

Assessing the Effectiveness of Source Water Protection Plan in Saugeen Valley Source Protection Area

by

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Abstract

The protection of drinking water sources is a cornerstone of public health, environmental sustainability, and economic resilience. This study critically evaluates the implementation and effectiveness of the source water protection plan within the Saugeen Valley Source Protection Area, established following Ontario's landmark Clean Water Act of 2006, itself a legislative response to the Walkerton tragedy of 2000. Using a combined framework of performance and process evaluation, this research investigates the degree to which source water protection initiatives have improved water quality, influenced stakeholder engagement, addressed financial issues.

Employing a qualitative mixed-method approach, data were gathered from semi-structured interviews with key stakeholders actively engaged in the source water protection implementation, supplemented by a comprehensive review of pertinent documents including water quality reports, committee minutes, financial records, and progress reports. Performance evaluation assessed tangible outcomes such as improvements in surface and groundwater quality indicators (phosphorus, E. coli, and macroinvertebrate populations), reliability and accessibility of safe drinking water, and aquatic ecosystem health. Complementing this, process evaluation examined governance elements including stakeholder participation levels, transparency, communications, institutional coordination, and financial continuity.

Findings demonstrate significant advancements in source water quality within the Saugeen Valley Source Protection Area, notably through successful nutrient management strategies that substantially reduced phosphorus and nitrate contamination, and improvements in municipal wastewater treatment infrastructure which have enhanced microbial safety and ecosystem health. Stormwater infrastructure upgrades and targeted management plans have effectively mitigated contamination risks despite increasing extreme weather events. Institutional coordination between municipalities, conservation authorities, and provincial bodies emerged as critical, facilitated by ongoing multi-tier governance. However, challenges persist, notably due to the exclusion of

private well systems from direct policy coverage, resulting in inadequate testing and persistent vulnerability.

Despite strong initial stakeholder engagement, the study identified limitations in sustained inclusivity, particularly in formally incorporating Indigenous communities and private well users, indicating a need for ongoing, targeted engagement strategies. Additionally, financial sustainability remains precarious, relying on inconsistent provincial funding streams vulnerable to shifting political priorities.

The study highlights anticipated challenges primarily arising from recent provincial legislative changes, particularly those altering the mandate of conservation authorities. Legislative shifts, notably Bills 66, 108, 229, and 23, have progressively limited conservation authorities' regulatory powers and environmental oversight capabilities. These legislative amendments risk undermining established water protection frameworks by prioritizing expedited development approvals and restricting comprehensive environmental assessments. Consequently, maintaining effective source water protection in the face of weakened oversight and financial uncertainty emerges as a central concern for sustaining the gains achieved under the source water protection plan.

Foreword

This major research paper represents the culmination of my academic journey in the Master's in Environmental Studies program at York University. This research paper was developed through a sustained interest in how institutional structures, public trust, and resource allocation shape the management and protection of drinking water sources. Focusing on source water protection in the Saugeen Valley Source Protection Area, this study examined how the protection plans were implemented on the ground, whether they were successful in achieving their intended objectives, and the challenges encountered throughout the implementation process.

This research was shaped by a number of courses that I undertook during the MES program. Foundational courses in environmental policy, policy research methods and environmental planning provided critical insights into how policies are developed, legitimized, and assessed, forming the basis of the dual performance and process evaluation framework adopted in this study. Complementary courses in research methods and environmental analytics equipped me with the qualitative tools such as document analysis and interviews that were central to my methodology.

An individualized directed reading course on collaborative water governance further enriched this research by framing my case study within broader debates on stakeholder engagement and institutional coordination. Meanwhile, a course on neoliberalism and political ecology prompted me to think critically about the political and structural contexts shaping participation, legitimacy, and equity in environmental governance. These insights encouraged me to move beyond abstract considerations of power and focus on how trust, coherence, and representation influence environmental policy outcomes on the ground. Concepts of environmental ethics course helped me reflect on the diverse responsibilities and perspectives of different actors involved in water stewardship particularly municipalities, landowners, and residents.

This major research has enabled me to meet several key learning objectives I had set at the beginning of the MES program: to understand how source water protection plan operates in practice; to assess institutional mechanisms and coordination efforts; to evaluate the depth and quality of public participation and to explore the financial and governance challenges of long-term

drinking water protection. More broadly, this work has allowed me to apply academic concepts to a real-world context, advancing my understanding of environmental governance and public policy.

I am grateful to the MES program for providing the learning space and guidance to pursue this research. Through my coursework and field inquiry, I have had the opportunity to engage critically with questions of participation, equity, and institutional capacity in water governance issues that will remain central to my future work in the environmental field.

Acknowledgement

I would like to express my gratitude to Professor Dr. Mark Winfield, my supervisor, for his consistent guidance throughout every stage of this research. His feedback and constructive comments helped shape the direction and depth of this work. I am also thankful to Professor Peter Timmerman, my advisor, whose advice and support in developing my plan of study helped me build a foundation for this research. I am grateful to Professor Liette Gilbert, Graduate Program Director of the MES program, for her support and encouragement, as well as to the other faculty members for their insights throughout my academic journey.

I am especially grateful to my family, whose emotional support gave me the stability I needed to carry out my MES journey. Thank you for your love, patience and immense support. To my friends, thank you for your encouragement and honest feedback along the way.

Finally, I would like to thank all the participants who generously took the time to share their experiences and perspectives. This research would not have been possible without their insights. Their contributions brought depth and meaning to this study.

List of Acronyms

CA	Conservation Authority
COA	Canada- Ontario Agreement
CWA	Clean Water Act
ODWSP	Ontario Drinking Water Stewardship Program
MECP	Ministry of the Environment, Conservation and Parks
MMAH	Ministry of Municipal Affairs and Housing
MNDM	Ministry of Northern Development and Mines
MNRF	Ministry of Natural Resources and Forestry
NWMO	Nuclear Waste Management Organization
OMAFRA	Ontario Ministry of Agriculture, Food and Rural Affairs
PGMN	Provincial Ground Water Monitoring Network
PTTW	Permit to Take Water
RMO	Risk Management Official
RMP	Risk Management Plan
SDWA	Safe Drinking Water Act
SPC	Source Protection Committee
SPP	Source Protection Plan
STP	Sewage Treatment Plan
SVCA	Saugeen Valley Conservation Authority
SVSPA	Saugeen Valley Source Protection Area
SWP	Source Water Plan
SWPP	Source Water Protection Plan

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1. Introduction

Access to safe, clean drinking water is a fundamental human right and an essential component of public health and environmental sustainability (United Nations, 2018). Water, as a shared resource, is integral not only for human consumption but also for sustaining ecosystems and supporting economic activities such as agriculture and industry (The United Nations,2021). Despite its importance, the protection of drinking water sources has often been reactive rather than proactive, particularly in the face of environmental degradation, industrial growth, and agricultural expansion(Office of the Auditor General of Ontario, 2014). The Walkerton tragedy of 2000 serves as a powerful reminder of the consequences of failing to protect water sources at their origin. In this event, the contamination of the municipal water system in Walkerton, Ontario, with *Escherichia coli* bacteria led to the deaths of seven people and serious illness in over 2,000 residents, highlighting the need for a more robust and preventative approach to safeguarding water resources (O'Connor, 2002a).

In response to this disaster, the Ontario government established the Walkerton Commission of Inquiry, led by Justice Dennis O'Connor, which ultimately recommended a comprehensive overhaul of water management policies in the province (Office of the Auditor General of Ontario, 2014). Central to these recommendations was the adoption of a multi-barrier approach to protecting drinking water sources, which begins with safeguarding water at its source before contamination can occur (O'Connor, 2002b) (Ontario. Advisory Committee on Watershed-based Source Protection Planning, 2003). The Commission's findings emphasized the critical importance of source water protection (SWP) as the first line of defense against water contamination, noting that preventing pollution at the source is far more effective and less costly than treating water after contamination (Fitzgibbon, & Simpson, 2017). As a direct outcome of the Commission's work, the Ontario government enacted the Clean Water Act (CWA) in 2006, establishing a legislative framework for source water protection across the province (Conservation Ontario, 2010).

The Clean Water Act mandates the creation of Source Protection Plans (SPPs) for each watershed in Ontario, developed through a collaborative, community-driven process involving municipalities, conservation authorities, agricultural sectors, Indigenous communities, and other

stakeholders (Government of Ontario, 2006). These plans are designed to identify existing and potential threats to drinking water sources and develop policies to mitigate or eliminate these threats (Office of the Auditor General of Ontario, 2014).

Despite the progress made under the Clean Water Act, significant challenges remain in protecting water sources from emerging threats such as climate change, industrial pollution, and agricultural runoff (Lindgren, 2018). Various reports, including those from the Auditor General of Ontario, have raised concerns about delays in the approval and implementation of source water protection plans, funding uncertainties, and weaknesses in addressing specific threats such as private wells and abandoned wells (Office of the Auditor General of Ontario, 2016) . Moreover, questions regarding the adequacy of governance structures, the financial sustainability of SWP initiatives, and the level of public participation, particularly from Indigenous communities, remain pressing (Marshall et al., 2020). Addressing these multifaceted challenges is crucial for achieving comprehensive water safety.

The Saugeen Valley Conservation Area (SVCA) is among one of Ontario's 19 designated source protection regions. The SVCA, covering a large area of southwestern Ontario, includes significant surface and groundwater resources, which provide drinking water to thousands of residents (Saugeen Valley Source Protection Area, 2015). This region faces unique challenges due to its diverse land-use patterns, including intensive agriculture, industrial activities, aggregate extraction and urban development, all of which pose potential risks to water quality and availability (Saugeen Valley Source Protection Area, 2015).

The region is largely rural, with a mix of agricultural lands, forests, and small towns, and it feeds into important water bodies like the Saugeen River and Lake Huron. This means the area faces certain risks, agricultural runoff (nutrients, bacteria) is a concern for both groundwater and surface water. The region's karstic geology can make groundwater very vulnerable, as contaminants can travel quickly through fractured bedrock (Saugeen Valley Source Protection Region, 2015). The current SWPP, by law, focuses on municipal water sources (wells and intakes). However, the SVCA region has numerous private wells and smaller systems outside the plan's coverage (Saugeen Valley Conservation Authority, 2023b). The Saugeen area was also the site of the Walkerton tragedy, making it emblematic of why source protection is crucial. Moreover, being part

of the Great Lakes basin (Lake Huron), the region's water management has downstream implications for one of the largest freshwater ecosystems. There are also emerging concerns such as climate change, which is expected to increase the frequency of heavy rainfall and flooding; events that can exacerbate runoff and septic failures, as happened in Walkerton. The local source protection plan has also started to consider climate change in its updates but studying its impact can provide valuable recommendations on how to climate-proof water sources. Additionally, land use changes (e.g. expanding agriculture or urban development) could introduce new risks, so it is important to continually evaluate whether current policies are sufficient.

In terms of broader significance, the Saugeen Valley case can provide a localized perspective that mirrors many of the successes and limitations observed across Ontario's source water protection initiatives. Successes here such as the high compliance rates and stakeholder collaboration can offer best practices for other regions. Challenges encountered such as funding constraints or any difficulties in policy enforcement can offer cautionary lessons. By focusing on this specific source water protection area, the study remains grounded and specific, but its findings will have relevance for the provincial policy discussion and even for other jurisdictions looking at source water protection.

1.1 Research Question

This study is guided by following research questions:

1. How effective are Source Water Protection (SWP) plans in the Saugeen Valley Source water protection Area at maintaining and improving water quality?
2. To what extent does stakeholder engagement influence the inclusiveness and transparency of decision-making processes?
3. What are the financial challenges and opportunities faced by the SVSWPA in implementing and sustaining Source Water Protection plan measures, and how does this impact on the anticipated risks?
4. What are the challenges faced during the implementation of the Source Water Protection Plan, and how can these inform its potential adaptation for use in other regions?

2. Methodology

In evaluating the effectiveness of the Source Water Protection Plan (SWPP) in the Saugeen Valley Source Protection Area (SVSWPA), this study employs a combined performance and process evaluation frameworks, grounded in established policy evaluation literature.

Performance evaluation refers to the systematic assessment of outcomes produced by policy interventions, focusing on the effectiveness and efficiency with which specified objectives are achieved (Organisation for Economic Co-operation and Development, 2015). It is concerned with determining whether intended outcomes such as improved water quality, increased stakeholder satisfaction, or enhanced environmental protection are realized following the implementation of a policy (Mergoni & De Witte, 2022). In this study, performance indicators used include measurable improvements in water quality metrics (e.g., contaminant reduction), changes in ecosystem health, and the reliability and affordability of water services. These indicators are selected because they directly reflect the core objectives of the SWPP and are consistent with environmental policy evaluation practices that emphasize quantifiable results and outcomes (Johnson, 1998; Organisation for Economic Co-operation and Development, 2015).

Process evaluation, on the other hand, examines the mechanisms, implementation strategies, and contextual factors that contribute to achieving or hindering policy goals (Johnson, 1998). It assesses how a policy was executed, focusing on aspects like stakeholder engagement, transparency in decision-making, institutional coordination, and financial sustainability (Organisation for Economic Co-operation and Development, 2015). Process evaluation is essential to understanding the quality of policy implementation, ensuring accountability, and identifying opportunities for improvement. This study has used indicators such as levels of stakeholder participation, frequency and transparency of communications and decisions, effectiveness of coordination mechanisms among involved institutions, and the adequacy and continuity of financial resources. These criteria are critical as they ensure that the policy not only achieves its intended outcomes but does so through equitable, transparent, and sustainable processes (Mergoni & De Witte, 2022).

The rationale for combining both performance and process evaluations in this study lies in the comprehensive understanding they provide when used together. Performance evaluation alone

might identify successful outcomes but fails to explain how these outcomes were achieved or why certain interventions failed (Johnson, 1998). Process evaluation complements this by offering insights into the underlying governance structures, stakeholder dynamics, and procedural elements that are pivotal to the policy's success or failure. Together, they allow for a more nuanced evaluation that can inform both policy refinement and replication in other contexts.

The following table gives the overview of the selected evaluation criteria, organized into Performance Evaluation Criteria (measuring the SWPP's outcomes/effectiveness) and Process Evaluation Criteria (measuring the implementation process).

Criterion	Definition	Indicator	Evaluation Type
Surface Water Quality	It refers to the condition of rivers, lakes, streams, and reservoirs, emphasizing their chemical, physical, and biological characteristics	Total Phosphorous	Performance evaluation
		Microbial Water Quality (E-coli)	
		Benthic Macroinvertebrates	
Ground water quality	The chemical, physical, and biological condition of water found underground in aquifers and wells, assessed to ensure it	Water Level	Performance evaluation
		Nitrite and chloride	

	is safe for human and ecological use.		
		E-coli	
Accessibility of Safe Drinking Water	Availability of safe drinking water for all households	Accessibility of safe drinking water supply in household	Performance evaluation
Reliability (Consistency) of Water Supply	Consistent and uninterrupted provision of water without contamination or shortages.	Records of supply interruptions, boil-water advisories frequency,	Performance evaluation
Aquatic Ecosystem Health	Health and biodiversity of aquatic ecosystems, indicating overall water quality and ecosystem health.	Fish population survey	Performance evaluation
Stakeholder Participation	Level and diversity of stakeholder engagement in planning and decision-making processes.	Number of meetings, attendance records, stakeholder group representation	Process evaluation

Monitoring and Evaluation Mechanisms	Existence and effectiveness of mechanisms tracking policy implementation and adapting based on feedback.	Annual progress reports, regular evaluation documents, corrective actions	Process evaluation
Institutional Coordination	Collaboration and alignment effectiveness among institutions involved in SWPP implementation.	Inter-agency coordination	Process evaluation
Financial sustainability	Availability, adequacy, and continuity of financial resources supporting the implementation of SWPP.	Annual budgets, funding continuity, financial reports, grant allocations	Process evaluation

Table 1: Performance and process evaluation criteria used in study

2.1 Data Collection

A mix method-qualitative approach was employed, incorporating semi-structured interviews and document reviews to ensure data triangulation and enhance the validity of findings (Yin, 2007).

The primary data collection method consists of semi-structured, open-ended interviews designed to gain detailed insights into the nature of community participation, the dynamics of institutional coordination, and the challenges encountered during the implementation of the source water protection plans.

Secondary data collection involved reviewing documents from source protection region including financial records, water quality reports, source protection committee meeting minutes, technical study, municipal report, annual budget report, annual progress reports and data on provincial stream and ground water quality. To carry out this study, five semi-structured interviews were held with diverse stakeholders actively engaged in the source water protection planning process. In the interest of maintaining participant confidentiality, specific roles and affiliations of the respondents have been withheld. To further enrich the study's understanding of community perspectives, informal conversations were held with residents of the study area. In addition, this study also considers viewpoints of the experts engaged in source protection planning from inception process through participation in Q&A of webinar held on 25th anniversary of Walkerton tragedy to supplement interview insights.

2.2 Participant Recruitment

Participants were selected using purposeful sampling methods, initially targeting individuals known for their involvement and expertise in source water protection activities within SVSPA. Government and organizational websites served as initial sources for identifying potential participants. Subsequent participants were identified using snowball sampling techniques, through referrals from initially identified participants. Recruitment was undertaken via email or telephone invitations, clearly outlining research objectives and ethical considerations.

