Skeleton Lake Watershed Management Plan

Prepared for:
Skeleton Lake Stewardship Association
P.O. Box 156
9768 – 170 Street NW
Edmonton, Alberta, T5T 5L4

Prepared by:
*Aqua*lity Environmental Consulting Ltd.
Suite 705, 10240 – 124 Street NW
Edmonton, Alberta, T5N 3W6

Writers:
Dr. Markus N. Thormann, P. Biol., QWAES
Joshua Haag, B.Sc., QAES
Melissa Logan, B.Sc., P. Biol., QWAES
Jay White, M.Sc., P. Biol., QWAES

November 23, 2009

Adoption of Watershed Management Plan – Resolution Page

This Watershed Management Plan was adopted by Resolution _____ by the County of Athabasca No. 12 on _____, 20___.

This Watershed Management Plan was adopted by Resolution _____ by the Village of Boyle on _____, 20___.

This Watershed Management Plan was adopted by Resolution _____ by the Summer Village of Bondiss on _____, 20___.

This Watershed Management Plan was adopted by Resolution _____ by the Summer Village of Mewatha Beach on _____, 20___.

Acknowledgements

We thank Hugh Harper, President, and Brian Curial, Secretary, of the Skeleton Lake Stewardship Association for their time and efforts towards this document. We also thank WorleyParsons, Edmonton, for providing a draft version of the groundwater assessment report for Skeleton Lake. We would like to thank Brent Welsh, hydrogeologist with Alberta Environment, who provided some background information on a groundwater assessment initiated in Skeleton Lake in late 2008.

Executive Summary

The Skeleton Lake Stewardship Association developed the Terms of Reference for a Watershed Management Plan for the Skeleton Lake watershed in consultation with the County of Athabasca No. 12, the Village of Boyle, the Summer Villages of Bondiss and Mewatha Beach, and the general public in 2006, which was subsequently approved in September 2006. This Watershed Management Plan (WMP) was developed to attain a balance between environmental, community and economic issues with government legislation for the protection and sustainable management of aquatic resources and habitats of the Skeleton Lake watershed.

The Skeleton Lake WMP will aid Alberta Environment to make water resource decisions in the Skeleton Lake planning area under the *Water Act* and the *Environmental Protection and Enhancement Act*. The plan will also assist the municipality, neighboring municipalities, and resource managers to make informed water management and land use decisions and provide information to the public. The WMP addresses sustainability of Skeleton Lake in terms of water quantity and quality, land use activities, riparian zones and wetlands, fish and wildlife habitat and groundwater dynamics. The main objectives of the WMP include:

1. Water management options to improve and maintain long-term sustainable and stable water levels in Skeleton Lake;
2. Restoration of impaired riparian zones and wetlands and the protection of existing wetlands, thereby providing high quality fish and wildlife habitat and restoring any lost or damaged habitat;
3. Development and approval of the Skeleton Lake WMP to comply with the *Alberta Land Stewardship Act* and take into account the cumulative effects of development;
4. To augment existing land use, area structure and municipal development plans in the County of Athabasca No. 12;
5. Manage sewage and other wastewater management options to reduce the impact on the water quality of Skeleton Lake;
6. Encourage low-impact alternatives for new subdivision and cottage developments and manage all other land uses, including industrial developments, recreational areas and golf courses, to minimize impacts to the watershed; and
7. Development of an education and awareness program that focuses on sustainable watershed management practices.

For each of these issues, the WMP provides short-term and long-term recommendations as well as a barometer for the successful implementation of these recommendations, i.e., a performance measure. The Summer Villages of Bondiss and Mewatha Beach, the Village of Boyle and the County of Athabasca No. 12 will review planning documents and their Land Use Bylaws and incorporate the recommendations in this WMP. The WMP process includes specific public outreach activities, newsletters, initiatives and education programs, which are essential to the success of this plan.

The following six issues were identified as priority action items in this WMP:

- Impoundments to surface water flows should be identified and restoration of overland water flows to the lake should be restored;
- Formulation of Water Conservation Objectives;
- Restoration of riparian zones and wetlands;
- Augmentation of land use, area structure and municipal development plans in the County of Athabasca No. 12 to reflect recommendations of this WMP;
- Detailed groundwater assessment for the entire watershed; and
- Education programs that focus on sustainable watershed management practices.

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Glossary and Abbreviations

AENV – Alberta Environment

AOPA – Agricultural Operations Practice Act

ASRD – Alberta Sustainable Resource Development

a.s.l. – above sea level

Drainage basin – An extent of land where water from precipitation or snow melt drains downhill into a body of water, such as a river, lake, reservoir, estuary, wetland, sea or ocean. The drainage basin includes both the streams and rivers that convey the water as well as the land surfaces from which water drains into those channels. Also known as a "watershed".

FOC – Fisheries and Oceans Canada

MGA – Municipal Government Act

RHA – Regional Health Authority

Riparian area – The interface between land and a water body. Plant communities along the water body margins are called riparian vegetation, characterized by water-loving plants. Riparian zones are significant in ecology, environmental management and civil engineering due to their role in soil conservation, their biodiversity and the influence they have on aquatic ecosystems.

RSMM – The *Riparian Setback Matrix Model* is a scientifically-based, legally defensible model that allows municipalities to take adequate precautions to prevent the most common forms of pollution of water bodies and wetlands from various types of land use activities.

SLSA – Skeleton Lake Stewardship Association

SoW – State of the Watershed

TMDL – Total maximum daily load

ToR – Terms of reference

WAC – Watershed Advisory Committee

Watershed – see "drainage basin".

WCO – Water conservation objective

Wetland – Land that is saturated with water long enough to promote wetland or aquatic processes as indicated by poorly drained soils, hydrophytic vegetation and various kinds of biological activity which are adapted to a wet environment.

WMP – Watershed management plan

1 Introduction

1.1 Background Information

Skeleton Lake is located about 170 km northeast of Edmonton, Alberta, in the Lakeland Region within the County of Athabasca No. 12 and within the Beaver River basin (Figure 1). The lake consists of two basins, is about 878 ha in size and has a small drainage basin of about 3,136 ha (Prepas and Mitchell, 1990). Aquatic habitats in Skeleton Lake have been negatively impacted by human activities. For example, extensive developments adjacent to the lake have resulted in the impairment of riparian zones and wetlands, fish habitat, and water quality, as well as the blocking or rerouting of natural surface flows to the lake. In addition, the active withdrawal of water and natural outflows from Skeleton Lake, appear to exceed the inflow of water into the lake via surface water and groundwater flow, resulting in a continual lowering of the water level, which further exacerbates the impairment of water quality, fish habitat and riparian and wetland areas.

The Skeleton Lake Stewardship Association (SLSA) approached *Aqua*lity Environmental Consulting Ltd., in 2006 to develop a State of the Watershed (SoW) report for Skeleton Lake. The SoW report was completed in August 2007 and highlighted the limited data on lake water quality and groundwater dynamics within the watershed (Logan et al., 2007). Consequently, the SoW report recommended a thorough hydrologic study, including a water balance and groundwater mapping, for the Skeleton Lake watershed along with assessments of land use practices, riparian health and fish habitat and fish population dynamics along and in the lake. In addition, it was recommended that the SLSA develop a Watershed Management Plan (WMP) and/or formulate Water Conservation Objectives (WCO) (Logan et al., 2007). The Terms of Reference (ToR) for the development of the WMP was composed by SLSA in consultation with the County of Athabasca No. 12, the Village of Boyle, the Summer Villages of Bondiss and Mewatha Beach and the general public. The ToR was submitted to Alberta Environment on September 06, 2006, and it was approved on September 22, 2006 (Appendix A). In 2009, SLSA approached *Aqua*lity Environmental Consulting Ltd. to develop the WMP for Skeleton Lake.

The Watershed Management Plan for the Skeleton Lake watershed aims to determine the causes of the decline in the environmental quality of the lake and watershed. The plan discusses the current state of knowledge of several issues identified in the SoW and through public consultation. Several recommendations are provided in this report, including the development of education and awareness programs and community-based watershed management tools, a review of enabling legislation to aid SLSA and a set of monitoring and performance measures. The WMP strives to balance environmental, social and economic issues with government legislation for the protection and management of water resources. Alberta Environment has regulatory responsibility for allocating water and protecting the aquatic environment (under the *Water Act*) and for controlling wastewater releases into the environment (under the *Environmental Protection and Enhancement Act*).

Figure 1. Location of the County of Athabasca No. 12 in Alberta, Canada (red circle) (map adapted from http://en.wikipedia.org/wiki/File:Alberta_municipal_districts.png).

1.2 Vision and Mandate of the Skeleton Lake Stewardship Association

The vision of the SLSA for Skeleton Lake is that the lake be managed as a resilient, high quality, sustainable aquatic ecosystem for the mutual benefit of all Albertans and for the protection and sustainability of Skeleton Lake as a viable aquatic environment for fisheries, wildlife and recreation. The SLSA has agreed to assume the obligations for the development of the Skeleton Lake WMP. The main functions of the SLSA in this endeavor will include:

- Provide direction for the Skeleton Lake WMP;
- Build partnerships with government agencies, environmental organizations and the public who can assist in achieving the plan's goals and objectives;

- Coordinate and facilitate public consultation during the planning process;
- Establish, if necessary, subcommittees to assist in developing the WMP;
- Submit the final WMP to Alberta Environment; and
- Promote public education and awareness.

1.3 Scope of the Watershed Management Plan

The planning area is outlined in Figure 2. The plan addresses the issues and concerns identified in the ToR. These issues include:

- Surface water quantity and lake sustainability;
- Surface water quality;
- Protection and renewal of the aquatic resources;
- Land use practices within the watershed and shoreline development;
- Education and awareness; and
- Compilation of groundwater information.

