

Final Capstone Project Report
Community Resilience with a Focus on Safe, Secure Drinking
Water in the Athabasca Watershed

Project Manager – Laura Nethery
Project Team – Petra Rowell and Ashley Johnson

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Executive Summary

Community resilience, especially related to safe, secure drinking water supplies, is going to play a very important role in the future of Alberta. One of the many possible outcomes of climate change may be an increase in natural disasters as has been witnessed in the province over the past 20 years. The Athabasca Watershed Council wants to gain an understanding of what kinds of resiliency steps have already been taken within the Athabasca watershed's many communities to protect source drinking water supplies and in what areas steps still need to be taken.

To explore this topic, the project developed a description of what community resilience, with a focus on safe, secure drinking water, is, and how it can be measured. This information was used to help develop a survey of no less than 10 but not more than 20 questions covering a variety of resilience and community preparedness measures. The survey was sent to representatives of the 35 municipalities and 10 Indigenous communities that lie within the watershed. Responses were collected on strategies already in place and to identify the gaps or holes in some communities' resilience planning. The collected response data was analyzed and presented through this project report. Some recommendations have also been included as a guide for potential next steps that could be taken to further the resiliency conversation. The findings of the survey were presented to the members of the Athabasca Watershed Council during the Annual General Meeting of June 2022.

Acknowledgements

I would like to take this opportunity to acknowledge and thank the people who helped make this capstone project a reality. First, Petra Rowell and Ashley Johnson from the Athabasca Watershed Council. Thank you for proposing this resiliency project as a capstone project that allowed me to delve into a subject of interest and importance that will hopefully add to the conversation about community resilience. And thank you for all the help, support and suggestions that led to the creation and delivery of the resiliency survey sent out to the communities of the Athabasca watershed. I would also like to thank Nisha Saini for providing both the intellectual and emotional support that kept this project steadily moving forward. I would like to acknowledge the use of the valuable information gathered from the Red Cross Society of America and the Harvard University Program on Survey Research in the creation of the survey which made up the key component of this project. And finally thank you to all those community leaders who responded to the survey. Your input was invaluable in creating a picture of community drinking water resilience in the Athabasca watershed.

Introduction

As more natural disasters are likely to occur as a result of climate change (USGS, n.d.), it will be important for communities to understand what protective factors contribute to resiliency so that those factors can be applied more widely to mitigate a given disaster when it happens. This project will seek to assess levels of community resilience in the 35 municipalities and 10 Indigenous communities that lie within the Athabasca watershed. The project began by defining community resilience with a focus on safe, secure drinking water. The focus of the project was the creation and delivery of a survey, designed to gather data which will be used to assess various aspects of community resilience. This survey was created with both ethical and cultural considerations at the forefront of its development. It consisted of 20 survey questions as reviewed and approved by the Athabasca Watershed Council (AWC). Only participants from within the Athabasca watershed were included in the survey. Survey results were assessed and delivered to the Council in the form of this project report, including recommendations for future areas of AWC work, and finally, an online webinar for the Council.

By identifying the protective factors that lead to resiliency, and where such factors are lacking, it is hoped that this information can be used by the Athabasca Watershed Council to inform their work which includes assisting communities with understanding risks to source drinking waters and sharing tools, such as Source Water Protection planning, to mitigate some of these risks.

This report includes this introduction to the subject matter, a list of definitions to help provide understanding of the subject, the methodology used to complete the project, the results of the survey sent out to communities, a discussion of the results, some recommendations made by the project manager and a conclusion summarizing the contents of the report.

Definitions

Drinking Water Safety Plan – a proactive method of assessing risk to drinking water quality, which better protects public health (City of Calgary, 2020).

FireSmart Program – a planning tool designed to reduce the likelihood of large uncontrollable wildfires in forests near communities and infrastructure. It is built on partnerships between government, industry, and homeowners (Silvacom, 2018).

Low Impact Development – An approach to land development that uses various land planning and design practices and technologies to simultaneously conserve and protect natural resource systems and reduce infrastructure costs (City of Calgary, 2020).

Residential 72-Hour Emergency Kit – In the event of an emergency, responders may be busy assisting those in immediate danger. The 72-hour kit holds supplies to support you and your family for three days in an emergency situation (City of Calgary, 2022).

Source Waters – water in its natural or raw state, prior to withdrawal for treatment and distribution as a drinking water supply (City of Calgary, 2020).

Source Water Protection Plan – a plan identifying required actions (management practices, statutory or regulatory changes, etc..) needed to mitigate existing and future threats to source water quality, which establishes priorities and a timetable for the plan’s implementation (City of Calgary, 2020).

Background

In 1955, Emmy Werner conducted a 30-year longitudinal study that followed 498 children born that year until they entered their 30s, to research what makes a person resilient. The study, entitled ‘Children of the Flower Island’ concluded, among other things, that no matter the circumstances of birth, early childhood, socioeconomic status or family structure, the majority of participants were doing well by the time they reached their 30s (Werner, 1988). They considered themselves to be happy and well adjusted to society. The study changed the way we talk about resilience. Prior to the study, resilience was considered a trait a person was born with or was not and no actions could be taken to alter this. Werner’s work demonstrated that resilience is something that can be developed and built.

The American Psychological Association defines resilience as, *“the process of adapting well in the face of adversity trauma, tragedy, threats or even significant sources of stress”* (Arshad, M., et al, 2020). Experiencing a natural disaster would be considered a source of significant stress or trauma by most people. People can reduce the level of stress experienced during a natural disaster affecting their community through preparation and planning for just such an emergency. Preparedness will be key in coping with and adapting to the changing world we are experiencing today.