2.3 Data Analysis

The recorded interviews were transcribed and subsequently analyzed. For transcription, Mac Whisper software was utilized due to its accessibility and its ability to uphold confidentiality as files are processed locally on the desktop, mitigating any risk associated with internet or cloud-based storage. Following transcription, a thematic analysis was conducted to identify patterns and key themes emerging from the data. Complementary to this, secondary literature primarily the Saugeen Valley Source Water Protection Area Assessment Report and Progress Reports were

subjected to content analysis. This dual approach provided a comprehensive understanding of both firsthand perspectives and documented insights, enhancing the depth and rigor of the research findings.

2.4 Study Area - Saugeen Valley Source Protection Area

The Saugeen Valley Source Protection Area is one of three source protection areas in the Saugeen, Grey Sauble, Northern Bruce Peninsula Source Protection Region of Ontario. It corresponds to the jurisdiction of the Saugeen Valley Conservation Authority and spans approximately 4,632 km² in the Lake Huron watershed (Saugeen Valley Source Protection Region, 2015). The Saugeen River's major tributaries include the North Saugeen, Rocky Saugeen, Beatty Saugeen, South Saugeen, and Teeswater Rivers. In addition to the Saugeen River basin, the SVSPA covers several smaller sub-watersheds that flow directly into Lake Huron, such as the Penetangore and Pine River watershed (Saugeen Valley Source Protection Region, 2015).

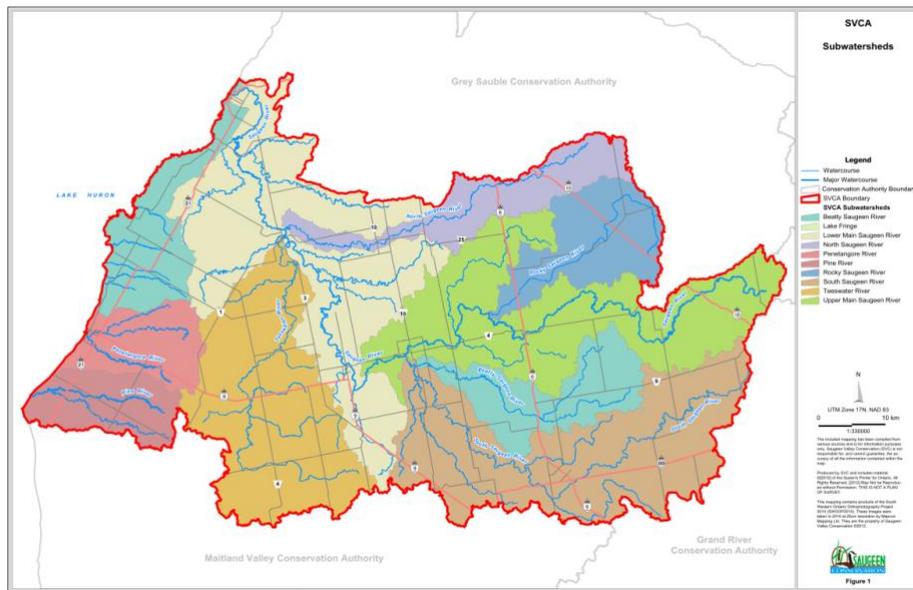


Figure 1: Map of Saugeen River Sub-watershed (SVCA Sub-watersheds Map, n.d.)

This broad jurisdiction gives the SVSPA a diverse hydrological network, from upland headwaters to Great Lakes shoreline, all falling under the source protection plan's scope. There are 15 municipalities wholly or partially within the Saugeen Valley Source Protection Area (Saugeen, Grey Sauble, and Northern Bruce Peninsula Source Protection Committee, 2009). The Source

Protection Plan for the SVSPA was approved in 2015 and took effect in 2016 under the requirements of Ontario's Clean Water Act.

The SVSPA's Source Protection Plan identifies vulnerable areas around municipal water sources and enumerates activities that pose threats to those drinking water sources. Key threats to water quality in this area include microbial contamination and nutrient loading from agricultural activities (e.g. manure runoff or fertilizers on farmland), septic system effluent, and industrial or domestic pollutants such as fuel and chemical spills. Other significant threat categories in the region include the application and storage of road salt (which can elevate sodium and chloride in groundwater), the handling and storage of fuel (e.g. heating oil or gasoline near wells), and the use or disposal of toxic chemicals (such as solvents or dense non-aqueous phase liquids) in vulnerable zones (Saugeen, Grey Sauble, Northern Bruce Peninsula Source Protection Region, 2015a). Aggregate extraction operations are also actively present within the Saugeen watershed and represent a potential risk to source water protection areas due to their impacts on groundwater resources, wetlands, and the broader hydrological system (Saugeen Valley Conservation Authority, 2024).

In response, the Source Protection Plan sets out a suite of risk management strategies and policies to mitigate these threats. The plan's policies are implemented by local municipalities, conservation authorities, and provincial agencies in coordination, and are subject to periodic reviews and updates as new data or conditions arise (Ministry of the Environment, Conservation and Parks, 2022a).

2.5 Limitation of this study

Given the time, resource and scope of this study, the following limitations are acknowledged

1. This study focuses exclusively on the Saugeen Source Protection Area, even though it is part of the larger Saugeen, Grey Sauble, and Northern Bruce Peninsula Source Protection Region. Therefore, while some findings may have broader relevance, the conclusions should not be generalized to this source protection region without further investigation. Moreover, as the analysis is limited to a single Source Protection Area, it may not reflect the full diversity of practices or challenges, found across Ontario's source water protection regions.

2. This research primarily relies on a review of secondary documents, supplemented by input from a limited number of participants within the source protection area. Although efforts were made to include diverse stakeholders, the level of engagement was constrained by the study's scope, and a more extensive stakeholder involvement could have enriched the findings.

3. While this study acknowledges the limited participation of First Nations in the Source Protection Committee and briefly notes the implications of this underrepresentation, it does not provide a detailed analysis of the reasons behind the lack of formal participation or the opportunities for enhancing their involvement, as these were beyond the scope of this research.

3. Source water Protection and Implementation Challenges in Global North

3.1 Introduction

Source Water Protection (SWP) is a critical environmental management strategy aimed at safeguarding water at its source before it enters public water systems (Minnes, 2015). It focuses on protecting both surface water (such as rivers, lakes, and reservoirs) and groundwater from contamination, ensuring the availability of clean, safe water for human consumption and ecosystem sustainability (Macartney, 2010). SWP is an essential component of water governance, intersecting with land use planning, agriculture, industrial practices, and urban development (Abell et al., 2019).

The concept of SWP has been defined and approached in various ways throughout the literature. Abell et al. (2019) define SWP as a means of addressing water security issues by utilizing natural infrastructure such as forests, wetlands, and riparian buffers to mitigate non-point source pollution and ensure reliable water quality and quantity. This approach highlights the integration of conservation and water management, recognizing the interdependence of healthy ecosystems and clean water sources.

Patrick (2010) emphasizes the role of SWP in addressing the uneven access to safe drinking water, particularly in Indigenous communities in Canada. He argues that SWP, by focusing on land use management around water sources, offers a more sustainable solution than relying solely on

technological fixes for water treatment (Patrick, 2011). This highlights how SWP not only addresses environmental concerns but also plays a pivotal role in social equity and public health.

SWP is also seen as a cost-effective approach to water management, as it reduces the need for expensive treatment technologies by preventing contamination at its source. Macartney (2010) discusses the importance of developing SWP plans to prevent pollutants, such as boron, from entering water supplies, especially in agricultural regions. Author underscores the collaborative efforts needed between governmental agencies, stakeholders, and the public to ensure long-term water quality.

Furthermore, Minnes (2015) highlights the importance of public engagement in SWP efforts, particularly in rural areas where resources for water management are limited. Increased public participation in SWP not only enhances community ownership of water resources but also ensures that local knowledge is incorporated into watershed management plans (Marshall et al., 2020). This participatory approach is seen as a key factor in the success of SWP initiatives.

In Ontario, Canada, following Part II of the Walkerton Inquiry, Justice O'Connor emphasized that protecting drinking water source must serve as the first barrier in a multi-barrier framework, recommending watershed-based planning be legally binding and integrated into provincial decision-making. Source Water Protection is formalized through Source Protection Plans (SPP), which provide communities with a framework to protect their drinking water sources (O'Connor, 2002b). These locally-developed plans are based on scientific studies and involve public consultation at multiple stages, ensuring that the policies they contain are both effective and democratically supported (Ontario. Advisory Committee on Watershed-based Source Protection Planning, 2003). The SPPs address various activities and land uses that pose risks to municipal water sources, such as industrial operations, farming practices, and urban development, and aim to either reduce or eliminate those risks (Fitzgibbon, & Simpson, 2017). The plans focus on designated zones around water intakes and wells to ensure that contamination risks are minimized before they become significant threats (Ivey et al., 2006).

The importance of SWP cannot be overstated. With growing pressures from industrial activities, agriculture, and urban development, safeguarding water at its source is essential for preventing

pollution, maintaining biodiversity, and ensuring the long-term sustainability of water resources (Marshall et al., 2020). As water demand continues to rise globally, effective SWP measures are increasingly critical in addressing both human and ecological needs.

3.2 Challenges in Implementing Source Water Protection Plans in Global North

Source Water Protection Plans (SWPPs) are proactive frameworks aimed at safeguarding drinking water sources (both surface water and groundwater) from contamination through land-use controls, risk management, and inter-agency collaboration (Al Ibrahim & Patrick, 2017). In the Global North, many jurisdictions have adopted SWPPs as part of a multi-barrier approach to ensure safe drinking water. However, the effectiveness of these plans often hinges on overcoming significant challenges. This review synthesizes the literature on five key thematic challenges: institutional coordination, funding, regulatory compliance, population pressures, and climate change impacts.

3.2.1 Institutional Coordination

Effective source water protection planning (SWPP) depends on collaboration across government levels and sectors, yet institutional fragmentation remains a persistent barrier (Bakker & Cook, 2011). In federal systems like Canada, water governance responsibilities are fragmented (Al Ibrahim & Patrick, 2017; Patrick, 2011) for example, in Canada water management is largely under provincial jurisdiction while municipalities control land-use planning. This division can lead to gaps or overlaps in policies. Ontario's experience after the Walkerton tragedy (2000) exemplifies efforts to improve coordination. Despite this integrated approach, aligning provincial regulations with municipal land-use decisions remains challenging, as local development interests often conflict with province-wide water protection goals (Al Ibrahim & Patrick, 2017).

Responsibilities for water management are distributed among numerous provincial bodies including the Ministry of the Environment, Conservation and Parks (MECP), Ministry of Natural Resources and Forestry (MNRF), Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA), Ministry of Municipal Affairs and Housing (MMAH), and Ministry of Northern Development and Mines (MNDM) alongside municipal governments and the province's 36 Conservation Authorities. Established in 1946, Conservation Authorities represent watershed-based partnerships between provincial and municipal governments and were an early institutional innovation designed to overcome fragmented local jurisdictions (Shrubsole, 1996). Ontario's

source water protection framework mandates protecting drinking water at its source as a shared responsibility, assigning specific duties to municipalities, provincial ministries, and Conservation Authorities (Office of the Auditor General of Ontario, 2018).

Overlapping mandates between provincial ministries often necessitate ongoing coordination to manage shared responsibilities effectively. In Ontario, both the MECP and OMAFRA are involved in addressing agricultural nutrient pollution, particularly within the context of source water protection. While OMAFRA is responsible for nutrient management planning, MECP oversees inspection and enforcement. The Office of the Auditor General of Ontario (2018) has recommended the need for stronger alignment between these agencies, particularly in ensuring that nutrient management plans are reviewed for farms located in vulnerable areas and that inspections are prioritized accordingly. This recommendation highlights shortcomings in the integration of planning and enforcement roles between the two ministries and suggests the need for inter-agency alignment regarding responsibilities. Winfield (2002) highlights that protecting drinking water sources requires more than just assigning responsibilities. It demands well-coordinated policy development and implementation across government levels. Without clear institutional roles, oversight mechanisms, and integrated frameworks, fragmented governance can undermine effective source water protection. Recent policy reforms have further altered Ontario's governance landscape. Amendments to the Conservation Authorities Act between 2017 and 2022 driven by provincial priorities to streamline development have redefined the role of Conservation Authorities, limiting their regulatory scope in land-use planning and increasing direct ministerial oversight (Dentons, 2025). While intended to clarify responsibilities, these changes provoked debate about potential fragmentation, as reducing the Authorities' mandate may weaken the very watershed-scale coordination they were created to provide.

In the USA, the federal Safe Drinking Water Act requires states to assess source water areas, but implementation is largely left to state and local entities. The Environmental Protection Agency (EPA) notes that local governments play a critical role for instance, by enacting zoning bylaws to keep contaminant-generating activities away from water sources (U.S. Environmental Protection Agency, 2025). In Germany, drinking water protection zones are designated by state or regional authorities to restrict certain land uses around water sources (German Environment Agency & Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, 2018). When local

land-use plans don't incorporate source protection, it creates a coordination gap despite state or federal programs. Wuijts et al., (2021) notes that frequent institutional barrier is the siloing of water resource management from urban planning.

A case in point is New York City's watershed management, it required unprecedented collaboration between the city, upstate counties, state agencies, and the EPA to protect the Catskill/Delaware watershed that supplies NYC's drinking water (National Research Council, 2000). The resulting partnership including land acquisition and stringent watershed rules allowed the city to avoid building a filtration plant, but only through complex intergovernmental agreements. This underlines that effective SWPPs demand consistent policy integration across jurisdictions.

3.2.2 Funding

Securing sufficient and sustainable funding is another major challenge in SWPP, primarily due to the significant financial burden they place on local authorities. Many source water protection initiatives require considerable investments that municipalities often struggle to sustain once initial one-time grants expire (Al Ibrahim & Patrick, 2017; Minnes & Simpson, 2020). In Canada, the rollout of SWPPs under Ontario's Clean Water Act was supported initially by provincial funds, but long-term implementation has shifted to municipalities that face budget constraints. Technical assessments and plan developments were provincially funded, yet funding for long-term implementation remains uncertain, impacting essential programs such as public education and agricultural management practices crucial for risk reduction (Saugeen, Grey Sauble, Northern Bruce Peninsula Source Protection Region, 2024c). Research on Canadian metropolitan areas confirms consistent concerns among practitioners regarding the need for stable funding to both develop and implement SWPPs effectively (Al Ibrahim & Patrick, 2017; Wang, 2014). Similar issues arise in the United States, where many water utilities depend on ad-hoc federal or state grants: for example, through the EPA or USDA programs to support source protection projects. The Trust for Public Land, (2005) observes that state and local programs often fail to provide adequate funds or support for land conservation efforts tied to source protection.

Various financing models have emerged to address these challenges, with mixed success. In the UK, an interesting model is utility-driven investment in watershed protection. Water companies

can invest in catchment management as part of their asset management plans. A flagship example is Southwest Water's Upstream Thinking program in England, where a water company funds farm improvements (e.g. fencing streams, improving slurry storage) to reduce pollution runoff (South West Water, n.d.). Similarly, in the Netherlands, there is a long tradition of stable funding through regional water authorities. Dutch water boards levy dedicated taxes to finance water management, including the protection of drinking water resources (Laubenstein & Leflaive, 2024). However, even wealthy countries encounter funding gaps. The UK and Netherlands cases are relatively successful, but elsewhere, small municipalities struggle to afford SWPP measures. The literature also notes the role of national governments and EU funds: for example, EU agricultural subsidies through the Common Agricultural Policy can be directed toward practices that benefit water quality, effectively subsidizing source protection on farmlands (Wuijts et al., 2021). When such alignment occurs, it eases local financial burdens. Conversely, lack of dedicated funding can derail SWPPs; a case study in Saskatchewan, Canada found that even when plans were developed, implementation lagged without secure financial resources and human capacity, highlighting that planning alone is insufficient if no money is available for action (Wang, 2014).

3.2.3 Risk Management and Regulatory Compliance

An effective SWPP not only identifies risks to water quality but also ensures that stakeholders comply with regulations and mitigation strategies to manage those risks. Despite of having stringent drinking water standards and rules for protecting water sources, achieving compliance at the source as opposed to just treating water is challenging, especially for diffuse pollution (OECD, 2017). One major barrier is enforcement of land-use regulations in source areas. A study on France's water sources found that by the late 2000s, nitrate and pesticide pollution remained widespread, forcing water suppliers to resort to expensive "curative" measures (Amblard, 2019).

In the United States, point sources of pollution are regulated under the Clean Water Act, but nonpoint sources (like agricultural runoff) are not directly regulated, which complicates source water protection. The famous Des Moines Water Works case in Iowa, where the utility sued county drainage districts over nitrate pollution from farm runoff, was dismissed in 2017 because existing law exempted such runoff from regulation (Good, 2017). Sweden is cited as a country with a precautionary approach: it requires special permits for pesticide use within designated water

abstraction zones (Lindahl et al., 2024). Such measures reflect strong regulatory compliance mechanisms that go beyond voluntary guidelines. Similarly, many German states enforce a “polluter pays” principle: if an activity in a water protection zone (like intensive farming) causes extra treatment costs for the water utility, the utility can seek compensation from the state or the polluters, creating an economic incentive for compliance (Amblard, 2019).

3.2.4 Population Growth and Additional Pressure on Water Sources

Rapid population growth and urbanization increase stress on drinking water sources, complicating protection efforts by driving higher water demand and intensifying pollution risks (MDPI, 2020). Cities such as Toronto experience deteriorating water quality due to increased stormwater runoff, wastewater effluent, and urban expansion into previously natural buffer zones, prompting stricter source protection measures. Cities like Atlanta have faced degraded water quality due to insufficient land management during rapid suburban growth, resulting in costly downstream treatments (Basmajian, 2011). Australia’s experience further highlights tensions: Melbourne historically relied on protected forested catchments, but growing water demands led to supplemental sources like desalination, reflecting increasing pressures from urbanization (Melbourne Water, n.d.). Nova Scotia strengthened water quality only after provincial intervention mandated stricter land-use restrictions (Al Ibrahim & Patrick, 2017). In Germany, conflicts emerged when development proposals clash with strict water protection zones, necessitating careful zoning to avoid contamination risks (Wuijts et al., 2021).

