell, D.J.B. and Macfarlane, N.A.A. 1999. The toxicity of iron to brown trout and effect on the gills: a comparison of two grades of iron sulphate. Journal of Fish Biology 55: 301-315.; Randall, S., Harper, D., and Brierley, B. 1999. Ecological and ecophysical impacts of ferric dosing in reservoirs. Hydrobiologia 395/396: 355-364.

181 Aquality. 2006-2010. Sturgeon River Water Quality Monitoring Program. Aquality Environmental Consulting Ltd.

182 North Saskatchewan Watershed Alliance (NSWA). 2009. Economic Activity and Ecosystem Services in the North Saskatchewan River Basin. The North Saskatchewan Watershed Alliance Society, Edmonton, Alberta. Report prepared by Watrecon Consulting. 42 p.

183 Wagner Natural Society. 2001. The Wagner Natural Area (WNA) of Alberta.

184 Op. cit., North Saskatchewan Watershed Alliance, 2009.

Sturgeon River State of the Watershed Report | Technical Report

Table 19. Summary of metal water quality parameters for water bodies within the Sturgeon River Watershed. Data from Alberta Environment (2010). Only water bodies for which at least 4 samples were available are included in the table. Shaded values indicate average concentrations that exceed guidelines; lighter shading indicates cases where a parameter exceeds the less stringent of two possible guidelines.

Sturgeon River main stem sites:

Water Body - Sturgeon River		Aluminum ug/L	Arsenic ug/L	Barium ug/L	Boron ug/L	Iron mg/L	Manganese mg/L	Mercury ug/L	Zinc mg/L
CCME Guideline		5 – 100	5.0	N/A	N/A	0.300	N/A	0.1	0.030
ASWQ Guideline								0.013	
Sturgeon River - Magnolia Bridge	Mean					1.06			
	N					11			
Sturgeon River - Darwell Bridge	Mean					0.22			
	N					13			
Sturgeon River - Alberta Beach Bridge	Mean					0.09			
	N					13			
Sturgeon River - 1.5 Km U/S RQB Confluence	Mean					0.38			
	N					13			
Sturgeon River - U/S Big Lake At Meadowview Drive	Mean	3175.62	1.86	91.93	46.10	0.35	0.10	0.01	0.01
	N	9	9	3	3	20	1	13	1
Sturgeon River - 0.5 Km D/S Big Lake	Mean	503.67	2.08			0.33		0.02	
	N	6	6			2		6	
Sturgeon River - At St. Albert	Mean					0.54	0.50	0.00	
	N					16	1	4	
Sturgeon River - Hwy 28 Bridge	Mean					0.92	1.70	.00	0.01
	N					13	1	1	1
Sturgeon River - Gibbons	Mean					1.10	0.07	0.00	0.02
	N					13	1	1	1
Sturgeon River - 7 Km U/S NSR Confluence	Mean					1.37	0.33	0.00	0.04
	N					18	9	12	10
Sturgeon River - 0.7 Km U/S NSR Confluence	Mean	1017.00	2.48	65.80		1.35	0.20	0.00	0.01
	N	1	1	1		19	20	37	34

Sturgeon River State of the Watershed Report | Technical Report

Table 19 cont'd. – other water courses and tributaries:

Water Body - Creeks		Aluminum ug/L	Arsenic ug/L	Barium ug/L	Boron ug/L	Iron mg/L	Manganese mg/L	Mercury ug/L	Zinc mg/L
CCME Guideline		5 – 100	5.0	N/A	N/A	0.300	N/A	0.1	0.030
ASWQ Guideline								0.013	
Mission Creek	Mean								
	N								
Kilini Creek	Mean	86.68	1.71	107.31	70.20				
	N	10	10	10	10				
Atim Creek - W Of Big Lake	Mean	379.14	2.27	78.00	82.90	0.23		0.01	
	N	7	7	4	4	13		7	
Carrot Creek - U/S Big Lake	Mean	3112.86	1.87	69.50	36.98	0.58		0.01	
	N	7	7	4	4	1		7	
Kirk Lake Creek	Mean	1392.00	1.33	54.82	79.88	0.50		0.02	
	N	9	9	4	4	1		9	

Table 19 cont'd. – Lakes:

Water Body - Lakes		Aluminum ug/L	Arsenic ug/L	Barium ug/L	Boron ug/L	Iron mg/L	Manganese mg/L	Mercury ug/L	Zinc mg/L
CCME Guideline		5 – 100	5.0	N/A	N/A	0.300	N/A	0.1	0.030
ASWQ Guideline								0.013	
Isle Lake	Mean					0.06	0.03	0.00	0.02
	N					100	10	11	7
Lac St. Anne	Mean					0.03	0.02	0.00	0.02
	N					132	7	16	6
Sandy Lake	Mean					0.15	0.20	0.00	0.00
	N					124	5	5	5
Big Lake	Mean	258.35	3.75			0.03	0.02	0.01	0.01
	N	4	4			8	2	14	2

7.2 AQUATIC ECOSYSTEM HEALTH

An aquatic ecosystem is made up of interacting organisms, dependent on each other and their water environment for nutrients and shelter. Aquatic ecosystems include lakes, ponds, rivers, creeks, wetlands and prairie potholes. A healthy aquatic ecosystem is one where the natural function and structure of the ecosystem has not been altered due to human impacts. Human impacts can be physical, chemical or biological. Symptoms of poor ecosystem health may include:

- loss of species
- rapid growth of organisms
- increased occurrences of tumours or deformities in animals
- change in chemical properties (e.g.) pH, pesticides
- presence of pathogens in abnormal concentrations

7.2.1 Sturgeon River

The Sturgeon River is a Class C fish-bearing watercourse, with a restricted activity period from April 16 to June 30. Low flows and shallow lake levels, like other prairie rivers, make it appealing to Northern Pike, Walleye and Whitefish. Fish passage to tributaries and the upper reaches of the Sturgeon River can be compromised by culvert crossings, beaver activity and debris jams.[185]

A healthy population of Northern Pike in the watershed uses the shallow lakes and riparian areas for spawning and rearing habitats. In 2005 and 2006, provincial fisheries staff collected adult Northern Pike, in St. Albert, to redistribute to lakes in Alberta that had to be restocked. The number of adult Northern Pike present in the Sturgeon River during the spring runoff period may be significant.

Although the submergent vegetation in Big Lake provides seasonal habitat for some species, such as the spawning and rearing of Northern Pike, the ability for fish to live through the winter is limited by the lake's shallow depth. Lake depths vary between 0.3 and 4.1 metres, with an average depth of approximately one metre.[186] Since Big Lake and the Sturgeon River cannot sustain significant populations of game fish during the winter, overwintering typically occurs in the North Saskatchewan River or in larger lakes in the area.[187]

Winter fish kills have been documented on the Sturgeon River at St. Albert in 1998, 2002, 2004 and 2010. In each instance fish were attracted to open, flowing water at stormwater outfalls during fall or winter months. Testing by Alberta Environment and others all indicated that extremely low oxygen levels in the river were likely forcing the fish to gather around the flowing water where oxygen levels would be higher. In two incidents, Alberta Fish and Wildlife came to St. Albert and collected the live fish and transferred them to other locations. In 1998, over 500 Northern Pike were transferred to Manywan Lake, and in 2002 over 400 Northern Pike, 900 White Suckers and thousands of small minnows and stickleback were salvaged and released in the North Saskatchewan River at Gold Bar Park.

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185 Alberta Environment. 1977. Interim Report: Sturgeon River Basin Study. Environmental Engineering Support Services. Alberta, Canada.; Op. cit., AMEC 2002.

186 Penner and Associates Ltd.. 1990. Environmental Evaluation of the Big Lake Area Structure Plan: Edmonton, Alberta. Prepared for IMC Consulting Group. Edmonton, Alberta, Canada., Op. cit., AMEC, 2002

187 Op. cit., Alberta Environment, 1977 – SAME AS ABOVE, Op. cit., AMEC, 2002

An article on a local environmental group's website (BLESS) described the 2002 fish kill. "On November 11, 2002, thousands of fish were discovered floating belly up in the river between the railroad trestle and the foot bridge downstream. Northern Pike, Whitefish, Minnows, even the occasional Pickerel, floated among their dead brethren."[188] Alberta Fish and Wildlife attributed the fish kill to natural causes (low oxygen levels), although some residents believe the City of St. Albert's stormwater outfalls were to blame. Some residents think that the unfiltered stormwater contained nutrients and sediment that killed the fish. Surviving fish were transplanted to the North Saskatchewan River.

Based on water quality testing of the stormwater outfall water in 2010, the water qualities from the stormwater outfall met all federal and provincial guidelines for aquatic life.