The province of Alberta has seen several natural disasters over the last couple of decades, from the Slave Lake wildfire in 2011, the southern Alberta floods in 2013, the 2016 Fort McMurray wildfire, incidences of drought, and the Covid 19 pandemic that has changed the world for the past two years. These are just a few of the more notable disasters, but not an exhaustive list. When a community suffers from a disaster it becomes important that it rebound as quickly as possible. The Athabasca Watershed Council wants to gain a better understanding of how the communities within the watershed have built or are building resilience at the individual and community level. One of the key components to resiliency is the continued access to safe drinking water in the aftermath of a disaster. Consequently, part of the exploration of the topic of community resilience must include an understanding of not only how each community provides potable water but also what sort of emergency plans they have in place to guarantee that access continues no matter the situation.

The Alberta Water for Life program was established in 2003 to *“manage and safeguard Alberta’s water resources. Water is not only a resource, but also a life source. We all share the responsibility to ensure a healthy, secure and sustainable water supply for our communities, environment, and economy”* (Government of Alberta, 2003). Along with a clearer understanding of risks to source drinking water, this project will also explore some of the other ways in which communities build resilience against disaster, such as FireSmarting, community based social support structures, green infrastructure, low impact development, and any source water and other planning already done by communities within the watershed. By exploring and assessing how communities are building resilience today, the Athabasca Watershed Council will be able to help encourage and develop these types of resilience measures in communities where they may be lacking. This could benefit every community within the watershed, allowing them to become stronger, more resilient, and ready to face whatever challenges may occur in the future.

Methodology

In order to gain an understanding of the level of and types of resilience measures being taken in the Athabasca watershed, information needs to be gathered from the various communities within the watershed. For this project it was determined that information could best be gathered by asking these communities directly. This is the key component and main focus of the project. To determine what kinds of questions should be asked several steps needed to be taken first to ensure that the right questions were posed that would most effectively gather the most valuable information.

Prior to beginning the creation of the survey there needed to be a clear definition of community resilience with a focus on safe, secure drinking water. Having a clear definition allowed the determination of what areas of resilience to focus in on. Once this definition was created and reviewed, the process of developing the survey was begun.

Research was conducted to ensure that the survey sent to the communities of the Athabasca watershed was culturally, ethically, and morally sound to the best of the project team's knowledge. The main sources for this research were Harvard University's Program on Survey Research and the Red Cross Society of America's Community Resilience Assessment tool which was used previously to run a community resilience survey in the United States. Harvard University's program provided some key strategies for creating a survey that respondents would be willing to complete in a timely fashion. First and most importantly, 'Don't Reinvent the Wheel':

"If you are trying to measure an attitude, concept or behaviour, there's a pretty good chance someone has done it before. In the course of your literature review, pay careful attention to how others are measuring the concept you want to measure. They may have already tested the reliability and validity of a measure, an identical question also allows for comparison across surveys" (Harrison, 2007).

Further survey generating tips from Harvard's program include pre-testing your survey before sending it out to your larger audience, thinking about the model of your survey (i.e., in person, by mail or online), keeping the questionnaire short, keeping question order in mind, and making sure the questions you are asking applies to the people you are asking them of (Harrison, 2007). What do each of these components mean? Pre-testing the survey allows for people who were not involved in the creation of the survey to provide opinions and comments about the questions asked. An outside look at the survey can help to clarify the meaning of questions to ensure that it is clear, concise, and understandable to the target audience. The model or mode of the survey may influence the number of responses received. In this digitally focussed online world, it is easy to create and send out a survey to an audience, but it can also be easy for that audience to ignore. If choosing the online delivery method, survey creators must be prepared to remind their target audience to complete the survey. The length of the survey can have a large impact on whether or not the project team receives responses and whether those responses provide valuable information. Too many questions and respondents are less likely to answer the survey. Too few questions and the information received will not provide an adequate amount of information. It is also important to make sure that the questions asked follows a logical train and that like questions are grouped together to assist with understanding. Previous questions can impact how following questions are answered. Start with generalized questions and then move into more complex ones. It is also useful to keep any open-ended questions for the end of the questionnaire as if they ask respondents to answer

in their own terms with opinions or comments related to the subject matter. Additionally, respondents are more likely to answer quick, multiple-choice questions than they are open-ended ones. By putting these near the end of the survey there will be a higher likelihood of receiving the most responses to the majority of questions. Finally, Harvard's program suggested the following three goals in writing the ideal question:

“It measures the underlying concept it is intended to tap”
“It doesn't measure other concepts”, and
“It means the same thing to all respondents” (Harrison, 2007)

The community resilience survey generated for this project was created with these key components in mind. Another valuable resource used was the American Red Cross Community Resilience Tool. This assessment tool covered many of the same areas of concern as were considered for this community resilience project including many relating to safe, secure drinking water. The resource was invaluable in question formulation, structure and subject matter covered.

The completed survey was sent out to the 35 municipalities and 10 indigenous communities within the Athabasca watershed via email. The email list was provided by the Athabasca Watershed Council and was directed at higher level officials from each community such as mayors, reeves, chiefs, chief administrative officers, or any other official who was believed to be able to provide the necessary information to accurately answer the survey questions. The survey link was sent with an introductory email explaining the nature of the survey along with supporting definitions of terminology used in the survey. Respondents were asked to complete the survey within two weeks of receiving it.

Once responses were received, data was collected and analyzed using the tools provided by the survey software (cdn.forms.office.net). These tools include collation of data in excel and graphical representations of the results per question. The results would then be presented here in this report for discussion and to formulate recommendations for further research.

The final step in this project is to present the findings of the survey both at SAIT during the final capstone presentations and to the Athabasca Watershed Council in an approximately one-hour long webinar. The date of this webinar was to be determined later at the convenience of the Council.

Results

The survey created to examine community resilience with a focus on safe, secure drinking water contained a total of 20 questions. The questions are a combination of multiple choice, short answer, and long answer (open-ended) questions. In this results section each question will be presented, in the same order as was sent to respondents, followed by the responses received. As the survey was designed to collate all the data gathered, all answers are combined and cannot be tied to any one community. Of the 45 communities in the watershed, fifteen responses were received meaning 33% of communities responded to the survey. It is important to note when reviewing these results that not all respondents answered all the questions so numerical values and percentages change for each question based on the number of responses to that question. Also please note some questions can have multiple responses as indicated by the question itself (i.e., check all that apply).

Question 1: The name of your community?

- Athabasca County
- County of Barrhead
- Fort McMurray
- Jasper
- St. Albert
- Summer Village of Birch Cove
- Summer Village of Island Lake South
- Summer Village of Larkspur
- Summer Village of Nakamun Park
- Summer Village of Sunset Beach
- Summer Village of West Baptiste
- Summer Village of Whispering Hills
- Town of Barrhead
- Town of Mayerthorpe

Question 2: What is your position in the community?

Eight of the respondents identified themselves as Mayors, Reeves, or Chiefs, one as a Councillor, two as Chief Administrative Officers, two as Staff and two as community residents. The majority of respondents come from leadership roles in their communities. See Image 1.

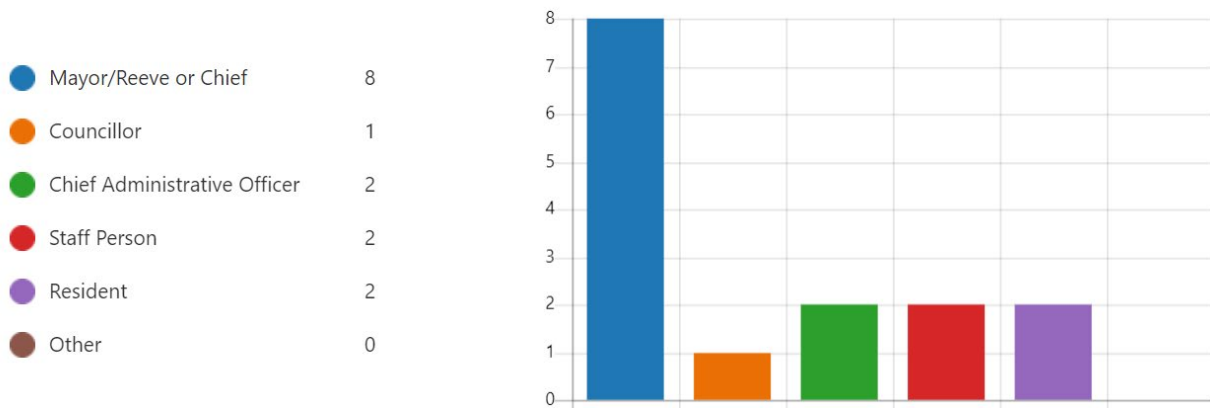


Image 1: what is your position in the community? Graphical representation

Question 3: Does your community have its own drinking water treatment plant, or does your community utilize the facilities of another municipality?

Six (43%) of the communities have their own drinking water treatment plant. An additional 2 (14%) communities indicated that they have their own treatment facility and supplied drinking water to other communities. Five (36%) communities receive their drinking water from another community and one (7%) indicated that they were not sure about where their drinking water originates from. See Image 2.

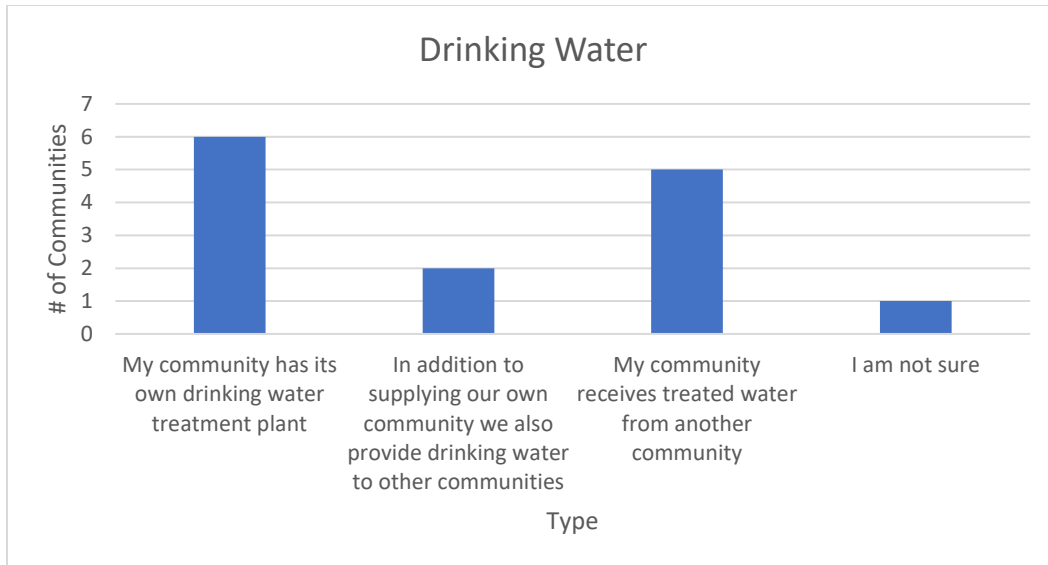


Image 2: Source of treated drinking water

Question 4: Regardless of where it is treated, what is the origin of your community's source drinking water supply?

For this question the respondents listed water sources as follows: one (6%) indicated a lake as a resource, nine (56%) indicated a river, four (25%) communities get their water from an aquifer and two (13%) communities indicated another water source. There was a total of sixteen responses which indicates that one community selected more than one water source. From the answers to question 5 we can determine the alternative water source to be individual groundwater wells. See Image 3.



Image 3: Breakdown of source water type

Question 5: What is the name of the water body?

The most common source of water for survey respondents is the Athabasca River at 40%. The North Saskatchewan River, Paddle River and 'answer not provided' each make up 13.3% of responses and Baptiste Lake, 'each cabin gets their own water' and SW 2005-3, 2005-4, 2005-5 each represent 6.7% of responses provided. By far the most commonly utilized source water is the Athabasca River, and over 50% of all water is provided by rivers within the watershed. See Image 4.

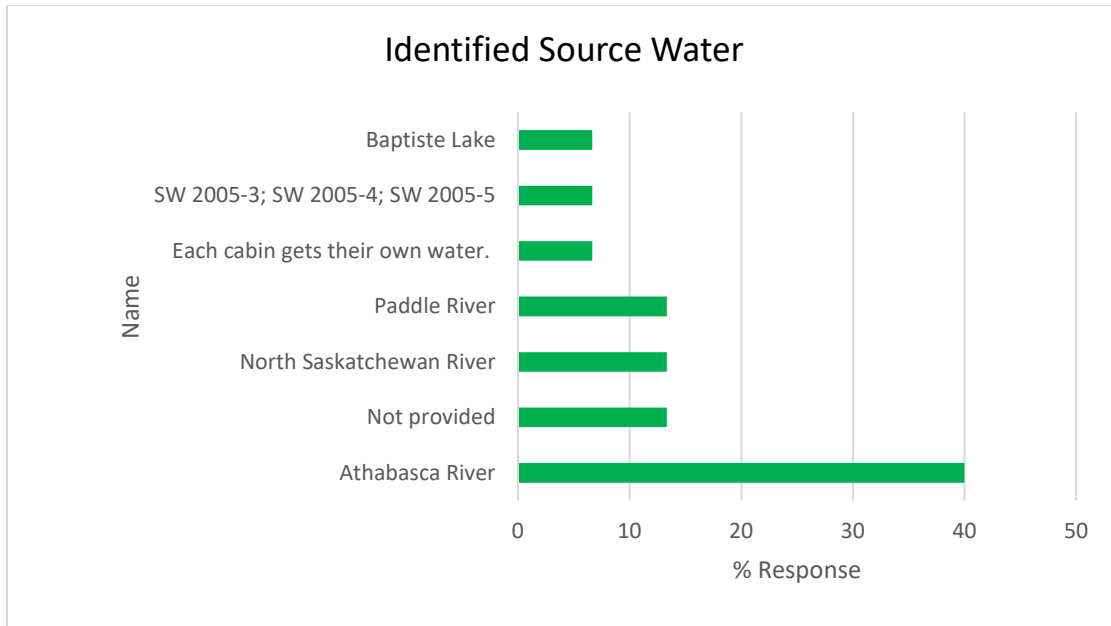


Image 4: Identified water source

Question 6: Does your community have a piped water distribution system? If yes, how much of your community receives its water through this piped system?

The majority (47%) of communities indicated that they did not have a piped water distribution system. Four communities (26%) indicated that the entire community receives its drinking water from a piped system. One community (7%) indicated that most of the community has piped water, and three (20%) indicated that less than half/very few members of the community have a piped water system. See Image 5.

- The entire community 4
- Most of the community 1
- About half the community 0
- Less than half/very few of the ... 3
- No one in the community 7



Image 5: Number of communities with piped water system

Question 7: Does your community use truck fill stations to distribute potable drinking water? If yes, how much of your community receives its water from truck fill stations (i.e., Have cisterns)?

The responses to this question included three (20%) communities indicating that most to half of the community use truck fill stations, six (40%) indicated that less than half/very few use truck fill stations,

and six (40%) indicated that they did not know the answer to this question. No responding community indicated that the entire community depended on truck fill stations. See Image 6.

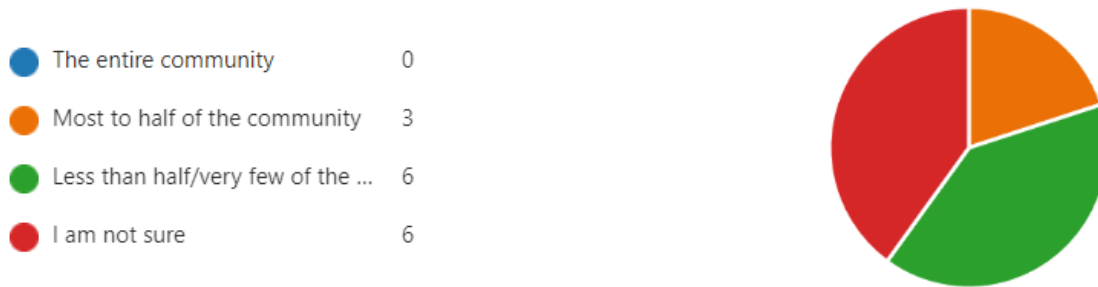


Image 6: Use of truck fill stations

Question 8: Many communities have potable water storage via reservoirs. If your community has such storage, what is your storage capacity for the needs of your current population?