There are also notable examples of success. New York City's successful preservation of Catskill watershed demonstrates effective integration of land-use controls and compensation strategies to protect source water amid urban growth (National Research Council, 2000). In Ontario, Rapid population growth in the Greater Toronto Area (GTA) intensified stress on regional water resources by driving urban sprawl into ecologically sensitive areas. In response, the Royal Commission on the Future of the Toronto Waterfront (1988-1992) underscored the need for a comprehensive watershed management approach. It’s reports stressed that upstream land use decisions from the Oak Ridges Moraine in the north to Lake Ontario in the south directly affect downstream water quality (Royal Commission on the Future of the Toronto Waterfront, 1989). The Commission explicitly recognized the Oak Ridges Moraine as critical to the region’s hydrology and

recommended the province to take actions to preserve the Moraine including stringent conservation measures and groundwater protection studies (Whitelaw & Eagles, 2007). This watershed-based vision strongly informed subsequent land-use policies.

Ontario Regulation 140/02, under the Oak Ridges Moraine Conservation Act, enshrined the Moraine's hydrological and ecological integrity as a priority, and the Greenbelt Plan (2005) expanded this protection by creating a permanent greenbelt to curb sprawl and safeguard vital headwater areas for the GTA (Ministry of Municipal Affairs and Housing, 2005). In this way, early recognition of bioregional water linkages by the Royal Commission laid the groundwork for enduring policy frameworks that address population growth pressures on source water areas in Ontario. Effective source water protection thus relies heavily on integrated urban planning, enforceable governance, and societal willingness to prioritize water security over unchecked development (Al Ibrahim & Patrick, 2017).

3.2.5 Climate Change Impacts on SWP Implementation

Climate change is introducing new challenges for source water protection in the form of more extreme weather events, shifting hydrological patterns, and ecological changes (Intergovernmental Panel on Climate Change, 2023; OECD, 2009). Scientific assessments indicate that floods can wash large amounts of contaminants (sediments, nutrients, pathogens, chemicals) into water sources, overwhelming existing protection measures (OECD, 2024). Droughts, on the other hand, reduce surface water flows and aquifer recharge, potentially concentrating pollutants and forcing water withdrawals from lower-quality sources as higher-quality sources dwindle. Developed countries are not immune to these effects.

In Finland, heavier rains enhance erosion and runoff, causing higher turbidity and microbial contamination, necessitating new protective tactics like buffer zones or retention basins (Räsänen et al., 2021). Concurrently, summer droughts reduce lake levels, increasing algal blooms and organic matter concentration, prompting Finnish authorities to consider securing backup sources and enhancing catchment resilience (Veijalainen et al., 2019). Canada's experiences with the 2013 Alberta floods and the 2001-2002 Prairie droughts underscore similar vulnerabilities, leading to climate-informed SWP planning requirements in Ontario. Adaptive management, emphasizing

flexibility and forward-looking strategies, has emerged as essential for effective SWP under climate uncertainty (Ontario Ministry of the Environment, Conservation and Parks, 2023).

Many historical SWP frameworks require updates to include frequent reassessment, improved monitoring, and enhanced infrastructure. Examples include the Netherlands' Delta Programme integrating nature-based flood control and drought resilience strategies such as wetland restoration and bank filtration (Deltares, n.d.). Sweden's pesticide permitting system within abstraction zones also exemplifies proactive resilience-building (Lindahl et al., 2024). Ontario updated its Clean Water Act technical rules to require that source protection plans include climate change impact assessments detailing the climate data used, the findings on local climate vulnerabilities, and whether the water system is resilient to those projected impacts (Ministry of the Environment, Conservation and Parks, 2021). In tandem, the provincial government developed a Climate Change Vulnerability Assessment Tool to guide these evaluations, reflecting an official recognition that climate adaptation must be embedded into source water planning (Conservation Ontario, 2020). Climate change is now considered in water quantity risk assessments under Ontario's drinking water source protection program, and similar guidance has been extended to water quality protection. These initiatives alongside broader provincial efforts like Ontario Climate Change Adaptation and Resilience Act (2024) proposes a comprehensive, multi-sectoral framework aimed at enhancing the province's resilience to climate-related threats through strategic planning, infrastructure adaptation, strengthened watershed governance, and the protection of water resources and natural ecosystems.

Adaptive management in SWPPs involves regularly revisiting risk assessments, updating land-use controls as needed, and sometimes engineering solutions (U.S. Environmental Protection Agency, n.d.). A review of European River Basin Management Plans found that many had not yet fully integrated climate change considerations, for instance, only about half of EU member states had considered drought as a significant factor in water management plans, and analyses often failed to connect climate "drivers" to water quality pressures (European Commission, 2019). On a positive note Germany has begun to incorporate climate adaptation into its water protection planning, such as adjusting the boundaries of water protection areas if flood risk maps change, and exploring managed aquifer recharge to buffer droughts (Arndt & Heiland, 2024). These examples show that

SWPPs in the Global North are evolving from static protection plans to dynamic, adaptive frameworks.

4. Legislative Framework of Source Water Protection in Ontario and Canada

4.1 Historical Background and Legislative Foundation

Ontario's Source Water Protection (SWP) framework emerged in the early 2000s as a direct response to a tragic drinking water contamination event. In May 2000, the town of Walkerton, Ontario experienced an *E. coli* outbreak in its municipal well water, leading to seven deaths and thousands falling ill (Eveleigh, 2018). The provincial government convened the Walkerton Inquiry led by Justice Dennis O'Connor to investigate and recommend safeguards. A key conclusion of the inquiry was that protecting drinking water at the source is one of the most effective and cost-efficient means to ensure safe water (Office of the Auditor General of Ontario, 2014). Justice O'Connor's report urged a comprehensive "multiple-barrier approach" to drinking water safety, with source water protection as the first barrier to prevent contaminants from entering water supplies (Collins et al., 2017). In response, Ontario enacted the Clean Water Act, 2006, which provided the legislative foundation for source water protection across the province (Office of the Auditor General of Ontario, 2014). The Clean Water Act established a locally driven, science-based planning process to protect existing and future sources of municipal drinking water (Water Environment Federation, 2016).

Under the CWA, Ontario's 36 conservation authorities (watershed-based agencies) were organized into 19 Source Protection Regions, each with a multi-stakeholder Source Protection Committee responsible for developing a source protection plan (Conservation Ontario, n.d.). The CWA mandated that these committees conduct technical studies to identify vulnerable areas and threats, then formulate policies to eliminate or manage significant risks to water sources (Clean Water Act, 2006). The emphasis was on prevention, for example, land use regulations, risk management plans, and education to keep pollutants like fuels, manure, or chemicals from contaminating wells and surface water intakes. This approach reflected the "source-to-tap" model of water safety: protecting water at the source, followed by treatment, distribution maintenance, monitoring, and contingency planning (Collins et al., 2017). By design, the SWP program focuses on municipal

drinking water systems and their contributing watersheds, as a cornerstone of Ontario's drinking water protection framework (Conservation Ontario, n.d.).

It is important to note that the CWA's scope is limited to municipal (public) water supplies. Private wells and small drinking water systems serving single households or very small communities were not included in the mandatory planning, a point that has been highlighted as a gap in coverage (Environmental Commissioner of Ontario, 2018). It built on other post-Walkerton reforms like the Safe Drinking Water Act, 2002 (which imposed treatment and testing requirements on water providers) by adding a proactive, preventive layer addressing land use and resource management in vulnerable source areas (Collins et al., 2017). The SWP framework thus has a strong legislative foundation rooted in the Walkerton lessons: underscoring the importance of safeguarding water sources before contamination happens.

4.2 Federal and National Framework

In Canada's constitutional structure, provinces hold majority of responsibility for water resource management, including drinking water supply and source protection (Bereskie et al., 2017). The federal government plays a supportive role by conducting research and developing non-binding guidelines. For example, Health Canada leads the development of the Guidelines for Canadian Drinking Water Quality, but these national standards are voluntary and rely on provinces to adopt and enforce them (Dunn et al., 2014). This contrasts with jurisdictions like the United States and European Union, where uniform federal laws ensure consistent drinking water standards (Abioye, 2024). The result in Canada is an uneven patchwork of provincial regulations and programs, varying in stringency and implementation across the country (Al Ibrahim & Patrick, 2017). Notwithstanding this variability, source protection is universally recognized as the crucial first barrier in Canada's widely endorsed multi-barrier approach to safe drinking water. In practice, however, the effectiveness of source water protection measures can differ markedly from one region to another under Canada's fragmented governance model (Abioye, 2024).

At the national level, several federal laws and policies indirectly contribute to safeguarding water sources. The Fisheries Act prohibits the discharge of deleterious substances into waters frequented by fish. This provision, aimed at protecting fish and fish habitat, has functioned as a de facto water

pollution control measure for over a century, linking water quality to federal oversight of fisheries (Fisheries Act, 1985) . The Canada Water Act (1970) further established a framework for federal-provincial cooperation in the conservation and development of water resources. Under this Act, the federal government works with provinces on watershed-based programs and research to protect water quantity and quality, although the Act does not impose mandatory standards (Environment and Climate Change Canada, 2024). Beyond legislation, federal-provincial forums e.g. the Canadian Council of Ministers of the Environment have promoted best practices such as integrated watershed management and land use controls to prevent source contamination. The multi-barrier approach endorsed by federal and provincial authorities emphasizes that protecting source waters is more cost-effective and sustainable than trying to remediate contaminated water later (Canadian Council of Ministers of the Environment, 2016). Nonetheless, in the absence of a dedicated federal law, much depends on each province's commitment and capacity to plan and enforce source water protection measures. The federal government also has direct jurisdiction over drinking water on federal lands and First Nations communities, and in those domains, it sets regulations and policies to ensure safety. Overall, federal influence on source water protection is exerted via leadership in setting science-based guidelines and promoting best practices, rather than through direct legislation in provinces (Al Ibrahim & Patrick, 2017). This means that consistent SWP across Canada depends largely on provincial policy commitments (Patrick, 2011).

Bereskie et al., (2017) have also noted that Canada's decentralized approach can result in uneven protection and duplication of efforts. Thus, strong provincial laws are critical to fill the void and ensure that the preventive ethos of source protection is implemented on the ground.

4.3 Source Water Protection Regulatory Framework in Ontario

The Walkerton tragedy (2000) underscored the necessity of a multi-barrier, source-to-tap approach to drinking water safety (Conservation Ontario, n.d.). Ontario responded with new legislation and policies, notably the Safe Drinking Water Act, 2002 and the Clean Water Act, 2006, to ensure such a disaster would not recur. The Clean Water Act (CWA) in particular established a mandatory province-wide program for protecting drinking water sources. This Act and its associated regulations form the core of Ontario's SWP regime, supported by complementary laws and overseen by a multi-level governance structure as detailed below

4.3.1 Clean Water Act, 2006

The Clean Water Act, 2006 (CWA) was enacted to “protect existing and future sources of drinking water” in Ontario (Clean Water Act, 2006 s.1). It embeds the preventive, science-based approach recommended after Walkerton. The Clean Water Act requires communities to assess and proactively manage threats to drinking water using science-based methods. It mandates public participation and transparency, and enforces legally binding policies to address significant threats, overseen by appointed local officials (Clean Water Act, 2006). In essence, the CWA backs its planning process with real regulatory teeth to ensure implementation. Importantly, the Clean Water Act is supported by several regulations that define its scope and administrative details. For example, O. Reg. 284/07 delineates the boundaries of Source Protection Areas and Regions, generally aligning with watershed or Conservation Authority areas (O. Reg. 284/07, 2007) and O. Reg. 288/07, (2007) establishes the composition and appointment process for Source Protection Committees.

Another regulation, O. Reg. 287/07, (2007), sets out technical definitions and processes (such as how to delineate wellhead protection zones, and the content of risk management plans), while O. Reg. 231/07, (2007) deals with procedural matters (service of documents). Together with provincial Director’s Rules and guidance documents, these regulations operationalize the CWA’s framework on the ground.

4.3.2 Implementation Structure and Responsibilities under the CWA

Ontario’s CWA created a multi-stakeholder governance structure to implement source protection, assigning clear roles to various bodies:

Entity	Responsibilities under Ontario’s Clean Water Act
Source Protection Authorities (SPA)	- Coordinate and administer the Source Protection program

<p>Source Protection Committees (SPC)</p>	<ul style="list-style-type: none"> - Central decision-making body for Source Protection planning <ul style="list-style-type: none"> - Prepare Terms of Reference (workplan) - Oversee technical studies for Assessment Reports <ul style="list-style-type: none"> - Develop Source Protection Plan policies <ul style="list-style-type: none"> - Conduct public consultations - Review annual implementation progress and propose updates
<p>Municipalities</p>	<ul style="list-style-type: none"> - Participate in SPCs and provide data/expertise during plan development - Implement Source Protection Plans through Official Plans and zoning by-laws amendments - Enforce Part IV policies, appoint Risk Management Officials (RMOs) and Inspectors <ul style="list-style-type: none"> - Engage with stakeholders, enforce risk mitigation measures - Optionally delegate enforcement to other bodies (e.g., SPA, board of health)
<p>Provincial Ministries and Agencies</p>	<ul style="list-style-type: none"> - Ontario Ministry of Environment, Conservation and Parks (MECP) oversees the program - Approve Source Protection Plans ensuring conformity to provincial standards <ul style="list-style-type: none"> - Ensure provincial permits (e.g., water-taking permits, waste management approvals) align with Source Protection Plan policies - Resolve regulatory conflicts giving priority to Source Protection objectives - Monitor compliance through annual progress reports and conduct inspections/audits - External oversight by Ontario Auditor General and Ombudsman
<p>Public and Other Stakeholders</p>	<p>Participate in public consultations and meetings, submit comments for consideration</p> <ul style="list-style-type: none"> - Engage through sector-specific advisory committees (e.g., agriculture) - Indigenous communities invited to SPCs or can develop their own Source Protection Plans on opt-in basis

Table 2: Key entities and their responsibilities under Ontario’s Clean Water Act

4.4 Complementary Laws and Policies

The Clean Water Act works in concert with other laws as part of Ontario's multi-barrier strategy for drinking water protection. While the CWA focuses on preventing source water contamination, the Safe Drinking Water Act, 2002 (SDWA) and related regulations ensure the treatment and delivery of drinking water meets health standards (Bakker & Cook, 2011). Following the Walkerton tragedy, Ontario's Safe Drinking Water Act (SDWA) was enacted, establishing strict standards for municipal drinking water systems. It mandates licensing, a statutory Standard of Care, regular testing by accredited labs, operation by certified professionals, immediate reporting of adverse test results, and an inspection and enforcement framework led by provincial Drinking Water Inspectors and the Chief Drinking Water Inspector (Safe Drinking Water Act, 2002).

In essence, where the Clean Water Act addresses the upstream, preventive barrier (keeping source water clean), the Safe Drinking Water Act reinforces the treatment barrier (making sure water is properly purified and tested before reaching consumers). Ontario's overall drinking water safety net relies on both laws: a source protection plan might, for example, reduce the pathogen load in a raw water source by restricting manure spreading near a well, while the treatment requirements of the SDWA ensure any pathogens that do enter the source are removed or neutralized at the water treatment plant (National Collaborating Centre for Environmental Health, 2014). Both are legally mandated, creating multiple lines of defense for public health.

Other Ontario and federal statutes complement source water protection indirectly by controlling pollutants and land uses that could affect water resources.

Ontario Water Resources Act, 1990 (OWRA) It is a longstanding law that prohibits discharging pollutants that may impair water quality and requires anyone taking significant amounts of water (e.g. for irrigation or industrial use) to obtain a Permit to Take Water (Ontario Water Resources Act, 1990).

Nutrient Management Act, 2002 (NMA) This act governs agricultural practices like manure and fertilizer application to minimize runoff into water sources. While the NMA sets baseline standards for farms across Ontario, the CWA allows for stricter measures in vulnerable zones if needed (Nutrient Management Act, 2002). The CWA explicitly provides that in the event of a conflict

between a source protection plan policy and a regulation or instrument under the NMA, the policy that offers greater protection to drinking water will prevail. This ensures that source water protection is not undermined by more lenient provisions elsewhere.

Planning Act (1990) The Planning Act mandates that municipalities incorporate source water protection considerations into their land-use planning decisions (Planning Act, 1990). This integration ensures that activities posing significant threats to drinking water sources are managed or prohibited, aligning with the objectives of the Clean Water Act, 2006. Even though the municipalities under the Planning Act, are required to integrate source water protection into local land-use decisions, but recent provisions under Bill 23 empower the Minister to issue Ministerial Zoning Orders (MZOs) that bypass municipal and Conservation Authority discretion, effectively weakening local oversight concerning waterways, wetlands, and natural heritage (Environmental Defence Canada, 2024). The Provincial Policy Statement (2024) provides policy direction on land-use planning matters of provincial interest, emphasizing the protection of water resources. However, it has dropped protection for unevaluated wetlands, while retaining only narrow prohibitions against development in provincially significant wetlands which substantially dilutes the previous standards for hydrologic features. (Environmental Defence Canada, 2024).

