

Article

# The Rocky Path to Source Water Protection: A Cross-Case Analysis of Drinking Water Crises in Small Communities in Canada

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**Abstract:** Source water protection (SWP) is increasingly seen as effective in reducing the incidence and extent of drinking water crises, yet its facilitation requires certain measures. Canada has one of the most decentralized water governance systems in the world. We sought to understand the experience and impacts of drinking water crises at community and government levels in a decentralized context: the Canadian province of Newfoundland and Labrador through cross-case analysis. We selected our three study communities through a database of media reports in 2014 followed by invitations to community leaders. We used descriptive and qualitative methods, specifically structured interview schedules with both closed- and open-ended questions, and interviewed four community leaders and three provincial government officials. We used NVivo in data analysis, especially in the identification of themes. While government officials defined water crises largely in terms of SWP, this was not the same for communities, whose concern was mainly water access, specifically water shortages. Thus, while the prioritizing of SWP can be useful, the current focus on SWP has the potential to overlook aspects of water security, particularly in some rural and Indigenous communities in Canada. If we envision water security as a ladder representing a hierarchy of needs, some communities are too far down on the ladder to operationalize SWP because their water problems are more extreme.

**Keywords:** source water protection; water policy; water security; water in small communities; Indigenous water security; rural water security; water security in Canada

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## 1. Introduction

Necessary for water security, source water protection (SWP) requires a comprehensive policy framework with directed resources that facilitate its planning and implementation. SWP itself is a planning process that aims to provide safe drinking water by preventing the contamination of untreated water at the source [1]. Source water is a body of water, such as rivers, ponds, lakes, and underground aquifers. The underlying premise of SWP is that it is more effective to avoid contamination at the source than to expend resources responding to contamination [2], especially given the high stakes of such contamination, as witnessed through the tragic results in Walkerton, Ontario, Canada in 2000 [3]. SWP prevents contamination by mitigating land-use activities that might impact drinking water quality and quantity [4]. Thus, SWP is vital for drinking water safety [5] and is a process for which all communities should strive so that safe drinking water is provided. The SWP process might include mapping, risk assessment, public education, infrastructure improvements, permitting for development, and the banning of potentially damaging land-use activities in designated areas. Yet

there are measures and pre-conditions that must be met if adequate SWP is to be achieved; some of these are identified through our study.

SWP is also a policy and governance issue; SWP exists in policy contexts and “it is widely acknowledged that the world water crisis is mainly a crisis of governance” [6]. Accordingly, we use a policy and governance lens throughout this paper to better understand the complexity of water provision and its challenges; “drinking water problems are interconnected, cumulative and complex, interacting in sometimes unexpected ways” [7] (p. 71). As others have concluded, the institutional environment must be conducive to source water protection [8,9]. We hypothesise that SWP is difficult to achieve in a decentralised policy environment; decentralisation assumes that junior governments “have a greater ability to handle certain tasks” [10], yet decentralisation does not necessarily lead to improved local capacity. Scholarship, especially of a comparative nature, is needed to evaluate the impacts of decentralisation in communities [10]. Accordingly, in this paper, we identify obstacles to SWP in small communities in the Canadian province of Newfoundland and Labrador and the policy changes necessary to facilitate SWP.

Because SWP is essential in the provision of safe drinking water, it is important to identify potential obstacles to its development and implementation. This descriptive and qualitative study provides insights into what these obstacles are and how they play out at local levels and, in so doing, points towards the necessary policy preconditions for SWP.

We knew from previous studies and from public discourse that water crises responses dominate water management efforts in much of the study province and that citizens point to government policies as problematic. We wondered how measures like SWP could be instituted and better water security achieved in this environment. As a result, we did a cross-case analysis of small communities that experienced water crises in 2014.

We defined water crisis as impaired access to adequate quantities of safe quality water, lasting at least three days. This definition is derived from the United Nations definition of water security and is in line with public discourse in Canada [11]. We focused on small communities, each with populations of less than 500, responding to the fact that small communities are more likely to experience drinking water-related challenges than medium and larger municipalities [12–14]. Therefore, there is a need to improve water management and security in Canada’s small communities [1,7,12,15,16]. Specifically, SWP efforts are often overlooked in communities of less than 1000 residents [7] (p. 6). We hypothesize that myriad drinking water challenges resulting from capacity and that appropriate policy infrastructure impedes the development and implementation of SWP plans.