The majority of communities (43%) indicated that they do not have potable water storage and four (28%) have less than one week of storage. Two (14%) communities have one to three weeks' capacity, one (7.5%) community has three to six weeks capacity and one (7.5%) community indicated they were not sure about the community's storage capacity. See Image 7.

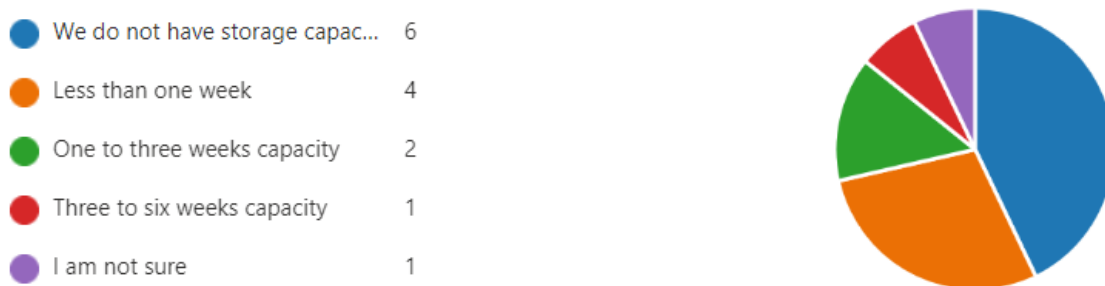


Image 7: Potable water storage capacity

Question 9: Not including the pandemic, has your community been affected by a natural disaster in the last ten years? If yes, what type of disaster was it (click all that apply).

Ten of the fifteen responding communities indicated that they have not experienced a natural disaster in the last decade. There were nine additional responses to this question which means that some communities have suffered multiple natural disasters during the ten-year period. These identified disasters include three floods, one forest fire, three droughts and two large precipitation events. All occurred within five communities. See Image 8.

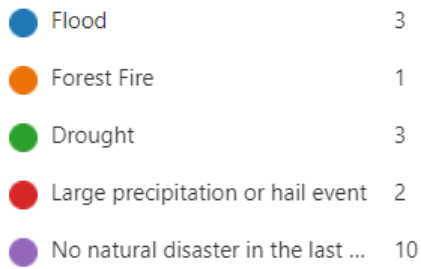


Image 8: Natural disasters in the last ten years

Question 10: If you selected multiple disasters in the above question, what impact did the most recent disaster event have?

Only seven responses were received for this question. One community reported only minor impacts to the community with recovery costs of \$0 to less than \$500,000, one community indicated moderate impacts to the community with recovery costs of \$500,000 to \$1 million, one community indicated major impacts of \$1 million to \$50 million and one indicated catastrophic impacts of \$50 million or higher. The remaining responses indicated ‘other’ providing no impact data. See Image 9.

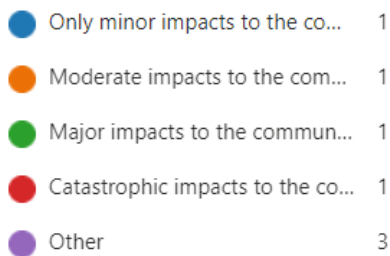


Image 9: Impacts to the community

Question 11: Does your community have any of the following (check all that apply)?

This is a ‘check all that apply’ question so more than 15 responses were received for this question. Two communities indicated they have a Water Conservation Program, zero communities have a Drought Protection Plan, four communities have a Flood Protection Plan, two communities have a Source Water Protection Plan, three communities offer a Residential 72-Hour Emergency Kit Program, and seven communities utilize a FireSmart Program. The nature of the survey does not allow for knowing if all responding communities have at least one program in place, just that 18 total responses were received regarding the listed programs. See Image 10.

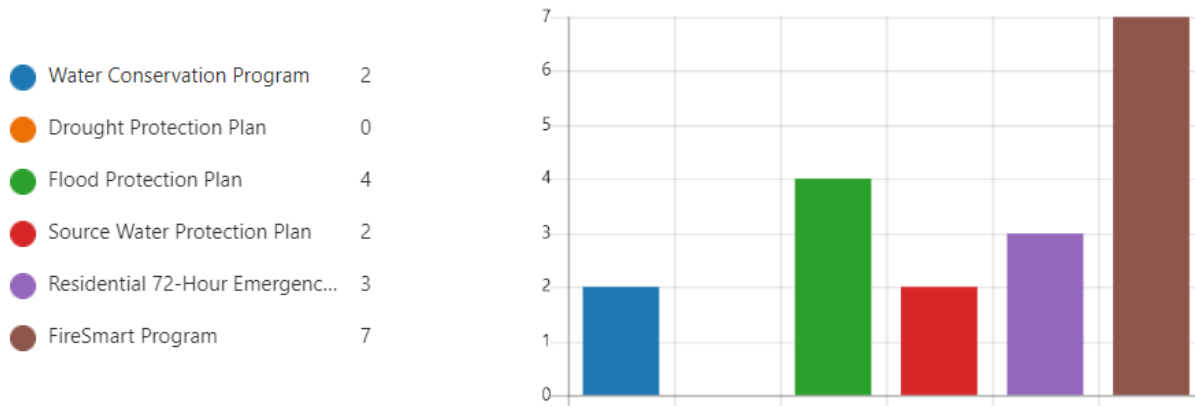


Image 10: Community Use of protection programs

Question 12: What are the barriers/obstacles to developing these types of plans?

Like the previous question multiple answers were received from responding communities, indicating multiple barriers/obstacles to developing plans. Three respondents indicated a lack of expertise in the field, six suggested financial considerations, eleven indicated staff resources and seven indicated ‘other’ as the barrier/obstacle to plan development. The ‘other’ category allowed for respondents to provide additional information. Comments include, “Utility Bylaw provides for water use restrictions, Storm Water Master Drainage Plan provides for flood protection, Drinking Water Safety Plan provides for water source protection procedures. We promote and advertise the Residential 72-Hour Emergency Kit Program and in process of making a formal application”. See Image 11.

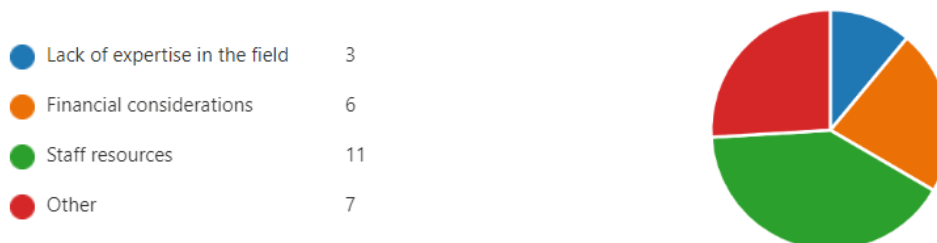


Image 11: Barriers to plan development

Question 13: Has your community suffered a period of water scarcity in the last ten years?

A total of fifteen responses were received, three (20%) indicating ‘Yes’ and twelve (80%) indicating ‘No’.

Question 14: What is the likelihood that a disaster could impact your drinking water supply by contaminating source waters or damaging water intake infrastructure, for example?

Four (28.5%) communities indicated a likelihood of impacts to drinking water, four (28.5%) indicated this scenario was unlikely and six (43%) respondents indicated they did not know the answer to the question. One respondent did not provide an answer to this question. See Image 12.

● Likely	4
● Not likely	4
● I am not sure	6



Image 12: Likelihood of a disaster impacting drinking water supply

Question 15: Has your community completed flood plain mapping?

For this question four (27%) respondents indicated ‘Yes’, five (33%) indicated ‘No’, five (33%) indicated they did not know the answer and one (7%) indicated the question was not applicable to their community. See Image 13. See Image 13.

● Yes	4
● No	5
● I am not sure	5
● Not applicable	1



Image 13: Completion of flood plain mapping

Question 16: Does your community utilize green space/natural infrastructure to reduce the chance of flooding? (Check all that apply)

This question allowed respondents to indicate multiple answers. Eight out of fifteen (53%) respondents indicated the question was not applicable to their community. As to the communities that do utilize green space/natural infrastructure five utilize wetlands, three beaver ponds, three riparian areas, three also indicated the use of swales, four use natural berms and four indicated ‘other’ in their responses. Additional information provided in the ‘other’ category included the use of park planning, drainage projects, the Paddle River Dam and natural dams. See Image 14.

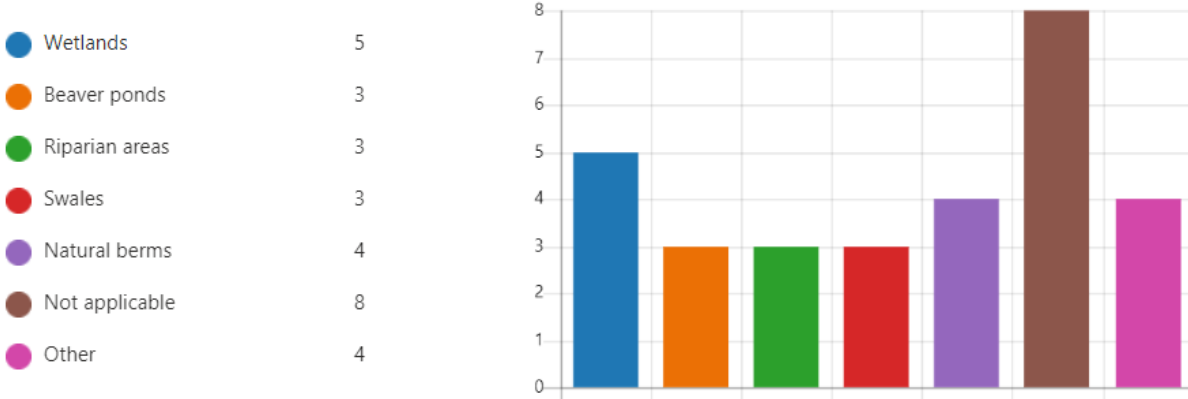


Image 14: Use of green space and natural infrastructure

Question 17: Does your community have sufficient stormwater systems and drains to handle excess water and prevent flooding when it rains?

Of the fourteen responses received five (36%) indicated 'Yes' to this question, five (36%) indicated 'No' and four (28%) indicated they were not sure. Only fourteen responses were received for this question. See Image 15.

