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Source Water Protection in Rural Newfoundland and Labrador: Limitations and Promising Actions

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Abstract: The purpose of this paper is to exemplify through recent research in Newfoundland and Labrador (NL) the extent of the current limitations for source water protection and potential opportunities for improvement in the province, particularly for rural communities. The findings of this paper draw from the results of four related studies led by the co-authors. These four studies took place in NL between 2012 and 2016, and derived data through a mixed-method approach using literature reviews, key informant interviews, surveys, and consultations. The article provides an overview of the state of source water protection in NL and the challenges faced, with case examples to illustrate key points. Findings indicate there is currently a source water protection gap in NL limiting local governments in implementing their source water protection obligations under provincial policy and regulations. This implementation gap has been attributed to a lack of capacity for watershed monitoring, a lack of awareness of the need for source water protection and of municipal responsibilities, conflicts over multi-use watersheds and a lack of watershed planning and management. Greater education and collaboration in source water protection efforts amongst all watershed users, watershed groups, local governments and the provincial government could offer promise to fill this gap.

Keywords: source water protection; watershed management; rural; Newfoundland and Labrador

1. Introduction

Access to safe, clean and affordable drinking water is a critical requirement for the vitality of any community. Safe water implies the absence of disease-causing entities and substances that can bring about public health complications. Furthermore, “access to safe water is a fundamental human need and, therefore, a basic human right. Contaminated water jeopardizes both the physical and social health of all people and it is an affront to human dignity” [1] (para. 1). Source water refers to untreated surface and ground water supplies such as lakes, rivers, and aquifers, used to supply public and private drinking water systems for human consumption [2–4]. Water sources (that is, surface water or groundwater) are exposed to several possible point and nonpoint sources of pollution. Point source pollution originates from a specific and recognized source (for example points of industrial chemical spillage, leakage and discharge) and non-point source pollution from scattered sources (such as nutrients, bacteria, oil, metals, chemicals, pesticides and litter) [5].

Source water contamination brings about a significant threat to public health and escalates the cost of drinking water treatment [6]. Major source water contaminations have occurred in the United States (e.g., lead contamination in Washington, D.C., and the *Cryptosporidium* contamination in Milwaukee) [7], and Canada (e.g., *E. coli* contamination in Walkerton, Ontario and the *Cryptosporidium* contamination in

North Battleford, Saskatchewan, Canada) [8]. Therefore, to safeguard the health of humans, ecosystems and economies, the sources of drinking water must be protected [3]. Source water protection (SWP) is a preemptive method of improving the quality and quantity of drinking water [6]. SWP involves putting together programs and activities that will help to reduce the possibilities of water resource contamination [9], enrich the quality of drinking water, and safeguard water sources for future generations [10,11]. SWP entails the identification and recognition of threats to water sources and devising plans to secure adequate quality and quantity of water required to meet human and ecological demands [2]. Additional SWP activities include zoning bylaws, land acquisition or the identification of permitted (and/or restricted) activities within vulnerable areas, and working with farmers on cost-shared projects such as livestock fencing, or with residents on septic system stewardship programs. Capping of abandoned wells, education and awareness programs, and efforts to preserve and/or rehabilitate wetlands are also elements of SWP strategies [11] (p. 10). Safeguarding water sources is imperative for the safe supply of water for domestic uses and involves comprehensive planning and environmental regulations targeted at minimizing risk to water resources from land use activities [12].

SWP also contributes to the sustainability of drinking water systems and its practice can be used to build local capacity in solving water challenges [13]. One primary benefit of practicing SWP is that it is significantly less costly to invest in preventative SWP measures than it is to address issues after contamination of a water supply has taken place [14]. Additionally, the cost of physical assets such as water treatment technologies far exceed that of natural assets like purchasing development rights or land within a watershed [15]. Available literature suggests that practicing SWP costs six to 20 times less than dealing with and treating contamination in water supplies [9,16]. It is suggested that this ratio is even greater in rural areas [17]. SWP has been identified as crucial for the preservation of drinking water quality, averting pollution [10], and also as a useful remedy for the conservation of limited financial and natural resources [2].

Despite the many benefits of SWP, such as sustainable drinking water systems management and enriching drinking water quality and quantity [5], small and rural communities encounter various barriers and limitations related to the supply of safe drinking water because practicing SWP entails a great deal of technical, institutional, financial and social capacity that many small and rural communities lack [13,18,19]. Deficient local capacity results in a reduced number of SWP initiatives and imprudent decisions from local governments in protecting drinking water sources, including investing in costly technologies as an alternative [20,21]. The absence of institutional arrangements to ensure that water facilities are supplied, maintained and operated efficiently, sustainably and equitably also presents SWP challenges, specifically in rural communities where financial capital is very limited [22]. Many rural communities have small populations, with lower than average or fixed incomes, resulting in small tax bases and limited financial resources available for funding capital and operating expenses, as well as difficulties in the recruitment and training of operators [13,23]. Training for water operators is critical to SWP as they are often charged with the responsibility for the development and/or enforcement of SWP measures [4].