Municipal Act (2001) It empowers municipalities to enact local by-laws and planning regulations that safeguard water resources, ensuring municipal actions align with overarching environmental policies and source protection objectives (Municipal Act, 2001).

Aggregate Resources Act (1990) This act mandates the regulation and management of aggregate extraction operations, requiring rehabilitation of extraction sites, and minimizing adverse environmental impacts (Aggregate Resources Act, 1990).

Conservation Authorities Act (1990) This act mandates regional conservation authorities to manage watersheds and implement source water protection measures effectively (Conservation Authorities Act, 1990). The 2024 amendments introduced through Bill 23 have altered the regulatory role of Conservation Authorities in Ontario by shifting regulatory authority to the Minister of Natural Resources and limiting their ability to regulate activities near wetlands. These changes particularly impact source water protection and water resource management by narrowing

Conservation Authorities' power to impose permit conditions aimed at safeguarding water quality and ecological integrity

Fisheries Act (1985) This is federal legislation that contributes to source water protection by prohibiting activities that results in the harmful alteration, disruption, or destruction of fish habitats, thereby safeguarding aquatic ecosystems (Fisheries Act, 1985).

Lakes and Rivers Improvement Act (1990) This act ensures proper management, protection, and preservation of lakes and rivers, emphasizing sustainable construction and maintenance of dams and structures to prevent degradation of water bodies (Lakes and Rivers Improvement Act, 1990).

4.5 Source Water Protection in Other Canadian Jurisdictions

Outside Ontario, approaches to source water protection vary, but the underlying principles remain similar. Many provinces stepped up source protection efforts in the early 2000s, influenced by the same events that spurred Ontario's reforms (Walkerton in 2000 and North Battleford, Saskatchewan in 2001). British Columbia, for example, enacted the Drinking Water Protection Act in 2001, which requires water suppliers to complete assessments of their water sources and, in some cases, to develop protection plans. However, implementation in B.C. has faced challenges due to institutional fragmentation. Patrick (2009) notes that a wave of government deregulation in the early 2000s in B.C. constrained the effectiveness of SWP at the local level. Regulatory oversight for drinking water became dispersed among agencies hindering coordination, data sharing and proactive water resource management (Bakker & Cook, 2011). The result was a gap between the policy intent of source protection and on-the-ground action. Patrick's study of the Okanagan region recommended that a single provincial agency take leadership for drinking water and that regional watershed governance be strengthened to overcome the fragmentation (Patrick, 2009).

This example underscores that even with laws in place, clear assignment of responsibility is crucial. By contrast, Manitoba and Saskatchewan have adopted watershed-based planning programs. Manitoba's Water Protection Act (2005) provides for the designation of water protection areas and the creation of watershed management plans, which include source water considerations. These plans tend to be more policy-based and rely on cooperation among municipalities, provincial departments, and local watershed districts. In Saskatchewan, the Watershed Authority (now the

Water Security Agency) worked with local watershed advisory committees to develop Source Water Protection Plans in the 2000s as a non-regulatory initiative. While many useful projects emerged, researchers observed that without binding legal force, implementation depended on voluntary uptake and funding availability (Bakker & Cook, 2011; Bereskie et al., 2017). Overall, a common theme in the literature is that strong provincial policy commitment and clear legal mandates yield more consistent source protection outcomes.

Provinces that have chosen a regulatory route (like Ontario's CWA or Alberta's Source Water Protection Guidelines incorporated into its Water Act licensing) tend to assign formal responsibilities to public authorities and enforce compliance, whereas provinces favoring a voluntary or guidance-based approach rely on education, incentives, and existing environmental laws to protect water sources.

At the national level, Canada lacks a single unified law on source water protection but through forums like the Canadian Council of Ministers of the Environment (CCME), all jurisdictions have endorsed the multi-barrier approach and the goal of preventing contamination at the source (CCME, 2002). The federal government, in addition to providing science and guidance, has programs to support source protection in specific areas (for instance, the Canada-Ontario Great Lakes Agreement addresses nutrient sources and runoff to Great Lakes drinking water intakes). Another important aspect is protecting source waters on Indigenous lands and communities, which is an evolving area of policy. Recent federal initiatives have started to involve First Nations in source water protection planning, recognizing the critical importance of safe drinking water in those communities (Crown-Indigenous Relations and Northern Affairs Canada, 2023). In summary, while approaches differ, the consensus in Canada's water policy community is that protecting water at its source is an essential first step for drinking water safety, and it requires an integrated effort among all levels of government and stakeholders (Federal-Provincial-Territorial Committee on Drinking Water of Federal-Provincial-Territorial Committee on Environmental and Occupational Health, & Water Quality Task Group of the Canadian Council of Ministers of the Environment, 2002).

Ontario's legal framework provides one model of how clear mandates and multi-stakeholder governance can operationalize that principle. Other regions continue to refine their policies and

laws to close gaps in source water protection, learning from each other's experiences and from past failures (Marshall et al., 2018).

5. Findings and Discussion

5.1 Effectiveness of Source Water Protection (SWP) plans at improving water quality

5.1.1 Water Quality Trends in the Saugeen Valley Source Protection Area

5.1.1.1 Surface Water Quality Trends

The surface water quality in Saugeen Valley source protection area is monitored at 31 sites. Indicators measured includes phosphorus with the acceptable limit ≤ 0.03 mg/L, E. coli with acceptable limit ≤ 100 CFU/100 mg/L as provided by the provincial water quality objectives and benthic macroinvertebrates which are assessed by the Hilsenhoff Biotic Index (HBI).

5.1.1.1.1 Total Phosphorous

Early 2010

Surface water quality in the Saugeen Valley Source Protection Area (SVSPA) has been systematically monitored since the mid-2000s. Long-term data indicate that certain pollutant levels were rising in the 2000s and early 2010s. For example, total phosphorus concentrations in sub-watershed like Lower Main Saugeen River, Teeswater River in (2002-2006) showed trend of frequently exceeding the Provincial Water Quality Objective (0.03 mg/L) (Saugeen Valley Conservation Authority, 2016). This suggests that nutrient enrichment from sources like agricultural runoff, fertilizers, and septic systems remained a persistent issue up to the early 2010s.

2010-2016

In 2018 sub-watershed report covering data up to ~2016, most rivers and streams in the Saugeen watershed were graded "B" (good) for overall quality, with grades ranging from "A" (excellent) to "C" (fair) depending on the location. Penetangore River sub-watershed for year (2002-2016) showed trend of threshold phosphorous concentration with overall water quality of grade "C". This rating was primarily driven by elevated nutrient levels (notably phosphorus), bacterial contamination (E. coli), and assessments of benthic invertebrate communities, which together

indicated moderate ecological stress in the watershed. Most sub-watershed-maintained grades “B” indicating steady conditions, but several showed clear gains. For instance, the Lower Main Saugeen, Rocky Saugeen, and Teeswater River sub-watersheds which drained through municipalities like Saugeen Shores, West Grey (Durham), and South Bruce respectively, all recorded improved surface water quality grades in 2018 watershed report (Saugeen Valley Conservation Authority, 2018b).

2017-2022

By the time of the 2023 watershed report card (covering data through 2021), 60% of monitoring sites were still graded “B” (Ministry of the Environment, Conservation and Parks, 2023). Most sub-watersheds remained stable, and some previously stressed areas showed further improvement. Phosphorus grades fell in the South Saugeen River and Lower Main Saugeen River from ‘A’ to ‘B’.

Saugeen Valley Conservation Authority, (2023) report shows that water quality data from the South Saugeen sub-watershed shows that phosphorus levels have increased slightly, with 5% of samples above acceptable limits. It is to be noted that South Saugeen and Lower Main Saugeen sub-watershed which includes the main communities of Southampton, Mildmay, Paisley and Walkerton, is predominantly agricultural land, so decreasing grade of phosphorous might be an area of concern that nutrients and pesticides use may still need supervision.

Most overall grades didn’t change from the 2018 report card; however, the Beatty Saugeen River, Lake Fringe and Upper Main Saugeen River areas have improved. This indicates that despite general progress, nutrient inputs remain a management concern in some agricultural pockets. Importantly, water quality is consistently higher in less developed, more forested catchments, and lower in areas of intensive agriculture or urban land use.

5.1.1.1.2 Microbial Water Quality

Microbial water quality has likewise been closely tracked. Escherichia coli (E. coli) levels in the Saugeen River system have generally met recreational water guidelines in recent years, although they continue to reflect human, and livestock influences during runoff events. The watershed report

card of 2018 with data from (2007-2016) shows that based on E-Coli concentration, 86% of sub-watershed were graded as B (good) 11% graded A (excellent) and 11% graded as C (fair) (Saugeen Valley Conservation Authority, 2018b). The watershed report card of 2023 shows that there has not been a dramatic watershed wide change in E. coli concentrations post-SWPP. Majority of sites maintained their previous grades but there were some positive exceptions (Saugeen Valley Conservation Authority, 2023a). For instance, the Penetangore River area showed an improvement in bacterial water quality from grade C to grade A (Ministry of the Environment, Conservation and Parks, 2023), suggesting better manure management and urban stormwater controls in that catchment.

Generally, the reduction in the E-Coil concentration in water as evident by improvement in every sub-watershed report card with grade of fair to Good to excellent after 2016 is a favorable sign, given that this period saw the introduction of mandatory septic system inspections and risk management for manure storage near watercourses. These measures were implemented as part of threat management strategies outlined in the Source Water Protection Plan to safeguard drinking water sources. Taken together, the surface water data indicate that the SVSPA's rivers and streams are in good to fair condition, with gradual improvements in nutrient and bacterial metrics in several municipalities.

5.1.1.1.3 Benthic Macroinvertebrates

The health of aquatic life in the Saugeen Valley watershed, particularly as indicated by benthic macroinvertebrate communities, has shown signs of improvement in recent years. Benthic macroinvertebrates (aquatic “bottom-dwelling” insects, crustaceans, worms, and mollusks) are widely used as ecological indicators because different species have varying tolerances to pollution (Saugeen Valley Conservation Authority, 2023b). In the late 2000s and early 2010s, benthic surveys at multiple sites across the Saugeen watershed revealed communities dominated by pollution-tolerant taxa, suggesting stressed conditions in many streams (Ministry of the Environment, Conservation and Parks, 2023).

Saugeen Conservation's biomonitoring program observed a shift in benthic macroinvertebrate communities over the five-year period preceding 2016, with an increase in species that can better tolerate pollution (Saugeen Valley Conservation Authority, 2016).

This indicated that issues like excess sediment, nutrients, or habitat disturbance were impacting sensitive aquatic organisms. The 2013 and 2018 watershed report cards consistently graded the benthic organism communities as “D” (poor) and “F” (Very poor) in most sub-watersheds, even where chemical water quality parameters scored better (Ministry of the Environment, Conservation and Parks, 2023). For example streams in both agricultural areas e.g. the Teeswater and Pine Rivers and near urban areas e.g. portions of the Saugeen River near Walkerton had a low diversity of mayflies, stoneflies, and other sensitive insects. Instead, they harbored more pollution-tolerant worms and midges, reflecting legacy impacts and the time lag for biological recovery (Ministry of the Environment, Conservation and Parks, 2023; Saugeen Valley Conservation Authority, 2018b).

After the implementation of source water protection plan in 2016, there is now evidence of improving benthic conditions as of the most recent data. The 2023 watershed report card reported that the grade of benthic micro-invertebrates has improved across the watershed compared to the previous assessment (Ministry of the Environment, Conservation and Parks, 2023; Saugeen Valley Conservation Authority, 2023b).

This positive improvement could be an indication that aquatic habitat improvements and pollution reductions over the past decade are benefiting stream life. Conservation initiatives have likely played a significant role. Riparian restoration projects for example, fencing cattle out of streams, planting buffer strips, and implementing erosion control in cultivated fields help reduce sedimentation and nutrient surges that harm benthic organisms. It is also worth noting that benthic communities integrate the effects of long-term water quality thus, the gradual reductions in phosphorus and bacteria after 2016, along with stable flow conditions likely contributed to better macroinvertebrate scores by 2021. The nutrient management, land use management might also have significant role in improving benthic life.

5.1.1.2 Ground Water Quality Trend

Groundwater in the Saugeen Valley Source Protection Area is generally of excellent quality and has exhibited stable levels over the 2006-2022 period (Ministry of the Environment, Conservation and Parks, 2022b) . To track groundwater conditions, the Provincial Groundwater Monitoring

Network (PGMN) operates a network of monitoring wells in partnership with the conservation authority. In the SVSPA, 23 PGMN wells have been established to continuously record groundwater levels and to collect annual samples for chemistry (Saugeen Valley Conservation Authority, n.d.). These monitoring stations serve as an early warning system for any changes in aquifer conditions (such as declining water tables or emerging contaminants) and guide water management decisions. Hydrologically, no significant long-term decline in groundwater levels has been observed in the monitored wells (Saugeen Valley Conservation Authority, 2023b) . Water level data through drought and wet periods show typical seasonal fluctuations, but importantly, there is no downward trend indicative of aquifer depletion (Ministry of the Environment, Conservation and Parks, 2022b).

The Saugeen area benefits from substantial recharge due to its extensive forest and wetland cover, especially in the upper watersheds and relatively lower pumping stresses compared to more urbanized regions. Thus, groundwater quantity has remained sufficient and resilient even during dry summers. There have been no reports of municipal wells failing or requiring deepening over the past two decades (Saugeen Valley Conservation Authority, 2024). Similarly, no significant groundwater quantity stress was identified in the water quantity stress assessment for the source protection area. The Tier 1 and 2 studies conducted during assessment phase found that the available groundwater supply comfortably meets current demand, with a healthy margin of safety for most areas (Saugeen Valley Source Protection Authority, 2015).

In terms of groundwater quality, the SVSPA's groundwater received an average grade of "A" (excellent) in consecutive watershed report cards (Saugeen Valley Conservation Authority, 2023a). This grade is based on aggregate measures of key contaminants (nitrates and chloride are common indicators) in dedicated monitoring wells. Most monitoring sites have concentrations well within safe limits, for instance, the 2023 report card noted that chloride levels at all tested sites were graded A, and about 86% of sites also earned an A for low nitrate (nitrogen) levels (Ministry of the Environment, Conservation and Parks, 2022b). Only two wells had slightly elevated nitrate giving a "B" grade, and one monitoring well in an intensely farmed area registered a "D" (poor) for nitrate (Saugeen Valley Conservation Authority, 2023a). The latter indicates a hotspot of groundwater nitrate pollution, likely from excessive use of chemical fertilizers, application of livestock manure, septic system leakage, and other waste. In heavily farmed regions, the predominant cause is often

the leaching of excess nitrogen from fertilizer and manure into the soil, which then percolates down into the aquifer.

Ferguson (2015) has documented that nitrate from nitrogen fertilizers readily migrates below the root zone and contaminates groundwater. However, this study also notes that the conservation authority stresses this result as a site-specific and a single well's poor nitrate grade not to be indicative of the overall drinking water quality of source protection region. Responses from the interview suggests that long term monitoring of data for nitrates in these wells have been established for the grades to reflect sustained data over a decade or more. This is to provide insight into ongoing environmental conditions rather than a limited or short-term snapshot.

Apart from these isolated cases, report from municipal groundwater wells is of high purity. There have been no detections of industrial chemicals, and bacteria are generally absent in the aquifers used for municipal supply. Policies such as prohibiting new waste disposal or regulating chemical storage in wellhead protection zones may have played role in maintaining groundwater quality. Additionally, initiatives like the Water Well Improvement Program in the region have contributed for the improvement and decommissioning of old, unused wells that could act as pathways for contamination, thereby safeguarding aquifers from surface pollutants.

5.1.1.3 Municipal Drinking Water Quality, Accessibility and Reliability

The SVCA region's municipal drinking water systems serve majority of towns and villages amid a rural landscape. These systems range from small groundwater well supplies in inland towns e.g. Walkerton, Durham, Chesley to a few Lake Huron-based systems on the coastline (e.g. Southampton/Port Elgin in Saugeen Shores). Overall, recent Municipal drinking water reports from 15 municipalities indicate that these municipal water systems are operating reliably and keeping up with current demands (Saugeen Valley Conservation Authority, 2023b), with ongoing upgrades to keep pace with growth.

No major deficits in supply have been identified in the latest municipal water reports, but some communities are nearing capacity as populations grow. For instance, West Grey's Durham water system (serving ~2,600 people) has historically met demand, but recent development has the system approaching its design limits. In response to the growing demand, they have initiated

drilling a new well and budgeted for a new pumphouse to boost Durham’s water capacity (Aitken, 2023). Similarly, the Municipality of Kincardine is conducting environmental assessment to expand Tiverton’s drinking water capacity, considering new wells or integration with the broader water network driven by anticipated growth and development around nuclear plant and industrial area (Saugeen, Grey Sauble, Northern Bruce Peninsula Source Protection Committee, 2024).

Reliability and regulatory compliance are strong across SVCA municipal systems. Since the early 2000s (post-Walkerton), all municipal drinking water systems in Ontario are subject to stringent oversight (e.g. treatment standards, regular sampling, operator certification). The SVCA-area systems are no exception. In 2021-2023, no significant compliance issues were reported in annual water reports for municipalities (Saugeen Valley Conservation Authority, 2023b). For minor incidents immediate actions were taken.

Looking forward, capacity planning is an ongoing concern to ensure accessibility as communities grow. Municipalities under SVCA are updating water master plans and securing funding for infrastructure. West Grey and Kincardine, as noted, are investing millions in new wells and towers. Saugeen Shores, experiencing some of the fastest growth in the region, has also expanded its Southampton water treatment plant in recent years and is planning further upgrades to increase peak capacity by 2031 (Town of Saugeen Shores, 2021).

