

**First Nations Boil Water Advisories: New Methods and New Approaches for Risk
Communication.**

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Abstract

When issuing drinking water advisories (such as boil water advisories, or BWAs) in First Nations, risk communicators must consider the unique historical, political, social and cultural context. A small number of studies have examined risk communication and message mapping in the First Nations context but First Nations drinking water-specific literature is scarce. A community-based participatory research (CBPR) project was conducted with two First Nations and their tribal council in Saskatchewan. The study examined the applicability of risk communication and message mapping in the First Nations context, with the overall goals of improving local risk communication practices and contributing to a First Nations drinking water risk communication framework.

Using the *Science in a Circle* © model, the research partners developed a four-phase CBPR project, rooted in mutual respect for Indigenous and western science worldviews. Through a series of initial community meetings, the research team determined a novel method would be required to investigate boil water advisory communications using culturally appropriate methods. The *Participatory Dot-Mapping Method* enabled local leaders, experts and everyday community members to participate in all steps of the research process, including data interpretation. Using coloured dots on a map-like response board, participants from each community used coloured dots to note their main concerns, questions and information needs around BWAs. Current and potential BWA communication tactics were also evaluated. Age-coded dot colours showed differences between life stages or age groups.

The results suggest effective risk communication must consider factors unique to each community. These include frequency of advisories and preferred methods of communication (e.g. radio, social media, interpersonal communication). Door-to-door flyers and social media alerts were more popular in one community, with youth and/or Elders showing more interest in other electronic alerts (e.g. text, email). Door-to-door flyers and local radio alerts were more popular in the other community. Like non-Indigenous communities, more research is needed to understand how frequency of boil water advisories should inform their communication, and/or what kinds of messages can improve communications of BWAs. Communities should consider health promotion and education activities around BWAs between advisories. Overall, the *Science in a Circle* © approach and *the Participatory Dot-Mapping Method* generated actionable local policy knowledge for First Nations and their agencies.

Acknowledgements: Thank You/Merci/Miigwetch/Ekosi

One of my earliest memories is watching my mom fill a drinking water barrel at a community tap in Thunder Bay, Ontario. We lived a land-based lifestyle in Kaministiquia near Thunder Bay. My cousins, neighbours and friends lived in this area without running water, indoor plumbing, electricity or phones for many years. When my mom talks about those days, she says she used to “chop the wood for the woodstove, haul the snow upstairs, melt it on the stove, then use that bucket of water to wash [us], wash [herself], then mop the floor”. Boiling water was a huge pain—she would never waste a drop. Even though they were busy taking care of two little kids with no modern luxuries, my mom and dad found the time to teach me to read, write and think. To question. To be resourceful. To stand up for myself and fight what’s unfair. These skills have served me well throughout my life and in my education. I thank them for this.

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Dedication

I dedicate this thesis to my husband Jason. He is the strong, patient and hilarious support that enables this work. He is *my tall drink of water*.

I also dedicate this thesis to the memory of my aunt, Carroll Lou Adams. Even though you went missing when I was just an infant 33 years ago, I owe part of my success to you.

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Preface

In late 2016, a research partnership was formed between the University of Saskatchewan School of Public Health, The Saskatoon Tribal Council, Mistawasis Nêhiyawak and Muskoday First Nation. Drawing on previous professional and research relationships, this group of co-investigators agreed that recurring (and in some cases frequent) short-term boil water advisories in the communities posed a communication challenge for the First Nations' public health officials. They also believed local water users sometimes found it difficult to comply with frequent BWAs, even when there was a potential risk to human health from pressure losses, water main breaks or treatment failures.

While many First Nations communities across Canada are just now in the process of taking over governance of their health services, the Saskatoon Tribal Council has provided environmental health services to their members for nearly 25 years through Saskatoon Tribal Council Health and Family Services Inc. Over those two decades, they have worked on behalf of their member communities to develop First Nations-oriented policies in health service delivery and research relationships. This includes very strong capacity to develop and implement community-driven research that complies with the principles of OCAP™. From the perspective of a researcher, this not only translates into a well-articulated partnership, but also research partners who are confident participants and leaders in the research process.

The bulk of the scholarly literature on Indigenous research methods tells us that when communities control and take leadership in research, the whole research process shifts. Indigenous knowledge and ways of knowing become part of the research process – even if the topic is largely rooted in western science. Research questions become nuanced to local priorities. Novel methods are designed to ask the right questions of the right people in a good way. That is how this project took form. The purpose of this project was to assess the applicability of risk communication theory to drinking water advisories in the First Nations context. By exploring this question through the *Science in a Circle* © community-based participatory research model, it also aimed to:

- a) identify the concerns, knowledge and communication needs of everyday drinking water system users from Mistawasis Nêhiyawak and Muskoday First Nation.
- a) uncover ways to improve drinking water advisory communication with the First Nations and develop local capacity.

- b) generate knowledge for a risk communication framework for adverse water events with First Nations and their agencies.

This was accomplished through a four-phase community-based participatory research project that was strongly situated within Cree Elder Willie Ermine (2007)'s Ethical Space of Engagement for cross-cultural research and Mi'kmaq Elder Albert Marshall's Two-Eyed Seeing approach to research. Part of this four-phase project also included the development of a novel research method for First Nations risk communication research. While this is exciting work, it is also particularly complex to write about each "layer", if you will, in a single paper that is compelling and clear.

Instead, I decided to write this thesis as a series of three separate papers, each with a unique focus for description and discussion. While this thesis is said to be in "Manuscript-style," I note that each paper exceeds the maximum length of a standard publishable article.

- a) First is a summary paper, with a strong focus introducing the topic, giving a review of the literature, and describing the theoretical framework around drinking water management, risk perception, and risk communication. This paper has the most substantive discussion around the main research question: how does risk communication apply to the First Nations context? This article (after editing) would be suitable for a publication such as the *Canadian Journal of Public Health*.
- b) The second paper offers a more theoretical discussion around the project's research philosophy and methodology. It describes the community-based participatory research approach and study design in more detail. The discussion explores the role of *Science in a Circle* in the Tribal Council context, and potential applications for environmental health professionals in other First Nations agencies. This would be appropriate for an environmental health industry journal such as *The Environmental Health Review*.
- c) The third paper describes the *Participatory Dot-Mapping Method*, which we developed to conform to our project's research, community and practical requirements. This paper discusses how the Integration of Indigenous ways of knowing into policy development can be a powerful force for change, and how fun, interactive methods can engage hard-to-reach community members on First Nations policy topics. This paper would be best suited for submission to the *International Journal of Qualitative Methods* or the *International Indigenous Policy Journal*.

While each of these papers can be read as a standalone, they are best read as a series. Each one provides a unique frame of analysis for this very exciting project, and I believe I speak for all the research partners when I say we are excited to share it with you. Thank you for reading!

Diane Adams

Chapter One: Risk Communication of Adverse Drinking Water Events in The First Nations and Tribal Council Context

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- d) Laura Parenteau, Environmental Health Program Manager, Saskatoon Tribal Council Health and Family Services Inc.
- e) Dr. Lalita Bharadwaj, School of Public Health, University of Saskatchewan.

1.1 Abstract

First Nations are responsible for issuing drinking water advisories (DWAs) when adverse water events occur. Boil water advisories (BWAs) are the most common type of DWA issued by First Nations and Canadian municipalities. While the Government of Canada focuses on improving long-term boil water advisories on-reserve, many First Nations experience occasional or frequent short-term (temporary) boil water advisories. Evidence suggests that the public is less likely to comply with BWAs if they are issued frequently.

Message mapping is a risk communication framework to improve the quality and efficacy of public health communications during emergencies or urgent events, such as boil water advisories. This project explored the relevance of risk communication to the First Nations and Tribal Council context. Using a novel participatory method, 152 participants from two First Nations, segmented by age, mapped their information needs, concerns and questions around boil water advisories. They indicated current and preferred BWA notification methods.

This project found that risk communication planning and research should be completed at the community-level. In one community, residents relied heavily on Facebook, door-to-door flyers, and interpersonal communication, while in another community residents preferred the existing system of door-to-door flyers and the local radio alerts.

Communities should conduct health promotion between advisories around water treatment science and different types of advisories. Like in other jurisdictions in Canada and globally, boil

water advisory compliance is a concern. Future research could examine the efficacy of door-to-door flyers and what messages may improve compliance when frequent BWAs are issued.

1.2 Introduction and Theoretical Framework

Waterborne outbreaks and chemical contamination events, also called adverse water events (AWEs), are water emergencies that can cause direct harm to human health. In Canada, two contemporary high-profile AWEs in Walkerton, Ontario and North Battleford, Saskatchewan caused widespread (and in the case of Walkerton, fatal) outbreaks in the early 2000s. In response, drinking water hazard management and emergency response policy in Canada substantially changed (Hrudey & Hrudey, 2002; Plummer, Velaniškis, de Grosbois, Kreutzwiser, & de Loë, 2010). When AWEs are known to have occurred or have potentially occurred in drinking water supply systems, local governments issue drinking water advisories (DWAs). These advisories notify the public of real or potential waterborne health risks and urge them to take actions to protect their health, *e.g.* boil their water. AWEs and DWAs are a routine, ongoing issue both for Canadian municipalities and First Nations. A report by the non-profit advocacy group Council of Canadians determined 1838 DWAs were in effect in Canada as of January 2015, with 1669 of those for non-First Nations communities and 169 for First Nations (Lui, 2015). In January 2017, Indigenous Services Canada reported there are 62 long-term drinking water advisories on First Nations south of the 60th parallel, having lifted 78 long-term advisories since late 2015, and 27 short-term advisories. These counts do not include data from the Saskatoon Tribal Council and all First Nations in British Columbia (Indigenous Services Canada, 2018a, 2018c). In Canada, most drinking water advisories are issued for small drinking water systems. In 2017, drinking water systems serving fewer than 500 people accounted for 77% of reported advisories in Canada (Environment and Climate Change Canada, 2018).

In 2016, a surface water contamination event in Saskatchewan renewed public and political interest in AWEs. In this incident, an oil pipeline owned by Husky Energy broke and spilled crude oil into the North Saskatchewan River. Several Saskatchewan municipalities source their drinking water supply from this river. The drinking water supply of Muskoday First Nation was shut off and the drinking water supply of Cumberland House Cree Nation was threatened (Government of Saskatchewan, 2016). These municipalities and First Nations tapped drinking water reserves or sought alternate water supplies to avoid DWAs, and stringent water

conservation measures were implemented for water users. One First Nation was forced to call a state of emergency (Water Canada, 2016). Municipal, provincial and First Nations governments, water authorities and public health departments responded to significant public concerns around drinking water safety and supply (Government of Saskatchewan, 2018; Saskatoon Star Phoenix, 2018).

Communication during emergencies or urgent public health matters is a complex process of information exchange between officials and the public. In risk communication, individuals, groups or institutions exchange information about the nature and magnitude of natural, industrial or ecological risks. Crisis risk communication aims to do so quickly and effectively during an emergency (Glik, 2007). The public's response to risk communication messages is mediated by the cause of the risk and the relationship between the communicator and recipient (November & Leanza, 2015; Slovic, 1993a; van der Pligt, 1998). Historical and cultural factors also affect public response (Glik, 2007; Wildavsky & Dake, 1990). First Nations communities have unique cultural, historical, political and social contexts. These uniquely shape contemporary issues such as access to safe drinking water. Therefore, any effort to examine risk communication of a contemporary public health issue like drinking water events must consider a community's unique history, culture, politics and social norms. Through a community-based participatory approach, this project explored the communication of DWAs in the context of two First Nations communities, in partnership with their Tribal Council. Both communities experienced recent drinking water issues that resulted in DWAs for their water treatment and/or distribution system(s). The communication needs and priorities of two Saskatchewan First Nations and their Tribal Council were identified and the applicability of risk perception and communication theory to the First Nations drinking water context was assessed.

1.2.1 Safe Drinking Water Management and Communication: The Canadian Context.

This section will discuss the overall context of safe drinking water management in Canada, particularly as it relates to DWAs. In Canada, drinking water management is largely a provincial (municipal) issue, and there is no national mandatory drinking water advisory surveillance system. Instead, Environment and Climate Change Canada (2018) reports drinking water advisory statistics obtained from the Canadian Network for Public Health Intelligence's Drinking Water Advisories application. Only a subset (representing <50% of the Canadian

population) of agencies and jurisdictions use or share information with this voluntary service. These datasets show the vast majority of DWAs are issued in small communities. In 2017, 77% of the DWAs issued were in communities of less than 500 people. Eighty-three percent of all DWAs issued in 2017 were precautionary, rather than due to a known health risk. The proportion of advisories issued for precautionary reasons steadily increased from 2010-2017 (Environment and Climate Change Canada, 2018). Residents of the Province of Newfoundland and Labrador experience a high number of DWAs. In 2015-2016, the Government of Newfoundland and Labrador (2017) reported 217 short and long-term boil water advisories in 157 communities. Nearly 44 000 (or 8%) of Newfoundland's 528 815 residents were affected (Government of Newfoundland and Labrador, 2017; Newfoundland and Labrador Statistics Agency, 2017). These numbers are attributed to the province's large number of small drinking water systems in small, low-resource rural communities (Government of Newfoundland and Labrador, 2017; Jones-Bitton, Gustafson, Butt, & Majowicz, 2016).

The *Guidelines for Canadian Drinking Water Quality* (GCDWQ) is the chief guidance document for drinking water quality for all jurisdictions in Canada (Government of Canada, 2017). The GCDWQ, along with its accompanying DWA technical guidance documents (Health Canada, 2010, 2016), identifies three key types of drinking water advisories:

1. Precautionary boil water advisories (PBWAs), also called boil water notices, are the most common type of advisory issued in Canada. They are often issued when drinking water treatment or distribution fails, often due to maintenance or equipment breaks. This results in the potential for infectious microorganisms to enter the system or survive treatment. They are issued even if a specific threat to public health has not been identified. (Health Canada, 2016).
2. Emergency boil water advisories, also called emergency boil water orders (EWBOs), are less common. They are issued when a public health threat has been identified. When a pathogen (usually *Escherichia coli*) is detected and confirmed through laboratory analysis, an emergency boil water advisory is issued. They can also be issued when a system experiences a significant treatment failure. Local authorities also call EWBOs when epidemiological evidence suggests that a local system is the cause of an outbreak.

3. Drinking Water Avoidance Advisories (DWAAs), also called “do not consume” or “do not drink” notices, are issued when a contaminant is chemical in nature. Chemicals cannot be neutralized through boiling or can cause adverse health effects through alternate routes such as dermal contact or inhalation (Health Canada, 2010).

It is important to note that the GCDWQ is a non-binding set of guidelines. Provinces (and federal jurisdictions such as First Nations, military bases, etc.) use the GCDWQ to set water quality standards. Canada’s *Constitution Act, 1967*, assigns authority over most drinking water issues to the provinces. As a result, Canada’s drinking water governance and management system is highly decentralized across provinces, territories and federal jurisdictions. The system lacks clearly-articulated national standards and protocols for drinking water management (Hrudey, 2011). In 2014, only 16 of the 94 guidelines in the GCDWQ were applied consistently across provincial jurisdictions.

Provincial approaches to safe drinking water management range from voluntary guidelines to full enforceable standards (Dunn, Bakker, & Harris, 2014). The definitions of and process of issuing DWAs also vary from province to province. This may contribute to public confusion when drinking water events in specific locales get national public attention (Jones-Bitton et al., 2016). In Saskatchewan, for example, precautionary DWAs are issued by the provincial Water Security Agency, in consultation with the province’s Ministry of Health. The provincial Health Authority issues Emergency Boil Water Advisories (called Emergency Boil Water Orders in Saskatchewan) in partnership with the Ministry of Environment (SaskWater, n.d.). In other provinces or jurisdictions, provincial health authorities may be responsible for issuing some or all DWAs. However, provincial authorities often delegate drinking water management “down” to individual municipalities (Bakker & Cook, 2011; Hrudey, 2011). In contrast, individual First Nations communities hold authority for drinking water management through Chief and Council, who may delegate some or all of this responsibility “up” to umbrella agencies such as Tribal Councils or First Nations Health/Water Authorities. These transferred authorities and responsibilities often include issuing and rescinding DWAs, as well the full policy development cycle for public communication of AWEs. The Government of Canada provides provinces and federal jurisdictions limited guidance on communicating AWEs through the GCDWQ’s BWA and DWAA guidance documents. These guidance documents state the

importance of effective communication during adverse water events and emergencies. They suggest local authorities include communication specialists on incident response teams.¹ Significant guidance is provided on message content, potential communication methods and consideration of vulnerable groups (Health Canada, 2010, 2016). Consideration of how messaging can affect public perception is limited to cautions of message fatigue when DWAs are issued and rescinded too frequently (Health Canada, 2016).

Overall, the Canadian drinking water management and response system is highly decentralized across provinces, territories and First Nations. While the Government of Canada has developed high-level guidance in drinking water management, including standards and protocols for issuing and rescinding DWAs, there is inconsistent uptake and application of these across jurisdictions.

1.2.2 Safe Drinking Water Management and Communication: The First Nations Context.

As discussed in the previous section, Canada's drinking water management system is a patchwork of authorities, largely distributed between provinces and federal jurisdictions such as First Nations. This section will describe the safe drinking water management context that is specific to First Nations. Safe drinking water management for First Nations south of the 60th parallel is generally shared between Individual First Nations and Indigenous Services Canada. Indigenous Services Canada is a federal ministry formed in 2017 after the dissolution of Indigenous and Northern Affairs Canada and the First Nations and Inuit Health Branch of Health Canada (Indigenous Services Canada, 2017). First Nations, led by Chief and Council, govern and manage the day-to-day operations of their drinking water plants and distribution systems. This includes water sampling, testing, issuing DWAs and communicating them to affected households. First Nations also plan for and develop new infrastructure, such as water treatment plants and wastewater plants.

Indigenous Services Canada provides funding for water systems and may provide advice on plant design, procurement, upgrades, operation and maintenance, or training water treatment

¹ Incident response teams are pre-identified interdisciplinary teams ultimately responsible for responding to adverse drinking water events in communities.

plant operators. Indigenous Services Canada also employs environmental health officers (who are generally certified public health inspectors) as a resource to First Nations. They provide service by request and are often a key source of public health expertise and guidance for communities, including safe drinking water programs (Indigenous Services Canada, 2018b). This includes support for communicating AWEs and issuing of DWAs directly to First Nation Band Councils. However, communities are able to assume these responsibilities through agreements such as health transfer policy (Government of Canada, 2016a). Nearly all First Nations drinking water advisory data is collected, managed and reported publicly by Indigenous Services Canada, (Indigenous Services Canada, 2018c). Some communities and agencies who are responsible for their drinking water management choose not to report their DWA data to the Government of Canada.

There is some variability to the way First Nations environmental health services are delivered across regions of Canada. In Saskatchewan and Manitoba, for example, the responsibility of providing Environmental Health Services is often delegated to Tribal Councils through health transfer agreements. These agencies are created and governed by groups of partner First Nations to provide community-driven aggregate services to member communities (Government of Canada, 2016b). These services may include, but are not limited to, environmental health, social, housing, community development, engineering and advocacy services. In British Columbia, health programs have been aggregated at a provincial level; the First Nations Health Authority has assumed operational authority for Environmental Health programs across the province, and they independently collect and report DWAs on their own website. Many other First Nations regions (such as those in Northwestern Ontario) still rely on ISC's environmental health services but are currently in negotiations with ISC and undertaking the appropriate institutional development to manage future service transfers. Thus, it is safe to say that at the time of publishing (2019), the devolution and/or transfer of authority and service delivery from the Government of Canada to First Nations is an ongoing process. In 2018, Indigenous Services Canada identified efforts to devolve or fully transfer health services through self-government agreements, tripartite agreements and health transformation policies (Indigenous Services Canada, 2018d). Through these transfers, First Nations drinking water management may be completely transformed. For example, the Atlantic Policy Congress of Chiefs Secretariat, representing 30 Atlantic First Nations, hopes to implement the Atlantic First

Nations Water Authority (AFNWA) in 2019. This institution was developed through nearly a decade of intense research and engagement with Atlantic First Nations. Through an opt-in process, they estimate 22 of their member First Nations will transfer the ownership, liability and operational authority for drinking water management to the AFNWA. First Nations across Canada (generally as provincially-oriented regions) are also currently negotiating the full transfer of spending authority, operational authority and service delivery for the First Nations housing and related infrastructure portfolio from ISC (Assembly of First Nations, n.d.).

Despite First Nations' increasing institutional capacity to develop and deliver environmental health and drinking water programs, communities and Tribal Councils may or may not use a formal risk communication approach to communicating DWAs. A plausible explanation for this gap is that risk communication was poorly supported by ISC and its predecessors, despite clear evidence from their own program evaluations that First Nations needed better communication around DWAs. Prior to 2017, First Nations drinking water functions were managed at the federal level by the now-dissolved Indigenous and Northern Affairs Canada (INAC) and the First Nations and Inuit Health Branch of Health Canada (FNIHB) (Indigenous Services Canada, 2017). Today, these functions are both housed under Indigenous Services Canada. ISC is responsible for funding drinking water systems, providing advice on design, maintenance and operation of those systems, and training key drinking water operational staff. also sets standards for drinking water operations through protocols (Indigenous Services Canada, 2018b). From 2008-2012, INAC and Health Canada implemented the First Nations Water and Wastewater Action Plan (FNWWAP). This program aimed to “improve the health and quality of life of people in First Nations communities by assisting First Nations to provide better water and wastewater services to their residents” (Government of Canada, 2012).

In 2011, EKOS Research Associates was contracted by Health Canada to conduct a national survey to evaluate the success of the activities of FNWAAP. The survey covered residents of non-urban First Nations (n=700) and residents of small (< 5000 residents) non-urban, non-First Nations communities (n=706). That survey found First Nations residents were consistently more likely than non-First Nations to report they would feel reassured about the safety of their water supply if they had improved access to information about their drinking water supply. First Nations families with five or more people in the household and three or more

children were the most likely (93%) to want more information about testing procedures. Approximately 4/5 of First Nation families said more information on what to do during a drinking water advisory would make them feel safer about tap water quality. The same proportion indicated a telephone number or website where they could check current water quality would increase perception of tap water safety (EKOS Research Associates, Inc., 2011). This survey showed that in 2011, on-reserve residents had clear need for risk communication around drinking water safety, both during advisories and on an ongoing-basis.

Indigenous and Northern Affairs Canada's Protocol for Safe Drinking Water in First Nations Communities (Indigenous and Northern Affairs Canada, 2010) emerged from the FNWAAP. This protocol requires communities to have Emergency Management Plans (EMPs). Official guidance documents, one developed for BC First Nations (BC Ministry of Environment, 2009) and another developed by the Government of Canada (Sockett & Poulin, 2014), direct communities to include a communication plan as part of their EMPs, noting communities may already have and use their own emergency communication plans. Communication plans identify key contacts in the event of an emergency, and key communication tactics for public notification of AWEs, generally through DWAs. These include public notices, phone trees and email lists, social media and word-of-mouth, media contacts and public signage. Communities are instructed to keep pre-written messages, press releases and social media posts. Despite the findings of the 2011 EKOS survey, no guidance is provided on the content or construction of those messages beyond basic guidance from the GCDWQ (Indigenous and Northern Affairs Canada, 2010). This omission from the Protocol for Safe Drinking Water in First Nations Communities is noteworthy. Without substantial policy guidance on risk communication from Indigenous Services Canada or its predecessors, the responsibility to develop and implement risk communication policies and practices lies on individual communities and their agencies. One way to support the development and implementation of these policies and practices is through formal research and community engagement, which may or may not be completed in partnership with outside research partners (university researchers, for example)

1.2.3 Crisis Risk Communication: Risk Communication and Emergency Response

Any research (particularly academic research) that supports First Nations and their agencies to develop and implement risk communication will likely draw on risk communication

theory and “wise practices.”² The next three sections will discuss risk communication theory generally and as it applies to the First Nations context and the drinking water context. Risk communication is “information exchange about health risks caused by environmental, industrial, or agricultural, processes, policies, or products among individuals, groups, and institutions” (Glik, 2007, p. 34). It aims to convey the magnitude of health risks and support the public in taking precautionary behaviours (Reynolds & Seeger, 2005). Risk communication is diversely applied in public health, occupational health and emergency situations and includes internal communications within organizations as well as external communications to the public (Glik, 2007). It can take a variety of forms ranging from health education to crisis response and use a variety of media, including print, internet, broadcast and interpersonal exchanges (Fitzpatrick-Lewis, Yost, Ciliska, & Krishnaratne, 2010; Glik, 2007). Briggs and Stern (2007) argue that risk communication should also aim to reduce inequality “by empowering all those affected to deal effectively and equitably with the risk” by ensuring all stakeholders have access to the resources they need to respond effectively (p.617).

Crisis risk communication, a form of risk communication, is the process of delivering important information to affected audiences during crisis or emergency. It is a key component of emergency response (Glik, 2007; Reynolds & Seeger, 2005). Briggs and Stern (2007) say that effective communication during an emergency is challenging, and difficulties are amplified in situations where diverse stakeholders must communicate and receive emergency messages. The reason, they add, is that different stakeholders need different kinds of information and for different reasons. For example, some will look to risk communicators for comfort and reassurance, others will look for advice on what actions to take, while others will want to know who to blame. Sandman (2012) also stresses the role of human emotion in crisis risk communication. They say while routine risk communication tries to “scare” people into caring about a risk, in crisis risk communication the goal is to “calm them down again” (p.1). Sandman

² Wise practices are “principles or decisions that contribute significantly to the development of sustainable and equitable social conditions (p. 19)” Wise practices are conceptually different from best practices, in that they advocate for the best approach for a given context, rather than the often de-contextualized ranking of best practices (Wesley-Esquimaux & Calliou, 2010). This paper, however, uses the term best practices in a contextualized context, meaning it is assumed all best practices applied to a local context are akin to wise practices.

(2012) suggests risk communicators think of risk as a function of hazard plus outrage. In this model, Lanard and Sandman (2004) suggest there are four levels of crisis communication:

1. Public relations (high risk and low outrage): despite high risk, the public is unaware or uninterested in the risk. *e.g.* influenza risk, seatbelts.
2. Stakeholder relations (medium-hazard, medium-outrage, *e.g.* drunk driving, distracted driving): the public is calm but interested in your message. This is the ideal stage.
3. Outrage management (low hazard, high outrage *e.g.* wind farms, glyphosate): despite low hazard, the public is angry. Communicators should focus on outrage management over the magnitude of the hazard.
4. Crisis communication (high hazard, high outrage, *e.g.* spills, natural disasters, outbreaks): the public is justifiably alarmed.

To address high hazard and high outrage situations, crisis communicators are encouraged to validate citizen's concerns, acknowledge uncertainty, encourage helpful action and resist the risk to over-reassure justifiably alarmed people (Lanard & Sandman, 2004). One way for public health communicators to manage communication when outrage is high is through message mapping. Message maps are a structured way to simplify, prioritize and limit risk messaging during a crisis, tailored to the specific needs and concerns of the affected audience. Message maps emerge from the theory of mental noise which says that when people are upset, they cannot hear or understand complex information (Covello, 2003; Covello, Minamyer, & Clayton, 2007; Minamyer, 2008). Understanding the dynamics and limits of an audience's ability to process information is also a key component of November and Leanza's (2015) framework for risk, disaster and emergency communication. They suggest risk information can only lead to action if it is available, received and appropriately assessed by the receptor(s). Risk communicators must understand risk information as having temporal and spatial attributes which moves in highly complex ways through the social sphere. In this model, effective risk communication must understand (1) community actors and their perceptions, knowledge and values, (2) the temporal nature of the risk and timing of messaging, and (3) the formal and informal channels of information flow within a community (November & Leanza, 2015). In emergencies, risk communicators are tasked with sending the right message through the right channel at the right

time. In crisis situations, this is very challenging when rapid response is required and uncertainty is high (Briggs & Stern, 2007).

Risk communication and crisis risk communication are new disciplines of public health: there is comparatively little established and published risk communication theory and professional practice guidelines when compared to traditional public health disciplines such as epidemiology, health promotion and sanitation. While the theory of risk communication has been steadily growing since the 1970s, there is relatively little evaluative research conducted on risk communication practices and interventions (Glik, 2007). Lurie, Manolio, Patterson, Collins, and Frieden (2013) argue many emergency response functions, including public communication, are limited by severe lack of data on public health risks. For example, during the Deepwater Horizon oil spill in 2010, public health responders faced major uncertainty due to a lack of data on the immediate health and environmental effects of oil spills. The only way to close this gap, they concluded, is to (1) develop data collection plans for emergencies and (2) conduct evaluative research, both in the periods between crisis events. To build trust and assess public needs, the evaluative research should carefully engage stakeholders and should consider community-based participatory research techniques (Lurie, Manolio, Patterson, Collins, & Frieden, 2013). Reynolds and Seeger (2005) advocate for a similar “integrative approach” to risk communication and response. In their model, public communication must continue until the full resolution of an emergent hazard, followed by ongoing evaluation and risk preparedness activities. This suggests effective crisis risk communication requires deliberate planning and evaluation. Governments who communicate DWAs, for example, should consider community engagement and research activities around DWAs between adverse water events.

1.2.4 Risk Perception Theory

To improve risk communication we also need to understand perceived risk, as public perceptions of risk are a necessary precursor for taking precautionary behaviours to protect health (van der Pligt, 1998). Perceived risk is the psychological perception of hazard or danger, separate from the technical or probabilistic assessments of risk often employed by public health practitioners and experts (Slovic, 1993a). Risk perception is the result of an individual’s interpretation of the risk information or message, based on prior experiences, opinions and social forces. It is prone to heuristics and biases (Doria, 2010). Alternatively, if an individual has few

initial impressions of a hazard, their perceptions will be fueled by the content, tone and nature of the message (Slovic, Fischhoff, & Lichtenstein, 1984) In another perspective, cultural beliefs and biases have been found to be the best to predict risk perceptions, where hierarchical cultures tend to be more trusting of government and institutions, coupled with lower perception of risk from institutional hazards (e.g. water treatment plants) (Wildavsky & Dake, 1990). Barton Laws et al. (2015) suggest that differences in risk perception between ethnicities are not simply explained by cultural beliefs but argue cultural differences in risk perception are better explained by inequitable exposure to environmental hazards rather than cultural influence. They suggest a group's geographic location defines the nature of the risks they face more than social or cognitive processes. Risk characteristics also strongly influence risk perception: risks that are man-made, fatal, unnecessary, proximal, infrequent and out of control are generally perceived as higher risk than those of the opposite nature (natural, non-fatal, necessary, distal, frequent), regardless of quantifiable risk to human health (Slovic et al., 1984).

Sandman's (2012) theory on risk, hazard and outrage suggests these factors not only influence risk perception but also the public's outrage response. Risk perception does not influence precautionary behavior alone. Trust is another key component of risk perception and precautionary behaviors (Slovic, 1993a; van der Pligt, 1998). Trust in risk communication and management is rooted in previous interactions with managers, local governance and participation, and quick response to issues. Poor trust, conversely, is likely when those in power live far away, problems are covered up, or local health status is poor (Slovic, 1993a). The phenomena of social amplification of risk is also a consideration, where risk messages are filtered, discussed and analyzed in the social sphere. Interpersonal interactions, news and social media, and inappropriate responses from risk communicators can amplify risk messages, increase fear and derail the efforts of public health officials to incite health-producing or protecting behaviors (Kasperson et al., 1988).

1.2.5 Risk Perception and Communication in the Drinking Water Context

Doria (2010) and Doria, Pidgeon, and Hunter (2009) are seminal literature on public perceptions of drinking water risk. These studies found the most important predictors of drinking water risk perception are taste, and to a lesser degree odour and colour. Called organoleptic properties, aesthetic qualities can be poor predictors of water safety, particularly

microbiological quality, but can directly influence a person's risk assessment of water safety or trust in their water system overall. They note six additional factors also affect public risk perception of drinking water:

- Contextual factors, such as perceived quality of the distribution system or marketing/packaging of bottled water;
- Impersonal or interpersonal information, such as media reports or information from friends and family;
- Trust in water companies or other groups, including governments and utilities;
- Perceived control, which tends to be restricted for individuals on public water systems;
- Demographics, cultural factors and worldview, these were noted to weaker predictors of risk perception and;
- Overall perceptions of water quality, which can be influenced by combinations of the factors above.

They note that even factors with a weak contribution can have a large effect if an issue is widespread (Doria, 2010; Doria et al., 2009).

Risk communication of water emergencies should follow best practices in risk communication. In a 2007 guide to risk communication of water emergencies, six hypothetical threats to water systems were identified. Message maps were developed for each of the scenarios using focus groups. One example is shown in Figure 1.2-1. They included potential chemical contamination of a reservoir, loss of power at a plant, and suspected bioterrorism. The guide suggests involving a variety of water stakeholders in the process of message mapping, such as vulnerable users, water utility employees and emergency responders (Covello et al., 2007). Comprehensive reviews of environmental and public health risk communication note that a multi-media approach to urgent environmental health risks is preferred (Fitzpatrick-Lewis et al., 2010; Glik, 2007). A recent survey following a boil-water advisory in Newfoundland and Labrador found that radio, television and word-of-mouth were the most effective methods of communication during the advisory, despite comprehensive door-to-door efforts (Jones-Bitton et al., 2016). Similar concerns were noted in another study, where affected people (particularly the elderly) noted issues with door-to-door notices. Their concerns included not knowing the

advisory notice had been left on the door, not being able to understand it, and mistaking it for an advertisement (O'Donnell, Platt, & Aston, 2000). In Saskatchewan, use of internet and social media were effective ways to notify citizens of DWAs, with the authors noting the importance of traditional communication methods for older citizens and for emergencies where social media may not be available (Bradford, Idowu, Zagozewski, & Bharadwaj, 2017). Regardless of method, DWAs may not always result in appropriate behaviour changes; BWA recipients often report not following the advisory's directives (Bradford et al., 2017; Jones-Bitton et al., 2016; O'Donnell et al., 2000; Rundblad, Knapton, & Hunter, 2010).

1.2.6 Risk Perception and Communication in the First Nations Context: A Research Opportunity

The previous sections suggest that culture and context are intrinsically linked to risk perception and, in turn, risk communication. For First Nations, the connection between culture and risk perception of AWEs is intrinsically linked to the value placed on water in Indigenous cultural worldviews, and the reliance of communities on safe water supplies for traditional lifestyles and livelihoods (Stephens, 2010). Other factors unique to First Nations have also been found to influence risk perceptions of drinking water sources. Analysis of data from the 2001 Aboriginal Peoples Survey found that that having a water contamination event in the previous year, being unsure of water's contamination status, having children under 15, being a woman, having less connection to culture, and living in a house in need of repairs were all significant

Figure 1-1: An example of a completed message map for a drinking water emergency. From (Covello et al., 2007, p. 3-18)

Power Loss Message Map 1	
Audience/Stakeholder:	Public/Media
Spokesperson:	Water Utility, City Manager, Mayor, and/or EMA Director
Stage of Crisis:	<input type="checkbox"/> Possible <input type="checkbox"/> Credible <input checked="" type="checkbox"/> Confirmed <input type="checkbox"/> Remediation/Recovery
Question:	How long can the water utility provide water using the back-up generators?
Our generators will enable us to provide water for 36 hours.	
<ul style="list-style-type: none"> ■ Our generators are functioning properly. ■ Our generators are designed to provide back-up power if there is a power outage. ■ We can operate at 100 percent capacity using our generators. 	
We will resume normal operations when full power is restored.	
<ul style="list-style-type: none"> ■ Treated water will be available soon after power is restored. ■ We will use all available resources to resume operations as quickly as possible. ■ Water will be safe to drink when normal operations resume. 	
People can help by conserving water.	
<ul style="list-style-type: none"> ■ Conservation efforts will help extend the time water is available. ■ People should not store water until the system is back to normal. ■ People should stay tuned to local radio stations for updates. 	

predictors of a higher perception of drinking water risk (Spence & Walters, 2012). Other studies have found differences in drinking water risk perceptions among First Nations across provinces, with participants from a Saskatchewan First Nation being less likely to spend money on bottled water for home use, express concerns about tap water consumption, or report someone becoming ill from tap water (Dupont et al., 2014). A recent community-based participatory research project conducted with youth in Yellow Quill First Nation in Saskatchewan found that youth may perceive lower risk to health from commercially treated drinking water (Bradford, Zagozewski, & Bharadwaj, 2016). Given these nuances, a Tribal Council and/or First Nation community risk communication strategy should account for perceived risk accordingly, suggesting risk communication approaches may be an effective way to improve the efficacy of DWAs in First Nations context.

The literature shows an existing, but limited, body of research related to risk communication, adverse water events, and First Nations. Risk communication has been described in the literature in relation to water events (Bradford et al., 2016; Covello et al., 2007; Herve-Bazin, 2014; Jones-Bitton et al., 2016; Minamyer, 2008; O'Donnell et al., 2000), and on risk communication for longstanding environmental and country food contaminants issues in Indigenous communities (Furgal, Powell, & Myers, 2006; O'Neil, Elias, & Yassi, 1997; Stephens, 2010). Community-based participatory research with Indigenous communities after the H1N1 influenza outbreak showed risk communication could be applied to generate more culturally appropriate communication for pandemics (Charania & Tsuji, 2012; Driedger, Cooper, Jardine, Furgal, & Bartlett, 2013; Driedger, Maier, Furgal, & Jardine, 2015). However, information on First Nations-relevant communication for water events for Indigenous peoples appears to be restricted to dated and/or government-issued publications (BC Ministry of Environment, 2009; Health Canada, 2007; Sockett & Poulin, 2014). This is a significant gap in the literature. First Nations drinking water management has a unique historical, cultural, political and social context. That translates into distinct health behaviours, risk perceptions and overall public health concerns. Many First Nations communities already experience drinking water issues and regularly communicate about drinking water risks. Many communities and their agencies have the need and desire to study, conduct and evaluate drinking water risk communication from a First Nations perspective. A literature review could not identify a current established framework or guidelines for this purpose.

1.3 Project Purpose and Objectives

The purpose of this research project was to explore the relevance of risk communication theory and practice to the First Nations and Tribal council context. This research is significant because its main purpose is to ensure adverse water events on-reserve are communicated in a way that allows community members to best protect their health.

The overall objectives of the project were to:

- a) assess the concerns, knowledge and communication needs of everyday drinking water system users on two First Nations who have experienced DWAs.
- b) determine context-appropriate methods, practices and policies that may improve drinking water advisory communication for First Nations and develop local capacity to implement them.
- c) contribute knowledge to the creation of a risk communication framework for adverse water events for First Nations and their Agencies, which is an overall research goal of the Safe Water for Health Research Group at the University of Saskatchewan.

1.4 Methodology

1.4.1 Risk Communication of Drinking Water Advisories: A Contextual Approach

The science and practice of safe drinking water management includes source water protection, water treatment, monitoring and response to adverse water conditions (including issuance of DWAs). It is based in Western approaches to environmental and human health sciences, epidemiology, risk assessment and communication policy. Risk perception and communication literature, however, shows that social context must be considered in the risk communication process. In the First Nations drinking water context, this means consideration of individual risk perception, but also consideration of the cultural significance of water, longstanding systemic problems with drinking water quality, and community cohesion and resilience. As such, research that aims to better understand or improve the efficacy of safe drinking water management on First Nations should consider these factors. Furthermore, First Nations are not only disproportionately affected by unsafe drinking water and DWAs in Canada, but also motivated, particularly at the community level, to improve their drinking water quality and safe drinking water programs. These factors point to CBPR as an appropriate and likely

necessary approach to investigating DWAs in First Nations communities. The *Science in a Circle* © model of community-based research emerges from the epistemological principles of Ermine’s “ethical space” (Ermine, 2007) and Marshall’s “two-eyed seeing” (Bartlett, Marshall, & Marshall, 2012; Bartlett, Marshall, Marshall, & Iwama, 2015) and the collaborative, action-focused partnership approach of CBPR (Israel, Eng, & Schulz, 2012, p.; Leung, Yen, & Minkler, 2004; Minkler, 2010). The model was developed for environmental health research with Indigenous communities and prioritizes research project designs and outcomes that emerge from equal, honest and ethical relationships (links) between researchers, community officials, elders and young people. Similar to the model for Indigenous CBPR described by C. Fletcher (2003), this model is particularly appropriate for this study as it was developed in part through previous research projects between University of Saskatchewan public health researchers and Saskatoon Tribal Council and encourages long-term research relationships over multiple projects that address evolving public health concerns (Nilson, Bharadwaj, Knockwood, & Hill, 2008). The project’s full research philosophy and approach is reviewed in Chapter Two.

1.4.2 Study Design

This section is a summary. A full description and discussion of the project’s CBPR approach can be found in Chapter Two. A full description and discussion of the project’s novel participatory approach and development of the *Participatory Dot-Mapping Method* can be found in Chapter Three.

1.4.2.1 Project Overview and Community Selection Rationale

The study was carried out as a community-based participatory research partnership between:

- University of Saskatchewan School of Public Health (SPH) researchers,
- Saskatoon Tribal Council Health and Family Services Inc. (STC H&FS Inc.),
- Muskoday First Nation (Muskoday) and;
- Mistawasis Nêhiyawak³ (Mistawasis).

³ Nêhiyawak translates to “Cree People” in the Plains Cree Language and is used as a replacement for the term “First Nation”.

As described in *Science in a Circle*© and other CBPR frameworks (C. Fletcher, 2003; Israel et al., 2012), this partnership was purposefully sampled to renew existing “community links” (Nilson et al., 2008). Over a two-year period beginning in December 2016, partners built upon their existing “links” and developed a four-step research project.

- 1) Formation of community “link” and formal research relationship
- 2) Development of specific research question and methods
- 3) Data collection and interpretation
- 4) Knowledge translation

In addition to the co-investigators, community members were also engaged for their lived experience and/or special expertise to participate in community meetings or be trained as data collectors. This group is collectively called the “research team.”

1.4.2.2 Research Setting

Saskatoon Tribal Council Health and Family Services Inc. (STC H&FS Inc.) is an arm of the Saskatoon Tribal Council, which is governed by seven First Nations in the Treaty 4 and 6 territories in central Saskatchewan. STC H&FS Inc. includes an environmental health team responsible for delivering safe drinking water programming to the communities and is comprised of environmental health officer(s), drinking water quality monitors and an Environmental Health Program Manager. This team delivers a safe drinking water program: they advise on drinking water and sanitation systems and assist communities in responding to AWEs and issuing DWAs. STC H&FS Inc. responds to adverse water events in accordance with their Safe Drinking Water Program Monitoring and Response Protocol. Muskoday First Nation and nearby Mistawasis Nêhiyawak are both Saskatoon Tribal Council member communities and agreed to participate in the project as research sites. Both Muskoday and Mistawasis have experienced AWE’s and issued DWAs in the past two years.

Muskoday receives drinking water from the nearby City of Prince Albert through a long distribution pipe connected to the city’s main water treatment plant via the Prince Albert Rural Water Utility. The water is purchased from the rural water utility through a municipal services agreement. If it is re-pressurized (and if required, re-chlorinated) in Muskoday’s water storage reservoir before it is distributed to homes in the community. In the past five years, Muskoday

has experienced occasional short-term precautionary boil water advisories. In the summer of 2016, Muskoday's water supply was cut off when an oil spill on the North Saskatchewan River contaminated Prince Albert's main source water supply. To protect their own water supply, the City of Prince Albert cut off supply to customers of the rural water utility, including Muskoday First Nation. Crisis communication during this event was at times inadequate, for example, the City of Prince Albert did not inform these rural customers of the shut-off until after supplies had been cut. Muskoday was forced to seek alternative water supplies, truck in water from nearby communities round-the-clock. While the safety of the water supply was never compromised, Chief and Council urged local residents to conserve water and called a state of emergency (Water Canada, 2016). Both Muskoday and the STC emergency response teams dedicated significant time, human and financial resources responding to the event. Since then, the community and STC has worked with external agencies to address communication gaps and refine emergency communication practices.

When an advisory is triggered by bacterial or chemical results of concern, STC H&FS Inc. receives the notification and the Environmental Health Program Manager or designate alerts Muskoday Health staff by cell phone. If the advisory is triggered by an incident in the community (i.e. power outage), the water plant operator or Public Works Manager alerts the Environmental Health Program Manager by cell phone. Once the need for an advisory is established, the Manager logs the advisory in the STC safe water database and generates an advisory notice which describes the type of advisory, date, and instructions affected water users should take to protect their health. This notice is then submitted electronically to Muskoday Health Centre. To alert affected drinking water users, Muskoday hires community members to deliver copies of the notice to affected households, uses Facebook and Facebook Messenger to alert users on Social Media, and sometimes posts a notice on the TV at the local store. To lift an advisory, any required repairs or treatment adjustments must be complete, and two consecutive samples, at least 24 hours apart, must be laboratory tested and confirmed as safe.

Mistawasis Nêhiyawak's community is served by five water treatment plants that draw source water from underground wells. The community replaced its main water treatment plant in 2016. Mistawasis also has four small water treatment plants, each treating water from small wells that serve a small group of homes that are not currently connected to the main community

distribution system. Mistawasis experiences very frequent precautionary boil water advisories on the homes connected to a small water treatment plant. Twenty-five short-term advisories were issued in the community in 2016 adding up to 100 total days on advisory that year. These advisories are the result of three main factors: most advisories relate to frequent electrical power outages and power fluctuations in the community that cause pressure loss in the distribution system. Occasionally advisories can relate to a breakdown in the plant and/or the distribution system(s), or detection of coliform bacteria by STC H&FS Inc. Advisories related to homes connected to the main plant were largely alleviated by the construction of the new treatment plant which has a backup generator that functions during power outages and allows water to continue to flow to the homes. One temporary Do Not Consume advisory was issued after a potential water quality problem emerged during the commissioning of the new water treatment plant. Upon further investigation, it was determined that the issue was isolated to a set of taps within the facility not connected to the public distribution system. The taps were replaced, the problem resolved, and the advisory was lifted.

When an advisory is triggered by bacterial or chemical results of concern, STC H&FS Inc. receives the notification and the Environmental Health Program Manager or designate alerts Mistawasis' Director of Public Works by phone. If the advisory is triggered by an incident in the community (i.e. power outage), the water plant operator or Director of Public Works alerts the Manager of Environmental Health Programs by cell phone. Once the need for an advisory is established, the Manager logs the advisory in the STC safe water database and generates an advisory notice which describes the type of advisory, date, and instructions affected water users should take to protect their health. This notice is then submitted electronically to Mistawasis Public Works. They alert affected drinking water users, by delivering copies of the notice to affected households and announce the advisory on their local radio station. To lift an advisory, any required repairs or treatment adjustments must be complete, and two consecutive samples, at least 24 hours apart, must be laboratory tested and confirmed as safe.

1.4.2.3 Study Protocol

Phase One: Developing the “Community Link” and Formal Research Relationship

In December 2016, University of Saskatchewan School of Public Health (SPH) researchers approached the STC H&FS Inc. Environmental Health Program Manager about a possible research project in drinking water communication. In the following year, a research agreement was negotiated between SPH and STC H&FS. Seven Saskatoon Tribal Council communities were invited participate, and two communities emerged as participants and identified co-investigators for the research project. Approval for the project was also obtained from the University of Saskatchewan Behavioural Ethics Board (BEH 17-364).

Phase Two: Developing a Specific Research Question and Choosing Methods

In the first part of Phase Two, the research relationship and research questions were developed in a community meeting.

In *Science and a Circle*©, respectful dialogue and discussion between research partners can give rise to many beneficial research outputs including methods, new skills and capacities, and the identification of research goals and priorities (Nilson et al., 2008). In Indigenous communities, this means that most CBPR projects begin with a face-to-face meeting held in the community whenever possible. These meetings used a version of the conversational method, led by an SPH researcher, with minimal notes taken. This was to ensure all participants could participate fully in the conversational nature of the meeting, an established Indigenous method (Kovach, 2010b). In early 2018, initial community meetings were held in both communities and were attended by:

- health centre staff and management;
- public works staff, for example water treatment plant operators;
- Drinking water quality monitors, and
- project co-investigators from the community, STC H&FS Inc. and the SPH.

These meetings had three objectives:

- 1) make friendly and respectful introductions and review the project's objectives
- 2) discuss local practices, priorities and concerns as they relate to boil water advisories
- 3) re-focus research priorities/questions for the research project.

In the second part of Phase Two, a Method was Developed and Validated

Following the initial meeting, all co-investigators determined that a previously published participatory method could not satisfy both the project's research objectives and practical preferences and constraints. In response, a novel participatory method would be needed to meet the project's objectives and leverage community resources. For example, engaging community members during their upcoming Treaty Days⁴ celebrations were a practical priority. Developing novel engagement tools for lower resource (E. P. Green, Warren, Broverman, Ogwang, & Puffer, 2016) and First Nations (C. Fletcher, 2003; F. Fletcher, Hibbert, Robertson, & Asselin, 2013) contexts has been described and applied in other projects. In this step, the research team developed an engagement tool called *the Participatory Dot-Mapping Method*. This method uses a novel data collection tool which uses spatial participatory mapping methods (Corbett & Lydon, 2014; E. P. Green et al., 2016; Warner, 2015) and an engagement method called "Dotmocracy," also called "dot-voting" (Diceman, 2013) to generate visual distributions of preferences across non-spatial qualitative concepts that have been spatially arranged (similar to a mind map (Craft of Communication, 2013)).