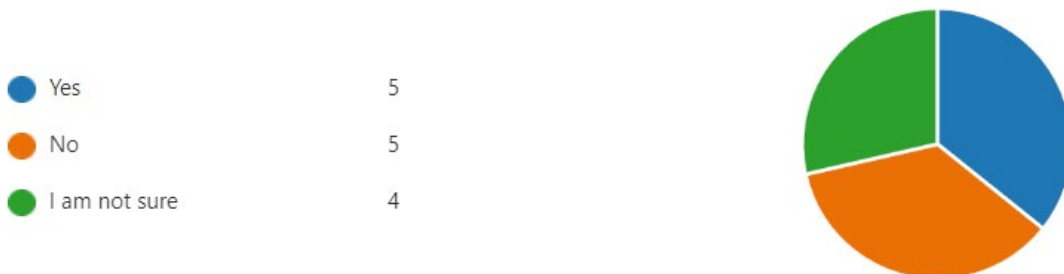


Image 15: Sufficiency of stormwater systems

Question 18: One of the biggest threats to communities in the northern boreal forest is forest fires. What are the chances that your community could be affected by forest fire?

Nine (60%) communities indicated that it was likely they could be affected by a forest fire. Four (27%) communities indicated it was unlikely and two (13%) were not sure. See Image 16.

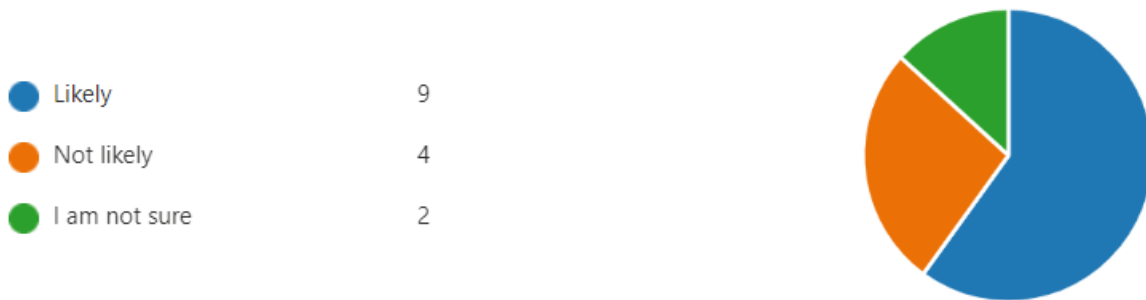


Image 16: Impacts from a forest fire

Question 16: Do you want to add any additional information about your community or about how the AWC can help your community improve your drinking water resilience?

This was one of two open-ended questions in the survey. Six responses were received, and four contained comments included in this report.

“We are pretty resilient but can always do more.”

“Wildlands fires are a greater risk in our community. Stormwater minor and major systems need to be improved to accommodate larger flood events. Need to complete more work on upgrading stormwater systems from surface drainage to underground systems. Need to implement erosion control measures around stormwater systems. Need to install more stormwater ponds as the land is developed. Need to complete a detailed Biophysical Assessment. Need to develop a stewardship group for the Little Paddle River.”

“We use nearby truck fills that distribute Edmonton water.”

“We are a small Summer Village with 95 lots. We have no extra land to house reservoirs or house water treatment plants.”

Question 20: Would you like any additional information regarding the topics addressed in the above questions (i.e., Source Water Protection Plans, Drought Plans)?

Six comments were added to this open-ended question. Three indicated ‘No thanks’, one responded ‘maybe’, and two additional comments were made.

“Every Community has to have a Drinking Water Safety Plan and update annually”

“Source water Protection plans; flood plain mapping”

Discussion

With a 33% response rate on surveys sent out to the communities of the Athabasca watershed we can take a look at the results and discuss the state of resiliency within the watershed. The nature of the information gathered and the fact that the survey responses are anonymous does not allow for concluding if any single community is resilient or not. This is a broader discussion of the types of resiliency measures currently utilized and by how many of the responding communities. Additionally, the project manager does not have the expertise or education to accurately draw any conclusions about which communities are resilient and which are not. That conclusion can only be drawn with significantly more information about each community over a longer period of time and engagement. What can be discussed is the results of the survey and what they imply about the watershed as a whole.

The survey results show that most communities within the Athabasca watershed get their water from rivers, mainly the Athabasca River itself. This is not surprising as this conversation is about the Athabasca watershed, but it does provide a point of note when discussing the risks to safe, secure drinking water. If there was to be a major contamination spill on the river, many communities would be affected. This information goes hand in hand with the discussion of whether a community has its own drinking water treatment plant. It does not make fiscal sense for many small communities to have their own plant. Plants require not only a large influx of cash to build but also the expertise to maintain and operate the facilities year over year. The survey results show that it is about a 50/50 split as to whether a community has its own treatment plant or receives water from a larger center's treatment plant. This does lead to the concern that if a larger city's water source or treatment plant was affected by contamination many smaller communities would have to consider alternative sources of potable water until such time that the contamination could be cleaned up.

When asked about piped water distribution systems a surprising number of communities indicated that no one in the community had a piped system. Surprising until bearing in mind that many of the responding communities are small and it therefore does make sense that they would not depend on a piped system. It is to be believed that all, if not most, of the bigger centers within the watershed would have a piped distribution system. This is one of the many questions that could be answered by further discussing the questions asked here, on an individual community basis. Along the same lines the question about the use of truck fill stations showed that while no communities identified as solely using truck fill stations, many did indicate that around half of their community does use these facilities and therefore store their water in locally housed cisterns.

One of the more interesting sets of responses from the survey came from the question about potable water storage. Two-thirds of all responding communities indicated that they had either none, or less than one week of potable water storage capacity. This indicates that should any of these communities suffer an event that affects their access to potable water, they will have to immediately find an alternative water source until the event is over and the situation rectified. Having to truck in an alternative water source is costly and requires coordination and planning. This is a complex problem as creating a storage facility requires funding and space. For smaller communities, storage capacity may not be feasible any time soon.