In St. Albert, the construction of Ray Gibbon Drive in 2004 involved the disturbance of fish and wildlife habitat through Riel Pond, across the Sturgeon River and near Big Lake. A comprehensive fish habitat assessment and compensation plan was undertaken in 2006 to mitigate the loss of fish habitat occurring as a result of bridge construction over the Sturgeon River. The City of St. Albert constructed 6,000 sq. m. of fish habitat along the south shore of the Sturgeon River, upstream of the new Ray Gibbon Drive Bridge and downstream of the river's outlet from Big Lake. The new habitat serves primarily as spawning and rearing habitat for Northern Pike.[189]

In addition, the City of St. Albert constructed 956 sq. m. of spawning and rearing habitat for northern pike as part of a project to upgrade a stormwater outfall located in the Braeside neighbourhood on the Sturgeon River. The City built three ponds adjacent to the outfall: the first small, deep pond was to settle out any large grit or sand; the second larger, shallower vegetated pond was to bio-treat the stormwater for common contaminants such as nutrients, E. Coli and fine sediment; and the third pond was for fish habitat.

In 2010, a research study was launched by students, under the direction of Laurie Hunt and Debbie Webb of the Northern Alberta Institute of Technology, to investigate water quality and stream crossings on the Sturgeon River and its tributaries. After one year of study, the water quality assessments indicated the Sturgeon River system is shallow, has low flows, high nutrient concentrations and high algal growth. These conditions result in poor fish habitat in most reaches of the Sturgeon River. Out of the 101 crossings assessed, 25 per cent of them had barriers to fish movement (mostly beaver dams) and 72 per cent were affected by sources of sedimentation (mostly caused by bridge decks that allow for the spillover of debris).[190]

7.2.2 Other Water Bodies

Lac Ste. Anne is known to support sport fisheries of Northern Pike, Lake Whitefish, Walleye and Yellow Perch. Isle Lake is known to contain sport fisheries of Northern Pike, Walleye, and Yellow Perch. Owing to its shallow nature and hyper-eutrophic nutrient status, the lake frequently experiences blooms of blue-green algae, and is occasionally subject to both winter and summer fish kills.

Both Isle Lake and Sandy Lake are considered hyper-eutrophic, are both are subject to winter- and

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188 BLESS website – http://bless.ab.ca/

189 Op. cit., Allen et. al, 2008.

190 Op. cit., Hunt and Webb, 2011.

summer-kills. Isle Lake contains sport fish populations of Northern Pike, Walleye, and Yellow Perch. Sandy Lake was known to support sport fisheries for Yellow Perch and Northern Pike, but has experienced significant issues with decreasing water levels and increasing eutrophication in the past decade, putting the status of the fisheries in doubt.[191] Hubbles Lake is one of the few mesotrophic lakes of note in the region, with relatively clear waters free from algal blooms, and it supports moderate fisheries of Yellow Perch and Northern Pike.[192]

Prior to the mid-1990s, high angling pressure, combined with high fish harvest rates, resulted in the over-harvest of Walleye (*Sander vitreus*) and Northern Pike (*Esox lucius*) populations in bodies of water across Alberta. The Walleye population in Lac Ste. Anne was classified as "collapsed" in 1997, while the Northern Pike population was classified as stable in 1999; changes to fish harvest regulations were placed on the harvest of these species following those classifications (zero bag limit for Walleye and a limit of three Northern Pike with a minimum size of 63 cm). The Alberta Conservation Association carried out test sampling in 2006 to assess what the effect of these regulations on population sizes and stability. The growth rates and size and population structures for Walleye suggested their population sizes were higher, but a truncated size distribution with an absence of larger fish indicated possible increased angling mortality due to anglers targeting larger fish. The growth rates and size and population structures for Northern Pike suggested their population sizes were moderate, but were subject to excessive harvest.[193]

7.2.3 Fish Species Occurrence Across the Watershed

Alberta Sustainable Resources Development (ASRD) has a record of fish stocking and capture in the Sturgeon River Watershed. Reported fisheries data are compiled into ASRD's Fish Management Information System (FMIS), from which archived fisheries information can be accessed. In February 2011, Aquality was provided by ASRD, the FMIS data for lakes and tributaries in the Sturgeon River Watershed. Fishes in the Sturgeon River Watershed that were reported to ASRD and entered in the FMIS database are presented in Table 20.

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191 Alberta Lake Management Society. 2006. Lakewatch Big Lake 2006 Report. 11 p. Edmonton, Alberta.

192 Op. cit., Mitchell and Prepas, 1990.

193 Patterson, B. 2008. Walleye and northern pike summer sport fishery at Lac Ste. Anne, Alberta, 2006. Data report D-2008-002, the Alberta Conservation Association. Sherwood Park, Alberta.

Table 20. Fish species in the Sturgeon River Watershed as reported to Alberta Sustainable Resources Development (ASRD) and accessed through the Fisheries Management Information System (FMIS) database.

Waterbody	Fish species		Year Reported to ASRD
	Common name	Scientific name	
Atim Creek	Brook Stickleback	Culaea inconstans	2002, 2007
	Lake Chub	Couesius plumbeus	2002
	Fathead Minnow	Pimephales promelas	
Big Lake	Burbot	Lota lota	1998
	Northern Pike	Esox lucius	
Birch Lake	Spottail Shiner	Notropis hudsonius	1976
	Northern Pike	Esox lucius	
	White Sucker	Catostomus commersoni	
	Yellow Perch	Perca flavescens	
	Burbot	Lota lota	
Carrot Creek	Brook Stickleback	Culaea inconstans	2003, 2007
	Fathead Minnow	Pimephales promelas	
Dog Creek	Brook Stickleback	Culaea inconstans	2004, 2008
	Fathead Minnow	Pimephales promelas	2008
Isle Lake	Northern Pike	Esox lucius	1986, 1997, 2005, 2006, 2007, 2009
	Burbot	Lota lota	1986, 1997
	Walleye	Sander vitreus	1986, 2006, 2009
	White Sucker	Catostomus commersoni	1986, 1997, 2006, 2009
	Brook Stickleback	Culaea inconstans	1986, 1997, 2005, 2006, 2007
	Fathead Minnow	Pimephales promelas	1986, 1997
	Spottail Shiner	Notropis hudsonius	1986, 1997, 2005, 2006, 2007, 2009
	Yellow Perch	Perca flavescens	1986, 1997, 2005, 2006, 2007, 2009
Johnny's Lake	Brook Stickleback	Culaea inconstans	1986
Kilini Creek	White Sucker	Catostomus commersoni	2002, 2003, 2005
	Iowa Darter	Etheostoma exile	2003, 2005, 2008, 2009
	Northern Pike	Esox lucius	2003, 2005
	Flathead Chub	Platygobio gracilis	2005
	Brook Stickleback	Culaea inconstans	2005, 2006

Waterbody	Fish species		Year Reported to ASRD
	Common name	Scientific name	
Kirk Lake	Lake Chub	Couesius plumbeus	2007
	Brook Stickleback	Culaea inconstans	
Lac Ste. Anne	Lake Whitefish	Coregonus clupeaformis	1984, 1989–2002, 2004-2008
	Northern Pike	Esox lucius	1984, 1985, 1989–2002, 2004-2008
	Walleye	Sander vitreus	1984, 1985, 1989–2002, 2004-2008
	Yellow Perch	Perca flavescens	1984, 1985, 1990-2002, 2004-2006, 2008
	Burbot	Lota lota	1989-1994, 1997, 1998, 2000, 2002, 2005, 2006, 2008
	White Sucker	Catostomus commersoni	1989-1994, 1997, 1998, 2000-2002, 2005, 2006, 2008
	Spottail Shiner	Notropis hudsonius	1997, 2001, 2002, 2005, 2006
	Iowa Darter	Etheostoma exile	2005
Little Egg Creek	Lake Chub	Couesius plumbeus	2002, 2005
	Brook Stickleback	Culaea inconstans	2005, 2007
	Fathead Minnow	Pimephales promelas	
	Longnose Sucker	Catostomus catostomus	2008
	Northern Pike	Esox lucius	
	White Sucker	Catostomus commersoni	
Manawan Lake	Northern Pike	Esox lucius	1978
Matchayaw (Devil's) Lake	Burbot	Lota lota	1969
	Walleye	Sander vitreus	
	White Sucker	Catostomus commersoni	
	Northern Pike	Esox lucius	
	Yellow Perch	Perca flavescens	
Mere Lake	Northern Pike	Esox lucius	1986
	Yellow Perch	Perca flavescens	
Mission Creek	Northern Pike	Esox lucius	1988
	Spottail Shiner	Notropis hudsonius	
	Walleye	Sander vitreus	
	Yellow Perch	Perca flavescens	
	Brook Stickleback	Culaea inconstans	2005

