FLOW

Future of the Lake of Old Wives Sustainability Plan

Group 9

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Mission Statement

The FLOW Plan is dedicated to securing a sustainable future for the Old Wives Subbasin, located in Saskatchewan, Canada, for clean water, healthy ecosystems, and resilient communities. By 2040, the FLOW Plan will:

- Reduce sediment and point-source pollution entering the Old Wives Lake and its tributaries by 50%.
- Restore and protect the area of wetland habitats to support biodiversity and migratory bird populations by 20 square kilometers.
- Enhance water retention and build resilience to incidents of drought and flooding by incentivizing the uptake of sustainable land use practices and increasing native vegetation cover by 5%.

We choose the timeframe of 15 years, with a 2040 deadline, due to the size of the subwatershed and the degree to which its current problems impact its quality. After the plan's initial implementation, consistent monitoring and adjustment to the procedure are expected to occur.

Background

Canada has 594 total watersheds, encompassing 25% of the world's wetlands. One of those watersheds, the Old Wives Lake Subbasin, is located on the southern border of Saskatchewan, Canada, near the border with Montana. Perhaps one of the most unique characteristics of the watershed is its endorheic nature. Essentially, the water bodies within this watershed do not have any outflow points, meaning water leaves the system through infiltration or evaporation. Its primary inflow is from the Wood River, which runs along the southern border of the watershed ("IBA Old Wives..., n.d"). The region's climate is semi-arid, making it susceptible to frequent droughts. However, as stated, the area's lack of outflow also leads to increased groundwater infiltration, which, contradictorily, has also led to a pattern of increased flood occurrences.

Its primary inflow is from the Wood River, which runs along the southern border of the watershed ("IBA Old Wives..., n.d"). Nearby communities where water enters Old Wives Lake include Mossbank, Limerick, Mankota, Cadillac, and Hodgeville [see Figure B]. The watershed, though vast in area, has a relatively small population of only 9,300 residents ("Water Security Agency", 2014). The surrounding 32 municipalities are highly rural, with their primary economic drivers being agriculturally focused, though some localized mining and petroleum extraction exist across communities ("Water Security Agency", 2014). Agriculture makes up most of the watershed's land uses, accounting for 58.10% of land cover through annual cropland and 26.24% of land cover being native pasture [see Figure A] ("Water Security Agency" 2014). These intensive forms of land use, which make up most of the region, contribute to most of the central problems that will be discussed in this report.

This watershed was first inhabited by the Lakota and Nakota First Nations, which are part of the Greater Sioux Nation. "Old Wives" acquired its name through a Cree legend which states a tribe's older women sacrificed themselves to a Blackfoot tribe so that the remaining tribe members could escape safely (*Old Wives Massacre*, 2022). This area was established as a Migratory Bird Sanctuary in 1925 and was recognized as an Important Bird Area in 1997, meaning habitat quality could be regulated in order to ensure the preservation of this area for the migratory species ("Old Wives Lake Migratory…", 2015). Tens of thousands of birds use the area within a single migration season, which also introduces another economic inflow of bird watching for the region ("IBA Old Wives..., n.d"). The Old Wives Watershed Association was first called the Wood River Environmental Authority, and then the Wood River Riparian Authority before its current title.

Policies and Mandates

The most recent policy in place is the Old Wives Lake Watershed Plan, which was established in 2014. Its key visions were to improve environmental health, specifically that of water quality, availability, and sustainable usage, and to ensure habitats were healthy, diverse, and protected ("Water Security Agency", 2014). The Water Security Agency established the Plan, based in Moose Jaw, a community directly within the watershed. The preceding key legislation established this Agency as the primary body tasked with water resource management for Saskatchewan, which was the Water Security Agency Act of 2005. Another important policy for the watershed was the Migratory Birds Convention Act of 1994, which designated the area as a Migratory Bird Sanctuary. This gave the Canadian government the ability to regulate the area accordingly in order to protect the habitat for the migratory species that would reside there. Finally, the overarching policy that guides the management of water systems today is the Canada Water Act of 1985, which essentially established the framework for the Provinces to coordinate efforts to conserve, develop, and use Canadian water resources

Governance Structure

The country of Canada is designed to have a constitutional monarchy reminiscent of its British roots, coupled with a parliamentary democracy. In other words, the country acts as a

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vessel of the British monarchy but derives its authority from the Canadian parliament. This system has three levels: federal, provincial, and municipal. Specific to the province, Saskatchewan has a unicameral legislature, a Lieutenant Governor, and a Premier. The Lieutenant Governor represents the British monarchy, and the Premier represents the executive branch. Local governments take on a collaborative approach to watershed management, involving the Water Security Agency, First Nations representatives, and municipal governance bodies. The Water Security Agency is an organization dedicated to water management for this province, ensuring that the quality and supply of the resource are accounted for. It was established in times when concern for water conservation was rising. In correspondence with municipal government bodies, the organization has been responsible for developing several local watershed management plans, including a previous draft for the Old Wives Lake Watershed.