Another question that provided interesting results was question 9 on natural disasters. Ten of the fifteen responding communities indicated that they had not suffered a natural disaster in the last ten years. While this is a good result, a lack of any traumatic event can lead a community to a false sense of security. A climate related event can take place at any time or location in the province and despite these communities not having experienced such an event, every community should be planning and preparing for one that may occur. As to the identified natural disasters that had occurred, the financial cost varied by event from minor to catastrophic. Thankfully, there was only one event marked as catastrophic, but it is reasonable to expect that the cost of natural disaster recovery will increase as the frequency of these events increases.

Respondents were also asked to identify any and all protection plans they may be utilizing. The FireSmart program was the most commonly selected program. This may be due in part to the fact that FireSmarting is something that can be done individually (households) as well as at a community level with a lower cost than some of the other programs. All the programs listed in this question are important and can assist communities in preparing for uncertainty. The reasons for not utilizing these programs were listed as mainly financial and staffing related. An area of further research could be in determining if any of the listed plans could be shared across multiple communities to help share the financial and staffing burden for all involved.

When communities were asked whether they had experienced a period of water scarcity, the majority responded in the negative. This is a very positive result, but it is important to remember that as glaciers melt and populations grow, water scarcity is likely to become more common. Planning for water conservation will play a key role in finding the water use balance in the future.

Question 16 on green space/natural infrastructure also produced some interesting results. Eight respondents identified as not seeing these types of infrastructure as applicable to their communities. Green spaces and natural infrastructure should be considered an important part of any community. The benefits are not only environmental but also esthetic and recreational. Perhaps the responses came out of a lack of understanding about their impacts and how each type of infrastructure can benefit a community. This may be an area where education will be key to promoting growth and development of wetlands and the other types of structures listed.

Regarding the sufficiency of stormwater structures, the answers were split evenly. While five respondents indicated sufficient stormwater capacity, an equal amount acknowledged that they did not have adequate capacity. A further almost equal number of communities were not sure what the answer to this question was. This could be another area of concern as 1 in 100-year events become 1 in 50-year events as an example. Across the province stormwater capacity will likely need to be increased.

The majority of communities did acknowledge concern over the impact of wildfires on the community. Fires cause damage to homes and all forms of infrastructure but can also have significant impacts on source water quality. It is therefore encouraging that so many communities have indicated utilizing FireSmart programs.

The results of this survey have provided a glimpse of how the communities of the Athabasca watershed are thinking about resilience. While these results show that many communities have taken steps to

protect their water, the results also show that many if not most communities still have a long way to go towards protecting themselves against the impacts of natural disasters. Hopefully, the survey will provide a gateway into further discussions with communities on how to continue to build resiliency wherever possible.

Recommendations

While some valuable information was gathered through the survey portion of this project, much more information is needed before there can be a determination of how resilient these communities currently are. The following are recommendations to be considered in continuing the conversation about resiliency within the Athabasca watershed.

This survey is just the start of the community resilience conversation, and it is an important conversation that needs to be had by all communities. Planning and being prepared for sudden and unexpected change can make all the difference when it comes to a community's ability to bounce back after a natural disaster. Ideally, the Athabasca Watershed Council would work towards engaging each individual community in this conversation, helping them determine what measures need to be taken to protect and prepare for future climate change impacts. Each community will have its own individual needs and sometimes just identifying those needs can help move that community forward towards developing resiliency.

One area that was lacking in this project was Indigenous engagement and input on the survey questions. This was mainly due to time constraints. Engagement is, and should be, a lengthy process, one that the four-month timeframe for this project simply did not allow for. Indigenous engagement would likely change the perspective of the project and survey, introducing new elements that should be considered in the conversation about community resilience, especially with respect to water. The engagement could also potentially provide solutions not previously considered, to some of the concerns regarding safe, secure drinking water.

It is also recommended that the Athabasca Watershed Council consider individual resilience measures when having the conversation about community resilience. Individuals who feel prepared for the change's life throws their way are more likely to be the people who can step up and help others when the need arises. Each individual who feels adaptable and ready for the challenges of drought, fire or flood, contributes to the bigger picture of community resilience. This means that when helping communities gain resiliency, individual actions must not be forgotten.

Awareness and education are going to be key to building resilience. This means public engagement. As was determined from the survey results, many communities had not suffered from any form of natural disaster over the last ten years. This can lead to a false sense of security and denial that such an event could take place in the future. So, it is recommended that the Athabasca Watershed Council work on engaging all communities within the watershed in preparing for disaster events through understanding the risks as well as the steps that can be taken to minimize the impacts of natural disasters.

Conclusion

The importance of community resilience cannot be underestimated. This project included defining community resilience with a focus on safe, secure drinking water and creating and distributing a survey gathering information on the state of resilience within the watershed. This project and survey were designed to start a conversation about the state of resilience with the hopes of educating respondents about some of the questions they should be asking about their own communities. The results of the survey show that while many resilience measures are being taken throughout the area of the watershed, there are definitely gaps in community resilience that need to be addressed. 15 out of 45 communities that were asked to respond to the survey provided valuable information that allowed for some discussion of the findings and recommendations about steps that could be taken to further the conversation. It is hoped that by asking these questions the Athabasca Watershed Council will have encouraged the watershed's communities to explore and learn about resilience measures that may assist them should a natural disaster ever affect their community. Adaptation, which is key to resilience, comes from being prepared and from having planned for the worst-case scenario. The Athabasca Watershed Council is in a good position to assist these communities by providing information and access to resources that may assist in growing key resilience strategies. This survey is just the beginning of a much larger conversation that can help protect communities should a natural disaster occur.

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