In summary, current water supply capacity is meeting needs in all serviced communities and where usage is rising close to capacity, projects are underway to augment supply water quality in these systems where demand is high, with compliance reports showing full adherence to Ontario’s standards. Occasional challenges like equipment maintenance or naturally occurring minerals are handled through technical fixes and public communication. Improvements in municipal drinking water quality can be directly attributed to effective source water protection planning. By proactively identifying and managing threats within vulnerable areas, source water protection initiatives has enhanced the overall reliability of the drinking water supply. It also safeguards drinking water sources from potential contamination events. These protective measures improve accessibility by ensuring that water sources are well-maintained and readily available. If system upgrades or additional water treatments become necessary, such measures can be implemented efficiently and conveniently, minimizing disruptions and ensuring continuous access to safe

drinking water. However, it is to be noted that these compliances are observed at serviced communities and fast-growing towns but there are still many rural communities in Saugeen source protection area that still relies on other non-municipal service, private wells being the primary one. So, still today, it cannot be said that municipal drinking water is accessible for everyone in the Saugeen Valley Source Conservation Area.

5.1.1.3.1 Private wells

The Saugeen Valley Conservation Authority region encompasses largely rural municipalities, so many households rely on private wells for drinking water. For example, the Municipality of West Grey which has population of 13,131 according to the statistics of Canada, 2021 has municipal drinking water supply in its two largest towns (Durham and Neustadt), with the remaining majority of residents using non-municipal drinking water service including private wells as well (The Municipality of Durham, 2017).

Likewise Municipality of Brockton with population of 9,784 (Statistics Canada, 2021) has three drinking water system where the total water supplied by the combined three drinking water system is for 5,202 residents which also indicates that many people still relies on private well for drinking water (The Municipality of Brockton, 2025). While there is no exact information on the number of private wells in Saugeen Source protection area, nearly all rural residential areas across the SVCA watershed are serviced by private wells and septic systems (Saugeen Valley Conservation Authority, 2024). Cumulatively, tens of thousands of people in SVCA municipalities depend on private well water, mirroring the broader province where about 1.6 million Ontarians use private wells (Office of the Auditor General of Ontario, 2014).

Private well water is untreated and vulnerable to contamination. Testing is voluntary, and many owners test infrequently. In 2025 special report of auditor general on safety of Non-Municipal Drinking water, it was highlighted that in Ontario less than 30% of drinking water from private wells was tested (Office of the Auditor General of Ontario, 2025). In 2013 about 166,000 private well samples were submitted in Ontario, and 36% tested positive for bacterial contamination (Office of the Auditor General of Ontario, 2014) whereas in between 2003 and 2022 about 35% of water sample from private wells tested positive for bacterial contamination (Office of the Auditor General of Ontario, 2025).

This figure underscores the continued vulnerability of residents who rely on private wells, highlighting that the risks that led to past drinking water tragedies have not been fully addressed.

Parts of the SVCA region sit on karstic limestone bedrock with thin soil cover, especially in upper Grey and Bruce counties (Saugeen Valley Source Protection Region, 2015) . This geology allows surface pollutants to rapidly enter aquifers through sinkholes and fissures.

Such hydrogeological vulnerability means private wells can be contaminated without warning, especially if located near sources of pollution like livestock operations or industrial sites. Unlike municipal water supplies, private wells are generally not covered by source water protection plans. The Clean Water Act’s source protection framework initially excluded single-household wells from mandatory risk management (Office of the Auditor General of Ontario, 2014). As a result, activities that could threaten a private well e.g. fuel storage, manure spreading nearby are not subject to the strict land-use controls that protect municipal wellhead zones. Responsibility for private well maintenance and testing rests entirely on owners. Public Health offers free bacteriological testing, but there is no regulatory requirement to test or report results. While private wells provide essential water access to many residents across the SVCA area, their users must contend with quality uncertainties and rely on personal diligence and public-health guidance to ensure their drinking water is safe.

5.1.1.4 Aquatic Animals

Before 2016, fish habitats in the Saugeen watershed were impacted by both anthropogenic and natural factors. Agricultural runoff and other land-use pressures contributed to elevated nutrient and bacteria levels in some tributaries, leading to algal blooms and “Fair” water quality grades in downstream areas (Ministry of the Environment, Conservation and Parks, 2023).Habitat fragmentation was another concern as number of old dams impeded fish migrations and altered flow regimes(Ontario Steelheaders, n.d.). The removal of Lockerby Dam on the North Saugeen in 2015 restored natural flow and eliminated a long-standing impediment to fish migration (Saugeen Valley Conservation Authority, 2015), marking a significant habitat improvement.

The source water protection plan implemented from 2016 onwards for targeted threats such as agricultural pollution and fuel spills, and although its primary goal was to secure safe municipal

drinking water, it also yielded ecological benefits. Maintaining high drinking-water standards translates into cleaner rivers, providing a healthier medium for aquatic flora and fauna (Saugeen Valley Source Protection Region, 2015). By the 2017-2021 period, surface water quality in parts of the Saugeen watershed showed signs of improvement. Several sub-watersheds (e.g. the Beatty Saugeen headwaters and Lake Fringe coastal area) improved from their 2018 report card grades (Saugeen Valley Conservation Authority, 2023a).

There have also been targeted efforts to improve aquatic habitat connectivity. For example, the removal of the Hamel Dam in Mildmay in 2016, which had obstructed Otter Creek (a tributary of the Lower Main Saugeen River) re-opened approximately 2 km of cold-water stream habitat for fish and invertebrates, allowing aquatic life to freely recolonize upstream areas (Saugeen Valley Conservation Authority, 2018a). Similarly, in 2019 there was a removal of Truax Dam in Walkerton. Scientific monitoring confirmed that removing this dam improved connectivity for migratory fish increasing fish diversity and biomass (Barnthouse et al., 2019).

Various on-the-ground projects have contributed significantly to the improvement of aquatic habitats in the Saugeen Valley. Initiatives such as tree planting, stream bank stabilization, and the installation of livestock exclusion fencing coupled with alternative watering sites have effectively reduced erosion and nutrient runoff. This has resulted in enhanced water clarity and cooler stream temperatures, creating favorable conditions for fish habitats.

Moreover, angling groups have played an integral role in habitat enhancement and fish population restoration. The Ontario Steel headers, in collaboration with the Lake Huron Fishing Club (LHFC) and other partners, have actively engaged in stream rehabilitation, egg collection, and fish stocking programs specifically aimed at bolstering wild Steelhead population (Ontario Steelheaders, n.d.). Additionally, community-driven initiatives including public education campaigns, actively involving Saugeen area schools and local volunteers, have targeted reductions in urban pollution entering streams.

The Saugeen Valley Source Water Protection Plan itself does not specifically address aquatic species conservation, rather, it focuses primarily on maintaining and improving water quality. It is important to acknowledge that these grassroots and community-led actions complement the direct

regulatory measures established through the source water protection program. While regulatory approaches provide the foundational framework for protecting water quality, the success observed in improving fish populations and building resilient aquatic ecosystems in the Saugeen Valley illustrates the significance of indirect measures those driven by active community participation and environmental stewardship.

5.1.2 Has Source Water Protection effort been effective in improving water quality?

Since the Saugeen Valley Source Protection Plan took effect in 2016, the region’s drinking water sources have shown notable improvements in both quality and stability of supply. Surface water quality monitoring at 31 sites indicates that most rivers and streams in the SVSPA are graded “Good” (B), with some reaching “Excellent” (A) (Ministry of the Environment, Conservation and Parks, 2023). These grades reflect low levels of contaminants like phosphorus and bacteria. In fact, the 2023 watershed report card shows that overall grades remained high (60% of sites rated B) including the E-coli (Saugeen Valley Conservation Authority, 2023a). Long-term biological indicators are positive as well. Pollution-sensitive benthic macroinvertebrate communities have generally improved, signaling healthier aquatic ecosystems (Ministry of the Environment, Conservation and Parks, 2023). These outcomes suggest that efforts under the SPP to curb pollution are yielding cleaner source water, which in turn eases treatment demands and enhances drinking water quality for municipalities.

Among 21 different threats identified for the drinking water, nutrient management has been a cornerstone of drinking water threat mitigation in the Saugeen region, leading to measurable water quality gains. Excess nutrients particularly phosphorus and nitrogen from manure and fertilizers were historically a persistent issue due to agricultural runoff and septic leakage. In response, the SPP introduced strict policies and leveraged Ontario’s Nutrient Management Act (2002) to control this threat. Farmers operating near vulnerable wells or intakes must now follow comprehensive nutrient management plans and, in many cases, negotiate Risk Management Plans (RMPs) with local officials (Saugeen, Grey Sauble, Northern Bruce Peninsula Source Protection Region, 2015a). These RMPs set site-specific requirements for manure handling, storage, and field application to minimize leaching into groundwater or runoff into streams (Source Water Protection Policy Implementation Portal, n.d.). These measures along with local stewardship programs, for

example, have fenced cattle out of streams and planted riparian buffer trees to reduce manure runoff and soil erosion, leading to measurable water quality gains.

In the Saugeen SVSPA, the payoff is evident in stable or dropping nitrate concentrations in municipal wells as many well supply systems report nitrates well below the 10 mg/L drinking water limit and the overall “Good” status of most sub-watersheds (Ministry of the Environment, Conservation and Parks, 2023). This suggests that improved manure handling along with fertilizer management have largely fulfilled their goal of keeping nitrate pollution in check. Indeed, broader studies affirm that adopting environmental farming practices like careful fertilizer application and cover cropping can significantly improve water quality over time (Blanco-Canqui, 2018; Kondraju & Rajan, 2019). However, scientists caution that progress can be gradual. Liu et al., (2024) note that long-standing nitrogen “legacies” in groundwater mean it can take years or even decades for nitrate reductions at the surface to translate into cleaner aquifers. The phosphorus concentrations in Saugeen SWPA have either improved or remained stable over time however, they still exceed established benchmarks particularly in sub-watersheds around agricultural hamlets. Similar result of phosphorous concentration can also be observed in agricultural areas of Grand River (Grand River Conservation Authority, 2020) east to the Saugeen River. In the SVSPA context, this underscores that while nutrient management has shown good results, continued diligence is needed to sustain and build on early gains.

Parallel efforts to manage stormwater runoff and upgrade wastewater infrastructure have also enhanced source water quality and availability. Under the SPP, municipalities in the Saugeen region were prompted to upgrade stormwater infrastructure and apply more protective design standards, especially in vulnerable areas. All existing stormwater management facilities within wellhead protection zones have been re-evaluated for effectiveness (Source Water Protection Policy Implementation Portal, n.d.). For new developments, the plan’s policies influence site plan controls so that stormwater systems do not exacerbate contamination risks. In the most critical groundwater recharge areas for municipal wells, infiltration-type stormwater features are generally prohibited unless water is first treated (Source Water Protection Policy Implementation Portal, n.d.).

Additionally, municipalities have worked to reduce combined sewer overflows and sewer cross-connections that can lead to untreated waste discharges during heavy rain. In SVSPA's urban centers, separate storm and sanitary sewers are now the norm, and any remaining overflow points are being eliminated or equipped with treatment. The cumulative effect is less polluted runoff reaching drinking water intakes and recharging aquifers. Notably, even with more intense rainstorms in recent years, the Saugeen River and its tributaries have not seen a corresponding spike in contaminant levels, indicating that stormwater controls are mitigating what could otherwise be a worsening threat. However, this study notes that it is essential to maintain storm water runoff considering future population growth and looming threat of extreme event due to climate change which may impact storm water runoff and affect drinking water source which is in alignment with finding by Arnone et al., (2018).

At the same time, significant investments have been made in wastewater treatment upgrades. For e.g., Municipal sewage treatment plants (STPs) in communities like Hanover, Kincardine, and Saugeen Shores have been upgraded or optimized to produce cleaner effluent (Municipality of Kincardine, 2024). Similarly, the Walkerton STP and others were retrofitted to tertiary treatment standards, resulting in effluent phosphorus concentrations dropping to well below previous levels. The Grand River provides a parallel success story as major upgrades at Kitchener and Waterloo's treatment plants led to dramatic improvements in river health, with dissolved oxygen levels rebounding since the early 2000s and aquatic life returning in greater numbers (Grand River Conservation Authority, 2020).

The SPP mandated regular septic system inspections in certain high-risk locations. By catching failing septic's before they contaminate groundwater with bacteria or nitrates, these measures have a direct protective effect on private wells and municipal drinking water. Beyond inspections, outreach programs have educated homeowners on proper maintenance and the importance of pumping out tanks regularly. Taken together, tighter control of wastewater discharges whether from big sewage plants or individual septic systems has contributed to the improved microbiological safety of drinking water. It is telling that since SPP implementation, no boil-water advisories for municipal systems in SVSPA have been issued due to drinking water contamination.

This study also notes that despite the aggregate extraction activities in Saugeen conservation area,

it is not formally labelled as drinking-water threat so, there are no direct threat management plan outlined. However, it is recognized as a pressing watershed concern and managed through regulated permitting, hydrogeological study requirements, and integration into watershed plans and monitoring programs. Similar issue has also been noted at the Waterloo region, where in spite of the continued extraction no action was taken to list it as a significant threat. In response to this frustration, one of the respondents used a striking analogy, asking, “Does that mean if you take the roof off a house, it won’t affect the contents when it rains?”.

Additionally, the Bruce Nuclear Generating Station is located within the source protection region, radioactive materials such as tritiated water are categorized under other threats and are not currently subject to specific source protection policies under the Saugeen, Grey Sauble, Northern Bruce Peninsula Source Protection Plan (Saugeen, Grey Sauble, Northern Bruce Peninsula Source Protection Region, 2015a). While the respondent from interview acknowledged Bruce Power’s proximity and perceived potential for localized threats, no significant drinking water threat designation has been assigned due to jurisdictional boundaries and the oversight of federal regulatory frameworks. Bruce Power coordinates its environmental monitoring and emissions reporting with federal authorities such as the Canadian Nuclear Safety Commission, which requires licensed facilities to implement pollution prevention and environmental protection programs under the Nuclear Safety and Control Act (Canadian Nuclear Safety Commission, 2024).

In terms of water quantity, the SVSPA has maintained stable groundwater levels and reliable surface flows since SPP implementation. No municipal wells have reported chronic declines in aquifer levels, and streams continue to meet demand even during dry periods. A combination of careful permitting and conservation measures has prevented over-extraction of water resources. The Permit to Take Water (PTTW) program, administered under Ontario’s water laws, has been instrumental in this stability. By law, any large withdrawal (>50,000 L/day) requires a permit and is subjected to conditions and monitoring (Prelaz & Bulman, 2020). The PTTW program has been proactive. It now often requires permit holders to implement water conservation measures e.g., recycling process water, fixing leaks and to report usage data annually (Prelaz & Bulman, 2020).

Some permits in SVSPA also come with conditions for seasonal cessation, for instance, during declared drought Level III conditions under Ontario’s Low Water Response plan, certain non-

essential takings must stop or reduce to protect stream flow. In practice, this system has kept groundwater levels in places like the Teeswater and Saugeen River wellfields remarkably stable. MECP's monitoring shows only normal seasonal fluctuations in municipal well static levels over the past decade, with no long-term decline (Saugeen Valley Conservation Authority, n.d.). The integration of PTTW with source protection as recommended by the Walkerton Inquiry's findings means SVSPA's water budget is managed holistically. While the region is relatively water-rich, climate change and growing demand could strain supplies. Even though the assessment report of the source protection region notes no notable threats for the drinking water quantity for now (Saugeen Valley Source Protection Authority, 2015), the increasing population around port Elgin and Owen sound due to the restructuring of Bruce power plant has led to the increased water demand.

In this scenario, this study acknowledges the PTTW framework through which the region has been adapting by adjusting permits and promoting efficiency without compromising the sustainable yield of aquifers. Based on the finding, this study also acknowledges the recent effort to integrate climate change in the water protection program. Even though Saugeen has been blessed with adequate water sources, the looming threat of climate change cannot be denied.

Despite the overall success in managing formal threats to municipal drinking water, private well water safety remains an ongoing concern in the Saugeen Valley and across Ontario. Unlike municipal systems, private wells are not covered directly by Source Protection Plan policies or regular regulatory oversight. Well owners are responsible for maintenance and water testing, yet many are not adequately doing so. In the SVSPA's rural townships, the health unit reports that slightly over than 10,000 test are carried out annually which is significantly less than the number of small drinking water system and private wells available there (Arra, 2025). This trend confirms the statement that less than 30% of private well owners submitted water samples for testing in a given year by auditor general in 2025 on special report on non-municipal drinking water services. Ontario's situation is not unique across Canada and the U.S., private well water is a known public health blind spot (DeSimone, 2009). This lack of monitoring means problems can go unnoticed until people get sick. Given the information that free water testing is carried by the public health units the limited number of testing's indicates broader issue than public awareness.

The investment made on (aggressive) public awareness campaigns and education before the Clean Water Act and outreach, and awareness program afterwards indicates that people possess adequate information regarding the necessity of well water testing. However, there remains a critical gap in understanding the potential negative consequences, as the Walkerton tragedy appears increasingly distant in collective memory. This study identifies such a gap through interview responses from individual in rural hamlets who express a belief in the safety of their well water based on generational use without reported illness. This study also found it interesting that supply-managed poultry and dairy farmers are required to test their private well water for bacteriological contamination at least once a year as part of their annual audit. If the results fail to meet the zero-tolerance standard, they must immediately implement corrective measures. Some livestock producers undertake these tests primarily out of concern that non-compliance could lead to reprimands.

Although the respondents acknowledged awareness of the need for routine water testing, they commonly neglected to follow through with these procedures. This phenomenon aligns with concepts such as risk normalization and information fatigue, where continuous and repetitive safety messaging can result in complacency over time. Routine actions, such as regular testing and documentation, may diminish in perceived importance when no immediate or visible crisis occurs (Arra, 2025). Additionally, insufficient engagement and limited face-to-face interactions with residents exacerbate this disconnection, despite the availability of relevant information. The lack of regular visits or inspections further contributes to residents decreased motivation to participate actively in water safety initiatives.

Moreover, practical barriers compound this issue. For instance, the number of water testing drop-off locations has decreased significantly since the pandemic, reducing convenience and accessibility. Although the respondents were generally aware of the free testing services provided by public health units, corroborative studies indicate that limited risk perception and low awareness of testing services persist as primary barriers hindering effective participation.

The Saugeen example underscores a policy insight even as we celebrate improved drinking water in regulated systems, more attention and possibly new regulations are needed to safeguard rural well users. This could include mandatory well testing programs, subsidies for well

upgrades/abandonments, or extending source protection planning to cover significant private well clusters. Until such measures are in place, private well owners in the region are urged to test three times a year and take preventative actions on their own (Kreutzwiser et al., 2010) a message consistently emphasized by health units, but one that has yet to fully resonate.

5.2 Stakeholder Participation in the SVSPA Source Protection Plan

Stakeholder participation was foundational in developing the Source Water Protection Plan for the Saugeen Valley Source Protection Area. Ontario's Clean Water Act mandated a collaborative, community-driven process for the multi-stakeholder Source Protection Committee, which was established in 2007 with members representing municipal governments, the agricultural sector (farmers), public health, environment, commerce and industries and public interests. The committee's mission emphasized the importance of inclusive engagement, striving to recognize all community members as valued stakeholders and making decisions through open, transparent communication (Saugeen, Grey Sauble, Northern Bruce Peninsula Source Protection Region, n.d.-a). In addition to the main committee, sector-specific working groups e.g. an Agricultural and Rural Working Group and a Planning Officials Working Group were formed to review draft policies and provide technical expertise reflecting local needs. Broad public consultation was also undertaken where the planning team held public open houses, circulated stakeholder surveys and information letters, and invited feedback at each stage of drafting (Saugeen, Grey Sauble, Northern Bruce Peninsula Source Protection Region, 2015b).

Two First Nation communities in the region (Chippewas of Saugeen and Chippewas of Nawash) were formally invited to participate in the planning process and even to nominate committee members. While these First Nations did not ultimately take a seat on the committee consistent with the jurisdictional reality that source protection plans under provincial law do not automatically cover reserve lands. The communication note shows outreach efforts made to include them in consultations e.g. sending draft documents and invitations for comment (Saugeen, Grey Sauble, Northern Bruce Peninsula Source Protection Region, 2015b). The respondent involved since the conception of source water protection plan informed about the informal, yet open communication mechanism established with the First Nations of Saugeen, where they would attend most of the meetings and provide feedback. The knowledge exchange was both ways where the First Nations

were receiving information for their drinking water management. However, there was no formal participation of the representative as a source committee member. By the time the SVSPA Source Protection Plan was approved (effective July 2016), it was a product of local stakeholder collaboration and consensus-building.

Stakeholder involvement did not end with plan approval. It has continued through the implementation phase of the SWPP. The multi-stakeholder Source Protection Committee remains active as an oversight and advisory body, meeting regularly to monitor progress, consider updates, and maintain communication with stakeholder groups. Farmers and business owners in vulnerable areas are now directly involved in implementation through compliance with risk management plans and best practices mandated by the SWPP. Notably, the plan's policies favor cooperative tools. This means landowners such as farmers work one-on-one with Risk Management Officials to agree on practical measures to reduce contamination risks, rather than facing top-down prohibitions.

The different stewardship, occasional grants and funding mechanisms has provided financial assistance to farmers, rural landowners, and small businesses for implementing protection measures on the ground, thereby encouraging their continued buy-in. The SVSPA conservation authority has also pursued partnerships with external institutions to bolster implementation. A notable example is the collaboration with the Nuclear Waste Management Organization (NWMO), which, while external to the original SWPP process, has partnered with the Saugeen Valley Conservation Authority to enhance groundwater monitoring in the watershed (Saugeen Valley Conservation, 2021). This partnership provides additional data on water quality and levels, demonstrating how outside stakeholders are contributing resources to support the plan's objectives.

Throughout both the planning and implementation stages, feedback mechanisms have been in place to ensure stakeholders can voice concerns and see their input reflected. During the development phase, the SVSPA Source Protection Committee and staff held consultation periods at each major step for example, when drafting the Terms of Reference, Assessment Report, and the Plan itself, they circulated the documents to all municipalities, First Nations, and relevant agencies and made them available for public comment (Saugeen, Grey Sauble, Northern Bruce Peninsula Source Protection Region, 2015b).

Public meetings and open houses allowed community members to ask questions and provide written feedback, which the committee reviewed and incorporated as appropriate. Many community suggestions did influence the final plan for instance, local knowledge helped identify previously unrecognized contamination sources, and business owners' feedback led to more flexible compliance timeframes in some policies (as noted in committee discussions). The Source Protection Committee structure itself is a feedback channel, since members act as liaisons to their sectors: agricultural reps relay farmers' concerns, while municipal reps gather input from their councils, and so on (Saugeen, Grey Sauble, Northern Bruce Peninsula Source Protection Region, 2015b). This ensured that stakeholder feedback was continuously funneled into decision-making rather than confined to one-off public meetings.

In the implementation stage, formal feedback mechanisms continue. Any significant amendment to the Source Protection Plan triggers a new round of public and stakeholder consultation by law. The review of meeting minutes of the source protection committee shows that comments from stakeholders are discussed and sometimes lead to revisions of policies or implementation.

Internally, the Source Protection Authority (conservation authorities) also collects annual implementation reports from municipalities and risk management officials, which serves as a feedback loop highlighting on-the-ground challenges or successes. The annual progress reports for the SVSPA region are publicly released each year, summarizing achievements and outstanding issues, thereby keeping the community informed and inviting continued dialogue (Saugeen, Grey Sauble, Northern Bruce Peninsula Source Protection Region, n.d.-b). The multi-year, iterative planning process gave stakeholders to influence on policy outcomes. In the aftermath of the Walkerton tragedy, some farmers feared they would be unfairly blamed for water contamination and faced with burdensome rules (Loggan, 2025). This initial mistrust could have led to significant conflict if the source protection planning was perceived as punitive. However, the SVSPA planning process actively incorporated farmers' perspectives to forestall this. Through their involvement on the committee and working group, policies were crafted to be practical for example, instead of outright bans on manure spreading near wellheads, the plan requires handling improvements or nutrient management plans, coupled with education on best practices.

Where farmers voiced concerns such as costs of upgrading fuel storage or decommissioning old wells, the committee pushed for the inclusion of funding programs to offset costs (Saugeen, Grey Sauble, Northern Bruce Peninsula Source Protection Region, 2015b). The participant also responded public engagement was more contentious when people were worried about implications of the policies on their farms, on their businesses but with the time, and financial incentives for buy-ins, they were able to achieve cooperation and engagement from farmers. One of the respondents noted that “initially there was a lot of rumors and people come into a meeting very worried but with the continuous effort of experts, agricultural representatives and trust of farmers over time, we were able to maintain right balance between protecting source water and allowing certain activities”.

The SVSPA case also highlights several challenges to effective stakeholder participation in source water protection, which are important to recognize. One challenge has been sustaining engagement and avoiding stakeholder fatigue. The development phase stretched over many years (2007-2015), and delays in provincial approval at times caused frustration. An audit by Ontario’s Auditor General in 2014 found that many Source Protection Committee members across the province began losing interest in the process due to slow progress and uncertainty in funding (Office of the Auditor General of Ontario, 2014). Even though the SVSWPA renews its source committee members time and again but getting constant feedback and involvement of farmers could be a challenge.

Another challenge is ensuring inclusivity across all stakeholder groups, despite best efforts, formal representation of First Nations in source committee was not achieved. Bridging the Indigenous participation gap requires trust-building beyond the formal committee structure, and capacity-building within First Nation communities so they can lead their own source water initiatives (Marshall et al., 2020). This is a broader challenge in Ontario (only a few First Nations opted into the provincial source protection process), and SVSPA is no exception. Additionally, not all community members are equally involved for example, private well owners and rural residents whose drinking water sources are outside the municipal scope might feel the SWPP is not directly about them, so they may not engage.

The informal conversation with the residents of Saugeen Valley Source protection area suggests that people within access of municipal drinking water services are aware of the open house hearing and communications circulated by the municipality even though they may not necessarily be involved. However, one of the respondents who doesn't rely on municipal drinking water system mentioned of not being involved at any stage of source water protection planning and implementation phase and also not being approached by any entity for feedback or open house discussion. This can lead to a portion of the populace being less informed or less supportive. To address this, SVSPA conservation authorities have run general outreach programs like well stewardship and septic education campaigns to capture those broader water quality issues, but it remains challenging to allocate time and resources to stakeholders officially outside the plan's scope.

Implementing a multi-stakeholder source water protection plan inevitably involves conflicts and disagreements; however, the experience in the Saugeen Valley Source Protection Area demonstrates that most challenges were effectively addressed through sustained dialogue. While achieving fully equitable and meaningful participation from all stakeholders, ranging from farmers and First Nations to industry is complex, the SVSPA case highlights that continuous communication, responsive feedback mechanisms, and collaborative conflict resolution processes contribute significantly to sustaining implementation by ensuring that local knowledge and community values are genuinely reflected in decision-making. Through this finding, this study notes that it is early to state that the stakeholder involvement process in SVSPA has largely been successful in this regard, even though the annual report suggests strong initial buy-in and collaborative problem-solving. The ongoing task will be to maintain this momentum and continually foster trust and dialogue, so that the protection of drinking water sources remains a shared responsibility among all stakeholders in the region.

5.2.1 Is Everyone at the Table?

The stakeholder participation process in the Saugeen Valley Source Protection Area demonstrated strong initial engagement but reveals some challenges in inclusivity and sustained involvement. On the 25th anniversary of Walkerton tragedy webinar, Justice O'Connor stated that widespread public backing empowered political leaders to take decisive action, noting that government

commitment for clean water act was a response to the strong support expressed by the public. “The political process was responding to the public support”. He highlighted meaningful participation especially from communities with local water knowledge, like farmers were critical not only for legitimacy but also for designing practical policies. Consistent with his remarks, in the initial phase of consultation and planning public engagement was broad but lacked formal representation from First Nations.

The available reports and the meeting notes suggest the attempt to receive feedback on the proposed plans and assessment reports from First Nations of Saugeen suggesting an attempt for open and effective communication channel for involving important stakeholders. The finding from the study suggests back and forth communication, where First Nations at Saugeen would attend majority of the meeting, even though they couldn't commit fully to being in a formal capacity on the committee. This attempt of open communication echo's Davis et al., (2023) feedback that honesty and effective communication fosters engagement of communities. At the conceptual phase of source water protection plan there were open houses, town hall consultation, series of feedback and revision, however sustaining continuous participation over period of time was a challenge. Aligning with this, this study findings also suggests regular communication over longer period of time was key to build trust and involve farmers for their buy-in for risk management. This study finding based on the response from participants from informal conversations that municipal drinking water serviced communities even though were aware of consultation processes but seldomly involves suggests engagement fatigue. However, some rural stakeholders, particularly private well users and farmers not connected to municipal services, reported feeling excluded from engagement opportunities. Participation also differed between crop and livestock farmers, with livestock producers expressing greater concern about the prospect of additional regulatory measures.

This limited outreach to certain rural communities may undermine broader acceptance and efficacy of the Source Protection Plan, which was also noted by the Office of the Auditor General of Ontario. Such gaps underscore limitation of the SVSPA's participatory approach, suggesting the need for targeted, inclusive strategies to ensure meaningful and equitable participation from all stakeholders, particularly those historically underrepresented or marginalized.

5.3 Institutional Coordination

Effective implementation of the Saugeen Valley Source Protection Plan (SVSPA) relies on strong institutional coordination across multiple organizations and levels of government. The Source Protection Committee (SPC) serves as the central hub for inter-organizational collaboration. The SPC's membership includes municipal representatives from across the region, agricultural and industrial sector reps, and an ex-official provincial liaison appointed by the source protection authority (Saugeen, Grey Sauble, Northern Bruce Peninsula Source Protection Region, 2016). Meetings are typically attended by senior staff from the Saugeen Valley and Grey Sauble Conservation Authorities and other stakeholders, ensuring that communication channels are open between local implementers and higher-level authorities. This diverse SPC composition and regular meeting schedule create a formal decision-making structure where plan updates, progress reports, and emerging issues are discussed collaboratively before any decisions or recommendations are made. The SPC chair appointed by the province and members collectively review implementation progress and propose plan amendments, while Source Protection Authority (SPA) boards provide formal endorsements required under the Clean Water Act. This multi-tier approval process illustrates the vertical coordination built into source water protection governance.

Communication and collaboration mechanisms are evident in the day-to-day implementation of the SVSPA plan. SPC meeting minutes since 2016 document routine information-sharing through staff reports, correspondence, and presentations involving various agencies. The SPC's project manager and technical staff act as liaisons, reporting on municipal progress and bringing forward issues from local levels to the committee. Regular "Communications Reports" to the SPC detail public outreach and inter-agency initiatives. For instance, the Communications Planner for the region reported on a Children's Water Festival that engaged 1,620 Grade 4 students from 38 schools across Grey and Bruce Counties in 2023, with activities supervised by conservation authority staff, high school volunteers, and staff from partner organizations and local utilities), CAs, and community groups, demonstrating robust horizontal collaboration (Saugeen, Grey Sauble, Northern Bruce Peninsula Source Protection Region, 2024a). The communication note reads that the organizing committee even invited municipal water operators and SPC members to volunteer, further blurring institutional boundaries in a positive way.

Another instance is after a 2023 industrial fire near Meaford's drinking water intake, the source protection staff worked in cooperation with MECP, the Ministry of Health, Grey Bruce Public Health, the municipality and Source Protection Risk Management Staff. They also updated and distributed a revised First Responders Training Guide to regional emergency management personnel (Saugeen, Grey Sauble, Northern Bruce Peninsula Source Protection Region, 2024a). This episode highlights both vertical coordination (municipal-provincial-public health collaboration during the emergency) and horizontal coordination (sharing improved protocols with all municipalities and emergency services in the region).

Communication channels also extend to First Nation communities. During plan updates, the SVSPA consulted Indigenous communities (e.g. Saugeen Ojibway Nation) and provided the required notices for feedback and comments to First Nation communities, aiming to keep those stakeholders informed and involved but the absence of First Nation representative from formal source protection committee gives different picture. Even though the participation of First Nations in the regular meeting was stated and the series of knowledge exchange to help the protect their drinking water source water stated, the hesitation to fully commit themselves in the legally mandated source water protection committee shows, the process of trust building in different governance system is still a challenge. Nevertheless, this study acknowledges the communication channel paved with the Saugeen First Nations to keep them informed anticipating their future involvement.

The roles and responsibilities for source water protection even though are clearly delineated but are closely interconnected. Municipalities are on the front lines. There are 15 municipalities in the Saugeen watershed that collectively host 21 municipal drinking water systems (Saugeen, Grey Sauble, Northern Bruce Peninsula Source Protection Region, 2024b). Each municipality is responsible for conforming its day-to-day planning decisions and local policies to the Source Protection Plan, as mandated by the Clean Water Act. By 2024, 100% of the municipalities in the SVSPA had established processes to ensure all planning and land-use decisions conform with source protection policies (Saugeen, Grey Sauble, Northern Bruce Peninsula Source Protection Region, 2025). This indicates a high degree of vertical alignment, as local governments incorporate provincial water protection requirements into their own frameworks. To achieve this, extensive coordination between the SVSPA staff and municipal councils was needed.

During the 2016 source protection plan amendment process the resolutions and feedback from municipalities were incorporated into the amendments, which underscores a two-way communication i.e., municipalities communicate local concerns or needed revisions, and the regional authorities adjust policies accordingly before finalizing amendments (Grey Sauble Conservation Authority, 2016). Many municipalities also collaborate by sharing resources notably through a central Risk Management Office.

Rather than each municipality hiring its own Risk Management Official, most have signed agreements to have the regional source protection staff (hosted by the conservation authorities) carry out risk management duties on their behalf. This shared-service approach enhances consistency and coordination across the SVSPA. The RMO team can take a uniform approach to risk management plans, threat verification, and landowner engagement across multiple jurisdictions. All of these efforts illustrate a concerted horizontal coordination among municipalities under the guidance of the source protection authorities.

5.3.1 Challenges and sustenance of Institutional Coordination

Institutional coordination has been a cornerstone of SVSPA's source water protection efforts, with strong multi-level collaboration but ongoing challenges in sustaining it. Building on the participatory foundation, the source protection plan is implemented through tight coordination among municipalities, conservation authorities, provincial bodies and other organization. This multi-tiered governance structure, with regular meetings and information flow between local implementers and higher-level officials, has helped synchronize actions such as land-use planning updates and enforcement of risk reduction policies across the region. The official minutes, communication notes as analysed and also documented in the finding shows the horizontal coordination. SVSPA mirror practices in other regions where conservation authorities serve as bridging organizations to unite stakeholders and agencies for water protection (Gowda, 2016). At the same time, maintaining such integrated governance over the long term is challenging. Effective source protection demands continual alignment of diverse agencies and levels of government, a task full with issues of fragmented responsibilities, shifting priorities, and resource limitations also as noted by Plummer et al., (2010). Without sustained commitment and communication, the initially strong vertical links and horizontal networks can weaken.

