Resident Water Survey
Municipality of Chester, 2020

Prepared for:
Municipality of Chester
151 King St.
PO Box 369
Chester, NS
B0J 1J0

Prepared by:
Coastal Action
45 School Street
Suite 403
Mahone Bay, NS
B0J 2E0

August 2020

Coastal Action
45 School Street, Suite 403, PO Box 489, Mahone Bay, Nova Scotia B0J 2E0
Phone: (902) 634-9977
Email: info@coastalaction.org
Web: www.coastalaction.org

Prepared by:
Taylor Creaser, B.Sc., American Eel Project Coordinator, Coastal Action

Contributing Authors and Surveyors:
Shanna Fredericks, M.Sc.
Molly LeBlanc, M.Sc.
Kaylee MacLeod, B.Sc.

Cover Photo: East River, Municipality of Chester, Taylor Creaser

Coastal Action is a non-profit organization based in Mahone Bay, NS with a mandate to address environmental concerns throughout the South Shore region of Nova Scotia and beyond. Our mission is to restore and protect the environment through research, education, and action. Coastal Action works mainly within four key research areas: Climate Change & Education, Species at Risk & Biodiversity, Water Quality & Watersheds, and Coastal & Marine.

Table of Contents

List of Figures

List of Tables

Executive Summary

In the fall of 2019, Coastal Action was approached by the Municipality of Chester to assist with the design, implementation, and analysis of a resident water survey for all residents and businesses within the Municipality of Chester. The consultation process was intended to create a baseline understanding of current public perceptions, attitudes, and opinions on water management and conservation in the Municipality. This public consultation is to be used as a means of informing the development of the comprehensive Water Strategy and Action Plan. The survey was designed over the winter of 2019/20 and 6,100 print copies were mailed to all residents of the Municipality at the beginning of April 2020. Participants also had the option to complete the survey online during the consultation period, which lasted approximately eight weeks.

In total, 1,220 surveys were returned, both through the online platform, Voices and Choices, and the return of completed print copies, a return rate of 20%. The survey primarily captured the responses of long-term (55%) and full-time (87.4%) occupants from all seven Districts in the Municipality. Public perceptions and knowledge levels of personal water quality and quantity and the risks to them were generally high. Underlying geology was identified as the top concern to water quality, while climate change and drought were considered the top threats to water quantity. There was much less certainty among respondents about threats to specific water bodies in their area and about who is responsible for managing water resources. The analysis revealed differing views among some of the Districts on how well the responsible stakeholders' function at managing water, displaying a change in attitude depending on the respondent's location.

Gaps in reporting to the Municipal Dry Well Inventory were identified, as only 42 of the total 270 dry well reports identified by the survey were also reported to the inventory since 2014. The survey also showed that rates of infrequent testing (every 6 years or more) or absence of testing altogether were high, with over 50% of participants from almost every District testing infrequently for both bacteria and chemicals. Barriers to water testing primarily included the view that it was unimportant (38.3%) and that it was too expensive (33.6%). Although most respondents indicated they would be willing to test their water if these barriers were removed.

Most respondents indicated that they employ water conservation practices in their home or business (84.4%), with the most common being general water conscientious actions (82.0%) and fixing leaks (80.3%). An assessment of the barriers among those that did not conserve water revealed the attitude that it is unimportant and not a priority, with many indicating they would be willing to if there were financial incentives to do so (36.4%).

Finally, the level of support for the Municipal Water Strategy and Action Plan was found to be a median value of 2, or 'somewhat support'. There was no difference in this level of support across Districts within the Municipality, indicating general approval for the plan among respondents.

1.0 Introduction

1.1 History and Background

A Water Strategy and Action Plan was created by the Municipality of the District of Chester (MOC) with the mandate to proactively manage surface and ground water resources while combatting water issues such as climate change, sea level rise, growth, and development within the Municipality. The strategy aims to address the needs of the environment, while meeting the economic and physical needs of residents for a safe and sufficient water supply. Using an integrated approach to manage both the surface and ground water supply, the strategy is meant to be a living document which will be amended and improved to maintain a clean and abundant supply of water for today and into the future. This strategy outlines several key objectives such as: understanding the current state of the Municipality's water supply, development of water conservation plans, addressing the needs of the natural environment, and creating plans for managing drought.

A Water Strategy Team has been created to meet the above objectives. This is in combination with the continued development of a comprehensive strategy with tools and programs that MOC and its partners can use when addressing water supply and water quality issues. There are several ongoing and past water-related initiatives that are being conducted as part of this strategy, in addition to the Municipal Water Survey. They include the investigation of a central water supply for the Village of Chester; a Municipal Dry Well Inventory; a Water Supply Upgrade Lending Program; and several ongoing water quality monitoring programs in conjunction with Coastal Action and the Municipality of the District of Lunenburg.

Discussions surrounding the installation of a central water system in Chester Village have been ongoing since a 1967 study which determined that the wells in the Village would not be able to provide a long-term supply to meet demand of residents and businesses. Since that time, many consultations and options have been explored. Currently, the two most feasible options are to obtain central water from a ground water source (Middle River) or surface water (Spectacle Lake). On January 26, 2019, residents of the village voted on whether to pursue a central system or not. This resulted in a 43% yes vote and 57% no (Municipality of the District of Chester, n.d.).

MOC began an initiative to track wells that are dry or nearly so within the Municipality. It began in 2016 and has continued annually. Residents can report to a Water Shortage Tracker, which is hosted on the Municipality's website. They report their name and address, the date, type of well, community, and any other relevant information, which is then compiled into a database to track annual shortage trends.

There is currently a Water Supply Upgrade Lending Program in place which provides eligible residents with low interest loans to help with costs of improving their supply of safe, potable water. The budget for this project is allocated annually on a first come, first serve basis to help with a variety of things including the construction of a new dug or drilled well; an upgrade to an existing well required to source potable water for the property; the installation of equipment such as a well pump, a water line, and an electrical connection to support the function of a new or upgraded well; and other equipment, such as cisterns and containers, to improve the supply, use, and conservation of potable water (Municipality of the District of Chester, n.d.).

MOC delivers several ongoing water quality monitoring programs in conjunction with Coastal Action. These programs were initiated due to public concerns over the recreational safety of water as well as the impacts of development. MOC currently supports the following monitoring programs: Fox Point Lake, Bayswater Pond, Rafuse Cove, and Sherbrooke Lake. The Sherbrooke Lake Water Quality Monitoring Program is completed in partnership with the Municipality of the District of Lunenburg.

1.2 Project Overview and Objectives

Coastal Action was approached by MOC in the fall of 2019 to assist with the design and implementation of a public consultation process which would engage all homeowners within the seven Districts of the Municipality on issues of water usage, conservation, quality, and quantity. The consultation process was intended to create a baseline understanding of current public perceptions, attitudes, and opinions on water management and conservation in the Municipality of Chester. This public consultation is to be used as a means of informing the development of the comprehensive Water Strategy and Action Plan.

Following discussions between Coastal Action and the Water Strategy and Action Plan Steering Committee, five objectives were identified for the public consultation process:

1. Determine public perceptions (knowledge level) of MOC residents regarding water usage, conservation, quality, and quantity.
2. Determine attitudes (level of concern) of MOC residents regarding water usage, conservation, quality, and quantity.
3. Determine current water conservation practices being used by MOC residents.
4. Determine barriers preventing MOC residents from implementing water conservation practices.
5. Determine opinions and level of support of MOC residents for various components/programs of a Municipal Water Strategy and Action Plan.

The survey questions and analyses were designed to directly answer the above consultation objectives by engaging all residents and businesses within the Municipality of Chester.

1.3 Survey Area

The survey was administered in the Municipality of Chester. The Municipality is located within Lunenburg County, on the South Shore of Nova Scotia. It covers a geographical area of approximately 1,122 km^2 within Lunenburg County (Statistics Canada, 2017). It borders Halifax Regional Municipality and the Municipality of the District of West Hants on one side, with the easternmost community being Hubbards. Most of the population is clustered in communities adjacent to the coast, although the Municipality extends substantially inland and borders on Kings County to the north. Finally, the community of Martins River defines its westernmost border, after which is also Lunenburg County, however, within the jurisdiction of the Municipality of the District of Lunenburg. The Municipality of Chester is divided into seven Districts, each including multiple communities.

Figure 1. Map of Nova Scotia showing the Municipality of Chester in red (Source: Wikipedia, 2009).

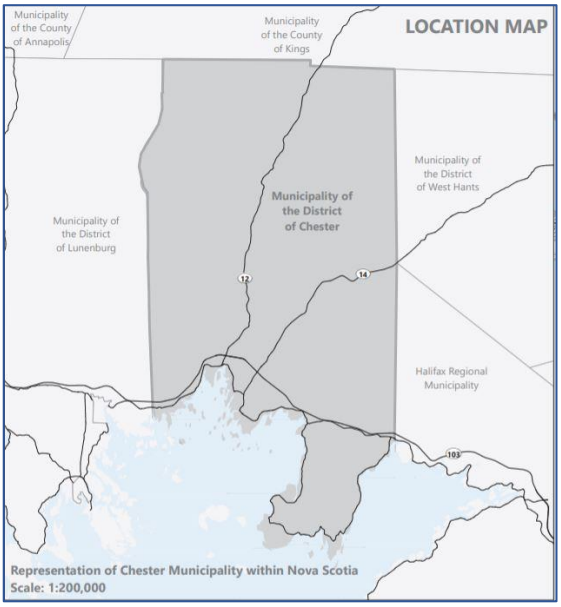

Figure 2. Municipality of Chester boundaries (Source: Municipality of the District of Chester).

District One is comprised mainly of the communities on the Aspotogan Peninsula including: Aspotogan, Bayswater, Blandford, Northwest Cove, Deep Cove, East River, and part of East Chester. District Two is comprised of Hubbards, Mill Cove, Fox Point, Simms Settlement, Mill Lake and The Lodge. District Three contains the most populated area in the municipality, Chester Village, and part of East Chester. District Four has the communities of Chester Basin, Chester Grant, and part of Middle River. District Five is comprised of Gold River, Beech Hill, Western Shore, Martin's Point, and part of Martin's River. District Six has the communities of Seffernsville, Lake Ramsay, Forties, Franey Corner, and Fraxville. Finally, the communities of Windsor Road, Canaan, Sherwood, and Marriotts Cove comprise District Seven.

2.0 Materials and Methods

2.1 Survey Design

This survey was designed using elements from the Total Design Method (Dillman, 1978) with the intention of increasing response rates. Dillman's method has been shown to yield an average response rate of 73%. Due to both financial and time constraints, not all facets of the Total Design Method were employed; however, several aspects were utilized.

Surveys were designed in booklet format, using standard letter-sized paper which was folded in half. This size is less likely to be viewed as junk mail, decreasing the likelihood of it being discarded. The first page began with an introductory covering letter to participants explaining the purpose of the survey and what the data will be used for. Easier "warm-up" questions that required less critical thinking to answer were placed at the beginning of the survey, while the more difficult questions were placed near the middle. Demographic questions were placed at the end of the survey as research shows they are more likely to be completed if they are asked later (Hoddinott & Bass, 1986).

MOC designed an online version of the survey, providing respondents with a digital option. It was hosted on the Municipality's online engagement platform, Voices and Choices. Deploying both hard copy and online surveys was important to target a wider range of demographics within the Municipality and to reduce barriers in survey return. Although the question formatting varied slightly between the online and paper versions of the survey, the total number of questions asked of all respondents was 54.

Included with the surveys was a prepaid return envelope, again to minimize barriers to returning the survey and allow participants to complete it at no cost. Finally, a postcard was mailed out to all addresses at the mid-point of the consultation period to remind them of the importance of filling it out and to encourage a greater response rate.

2.2 Implementation & Timeline

Once the design phase was completed, MOC handled distribution and promotion of the survey. In total, 6,100 print surveys were sent via Canada Post's unaddressed neighborhood mailing to every address within the Municipality. The sealed survey booklet was sent along with a return envelope, each of which had a unique alpha-numeric code to avoid survey duplication when using Voices and Choices. At the mid-point of the consultation period, Canada Post's unaddressed mail-out was once again utilized to send out the reminder postcards to every address in the Municipality.

The consultation period lasted approximately eight weeks. Surveys were mailed at the beginning of April 2020 and the cut-off date for accepting returns was approximately June 5, 2020. This was not a hard date as both paper and online surveys were still accepted during the data entry phase, which was completed by both MOC and Coastal Action staff by the end of June 2020.

3.0 Results

3.1 Participant Demographics

At the conclusion of the survey period, a total of 1,220 surveys were completed by residents and businesses located within the Municipality of Chester. This is a 20% return rate of the total 6,100 copies of the survey that were mailed out. Responses were collected both through the return of hard copy surveys and the online survey platform. The paper questionnaires were then entered into the online platform by Municipal staff and Coastal Action staff for analysis.

Respondents from all seven Districts were represented in the survey analysis (Figure 3). Participants were asked in an open-ended question to identify their communities, which in turn, allowed for sorting into Districts. Over 40 communities in the Municipality were represented from each of the seven Districts. District Three is comprised, in part, by the most densely populated area in the Municipality, Chester Village, and was represented with the largest number of respondents (22.1%). This was followed by a relatively comparable number of participants from the remaining six Districts in the Municipality, with District Seven having the least number of respondents (Figure 3).

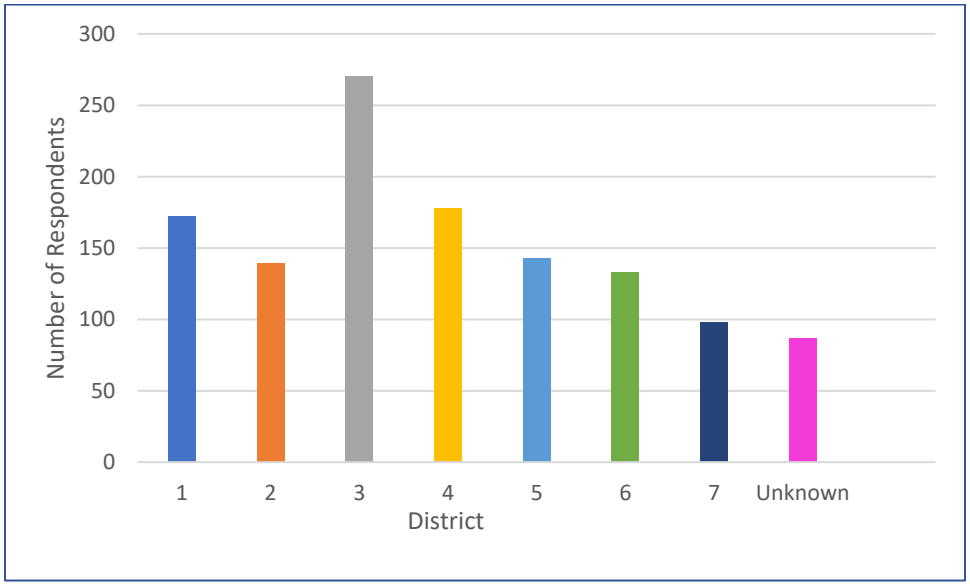

Figure 3. Number of survey participants from each of the seven Districts in the Municipality.

This questionnaire primarily captured responses from long-term and full-time residents of the Municipality. Of the 1,207 respondents who chose to answer, only 27 (2.2%) filled the survey out for a commercial property and the remaining 1,182 (97.8%) were residential. Eight hundred fifteen (87.4%) were full-time occupants of the Municipality, living and/or operating businesses on a year-round basis (Figure 4). Five hundred thirty respondents (55.0%) also indicated that they have been residents/business operators within the Municipality for 20 years or greater, with the remaining time categories split into residents who had lived in the Municipality for five years or less (15.7%), between six and ten years (11.4%) and 17.8% who had lived there for 11 to 20 years (Figure 5). Further demographic questions indicated most respondents were also homeowners (85.0%) as opposed to tenants, who occupied single family,

detached homes (91.6%). Other housing types included apartments (1.4%), mobile homes (2.4%), duplex's (1.6%), cottages, and townhomes.

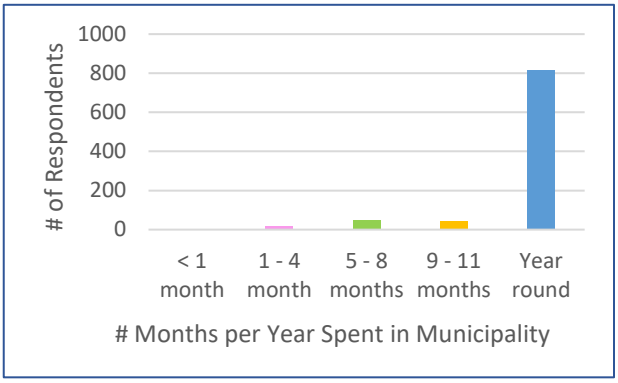

Figure 4. Number of respondents versus number of months per year lived in the Municipality.

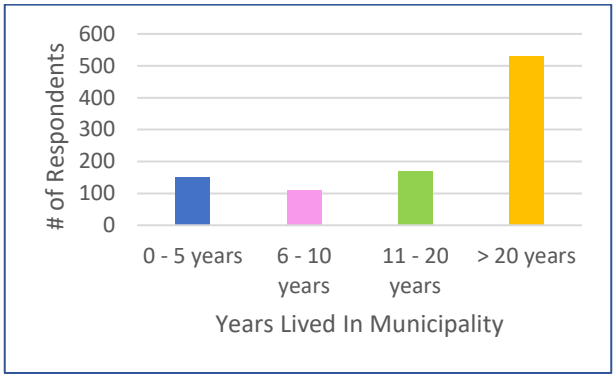

Figure 5. Number of respondents versus number of years lived in the Municipality.

3.2 Household Water Infrastructure

The certainty among respondents about the source of their drinking water was high, with the question receiving a 98% response rate. Of the respondents, only 0.5% answered that they did not know where their water came from. Most residents obtained their household water from either dug (49.6%) or drilled wells (47.5%). Other sources included cisterns, springs, surface water, brought from elsewhere, or did not know; however, these sources accounted for less than 1% each. The twelve "other" responses were coded and sorted into categories, all of which indicated a combination of two or more of the above water sources. Of those that indicated they have a well, 81.8% reported that they drink the water from it, with the remaining 18.2% stating they do not.

There was also a great deal of certainty among respondents regarding whether their drinking water was treated or not. The question received a 98% response rate, with only 1.1% of respondents answering that they did not know. The proportion of residents who treat their water (45.8% all household water; 5.9% drinking water only) was slightly larger than the proportion of residents who had no treatment installed (47.2%). However, this certainty changed when it came to identifying the type of treatment they used. Only 37% of participants responded to the question. The most common types of treatment used were ultraviolet light (31.3%), water softeners (30.7%), and reverse osmosis (14.6%). In the coded "other" responses (5.1%), several residents indicated that they used particle filters, bleached their water, boiled their water, or used iron filters (Figure 6).

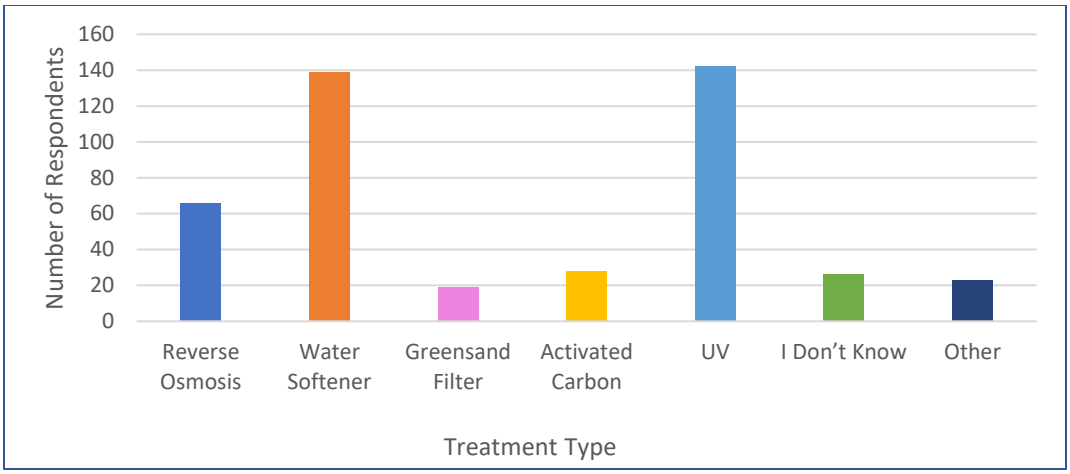

Figure 6. Type of water treatment systems used by residents.

Just over half of respondents (50.4%) maintained their own treatment systems, followed by 35.9% who employed a company and 8.0% that were maintained by a plumber. The remaining 5.7% of respondent's treatment systems were maintained primarily by friends, other members of the household, or property managers. The response rate for this question was higher (49.3%) than the previous question asking the type of treatment system (37%). This result is surprising due to the large proportion that indicated they maintained their own system but did not indicate the type that they had (Figure 7).

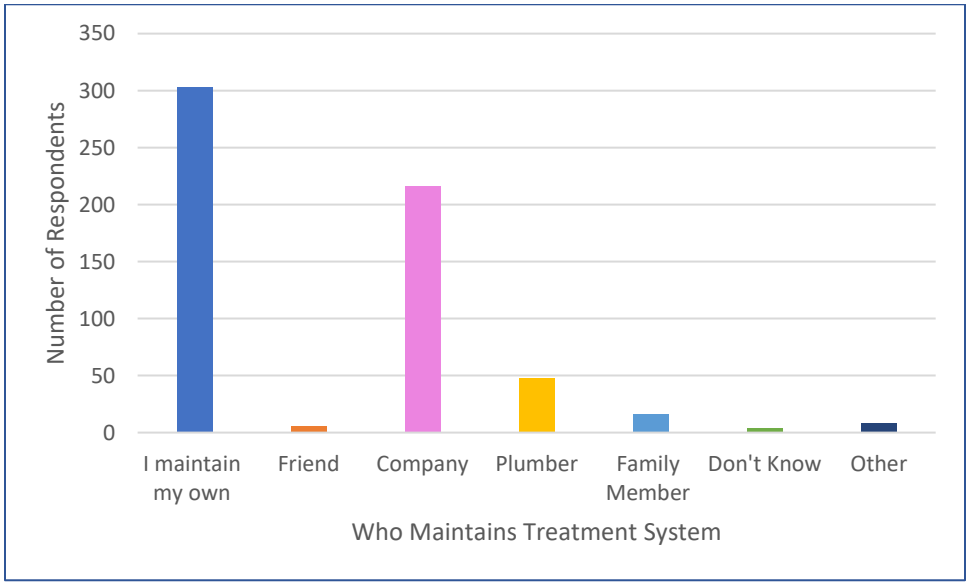

Figure 7. Party that most frequently maintains water treatment systems.

The annual cost of maintaining these systems was reported, with the largest proportion of respondents who had treatment systems installed (47.3%), paying between $100 - $299 annually and 28.9% paying between $1-$99. Very few (2.1%) paid over $1,000 and 9.4% stated that they did not pay anything (Figure 8).

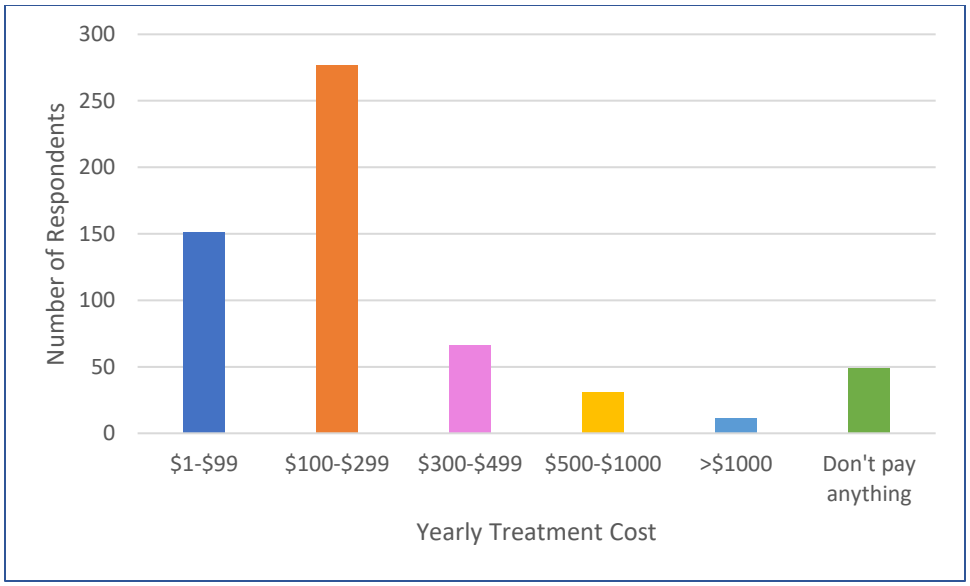

Figure 8. Annual cost of maintaining water treatment systems with purchase and installation costs omitted.

Participants were also asked to describe their septic systems, in which there was a large amount of certainty, again with a 98% response rate. The most common type of septic system is a holding tank and distribution field (71.0%) followed by central sewer (20.9%) and holding tank only (2.9%). Very few residents had cesspools, outhouses/composting toilets, or "other" such as peat and anaerobic composting systems. Several residents indicated they did not have septic systems; some were unsure of the type and some indicated within the "other" response section that they were on town systems (Figure 9).

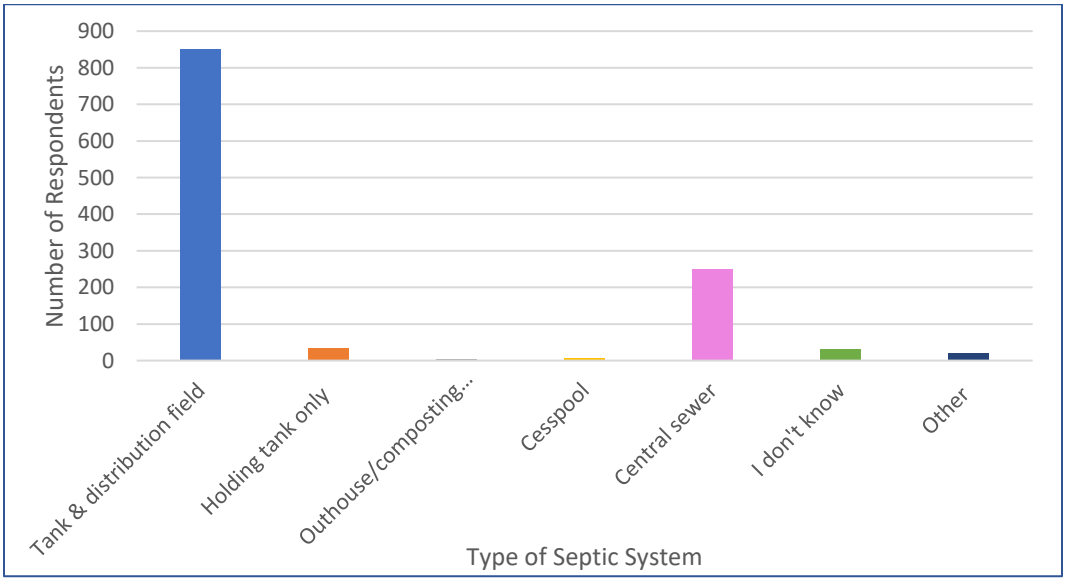

Figure 9. Most common types of septic systems survey respondents have.

Those with their own septic systems reported how frequently they are pumped. Most fell within the Nova Scotia provincial recommendations of every three to five years, with 38.4% stating they pumped their septic every one to three years and 31.4% getting it pumped every four to five years (Figure 10).

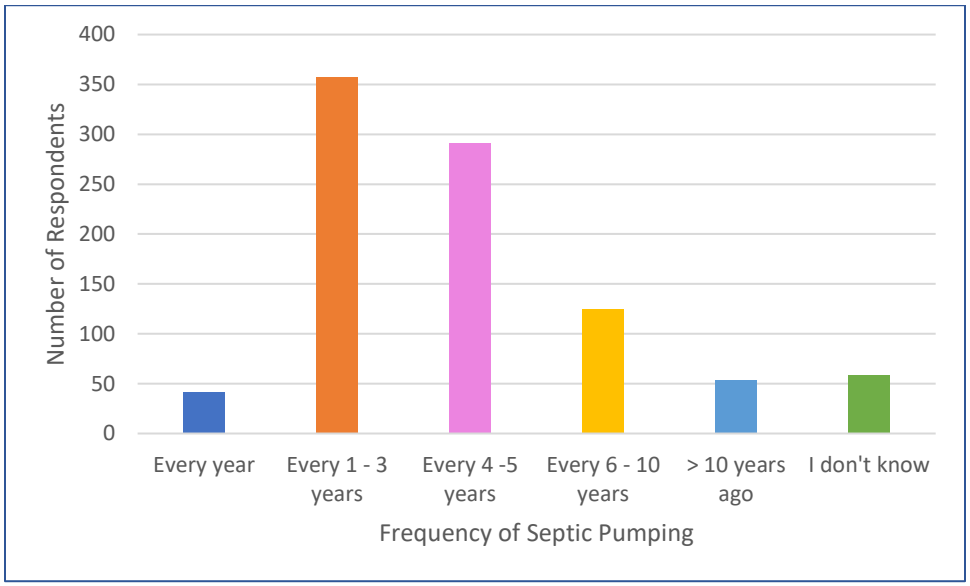

Figure 10. Frequency of septic pumping of respondents.

3.3 Public Perceptions

One of the primary objectives of the questionnaire was to examine public perceptions and knowledge levels pertaining to water quality, quantity, usage, and conservation. The survey began with three questions which were designed to be relatively simple to encourage higher overall response rates. They were Likert Scale questions which asked participants to rank their water quality and quantity from excellent (1) to very good (2), fair (3), poor (4), very poor (5), with a don't know (6) option. Overall, most respondents reported both their drinking water quality and quantity to be either very good or excellent. These questions had high response rates, with few participants skipping them. The median rank when examining participant's perceived water quality was 2 (very good) and the perception of quantity yielded a median value of 1 (excellent). Participants seemed to be very knowledgeable about the quality and quantity of their water sources, with only 4.8% and 2.45% respectively, answering that they did not know (Table 1). Respondents also indicated with a high degree of certainty that water issues were very important (72.8%) or important (13.8%) to them, with the question having a median value of 2 (very important).

Table 1. Analysis showing participant responses to Likert Scale questions asking about water quality, quantity, and importance of water issues in the Municipality.

Variable	Scale Range	Mean	Median	Standard Deviation	% Don't Know
Quality of Water	Excellent (1) to Very Poor (5)	2.60	2	1.88	4.84
Quantity of Water	Excellent (1) to Very Poor (5)	1.99	1	1.39	2.45
Importance of Water Issues	Very Important (1) to Not Important (5)	2.6	2	1.2	0.6

Participants were then asked to choose what they thought were the top three factors impacting both water quality and quantity from a list. The largest perceived impact to water quality in the Municipality was underlying geology, as 67.7% of respondents felt it was important. This was followed by residential development (51.2%), industry (28.4%), forestry (22.8%), recreation (23.1%), business (19.4%), other (19.3%), and mining and quarries (19.0%). Many threats to water quality were described, when "other" responses were coded and sorted, some of which fell into the above categories. The main "other" threats identified by residents included: farming, acid rain, climate change and drought, runoff from roads, poor septic and well design, surface water contamination, infilling of wetlands, and saltwater intrusion (Figure 11).

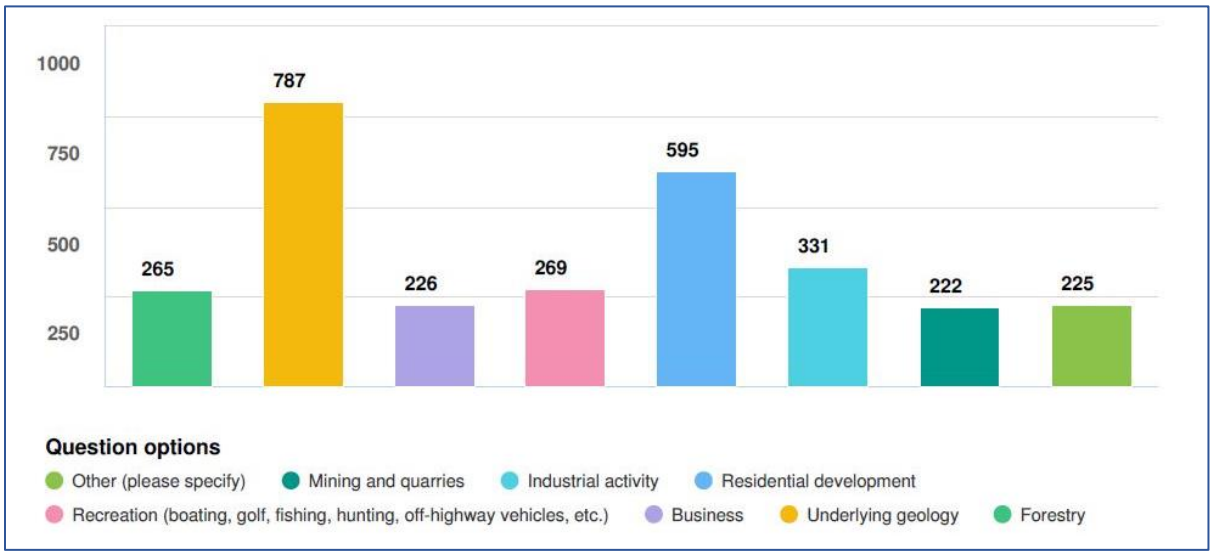

Figure 11. Participant opinions on the top three factors influencing water quality in their communities.

These threats were analyzed based on the District in which respondents live. The top three threats were ranked for each District (Table 2). Each of the seven Districts agreed that underlying geology was the top factor impacting water quality. All Districts, except for Five and Six, ranked residential development as

the number two concern. District Five listed recreation and District Six said forestry was the secondary factor impacting water quality. Finally, most areas listed industry as the third most important factor; however, business, mining and quarries, and "other" were also chosen.

Table 2. Percentages indicating respondents perceived primary (gold), secondary (green), and tertiary (grey) threats to water quality in each District. Percentages (including % skipped) sum to 300 as respondents could choose up to three options.

District	Geology (%)	Residential Development (%)	Industry (%)	Recreation (%)	Forestry (%)	Business (%)	Mining & Quarries (%)	Other (%)
1 n = 172	72.7	45.3	41.3	16.9	22.7	13.4	20.9	18.6
2 n = 139	63.3	54.7	31.7	30.2	24.5	10.8	14.4	15.8
3 n = 270	69.6	60.4	20.0	14.1	10.0	30.7	15.2	19.6
4 n = 178	61.2	46.1	35.4	19.7	23.0	19.1	27.0	14.6
5 n = 143	60.8	18.9	18.9	25.2	16.1	16.1	11.9	22.4
6 n = 133	65.4	33.1	18.0	39.1	48.1	8.3	16.5	21.8
7 n = 98	62.2	41.8	23.5	20.4	21.4	15.3	26.5	18.4
DK n = 87	48.3	48.3	28.7	19.5	18.4	25.3	13.8	14.9

The largest perceived impact to water quantity was drought (68.9%), followed by climate change (64.5%), household consumption (49.7%), residential development (41.3%), industrial activity (17.5%), other (12.1%) and agricultural irrigation (6.1%). The "other" responses were coded and sorted into categories such as land use changes, recreation, fish farms, tourism, and seasonal residents (Figure 12).

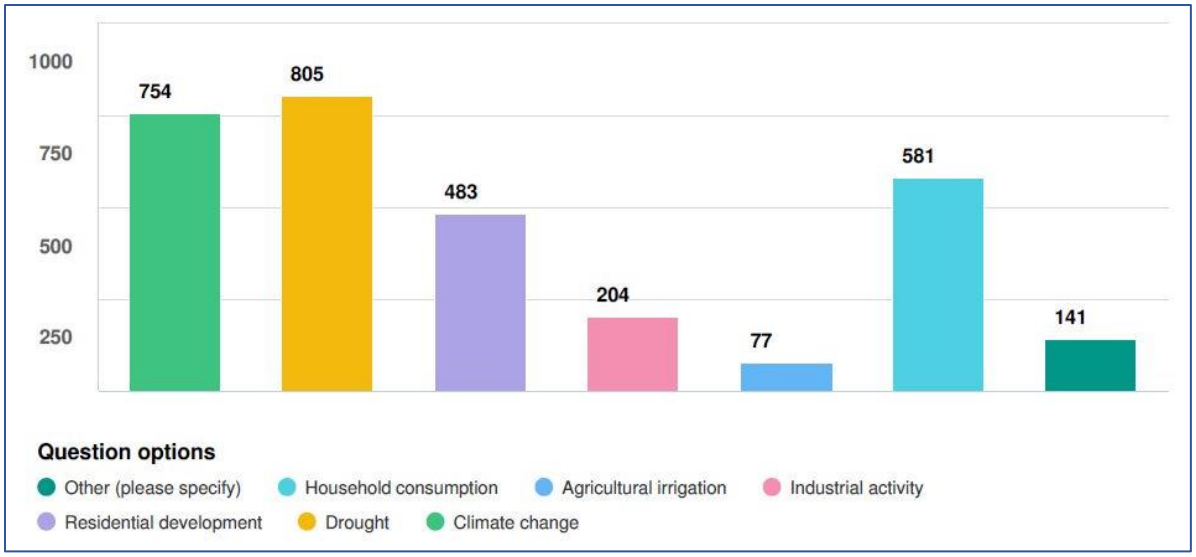

Figure 12. Participant opinions on the top three factors influencing water quantity in their communities.

Perceived threats to water quantity were also divided and examined based on District. There seemed to be a consensus across all of the Districts about the main water quantity threats. Climate change and drought were listed as the top concerns in each of the Districts, followed either by residential development or household consumption (Table 3).

Table 3. Percentages indicating respondents perceived primary (gold), secondary (green), and tertiary (grey) threats to water quantity in each District. Percentages (including % skipped) sum to 300 as respondents could choose up to three options.

District	Climate Change (%)	Drought (%)	Residential Develop-ment (%)	Industrial Activity (%)	Agricultural Irrigation (%)	Household Consump-tion (%)	Other (%)
1 n = 172	62.8	65.1	41.3	23.8	6.4	45.9	10.5
2 n = 139	54.1	64.0	48.2	17.3	5.8	50.4	7.91
3 n = 270	53.0	67.4	51.5	15.9	4.4	50.4	13.7
4 n = 178	68.0	73.0	35.4	20.8	6.2	46.1	7.3
5 n = 143	58.0	69.2	30.1	11.2	2.1	47.4	14.0
6 n = 133	70.7	63.9	27.1	10.5	13.5	47.4	1.6
7 n = 98	68.4	67.3	32.7	15.3	7.1	51.0	11.2
DK n = 87	51.7	48.3	36.8	16.1	8.0	39.1	11.5

In an open-ended question, participants were asked to identify freshwater bodies within the Municipality which they were concerned about with a brief explanation as to why. This question was skipped by 65% of survey participants. It is unclear if this was due to not having any concerns about freshwater bodies, or if it can be attributed to a general lack of knowledge about water quality and quantity in the area. Both statements are likely true as within the responses, 157 participants (12.9% of all survey participants) stated they were not concerned, or their answers were not applicable to freshwater bodies in the survey area. Twenty-six (2.1%) respondents also stated they did not have enough knowledge to answer the question. Seventy-three respondents (6.0%) provided general comments over concerns such as deforestation, road salt, development, sewage systems, algae blooms, and industrial runoff, but did not specify what systems they were concerned about.

The number of times each water body was mentioned was tallied. Water bodies of concern were then separated into three different categories: Low concern (1-7 mentions), medium (8-14 mentions) and high concern (>15 mentions). Stanford Lake, Gold River, and Fox Point Lake were rated as high concern. Sherbrooke Lake, East River Watershed, Bayswater Pond, Middle River, and Spectacle Lake were areas of medium concern (Figures 13 & 14). Over 40 freshwater bodies in total were mentioned in the responses to this question, including but not limited to: Millett Lake, Hutt Lake, Harris Lake, Martin's River, Dauphinees Mill Lake, Little Vaughn Lake, Goat Lake, Wallaback Lake and Lake Ramsay, which were all mentioned more than once.

The main concerns at Stanford Lake were varied, but included sedimentation, development, and pollution from infilling of wetlands, road salt, and garbage such as old cars in the lake. The concerns within the Gold River Watershed were mainly related to water acidity, lack of suitable fish habitat, and untreated sewage. Excess nutrients and declining water quality due to the new golf course and housing developments were the largest concerns surrounding Fox Point Lake.

Concerns on Sherbrooke Lake were primarily centered around algal blooms, and residential and park development. In the East River Watershed, the primary concerns were industries that use the water, pollution, and runoff from roads. At Bayswater Pond, many noted that the beach is often closed during the summer due to pollution and possible *E. coli* in the pond. In Middle River, residents were concerned about overdevelopment and a lack of riparian buffers, along with pollution and contaminants such as lead and arsenic. Finally, Spectacle Lake was listed as an area of concern, mainly due to its watershed area designation, along with development and recreational uses of the lake.

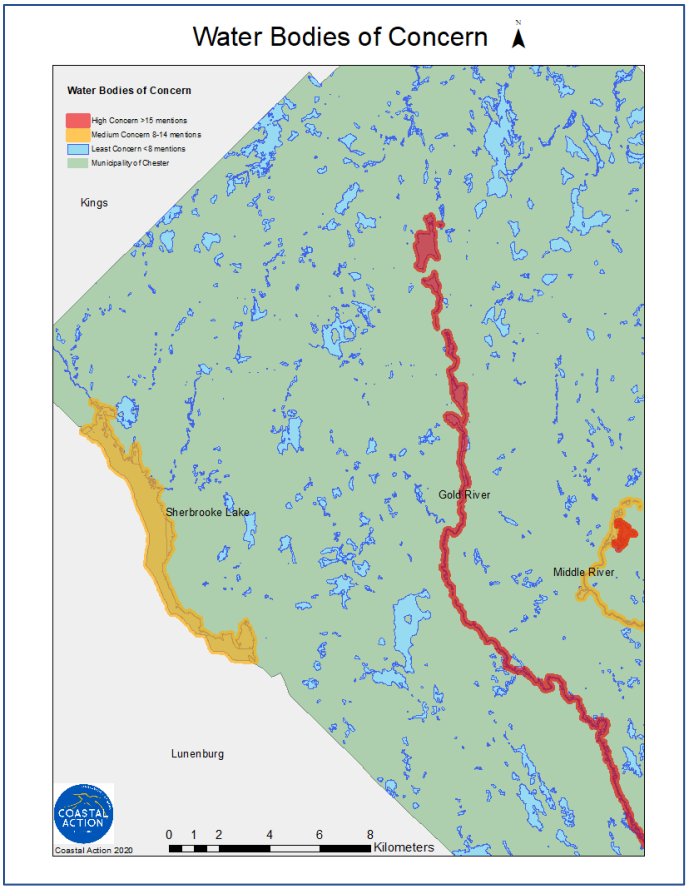

Figure 14. Map showing water bodies of medium and high concern in the Municipality; including Sherbrooke Lake (medium) Gold River (high) and Middle River (medium).

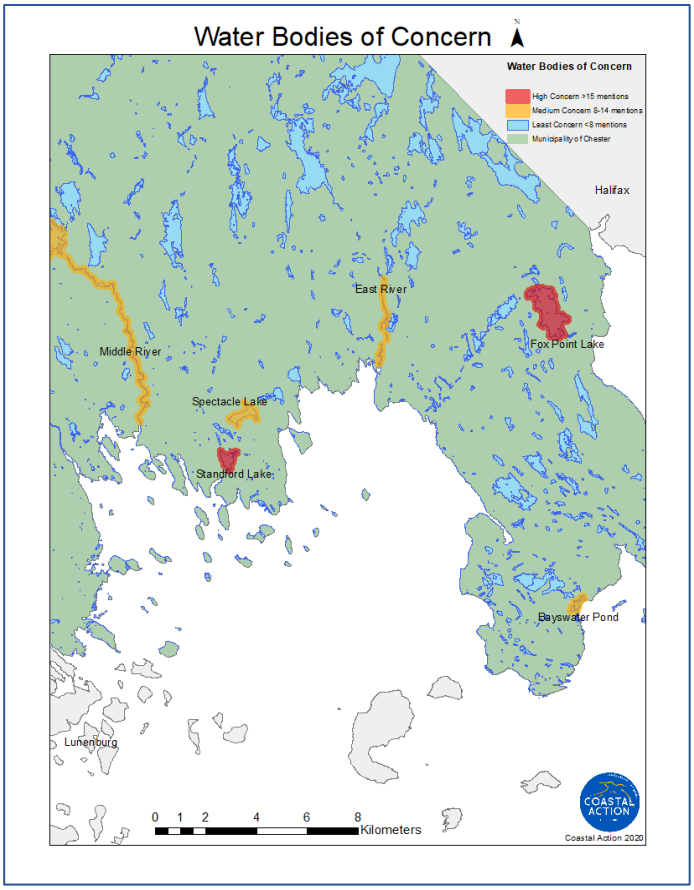

Figure 13. Map showing water bodies of medium and high concern in the Municipality; including Middle River (medium), Stanford Lake (high), Spectacle Lake (high), East River Watershed (medium), Fox Point Lake (high), and Bayswater Pond (medium).

3.4 Level of Concern

Participants were asked to choose the top three parties they viewed as most responsible for managing both water quality and quantity issues in their area. Out of the 1,143 participants who answered the question, the findings revealed that the top three parties were the Municipal Government (82.9%), the Provincial Government (74.5%), and citizens (54.9%). This was followed by the Federal Government, watershed groups, industry, First Nations Council, and 'other'. 'Other' responses were coded and tallied. Most responses fit into the above categories, with participants answering "myself", or listing a branch of government. Others did not know or said no one was responsible, and several indicated that homeowners specifically were responsible for water quality and quantity within the Municipality (Figure 15). The top three parties responsible did not vary by District.

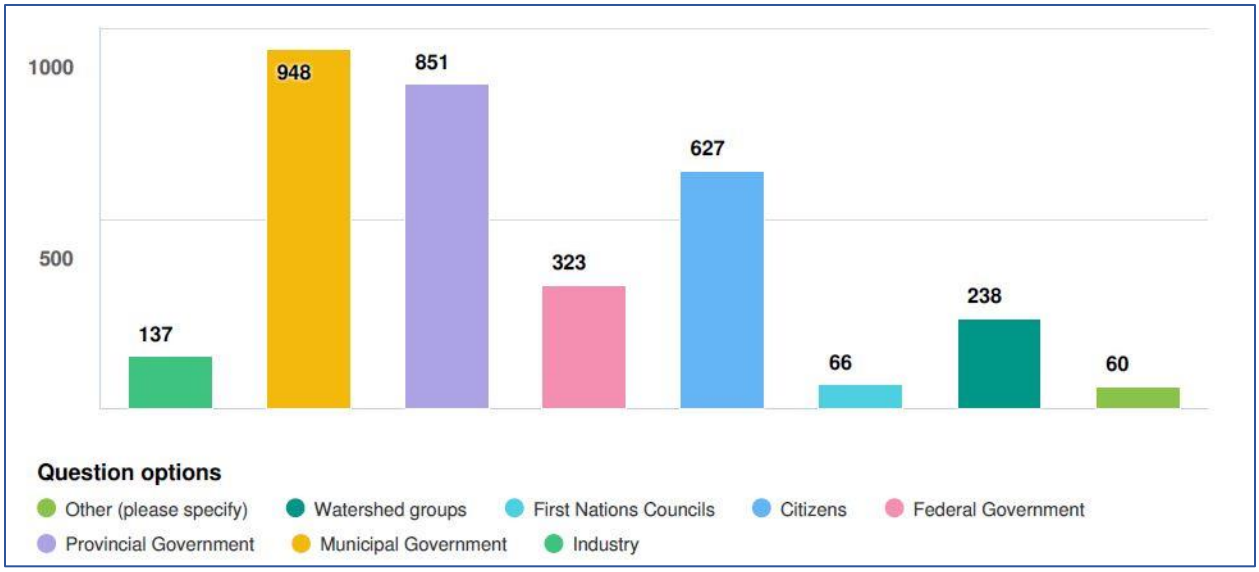

Figure 15. Parties most responsible for managing quality and quantity of water in the Municipality of Chester.

Following identification of responsible groups, participants were asked to rank each of the groups above on how well they fulfill their responsibility in managing water resources. Each party was ranked on a scale from poorly (1) to well (3) with a don't know (4) option. There was a great level of uncertainty among the rankings for all groups and large percentages of respondents skipped these questions or answered that they did not know (Table 4). The median rank for all the groups was two (adequate), possibly indicating that respondents did not have a strong opinion either way.

Table 4. Analysis showing participant views on how well each party fulfills their water managing responsibility on a survey wide scale. The median response in all cases was 2 (adequate).

	Scale Range	Mean Rank	Median	Standard Deviation	% Don't Know	% Skipped
Industry	Poorly (1) to Well (3)	1.63	2	0.66	53.5	20.8
Citizens	Poorly (1) to Well (3)	2.03	2	0.69	32.0	16.4
First Nation's Council	Poorly (1) to Well (3)	1.85	2	0.71	77.7	25.7
Municipal Government	Poorly (1) to Well (3)	1.79	2	0.68	34.0	14.7
Provincial Government	Poorly (1) to Well (3)	1.70	2	0.67	40.7	14.1
Federal Government	Poorly (1) to Well (3)	1.63	2	0.65	54.2	18.3
Watershed Groups	Poorly (1) to well (3)	2.17	2	0.73	64.1	22.9

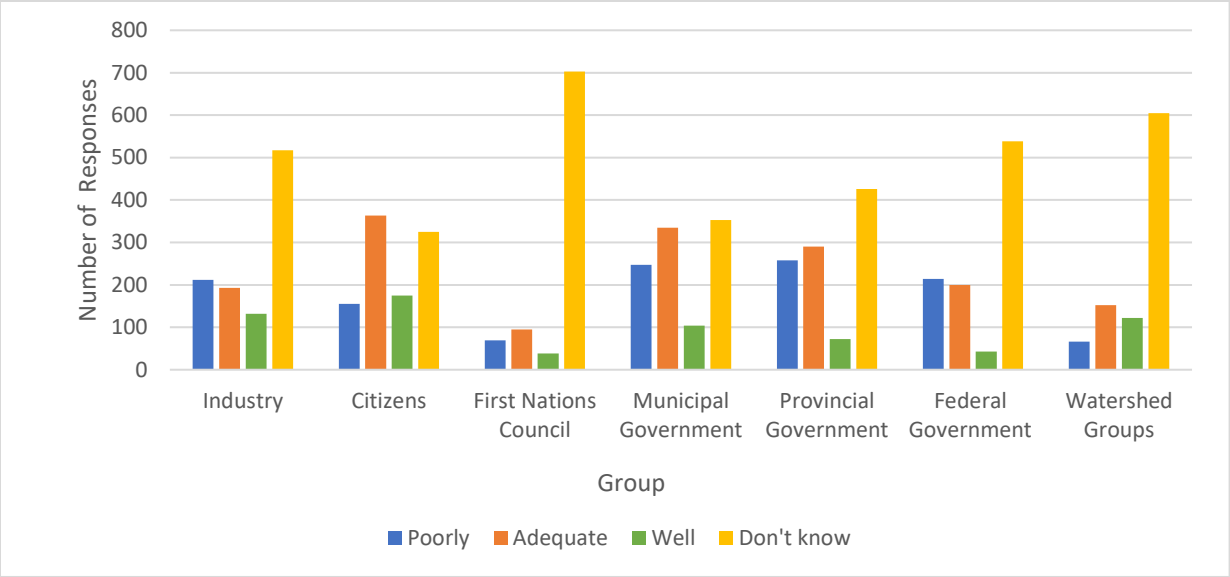

Figure 16. Graphical representation of respondent's views on performance of each party managing water resources.

Views on how well each group fulfills their water quality roles was broken down and examined by District. A Kruskal-Wallis test was performed to compare views on how well the Municipality performs across each District using an alpha of 0.05, which found there is a significant difference in views between the Districts (p=1.52e-08). Post hoc testing was completed with a Dunn test and Bonferroni correction, which showed that the differences lie between District Three and One, Two, Four, Five and Six (p=4.03e-6, p=1.94e-6, p=3.11e-4, p=1.04e-5, p=3.82e-4). Although the median value for each District is two (adequate), Figure 17 shows that District Three has a much larger proportion of respondents who rated the Municipality's performance as 1 (poor).

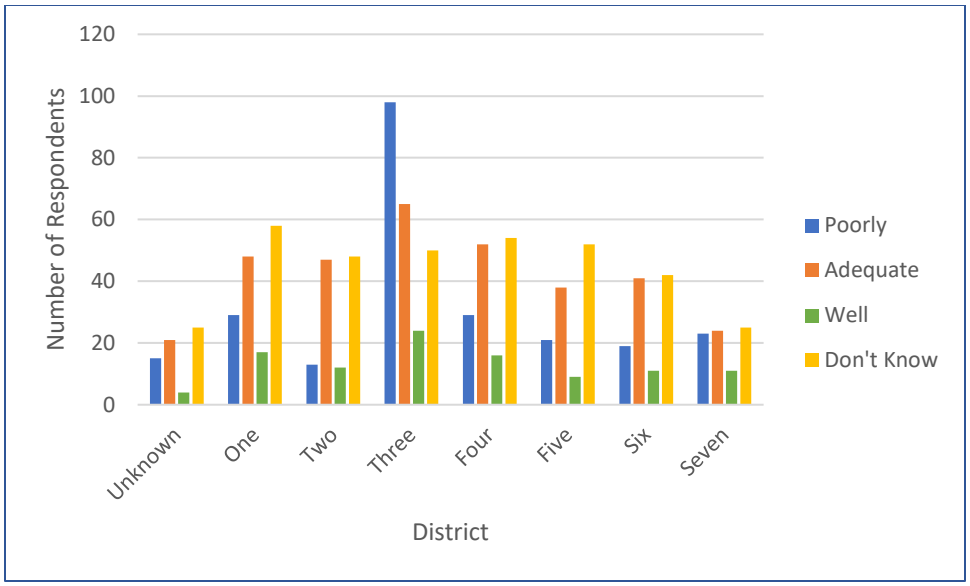

Figure 17. Each District's perception of the Municipal Government's performance managing water quality and quantity.

The performance of the Provincial Government was also examined using a Kruskal-Wallis test. Again, there was a significant difference detected between the Districts (p=0.016). Post hoc testing with a Dunn test and Bonferroni correction indicated that the only place this difference in views was significant was between District One and District Three (p=0.034). District One had a relatively high proportion of respondents rating the Provincial Government's performance as adequate (2), as compared to District Three, which predominantly rated their performance poorly (1). Across all Districts, a ranking of three or "well" was the least chosen option (Figure 18).

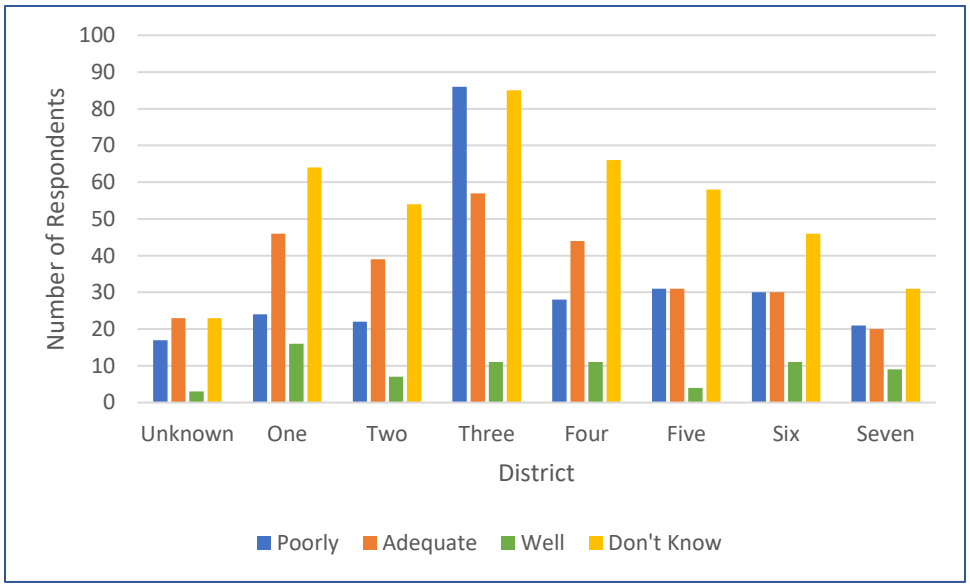

Figure 18. Each District's perception of the Provincial Government's performance managing water quality and quantity.

Finally, the third group that was compared across the Districts was citizens, as they were ranked as third-most responsible overall for managing water within the Municipality. A Kruskal-Wallis test was used for comparison purposes. Again, there was a significant difference detected between the Districts (p=0.01).

Post hoc testing with a Dunn test and Bonferroni correction indicated that the differences were between District Two and Three (p=0.027) and Three and Four (p=0.04). The most common ranking provided by District Three respondents was adequate (2). Both Districts Two and Four had large proportions of respondents agree that citizens fulfill their responsibility adequately; however, there was less certainty, with more don't know (4) responses (Figure 19).

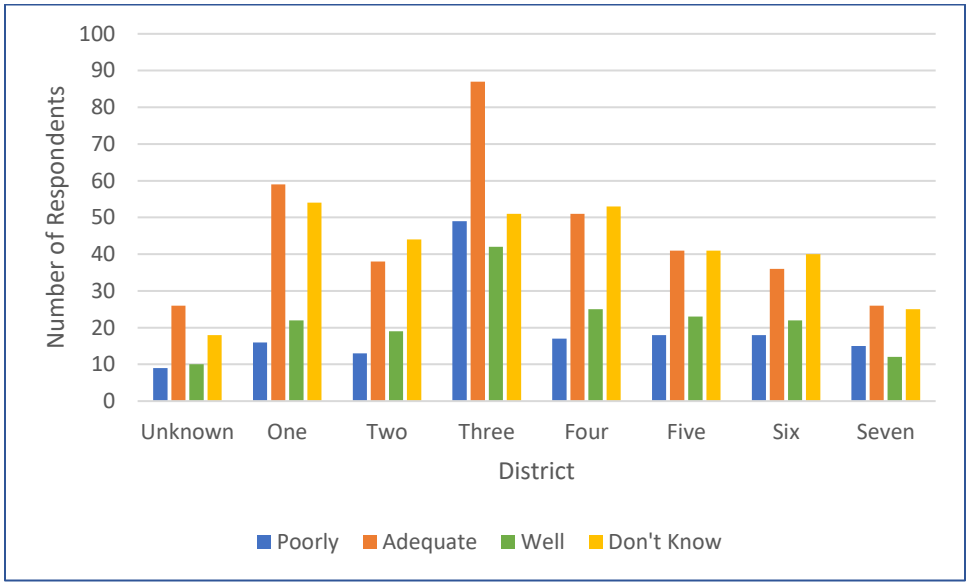

Figure 19. Each District's perception of citizen's performance managing water quality and quantity.

3.5 Water Conservation & Healthy Water Practices

Coastal Action was provided with the Municipality of Chester's Dry Well Inventory which has tracked reports of wells with water shortages since 2016. These wells are catalogued with resident's addresses, associated community, year, and type of well. These data were then compared against the results of dry well reports in the questionnaire. In total, 1,193 participants answered the question about their water quantity, of which, 347 (29.1%) indicated they had experienced a water shortage at their current residence. Two-hundred seventy of these shortages have taken place since 2014. Of those, only 42 (15.6%) had reported the shortages to the Municipal Dry Well Inventory (Table 5). Water shortages in the survey were compiled from 2014 onward and the Dry Well Inventory began in 2016.

The percentage of drilled wells that had shortages were also much larger in reports from the survey as opposed to the inventory. A Two Proportions z test was completed and found that there was a highly significant difference between the number of drilled wells reported to the survey versus reported to the inventory ($p = 0.0008$) at a 95% confidence interval.

Table 5. Comparison of well number and well type with shortages reported to the Municipal Dry Well Inventory versus the survey after 2014.

	# Wells reported after 2014	# Wells reported to survey and inventory	# Wells not reported to inventory	Drilled wells (%)	Dug wells (%)	Other water sources (%)
Survey	270	42	228	26.6	69.6	3.7
Dry Well Inventory	252	42	-	6.0	91.7	2.4

Participants were asked to indicate when water shortages occurred. Of the respondents who had shortages, 14.5% indicated they took place over more than one of the time periods, meaning they persisted over multiple years. In addition to this, the highest occurrences of water shortages (43.9%) took place between 2017 and 2019. Unsurprisingly, most wells went dry during the summer season (85.7%), although nearly 20% of respondents reported shortages over one or more seasons of the year and 2% reported year-round shortages (Figure 20).

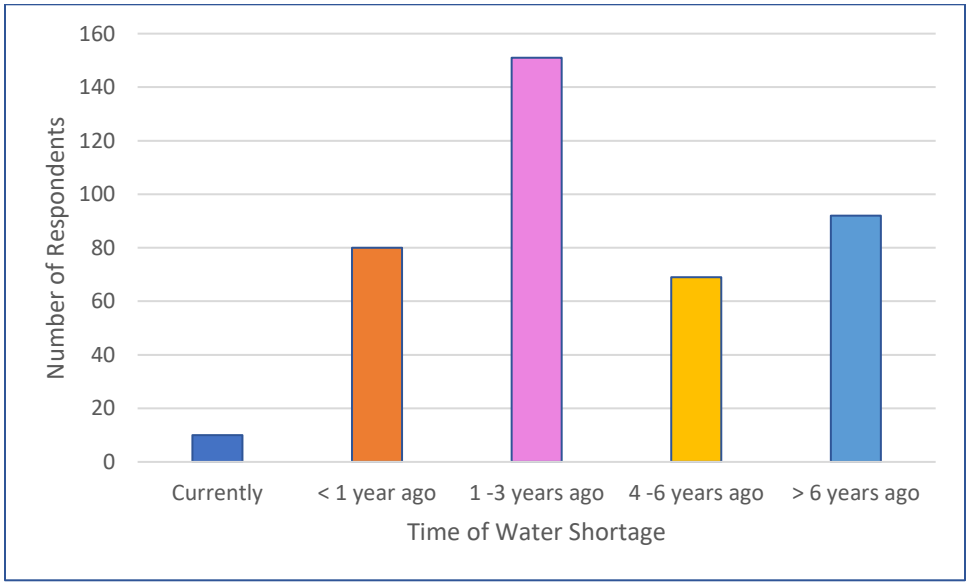

Figure 20. Occurrences of water shortages in the Municipality.

Reported water shortages in the survey (after 2014) and inventory were separated into communities and mapped based on the number reported (Figures 21 & 22). For both the inventory and survey, Chester and Chester Basin have high frequencies (>26) of dry wells reported, and the inventory reported Western Shore in this high frequency category as well. In the medium frequency category (11-25 reports), the inventory identifies the communities of Marriott's Cove and Gold River. The survey includes these communities and in addition reports New Ross and East Chester as also falling into the medium category. Communities reporting low frequencies (1-10 reports) include Forties, New Ross, Beech Hill, Chester Grant, Windsor Road, East River, East Chester, East River Point, Simms Settlement, Fox Point, Hubbards,

Mill Cove, Aspotogan, and Blandford. The survey includes all of these communities with the exception of Beech Hill and East River Point, while also identifying new reports from Bayswater, Northwest Cove, Martins River and Martins Point, which were not included in the inventory data.

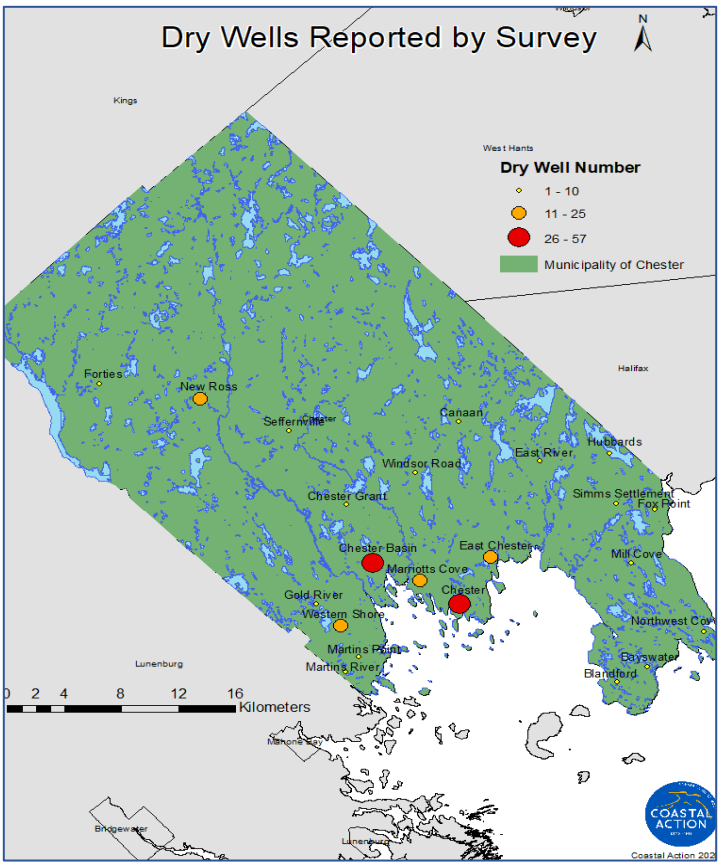

Figure 21. Map of the Municipality showing location and number of water shortages reported to the water survey since 2014.

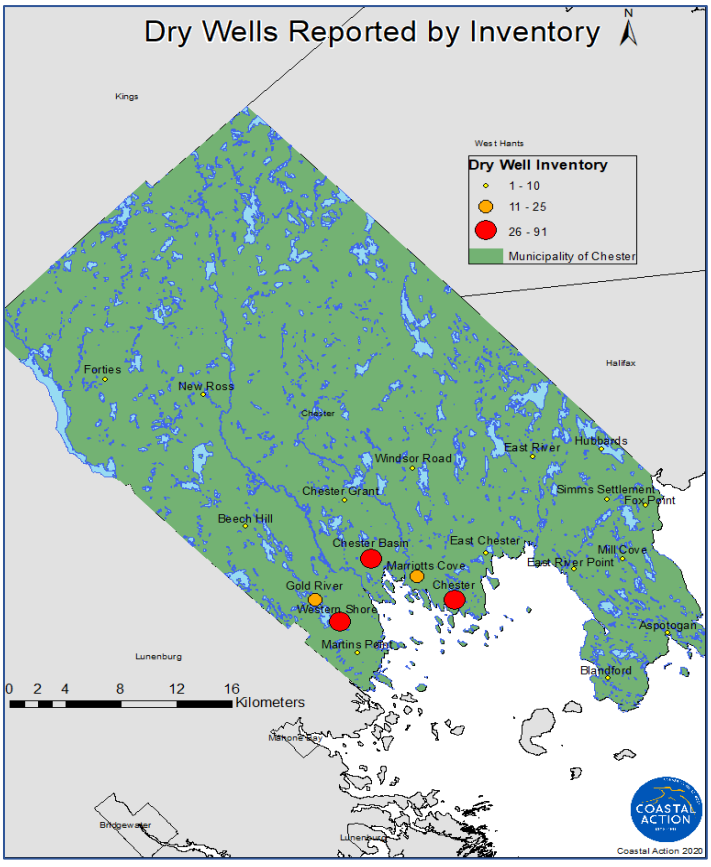

Figure 22. Map of the Municipality showing location and number of water shortages reported to the Dry Well Inventory since 2016.

Survey participants were asked if and how often they tested their water, both for bacterial and chemical contamination. Most residents (66.6%) answered "yes" they do test their water for bacteria, where 33.4% said they do not. Approximately half tested for bacteria every 13 months to five years (45.6%), with 19.8% and 18.8% testing every six to 14 months and every six to 10 years, respectively. Few participants met the recommended Nova Scotia guideline for bacteria testing every six months (4.3%). Likewise, a minority of respondents (11.5%) tested their water more than 10 years ago (Figure 23). The response rate for both questions was high, with very few participants skipping them.

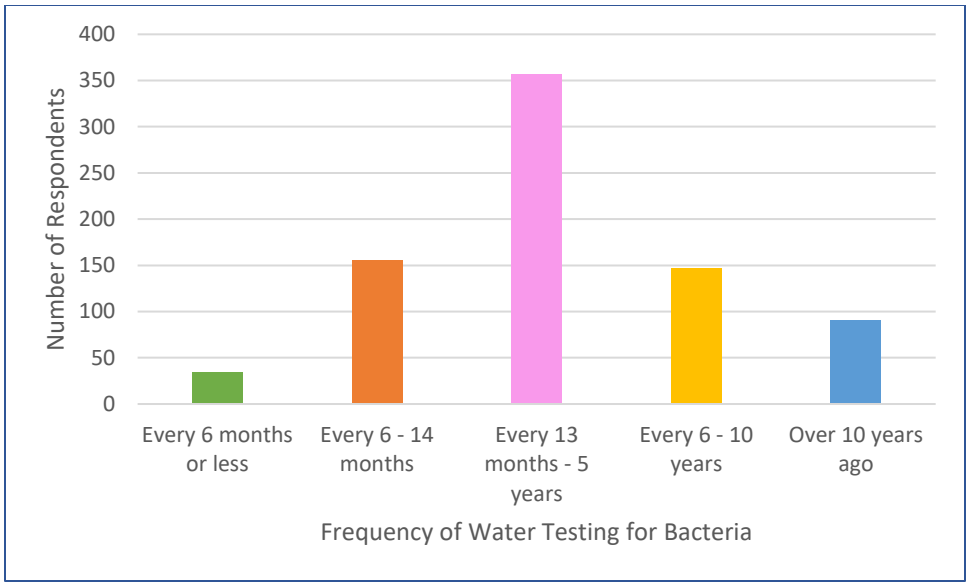

Figure 23. Frequency of water supply testing for bacteria (fecal coliforms and E. Coli) among 66% of participants who indicated they test their water for bacteria.

Chemicals such as arsenic, uranium, lead, nitrate, nitrite, and fluoride were tested for on a much smaller scale than bacteria. Just over half of respondents said they tested for chemicals, whereas the remaining 49.2% did not. This is also representative of most survey participants, as only 2.7% of the overall respondents skipped this question. The most common frequency of chemical testing was every 25 months to five years (37.8%) followed by every 12- 24 months (27.4%). Nineteen percent and 15.8% tested their water every six to 10 years and over 10 years ago, respectively (Figure 24).

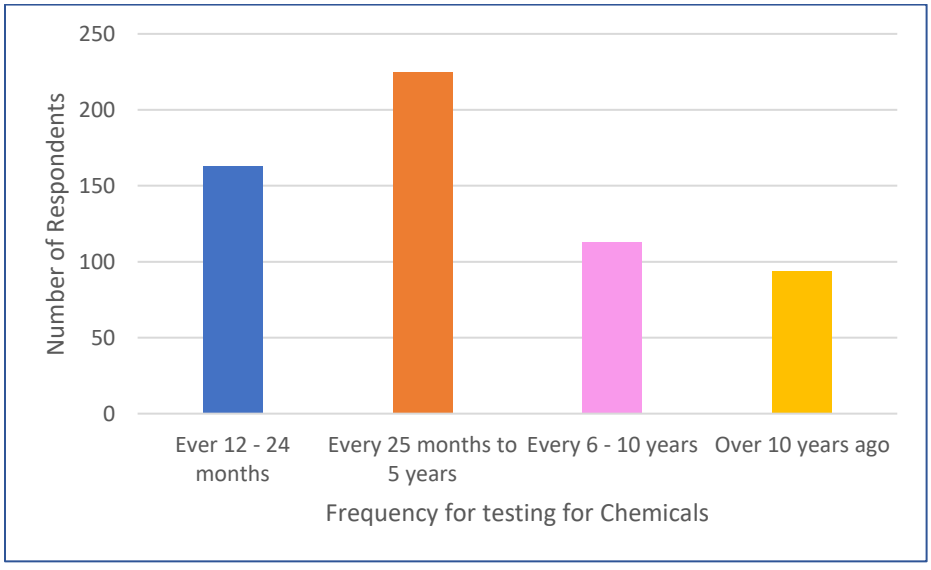

Figure 24. Frequency of water supply testing for common chemicals (arsenic, uranium, lead, nitrate, nitrite, and fluoride) among just over 50% of participants who indicated they test their water for chemicals.

Percentages of respondents who do not test their water, or test it infrequently (regular testing occurring only every six years or less) were compiled and examined on the District level, which shows larger percentages of respondents that do not test their water regularly for bacteria or chemicals across all Districts (Table 6). Percentages of absent and infrequent testing for bacteria ranged from 43.7% in District Three to 62.4% in District Six, with all others falling in between. Percentages of absent and infrequent testing for chemicals were higher, ranging from 56.7% in District Three to 76.7% in District Six. In both cases, District Six has the highest rates of infrequent testing and Districts Three, Two, and One have the lowest. In almost every case, less than 50% of respondents in each District are meeting provincial recommendations for bacterial and chemical testing.

Table 6. Proportions of absent (respondents that indicated they do not test) and infrequent (testing every six years or less) resident water testing based on District.

District	Absent and infrequent bacteria testing (%)	Absent and infrequent chemical testing (%)
One	50.6	66.8
Two	52.5	59.0
Three	43.7	56.7
Four	55.1	68.5
Five	52.4	67.1
Six	62.4	76.7
Seven	53.1	69.4
Unknown	56.3	62.1

Barriers to testing were examined for those respondents that indicated they did not test their water for chemicals and/or bacteria. Nearly 500 respondents listed barriers, along with factors that would make them consider testing their water. Participants were invited to select all answers that apply and the most common reason why they did not test their water was that they did not feel they had to (38.3%). This was followed by the expense of water testing (33.6%), and other reasons (20.8%). The “other” responses were quite varied, but included barriers such as: water was tested when home was purchased; landlord’s responsibility; water is treated; water is not consumed; have never gotten sick from drinking water; the water seems fine; haven’t thought of it; don’t know what to do with a poor result; and can’t get samples to the lab. Following these responses was respondents not wanting to know what is in their water (18.5%) and not knowing what to test for (18.5%) (Figure 25).

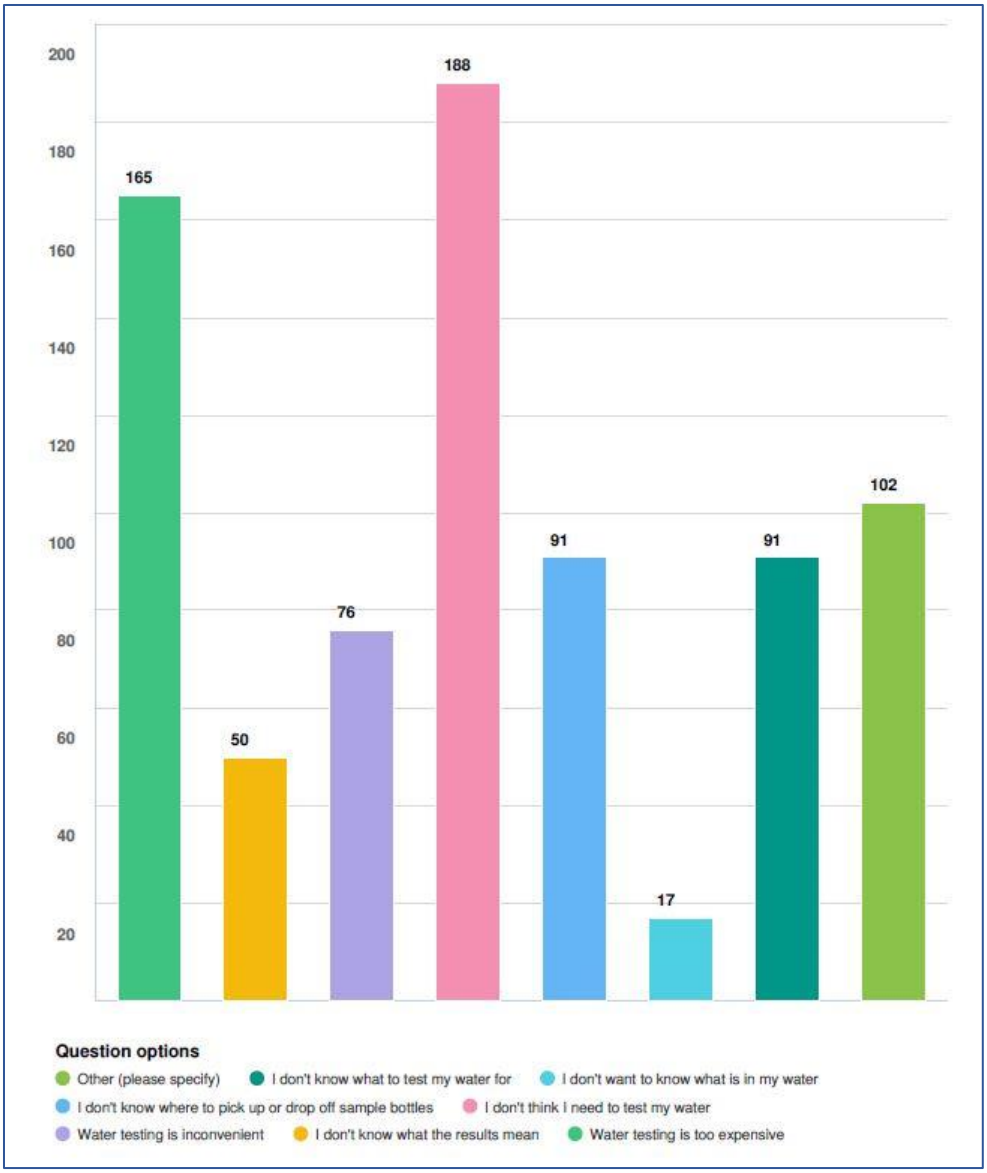

Figure 25. Most common barriers for water testing reported in terms of the number of respondents who indicated they did not test their water for bacteria and/or chemicals.

When asked what would make respondents willing to test their water, very few indicated that they would not be willing to do it at all. Many cited that they would be willing to test their water if it were cheaper (44.1%), easier (23.6%), if they knew where to bring sample bottles (27.9%), and if they knew what to test for (25.7%) (Figure 26). The "other" responses (18.5%) to this question were also quite varied but the most common included: if testing was free; if water was consumed; if treatment was cheaper; if someone got sick; if a problem was suspected; if it was promoted by the Municipality; and if something changed the quality.

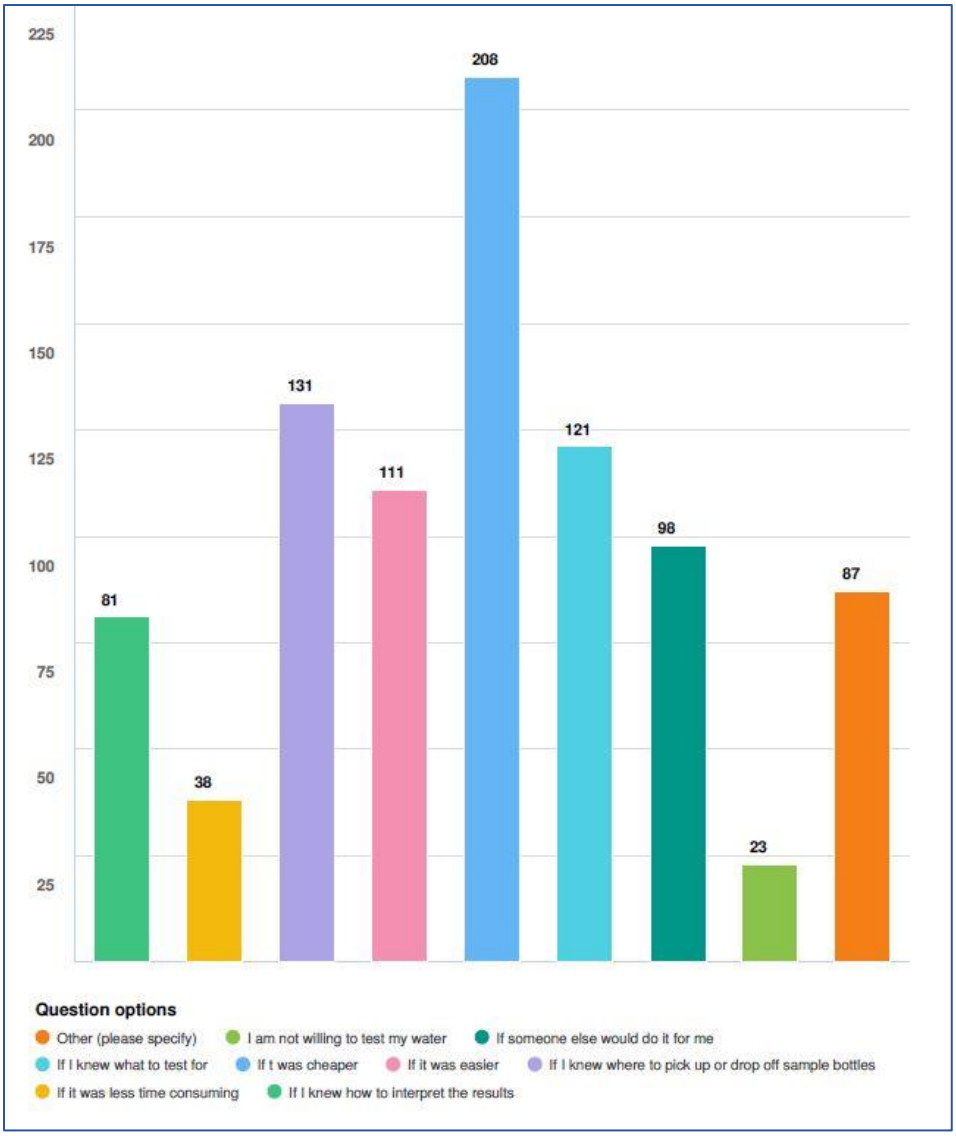

Figure 26. Breakdown of ways to remove barriers to water testing, reported by respondents who indicated they did not test their water.

Following the question about water testing, respondents were asked about known water quality issues they have at their residence/business. This question had an extremely high rate of response, with only 20 participants skipping it and 9% indicating that they did not know. Most respondents answered "no" (58.4%), with the remaining 32.5% indicating that they did have water quality issues. Participants were asked about aesthetic aspects to water quality (taste, odour, sediment, staining, and cloudiness); bacteria (*E. coli* and coliform); chemical contaminants (uranium and arsenic) and saltwater intrusion. Three-hundred eighty-six respondents reported on their known water quality issues. The most common issue reported was staining (36.5%) followed by "other" issues (36.5%). These were coded and sorted into categories. The most common other responses were lead, manganese, and hard water (high mineral content). Bacterial coliform presence was also reported by 21.7% of respondents along with other aesthetic parameters such as odour (27.7%), sediment (20.2%), and bad taste (20.2%) (Figure 27). Uranium, *E. coli*, and saltwater intrusion were reported less frequently than all other issues.

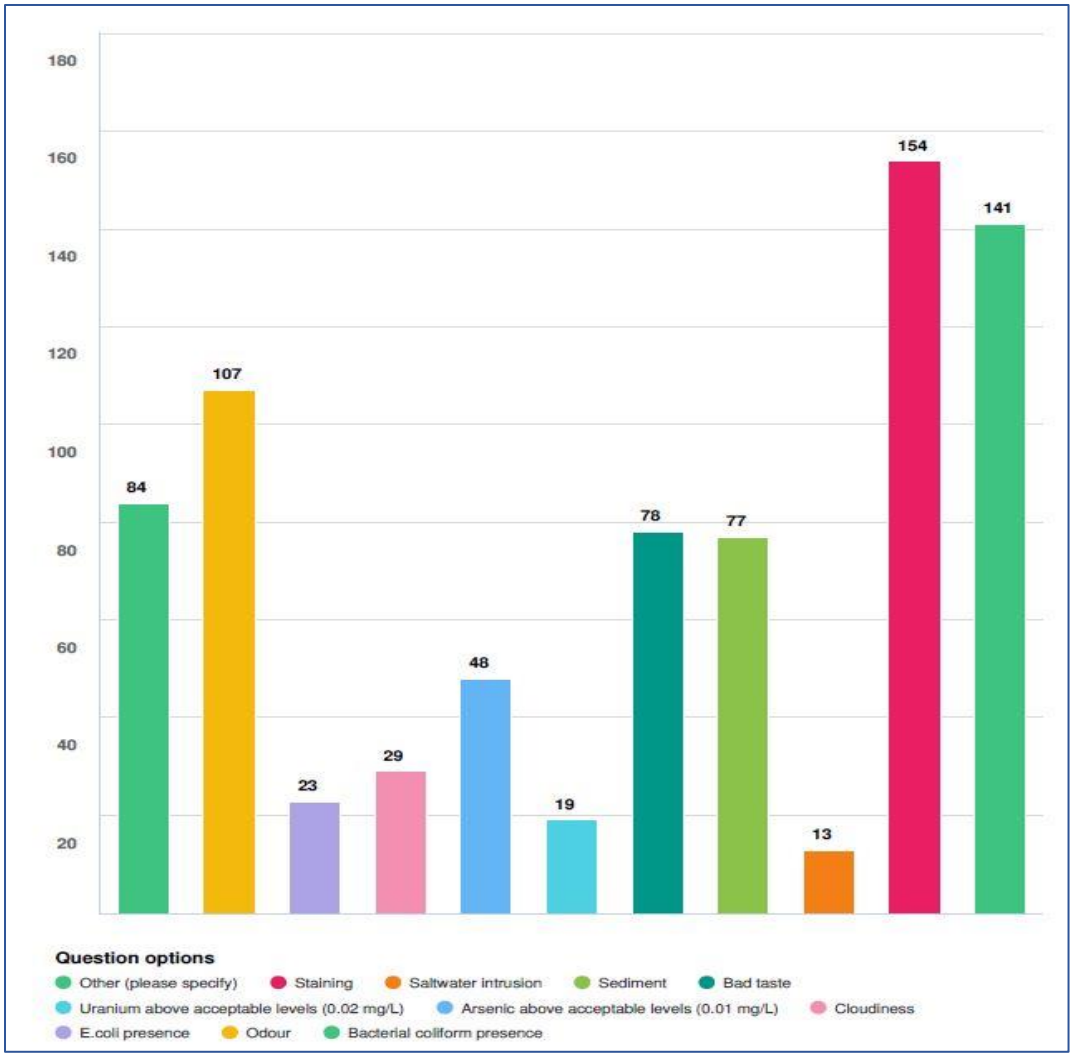

Figure 27. Known water quality issues reported by survey respondents.

The type of issue was assessed at the community level and mapped. All issues, except for aesthetic parameters, were included, along with the main and most important concerns revealed through the "other" category. These were: lead, manganese, and hard water (high mineral content). All reported issues were sorted into four frequency categories; low (1-3 reports), medium (4-6 reports), high (7-9 reports), and very high (>10 reports) and mapped by community.

Most known water quality problems were reported along coastal communities, with no reports in communities within District Six. The Village of Chester reported on all nine of the issues, with bacterial coliform presence and iron in the very high category. *E. coli* reports were high; and arsenic, hard water, and saltwater intrusion were reported with medium frequency in Chester Village. Coliform and arsenic were reported with high frequency in Chester Basin, along with *E. coli* presence and iron in the medium category with a few other issues in the low category. