

**WATER OPERATOR AND COMMUNITY ENGAGEMENT TO IMPROVE DRINKING
WATER ACCESS IN FIRST NATIONS IN BRITISH COLUMBIA**

by

Kaitlynn Anne Livingstone

B.A.Sc., The University of British Columbia, 2012

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF
THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF APPLIED SCIENCE

in

The Faculty of Graduate and Postdoctoral Studies
(Chemical and Biological Engineering)

THE UNIVERSITY OF BRITISH COLUMBIA
(Vancouver)

April 2015

© Kaitlynn Anne Livingstone, 2015

Abstract

Lack of access to safe drinking water is an issue disproportionately affecting First Nations in Canada and putting the health of First Nations communities at risk. Many First Nations in British Columbia are facing additional challenges for water treatment system design due to their small population and rural and remote location. Investing in infrastructure alone is not sufficient to ensure long-term water access and protection of community health. Water operators have been identified as key individuals to engage to ensure community appropriate water treatment solution design as well as long-term operation and maintenance of treatment systems. This work highlights the important role that water operators have both within their community and with external stakeholders involved in the design and management of treatment systems. It has also been identified that water operators are well placed to be educators in their community and be a trusted source of information for community members about their water. There is a need for increased support for operators from community leadership as well as more transparency and operator involvement in decision making, especially in relation to budgeting. Water operators reported serving their community as one of the main motivations in their work; however, it was also expressed that there was a lack of recognition and appreciation for their work from within their community. Increased community awareness about the importance of water operators is considered to be essential to increase operator support from their community. In turn, this support contributes to increased water operator job satisfaction and motivation, and ultimately water operator retention in communities. Community support for operators and the inclusion of operators in water related budgeting and decision-making is key to finding appropriate water treatment solutions and ensuring operators are able to provide communities with long-term access to safe drinking water.

Preface

This thesis draws from work on two related projects. Ethics approvals for these projects were obtained through the University of British Columbia's Behavioural Research Ethics Board. The ethics applications are as follows:

H12-01157 – Aboriginal Water Health

H13-02437 – Investigation into Water Operator Training and Support Systems

The initial Aboriginal Water Health (AWH) community questionnaire was developed by Teresa Howell, a Research Associate at the Institute for Aboriginal Health, Darlene Sanderson, and Madjid Mohseni. The author worked with research assistant Jessica Dunkley to develop the talking circle guide, make revisions to the questionnaire, and perform the data collection for the AWH project. Two undergraduate research assistants worked on data entry, transcription, and preliminary data analysis, including Microsoft Excel analysis of questionnaire data and the use of NVivo to create Figure 3.1. The author performed the qualitative data analysis for this project as well as a portion of the quantitative analysis.

The design, data collection, and data analysis for the Investigation in Water Operator Training and Support Systems was performed by the author.

This thesis is original and unpublished work by the author.

Table of contents

| | |
|--|-------------|
| Abstract | ii |
| Preface | iii |
| Table of contents | iv |
| List of tables | vii |
| List of figures | viii |
| Acknowledgements | ix |
| Chapter 1. Introduction..... | 1 |
| 1.1 Safe drinking water access in First Nations communities across Canada..... | 1 |
| 1.2 Additional challenges facing small, rural, and remote First Nations in British Columbia | 6 |
| 1.3 Why focus on water operators | 8 |
| 1.4 Thesis overview | 11 |
| Chapter 2. Methods..... | 14 |
| 2.1 Introduction | 14 |
| 2.2 Community partnerships & engagement activities | 14 |
| 2.2.1 Boothroyd Indian Band | 15 |
| 2.2.2 Lytton First Nation | 16 |
| 2.2.3 Tl'azt'en Nation | 17 |
| 2.2.4 Knowledge transfer events | 18 |
| 2.3 Data collection, data analysis, and sharing back results..... | 19 |
| 2.3.1 Community engagement | 19 |
| 2.3.2 Water operator interviews | 20 |
| 2.3.3 Data analysis | 22 |
| 2.3.4 Sharing back information with participants | 23 |
| 2.4 Limitations of water operator engagement work | 23 |
| 2.5 Building community relationships and honouring ethics of Aboriginal research | 25 |
| 2.6 Challenges experienced and lessons learned from community engagement work..... | 28 |

| | |
|---|---------------|
| Chapter 3. Community perspectives on health and drinking water | 33 |
| 3.1 Introduction | 33 |
| 3.2 Improving and maintaining community health through safe drinking water..... | 34 |
| 3.2.1 Physical health impacts | 35 |
| 3.2.2 Emotional and mental health impacts | 36 |
| 3.2.3 Spiritual health and the cultural importance of water | 38 |
| 3.3 Concerns about drinking water in each community | 42 |
| 3.4 Community perspective of water treatment | 46 |
| 3.4.1 Desire for “natural water” and concerns about chlorination..... | 47 |
| 3.4.2 Concerns about impacts of resource extraction | 55 |
| 3.5 The importance of trust when communicating risk | 58 |
| 3.6 Conclusion..... | 61 |
| Chapter 4. Importance of water operators in ensuring appropriate design, operation, maintenance and management of water treatment systems..... | 63 |
| 4.1 Introduction | 63 |
| 4.2 Building capacity through water operator training | 65 |
| 4.2.1 Water operator training and certification..... | 65 |
| 4.2.2 Operator experiences with training..... | 67 |
| 4.2.3 Training accessibility..... | 71 |
| 4.2.4 Suggestions to improve training | 72 |
| 4.3 Sources of water operator motivation and job satisfaction | 74 |
| 4.4 Threats to water operator retention: lack of support and issues with wages..... | 76 |
| 4.5 Water operator recruitment..... | 80 |
| 4.6 Support from other operators..... | 81 |
| 4.7 Involving operators in the design and management of water treatment systems..... | 83 |
| 4.7.1 Value of operator and community involvement in design process..... | 83 |
| 4.7.2 Water operators relationship with Chief and Council in the management of systems | 86 |
| 4.8 Discussion of factors affecting water operator retention..... | 89 |
| 4.9 Conclusion..... | 91 |

| | |
|--|------------|
| Chapter 5. Water operators role in building awareness of community water issues .. | 93 |
| 5.1 Introduction | 93 |
| 5.2 Building trusting relationships with community members..... | 94 |
| 5.3 Challenges for operators with outreach and education | 99 |
| 5.4 Best practices shared by water operators: community outreach and education to build awareness about water issues | 103 |
| 5.5 Conclusion..... | 104 |
| Chapter 6. Conclusions and recommendations | 106 |
| 6.1 Key findings | 106 |
| 6.2 Highlighting recommendations on how to move forward..... | 110 |
| 6.3 Recommendations for future research | 113 |
| Works cited | 115 |
| Appendices | 123 |
| Appendix A: Aboriginal Water Health Project: interview guide and community questionnaire..... | 123 |
| Appendix B: Water operator interview guide..... | 134 |
| Appendix C: Regional map of British Columbia..... | 136 |
| Appendix D: Supplemental community questionnaire data | 137 |
| Appendix E: Handout distributed at water and wastewater operator conference | 145 |

List of tables

Table 2.1 Experience level of water operator interview participants.....21

Table 2.2 Level of training achieved by water operator interview participants.....21

Table 2.3 Geographic distribution of water operator interview participants.....22

Table 3.1 Number of questionnaire respondents who expressed drinking water concerns.....42

List of figures

Figure 3.1 Word cloud representing the cultural importance of water.....39

Figure C.1 Regional map of British Columbia.....136

Figure D.1 Boothroyd Band questionnaire responses: water and culture137

Figure D.2 Boothroyd Band questionnaire responses: water consumption, awareness and concerns.....138

Figure D.3 Lytton First Nation questionnaire responses: water consumption and concerns.....140

Figure D.4 Lytton First Nation questionnaire responses: drinking water awareness.....141

Figure D.5 Tl’azt’en Nation questionnaire responses: water and culture.....142

Figure D.6 Tl’azt’en Nation questionnaire responses: drinking water awareness.....143

Figure D.7 Tl’azt’en Nation questionnaire responses: water consumption.....144

Figure D.8 Tl’azt’en Nation questionnaire responses: tap water consumption.....144

Acknowledgements

First and foremost, I would like to acknowledge and extend my heartfelt thanks to all of the water operators who shared their experiences with me for this project. As well, to all of the community members who participated from Lytton First Nation, Boothroyd Band, and Tl'azt'en Nation, thank you for your kindness and hospitality, and above all, your trust in partnering with us for this work.

I would like to thank my supervisor Dr. Madjid Mohseni for his support and for giving me the opportunity to pursue this work in the first place. As well, I would like to thank my thesis committee members, Dr. Naoko Ellis and Dr. Leila Harris, for their input and feedback. I would like to acknowledge past colleagues and collaborators on this work, Teresa, Darlene and Jess, I appreciate all of the knowledge and experiences that you shared with me, I learned so much from each of you. This work would not have been possible without the financial support from the Peter Wall Solutions Initiative and the RES'EAU-WaterNET Strategic Network. As well to Ted, Danny, and Krista from AANDC, thank you for your support and guidance. Thank you to Shawn and Marie at MTS who took the time to talk with me and take me on a tour of their facility.

Rosie, thank you for all of the conversations, feedback, and the many hours spent working in the coffee shops of Vancouver. Emilie, I appreciate that you were always there to listen and share your research wisdom. Marisa, thank you for all of your insights and for being a champion of early morning meet-ups.

Last but most certainly not least, I want to thank my friends and family. I am so lucky to have you all in my life and I cannot thank you enough for always being there for me. Mom and Dad, you have always supported me and I wouldn't have been able to get where I am today without you. Scott and Claire, you are the best siblings a person could ask for, thanks for always being there to listen and make me laugh. Stephen, I couldn't have done this without you, thank you for all of your love and support and for helping me to keep things in perspective.

Chapter 1. Introduction

1.1 Safe drinking water access in First Nations communities across Canada

There are 617 First Nations in Canada (AANDC, 2014). “As of November 30, 2014, there were 135 Drinking Water Advisories in effect in 91 First Nations communities across Canada, excluding British Columbia¹” (Health Canada, 2015). Even without the inclusion of drinking water advisories in the 198 First Nations in British Columbia, this means that more than 1 in 5 First Nations do not have safe tap water available to them. When considering these advisories, it is also important to note that while some are temporary, there are also many advisories that have been ongoing for a number of years (Eggertson, 2008; Health Canada, 2009).

Boil water advisories may be issued due to a number of reasons related to known water quality issues or as a precautionary measure when there are known risks to a treatment system. When looking to find solutions to drinking water access in First Nations, it is important to recognize that boil water advisories are symptoms of much larger problems. In order to properly diagnose these issues and provide communities with safe drinking water, it is necessary to have an understanding of both the technical challenges of drinking water treatment as well as political, cultural, economic, and social factors which affect water access in communities.

¹ The exclusion of British Columbia in this statistic is due to the transfer of responsibilities from Health Canada to the newly created First Nations Health Authority, from Health Canada’s website:

“As part of the British Columbia Tripartite Framework Agreement on First Nation Health Governance, on October 1st 2013, Health Canada transferred its role in the design, management, and delivery of First Nations health programming in British Columbia to the new First Nations Health Authority (FNHA). Therefore, Health Canada no longer reports drinking water advisories in BC First Nations.” (Health Canada, 2015)

The origins of issues of safe drinking water access for First Nations can be traced back to colonization in Canada. The Indian Act of 1876 forced First Nations communities onto reserves resulting in some communities being cut off from their traditional water source and in some cases being given land where a potable source of water was not present. Additionally, many First Nations have been subjected to development surrounding their community that has affected water quality. These issues were compounded by a chronic lack of funding for First Nation's water and wastewater infrastructure, resulting in many communities with inadequate or nonexistent drinking water treatment (Kelm, 1998; Patrick, 2011; White et al., 2012).

A complicated regulatory framework adds additional challenges to managing drinking water issues in First Nations communities. Multiple federal departments work with First Nations to supply drinking water to communities. The department of Aboriginal Affairs and Northern Development Canada (AANDC) is responsible for funding capital costs for systems as well as funding 80% of operation and maintenance costs. AANDC is also responsible for overseeing "the design, construction, and maintenance of water facilities" (Simeone, 2010, p. 2). Further, AANDC provides funding for water operators to attend training. Health Canada plays a role in monitoring drinking water quality and Environment Canada has a role to play in source water protection (Health Canada, 2007). However, in many cases source water protection is complicated as water in many communities is at risk of contamination from off-reserve activities. Therefore, source water protection requires collaboration with surrounding municipalities as well as provincial authorities (Indian and Northern Affairs Canada, 2003).

Included in the responsibilities that communities have in the provision of safe drinking water is “ensuring that water systems are operated by trained operators as well as for monitoring drinking water quality through effective sampling and testing programs” (Simeone, 2010, p. 2). Although AANDC oversees the design and maintenance of water treatment systems, communities are responsible for leading this process. Communities are also required to cover 20% of operation and maintenance costs. However, it is important to note that it has been identified that this cost is too great for many communities (Swain et al., 2006).

In 2003, Indian and Northern Affairs Canada (now AANDC) published a national assessment of drinking water and wastewater systems in First Nations across Canada. This assessment highlighted a number of issues related to First Nations water and wastewater systems and led to a number of recommendations regarding the design, operation and maintenance of treatment systems in First Nations communities (Indian and Northern Affairs Canada, 2003). The 2003 assessment led to the creation of the First Nations Water Management Strategy, focused primarily on systems that were identified as high-risk. In order to implement this strategy, the federal budget included an additional \$600 million to be invested in First Nations water and wastewater infrastructure between 2003 and 2008, in addition to \$1 billion already budgeted for these five years (Indian and Northern Affairs Canada, 2006a).

The next significant action taken by the federal government was the creation of the Plan of Action for Drinking Water in First Nations Communities in 2006. This plan included a number of components including the creation of the *Protocol for Safe Drinking Water in First Nations Communities*. This protocol stressed a multi-barrier approach to water protection, including water

quality and reporting standards as well as clarifying roles of stakeholders in the decision making and management of water treatment systems (Indian and Northern Affairs Canada, 2006b). This plan also mandated that all operators receive training and included a targeted approach to address 21 systems that had been identified as the most at risk. Finally, an expert panel was created to look at the regulatory framework surrounding drinking water in First Nations (Simeone, 2010).

Another national assessment was completed in 2011. As can be seen in the 2011 report, 39% of water systems were still ranked as being high risk. This report included recommendations related to infrastructure needs, building operator capacity, and the need for better standards and regulations. (Indian Affairs and Northern Affairs Canada, 2011)

In addition to calling for more funding to be allocated to address First Nations drinking water issues, there was also pressure to address some of the systemic issues related to management and regulation of drinking water in First Nations. Key concerns were raised regarding the absence of legislation governing drinking water in First Nations which resulted in a lack of clarity and ultimately a lack of accountability (Eggertson, 2008; Graham, 2002; Macintosh, 2009; Simeone & Troniak, 2012).

The response of the Canadian government to this lack of legislation was the introduction of Bill S-8, The Safe Drinking Water for First Nations Act. This act came into force in November 2013 and gives the federal government the power to set regulations related to drinking water in First Nations. The response to the creation of Bill S-8 has been mixed. The main criticism of this

legislation is that many communities are currently lacking the resources and capacity to fulfill requirements that may be put forth in regulations (Canada, 2012; Simeone & Troniak, 2012).

This was clearly expressed by the Expert Panel on Safe Drinking Water for First Nations who concluded in volume 1 of their report that “Ensuring safe drinking water involves much more than setting standards and requirements. In some ways, this is the least important aspect of water system safety. The really critical element is the capacity of facilities and operations to meet the standards” (Swain et al., 2006, p. 60).

In order for regulations related to drinking water safety to be effective, there first needs to be an investment in community capacity. However, there has not been adequate work done to understand what the gaps in capacity are within communities and how to best address these. This work seeks to understand the capacity gaps that exist within communities with regard to the operation and management of their drinking water treatment systems by focusing on the role of First Nations water operators in ensuring communities have access to safe drinking water. In this context, a high capacity operator is understood to be an operator who has the training, resources, and support available to them so that they are able to confidently operate and maintain their water treatment system.

1.2 Additional challenges facing small, rural, and remote First Nations in British Columbia

This research is focused on First Nations located in British Columbia, Canada. British Columbia is home to nearly one third of all First Nations in Canada. Many of these communities are facing additional challenges related to drinking water access as the majority of communities have small populations and many are considered both rural and remote. Some of the risks facing small systems are outlined below in an excerpt from the 2011 National Assessment of First Nations Water and Wastewater Systems. In this report a weighted risk score was given to each water system based on the risks related to source, design, operations, reporting, and operators. This report found that 39% of water systems assessed in First Nations across Canada were high risk. However, it is important to note that these high-risk systems are only serving 25% of the population considered. Additionally, this report found that British Columbia has the highest percentage of high-risk water systems with 53% of the water systems in BC First Nations classified as high-risk.

Small water systems are generally found to have a higher risk rating than larger water systems. In many cases, these small facilities were not designed to meet current protocols and do not have the same level of resources available for operation as larger systems. In addition, the overall risk of a system appears to increase with remoteness. (Indian and Northern Affairs Canada, 2011, p. ii)

A considerable challenge for designing water treatment systems for small communities is the high per capita cost. As noted in the Report of the Walkerton Inquiry “The challenge lies not in making small systems safe; technically, this is rarely difficult. Rather, the challenge lies in doing so affordably” (p.472). This report also notes that small communities “may have difficulty attracting, retaining, and affording the expertise they need” (O’Connor, 2002b, p. 472).

Additionally, the location of many small water systems puts them at risk to contamination from nearby industrial activities as described below:

Small water systems are more prone to contamination from logging, mining, agricultural, and other land use activities which lead to contaminants entering hydrologic systems, simply because these activities take place nearer to small communities than large urban centres. These water systems often rely on small bodies of source water with variable flow rates, resulting in reduced capacity of the water source to dilute contaminants and high variation in concentration levels of contaminants. (Centre for Aboriginal Health Research, 2011, p. 4)

The capital funding for First Nations water treatment infrastructure comes from AANDC through an application and prioritization process. The reality is that unless the federal government allocates significantly more money to address systems identified as high risk, it is going to be many years until all First Nations across Canada have access to safe drinking water. The most recent national assessment of First Nations water systems estimated that it would require a minimum of \$846 million dollars to have water systems “comply with applicable guidelines, protocols and legislation” (Indian and Northern Affairs, 2011, p. 35).

This cost has created a need for innovation and research to create low cost drinking water solutions for small communities. However, investing in infrastructure alone will not provide a solution to drinking water access for communities. There is a need to understand the non-technical issues that are related to water access in communities, especially issues related to a community's capacity to operate and maintain a water treatment system. Communities must be placed at the centre of the design process when designing new water treatment solutions requiring high level of engagement in order to design systems that are appropriate. Also, this support for communities cannot end after the design process, there needs to be ongoing support for communities, especially for water operators, in order to ensure that communities have long-term access to safe drinking water.

1.3 Why focus on water operators

Water operators are individuals in communities who are trained to operate the water treatment system. The more complex a water treatment system is, the higher the level of training required for an operator to have. Since operators are responsible for the day-to-day operation of a water treatment system, ensuring that a community has a qualified water operator is key to ensuring that a water plant is running safely and effectively. In addition, it is important for water operators to be trained to recognize the maintenance needs of their system, thereby ensuring the long-term functioning and sustainability of the community's drinking water treatment system.

The tragic events that occurred in Walkerton, Ontario, in the spring of 2000 illustrated the importance of well-trained operators and their role in ensuring community health. These events had a number of compounding causes that led to seven deaths and thousands of people becoming ill as a result of *E. coli* contamination in the water supply. The Walkerton Inquiry found that the operators at the water treatment plant were not following proper procedures and in addition lacked training to identify and deal with risks to the town's drinking water (O'Connor, 2002a).

This was a lesson learned the hard way – what can happen when water treatment systems fail and there are not competent operators to deal with the situation. Walkerton is frequently referenced when talking about drinking water in Canada and in many ways is viewed as a “wake-up call”. However, when thinking of this as a wake-up call, as one operator who participated in this work remembers his supervisor at the time of Walkerton saying:

“Well, if this is a wake up call, why was everyone asleep?” and that really stands out in my mind. Rather than being reactive, we have to be proactive. You know, seek out ways to improve the system before it fails.”

Water operator interview participant, March 2014

In the years since Walkerton there has been an understanding of the importance of building systems with multiple barriers to decrease the risk of catastrophic failures (Plummer et al., 2010). As a part of a multi-barrier approach, operators play a vital role in maintaining health in their community and must be adequately trained and supported in order to ensure that they are providing their community with safe drinking water.

Another reason to focus on water operators is that many water operators have direct communication with AANDC, contractors, and engineering firms. This puts operators in a position to advocate for their community's water system from a place of technical understanding and have input on water treatment system design.

Finally, operators are the face of the water system in their community. Water operators are in a good position to be educators about their water system and a trusted information source for community members about their drinking water. The relationship between water operators and the rest of their community is important to explore as community support for water operators is crucial in ensuring drinking water access. The following quote illustrates the importance of operators, and those who support them, in ensuring drinking water safety in communities.

Safe systems are built on the dedication of operators, the support they get from system managers and owners, the professionalism and integrity of consultants and contractors, and understanding by everyone – from builders and designers through to the final consumers – of what is needed to make and keep water safe. (Swain et al., 2006, p. 60)

1.4 Thesis overview

Ensuring that a community has access to an adequate supply of safe drinking water is crucial to improving and maintaining community health. In order to achieve safe drinking water access, water treatment system design must be appropriate for a community's water needs and the treated water must be trusted and accepted by the community. Determining what is an appropriate design for a community involves an understanding of community needs and engagement with the community in order to design within the community's capacity to operate and maintain. The focus of this thesis is on the role that water operators have in ensuring safe drinking water access in First Nations communities in British Columbia both through the design, operation, maintenance and management of treatment systems, and through providing education to community members about their water quality and the importance of water treatment.

The specific objectives of this thesis are as follows:

1. Work with community members in three partner communities to identify drinking water concerns and understand how drinking water is perceived in communities.
2. Identify resources and support that operators require and highlight any gaps that are found to be preventing operators from succeeding in their work or threatening water operator retention in First Nations.
3. Explore the role that water operators have to play in building awareness about community water issues and making water a community priority. Identify best practices and barriers for operators working to build water awareness in communities.

In order to achieve these objectives, the outline of this thesis is as follows:

- Chapter 2 will discuss the research methods employed in this work and will explore some of the challenges and lessons learned from this work.
- Chapter 3 will focus on the connections between water and health and community member's perceptions of water quality, especially risk perception. These are important considerations for water treatment system design and operation because unless community members perceive their tap water to be safe, they will likely not choose to drink it, which undermines the investment in water treatment in the first place.
- Chapter 4 will look at the valuable role that water operators play in ensuring appropriate design, management, and operation and maintenance of water treatment systems. Water operator training will be considered in order to better understand how to ensure training is accessible and relevant to operators. Factors that influence water operator recruitment and retention will be discussed, as operator recruitment and retention is crucial to ensure long-term water access in communities. Finally, the role that water operators have to play in design and management of treatment systems will be considered in order to identify areas where operators could provide valuable contributions to improve design and management of water treatment systems.

- Chapter 5 will consider the important role that water operators have within their communities, especially the importance of operators building trusting relationships with community members and engaging with community members about their drinking water. This is important for building trust in drinking water, and also for making drinking water a community priority and building an understanding of the importance of safe drinking water for community health.
- Finally, Chapter 6 will conclude with highlighting key findings and recommendations from participants as well as some directions for future research in this field.

Chapter 2. Methods

2.1 Introduction

There were two main components to this research: (1) community engagement activities with three partner First Nations and (2) interviews with First Nations water operators from throughout the province of British Columbia. The community engagement portion of this work started in 2012 and has been ongoing since then. From this community engagement work, it was found that water operators were key individuals to work with in order to ensure safe drinking water access in communities. After identifying the importance of working with water operators, water operators from communities throughout British Columbia were interviewed in order to better understand the perspectives of water operators and issues that they are facing in their work.

The following sections will describe the methods used in this work, as well as some of the limitations, challenges encountered, and lessons learned.

2.2 Community partnerships & engagement activities

Three communities were partners in this project. These three community partners were selected based on the fact that they are at differing levels of water access and each facing unique challenges related to drinking water in their community. The three communities are different sizes, and two of the community partners are comprised of a number of smaller communities that

have multiple water treatment systems. Within these communities, there are both surface and ground water sources. There is also a significant range of treatment systems, ranging from no water treatment to communities that have slow sand filtration plants. In addition, these communities have differing numbers of water operators who had received varying levels of training.

Having community partners at different stages of water access allowed researchers to build an understanding of different challenges faced by each and also factors that contributed to communities achieving safe drinking water access. Initial contact with these communities was made at conferences as well as through introductions by AANDC. Following this, memorandums of understanding (MOU's) were prepared based on ongoing conversations with researchers and communities.

2.2.1 Boothroyd Indian Band

Boothroyd Indian Band is a small community of approximately 40 households located in the Fraser Canyon approximately 200 km from Vancouver along the TransCanada Highway. They have a ground water source with no water treatment.

On October 25th, 2012 research assistants and a community-based researcher visited Boothroyd to meet with community members and have people respond to a questionnaire about their water. The majority of questionnaires were completed in an interview style though a few participants opted to fill out the survey themselves. There were some questionnaires left with the community-based

researcher to be completed by community members who were not at home during the visit. During a second visit to Boothroyd on March 22nd, 2013, there were some additional questionnaires filled out by community members. A total of 14 questionnaires were completed. 12 community members participated, along with two people who were involved in the operation of Boothroyd's water system. In addition to these questionnaires, two structured talking circles were conducted in Boothroyd on March 22, 2013 involving 10 community members.

2.2.2 Lytton First Nation

Lytton First Nation is also located in the Fraser Canyon. Lytton is approximately 250 km from Vancouver, BC along the TransCanada Highway. This is a large community in both land area and population, but the population is very dispersed. This creates a number of challenges for water treatment. Lytton First Nation has 9 water systems that are operated by the band in addition to some private systems. These systems have a combination of surface water and ground water sources.

The research team consisting of the principal investigator and research assistants went with one of Lytton's water operators to visit some community members in their homes on October 29th, 2012. During these visits, community members were interviewed and asked the survey questions. In addition, band office employees were also interviewed during this visit.

A second community visit occurred on April 25th, 2013. For this visit a community day was organized and the graduate research assistants were available to distribute questionnaires and

assist community members in completing the forms at a central location within the community. Community members came to talk with researchers at various times throughout the day and complete a questionnaire. A talking circle was also held mid-way through the day with around ten participants; however, as the structure of the event was flexible some people came and went during the talking circle. A total of 61 questionnaires were completed in Lytton in addition to 2 detailed water operator questionnaires.

2.2.3 Tl'azt'en Nation

The third partner community is Tl'azt'en Nation. Tl'azt'en is located near Fort St. James, BC. Tl'azt'en Nation is comprised of three smaller communities that are geographically separated. One of these three communities, Middle River, is very remote and is currently without water treatment. Although there are water related challenges in the other two communities, Tache and Binche, this project's main focus is on Middle River as bottled water is currently being trucked into this community to provide the residents with drinking water.

Between June 3rd and 5th 2013 researchers visited Tl'azt'en Nation. In each of Tl'azt'en's three communities, researchers were located at a central location within the community and community members came to watch a presentation, fill out questionnaires and participate in a talking circle. The majority of questionnaires were self-completed though some community members chose to participate in an interview. Additional questionnaires were left for the community-based researcher to distribute to community members. In addition to the questionnaires, in each of Tl'azt'en's three communities, a talking circle was conducted to allow for deeper discussions

about each community's water. A total of 7 questionnaires were completed by residents of Middle River, 8 questionnaires were completed in Tache, and 6 questionnaires were completed in Binche.

2.2.4 Knowledge transfer events

Community partners were invited to participate in community workshops at UBC in November 2013 as well as in November 2014. These workshops allowed for sharing back of findings with key community partners and a discussion of how to best share findings with the wider community. These community workshops provided an opportunity for sharing among community partners and a space for partners to provide feedback on the project. This feedback was valuable for shaping subsequent work in communities and setting metrics for what success would look like in each of the three communities for this project.

These two workshops were held in conjunction with the Peter Wall Solutions Initiative's annual events. As the funding for this work was provided by the Peter Wall Institute for Advanced Studies, community partners were invited to share their experience as project partners and learn more about other projects funded by the Peter Wall Solutions Initiative.

2.3 Data collection, data analysis, and sharing back results

2.3.1 Community engagement

When engaging with communities in this research, data was collected through questionnaires and talking circles. Copies of the questionnaire and talking circle (focus group) guide are included in Appendix A. Some questionnaires were filled out by participants and others were filled out by researchers in an interview style. Interviews were favoured as this allowed researchers to connect with community members and resulted in more in-depth responses. However, due to time restraints, researchers were not able to interview all participants directly. Additionally, some participants felt more comfortable filling out the questionnaire themselves and chose this option over an interview. Participants included Elders, water operators, band council members, and band members.

Community members were asked about the cultural importance of water, the links between water and health, and finally, about their perceptions of their drinking water and their community's water needs. It was found in this work that the majority of people interviewed in younger generations expressed that they felt disconnected from their cultural connection to water. Much of the information about the relationship between water and culture was from Elders who participated in interviews.

This engagement process allowed researchers to better understand how to involve community members during the design of water treatment solutions as well as the importance of keeping

people informed of water treatment plans as they develop. There is generally little to no consultation with community members prior to water treatment system design and so it was important for researchers to learn how to best engage with community members about their water and to learn how people wanted to participate in this process.

2.3.2 Water operator interviews

In addition to community engagement activities in the three partner communities, this work also involved interviews with water operators from throughout British Columbia. Semi structured interviews were the main form of data collection with water operators. Interview questions were formulated through preliminary conversations with water operators in the three partner communities as well as through presentations by water operators at the 2013 AANDC Water and Wastewater Operator Conference, held in October 2013 in Vancouver BC. The interview guide used is included in Appendix B.

A random sampling of communities was initially used to begin to approach operators to participate. However, this random selection only resulted in one operator participating in a phone interview. It was found that “cold calling” communities was a challenge as there was found to be a sense of wariness from communities when being approached about research. Water operators were hesitant about participating and were not responsive when asked to participate in phone interviews. Additionally, it was difficult to contact operators directly as they were often out in the field. In addition, after having one phone interview, it was determined that face-to-face interviews would be a better method of interviewing as this helped to build trust between the participants and

the researcher resulting in more in-depth responses. For these reasons, the majority of interviews for this part of the work were with First Nations Operators who attended the 2014 BC Water and Waste Association (BCWWA) Annual Conference in Whistler, BC. Operators volunteered to participate in an interview while attending this conference.

In total 18 interviews were performed with water operators. The range of operator experience varied as well as their level of training as can be seen in Tables 2.1 and 2.2. Three of the operators who were interviewed were in a management position in their band. Geographically, there was representation from nearly all regions of British Columbia; however, due to the fact that travel can be challenging and costly, as well as the fact that the majority of interviews were performed in Whistler, most participants were from the southern part of the province as can be seen in Table 2.3. The map that was used to define these regions can be found in Appendix C.

Table 2.1 Experience level of water operator interview participants

| Years of experience as a water operator | Less than 5 years | 5 – 10 years | 10 – 15 years | More than 15 years | Unknown |
|--|--------------------------|---------------------|----------------------|---------------------------|----------------|
| Number of participants | 5 | 1 | 7 | 4 | 1 |

Table 2.2 Level of training achieved by water operator interview participants

| Highest level of training completed | Small water systems course | Level 1 | Level 3 | Diploma | Certified (level not specified) | Unknown |
|--|-----------------------------------|----------------|----------------|----------------|--|----------------|
| Number of participants | 5 | 4 | 3 | 3 * | 2 | 1 |

* Two participants were enrolled in the diploma program but at the time of their interview had not yet graduated

Table 2.3 Geographic distribution of water operator interview participants

| Region | Northern British Columbia | Cariboo Chilcotin Coast | The Islands | Vancouver Coast and Mountains | Thompson Okanagan | BC Rockies |
|-----------------------------------|--|--|------------------------|--|------------------------------|-----------------------|
| Number of participants | 3 | 1 | 2 | 5 | 7 | 0 |

2.3.3 Data analysis

Community questionnaire data was inputted and analyzed using Microsoft Excel. The talking circles were recorded and transcribed, and then a thematic analysis was performed using QSR NVivo 10. This analysis was used to identify key issues facing individual communities as well as a comparison between the three partner communities to identify common themes and factors that have contributed to the varying levels of water access that exist in the different communities. However, it must be stressed that the goal of this work was not to make any generalizations about issues facing First Nations communities across the province. Although there were some common themes seen across communities, it was clear that each community is facing unique issues related to their water access. This shows the importance of investing time in community engagement to ensure proper diagnosis of issues and to find community appropriate solutions when working with any one community.

All water operator interviews were audiotaped, transcribed, and a thematic analysis was performed using QSR NVivo 10. The first stage of data analysis involved line-by-line coding to identify emerging themes followed by a secondary stage of analysis which involved grouping codes to identify the larger key themes. (Bernard & Ryan, 2010; Saldana, 2009)

2.3.4 Sharing back information with participants

A report detailing the results of community questionnaires and talking circles was sent to community partners for their feedback and review. Community partners from all three communities attended a workshop in November 2013 where results were shared. In addition, researchers attended community events in Lytton First Nation (April 2014) and Tl'azt'en Nation (August 2014) to present results to community members.

Results from interviews with water operators were presented at the 7th Annual BC First Nation Water and Wastewater Operational Excellence Conference hosted by AANDC in Vancouver, BC in October 2014. All operators who attended this conference were given a handout highlighting results of this work. This handout is included in Appendix E.

2.4 Limitations of water operator engagement work

There are some limitations to the water operator engagement portion of this work that are important to discuss. Firstly, it is recognized that an inherent bias in this work resulted from the fact that a majority of operators interviewed were motivated to attend the BCWWA Annual Conference. These operators applied and were selected and sponsored by AANDC to attend this conference. This is likely to lead to a bias towards operators who are interested and passionate about their work as they were motivated to apply and attend the conference. This is also likely to result in a bias towards operators who already have a good working relationship with AANDC or to those who receive support from their community leadership to attend training and conferences.

In addition, as the BCWWA Annual Conference was located in Whistler, the majority of operators who attended the conference were from the southern part of the province. As a result of this, there may be additional challenges that are facing operators in more remote northern communities that are not included in this work. However, while these biases do exist, interviews with operators revealed systemic challenges that are facing operators and identified many factors that contribute to both challenges and successes in operators work.

Another limitation of this work is that due to resource constraints, it was not possible to travel to communities to interview additional operators in their place of work. Although seeing firsthand the systems that water operators are working with would have added an interesting dimension to this work, this was simply not possible due to the cost and time that would be required for this type of study. As well, because this research was limited to operators who are willing to travel away from their communities, it is recognized that this study does not allow for investigation into reasons why some operators are either not able to leave, or choose not to leave, their communities.

Finally, although part of this work involved conversations with some professional engineers, AANDC employees, and people in community leadership positions, these interviews did not form the core part of this work. As the focus of this work was on water operators, many of these conversations revolved around the relationship of these individuals to water operators and the support that they provide. Due to time constraints it was not feasible to explore this further in this work; however, a better understanding of how water operators are perceived by community leadership and how community water issues are prioritized have been identified as important areas for future work.

2.5 Building community relationships and honouring ethics of Aboriginal research

If researchers and those researched have vastly different notions of what constitutes social benefit and how it is achieved, the research is unlikely to satisfy the needs and expectations of participants on both sides of the divide. (Brant Castellano, 2004, p. 103)

Building trusting relationships between researchers and community members is key to understanding actual community needs and identifying how researchers can best contribute to addressing these. In the community engagement portion of this work it was found that there was mistrust from some community members about the intentions of researchers, especially during initial visits. This mistrust was fueled by both the fact that researchers were outsiders to the community and also due to negative associations with research in general. These negative associations stem from a history of research in First Nations communities that has been neither respectful nor beneficial to communities (Brant Castellano, 2004; Schnarch, 2004).

There has been a movement towards ethical research in First Nations that is community driven and meets community identified needs. However, challenges remain that are preventing research from being truly participatory and community based. Even if researchers engage with communities about how they can best contribute to their needs, as illustrated in the following quote, there may be underlying motivations or fears that may lead communities to pursue participation in research even if the research is not a priority.

The research is often funded by governments that control resources on which the community depends. Rightly or wrongly, many Aboriginal Peoples fear that refusing to consent to research may result in loss of funding for essential needs. They are at a disadvantage in negotiating conditions that would alter the imbalance in power between researchers and the community and give adequate recognition to community priorities and approaches to knowledge creation. (Brant Castellano, 2004, p. 105)

There is also pressure on researchers to meet expectations and timelines that are separate from the needs of communities that they may be working with. As stated by Schnrach (2004) “There are significant pressures on researchers to complete their projects in a timely manner, publish extensively and for students to complete their theses and get their degrees before debt overwhelms them.” (Schnarch, 2004, p. 84). Research funding is another key component in this power dynamic as researchers may be required to meet expectations set forth from their funding organization which may or may not be in line with community needs.

To begin to address concerns about research in First Nations, in 1998 the National Steering Committee of the First Nations Regional Longitudinal Health Survey determined four important research principles to be adhered to in order to ensure that research is not only meeting the needs of First Nations, but that First Nations have total control over their information and research. These are the principles of ownership, control, access and possession (OCAP) (Schnarch, 2004). These principles are crucial to building trusting research partnerships and conducting ethical community based research. However, as Schnarch (2004) discusses, adhering to these principles requires a shift in thinking from traditional research methods and requires researchers to give up

power. In order to move towards research that truly benefits communities, researchers must be continually thinking about the power imbalances that exist in research partnerships and how this can be shifted to empower communities and positively contribute to community goals.

In this project, OCAP principles were honoured by returning all original data to communities. Prior to talking with community members, community leadership was consulted and MOUs were signed to ensure that all information shared would remain in the community and that they would have control over this. There were discussions with communities to determine whether or not this project met their needs and researchers were up-front with what they could offer in order to identify how this project could address needs that exist within communities. When speaking with community members, it was stressed that their input was being used to come up with designs that would meet their needs and that this project was working towards tangible outcomes, in this case water treatment solutions. It is important to note that this was possible in this work largely due to the funding provided by the Peter Wall Solutions Initiative. This initiative is working to challenge some of the issues with traditional research structures by focusing on projects with short timelines, strong community partnerships, and tangible outcomes. This type of funding allowed for more freedom in this work and ultimately for the focus of the work to be fully on communities.

2.6 Challenges experienced and lessons learned from community engagement work

During the course of the community engagement work with the project, many of the challenges experienced were related to the fact that researchers were outsiders and strangers to the communities they were working with. This resulted in a need to invest in building trust with community members and required patience as relationship building took time. Early on in this work, some community events were hosted that were not well attended which led researchers to wonder whether or not a lack of attendance was an indication that this project was not actually meeting the needs of community partners or if there had not been enough time invested in building relationships with community members. However, meeting with people individually, especially when researchers visited their homes, resulted in better connections with community members. It was found that when other community members facilitated introductions between residents and researchers, people were more trusting and open to participating in an interview. As well, hosting meals in the community was found to be a good way to start relationship building with community members.

Another issue identified in this work was that the turnover of students and other professionals in academia is a potential hindrance to successful relationship building as many researchers do not stay in academia long-term. In this project it was found to be important that the Principal Investigator be involved in community events as well as staff that will be involved in the project long-term. It was important to communicate timelines with communities and be clear about the role of different researchers while maintaining as much consistency as possible with the researchers who were in contact with communities. When there is turnover, introducing new

researchers to communities and ensuring there is some transition time where out-going and in-coming researchers can work together is important to reduce risks to community relationships.

As resources for travel is a limiting factor, not being in close proximity to the community was a barrier in relationship building. If a researcher were to live in a community for the duration of research, much stronger relationships could be built with community members. An alternative approach would be for researchers to focus on building strong partnerships with a small number of community members to support them to do research in their community. Based on the experience that researchers had with this work, it is felt that the latter approach would not only result in a more in depth information but is also likely to aid in building a culture of dialogue and community involvement around water issues which would have long term benefit for the community.

Communicating information back with community members was an important part of this work, but was found to be one of the more difficult parts of the engagement process. In some communities the challenges encountered with this were due to the fact that communities were large and many people did not attend community engagement events. A lesson learned from this was that in future work an ongoing engagement strategy should be determined in advance in order to keep in contact with community members. This was not done in this work, but it would have been beneficial to have regular communication with a Councilor in order to have them give regular project updates at Chief and Council meetings. In terms of communication with community members, if a community has a newsletter, it would be beneficial to write small updates to be included in this.

It was found to be very valuable to have community based research partners who were working on this project. When first approaching communities, community contacts were employed by the band or in an elected leadership position. This connection with band leadership was important in ensuring that this project was meeting community needs and that researchers were approaching communities through appropriate channels. However, for people who already had full-time work with the band, it was felt that this project was a potential burden for these people with already heavy workloads. A lesson learned from this, is that while it is important to engage with the band leadership in the early stages of research, it would be very beneficial to employ a community member to focus on this work from within the community who would not have other duties and hence, is able to focus on the project. In this process it would be valuable to have community leadership assist in identifying someone who would be able to take on a leading role for research within the community. There would also be value in employing a youth intern in order to engage youth in this work and start a dialogue with the younger generation about water in their community.

When working with communities, especially when talking with Elders, there was a level of awkwardness felt by researchers when addressing the consent form and asking for a signature. This process felt very impersonal and made the interview feel very formal in stark contrast to the informal environment of performing interviews in the homes of Elders. Concerns raised by student researchers surrounding written consent are documented in the work of Davison, Brown, & Moffitt (2006). Some of the issues raised around obtaining written consent were related to the fact that Aboriginal communities have a long oral tradition and that researchers encountered the

opinion that written consent was not necessary. It was also expressed by researchers that “the use of a signature and the idea of signing a document are parallel to the signing of treaties between Aboriginal and non-Aboriginal people in earlier times. There might be a mistrust of forms that are used by “Western” people” (Davison et al., 2006, p. 6).

These comments are not meant to undermine the importance of informed consent in the interview process, as ensuring that all participants understand the potential implications and having their full consent is crucial to building trust with community members. However, in terms of communicating and obtaining consent, oral consent may be a more culturally appropriate way to address the consent process and create a space that allows a better connection to be built between interviewers and community members.

There are also challenges with the ethics review process as a whole. When looking at the ethics review process in Aboriginal research, Patterson et al. state that “work in the community involves a constant learning/and changing process that is oral in nature, flexible and open-ended” (Patterson, Jackson, & Edwards, 2006, p. 49). Patterson et al. highlight a number of challenges that exist when working to balance the expectations of academic ethical review procedures with the realities of collaborative work that allow for the inclusion of community opinions in a respectful way. As identified by Glass and Kaufert, “Participatory projects develop through stages, and do not fit neatly into the standard REC² review model of defining study elements before a project is reviewed and approved” (Glass & Kaufert, 2007, p. 29). This was experienced in this work as relationships were built with communities and it was found that in each

² As stated by Glass and Kaufert: “In the U. S., the institutional level research review body is an REC: Institutional Review Board. In Canada, it is an REB: Research Ethics Board. We use the term REC to mean both” (Glass & Kaufert, 2007, p. 25).

community unique approaches were suggested for community engagement and new findings required amendments to be made to the original ethics application. In this project, it would have been beneficial if the team had had more engagement with community partners prior to submitting an ethics review and hired community based researchers to assist in the design the community engagement process earlier on in this work. This would likely have resulted in a greater number of participants in this work and may have also allowed for a deeper level of engagement and involvement of community members in this project. This may also have allowed for more opportunities to connect this work with existing community gatherings and through this give more regular updates to community members about this project. These are important considerations for future work and also more broadly for formulating best practices for relationship building and moving towards respectful community based engagement processes.

Chapter 3. Community perspectives on health and drinking water

3.1 Introduction

“I have been living on the reserve my whole life I am interested in this meeting to keep our water clean, because there are grandchildren we have to look after”

Talking circle participant, Tache, June 2013

Ensuring that communities have access to safe drinking water both now and for future generations is the ultimate goal of this work. However, in order to achieve this, it must be understood that there are different perspectives both on health as well as what constitutes safe drinking water. Understanding how people perceive their drinking water quality and what factors affect people's trust in their water is important in order to start a dialogue about drinking water and health in a community. In conversations with community members about drinking water, the concerns of all participants are linked back to concerns for their community's health and the health of future generations. Understanding and placing community health at the centre of the design process is necessary in order to understand and design water treatment solutions that will address community needs.

This chapter focuses on the results of community questionnaires and talking circles with the three project partner communities. This chapter will look at the links between water and health in communities from a holistic health perspective. Additionally, this chapter will consider how people perceive water quality and consider some factors that contribute to people believing their water is safe. This chapter is meant to provide context for drinking water issues in communities and give background information as to why operators were identified as important individuals to connect with and support within communities. It is crucial to build a better understanding of factors that affect drinking water access in communities as these factors may influence the effectiveness of a proposed drinking water treatment solution. Furthermore, it is important to emphasize that each community is unique in the challenges they may be facing and investing time in community engagement and relationship building with community members, leaders, and water operators is important to ensure appropriate solutions are designed and implemented.

3.2 Improving and maintaining community health through safe drinking water

As the ultimate goal of this work is to improve the health of communities through access to safe drinking water, it is crucial to recognize that community health encompasses more than just physical health for community members. When considering the impacts of water issues on First Nations a holistic view of health must be adopted. This holistic view must take into account the mental, spiritual, emotional and physical health of community members (First Nations Health Authority, 2013). In addition, as noted in the Report by the Royal Commission on Aboriginal Peoples, from an Aboriginal perspective “the essence of good health is balance and harmony

within the self and within the social and natural environments we inhabit” (Canada. Royal Commission on Aboriginal Peoples, 1996).

3.2.1 Physical health impacts

When talking to community members about their water, community members expressed a high level of concern for the physical health and the health of others, especially Elders and children who are more susceptible to waterborne illness. As included in Appendix D, community members showed a high level of concern for their health and expressed how the consumption of water influences this.

The most common causes of waterborne illness are microbiological in the form of viruses, bacteria, or protozoa. This results in gastro-intestinal illness that in severe cases can lead to death. There are also potential risks to water from chemical contamination; however, as opposed to outbreak events caused by microbiological contaminants, health risks from chemical sources are more likely to be cumulative and chronic (S. E. Hrudey & Hrudey, 2004; S. Hrudey, 2009).

One challenge with the physical impacts of drinking poor quality water is that, over the long term, people may not realize that they have been experiencing health issues from their drinking water. People may also develop some resistance to pathogens resulting in lessened impacts on their health (Raina et al., 1999). This can lead to underreporting of the health complaints related to water (Moffatt & Struck, 2011). It is also possible that people may attribute health complaints to other things or become accustomed to their health issues. Because of this, some people may not

realize that their drinking water was the source of their health issues until they started drinking safe water and feel better. This was seen in this work as shown by the following quote which describes how one family's health improved after they started drinking treated water. Prior to this switch, they did not attribute their health issues to their drinking water.

“after two weeks of not drinking it straight from the creek, they had less GI problems. They didn't feel bloated, they didn't have to go to the bathroom as often, and they're health kind of came up, just within a matter of three weeks”

Talking circle participant, Lytton, April 2013

3.2.2 Emotional and mental health impacts

There are also a number of mental health impacts that can be experienced by community members related to their water. In this work, it was seen that in communities that have had boil water advisories or where there is awareness of poor water quality, people expressed feeling nervous about the fact that their water could make them sick. This was also observed by the Polaris Institute in their work documenting cases of First Nations experiencing water crisis. “For many, water has become a source of fear, and people have good reason to believe that what comes out of their taps may be making them sick” (Polaris Institute, 2008, pg. 6).

In one of the partner communities, there has been a lack of safe drinking water for many years as a result of a broken down treatment system. In this particular community, participants expressed extreme frustration with the process and stated that they were tired of asking for help. In a case

such as this, where a community is concerned for their health but does not have the resources to build a new water treatment system, water becomes a source of stress and conflict.

“They told us back in 1997, within 10 years we’ll have the best water system you ever had, that’s what they told us, and today we’re still stuck with that. What I am saying is, who is going to be willing to help our people here to put a better system in place its hard to repeat yourself over and over again or complain about the same thing”

Talking circle participant, Middle River, June 2013

There was also the case seen where some members of a community did not want to have chlorination in their community and felt that this was being pushed on them by government agencies. Frustrations were expressed as the community did not feel that they were being heard or that their views were being respected with regard to chlorination. This again, creates a situation of stress and conflict around a community’s water and has the potential to negatively affect the mental and emotional health of community members.

It was seen that transparency in communication and decision-making are key to creating a respectful consultation process with community members. However, one issue that surfaced as part of this work is related to the consultation process and questions related to who ultimately has the final say in the decision making process. As there are numerous decision makers including those outside of communities, such as engineering firms and government, there needs to be engagement with all involved parties in order to bring communities into the design process. It is

important that there is clarity in the decision-making process and communities are consulted early on to ensure designs are appropriate and in line with expressed community needs.

3.2.3 Spiritual health and the cultural importance of water

“We ourselves are mostly made of water. Water is our life blood, if we do not have fresh, clean, pure water - we are diseased ourselves.”

Talking circle participant, Lytton, April 2013

When asked about the cultural importance of water, community members spoke about the grounding, cleansing, and healing power of water. The importance of water in ceremonies such as sweats and puberty rights was discussed as well as the role of water in medicines. The important relationship between water and food was also mentioned, as water is crucial for growing food and cooking as well as for fishing and hunting. The following word cloud shows the words that people used when talking about the cultural importance and value of water in response to questions related to water and culture. The size of the words in Figure 3.1 corresponds to the frequency with which these words were mentioned by participants. This word cloud was created using the questionnaire responses to questions about water and culture from all three partner communities (n= 94).

Figure 3.1 Word cloud representing the cultural importance of water



Source: Figure created using NVivo

Some of the most strongly represented words in the above figure - food, hunting, and fishing - illustrate that water is directly connected with many important aspects of spiritual health including traditional food and medicines. The importance of traditional food and medicines for health is discussed by Wilson (2003). It is not only the consumption of these foods and medicines that is important, but also the act of participating in traditional practices that can be viewed as a medicine in and of itself. Richmond & Ross (2009) identified environmental/cultural connection as one of

six determinants of health in First Nation and Inuit communities. This connection shows the importance of protecting watersheds and ensuring environmental health as community members health is seen to be directly related to them being able to spend time in their traditional territory. The importance of these activities was emphasized by participants in this research who talked about the importance of traditional activities such as hunting and fishing, and the growing and gathering of traditional food and medicines. Water plays a crucial role in ensuring that these foods and medicines are healthy.

“Water is all life. We hold life sacred.”

Talking circle participant, Lytton, April 2013

Community members who participated in this work also spoke about the deep connection that they had with water and the sacredness of water. This connection to water and the view that water is sacred is emphasized in the Indigenous Peoples’ Water Declaration made in Kyoto Japan in 2003 as follows: “We recognize, honor and respect water as sacred and sustains all life. Our traditional knowledge, laws and ways of life teach us to be responsible in caring for this sacred gift that connects all life” (UNESCO, 2006, p. 112). Sanderson (2008) found many commonly held beliefs about the sacredness of water and the role of water in indigenous cultures as a medicine in her work with Elders from three different indigenous traditions.

Furthermore, Blackstock (2001) spoke with Elders about the importance of water in First Nations and the role of water in creation stories and from these interviews observed that “Water is the element from which all else came, and it is therefore the primary substance within the

interconnected web of life; it is the centre of the web rather than being a component among equals” (Blackstock, 2001, p. 164).

Participants spoke of the importance of protecting water not only for human health, but also to ensure the health of the environment. Community members spoke about the journey that water takes from its source and the importance of protecting water quality throughout its journey, not just treating it for the purpose of human consumption. This view is in contrast to what could be considered the dominant Western perspective which views water as a commodity and seeks to place an economic value on water. A sentiment that was expressed repeatedly throughout this work was the intrinsic value of water and the interconnectedness between humans and the natural world. This value must be appreciated and understood in order to understand many of the conflicts surrounding water and resource development. As water plays a key role in spiritual health, this cannot be forgotten in conversations about potential risks to water and the need for water protection. The following quote illustrates the spiritual value of water and the importance of protecting water from a spiritual perspective.

Water is not only an aspect of Indigenous spirituality, but a very major component of that spiritual world. Water, whether as a substance, or in the form of water bodies (rivers, lakes) and meteorological phenomena (rain, snow, fog, clouds), is seen through a spiritual – not an economic – lens. Water is not viewed as a way of making money any more than children are seen as sources of revenue. Money can, of course, be derived from the labour of children, and from water projects, but this is not the dominant motivation for having children, or for protecting water. (UNESCO, 2006, p. 112)

3.3 Concerns about drinking water in each community

As shown in Table 3.1, when community members were asked about their drinking water and whether or not they had concerns about it, the results were found to be drastically different in each community as would be expected based on the different state of drinking water access in each area.

Table 3.1 Number of questionnaire respondents who expressed drinking water concerns

| Do you have any concerns about your drinking water? | | | |
|--|------------|-----------|-----------------------------|
| | Yes | No | Not sure/no response |
| Boothroyd (n=12) | 2 | 9 | 1 |
| | | | |
| Lytton (n=61) | 31 | 20 | 10 |
| | | | |
| Tache (n=8) | 2 | 6 | 0 |
| Binche (n=6) | 6 | 0 | 0 |
| Middle River (n=7) | 5 | 1 | 1 |

Follow-up discussions in the form of community talking circles were held with community members in order to better understand these concerns. In the case of Boothroyd, where there is currently no water treatment, community members expressed pride in the fact that their water was naturally of high quality and felt that chlorination was unnecessary in their water. As shown in Table 3.1, the majority of residents in Boothroyd had no concerns about their water. This was a very emotional issue for some community members as it was felt that they were being forced to chlorinate their water against their will. Two important issues were identified during the talking circles in Boothroyd. Firstly the fact that people placed a high value on having natural water and

felt that chlorine would make their water less natural and thus less healthy. Secondly, the process of decision-making had not adequately involved the community and the community was feeling cornered and powerless in this decision. This may have led to resistance from the community as it is possible that a component of this issue was in fact not related to chlorination, but a reaction to feeling a loss of control. This leads to important questions about the decision making process, especially in relation to chlorine. In the case where a community is opposed to chlorination, what level of consultation is adequate and who ultimately makes the decision about whether or not to chlorinate. This also leads to further questions about how information is shared and how people understand and perceive risks. These issues will be further explored in the following section in order to understand ways in which communities can best be engaged in decision making about their water.

An important note to make about Lytton is that due to the fact there are multiple water treatment systems in addition to private wells it is difficult to make any generalizations about opinions in the community. When talking to individuals in Lytton an important area of concern identified was the water quality in private wells. As per AANDC's policies, a minimum of five households is required to receive funding for a water treatment system. As Lytton's population is widely dispersed there are many areas where there are not five houses close enough together to feasibly have a central treatment system. Many of these private wells are untreated and residents have concerns about their water quality. One potential solution to these issues would be to consider point of use systems. This would require a change in funding policies to allow for the cost of these systems to be covered by AANDC. This would also require considerations into the management of these systems to ensure that they are managed and operated correctly.

Another concern identified in Lytton was for some areas where there was just chlorination and no additional treatment. One of these communities, Nickeyeah IR25, was of particular focus as this community has been on boil water advisory every spring due to increased turbidity during the freshet. It was found that residents in this area did not trust their tap water at any time due to the recurring boil water advisories each spring. These recurring advisories were found to break people's trust in their drinking water.

In Tl'azt'en Nation it was found that each of the three communities were facing very different issues. Tache has a slow sand filtration plant which in theory should be providing the community with safe drinking water. However, a couple of years ago there was an *E. coli* scare in the community and the community went on a boil water advisory. Community members did not know what had caused this or what had been done to address it. Without having this information, people were hesitant to resume drinking their water and similar to the case for residents of Nickeyeah in Lytton, had their trust in their water broken.

An additional issue in Tache is related to the chlorine and variation in chlorine levels. Some residents close to the treatment plant complained of high levels of chlorine, while residents furthest away could not detect chlorine and so did not know if their water was still safe at the end of the line. Operators in Tache are working to get funding to put in a booster station to even out the chlorine levels to remedy this. This highlights the importance of aesthetics in how people form perceptions of their drinking water, this also highlights the importance of consistency in water quality. If water quality is perceived to change over time or location people were found to be

distrustful of their tap water as these changes led people to wonder if it was being properly monitored.

In the community of Binche in Tl'azt'en Nation there has been an on-going boil water advisory for many years. People did not trust their tap water with all participants expressing they had concerns about their drinking water. However, Binche is the closest community to Fort St. James and many residents are accustomed to going into town to buy bottled water. For this reason, even though there is a high level of mistrust, residents of Binche did not express a sense of urgency about fixing the issues with their system. Also, residents in Binche expressed that they did not have information about their water quality as they did not receive any information from the band office about their water quality. This was attributed to the fact that Binche is geographically isolated and as a result also somewhat politically separate from the band office in Tache. It is important to note that Binche residents did not report attempting to seek out information from the band office about their water and so there were no issues identified related to the disclosure of information. However, this does show that unless there is an understanding of the importance of proactively sharing information with community members, communication breakdowns and a resulting lack of information shared with residents may further contribute to the public's mistrust of their water.

Finally, Middle River was seen to be facing the most severe issues of drinking water access as this community is remote and very small. This community is only accessible by logging road and has approximately ten households with a population that varies seasonally. There is currently no water treatment in Middle River and bottled water is being trucked into the community. Of considerable

concern to residents was the health of children who visit the community and do not know that they cannot drink the water. A pilot water treatment plant was built in the community about a decade ago, but this plant has been broken down for years. This has been a source of great frustration for Middle River's residents and many expressed that they felt their needs had been forgotten. Water has become a source of stress for Middle River's residents and these issues have furthered mistrust for AANDC and even for the band office in Tache for not prioritizing water needs in Middle River.

3.4 Community perspective of water treatment

When considering issues of drinking water access, the ultimate goal is to ensure access to achieve positive health outcomes for a community. Building community appropriate infrastructure and ensuring proper operation and maintenance is crucial in order to provide a community with safe drinking water. However, in order to realize goals related to community health outcomes, people need to believe their tap water is safe and choose to drink it. If people do not understand the value of safe drinking water, or if people have a different understanding of what constitutes safe drinking water, then they may for example, choose to consume untreated water or take on the unnecessary financial burden of paying for bottled water.

One important finding from talking with community members has been that, although there is certainly agreement with the goal of ensuring that communities have access to safe drinking water, different people have different understandings on what constitutes safe drinking water.

3.4.1 Desire for “natural water” and concerns about chlorination

When making decisions about whether or not drinking water is safe, the aesthetics of water were seen to be a key concern for community members. This is consistent with the findings by other researchers. The important role that taste and odour play for consumers is supported in the work of Jardine et al. who note that many consumers consider poor odour to be linked with health risks in their drinking water (Jardine, Gibson, & Hrudey, 1999). Additionally, in their work looking at public perceptions of drinking water in South Africa, Wright et al. found that “water clarity, odour, and taste were strongly associated with perceived drinking water safety” (Wright, Yang, Rivett, & Gundry, 2012, p.8). Similarly, in a study comparing perceptions of water quality between Portugal and the UK, it was found that water flavour was “the most relevant variable and more adequately explains consumption than perceived water quality” (Doria, Pidgeon, & Hunter, 2009, p. 5463). This shows the importance of understanding how consumers form opinions about water and engaging with consumers about how aesthetic parameters relate to drinking water safety. This also indicated the importance of addressing aesthetic concerns in drinking water treatment processes whenever possible.

Concerns about the aesthetics of water and related health concerns become more complex when related to chlorination. Although there were a variety of issues and opinions expressed in relation to chlorination, regardless of people’s opinions about whether or not their water should be chlorinated, the majority of participants in all three communities had reservations about the taste and smell of chlorine in their water.

“To me, I don’t like it, because I just don’t like the taste, that’s all.”

Talking circle participant, Lytton, April 2013

Another area of concern for people in communities where there was chlorination resulted from inconsistencies in the amount of chlorine that they could detect in their water. This is supported by the work of Dietrich (2006) in which it is noted that consumers value consistency, and drinking water is no exception to this. When speaking with community members in partner communities in this work, it was found that inconsistencies in drinking water aesthetics, especially chlorine levels, led people to question whether or not their water treatment system was operating properly and if it was being monitored. In these cases, some participants expressed some hesitancy about drinking their water because they did not know why the chlorine levels varied. There were also questions raised about whether or not there were standards for operators to follow in relation to the amount of chlorine that should be in the water and also if there were risks to the public if chlorine levels were too high.

“I don’t know, sometimes it’s too strong. But sometimes it is not. I am not sure exactly how they run that.”

Talking circle participant, Tache, June 2013

There are challenges with regulating chlorine levels in some small systems and so in order to maintain an appropriate chlorine level at the end of the line, a high dose of chlorine is used at the plant. This results in areas of a community closest to the water treatment plant receiving a high

dose of chlorine. Community members located close to the plant complained of very noticeable levels of chlorine in their water leading them to not drink their tap water.

“In my house it is still quite noticeable, when we turn it on and even if we do leave it out, there is this concentrated smell of chlorine. That is one of the reasons why we don’t drink it.”

Talking circle participant, Binche, June 2013

In extreme cases, people may be so opposed to chlorination that they may seek alternate sources of water. In some cases residents may choose to purchase bottled water, but in other situations this may mean that people are seeking out sources of untreated water. This was observed by Minnes, Vodden and their team (2014) who saw residents in communities in rural Newfoundland collecting water from roadside springs as it was perceived as being safer than tap water due to concerns about chlorine and distaste for tap water. This was also observed in British Columbia as a recent article in the Vancouver Sun reveals that there are residents in the lower mainland who seek out untreated spring water as they believe it to be healthier than tap water (Lee-Young & Robinson, 2015).

An important tension to understand is that some people believe that the focus should be on source water protection and that if this is done well, water treatment is not necessary. This view was expressed by some community members who believed that if water is monitored properly then it should not be necessary to treat their water.

“If the water supply is monitored properly, there should be no problems. This was neglected over here, that’s where the problem comes in”

Talking circle participant, Boothroyd, March 2013

Through conversations with community members it was found there was a perception held by several people that natural water equates to safe water. Community members shared that in the past people drank water right from the source and that it has only been in recent times that water has become contaminated. A challenge with this view in terms of water treatment is that for communities that perceive their source water as being pristine, there is the potential for strong opposition to water treatment, and specifically a resistance to using chlorine disinfection in the treatment process.

“Because right now, water is as good as it is going to get and with chlorine added to it, I think it will take away the natural flavour and make some people sick.”

Talking circle participant, Boothroyd, March 2013

This was also noted by Grover (2011) in relation to a community’s adherence to boil water advisories and acceptance of chlorination. Grover writes about a story shared by a health authority official in which “a community that considered their water supply a “fountain of youth”. When a BWA was issued on their water system, community members tore down the BWA signs. Such strong opinions and beliefs about drinking water supplies are common in rural communities in BC, where there are a large number of people who oppose chlorination, perceive their water as

pure and pristine and are defiantly trying to keep their drinking water supplier from being chemically disinfected” (Grover, 2011, p. 70 - 71).

Yim (2005) observed that there was a strong relationship between people’s sense of place and a resistance to chlorination in the town of Erikson, BC. As noted by Yim, “it was observed that for some residents the very idea of adding chlorine to their water almost seemed to set off a feeling of moral indignation” (Yim, 2005, p. 57). People were seen to feel a strong sense of “emotional, psychological, and cultural attachment to the community” (p. 57) and this attachment led people to feel that their community identity was threatened by the addition of chlorine to their water.

Similar observations were made in this work as some people expressed that their water was pristine and they did not see any need to chlorinate. Chlorination was an emotional issue for some community members and was seen to be related to a sense of pride about their water. In addition, this emotional response was related to some people feeling as though they were being forced into chlorination. Chlorination was found to be a very political issue within some communities. When speaking to community members in these communities, it was identified that people had a basic understanding of why chlorine is used, but they did not feel that their water required chlorination. People wanted proof that they needed to chlorinate.

“See, that was one of the biggest question from all our members: why do we need to chlorinate”

Talking circle participant, Boothroyd, March 2013

However, on the other hand, there were also community members interviewed that did not feel that any risk was acceptable. As indicated by the following quote, there was the opinion expressed by some that even if they did not like the taste of chlorine in the water, they felt more comfortable being able to taste chlorine because then they knew that their water was being treated. Again, this opinion was related to people's perception about their water quality and whether or not they were at risk from drinking their source water. People's understanding of the water treatment process was also seen to influence this as people who were more informed about why and how water is treated were more likely to accept chlorination. It was seen that water operators had an influential role in how people perceived the risk of drinking untreated water versus the perceived risks from chlorination.

"I'd rather have chlorinated water, knowing that something's been done about it, anyway, better than having no system"

Talking circle participant, Lytton, April 2013

Related to questions about chlorination are challenges with risk communication and questions of acceptable risk and liability. Some important questions that this work raised were regarding who should have the final say about chlorination in a community and who is ultimately liable if there were to be an outbreak of waterborne disease in a community that has decided not to chlorinate. Ultimately, when deciding whether or not to chlorinate when the consequences may be severe, how can risk be adequately communicated, what constitutes an informed decision and who is responsible for making a final decision? Currently regulations require chlorination as a method of disinfection for centralized treatment systems (Indian and Northern Affairs Canada, 2010). For

communities that are opposed to chlorination, if there is to be consideration of alternate treatment options, there needs to be investigation in the safety and management of alternate systems. An investigation into the feasibility, safety, and management of alternative treatment systems was outside of the scope of this work but has been identified as an important area for future work.

When speaking to community members about issues surrounding chlorination, there was seen to be a disconnect between the opinions of experts and community members. Similar challenges were observed in the work of Weterings and Van Eijndhoven (1989) who considered challenges in communicating risk to the public, especially when there is uncertainty associated with the risk. In their work, it was noted that “communication problems are due to the different ways in which authorities and residents interpret the results of the risk assessment” (Weterings & Van Eijndhoven, 1989, p. 482). Another example of this can be found in the work of Owen et al. (1999) who considered consumer complaints in an area where source water had been switched from a surface water to a harder groundwater source. There was no adequate engagement with consumers about this switch, which led to increased calls to the water company when people noticed a change in their water. However, the company was not prepared to answer questions from the public about the issues and when the public did not receive adequate answers to their questions they formed their own conclusions. In their paper Owen et al. note that “Experts tend to disseminate information in a technical way and as a one-way transfer of information from them to others. This, together with their use of technical terminologies and statements and the expert mental representations which they hold, makes it difficult for them to understand laypeople’s mental representations of water quality” (Owen, et al., 1999, p. 244).

This breakdown of understanding between experts and laypeople results in ineffective or nonexistent communication that contributes to mistrust of drinking water quality. This is important when considering how to approach issues such as whether or not to chlorinate, as bringing in experts to talk to communities may cause further mistrust depending on how the message is shared and whether or not the expert is willing to listen and engage with a community about their concerns. One suggestion that was made by Weterings and Van Eijndhoven was the creation of community focus groups in order “to find out more about the needs, demands, and values of the community, and about how people are likely to respond to certain messages” (Weterings & Van Eijndhoven, 1989, p. 482).

There are also some intangible components to risk perception that are more difficult to understand and account for. Slovic and Peters (2006) explored the role that intuition and feelings play in risk perception. They acknowledged that although there is an analytical side to risk perception, many people rely heavily on their feelings related to risk. Slovic and Peters reference earlier studies relating to risk perception which found that “feelings of dread were the major determiner of public perception and acceptance of a risk” (Slovic & Peters, 2006, p. 322 - 323). These feelings, especially in relation to risks that are unfamiliar, may lead the public to have a perception of risk that is not in agreement to what experts assess a risk to be. This was seen in this work in relation to chlorination as some people felt that adding a chemical to their water was an unacceptable risk that they feared would negatively affect their health. Similarly, Yim (2005) found that the majority of residents of the town of Erickson, BC, a non-First Nations community, did not view microbial risks to be as severe as the risks of chlorination. Yim states that “most respondents’ viewed microbial contaminants as only moderately risky to drinking water and were quite tolerant

toward small amounts of microbial contaminants, even when presented in terms of 'disease-causing microorganism" (Yim, 2005, p. 48).

This is not to say that there are not risks that can come from human contact with certain chemicals, however, this does shed some light on how people perceive risks and how risks are balanced. In the case of chlorination, if people feel that chemicals pose a great risk to their water supply, and are not aware of microbiological risks or believe that microbiological risks are natural and thus less severe, people are likely to oppose chlorination as they feel that the risks are too great. Therefore, building an understanding about how people view and balance different types of risk is important in order to have a productive discussion about drinking water treatment and drinking water safety within communities.

3.4.2 Concerns about impacts of resource extraction

The pursuit of the "American dream," promising endless economic prosperity, still poses the greatest challenge to protecting the sustainability of North American water resources. In contrast, Native cultures are far less likely to risk such essential resources for the sake of profit and thus strike a different balance between conservation and economics. Since Native American natural resources define Native cultures, they are synonymous with cultural resources. To degrade one is to destroy the other. (Reynolds, 2003, p.145-146)

Concerns related to both water supply and water quality were raised in communities. Community members expressed high levels of concern for the environmental impacts of logging and mining

activities that had taken place in their territory and surrounding areas. Many people expressed the opinion that resource extraction has led to drinking water quality issues in communities.

“So you see how, logging affects us for years now, before that we’d just drink our water and it was nice and clean.”

Talking circle participant, Tache, June 2013

Community members expressed frustration over resource extraction and the fact that many First Nations are dealing with the negative impacts of resource extraction while others outside their communities are profiting. There were additional frustrations expressed about the inequality that exists between First Nations and non-Indigenous communities in Canada.

“They developed the resources so much that it is contaminated and the reserves are the ones who suffer because of where we are located.”

Talking circle participant, Boothroyd, March 2013

These concerns led to community members and water operators calling for more industry accountability as well as for more source water protection measures to be put into place. It was expressed by some community members that they did not feel there had been enough testing done to determine the effects of mining and logging. People had a very holistic approach when thinking about drinking water safety and did not feel that water treatment alone is enough. People wanted to see more of a watershed scale approach to water management that focused on long-term water

safety and sustainability for their community. Although looking at larger governance issues related to drinking water was outside of the scope of this work, this certainly has implications for drinking water in communities and was an issue that was raised in communities, especially in relation to source water protection.

“it is not just the water plant system, it’s the whole water system, where it is originating how it is impacting all the people”

Talking circle participant, Tache, June 2013

Some community members were calling for more water testing to be done and the results shared in order to hold industry accountable for their actions.

“We need independent testing from Health Canada on a regular basis and like they were just saying, the testing and the monitoring of the rivers and lake waters and making issues, making companies, industry, accountable for their actions, and taking the care to protect our water system, because we are downstream and we’re susceptible to everything that happens upstream from us and I’m from the other side of this lake myself and its all going in the air including the mercury and stuff, and we eat the fish and the salmon on regular basis, and that’s affecting us and the independent testing to me that’s important because as caretakers of our system, we could protect our systems”

Talking circle participant, Tache, June 2013

3.5 The importance of trust when communicating risk

When talking to community members about drinking water safety, it is important to understand that each individual will perceive and weigh risks differently. There are many complex factors that influence risk perception. These factors are related to the actual information that people receive about a risk, the way in which information is shared, and how the messenger is perceived within a community. Fessenden-Raden, Fitchen, and Heath (1987) stress in their work that risk communication is a process. Within this process, there needs to be consideration placed on not only the message and how it is communicated, but also on the recipient of the message. It is noted that “risk information may be misperceived or rejected if those who give information are unaware of the complex, interactive nature of risk communication and the various factors affecting the reception of the risk message” (Fessenden-Raden et al., 1987).

The work of Scherer and Cho (2003) considers the important role that social connections have to play in risk perception. Their study found that those with strong social networks tend to share similar risk perceptions as those in their network. This has implications in this work as perceptions of risk may be strongly held by entire communities. In the event that there is a risk to be communicated that is contrary to the community’s perceptions, it may be difficult to connect with the community about this issue especially if you are entering the community as an outsider.

Access to information is important for consumers to understand and assess drinking water quality and safety. However, it is not simply the access to information that is important, but how it is shared and perhaps most importantly, how the messenger is perceived. This perception and

interpretation is based on a number of factors including, but not limited to, trust in institutions, perceptions of credibility, perception of control over risk, personal experiences and existing knowledge, and cultural values (Dupont et al., 2014; Fessenden-Raden et al., 1987).

A very important consideration in risk communication and perception is the trust that people have in the person communicating risk and how credible they view this source of information (Trumbo & McComas, 2003). Hadden (1989) identifies challenges in relation to the sharing of information and how this relates to trust stating “information alone is not adequate; because of the inevitable gaps and uncertainties about how to evaluate risks, effective risk communication depends upon trust among all parties to the communication” (Hadden, 1989, p. 307).

Therefore, when communicating risk, it is important to understand that if there is no trust in the person who is sharing information about risk, it does not matter how many facts they share, they will still not be seen as a credible source of information. People’s trust in institutions is a key factor in risk perception (Dupont et al., 2014; Fessenden-Raden et al., 1987). This is of great relevance for First Nations as colonialism in Canada resulted in a high level of mistrust between Aboriginal people and the federal government. This mistrust was furthered by the creation of assimilative policies such as the Indian Act and the creation of the residential school system. Residential schools aimed to alienate children from their families and their culture in order to assimilate them into dominant society. The effects of residential school and the abuses that students suffered there are still being felt by communities today and have very much influenced how many Aboriginal Peoples view Canadian institutions (Michael D Blackstock, 2001; Kelm, 1998; Royal Commission on Aboriginal Peoples, 1996; Woons, 2008).

Trust in institutions was seen to be an issue in this work. A number of participants expressed a lack of trust with AANDC and frustrations with the decision making process and policies affecting water treatment decisions. This lack of trust was also related to a perceived lack of transparency as community members did not know how decisions were made and did not feel that they were included in the process.

Wildavsky and Dake further deconstruct the concept of trust in institutions by stating that “however conceptualized - whether as political ideology or cultural biases - worldviews best account for patterns of risk perceptions” (Wildavsky & Dake, 1990, p. 56). Their work argues that a person’s ideology and worldview dictates which institutions can be trusted and therefore forms the basis of how a person perceives risk. This has important implications for understanding how to communicate risks related to drinking water. Knowing that underlying conversations about risk are cultural values and ideologies, this requires a deeper level of conversation about risks and why people perceive risks the way they do. Again, providing people with more facts about risks will not aide in changing people’s perception of risk unless they trust the source of the information and perceive the source as credible.

Having a trusted source of information is important for communities to build an accurate perception of their water. As such, this work sought to determine who would be a trusted source of information for community members. From conversations with community residents, they were seen to be more trusting of their water if they knew who was taking care of the system and if they trusted that person. In addition, it was identified that water operators in partner communities were

long-time residents of the communities that they work in, and already have strong social ties and trusting relationships with community members. Based on this, it was hypothesized that water operators would be in a good position to share information related to drinking water risk with community members. This was a topic that was investigated in interviews with water operators and the results of this will be discussed further in Chapter 5.

3.6 Conclusion

When designing a water treatment solution for a community, it is important to engage with community members in order to understand how the community views the links between water and their health as well as how the community views water treatment. In this work it was seen that community members are interested in engaging about their community's drinking water. The primary concerns expressed by community members were related to health, both their health and the health of future generations.

From a western perspective, the links between water and health are generally just linked to physical health benefits of safe drinking water. However, from an Aboriginal health perspective, it was seen that a holistic view of health must be adopted. This holistic view encompasses mental, spiritual, and physical health as well as the interconnectedness between humans and the rest of the natural world. It was found that water is deeply tied to each of these aspects of health and must be considered when working to design a water treatment solution for a community. Furthermore, the process of decision-making about water was seen to impact the mental health of community members. In order to minimize stress that can be involved in the consultation process, it is crucial

to involve the community from the very beginning of the process to design a respectful and culturally appropriate community engagement strategy.

This work also highlighted the fact that different people understand and interpret risk differently. This results in different understandings of what constitutes “safe” drinking water. The aesthetics of drinking water are a key factor in how people perceive their water. This was seen to be especially significant when speaking with community members about chlorination, which was found to be a very important issue in communities.

Many factors were seen to influence risk perception. The information that community members receive about their water was seen to be important, but what is of greater importance is the trust that people have in the person sharing information with them. When working with communities and designing a water treatment system it is important to invest time in building trust with community members. However, as there was seen to be mistrust of people who were outside of communities, it was seen to be valuable to have community members sharing information and engaging with other community members. As will be discussed further in Chapter 5, water operators have been identified as important people to engage with their community about their water.

Chapter 4. Importance of water operators in ensuring appropriate design, operation, maintenance and management of water treatment systems

4.1 Introduction

“After Walkerton, everything was so much emphasized in certification. It was harder to attain your license because they put more kind of stringent guidelines. Training became more available though, that was really a big thing. They wanted more operators to take courses, like that pertained to their line of work, well, water treatment, there was just more emphasis on having the credentials to run your facility and knowing that you are competent in doing it.”

Water operator, interview participant, May 2014

After the *E. coli* outbreak in Walkerton in May 2000, there was a formal inquiry into the causes of the outbreak and recommendations made to address issues uncovered. One of the focuses of this inquiry was the operations staff in Walkerton. It was found that operators had not been following procedures for many years prior to the outbreak and were not trained to have properly identified risks that led to the outbreak occurring. Following the events in Walkerton, there were recommendations made to improve water operator training and ensure operators working at treatment plants are adequately trained (O’Connor, 2002a, 2002b).

A well-trained operator ensures that their water treatment system is being operated properly and is able to identify needs for maintenance and upgrades. However, training alone is not enough to ensure long-term treatment system operation and maintenance. In addition to making training programs accessible for water operators, there also needs to be consideration into factors that affect the ability of operators to perform required tasks, such as access to resources and receiving support. In addition, factors that affect water operator recruitment and retention, such as job satisfaction and motivation, are important to consider as these factors are important to ensure long-term safe drinking water access in communities.

In order to better understand these issues, this chapter will focus on the results from interviews with 18 First Nations water operators from throughout the province of British Columbia. Water operators experience with training will be discussed, as well as water operators job satisfaction and motivation. Support for water operators will be explored and gaps identified in support will be discussed. This chapter will also explore the role that operators have in the design of new systems and the management of existing systems with a focus on the relationships that water operators have with their community leadership.

4.2 Building capacity through water operator training

Ensuring the proper operation and maintenance of water treatment systems begins with having well-trained operators on staff. This section will describe the training currently offered to water operators in British Columbia and the feedback about their training that operators have shared.

4.2.1 Water operator training and certification

Training specific to First Nations water operators started with the Circuit Rider Training Program in the 1990's. This program involves having highly trained operators travel to communities to provide on-the-job training to other operators (AANDC, 2011; Le, 2012). As stated by AANDC:

the goals of the Circuit Rider Training Program include: supporting on-reserve water and wastewater system operators in developing and maintaining the capacity to manage their systems well; improving the maintenance, management and effectiveness of on-reserve drinking water and wastewater systems; reducing the number and duration of drinking water advisories (DWAs); and, helping First Nations communities to exploit the full service life of their water and wastewater infrastructure. (Aboriginal Affairs and Northern Development Canada, 2012, p. 5).

In the years since the inception of the Circuit Rider Training Program, there has been more emphasis on water operator certification and training courses. However, the Circuit Rider

Training Program remains an important source of one-on-one training for operators, especially because it provides training specific to an operators water treatment system.

Water operator certification is examined and overseen by the Environmental Operators Certification Program (EOCP) (EOCP, 2014). The training courses that water operators take prior to taking certification exams are offered by two main organizations in British Columbia. Firstly, the British Columbia Water and Wastewater Association (BCWWA) offers training courses to water and wastewater operators in British Columbia (BCWWA, n.d.). In addition, Maintenance Training Systems (MTS) is a training facility that offers training courses in partnership with AANDC specifically for First Nations water operators (MTS Maintenance Training Systems Inc., 2014).

Thompson Rivers University (TRU) in Kamloops offers training programs specifically for First Nations water operators. TRU developed the Water Treatment Technology Diploma Program which allows water operators to continue to work while they are attending classes. As stated in TRU's program brochure:

Thompson Rivers University's Water Treatment Technology Program endeavors to meet the requirements of operators in remote communities with their face to face training as well as a flexible distance delivery format which allows operators to remain in their community with minimal disruption to their personal lives and their occupations as a water system operator. (Thompson Rivers University, n.d.)

One other valuable source of training for operators comes from engineering firms and suppliers. This training is particularly valuable as the training is specific to the system and equipment that operators work on. However, depending on the system that is in a community, this type of training may or may not be available to operators. Generally, engineering firms provide training when a plant is commissioned, and so for older systems it is less likely that they will have direct training support from the designing engineering firm.

4.2.2 Operator experiences with training

Overall, operators reported having positive experience in their training. The primary source of training for operators was through MTS as almost every operator interviewed has attended training courses offered at this facility. MTS offers courses specifically for First Nations operators in partnership with AANDC. Operators valued these courses and some operators stated that they felt more comfortable taking classes with other First Nations operators. During the interview process, one operator spoke about how operators may have had negative experiences in school and that creating a comfortable learning environment for operators is very important. When speaking with operators, the majority of operators identified the value of hands on learning in their training. MTS's facility has a number of simulated water plant set-ups to allow for operators to apply what they are learning in their training. This training set-up was highly valued by operators.

“I think a lot more technical hands-on training is beneficial...a great facility is in Vernon at MTS. Where they have rooms like this all set up with pipes and actual running water. And you can actually go in there and manipulate things. Turn things on, turn things off.

Wash filters. It is amazing. And they even have a back hoe, and they even have man-holes out the back where you can go out there and dig if you are in a collection situation, where they train you how to install a coupling or a water break where they...that kind of training is priceless”

Water operator interview participant, May 2014

The majority of operators interviewed have worked with a circuit rider and had positive experiences to relate from working with their circuit riders. Water operators that have worked with circuit riders reported that circuit riders are not there to just do the work, but that they teach and train operators so that in the event that an issue comes up again, operators are able to deal with it on their own. There were also some cases where operators needed assistance or did not have the proper training to deal with an issue and so they called in their circuit rider for assistance. When speaking about the value of working with circuit riders, operators expressed that being able to receive training on their own system was really important and helpful for training.

“I am the type of learner where I would like to be shown how to do something and on my equipment. So when you go to a classroom it is not necessarily the same pump or something and things are just a little bit different, and again in a class, things are not like set up, turn the pump on and you know this happens, and then just process down, I guess the line, or whatever, you don’t see all that. So yeah, I would like to sort of be shown on my stuff and I would understand it a lot better.”

Water operator interview participant, May 2014

Five operators interviewed had experience with the TRU water operators diploma program. Three operators had completed this program, and two operators were currently enrolled. These operators had very positive feedback about the TRU program. Operators stated that they found the work to be demanding and challenging. This resulted in operators who completed the program feeling very accomplished and well equipped for their work. It was also found TRU graduates went on to act as mentors for other operators and encourage others to pursue further training. An important outcome from the TRU program was the relationships that operators built with others in their class. These operators report still being in close contact with their classmates and communicate with them when they have issues with their systems. The following quote is related to one operator's experience in the TRU program.

“Actually, the camaraderie that we developed was really helpful. Like I will be friends with every one of those people that I started with. And I am, I see half of them here every time I come here. That was a big thing, just having, knowing that we are all from the same background, we are all in the same boat. You know, you don't go to school and feel like you are looked down upon or anything, we are all the same. Not that it would have bothered me anyways in a regular university background or setting, but it made a difference for me a little bit, it made me more comfortable. But I could see, in other students, that it is huge for them. They would not be there in the first place if it wasn't just First Nations operators in that class. They wouldn't even bother coming. It would have been too hard, too stressful. They would not know how to associate or relate. It would be harder for them because they are so remote. They feel maybe, they should not be there, or I don't know. But I know it made me feel a little bit more comfortable so I know it hugely

made a difference for the more remote students and it was really huge for them. Making them feel comfortable is big.”

Water operator interview participant, May 2014

Training provided by engineering firms and suppliers was less common, but for those operators who received this type of training, they found it very helpful in familiarizing them with their equipment and the in-depth understanding helped them to troubleshoot issues and better maintain their system. Seven of the operators reporting have received support from an engineering firm. Training and operations support from engineering firms was more common during the design and first few years of operation for a treatment system, but some operators had ongoing relationships with the engineering firm that designed their system. In addition, there were a small number of operators who had received training from suppliers or manufacturers. These operators valued the fact that this training was specific to the exact equipment that they had in their plant.

“Well I went to MTS for fire hydrant maintenance, but it is a just a general overall, they talk about all the different hydrants. But I have just gone to the different brands of hydrants that we deal with, I just went to the manufactures directly and asked if they offer a training course, and they do so I have just gone there to get specific training on our systems hydrants.”

Water operator interview participant, May 2014

4.2.3 Training accessibility

“Because there is 3 of us here, it makes it easier for two of us to go and do our training and one of us will be staying here. He’ll look after the water while we are gone. So it is pretty much easy, and our accommodations and our funding that is paid, gets us there and gets us back so I think it is pretty good.”

Water operator interview participant, March 2014

When asked about barriers to accessing training, the majority of operators interviewed did not experience issues accessing training. Aboriginal Affairs reimburses operators for the cost of training courses and associated travel and accommodation costs. For this reason, operators described training as financially accessible. However, there were some cases where there will be issues with band covering upfront costs for operators to attend training. These issues were described as being related to personal issues with supervisors. However, it is important to acknowledge that although these findings indicate the training is accessible due to the financial support of AANDC, operators still need to be motivated to attend training. It has already been discussed that the operators who participated in this study were found to be motivated and had a good working relationship with AANDC. A limitation of these results is that they do not offer insights into the experience of operators who do not feel motivated to attend training or do not feel supported to attend by AANDC or their community leadership.

Travel and time away from communities were both found to be challenges for some operators as some operators were travelling a considerable distance to attend training. MTS has worked to

mitigate this by offering training at various locations around the province; however, even with this, some operators found that receiving the necessary training still required traveling. There were also some operators who did not like leaving their community and found that travel was a stress. As this was identified as an issue for some operators, it is acknowledged that there is the possibility that this could be preventing some operators from leaving their community altogether.

Finally, whether or not there is a back-up operator in a community is an important consideration when operators are leaving their community to attend training. In the event that there is no back-up operator, a water system may be unattended for the time that an operator is away or this may prevent an operator from leaving their community. Although the issue of back-up operators was not central to this work, through interviews with operators, some reasons for why communities do not have back-up operators were identified. In some cases there was no one in the community willing to attend training to learn how to operate the system. Another important issue identified was a resistance from the band to pay a back-up operator, or only to pay them part-time, so then back-up operators were leaving to find full-time work instead. This is an area that would benefit from additional research in the future.

4.2.4 Suggestions to improve training

One suggestion that operators made for improving training was to have more operators providing training. Operators felt it was very valuable to learn from an operator who could relate to their experience in the field.

“I guess to have a little bit more of an operator that trains, like I have seen a lot of engineers and supervisors, not too many operators really training. Like where they understand you and relate when you are talking to them.”

Water operator interview participant, May 2014

One operator who participated in an interview for this work was working to become a trainer himself. He really valued the education that he had received and saw the potential in sharing his experience with other operators.

“Very rewarding. It has opened up many opportunities for me, it provides things for me to be able to travel and go to things like this. And it provided me with an education where I can teach other people, which I am in the stages of doing. I am starting to do some teaching. So that is a big thing. It is not just going to work anymore, it is passing on your knowledge to other people and that is a huge step.”

Water operator, interview participant, May 2014

Another suggestion that was shared by operators was to hold training sessions in communities around the province. This would allow operators to share their experience and also to receive hands on training in a functioning water treatment facility. The following quote is from an operator speaking about the benefits of holding training in a treatment plant such as the one he is currently working in.

“we have all of the equipment there for actual hands on, and not just theoretical like reading books and stuff. We can, we got spare pipe that people can drill into, clamp on to, we can rig something up that can help the students get a nice hands on feeling for the studying.”

Water operator interview participant, May 2014

4.3 Sources of water operator motivation and job satisfaction

“Just knowing that our people are getting safe drinking water. And that is my main concern, is that they always have that good water.”

Water operator, interview participant, March 2014

In order to build an understanding of factors that contribute to water operator job satisfaction and motivation, operators were asked about what they enjoy most about their work and if they find their work rewarding. They were also asked about their level of motivation and where their motivation comes from. The findings from this work indicated that the main motivation for water operators was that through their work they were serving their community and making a positive contribution. Community health and safety is a primary concern for operators and fuels their motivation for their job.

“Yep, there is, like I mean, in the end you love the job. I like providing my community with safe drinking water and always know that there is always enough to provide. And in the end I have a young family, my kids are 12, 11, and 10 so I go to work provide a living for them. So at the same time I do like being an operator too.”

Water operator, interview participant, May 2014

Nearly all of the water operators interviewed found their work rewarding in some way and took pride in the work they were doing for their community. Professional growth and achieving higher levels of training provided additional motivation for some operators. A number of operators who were interviewed had previously worked in industries that required them to leave their community, so the fact that being in this position allowed them to be with their families was a source of job satisfaction. Some operators also expressed that they appreciated the variety in their work, the job stability, and the fact that they were constantly challenged and learning new things. Work environment was seen to be important to operators, those operators that had back-up or other operators to work with, expressed the fact that not only did this make their work safer, but it was also good for their morale. Finally, appreciation from communities was seen to be important for water operators, but for many operators this recognition and appreciation was found to be lacking.

“The best thing that I enjoy about my job is the stability. I enjoy that my job is very stable. And the pride that I have in taking care of my water, my community’s water system is a good thing too. I have a good amount of pride for doing that. Because when the opportunity came up, not that many people stepped up to take the training, go to school. So I was quite fortunate that way and I am quite proud of that, because you take on a

commitment when you take on the challenge of doing the training, that is a big thing. That was a big thing for me that I took that leap and that I followed through with my challenge and successfully completed all of the things I needed to.”

Water operator, interview participant, May 2014

4.4 Threats to water operator retention: lack of support and issues with wages

Operator retention is very important in order to ensure long-term access to safe drinking water in communities. An issue that was raised by a number of water operators was the wage that they received for their work. A lack of recognition and support from community members was also seen to be a risk to water operator retention.

The majority of water operators interviewed have had issues with their wage at some point in their career. A few operators expressed that they felt that their wage was lower than if they were to work in a non First Nations community. However, it was also acknowledged that for many operators, there were trade-offs in terms of wages and job satisfaction. For example, some operators expressed that they had previously made more money in other jobs; however, issues such as working conditions, location, and not being able to receive the same type of training and education would make working as a water operator preferable, even if the wages were lower. Many operators expressed that working for their community was important to them and accepted that lower wages were a cost for choosing to stay in their community.

“I was a logger. So when I did come to the water industry I took quite a big pay cut, I make about half as what I used to make, but being a water operator gave me a chance to use my education. So, that was the interesting part for me I guess.”

Water operator, interview participant, May 2014

Operators, and especially those who are also in a management position, recognized that many of the issues with wages were related to larger issues with budgeting and funding within the band. First, there are questions about whether or not operations and maintenance budgets are enough to cover costs and pay water operators a competitive salary. There is a perception among operators who participated in this work that operators who are working in off-reserve communities are making higher wages. There has not been a formal wage study and comparison done into water operator wages, so these claims are anecdotal but certainly an area that would be of value to look into.

The comments received from individual First Nations note a general feeling among First Nation communities that current Operation & Maintenance budgets are often insufficient to retain operators, to provide ongoing component replacement, and to perform all of the monitoring and recording requirements. (Indian and Northern Affairs Canada, 2011)

There was a wage enhancement initiative introduced to supplement First Nations water operator wages in BC; however, as shown by the quote below, these wage enhancements did not necessarily make their way to operators and had the potential to create tension between water operators and community leadership and others employed by their band.

“Well, Chief and Council and band administrations tend to see that offering as an inequality for other staff members in the band. So that is one aspect of conflict.”

Water operator interview participant, March 2014

The second issue identified is that operation and maintenance (O&M) budgets may be limited due to the fact that some communities may not be able to afford their 20% contribution to this budget (McCullough, 2012; Swain et al., 2006). O&M budgets may also be compromised if communities prioritize other funding needs over the needs of the water treatment system. A number of water operators expressed that they felt their community leadership lacked an understanding of their work and the demands of their job. Some operators felt that this lack of understanding led their community leadership to devalue operators work and not pay them enough.

“Our Councilors all thought we were just plumbers, they didn’t realize we were the ones who were making sure that they have safe drinking water.”

Water operator interview participant, May 2014

As shown by the following quote, in the event that a band is lacking the financial capacity to offer competitive salaries and wage increases, they risk decreasing operator’s motivation and job satisfaction, and potentially retention.

Participant: “Yeah, we have always had kind of issues here and there. Our band hasn’t given out any wage increases in quite a while so a lot of people are wondering why that is. Nobody has any motivation to do any job evaluations because really what is the sense, at the end of your evaluation, even if it was really good there is no reward for really working hard and stuff like that. Like a lot of people kind of put their evaluation and an increase together. So now that our band hasn’t given any increases, it is like why do an evaluation?”

Researcher: Do you think that affects work morale and motivation?

Participant: Yeah, for sure. For sure it does. A lot of people decide that it is not worth it and they will move on. Look for other jobs.”

Water operator, interview participant, May 2014

Appreciation and recognition from community members was seen to influence water operator job satisfaction, and ultimately has the potential to affect water operator retention. Operators who felt their work was valued were seen to have higher levels of job satisfaction and motivation. However, most operators did not have a high level of support from their community. One operator described their work as “thankless” and many operators expressed that they only hear from people when they have complaints. Some operators spoke about how this is related to a general lack of understanding from their community about the work that they do and the demands of their job.

“...because you gotta be here 7-days a week if you want to be a good operator, and people don't seem to understand that...its a 24-hour day job, the water system, it stops and then

you have to fix it, and you gotta see where to fix it, that's why you have to be here 7 days a week, 24 hours a day.”

Water operator, June 2013

4.5 Water operator recruitment

The issue of water operator recruitment came up in both conversations with community members and with operators themselves. Some issues identified in water operator recruitment were related to the fact that there was no interest from people within the community to become trained. This could be for a number of reasons, including not wanting to travel, not wanting to invest the time, or not having the literacy skills to complete exams and training courses. Not having driver's license was also identified as an issue when looking to recruit new operators.

“And you can't just have anybody go and do this position, because of the liability and the health risks of the community members. A lot of people think that you could just hire a summer student to go do this, but you have to have the training and the education the certification. And that's one problem...finding someone that is willing to go to school.”

Water operator, April 2013

Some operators brought up youth engagement as an important way to draw attention to water issues in the community and the work of water operators.

“I guess it would be easier to try and get the elementary kids or the younger high school kids involved to help. Like I said, it is hard, trying to change the adults and the elders, it is that much more difficult to change, to try to teach, than it is for the younger generation.”

Water operator interview participant, April 2014

One idea that was brought up was to have students in high school apprentice with water operators and receive high school credits for this work. Also, having operators visit schools to talk to students about water treatment and the importance of drinking high quality drinking water was suggested as a way to get youth interested in water operations and to inform youth that this was an opportunity available to them in their community.

4.6 Support from other operators

When asked about their relationship with other operators, every operator who participated in the interview process spoke of the value of being able to connect and talk to other operators to troubleshoot issues. There were some operators who live in nearby communities and hence, share resources and provide assistance when needed. Many operators met one another through training

courses and conferences. Social media has provided a valuable platform for water operators to network and share their experience. For example, some water operators have started a Facebook group that allows them to stay in contact and share ideas.

There is currently a movement in BC towards the creation of a First Nations water operator association to support and advocate for the needs of operators. Some operators have expressed that they are not receiving the support that they need from within their community and so the formation of an association would be of great value as a support network. Some potential benefits of this association would be to facilitate knowledge and resource sharing between operators and to create a space for peer support for operators. There is also the potential for an operators association to create mentorship opportunities for operators and for operators to share their experience with others. Finally, the potential for an association to advocate for the needs of operators and determine ways to address operator issues within the province would be of great value to increase water operator job satisfaction and motivation. One operator working towards the creation of an association articulated this point in the following statement:

“I think what motivates me is the fact that when I listen to other operators and the position that they are in, because, mainly because of their leadership and their administration, they really have no input on any of the budgets or constraints. And I think that has to be known and shared between other operators, in an association atmosphere.”

Water operator interview participant, February 2014

4.7 Involving operators in the design and management of water treatment systems

This research highlighted the importance of engagement with water operators during the design as well as the management of water treatment systems. When considering water treatment system design there is considerable value to taking a “participatory innovation” approach to water treatment system component design. Burr and Matthews describe the process by which they used a participatory innovation approach to engage with wastewater operators to optimize wastewater treatment plant design. This process focused on in depth engagement with operators to diagnose operator needs and work to collaboratively design solutions (Burr & Matthews, 2008). If a similar approach were taken and water operators were directly involved in drinking water treatment system design, it is hypothesized that water treatment systems would better meet the needs of operators, resulting in improved drinking water plant operation, operator job satisfaction, and ultimately community drinking water safety.

4.7.1 Value of operator and community involvement in design process

“Yeah, that is what our administrator was talking about, when we sat down the other day she was saying that when the new system comes in and when they start working up there that I would be with them helping them right from start to finish so that I have an understanding of where everything is and right down to what size the pipes are. You know, all the kinks and breaks that go which way. You know, how everything is set up deep underground.”

Water operator interview participant, March 2014

In the event that a new water treatment system is being designed, water operator engagement is beneficial for a number of reasons. Firstly, this allows designers to design a system that is in line with the operator's training, or will allow the operator time to acquire the appropriate level of training prior to the plant being commissioned. Secondly, this allows the water operator to have a more in depth understanding of the water treatment system and build a relationship with the engineering firm. This understanding will help the operator troubleshoot potential issues more effectively and anticipate maintenance needs within the plant. Finally, engagement with the water operator works to build feelings of ownership and responsibility for the operation and maintenance of the plant.

Although issues of ownership were not explicitly explored in this work, this was an issue that did come up in interviews. Since capital costs for a water treatment infrastructure are covered by AANDC, some operators questioned whose responsibility it was to ensure water treatment systems were operating properly and who was ultimately responsible for repairs in the event of a breakdown. This was also identified as an issue in the work of Smith et al. (2006) who observed that there exists a "disassociation between responsibility and public health protection because First Nations people do not fund their own systems: one government agency pays for the system infrastructure and another agency monitors the water quality" (p. S15). In terms of asset management, a lack of community ownership over their treatment system may lead to underfunding and allowing systems to fall into disrepair. To prevent this from occurring, a high level of engagement with both operators and Chiefs and Councils in this process of designing a system is required to increase community ownership and commitment to system upkeep and maintenance. It is also important to engage with the Chief and Council regarding the importance

of trained operators working at the plant and supporting operators to pursue training and certifications.

Issues of ownership are discussed by Davies (2009) in relation to the work done on leadership capacity building in rural Australia. In this work, it is noted that “Projects that simply adopted a top-down leadership model, and maintained this style of leadership throughout the project, were often successful in delivering new infrastructure or resources to the community; however, they were frequently lacking in community support and participation.” (p. 384). Davies goes on to state that “Such top-down projects did not facilitate community ownership of the project or, more importantly, the wider socio-economic development issue being addressed by the project.” (Davies, 2009, p 384). A parallel can be drawn between these observations and the decision making process that had been traditionally adopted for the design and implementation of drinking water infrastructure in First Nations that did not involve community engagement.

In speaking with some engineering consultants as a part of this work, it was seen that some firms are moving towards a much more collaborative approach with more community engagement. However, there are limits to how much time can be afforded to send professionals in to engage with communities. It is also important to raise the fact that since capital costs of water treatment infrastructure are paid for by AANDC, there is the potential risk of confusion in the client-consultant relationship and communities may not be brought into the decision making process as they should be as the client and end-user.

Marino et al. (2009) found in their work looking at water treatment in rural Alaska, that “agency” was an important factor in whether or not a community took ownership of their water treatment system and how the system was viewed in the community. It was found in their interviews in one community that community members expressed pride in their water treatment system and valued those who were instrumental in operating the system and for bringing the treatment system into the community. As summarized by Marino et al., “the centralized water system and its installation, success, and subsequent upgrades are conceptualized as having been brought into the village by the village itself. The modernization process therefore is locally driven and agency is retained. In effect, the new technology has become “our” new technology “ (p. 81). This is very important when considering factors that contribute to a community’s ownership and commitment to operating and maintaining their water treatment system, and the importance of working with communities from the first stages of the design process to ensure the long term functioning of water treatment systems.

4.7.2 Water operators relationship with Chief and Council in the management of systems

Political instability in some communities was noted as being a potential issue for operators. Some operators had experienced threats to their employment with a change in community leadership. Other operators expressed that there was some personal issues with leadership that affected their work as an operator and expressed frustrations when relationships become political, thereby potentially threatening their job or their access to funding for the treatment system.

“You got to go through Chief and Council for hiring process, but the trouble is politics plays a big part in our bands, you know, we are probably not the only band in that boat, it is not what you know it is who you know.”

Water operator interview participant, May 2014

There is also the potential issue of a band not prioritizing their operation and maintenance (O&M) budget for their water treatment system and not making funds accessible to water operators for necessary equipment. As shown by the following quote, a challenge faced by some operators is related to not having the proper resources and equipment to do their work. Depending on the trust that the Chief and Council have in an operators decisions, the process to provide funds to purchase equipment may be challenging and frustrating for operators and has the potential to affect system function and thus drinking water safety.

“The most challenging part about my work I guess would be needing equipment, and I guess going to Chief and Council saying we need the equipment to do our job and not given an okay to purchase the equipment right away, that we almost have to go through a long process of why we need it, why does it cost so much, and so I mean, the most difficult part is trying to do your job with no tools, no material.”

Water operator interview participant, May 2014

One third of the operators who participated in the study expressed that they were experiencing issues related to financial transparency in their work. These frustrations were related to the fact that these operators did not have any access to their budgets or that they were not involved in

budgetary decisions about their water treatment system. Operators who did not have access to their budgets expressed frustration, as they wanted to see what they are supposed to be paid and to know how much money they had available for repairs and maintenance. Although the majority of operators felt it was important to have access and input into their budget, the level of involvement that operators wanted to have in their budget varied. For example, there were a few operators who did not want to have additional paperwork and so were not interested in being responsible for making their own budget. There were also some operators who did not express concern about budgeting as they had a direct supervisor who they trusted who was responsible for the budget.

“For those who aren’t included in the administrative, I like to call it “money laundering”... kind of a bad example. If they are not involved in their budget they really don’t know if they are paid adequately or if there is any funding available for emergency breakdowns. I think it’s hard for some of the operators to convince the Chief and council and the administrator to spend 500 dollars on their replacement part that is necessary. If the budget is there why not use it. But if they are not aware of the budget then obviously they will be denied.”

Water operator interview participant, February 2014

4.8 Discussion of factors affecting water operator retention

There has been a considerable investment made into water operator training in British Columbia in order to ensure that well-trained water operators are present to provide safe drinking water to community members. However, a threat to this investment in drinking water safety is a lack of water operator retention, especially in remote communities. As shown by the follow excerpt from an article published by the American Water Works Association, operator retention is not an issue that is unique to First Nations communities or to British Columbia.

Throughout the United States, water systems are losing one of their most critical assets - the water operator. We all have seen the signs: long-term operators retiring or relocating with no one to fill their positions or experienced operators taking their knowledge to larger, higher-paying water systems or to higher-paying professions. (Bergman, 2008, p. 58)

When considering how to improve water operator retention, this work sought to better understand water operator's motivations and sources of job satisfaction. Although wages were seen as a factor in water operator's job satisfaction, the main motivation and source of job satisfaction was found to be the positive contribution that operators make to their community. As such, in order to keep water operator motivation and job satisfaction high, it is important that they receive appreciation and recognition for their work from both community members and community leadership. Turnover in community leadership and community politics may make relationship building between water operators and community leadership a challenge. Since carrying on

individual relationships may not be possible, building a general awareness of water issues in communities is important in order to create a culture of support around community water issues. It is believed that this support for water issues, and by extension the work of water operators, will lead to greater prioritization of funding towards water infrastructure and operator salaries, especially when water issues are framed as community health issues and not those of infrastructure.

Water operators were found to enjoy the challenge of their work and value the training that they have received. In addition, many operators expressed that they would like to become more involved in budgeting or management of their systems. Water operators are seen to have a valuable role to place in long-term system management and planning for upgrades and maintenance. For these reasons, it is suggested that water operators be given more responsibilities and opportunities to use their training to make recommendations regarding system maintenance. One opportunity for this is for operators to take an active role in asset management in their community. As observed by Minnes & Vodden (2014) “Another measure to reduce BWAs as well as preserve already degrading infrastructure is asset management. For asset management to be successful qualified personnel are required to lead these efforts. In rural areas certified regional water operators, when feasible, appear to be a viable option” (Minnes & Vodden, 2014, p. 72). Not only will asset management be valuable for ensuring the proper functioning of community infrastructure, this increased responsibility may also have a positive affect on water operator retention as operators are given more respect and trust from community leadership to provide input on this process.

4.9 Conclusion

Central to the successful operation and maintenance of treatment systems are well-trained water operators who receive the resources and support they need to do their work. Water operators were seen to be passionate about the work they do for their community and were motivated by the fact that their work was contributing to the health of their communities. However, there were threats seen to water operator retention when operators did not receive fair wages, or did not receive support or recognition from their community. These issues are important to address in order to ensure long-term drinking water access in communities. Related to this, are issues associated with water operator recruitment in communities and challenges in finding people who are willing to commit to training to become an operator.

The most significant gaps in water operator support seen in this work were in the relationship between operators and their community leadership. Financial transparency was identified as an issue for one third of the operators who participated in this work. In addition to this, nearly all operators have experience issues related to wages. There were other issues identified related to budgeting as some communities either do not prioritize O&M budgets for their water treatment system, or some communities do not have the financial capacity to cover the costs of running their system. It is acknowledged that these issues are related to larger issues related to the amount of funding that bands receive and the fact that there are numerous competing demands for funding in communities. As such, there are issues to address both in the amount of funding provided to communities, but also in the prioritization of allocating budget money to ensure proper operation and maintenance of water treatment systems in communities. It is recommended that operators as

well as community leaders are engaged in the design process to ensure that a community has both a trained operator and the financial capacity and will to operate and maintain their water treatment system.

Finally, there has been a movement to create a water operators association in British Columbia to provide support to operators. Operators have expressed the value and potential benefits that an association would provide, such as resource sharing and peer mentorship. This has the potential to increase water operator capacity and job satisfaction, ultimately having a positive affect on long-term drinking water access in communities.

Chapter 5. Water operators role in building awareness of community water issues

5.1 Introduction

When considering drinking water access in communities, not only is it crucial to ensure that there is a safe drinking water supply, but also that community members understand the importance of safe drinking water and that they trust their water. Spence & Walters (2012) highlight the importance of this is their work looking into risk perception of drinking water in First Nations. They acknowledge the importance of improving issues related to system operation and maintenance, but argue that this must be considered in conjunction with risk perception and the behaviours of consumers.

As will be discussed in this chapter, water operators have the potential to build education and awareness about water issues in their community. If water operators are able to build trusting relationships with community members, they can be a credible source of information for community members and can impact public perception of drinking water. Barriers to building relationships with community members and community leadership will be discussed in addition to best practices that were shared by water operators. This chapter draws on results from both community engagement activities as well as from water operator interviews in order to better understand the relationships between water operators and their communities.

5.2 Building trusting relationships with community members

When talking to community members about their trust in their drinking water some residents said that having knowledge of their water operator's work contributed towards them trusting their tap water. One thing that contributed to people's trust was simply seeing their water operator doing their work and having their water operator visible in the community.

"I think the water here is not the problem. Its making sure that everybody knows that the water is being taken care of by the people who are responsible for it and on top of it."

Talking circle participant, Boothroyd, March 2013

When asked about their level of trust in their drinking water, community members also talked about the relationship that they had with their water operator. People who knew their operator and had talked to their operator about their water quality had a higher level of trust in their water. This is especially important in small communities with strong social networks. The majority of water operators are residents of the community that they work in and have grown-up and lived in that community for a number of years. Many operators stated that they enjoyed getting to know residents and would stop to talk to residents during their workday. This is important for building recognition for water operators and having residents know who to talk to if they have any concerns about their drinking water.

“I do my best to build a stronger relationship with all my community members, who I interact with, with the water, last year when the study started, I dropped of an information form, or questionnaire, like what you guys formatted, I am just starting to get to know the majority of the people on all of the reserves, I personally wanted to actually have individual info sessions at each water system and at each private water system, just to have a little gathering and take notes and get to know them better, so they can trust me a lot more.”

Water operator, April 2013

Another important factor in building trust in drinking water is giving community members access to information about their water. Community members who had concerns about their water and did not have any information about their water quality were hesitant to drink their water, as they did not feel they have reliable information about their water quality.

“that’s why there is not much trust form me in the tap water it is because I am not kept in the loop of how our water is.”

Talking circle participant, Binche, June 2013

If water operators have a trusting relationship with community members, the information that they share with their community is likely to be much better received and accepted as legitimate by

community members. Community members appreciated having water operators take the time to speak with them directly about their water quality as noted by the quote from a resident below.

“this is good that (the water operator) comes around; she’ll stop in and let me know about the water. Whether it’s safe. She’ll say, well boil your water. Years ago, I never had anybody come up and say anything and I’ve lived here for so many years”

Talking circle participant, Lytton, April 2013

People also felt there was value in having water operators present at meetings so that community members could become better informed about their water.

“I feel like the people directly involved with the monitoring and treating of the water, should be sitting and attending at the meetings, they should have them here, so that the members of the community can speak directly to the person who’s treating it.”

Talking circle participant, Boothroyd, March 2013

When speaking to community members, many people stated that they would like to know more about their water quality and would be interested in having access to water quality results. As illustrated by the quote below, even in the event that people do not believe their water to be

unsafe, they would still like to have the added assurance of knowing the results of water testing.

“Everybody here is healthy, we have no health problems with the water here as far as I know. Nobody is getting sick from the water here, except for maybe one person, but that could be because of the piping. The solution for that is a little bottle of water, go have it checked, and when it comes back to you, then you know what you’re dealing with.”

Talking circle participant, Boothroyd, March 2013

Even if there is not an existing threat to their water, people’s trust in their drinking water was influenced by past experiences. For example, some community members would not drink their water because there had been a boil water advisory in the community in the past. People expressed that they did not know why there had been an advisory, or what had been done to address the issue. This issue was also seen in communities where there were seasonal variations in water quality resulting in recurring boil water advisories.

“I don’t want to get sick from water. We had E. coli problems here”

Talking circle participant, Tache, June 2013

“Even though for me, knowing the boiled advisory was looked at here, I don’t drink directly from the tap, I always boil my water.”

Talking circle participant, Tache, June 2013

When asking community members what would make them feel comfortable drinking their water, they wanted to see proof that their water was in fact safe. Having had *E. coli* in their water in the past led people to have a number of concerns about their water and a number of people stated that they do not trust their tap water. In order to rebuild trust in their water, people wanted to understand what led *E. coli* to be in their water and how the issue has been fixed.

“Hypothetically I probably might feel comfortable drinking water from the tap, If there was a report saying, your water system has been fixed, and this is a quality water you’re getting now, yeah maybe I would be comfortable drinking straight from the tap”

Talking circle participant, Tache, June 2013

These results show the importance of ongoing communication with community members in order to build and maintain trust in a community’s tap water quality. This communication was seen to be especially important after a contamination event as rebuilding public trust in water after trust had been lost was identified as a challenge in this work. Similar to the finding of Dunn et al. (2014), it was found to be valuable for communication water quality information to be both regular and proactive. Furthermore, Dunn et al. stress the need “for information to be communicated in a way that makes implications clear” (Dunn et al., 2014, p. 592).

5.3 Challenges for operators with outreach and education

Nearly every operator interviewed expressed that education and outreach about water in their community was incredibly important, but could also be a considerable challenge. This was expressed both in relation to community members as well as with community leadership. One challenge expressed was the fact that people have a number of concerns within the community and that water has a tendency to be taken for granted. Some operators stated that they only heard from people when they had complaints and that it was difficult to create awareness for water issues and the importance of water unless they were currently facing issues with their water.

“Come to a meeting and three people show up, because everybody else is late behind the meeting for that day, it gets shoveled of as a side, because the communication is missing”

Talking circle participant, Boothroyd, March 2013

One issue that was brought up in relation to building relationships with Chief and Council is the turnover in these positions and the challenge to make water a priority each time there is a turnover in leadership. The term for Chief and Council in communities is only two years. Depending on the level of turnover in a community, this may mean that an operator would have to start from scratch with engaging with their community leadership every two years.

“As far as management, politics, people up in those areas, I wish they would participate more in events like this and come and see and get to know what you actually do, to

appreciate my work more. That would make my work more rewarding, more pleasant. I have been there 12 years and I maybe have had 1 or 2 people way up high above, come and actually look at our water plant and see what we do. And it is just such a big turnover in those upper management areas, just such a big turnover because every time there is an election someone else gets put in and you just don't get that recognition from those upper people. Because they just don't, they just aren't interested. All they know is the bottom line, the money, keep that in line and that is all they are worried about. And they don't actually think about what you actually do for your job. So a better understanding from them would be great."

Water operator interview participant, May 2014

Another issue facing operators is that they may be put in a position where they are going against the opinion of community members and challenging community members' perceptions. Similar to the findings of Chess et al. (2002) and Dunn et al. (2014) who identified, in New Jersey and British Columbia respectively, that residents held misperceptions about their drinking water, many community members interviewed in this work either held misperceptions or a limited understanding of the risks associated with their drinking water.

Operators also have to deal with complaints from residents, especially in relation to chlorination. Although many operators talked about this as being just a part of their job, there is a potential for operators to experience frustration or conflict as a result of this. Many operators spoke about receiving complaints about chlorination and having to talk with residents about potential health risks and the liability that they have as an operator.

“No. The main thing is, why do you have to chlorinate? It tastes ugly...then they say, you are poisoning us. I just tell them, it is for my own good, if something happens to that water, if some baby or Elder gets sick and it is caused from the water, the first person that they look at will be me.”

Water operator interview participant, May 2014

Another challenge for operators may be communicating with residents about risks to their water, especially when they are communicating with Elders in the community. Some operators expressed that it was challenging to engage with community members about their water when information they were sharing was contrary to public opinion.

“Our Elders were saying that they do not understand or like that, but, we were saying that’s why you’re getting sick, they didn’t want to believe that, but they had to understand when they were listening, things going on, I mean so many things going on, people moving further up didn’t understand that that stuff can’t go into the water and they were telling us we weren’t even allowed to drink our spring waters, that’s close by the lake”

Talking circle participant, Middle River, June 2013

There is also the issue that people have become accustomed to their drinking water and as described in the following quote, people have trouble imagining that there could be an issue with their water.

“we have nothing to compare to, we’ve lived this way for so many years, what’s better water? It’s coming out of our tap, we can use it that’s basically what it comes down to, for me, and I’ve lived up there for 25 years...so I’ve been around that water my whole life, there’s nothing really to say that if it’s good or bad, because it has been our life, we’ve got nothing to compare to. What’s a better water system? Besides from it being treated, because we don’t know, and it’s the education again, that becomes a big part of it”

Talking circle participant, Lytton, April 2013

Finally, it is very important to consider whether or not all water operators have the time, training, and willingness to take on a role of an educator in their community. It was found that many operators are not only in charge of the water system, but take on a number of general maintenance tasks in their community as well. This results in operators having a demanding schedule with the potential for unexpected issues to come up which require additional time. Therefore, even though operators may see the value in more community outreach, it may be difficult for operators to find the time to dedicate to this. There is also the issue of whether or not water operators have been trained in public relations and if this is a part of their job that they want to undertake. Although the operators interviewed for this work were interested in community outreach, additional work would need to be done to determine whether or not other operators would feel comfortable taking on more of an educator role in their community. It would also be valuable to work with operators who are interested in community outreach to better understand how to best support them as educators in their community. This could potentially be through additional training in this area or through providing operators with resources and sharing best practices for community education.

5.4 Best practices shared by water operators: community outreach and education to build awareness about water issues

Nearly every operator interviewed was working to increase awareness in their community for their water. Some of the ways that operators shared that they are working to build relationships and share information are as follows:

- **Tours & open houses.** Many operators give tours of their treatment plant to community members, community leadership, and to youth in the community. Operators enjoyed sharing their work with the community and sharing information about the water treatment process. Operators said that this helped community members to understand why certain processes were used and how this contributed to water quality. Operators who took students on tours of the plant talked about the value of youth engagement and how youth can talk to their families and become educators themselves about their community's water. This also creates an opportunity to talk with youth about the potential for them to pursue a career as a water operator.
- **Presentations at band meetings and events.** Some operators participate in meetings or community events to share their work and give updates about water quality and water needs in the community. This provides an opportunity for community members to talk with their water operator and to get a better sense of the work required to keep their drinking water safe.
- **Individual conversations.** Water operators shared the value of speaking with community members to increase awareness of drinking water issues. This personal relationship was

valued by community members and created more trust for water operators from community members.

- **Community newsletters.** Newsletters as well as public notice boards are used by some operators to post updates about their water treatment system and water quality results. This regular posting of updates from water operators is an effective way to keep up communication with community members and provide a consistent source of information about water quality.
- **Involving leadership in conferences.** Some operators have invited some of their Chief and Council or those working in administrative or management roles in the band to attend water operator conferences. This has the potential to show Chief and Council the important role that water operators have to play in ensuring community health and build respect for water operators from Chief and Council or administration.

5.5 Conclusion

Water operators have been identified as key individuals to engage with their community to provide education about their community's water treatment system. This is important for building public trust in drinking water and also in building awareness for the importance of water operators. Community members were found to value information from their water operator about their water quality. Furthermore, this increased understanding of drinking water is an important step in making water issues a priority for a community.

Water operators who participated in this work expressed an interest in community engagement and education. Operators shared a number of methods such as treatment plant tours, presentations at meetings, one-on-one conversations, publishing information in community newsletters, and involving community leadership in conferences as key ways to increase education and awareness about their community's water. Moving forward, it will be important to work with operators who are interested in community engagement to share these best practices and understand how to best support operators to engage with their community about their water. It will also be valuable to engage with community members to understand the most effective engagement methods from their perspective.

There were barriers identified which could make it challenging for some operators to engage with their community. These barriers were related to constraints on operator's times due to their demanding schedules as well as potential issues that could arise from operators sharing an opinion that conflicts with those of other community members. It is also possible that some operators may not feel comfortable taking part in community engagement or may feel that in order to do this they will require more training in public relations. Moving forward, it will be important to further investigate barriers and how these could be reduced or eliminated in order to best support operators.

Chapter 6. Conclusions and recommendations

6.1 Key findings

As highlighted in the introduction of this thesis, access to drinking water in First Nations is an important issue that persists in many communities across Canada. Boil water advisories are an indicator of the extent of this issue; however, there needs to be further research into the root causes of the advisories in order to find sustainable solutions to issues of drinking water access in communities. In order to understand these root causes there need to be time invested in engaging with communities to understand issues of water access and find community appropriate solutions to these issues.

The community engagement portion of this work found that each of the three community partners faced unique challenges related to drinking water access. This work highlighted the importance of engaging with each individual community in order to understand how to best address issues of water access. It was identified that an important part of engaging with communities about water involves understanding how people perceive their water. In all three communities it was found that people's perception was related to aesthetic properties of their water, especially in relation to chlorination, as well as concerns related to resource extraction. In addition, building an understanding of factors that affect risk perception and identifying trusted individuals who are able to communicate water risks to a community are important in order to ensure that water treatment solutions will be trusted and accepted by a community.

An important outcome from working with community partners was the identification of water operators as key individuals in ensuring safe drinking water access in communities. Water operators were found to be crucial in the design, operation, maintenance, and management of water treatment systems. In addition, it was found that water operators have a valuable role to play in building education and awareness of community water issues. Moving forward with any initiatives to address issues of drinking water access in First Nations will require placing communities at the centre of the design process and must involve in-depth collaboration with water operators. This is important in order to properly assess the needs of the community and to understand the community's capacity to operate and maintain their water treatment system. This engagement is also crucial to build community ownership of their water treatment system in order to ensure that a community is committed to allocating the necessary resources to their water system and water operator.

In order to ensure safe drinking water access, the treatment system must be operated and maintained by a well-trained water operator. As there has been significant investment in water operator training over the past couple of decades in British Columbia, and water operators who participated in this work reported training to be accessible to them, the availability of training is not seen to be a barrier to drinking water access in British Columbia First Nations communities. However, operator motivation to attend training may limit how many operators are taking advantage of training opportunities.

This research identified gaps in the support that water operators receive from their community leadership, as well as a lack of understanding regarding the role that water operators play in maintaining health in communities. Although there were exceptions to this, several operators reported that they do not feel supported by their leadership and this has translated into a lack of inclusion in decision making, a lack of funds allocated to run the water treatment system, low wages, and threats to their job stability. Support from community leadership was found to be important for a number of reasons. First of all, community leadership must support their water treatment system by allocating adequate money in their budget to ensure that the materials needed to run the system are available and money is set aside for system upgrades and maintenance. This ensures that operators have the resources required for them to perform their duties. Trust from community leadership for their water operator and inclusion of the water operator in decision making and budgeting for the water treatment system is important to ensure that future maintenance needs are being considered. Finally, financial support in the form of competitive wages is important for water operator job satisfaction and retention.

Nearly all water operators interviewed reported being motivated by serving their community and ensuring the health of their community members. Appreciation, recognition, and support from community members was found to be important for operator motivation and job satisfaction. This is especially important in communities where there is a high turnover in community leadership. Creating a culture of support for water operators from community members may help to ensure that the prioritization of water issues is not lost if there is considerable turnover after an election.

In relation to the prioritization of water issues in communities, this work identified a need for increased awareness and education about water issues in communities. This work found that water operators are in a good position to be educators regarding the importance of safe drinking water and a source of information for community members about their water quality. This was found to be important as community members need to have a trusted source of information in order to build an accurate perception of their drinking water. For communities that have safe tap water, the relationship between community members and their operator is key to building public trust of drinking water and ensuring community health through the consumption of safe drinking water.

Some limitations of this work are related to the fact that the community engagement portion of this work was focused on three communities. As such, the conclusions from this work are in no way meant to be representative of First Nations across the province of British Columbia. Rather, these findings are meant to emphasize the importance of community engagement in order to identify issues facing individual communities. In terms of limitations to the work related to water operators, the majority of operators who participated in an interview for this work applied and were sponsored by AANDC to attend the conference at which most interviews were performed. For these reasons, there is likely to be a bias towards operators who are passionate and motivated in their work as well as those operators that have a positive working relationship with AANDC.

As well, since operators were interviewed at a conference, this may result in a sample of water operators who are more likely to have the support of their community leadership to leave their community to attend conferences and training. Due to resource limitations, traveling to communities across the province to interview operators was not possible. As a result, this study is

biased towards operators who are able and willing to travel away from their communities and does not allow for a discussion about factors that may affect operators leaving their communities.

6.2 Highlighting recommendations on how to move forward

There were a number of recommendations from water operators, as well as from community members and community leadership, as to how to best move forward and address some of the issues identified in this work. In order to build education and awareness of water issues in communities, many water operators shared best practices from their own experience. These included tours and open houses, presentations at band meetings and events, individual conversations with community members, and sharing information in community newsletters. These activities are also very important in building an understanding of the work of water operators and the important role that they play in ensuring safe drinking water is provided to their community. It would be valuable to engage further with operators who have successfully reached out to their community in order to understand factors that contributed to their success in this and provide resources to other operators who are working to do this in their own community. Feedback from community members indicated that they would appreciate more information about water quality data. Best practices for this from operators includes publishing water quality data in community newsletters or posting this information in a public location. Again, it would be valuable to share best practices among operators to assist operators in sharing information within their community.

As discussed in Chapter 4, some operators are currently working to create a First Nations water operators association in British Columbia. The formation of a water operators association would be beneficial as it would create a space for operators to share best practices, provide operators with peer support, and facilitate opportunities for mentorship and resource sharing. This association would also allow for water operators to work together to advocate for operators' needs such as receiving fair wages. The findings of this thesis maintain that the creation of a water operators association in British Columbia has the potential to provide valuable support and resources for First Nations water operators.

In addition to relationship building with community members to share information about water issues, operators also spoke about the importance of building their relationship with their Chief and Council. Operators identified some ways to start building this relationship such as taking their Chief and Council on a tour of the water treatment plant and inviting their Chief or councilors to operators conferences. Finding ways to shift the perception of water operators in communities across the province is seen to be the first step to building better relationships between operators and their community leadership. An example of this was shared by a Chief at the opening reception for First Nations water operators at the 2014 BCWWA Annual Conference. This Chief spoke about how she had not understood or appreciated the work of the water operator in her community until attending a water operators conference. Attending this conference allowed her to see all of the technical work required in water and wastewater operations and understand the responsibilities that operators have in ensuring community health. Acknowledging that operators are key to community health aids in building recognition and appreciation for the work of water operators and contributes to improving water operator's job satisfaction.

This work highlighted the importance of water operators being involved in budgeting and decision making. It was found that additional training may be valuable to give operators the resources they need to participate in the budgeting process and advocate for the financial needs of the water treatment system. This training could be provided to operators through training courses or alternatively, through in-community asset management training. An asset management program has recently been piloted in British Columbia. This program brought together a consulting firm, AANDC, and communities to make a long-term plan for a community's infrastructure and understand how to budget to ensure maintenance needs are addressed. This type of training has considerable potential to have a positive impact on communities, as it not only provides communities with the tools to ensure their infrastructure is maintained in the long-term, but also has a great potential to build respectful professional relationships between operators, community leadership and administration who are all involved in the process.

In addition to the importance of AANDC's support for asset management initiatives, it was also identified that some communities could benefit from the consideration of non-centralized water treatment options. This would require a shift in thinking about water treatment solutions in communities and may require a change in AANDC's funding policies and regulations. For example, point of use systems could be beneficial for areas that do not currently have enough houses to qualify for funding for a centralized water treatment system. There may also be potential for point of use systems in communities who are opposed to chlorination. However, it is important to recognize that point of use systems would require a very different management approach to ensure that they are being operated properly. Any shift towards point of use systems would require considerable thought into the potential impacts of this and ensuring that public

health is maintained. Investigating whether or not point of use systems would be a viable option for communities is outside of the scope of this thesis, but further investigation into this would be valuable as this may prove to be a safe, cost-effective option that would be accepted by community members.

6.3 Recommendations for future research

As this work focused primarily on water operators, it would be beneficial to have future research engage more directly with community leadership in order to investigate challenges with water management from the perspective of Chiefs and Councils. This would be valuable in order to better understand how water related decisions are made, specifically in relation to budgeting and the prioritization of funding related to water. There is also value in connecting this work with larger issues related to water governance and exploring not only how operators can be better connected to water related decisions within their community, but also how operators and community leadership can engage in watershed governance and how policy and regulation could be created or changed to support communities to do this.

As wages were an issue that came up frequently when talking with operators, it would be valuable to have a wage study that could compare water operator wages both on and off- reserve as well as to compare wages between communities. This would be helpful in creating guidelines to assist communities in setting fair and competitive wages for their water operators and would allow operators to approach leadership in their community with data in the event that operators are earning below the wage guidelines.

The issue of back-up operators was raised in interviews with water operators. This is an area that would be valuable to explore further. Specifically, it would be of value to research factors that affect back-up operator recruitment and retention, and whether or not back-up operators are being employed full-time. Funding policies that affect the ability of bands to employ back-up operators would be important to explore. Finally, the effect of back-up operators on the job satisfaction of the main operator would be important to explore in order to gain a better understanding of the impact that back-up operators could have on long-term community drinking water access.

In general, partnerships between researchers and communities with the support of AANDC is important for the continuation and expansion of research into low-cost water treatment technology that is appropriate for rural and remote communities. One example of this that was discussed in the previous section, is the potential to look into the feasibility of non-centralized water treatment solutions in communities. Research into not only the design of these systems, but also how to best manage household water treatment would be needed in order to determine the potential applicability for communities. Cost analysis into point of use versus central treatment systems would also be important to determine if this could be a cost-effective solution for communities.

Finally, more in depth research with community members would be valuable to better understand risk perception of drinking water, especially in relation to chlorination. As this work involved only three communities, a more widespread study would be valuable in order to assess how opinions are formed about water and to better understand the influence of water operators from the perspective of community members.

Works cited

- Aboriginal Affairs and Northern Development Canada. (2011). Fact Sheet - Capacity and Training and Circuit Rider Training Program. Retrieved from <https://www.aadnc-aandc.gc.ca/eng/1313688917297/1313689760570>
- Aboriginal Affairs and Northern Development Canada. (2012). *Circuit Rider Training Program: Minimum Program Requirements for Water and Wastewater Systems*.
- Aboriginal Affairs and Northern Development Canada. (2014). First Nations People in Canada. Retrieved April 20, 2012, from <https://www.aadnc-aandc.gc.ca/eng/1303134042666/1303134337338>
- BCWWA. (n.d.). About BCWWA. Retrieved from <https://www.bcwwa.org/about/history-of-bcwwa.html>
- Bergman, R. W. (2008). Marshaling Resources to Support Drinking Water Operators. *Journal (American Water Works Association)*, 100(4), 54–58. Retrieved from <http://www.jstor.org/stable/41314593>
- Bernard, H. R., & Ryan, G. W. (2010). *Analyzing Qualitative Data*. Sage Publications.
- Blackstock, M. D. (2001). Faces in the Forest: First Nations Art Created on Living Trees (pp. 176–223). McGill-Queens University Press.
- Blackstock, M. D. (2001). Where Is the Trust? Using Trust-Based Mediation. *Conflict Resolution Quarterly*, 19(1).
- Brant Castellano, M. (2004). Ethics of Aboriginal Research. *Journal of Aboriginal Health*, 1(1).
- Buur, J., & Matthews, B. (2008). Participatory Innovation. *International Journal of Innovation Management*, 12(3), 255–273.

- Canada. An Act Respecting the Safety of Drinking Water on First Nation Lands. BILL S-8 (2012). Senate of Canada.
- Canada. Royal Commission on Aboriginal Peoples. (1996). *Report of the Royal Commission on Aboriginal Peoples: Volume 3: Gathering Strength* (Vol. 3). Ottawa.
- Castellano, M. B. (2004). Ethics of Aboriginal Research. *Journal of Aboriginal Health*.
- Centre for Aboriginal Health Research. (2011). *Crisis on Tap: Seeking Solutions for Safe Water for Indigenous Peoples*. (J. Reading, D. Perron, N. Marsden, R. Edgar, B. Saravana-Bawan, & L. Baba, Eds.). Victoria: University of Victoria.
- Chess, C., Johnson, B., Kovacs, D., & Schwar, C. (2002). Using Research to Inform Agency Communications: Perceptions of Drinking Water. *Applied Environmental Education & Communication*, 1(4), 221–228. doi:10.1080/15330150290106149
- Davies, A. (2009). Understanding Local Leadership in Building the Capacity of Rural Communities in Australia. *Geographical Research*, 47(4), 380–389. doi:10.1111/j.1745-5871.2009.00586.x
- Davison, C. M., Brown, M., & Moffitt, P. (2006). Student Researchers Negotiating Consent in Northern Aboriginal Communities. *International Journal of Qualitative Methods*, 5(2).
- Dietrich, A. M. (2006). Aesthetic issues for drinking water. *Journal of Water and Health*, 4, 11–16. doi:10.2166/wh.2005.034
- Doria, M. D. F., Pidgeon, N., & Hunter, P. R. (2009). Perceptions of drinking water quality and risk and its effect on behaviour: a cross-national study. *The Science of the Total Environment*, 407(21), 5455–64. doi:10.1016/j.scitotenv.2009.06.031
- Dunn, G., Henrich, N., Holmes, B., Harris, L., & Prystajecky, N. (2014). Microbial water quality communication: public and practitioner insights from British Columbia, Canada. *Journal of Water and Health*, 12, 584. doi:10.2166/wh.2014.126

- Dupont, D., Waldner, C., Bharadwaj, L., Plummer, R., Carter, B., Cave, K., & Zagozewski, R. (2014). Drinking water management: health risk perceptions and choices in First Nations and non-First Nations communities in Canada. *International Journal of Environmental Research and Public Health*, 11(6), 5889–903. doi:10.3390/ijerph110605889
- Eggertson, L. (2008). Despite federal promises, First Nations' water problems persist. *Canadian Medical Association Journal*, 178(8), 985. doi:10.1503/cmaj.080429
- EOCP. (2014). About the EOCP. Retrieved from <http://www.eocp.ca/about-us/>
- Fessenden-Raden, J., Fitchen, J. M., & Heath, J. S. (1987). Providing Risk Information in Communities: Factors Influencing What is Heard and Accepted. *Science Technology and Human Values*, 12(3/4), 94–101.
- First Nations Health Authority. (2013). *A Path Forward: BC First Nations and Boriginal People's Mental Wellness and Substance Use - 10 Year Plan*.
- Glass, K. C., & Kaufert, J. (2007). Research Ethics Review and Aboriginal Community Values: Can the Two be Reconciled? *Journal of Empirical Research on Human Research Ethics*, 2(2), 25–40.
- Graham, J. (2002). Safe Water for First Nation Communities: Learning the Lessons from Walkerton. In *First International Conference on Water*. Ottawa, Canada.
- Grover, R. (2011). *Boil Boil, Toil and Trouble: The Trouble With Boil Water Advisories in British Columbia*. University of British Columbia.
- Hadden, S. G. (1989). Institutional Barriers to Risk Communication. *Risk Analysis*, 9(3), 301–308. doi:10.1111/j.1539-6924.1989.tb00995.x
- Health Canada. (2007). *Procedure Manual for Safe Drinking Water in First Nations Communities South of 60 °*.

- Health Canada. (2009). *Drinking Water Advisories in First Nations Communities in Canada: A National Overview 1995 - 2007*.
- Health Canada. (2015). Drinking Water Advisories in First Nations Communities. Retrieved from <http://www.hc-sc.gc.ca/fniah-spnia/promotion/public-publique/water-dwa-eau-aqep-eng.php>
- Hrudey, S. (2009). Public health wonder or unwitting vector of disease: the challenge of delivering safe supplies. *Reviews in Environmental Science and Bio/Technology*, 8(3), 235–237. doi:10.1007/s11157-009-9160-4
- Hrudey, S. E., & Hrudey, E. J. (2004). *Safe Drinking Water: Lessons From Recent Outbreak in Affluent Nations*. London: IWA Publishing.
- Indian and Northern Affairs Canada. (2003). *National assessment of water and wastewater systems in first nations communities*.
- Indian and Northern Affairs Canada. (2006a). *Plan of Action for Drinking Water in First Nations Communities Progress Report*.
- Indian and Northern Affairs Canada. (2006b). *Protocol for Safe Drinking Water in First Nations Communities*.
- Indian and Northern Affairs Canada. (2010). *Protocol for Centralised Drinking Water Systems in First Nations Communities*.
- Indian and Northern Affairs Canada. (2011). *National Assessment of First Nations Water and Wastewater Systems National Roll-Up Report*.
- Jardine, C. G., Gibson, N., & Hrudey, S. E. (1999). Detection of Odour and Health Risk Perception of Drinking Water. *Water Science & Technology*, 40(6), 91.
- Kelm, M.-E. (1998). *Colonizing Bodies: Aboriginal Health and Healing in British Columbia 1900-50*. UBC Press.
- Le, M.-L. (2012). *Circuit Rider Training Program for Water Operators*.

- Lee-Young, J., & Robinson, M. (2015, January 14). Lower Mainland's natural springs attract devoted following. *Vancouver Sun*. Vancouver, BC. Retrieved from <http://www.vancouversun.com/Lower+Mainland+natural+springs+attract+devoted+following/10730058/story.html>
- Macintosh, C. (2009). Public Health Protection and Drinking Water Quality on First Nation Reserves : Considering the New Federal Regulatory Proposal, 5–12.
- Marino, E., White, D. A. N., Schweitzer, P., Chambers, M., & Wisniewski, J. (2009). Drinking Water in Northwestern Alaska: Using or Not Using Centralized Water Systems in Two Rural Communities, 62(1), 75–82.
- Mccullough, J. (2012). Square Peg, Round Hole: First Nations Drinking Water Infrastructure and Federal Policies, Programs, and Processes, 3(1).
- Minnes, S., & Vodden, K. (2014). *Exploring Solutions for Sustainable Rural Drinking Water Systems: A study of rural Newfoundland & Labrador drinking water systems. Cartographic Perspectives*. doi:10.14714/CP75.1220
- Moffatt, H., & Struck, S. (2011). *Water-borne Disease Outbreaks in Canadian Small Drinking Water Systems*.
- MTS Maintenance Training Systems Inc. (2014). Our Facility. Retrieved from <http://www.mtsinc.ca>
- O'Connor, D. R. (2002a). *Report of the Walkerton Inquiry Part One*. Toronto.
- O'Connor, D. R. (2002b). *Report of the Walkerton Inquiry Part Two*. Toronto.
- Owen, A. ., Colbourne, J. S., Clayton, C. R. I., & Fife-Schaw, C. (1999). A Mental Model's Approach to Customer Perception of Drinking-Water Supply and Quality. *Water and Environment Journal*, 13(4), 241–244. doi:10.1111/j.1747-6593.1999.tb01041.x

- Patrick, R. J. (2011). Uneven access to safe drinking water for First Nations in Canada: connecting health and place through source water protection. *Health & Place*, 17(1), 386–9. doi:10.1016/j.healthplace.2010.10.005
- Patterson, M., Jackson, R., & Edwards, N. (2006). Ethics in Aboriginal Research: Comments on Paradigms, Processm and Two Worlds. *Canadian Journal of Aboriginal Community-Based HIV/AIDS Research*, 1.
- Plummer, R., Velaniškis, J., de Grosbois, D., Kreutzwiser, R. D., & de Loë, R. (2010). The development of new environmental policies and processes in response to a crisis: the case of the multiple barrier approach for safe drinking water. *Environmental Science & Policy*, 13(6), 535–548. doi:10.1016/j.envsci.2010.05.004
- Polaris Institute. (2008). *Boiling Point!* Ottawa.
- Raina, P. S., Pollari, F. L., Teare, G. F., Goss, M. J., Barry, D. A. J., & Wilson, J. B. (1999). The Relationship Between E . coli Indicator Bacteria in Well-water and Gastrointestinal Illnesses in Rural Families. *Canadian Journal of Public Health*, 90(3), 172–175. Retrieved from <http://www.jstor.org/stable/41993003>
- Reynolds, G. C. (2003). A Native American Water Ethic. *Transactions of the Wisconsin Academy of Sciences, Arts and Letters*, 90.
- Richmond, C. a M., & Ross, N. a. (2009). The determinants of First Nation and Inuit health: a critical population health approach. *Health & Place*, 15(2), 403–11. doi:10.1016/j.healthplace.2008.07.004
- Royal Comission on Aboriginal Peoples. (1996). *Report of the Royal Comission on Aboriginal Peoples, Volume 1*. Ottawa, Canada.
- Saldana, J. (2009). *The Coding Manual for Qualitative Researchers*. Sage Publications.
- Sanderson, C. D. (2008). *Nipiy Wasekimew / Clear Water : The Meaning Of Water, From The Words Of The Elders*. Simon Fraser University.

- Scherer, C. W., & Cho, H. (2003). A Social Network Contagion Theory of Risk Perception. *Risk Analysis*, 23(2), 261–267. doi:10.1111/1539-6924.00306
- Schnarch, B. (2004). Ownership, Control, Access and Possession (OCAP) or Self-Determination Applied to Research. *Journal of Aboriginal Health*, (January), 80 – 95.
- Simeone, T. (2010). *Safe Drinking Water in First Nations Communities*.
- Simeone, T., & Troniak, S. (2012). *Legislative Summary: Bill S-8: The Safe Drinking Water for First Nations Act*. Ottawa, Canada.
- Slovic, P., & Peters, E. (2006). Risk Perception and Affect. *Current Directions in Psychological Science*, 15(6), 322–325.
- Smith, D. W., Guest, R. K., Svrcek, C. P., & Farahbakhsh, K. (2006). Public health evaluation of drinking water systems for First Nations reserves in Alberta, Canada. *Journal of Environmental Engineering and Science*, 5, S1–S17.
- Swain, H., Louttit, S., & Hrudey, S. (2006). *Report of the Expert Panel on Safe Drinking Water for First Nations*.
- Thompson Rivers University. (n.d.). First Nations Water Education Programs. Kamloops, BC.
- Travel.bc.ca. (2015). Map of BC & Regional Maps of BC. Retrieved from <http://www.travel.bc.ca/map/>
- Trumbo, C. W., & McComas, K. a. (2003). The Function of Credibility in Information Processing for Risk Perception. *Risk Analysis*, 23(2), 343–353. doi:10.1111/1539-6924.00313
- UNESCO. (2006). *Water and Indigenous Peoples*. (R. Boelens, M. Chiba, & D. Nakashima, Eds.). Paris.
- Weterings, R. A. P. M., & Van Eijndhoven, J. C. M. (1989). Informing the Public About Uncertain Risks. *Risk Analysis*, 9(4), 473–482. doi:10.1111/j.1539-6924.1989.tb01258.x

- White, J. P., Murphy, L., & Spence, N. (2012). Water and Indigenous Peoples : Canada's Paradox. *The International Indigenous Policy Journal*, 3(3).
- Wildavsky, A., & Dake, K. (1990). Theories of Risk Perception: Who Fears What and Why? *Daedalus*, 119(4), 41–60.
- Wilson, K. (2003). Therapeutic landscapes and First Nations peoples: an exploration of culture, health and place. *Health & Place*, 9(2), 83–93. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/12753791>
- Woons, M. J. (2008). *Aboriginal Participation in Canada: Overcoming Alienation and Mistrust in a Situation of Complex Interdependence*. University of Northern British Columbia.
- Wright, J. a, Yang, H., Rivett, U., & Gundry, S. W. (2012). Public perception of drinking water safety in South Africa 2002-2009: a repeated cross-sectional study. *BMC Public Health*, 12(1), 556. doi:10.1186/1471-2458-12-556
- Yim, Y. (2005). *Public Perceptions of Drinking Water Risk: A Community Perspective*. University of British Columbia.

Appendices

Appendix A: Aboriginal Water Health Project: interview guide and community questionnaire

Aboriginal Water Health Project: Focus group guiding questions

1. Start with introductions: name and where you are from.
2. Do you have any concerns about the amount of water available to your community? If so, what are these concerns.
3. Do you have any concerns about the quality of water in your community? If so, what are these concerns.
4. How is your community water treated? Do you have any concerns about your community's water treatment?
5. Do you have any suggestions for how to improve your community's water? What would you like for your community's water?
6. Who is in charge of managing water in your community? Can you talk about their roles and responsibilities in managing your community water?
7. Is there anything else that we have missed that you would like to say about your community's water?

Aboriginal Water Health Project - Community Questionnaire

A collaborative partnership between First Nations communities, UBC Institute of Aboriginal Health and Department of Chemical and Biological Engineering to strive for improved quality of drinking water

Thank you very much for being involved in the Aboriginal Water Health Project. The goal of this partnership is to honour the 4 R's of Aboriginal Health at UBC; respect, relevance, reciprocity and responsibility in developing strategies for quality drinking water in your community.

Our dialogue will gather information about:

1. Your views of water on your culture and health
2. Proposed solutions from you and your community about your drinking water
3. Challenges with your drinking water
4. The current status of your water treatment system

Our goal is to ensure inclusion of the community's voice in their proposed solutions for their drinking water. The above information gathered from this knowledge sharing dialogue between us will help us develop strategies to ensure safe drinking water in your community.

****This information will be kept for 5 years in an encrypted database so that your identity will be protected. We will also share the results with you for your comments and feedback.**

Your Community

1. Which community are you from?

2. How long have you lived in this community?

Your Culture

We would like to learn about your connection to water in your community. In Indigenous cultures, water has such an important role and historical meaning. This is unique to each community. We would like to learn about some of the traditions and celebrations that your community is involved in.

3. Could you tell us about some of the things that you or your community is involved here that reflects your culture?

4. From the different traditions and celebrations you have shared with us, is water used in those traditions?

☐ Yes ☐ No ☐ Not sure

5. We would like to hear about why water is important in those traditions and celebrations.

Community Water Health

6. Do you know where your drinking water comes from?

☐ Yes ☐ No

7. Is your water treated?

☐ Yes ☐ No ☐ Not sure

8. If you said “yes”, do you know how your water is treated? *Otherwise, skip to Question #9.*

☐ Yes ☐ No ☐ Not sure

9. On a scale of 0-10, how satisfied are you with the way your water is treated? *Circle your answer.*

| | | | | | | | | | | |
|--------------|---|---|---|---|--------|---|---|---|---|-----------|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| very | | | | | unsure | | | | | very |
| dissatisfied | | | | | | | | | | satisfied |

10. On a scale of 0-10, how satisfied are you with the water management in your community? *Circle your answer.*

| | | | | | | | | | | |
|--------------|---|---|---|---|--------|---|---|---|---|-----------|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| very | | | | | unsure | | | | | very |
| dissatisfied | | | | | | | | | | satisfied |

11. Do you think there are any challenges with the water management in your community?

☐ Yes ☐ No ☐ Not sure

12. If you said “yes”, do you have any comments about the challenges you have seen with the water management? *Otherwise, skip to Question #13.*

13. Are you aware of any new treatment plans for your community?

☐ Yes ☐ No ☐ Not sure

14. If you said “yes”, what do you know about the new treatment plan? *Otherwise skip to Question #15.*

15. What do you think of the treatment plan? *Please answer only if you know about the treatment plan. Otherwise skip to Question # 16.*

16. How do you feel about your water being chlorinated?

17. Have you had any boil water advisories?

☐ Yes ☐ No ☐ Not sure

18. If “yes”, do you know the reason(s) for the boil water advisories?

19. How do you hear about these boil water advisories?

20. On a scale of 0-10, how safe do you think your drinking water is?

| | | | | | | | | | | |
|----------------|---|---|---|---|--------|---|---|---|---|--------------|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| very unsafe | | | | | unsure | | | | | very safe |

21. Do you have any concerns about your drinking water?

☐ Yes ☐ No ☐ Not sure

22. Can you tell us about some of your concerns?

Your Water Health

23. Do you drink water everyday?

☐ Yes ☐ No ☐ Not sure

24. Do you drink tap water?

☐ Yes ☐ No ☐ Not sure

25. Do you drink bottled water?

☐ Yes ☐ No ☐ Not sure

26. Do you prefer tap or bottled water?

☐ Tap water ☐ Bottled water

27. Can you tell us why you prefer tap or bottled water?

28. On average, how many glasses of water do you drink in a day?

29. Is there anything that would encourage you to drink more water in a day?

30. How important is water for your overall health?

31. Can you tell us about some health benefits to drinking water?

32. What else do you drink?

☐ Coffee ☐ Tea ☐ Juice ☐ Pop ☐ Other: _____

33. Do you have any comment about your beverage preferences? *ie. Why you like certain drinks over others.*

Water Conservation

34. How important is it to conserve water in your community?

| | | | | | | | | | | |
|-------------|---|---|---|---|--------|---|---|---|---|-----------|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| very | | | | | unsure | | | | | very |
| unimportant | | | | | | | | | | important |

35. Can you describe why you feel that it is or is not important?

36. What are some ways people can conserve water?

37. Do you have any concerns about your water supply?

☐ Yes ☐ No ☐ Not sure

38. If you said “yes”, why do you think there is a problem with your water supply? *Otherwise, skip to Question #39.*

39. What do you think are some ways to improve the water supply in your community?

Community Feedback for Water Treatment: self-governance & ownership

40. Do you have any ideas or suggestions about how your community could manage the water operation system here?

41. Do you have any ideas or suggestions how you would like your water to be treated?

42. Do you have any other ideas or suggestions about your water that you would like to share with us?

43. This Aboriginal Water Project is a partnership between your community and UBC. How do you feel about this partnership?

44. Do you have any feedback you would like to share with us?

45. How would you describe your community's relationship with the water operator?

46. How would you describe your community's relationship with AANDC about your water?

Thank you very much for being part of this talking circle

Appendix B: Water operator interview guide

Investigation into Training and Support Provided to Water Operators in BC First Nations Communities

Potential interview questions

Questions about job satisfaction:

Do you enjoy your work as a water operator? Why or why not?

Do you find your work rewarding? Why or why not?

Can you think of things that could be changed to make your work more enjoyable and/or more rewarding?

Do you feel motivated? If yes, what motivates you? If not, can you think of something that would make you feel more motivated in your work?

Questions about training:

Do you think the training that you have received is adequate?

Do you find your work challenging? Has the training that you have had allow you to deal with challenges?

Are there barriers that exist for you to go to training (ie. cost, transportation, having work covered)? If so, how do you think these could be reduced or eliminated?

What suggestions do you have to improve training?

Questions about support:

Could you please describe your relationship with your community?

What is your relationship with leadership in the community?

Involvement/support from Chief and Council?

How do you communicate information with your community?

What information do you share with your community?

Do you feel accountable to your community?

Do you feel that your community values your work?

Are there any changes that you would like to see in the ways that you interact with your community?

■ Could you please describe your relationship with Aboriginal Affairs (AANDC)?

- How often do you communicate with someone from AANDC? - Would you like to communicate more/less with AANDC? - Do you feel that your opinions are valued when you speak to AANDC? - Do you feel that AANDC could better support you in your work? If so,

how?

Depending on the type of water system, this may or may not be applicable:

- Have you had any interactions with engineering firms in your work?
- If so, have you had any input on water treatment system design?
- Do you have ongoing communication with the engineering firm(s) that designed your treatment system? Are there any topics that I have not covered that you would like to talk about?

Appendix C: Regional map of British Columbia

Figure C.1 Regional map of British Columbia



Image source: *Travel.bc.ca* (*Travel.bc.ca*, 2015)

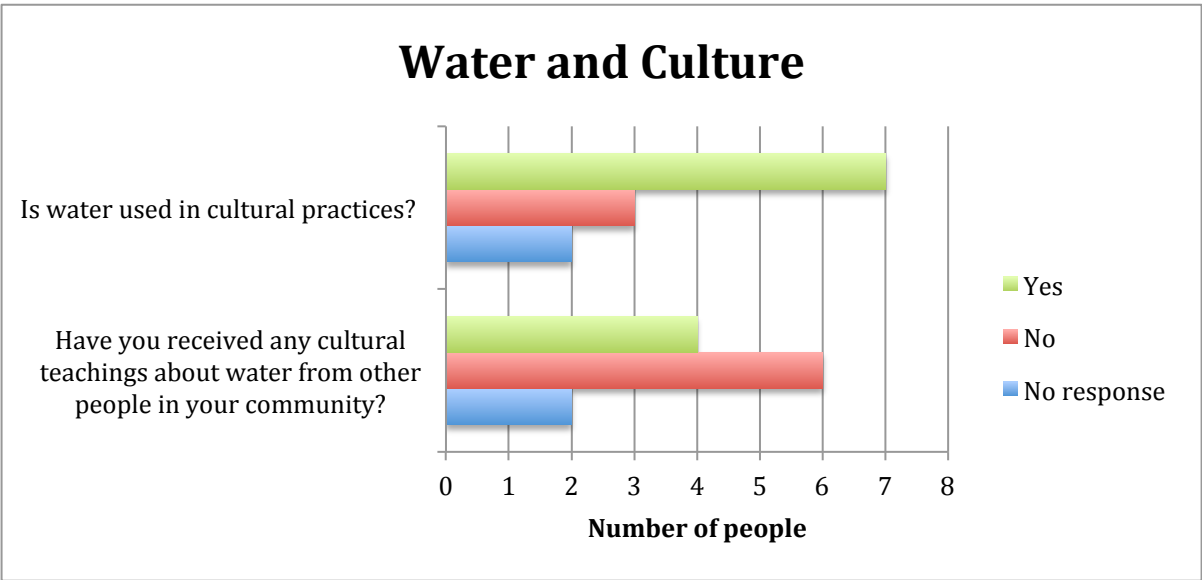
Appendix D: Supplemental community questionnaire data

The following section contains additional qualitative data obtained from community questionnaires. Results for each community are summarized below and grouped related to the three sections of the questionnaire: (1) water and culture, (2) Drinking water consumption, awareness about water treatment, and concerns, and (3) water and health

Boothroyd Band

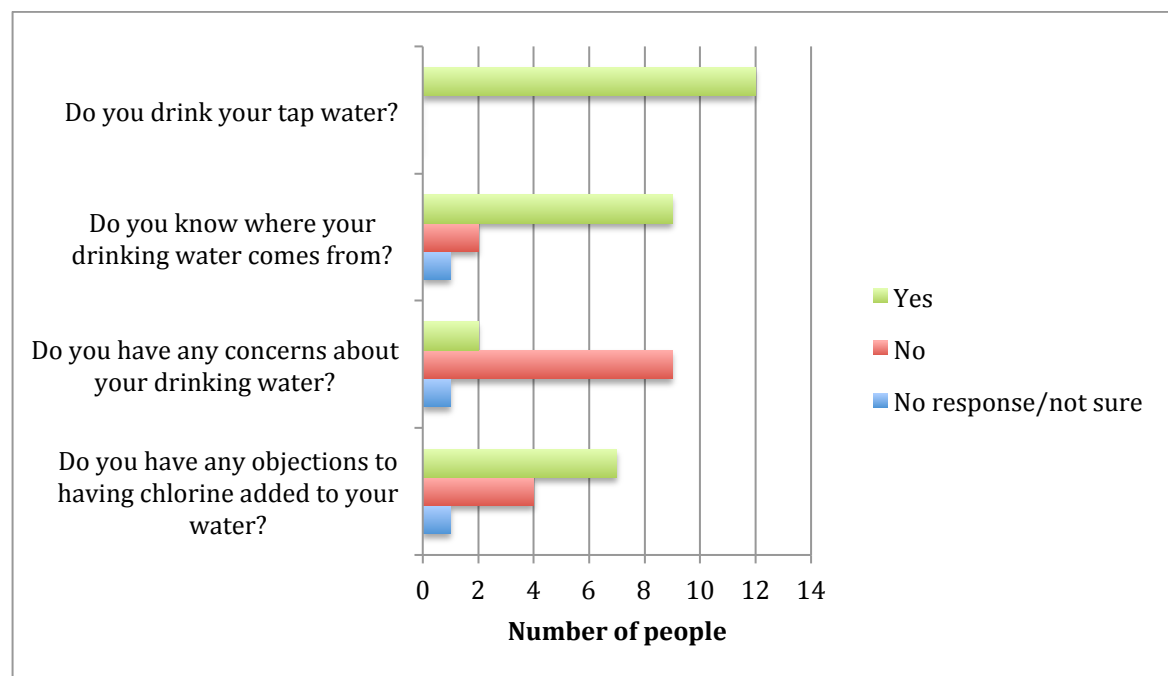
(1) Water and culture: When asked about the cultural importance of water, people talked about the value of water in ceremonies such as sweats, and the cleansing and healing powers of water. People also talked about the importance of water for cooking and that water provides people with fish. The following chart shows the responses from the questions related to the cultural importance of water from the 12 completed questionnaires.