In the SVSPA case, the findings of the study suggest ongoing provincial municipal funding partnership and the source protection committee have so far helped keep actors coordinated. Yet, as scholarly evaluations warn, achieving integration across sectors and scales requires continuous effort to address capacity gaps and power imbalances (Plummer et al., 2010). Furthermore, SVSPA's coordination model illustrates ongoing challenges in fully incorporating First Nations perspectives, suggesting persistent gaps in inclusivity common across Ontario and North America (Marshall et al., 2020; Marshall et al., 2018). While the SVSPA showcases good institutional arrangements that foster effective collaboration, maintaining these efforts long-term requires ongoing commitment to addressing resource limitations and inclusion barriers.

5.4 Financial Sustainability

The Saugeen Valley Conservation Authority (SVCA) oversees Source Water Protection (SWP) in a region of 15 member municipalities. Funding for SWP implementation in this region is a shared responsibility involving municipal budgets, provincial contributions, and occasional grants. A review of recent municipal financial statements and budgets shows that many SVCA municipalities allocate specific funds for SWP. For example, the Municipality of Arran-Elderslie's 2020 operating budget notes expenditure of \$10,000, covered from reserve for source water protection -well monitoring program (Municipality of Arran-Elderslie, 2020). In South Bruce, the annual budget includes a line for SWP activities delivered by Grey Sauble Conservation Authority, and these costs on the order of only a few thousand dollars per year are fully recovered from local water users rather than general taxation (Reinhart, 2025).

This indicates that, apart from provincial grants SWP implementation at the municipal level is often financed through user fees (water rates) or reserve funds earmarked for water services. Several municipalities integrate SWP into their water department budgets, ensuring that expenses for risk management officials, wellhead monitoring, and plan enforcement are sustained by water utility revenues or inter-municipal agreements. These dedicated budget allocations demonstrate local commitment, but they also underscore that SWP programs operate on relatively small budgets at the local level, which can be vulnerable to funding constraints in small rural municipalities.

During the initial years of Ontario's source protection initiative (post-Walkerton Inquiry), significant provincial investments and special programs strengthened SWP funding. Notably,

under the Ontario Drinking Water Stewardship Program (ODWSP), over \$1 million in grants were distributed to landowners in the Saugeen-Grey Sauble-Northern Bruce region between 2007 and 2013 for voluntary projects like well decommissioning and pollution prevention (Saugeen, Grey Sauble, Northern Bruce Peninsula Source Protection Region, n.d.-c). This early stewardship funding led to many on-the-ground risk mitigation projects however, ODWSP was discontinued after 2013 till present date.

The end of ODWSP left a gap in incentive funding for landowners, prompting source water protection region and municipalities to seek alternative support. In one successful response, the SVCA partnered with the Nuclear Waste Management Organization (NWMO) to establish a one-time Water Well Improvement Program in 2020. NWMO contributed \$50,000 to this program, which provided financial support to private well owners for well upgrades or decommissioning (Robertson, 2020). The program was delivered by SVCA and helped fund 24 projects (9 well upgrades and 15 well decommissions) before fully disbursing its funds through Saugeen valley well monitoring and improvement program. This is one example of how Saugeen source water protection area has pursued new funding partnerships to maintain source protection efforts when regular funding was insufficient.

Another source of external support has been Great Lakes protection grants. SVCA joined other conservation authorities in the multi-agency “Healthy Lake Huron” initiative, which received funding through the Canada- Ontario Agreement (COA) on Great Lakes water quality. In 2021, for instance, Ontario’s Ministry of Environment, Conservation and Parks announced \$2.5 million for Great Lakes protection projects, including \$300,000 shared by five conservation authorities (SVCA among them) to help local farmers adopt best practices that reduce runoff into Lake Huron (News, 2021). Such COA-funded projects support agricultural outreach, soil health, and water quality improvements that complement SWP goals in the SVCA region.

Additionally, several SVCA member municipalities have taken advantage of broader infrastructure funding programs that, while not exclusive to source protection, improve water and wastewater systems. Under the federal-provincial Clean Water and Wastewater Fund (CWWF) (2016-2018 infrastructure program), communities like Municipality of Arran-Elderslie, Municipality of Kincardine, Township of Chatsworth, Town of Hanover, Town of Saugeen Shores received joint

funding to upgrade water mains, sewers and related infrastructure (Government of Canada, 2017). These infrastructure investments indirectly support source protection by improving the safety and reliability of drinking water systems. It should be noted, however, that programs like CWWF were one-time injections and not ongoing. By design they addressed capital needs rather than the operating costs of SWP plan implementation.

In this pretext of narrow funding streams, financial sustainability remains a concern for SWP in the SVCA's rural region. A consistent theme in annual reports is that ongoing implementation relies heavily on government funding. In fact, the local Source Protection Committee has explicitly warned that the progress made in the development and implementation of the source protection plan would be diminished without the continued financial support. In the 2023 annual progress report, the committee commended the province's commitment via a recent three-year funding allocation for source protection, crediting this support for helping achieve 100% implementation of all significant-threat policies to date (Saugeen, Grey Sauble, Northern Bruce Peninsula Source Protection Region, 2024b). The committee also noted the need for renewed funding for stewardship initiatives to address newly identified risks and to maintain landowner engagement (since previous grant programs had lapsed). The response from the participants indicated temporary relief for the municipalities through provincial-municipal fund. In 2024, three-year funding agreement with Ontario Ministry of the Environment, Conservation and Parks for 2024-2027 was secured for policy implementation, municipal engagement, and technical updates (Saugeen, Grey Sauble, Northern Bruce Peninsula Source Protection Committee, 2024).

A major challenge identified is the uncertainty of provincial funding over time. In 2019, legislative changes under Ontario's Bill 108, later enacted as More Homes, More Choice Act, 2019 raised alarms about potential budget cuts to conservation authorities. SVCA's Chair at the time, Dan Gieruszak, publicly stated that proposed changes could result in a loss of provincial funding for the local SWP program (Bayshore News Team, 2019). This would include cuts to funds for monitoring, technical updates, as well as future risk management official expenses.

Such a loss would effectively download those costs to municipalities, many of which have limited capacity to absorb them. This episode highlights the precarious nature of relying on year-to-year provincial grants. It is worth noting that the Drinking Water Source Protection program was later

affirmed as a mandatory program under the revised Conservation Authorities Act, allowing CAs to continue levying municipalities for it. Provincial funding for source protection was about \$6 million annually across Ontario's CAs as of 2019 (Conservation Ontario, 2019) but long-term provincial commitment remains a concern.

On the municipal side, smaller rural municipalities face inherent challenges in funding SWP compliance. Many have limited tax bases and must prioritize core services thus, dedicating resources to hire risk management officials or to run education programs can strain local budgets (Minnes & Simpson, 2020). Indeed, research on rural source protection capacity in Ontario has noted that limited financial and human resources in low-population areas impede program implementation. In the SVCA context, one adaptive approach has been cost sharing and collaboration, instead of each municipality hiring full-time staff, the region often shares services.

For example, Grey Sauble Conservation Authority hosts a regional Risk Management Office that provides services under contract to multiple municipalities (including some SVCA members). Municipal budgets then reflect only a fee for this shared service. The Town of South Bruce Peninsula, for instance, notes that Grey Sauble CA provides its risk management official under the SVCA source protection plan (Town of South Bruce Peninsula, n.d.). This kind of collaborative service delivery helps contain costs for individual municipalities while ensuring compliance with the Source Protection Plan.

Nonetheless, even with cost-sharing, the ongoing maintenance of SWP measures (e.g. periodic updating of risk management plans, monitoring of vulnerable areas, public outreach) can be challenging if external funding wanes. Municipal councils in the SVCA area have occasionally flagged rising costs of water services for example, budgeting for required upgrades or inflationary increases in water rates which indirectly affects how much fiscal room is available for source protection tasks.

The sustainability of SWP programs in Ontario hinges on stable government support. The Office of the Auditor General (2014) have emphasized that after the completion of initial source protection plans, sufficient funding must be provided for ongoing implementation and enforcement of policies. In the early 2010s, observers warned it would be detrimental to the effectiveness of the

program if the implementation of approved Source Protection Plans were compromised due to insufficient financial resources (Canadian Environmental Law Association, 2012). This perspective was asserted by subsequent developments, while the province did continue funding albeit at reduced levels compared to the initial planning phase, periodic funding uncertainties have forced local authorities to be proactive in finding efficiencies and supplemental funds.

A positive trend is that many source protection areas, including SVCA's, have achieved significant risk reduction milestones, indicating that available funds (provincial grants, municipal contributions, and ad-hoc grants) have been used effectively. There have also been innovative success stories in the SVCA region, the Pine River Watershed Initiative supported by local farm groups, SVCA, and Huron-Kinloss Township and other community-based projects have leveraged small amounts of funding into on-the-ground improvements in water quality. In October 2021, local farm-focused programs in the SVCA area received provincial support to help keep nutrients and manure out of waterways (News, 2021), illustrating a continued commitment to protect drinking water sources through partnerships with the agricultural sector. These initiatives, coupled with the conservation authority's own programs (e.g. well decommissioning support), have helped offset some funding shortfalls by targeting external resources toward critical gaps.

In summary, the financial review reveals that Source Water Protection implementation under SVCA is managed through a patchwork of municipal funding, provincial transfers, and special grants. All 15 member municipalities contribute in some form whether through direct budget line items for SWP, contributions to SVCA levies, or allocation of water rate revenues to sustain the required risk management and monitoring activities. While this has enabled the SVCA region to make strong progress in protecting drinking water by achieving policy implementation targets on schedule, it has not been without challenges.

The end of earlier funding programs (like ODWSP) and periodic threats to provincial support have created financial uncertainty. The SVCA and its municipalities have responded with measures such as cost-sharing services, tapping reserve funds, raising water rates modestly, and seeking new funding partnerships. Ongoing oversight reports call for sustained provincial funding and even the re-introduction of incentive programs to ensure long-term success. It can be inferred that the SVCA case exemplifies the broader trend for rural Ontario, multi-level collaboration is essential for

financial sustainability of source water protection. Continued provincial and federal support e.g. through agreements like COA or infrastructure funds combined with local initiatives will be needed to maintain and build on the gains in safeguarding drinking water sources in the Saugeen Valley Source Water Protection Area.

5.4.1 Influence of finance in the implementation of source protection plan

In evaluating what has worked versus what remains challenging, it is clear that Ontario's source protection initiative has achieved important successes but still depends on delicate financial support. In the Saugeen Valley Source Protection Area, the program's financial sustainability has been an ongoing concern. On the success side, SVSPA have implemented many of their source protection policies effectively as significant threat activities have been managed or eliminated through risk management plans, and public awareness of drinking water protection has improved. No major contamination incidents have been reported in municipal supplies under these plans till date suggesting preventive measures and vigilance. The collaborative approach bringing municipalities, conservation authorities, and stakeholders together has also been a strength, yielding local buy-in and expertise. Furthermore, the province's willingness to continue funding into the implementation era albeit not at the initial scale has so far averted the program's collapse.

The SVSPA continues to operate its source protection program through a combination of provincial grants and municipal cooperation, demonstrating a commitment to keep drinking water safe. The Source Protection Program in the SVSPA has been a cautious success but not an outright triumph of financial sustainability. It has delivered clear benefits for municipal drinking water operations by fostering preventative management and reducing threats to water quality. Those outcomes, however, have been made possible by external funding that must be regularly renewed. The experiences of SVSPA and other source protection regions like Grand River, Credit Valley, Lake Simcoe, etc. all point to the same lesson i.e., stable, long-term funding is essential for sustained source protection.

On the fragile side, however, the long-term financing of this program remains uncertain and largely outside local control. Annual or bi-annual funding commitments, while helpful, do not equate to a permanent solution. Changes in government priorities or fiscal constraints could still lead to budget cuts, which would disproportionately impact small towns of SVSPA that lack alternative funding

streams. The reliance on a small number of technical staff and risk officials, some shared across multiple rural municipalities, means that any funding shortfall can quickly erode capacity. Moreover, the current scope of the program covers only municipal systems, leaving privately serviced rural residents outside the protected framework, in part because extending coverage would require additional funds and resources that are not yet forthcoming.

Ontario's model shows that when funding is available, even in a piecemeal fashion, local agencies can protect drinking water sources effectively and cost-efficiently, saving money in avoided water treatment upgrades and health costs (Office of the Auditor General of Ontario, 2014). Yet the model's weakest link is financial uncertainty; a risk that has been mitigated but not eliminated. This gap represents an opportunity and a challenge. Expanding source protection to more rural communities would increase resiliency but may require new financial models, such as incorporating source protection costs into water rates which again may not be affordable to everyone and needs to be studied on feasibility.

5.5 Monitoring and Evaluation

Before 2006, Ontario did not have a formalized source protection monitoring policy framework. Protection of drinking water sources relied on general water quality monitoring programs and treatment-level safeguards. The provincial Ministry of Environment operated broad monitoring networks to track surface water and groundwater quality. These programs focused on aquatic ecosystem health and detecting contaminants, but there was no mandatory, locally tailored monitoring policies tied to source water threats.

In the Saugeen Valley source protection area, any monitoring of source water was ad hoc for instance, conservation authorities collected environmental data and municipalities tested drinking water at water treatment facilities as required by regulations, but no comprehensive watershed-based monitoring plan existed to evaluate land-use threats to water sources. Public health crises like the Walkerton incident in 2000 revealed critical gaps in this patchwork approach, prompting calls for a dedicated source water protection regime (O'Connor, 2002b). The Clean Water Act (2006) established formal, mandatory monitoring policies for source water protection plan where implementing bodies are legally obligated to collect data on policy implementation and share it

annually. In short, post-2006 monitoring was formalized, mandatory, and tied to specific plan policies, in contrast to the earlier informal or unrelated monitoring efforts.

The Source Protection Plan for the Saugeen Grey Sauble and Northern Bruce Peninsula Region contains a robust set of monitoring policies. There are approximately 32 distinct monitoring policies labeled as “MP-01” through “MP-32” in the plan dedicated to tracking the implementation of source protection measures and the state of drinking water risks (Saugeen, Grey Sauble, Northern Bruce Peninsula Source Protection Region, 2022).

These policies exist alongside the plan’s threat management policies. The source water protection plan comprises of 66 policies directly addressing significant drinking water threats, and 57 cover general measures, transport pathways, and monitoring (Saugeen, Grey Sauble, Northern Bruce Peninsula Source Protection Region, 2024b). The monitoring policies specifically require various agencies and stakeholders to report on their activities and on water quality conditions. For example, Monitoring Policy MP-29 obligates the Municipality of Brockton to regularly sample nitrate levels in the Walkerton municipal wells and provide the results to the Saugeen Valley Source Protection Authority (Saugeen, Grey Sauble, Northern Bruce Peninsula Source Protection Region, 2022).

In general, for every significant threat policy or significant area of action, there is a corresponding monitoring policy ensuring that progress is tracked and communicated. This design reflects the CWA’s intent that source protection planning be an adaptive management process. By embedding monitoring requirements, the plan creates a feedback loop to evaluate whether policies are implemented and effective. The response from the participants also suggested that the risk management policies, monitoring and evaluation in place are scientific, robust and adequate in managing current and anticipated risk.

The Source Protection Plan introduced several enforcement tools to ensure that policies on paper translate into action on the ground. A key mechanism is the appointment of Risk Management Officials and Inspectors who work with landowners and businesses in vulnerable zones. These officials negotiate and enforce Risk Management Plans (RMPs) for activities deemed significant drinking water threats such as handling of fuels, agricultural nutrient storage, or application of

chemicals. By the end of 2024, 214 Risk Management Plans were established across the Saugeen-Grey Sauble region to control such threats.

Impressively, there is a 100% compliance rate with the agreed risk management plans among landowners and businesses in the region (Saugeen, Grey Sauble, Northern Bruce Peninsula Source Protection Region, 2025) . This indicates strong buy-in and cooperation, likely aided by education and the collaborative approach of RMOs. In response to the 2021 updates to the Technical Rules, four risk management plans targeting salt storage and handling risks were developed in 2024 (Saugeen, Grey Sauble, Northern Bruce Peninsula Source Protection Region, 2025), which suggests the vigilance and responsiveness of ongoing monitoring and evaluation processes in detecting and mitigating newly recognized threats.

Several Ontario ministries e.g., Environment, Agriculture, Transportation are assigned monitoring duties, especially where provincial instruments (permits, approvals) are used as policy tools. For instance, MP-01 directs the Ministry of the Environment, Conservation and Parks (MECP) to review all Environmental Compliance Approvals in vulnerable areas and report any amendments made as a result of the plan. Similarly, MP-08 requires the Ministry of Agriculture, Food and Rural Affairs to annually report how many nutrient management approvals were issued or denied in vulnerable areas under the new policies (Saugeen, Grey Sauble, Northern Bruce Peninsula Source Protection Region, 2022). These provisions mean that provincial regulators must keep the Source Protection Authority informed of how the plan is influencing provincial permits and must flag any issues observed.

Although the monitoring and evaluation framework is extensive, it continues to face notable challenges. Implementing thorough monitoring is resource-intensive, maintaining the same level of monitoring rigor over time can be challenging if budgets shrink. The participant of this study also expressed concern in implementing risk management policies in resource constrained state as “financial aid, grants and implementation funds were available in getting buy-in from the local farmers to do a number of well-upgrades, septic upgrades, some manure storage projects, that showed that plan is supporting them in meeting the new requirements”.