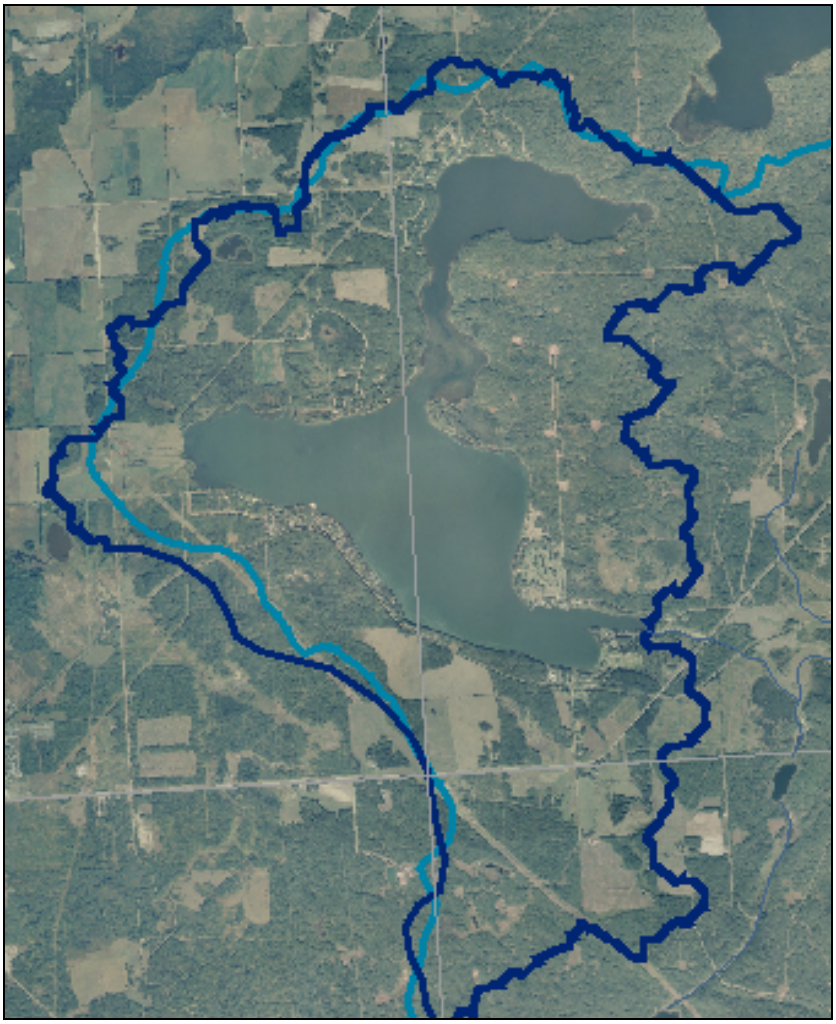

Figure 2. Outline of the Skeleton Lake watershed (dark blue line) (PFRA, 2007).

1.4 Goals of the Watershed Management Plan

A WMP is a site-specific, comprehensive tool that watershed groups, municipalities and other entities can use to achieve their stewardship goals. An approved WMP is used by government and other resource decision makers as a reference when making decisions that impact water within that watershed. As the regulator, Alberta Environment is responsible for approving WMPs in Alberta. Alberta Environment will approve a WMP if the proponent adequately presents:

- A summary of the issues considered;
- A description of the area in which the WMP applies;
- A summary of the information assembled as part of the planning process;
- The relationship of the WMP to regional strategies or other planning initiatives;
- The inclusion of public and stakeholder consultation;
- The recommended options and strategies to address the issues; and
- A list of performance monitoring requirements.

The Skeleton Lake WMP will help Alberta Environment make water resource decisions in the Skeleton Lake planning area under the *Water Act* and the *Environmental Protection and Enhancement Act*. The resulting plan will also assist the County of Athabasca No. 12, the Village of Boyle, the Summer Villages of Bondiss and Mewatha Beach, SLSA, stakeholders and resource managers to make informed water management and land use decisions, and it will provide information to the public. The draft *Watershed Management Planning Framework for Alberta* is used to guide the plan. Water management issues in the watershed were identified through a consultative process.

The WMP addresses the sustainability of the lake in terms of water quantity and quality, watershed development, aquatic and wildlife habitat and groundwater dynamics. "Sustainability" here implies the capability of Skeleton Lake to be maintained indefinitely, integrating the environment, the economy and the social system.

1.5 Watershed Management Plan Objectives

The Skeleton Lake WMP objectives are: water quantity, quality, land use practices, protection of riparian zones, wetlands, fish and wildlife habitat and an education and outreach program (SLSA, 2006).

1. Identify restoration targets by:
    - Determining the range and mean water levels in Skeleton Lake and compare them to current mean annual water levels and fluctuations.
    - Determining groundwater dynamics in the Skeleton Lake watershed.
    - Identifying point sources and non-point sources of nutrients in the watershed, and determine performance indicators for nutrients of concern for future performance monitoring.
    - Identifying existing and historic (e.g., via aerial photographs) riparian zones and wetlands as a baseline to determine areas for riparian zone and wetland restoration. This will aid in the

restoration of fish and wildlife habitats, buffering against flooding, filtering of silt and nutrients and other ecosystem functions.

- Performance indicators: long-term water level record of Skeleton Lake; development of a water level monitoring and sustainable management plan; development of water conservation objectives; groundwater assessment of the Skeleton Lake watershed; implementation plan for the progressive reduction of nutrient loading; inventories of disturbed riparian zones and wetlands; no further loss or disturbance of riparian zone and wetlands; development of a toolbox for riparian zone and wetland restoration techniques; data base of critical fish and wildlife habitat; development and implementation of a fish and wildlife habitat restoration and conservation plan.

2. Integration

- Identify the needs of the Municipality, Village and Summer Villages, and incorporate them into the WMP data gathering process so that planning efforts will be integrated into the municipal planning process.
- All participants will work with the County, Village, Summer Villages and Province to integrate this plan with their existing and future planning documents for private and Crown lands.
- All participants will work to ensure the implementation of policies and land use practices that will (1) stabilize water levels in Skeleton Lake, (2) encourage best management practices for activities in upland areas that have the potential to export soil/sediment- or nutrient-rich runoff into Skeleton Lake, and (3) apply “no net loss” of riparian zone and wetland “values” for any activities or developments that have the potential to negatively impact riparian zones and wetlands.
- Performance indicators: reduction of nutrients into Skeleton Lake by adopting Best Management Practices; develop a nutrient budget for Skeleton Lake; stabilization and/or increase of water levels in Skeleton Lake; assessment of groundwater dynamics in the watershed; protection of riparian zones, wetlands and fish and wildlife habitat; incorporation of the WMP into existing Provincial, Municipal and Summer Village Plans (Municipal Development Plan, Area Structure Plan, Land Use Bylaws, others); development and maintenance of a readily accessible bank of watershed-related resources for stakeholders to consult.

3. Public Education and Outreach

- Undertake public outreach and education using a comprehensive communication strategy to identify land stewardship practices that promote “healthy” and functional ecosystems, including riparian areas and wetlands.
- Ensure knowledge of and compliance with all regulations, guidelines and best management practices regarding management of shorelines, residential and agricultural lands, runoff, sewage, pesticides and herbicides.

- Performance indicators: active websites, number of newsletters mailed, number of articles in local newspapers, increased use of best management practices, attendance at open house sessions.

1.6 Authority

Human activities that affect the health of any watershed in Alberta are governed by a variety of Acts, Regulations, and Policies (Table 1). The authority of this legislation, when properly implemented and enforced, will support the goals of the Skeleton Lake WMP.

Table 1. Legislation and policy involving water and watershed management in Alberta.

Legislation/policy	Description
Federal *Fisheries Act* - Fisheries and Oceans Canada (FOC)	Regulates and enforces on harmful alteration, disruption and destruction of fish habitat in Section 35.
Provincial *Water Act* – Alberta Environment (AENV)	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, in-stream construction practices, storm water management.
Provincial *Environmental Protection and Enhancement Act (EPEA)* – AENV	Management of contaminated sites, storage tanks, landfill management practices, hazardous waste management practices and enforcement.
Provincial *Alberta Land Stewardship Act (ASRD)*	This legislation supports implementation of the Land-use Framework. It creates the seven land-use regions, establishes the Land-use Secretariat and gives authority for regional plans, creation of Regional Advisory Councils and addresses the cumulative effects of human and other activity.
Provincial *Agricultural Operations Practices Act* (AOPA) – Natural Resources Conservation Board (NRCB)	Regulates and enforces on confined feedlot operation and environment standards for livestock operations.
Historical Resources Act – Culture and Community Spirit	Concerns any work of humans that is primarily of value for its prehistoric, historic, cultural or scientific significance, and is or was buried or partially buried in land or submerged beneath the surface of any watercourse or permanent body of water.
Provincial *Municipal Government Act* (MGA) – Municipal Affairs	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.
Provincial *Public Lands Act* - Sustainable Resource Development (ASRD)	Regulates and enforces on activities that affect Crown-owned beds and shores of water bodies and some Crown-owned uplands that may affect nearby water bodies.
Provincial *Safety Codes Act*- Municipal Affairs	Regulates and enforces septic system management practices, including installation of septic field and other subsurface disposal systems.
Regional Health Authorities Act – Alberta Health	RHA 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.
Wildlife Act - ASRD	Regulates and enforces on protection of wetland-dependent and wetland-associated wildlife, and endangered species (including plants).
Provincial Parks Act & Wilderness Areas, Ecological Reserve and Natural Areas Act – ASRD and Community Development	Both Acts 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.

Federal *Navigable Waters Protection Act* - FOC	Protects the public's right of navigation in Canadian waters, by prohibiting the building, placing or maintaining of any work whatsoever in, on, over, under, through or across any such navigable water, without the authorization of the Minister of Fisheries and Ocean Canada.
Provincial Wetlands Policy (expected 2009)	This policy will be used to protect wetlands and mitigate losses through a No-Net-Loss policy.
Land Use Bylaws (Municipal)	The bylaw that divides the municipality into land use districts and establishes procedures for processing and deciding upon development applications. It sets out rules that affect how each parcel of land can be used and developed and includes a zoning map.
Area Structure Plans (Municipal)	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.
Municipal Development Plans	The plan adopted by Council as a municipal development plan pursuant to the Municipal Government Act.

Current and past Land Use Plans, guiding documents and bylaws enacted for Skeleton Lake include:

- Summer Village of Mewatha Beach Land Use Bylaw;
- Summer Village of Bondiss Land Use Bylaw;
- Skeleton Lake Management Study (1979);
- Skeleton Lake Area Structure Plan (1980);
- County of Athabasca No. 12 Land Use Bylaws and Municipal Development Plan (2002);
- ToR for the Skeleton Lake WMP (2006); and
- Skeleton Lake - State of the Watershed Report (2007).

1.7 Public Consultation

Regular communication is integral to the successful planning and creation of a publicly-valued WMP that is of benefit and value to the affected stakeholders and the public. The communication strategy is designed to convey timely and accurate information to the public and to facilitate identification of community issues and concerns. The WMP is committed to the principles of open and visible communication and access to relevant information that fosters trust, credibility and integrity.

The following public consultation strategy will be adopted to ensure that local community interest and concerns are adequately accounted for in the planning process:

- The local MLA will be kept informed about the different stages of the planning process;
- Regular stakeholder and public consultation and information sessions will be held;
- SLSA members are representative of landowners, lake users and the general public; and
- Planning process updates will be provided through the local newspapers.

In addition, information will be disseminated to the public through the SLSA web site (http://www.skeletonlake.com), fact sheets, workshops, displays, feature stories, mail-outs, newsletters, news releases, ads and presentations to groups. The public's ideas, issues and concerns will be solicited through workshops, review of planning documents at open houses or public meetings and via the County and SLSA websites.

1.8 Timelines and Schedule for Review

Table 2. Development and implementation of the Skeleton Lake Watershed Management Plan.

Plan formulation	**Timeline**
1. Draft the WMP	April - May 2009
2. Public review of the draft WMP	May - June 2009
3. Finalization of the WMP and submission to Alberta Environment for approval	2009
Implementation, evaluation and monitoring	
1. WMP implementation, monitoring and 5-year incremental review	2011

2 Site Description and History

Skeleton Lake is located about 170 km northeast of Edmonton, Alberta, in the Lakeland Region in the County of Athabasca No. 12. It is within the boundaries of the Beaver River basin. The Summer Villages of Mewatha Beach and Bondiss are located on the shores of the lake (Figure 3). Skeleton Lake has a small drainage basin of about 3,136 ha, excluding the lake area, which is about 878 ha (Alberta Municipal Affairs, 1979). The lake consists of two basins connected by a narrow channel, known locally as "The Narrows" (Figure 3). There is anecdotal information that the narrows dried up about 60 years ago, thereby separating the two basins of the lake (Mitchell and Prepas, 1990). The lake's name is a translation of the Cree words *Cheply Sakhahigan*, which means "place of the skeletons". A Cree chief is buried near the entrance to the Boyle Old-timers Golf Course along the eastern shore of the lake, which is how the lake got its name (Mitchell and Prepas, 1990).

The early local history of the area reflects the harvest of natural resources such as fur, fish and timber (Mitchell and Prepas, 1990). Large stands of spruce around the lake attracted logging activity. One sawmill operated on the lakeshore sometime after 1915 and another operated at Bondiss from 1923-1940 (Mitchell and Prepas, 1990). Log booms were frequently seen on the lake during this period. The Northern Alberta Railway reached the vicinity in 1914, bringing homesteaders and providing the means to ship lumber and fish to local markets. The area immediately north of Boyle was settled mostly by Ukrainian immigrants (Mitchell and Prepas, 1990). The major economic activity in the region eventually became mixed farming.

More recent history of the area reflects the importance of the lake's recreational resources. In 1946, a private resort opened at the end of the southeast bay on the site of one of the former saw mills, and the Summer Village of Bondiss grew around the resort later. Seasonal cottage development began in the 1960s and 1970s, and it is the predominant form of recreational land use at Skeleton Lake. There are 11 subdivisions, containing more than 300 lots, surrounding Skeleton Lake, which are part of the County of Athabasca No. 12. As well, the Summer Village of Mewatha Beach with about 220 properties, the Summer Village of Bondiss with about 195 lots and Shoreline Campground with about 170 sites are all

located on the shores of the lake. A public golf course is located in the Summer Village of Bondiss on the east side of the lake. The most popular recreational activities at the lake during summer are fishing, swimming, golfing, general relaxation, off-road vehicle use, power boating, water skiing and wakeboarding. In winter, ice fishing and snowmobiling are the favoured activities.

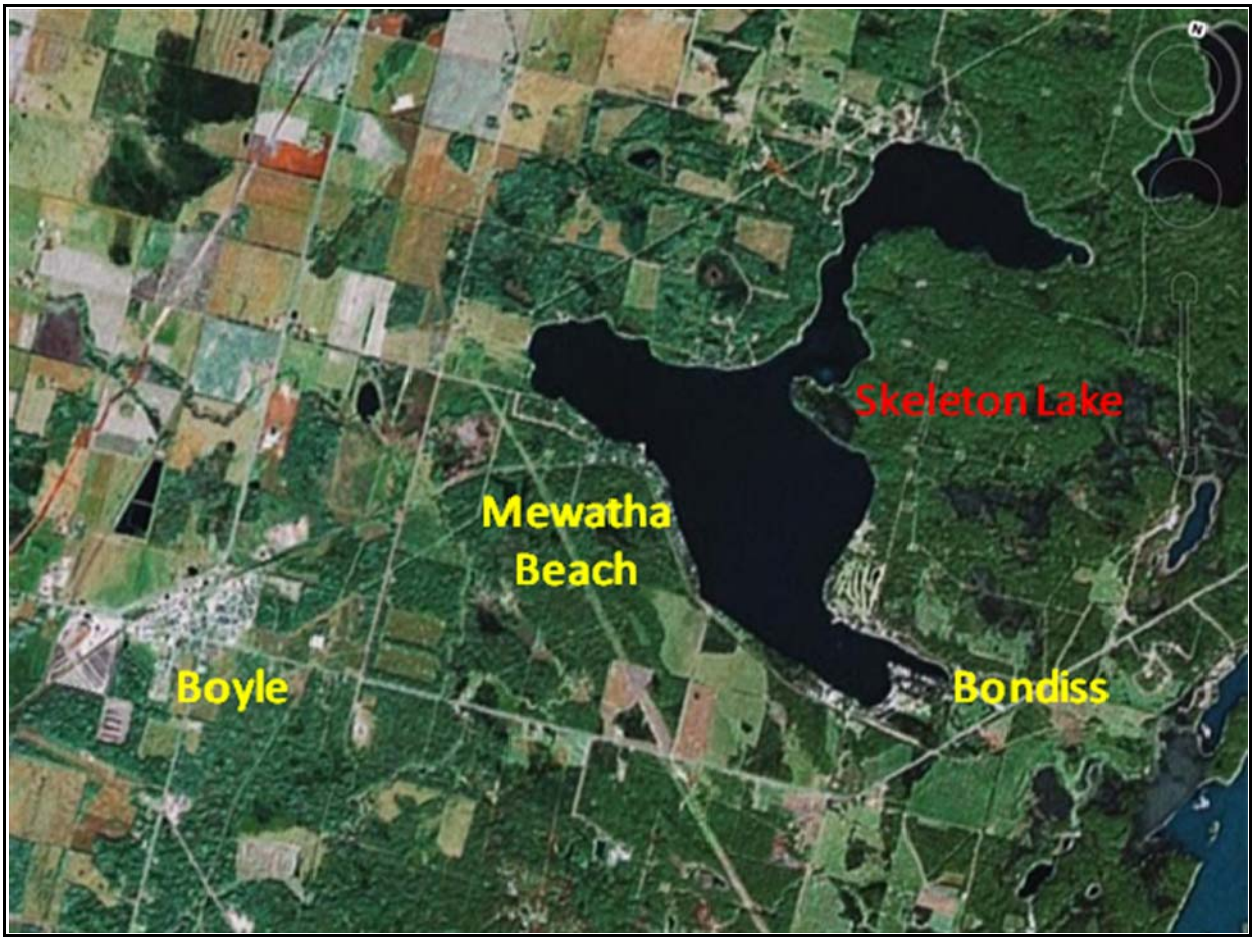

Figure 3. Location of Skeleton Lake and the Village of Boyle and the Summer Villages of Bondiss and Mewatha Beach (map adopted from Google Maps, 2009).

Aquatic habitats in Skeleton Lake have been negatively impacted by human activities. For example, extensive developments adjacent to the lake have resulted in the impairment of riparian zones and wetlands, fish habitat, and water quality as well as the blocking or rerouting of natural surface flows to the lake. The active withdrawal of water from Skeleton Lake has contributed to a continual lowering of the water level, thereby exacerbated the impairment of water quality, fish habitat, and riparian zones and wetlands (SLSA, 2009). Water diversions were dominated by the Village of Boyle, beginning in 1969 and scheduled to cease in June 2010. The original license to divert water issued by AENV to the Village of Boyle was for a gross diversion of up to 185,025 m^3 annually; however, this level has been exceeded by up to 17% per year from 1999-2008 (Logan et al., 2007). The recorded water level of Skeleton Lake has been declining during the last 12 years from an historic maximum level of 623.89 m above sea level a.s.l. in June of 1997 to a historic minimum of 622.053 m a.s.l. in October 2008. The drainage area of

Skeleton Lake is about four times the size of the lake, which suggests that the lake is susceptible to climate fluctuation and developments around the lake (SLSA, 2009). In addition, a regional groundwater assessment indicates that likely the entire Skeleton Lake watershed is located in a groundwater recharge area (Figure 4), i.e., water flows from the lake via subsurface conduits and recharges local groundwater reservoirs that extend far beyond the watershed boundaries (HCL, 2000). AENV initiated a pilot groundwater monitoring program in Skeleton Lake in October 2008; however, data were not yet available when this WMP was completed (B. Welsh, AENV hydrogeologist, pers. comm., 2009).

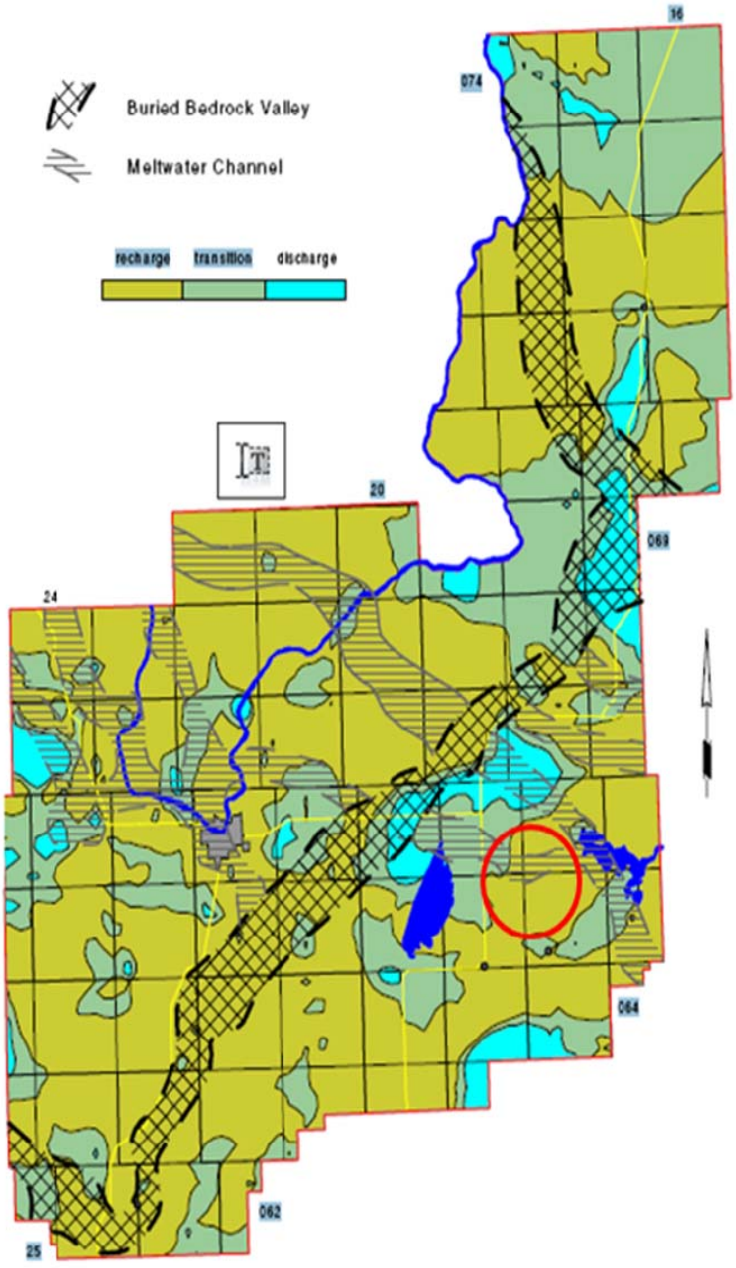

Figure 4. Recharge/discharge areas between surficial deposits and upper bedrock aquifer(s) (the red circle indicates the location of the Skeleton Lake watershed; figure modified from HCL, 2000).

3 Watershed Management Plan Implementation and Accountability

This WMP will not succeed until its recommendations are implemented, and it will not be effective unless the tasks identified are performed and an accountability process is established and adhered to. For the purposes of this plan, "Short-Term Recommendations" will be completed within three years of implementation, while "Long-Term Recommendations" may take more than three years to complete. Improved coordination and partnership with provincial and municipal government departments will be realized through the implementation of this plan. Councils, planners and administration from the County of Athabasca No. 12, the Village of Boyle, the Summer Villages of Bondiss and Mewatha Beach and the provincial government must publicly endorse, support and enforce this plan to ensure its success.

3.1 Short-Term Recommendations

- Develop and implement partnership agreement(s) with provincial, federal and local government agencies and conservation groups to assist with the implementation of the Skeleton Lake WMP;
- Maintain ongoing communication and collaboration with non-profit environmental groups, community groups, landowners, agriculture producers and industry to address the issues identified in the WMP; and
- Finalize an annual action plan budget by November of each year.

3.2 Long-Term Recommendations

- The SLSA should provide an annual progress report on implementation of the WMP to the local governments, the public, all stakeholders and Alberta Environment;
- A comprehensive review of the WMP should be conducted at minimum intervals of five years or as is otherwise deemed appropriate or necessary; and
- The SLSA should participate in any future watershed management planning that may be proposed for the larger basin under the provincial *Water for Life* strategy, such as with the Athabasca basin Watershed Planning and Advisory Council currently under development.

3.3 Performance Measures

- Annual progress reports are completed and presented to the respective municipal governments, stakeholders and Alberta Environment;
- Minimum of two public open house sessions are held per year to keep the public aware and involved with SLSA's activities;
- Number of distributed newsletters to residents and other stakeholders;
- Partnerships and collaboration with other resource agencies; and
- Number of completed reviews and revisions of the WMP.

4 Watershed Issues and Their Resolution

4.1 Lake Water Levels and Their Sustainability

Lake levels in Skeleton Lake have been relatively constant from 1965-1987, but they have dropped dramatically from 1987-1997, increased to record highs by 1997 (to a maximum of 623.885 m a.s.l.) and then began to steadily decline again. In October 2008, lake levels reached an historic low (622.053 m a.s.l.), which is a drop of 1.83 m in 12 years (Figure 5). Based on digitized outlines of the lake from 1964 and 2003 airphotos, it has been estimated that the surface area of the lake has been reduced by about 70 ha (WorleyParsons Komex, 2007).

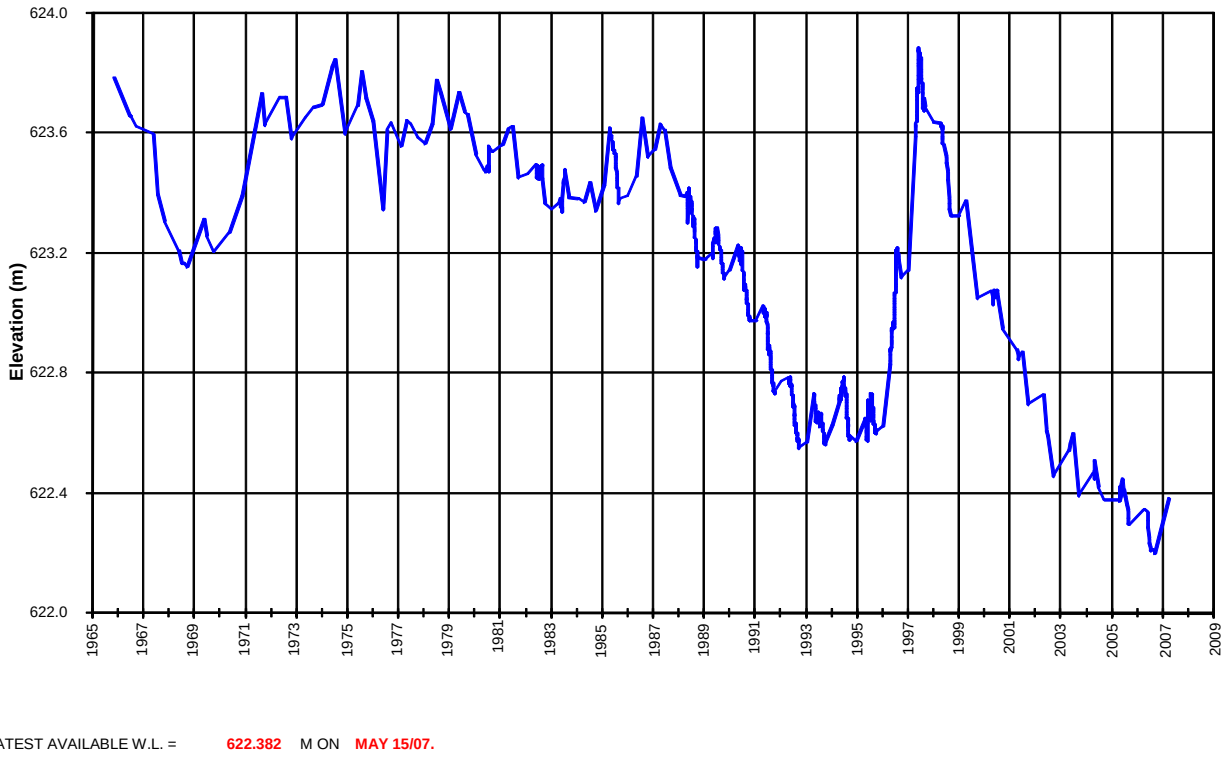

Figure 5. Water level fluctuation in Skeleton Lake from 1965-2007 (AENV, 2007).

If water levels continue their current decline, there will be an extensive loss of riparian zones and wetlands, fish and wildlife habitat, and recreational use of the lake. The Narrows have dried up, thereby separating the two basins of the lake. Examples of extreme water loss have recently occurred at other Alberta lakes, including Sandy, Muriel and Beaverhill Lakes. These lakes have lost extensive areas of shoreline, experienced declines in water quality and now have impaired aquatic ecosystem health and functionality.

Due to the small watershed to lake area ratio (4:1), any significant deviations from historical averages in outflow and inflow rates have the potential to significantly increase or decrease water levels in Skeleton Lake. The following are the key issues related to lake water levels and their sustainability in the long-term (SLSA, 2006):

- The cumulative impacts of water diversions on declining lake water levels;
- Increased demand for water resulting from increased development in the vicinity of the lake;
- The adverse affects of increased development in the watershed on inflows into the lake;
- Drying of the narrows between the north and the south basins of the lake; and
- The significant threat posed to the aquatic ecosystem by declining lake water levels, including the loss of area previously used for fish spawning and fish and waterfowl habitat.

Although atmospheric temperatures have increased and total annual precipitation has decreased in the Skeleton Lake area, these climatic variables themselves did not significantly contribute to the decline in lake water levels from 1987-1995 and 1997-2008 (Figure 5). Statistical analyses using lake level data from Alberta Environment (2007) and climatological data from Environment Canada (2009) have shown that there is a disconnect between total annual precipitation and lake water levels (analyses not shown). i.e., influences other than climate are largely responsible for declining water levels in Skeleton Lake.

Short-Term Recommendations

- Continue monitoring water levels in Skeleton Lake to assess the long-term sustainability of the lake.
- Develop a comprehensive nutrient budget for Skeleton Lake.
- Development of a comprehensive water budget for Skeleton Lake.
- Adoption of a Water Conservation Objective (WCO) for Skeleton Lake, that sets the water level at 623.05 m a.s.l. and satisfies water volumes required for human use (including existing consumptive and non-consumptive uses) and meets the necessary water quality required to protect the aquatic environment.
- Identify other possible features that may be responsible for impounding water and preventing surface flow into the lake i.e., culverts, roads etc.

Long-Term Recommendations

- Monitor water levels to assess long-term sustainability and ensure that WCO levels are followed.
- Land use and development decisions should be based on the sensitivity of water level fluctuations to natural and anthropogenic disturbances.
- Undertake a drained wetland inventory and begin restoration of wetlands that may have assisted in groundwater recharge in the area.

Performance Measures

- Stabilization and/or increasing water levels in Skeleton Lake by a variety of techniques.

Enabling Legislation and Policy

- *Water Act* (AENV) - The Act governs the diversion and use of water. Regulates actions that affect water and water use management, fisheries habitat protection practices, in-stream construction practices, storm water management and enforcement.

- *Environmental Protection and Enhancement Act* (AENV) - Management of contaminated sites, management of storage tanks, landfill management practices, hazardous waste management practices, enforcement.
- *Land Use Bylaws* - The bylaw that divides the municipality into land use districts and establishes procedures for processing and deciding upon development applications. It sets out rules that affect how each parcel of land can be used and developed and includes a zoning map.
- *Area Structure Plan* - A plan adopted by Council as an area structure plan bylaw pursuant to the MGA that provides a framework for future subdivisions and development of an area.
- *Municipal Development Plan* - The plan adopted by Council as a municipal development plan pursuant to the MGA.

4.2 Land Use Practices in the Watershed

The development of Skeleton Lake Resort in 1946 was followed by the development of a Boy Scout Camp in 1956 (Alberta Municipal Affairs, 1979). Since then, much of the shoreline of Skeleton Lake has been subdivided for cottages (Alberta Municipal Affairs, 1979). Currently, there are three municipalities around the lake: the Summer Villages of Mewatha Beach (221 lots) and Bondiss (199 lots) and the County of Athabasca No. 12 (620 lots) (B. Curial, SLSA Director, pers. comm., 2006, 2007). The southeast and entire western portion of the watershed has experienced the most growth with the development of three new subdivisions, the expansion of others and the development of a public golf course.

Agricultural activities are generally restricted to the west, northwest, and south of Skeleton Lake due to topographical and soil limitations, and consist mainly of coarse grain and forage crop production and livestock operations (Alberta Municipal Affairs, 1979). The shores of Skeleton Lake have moderate to severe limitations for the growth of commercial forests due to dry soil conditions. The nearly complete harvest of white spruce in the early 1900s has resulted in forests dominated by trembling aspen and balsam poplar. As a result, the County of Athabasca No. 12 (2002) identified almost the entire Skeleton Lake watershed as a Logging Control Area, wherein any logging activities require municipal approval. The forested land base has decreased by about 17% since 1964. Several oil and gas wells exist in the Skeleton Lake watershed (Logan et al., 2007). It is likely that the Skeleton Lake region is rich in historical and archaeological resources, since arrowheads have been found along the north shore of the south basin.

Land use has dramatically changed in the 12-year period between 1986 and 1998 (Figures 6, 7). Most notably, a large portion of the wetlands to the south and west of the lake have been lost. These wetlands may have formed an important groundwater recharge system for the lake itself, and loss of these wetlands may have resulted in eventual groundwater drawdown.

The following key issues associated with land use changes in the watershed have been identified (SLSA, 2006):

- Land use practice effects on water quantity, quality and aquatic resources in the Skeleton Lake watershed; and
- The lack of a watershed perspective in the current municipal land use planning practice.

Short-Term Recommendations

- Updates on the human population and use in the watershed in and around the lake, e.g., the number of seasonal/permanent cottages, private campground utilization rates, number of lake users per day and use of water and sewage treatment facilities.
- Updates on the extent of agricultural, resource exploration and extraction and forestry activities.
- An education and outreach program, involving newsletters to residents, pamphlets, fact sheets, and a website that addresses impacts of different land use activities on terrestrial and aquatic resources in the watershed.

Long-Term Recommendations

- Municipal legislation for existing and future developments to protect and maintain riparian zones and wetlands around all environmentally sensitive areas.
- Initiation of a historical and archaeological resource research program. The County of Athabasca No. 12, the Village of Boyle, the Summer Villages of Bondiss and Mewatha Beach and SLSA can collaborate with the Archaeological Survey of Canada, the Alberta Historical Resources Foundation, the Historic Places Stewardship Section and First Nations to acquire financial resources and legislative support for this program.

Performance Measures

- Revisions to Land Use Bylaws, Area Structure Plans, Municipal Development Plans and other planning documents to reflect the restoration and/or protection of sensitive areas, protection of water quality and maintenance or increasing water levels in Skeleton Lake.
- Development and implementation bylaws or regulations regarding minimum engineering standards for new and existing septic systems.
- Protection of historical and archaeological sites in the Skeleton Lake watershed.
- Number of public outreach and education sessions held and attendance numbers at these sessions.

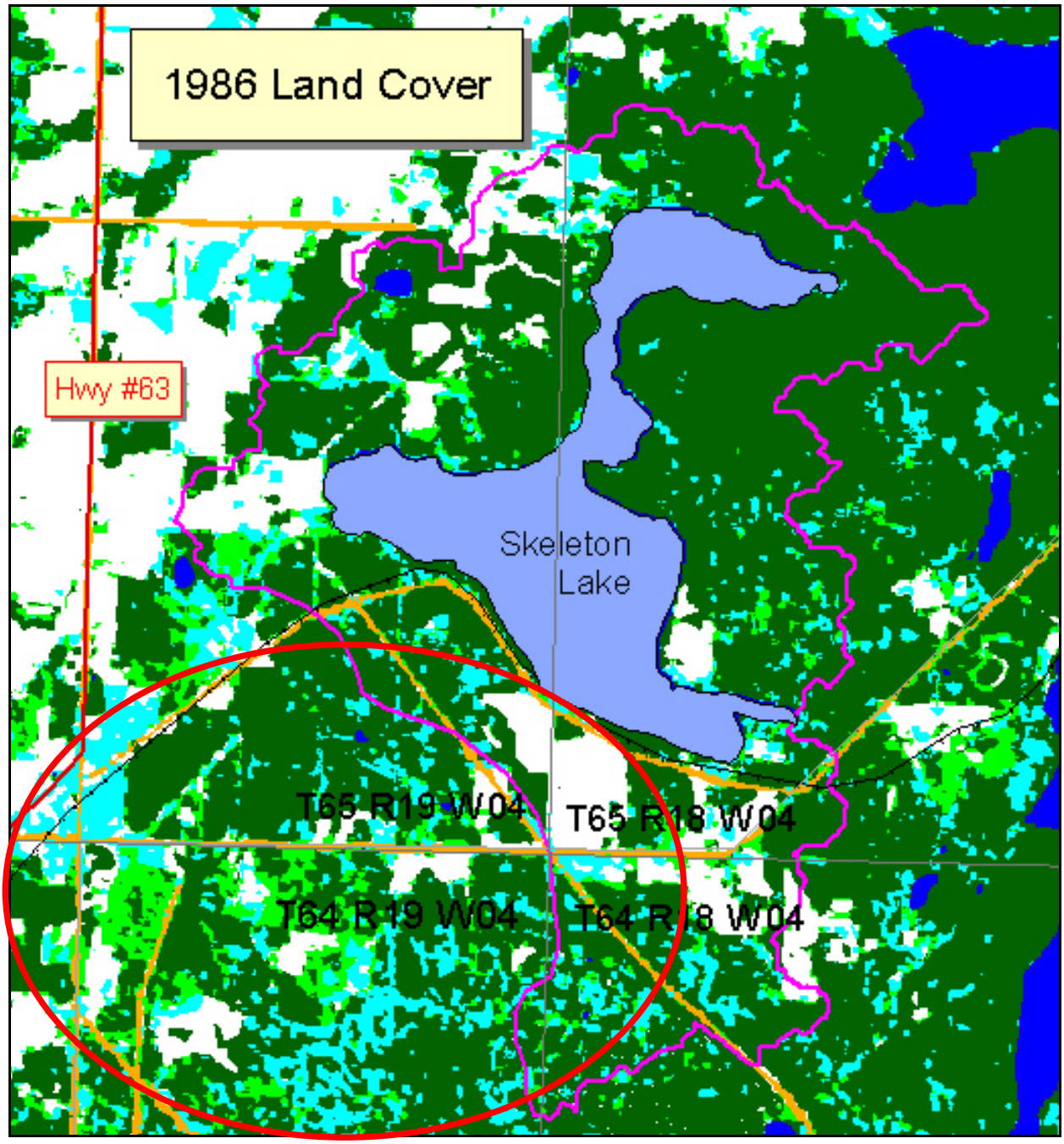

Figure 6. Land use near Skeleton Lake in 1986. Important areas to note are the light blue areas (wetlands), orange areas (settlements) and white areas (agricultural lands). The area outlined in red should be used for comparison purposes with the following figure.

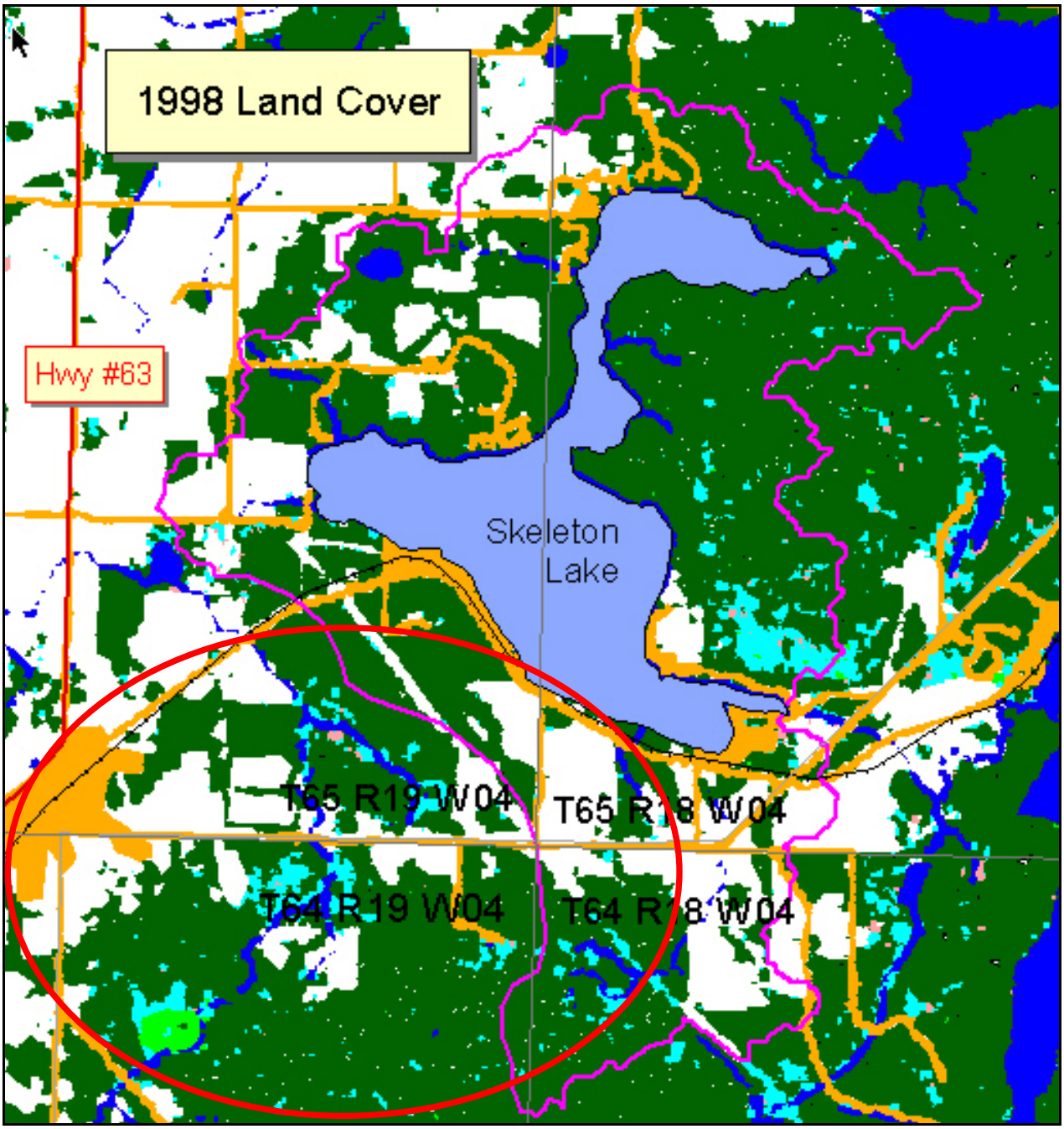

Figure 7. Land use near Skeleton Lake in 1998. Important areas to note compared to the above figure are the light blue areas (wetlands), orange areas (settlements) and white areas (agricultural lands). Within the red circle, we can see that extensive amounts of wetlands have been lost (compared to Figure 6) to the southwest of the lake.

Enabling Legislation and Policy

- *Provincial Parks Act & Wilderness Areas* and *Ecological Reserve and Natural Areas Act* - Both Acts can be used to minimize the effects of land use activities have on water quality and the protection of aquatic resources.

- *Historical Resources Act* – The Act concerns any artifacts or works of humans that are valued for prehistoric, historic, cultural, or scientific significance, and are buried or partially buried in land or submerged beneath the surface of any watercourse or permanent body of water.
- *Land Use Bylaws* - The bylaw that divides the municipality into land use districts and establishes procedures for processing and deciding upon development applications. It sets out rules that affect how each parcel of land can be used and developed and includes a zoning map.
- *Area Structure Plan* - A plan adopted by Council as an area structure plan bylaw pursuant to the MGA that provides a framework for future subdivisions and development of an area.
- *Municipal Development Plan* - The plan adopted by Council as a municipal development plan pursuant to the MGA.
- *Environmental Protection and Enhancement Act* (AENV) - Management of contaminated sites, management of storage tanks, landfill management practices, hazardous waste management practices, enforcement.
- *Municipal Government Act* (MGA) - MGA provides municipalities with the authority to regulate the management of private lands to control non-point sources of pollutants and enact bylaws and municipal land uses to ensure that land use practices are compatible with the protection of aquatic environment.
- *Public Lands Act* (SRD) - Regulates activities that can affect bed and shores.

4.3 Surface Water Quality

Water quality data for Skeleton Lake are limited. Some monitoring was undertaken by Alberta Environment in 1977-1979, 1985-86, and 1989, and Skeleton Lake participated in the Alberta Lake Management Society's LakeWatch Program in 2005. The most recent water quality analyses were performed by *Aqua*lity Environmental Consulting Ltd. in the fall of 2006 as part of a biological assessment of Skeleton Lake (Aquality Environmental Consulting Ltd., 2007).

Skeleton Lake is mesotrophic, with most of the phosphorus in the lake originating from runoff from forested land (33%) and precipitation and dustfall (30%) (Mitchell and Prepas, 1990). The phosphorus supply that enters the lake in sewage effluent from residential areas and campgrounds has not been measured, but was estimated to be about 21% of the external total phosphorus load (Alberta Municipal Affairs, 1979). Surface runoff from agricultural activities has not been quantified, and phosphorus loading from internal sources, e.g., from sediments and groundwater, has not been estimated to date. The lack of information on internal loading is a major data gap that needs to be addressed if any initiatives to stabilize or improve surface water quality are to succeed.

A shift from predominantly diatoms in early spring to blue-green algae (cyanophytes) in summer is common in the south basin, particularly in late August (Zurawell et al., 1999), while the north basin typically experiences some blue-green algal growth in June (Alberta Municipal Affairs, 1979). Cyanophytes can produce liver toxins that can negatively impact human health following exposure and/or ingestion. Zurawell et al (1999) found that the south basin contained moderate concentrations

of cyanophyte toxins in the phytoplankton biomass and lake water. To date, no nuisance algal blooms have been reported by the public to the Athabasca Public Health Unit, and no beach testing has been done for *E. coli* and fecal bacteria levels.

Nutrient runoff from developed areas may negatively impact water quality in Skeleton Lake due to its relatively small watershed to lake area ratio (Logan et al., 2007). Decreases in water levels will likely exacerbate water quality problems within the lake through concentration of solutes and nutrients. In addition, algal blooms will likely increase in frequency and size. While there are limited water quality data for Skeleton Lake, key issues of surface water quality concerns include:

- Algal blooms and unpleasant odors;
- Spatiotemporal trends in nutrient concentrations and algal growth;
- Depressed property values, reduced tourism and recreational capability of the lake due to algal blooms and reduced water levels;
- Protection of drinking water source;
- Pollutants entering the lake from the watershed, leaky septic systems, erosion, and other sources;
- Land use in the watershed and how this affects water quality;
- Lowering water levels and how this affects water quality;
- General public awareness of the impacts of human activities on water quality and aquatic ecosystems; and
- Protection of water quality and sensitive areas (e.g., riparian, wetlands, lakeshore) in the watershed for future generations.

Short-Term Recommendations

- Identify point and non-point sources of contamination within the watershed.
- Establish a permanent working relationship with Alberta Health Services to initiate routine fecal coliform sampling at all public use sites throughout the open water season.
- Alberta Health should partner with the SLSA to establish a long-term strategy for sewage management, including regular testing for sewage, to identify and quantify sewage inputs into Skeleton Lake.
- Implement best management practices for agricultural fertilizer and pesticide use.
- Develop an education and outreach program, involving newsletters to residents, pamphlets, fact sheets, and a website, that addresses proper use of fertilizers on both residential and agricultural lands.

Long-Term Recommendations

- Initiate an intensive annual water quality monitoring program in both basins of Skeleton Lake.
- Establish a Total Maximum Daily Load (TMDL) for the lake, based on the nutrient budget for the lake.

- Divert or treat sources of runoff as required. This may involve stormwater management diversion or treatment methods, such as infiltration, decreasing impervious surfaces or grit and oil separation.
- Implement best management practices for land owners to improve runoff quality. This could include guidelines for residential application of pesticides and fertilizers, waste management procedures or bylaws discouraging vegetation removal from environmentally sensitive areas.
- Any new developments or roadways should have stormwater best management practices in place to promote stormwater retention and/or infiltration.
- A septic leachate survey should be conducted to identify leaking septic system. The contribution of septic leachate to the annual nutrient budget of Skeleton Lake needs to be quantified before management decisions can be made.
- Develop and establish a regional sewage system.
- Set minimum standards and guidelines for any installation of new sewage disposal systems around the lake as an interim solution until a regional system can be implemented.
- GIS techniques should be used to quantify land cover and land use changes within the watershed. This will help determine future land use allocations and management.

Performance Measures

- Improvements in water quality indicators as measured in the monitoring program, e.g., a decreases in lake phosphorus concentrations, with a long-term goal of moving the lake to mesotrophic levels.
- A decrease in algal bloom frequency based on water quality management, public education and remediation efforts.
- Identify non-point sources and point sources of pollution in the watershed.
- Developed and implemented bylaws or regulations regarding minimum engineering standards for new and existing septic systems, changes to the Land Use Bylaws, Area Structure Plans, Municipal Development Plans and other planning documents.
- Number of public outreach and education sessions held and attendance numbers at these sessions.

Enabling Legislation and Policy

- *Water Act* (AENV) - The Act governs the diversion and use of water. Regulates actions that affect water and water use management, fisheries habitat protection practices, in-stream construction practices, storm water management and enforcement.
- *Fisheries Act* (FOC) - Section 35 of the Act regulates harmful alteration, disruption and destruction of fish habitat, enforcement.
- *Agricultural Operations Practice Act* (AOPA) - Confined feedlot operations, environment standards for livestock operations.
- *Environmental Protection and Enhancement Act* (AENV) - Management of contaminated sites, management of storage tanks, landfill management practices, hazardous waste management practices, enforcement.

- *Municipal Government Act* (MGA) - MGA provides municipalities with the authority to regulate the management of private lands to control non-point sources of pollutants and enact bylaws and municipal land uses to ensure that land use practices are compatible with the protection of aquatic environment.
- *Land Use Bylaws* - The bylaw that divides the municipality into land use districts and establishes procedures for processing and deciding upon development applications. It sets out rules that affect how each parcel of land can be used and developed and includes a zoning map.
- *Area Structure Plan* - A plan adopted by Council as an area structure plan bylaw pursuant to the MGA that provides a framework for future subdivisions and development of an area.
- *Municipal Development Plan* - The plan adopted by Council as a municipal development plan pursuant to the MGA.
- *Public Lands Act* (ASRD) - Regulates activities that would affect bed and shores.
- *Safety Codes Act* (Municipal Affairs) - Septic systems management practices, installations of septic field and other subsurface disposal system.
- *Regional Health Authorities Act* - RHA 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.
- *Provincial Parks Act & Wilderness Areas* and *Ecological Reserve and Natural Areas Act* - Both Acts can be used to minimize the effects of land use activities have on water quality and the protection of aquatic resources.