Problems

Problem	Description	Causes	
Excessive Nutrient and Sediment Runoff	Substantial amounts of pollutants and sediment enter this watershed, resulting in poor water quality, algal blooms, and reduced aquatic habitat health.	Since the majority of the land use is agricultural, nutrients, including nitrogen and phosphorus, can enter the waterbodies following a precipitation event through runoff.	
Wetland Degradation and Habitat Loss	Many wetlands in the subbasin have been drained or degraded from their previous standards. This loss reduces critical habitat for migratory birds and other wildlife organisms that rely on the area.	Intensive land uses, like agriculture and some of the minor land development of surrounding communities, lead to the draining and degradation of the natural landscape. Agriculture makes up 58.10% of land cover in the watershed.	
Vulnerability to Climate Stress	The subbasin is highly vulnerable to both drought and flooding. At least twice in the past century, the droughts experienced have been severe to the point that the Old Wives Lake has completely dried up. Flooding events have also become increasingly frequent in recent decades.	The semi-arid climate, coupled with the endorheic water system, makes the region especially prone to drought events. Old Wives Lake Watershed is also susceptible to variable moisture conditions, which, once again, paired with the endorheic design of the water system, leads to heightened flooding. Climate change only exacerbates these occurrences, in both frequency and magnitude.	

Problem 1: Excessive Nutrient and Sediment Runoff

Agricultural runoff in this region is the primary contributor to increased nutrient and sediment loads in the waterways. In the years of 2011 and 2012, it was found that Phosphorus levels were 0.39 mg/L and 0.31 mg/L, respectively ("Water Security Agency", 2014). Nitrogen levels were within acceptable levels during these measured periods. The heightened Phosphorus measurements are likely correlated with fertilizer usage and animal waste decomposition. The impairment of water quality within the Old Wives Lake watershed has led to substantial negative impacts on the ecosystem, such as increased frequency and intensity of algal blooms and habitat degradation. Water quality is necessary for overall ecosystem health, recreational use, and the long-term sustainability of the watershed.

Goal 1: Reduce Pollution

The FLOW team's vision to reduce excessive nutrient and sediment loads in runoff will be accomplished through several proposed actions. Restoring riparian buffers by increasing native plant and vegetation cover will ensure that habitat disruption is minimized. If funding is available, rain gardens may possibly be an effective approach that is both effective and engages community members.

Additionally, since agriculture presents such a challenge to the watershed, it is important that it be addressed in our goal. There are a number of farming best management practices, some which will require a monetary supplement, that can be implemented to reduce their intense ecosystem impacts. Implementing cover crops, conservation tillage modifications, and improving drainage methods are all feasible methods in reducing the effects of agriculture without sacrificing the source that makes up a majority of the region's economic sector.

Problem 2: Wetland Degradation and Habitat Loss

The second problem that will be addressed within this report is wetland degradation and habitat loss. Most land uses are at least detrimental to the surrounding ecosystem to some extent, though this relationship is especially pertinent between agricultural uses and wetlands. Not only does the physical expansion of agricultural land lead to habitat and wetland loss, but the practices of tilling, irrigation, pesticide use, and fertilizer use disrupt the functions of the natural ecosystem (*Wetlands and Agriculture*..., 2021). Agricultural land cover in the past decade has continued to follow an increasing trend, while water and its associated riparian areas only account for 5.13% of total land cover within the watershed ("Water Security Agency", 2014). It is important to note that a majority of these water bodies and wetland areas either have an extremely minimal or nonexistent aquatic buffer between themselves and the crop lands, meaning that runoff is easily able to infiltrate the waterways.

The recognition of this problem is important for a number of reasons. As mentioned, the Old Wives Lake Watershed is both a Migratory Bird Sanctuary and an Important Bird Area. It has been quantified that tens of thousands of organisms utilize the habitat throughout their migration journey ("Bird Studies Canada", 2011). Beyond the species themselves, wetlands have been quantified to accrue both monetary and use benefits through their provided ecosystem services (*Why are Wetlands Important*, 2025).