Waterbody	Fish species		Year Reported to ASRD
	Common name	Scientific name	
Parkland Stormwater Mgmt. Pond	Goldfish	Carassius aurata aurata	2007
Pollock Pond	Northern Pike	Esox lucius	2005
Rivière Qui Barre	Brook Stickleback	Culaea inconstans	2005, 2006
Salter's Lake	Northern Pike	Esox lucius	1961
	Rainbow Trout	Oncorhynchus mykiss	2005, 2006, 2007, 2008, 2009, 2010
Sandy Lake	Northern Pike	Esox lucius	1987, 1989
	Yellow Perch	Perca flavescens	1987
	Brook Stickleback	Culaea inconstans	1990, 2005, 2008
Sturgeon River	Emerald Shiner	Notropis atherinoides	1998
	Fathead Minnow	Pimephales promelas	1998, 2004, 2007,
	Longnose Dace	Rhinichthys cataractae	1998
	Northern Pike	Esox lucius	1998, 2002, 2006-2008
	River Shiner	Notropis blennius	1998
	Shorthead Redhorse	Moxostoma macrolepidotum	1998, 2002
	Spottail Shiner	Notropis hudsonius	1998
	Trout-perch	Percopsis omiscomaycus	1998
	White Sucker	Catostomus commersoni	1998, 2001, 2002, 2005-2008
	Brook Stickleback	Culaea inconstans	2001, 2002, 2004, 2005, 2007
	Lake Chub	Couesius plumbeus	2002
	Yellow Perch	Perca flavescens	2004
	Threespine Stickleback	Gasterosteus aculeatus	2004
Toad Creek	Northern Pike	Esox lucius	1990

7.2.4 Benthic Invertebrates

A single study of benthic invertebrates in the Sturgeon River Watershed was found, restricted in scope to the Sturgeon River west of the city.[194] These species found were more typical of the assemblages found in standing rather than flowing waters, and were also indicative of low dissolved oxygen concentrations in the water column. Sampling was not detailed or widespread enough (in either space or time) to determine potential human impacts on benthic invertebrates.

7.3 PUBLIC HEALTH

Alberta Beach at Lac Ste. Anne was closed to swimming on August 2, 2006 due to E. coli and total coliforms detected in the water, but it reopened three weeks later when bacteria counts decreased to a satisfactory level.[195]

On February 2, 2009, Alberta Health and Wellness issued a fish consumption advisory for Lac Ste. Anne. Fish consumption advice was issued for children and women of childbearing age due to mercury concentrations in Walleye and Northern Pike. This advisory is still in effect and Health Canada recommends a limit of one to four servings per week (for pregnant women and women of childbearing age), one serving per week (for children aged 1-4), two servings per week (for children aged 5-11), but no limit for adult consumers (aged 12 and up). There are no other fish consumption advisories for lakes are rivers in the watershed.

On August 17, 2011, Alberta Health and Wellness issued a blue-green algae health advisory for Lake Isle. Blue-green algae produce a toxin that can cause serious illness to animals and humans. Residents and visitors of the lake were advised not to drink the water, swim or wade in the water, consume fish from the lake and to avoid all contact with the algae along the shoreline.[196]

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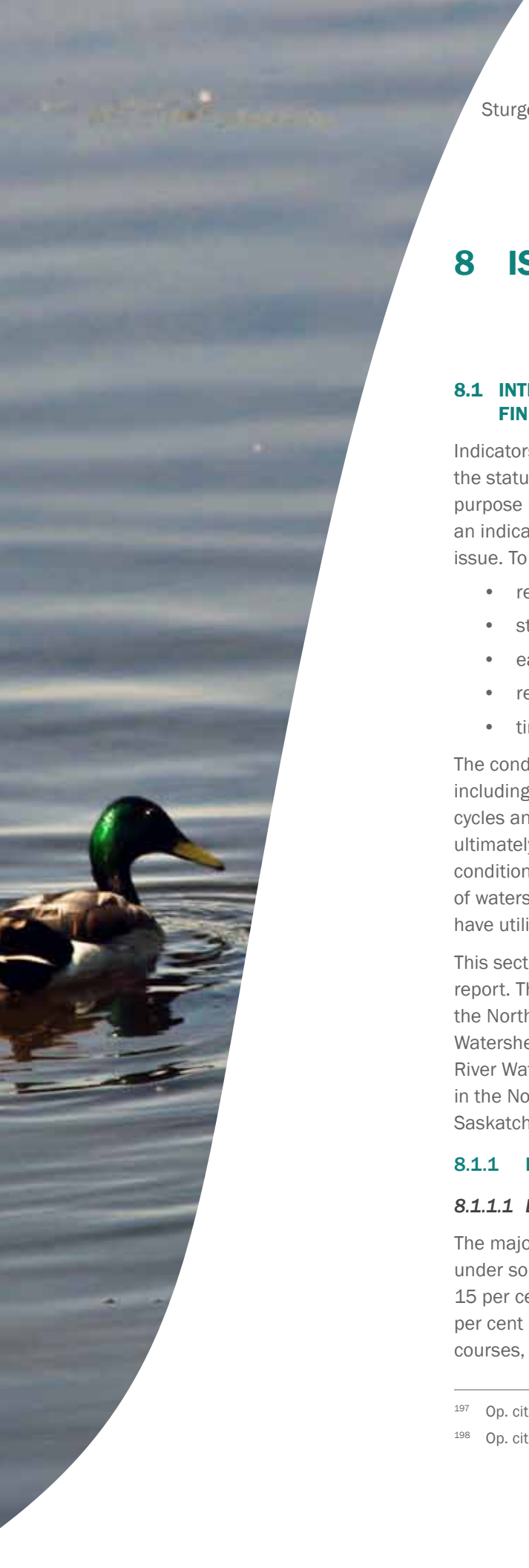
194 Spencer Environmental. 2003. West Regional Road Environmental Impact Assessment. Edmonton, Alberta.

195 Mayerthorpe Freelancer. 2006. Public ordered to stay out of Lac Ste. Anne. Mayerthorpe, Alberta.

196 Alberta Health Services. 2011. Blue-green algae health advisory issues for Lake Isle (Edmonton & North zones. August 17, 2011.



8 ISSUES AND CHALLENGES

8.1 INTERPRETATION OF STATE OF THE WATERSHED ASSESSMENT FINDINGS USING INDICATORS

Indicators are measures of environmental quality that are used to assess the status and trends of the physical condition of a watershed. Their purpose is to show how well a system is functioning. If there is a concern, an indicator can help determine what direction to take to address the issue. To be effective, an indicator must be:[197]

- relevant – able to educate the public about the ecosystem
- straightforward
- easy to understand
- reliable – the information the indicator provides is trustworthy
- timely – the information is available while there is still time to act

The condition of a watershed can be described by its ecological functions, including the hydrologic cycle, water quality, water quantity, the nutrient cycles and biological diversity; however, the condition of a watershed will ultimately be determined by the users of its resources. While assessing the condition of a watershed is challenging, it is possible to choose indicators of watershed condition that effectively describe current conditions and that have utility in integrated watershed management planning.[198]

This section discusses the findings of the previous sections of the report. These indicators follow the assessment methodologies used by the North Saskatchewan Watershed Alliance (2005) and the Red Deer Watershed Alliance (2009). Where possible, conditions within the Sturgeon River Watershed are also considered relative to other sub-watersheds in the North Saskatchewan River Watershed, or to the entire North Saskatchewan River Watershed.

8.1.1 Land Use Indicators

8.1.1.1 Land Use Inventory

The majority of the Sturgeon River Watershed (greater than 70 per cent) is under some form of agricultural usage, with forests making up less than 15 per cent of the land base. Developed areas make up approximately four per cent of the land base; however, due to their general proximity to water courses, the high densities of population, and the high densities of linear

197 Op. cit. Aquality, 2009.

198 Op. cit., NSWA, 2005.

developments that are generally found in the surrounding areas, they likely have a disproportionately large effect on the watershed.

The total area of land under agricultural use in the Sturgeon River Watershed is currently in an apparent decline. However, much of this change is not a reversion to natural land cover, but rather a conversion to developed urban and suburban areas and the associated increases linear developments and impermeable surfaces. Due to the higher population densities present in urban versus rural areas, a conversion to urban lands represents an intensification of land use and poses a significant potential risk to watershed health.

Based on the scheme of Red Deer River Watershed Alliance (2009), disturbances from urban, rural, agricultural and recreational developments of less than 50 per cent of the land base were deemed good, from 50 to 89 per cent were deemed fair and greater than 90 per cent were deemed poor. Overall, the health of the Sturgeon River Watershed based on land use and cover is assessed as fair, due to both the moderately high density of agricultural lands and the trend towards increasing urban development within the watershed. However, several areas, especially in the central areas of the watershed in the Morinville vicinity, have densities of disturbed land exceeding the cutoff for the poor rating, and so should be considered for additional protections or conservation efforts in the future.