Following initial community meetings, the research team developed a set of questions and potential responses that, when deployed, could collectively meet the objectives of the study. These questions and responses are noted in Table 1-1. Responses were illustrated using basic clip art icons and arranged spatially similar to a "mind map" on a craft board (Craft of Communication, 2013). Each of these elements was validated through a separate community meeting in both Mistawasis and Muskoday. The completed dot-maps were displayed on four foam boards, each displaying a single question and corresponding responses. An example is in Appendix A.

The research team also adapted the dot-maps for letter-size paper to be made into booklets. If needed, data collectors could use these booklets to gather responses in settings where a large map may not have been appropriate. An example of a completed booklet is in Appendix

⁴ Each year, the Government of Canada visits First Nations communities who are signatories to Treaty to distribute treaty annuity payments (Government of Canada, 2008). Some First Nations and Tribal Councils host events and trade fairs in tandem with the annuity payment event.

B. When complete, the dot-maps were first deployed at community events. Trained data collectors asked participants to place a pre-determined number of coloured dots sticker(s), colour coded by age group, on the area(s) of the mind map that best represented their response to the question displayed. At events, the dot-voting method was completed on the foam boards. In other community settings, data collectors used the individual response booklets and transferred the stickers to their respective responses on the main dot-map boards. Data collectors were also instructed to periodically note, in writing, any repetitive or interesting comments heard from participants. The result of the dot-mapping exercise was a visual map-like distribution of individual participants' responses. When viewed as a whole, patterns of individual dots showed a collective picture of the community's responses. The distribution of each colour showed the differences between age groups.

Table 1-1: Questions and Responses for the Dot-Mapping Exercise, by Community

When drinking water advisories happen, what are your main concern(s) and question(s)?	Muskoday*	Mistawasis*
Could I get sick from the water I drank recently?	Y	Y
What will happen if I drink the water anyway?	Y	Y
Can I use the water for washing dishes, brushing teeth or bathing?	Y	Y
What is the reason for this advisory?	Y	Y
Will I need my water storage tank cleaned after the advisory is over?	Y	Y
Is the water contaminated?	Y	Y
I want to know where I can get updates and more information.	Y	Y
I want to know how long the advisory will be on for.	Y	Y
I worry about the elders getting the help they need.	Y	Y
Where can I get bottled water?	Y	Y

When advisories happen, how are you CURRENTLY notified?	Muskoday	Mistawasis
Friends and Family	Y	Y
I receive a home visit from health centre or band staff.	Y	
I visit the band office or health centre in-person.	Y	
Someone delivers paper notices to my house.	Y	Y
I call the band office or health centre.	Y	
I receive notice by email, text or Facebook messenger.	Y	
I receive a call from the health centre or band office.	Y	
I see Facebook posts in my newsfeed from the health centre or band office.	Y	
I hear about it through radio or TV news.	Y	
I see it displayed on a TV screen at the gas station.	Y	
I hear about it through online news.	Y	
I call public works or health centre.		Y
I am not always aware of a notice.		Y
I visit public works or health centre in person.		Y
I receive a call from the health centre or public works.		Y
I see Facebook posts in my newsfeed.		Y
I hear about it through radio news.		Y

If you had a choice, what would be the BEST way to notify you about drinking water advisories?	Muskoday	Mistawasis
Talking to Friends and Family	Y	Y
A home visit from health centre or band staff.	Y	
Facebook messenger	Y	
Text messages	Y	Y
Delivery of paper notices to my house.	Y	Y
Facebook posts in my newsfeed from the health centre or band office	Y	
E-mail notices	Y	Y
Receiving a call from the health centre or band office.	Y	
Display a message on the school's electronic message board.	Y	Y
The TV screen at the gas station.	Y	
TV, radio or online news.	Y	
Muskoday Community Radio Station.	Y	
Facebook posts in my newsfeed from the public works or health centre		Y
Receiving a call from the public works or health centre.		Y
Community Radio Station		Y

What is a precautionary boil water advisory? Choose one option you think is most correct.	Muskoday	Mistawasis
It's possible that illness-causing bacteria have entered the water system, but it's impossible to know for sure. I must boil my water just-in-case.	Y	Y
Something minor happened with the water lines. I can boil my water or switch to bottled as a precaution if I am worried about it.	Y	Y
The drinking water is contaminated with bacteria. I must boil my water or switch to bottled water to prevent illness.	Y	Y
It's possible that illness-causing bacteria have entered the water system. Children and elders should boil their water as a precaution, but healthy adults are safe.	Y	Y
I don't know!	Y	Y

****Y** indicates the question was included in that community's dot-map.**

Phase Three: Data Collection

From May-November 2018, SPH Researchers, STC H&FS Inc. Staff and other data collectors deployed each community's dot map tool at their respective Treaty Day events and in the communities. Data collectors (who were community members or SPH researchers) recruited participants, asked them to approach the table, where the four foam boards were displayed, and obtained verbal consent to participate. Once consent was given, each participant was provided a set of coloured dot-stickers corresponding to age group. For example, participants who were between the ages of 18-34 received red dot stickers, those aged 25-59 and over 60 were provided blue or yellow dot stickers respectively. The participants were guided through the exercise with a data collector.

At most events, a small incentive was offered for participation, such as vouchers for a Saskatoon Tribal Council Treaty Day produce market. When complete, each participant was thanked for their time and offered a leaflet with additional information about the research project. Following the Treaty Day events, the research team determined that a larger sample was needed for both communities, particularly to ensure each age group was adequately represented. To enlist participants from these groups, data collectors attended an additional family event in Mistawasis, and deployed the individual booklets in additional settings in Muskoday and Mistawasis (homes, local meetings, etc.). A breakdown of those who completed the large board dot-maps vs. those who completed individual booklets is provided in the results.

Phase Four: Data Interpretation and Knowledge Translation

Research team members attended community meetings to analyze and interpret the results of participatory dot-mapping. The reasons for using a community meeting for data analysis was to:

- 1) Ensure First Nations leaders and public health practitioners could meaningfully interpret results in their community context scope of practice, if applicable.
- 2) Have SPH researchers interpret results in terms of previous studies, relevant theories and other scientific frameworks.
- 3) Using “two-eyed” knowledge, collaboratively develop a local action plan for knowledge translation and implementation.

For both Mistawasis and Muskoday, co-investigators and other community drinking water practitioners attended the meetings. Mistawasis’ Chief, Director of Lands and Resources, and an interested high school student took part in interpreting that community’s dot-map. Using the conversational method (Kovach, 2010a), each team member reviewed the board and shared their interpretation of the results, often building on the comments of others. The results of the data collectors’ qualitative notes (e.g. “we are told that boil water advisories are precautionary”) were introduced mid-discussion. An SPH researcher lightly guided the conversation and the group reached consensus on the clearest visual patterns observed on the board and what those patterns meant. Once these key results were established, the group decided on an appropriate knowledge translation/implementation strategy for each. For example, the research team suggested a visual display could educate community members about the reasons for PDWAs. In another community, basic message maps around DWAs were requested. The purpose of these maps would be to ensure all band staff had access to consistent information about the types of DWAs and what to do when they happen.

1.5 Results

In total, 152 people participated in the dot-mapping activity at three community events and in other community settings. Photos of the completed dot maps can be found in Appendix A. The results are tabulated by community and age group in Table.1-2.

Table 1-2: Participants in Dot-Mapping Activity in Mistawasis and Muskoday.

Community	Number of Participants, By Age Group			Total
	Youth/Young Adults (18 – 34) Red Dots	Adults (35-59) Blue Dots	Older Adults/Elders (60+) Yellow Dots	
Mistawasis Nêhiyawak	22 *22	39 *39	24 *9	83
Muskoday First Nation	27 *8	18 *18	22 *7	69

*Number of total participants who responded on the large dot-maps during events. This is considered the main form of data collection.

1.5.1 Understanding Community Concerns during DWAs

In Mistawasis, the dot-maps indicated community members were especially concerned about the risks of illness from drinking water just before or during an advisory. No clear

differences across age groups were identified. In Muskoday, the dot-maps showed youth/young adults and older adults/Elders are members of the community who may miss information that is included on door-to-door advisory notices, such as hygiene and cooking instructions.

1.5.2 Current vs. Preferred Methods of DWA Communication

Most Mistawasis community members currently receive their notice via door-to-door notices, the community radio station, or through friends and family. Door-to-door notices and the community radio station were also the preferred form of communication, the desire for text, email or social media alerts was minimal. The community said this was the result of careful engagement with community members in recent years, noting public works recently assumed responsibility for communicating DWAs, a role previously held by the health centre. Few respondents preferred electronic communication, but those who did were largely youth/young adults.

In Muskoday, youth/young adults and older adults/Elders were more likely to hear about advisories from information from friends and family, this is the same group more likely to miss information from official paper notices. Overall, Muskoday residents indicated that they hear about advisories through Facebook, door-to-door flyers, and friends and family. Some community members expressed interest in text or e-mail notices; youth/young adults and older adults/Elders indicated that that they prefer text/e-mail options.

1.5.3 Precautionary Boil Water Advisories: What Message is Getting Through?

In both communities, approximately half of the respondents could identify the meaning of a “precautionary boil water advisory,” with most others believing it meant the water was known to be contaminated. No difference between age groups were observed.

1.6 Discussion

The results of the dot-mapping demonstrate the importance of local community engagement in risk communication planning. While both communities are members of the same Tribal Council and are located less than 100 km apart, each had a unique yet successful approach to communicating DWAs. The results from each community will be discussed separately in the next section, followed by a general discussion.

1.6.1 Muskoday First Nation

In Muskoday, the dot-map results showed many respondents both use and prefer Facebook and Facebook messages to hear about drinking water advisories. Door-to-door notices and interpersonal communications from family and friends were also listed. This is consistent with the findings of Bradford et al. (2017), who found social media to be a fast and simple method to communicate with drinking water users, but also warned of the risk of over-reliance on these methods for emergency communication. Muskoday's dot-map also revealed a clear interest from some older adults/Elders and youth/young adults, with less interest from the adult group, for e-mail or text notices. This was an unexpected result, the research team expected text and email would increase in preference with decreasing age. It is, however, consistent with communication preferences in Muskoday. In their Muskoday First Nation Community Communications Strategy, released in 2012, a similar trend was noticed. In that report, those 60+ were more likely than those 50-59 to prefer text communications from the band and more likely than nearly all other age groups to prefer email (Muskoday First Nation, 2012). It is worthy to note that this 2012 report recommended Muskoday use Facebook to communicate with band members. This suggests that overall communications planning is a valuable strategy for communities to improve their risk communication, and vice-versa.

Muskoday's results also identified a potential gap in DWA communications. On the map, youth and older adults/Elders appeared to hear about boil water advisories through interpersonal communications with friends and family. This was evident from the display of color-associated dots on the map. While interpersonal communications are an important method of risk communication within a community (Bradford et al., 2017; Doria, 2010), the dot-maps also revealed these groups were concerned or have questions about topics that are usually included on official notices (for example, "Can I use the water for washing dishes, brushing teeth, or bathing?"). These results were likely related; the result of hearing second-hand information especially if the details of a door-to-door notice were not shared amongst the household. Potential ways to address this gap were discussed, including improving the clarity of notices and prompting household heads to share notice information within the home. These challenges and limits of door-to-door notices have been noted in studies outside the First

Nations context (Jones-Bitton et al., 2016; O'Donnell et al., 2000), further emphasizing the need for multiple communication methods for drinking water advisories regardless of context.

1.6.2 Mistawasis Nêhiyawak

In Mistawasis, the dot-maps revealed that community members are currently notified about drinking water advisories through two main channels: door-to-door notices and the local radio station. This is consistent with other studies that noted radio is an effective way to communicate during advisories (Jones-Bitton et al., 2016; Rundblad et al., 2010). Door-to-door notices and radio were also the preferred methods for most community members regardless of age. The two dot-maps which asked about current notification methods vs. preferred community methods looked nearly identical. Two factors are likely the cause: first, Mistawasis recently reoriented their drinking water advisory practices, transferring this responsibility from their health department to the public works department. Second, Mistawasis has experienced very frequent precautionary boil water advisories in the past. This necessitated regular engagement with community members about the advisory process, developing a sense of understanding and trust in the DWA process. While it appeared Mistawasis residents had trust in the community's process, it did not necessarily mean community members followed advisory instructions, even though it also appeared they did not trust the quality of the water. Mistawasis' dot-map also revealed community members were concerned about the health risks if they "drank the water anyway" and wondered "is the water contaminated." Data collectors noted during the exercise that community members had concerns about the water quality in their new water plant and used bottled water or untreated spring water instead. Research team members from the community felt this behavior may have been heavily influenced by the single precautionary Do-Not-Consume advisory that was issued during the plant's commissioning due to lead solder in an auxiliary water tap. This is consistent with risk perception theory, that says perceived risk will be higher for an uncommon and unfamiliar risk (lead) vs familiar risks (PDWAs). The research team felt that using a risk perception approach to improve local water quality perception may be helpful. Drawing on the knowledge that taste is the greatest influence to risk perception (Doria, 2010; Doria et al., 2009), Mistawasis and Tribal Council staff planned a water taste test at next year's Treaty Days, comparing water from the new plant to commercially bottled water.

It is common for individuals to partially comply or non-comply with boil water advisories (Bradford et al., 2017; Jones-Bitton et al., 2016; O'Donnell et al., 2000; Rundblad et al., 2010). The likelihood of non-compliance further increases when advisories are common (Hrudey, Hrudey, & Pollard, 2006). Furthermore, perception of risk decreases for risks that are common, familiar, and in-control (Doria, 2010; Slovic et al., 1984). For some residents of Mistawasis advisories have been so common they could be described as routine. This was a concern for the community's and the Tribal Council's public health staff, since compliance with boil water advisories, even precautionary, is key to reducing the risk of waterborne illness. The research team hypothesized that the root causes of non-compliance were also related to a common misunderstanding of the true meaning of a "precautionary boil water advisory." They believed both could be explained, at least in part, by a lack of understanding of the general principles of water treatment and how water treatment or distribution failures cause risk to human health. One research team member shared a noteworthy best-practice from her household. In her family, the first person to receive the DWA notice (which arrives as a coloured doorknob hanger) hangs it on the kitchen tap, where it remains until the notice is lifted. This practice is consistent with a well-established form of health behaviour modification called "prompting" or "nudging". While it has been described in both scientific studies (Shearer, Gatersleben, Morse, Smyth, & Hunt, 2017; Sussman & Gifford, 2012) and in health policy reports (Behavioural Insights Team, 2011, 2018), it has not yet been described in the context of boil water advisories. This practice could be easily applied in other contexts and warrants further attention.

1.6.3 The Precautionary Boil Water Advisory: A Health Promotion Challenge

In both Muskoday and Mistawasis, only about 50% of residents who participated in the dot-mapping exercise, regardless of age, could correctly identify the meaning of a "precautionary boil water advisory." While some other respondents characterized the advisory as optional or responded "I don't know," most other respondents indicated they thought it meant the water was contaminated. Nonetheless, it highlighted the need for additional education around the meaning of different types of advisories, the causes of advisories, and the risks of drinking unsafe water. Crisis risk communication (what happens during DWAs) must be focused on short, easy-to-digest and pertinent information. To ensure PDWAs had consistent and clear messaging across

channels in each community, message maps were designed for local staff and communicators (e.g. radio hosts) to use during PDWAs. An example of a draft message map is noted in Appendix C. Communicating about science of water treatment, the difference between potential contamination and known contamination, and the complex personal assessments of acceptable risk requires a different approach. Risk communication can also be a part of health promotion. Health promotion is the practice of improving health through approaches like education, social marketing, capacity building (Glik, 2007). The knowledge gaps around PDWAs in both communities demonstrated a need for ongoing education around drinking water systems and advisories in the community setting. In response, the communities requested a visual or interactive display that could communicate complex topics around drinking water treatment, distribution, and risk to community members of a variety of ages and education levels. They planned to work with the SPH to produce this display. Other ways communities could improve drinking water safety knowledge could include school presentations or tours of the water treatment plant (s) for children, band staff and other community members.

1.7 Policy Implications and Conclusion

Risk perception and communication must be considered in First Nations drinking water policy, even if the immediate water quality problems had been addressed. Indigenous Services Canada says they will eliminate long-term drinking water advisories by 2021, having eliminated 79 since November 2015 (Indigenous Services Canada, 2018a). These improvements are much needed. Risk perception, however, is not based on water quality alone. Indigenous people experience the effects of destructive colonial policies, even though some (such as residential school) have long been changed. This means drinking water risk perception is likely to be shaped by past threats, government inaction and chronic underfunding of drinking water programs, even if the immediate crisis is resolved. Furthermore, Indigenous Services Canada has not published any commitments to reduce the impact of short-term boil water advisories (Indigenous Services Canada, 2018c). This study shows that short-term boil water advisories are both exposing First Nations communities to risk of waterborne illness, particularly when advisories are frequent.

This study identified some of the ways Doria (2009, 2010)'s drinking water risk perception theory applied to the context of two First Nations. These include past experiences

(history of boil water advisories and other water quality issues), level of control in the system (level of input into governance, community vs. outside control of water system), information or misinformation (consistency and quality of information from official sources and informal channels), trust in water treatment and governance (level of trust in band, plant operators and tribal council) and perception of water quality (does the community make good water) are contributing to overall risk perception Mistawasis Nêhiyawak and Muskoday First Nation. In this study, these risk perception factors were variable between two communities who appear to be very similar: they are both from Treaty Six, are less than 100 kilometres apart, and are members of the same Tribal Council. In turn, their risk communication strategies, methods of local engagement, and overall structure of drinking water advisories were also variable. The overall success of each community's individual approach suggests that the application of risk communication by First Nations need not focus on the pan-Canadian First Nations social, political, economic and historical context. Instead, risk communication planning and practice should focus on local engagement and consider the nuanced ways each of these factors shapes individual and community-level risk perception, communication preferences, health behaviours and trust in local governance, which was also noted in Spence and Walters (2012).

Risk communication planning requires engagement and education outside the immediate communication during an advisory. Community engagement through participatory research, such as this project, is a useful approach. Through research activities that invite community participation, First Nations governments and agencies can engage community members directly, identifying concerns and educating community members in the process. As Indigenous Services Canada devolves and transfers authority to allocate and operate public services (including Environmental Health) to more communities, First Nations and their agencies will increasingly conduct local engagement for program development and evaluation. When a relationship with university researchers may be beneficial, CBPR projects can be a useful approach, particularly if the research partnership includes representation from both the communities and the agency or Tribal Council. Newly formed agencies and health authorities will also manage their own continuous improvement efforts and may seek accreditation from a health quality evaluation organization, as is the case in the Saskatoon Tribal Council and six of its communities. Risk communication planning can contribute to these overall goals. Informal engagement between First Nations and their citizens is also a valuable practice, in Mistawasis, open and ongoing

communication generated important insights and fostered trust in the community's drinking water management, even in the face of water quality challenges. Education and health promotion activities should also be considered where known knowledge gaps exist, such as water treatment sciences. These practices can contribute to an overall emergency response and risk communication strategy (Reynolds & Seeger, 2005), but can also foster a strong sense of trust in local water systems and governance (Lurie et al., 2013). When possible, education efforts should use a health promotion approach, and use engaging and interactive methods whenever possible. Groups that have a mandate for science education, including science centres, drinking water organizations, university outreach programs and school curriculum developers should also consider developing materials on safe drinking water for communities who experience drinking water issues and advisories.

An increasing body of literature is showing that people in a variety of contexts do not follow boil water advisories (Bradford et al., 2016; Jones-Bitton et al., 2016; O'Donnell et al., 2000; Rundblad et al., 2010). This likelihood increases when advisories are issued too frequently (Hrudey et al., 2006). There is little evaluative research available to show what approaches, method or messages may increase compliance for risk communication activities (Glik, 2007). This includes drinking water advisories. In response, more institutional and community-based participatory research should investigate how public health officials can reduce the risk of waterborne illness in their communities through improved risk communication, both in general and the First Nations context.

1.8 Study Limitations

This study used extensive purposeful sampling for the dot-mapping exercise, as random sampling was not feasible, nor preferred for this activity. While a diverse and reflective sample of the community was targeted, those who participated through events or one-on-one engagement may not fully represent the community's overall membership or households. For example, while every effort was made to have a sample reflective of the communities' actual age distributions, they may not exactly reflect the population of interest. It is also unknown if they are representative of demographic factors such as gender, neighborhood, education level, as this data was not collected.

When the data was collected, names were not recorded. Because data was collected at multiple time points, individual could have participated more than once. This likelihood is low, as there would be little incentive to participate multiple times and past participants could verbally identify themselves before participating again. In addition, the data collectors were known to community members.

The nature of the dot-mapping exercise does not allow for individual responses within questions or between questions to be identified. Therefore, it is not possible to assess if one pattern of responses is (or is not) associated with another collection pattern. Analysis of the map's findings should be considered in the context of this limitation.

Chapter Two: First Nations Drinking Water Communication: Embracing Two Worldviews through a Community-Based Participatory Approach

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2.1 Abstract

Drinking water management in Canada is largely rooted in western approaches to science and risk. To effectively communicate about risks and encourage health-protecting behaviour, public health officials must consider social, cultural and historical factors. The *Science in a Circle* © model for community-based participatory research (CBPR) informed a research partnership between environmental health researchers, two First Nations and their Tribal Council in Saskatchewan. Drawing on existing community research links, this partnership developed and executed a four-phase CBPR research design, enabled the development of a novel participatory research method, and generated actionable insights for First Nations policymakers and practitioners in environmental health and risk communication.

Forming research links with the Tribal Council was an effective strategy to reduce some of the risks of community-based partnerships between universities and communities. For example, the Tribal Council representative ensured the research topic did not conflict with existing work in the community and provided advice on a project topic that may address a known issue for communities. Many First Nations in Canada are assuming governance of their health services, many of which will be provided by Tribal Councils or similar agencies. The *Science in a Circle* © model and *the Participatory Dot-Mapping Method* may be useful tools for agencies looking to improve their own policies and programs through research, while ensuring Indigenous knowledge is considered.

2.2 Introduction

Risk perception and risk communication theory suggests the cultural, political, social and historical context of a community can strongly influence their perception of health risks and the health-protecting behaviours they choose to take (Slovic, 1993b; Slovic et al., 1984; van der Pligt, 1998). Those who communicate with the public about health risks must consider these factors when crafting and delivering their message(s) to various public audiences. When that audience is Indigenous community members, communicators must understand that community's individual history, culture, politics and social dimensions as they relate to tangible or perceived health hazards. These considerations may significantly diverge from those of mainstream Canadians, or even other Indigenous communities. Contemporary Indigenous health outcomes and perceptions are heavily mediated by the historical impacts of colonization, including the legacies of land loss and autonomy through the Indian Act and residential schools (Reading & Wien, 2009). Many Indigenous communities are improving public health programming and risk communication by integrating cultural and contextual factors into public and community health practice. For example, risk communication has been applied to longstanding environmental and country food contaminants issues in Indigenous communities (Furgal et al., 2006; O'Neil et al., 1997; Stephens, 2010). Community-based participatory research with Indigenous communities after the H1N1 influenza outbreak showed risk communication could be applied to generate more culturally appropriate communication for pandemics (Charania & Tsuji, 2012; Driedger et al., 2013, 2015).

Community-based participatory research is a common and acceptable approach, linking Indigenous communities with academic researchers in productive, collaborative and action-oriented academic studies. This article will discuss the application of the *Science in a Circle* © (Nilson et al., 2008) approach to community-based participatory research to a risk communication study conducted with partners from two Saskatchewan First Nations, their Tribal Council, and university environmental public health researchers. Drawing on both strong technical expertise and local knowledge within the project team, this study examined how risk communication could be applied to the First Nations context. Guided by concepts of “ethical space” (Ermine, 2007) and “two-eyed seeing” (Bartlett et al., 2012, 2015), the project explored how to meaningfully engage First Nations stakeholders on an environmental health issue when

both Indigenous and western science perspectives must be considered. Overall, the project aimed to improve the risk communication of drinking water advisories when they occur.

Risk communication has been described in the literature in relation to adverse drinking water events (Covello et al., 2007; Health Canada, 2007; Herve-Bazin, 2014; Minamyer, 2008; Sockett & Poulin, 2014), but information on First Nations-relevant communication for water events affecting Indigenous peoples is restricted to dated and/or government-issued publications (BC Ministry of Environment, 2009; Health Canada, 2007; Sockett & Poulin, 2014). Environmental health issues such as drinking water safety, air quality, housing and food safety are of concern to many First Nations communities. There is a strong and longstanding desire for quality, community-driven environmental health programs and infrastructure, particularly in drinking water quality (National Collaborating Centre for Aboriginal Health, 2012). Drinking water problems are a longstanding issue in First Nations communities. First Nations communities and public health advocates have characterized the situation as a crisis (Lui, 2015; Nishnwbe Aski Nation, 2016). When drinking water from a water treatment or distribution system is contaminated or could become contaminated (also called an adverse water event, or AWE), local public health authorities or First Nations governments issue a drinking water advisory (DWA). Boil water advisories are the most common, instructing water users to boil their drinking water and take other actions to protect their health. Today, Indigenous Services Canada (ISC) reports 63 long-term drinking water advisories on First Nations in Canada and 78 long-term advisories lifted since the peak of the crisis in 2015. Advisories from communities from the Saskatoon Tribal Council and the province of British Columbia are not reported in these numbers (Indigenous Services Canada, 2018a). Many more communities experience short-term drinking water advisories (Indigenous Services Canada, 2018c).

Canada's national safe drinking water system was transformed by crisis in the early 2000s. Fatal outbreaks in Walkerton, Ontario in 2001 and North Battleford, Saskatchewan in 2001 spurred national, system-wide changes to drinking water regulation, treatment, management and communication (Hrudey & Hrudey, 2002; Plummer et al., 2010). The key outcome of these reviews was the development of the *multi-barrier approach*, a comprehensive drinking water management framework that advocates for technical and policy-level management of source water, drinking water treatment, drinking water monitoring, and response

to adverse drinking water events (including issuance of drinking water advisories) (Health Canada, 2004; Plummer et al., 2010). In a source water protection guide issued by ISC, they describe the approach as “system of redundancies that allows a drinking water system to avoid failure should a single barrier fail (pp.8)” (Indigenous Services Canada, 2014). Data suggests this approach has been largely successful in preventing waterborne outbreaks, particularly in large drinking water systems. However small drinking water systems (serving 5000 people or less) have since been implicated in a number of waterborne disease outbreaks. These have been attributed to changes in source water quality or failures in water treatment or distribution systems (Moffatt & Struck, 2016).

Drinking water policy and management in Canada largely remains rooted in Western approaches to environmental and human health sciences, epidemiology, risk assessment and communication policy. Currently, individual First Nations own, manage and operate their drinking water plants and systems, and are responsible for issuing drinking water advisories. Indigenous Services Canada funds drinking water systems, provides directives on design, maintenance and operation of those systems, and, in some cases, trains drinking water operational staff. ISC also sets standards for drinking water operations through protocols (Indigenous and Northern Affairs Canada, 2016). Environmental health officers (who are usually certified public health inspectors) usually manage and deliver safe water programs with First Nations communities. This includes monitoring drinking water systems, notifying First Nations governments of adverse water events, help issue advisories and communicate them to affected water users. In many cases, these services are provided by the Government of Canada through ISC. However, First Nations are increasingly assuming control over health programs through the health transfer process, self-government agreements, and other pathways. Many First Nations, particularly in Ontario, are planning to or in the process of taking control of their health programs (Government of Canada, 2016a; Indigenous Services Canada, 2018d). In Saskatchewan and Manitoba, communities often delegate responsibility for services to Tribal Councils. Tribal Councils are service agencies governed by groups of partner First Nations. They allow communities to aggregate funds for delivery of services such as environmental health, social, housing, community development, engineering and advocacy programs (Government of Canada, 2016b).

First Nations and Tribal Councils may or may not use a risk communication approach to report water related issues. Technically and scientifically-sound safe drinking water management remains a priority for First Nations and their agencies. First Nations governments also have a strong mandate from their citizens to deliver effective public health services that are culturally and contextually-appropriate. Many communities are exploring how to design and deliver effective and appropriate health services through research. In this study, two First Nations, Muskoday First Nation and Mistawasis Nêhiyawak, with the Saskatoon Tribal Council, sought to evaluate and improve the effectiveness of their current drinking water communication practices. Both communities had issued precautionary boil water advisories in the recent past. In nearly all cases, the reason for these advisories was a remote risk of contamination due to power failure at the water plant, a water main break, or other operational problem. Both communities felt that their community's perception of risk may influence their willingness to take precautionary measures during boil water advisories. They also believed that previous and/or ongoing water events may be eroding trust in their community's water systems, even when drinking water was safe. In response, the communities and the Tribal Council partnered with researchers from University of Saskatchewan. Working as equal partners, they co-designed a community-based participatory research study which could explore how risk communication theory may apply to drinking water advisories in their communities.

2.3 Research Philosophy: The Best of Two Words

First Nations are disproportionately affected by unsafe drinking water in Canada, despite a strong cultural and practical respect for water and a commitment to drinking water safety and water security. CBPR is an appropriate and likely necessary approach to investigating drinking water advisories in First Nations communities because it allows communities to lead research projects that consider the important social context of drinking water and water security. The *Science in a Circle* © model of community-based research is a model for CBPR with Indigenous communities, particularly for environmental health topics. It is rooted in Indigenous epistemological principles, particularly Ermine's "ethical space" (Ermine, 2007) and Marshall's "two-eyed seeing" (Bartlett et al., 2012, 2015) and the foundations of collaboration, participation and partnerships that underlie CBPR (Israel et al., 2012, p.; Leung et al., 2004; Minkler, 2010). The model emphasizes that CBPR projects should co-design research project designs and co-

define outcomes through those community “links” – the equal, honest and ethical relationships that form between university researchers, community officials, elders and youth. *Science in a Circle* © was especially appropriate to this project because it was developed through previous research projects between University of Saskatchewan public health researchers and STC H&FS Inc. and encourages long-term research relationships over multiple projects that address evolving public health concerns (Nilson et al., 2008).

Increasingly, Indigenous philosophy is being integrated into public health research, especially when the research includes Indigenous participants or examines the health status of Indigenous peoples. Most notable is Ermine’s “ethical space” framework and Marshall’s “Two-Eyed Seeing” approaches to integrative health research. This openness to multiple forms of knowledge of inquiry is similar to methodological pluralism, which is a research philosophy where value and meaning is found in multiple types of evidence and through multiple ways of knowing, without placing higher value on any type of knowledge (May, Hunter, & Jason, 2017). Public health is an interdisciplinary practice, combining vast knowledge from quantitative sciences, natural and life sciences, social sciences, policy and community development. As such, it is considered a “pluralistic research discipline” (May et al., 2017).

2.3.1 *The “Ethical Space” and “Two-Eyed Seeing”*

Ermine, a Cree Ethicist and researcher from Northern Saskatchewan, identifies an ethical duty of researchers from western paradigms to engage Indigenous communities as full partners in the research process to create mutually beneficial research outcomes (Ermine, 2007). The historical context of the harms done to communities through interactions between westerners and Indigenous communities demands a stringent ethical approach. Ermine’s “ethical space” framework calls on researchers and partner communities to create a collaborative, respectful and equal environment for cross-cultural dialogue, which “will create new currents of thought that flow in different directions and overrun the old ways of thinking.”(Ermine, 2007, p. 203)^{p.203}. Marshall’s two-eyed seeing approach is similar. Marshall, a Mi’kmaq elder from Cape Breton Island, advocates for “seeing” the strengths of western knowledge and the strengths of Indigenous knowledge, then using both “eyes” equally to synthesize knowledge and generate better outcomes for all of humanity. He also stresses the importance of using strong personal relationships and exchange of story to achieve these shared outcomes (Bartlett et al., 2012,

2015). These Indigenous approaches are similar to the philosophical and methodological approaches described by contemporary Indigenous scholars, particularly in education (Donald, 2012; Kovach, 2010b). Kovach, for example, describes how the use of mixed-method approaches in Indigenous contexts to allow for both interpretative meaning-making from story, but also allowing subsequent thematic analysis. She explains that analyses allow for results that will resonate with the larger Indigenous community, Western research standards, and Indigenous researchers (Kovach, 2010b). While Donald's *Indigenous Métissage* approach is similar in that it advocates for the collective re-framing of history and knowledge by "braiding" Indigenous and "colonial" perspectives, is divergent in that it calls for greater importance be placed on Indigenous ways of knowing (Donald, 2012). Public health, however, is distinct from educational disciplines. Particularly in environmental and biological health sciences, western science remains strongly embedded in First Nations health policies and programs. Therefore, research that aims to evaluate or explore these topics must strike a balance between honouring Indigenous knowledge and leveraging the most relevant western science perspectives.

2.3.2 *The Community-Based Participatory Approach*

The community-based participatory approach to research (CBPR) is defined as the "systematic inquiry, with the collaboration of those affected by the issue being studied, for the purposes of education and taking action or effecting [sic] change (p.1)" (L. Green et al., 1995). The use of CBPR in public health research is increasingly common across health disciplines (e.g., medicine, nursing, epidemiology, environmental health, etc.). The approach emerges from the need for research that not only generates knowledge but also aims to improve health in the context of social and environmental factors that contribute to health inequities (Israel et al., 2012; Leung et al., 2004). It achieves this through the creation of respectful and collaborative research partnerships with communities who desire to define and/or act on their health needs and goals, and co-developing research projects that contribute to beneficial community change (L. Green et al., 1995; Israel et al., 2012; Minkler, 2010, 2010). Communities, as the intended users of the knowledge generated, are engaged throughout the research process (L. Green et al., 1995; Israel et al., 2012), from problem definition to knowledge translation and partnership maintenance (Israel et al., 2012).

The field of epidemiology is recognizing the importance of considering the social context of health and the inherent value of community partnerships when conducting research studies. According to Leung, Yen and Minkler (2004), traditional epidemiology relies on the quantitative analysis of health factors, measured using instruments that were designed by institutional experts (without community input) to measure health on an individual level. In contrast, a new form called “popular epidemiology,” embraces CBPR (Leung et al., 2004). The authors argue this participatory arm of epidemiology is necessary to address the limited capacity of traditional epidemiology to leverage extensive human health data and measurement into actual improvement of health status across population strata. The use of non-traditional methods such as participatory mapping and community-led surveys is specifically mentioned, particularly when communities seek to engage their members and define, understand and act on local health priorities. In these cases, communities will often seek out external experts to help “corroborate their experiences, engage in health studies, and act as a primary source of information to [their community members]” (Leung et al., 2004, p. 502) ^(p.502). In a review of two CBPR case studies, Minkler found CBPR is specifically well-suited when policy changes are a desired outcome for the community partners, as policy action is often both a necessary condition and achievable outcome for health issues that are tied to systemic and slow-to-change social and environmental factors (Minkler, 2010). CBPR approaches are also particularly appropriate when the participation of many community members is desired in a difficult-to-reach population, as local community members are engaged in the data collection process (Leung et al., 2004).

2.3.3 CBPR and Indigenous Communities

Western scientific approaches to data collection, analysis and translation are, in the positivist tradition, described and applied as infallible, objective truth. This, as discussed previously, has limited the efficacy of decision-making, policies and interventions that fail to consider the social contexts of the communities affected. For Indigenous communities, the impacts of involuntary application of western thought, science and policy have impacted not only health, but have generated broad “economic, political and physical marginalization since the earliest contacts with non-natives” (C. Fletcher, 2003)^(p.34). This resulted in a significant power imbalance between Indigenous communities and institutions, a relationship that has long-shaped

the interactions between researchers and Indigenous communities, where science, scientists and their institutions may be viewed as manipulative, foreign or self-serving (C. Fletcher, 2003).

Community-based participatory research is now considered the most appropriate, and in many cases, the only appropriate approach when conducting research that involves Indigenous people and/or communities. The Canadian Institutes for Health Research requires all projects it contributes to that involve Indigenous communities to offer them the option of a participatory research model, including a level of participation and shared decision-making of their choice (Canadian Institutes of Health Research, 2005). Furthermore, CBPR can create a safe space for Indigenous communities to work with researchers to determine appropriate and beneficial applications of scientific information and methods, while also protecting community well-being, cultural norms and traditional knowledge (C. Fletcher, 2003). For this reason, CBPR is an effective approach to create the “ethical space”(Ermine, 2007) and use “two eyed seeing” (Bartlett et al., 2012, 2015).

2.4 Communicating Drinking Water Advisories on First Nations: A CBPR Study Design

2.4.1 Project Overview and Community Selection Rationale

This section describes the study design of the CBPR project carried out as a partnership between the University of Saskatchewan School of Public Health (SPH) researchers, Saskatoon Tribal Council Health and Family Services Inc. (STC H&FS Inc. or STC), Muskoday First Nation and Mistawasis Nēhiyawak. Consistent with *Science in a Circle*© and other CBPR frameworks (Bull, 2010; C. Fletcher, 2003; Israel et al., 2012), this partnership was purposefully sampled to renew existing “community links” (Nilson et al., 2008) between the researchers and the community partners. One SPH researcher, a Master of Public Health student, had recently completed an environmental health practicum with STC H&FS Inc. as part of her certification requirements for her professional *Certificate in Public Health Inspection* designation. During that time, she participated in the response to a 2016 water incident in Muskoday. Muskoday and Mistawasis and STC H&FS Inc., each had previous or ongoing research relationships with Bharadwaj and her research team in water and other environmental health topics, dating back nearly 15 years. Over a two-year period beginning in December 2016, this renewed “link”

developed into a successful four-phase research project:

Phase One: Renewal of community “link” and formal research relationship

Phase Two: Development of specific research question and methods

Phase Three: Data collection

Phase Four: Knowledge translation

2.4.2 Research Setting

The research setting is described in Section 1.4.2.2.

2.4.3 Study Protocol

Phase One: Developing the “Community Link” and Formal Research Relationship

Developing positive and respectful relationships with community partners is a cornerstone of CBPR (L. Green et al., 1995; Israel et al., 2012; Leung et al., 2004; Nilson et al., 2008). In December 2016, University of Saskatchewan School of Public Health (SPH) researchers approached the STC H&FS Inc. Environmental Health Program Manager about a possible research project in drinking water communication. The student researcher and project manager was a Master of Public Health (MPH) thesis student originally from the Northern Lake Superior Métis community in Thunder Bay. She had recently completed an environmental health practicum with STC and participated in response to Muskoday’s water shortage after the 2016 oil spill. The supervising principal researcher had worked with STC and their member communities in different environmental health research projects spanning a nearly 15-year period. Having recently secured funding for the MPH student to complete a research project in First Nations water security, the researchers arranged for a casual meeting with the STC H&FS Inc. Environmental Health Program Manager to discuss possible interest in a research project on risk communication and drinking water. Before the meeting, the MPH student prepared a short proposal relating to risk communication around Muskoday and STC’s experience responding to the oil spill. During the meeting, the three parties discussed the proposal and determined that a research project on the oil spill response may compete or conflict other work already happening on this file by the First Nation and government agencies. Instead, they decided that boil water advisories were a longer-term issue for STC communities and therefore more appropriate for examination through a research project. In winter 2017, after one additional meeting between the

same three parties, STC H&FS Inc. management agreed in-principle to the project if there was interest from one or more STC community, and a new research question was developed collaboratively between SPH and STC H&FS.

Also in winter 2017, SPH researchers developed a plain-language invitation (Appendix D) for communities to participate in the project. The purpose of this invitation was to inform each of STC's member communities about the project, and to invite them to participate on a voluntary basis. It outlined the project's purpose, objectives and projected benefits of participation. It also provided a preliminary overview and projected costs to participate. All of STC's seven member communities were sent the invitation. The STC H&FS Inc. Environmental Health Program Manager distributed the invitations and followed up with each community, particularly those who were likely to be interested and/or benefit from participation. Two communities emerged as participants and identified co-investigators for the research project. In Spring 2017, research agreements were developed for each community and STC using collaborative document-writing. These agreements were all signed by late 2017. A sample is provided in Appendix E. In June 2017, a co-investigator from Mistawasis, Russ Head, joined Adams at the CREATE H2O Water Rights conference. They co-developed a presentation defending the project rationale, where Adams gave a brief (5-min) introduction to the topic and Head spent the remaining time (25 min) sharing his stories about providing safe drinking water and issuing BWAs in his community. Approval for the project was also obtained from the University of Saskatchewan Behavioural Ethics Board (BEH 17-364) during this period.

Phase Two: Development of specific research question and methods

In *Science and a Circle*©, respectful dialogue and discussion between research partners can give rise to many beneficial research outputs including methods, new skills and capacities, and the identification of research goals and priorities (Nilson et al., 2008). In Indigenous communities, this means that most CBPR projects begin with a face-to-face meeting held in the community whenever possible. This shows respect for the community, their land and customs, and creates a safe space for knowledge sharing (C. Fletcher, 2003; Nilson et al., 2008). Community meetings, in this context, may be operational or may generate outputs directly connected to the research objectives. In the case when a community meeting contributes to a research objective, it functions in a similar way to a semi-structured focus group, with the

addition of incorporating community customs, protocols and creating an “ethical space” (Ermine, 2007) for participants (Nilson et al., 2008). In late 2017/early 2018, Muskoday and Mistawasis worked with STC H&FS to compile a list of community leaders and practitioners in safe water who should attend a community meeting with the SPH research team. The purpose of these meetings was to (1) make friendly and respectful introductions for all project participants and give an overview of the project’s topic and objectives (2) discuss local practices, priorities and concerns as they relate to communication during water emergencies and (3) determine a specific set of research priorities/questions for the research project. The meetings, held separately in each community, were attended by a mix of health directors and health centre staff, public works and water treatment staff and management, water quality monitors, and project co-investigators from the community, STC H&FS Inc. and the SPH.

The results of these initial meetings were used to describe and clarify the research setting as described in section 2.4.2. While a specific research question was not identified in these initial meetings, specific yet similar priorities emerged from each community. Both communities wanted to:

- 1) measure the effectiveness of current BWA communication methods and messages, including potential unmet communication needs.
- 2) identify how those needs may change for different age groups, especially when considering the use of technology and social media.
- 3) measure and address a recognized knowledge gap around the meaning of “precautionary” boil water advisories and their causes.
- 4) use a community engagement method instead of a focus group, survey tool or interviews.

Following the meetings, email and phone conversations were used to follow up on the meeting’s outcome, refine the project’s research question, and choose an appropriate method. In general, the SPH researchers would use their expertise in question development and methods and community partners would review and comment until a final set of questions and a method was determined to meet the needs of each community. As a result of these exchanges, project partners determined that a novel community engagement method would be developed specifically for the research question and setting. As mentioned above, a traditional qualitative tool was not appropriate. Community partners felt that many community members were over-

surveyed and over-researched and were experiencing “research fatigue”. In addition, there was significant interest in engaging community members during their upcoming Treaty Days⁵ celebrations. Many community members attend, including elders, parents with families, and youth. It was thought that Treaty Day may be a unique opportunity to encourage participation from otherwise hard-to-engage community members. In general, trade fairs are a useful setting when there is a desire to engage a large group of people, but due to the high volume of people and short time windows, engagement activities should be limited to a short but engaging activity, such as a mapping exercise (Community Places, 2014).

Developing the BWA communication “mapping” tool.

Mapping exercises are a well-established community participatory method which can engage community members on a health topic in a visual way which is accessible to many education levels, age groups and literacy levels (E. P. Green et al., 2016; Israel et al., 2012; Leung et al., 2004). When well-developed, visual representations can convey complex relationships and information which may otherwise take pages and pages of text to explain and can break down barriers between people of different cultures and education levels (Morton Ninomiya & Pollock, 2017). A mapping tool, for these reasons, fit the need to engage a wide variety of community members at Mistawasis’ and Muskoday’s Treaty Day events.

Participatory maps generally employ spatial data (E. P. Green et al., 2016; Israel et al., 2012; Leung et al., 2004; Warner, 2015), which was not an element of interest for this study in risk communication. Message mapping, in contrast, is a framework used in risk communication to create compelling, relevant and consistent messages for various audience segments. In the message mapping process, risk communicators (local leaders, public health officials) determine how to segment their audience then identify the health and safety concerns of each audience segment through engagement or research. Risk communicators and/or spokespeople then develop well-crafted messages to address these specific concerns, and determine appropriate media channels to disseminate those messages during an emergent event (Covello, 2003). The

⁵ Each year, the Government of Canada visits First Nations communities who are signatories to treaty to distribute treaty annuity payments (Government of Canada, 2008) and some local First Nations and Tribal Councils host events and trade fairs in tandem with the annuity payment event.

research team co-investigators identified the need for a map-like, visual and interactive tool that could gather the information necessary to conduct message mapping across ages/life stages: youth/young adults (age 18-34), adults (age 35-59), and older adults/Elders (age 60+). It was also important to develop, validate and deploy the tool using limited financial resources and a time-period appropriate for the communities and a masters student project. After careful review of existing methods, the co-investigators determined the project must employ a novel data collection tool. The need to develop special tools for lower resource places (E. P. Green et al., 2016) and First Nations contexts (C. Fletcher, 2003; F. Fletcher et al., 2013) has been described and successfully applied in other projects. To build the tool, SPH researchers developed four main questions and a list of potential participant answers from the discussion around community priorities and concerns from the initial community meetings. These questions were:

- 1) When drinking water advisories happen, what are your main concerns and questions?
- 2) When drinking water advisories happen how are you CURRENTLY notified?
- 3) If you had a choice, what would be the BEST way to notify you about an advisory?
- 4) What is a “Precautionary Boil Water Advisory”?

Pre-determined answers to each of the four questions were illustrated and arranged spatially under each question and on four separate large foam poster boards. Similar to a mind map, analogous answer options, for example such as social media (e-mail, text Facebook) and direct contact (e.g. door-to-door, home visits) were grouped together (Craft of Communication, 2013; Eppler, 2006). In action, participants would note their responses to these questions using a pre-determined number of dot-stickers, colour coded by age. This dot-voting method originates from an established facilitation method called “dotmocracy” (Diceman, 2010). Prior to use in the community setting (e.g. events, meetings, private homes) a community meeting was held in Muskoday and Mistawasis, where research team members (e.g. co-investigators, local leaders and practitioners) validated the tool, questions, responses and overall process to engage community members. Community-specific answers were required for questions 2 and 3, based on Muskoday and Mistawasis’ unique existing communication methods and potential to implement future methods. Through participating in the validation process, all co-investigators and five potential community-based data collectors were trained to use the tool. Also during this meeting, the research team determined that qualitative statements from participants would add

additional value and depth to the information collected and further validate the appropriateness of the finished dot-mapping tool. Data collectors were instructed to periodically note any comments or insights from participating community members that were heard repeatedly or were particularly interesting or relevant.

During the meeting to validate and pilot the tool, the research team recognized that data collection at Treaty Day may not provide enough responses or responses that were acceptably representative of the community's age distribution. In response, the communities indicated that additional community members could be engaged through local events, meetings or individual face-to-face visits. This approach noted in Warner (2015)'s review of participatory mapping methods, which suggests researchers should actively seek out hard-to-reach community stakeholders to participate in a community mapping project, warning that failure to do so may undermine efforts to include underrepresented voices. For cases when the use of the large boards was not feasible, the question boards were reproduced on single pages and put into booklets for individual completion. When returned, the SPH researchers would place the stickers from the booklets on the appropriate space on the main boards. Partners recognized the potential for bias when using multiple collection methods but determined the need to reach a diverse group of water users, especially elders and young adults, outweighed this concern.

Phase Three: Data Collection

Between spring and fall 2018, SPH Researchers, STC H&FS Inc. staff and other data collectors deployed each community's dot-mapping tool at their respective Treaty Day events and in the communities. During the community events, the data collectors approached potential participants and obtained verbal consent to participate. As a small incentive to participate, in many cases, community members were provided with a snack and/or "tickets" which could be exchanged for fresh produce as part of a wider Saskatoon Tribal Council nutrition initiative at trade fairs. Data collectors guided each participant through the activity, noting that some participants may need extra guidance if they had trouble seeing or reading the posters. The data collectors asked participants to place the pre-determined number of dots stickers, colour coded by the participant's age group, on the answers(s) that best matched their preference or response to each question. Participants were provided with the option to place more than one dot on answers they felt strongly about and no requirement to use all dots. The end-result of this

process was a visual, map-like distribution of individual participants' main concerns and questions, current and preferred BWA notification methods, and definitions of precautionary BWAs. The finished map also showed a large collective picture of each community's responses, with different colours giving insight on the differences between age groups/life stages.

For Muskoday, co-investigators agreed there was a need for additional participants from the "youth/young adult" and "older/Elder" age group. These were collected by Muskoday's Chronic Disease Coordinator who attended a community elders' meeting and accessed young people through additional community groups and networks. For Mistawasis, co-investigators also agreed there was a need for participants from the "youth/young adult" and "older/Elder" age groups. To collect additional "younger" responses, one of the SPH researchers attended a community "amazing race" event. To collect additional "older" responses, two community members with strong connections to the elder community were trained in data collection and visited elders at-home to collect their responses.

Phase Four: Data Interpretation and Knowledge Translation

After the BWA dot-voting data collection was completed in Fall 2018, another community meeting was held within the months of September (Muskoday) and November (Mistawasis) to determine the map's results, reflect on findings and determine potential actions arising from the map or any other part of the research project. For both Mistawasis and Muskoday, co-investigators and other community drinking water practitioners attended the meetings. In Mistawasis' meeting, the Chief and an interested high school student with family ties to Mistawasis also joined the meetings. The purpose of using a community meeting to analyze the results were:

- 1) To have local practitioners analyze the maps and interpret the results in their community context and to their scope of practice.
- 2) To have SPH researchers analyze the maps and interpret the results in terms of previous studies, major theories and other scientific frameworks.
- 3) Using this "two-eyed" knowledge, collaboratively develop a local action plan for knowledge translation and implementation.

The results of these community meetings, including local action plans for knowledge translation, are summarized in Tables 2-1 to 2-3 and were discussed in detail in Chapter One. At publication, knowledge translation activities were in the preliminary phase.

Table 2-1: Participants in Dot-Mapping Activity in Mistawasis and Muskoday.

Community	Number of Participants, By Age Group			Total
	Young Adults (18 – 34) Red Dots	Adults (35-59) Blue Dots	Older Adults/Elders (60+) Yellow Dots	
Mistawasis	22	39	24	83
Nêhiyawak	*22	*39	*9	
Muskoday	27	18	22	69
First Nation	*8	*18	*7	

*Number of total responses collected on the large dot-maps during events. This is considered the main form of data collection.

Table 2-2: Summary of Dot-Map Interpretation, Muskoday First Nation

Main Question	Dot-Map Result	Collective Dot-Map Interpretation/Action Plan
Main BWA Concerns and Questions	Youth and elders appear to be missing information that is available on the paper delivery notices.	Suspect this is because notices are not being shared by head of household. All partners to collaborate on improving paper notice wording including a prompt to share with family members.
How are you Currently Notified?	Youth and elders appear to be getting their information through informal channels more than formal channels. Facebook posts are effective here.	Adams to write a policy brief for leadership which will explain how to integrate these findings with existing policies medium-long term.
Best Way to Notify?	Current practice seems to be working but room for improvement. Youth and elders more interested in electronic notifications than 35-59 age group.	
What is a precautionary BWA?	An overall split between the correct answer and believing it means there is confirmed contamination. No age patterns noted.	Working with STC to develop message maps for local staff and educational materials for water users on the cause of precautionary BWAs.

Table 2-3: Summary of Dot-Map Interpretation, Mistawasis Nêhiyawak

Main Question	Dot-Map Result	Collective Dot-Map Interpretation/Action Plan
Main BWA Concerns and Questions	Community members (no age difference) seem to have more concerns about drinking water while on advisory. This is likely because they can be frequent and intermittent. Youth and older adults have questions about bottled water, but this is a changing process.	Working with STC to develop risk communication message maps for local staff and educational materials for water users on the cause of precautionary BWAs.
How are you Currently Notified?	Community members overwhelmingly receive their information from the community's main channels: hand-delivery and radio.	Adams to adapt risk communication message maps for radio.
Best Way to Notify?	Community members are overwhelmingly satisfied with current communication process.	Thesis to include discussion on Mistawasis process in thesis – community may use later for evaluation, grant proposals, etc.
What is a precautionary BWA?	An overall split between the correct answer and believing it means there is confirmed contamination. No age patterns noted.	Working with STC to develop message maps for local staff and educational materials for water users on the cause of precautionary BWAs.

2.5 Discussion

The *Science in a Circle* © model provided an appropriate framework for renewing community links and exploring an environmental health topic through community-based participatory research. From the outset, existing relationships were renewed between environmental health university researchers and environmental health practitioners from First Nations and their agencies. This ensured the project co-investigators shared an immediate sense of purpose – to improve the capacity of local people to protect their health during a boil water advisory. In many fields of Indigenous research, such as education, research methods and ethics often call for a decolonizing approach, advocating for Indigenous ways of knowing to replace western scientific methods (A. Dawson, Toombs, & Mushquash, 2017; Donald, 2012; Wilson, 2001). However, environmental health research requires a different approach: environmental health practitioners such as environmental health officers (public health inspectors), toxicologists, water treatment plant operators and water quality monitors are all trained and certified (if applicable) in western approaches to drinking water treatment and management. In this project, applying *Science in a Circle* © meant these scientific/technical approaches were situated within a First Nations context. The co-investigators aimed to create an “ethical space” for engagement (Ermine, 2007) and “two-eyed seeing” (Bartlett et al., 2012, 2015) in each

community meeting, which resulted in two important outcomes: (1) Indigenous knowledge and western environmental health approaches could be discussed in a conversational and respectful space and (2) community members could validate each element of the project (e.g. research questions, dot-mapping tool) before it was finalized or implemented. This kind of “collective validation” is described in Brant Castellano (2004)’s seminal discussion paper on Indigenous research ethics, explaining that in Indigenous tradition, new knowledge must be discussed and vetted by an Indigenous community before it becomes collective knowledge or action.

Indigenous communities, researchers and institutions are recognizing the need to shift from community-consulted research projects to community-led research projects. Community-based participatory research, such as the *Science in a Circle* © method (Nilson et al., 2008) and other community-based approaches to Indigenous research (Bull, 2010; Cochran et al., 2008; C. Fletcher, 2003), are models designed to scale up community participation and leadership, when it is appropriate and desired by the community. The increased leadership of communities in research partnerships and study protocols predictably demands culturally and practically appropriate research methods (Bull, 2010; A. Dawson et al., 2017). These are necessary factors for the development of valid Indigenous research knowledge (Brant Castellano, 2004; Cochran et al., 2008). In this study, the co-investigators determined that existing published methods could not answer the research questions on risk communication of boil water advisories, be culturally appropriate, and practically implementable. In this project, this challenge became an opportunity: to meet all three criteria above, the research team developed the *Participatory Dot-Mapping Method*. This method not only addressed practical considerations such as setting, time and costs, but also allowed the community to validate each element of the project, even when it was led or developed by researchers. While the SPH researchers led discussions and generated many project elements (e.g. draft dot-maps, draft communication materials), the community’s input and approval were required to finalize or deploy those elements. When preferred and/or possible, the communities and/or the Tribal Council took the lead, particularly in defining the research questions, validating the dot-mapping tool, and determining appropriate knowledge translation strategies. While the *Participatory Dot-Mapping Method* was well-received by the community partners and participants, developing a new method extended the project schedule by several months. When forming research partnerships that use a CBPR model such as *Science in a Circle* © (Nilson et al., 2008), all research partners should consider the likelihood a novel

method will be required, and plan project timelines accordingly. When a novel method is used, there will not only be additional time required to develop, test and deploy the method, but significant additional time to justify and communicate the process in theses and publications.

Another way to enable community control in research projects is suggested by Cochran et al. (2008), who say Indigenous partners should have significant input into conference presentations, and given adequate presentation time to share their story. When a Mistawasis Public Works Director joined the SPH masters student for a conference presentation in Spring 2017, they co-developed the presentation, leaving most presentation time for the Mistawasis representative to contextualize their drinking water communication practices and challenges. The conference audience response was overwhelmingly positive; many commented on how much they learned by hearing his story. For the masters student, this was not only opportunity to practice co-presenting with Indigenous partners, but to see the benefits of giving community voices equitable time and importance in academic knowledge sharing. Student capacity-building is an important aspect of *Science in a Circle* ©, and in this project, STC's university summer student attended a community meeting in Mistawasis. A high school student (a Mistawasis band member) doing a project on safe drinking water joined the research team at the Tribal Council office for Mistawasis' data interpretation meeting, where they participated in the interpretation and received a tour of STC's water monitoring laboratory. Muskoday's Chronic Disease Coordinator, who led data collection in that community, left her position for post-secondary education during the project. *Science in a Circle* © recognizes that students are leaders. Through research, it is not only important to generate capacity, but to recognize that these students may renew research links with the co-investigators, other members of the research team, or each other in the years and decades to come.

Saskatoon Tribal Council Health and Family Services, Inc. played a very important role in renewing a *Science in a Circle* © (Nilson et al., 2008) research partnership and carrying out this study. The Tribal Council has provided environmental health services to their member communities for nearly 25 years, and their environmental health staff have the unique lens of familiarity each community's individual context, and the ability to note shared priorities, strengths and challenges across communities. This knowledge was particularly important in the early stages of the project, when STC's Environmental Health Programs Manager was initially

contacted for the research project. Studies have noted that CBPR projects with Indigenous communities often struggle to prioritize community interests and priorities over scholarly interests (such as novel events) (Bull, 2010). Morton Ninomiya & Pollock (2017) note another common dilemma, where CBPR projects conflict or duplicate work already happening in the community. Had the SPH researchers contacted community(ies) directly with their initial research topic, the proposal may not have been well-received or may not have sustained lasting interest due to one or both of these factors. The Environmental Health Program Manager's input in early conversations ensured communities were approached with a risk communication research topic that was relevant and distinct from other work happening in the community.

Because Tribal Councils provide aggregate services, they can also support community control of research projects and designing research partnerships that meet the standards of ownership, control, access and possession prescribed by OCAP™ (The First Nations Information Governance Centre, 2014). Formalizing the research partnership with a well-articulated research agreement is essential to the *Science in a Circle* © model (Nilson et al., 2008). In this project, the STC H&FS Inc. was able to negotiate a standard research agreement on behalf of each community at their request. In this project, the renewed community links further supported these efforts, as the agreement was adapted from previous projects with Bharadwaj during the development of the *Science in a Circle* © (Nilson et al., 2008). The research agreement articulated how OCAP™ would be applied in the project, and STC further supported the project by offering long-term data stewardship for their communities if required.

2.6 Conclusion

Community-based participatory research has emerged as a best-practice for Indigenous communities who wish to conduct ethical and appropriate research in their communities. The approach allows communities to leverage the significant knowledge and resources housed in research institutions while governing research processes. This is necessary to ensure research results are actionable by the community and the outcome of research is improvement in health and well-being. For environmental health research topics such as safe drinking water, the *Science in a Circle* © approach is an effective way to engage public health experts (e.g. environmental health officers), university researchers and First Nations leaders and practitioners in a community-based participatory research partnership. When the research topic will evaluate

and/or inform local policy, the *Science in a Circle* © approach can engage research partners and the wider community in conversations that honour both Indigenous knowledge and western science approaches. In addition to increased local capacity to improve health, this process can also generate new methods, knowledge and/or new community links.

First Nations are increasingly assuming governance of their own health services. For services like environmental health, communities are likely to partner with other First Nations and aggregate these services through shared agencies such as tribal councils and health authorities. This governance shift means tribal councils, along with their member communities, are tasked with re-orienting services to better reflect First Nations values and priorities and ultimately provide better outcomes to the First Nations citizens they serve. When this policy and program development process can be improved through institutional research, this project shows that First Nations and agencies can successfully partner with researchers through community-based approaches. The *Science in a Circle* © approach is particularly appropriate for First Nations who wish to develop policy in science-based practical areas, such as drinking water treatment, while also respecting local customs, Indigenous ways of knowing, and local politics.

Chapter Three: Participatory Dot-Mapping: A New Tool for Community Engagement in Health Risk Communication

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3.1 Abstract

Research protocols and methods are increasingly rooted in Indigenous epistemologies and focused on the priorities, strengths and limitations of Indigenous contexts. This paper discusses the development of a novel Indigenous research method, *The Participatory Dot-Mapping Method*. This method was developed through a community-based participatory research partnership between two First Nations, one Tribal Council, and university researchers in Saskatchewan, Canada. The project explored risk communication of boil water advisories on First Nations.

Through a series of community meetings, the method enables research partners, local leaders, experts and everyday community members to meaningfully and equitably participate in each step of the project. These steps include research definition, tool development, data collection, data analysis and knowledge translation. The method is hybrid of three established qualitative participatory methods: participatory maps, dot-voting and mind mapping. Data is collected at community events and other community settings. Participants use coloured stickers to choose pre-determined answers to research questions, creating a colourful visual distribution of community responses.

This method is just one example of a wider trend of combining western research methods with Indigenous research methods to solve Indigenous research questions. This method is a fast, inexpensive and simple community engagement method for risk communication research on

First Nations. It is simple and appropriate for participants of many ages, knowledge and literacy levels. It is particularly useful for topics where participation and dialogue alone may improve local knowledge and capacity. It has likely applications in other low-resource settings and on additional local policy topics.

3.2 Introduction

Canada's First Nations, Métis and Inuit communities are rapidly assuming control of research activities in their communities. In the past, research involving these Indigenous communities was initiated, controlled and carried out largely by institutional researchers. Often, the outcome was of little benefit, or even destructive, to those communities (Brant Castellano, 2004; Canadian Institutes of Health Research, Natural Sciences and Engineering Research Council of Canada, & Social Sciences and Humanities Research Council of Canada, 2014). Today, Indigenous and many non-Indigenous research communities are keen to reverse this trend. They are rapidly entrenching Indigenous research ethics in their research activities (Brant Castellano, 2004; Canadian Institutes of Health Research et al., 2014; Schnarch, 2004). Research policy is also shifting: *Canada's Tri-Council Policy Statement on the Ethical Conduct for Research Involving Humans* is prescriptive in its requirements to partner with Indigenous communities when conducting research with Indigenous people (Canadian Institutes of Health Research et al., 2014). Researchers who work with Indigenous communities widely apply OCAP™ to their studies. The First Nations Governance Centre (2014) developed the research standard, which requires Indigenous communities to own research their data, control how it is used, and define who can access and possess their data. Institutional researchers must, in many cases, adapt long-established research practices to meet these ethical requirements. Bull (2009) notes that “ethical research in an Aboriginal context may require altering the proposed methodology to be wholistic rather than individually centered, and it may require a shift in the researchers’ understanding of ‘ownership’ or ‘sharing’ of traditional knowledge (Bull, 2009)” (as cited in Bull, 2010, p. 13). While this may challenge deep-seated assumptions within the western academy such as data ownership and academic freedom (The First Nations Information Governance Centre, 2014), it is not without merit. Indigenous communities are driving this transformation out of a genuine need and desire to improve their communities through research. Improvements, however, require valid, useful knowledge. Institutional research can only

accomplish this through methods that honour and use Indigenous ways of knowing (Brant Castellano, 2004; Cochran et al., 2008).

Indigenous communities have long used research to generate the knowledge they needed to adapt and prosper in harsh environments or rapidly changing circumstances (Brant Castellano, 2004). A 2017 review of Indigenous research methodologies found that as communities take increasing control of institutional research activities, these forms of Indigenous philosophy, inquiry and knowledge are joining or replacing western paradigms in research practice (A. Dawson et al., 2017). A new academic discipline has emerged, led by Indigenous academics and dedicated to the documentation, development and application Indigenous research methodologies (A. Dawson et al., 2017; Kovach, 2010a). Some of these methods are akin to deeply sacred traditions of knowledge generation (Kovach, 2010a; Wilson, 2001). Others combine Indigenous and western approaches to knowledge creation, becoming novel methods for inquiry in the Indigenous context (A. Dawson et al., 2017). When an Indigenous research project requires significant involvement from university researchers, especially in health and social science research, a community-based participatory research (CBPR) approach is common (Brant Castellano, 2004; Cochran et al., 2008; A. Dawson et al., 2017). This approach aims to correct power imbalances between communities and institutions, increase community control over research, and foster trust through strong relationships between researchers and community partners (Castleden, Garvin, & Huu-ay-aht First Nation, 2008; Israel, Schulz, Parker, & Becker, 1998). These qualities situate CBPR as an appropriate approach to ethical Indigenous research (Bull, 2010; A. Dawson et al., 2017). When applied to projects with Indigenous communities, CBPR encourages community participation in all aspects of the research design, data collection, data interpretation and dissemination. This often includes the incorporation of Indigenous research priorities and ways of knowing into the study's research design, research methods, and data interpretation (Bull, 2010; Cochran et al., 2008). In the health context, valid research is needed not only to generate knowledge around health and health inequalities, but also to evaluate interventions that act on those inequities (Cochran et al., 2008).

3.2.1 Risk Communication: An Overview

Risk communication is the process of informing populations about human health hazards in the environment (Fitzpatrick-Lewis et al., 2010; Glik, 2007). Crisis risk communication is a

type of risk communication; the practice of delivering important information to audiences during an emergency or urgent situation (Glik, 2007). Crisis risk communication is an important part of overall emergency response. Messaging that aims to encourage a precautionary health behaviour must consider risk perception (van der Pligt, 1998). Risk perception is complex and multi-factorial; it is shaped by a person's experiences and social world rather than empiric and probabilistic risk assessments. Major predictors of risk perception include trust (Slovic, 1993b), culture and worldview (Wildavsky & Dake, 1990), and qualitative risk characteristics such as level of control, familiarity, natural vs. man-made, etc. (Slovic et al., 1984; Wildavsky & Dake, 1990). "Message mapping" is a well-established method to improve crisis risk communication for public health. In message mapping, risk communicators assess the public's most salient health concerns and questions through a variety of methods, including engagement with affected or potentially affected groups. The communicators then pre-plan a limited number of (no more than three) short, well-crafted responses to those concerns (Covello, 2003). During an event (such as a boil water advisory), risk communicators can then rely on the message maps to ensure only the most important and consistent communication is released to the public. This can happen through a variety of channels, including TV, radio, print, social media, or face-to-face conversations.

3.2.2 Project Rationale: A New Method for Risk Communication Research with First Nations

When boil water advisories happen on First Nations, risk communication is largely the responsibility of the First Nation government (band). Environmental health experts employed by First Nations agencies (such as Tribal Councils) or Indigenous Services Canada may provide advice or assistance in this process (Indigenous Services Canada, 2018b). First Nations who engage their members on local policy topics, such as risk communication, are tasked with choosing methods that are both culturally appropriate and feasible. Barriers to participation and implementation must be considered in community engagement activities (Community Places, 2014). For First Nations, they may include time constraints, budgets, research skills and the community's overall interest and capacity to participate in research. This paper will describe the development and application of a novel method for First Nations community engagement. The "participatory dot-mapping" method examined risk communication during boil water advisories in two First Nations communities in Saskatchewan. Collaboratively developed by university

researchers and First Nations partners as part of a CBPR project, this novel method engaged more than 150 community members on risk communication during boil water advisories. This method was designed because the researchers could not find a published participatory method for research that would both meet the needs and limitations of the project, which included the need to assess non-spatial conceptual data, use an interactive and inclusive visual method that could be deployed at community events, and meaningfully incorporate Indigenous knowledge and context. The resulting *Participatory Dot-Mapping Method*, combined:

1. participatory mapping, an established method in CBPR (Corbett & Lydon, 2014)
2. dotmocracy, a method commonly used in community engagement (Diceman, 2010), and;
3. mind mapping, a method to arrange non-spatial concepts into visual diagrams (Craft of Communication, 2013).

It promoted meaningful involvement of First Nations decision-makers in data analysis and interpretation and generated actionable insights for program planning, program evaluation and policy development.

3.2.3 *Mapping Exercises: A Participatory Method*

At the heart of CBPR is a goal to create social change through community participation in research (Israel et al., 2012). To meet this goal, CBPR researchers must seek new and interesting ways to engage and educate populations who are under-represented in the research and policy-making process (Corbett & Lydon, 2014). In the research process, this begins with research partners defining their research goals, working together to better understand the factors behind a health or social issues, then “draw[ing] on a variety of methods for systematic collection and analysis of information” (Israel et al., 2012, p. 189). Mapping exercises are a well-established community participatory research method which can engage community members on important social topics in a visual way. This approach makes research participation accessible to many education levels, age groups and literacy levels (Corbett & Lydon, 2014; E. P. Green et al., 2016; Israel et al., 2012; Leung et al., 2004). Well-developed, visual representations can convey complex relationships and information which may otherwise take many pages of text to explain. They can bridge important gaps in culture, skill levels (such as literacy and numeracy) and abilities when conducting research with Indigenous peoples or

vulnerable groups, which is an important ethical consideration for community-based participatory researchers (Morton Ninomiya, 2017; Morton Ninomiya & Pollock, 2017). Participatory maps are generally used to collect community-relevant spatial data (Corbett & Lydon, 2014; E. P. Green et al., 2016; Leung et al., 2004; Warner, 2015). Spatial data collects information about a real place in space. The applications of participatory mapping are broad, examples include roads and traffic planning, identifying community assets, recognizing important environmental features or assessing population densities (Corbett & Lydon, 2014). Spatial arrangement of non-spatial data (such as themes hierarchies, ideas, priorities, lists) is frequently used in qualitative research, for example through the use of mind maps (Craft of Communication, 2013; Eppler, 2006), diagrams (Eppler, 2006; Morton Ninomiya, 2017) and concept maps (Eppler, 2006; Trochim, 1989). Some applications include simplifying complex ideas and relationships, understanding conceptual relationships, and facilitating dialogue (Eppler, 2006; Morton Ninomiya, 2017). Participatory mapping methods have not, however, been recorded in the literature for use in conjunction with non-spatial conceptual data (and therefore risk communication message mapping) that we can find. We could also not identify a published participatory method (such as diagrams, mind maps, concept maps) that could be deployed in a community event setting, such as Treaty Days.

Despite the abovementioned gaps, participatory mapping is a well-established method for Indigenous contexts, having been applied in Indigenous contexts worldwide. In Australia, participatory mapping has been used to identify areas of ecological significance for environmental assessments (Robinson, Maclean, Hill, Bock, & Rist, 2016). In Latin America, participatory mapping is used to define territories and natural resources to protect Indigenous rights (McCall, 2014). In Africa, novel participatory mapping methods have generated important health knowledge in a low-resource context (E. P. Green et al., 2016). In one example, coloured dot-stickers were used by local youth to answer questions about neighbourhood points of interest. Similar to the *Dotmocracy* community engagement method (Diceman, 2010, 2013), the dot-map's results were later discussed in focus groups. In First Nations in BC and Quebec, community-build maps have been used to define local territories and natural assets (Corbett & Lydon, 2014). Other visual methods, such as 3D landscape generation and photovoice, have also proven successful to engage First Nations in environmental and health research (Bradford et al., 2016; Castleden et al., 2008; Israel et al., 2012; Lewis & Sheppard, 2006).

3.3 Project Overview: The First Nations and Tribal Council Context

In 2016-2018, researchers at the University of Saskatchewan School of Public Health (SPH) formed a research partnership with two First Nations and their Tribal Council. The resulting community-based participatory research project examined how risk communication techniques could apply to First Nations who experience drinking water advisories (more commonly called “boil water advisories”). While co-developing the study design, all community partners identified the need for a novel community engagement tool. This tool, called *Participatory Dot-Mapping*, combines several existing community engagement methods. Participatory mapping techniques were blended with elements of non-spatial mind mapping and dot-voting to generate important knowledge around risk perception and risk communication preferences in these communities in the Summer and Fall of 2018. The full project design and rationale are described in Chapter 1.

3.4 Why develop a new method?

Through a series of community meetings, the research partners identified the need for a map-like, visual and interactive engagement tool. Novel participatory methods have been developed and successfully applied in low-resource settings (E. P. Green et al., 2016) and First Nations contexts (C. Fletcher, 2003; F. Fletcher et al., 2013). Furthermore, a 2017 systematic review of Indigenous research methods found that a key component of Indigenous methodological research is the development of innovative methods. In their paper, authors argue that any method, whether rooted in Indigenous traditions (e.g. storytelling) or Western science (e.g. mapping) becomes an Indigenous method when adapted to an appropriate and ethical Indigenous research project with an Indigenous community (A. Dawson et al., 2017). Emerging from the project’s purpose and objectives, the research team determined they required a tool that could meet the following criteria:

- Generate useful knowledge around risk communication of boil water advisories; particularly around community priorities.
- Allow for the rapid engagement of many community members that represent the community’s diversity, including a variety of ages, education levels, level of cultural connection, personal histories, and family status.

- Participating in the data collection method should increase their personal capacity to respond to boil water advisories.
- Create a visual representation of the information, which could be easily co-analyzed without quantitative analysis.
- Allow for comparison between responses generated by youth, adults and elders.

The need to eliminate quantitative analysis was a key factor in the decision to develop a new tool. Most non-spatial mapping methods, e.g. concept mapping require significant training to conduct, and require quantitative analysis of the results, which can limit participation of community partners in the planning and analysis (Eppler, 2006; Trochim, 1989). Methods such as concept mapping (Trochim, 1989) also require participation at multiple time points, which was also not feasible in this case, as communities wanted to engage community members during local events. In addition, the First Nations partners were clear that their communities experience “survey fatigue” and predicted local community members would decline participation or provide low-quality data if surveyed using traditional methods. As such, they preferred to reserve traditional surveys for higher-investment and higher- priority inquiries such as community health surveys. Instead, communities noted an opportunity to engage a large and diverse sample of community members during trade fairs held during the community’s annual Treaty Day. Treaty Days are an annual community gathering held during the distribution of treaty annuities to community members by the Government of Canada. In the communities participating in this study, this event is usually well attended by a wide variety of residents. Street stall displays with a short activity, such as mapping, are an ideal method to engage community members during an event or trade fair. When well-planned, they can engage a large group of participants and reach people who may not normally participate in research and engagement (Community Places, 2014). Because of this, the partners determined a novel participatory mapping method would best meet the project’s objectives. Building on the dot-mapping process described by Green et al. (2016), this method would convert non-spatial concepts in drinking water risk communication into spatial representations through a process similar to mind-mapping (Craft of Communication, 2013). It would also use the conversational method (Kovach, 2010a) to analyze the data, encouraging deeper participation from First Nations partners. The result is the *Participatory Dot-Mapping Method*.

3.5 The Participatory Dot-Mapping Method

The *Participatory Dot-Mapping Method* was developed by University of Saskatchewan researchers and the project community partners Muskoday First Nation, Mistawasis Nêhiyawak and the Saskatoon Tribal Council Health and Family Services Inc. It was developed between January and May 2018 through a series of community meetings, research briefs and email exchanges. Developed for use in Indigenous community-based participatory research settings, this method uses a simple, visual and interactive data collection tool. It allows everyday community members to participate in drinking water communication policy planning and evaluation, while also contributing to theory development in this area. This method encourages meaningful participation from First Nations leaders, managers, professionals and everyday citizens in risk communication research. Equitable contributions from Indigenous and non-Indigenous researchers are encouraged, understanding community partners may not have the time, resources or desire to lead every step of a given research project. Partner communities can, however, appoint any interested person(s) with relevant lived experience and knowledge to participate in the research design, deployment, analysis, and knowledge translation. This group is collectively called the research team. This team included:

- Research partners: the university and community co-investigators leading the project through an established research partnership.
- Leaders and local experts: Those who will contribute to the method with a high level of expertise in the topic due to their lived experience, occupation or both. May include Chief and Council, managers and practitioners from the First Nation and/or their subsidiaries and/or agencies, Elders, community activists, community members who are highly engaged in the research topic.
- Research contributors: Those who will participate in the project in a primarily learning or support role. These may include university graduate students or university researchers, representative from outside agencies or governments, or community support staff.
- Data collectors: any team member who will be trained to deliver the dot-mapping exercise in the community. In many cases, these will be community members who are familiar with and familiar to community members. Some communities

may appoint partners (e.g. university researchers or students) to assist if enough local are not available.

Different team members may be appointed to participate in different steps and elements of the research project depending on the purpose of each step and their availability. The team can (and likely will) be modified at any time. For example, some data collectors may be identified and appointed later in the process, or the Chief may be asked to join in data analysis during a lunch break from another meeting (this happened!).

The method's five-step process is described below in detail and summarized in Table 3-1.

Table 3-1: Summary of the Participatory Dot-Mapping Method

	Step One: Prepare, Understand and Focus!	Step Two: Build the Tool!	Step Three: Make the Map!	Step Four: Analyze the Results!	Step Five: Take Action!
Purpose/Goals	In this step, the research team, research focus and question(s) are defined.	A draft map and supporting materials are made and validated by community members. Data collectors are trained. The mapping exercise is finalized.	The mapping exercise is deployed. Data is collected.	The results of the participatory dot-mapping exercise are analyzed and interpreted. Knowledge translation is planned.	The most important findings from the mapping exercise are integrated into actual policy or practice improvements.
Research Team	Research Partners Leaders and Local Experts Research Contributors	Research Partners Leaders and Local Experts Data Collectors Research Contributors	Data Collectors	Research Partners Leaders and Local Experts Research Contributors	Research Partners Leaders and Local Experts Research Contributors Outside Collaborators
When/How	1-2 Preliminary Meetings per Community (60-120 mins each)	1 Validation Meeting per Community (90-150 mins)	Community Events Meetings Home Visits As many as required.	1 Analysis/Interpretation Meeting per Community. (90-'50 mins)	Length of research partnership and beyond.

3.5.1 Step One: Prepare, understand and Focus!

In this step, the research team, research focus and question(s) are defined.

Prior to this step, a general research question or topic will have been defined by the co-investigators through the development of the research partnership. Each community should now identify the research team. Once the research team has been developed, the research partners

should hold their initial community meeting. The purpose of this meeting is to introduce the research team and develop the research relationship and focus. It will also allow the team to situate the research topic within local knowledge systems and experience. To achieve this, the meeting should be attended, at minimum, by leaders and local experts and the research partners. This meeting should use a conversational method (Kovach, 2010a), and the research partners should agree on how it will be facilitated and recorded. In this meeting, the discussion should explore the topic from a variety of perspectives and viewpoints and determine the community's most important research priorities. Following this meeting, delegated members of the research team should use the results of the meeting to develop a set of research objectives, and a draft set of question(s) and possible responses to be put forth to the community in the mapping exercise. The questions should stem from the research objectives, the possible responses should emerge from the discussion. A community sample and potential events/meetings/settings to deploy the tool should also be defined.

3.5.2 Step Two: Build the tool!

A draft map and supporting materials are made and validated by community members. Data collectors are trained. The mapping exercise is finalized.

First, research team members or research contributors (e.g. university graduate students) create white board(s), each with a question at the top. The possible responses should be individually illustrated (for example, using basic clipart) and arranged spatially on the board with similar answers grouped together. This map of responses is similar to a mind map (Craft of Communication, 2013). Grouping similar answers ensures that visual patterns can emerge among similar concepts, avoiding the pitfalls of vote splitting as described by (Diceman, 2013). Draft supporting materials are also developed, they may include a script or handout.

At least one community meeting is held at each partner site to validate and pre-test the map. The purpose of this step is to test the maps and process for community appropriateness prior to deployment with community members. For these meeting(s), the research team should include leaders, local experts and any other contributors who are and/or have first-hand experience with the concerns of everyday community members. Data collectors should also attend to validate and learn the process, understanding they may also bring first-hand personal or professional experience.

At this community meeting, research team members should discuss the appropriateness of the questions, potential responses and the orientation of the mind map, and agree on a mock-up. The team also assigns the age ranges or other respondent criteria to dot colours, (e.g. age ranges, gender, neighborhood, etc.) criteria. The number of dots available for each question are also assigned, assigning more dots to questions where an individual may have a wider range of responses. Once this is complete, the team should take turns engaging each other in a mock mapping exercise, fine tuning the process or the mock-up as required. Once data collectors feel confident to conduct the activity and a final map, process and supporting materials are agreed upon, the activity is ready to deploy. A data collection schedule should be finalized, keeping in mind additional data collection may be required at additional events and community settings. This approach is identified in Warner (2015) which warns that efforts to engage underrepresented voices in mapping projects can be undermined if researchers do not actively seek out these stakeholders for participation in community mapping projects. At this step, university co-investigators may need to amend/update their institutional ethics approval.

3.5.3 Step Three: Make the Map!

In the community setting(s), the mapping exercise is deployed and data is collected.

Data collectors are responsible for identifying participants and seeking their consent to participate, whether at community events, meetings or other community settings. Using the pre-determined scripts, data collectors guide participants through the exercise. Participants identify their response(s) to a set of pre-determined questions by placing the pre-determined coloured dots on a response map of potential answers. Distinct dot colours are given to each participant depending on their age category or other factor. For questions with multiple dots, participants may place multiple dots on responses they feel strongly about. They may use some, all or none of the dots. If a question requires, the map areas may be covered with paper to blind the participant to existing answers. To ensure the maps do not miss important insights unaccounted for in the map's design, data collectors are instructed to note any repetitive or interesting comments made by participants as they complete the exercise. At large events, the main map can be collaboratively built on large foam boards, poster board, or papered walls. For meetings or smaller settings, responses may be recorded in individual booklets of paper maps and later transferred to the main map by a research team member. The output of this method is a rich and

colourful dot-map of responses forming visual distributions that can be interpreted by nearly anyone.

3.5.4 Step Four: Analyze the results!

The results of the participatory dot-mapping exercise are analyzed and interpreted. Knowledge translation is planned.

Members of the research team convene and review the map and the additional notes from data-collectors. The purpose of using a community meeting to analyze the results is:

- 4) To have local practitioners analyze the maps and interpret the results in their community context and to their scope of practice.
- 5) To have researchers analyze the maps and interpret the results in terms of previous studies, major theories and other scientific frameworks.
- 6) Using these two lenses, collaboratively develop a local action plan for knowledge translation and implementation.

This meeting should be attended by the research partners and local leaders and experts who are well-situated to interpret the results in the context of local communication policy and practices. This may include practitioners, managers or even the Chief and/or councilors. This meeting, as with the initial meeting(s), should follow a conversational method (Kovach, 2010a), and be facilitated and recorded according to the preferences of the research team. In the meeting, each participant should share their interpretation of the map's results. Those insights may be recorded on the map using markers or sticky notes. The group should then discuss the meaning and context of each insight and recorded comment from data collection and determine the most valid results. Once those results are identified, the team identifies how to act on the results through policy, program or practice changes and what communication materials should be developed.

3.5.5 Step Five: Take Action!

The most important findings from the mapping exercise are integrated into actual policy or practice improvements.

Following analysis, research team members and other contributors develop communication and knowledge translation materials. These may include, but are not limited to:

message maps, community health promotion materials (e.g. displays, videos), academic theses or publications, conference presentations, policy briefs, posters and/or social media graphics and copy. Usually, the drafts will be developed by university researchers, and sent to the appropriate research team member for comments, additions and edits. Outside collaborators (e.g. communication experts, designers) may also participate in this step. In each community, the project's results and knowledge translation materials are used to communicate the results of the project to community members. They also contribute to policy/program planning and evaluation and overall changes in risk communication practice. New research questions and research partnerships may develop.

3.6 Developing and Applying the Dot-Mapping Method: Muskoday First Nation and Mistawasis Nêhiyawak

3.6.1 Step One: Prepare, understand and Focus!

In January 2018, initial community meetings were held with both participating First Nations communities (Mistawasis Nêhiyawak and Muskoday First Nation). Each meeting took approximately two hours. In Muskoday, the meeting was held at the health centre and in Mistawasis the meeting was held in Saskatoon at the Saskatoon Tribal Council office. Prior to these meetings, the project partners identified agreed to examine drinking water risk communication in their community context through a community-based participatory research model called *Science in a Circle* © (Nilson et al., 2008). The research partners and local leaders and experts involved in the management of safe drinking water attended the meetings. In Muskoday, local leaders and experts included a band councilor, health centre staff and drinking water monitors employed by the Tribal Council. In Mistawasis, the water treatment plant operator, Health Director and Tribal Council water monitor attended the initial meeting. The purpose of these initial meetings was to acquaint the research team and situate the topic of drinking water risk communication in the community's experience and local knowledge systems. Attendees identified community priorities, concerns and communication practices related to boil water advisories. Each community noted strengths in their current approaches, including previous community engagement efforts and successful program changes. Concerns included lack of trust in drinking water system, misunderstandings around reasons for advisories, and

concerns that specific age groups (e.g. youth, elders) may not be receiving advisories through current advisory communication channels.

Based on information shared at the initial meeting, SPH researchers developed a set of focused research objectives and determined this research sample should include as many local drinking water users as possible, who could be easily engaged at upcoming events such as Treaty Day. They also generated a draft list of questions and potential responses to bring back to the community for feedback. These questions were:

- 5) When drinking water advisories happen, what are your main concerns and questions?
- 6) When drinking water advisories happen how are you CURRENTLY notified?
- 7) If you had a choice, what would be the BEST way to notify you about an advisory?
- 8) What is a “Precautionary Boil Water Advisory”?

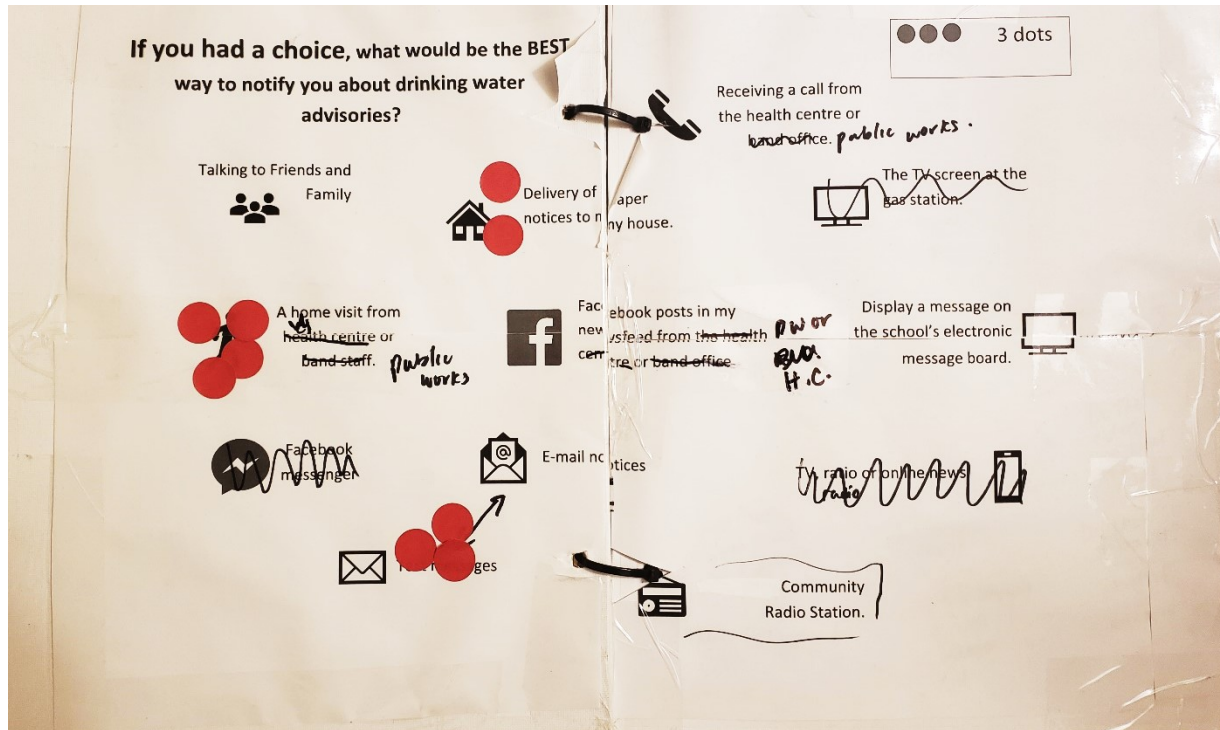
In this step, SPH researchers also developed a draft script and data collection process for data collectors.

3.6.2 Step Two: Build the tool!

First, SPH researchers illustrated each pre-determined response with a basic visual icon and arranged them spatially on a large white paper. Similar options were visually grouped together in what we described as a “response map”, similar to a mind map (Craft of Communication, 2013; Eppler, 2006). A two-hour community meeting was held to validate this draft map, in Mistawasis at the band office and in Muskoday at the health centre. In each community, this meeting included the research team, potential data collectors and other First Nation and Tribal Council staff who could speak to the experiences and views of everyday community members. In Muskoday, for example, the Chronic Disease Coordinator took a lead role in data collection because of her strong knowledge of the local community and their health concerns. In each community’s meeting, participants workshopped the questions, response maps and overall data collection process, adjusting for clarity, correctness, understandability and flow. A workshopped draft map is shown in Figure 3-1. For questions two and three, community-specific response maps were developed based on the community’s unique context. Each community had unique current boil water advisory communication methods and distinct options for new methods. Once the script, process, questions and maps were finalized, the group assigned a maximum number of

coloured dots to be used for each question (1-6, depending on question), and the age ranges assigned to each coloured dot (red=18-34, blue=35-59, yellow=60+).

Figure 3-1: A Workshopped Draft Dot-Map



After workshopping and achieving group consensus on their readiness for deployment, the SPH researchers reproduced the final response maps on freestanding displays made of white foam display boards. They also reproduced the maps on letter-size paper, to be used in single-response booklets, if required.

Some data collectors were also trained during the pre-testing process. All co-investigators and five additional potential data collectors were trained to engage community members using the method. Data collectors were also instructed to periodically note any comments or insights from respondents that were heard repeatedly or were particularly interesting or relevant.

In this meeting, the research team also developed a data collection schedule. Through this process, the research team felt that data collection on Treaty Day may not result in enough overall responses or may result in a sample that did not reflect the community's water users,

particularly across age groups. In response, community partners suggested that some community members could be engaged through additional events or individual face-to-face visits. For cases when the use of the large boards was not feasible, such as Elders' meetings or home visits, the question boards were reproduced into single page booklets. When returned, SPH researchers would then transfer the stickers from the booklets to appropriate space on the main display boards.

The research team also determined that additional information would have to be provided by printed handout to each participant. This handout included the purpose of the study, what the data would be used for, and ethical considerations for participants. This handout is in Appendix F.

3.6.3 Step Three: Make the Map!

Between spring and fall 2018, SPH Researchers, STC H&FS Inc. Staff and other data collectors deployed each community's participatory dot-mapping tool in the community setting. During public events, participants were usually offered a small incentive to participate. During Treaty Day events, for example, they received vouchers that could be exchanged for fresh produce as part of a wider Saskatoon Tribal Council nutrition initiative. Using the approved script (Appendix G), data collectors identified and guided each participant through the activity of dot-mapping their responses to the four questions developed in Step One, regularly noting any repetitive or interesting insights from participants on a notepad. For question four, "What is a 'Precautionary Boil Water Advisory'?", the response areas were blinded with large sticky notes to ensure participants did not simply choose the most popular answer. When possible, local data collectors took the lead in identifying potential participants at each event.

In Muskoday, co-investigators agreed there was a need for additional participants from the (18-34) and (60+) age group. These were collected using the individual dot-map booklets by Muskoday's chronic disease coordinator at a community elders' meeting and other community settings. For Mistawasis, co-investigators also agreed there was a need for participants from the "younger" and "older" age groups. To collect additional (age 18-34) responses, one of the SPH researchers attended a community amazing race event. To collect additional (age 60+) responses, a grandmother and granddaughter with strong connections to Mistawasis' Elder

community were trained in data collection by an SPH researcher. They visited elders at-home to collect their responses. An example of a completed dot-map booklet is shown in Appendix H.

The dot-mapping activity produced a visual, map-like distribution of coloured dots. These distributions, comprised of many individual responses, became a collective representation of the community's response. The three dot colours formed additional distributions representing the difference between age groups. An example of the completed dot-maps is shown in Appendix H.

3.6.4 Steps Four & Five: Analyze the Data! & Act!

A two-hour community meeting was held to analyze each partner community's dot-mapping data in Fall 2018. Both meetings were attended by SPH researchers, the community's co-investigator, and the Saskatoon Tribal Council co-investigators. For Mistawasis, the meeting was held at the Saskatoon Tribal Council's head office when many Mistawasis leaders and experts were in the city for meetings. Local leaders and experts from Mistawasis also joined this meeting, they included the Chief and the Director of Lands and Resources. A high school student from Mistawasis joined as a research contributor, he was completing a school project on safe water in the community. For Muskoday, the meeting was held at the local health centre and health centre staff joined the research team to participate in the analysis.

The data analysis procedure was similar in each meeting. To begin, the completed dot-boards were displayed prominently. The meeting was lightly facilitated by an SPH researcher. Each participant was given the opportunity to reflect on the key visual patterns they observed. These patterns included overall response patterns, differences across age groups, and a comparison between the questions that measured current and preferred boil water advisory communication methods. In Mistawasis the facilitator noted key insights on the maps using post-its and markers. The research team added this step after fine-tuning the process used in Muskoday. The facilitator also introduced the data collectors' notes about repetitive or interesting comments as appropriate. For example, comments included "We don't always hear about advisories" or "we are told precautionary means optional." Through discussion, the meeting's participants agreed on key insights from the maps. The group then discussed how to translate that knowledge into a new or improved policy, practice or process at the community or Tribal Council level. It should be noted that not all participants attended the full meeting. In

Mistawasis’s meeting, the Chief and Director of Lands and Resources were able to join for a portion of the meeting during their lunch break from other meetings. A summary of the results is noted below in Tables 3-2 to 3-4.

Table 3-2: Participants in Dot-Mapping Activity in Mistawasis and Muskoday.

Community	Number of Participants, By Age Group			Total
	Young Adults (18 – 34) Red Dots	Adults (35-59) Blue Dots	Older Adults/Elders (60+) Yellow Dots	
Mistawasis	22	39	24	83
Nêhiyawak	*22	*39	*9	
Muskoday	27	18	22	69
First Nation	*8	*18	*7	

***Number of participants who responded to the large dot-maps during events. This is considered the main form of data collection.**

Table 3-3: Summary of Dot-Map Interpretation, Muskoday First Nation

Main Question	Dot-Map Result	Collective Dot-Map Interpretation/Action Plan
Main BWA Concerns and Questions	Youth and elders appear to be missing information that is available on the paper delivery notices.	Suspect this is because notices are not being shared by head of household. All partners to collaborate on improving paper notice wording including a prompt to share with family members.
How are you Currently Notified?	Youth and elders appear to be getting their information through informal channels more than formal channels. Facebook posts are effective here.	Adams to write a policy brief for leadership which will explain how to integrate these findings with existing policies medium-long term.
Best Way to Notify?	Current practice seems to be working but room for improvement. Youth and elders more interested in electronic notifications than 35-59 age group.	
What is a precautionary BWA?	An overall split between the correct answer and believing it means there is confirmed contamination. No age patterns noted.	Working with STC to develop message maps for local staff and educational materials for water users on the cause of precautionary BWAs.

Table 3-4: Summary of Dot-Map Interpretation, Mistawasis Nêhiyawak

Main Question	Dot-Map Result	Collective Dot-Map Interpretation/Action Plan
Main BWA Concerns and Questions	Community members (no age difference) seem to have more concerns about drinking water while on advisory. This is likely because they can be frequent and intermittent. Youth and older adults have questions about bottled water, but this is a changing process.	Working with STC to develop risk communication message maps for local staff and educational materials for water users on the cause of precautionary BWAs.
How are you Currently Notified?	Community members overwhelmingly receive their information from the community's main channels: hand-delivery and radio.	Adams to adapt risk communication message maps for radio.
Best Way to Notify?	Community members are overwhelmingly satisfied with current communication process.	Thesis to include discussion on Mistawasis process in thesis – community may use later for evaluation, grant proposals, etc.
What is a precautionary BWA?	An overall split between the correct answer and believing it means there is confirmed contamination. No age patterns noted.	Working with STC to develop message maps for local staff and educational materials for water users on the cause of precautionary BWAs.

3.7 Discussion

3.7.1 *A Practical Method for Indigenous Research*

The *Participatory Dot-Mapping Method* was a rapid method for both partner First Nations and the Tribal Council to generate knowledge that could inform future drinking water communication and education, including boil water advisories. Upon completion, one of the co-investigators, a Health Director, commented that the tool itself may be the most valuable outcome of the research project. She said they intend to adapt the method to engage community members on future health and social topics. They valued the method's low-cost materials, simple protocol and visual and interactive nature, especially when compared to surveys. This method encouraged participation from a wide range of community members, some considered hard-to reach. These groups may miss or avoid participation in research projects due to varying literacy levels, lack of interest in local governance/policy/research, or busy lifestyles. There is often a cultural and practical imperative to engage Indigenous community members at different ages and/or life stages (Nilson et al., 2008). The colour-coding offered a simple way to observe differences in responses between youth, adults and older adults/Elders. Partners noted the method could also be used to generate data for organizational continuous improvement efforts. For example, the Saskatoon Tribal Council and their members' health care sites participate in third-party health quality accreditation. One Health Director indicated this method could contribute to meeting and demonstrating health quality standards in community and/or client engagement. This, in turn, could assist health centre staff in the comprehensive accreditation process.

This tool also provided limited, clear and actionable insights for communities. Most elected officials and managers who work for First Nations juggle competing interests, priorities and resources. Like policymakers and decision-makers in all levels of government, First Nations leaders have little appetite for long lists of unprioritized findings which cannot be implemented using existing time, financial and human resources. The results of statistical analysis, for example, may include many statistically significant results which are not practically relevant for community leaders and decision-makers. In contrast, the dot-maps produced clear but limited

visual patterns which could be easily identified and interpreted by a wide variety of potential community analysts, even those with limited previous knowledge of the project.

We stress the analytical approach in the *Participatory Dot-Mapping Method* was not designed for simplicity and ease-of-use. The approach reflects Indigenous approaches to validation and analysis of research. Brant Castellano (2004) and Bull (2010) note that community participation and reciprocal relationships are the key to valid knowledge gathering for Indigenous research projects. Brant Castellano (2004)'s seminal paper on Indigenous research ethics explains that Indigenous knowledge must face "collective validation" (p. 105) where "individual perceptions had to be validated by community dialogue and reflection before they became collective knowledge, the basis of collective action" (Brant Castellano, 2004, p. 105). In the dot-mapping method, each project element was carefully subjected to dialogue and reflection with community members and representatives. In the initial meeting, for example, community members discussed and contextualize the project's overall research topic, resulting in community-specific research objectives and questions. Community members also validated project elements such as the questions, script and dot-map mock-ups during the pre-testing process. This ensured the final map exercise was appropriate for deployment in the community. The community-at-large then validated the work of the research team during the map-making process. If the maps had major omissions or errors, the community could discuss these issues with the data collectors, who would then note these issues for further consideration during analysis.

During analysis, the research team, leaders and local experts discussed the patterns of response and their meaning within a local drinking water communication policy and practice context. This collective review of the visual patterns was not only an important point of collective validation [as described by Brant Castellano (2004)] but also aligns with their description of Indigenous science and the analytic traditions of pattern recognition. Brant Castellano (2004) further explains that "Aboriginal science does not ignore analysis of the particular. In fact, the perception of patterns is synthesized from multiple keen observations" (p. 104). Aligning the dot-mapping method with Indigenous thought was intended to generate acceptable research and valid results within the First Nations context, particularly that of

Muskoday and Mistawasis. This should not preclude the method from being applied in other contexts or the findings from external validity, even in a western context.

Throughout the project, the SPH researchers and drinking water experts participated in the collective validation process. When appropriate, they situated the project within a wider First Nations and/or western science theoretical framework. A notable example is the action strategies and knowledge translation materials that emerged from the analysis. Following the analysis process, the research team co-generated communication materials, policy advice, educational materials and academic publications (such as this paper). These products were designed to leverage well-established and culturally-acceptable western approaches (such as risk communication, message mapping and health promotion) within the community's best Indigenous approaches (focusing youth and Elders, engaging with community networks, attending gatherings). The final stage of validation will occur during the "Take Action!" step, both the partner communities and the academic community will integrate these results into theory and practice.

Morton Ninomiya and Pollock (2017) found that community-based participatory research projects with Indigenous communities can face challenges when academics expect communities to participate in extensive academic processes and bureaucracy. In designing the tool, there was an assumption this conflict could extend beyond the administrative sphere; conflict can also arise when researchers ask communities to use scarce resources in the pursuit of irrelevant or impractical research goals. As quoted in Bull (2010) communities have noted, "[research] that's taking place [should be] on topics that are going to be beneficial to us and not only to the researcher to get their masters degree" (p.19). The author adds while the onus falls on communities to articulate their research priorities, research should not happen for its own sake, nor to pursue "scholarly curiosity" (p.19) alone. The method was designed to ensure the community's scholarly or practical interests were balanced with the researchers' academic pursuits. Researchers and local leaders and practitioners were involved in all aspects of the study design. This was particularly important during analysis and interpretation. This ensured, at minimum, a balance between academic and practical insights brought forward in the analysis. In Mistawasis' case, the Chief and Director of Lands and Resources were able to participate in the analysis. They noted a need for consistent messaging around drinking water advisories from all

possible sources. The Chief requested a set of “talking points” be developed for local communicators. A message map for this purpose was incorporated in the project’s knowledge translation materials.

3.7.2 *A Tool for Developing Capacity*

Capacity-building is a central concept in community-based participatory research, including research with Indigenous communities (A. Dawson et al., 2017; Israel et al., 2012; Nilson et al., 2008). Capacity building is measurable; previous research has shown community-based participatory research can increase community and individual capacity in the First Nations context (C. Fletcher, 2003). The Participatory Dot-Mapping Method allowed for capacity building for not only community members, but also improving the academic and community capacity of SPH researchers. This reciprocal benefit is foundational in the *Science in a Circle* © approach (Nilson et al., 2008). Some of the opportunities for capacity development we found in implementing the tool included:

- All project partners and each community’s leaders and local experts developed new professional practice relationships, building a new network for First Nations drinking water management in Saskatchewan.
- For the co-investigators, leaders and local experts, the community meetings and collective validation process brought clarity around each community’s challenges and successes in communicating boil water advisories.
- The project team members developed research skills in community-based participatory research approaches, study design, methods development, data collection, interpretation and knowledge translation.
- Project team members developed skills in First Nations and western science approaches to drinking water management.
- SPH researchers and co-investigators developed skills in scholarly practice and knowledge dissemination. For example, an SPH researcher completed this thesis as part of their Masters’ degree and a Mistawasis co-investigator joined researchers at an academic conference.

- Everyday community members were encouraged to critically think about and share needs and priorities around drinking water communication, particularly boil water advisories.

As noted in the final point, the project team was not the sole beneficiary of capacity building. Rather, the method encourages capacity-building in the community setting. In Muskoday, for example, the Chronic Disease Coordinator was able to leverage their community connections and conduct the exercise independently in the community setting at Elders' meetings, with youth, etc. In turn, the dot-mapping exercise catalyzed dialogue and reflection around boil water advisories within those community settings and groups.

3.7.3 *A Risk Communication Research Tool*

Covello (2003) says “one of the most important tools available to a risk communicator is the ‘message map’ (p.21).” In their message mapping procedure, a key step is identifying the key questions, concerns and informational needs of important stakeholders through a variety of sources, including media reviews, focus groups, surveys and proceedings of community meetings. These elements are closely tied to risk perception. In the case of First Nations boil water advisories, the factors that influence risk perception may be very specific to a community's local culture, history and current situation. These factors may be distinct from those of non-First Nations communities, or even other First Nations. Drawing on the work of Slovic, Fischhoff, & Lichtenstein (1984), these distinctions may include frequency of the risk (e.g. how many boil water advisories they have experienced) or how much control they have in managing the risk (e.g. community-owned water plant vs. piped water from another jurisdiction). The *Participatory Dot-Mapping Method* allowed communities to apply risk communication by:

- Ensuring local concerns, priorities and questions identified for message mapping were reflective of local context. By including local leaders and experts in the research team, community members collectively validated each element of the project, especially the content of the dot-maps to be deployed in the community. For example, the research team identified a knowledge gap around the meaning of precautionary boil water advisories and their causes through the initial meeting process. One of the four maps in each community was designed to assess this gap.

- Integrating only appropriate existing and potential communications channels into the risk communication planning process. For example, after door-to-door notices, Facebook is Muskoday's primary notification method, while radio is key in Mistawasis. In Muskoday, the health centre leads boil water advisory communication, public works assumes that responsibility in Mistawasis. These intricacies could be represented in the method because of community members and representatives' contributions.
- Assessing major differences between youth/young adults, adults and older adults/Elders. The flexibility and intuitiveness of the exercise ensured these groups could be engaged in mixed crowds (e.g. Treaty Days) or in specific settings (e.g. Elders' meetings, youth groups, etc.).

The ability to assess different life stages/age groups was a key feature of the tool not only because of the special cultural importance placed on youth and elders, but also served as a useful program planning and evaluation tool for the partners' drinking water response programs. Communication trends are rapidly changing among Canadian youth, with less face-to-face social contact with friends and family, and increased contact by text message, email and social media (Statistics Canada, 2015). In tight-knit First Nations communities, strong family and community links are well-established, but a shift toward new communication technologies is underway. Muskoday, Mistawasis and the Saskatoon Tribal Council are monitoring how these trends are changing communication dynamics and how these trends could inform their drinking water response programs. For example, Muskoday developed a comprehensive community communication strategy in 2012 and already uses Facebook heavily in boil water advisory communications. There was caution from both communities around implementing a text or email alert system, especially without a clear business case for implementation. In response, the Dot-Mapping exercise developed would serve both as a form of evaluation for current communication programs, but also to gauge the need for text and email alerts. For Mistawasis, the results of the mapping exercise showed a convincing preference for the community's current program, which uses door-to-door and radio alerts. For Muskoday, the status quo was preferred by adults, with some youth and older adults/elders preferring a text or email notification system. While the results of the Participatory Dot-Mapping method are not a standalone program planning and evaluation tool, it can provide useful planning and evaluation insights.

3.7.4 *Strengths and Limitations*

This method has several advantages when applied in First Nations settings. First, researchers and community members can use the method using existing or easy-to-access resources. Because the data is stored directly on the boards, manual data entry is not required. The data is easily portable between communities, events, or from universities. This saves time and human resources (or the money that would be required to hire someone for data entry). The timing of data collection and analysis is flexible to be convenient to community members and data collectors' schedules. For example, the analysis meeting in Mistawasis was able to be rapidly moved from the community to the Tribal Council's Saskatoon office to accommodate last-minute scheduling conflicts.

Having the option to use individual booklets further contributes to flexibility, ensuring the opportunity to engage the required community members. The research team did recognize that using two different methods to collect the map data (e.g. direct-to-board vs. individual booklets) may introduce some bias into the data collection process. However, the benefits of including hard-to-reach stakeholders were deemed more important. This is supported by Warner (2015), who says participatory mapping activities must actively recruit and seek out diverse stakeholders. In this project, the individual mapping booklets were required to get a representative sample of the appropriate size. The dot-mapping exercise requires enough participants to have clear visual distributions emerge in the map. We estimate our maps are close to the smallest sample size that could achieve this goal.

The use of community data-collectors was essential, particularly to recruit enough participants for the dot-mapping exercise. During fast-paced events like Treaty Day, known data collectors were able to bring instant rapport to the process, increasing likelihood to participate. Having university-based data collectors was also important, as a large data collection team (3-4 people) was needed in some settings. The method uses standard data collection and training to reduce the likelihood of bias from using a mixed team of data collectors. However, the impact of known (community) vs. unknown (university) data collectors on the quality of data in this exercise is not clear. Kovach (2010)'s discussion of the conversational method stresses the relational nature of all interactions in research, and so it is tempting to conclude that those with a stronger existing relationship collect more valid data from participants. In Muskoday, however,

the Health Director said they sometimes prefer outside data collectors as they provide research participants a sense of anonymity and freedom to respond with honesty.

In this project, many of the research team members were either part of the target population, had extensive experience dealing with the target population during boil water advisories, or both. Each element of the research project was collectively validated by the community. Because the questions, possible responses and overall orientation are pre-determined, ensuring an appropriate local context and Indigenous worldview in during map development is critical. This ensures the response maps accurately represent a reasonable range of responses for community members. Even so, data collectors were asked to note any repetitive or interesting comments from participants to ensure any major gaps in the map design could be captured. Any research team planning to use this tool in future studies should ensure strong representation from the target population in the map development process.

Any kind of group dot-voting activity is vulnerable to bias, particularly the bandwagon effect, where participants simply choose what is popular rather than their personal opinion. (Diceman, 2013). When developing the method, the co-investigators determined this effect could be minimized by instructing participants to choose their preference, rather than the most popular choice. One exception was a question that required participants to choose a single correct answer. In this case, participants were blinded to previous answers by covering them up with a large post-it note. Another criticism of the dot-voting approach is being limited to the pre-determined answers (Diceman, 2013). The data collectors' notes were added to the method to ensure any major omissions in the response maps could be identified. The research team could then consider any omissions during the analysis. The dot-voting method does allow for comparability across groups, provided the overall questions and response maps are similar (Diceman, 2010). Although Mistawasis and Muskoday's response maps were unique, two questions had identical response maps. This allowed the research team to compare across communities for those two questions. For example, both communities had distinct patterns of response to their concerns and questions. Both communities had a similar distribution of responses to "What is a Precautionary Boil Water Advisory?" While these questions and their response maps may be valid as-is in other communities, this must be confirmed through the initial meetings and map validation process.

Dot-voting has been used by professional facilitators since at least the 1980's (Diceman, 2013). Companies use it in continuous improvement efforts, and it is used in policy and community engagement (Diceman, 2010, 2013). Dot-voting methods allow groups to rapidly and collaboratively consider a problem, note points of agreement and disagreement, and determine practical solutions. In the *Participatory Dot-Mapping Method*, participants also considered the collective implications of their responses. Data collectors noted participants wanted to consider the larger group's preference rather than their own benefit alone. The research team felt this was indicative of a larger responsibility to collective, rather than individual benefit—a cultural quality of many Indigenous cultures around the world. This suggests the method may be appropriate in other Indigenous contexts. We also believe this method, when conducted in an established and well-articulated community-based participatory research partnership, may be applicable to non-Indigenous contexts, or used to answer different research questions.

3.8 Conclusion

First Nations (and other Indigenous) communities will take on increasingly active partnerships and leadership roles in research. As a result, Indigenous research will adapt to the priorities, preferences, strengths and limitations unique to that context. One of the ways this adaptation will occur is through the development of novel methods. The *Participatory Dot-Mapping method* is one such novel method, designed through community-based participatory research and intended to generate important knowledge and community capacity in that setting. A key feature is using multiple tactics to include hard-to-access stakeholders in the process, whether as participants or part of the research team. The method was designed and first employed to generate knowledge around risk communication of boil water advisories by two First Nations and their Tribal Council. However, there are likely many more applications of the method, including different communities and contexts (e.g. Indigenous communities, other low-resource settings, organizations), risk communication of different public health issues (e.g. pollution, chronic diseases, injury/safety) or different fields of study.

Chapter Four: Overall Discussion and Conclusions

This study suggests that risk communication can improve understanding and ultimately the effectiveness of First Nations DWA. Through this community-based participatory research project, five key insights emerged:

Insight One: First Nations who experience DWAs already conduct risk communication for boil water advisories. Therefore, First Nations risk communication research should focus on evaluating and documenting existing efforts.

Muskoday, Mistawasis and the Saskatoon Tribal Council each had a distinct but clear DWA communication strategy and approach but had not formally evaluated those practices through formal research. This research gap is not uncommon, even outside the First Nations context. Glik (2007) explains that risk communication is a new discipline, and evaluative research is emerging across the field. A limited body research has explored the risk communication of health risk topics in the First Nations context (Charania & Tsuji, 2012; Driedger et al., 2013, 2013; Jardine, Banfield, Driedger, & Furgal, 2013; O’Neil et al., 1997). But, the First Nations risk communication body of literature is developing, particularly using community-based approaches to research with university partners. This project will contribute both to First Nations risk communication theory, but also make a significant contribution to First Nations risk communication methods. This project demonstrated the *Science in a Circle* © (Nilson et al., 2008) approach to community-based participatory research was a useful framework to pursue a research partnership and investigate a relevant First Nations risk communication research topic. The *Participatory Dot-Mapping Method* emerged as a low-cost and culturally-appropriate way to explore and evaluate First Nations risk communication in the community setting.

Insight Two: Risk communication of boil water advisories must consider the individual context of First Nations. This should be the primary consideration, ahead of pan-Indigenous and wider risk communication theory.

In this study, both communities’ advisory protocols met the notification requirements of the GCDWQ and used door-to-door notifications. But each community also used distinct strategies in-line with each community’s situation, norms and preferences. In the dot-mapping

exercise, community members indicated they are notified (and preferred to be notified) by those supplementary strategies (e.g. community radio in Mistawasis, Facebook in Muskoday). November and Leanza (2015)'s framework for risk and crisis communication stresses that effective crisis risk communication must consider the message recipients, context, communication and timing of messages. Only First Nations policy-makers, practitioners and other local leaders have the in-depth knowledge of a community to be able to identify (1) what is the problem (2) who needs to know, (3) where to find them and (4) when, why and how to reach them. In Mistawasis and Muskoday, their individual approaches ensured a broad section of community members could be quickly reached during an advisory to protect public health. Research that aims to further improve public health through improving DWAs must be able to capture a First Nations community's drinking water risk perceptions, communication preferences and baseline knowledge through direct engagement with citizens. The *Participatory Dot-Mapping Method* was specifically designed to engage local citizens through a dot-mapping exercise designed with community

Insight Three: Risk perception and risk communication are largely cross-cultural theories and can effectively capture these First Nations contextual factors. This is consistent the growing literature on First Nations drinking water perception.

This study showed that Doria (2009, 2010)'s factors that influence drinking water perception applied to respondents in Muskoday and Mistawasis. Some examples of those factors (and how they applied) are listed below:

- past experiences (history of boil water advisories and other water quality issues)
- level of control in the system (level of input into governance, community vs. outside control of water system)
- information or misinformation (consistency and quality of information from official sources and informal channels)
- trust in water treatment and governance (level of trust in band, plant operators and tribal council) and;
- perception of water quality (does the community make good water)

The results of this project also strongly suggested that community members are uncertain about the contamination status of the water in both Muskoday and Mistawasis, where approximately half of respondents thought a “precautionary” boil water advisory meant the water was contaminated. (Spence & Walters, 2012) found that First Nations survey respondents who were unsure of their water’s contamination status were more likely to perceive it as high-risk. This suggests that clear, consistent messaging around drinking water status can ensure community members have an appropriate risk response to advisories and take appropriate precautions. Message mapping (Covello, 2003; Covello et al., 2007) is a framework for developing clear, consistent messaging during crisis events. It was used in this study to guide the dot-map research questions and eventually used to generate appropriate, clear and consistent “talking points” for community staff who answer questions about BWAs and informed the development of new BWA notification materials.

Insight Four: Crisis risk communication during DWAs should be complemented by emergency communication planning and health promotion risk communication. These functions should occur between advisories.

Planning and research are an important but often overlooked part of crisis risk communication and overall emergency response (Lurie et al., 2013; Reynolds & Seeger, 2005). Public health officials can use message mapping as a planning tool for drinking water emergencies (Covello, 2003; Covello et al., 2007). Lurie et al., (2013) add that community-based participatory research is an important approach for engaging diverse stakeholders during emergency response planning and evaluation. This project demonstrated that community-based participatory research can be used to generate important knowledge needed to conduct message mapping for DWAs such as knowledge gaps, community concerns and communication preferences. Participation from community leaders and local experts throughout the study design ensured Muskoday, Mistawasis and the Saskatoon Tribal Council could then act on that knowledge to improve crisis risk communications (e.g. boil water advisories) as part of their overall emergency response and communication strategies. For example, this project identified clear knowledge gaps around the technical reasons for BWAs (particularly precautionary BWAs). Two key action strategies developed from this finding: (1) Muskoday, Mistawasis and Saskatoon Tribal Council Health & Family Services Inc. are assessing whether BWA notices

should include more information on the nature of the advisory and (2) the SPH is collaborating with a plumber to develop interactive display that can demonstrate basic water treatment, distribution and failure principles. The partners will then use the display(s) as a health promotion tool at community events, in schools, etc. This is significant because health promotion outside of crisis situations is an important part of the overall risk communication discipline (Glik, 2007). In this project, both the reasons for each community's water treatment or distribution failures and the concept of risk within a precautionary advisory are complex technical subjects. Mental noise theory suggests that during a crisis event, the public is unable to process complex information (Covello et al., 2007). Furthermore, regular engagement with community members can improve knowledge and trust in local water systems (Kasperson et al., 1988; Slovic, 1993b). This is significant because trust is a predictor for health risk behaviours (van der Pligt, 1998). Therefore, to improve the overall effectiveness of DWA communications, ongoing community engagement and health promotion should be integrated into a First Nation's safe drinking water program.

Insight Five: First Nations environmental health research must balance Indigenous knowledge with western science approaches to risk management and communication.

When the research includes university partners, community-based participatory research is an effective project model.

First Nations environmental health research may include First Nations and institutional partners who have extensive background training in western approaches to science, knowledge-gathering and analysis. However environmental health policy and communication research must also consider the social, historical and cultural influences that shape people, communities and societies. By using the *Science in a Circle* © approach to community-based participatory research partnerships (Nilson et al., 2008), the project partners were able to design a research project that could consider both worldviews in the context of drinking water risk communication. This gave rise to the *Participatory Dot-Mapping Method*, which the combined western-based participatory methods (e.g. mind mapping (Craft of Communication, 2013) and dot-voting (Diceman, 2013) with Indigenous methods of knowledge generation such as pattern recognition and collective validation (Brant Castellano, 2004). We believe this integrative approach to research in environmental health is a key component to building strong research links throughout

the project and beyond. Respectful and authentic relationships are a key predictor of success in community-based participatory research projects, and contribute to better collective outcomes (including more valid research) for communities and Institutional partners (Bull, 2010; C. Fletcher, 2003; Nilson et al., 2008). In this project, existing relationships between partners were leveraged and built-upon, allowing the ambitious project to be completed in just over two years. Ideally, these relationships will shape future research questions and projects in environmental health, even if those projects are months or years away.

Final Thoughts:

This project shows that risk communication is a cross-cultural theory that can be applied in the First Nations context at the local level. First Nations already communicate their DWAs, and with each passing year more communities are assuming responsibility for the wider environmental health services provided by Indigenous Services Canada (previously Health Canada). Tribal Councils, health authorities and other First Nations-governed agencies will provide advice and leadership to their communities on drinking water communication policy. This study provides a blueprint for other communities and/or their agencies who wish to develop and/or evaluate drinking water risk communication programs. While university partners may be an excellent resource, this research should be led by the communities themselves, ideally in partnership with other safe drinking water service providers. Potential partners may include environmental health officers employed by First Nations' agencies, or even Indigenous Services Canada. For researchers with relevant skills and resources in this area, this project may serve as a discussion point when approaching potential First Nations partners on DWA research. This study approach and design could also be adapted for other communities who experience persistent drinking water issues, such as Indigenous communities (e.g. Métis) communities, rural communities, ethnic communities and neighborhoods affected by regular DWAs.

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Appendix A

Figure A-1 Completed Dot Map, Muskoday First Nation

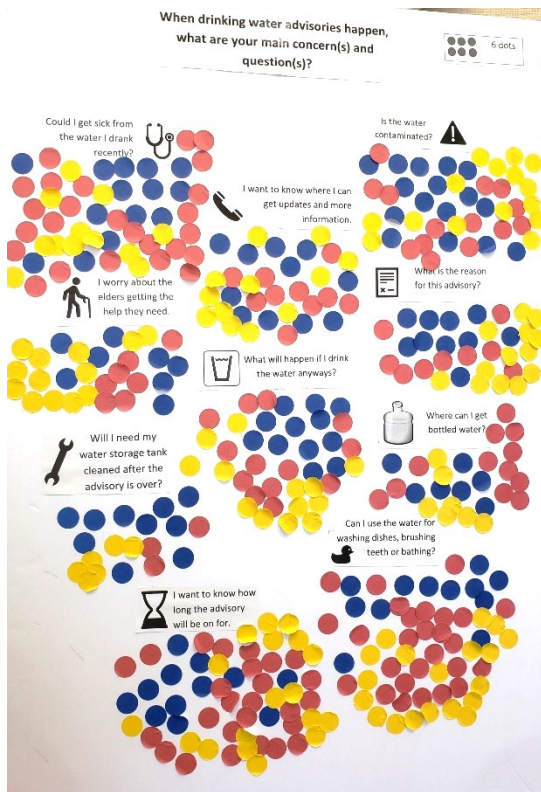
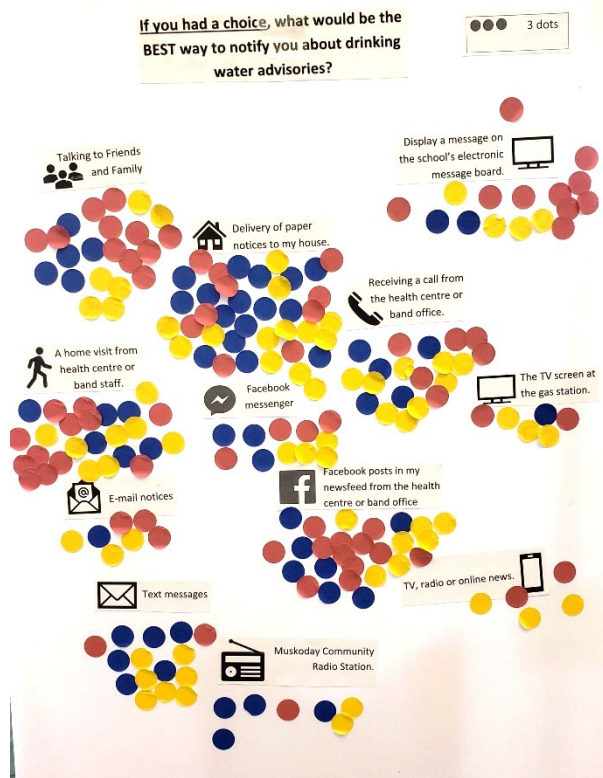
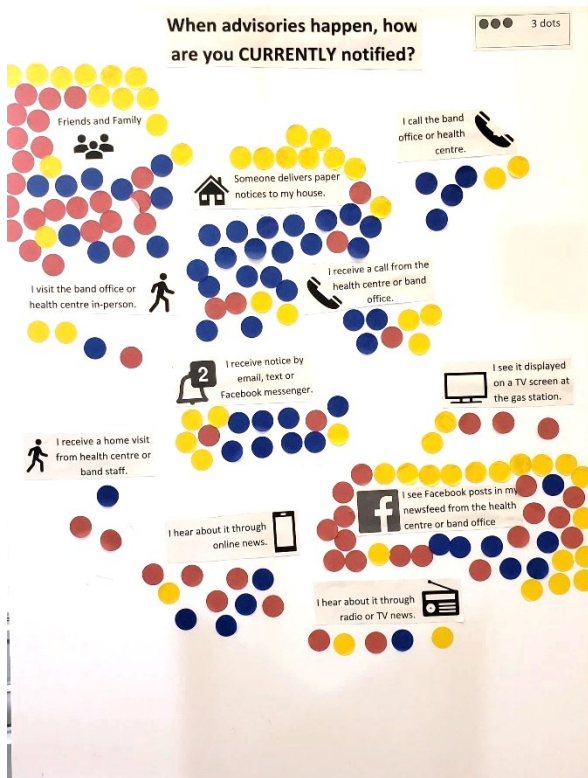
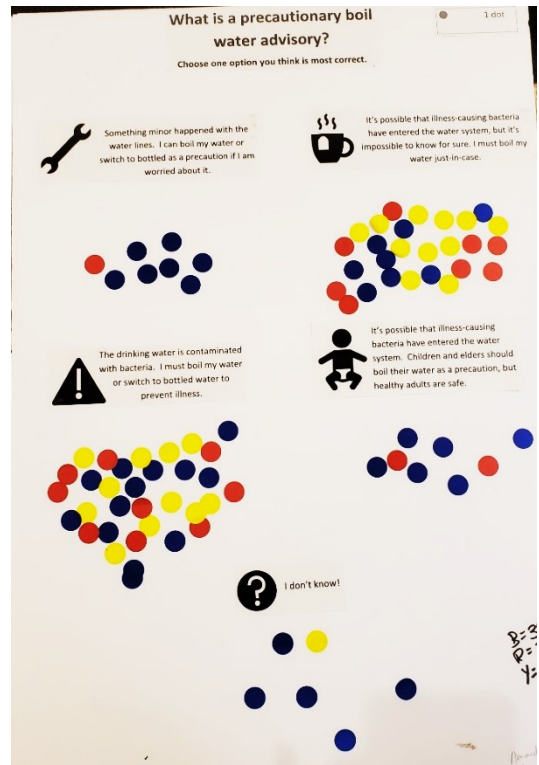
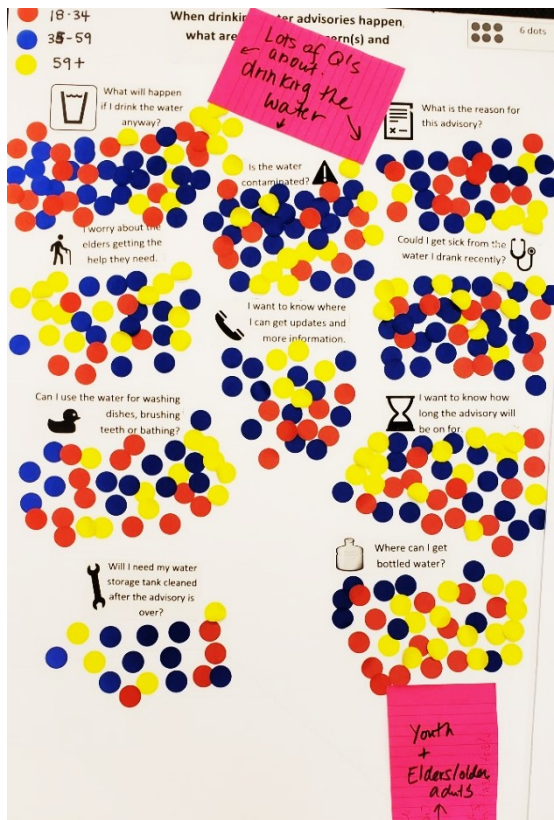
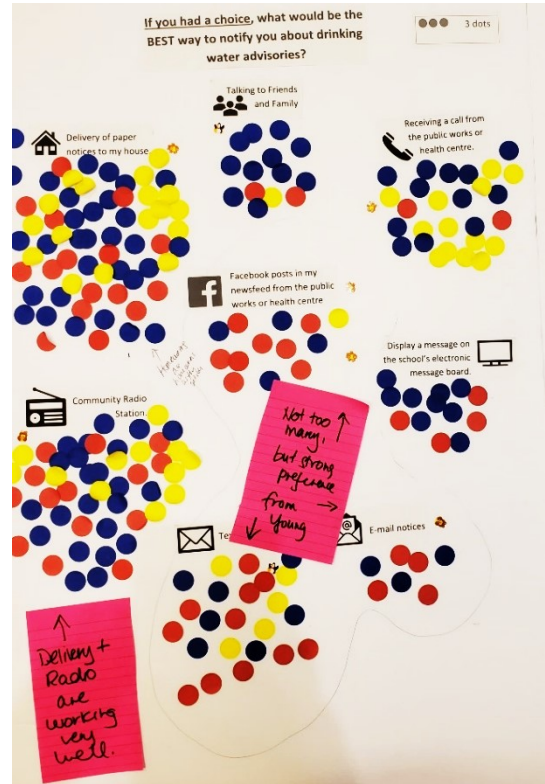
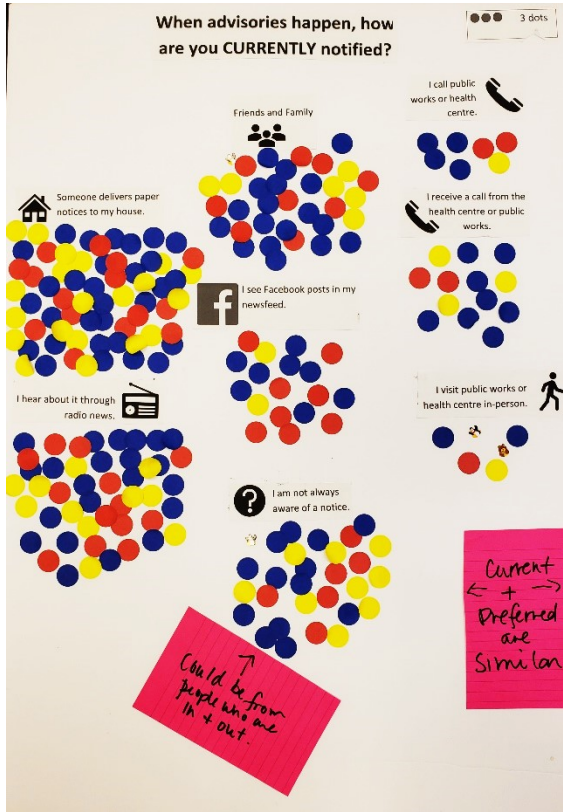


Figure 2 Figure A-2: Completed Dot Map, Mistawasis First Nation





Appendix B


Figure B-1: Completed Individual Dot-Map Booklet Example


When drinking water advisories happen, what are your main concern(s) and question(s)?


6 dots


Could I get sick from the water I drank recently? 


What is the reason for this advisory? 


What will happen if I drink the water anyway? 


Will I need my water storage tank cleaned after the advisory is over? 


Can I use the water for washing dishes, brushing teeth or bathing? 

Is the water contaminated? 

I worry about the elders getting the help they need. 

I want to know where I can get updates and more information. 


Where can I get bottled water? 


I want to know how long the advisory will be on for. 


What is a precautionary boil water advisory?


1 dot


Choose one option you think is most correct.

 It's possible that illness-causing bacteria have entered the water system, but it's impossible to know for sure. I must boil my water just-in-case.

 The drinking water is contaminated with bacteria. I must boil my water or switch to bottled water to prevent illness.


 Something minor happened with the water lines. I can boil my water or switch to bottled as a precaution if I am worried about it.


 It's possible that illness-causing bacteria have entered the water system. Children and elders should boil their water as a precaution, but healthy adults are safe.


 I don't know!


When advisories happen, how are you CURRENTLY notified?


Friends and Family 


 Someone delivers paper notices to my house.

 I receive a home visit from health centre or band staff.


 I call the band office or health centre.

I visit the band office or health centre in-person. 


 I receive notice by email, text or Facebook messenger.



 I receive a call from the health centre or band office.

 3 dots

 I see it displayed on a TV screen at the gas station.


 I see Facebook posts in my newsfeed from the health centre or band office 


I hear about it through online news. 



 I hear about it through radio or TV news. 

If you had a choice, what would be the BEST way to notify you about drinking water advisories?



Talking to Friends and Family 


 Delivery of paper notices to my house.


 A home visit from health centre or band staff.


 Facebook posts in my newsfeed from the health centre or band office 


 Facebook messenger


 Receiving a call from the health centre or band office. 



 3 dots


 The TV screen at the gas station.

Display a message on the school's electronic message board. 

TV, radio or online news. 

 Text messages

 E-mail notices 

 Muskoday Community Radio Station.

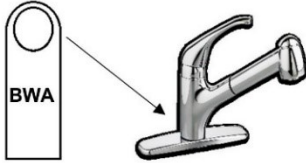
Appendix C

Figure C-1 Draft Message Map for Mistawasis Staff: Precautionary Boil Water Advisories

BOIL WATER ADVISORIES: WHAT TO DO

MISTAWASIS NĒHIYAWAK


TELL YOUR FAMILY & VISITORS




- If your home is under advisory, you should find a notice on your door.
- Make sure everyone in your house knows about the advisory.
- Consider putting the doorknob hanger on your kitchen tap until the advisory is over (see left).

FOOD AND DRINK

- You should boil your tap water for **one minute at a rolling boil**.
- Bottled water from a safe source can also be used.
- Use boiled or bottled water for making any food that won't be cooked or boiled (Washing fruits & vegetables, making juice, Jell-O)



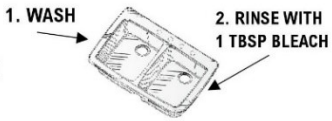
PERSONAL CARE



- Boiled or bottled water should be used to brush teeth or wash dentures.
- Bathing in the water is okay.
- Make sure small children don't swallow bathwater.

CLEANING

- You can wash your dishes in your sink or dishwasher.
- You should sanitize dishes. After washing with soap, rinse in a full sink of warm water mixed with a tablespoon of bleach.



GET MORE INFORMATION

- When the advisory is lifted, public works will deliver paper notices.
- The local radio (93.7 FM) will also provide updates.
- **Public Works** can answer your questions, such as:
 - The reason for the advisory
 - The process of lifting advisories
 - Information about the bottle filling station

PUBLIC WORKS PHONE:
(306) 466- xxxx

Appendix D

Figure D-1 Invitation to Participate in BWA Communication Project

Invitation to Participate in a Community-Based Research Project:

Communication of Adverse Water Events for First Nations: Towards a Community-Based Drinking Water Risk Communication Framework

Who is invited? Saskatoon Tribal Council, for consideration by the agency and member First Nations.

Who is proposing this? Diane Adams, Graduate Student Researcher, University of Saskatchewan School of Public Health under the supervision of Dr. Lalita Bharadwaj, Safe Drinking Water for Health Research Team and School of Public Health, University of Saskatchewan.

Why is this important? When adverse water events happen, it is critical that people take the steps necessary to protect their health. Timely and effective communication is key to ensuring community members are able to take these steps. Here's what we know:

- ✓ Right now, there is good information about best practices for communicating adverse water events.
- ✓ Research has shown how important culture, worldview and community values are when communicating about environment and health risks.
- ✓ In some areas of health, like H1N1 and environmental contaminants, First Nations communities have generated significant knowledge around effective, relevant risk communication best practices.
- ✓ Unfortunately, very little information is available on best practices in water communication for First Nations communities. For example, communication methods and messages that consider the cultural views, history, governance and service delivery structures, or community preferences of First Nations. The information that is available is limited to dated publications from the Government of Canada.

Examples of adverse water events:

- 1) Water contaminated with bacteria (e.g. *E.coli*)
- 2) Water contaminated with chemicals (e.g. arsenic, oil)
- 3) Chlorine residuals too low
- 4) Treatment system failures
- 5) Loss of pressure in the water system
- 6) Low water supply



This research project aims to address this **knowledge gap** by developing a framework for the communication of adverse water events that is specific to the First Nations community context.

What are the benefits of participating? This project was designed to bring value to participating communities and agencies by:

- ✓ Bringing together the views of diverse stakeholders in safe drinking water. Possible contributors could include leadership, community members (e.g. elders, youth, parents), health centre staff, WTP operators, community water monitors, EHO's, technical advisors, etc.
- ✓ Identifying best practices and strengths for communicating drinking water advisories.
- ✓ Identifying communication gaps, their causes, and possible solutions.
- ✓ Creating a preliminary framework for communicating adverse drinking water events for First Nations. This framework could be adapted and/or built upon by other communities/agencies in the future.
- ✓ Generate data for program planning needs assessment, evaluation, and reporting.
- ✓ Strengthen ties with the University of Saskatchewan's School of Public Health.

What if my community has a stable water system? There is no requirement that a community have regular adverse events (e.g. frequent boil water advisories) to participate, but communities who do experience these events are strongly encouraged to participate. Any community with the desire to contribute their knowledge and examine their drinking water communication plans and processes is welcome.

How will this project roll out?

- **Phase 1:** Participant communities/agencies are identified and a research agreement is made. (By April 2017)
- **Phase 2:** The researcher will conduct a systematic review study which will identify the range of knowledge and best practices around communication of adverse drinking water events. (Summer 2017)
- **Phase 3:** Communities/agencies will identify key interests and concerns regarding communication of adverse water events. In partnership with the researcher, communities will also determine the right community participants ("key informants"). (Summer/Fall 2017)
- **Phase 4:** The key informants will participate in semi-structured focus groups, interviews or other knowledge-sharing methods. (Fall 2017)
- **Phase 5:** The results of those interviews will be analyzed by the researcher using a method previously agreed-upon. (Winter 2017-2018)
- **Phase 6:** The results will be presented to the participating communities/agencies. (Spring 2018)
- **Phase 7:** The results will be disseminated/published in forms agreed upon by the researchers and participating communities/agencies. (Spring/Summer 2018)

Will this project cost anything? The major costs of this project will be covered by the research budget of Diane Adams and Dr. Lalita Bharadwaj. Communities and agencies will contribute their time, knowledge, and expertise.

Who do I contact for more information? Please contact Diane Adams at diane.adams@usask.ca.

Appendix E

RESEARCH, DATA, STATISTICS & PUBLICATION AGREEMENT

THIS AGREEMENT MADE IN QUADRUPPLICATE this ___ day of _____, 2017, WITNESSETH AS FOLLOWS:

PURPOSE OF THE AGREEMENT: The purpose of this agreement is to provide a framework for the use of the data collected during the Research Project as described in the research proposal (see Appendix “A”). This agreement supports the principles adopted by First Nations in Canada and described as OCAP; Ownership, Control, Access and Possession of First Nations’ collective data. The agreement supports the information needs of Saskatoon Tribal Council, Health & Family Services Inc. and other involved First Nations as well as acknowledging the desire of the University of Saskatchewan to conduct this collaborative research. It defines the opportunity (ies) to develop research capacity at the local level. Saskatoon Tribal Council, Health & Family Services Inc. anticipates this research project will assist in planning, advocacy, determining health priorities and identifying trends with the intent of improving the health status of their members.

PRINCIPLES:

Maintain mutual respect and accountability between the parties;
Recognize the complementary and distinct expertise, responsibilities, mandates and accountability structures of each party;
Ensure the highest standards of research ethics, including the acknowledgment of First Nations’ specific principles of OCAP;
Respect the individual and collective privacy rights of First Nations;
Recognize the value and potential of research that is scientifically and culturally validated;
Recognize the value of capacity building at all levels;
Support First Nations and district processes, including the analysis and disseminating of survey results.

OBJECTIVES:

Measure and improve the health outcomes of First Nations’ members;
Produce information which will be used in planning to reduce the gap in health status between First Nations and Canadians in general and, inform policy to support positive change;
Build First Nations capacity in research information collection, analysis, management and interpretation at all levels;
Optimize the dissemination of First Nations data for analysis and comment in a manner that is considered with the principles of this agreement, and the objectives outlined.

AGREEMENT:

WHEREAS Saskatoon Tribal Council, Health & Family Services Inc. has entered into a partnership with the University of Saskatchewan for a research project which entails the collection of Saskatoon Tribal Council, Health & Family Services Inc. ’s specific data and information;

AND WHEREAS Saskatoon Tribal Council, Health & Family Services Inc. has an inherent right to self-government, specific rights as negotiated in Treaty # 6 and rights as outlined and enshrined in the Constitution Act of Canada (1982);

AND WHEREAS Saskatoon Tribal Council, Health & Family Services Inc. has adopted the sovereign policy framework of OCAP (Ownership, Control, Access & Possession) principles for data collection, analysis and dissemination;

AND WHEREAS the OCAP principles must be articulated in a written format as a result of the gap in legislation applicable to First Nations with respect to the collective ownership and possession of data, statistics and information;

AND WHEREAS Saskatoon Tribal Council, Health & Family Services Inc. wishes to use this opportunity to build research capacity and/or provide research opportunities to its members by working in collaboration with the University of Saskatchewan;

AND WHEREAS Saskatoon Tribal Council, Health & Family Services Inc. would like to maintain a positive and good faith relationship with the University of Saskatchewan;

NOW THEREFORE THE University of Saskatchewan covenants and agrees as follows for the consideration of the sum of One (\$1.00) Dollar paid to Saskatoon Tribal Council, Health & Family Services Inc. by _____, and other valuable consideration, the receipt and sufficiency of which is hereby acknowledged:

University of Saskatchewan acknowledges that any and all data collected as a result of this research project is rightfully owned by Saskatoon Tribal Council, Health & Family Services Inc. Utilization of the data collected for the purpose outlined in the research proposal is acknowledged and granted by Saskatoon Tribal Council, Health & Family Services Inc. to University of Saskatchewan in accordance with the terms and conditions contained in this agreement.

The First Nation agrees that the data collected from First Nation participants may be used as part of a thesis in fulfillment of U of S and School of Public Health requirements. Any further use of the data requires prior approval of the community.

The University of Saskatchewan agrees to the inclusion of project team representative(s) from Saskatoon Tribal Council, Health & Family Services Inc. as co-principal investigators and they will be so be acknowledged in any and all publications, reports, documents or other written material for which this data is utilized. The representative(s) from Saskatoon Tribal Council, Health & Family Services Inc. will be included by University of Saskatchewan in the complete research process or to the level the representative(s) is directed by Saskatoon Tribal Council, Health & Family Services Inc. to be involved.

The Saskatoon Tribal Council, Health & Family Services Inc. Research Project Representative(s) shall be able to provide a dissent opinion of any findings. Any dissent opinions will be included as a part of the overall report in all publications and/or pertinent published or produced materials.

Utilizing the data gathered from this research project for secondary publishing will require specific written permission from Saskatoon Tribal Council, Health & Family Services Inc. The University of Saskatchewan is to protect the data and act as stewards of this data on behalf of the rightful owner Saskatoon Tribal Council, Health & Family Services Inc. is the sole and rightful owner of all data collected from Saskatoon Tribal Council, Health & Family Services Inc. and as such a clean record level set of the data will be returned to Saskatoon Tribal Council, Health & Family Services Inc. in a useable electronic format. Should the University of Saskatchewan decide to maintain the data set within its databank, the University of Saskatchewan will be required to protect the data from unauthorized use and act as stewards on behalf of the rightful owner.

The University of Saskatchewan agrees that this agreement is irrevocable and shall ensure to the benefit of and be binding upon the University of Saskatchewan, its employees, administrators and legal and personal representatives.

In the event of a breach of this Agreement by the U of S, the Saskatoon Tribal Council, Health & Family Services Inc. may withdraw their consent for the use of recorded and documented interview data, relevant to Project Objective B by notice in writing to the U of S, and on receipt of such notice, the U of S shall return interview data, including any recordings, transcripts and notes, collected from First Nation participants and analyses derived from these notes and transcripts, as specifically directed by the First Nation.

The University of Saskatchewan represents that they understand and agree to the terms contained within this agreement. Any breach will result in damages amounting to not less than \$5,000.

The University of Saskatchewan declares that they have been given the opportunity to obtain independent legal advice with respect to the details of the terms evidenced by this Agreement and confirms that they are executing this Agreement freely and voluntarily.

The University of Saskatchewan further understands and agrees that the Release contains the entire agreement between the parties hereto and the terms of the Release are contractual and not merely a recital.

The Releasor confirms that if they transmit this Agreement by facsimile or such similar device that the reproduction of signatures by facsimile or such similar device will be treated as binding as if originals and undertakes to provide all parties with a copy of this Agreement bearing original signatures forthwith by courier.

SIGNATURES:

IN WITNESS WHEREOF the University of Saskatchewan through their designated representative,
_____, has hereunto affixed their hand and seal this _____ day of
_____, 2017.

Signature
University of Saskatchewan

(Please print)

Signature
University of Saskatchewan

(Please print)

Signature
Saskatoon Tribal Council, Health & Family Services Inc.

(Please print)

Witness
Saskatoon Tribal Council Health & Family Services Inc.

(Please print)

Witness
Saskatoon Tribal Council Health & Family Services Inc.

(Please print)

Appendix F

Figure F-1: Information Handout for Participants Example



Welcome to the Mistawasis water ommunication project!

This project asks you to identify your priorities and knowledge about drinking water advisories (such as boil water advisories). You will do so by using coloured dots to answer a series of questions, as instructed by a trained data collector.

Your answers will be used to create a visual map of the community's knowledge, concerns and preferences about drinking water advisories. This map will be used to improve how Mistawasis Nêhiyawak communicates with community members when these advisories happen. The goal is to make sure community members can best protect their health when drinking water risks arise.

Your participation is voluntary, and you can choose to skip any question or withdraw from the activity any time. Your answers will remain confidential, although people in the room may be able to see or hear your choices as you make them. If you see or hear another person's choices, please do not share them with others.




This project is a partnership between Mistawasis Nêhiyawak, Saskatoon Tribal Council, and the University of Saskatchewan's School of Public Health. Mistawasis is the owner of all data collected. If you have questions, please contact U of S graduate student researcher diane.adams@usask.ca or (306) 737-5989.

Appendix G

Figure G-1: Data Collection Script Example

Muskoday First Nation Data Collection Training

Hello, my name is _____. I am working on a research project that aims to improve how Muskoday communicates with community members about drinking water advisories. We are looking at the concerns of different age groups and how they want to hear about advisories. Would you like to participate in a short activity? Your participation is voluntary and you can quit at any time.

1. What is your age? (Provide a different colour sticker for (18-34) (34-59) (60+) )  

For each question, I will ask you to use these dot stickers to indicate your top choice or choices. You may place them all on different choices, or place multiples on choices you feel strongly about. Try not to pick ones just because they are popular with others.

2. Please feel free to explain your choice to me if you like.
3. Thank you for participating!
4. Periodically, the data collector should note their top three insights they heard from participants about the choices they made. E.g. challenges, reasons for choosing, etc.
5. Please email these to diane.adams@usask.ca at the end of each week.
6. Thank you!

Appendix H

Figure H-1: Information Handout for Participants Example

When drinking water advisories happen, what are your main concern(s) and question(s)?

6 dots

Could I get sick from the water I drank recently? 

What is the reason for this advisory? 

What will happen if I drink the water anyway? 

Will I need my water storage tank cleaned after the advisory is over? 

Can I use the water for washing dishes, brushing teeth or bathing? 

Is the water contaminated? 

I worry about the elders getting the help they need. 

I want to know where I can get updates and more information. 



Where can I get bottled water? 


I want to know how long the advisory will be on for. 


What is a precautionary boil water advisory?


1 dot


Choose one option you think is most correct.

 It's possible that illness-causing bacteria have entered the water system, but it's impossible to know for sure. I must boil my water just-in-case. 

 The drinking water is contaminated with bacteria. I must boil my water or switch to bottled water to prevent illness.

 Something minor happened with the water lines. I can boil my water or switch to bottled as a precaution if I am worried about it.

 It's possible that illness-causing bacteria have entered the water system. Children and elders should boil their water as a precaution, but healthy adults are safe.

 I don't know!

When advisories happen, how are you CURRENTLY notified?



Friends and Family



Someone delivers paper notices to my house.



I receive a home visit from health centre or band staff.



I call the band office or health centre.

I visit the band office or health centre in-person.



I receive notice by email, text or Facebook messenger.



I receive a call from the health centre or band office.



I see it displayed on a TV screen at the gas station.



I see Facebook posts in my newsfeed from the health centre or band office



I hear about it through online news.



I hear about it through radio or TV news.



If you had a choice, what would be the BEST way to notify you about drinking water advisories?



Talking to Friends and Family



Delivery of paper notices to my house.



A home visit from health centre or band staff.



Facebook posts in my newsfeed from the health centre or band office



Facebook messenger



Receiving a call from the health centre or band office.



The TV screen at the gas station.

Display a message on the school's electronic message board.



TV, radio or online news.



Text messages



E-mail notices



Muskoday Community Radio Station.