Goal 2: Restore Wetlands and Critical Habitats

Our corresponding goal to the second problem is to restore wetlands and critical habitats by twenty square kilometers. Given that this watershed provides such a critical habitat for migratory bird species, the FLOW team feels that this is an ambitious but necessary goal to be achieved by 2040. Restoring the wetland area will require the coordination of local municipal bodies and private landowners. A number of approaches can be enacted, including land acquisition programs, conservation easements, an increase in minimum setback requirements, and landowner stewardships. One possible strategy that the FLOW team is particularly interested in, but would require significantly more planning, is Alternative Land Use Services, which have had success throughout Canada (Melchior, 2019). This has been implemented at the national level and provides either annual payments or best management practice implementation cost-share assistance to farmers who actively work to restore wetlands on their property (*Alternative Land Use Services*, 2025). Though this alternative requires funding, the long-term benefits of wetland services are essentially balanced with the farmers' incentive to convert natural land into agricultural expansion.

Problem 3: Vulnerability to Climate Stress

The final problem that will be addressed in this report is the Watershed's particular vulnerability to climate stress. As discussed, drought and flood events have been historically severe and frequent. Since 1980, there have been nine adverse drought or drought-caused events and eighteen adverse flooding or flood-caused events that have impacted the Watershed, as of 2011 [see Figure C] (Espeseth et al., 2012). The endorheic topography of the Old Wives Lake

Watershed, coupled with its semi-arid climate, leaves it especially susceptible to these impacts, which are unfortunately only further amplified under the conditions of climate change. As these extreme weather events become more frequent and severe, the ecosystem's ability to regulate itself is threatened. Water supply is reduced during droughts, while flooding can lead to increased runoff and diminished water quality; in both cases, surrounding land, whether agricultural or developed, may be compromised.

Goal 3: Build Resilience to Climate Impacts

Mitigating the causes of drought and flooding events is extremely challenging; however, proactive adaptation involves effective measures that can be implemented to reduce the intensity of impacts experienced in the area. The FLOW team's primary action item is to increase permeable and native vegetation cover by 5% through promoting flood-preventative and drought-resilient practices for agriculture, individual land management, and nearby communities. This approach will increase groundwater retention within the Watershed, reducing the impacts of both extreme weather events on the land and its uses.

Several approaches can be discussed and implemented if deemed fit by the surrounding communities. For farmers, the implementation of cover crops, irrigation best management practices, and conservation tillage systems should be considered. Bioswales may also be implemented as an innovative alternative to improve infiltration and reduce stormwater runoff. Finally, increasing permeable surface and native vegetation cover, especially in areas in close proximity to sensitive waterways or wetlands, will be effective in addressing this problem. Since our goals correlate and even overlap in some cases, addressing the problems discussed in this

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report by the 2040 deadline will be highly feasible if the implementation, monitoring, and adjustments stages of the watershed management plan are executed effectively.

Recommendations

It is the recommendation of this committee that these goals and action items be implemented to preserve the quality of the Old Wives Lake Watershed. A suggested timeline [see Figure D] would begin from 2025 to 2030, where stakeholders are engaged, pilot implementation projects are tested, and baseline data is collected. Following this period, from 2030 to 2035, would involve the implementation of full-scale BMPs through our drafted action items and the usage of a consistent monitoring mechanism to make adjustments to the plan if needed. Finally, from 2035 to 2040, the committee expects to continue its evaluation of progress and prepare for long-term enforcement procedures following the plan's conclusion.

Conclusion

The Old Wives Lake Watershed is a uniquely valuable ecosystem—both environmentally and economically—that now faces serious and complex challenges. With a semi-arid climate, endorheic hydrology, and high dependence on agriculture, the region must address the mounting threats of nutrient runoff, wetland degradation, and water retention loss. By targeting pollution reduction, habitat restoration, and land use improvements, the plan balances ecological integrity with rural economic needs. Protecting the watershed will require strong collaboration among local communities, industries, and environmental stakeholders. The long-term health of the Old Wives Lake Watershed depends not only on bold goals but also on sustained commitment, adaptive management, and an appreciation of water as a shared and vital resource.

Appendix





Source: Water Security Agency





Source: Water Security Agency

Figure C

Table 1. Participatory Mapping Exercise Old Wives Lake Watershed November 17, 2011

1	1997 spring flood	18	Prairie fire 2011
2	Seven day storm in February 1978	19	June 2011 rain resulting in a flash flood
3	Periods of drought in 2001-03 and early 1980's	20	April 2011 flood Notukeu Creek overflow, sandbagged water treatment plant in Vanguard. South town access was flooded
4	Large snow pack in 2009-10 and 2010-11	21	1997 Spring flood in RMs 106, 105, 76 and 75
5	Prairie fires in August 2005 (roughly 3000 acres burnt over 2 weeks)	22	2000 flood
6	Huge flood – Vanguard July 3 rd 2000 336-375 mm in 8 hour period	23	Widespread drought in the south west portion of the watershed in 2004 and 2009
7	Wells dry in 2007 and 2008	24	1952-53 flood washed out Gouverneur dam
8	Approximately 25 inches of rain in 1991	25	Huge snowfall in the 1970's
9	Flood prone area typically floods every year	26	Approximately 7 inches of rain over 12 hours in 2011
10	Flood prone area typically floods every year	27	Unable to seed in 2010 due to excess moisture
11	Flood prone area typically floods every year	28	Channel erosion, river changed course River bridge underwater for roughly 2 months
12	Wells dug in May 2011	29	Significant infrastructure damage due to high runoff event in 1997
13	9 inches of rain in 2011 over two weeks	30	Backflood structure damaged in 1997 and decommissioned
14	Plow wind and rain in 2005	31	1985 and 1988 droughts
15	Lake dry in 1998 and 2007	32	Sudden runoff in 1999 led to erosion issues
16	Lake full in 1991 and 2011 Road under water in 1991 and nearly in 2011	33	Highway 58 washout in 2011
	Culverts washed out in 2011 Could potentially lose road in 2012	34	Flooded acres throughout watershed in 2011
17	Prairie fire 1990	35	Old Wives Lake went dry in 1988 and salt blowing

Source: Old Wives Watershed Association

Figure D

2025-2030	Engage stakeholders, pilot restoration sites, and collect baseline data.
2030-2035	Implement full-scale BMPs, expand wetlands, and enhance monitoring.
2035-2040	Continue to evaluate progress, make adaptive improvements, and measure long-term outcomes.

Source: FLOW team



Figure E (Source: FLOW Team; Data: ArcGIS Online and LivingAtlas)

Figure F (Source: FLOW Team; Data: ArcGIS Online and LivingAtlas)





Figure G (Source: FLOW Team; Data: ArcGIS Online and LivingAtlas)



Figure H (Map Array): (Source: FLOW Team; Data: ArcGIS Online and LivingAtlas)

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Works Cited

About the Old Wives Watershed. (n.d.). Retrieved March 16, 2025, from

https://www.oldwiveswatershed.com/about-us/about-us/

Agriculture and Agri-Food Canada. (2018). Beneficial Management Practices for Agricultural Land. Retrieved from: https://agriculture.canada.ca

Agriculture Canada. Crop Inventory, 2018 (Feature Layer). Living Atlas, Agriculture and Agri-Food Canada, 24 Sep. 2020.

https://www.agr.gc.ca/atlas/rest/services/imageservices/annual_crop_inventory_2018/Ima geServer.

"Bioswales: How They Work." V-k.net, Veenstra & Kimm Inc., 2025.

https://www.v-k.net/bioswales-how-they-work/

Bird Studies Canada. (2021). Prairie Habitat Joint Venture Bird Monitoring Report. Retrieved

from: https://www.birdscanada.org

Canadian Wildlife Federation, Natural Resources Canada, and Environment Canada. (2006).

Canada's Watersheds [Map]. Her Majesty the Queen of Canada, Natural Resources

Canada.

https://ftp.geogratis.gc.ca/pub/nrcan_rncan/raster/atlas/eng/poster_affiche/watershed_bass in versant.pdf

Crandon, Murray. "Old Wives Lake Nature Area and Interpretive Trails."

Tourismsaskatchewan.com, Tourism Saskatchewan Canada, n.d.

https://www.tourismsaskatchewan.com/listings/470/old-wives-lake-nature-area-and-inter pretive-trails. Dempsey, Kevin and Kevin Friesen and Dale Poulter. "Wetlands: The Unsung Heroes Of Our Natural World." Blog.cwf-fcf.org, Canadian Wildlife Federation, 02 Feb. 2017. https://blog.cwf-fcf.org/index.php/en/wetlands-the-unsung-heroes-of-our-natural-world/.