Smaller municipalities also struggled with limited resources and expertise as integrating different water systems and management practices posed significant operational challenges. In 25 years of anniversary of Walkerton tragedy webinar, president of Ontario Municipal Water Association also stated that benchmarking was a challenge as some municipalities struggled with collecting and reporting accurate data which impacted the effectiveness of performance measurements (Pulleyblank, 2025).

Another limitation is that private wells are not included in the legal protections or enforcement mechanisms of drinking water protection plans. Even though free drinking water test are offered by public health Ontario, there is no structured enforcement or reporting requirement for private well maintenance or contamination detection. Dr. Arra, Medical Officer of Health and CEO, Grey Bruce Public Health on his presentation on 25 years of anniversary of Walkerton tragedy, stated that use of the service for the water quality test is little over 10,000 test per year in Grey Bruce public health unit where there are 433 small drinking water systems and hundreds of private well (Arra, 2025). Lacking comprehensive data on the state and quality of water from these alternative sources of water may give incomplete picture of the availability of safe drinking water.

Another technical challenge is assessing environmental outcomes. Monitoring policy compliance e.g., number of risk plans in place is straightforward, but linking that to water quality improvements can be complex. Many factors influence aquifer and surface water conditions, and improvements may take years to materialize. Thus, isolating the plan's impact via monitoring data can be difficult. For example, if nitrate levels in groundwater decline, one must consider whether this resulted from agricultural practice changes due to the plan or from other trends. Designing monitoring programs that effectively measure environmental indicators not just administrative outputs is an ongoing challenge as 4 out of 32 monitoring policies in the source protection region are centered on direct environmental indicator. Ensuring that all parties fulfill their monitoring duties can be complicated. Different entities have different reporting cycles and systems, and early on there were concerns about whether everyone would “buy in” to the new requirements. The CWA gives legal weight to many policies e.g., municipalities “shall” enforce and report, but some monitoring policies use softer language as “should” provide reports. If an implementing body treats monitoring as a low priority, data could slip through the cracks. Even though, SVSPA has

managed high compliance in inspections, it also requires constant coordination, communication, financial support and involvement to gather complete information.

5.5.1 Monitoring and evaluation of the source protection plan: Achievements and challenges

The implementation of formalized monitoring under the Saugeen Valley Source Protection Area (SVSPA) reports has helped in the achievement of fully implementing significant proportion of drinking water threat and risk management policies. While the monitoring, evaluation and reporting are regular and transparent. Document analysis and participant response shows that the monitoring and feedback mechanism has led to the improvement in the threat management policy and improved trust among the people. In other hand the constant vigilance has helped identify the anticipated risk like road salt and fuel handling and study of the karst geology around the water sources even though it is outside the scope of source protection area. This process also has been helpful to record the improvement in the water quality and quantity encouraging the protection initiative.

As comprehensive and rigorous as this process is, it demands sustained financial resources and extensive collaboration among various stakeholders, posing difficulties especially for smaller municipalities that often lack sufficient technical and financial capacities. These financial constraints are echoed by SVSPA stakeholders, who emphasize the critical role of financial aids and grants in securing cooperation from different stakeholders. Further complicating the monitoring effectiveness is the lack of proper record and monitoring of private wells which limits the comprehensiveness of water quality data, thus potentially obscuring the true extent of drinking water safety. Given the scenario, this study commends the Saugeen Valley source protection for its commitment to locate and contain risk through best practice. In the meanwhile, also suggest for continuous adaptive management, collaboration and secure funding streams for sustained effectiveness of the SVSPA's monitoring and evaluation processes.

6 Anticipated Challenges

Based on the findings and discussion of this study, following challenges are anticipated in the future for the effective implementation of source water protection plan

Climate change

Climate change is introducing new risks to source water quality and availability leading to increased phosphorus loading, temperature shifts affecting aquatic life, and flood risks spreading contaminants into water systems (Lake Simcoe Region Conservation Authority, 2009). While SWP plans identify existing threats to drinking water, climate change impacts such as flooding, drought, and extreme weather exacerbate vulnerabilities are not adequately integrated.

Climate change is also linked to increasing harmful algal bloom as warmer water temperatures and nutrient-rich runoff accelerate eutrophication in lakes, promoting toxin-producing algae that threaten drinking water sources (Water Canada, 2022). In SVSPA, climate change is sort of on their radar but not a big concern right now because of the luxury of large water bodies and fairly low population. While the source protection region is exploring different future scenarios for water impacts and monitoring blue green algae blooms in small lake, this study suggests staying vigilant on the possible climate threats and taking proactive action to protect the water source.

Provincial Legislative Changes and Weakened Oversight

Another anticipated risk highlighted by this study is the potential weakening of the source water protection mandate established by Ontario's Clean Water Act due to recent legislative changes. Since 2015, Ontario regime has encountered considerable challenges stemming from shifts in legislation and regulations at provincial, federal, and municipal levels. Many of these shifts have been justified under the banner of reducing red tape, yet they have frequently led to weakened environmental oversight and favored developmental priorities.

At the provincial level, successive governments have introduced omnibus bills that significantly reshaped land-use planning and environmental regulation. Bill 66 (Restoring Ontario's Competitiveness Act, 2018) exemplified this trend. It proposed open for business by-laws empowering municipalities to fast-track industrial and commercial projects (Restoring Ontario's Competitiveness Act, 2019). Crucially, Schedule 10 of Bill 66 would have exempted these special by-laws from conforming to key environmental protections, including the requirement that planning decisions comply with source protection plans. In effect, developments could proceed even in wellhead protection areas or intake zones without regard to SWP plan policies. Legal analysts denounced this proposal as a “regressive, unwarranted and potentially risky” push back

of post-Walkerton safeguards (McClenaghan & Lindgren, 2017, p. 2). Under heavy public pressure the government withdrew Schedule 10 in early 2019, averting a direct override of SWP requirements. The Bill 66 episode nevertheless signaled an intent to loosen environmental rules in the name of cutting red tape.

Subsequent legislation followed a similar pro-development trajectory. Bill 108 (More Homes, More Choice Act, 2019) amended the Planning Act and Conservation Authorities Act, aiming to accelerate housing development. It redefined the core mandate of Conservation Authorities, narrowing their provincially mandated functions to a list of essential programs like flood risk management, CA owned lands, and duties as source protection authorities under the Clean Water Act. While source water protection was affirmed as a mandatory program in this amendment, many traditional CA activities e.g. broad watershed planning, habitat restoration was deemed non-core. Bill 108 also introduced faster planning approval timelines and other changes that limited thorough environmental review in the development process such as adjustments to appeal rights and development charge rules, which indirectly pressure municipalities to approve projects quickly. These changes set the stage for further constraints on CAs' role in planning.

In late 2020, Bill 229 (Protect, Support and Recover from COVID-19 Act) delivered more sweeping curtailments to CAs' authority. Through Schedule 6, the Conservation Authorities Act was amended to limit CAs' regulatory and decision-making powers. The amendments gave the provincial Minister discretion to overturn or bypass a CA's refusal of a development permit. Moreover, if the Minister of Municipal Affairs issues a Minister's Zoning Order to expedite a development, the CA is now obliged to issue any necessary permits for that project, even if CA experts conclude the project will cause flooding, erosion, or water contamination risks. This effectively sidelines the science-based oversight that CAs traditionally provided. By replacing watershed-based, technical decision-making with political discretion, Bill 229 marked a significant weakening of environmental oversight in land-use decisions.

These trends culminated in Bill 23 (More Homes Built Faster Act, 2022), which introduced amendments to multiple statutes (Planning Act, Conservation Authorities Act, Ontario Wetlands Evaluation System, etc.). Bill 23's changes explicitly prioritize development speed over environmental due diligence, further constraining the enforcement of source water protection

measures. Notably, the Act removed the longstanding requirement for CA permits in many circumstances. If a development project has received municipal Planning Act approval, the local conservation authority can no longer refuse it on environmental grounds. In other words, CAs lost the ability to independently prohibit or modify projects that might negatively impact wetlands, rivers or aquifer recharge areas, so long as the project is municipally approved. In addition, Schedule 2 of Bill 23 amended of the Conservation Authorities Act. Previously, conservation authorities were empowered to consider factors such as pollution and the conservation of land when deciding whether to issue development permits.

Following the amendment, these considerations were removed. The revised language limits permit evaluations to determining whether the proposed activity is likely to impact flood control, erosion, shifting shorelines, or unstable ground condition. This narrows the scope of environmental factors a CA can address to primarily natural hazard risks. The Act also barred CAs from entering agreements with municipalities to review development applications on their behalf. Previously, many municipalities relied on CAs' technical expertise in the planning process. Under Bill 23, such cooperative planning is largely forbidden, except in areas of natural hazards or source water protection mandate. This places burden on the municipalities who are already strained by the uneven capacity. Bill 23 also eliminated the planning approval role of certain regional governments (upper-tier municipalities), removing another layer of oversight that formerly helped coordinate cross-municipal water resource protection, which may adversely impact the institutional coordination.

Similarly, Bill 97, Helping Homebuyers, Protecting Tenants Act (2023), continues Ontario's drive towards increased housing development, introducing further amendments to planning regulations. This Act expands ministerial authority and restricts third-party appeals on developments, thereby streamlining approvals in rural and smaller municipalities. Such expedited processes potentially allow increased installation of septic systems and intensified land use near sensitive recharge zones without adequate environmental scrutiny (Federation of Ontario Cottagers' Associations, 2022). The shift towards centralized decision-making and accelerated approvals raises significant concerns regarding the potential bypass of critical local source water protection considerations. Collectively, these legislative adjustments prioritize development efficiency over thorough

environmental assessments, undermining Ontario's multi-barrier drinking water safety framework established in response to the Walkerton crisis.

Risk of sustaining implementation program due to funding constraint

Sustaining and expanding source water protection efforts requires adequate resources and political commitment, both of which have at times been limited. Conservation authorities and municipalities depend on provincial funding to implement Source Protection Plans, but in recent years funding has been constrained, and some programs have been scaled back. This study notes that source protection committees are looking for long-term financial commitment from the MECP. While the Clean Water Act established a strong framework for municipal supplies, no equivalent mandate or funding exists for private water system protection.

The only form of the incentive provided for the private well water users is availability of free water testing in public health unit. Given the reduction in the number of drop off locations in water testing and static number of water testing of less than 10,000 per year despite the estimation of presence of thousands of wells as noted by this study, in source protection region shows limitation in accessing safe drinking water for all. Constraints in funding also limit the human resources to carry out outreach and education programs. Another challenge comes from the limited financial resource in upgrading the available drinking water and wastewater treatment system to expand the service. This also limits their capacity to conduct necessary technical study on karst geology and other emerging threats, even if these fall outside the formal source protection area. However, understanding how aquifers behave and how groundwater flow is maintained is essential as these factors can influence future water quality and availability.

7. Conclusion

In conclusion, the assessment indicates a clear improvement in both stream and groundwater quality since the initiative began in 2016. Phosphorus levels generally remain within acceptable limits, although occasional spikes occur during rainy seasons, particularly in agriculturally dominant sub-watersheds. Nitrate concentrations have notably improved overall, though ongoing long-term monitoring continues in some areas due to complex factors influencing groundwater nitrate levels. This study acknowledges that these parameters need to be monitored regularly over

long period of time, so, the occasional spike while suggest caution to be taken doesn't disregard the effort that has been made so far in improving these water quality parameters.

The bacterial and benthic invertebrate indicators reflect positively on overall water quality, contributing to a favorable evaluation in the 2023 watershed report card. Improvements in fish populations suggest indirect benefits from the combined conservation efforts, including dam removals and hatchery management, highlighting the broader ecological value of maintaining good water quality. This improvement can be attributed to the different threat management and monitoring policies in place.

In regard to water quantity, it has remained stable over the period of time however, the economic incentives linked to the Bruce power plant is driving population growth in nearby towns. Even though water quantity fairly remains stable due to the region's abundant water resources and relatively low overall population pressure but future considering of climate change is must.

Municipal drinking water systems have consistently provided reliable and safe drinking water to connected residents. Nevertheless, the persistence of numerous household's dependent on private wells presents an ongoing challenge. Although free water testing services are accessible through public health unit, this service uptake remains low, suggesting a risk normalization among residents who have not yet experienced contamination incidents. This situation is complicated further by inadequate tracking, as records of private well users are incomplete, partly due to infrequent testing. Funding limitations significantly constrain the capacity to expand critical outreach and monitoring programs, especially door-to-door initiatives. While the Source Protection Initiative has successfully promoted best practices for private well, the absence of monitoring frameworks to ensure compliance limits our understanding of actual implementation effectiveness.

Stakeholder participation after the Walkerton crisis, was initially robust due to intensive public outreach and significant funding allocations. Farmers, initially cautious about risk management policies perceived it as punitive. Despite of this, overtime they were effectively engaged through representation in source protection committees and availability of financial incentives, emphasizing the critical role funding plays in sustaining stakeholder buy-in. Nonetheless,

sustained engagement faces challenges, such as participation fatigue, particularly among rural communities disconnected from municipal services. Though communication channels through committees and open houses remain active, participation has declined from the initial phases, indicating the necessity for continuous efforts and incentives to maintain community involvement.

Crucially, communication and coordination between First Nations and the Source Protection Committee have remained informal yet consistently maintained. Although First Nations hold authority to manage and protect drinking water within their reserve boundaries, they lack jurisdiction to directly enforce protective measures for water sources located off-reserve within the broader watershed (Indigenous Services Canada, 2014). Consequently, when activities occurring off-reserve threaten drinking water sources on-reserve, First Nations must rely on external governmental agencies or authorities to intervene, highlighting significant jurisdictional challenges (Marshall et al., 2020). Therefore, transitioning toward formal involvement of First Nations in the Source Protection Committee is critical to enhancing decision-making processes and ensuring greater inclusivity. Aligning with the findings of Marshall et al., (2020) this study underscores the importance of formal committee membership, which would empower First Nations to actively contribute to decisions directly affecting their water resources, thereby integrating Indigenous knowledge, values, and perspectives into comprehensive watershed planning.

Finally, Saugeen has demonstrated considerable success in managing water quality risks through diligent policy implementation. No boiling water advisories or major public health crises have been recorded since the Walkerton tragedy, validating the effectiveness of current risk management approaches. However, the initiative's success remains cautious due to emerging threats and potential policy conflicts from new legislation. Hence, a sustained and long-term financial commitment and vigilance is essential to ensure continued progress and stability in protecting water resources and public health.

8. Recommendation for Future Study

Based on the findings and limitation of this study, the following recommendations are proposed for future research

- Conducting comparative analyses of Source Protection Plans across different regions in Ontario to identify common barriers to effective implementation, and to evaluate whether the resources, time, and efforts invested have effectively achieved their intended goals.
- Undertaking a comprehensive evaluation of drinking water threat management and monitoring policies to assess whether current measures effectively meet their stipulated objectives.
- Investigating the motivations and engagement practices among private well users, identifying factors that influence their sustained participation in planning processes, regular water testing, and feedback mechanisms.
- Investigate impacts of changing in planning legislation and policies on source water protection (Bill 23 etc)
- Impact of changing in funding frameworks and limitations on Conservation Authority mandates and funding sources.

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Appendix- Interview Questionnaires

1.Role and Involvement

- 1.1 Could you describe your involvement in the source water protection planning process?
- 1.2 How have you or your organization engaged with the Source Protection Plan and/or the Source Protection Committee?

2. Public Engagement

- 2.1 What did public engagement look like at the beginning of the planning process?
- 2.2 How has stakeholder or community engagement changed over time?
- 2.3 What challenges have you observed in maintaining participation throughout implementation?

3. Representation and Participation

- 3.1 From your perspective, how effectively were different groups (e.g., agricultural producers, municipalities, Indigenous communities, residents) represented in the process?
- 3.2 How would you describe the level and nature of participation from the agricultural sector?
- 3.3 Were there differences in perspectives or participation between different types of farmers (e.g., crop vs. livestock)?

4. Concerns and Responses

- 4.1 What concerns or priorities did stakeholders most often bring forward?
- 4.2 To what extent were these concerns addressed in the final Source Protection Plans?
- 4.3 Do you feel financial supports or subsidies influenced stakeholders' ability or willingness to participate in the process?

5. Collaboration and Implementation

- 5.1 Have there been meaningful opportunities for collaboration between different groups (e.g., farmers, conservation authorities, municipalities, Indigenous communities)?
- 5.2 What logistical, regulatory, or community-based challenges have you observed in implementing source water protection measures on the ground?
- 5.3 Has your organization (or community) maintained an active role in the ongoing implementation of the Source Protection Plan?

6. Outcomes and Effectiveness

- 6.1 In your experience, has the implementation of source water protection policies improved water protection outcomes in the region?
- 6.2 Do current provincial legislation and policies provide adequate guidance for protecting drinking water at the local level?
- 6.3 Looking at future pressures (e.g., population growth, climate change), are improvements needed?

7. Opportunities and Future Directions

- 7.1 What opportunities have emerged during the planning and implementation process?
- 7.2 If you could enhance or improve any aspect of the current risk management framework, what would it be, and why?
- 7.3 What new risks or challenges do you anticipate in the coming years?

8. Additional Information

- 8.1 Does the conservation authority maintain records of private wells within its jurisdiction?
- 8.2 Is there anything else you would like to share about your experience with source water protection planning and implementation?