The purpose of this paper is to exemplify through recent research in Newfoundland and Labrador (NL) the extent of the current limitations for SWP and potential opportunities for improvement in the province, particularly for rural communities. For the purposes of this research, municipalities of 1000 residents or fewer and local service districts (LSDs) were considered “rural”. (LSDs are administered by an LSD committee (5–7 elected persons) and town staff. The services that an LSD provides are limited to: water supply; sewer systems; fire services; garbage collection–disposal; street lighting; animal control; snow clearing–maintenance of some roads within the LSD [24].)

Source Water Protection in Newfoundland and Labrador

Drinking water governance in Canada is shared between federal, provincial and local governments [13]. Hanrahan (2017) explains regarding the Canadian water policy context, “There is no national unified water governance system, no national enforceable drinking water standards and no

standardised measures for water governance” [25] (p. 75). At the national level, Health Canada does issue the Guidelines for Canadian Drinking Water Quality. These guidelines are used by Canadian provinces, territories and the federal government; however, adherence to these guidelines is optional [26].

NL is located on the eastern coast of Canada, with the island of Newfoundland spanning 111,390 km² and the territory of Labrador covering 405,212 km² [27]. NL has a population of 519,716, with 205,955 people living in the capital city of St. John’s and the surrounding census metropolitan area [28]. The remainder of the province lives in smaller more rural communities [29]. NL has ample freshwater resources [30] and like other provinces in Canada, NL utilizes a multi-barrier approach to drinking water management [31]. The Multi-Barrier Strategic Action Plan was instituted in 2001 as the overall guiding framework for guaranteeing the protection of drinking water in the province of NL. The Multi-Barrier Strategic Action Plan acknowledges the chances of the breakdown of technology, systems or people involved in managing water systems and therefore comprises of three protection phases. Level one of the Multi-Barrier Strategic Action Plan involves SWP, drinking water treatment, and distribution systems. Second level components include monitoring data management and reporting, inspection and enforcement, operator education, training and certification, and corrective measures. The third level components are legislative and policy frameworks; public involvement and awareness; guidelines, standards and objectives; and research and development. The execution of the Multi-Barrier Strategic Action Plan encompasses the concerted efforts of three provincial government departments: the Department of Municipal Affairs and Environment (lead agency), Health and Community Services, and Service NL (Formerly two separate departments: the Department of Environment and Conservation and the Department of Municipal Affairs have now been amalgamated into one [32]) [33].

Public drinking water sources in NL are supplied by both surface water and groundwater. Legislation governing public drinking water systems in the province includes: the Water Resources Act, the Municipal Affairs Act, and the Municipalities Act. SWP is legally enforced in NL under Section 39 of the Water Resources Act SNL 2002 cW-4.01, which provides the authority for the protection of public water supply areas. Currently 92% of the NL population (373,854) is serviced by public drinking water systems. In 2015, there were a total of 478 public water sources comprising 298 surface water sources (254 protected and 44 unprotected) and 180 groundwater sources (59 protected and 121 unprotected) in the province [33]. Surface water is used by the majority of communities because of the easy accessibility of many lakes, ponds and rivers in the province [34]. Municipalities under the Water Resources Act 2002, are required to apply for designation and pay a fee (\$400 plus HST) to the water resources management division (WRMD) of the Department of Municipal Affairs and Environment for the protection of their water supply areas as designated protected public water supply areas (PPWSA) (In the case of water supplies sourced by groundwater these are called a wellhead protected water supply area. For the purposes of this article both protected areas are referred to as PPWSAs.) [35].

Prohibited activities in designated PPWSAs include activities impairing the quality of water such as fishing, swimming, and depositing sewage. Waste disposal facilities or any other facilities that the NL Minister of Municipal Affairs and Environment deems unsuitable may also be prohibited [35,36]. Ministerial approval is required prior to undertaking activities such as logging or road construction in designated protect areas [36]. Development activities around PPWSAs are regulated and monitored by the WRMD using several tools such as: permits for development activity; watershed management plans; referrals from the Interdepartmental Land Use Committee, Crown Lands Administrative Division, Natural Resources, Municipal Affairs and other agencies (e.g., environmental assessment); and watershed management committees [33].

In NL, both provincial and municipal governments have some level of responsibility in guaranteeing the safety of drinking water [36]. Municipalities and local service districts (LSDs) are responsible for protecting their PPWSA by posting signs and maintaining them, organizing regularly to survey the area, conducting monitoring for permitted development activity within a PPWSA, and making sure that activities are being handled in an environmentally acceptable way.

Local governments are also required to request a halt to, and inform the provincial government of, any potential breaches of the Water Resources Act such as developmental undertakings occurring without prior authorization from the Minister. The WRMD acts in response to permit violations when infringements are reported [37]. This implies that communities must first monitor, to enable the WRMD to carry out enforcement of permits within a PPSWA. There are some circumstances, however, where provincial employees do inspect permits for development [38,39].

Drawing from the results of four SWP research studies in NL, this article seeks to present an overview of the state of SWP in NL, particularly in rural communities, and the challenges to SWP practices that are faced in communities with public water systems. The presence of important policy implementation gaps and the need and potential for collaboration in watershed management in the pursuit of SWP is outlined.

2. Materials and Methods

The findings discussed in this article draw from the results of four related studies led by the co-authors. These four studies took place in NL between 2012 and 2016. These include a province-wide research study entitled, Exploring Solutions for Sustainable Rural Drinking Water Systems (hereafter referred to as the Exploring Solutions project), as well as three other individual case studies. These include a community case study in Indian Bay and Centreville-Wareham-Trinity [40], two PhD Mitacs internship research projects—the Mitacs Accelerate internship program supports a graduate student, academic advisor and a partner organization in developing a research project and funding a related internship [41]—examining two case studies of PPWSAs with active logging operations [38,39]. The rural drinking water project interview guide, the water operators drinking water survey and the administrators municipal drinking water survey are attached as Documents S1, S2 and S3 respectively as Supplementary Materials.

The Exploring Solutions project provided an overview of drinking water issues in rural NL communities (from source to tap), focusing on small communities of 1000 residents or fewer and the unique challenges that small water systems pose. The focus on communities of this size was chosen after consultation among the research team, as communities of 1000 residents or fewer were deemed representative of rural communities in the NL context. The Exploring Solutions project was undertaken from 2013 to 2014 as a partnership between Memorial University of Newfoundland researchers and two provincial associations (Municipalities NL and the Professional Municipal Administrators of NL). The research team, led by the Environmental Policy Institute, included researchers from the departments of civil engineering, environmental studies, environmental science, community health, and humanities, as well as industry associations, other non-governmental organizations, and municipal, provincial and federal governments as part of the project's advisory committee [19].

This article also draws on several case studies, including a study conducted in the neighboring communities of Indian Bay (175) and Centreville-Wareham-Trinity (1160) from 2012–2013 [40]. This study examined public perceptions and behaviors related to drinking water and their water supply area, a relatively large (1000 km²) multi-use watershed. As part of the Exploring Solutions project there were eight community case studies conducted (at least one in each Municipalities NL region). These included: Port au Port East, Black Tickle-Domino, Sunnyside, Greenspond, Centreville-Wareham-Trinity, Woody Point, Old Perlican, and Makkovik [19]. Each of these case studies examined SWP among other aspects of drinking water systems and their management and operations.

The Steady Brook and Gander Lake case studies, conducted in 2015 and 2016 respectively, focused on the working relationships of local and provincial representatives with the activities of Corner Brook Pulp and Paper Limited in the Steady Brook and Gander Lake PPWSAs. These case studies aimed to exhibit how industry, and local and provincial governments can function together to achieve SWP objectives in a mixed-use watershed.

A mixed-methods approach was employed in each of these studies including a review of literature and water quality data, media scans, surveys (in two of four projects), consultations and policy

workshops, and key informant interviews. The data sources and analysis techniques used in this research are further outlined in Sections 2.1–2.5 below.

2.1. Literature Review

Each of the four studies analyzed involved a review of academic and grey literature related to drinking water systems, and SWP particularly, in NL and other jurisdictions. A review of provincial policies and reports, Municipalities NL documents (regional meeting notes, convention and workshop reports), media and academic reports, as well as water quality data for the various case study communities through the NL Water Resources Portal, were also reviewed during the four studies. In the Exploring Solutions study, the results of the literature review were compiled in the form of a driver-pressure-state-impact-response report, which was used to highlight the current threats to drinking water systems, as well as current legislative and governance structures. The report allowed for existing knowledge to be integrated and provided a holistic understanding of the policy issues before undertaking primary data collection [42]. The Steady Brook and Gander Lake PPWSA studies involved a review of legislation, policies and associated documents related to the management of these PPWSAs and overall watersheds.

2.2. Surveys

Surveys were used in both the Indian Bay and Centreville-Wareham-Trinity and provincial studies. In the former case, the survey was intended to examine patterns of drinking water consumption and watershed use, particularly for recreation, as well as resident perceptions related to drinking water and potential conflicts between drinking water and other watershed values [40]. The survey was conducted door-to-door in summer 2012. Every occupied home in the communities was contacted by data collectors on at least two occasions at varying times during the day to ensure that no one was left out due to their work schedules. In total, 268 of 485 households participated in the survey, which resulted in a 55% response rate [40].

Two surveys were conducted in the Exploring Solutions project: one for administrators (i.e., town managers, clerks and town staff) and one for water operators, with the intention of revealing information concerning municipality and LSD drinking water systems not available from previous research and documentation. The survey was delivered via mail (the package was sent to the town office/contact) and operators had the option of either completing the survey online (via a link to Survey Monkey) or completing the paper copy of the survey and returning it to the researchers with prepaid envelopes that were provided. Municipalities of all sizes were surveyed to facilitate the comparison of smaller and larger communities. The administrator survey targeted 454 communities (178 LSDs, 276 municipalities) from 5 July to 13 September 2013; 199 respondents returned surveys (48 LSDs, 151 municipalities), which constituted an overall response rate of 44% (27% of LSDs, 55% of municipalities). The water operator survey was delivered from October 2013–March 2014 and had 71 respondents, representing approximately 22% of communities that have permits to operate (i.e., that operate a water system for residents) [19].