Drugge, Jordan and Sharon L. Doty. Edited by Elizabeth Rogers. "Riparian Buffers in

Agricultural Areas." Openknowledge.fao.org, International Polar Commission, Mar. 2019.

https://openknowledge.fao.org/server/api/core/bitstreams/aae3a349-0b36-4115-bfe4-c228 313379af/content.

- Ducks Unlimited Canada. (2023). Wetland Restoration Initiatives in Saskatchewan. Retrieved from: https://www.ducks.ca
- Environment and Climate Change Canada. (2020). Canadian Environmental Sustainability Indicators: Water Quality. Retrieved from:

https://www.canada.ca/en/environment-climate-change/services/environmental-indicators /water-quality.html

Esri Canada. Canada's Census of Agriculture 2021 (Feature Layer). Living Atlas, 19 Apr. 2023, https://services.arcgis.com/wjcPoefzjpzCgffS/arcgis/rest/services/Agriculture_Census_20 21/FeatureServer.

Esri Canada. Census of Agriculture 2016 - Livestock, Poultry & Bees (Feature Layer).

Government of Canada, Statistics Canada, 29 Mar. 2019,

https://services.arcgis.com/zmLUigh7X11gGV2d/arcgis/rest/services/Census Ag CD 2

016_Animal/FeatureServer.

Government of Saskatchewan. (2021). Riparian Area Management Guidelines. Retrieved from:

https://www.saskatchewan.ca

- Gringas, Bev, et al. "Boreal Wetlands of Canada and the United States of America." Cclmportal.ca, Canadian Conservation and Land Management, Aug. 2016. https://www.cclmportal.ca/resource/boreal-wetlands-canada-and-united-states-america.
- Heaton, Grigory. "Piping plovers forage..." Chesapeakebay.net, Chesapeake Bay Program, 2025. https://www.chesapeakebay.net/discover/field-guide/entry/piping-plover.
- Kotoski, James E. "Black Earth Creek & Limnology Minifacts & Analysis Sheet 2." Osse.ssec.wisc.edu, Spring Harbor Environmental Magnet Middle School, 1997. <u>https://osse.ssec.wisc.edu/curriculum/earth/Minifact2_Phosphorus.pdf</u>.
- Lewry, Marilyn. "Old Wives Lake." Esask.uregina.ca, University of Regina, 2006. https://esask.uregina.ca/entry/old_wives_lake.html#:~:text=Once%20named%20Johnston e%20Lake%20after,their%20community%20from%20Blackfoot%20warriors.
- North American Waterfowl Management Plan. (2018). Plan Update for Wetlands and Waterfowl Conservation. Retrieved from:

https://www.fws.gov/birds/management/bird-management-plans/north-american-waterfo wl-management-plan.php

"Old Wives Lake Nature Area and Interpretive Trails." Tourismsaskatchewan.com, Tourism Saskatchewan Canada, n.d.

https://www.tourismsaskatchewan.com/listings/470/old-wives-lake-nature-area-and-inter pretive-trails.

Prairie Adaptation Research Collaborative. (2020). Climate Change Impacts and Adaptation Strategies for Saskatchewan Watersheds. Retrieved from: <u>https://www.parc.ca</u> Saskatchewan.Government. Resource Map (Feature Layer). ArcGIS Online, Saskatchewan Government, 12 Nov. 2024,

https://gis.saskatchewan.ca/egis/rest/services/Economy/Resource Map/FeatureServer.

Saskatchewan Ministry of Environment. (2020). Invasive Species Strategy. Retrieved from: https://www.saskatchewan.ca

- Saskatchewan Water Security Agency. (2021). Saskatchewan Watershed Planning Guide. Retrieved from: <u>https://www.wsask.ca</u>
- "TDS And PH." Safewater.org, Safe Drinking Water Foundation, 2025,

https://www.safewater.org/fact-sheets-1/2017/1/23/tds-and-ph.

- Water Rangers. (2022). Citizen Science Water Monitoring Toolkit. Retrieved from: https://www.waterrangers.ca
- Natural Resources Canada. (2021). Remote Sensing for Environmental Monitoring. Retrieved from: <u>https://www.nrcan.gc.ca</u>
- Water Security Agency. (2014). Old Wives Lake Watershed Plan. Retrieved from:

www.wsask.ca/wp-content/uploads/2021/02/OldWivesLakeWatershedPlan.pdf.