4.4 Riparian Zones and Wetlands

Functional riparian zones and wetlands develop and maintain stream banks and shorelines, reduce erosion and sedimentation, decrease water velocities, store water, recharge aquifers, filter nutrients and contaminants and increase biodiversity. Riparian zones and wetlands provide water treatment, flood mitigation, wildlife and other vital environmental services. The cumulative loss and degradation of riparian zones and wetlands contribute to the decline of fish communities in Skeleton Lake. Current land use and development practices and lowered lake water levels have been cited as causing the loss of this habitat. Currently, there are no inventories of wetlands in Skeleton Lake. A Shoreline Assessment Summary was conducted in August 2008 by Alberta Environment, which examined 201 lake lots. The Assessment showed 36% of the sites had intact riparian areas, while 64% were moderately impacted or degraded (Alberta Environment, 2009). Approximately 70% of sites had encroachment onto Environmental Reserve areas (Alberta Environment, 2009).

Short-Term Recommendations

- Conduct a wetland survey/inventory for Skeleton Lake, as well as a more thorough riparian health assessment.
- Establish riparian setbacks for all developments along Skeleton Lake and other sensitive areas.

- Interpretive signs on existing walking paths through riparian areas could be used to educate tourists and property owners about the importance of riparian vegetation and functional riparian zones and wetlands.
- Updates on the human populations and use in the watershed, in and around the lake are required. To address this issue, data should be collected on the number of seasonal/permanent cottages, private campground utilization rates, number of lake users per day and use of water and sewage treatment facilities. Surveys could be sent to all residents of the lake and to all users of the lake through the campgrounds to gather information to address this data gap. This would help determine specific high use areas that need to be addressed and protected.

Long-Term Recommendations

- Collaborate with land owners, Cows and Fish, Ducks Unlimited Canada, and other agencies to restore or enhance lost/impaired riparian zones and wetlands. This could involve replanting programs, erosion control and educating cottage owners and developers regarding clearing of riparian and wetland plants. Bylaws restricting the clearing of vegetation on County lands should be enacted.
- Riparian buffer areas need to be preserved in their natural state. No new construction of roads, pathways, etc. should be allowed within these areas. This may require changes to existing land use bylaws and other planning documents.
- Changes to Land Use Bylaws to include riparian setbacks.

Performance Measures

- Municipal legislation in place for existing and future developments to protect and maintain riparian zones and wetlands around all environmentally sensitive areas.
- Remediation and reclamation of existing impaired riparian zones and wetlands.
- Improvement in riparian health as determined by riparian health surveys.
- No net loss of riparian zones and wetlands.
- Improvement in water quality in the lake.

Enabling Legislation and Policy

- *Water Act* (AENV) - The Act governs the diversion and use of water. Regulates actions that affect water and water use management, fisheries habitat protection practices, in-stream construction practices, storm water management and enforcement.
- *Fisheries Act* (FOC) - Section 35 of the Act regulates harmful alteration, disruption and destruction of fish habitat, enforcement.
- *Municipal Government Act* (MGA) - MGA provides municipalities with the authority to regulate the management of private lands to control non-point sources of pollutants and enact bylaws and municipal land uses to ensure that land use practices are compatible with the protection of aquatic environment.
- *Public Lands Act* (ASRD) - Regulates activities that would affect bed and shores.

- *Wildlife Act* (ASRD) - Protection of wetland-dependent and wetland associated wildlife and endangered species.
- *Provincial Parks Act & Wilderness Areas* and *Ecological Reserve and Natural Areas Act* - Both Acts can be used to minimize the effects of land use activities have on water quality and the protection of aquatic resources.
- *Land Use Bylaws* - The bylaw that divides the municipality into land use districts and establishes procedures for processing and deciding upon development applications. It sets out rules that affect how each parcel of land can be used and developed and includes a zoning map.
- *Area Structure Plan* - A plan adopted by Council as an area structure plan bylaw pursuant to the MGA that provides a framework for future subdivisions and development of an area.
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4.5 Fish and Wildlife Habitat

In the past, Skeleton Lake supported abundant populations of northern pike, yellow perch, cisco, lake whitefish and some walleye. Commercial fishing occurred for 50 years, with cisco and lake whitefish being the predominant species harvested (Alberta Municipal Affairs, 1979); however commercial fishing operations ceased in 2001 as by-catches began to exceed non-target species allowances (walleye and pike) (C. Davis, pers. comm., 2007). By 1985, the walleye sportfishery had collapsed (Patterson and Sullivan, 1998) and this species was almost extirpated (Latty, 2005). Walleye restocking endeavors occurred from 1988-1991 and in 1993 in an attempt to recover the population (Latty, 2005). Test angling showed that some recruitment had occurred by 2001 (Latty, 2005). All areas of Skeleton Lake are used by fish species similarly; however, some areas are more sensitive to development pressures, pollution and lowered water levels (e.g., the narrows and cattail marshes and weed beds adjacent to the shore are more sensitive than gravel or sand beds) (C. Davis, pers. comm., 2007). The lake is currently closed to angling during the spawning season for walleye and pike (April 1 - May 15), with a no-kill limit on walleye and reduced-catch limit on pike (maximum of one over 63 cm in length) during the remainder of the year (Alberta Sustainable Resource Development, 2008).

The shores of Skeleton Lake have limited waterfowl production potential due to adverse topography, reduced marsh edge and low soil fertility; however, the Narrows are rated as having only slight limitations to waterfowl production. While Skeleton Lake is not a significant regional waterfowl or waterbird nesting area, gulls, terns, goldeneye, grebes, scaup, loons, mallards, buffleheads and raptors have been spotted in the Skeleton Lake area (Alberta Municipal Affairs, 1979; ASRD, 2005). The forested areas surrounding Skeleton Lake provide habitat for ungulates, black bears, game birds, small mammals and coyotes.

Continued loss of forested areas and the impairment of riparian zones and wetlands will decrease the habitat available for fish and wildlife species (Logan et al., 2007). For example, the Cape May Warbler (*Dendroica tigrina*) is a migratory bird that requires mature to old forest stands with a predominantly

coniferous canopy. Currently, this bird species is included on the 'Blue List' of species that may be at risk in Alberta due to concerns over habitat loss and declines in populations in some areas. The Alberta Natural Heritage Information Centre has assigned this warbler a provincial rank of S2, indicating imperilment due to rarity. In addition, the yellow rail (*Coturnicops noveboracensis*) occurs in the area and is listed as a species of 'Special Concern' on the list of Species at Risk in Canada (Environment Canada, 2009). Nesting yellow rails can be found in damp fields and meadows, on the floodplains of rivers and streams and in the herbaceous vegetation of bogs. A decline in wetlands in the Skeleton Lake watershed due to increasing development will decrease the available breeding habitat for this species.

The following key issues and concerns have been identified for the protection of the aquatic resources (SLSA, 2006):

- Continuous disturbance of the shoreline and the riparian areas poses significant threat to critical fish and wildlife habitat; and
- Concerns regarding disappearance of fish spawning areas and critical wildlife habitat.

Short-Term Recommendations

- Identify critical fish spawning and wildlife habitat.
- As suggested by ASRD (2004), fisheries management plans need to be basin/watershed-specific to maintain the productive capacity of the water body. Requirements of all fish species need to be quantified for survival and subsequent population increase.
- Educate the public about the importance of maintaining aquatic and riparian vegetation. This may include interpretive signs along the shoreline of Skeleton Lake or fact sheets that explain the link between habitat conservation and fish and wildlife populations.

Long-Term Recommendations

- Develop a nutrient budget and a total maximum daily load (TMDL) for Skeleton Lake to help control phosphorus and nitrogen levels, thereby reducing excessive plant and algal growth and preserving oxygen levels throughout the water column in both basins. This will provide more available habitat for fish populations.
- Stabilize and/or increase water levels in Skeleton Lake to provide more available habitat for fish.
- Protect wildlife habitat through conservation easements or other methods.
- Develop and implement a wildlife management plan, e.g., for fish, waterfowl and amphibian populations.
- Collaborate with land owners, Ducks Unlimited Canada, Alberta Conservation Association, Cows and Fish, and other such agencies to restore or enhance lost/impaired riparian and wetland areas, which provide important wildlife habitat.

Performance Measures

- Increase in submerged, emergent and riparian zone plant communities, which provide habitat for fish and wildlife.

- Development and implementation of a fish and wildlife management plan specific for the Skeleton Lake watershed.
- Increase in populations of waterfowl and fish species.

Enabling Legislation and Policy

- *Water Act* (AENV) - The Act governs the diversion and use of water. Regulates actions that affect water and water use management, fisheries habitat protection practices, in-stream construction practices, storm water management and enforcement.
- *Fisheries Act* (FOC) - Section 35 of the Act regulates harmful alteration, disruption and destruction of fish habitat, enforcement.
- *Municipal Government Act* (MGA) - MGA provides municipalities with the authority to regulate the management of private lands to control non-point sources of pollutants and enact bylaws and municipal land uses to ensure that land use practices are compatible with the protection of aquatic environment.
- *Public Lands Act* (ASRD) - Regulates activities that would affect bed and shores.
- *Land Use Bylaws* - The bylaw that divides the municipality into land use districts and establishes procedures for processing and deciding upon development applications. It sets out rules that affect how each parcel of land can be used and developed and includes a zoning map.
- *Area Structure Plan* - A plan adopted by Council as an area structure plan bylaw pursuant to the MGA that provides a framework for future subdivisions and development of an area.
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4.6 Groundwater Resources

Groundwater dynamics are likely relevant components of water resources in Skeleton Lake. There is a growing concern regarding groundwater availability and its relationship to lake water levels (SLSA, 2009). Within the Skeleton Lake Watershed, about 280 groundwater wells (domestic, industrial and diversion) have been drilled, which includes all active and reclaimed wells registered since 1977; however, not all wells drilled have been reported (Alberta Environment, 2002). At this time, there are not enough data available to determine what effect groundwater allocations have on the overall groundwater budget in the Skeleton Lake watershed (Logan et al., 2007).