2.3. Consultations

Consultations with local government leaders, water managers, and provincial government were an important research method. The Exploring Solutions project involved over 13 consultations at Municipalities NL events throughout the period of the project. The Exploring Solutions project also facilitated a policy workshop attended by 13 targeted policy-relevant actors from municipal, provincial and federal governments, as well as a local conservation organization (Ducks Unlimited), and academic representatives. The final results of the Exploring Solutions project were summarized in a draft report, which was reviewed by the research team and by partner communities and agencies, and discussed by the Exploring Solutions project advisory committee (comprising academic, municipal–regional, provincial and federal government, and industry representatives) and at Municipalities NL event

sessions. Furthermore, the project advisory committee was requested to rank the final report recommendations according to their level of likely impact on rural NL drinking water systems as well as their ease of implementation. This helped to facilitate dialogue and to prioritize the recommendations. The Indian Bay and Centreville-Wareham-Trinity, Steady Brook and Gander Lake PPWSA case studies also involved consultations with municipal and provincial representatives as well as officials at Corner Brook Pulp and Paper regarding their operations in the watersheds.

2.4. Key Informant Interviews

The Exploring Solutions project conducted six to 12 key informant interviews in each of the eight case study communities with mayors, residents, water operators, business owners, health representatives and key provincial actors. As part of the case studies of the Steady Brook and the Gander Lake PPWSAs, eight and five key informants were interviewed, respectively.

2.5. Analysis

In each of the four projects researchers employed pattern searching and theme analysis. NVivo software was used for analysis of all results from the various projects, utilizing both the qualitative and quantitative outcomes from all related research projects. SPSS and Microsoft Excel were employed in analyzing the survey results, which was done primarily in an exploratory manner dependent on simple descriptive statistics and frequency distributions. Data results from these surveys were broken down between LSDs, municipalities of 1000 residents or fewer, and municipalities of over 1000 residents. Both LSDs and municipalities with 1000, residents or fewer were considered by the research team to be rural. Focusing on the specific themes of each project and any additional key themes that emerged throughout the study in relation to SWP, codes were designed, and then patterns established, examined, and discussed amongst the research team. Key findings were then derived relating to the limitations and opportunities for SWP in NL, which are described below.

3. Discussion and Results

3.1. Source Water Protection Implementation Gap in Newfoundland and Labrador

One of the key findings of the Exploring Solutions project was the presence of an implementation gap at the local level with SWP policies and regulations [19]. For example, there was evidence of non-compliance with PPWSA regulations on monitoring and enforcement. As illustrated in Table 1, when community administrators were asked which activities are prohibited in their community's drinking source, many indicated that activities that should be banned under the PPWSA regulations were not. However, it should be noted that some of these communities have not recognized their community's water supply as protected. Of the 25 communities that indicated they do not prohibit activities in their drinking water supply area, nine were communities with recognized PPWSAs, and therefore were simply not enforcing regulations [19].

Table 1. Non-Compliance with prohibited activities under Protected Public Water Supply Area (PPWSA) regulations [43].

Prohibited Activities in PPWSA	LSDs (<i>n</i> = 30)	1000 or Fewer Municipalities (<i>n</i> = 79)	Over 1000 Municipalities (<i>n</i> = 43)
Bathing or washing clothes	45% (<i>n</i> = 31)	35%	16%
Boating	47%	27%	19%
Fishing	47%	32% (<i>n</i> = 78)	26%
Material deposit	47%	27%	2%
Swimming	43%	28%	19%
Use or diversion of water for purposes other than municipal drinking water supply	63%	41%	30%
None of the above	43%	22% (<i>n</i> = 77)	2%

Notes: Changes in *n* for specific answers are due to the sub-question being skipped or only that sub-question being answered by a community. Unless noted, *n* is what is indicated in column 1.

As Table 1 illustrates, according to the community administrator survey, 43% of LSDs, 22% of municipalities of 1000 residents or fewer, and 2% of municipalities over 1000 residents do not prohibit any of the banned activities under the PPWSA regulations (e.g., swimming, bathing, fishing) in their drinking water supply area. There is a notable increase in the presence of implementation gaps in PPWSA use restrictions in communities without a municipal government (LSDs) and with less than 1000 residents. This difference compared to communities with a population of over 1000 residents can be attributed to a lack of capacity to implement regulations, mainly in small communities [43].

Generally, the case studies showed that communities in the province are at varying levels of fully implementing their mandated drinking water responsibilities. Hence there were mixed results, as with the survey, with evidence of non-compliance of mandated SWP responsibilities in some but not all cases. For example, heavy recreational use of the Indian Bay watershed was reported by residents [40], but restrictions of activities in the Greenspond PPWSA were noted due to an increase of public enforcement (e.g., community members are aware of recreational use prohibitions and willing to report violations) [44].