8.1.1.2 Linear Developments

Linear developments include human disturbances to the environment in the form of roadways and easements, transmission lines, pipelines, forest cutlines and other features that form corridors of disturbance through a watershed. They are a quantitative measure, based on the total area of linear disturbance by linear developments within the watershed. Other metrics of linear disturbance, such as habitat fragmentation are possible, but the total area provides the simplest, most direct and most easily understandable means of measuring the magnitude of linear developments within an area.[199]

Linear developments, predominantly made up of roadways in the Sturgeon Watershed, take up an estimated 2.3 to 2.6 per cent of the land base. This percentage is high relative to the density of linear developments further west within the North Saskatchewan River Watershed, but it is lower than some nearby sub-watersheds, such as Modeste and Strawberry. This density of linear developments reflects the presence of the urban centres within the watershed, the proximity of the City of Edmonton and its associated high population density, and the rapid rate of development, urbanization and urban population growth occurring within the watershed. Population growth and the process of urbanization in the watershed are expected to result in increases in linear developments in the future, as new roadways are constructed or widened.

Linear developments were rated following the scheme of RDRWA (2009), wherein linear development totals of less than two per cent were considered good, from two to three per cent were deemed fair and greater than three per cent were deemed poor. Overall, the health of the Sturgeon River Watershed based on linear developments is assessed as fair. On a regional basis, this assessed ratings is supported by the fact that linear development densities within the Sturgeon are moderate relative to other sub-watersheds in the North Saskatchewan River basin, with other areas having both higher and lower densities of linear developments.

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[199] Op. cit., NSWA, 2006.

8.1.1.3 Livestock Density

Manure density is used as an integrated measure of the impacts of livestock density on a watershed. It reflects the biomass density of livestock, the rate of production of livestock biomass, and major pathways that livestock can impact a watershed, through nutrient and bacterial runoff from manure. It is a quantitative measure, expressed on an aerial basis in kilograms of manure/hectare (kg/ha).

Cattle dominate manure production in the Sturgeon River Watershed; other livestock types such as pigs, sheep, and goats make up a smaller fraction of the total livestock biomass and contribution to manure production. The Alberta Environmentally Sustainable Agriculture (AESA) Program classified manure production into categories based on province-wide rankings, classifying manure production as low, moderate, or high, with low falling below the 40th percentile (940 kg/ha), moderate falling between the 40th and 75th percentiles (940 to 2,650 kg/ha), and high falling above the 75th percentile (greater than 2,650 kg/ha).[200] Overall, the Sturgeon River Watershed contains moderate densities of cattle and manure, with much higher densities than the other North Saskatchewan River (NSR) sub-watersheds located to the west, but comparable densities of both cattle and manure compared to those NSR sub-watersheds located to the east and other areas along the north-south corridor between Edmonton and Calgary. Annual manure production across the entire watershed is approximately 2500 kg/ha, falling in the upper end of the AESA's moderate ranking.

Within the watershed, cattle and manure densities are generally highest in the central to western portions of the watershed, primarily upstream of the City of St. Albert. This represents a potential risk to water quality if the implementation of agricultural best management practices are not followed and updated. This is important, if the apparent trend towards conversion of cropland to livestock use continues.

Overall, the health of the Sturgeon River Watershed based on livestock density is assessed as fair based on the AESA rankings of manure production. From a regional perspective, the use of the AESA rankings agrees with the relatively densities of livestock/manure found within other sub-basins of the North Saskatchewan River, since both higher and lower densities of livestock and manure are found within the other sub-basins of the North Saskatchewan River Watershed.

8.1.1.4 Riparian Health

Riparian areas are the important transition zone between uplands and surface water bodies. These areas perform several critical watershed functions and benefits such as trapping sediments and filtering nutrients and pollutants, providing fish and wildlife habitat, aiding in erosion control, forage and hay production, improving water quality, and water storage and slow release of water.[201] Riparian health assessments have been completed by various agencies and are generally based on the Cows and Fish (Alberta Habitat Management Society) inventory and assessments protocols. The rating of riparian health is a quantitative measure following directly from the Cows and Fish assessments.

Across the entire Sturgeon River Watershed, only a single study of the health of riparian areas was available, which was performed on Sandy Lake. Approximately equal proportions of the shoreline were found to fall in the categories of healthy, healthy but with problems, and unhealthy. However, given the narrow scope of that study, it is impossible to generalize to the status of riparian health

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[200] Anderson, A.-M, Cooke, S. and MacAlpine, N. 1999. Watershed Selection for the AESA Stream Water Quality Monitoring Program. Alberta Environmentally Sustainable Agriculture. Alberta Agriculture, Food and Rural Development, Edmonton, Alberta, Canada.

[201] Op. cit., NSWA, 2005.

in the entire Sturgeon River Watershed. This lack of information on the health of riparian areas represents a significant data gap.

Overall, there is insufficient data to provide a grade for riparian health within the Sturgeon River Watershed. However, the Northern Alberta Institute of Technology has recently received an Environmental Initiatives Grant to do a riparian assessment of Carrot Creek in St. Albert.

8.1.1.5 Wetland Inventory

Wetlands serve many functions in the natural landscape including water storage, flood attenuation, evaporation, wildlife habitat, groundwater recharge and general water quality improvement. The loss of wetlands and their function to agriculture and other development can have significant negative impacts on water quantity and quality within a watershed. Based on the methods of RDRWA (2009), the gain, improvement or maintenance of any wetlands was deemed good, the maintenance but impairment of existing wetlands was deemed fair and any loss of wetlands was deemed poor.

Various inventories of wetlands, water bodies, and saturated soils place wetland density somewhere in the range of two to seven per cent in the Sturgeon River Watershed, with the most recent survey by Ducks Unlimited indicating that 6.8 per cent of the land base of the watershed is covered by wetlands. This density is comparable to other areas within the settled regions of Alberta. There have been no comprehensive historical or drained wetland inventories for the watershed, so the rate of wetland loss cannot be assessed quantitatively. However, it is believed that at least 60 per cent of wetlands in the settled areas of the province have been lost through draining, land clearing, or other landscape modifications. The abundance of wetland soil types within agricultural lands in the watershed suggests that this figure may be a reasonable approximation of wetland density and loss in the watershed.

Overall, the health of the Sturgeon River Watershed based on wetland inventories is assessed as fair, due to the historical loss of wetlands because of settlement and agriculture. However, there is considerable uncertainty in this assessment, due to the lack of a comprehensive drained or historical wetland inventory of the area. From a regional perspective, rates of wetland loss within the Sturgeon River Watershed are expected to be similar to other watersheds and sub-watersheds in the region.

8.1.2 Water Quantity Indicators

8.1.2.1 Water Allocations by Sector

The number of licensed water allocations from the Sturgeon River Watershed account for approximately one per cent of the total licensed water allocations from the North Saskatchewan River Watershed. Water allocations in the Sturgeon River Watershed are dominated by the other sector (which includes predominantly uses not addressed by other, more specific classifications such as municipal, industrial, etc.), followed by the agricultural and commercial sectors. Allocations to the petroleum and commercial sectors are low relative to nearby sub-watersheds within the North Saskatchewan River.

Overall, the health of the Sturgeon River Watershed based on sector allocations is qualitatively assessed as good, based on the low total use and allocation in the watershed, and the relatively low allocation to the petroleum and industrial sectors.

8.1.2.2 Groundwater diversions

Groundwater allocations in the Sturgeon River Watershed are dominated by the other sector; allocation for this sector is higher in the Sturgeon River than in any other sub-watershed of the North Saskatchewan River. However, total use of groundwater is dominated by the municipal sector, which is the highest of any of the North Saskatchewan River sub-watersheds. The Sturgeon River Watershed has allocations and total use estimates for the remaining sectors that are comparable to other North Saskatchewan River sub-watersheds.

Overall, the health of the Sturgeon River Watershed based on groundwater diversions is assessed as fair, based on the moderate allocations and total use of groundwater relative to the nearby North Saskatchewan River sub-watershed, and the high yield potential of the aquifers in the area. However, while overall health is fair, groundwater diversions represent a significant risk in the watershed, due to both the relatively high risk of groundwater contamination throughout much of the watershed, and the pressure that is likely to be placed on both the quantity and quality of groundwater resources as development and population growth within the watershed continues.

8.1.3 Water Quality Indicators

8.1.3.1 Surface Water Quality Index

The Alberta Surface Water Quality Index[202] has not been calculated by the Province for the Sturgeon River Watershed. The data required for the calculation of the index are not available at sufficient points either in space or across time, to calculate the index in a way that would allow for meaningful comparisons to be made with other bodies of water in the province. This situation represents a significant data gap.

A surface water quality index was calculated for the North Saskatchewan River at Whirlpool Point, in the watershed headwaters, and at Lea (Jubilee) Park and the Highway No. 17 crossing, near the Saskatchewan border, for the period of 1983-2002. River water quality was found to be marginal (calculated WQI = 53) at the Lea Park and Highway No. 17 sites. A marginal value (calculated WQI 45 to 59) means that water quality is frequently threatened or impaired, and conditions often depart from natural or desirable levels. The average river water quality at Whirlpool Point was found to be fair (calculated WQI = 64). A fair value (calculated WQI between 60 and 79) means that water quality is usually protected, but occasionally threatened or impaired by conditions that depart from natural or desirable levels.[203]

8.1.3.2 Nitrogen and Phosphorus

Following RDRWA (2009), total phosphorus concentration of less than 0.05 mg/L was deemed good, from 0.05-0.10 mg/L was deemed fair and greater than 0.10 mg/L was deemed poor. Total nitrogen concentration of less than 1.0 mg/L was deemed “Good,” from 1.0-1.5 mg/L was deemed fair and greater than 1.5 mg/L was deemed poor. The good rating for both variables follows Canadian Council of Ministers’ Protection of Aquatic Life (CCME PAL) and Alberta Surface Water Quality (ASWQ) guidelines (0.05 mg/L for total phosphorus and 1.0 mg/L for total nitrogen).[204]

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202 Alberta Environment. 2011. Groundwater Evaluation Guideline. Alberta Tourism Parks, and Recreation. Edmonton, Alberta.

203 Op. cit., NSWA 2005.

204 CCME. 1999. Canadian Environmental Quality Guidelines. Canadian Council of Ministers of the Environment. Environment Canada. Hull, Quebec. 8 Chapters.; Op. cit., Alberta Environment, 1999.

Average total nitrogen concentrations exceed the guideline of 1.0 mg/L at the majority of sites within the Sturgeon River Watershed, with an average concentration across all sites of approximately 2.1 mg/L. The only areas with average concentrations consistently below this guideline are located to the west of Stony Plain and Spruce Grove, on Eden Lake and Kilini Creek. Concentrations in Isle Lake, Lac Ste. Anne, Sandy Lake and Big Lake generally fall within the range of one to four times the guideline. Concentrations along the Sturgeon River main stem are more moderate, with averages total concentrations generally falling within the range of 1.0 to 2.0 mg/L, and no substantial change in average concentrations from upstream to downstream.

As with total nitrogen, average total phosphorus concentrations exceed the guideline of 0.05 mg/L at the majority of sites within the Sturgeon River Watershed, with an average concentration of approximately 0.22 mg/L. The spatial pattern of total phosphorus concentrations are similar to total nitrogen, with a few isolated areas of lower concentration to the west of Stony Plain and Spruce Grove, and higher concentrations (two to four times the ASWG guideline or more) on Isle Lake, Lac Ste. Anne, Sandy Lake, Big Lake, and their respective tributaries. There is no apparent propensity for increasing concentrations of total phosphorus along the main stem of the Sturgeon; although concentrations of total phosphorus at the confluence with the North Saskatchewan River exceed the ASWG guideline two- to four-fold, higher concentrations are consistently seen further upstream on the main stem.

The high concentrations of nitrogen and phosphorus seen in the Sturgeon River Watershed are typical of prairie (non-glacier fed) rivers within the settled region of the province. Such rivers typically have naturally high levels of nutrients, but they may also experience elevated nutrient loadings due to surrounding land use, such as urban developments and agriculture. They also typically experience high flow volumes during the period of spring snowmelt and extended periods of low flows throughout the rest of the year. These two factors combine to elevate nutrient concentrations because increased total amounts of nutrients are diluted in a smaller total volume of water.

Using only nutrients, the overall health of the Sturgeon River Watershed is assessed as poor because average concentrations of nitrogen and phosphorus, at the majority of sampling locations, exceed their respective Canadian Council of Ministers of the Environment and Alberta Surface Water Quality guidelines by more than two-fold. There is the possibility of bias in these results if “problem” water bodies are sampled more often or more intensively than areas where nutrients are not expected or believed to be a problem. Nearly all sites show average concentrations of nutrients in excess of guidelines, with the exception of several stations located just to the northwest of Spruce Grove and Stony Plain.

8.1.3.3 Pesticides

If any pesticide concentrations exceeded CCME PAL[205] or ASWQ PAL[206] guidelines, a rating of poor was given, otherwise a rating of good was given.

Various pesticides have been detected in a number of water bodies in the Sturgeon River Watershed. They appear to be the least prevalent in major lakes such as Lac Ste. Anne and Isle Lake, and much more prevalent in smaller watercourses such as Carrot Creek and Atim Creek. The Sturgeon River

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[205] Op. cit., CCME, 1999.

[206] Op. cit., Alberta Environment, 1999.

had the highest number of different pesticides detected, though the frequencies of detections were lower than in the tributaries.

The diversity of pesticides that were detected along the Sturgeon River main stem reflects the fact the river collects water from tributaries with diverse land uses, including both urban and rural areas. The fact that higher frequencies of pesticide detections occurred in the smaller tributaries than in the Sturgeon main stem likely reflects a combination of factors. Riparian buffers along tributaries are likely to be smaller because the valley slopes and channels on smaller watercourses are less of a hindrance to urban developments and agricultural activities, which would allow pesticide application to occur in closer proximity to these water bodies.

Overall, the health of the Sturgeon River Watershed based on pesticides is assessed as good, because concentrations of pesticides never exceeded their respective ASWQ or CCME guidelines, though not all compounds have established guidelines. However, some compounds were detected relatively frequently on some bodies of water, and a number have been detected on the Sturgeon River main stem.

8.1.3.4 Bacteria

E. coli are an indicator of fecal contamination of surface waters that may arise from sewer/septic systems that are in disrepair, agricultural activity, or pet fecal matter, among other sources. They represent a risk to both human health (due to their direct pathological effects on humans) and to aquatic ecosystem health (as indicators of surface water contamination). Following RDRWA (2009), E. coli counts from zero to 100 CFU/100 mL were deemed good and counts greater than 100 CFU/100 mL were deemed poor. The good-poor rating follows CCME Agriculture/Irrigation guidelines (E. coli concentration of 100 CFU/100 mL).[207]

Average E. coli concentrations at the majority of sites within the Sturgeon River Watershed fall below the CCME guideline for Irrigation Water (100 CFU/100 mL) and for Recreation and Aesthetics (200 CFU/100 mL). However, several areas did have elevated concentrations, including Isle Lake and tributaries, sites on Lac Ste. Anne, and Atim Creek. These elevated concentrations may be problematic for both recreational and agricultural users, and may indicate areas requiring special consideration for protection or conservation.

Overall, the health of the Sturgeon River Watershed based on E. coli is assessed as good. However, while the majority of sites showed average concentrations falling below guidelines, sometimes the concentrations do exceed the guidelines, suggesting that some risk for poor water quality, due to bacterial contamination of surface waters, exists within the watershed.

8.1.4 Biological Indicators

8.1.4.1 Vegetation Types

Based on the methodology of RDRWA (1999), combined land cover values for natural land cover classes (such as wetlands, grasslands and all forested areas) greater than 50 per cent total watershed area were deemed good, 25–50 per cent were deemed fair and less than 25 per cent were deemed poor.

Vegetation in the Sturgeon River Watershed is heavily modified, with only about 20 per cent falling

[207] Op. cit., CCME, 1999.

under natural land cover classes such as forest, shrub, and grassland. Much of the remaining land base is under agricultural development as either pasture or cropland. The total amount of natural vegetation types (treed and shrubbed lands and wetlands) does not appear to have changed significantly over the past several decades; changes in land cover have primarily been conversions from one agricultural use to another, or conversion of agricultural lands into developed urban areas.

Overall, the health of the Sturgeon River Watershed based on vegetation cover is assessed as poor, due to the low percentage of natural vegetation types and the high densities of human-modified land cover and vegetation types in the watershed.

8.1.4.2 Aquatic macrophytes

No detailed studies of aquatic macrophyte densities or distributions were found within the Sturgeon River Watershed. This lack of information on aquatic macrophytes represents a significant data gap.

Overall, there is insufficient data to provide a grade for aquatic macrophytes within the Sturgeon River Watershed.

8.1.4.3 Fish

Numerous species of sport fish and other fish species are known to be present in various water bodies in the Sturgeon River Watershed. However, detailed population estimates are not available for the entire watershed. Because the Sturgeon River Watershed does not derive its water from glacial sources, it is expected that under natural conditions, the various rivers and tributaries will experience high seasonal variation in flows, with strong peaks during snowmelt and sustained low flows throughout much of the remainder of the year. Rivers, streams and lakes within this region will also tend to have naturally high nutrient concentrations (eutrophic), and as such are susceptible to naturally-occuring winter- or summer-kills. Although these are naturally occurring conditions, they can be exacerbated by humans, such as increased eutrophication, increased variability of water levels within water bodies due to diversions or land-use practices, or the construction of barriers to fish migration.

Overall, the health of the Sturgeon River Watershed based on fish populations is qualitatively assessed as poor, but with considerable uncertainty due to lack of broad-scale information. Numerous sport fish and other fish species continue to be confirmed in bodies of water across the watershed, though there is evidence of winter- and summer-kills in some locations. The Sturgeon River itself is considered fish-bearing, but has limited potential as a fishery due to a present-day paucity of overwintering habitat. There is a relatively high incidence of sedimentation or barriers to fish migration at water body crossings throughout the watershed, which may prevent fish from reaching either spawning or overwintering habitats. The eutrophication of fish-bearing water bodies is a concern, due to the possibility of increased incidences of winter- and summer-kills. Direct human actions have also had an impact on fish populations within the watershed, with angling pressure and overharvesting resulting in the collapse of Walleye and other fisheries across the Province and in Lac Ste. Anne in particular. Thus, while limited information is directly available on fish populations, there is considerable evidence suggesting they are at risk due to both anthropogenic and natural conditions.

8.1.4.4 Benthic invertebrates

Benthic invertebrates are important components of the food webs of aquatic ecosystems, and due to their dependence on a wide variety of water-quality parameters, they can be used as integrated measures of aquatic ecosystem health. However, no detailed studies of benthic invertebrate densities or distributions were found within the Sturgeon River Watershed, except for a single study conducted at a single point in time just to the west of the City of St. Albert. Because of the changes with the seasons in benthic invertebrate densities and a high degree of specificity to habitat types, a snapshot of a single area is not sufficient to determine benthic invertebrate health across the entire watershed. This lack of information on benthic invertebrates represents a significant data gap.

Overall, there is insufficient data to provide a grade for benthic invertebrates within the Sturgeon River Watershed.

8.2 SUMMARY OF INTERPRETATIONS

Overall, the health of the Sturgeon River Watershed is assessed as fair. This assessment is based on the average of individual values for the 15 indicators discussed above, of which three were ranked as good, five were ranked as fair, and three were ranked as poor (Table 21). To determine the average across all indicators, those with a rating of good were assigned a value of two, those with a rating of fair were assigned a value of one, those with a rating of poor were assigned a value of zero, and those with insufficient data were excluded from the analysis. Values were averaged across all indicators, resulting in an average numerical rating of 1.0, corresponding to fair.

Insufficient data were available on four of the indicators (Riparian Health, the Alberta Surface Water Quality Index, Aquatic Macrophytes, and Benthic Invertebrates). The indicators rated as poor were Nitrogen and Phosphorus, Fish, and Vegetation Types. Due to a lack of in-depth watershed-wide studies, considerable uncertainty surrounds the health based on the Wetland Inventory and Fish. However, much of the data indicates that these two factors are in poor condition and are at risk of further degradation due to a combination of both natural and anthropogenic causes, so a conservative approach was taken in their assessment.

Table 21. Summary of assessed health ratings for selected indicators.

Indicator Category	Indicator	Assessed Health Rating
Land Use Indicators	Land Use Inventory	Fair
	Linear Developments	Fair
	Livestock Density	Fair
	Riparian Health	(Insufficient Data)
	Wetland Inventory	Fair (with uncertainty)
Water Quantity Indicators	Water Allocations by Sector	Good
	Groundwater Diversions	Fair
Water Quality Indicators	Surface Water Quality Index	(Insufficient Data)
	Nitrogen and Phosphorus	Poor
	Pesticides	Good
	Bacteria	Good
Biological Indicators	Vegetation Types	Poor
	Aquatic Macrophytes	(Insufficient Data)
	Fish	Poor (with uncertainty)
	Benthic Invertebrates	(Insufficient Data)

The Sturgeon River is a prairie river, and as such experiences high seasonal variability in flows, with nutrient concentrations and productivity expected to be higher than in glacially-fed rivers. Impacts to this condition are potentially exacerbated by human activities within the watershed, such as urban development, industrial/commercial development and agricultural activities. The majority of the land base of the watershed has been modified by human activities, with over 70 per cent of the land use in agriculture. However, the total area under agriculture has not changed appreciably over the last several decades, while the expansion of urban areas has resulted in an increase of developed lands by three- to four-fold.

The cumulative effects of population growth and urban expansion driving this trend have been analyzed within the context of the entire North Saskatchewan River Watershed,[208] using the A Landscape Cumulative Effects Simulator (ALCES) model. Four cases were examined: business-as-usual; business-as-expected; best practices and green cities; and best practices, green cities, and climate change. The model demonstrated the North Saskatchewan River Watershed is, and will continue to be, heavily influenced by human development, even under best-case scenarios. The effects of human development are expected to be most detrimental to biodiversity, landscape integrity (including road density and wetland loss), and water quality. Effects on the quantity of water available are expected to be relatively minor, which is reflected in the good and fair rankings received by sector-based water allocations and groundwater diversions, respectively. The report recommends that priority should be given to minimizing the effects of urban and residential sprawl, the restoration of riparian areas, and reducing non-point source pollution.

[208] North Saskatchewan Watershed Alliance (NSWA). 2009. Cumulative Effects Assessment of the North Saskatchewan River Watershed using ALCES. Submitted by Dr. MG Sullivan, ALCES Group. The North Saskatchewan Watershed Alliance Society, Edmonton, Alberta.

Within the context of the Sturgeon River Basin, minimizing the impacts of urban sprawl and residential expansion are likely to be even more critical than in the North Saskatchewan River as a whole. Population growth in the larger urban areas in the watershed is higher than in the rest of the North Saskatchewan River Watershed, as are average household incomes;[209] the combination of high growth and high demand for services will likely place additional strain on the watershed due to demand for services. Although much of the landscape within the watershed is currently modified for agricultural activity, the conversion of agricultural and natural lands to urban and residential land use is likely to increase impacts on the watershed.[210] Moreover, as development continues within the watershed, conflicts between human land and resource uses within the watershed are likely to become more pronounced. In addition to the direct tradeoffs involved with the conversion of land uses from agricultural to urban/residential, additional pressures will be also placed on existing recreational resources.

8.3 DISCUSSION OF DATA AND DATA GAPS

This section discusses limitations in our knowledge of the current state of the Sturgeon River Watershed due to limitations in the availability of data.

8.3.1. Land Use Indicators

8.3.1.1. Land Use Inventory

Land cover data (which includes some information on land uses within the watershed) are current circa the year 2000,[211] with the dataset completed in 2007. There are no gaps in the coverage, but the data are currently over a decade old and do not reflect recent expansion that has occurred around various municipal centres. Due to the time and resources required to produce such data, it is likely that they will always be several years out of date.

Information on agricultural land use is current as of 2006, with no gaps in the coverage.[212] More recent data are currently being collected as part of the 2011 Census, but for agricultural land uses, these are not scheduled to be completed or released until 2013.

8.3.1.2. Linear Developments

Information on linear developments is based on 1:50,000 scale data that are updated on an ongoing basis;[213] however, they are not maintained in real-time and will not reflect the most recent years of development. Given the pace of development in the watershed, especially within urban and residential areas, information on the impacts of linear developments should be viewed as an underestimate. This dataset should be revisited frequently.

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209 Op. cit., North Saskatchewan Watershed Alliance, 2010.

210 North Saskatchewan Watershed Alliance (NSWA). 2009. Engaging Rural Municipalities: Forum Final Report. The North Saskatchewan Watershed Alliance Society, Edmonton, Alberta. 72 p

211 Op. cit., Natural Resources Canada, 2009.

212 Op. cit., Statistics Canada, 2008 and Op. cit., Agriculture and Agri-Food Canada, 2005.

213 Op. cit., Natural Resources Canada, 2010.

8.3.1.3. Livestock Density

As with agricultural land use, information on livestock and manure density is current as of 2006, with no gaps in the coverage.[214] More recent data are currently being collected as part of the 2011 Census, but for agricultural land uses, these are not scheduled to be completed or released until 2013.

8.3.1.4. Riparian Health

Information on riparian health is restricted to a single study on one water body within the watershed. This lack of information makes it impossible to draw broader conclusions about the size and health of riparian buffer areas along water bodies across the watershed. This is a significant gap, and given the importance of riparian areas in managing non-point source pollution, future studies should be undertaken to assess their condition within the Sturgeon River Watershed.

8.3.1.5. Wetland Inventory

Information on existing wetlands in the watershed is limited with estimates between 2 – 7 % of the land base. There have been no comprehensive historical or drained wetland inventories for the watershed, so the rate of wetland loss cannot be assessed quantitatively. This is a significant data gap and future studies should completed to assess the historical and existing wetland coverage as well as an assessment of the condition of existing wetlands and areas for potential future wetland compensation projects.

8.3.2. Water Quantity Indicators

8.3.2.1. Water Allocation by Sector

Alberta Environment and Sustainable Resource Development maintains water allocation data. This information is current and complete; however, not all sectors are required to report actual water use, and so only estimates of this parameter are available. The use of total allocations may be sufficient as a conservative measure of water use within the watershed, but accurate assessments of actual use may become critical as demand for water increases, or if allocation in the basin is closed and a water allocation transfer market is established.[215]

8.3.2.2. Groundwater Diversions

As with the discussion of sector-based water allocations above, the primary shortcoming of information groundwater diversions is that actual water use reporting is not required for all sectors.

8.3.3. Water Quality Indicators

8.3.3.1. Surface Water Quality Index

The Alberta Surface Water Quality Index has not been calculated for the watershed. The Index could be calculated for a few isolated sites and times, but since the data required for its calculation have not been collected consistently, comparisons to other locations where it has been calculated would not be meaningful. Future monitoring programs should collect the required data on a regular basis to make comparisons across sub-watersheds possible.

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[214] Op. cit., Statistics Canada, 2008 and Op. cit., Agriculture and Agri-Food Canada, 2005.

[215] Alberta Water Council. 2009. Recommendations for Improving Alberta's Water Allocation Transfer System. Alberta Water Council. Edmonton, Alberta.

8.3.3.2. Nitrogen and Phosphorus

Information on nutrients has been collected with reasonable frequency across the watershed. Although additional data collection would be beneficial, sufficient data currently exist to draw conclusions about the overall state of nutrient concentrations in the watershed. Future monitoring programs should be carried out on a consistent basis at a number of reference sites within the watershed so as to monitor potential changes as they occur, and to avoid significant gaps in the historical record.

8.3.3.3. Pesticides

Data on pesticide concentrations have been collected from a number of sites within the watershed, but have not been collected with sufficient frequency to get an accurate representation of changes in concentrations or in the frequency of detections over time. Future monitoring programs should be carried out on a consistent basis at a number of reference sites within the watershed so as to monitor potential changes as they occur and to avoid significant gaps in the historical record.

8.3.3.4. Bacteria

Information on E. coli concentrations have been collected with reasonable frequency at a number of sites within the watershed. Although additional data collection would be beneficial, sufficient data currently exist to draw conclusions about the overall state of E. coli concentrations in the watershed. Future monitoring programs should be carried out on a consistent basis at a number of reference sites within the watershed so as to monitor potential changes as they occur and to avoid significant gaps in the historical record.

8.3.4. Biological Indicators

8.3.4.1. Vegetation Types

Information on the cover of various vegetation types within the watershed is current as of the most recent land cover survey. However, as noted above, information on this subject is likely to remain somewhat out of date due to the resources required to produce the data.

8.3.4.2. Aquatic macrophytes

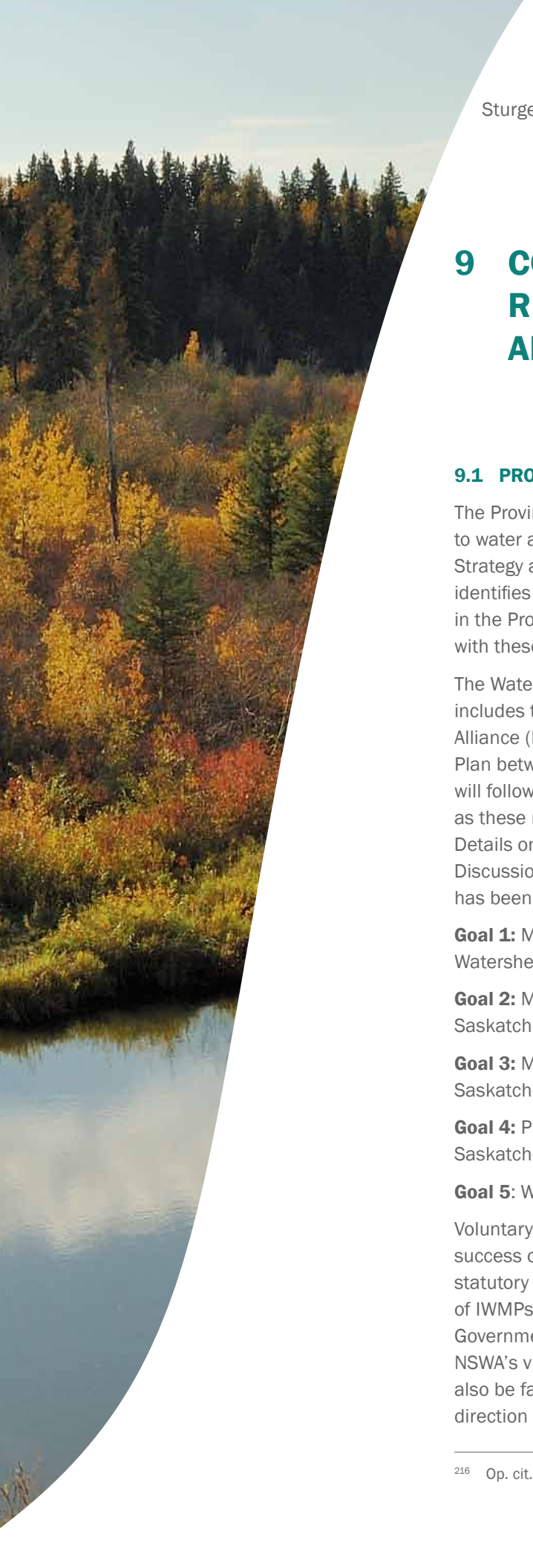
Information on the watershed-wide densities and distributions of aquatic macrophytes are not currently available. This data gaps may be significant in the future, as aquatic macrophytes can be an important indicator of aquatic ecosystem health. Moreover, invasive aquatic plants are known to be present in other watersheds within the province and monitoring their spread if or when they enter the watershed will be difficult if current distributions are not known.

8.3.4.3. Fish

Information on fish occurrences submitted to Alberta Sustainable Resource Development is complete for the watershed. However, detailed information on the status of fish populations is only available for a select few water bodies, and is not available across the watershed.

8.3.4.4. Benthic Invertebrates

Information on benthic invertebrates is currently not available for the Sturgeon River Watershed. However, studies of benthic invertebrates are currently planned for the watershed, which should provide a strong basis for their use as a measure of diversity and aquatic ecosystem health for future studies.



9 CONCLUSIONS, RECOMMENDATIONS, AND STEWARDSHIP OPPORTUNITIES

9.1 PROVINCIAL INITIATIVES (REGULATORY AND PLANNING)

The Province of Alberta implemented a shared governance approach to water and watershed management under the current *Water for Life* Strategy and Land-use Framework. Section 5 of the current report identifies the major agencies involved in regulating water-related activities in the Province. All basin residents and decision-makers should be familiar with these policies, strategies and legislation.

The Watershed Planning and Advisory Council (major basin planner) that includes the Sturgeon River Basin is the North Saskatchewan Watershed Alliance (NSWA), who will finalize their Integrated Watershed Management Plan between 2012-2019. Direction on how to manage the Sturgeon basin will follow from NSWA Integrated Watershed Management Plan direction, as these management plans are nested under the rules of *Water for Life*. Details on the NSWA proposed IWMP can be found in the January 2011 Discussion Paper.[216] While the NSWA IWMP has not been drafted, there has been strong support for the proposed five goals:

Goal 1: Maintain or improve water quality in the North Saskatchewan River Watershed.

Goal 2: Maintain or improve water quantity (flow) conditions in the North Saskatchewan River.

Goal 3: Maintain or improve aquatic ecosystem health in the North Saskatchewan River Watershed.

Goal 4: Protect groundwater quality and quantity in the North Saskatchewan River Watershed.

Goal 5: Water and land-use planning are aligned at the regional scale.

Voluntary action of decision-makers at the Provincial level will be key to the success of the NSWA IWMP and improving watershed health. Currently no statutory framework is in place to require the adoption or implementation of IWMPs, so it will be up to ministers, directors under the *Water Act*, Government of Alberta approvals managers, and others to implement NSWA's vision. Residents and decision-makers within the basin should also be familiar with the existing work of and involved with charting the direction of the North Saskatchewan Watershed Alliance.

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[216] Op. cit., NSWA, 2011.

The NSWA is actively seeking a sub-basin planning group for the Sturgeon River to undertake specific planning and on-the-ground initiatives for the basin. The role of the NSWA will be to bridge organizations and provide critical linkages between science and policy, community and government, assurance and stewardship, and regulatory and non-regulatory mechanisms.[217]

We recommend a watershed group for the Sturgeon River be established immediately to oversee and undertake this work. There are several initiatives for the watershed group to immediately implement, such as Water Quality Objectives for the Sturgeon River (NSWA IWMP Goal 1). Through a partnership with the NSWA, the new group should work towards developing a watershed management plan for the Sturgeon River Watershed.

At a much broader level, the Alberta Water Council provides policy advice to the Government of Alberta, stakeholders and the public on effective water management practices and solutions to water issues, as well as priorities for water research.[218] Residents and decision-makers within the basin should also be familiar with the work of the Alberta Water Council. Most notably, Sector Planning for Water Conservation, Efficiency and Productivity plans have been requested for all major water-using sectors, including urban municipalities. In March 2010, the Urban Municipalities Association (AUMA) presented the first completed sector plan, with a focus on getting individual CEP plans in place for cities, town and villages, and implementing incentives or disincentives to promote water-efficient fixtures and technologies.[219]

Another project team is the Moving From Words to Action group, with the goal of improving coordination and communication among *Water for Life* partnerships by working together to identify and more effectively address shared strategic priorities to meet *Water for Life*'s three goals.[220] Other more technical project teams include the Non-Point Source Pollution and Riparian and Land Conservation and Management teams. The purpose of both of these teams is to address the Healthy Aquatic Ecosystems goal of Water for Life. It is hoped that the latter team will result in a much-needed Provincial Riparian Lands Policy, to go along with the proposed *Provincial Wetland Policy* for Alberta.