Figure D.1 Boothroyd Band questionnaire responses: water and culture



(2) Drinking water consumption, awareness about water treatment, and concerns: When asked if they drink the tap water, 100% of people surveyed responded that they did. People also were quite aware of where their water came from as 75% people responded knowing their drinking water source. When asked about drinking water concerns, one respondent was concerned that their water appeared cloudy and had a metallic taste to it. Another respondent shared that they were concerned about the sediment in the water, as well as possibly contamination from septic tanks. Finally, there were some questions about water testing and one respondent expressed that they would like to have water test results shared as they wanted to know that the water was not making affecting their health. Respondents who did not have concerns about their water commented on this and some of the reasons expressed were that the water tastes good and is checked often.

Figure D.2 Boothroyd Band questionnaire responses: water consumption, awareness and concerns



Finally, when asked about chlorination, 7 people responded that they had concerns about chlorine being added. The main concern about chlorine was taste, 5 people responded that they did not like the taste of chlorine. 3 people who responded that they had concerns also mentioned that they had objections unless adding chlorine was necessary. Finally, one person responded by asking why chlorine was needed.

(3) Water and health: In the questionnaire when asked about the importance of water to their health, 11 out of 12 respondents reported that they thought water was “very important”, one respondent stated they thought water was “somewhat important”. The average number of glasses of water people reported to consume per day was 4.

Lytton First Nation

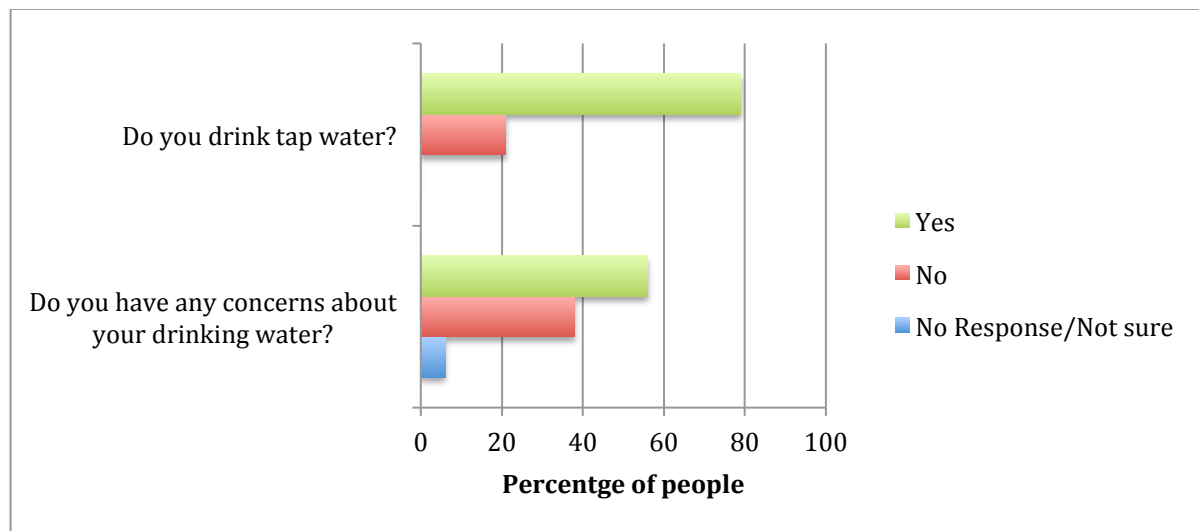
(1) Water and culture: When asked about the cultural importance of water, people talked about the value of water in ceremonies such as sweats or puberty rights. Additionally, people spoke about the grounding and cleansing power of water. It was also mentioned that water is important for growing food in gardens in the community.

When asked if water is used in cultural activities, of the 61 questionnaire participants, 94% of people who responded said yes, 4% of people said no, and 2% of people said they were not sure. People talked about the importance of water in ceremonies such as sweats, and of the cleansing and purifying power of water. There were also responses that talked about the connection between water and food, both for growing food and the connection to water and fish. Many people spoke of water being sacred and of the connection with water and all living things.

(2) Drinking water consumption, awareness about water treatment, and concerns: In their survey responses, the majority of people surveyed drink tap water (79% of people said they drink tap water). When asked if they have concerns about their drinking water, 56% of people said that they do, 38% of people responded that they have no concerns, and 6% of people said that they

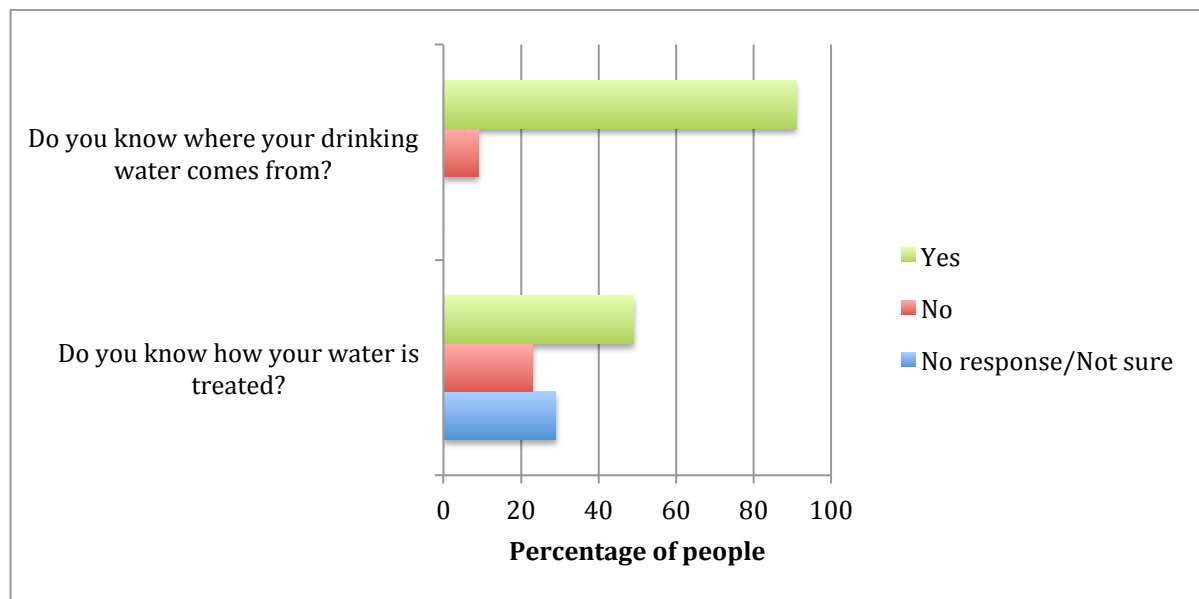
were not sure. Most of the concerns that people had were related to their health and concerns about their water quality. Some people stated that they wanted more information about why water treatment is needed. There were some concerns raised about chlorine, as well as concerns about water hardness.

Figure D.3 Lytton First Nation questionnaire responses: water consumption and concerns



There was a high level of awareness of people's water source. 91% of people know their water source, 9% did not know. There was less awareness of water treatment with only 49% of people stating that they know how their water is treated, 23 % of people stated that they don't know how their water is treated, and 29% reported that they were not sure.

Figure D.4 Lytton First Nation questionnaire responses: drinking water awareness



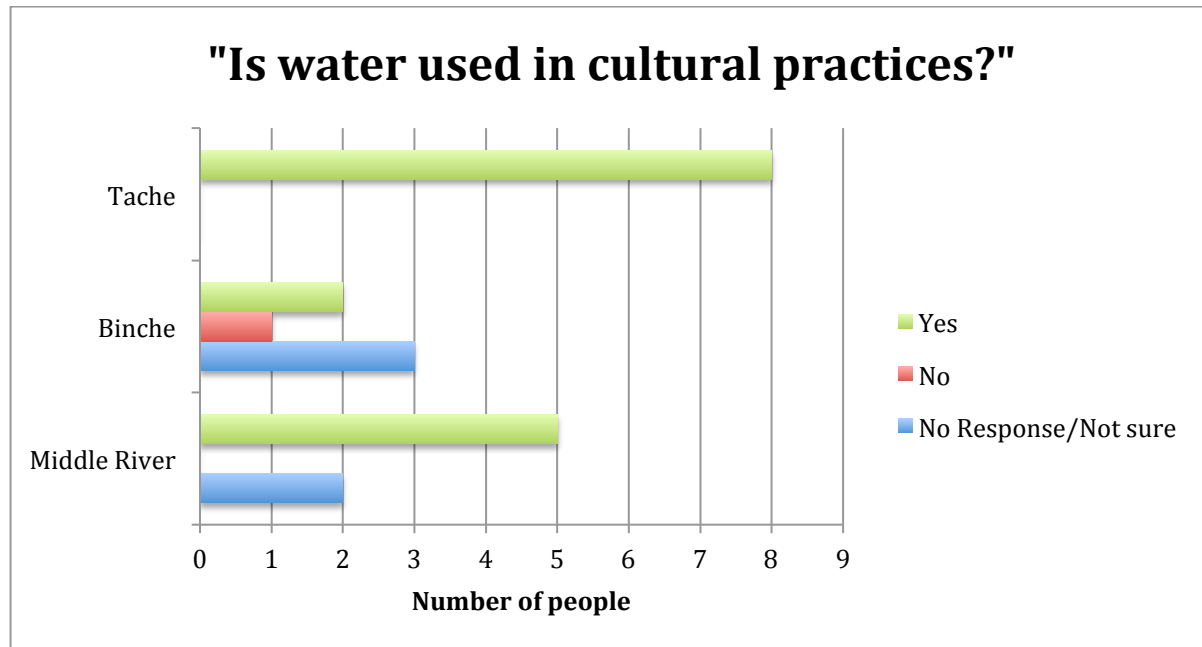
(3) Water and health: When asked how many glasses of water people drink in a day, the average was 5 glasses of water. 54% of people reported drinking more than 5 glasses of water per day. There was a high level of awareness of the benefits of drinking water for ones health. 94% of people who answered the question “How important is water to your overall health?” stated that water was “very important” for their health. 4% responded that water was “somewhat important” and 2% of people did not believe water was important to their health.

Tl’azt’en Nation

(1) Water and culture: In their responses to the questionnaire community members talked about the use of water in ceremonies, such as sweats, as well as the importance of water for fishing and hunting. The use of water in medicines was talked about as well as cleansing power of water.

The following chart shows the responses from the three communities when asked “Is water used in cultural practices?”

Figure D.5 Tl’azt’en Nation questionnaire responses: water and culture



(2) Drinking water consumption, awareness about water treatment, and concerns: As can be seen in the following chart, the level of concern for in drinking water is different in each community. People in Binche and Middle River expressed greater concern about their drinking water than people surveyed in Tache.

There was a high level of awareness about their water source in Tache and Middle River. Binche the awareness about their water source was lower than the other two communities.

Figure D.6 Tl'azt'en Nation questionnaire responses: drinking water awareness



As can be seen in the following chart, the response to the question “Do you drink your tap water?” had varied responses within each community. Further information would be needed to know the reasons why people choose to drink tap water vs. bottled water. Some possible reasons that came up in the talking circles were taste preference, cost, convenience, habits, transportation required, and access to information about water quality.

(3) Water and health: The majority of people in all three communities reported that they drank water everyday. Many people expressed concerns about possible impact of their water quality on their health. Some people reported drinking bottled water because of their concerns about their tap water.

Figure D.7 Tl'azt'en Nation questionnaire responses: water consumption

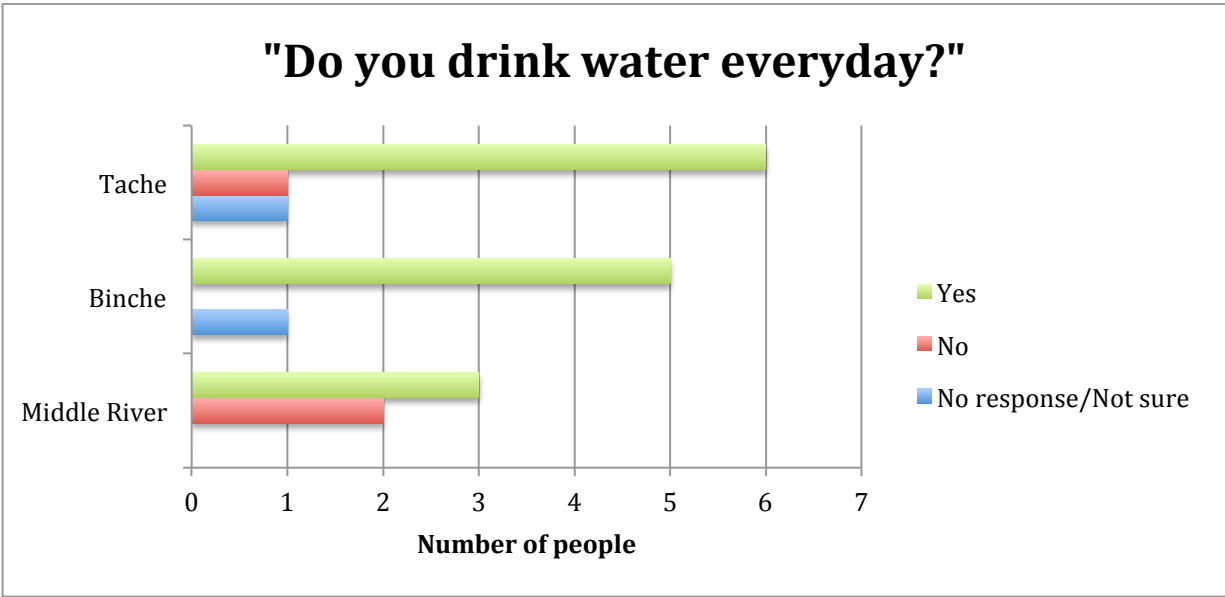
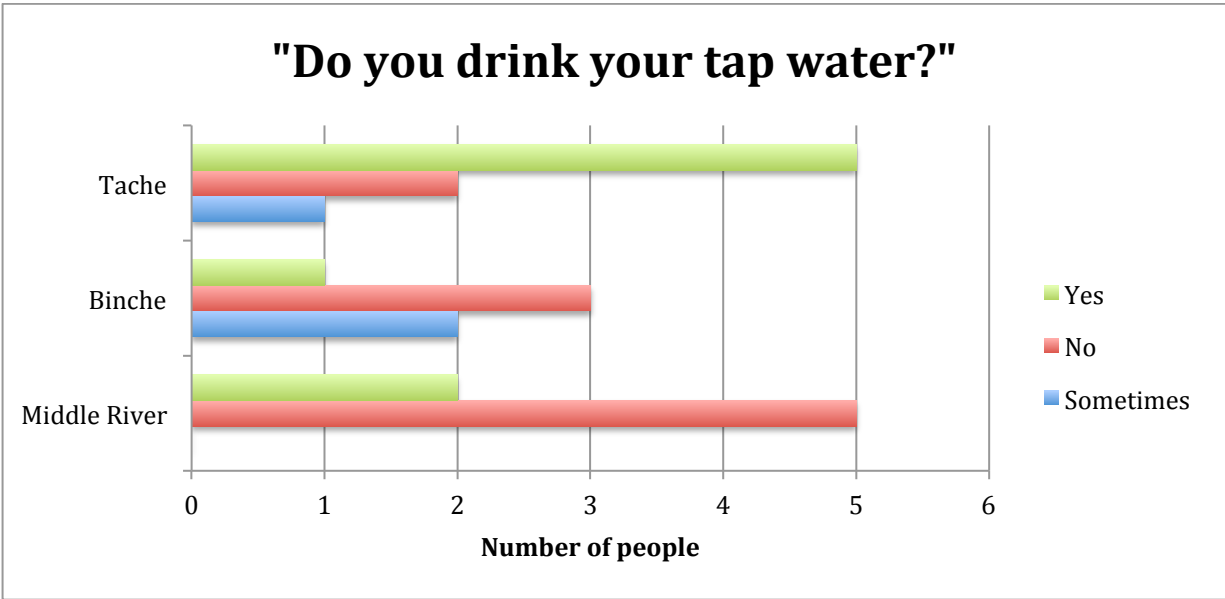


Figure D.8 Tl'azt'en Nation questionnaire responses: tap water consumption



Appendix E: Handout distributed at water and wastewater operator conference

The handout on the following page was distributed to attendees of the 2014 BC First Nation Water and Wastewater Operational Excellence Conference hosted by AANDC in October 2014 in Vancouver BC. The original document was on legal sized paper (8½ by 14 inches) and accompanied a presentation made by the author that shared research findings with conference attendees.

FIRST NATIONS WATER OPERATOR SUPPORT & TRAINING

IN BRITISH COLUMBIA

JOB SATISFACTION

MOST OPERATORS REPORTED BEING SATISFIED WITH THEIR WORK & IDENTIFIED A NUMBER OF FACTORS THAT CONTRIBUTE TO JOB SATISFACTION

JOB FLEXIBILITY, JOB SECURITY, FAIR WAGES, OPPORTUNITIES FOR LEARNING AND PROFESSIONAL GROWTH

WORK ENVIRONMENT: RELATIONSHIP WITH CO-WORKERS & SUPERVISOR, SAFETY, VARIETY OF TASKS, ADEQUATE RESOURCES

ROLE IN COMMUNITY: RECOGNITION, TRUST & APPRECIATION FROM COMMUNITY (CURRENTLY LACKING FOR A NUMBER OF OPERATORS)

SUPPORT FROM WITHIN COMMUNITY

COMMUNITY MEMBERS

IT WAS FOUND THAT IN MOST CASES THERE WAS A LACK OF UNDERSTANDING FROM COMMUNITY MEMBERS ABOUT WHAT OPERATORS DO AND THE IMPORTANCE OF THEIR WORK

COMMUNITY LEADERSHIP

MANY OPERATORS FELT THERE WAS A LACK OF RECOGNITION AND A LACK OF TRUST FROM THEIR COMMUNITY LEADERSHIP

CO-WORKERS & SUPERVISORS

MOST OPERATORS HAD POSITIVE & SUPPORTIVE RELATIONSHIPS WITH THEIR CO-WORKERS & SUPERVISORS

SUPPORT FROM OUTSIDE COMMUNITY

AANDC

FINANCIAL SUPPORT & INVESTMENT IN TRAINING. POTENTIAL TO CREATE TENSION WITH LEADERSHIP BECAUSE OF HAVING A SEPARATE RELATIONSHIP WITH AANDC

CIRCUIT RIDERS

POSITIVE RELATIONSHIPS, PROVIDE ON THE JOB TRAINING & RESOURCES, VALUABLE BACK-UP

ENGINEERING FIRMS

GENERALLY POSITIVE RELATIONSHIPS, COST IS AN ISSUE, FACILITY SPECIFIC TRAINING ON SYSTEMS IS VALUABLE

OTHER OPERATORS

VERY IMPORTANT SOURCE OF MORAL SUPPORT AS WELL AS RESOURCE & KNOWLEDGE SHARING, CURRENTLY OPERATOR DRIVEN MOVEMENT TO FORM AN OPERATOR ASSOCIATION

WHY WORK WITH OPERATORS?

- WELL TRAINED & WELL SUPPORTED OPERATORS ARE NEEDED TO ENSURE WATER TREATMENT SYSTEMS ARE OPERATING PROPERLY AND PROVIDING COMMUNITIES WITH SAFE DRINKING WATER
- OPERATORS ARE KEY EDUCATORS AND ADVOCATES FOR THEIR WATER SYSTEM AND THEIR COMMUNITY'S HEALTH

GOALS OF THIS WORK

- INTERVIEW OPERATORS IN ORDER TO UNDERSTAND CHALLENGES FACING FIRST NATIONS WATER OPERATORS IN BC
- COMMUNICATE THESE CHALLENGES BACK TO OPERATORS IN ORDER TO START DISCUSSIONS ON HOW TO BEST ADDRESS THESE ISSUES

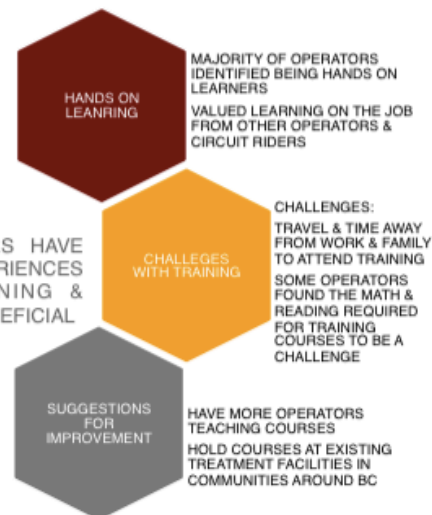
MOTIVATION

OPERATORS ARE PRIMARILY MOTIVATED BY A DESIRE TO MAKE A POSITIVE CONTRIBUTION TO THEIR COMMUNITY



TRAINING

OVERALL OPERATORS HAVE HAD POSITIVE EXPERIENCES WITH THEIR TRAINING & FOUND TRAINING BENEFICIAL



ISSUES TO ADDRESS

OPERATORS IDENTIFIED THE FOLLOWING ISSUES & CHALLENGES AS WELL AS SOME SUGGESTIONS TO ADDRESS THESE

INCREASED SUPPORT FROM COMMUNITY LEADERSHIP

- NEED FOR LEADERSHIP TO INVEST TIME IN LEARNING ABOUT WHAT OPERATORS DO & THE VALUE OF THEIR WORK
- FINANCIAL SUPPORT THROUGH PAYING FAIR WAGES
- TRUST IN WATER OPERATOR OPINIONS
- SUPPORT & ENCOURAGEMENT FOR OPERATORS TO GO TO TRAINING

INCREASED FINANCIAL TRANSPARENCY AND OPERATOR INVOLVEMENT IN BUDGETING

- SEEK OPERATOR INPUT WHEN PREPARING BUDGET
- ALLOCATE ADEQUATE FUNDING FOR WATER SYSTEM
- OPERATORS SHOULD HAVE ACCESS TO THEIR BUDGET

MORE COMMUNITY AWARENESS AND APPRECIATION OF OPERATORS

- OPERATORS HAVE HAD SUCCESS WITH PUBLIC EDUCATION THROUGH WATER PLANT TOURS, SENDING OUT INFO IN NEWSLETTERS & PARTICIPATING IN COMMUNITY MEETINGS
- IMPORTANT TO HAVE PUBLIC RECOGNITION & APPRECIATION OF OPERATORS WORK

BY KAITLYNN LIVINGSTONE, MASC CANDIDATE IN CHEMICAL AND BIOLOGICAL ENGINEERING, UBC VANCOUVER
FOR MORE INFORMATION EMAIL: klivingstone@chbe.ubc.ca