The majority of the Skeleton Lake watershed is at low risk of groundwater contamination, but the southwest portion along The Summer Village of Mewatha Beach and near the Village of Boyle is ranked as high risk for contamination (Figure 8; HCL, 2000). The high risk areas should be avoided for developments that have products or by-products that could cause groundwater contamination (Logan et al., 2007). Detailed hydrogeologic studies should be completed at any proposed development site to ensure the groundwater will be protected from contaminants. In addition, good environmental practices should be exercised throughout the watershed to ensure that contaminants do not affect groundwater quality.

Short-Term Recommendations

- Continue monitoring of water levels in Skeleton Lake.
- Develop a groundwater quality and quantity testing program and assess groundwater and surface water interactions.
- Adopt a WCO for Skeleton Lake, which encompass the identification of water volumes required for human use (including existing consumptive and non-consumptive uses), lake levels and the necessary water quality required to protect the aquatic environment.

Long-Term Recommendations

- Detailed groundwater mapping should be performed to determine important discharge and recharge areas throughout the Skeleton Lake watershed and in proximity of Skeleton Lake.
- Land use and development decisions should consider the sensitivity of groundwater resource to contamination from point sources and non-point sources of pollution within the watershed.
- Move to a regional water supply system.

Performance Measures

- Development of a water availability study to determine impacts of groundwater diversions on water levels in Skeleton Lake.
- Adopt a Water Conservation Objective (WCO) for the Skeleton Lake basin to ensure minimum levels required for the protection of the lake and its aquatic environment.
- Annual groundwater quality testing and reporting to measure parameters of interest to groundwater quality, e.g., nutrients, suspended solids and bacteria.
- Development of groundwater quality indicators.
- Mapping of groundwater interactions in the area.

Enabling Legislation and Policy

- *Water Act* (AENV) - The Act governs the diversion and use of water. Regulates actions that affect water and water use management, fisheries habitat protection practices, in-stream construction practices, storm water management and enforcement.
- *Environmental Protection and Enhancement Act* (AENV) - Management of contaminated sites, management of storage tanks, landfill management practices, hazardous waste management practices, enforcement.
- *Safety Codes Act* (Municipal Affairs) - Septic systems management practices, installations of septic field and other subsurface disposal system.
- *Regional Health Authorities Act* - RHA 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.
- *Land Use Bylaws* - The bylaw that divides the municipality into land use districts and establishes procedures for processing and deciding upon development applications. It sets out rules that affect how each parcel of land can be used and developed and includes a zoning map.

- *Area Structure Plan* - A plan adopted by Council as an area structure plan bylaw pursuant to the MGA that provides a framework for future subdivisions and development of an area.
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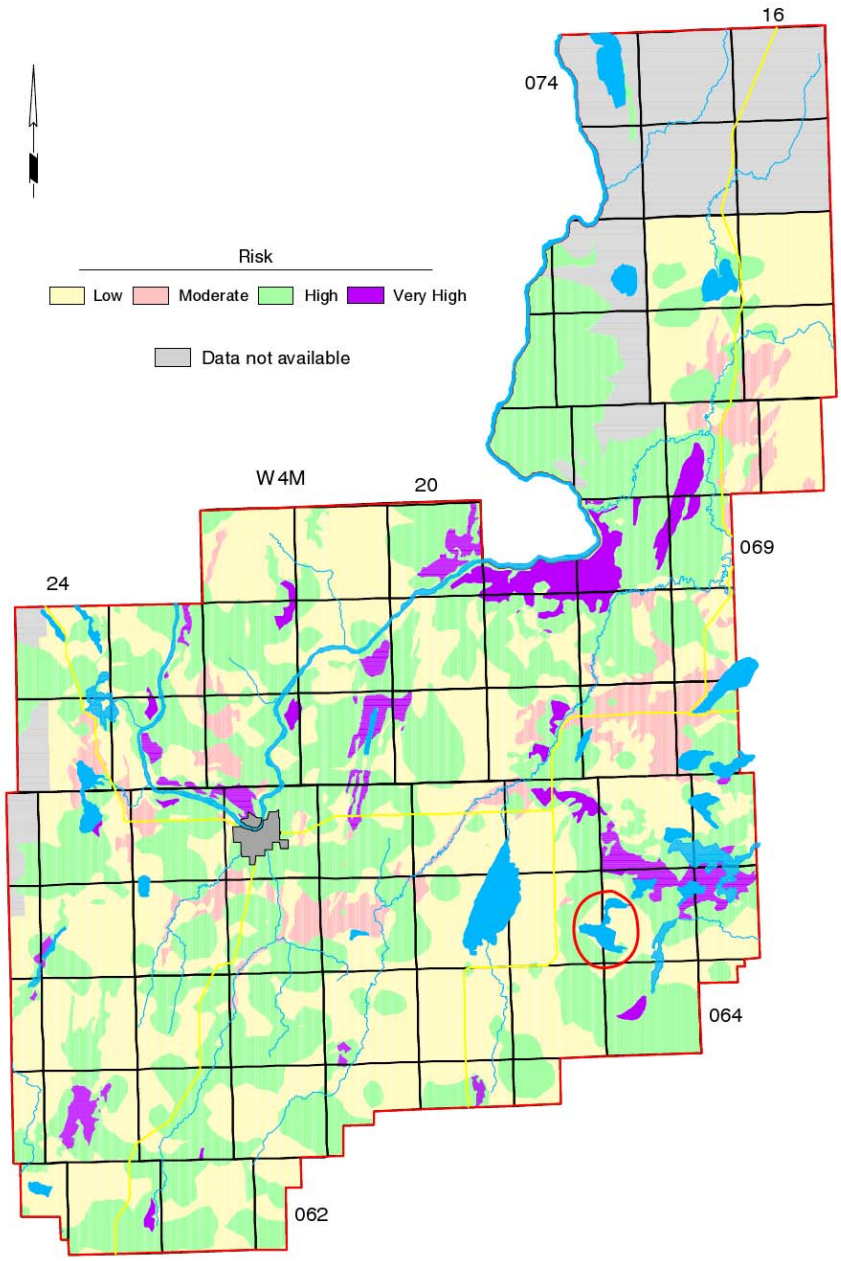

Figure 8. Risk of groundwater contamination (the red circle indicates the location of the Skeleton Lake watershed; modified from HCL, 2000).

5 Conclusions

The Skeleton Lake WMP objectives were outlined in the ToR in 2006 and consist of issues relating to water quantity, quality, land use practices, protection of riparian zones, wetlands and fish and wildlife habitat. These issues are interconnected. Consequently, several recommendations appear repeatedly in different sections. This WMP recommends that the following issues be addressed as soon as possible: (1) detailed groundwater assessment for the entire watershed; (2) formulation of Water Conservation Objectives; (3) restoration of riparian zones and wetlands; (4) augmentation of land use, area structure and municipal development plans in the County of Athabasca No. 12, the Village of Boyle, the Summer Villages of Bondiss and Mewatha Beach to reflect recommendations of this WMP; and (5) development of an education program that focuses on sustainable watershed management practices. These issues are addressed in more detail below.

1. Water levels in Skeleton Lake have decreased considerably over the past 12 years, partly in response to water diversions by the Village of Boyle since 1969 (to be ceased in June 2010), private water consumption, climatic variability, groundwater recharge to local aquifers, and agricultural activities. Lowered water levels have resulted in the drying up of the Narrows and an impairment of fish and wildlife habitat, deterioration of water quality and restrictions to recreational uses of the lake. Since it is likely the entire watershed lies in a groundwater recharge area, water inputs via precipitation and surface water flow alone will likely not be able to sustain stable water levels in Skeleton Lake in the long-term. This WMP strongly recommends that a comprehensive groundwater assessment of the Skeleton Lake watershed be done to determine how much water leaves Skeleton Lake via groundwater flow. Artificial (e.g., rhodamine WT, deuterium, tritium, CFCs, etc.) or natural tracers (e.g., sodium, bromine, strontium isotopes, etc.) can be used to determine the age of groundwater reservoirs as well as groundwater flow rates and direction through aquifers underlying the Skeleton Lake watershed. These tracers can also be used to identify natural (e.g., lakes, creeks) and anthropogenic (dug outs, gravel pits, ditches, etc.) bodies of water that have received water from Skeleton Lake via groundwater flow.
2. WCO pursuant to provisions provided in the *Water Act* need to be adopted to ensure the long-term sustainability of the lake and enjoyment by future generations of lake residents and visitors. The WCO needs to identify water volumes required for human and industrial/commercial uses, minimum lake water levels and the necessary water quality required to protect the aquatic environment as well as riparian and wetland habitats. The WCO must be adopted in consultation with local land owners and visitors to the lake, industry and the County of Athabasca No. 12 and partner municipalities in the watershed planning area.
3. Impoundments to surface water flows should be identified and restoration of overland water flows to the lake should be restored.
4. The restoration and/or maintenance of riparian zones and wetlands are crucial in improving water quality in Skeleton Lake. All existing and degraded riparian zones and wetlands can be identified at low cost using aerial photographs and on-the-ground surveys. Subsequently,

collaborative endeavors with Cow and Fish or Ducks Unlimited Canada can assist in the identification of *critical* riparian zones and wetlands, restoration efforts for degraded riparian zones and wetlands and in their subsequent proper management. Legislatively, there are many tools available for the protection of critical riparian zones and wetlands that can be explored, including Conservation Easements, Environmental Reserves, Protective Notations, Land Trusts, purchasing land or land trades.

5. From a land use perspective, the County of Athabasca No. 12, the Village of Boyle, the Summer Villages of Bondiss and Mewatha Beach and partner municipalities in the watershed planning area should review their existing planning documents and land use bylaws and incorporate the recommendations listed in this WMP. In addition, appropriate enforcement measures will also be a vital component of the implementation of this plan. Individuals choosing to ignore environmental protection tools, such as best management practices, bylaws and guidelines, must be made aware of the importance of changing their perspectives and increasing their awareness of environmental issues in the Skeleton Lake watershed.
6. Public outreach and education programs form an important component of any WMP. The SLSA should develop outreach activities, publish newsletter, articles and pamphlets and maintain their web site regularly to generate public support for the WMP and assist in the implementation of the recommendations contained herein. Thoughtful and creative use of the tools recommended in this plan can result in a marked improvement in the water quality in Skeleton Lake and in the general overall ecological health and functionality of the entire watershed.

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7 Appendix

Terms of Reference for the Skeleton Lake Watershed Management Plan