9.2 MUNICIPAL INITIATIVES (PLANNING AND MANAGEMENT)

The *Municipal Government Act* gives broad powers to municipalities to manage water within their jurisdiction. As well, Municipalities have the responsibility for the majority of land-use planning and decisions affecting aquatic ecosystems and other environmentally sensitive areas. Wetlands and riparian areas are directly under the control of municipalities and effective bylaws protecting wetlands and riparian areas are of critical importance to the protection of these sensitive ecosystems. Numbers of wetland and areal coverage and riparian area, health and function have all been targeted for improvement in the NSWA IWMP. As part of their planning, the NSWA will ask municipalities to use the IWMP to guide development and implementation of future municipal development plans, land-use bylaws and implementing best management practices. This is an attempt to align water and land-use planning on a regional scale.

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217 Op. cit., NSWA, 2011.

218 AWC, 2011.

219 AUMA Online Water Microsite – Website: http://water.auma.ca/

220 Op. cit., AWC, 2011.

Voluntary action by decision-makers, such as municipal councillors, will be key to the success of the IWMP, as currently no statutory framework is in place to require the adoption or implementation of it. From this state of the watershed report, municipal bylaws, policies and legislation should be reviewed and harmonized to protect environmentally sensitive areas within the watershed. For example, the City of St. Albert has implemented a 50 m buffer around Carrot Creek to protect the floodplain and riparian areas, but more details on how to manage those lands needs to be discussed. There are some City of St. Albert initiatives (Economic Development Master Plan, Downtown Area Redevelopment Plan and Tourism Master Plan) with development recommendations that could have negative impacts on watershed health, such as river stabilization projects. The impacts of these recommendations should be fully addressed before they are implemented to ensure there is a balance between economic growth, the needs and desires of residents, and the protection of the natural environments of the watershed.

Municipal leaders should work with the Association of Urban Municipalities of Alberta (AUMA) to encourage Water Conservation, Efficiency and Productivity Plans for Sturgeon basin cities, town and villages, and to implement incentives or disincentives to promote water-efficient fixtures and technologies.[221]

Managing development pressure throughout the basin will be the largest challenge as we move forward. As Alberta's economy continues to grow, the Sturgeon River Watershed will continue to be an attractive area for development, which will continue to strain resources in the basin. As noted by the Alberta Water Research Institute (AWRI) "the anticipated economic growth, demographic trajectories, and climate change impacts will amplify the pressures on the already scarce water resources of Alberta."[222] AWRI is currently exploring financial and market-based instruments for sustainable water resource management. The goal of this work is to identify which types of financial or market-based mechanisms will offer the best potential to optimally allocate water to communities, agriculture and municipalities, while meeting water conservation objectives and environmental management goals linked to ecosystem services.[223] While the North Saskatchewan River basin is still open for surface water allocations, the South Saskatchewan River Basin has been closed to new applications, which has resulted in a variety of water management challenges. With time, the North Saskatchewan River Basin, including the Sturgeon River basin, may also experience restrictions in water allocations, which may limit economic development in the basin.

Municipalities exert the greatest control over shaping land-use decisions in the basin, and have broad powers over the management of water within their boundaries as given by the *Municipal Government Act*. To maintain or improve watershed health in the basin, the NSWA IWMP has recommended that environmental impacts from municipal and industrial expansion are minimized or reduced and impacts from resource and utility industries are minimized or reduced.[224] This will only be achieved with the cooperation and direction of the local municipal planning authorities as directed by councils. Many municipalities have developed environmental departments that work closely with planning departments to ensure sustainable development and protection of sensitive areas. As well,

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221 Op. cit., AUMA online water microsite

222 Gibbins, R. and Zehnder, A.J.B. 2010. Toward a Unique Solution: Sustainable Management of Alberta's Water Resources. Canada West Foundation and Alberta Innovates Energy and Environment Solutions. 10pp.

223 Ibid.

224 Op. cit., NSWA, 2011.

the role of the agricultural fieldman has proved invaluable in basin planning in other jurisdictions. On the ground initiatives, and best management practices such as riparian exclusion fencing, and off-site watering programs are critical to ensure the health of the creek and river. For example, Red Deer County promotes several programs[225] and their extension activities are documented in the "Off the Creek" weblog.[226]

All municipalities in the basin should work towards developing or harmonizing language contained within their municipal development plans, intermunicipal development plans, land use bylaws and area structure plans with the goal of protecting the natural environment. Particular attention should be given to grading and environmental reserve policies to ensure maximum protection of the Sturgeon River, its tributaries, and existing natural areas. The City of St. Albert's 2007 Municipal Development Plan and the 2001 Intermunicipal Development Plan between Sturgeon County and the City of St. Albert do a good job of ensuring that environmental reserves and other environmental protections are put in place around Carrot Creek, the Sturgeon River valley, and other environmentally significant or sensitive areas, and that linkages and corridors between natural areas will be maintained. Efforts should be made to ensure that the MDPs of other municipalities, as well as the IDPs between other municipalities, will maintain equal or greater levels of protection for similar areas within the watershed. Several municipalities in Alberta have implemented their own wetland and riparian area policies, and these could also be instituted. Municipalities provide important direction and encouragement to their citizens about responsible actions in the watershed, such as water use reduction, by developing sustainability or environmental strategic plans.

9.3 LOCAL INITIATIVES (PLANNING AND STEWARDSHIP)

Local citizens can do many things to protect the watershed. Voluntary action of local citizens is the key to success in the watershed, as there is currently no statutory framework in place to require the adoption or implementation of IWMPs. Non-government organizations, landowners and recreational users of public and private lands will be key to the success of the NSWA and *Water for Life* vision. The NSWA recommends industry and landowners work to continuously improve their water and land management practices. Users of both private and public lands are asked to minimize their impacts on the watershed by practicing and promoting responsible recreation.[227] Several resources already exist for the public to compost, minimize their environmental footprint, minimize fertilizer and pesticide use, conserve water, and protect the watershed.

Many more basin-specific initiatives can follow from municipal green plans and other sustainability approaches. For example, encouraging the use of rain barrels, or initiating recycling programs and waste disposal programs will all have beneficial effects on the river. Specifically, the use of rain barrels will help reduce contaminant loading into the Sturgeon River, and ultimately the North Saskatchewan River, which will help maintain or improve water quality in the watershed (Goal #1 in the NSWA IWMP). For agricultural operators, best management practices to ensure restricted access to water by animals is important to protect riparian ecosystems and water body beds and shores. The local agricultural fieldmen should encourage fencing and off-site watering. Several other agricultural practices, such as minimizing fertilizer and pesticide use should also be encouraged.

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225 Red Deer County (2011) Off the Creek - http://rdcounty.ca/Agriculture/Agriculture-and-Environment/Off-The-Creek

226 Off the Creek Blogspot. Website Off the Creek - http://www.offthecreek.blogspot.com/

227 Op. cit., NSWA, 2011.

Other initiatives may evolve by working with other provincially recognized stewardship groups like the Alberta Lake Management Society (Lakewatch), Alberta Riparian Habitat Management Society (Cows & Fish), Land Stewardship Centre (Alberta Stewardship Network) and many others. Residents are encouraged to enlist the assistance of these various organizations to meet their stewardship objectives.

Recommendation	Short, Medium or Long Term[228]
Establish a municipal Sturgeon River Watershed Group (who will participate fully with the North Saskatchewan Watershed Alliance)	Short-Medium
Promote watershed education and outreach programs (Shoreline Cleanup, Yellow Fish Road, Cows and Fish, Project Webfoot)	Ongoing
Harmonize Inter-municipal Planning (wetland preservation, riparian area and floodplain protection, stormwater best management practices)	Medium
Encourage and support Sturgeon River Watershed research to address data gaps (NAIT, University of Alberta)	Ongoing
Promote sustainable urban development (higher density developments, improved transit systems, reduced dependence on vehicles, preservation of natural areas)	Medium
Undertake a drained wetland inventory for future restoration projects (involve partners such as Ducks Unlimited Canada)	Medium-Long
identify and prioritize environmentally sensitive areas in watershed for protection	Medium-Long
implement Sub basin recommendations from North Saskatchewan Watershed Alliance Integrated Watershed Management Plan	Medium-Long

[228] The Sturgeon River Watershed Committee (when formed) will need to define short, medium and long-term, based on local interest, resources and funding.

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