We relate the lack of SWP in these (and other) communities at least partly to water governance policy and the human and financial capacity problems that result from such policy. A key feature of Canada’s extremely decentralised drinking water management system [15] is fragmented governance characterized by the involvement of multiple institutions in drinking water management [17]. In this context, fragmentation occurs where responsibility for water governance is allocated amongst multiple actors and/or agencies with relatively little or no coordination and no clarity about how final decisions are made [15]. This creates challenges of integration, coordination, and data access and has had negative impacts on Canada’s ability to manage water resources effectively [15,18].

The Constitution of Canada delegates powers for the management of water primarily to the provincial level [15,19]. Each of Canada’s provinces and territories conducts and manages its own largely independent decentralised system [20]. At the provincial level, responsibilities have been increasingly devolved to lower levels of governance in order to follow the principles of “subsidiarity” and “co-management” [19]. This includes off-loading to small communities.

There has been significant progress in water governance in Canada at the provincial level, including the formulation and implementation of stricter guidelines to strengthen drinking water protection, improved source water protection (SWP), more robust monitoring and surveillance, and better efficiency and financial sustainability of water supply utilities [21]. However, Canada remains the only Organisation for Economic Cooperation and Development (OECD) country not to have legally

enforceable federal drinking water standards. Thus, Canada's legislative and governance frameworks are not sufficiently robust to manage domestic and international water issues effectively [17]. In fact, Canada's Federal Water Policy (1987) has been largely ignored by subsequent governments, remaining little more than a statement of good intentions that have gone unfulfilled [19,22]. Accordingly, while SWP has been touted as the first line of defense [7] (p. 34), it is not mandatory in some provinces, including our study province Newfoundland and Labrador.

The underutilization of SWP is part of a pattern of poor water governance; as Hurlbert and Diaz [18] concluded, the responsiveness of water governance in Canada is limited, especially at the local level. At the crux of the problem is a mismatch between responsibilities and capacity with communities primarily responsible for the provision of supplies of drinking water [5], often with insufficient and inadequate funding from provincial governments [5]. In largely rural provinces such as Newfoundland and Labrador, local water management agencies and even small communities are almost solely responsible for water governance, system maintenance, and operations. Communities are responsible for the daily testing of chlorine residual and the implementation of SWP. Remote communities, which are often small and Indigenous, take on tasks that are normally in the province's domain, such as the collection of bacteriological samples. The provincial government funds infrastructure development and installation but not operations and maintenance.

In Newfoundland and Labrador, local governments are municipalities with paid staff with water-related duties, or local service districts (LSDs), run by volunteers without paid staff. In the absence of any such governance structure, there may be a local water committee, sometimes established on an ad hoc basis in response to crises or concerns.

Thus, drinking water systems in rural Newfoundland and Labrador and elsewhere in Canada are shaped by a decentralized water governance system and a corresponding high degree of off-loading from senior to less-resourced junior governments, sometimes referred to as the shift from government to governance [19]. This policy framework does not provide the required supports and jeopardizes such necessary measures as SWP.

SWP requires well-developed technical, institutional, financial, and social capacity because its planning, coordinating, and implementation requirements can be expensive and complicated [1,5,19,23]. As Vodden and Minnes note, "[small communities] . . . fully meeting their mandated drinking water responsibilities is virtually impossible with existing human and financial resources" [7] (p. 6). Long-term boil water advisories (BWAs), some lasting for years, and water shortages are among the evidence for this.

There is much scope for development of SWP in Newfoundland and Labrador beginning, perhaps, with education. Fifty-nine percent (59%) of LSDs and 49% of municipalities in one study reported "no threats" to source water [7] (p. 35), although there are always potential threats to water supplies [6]. Those respondents who did recognize potential threats cited hunting and fishing, domestic wood cutting, and recreational use [7,24]. Although SWP is not mandatory in the province, some Protected Public Water Supply Areas (PPWSAs) have been established, but there is a widespread failure to monitor source water, even in these cases; only 15% of LSDs reported regular monitoring of source water [7] (p. 35).

Timmer et al. [5] have identified public engagement as a means to increase local capacity and advance SWP. We hold that, given the enormity of local capacity issues in small communities, while public engagement may be useful, more emphasis needs to be on resource provision and targeted capacity-building. Capacity-building relies on financial investments. Simply put, very little can happen in terms of water provision and SWP without the necessary resources. The lack of local capacity is something small communities in Canada have in common with other communities globally [5]. Finances, for instance, are one of the most pressing problems with no obvious solution in sight; since raising levies works best when communities have large rate-payer bases [19] (p. 14), many small communities have limited tax bases.

## 2. Materials and Methods

Our study began with a rights-based approach. In 2010, the United Nations officially recognized that the human right to water is not something to be earned or deserved but a right related to human health. The human right to water can be equated to all other human rights and is legally binding and enforceable in existing human rights treaties [25]. Our research was carried out on the premise that drinking water crises constitute infringements on the right to water. The aim was to describe how communities and government experience and understand dominance of drinking water crises, including their relationship to SWP, and to identify necessary improvements in policy frameworks and infrastructure.

The research adopted a case study approach using cross-case analysis. A case study is “an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and concept are not clearly evident” [26] (p. 18). Even single case studies can provide comprehensive and in-depth explanations of issues [27]. To identify appropriate communities, we reviewed existing government documents on drinking water resources in Newfoundland and Labrador (see Figure 1) and compiled a media inventory of communities that experienced serious water insecurity experiences in 2014. We used a definition of water security that conceptualizes water security as a function of four variables namely, drinking water access, availability, quality, and preference [16]. Water security implies that freshwater, coastal, and related ecosystems are protected and improved; that every person has access to adequate safe water at an affordable cost to lead a healthy and productive life; and that the vulnerable are protected from the risks of water-related hazards.

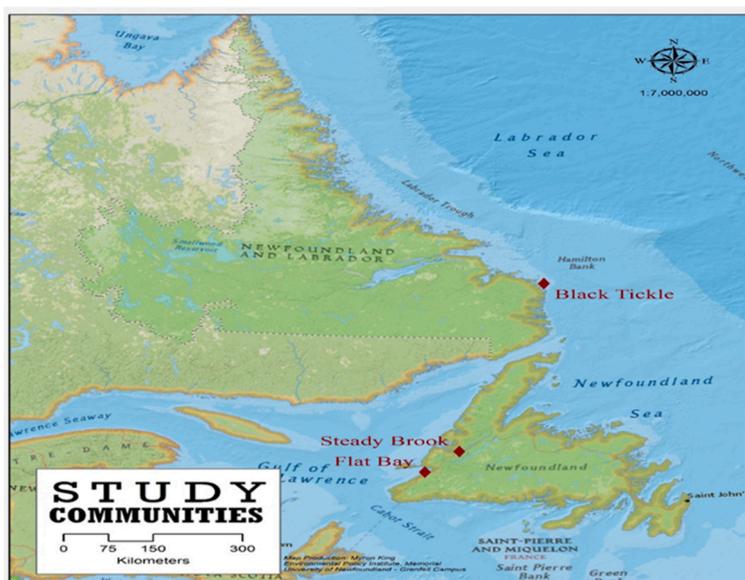


Figure 1. Source: Myron King, Environmental Policy Institute, 2016 [28].

Given scarce human resources in rural regions, we anticipated that not all communities would take part. With the goal of using three cases, we identified five rural communities with well-documented water crises and invited their leadership through emails and phone calls to take part in the study. We did not receive responses from two communities but three others were eager to participate: Black Tickle in Labrador; and Steady Brook and Flat Bay, both in Newfoundland. Black Tickle had taken part in previous water security studies with one of the researchers. We sought and received approval from our university’s research ethics board and, in line with Chapter 9 of the Tri-Council Policy Statement II, from NunatuKavut Community Council, Happy Valley-Goose Bay, Labrador, the Indigenous political organization of which Black Tickle is a member. Flat Bay, the other Indigenous community in the study,

did not have a research ethics approval process. Four community leaders were interviewed: two from Flat Bay and one elected leader each from Steady Brook and Black Tickle.

Given its central role, we also wanted the perspectives of the provincial government. Accordingly, we approached those government departments with specific water management responsibilities, especially duties related to water crises; these are the Departments of Municipal Affairs (MA), and Environment and Conservation (E&C). MA identified three individuals to take part, while E&C submitted a written response to our interview schedule, involving three individuals. The highest-ranking official was an assistant deputy minister.

We used different interview schedules for government officials so that we could identify gaps in perceptions and experiences; these are included as Appendixes A and B. Our interview schedules were structured and amply allowed for discussion. Interviews were at least two hours in duration.

During the interviews, we asked respondents a series of questions regarding their understanding and experience of water provision and security. For communities, the questions were divided into the following sections: community; the local water system; the 2014 water crisis; and community and the provincial government. The questions covered these topics: community: population data, governance system, transportation links, community infrastructure; local water systems: infrastructure; water provision history; local water-related responsibilities; local water-related activities; capacity; source water, source water threats, and SWP; the 2014 water crisis: its nature; related history; community response, including options considered, strategies used, and the identification of resources and allies; for community and government: the provincial government's role; its actions; processes used during the 2014 crisis; communications. Government officials were asked about the following issues: government and community water provision responsibilities; water crises responses and emergency management in a decentralized water system; plans for long-term solutions such as capacity enhancement and SWP; SWP plan implementation.

Each of the study communities has a different governance system. Steady Brook is a municipality; Black Tickle is a local service district (LSD) with a volunteer chair and board members and a part-time paid water operator. Flat Bay is an unincorporated community with a water committee made up of volunteers, including a volunteer water operator. Only Steady Brook, as a municipality, has full-time paid staff, although staff duties are wide-ranging beyond water-related responsibilities.

The primary data were analyzed with the use of NVivo qualitative software and contextualized with reference to the literature. Themes were identified and responses from community leaders were compared with responses from government officials. Inferences were therefore drawn from the two distinct responses concerning the understanding of the term 'drinking water crisis' and, in effect, approaches. We then considered and evaluated gaps in understandings and experiences as well as policy gaps, needs, and options, again with reference to the existing literature. Key questions for researchers were: how can water security, including SWP, be facilitated in small communities? and what changes have to be made to existing policy frameworks and infrastructure so the stage can be set for water security? Thus, we spent some effort identifying impediments to SWP and possible policy remedies.

Although small numbers of in-depth case studies are often used in the social sciences, the scale of the study can be considered a limitation; although we were able to retrieve rich data through our case studies, funding restricted us to three such studies. The study was also specific to the province of Newfoundland and Labrador, although other provinces in Canada are similarly affected by the country's decentralized water governance structure. Accordingly, we encourage other researchers to turn their attention to small communities in Canada, where SWP may be absent, potentially compromising community health and community development.

We submitted a technical report to our funding agency and to the study communities, with whom we will also share this paper.

### 3. Results

Local water management systems are stretched and undeveloped. Water-related activities at the community level tend to be crisis-driven rather than pro-active or aimed at long-term goals; as a community leader explained, “We give two thumbs up for what [the provincial] government did for us because of the crisis. But if there was no crisis or if we were asking for upgrades, they [government] wouldn’t look at us.” The reactive approach of government described here does not facilitate the planning, coordination, and implementation of source water protection. Community and government definitions of drinking water crises do not correspond and the gap between these understandings can prolong such crises. In Newfoundland and Labrador, communities define drinking water crises in terms of effects and certainly not just in relation to source water. For instance, community leaders pointed to line breaks and lost water pressure as crises; thus, identifying items and issues that require scarce or absent resources to be remedied. On the other hand, the provincial government focuses on causes and considers a crisis to be a serious problem with source water. We note that the most senior level and best-resourced level of government in Canada, the federal government, is entirely absent from water crises responses. The provincial government’s definition of water crisis is narrow; according to one official, “. . . in the strict sense, [a] crisis would be a town that has either no water or has a situation whereby a town or community has a non-consumption order in place . . . in relation to source water only.” Thus, the government’s definition does not include many of the factors that lead to drinking water crises as understood by communities, such as limited or no water access due to aging water infrastructure, equipment breakdown, parts replacement, and technical difficulties. Government is much more likely to respond to crises directly related to source water contamination. The lack of a comprehensive approach to ensuring water security affects the likelihood of SWP being realized. Community leaders experienced frustration with stalled efforts in this direction: “I just think there needs to be a more giving hand when it comes to money for improvements and training and operations of the systems. I think it’s a bit ridiculous when you think about the fact that it’s water.”

Water crises responses demonstrate how the shift from government to governance plays out for small communities. Financial capacity was at the root of all of the crises identified by study communities; because of government off-loading, communities are responsible for water system operations and for 10% of infrastructure funding, but these demands exceed local capacity. For instance, having to come up with \$3000CAD out of the required \$30,000CAD was too much for one remote Indigenous community with a population of under 150. A community leader put it succinctly, “Well, we don’t get sufficient funds.” Because of financial and related capacity in other areas—technical, social, and institutional capacity—communities are not able to implement SWP plans; this is even true of the only study site that had such a SWP plan. The existing policy framework and resourcing strategy did not support reliable water provision infrastructure that would allow for the avoidance of crises and crisis management; therefore, despite its promise, SWP was not a real possibility for these small communities.

Other basic issues in terms of drinking water provision have to be resolved before small communities can devote time and energy to education about SWP and, ultimately, the development and implementation of SWP plans. Locally, these include the replacement of deteriorating infrastructure, sufficient funding for equipment and parts replacement, and consistent funding for operations, including comprehensive training of operators. Under the current water governance approach, communities have to develop capacity so that water management systems can stabilize, which would allow room for enhancement including SWP; as a community participant said with reference to more secure water management, “we weren’t really sure . . . what steps we are supposed to take.” If capacity development is not supported, SWP will remain out of reach for many small communities. In the current policy climate, in which communities tend to react to crises, SWP sits at the top of a hierarchy of water provision initiatives and small communities are not in a position to aspire to it.

## 4. Discussion

Three small communities in Newfoundland and Labrador took part in the study; these were Steady Brook and Flat Bay West-Birchy Bay on the west coast of the island of Newfoundland, and Black Tickle-Domino on the Labrador coast.

Two of the selected communities—Black Tickle (Southern Inuit) and Flat Bay (Mi'kmaq)—are Indigenous communities (but neither has a local government regulated by the federal government's Indian Act or by an Inuit land claim settlement which, for governance purposes, makes them rural communities). Black Tickle has a Local Service District while Flat Bay has a Water Committee supported by a non-Indian Act band council. Steady Brook, which lies approximately ten kilometres east of the small city of Corner Brook, is a municipality with a population of 408 people. Located in Western Newfoundland nine kilometres off the Trans-Canada Highway, Flat Bay is a Mi'kmaq community with 250 people, while Black Tickle is a remote Southern Inuit community located on an island on the southeast coast of Labrador with a population of about 140 people.

### 4.1. Steady Brook

Steady Brook has a gravity-feed system with piped chlorinated water. The infrastructure is aging and boil water advisories (BWAs) are in effect in the community for approximately one-third of the year. Steady Brook had five BWAs in 2015 and four in 2014. The most recent BWA caused solely by source water quality was in 2010. Town leaders believe that source water is contaminated by logging, wood preserver on “green” telephone poles, snowmobiling activity, and the presence of cabins. The town has asked the provincial government to buy out the cabins, but this request was not successful; however, no further cabin construction will be permitted and, upon the deaths of their owners, existing cabins will be removed. At times, weather is another cause of BWAs, affecting the chlorine system. According to an interviewee, “In rainy seasons we get a lot of runoff—mainly in the spring you get all the junk washing out on high water and it plays havoc with our chlorine system because of the fact that it's runoff and we can't keep up with it. If we get a massive rain storm the system, just the system goes overloaded. [Then] we got to go on boil order.”

Two town employees are responsible for all outside maintenance, including water operations, and have received some training from the provincial government. They check the chlorine residual water twice daily, as per government requirements. Steady Brook sometimes remains “on BWA” for lengthy periods, since BWAs can be lifted only by provincial government inspectors who serve a large region where winter weather often impedes travel. As a result, Steady Brook's BWA was in effect three weeks longer than technically necessary in 2015. This exasperated local business owners who could not provide fresh water to their customers and were forced to close for some days. Steady Brook remained under BWAs for so long that some residents ceased paying attention to these advisories. In such cases, BWAs become the norm [29].

Steady Brook should have a great deal of capacity for SWP [30–33].

Steady Brook is one of five towns in the province that has a watershed management committee and one of three towns with a watershed management plan, with SWP at the centre [26]. A government report entitled “A Municipal Guide to the Development of a Watershed Management Plan” was based on the experience of Steady Brook and its creation of the town's watershed management plan [34]. Further, Steady Brook was even profiled in the Drinking Water Safety in Newfoundland and Labrador 2014 Annual Report, where it was highlighted as a town where, “government, the public, and industry can work together to safeguard our water resources for future generations” [34] (p. 6). However, a local leader says that, in practice, the Protected Public Water Supply Area legislation under the *Water Resources Act* [35] is currently not being implemented locally and not always enforced at the provincial levels.

Steady Brook is a relatively affluent community, given its place at the foot of Marble Mountain, the site of a ski resort. In 2012, the average income in Steady Brook was \$51,200CAD versus \$41,400CAD for the province as a whole [36]. Arguably, town taxes could be raised on this basis, but the council is aware

of local economic disparities and does not want to exacerbate these disparities. Thus, policy-makers in senior governments should recognize that cultural and local political factors have to be considered in terms of water provision.

Steady Brook received a cost-shared grant from the provincial government to dig artesian wells. Like most such grants, this one is a 90–10 agreement, with the province paying 90% and the community expected to raise 10%. However, the total amount—\$430,000CAD—is only half of the project estimates provided by engineers—\$860,000CAD—so progress has stalled. Because of high costs, Steady Brook cannot invest in infrastructure development and maintenance that would prevent BWAs. Accordingly, its SWP plans remain moot.

#### 4.2. Flat Bay West-Birchy Bay

The First Nations (Mi'kmaq) community of Flat Bay West-Birchy Bay has piped chlorinated water from an artesian well, which is 190 feet deep. The source water is a large body of water that is more than ample for the local population of about 250 people. Source water in Flat Bay is protected, as the pump house is enclosed and secure. There is no paid water operator in Flat Bay; the community relies on a small number of volunteers who serve on the Flat Bay West-Birchy Bay Water Committee, engaging in a range of activities related to drinking water. One individual received the 2016 Volunteer Water Operator of the Year Award from the provincial government, which demonstrates the institutionalization of reliance on volunteers for daily water systems management. On a more positive note, Flat Bay just recently received access to a regional water operator that it will share with other towns.

In 2014, aging water infrastructure in Flat Bay broke down, leading to a complete absence of potable water for eight weeks in part of the community, with a shorter absence in the rest of the community. This infrastructure was over 35 years old and, according to interviewees, built with inferior material. Flat Bay had experienced annual water infrastructure breakdowns since 2006. Although the Red Cross distributed bottled water during this time, at least some people decided to collect water from unmonitored springs and other sources, which may have compromised health.

There was a long-term resolution of the problems in Flat Bay West-Birchy Bay, involving infrastructure improvements, including a new completely sheltered pump house and piping, provided through government funding buoyed by a loan from the band council. Study participants attributed their success to their representation in government by a cabinet minister and to strong band leadership; they are aware that most non-SWP crises are not addressed so quickly and robustly. Because of infrastructure improvements, SWP is not a concern in the community. As one community leader stated, “There is no human activity around. It might have [the] odd dog pass [by] but nothing can get down. The pump house is secured.”

#### 4.3. Black Tickle

Black Tickle is one of many Indigenous communities in Canada in which drinking water crises have become the norm. Part of the problem is scale and inappropriate technology, a common occurrence in remote and Indigenous communities in Canada, where there is an ongoing practice of bringing high cost drinking water units to small population bases [29]. Thus, communities are left to deal with inappropriate design specifications, dependency on chemical treatment, lack of trained operators, and high operation and maintenance costs with increased human vulnerability resulting from technology failure [29]. As Goldhar et al. point out, a key step in advancing genuine water security involves adequately adapting technologies to meet local environmental demands; otherwise, the drinking water produced may be “undesirable” to residents and of “little use” [16] (p. 480–481). Black Tickle has no piped water and relies on an inappropriately-scaled, inconsistently funded potable water dispensing unit (PWDU) or Advanced Drinking Water System (ADWS). Thus, Black Tickle suffers from frequent drinking water shortages. The PWDU is located about two kilometres from the furthest house and one kilometre from the nearest, presenting access problems for many residents and incurring costs for all residents. Source water comes from Martin’s Pond and there is no SWP at all.

Because of inconsistent PWDU funding, residents sometimes rely on unmonitored water sources, raising the issue of quality [24]. In 2014, infrastructure problems, related to source water, with the PWDU meant there was no potable water for a week. The community ran out of filters due to poor quality source water which affected the rate at which filters were used. As a resident explained, “What happened was that the water quality coming from Martin’s Pond was so poor that instead of filters lasting a month they were lasting a day there was so much sludge and silt and things in the water that we were just chewing up the filters. We were going through them faster than we could get them in”. Eventually, the PWDU was shut down.

Community leaders are aware of the need for SWP, given that animals frequent the pond and snowmobiling occurs around it. However, it is not obvious to residents how they should proceed with SWP. The community’s crab processing plant, its main employer, closed several years ago, causing widespread unemployment, so the LSD cannot raise the required annual operational funding of \$30,000CAD, let alone funding for SWP.

Each year, Black Tickle applies for one-time grants, as the province refers to them, to fund its PWDU; although these applications have often been successful, there is a great deal of uncertainty and stress around the process. These multiple stressors have led to an entrenched culture of water insecurity and a perception of injustice, considering there is no piped water. Residents of Black Tickle do not understand why they need to submit a proposal for funding every year for water nor why crisis prevention is not a priority: as a community leader explained, “We had to fight like tooth and nail to get the money the last time”.

There appears to have been almost no working relationship with the provincial government at the time of the 2014 crisis, which was resolved through a media campaign and a government response consisting of one-time funding for the PWDU and the necessary parts. Meanwhile there are no plans for SWP, which means that further crises will likely occur.

## 5. Discussion Summary

Our cross-case analysis points to the range of water provision challenges and crises faced by small communities in Newfoundland and Labrador and to the absence of appropriate policy infrastructure, including regular training and a province-wide plan for water provision leading to water security through SWP and other measures. Communities are not adequately resourced to manage downloaded responsibilities, including costs. Yet this is expected of them; as one government official told us, “Community based source water protection committees can provide local resource management, oversight and public awareness.” In addition to the problem of local governments lacking resources, there is also the challenge of demographic transition; due to aging populations and youth out-migration, there is a high risk of increasingly vulnerable aged populations having to manage essential services such as drinking water systems [12]. The reliance on volunteers to which many communities resort is not sustainable and, again, can work only in centres with large populations [19] (p. 14). This is especially true for communities with aging populations, as in our study communities and many others in rural Canada. It is unlikely that volunteers can develop and implement SWP plans, given the complexity of such initiatives—yet SWP is essential for water security.

## 6. Conclusions

In 2014, certain factors existed in all the study communities, including, primarily, poor or no drinking water access, a breakdown of drinking water infrastructure, and an uncertain path to long-term resolution. Only Flat Bay was successful in this regard. In two communities, SWP was conceptualized as a necessary but distant, if not impossible, goal because of resource constraints. Our research is in line with the literature in which adequate funding is the most commonly cited factor in water management [37]. Related to this, our case studies provide community-based evidence that other forms of capacity, especially trained human resources, are a significant concern. Such concerns

are pressing in the affluent North, as we demonstrate here, as they have proven to be in Southern countries [5].

Our study demonstrates the need for senior governments to recognize that decentralisation cannot work unless local organizations have sufficient resources; otherwise, the shift to governance from government will continue to have negative impacts on small communities, maintaining and even exacerbating water disparities. It is not sufficient to involve local actors in the provision and management of water resources without adequate power and resources to carry out their legitimate mandate [38–40]. As experienced in our case study communities, the transfer of responsibilities and accountability through decentralised governance often fails to transfer the required power and resources for capacity-building and solid drinking water governance [19]. This is a global concern given that many governments are committed to decentralized water governance; in the “developed” world, these include New Zealand, and many European Union countries such as Italy, Belgium, Greece, and Portugal [41] while in the “developing” world they include Chile [41] and Mexico [42]. Resources that lead to better capacity and SWP will continue to challenge these countries, sometimes in ways that are not easily anticipated. Our work illustrates how this happens at local levels. Water security is a human right, but it will not be guaranteed without SWP. Meanwhile, SWP will not become general and institutionalized without comprehensive supportive policy frameworks; adequate resourcing must be a central pillar of such frameworks.

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**Author Contributions:** Maura Hanrahan conceived and designed the research process and did the research with some assistance from graduate students; Maura Hanrahan and Benjamin Dosu Jnr analyzed the data and wrote the paper.

**Conflicts of Interest:** The authors declare no conflict of interest. The founding sponsors had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, and in the decision to publish the results.

## Appendix A : Community Interview Schedule

### Appendix A.1 SECTION A—Descriptive Questions

1. Who/which organization is in charge of or leads community governance?
2. Who/which organization is responsible for community water system?
3. Does the community receive regular and stable funding for its water system?
4. What education/training has been given to the community about its water supply?
5. What is the population in your community?
6. How many households does the community have?
7. What is the average household size?
8. Is the community aging or is there a good distribution of all ages?
9. Can you describe the local economy? (What do most people do for a living? What is the unemployment rate? Do people work away?)
10. Are there any vulnerable groups within the population that might have special needs or requirements?
11. What are the community’s transportation links?
12. What other infrastructure does the community have (e.g., school, clinic)?

*Appendix A.2 SECTION B—The Community Water System*

1. Please describe the community's water system, including treatment systems and distribution.
2. What is the source of the community water supply? (e.g., Ground water, spring water, surface water, etc.)
3. What human activities take place around the main water sources?
4. Are there any protection measures (SWP prompt) around the main water sources? (e.g., Fencing)
5. Are there seasonal or weather variations that impact water quality and quantity?
6. Is water quality monitored? How? How often? Where?
7. Is the water distribution system simple and easy to control?
8. Are treatment plant operators trained?
9. Are the storage tanks protected? (e.g., Rainproof, locked gates)
10. Does the water system/infrastructure work in good condition?
11. What construction materials are used in the infrastructure, and how old is the infrastructure?
12. What is the average pressure in the system, and does it vary?
13. How is wastewater handled?

*Appendix A.3 SECTION C—Water Crises*

1. How did the 2014 water crisis happen? What caused it?
2. When did you realize it was a problem that needed immediate action?  
- In what circumstances?
3. Does the community have a water crisis response plan?
4. How did the community respond? (What did you do? What steps did you take?)
5. What were the options available to the community to deal with the crisis?
6. Were there allies or resources people in the community could call on during the crisis?  
- If so, what was their role?
7. How were residents notified about the water issue?
8. Were you able to obtain drinking water?  
- How was water distributed to the community during the crisis?
9. Was the amount of available drinking water adequate?  
- How much water was distributed per person per day during the crisis?
10. What were your ongoing concerns during the water crisis?
11. How long did the water crisis last?
12. Did the water shortage result in any long-term impacts on the community?

*Appendix A.4 SECTION D—Community and Government*

1. How did the provincial or federal government respond? What did they do?
2. What steps did they take?
3. Did they have a response plan?
4. What options or alternatives were presented to the community?
5. Did the government declare state of emergency/issue any orders/alerts?
6. Did the government launch any monitoring programs during the crisis or to follow up?
7. Did the government hold any public meetings after the crisis soliciting opinions?
8. How did the government communicate with you before/after the crisis?
9. Can you comment on the government's water crisis responses?
10. Is there a response plan in case of water crisis (shortage/contamination) in your community?

11. Do you have suggestions to improve government responses to water crises? Water management in general?

*Appendix A.5 SECTION E—Other*

12. Are there any questions we haven't answered or comments you would like to add?

*Again, we very much appreciate your participation and your generosity with your time and expertise.*

**Appendix B : Government Interview Schedule Interview with Government of Newfoundland and Labrador Officials**

1. Does the NL government have any water crisis response plans or procedures?  
Discussion points:
  - Definition of water crisis?
  - Please describe the principles behind these plans.
  - Please describe the plans and procedures themselves?
2. Some communities in NL have experienced water shortages, crises, emergencies. Can you describe the government's responses to these situations? Are there any guidelines for the required amount of water for using during an emergency?
3. How do you manage emergencies in a decentralized water supply system? Any established protocols and existing organizations?
4. Do departments share responsibilities in planning for or responding to water crises? If yes, how?
5. How do interdepartmental communications work in an emergency? See above.
6. Are there successful cases in interdepartmental emergency coordination?
7. Traditional responses to water shortages here and throughout North America tend to concentrate measures on reducing demand for water, and provide short-term water supply but overlook long-term solutions. Is this a fair assessment? Can you comment on it?
8. For communities with frequent water shortages, has the government implemented any long-term conservation plan?
9. Has the NL government launched any initiatives that are aimed at enhancing the capacity of small water systems?
10. Can you give us some description of technical specialists who work with the community water system? What is their scope of practice?
11. What is the role of communities in water crises?
12. How can the multi-barrier approach, including source water protection, be implemented at the community level?
13. What are the challenges that the government faces? Any trade-off decisions?
14. Do NGOs have a role to play here? If so, can you describe that role?
15. Do you have suggestions or comments that haven't been covered?

*Again, we very much appreciate your participation and your generosity with your time and expertise.*

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