As will be discussed in the sections that follow, a lack of capacity for watershed monitoring, a lack of awareness of municipal responsibilities, conflicts over multi-use watersheds, and a lack of watershed planning and management are major contributors to the SWP implementation gap in rural NL.

3.1.1. Lack of Capacity for Watershed Monitoring

Surveys, as well as the consultations and interview results, uncovered that numerous communities do not actually monitor their water supplies, even if they are designated as PPWSAs and restrictions are in place. Table 2 displays the answers from the administrators' survey asking only the communities that do prohibit one or more activities in their watershed, if they are actually monitoring and enforcing to ensure compliance with these prohibitions. LSDs have the lowest monitoring rate, but the most volunteers monitoring their supplies. Also, nearly half of all municipalities are not monitoring their supplies on a regular basis. Many communities are not monitoring due to human capacity restraints, and there is very little reporting of problems to the province even when problems are found [43].

This lack of monitoring is often due to insufficient financial and human resource capacity (e.g., a lack of relevant knowledge and training among staff members) together with inadequate instruments of coordination [19]. According to the driver-state-impact-response analysis "COTOLs often lack human capacity, which could pose a problem in meeting mandated source water protection responsibilities" [42] (p. 18). COTOLs refers to communities of 1000 residents or less. As reported in other Canadian provinces, the capacity to implement policies depends on a multitude of factors, including financial, but also institutional, technical-human, and social factors [21]. A major reason for the lack of capacity in small communities is inadequate financial resources needed to employ staff at all, let alone staff members that have the time in their already over-extended job descriptions to take on the monitoring of PPWSAs. In some cases, this can be a time-consuming and arduous job, depending on the geography of the watershed. Hanrahan et al. 2016 (p. 28) states in relation to NL that "for financial, cultural and political reasons, many municipalities and LSDs in this province have limited capacity to raise levies" [20]. One municipal representative in the Gander Lake PPWSA case study explained, for example, that they depend greatly on volunteers to fulfill this obligation under the town's drinking water permit because they do not have staff to conduct monitoring activities within the water supply area [38]. The inadequate implementation of SWP measures identified in the province appears to be mainly due to either the absence of people available to monitor source water supplies or an absence of recognition of the importance of SWP, due to low levels of awareness [43].

Table 2. Compliance with source water monitoring [43].

Monitoring Activities in PPWSA	LSDs (<i>n</i> = 20) *	1000 or Fewer Municipalities (<i>n</i> = 66) *	Over 1000 Municipalities (<i>n</i> = 42) *
Source drinking water supply is monitored on a regular basis by municipal/LSD staff.	15%	55%	43%
Source drinking water supply is monitored on a regular basis by volunteers.	20%	12%	2%
Source drinking water supply is monitored occasionally by municipal staff.	5%	21%	31%
Source drinking water supply is monitored by volunteers.	30%	9%	7%
Source drinking water is only monitored when there are complaints.	10%	12%	24%
Town does not have the human resources to monitor activities in our drinking water system.	20%	11%	10%
When a prohibited activity is observed or reported, the municipality notifies the Department of Environment and Conservation	25%	33%	33%

Notes: * Changes in *n* for specific answers are due to the sub-question being skipped or only that sub-question being answered by one community and the other sub-questions being skipped. Unless noted, *n* is what is indicated in row 1.

3.1.2. Lack of Awareness

The absence of institutional capacity and appreciation of the significance of SWP can further contribute to non-compliance with PPWSA regulations. For instance, most rural respondents of the Exploring Solutions project's community administrator survey (59% of LSDs and 49% of municipalities of 1000 residents or fewer) indicated that there were "no" threats to their drinking water supply, which is virtually impossible [43]. Additionally, the fact that 35% of public water sources are not protected under PPWSA designation, shows that there is a significant number of communities that either do not value or understand the importance of SWP [33].

In 2015/2016, Municipalities NL (MNL) members passed a resolution outlining the need for municipalities to not only designate their source water supplies as protected public water supplies, but to also actively implement their responsibilities. The resolution read:

Be it resolved that: MNL lobby the Government of Newfoundland & Labrador to ensure all water supply areas are designated Protected Public Water Supply Areas (PPWSA), and to work with MNL to build municipal capacity to actively implement PPWSA regulations, appropriate local and/or regional governance means, and watershed area monitoring measures [45] (p. 5).

Training and support for municipalities is provided by Municipalities NL, an organization established to seek the welfare and benefit of municipalities in the province. Municipalities NL organizes regional meetings, conventions, symposiums drinking water workshops for its members [46]. In regional workshops, they have focused on a three-pronged approach to improve SWP in NL municipalities: protect, monitor, plan [45]. Efforts like this are much needed in improving understanding at the local level of SWP responsibilities.

3.1.3. Managing Multi-Use Watersheds

The PPWSA regulation permits multiple uses of PPWSAs—such as agriculture, transportation, aggregate extraction, recreational, domestic or commercial forest harvesting, and mineral exploration—if the activities do not cause impairments to the quality of water [30]. According to the 2014/2015 Drinking Water Safety Annual Report, 128 development activity permits were issued

in 2015 [33]. Additionally, 196 land use referrals were reviewed for proposed activities concerning protected public water supply areas. The WRMD issued developmental activity permits for forestry (43%); cabin-crown lands (21%); linear developments (e.g., power lines, railways, roads and other developments that are built in a line) (18%); industrial, commercial or domestic development (10%); and mineral lands (8%) during the 2014–15 fiscal year [33].

Research results suggest concerns related to the management of multi-use watersheds and activities that pose threats to public drinking water supplies and water quality delivery. For example, during the study in the Indian Bay and Centreville-Wareham-Trinity communities, several residents expressed apprehension about the effects of cabin development and recreational uses such as swimming and use of recreational vehicles on drinking water supplies. Cabins in NL can range from small one room structures to more sophisticated second-home-like structures. Other activities in their watershed noted in the study as causing concern were mineral exploration and forestry development in the watershed, including both domestic cutting near the main river stem and commercial harvesting in the headwaters of the watershed [40]. According to interviewees in the Old Perlican community case study, residents frequently snowmobile over the drinking water source, despite the posting of signs informing residents that it is a PPWSA [47]. Similarly, it was found in the Steady Brook and Gander Lake case studies that certain recreational activities can pose a threat to achieving SWP. There were instances in the Steady Brook watershed where recreational vehicles such as all-terrain vehicles, dirt bikes and snowmobiles were identified as a threat to their PPWSA if not properly controlled by active SWP efforts [39]. One municipal representative explained the importance of enforcing SWP and raising awareness about SWP to help reduce recreational use,

I feel that we are doing a good job in protecting our water and making everyone aware that it is a protected water supply area, otherwise if we didn't do that way in there back, you know how far in it is, way back in those mountains, what do you think all those snowmobiles and all those ATVs and all of those dirt bikes and everything, they would be in there having a field day on our water if we didn't have a buffer zone and we didn't have a water protection area, and management plan, they would be in there fishing everyday.

—Municipal government representative [39] (p. 3)

While some safety concerns are valid, others are perceived [40]. For instance, an unconfirmed suspicion of water contamination was noted in the Port au Port East community, relating to an abandoned US military radar location [48]. Results from the Exploring Solutions project revealed that, from the perspective of municipal administrators, the most common land use activity threats were recreational use, domestic wood cutting and hunting and fishing, domestic [19]. Cabin development was also noted as a source of concern to residents [40]. One way to address the conflicts between multiple uses is watershed planning. An organized and collaborative management approach to developments of any kind in the watershed area is fundamental to safeguarding the waterways and reconciling conflicting uses of the watershed area [49].

3.1.4. Lack of Watershed Planning and Management

Despite the well-known best practice and necessity of watershed planning for managing drinking water supplies [14], to date there are only five watershed management committees and three watershed management plans in the province, with only one watershed management plan being from a community of 1000 residents or less (Steady Brook) [19]. With regards to Steady Brook's watershed management planning, it was explained,

They're very proactive, which is not something you see a lot in small communities, so it's really great to see in a town like the size of Steady Brook, but also because they have the capacity to do it. They have, it seems to me, they have a little more funds than some of the other small communities so they have the capacity to push it, they think big for a very small town.

—Provincial government representative [39] (p. 3)

It is obvious from the Steady Brook study that some communities having a higher capacity than others for SWP. This suggests that Steady Brook is the exception, not the rule, in their proactive SWP efforts. Participants in the expert policy workshop disclosed that there is presently inadequate capacity at both the local and provincial levels for several NL communities to develop watershed management plans. Without these plans, strategies for SWP are likely to be absent or weak [19]. In NL, the phases involved in developing a watershed management plan include establishing a watershed management committee; characterizing the watershed (PPWSA); identifying potential contaminants and conducting a risk assessment; and the implementation, review and amendment of the developed watershed plan [30]. These require a considerable amount of financial, technical and human resource capacities, which are lacking in many communities in the province. Not only is capacity at the municipal level lacking, but the provincial level is also challenged in having the staff to support communities in watershed planning efforts. It was explained,

When it comes to actually doing the annual review of the plan it's a lot of work and it usually ends up on my desk so there's still a bit of a capacity issue there, because if I had to be a part of 20 more of these watershed committees I don't know how I would find time to do anything else.

—Provincial government representative [39] (p. 7)

Measures such as expropriating or purchasing land can avert developments in vulnerable areas, limit development patterns, and alleviate the effects of contaminants. Expropriating or purchasing land is important because, according to a report entitled “Protecting the Source” released by the Trust for Public Land and the American Water Works Association “When communities invest in land protection to protect their drinking water, they are investing in the long-term health and quality of life of their citizens—guiding growth away from sensitive water resources, providing new park and recreational opportunities, protecting farmland and natural habitats, and preserving historic landscapes” [50] (p. 7). However, the community administrator survey reported that very few (9% of LSDs, 4% of municipalities of 1000 residents or fewer, and 9% of municipalities over 1000 residents) had expropriated or purchased lands to protect their drinking water supply from potential pollution [43].

3.2. Collaborative Source Water Protection in NL

As Norman et al. [51] (p. 3) point out, “Water is a flow resource that is difficult to manage at fixed jurisdictional scales”. They add that this presents managers with three difficult issues to address: “competition between users of water resources; coordination between the multiple scales at which water is used and managed; and a mismatch between geopolitical and administrative boundaries, on the one hand, and hydrological boundaries on the other” [51] (p. 3). One way to work towards the resolution of these challenges is through collaboration. Collaboration can help to resolve challenging environmental issues, such as the preservation and restoration of water quality. Collaboration in SWP entails different groups of people, including public, governmental and non-governmental players, work together towards reaching agreed-upon tasks, or shared goals and objectives that call for joint action and would otherwise not materialize through individual action [52]. Collaborative watershed partnerships assemble various stakeholders, both private and public, to tackle public policy issues related to water and land such as SWP [53]. Far-reaching acknowledgment for collaborative approaches can be ascribed to the understanding that top-down command and control practices are no longer effective for managing complex social-ecological systems [49].

The Gander Lake and Steady Brook case studies focused on the working relationships of local and provincial representatives with representatives of Corner Brook Pulp and Paper Limited in the Gander Lake and Steady Brook PPWSAs. These case studies illustrated how industry and local and provincial governments can function together to achieve SWP objectives in a mixed-used watershed. The case studies draw attention to collaborative watershed management activities involving the Corner Brook Pulp and Paper Limited and local and provincial delegates [38,39]. One informant explains the positive relationship created between Corner Brook Pulp and Paper Limited and

a municipality where the company is conducting forestry activities within their drinking water source area. One informant explains,

Corner Brook Pulp and Paper is I will say excellent stewards of the environment. I sit on a public advisory committee with Corner Brook Pulp and Paper so that allows me to bring any concerns that [the] municipality has to that forum.

—Municipal government representative [38] (p. 6)

It has made good business sense for Corner Brook Pulp and Paper Limited to collaborate on source protection efforts, particularly given requirements under environmental certifications. Some of the compromises that both the local and provincial government and Corner Brook Pulp and Paper Limited have taken for SWP efforts were explained:

... and that compromise was basically forestry wanting to go in and cut but also appeasing the town to limit access, because had they put a full road right to where they wanted to put it you would literally be able to jump in your jeep and go right through your water supply area. And now they can't because we sat down and talked about how we can get the best of both worlds in there so they can do their cutting but not allow access for recreation. So that's my shining star of a success as to why we have plans and why we have source water protection in general.

—Provincial government representative [38] (p. 4)

These types of collaborative structures are needed in SWP to ensure that environmental, economic and social considerations are adequately considered in decision-making. Furthermore, effective citizen and public engagement can result in successful collaborations for SWP in NL.

Citizen involvement in watershed planning, governance, and management has been demonstrated as a way of getting local level actors to better participate in the management of their water and water supply areas, therefore resulting in an increase in the technical and human capacity engaged in watershed management efforts [54,55]. It was suggested by one key informant:

We are really trying to push a little bit more community involvement in the protected water supply areas and this would involve sort of any activities within Gander Lake... It is protected under the Water Resources Act, but the town has the big responsibility in sort of proactively, managing their watershed as well and not just depending solely on provincial people to try to do that monitoring.

—Provincial government representative [38] (p. 6)

Another municipal informant explained,

So one of the challenges is that we rely heavily on the general public, so getting the information out to the general public and saying listen, if you see anything that is suspicious, if you see a dirty looking stream in our water. Pristine in Newfoundland, so if you see a milky stream that should give you concern, or if you see suspicious activity. That's one [of] the biggest challenges with having such a huge geographic [area] for our watershed.

—Municipal government representative [38] (pp. 7–8)

Watershed groups in the province include the Corduroy Brook Enhancement Association, Exploits River Management Association, Freshwater Alexander Bay Ecosystem Corporation, Northwest River Conservation Group, ACAP Humber Arm Environmental Association, Gander River Ecosystem Corporation, and the Indian Bay Ecosystem Corporation. These groups, generally focused on freshwater fisheries values, provide some opportunities for public involvement in watershed stewardship, but overall there is much room for improvement in public awareness and engagement in SWP in NL [22].

Citizenship engagement in water management is an integral component of both the governance and management of water systems [56,57]. Involving the public in the policy and planning process

results in improved implementation of and compliance with protection regulations, such as the prohibition of activities (swimming, boating) in a PPWSA, if citizens appreciate the reason behind the regulation [54]. Involving the public in decision-making allows access to the “local knowledge” of the day-to-day local experiences of individuals in the community and this knowledge can be used to increase the effectiveness of policies and regulations by uncovering problems and potential solutions. Public involvement also ensures that citizens’ interests are included in decision-making, which makes policies more likely to succeed by lessening future dissent and increasing public participation in implementation [55]. The public plays a significant role in protecting drinking water supplies at the source due to the impact that can be made through human activity. There is potential in NL, as seen in other places in Canada and beyond, for the engagement of the public in managing source water supplies in order to create a myriad of benefits, including maximizing limited financial and human resources.

4. Conclusions

Ultimately, it was found that particularly in rural NL, a SWP implementation gap currently exists. This implementation gap has been attributed to a lack of capacity for watershed monitoring, a lack of awareness of the need for SWP and of municipal responsibilities, conflicts over multi-use watersheds (as seen in the Steady Brook and Indian Bay case studies), and a lack of watershed planning and management. The optional and unenforced nature of regulations pertaining to protecting drinking water sources does not reflect the importance of SWP for drinking water safety, which has been widely accepted as the first barrier to drinking water contamination [57]. Evidently there is need for much improvement as it relates to the implementation of SWP at the local level. The recommendations derived from the Exploring Solutions project regarding SWP efforts are summarized below in Table 3.

Table 3. Source water protection report recommendations (from [19], pp. 73–74).

Policy, Regulations and Governance	
1.	Enhance stewardship of PPWSAs by local governments.
a.	Include PPWSA monitoring requirements and efforts taken to protect drinking water supplies in local level self-reporting.
b.	Encourage towns with supplies that are not designated as a PPWSA to do so.
c.	Provide outreach and education on the importance of and measures for protecting PPWSAs (see also recommendations for education and training below). Towns should explore potentials for partnerships with non-governmental groups to undertake these activities.
2.	Improve water conservation programs and policies.
3.	Increase opportunities for multi-level governance and dialogue at the local, regional and provincial scale, bringing together all levels of government as well as representation from other stakeholders, such as non-governmental and industry groups. This would involve creating venues for integration, coordination and sharing information concerning water-related matters.
4.	Provide further incentives and sustained support for regional operators and other regional service sharing and drinking water management initiatives.
Education and Training	
5.	Offer more (and diverse) public outreach and education opportunities in various mediums concerning drinking water issues (e.g., SWP, risks associated with untreated spring water collection, chlorination disinfection by-products, home treatment options and conservation).
6.	Provide greater education and capacity building opportunities concerning best practices on the management of drinking water systems for decision-makers such as mayors, councillors and town staff.
Infrastructure and Operations	
7.	Implement maintenance assurance manuals across the province with manuals that consider the particular challenges faced in small drinking water systems. (Maintenance assurance manuals assist communities with the day-to-day operations of their water and/or sewer systems to make sure that they meet regulatory obligations and conditions of their “permit to operate” those systems [58].)
8.	Include full cost accounting and appropriate pricing for water services in fiscal framework discussions.

As seen with the case studies from communities that currently have watershed management committees and plans, proactive SWP is occurring in a collaborative manner and creating successful outcomes. This suggests that these types of efforts are needed and can be successful. These cases are, however, the exception in NL with only five watershed management committees and three watershed management plans in place in the province and little involvement of other watershed groups in SWP issues. Greater education and collaboration in SWP efforts amongst all watershed users, watershed groups, local governments and the provincial government could offer promise to fill the noted SWP implementation gap. Though it would be ideal to recommend that there be greater human and financial capacity devoted to SWP, this is not a reality that can be currently achieved. Unfortunately, the lack of financial and human resource capacity at both the local and provincial levels, with further recent provincial cuts to the NL budget [13], means communities will have to be creative in SWP efforts.

For communities, increased efforts in SWP could start small such as ensuring their water sources are protected under the Water Resources Act and the PPWSA regulations. This was explained by one key informant,

You don't have to be as elaborate as Steady Brook, if you have some little town that doesn't have a bunch of money and not as big of an area to protect as we do, because we have a big area to protect, but they might only have down the road, a mile or two, whatever. They might only need to put a fence around their watershed protection, or they might only have to have a committee.

—Municipal government Representative [39] (p. 7)

Further capacity building at the local level regarding SWP is also needed, such as the efforts made by Municipalities NL through its regional workshops and emphasis on SWP within provincial operator training.

Progress has been made in NL on recommendations from previous drinking water research [19] in collaboration with Municipalities NL and the provincial government. Particularly recommendations 1a–c have been acted upon, with the regional workshops on SWP and drinking water workshops for municipalities held on a variety of topics (including SWP) being delivered by Municipalities NL in partnership with Memorial University researchers and the provincial government. These workshops went through critical materials, such as the maintenance assurance manuals, which include a “watershed survey log” to guide communities in what is required when they are monitoring their watershed [58]. However, despite this progress on SWP education, there is still work to be done to bridge the policy–implementation gap. Ultimately, the limitations of SWP in NL pose a greater issue than just a policy–implementation gap. This research displays a significant gap in keeping drinking water resources safe and clean, showing that the residents of NL are potentially in danger of water contamination and subsequent public health safety issues. Change is required in order to prevent a tragedy due to drinking water contamination, instead of waiting for change to ensue in the response of a tragedy.

Supplementary Materials: The following are available online at www.mdpi.com/2073-4441/9/8/560/s1, Document S1: Rural Drinking Water Project Interview Guide, Document S2: Water Operators Drinking Water Survey, Document S3: Municipal Drinking Water Survey.

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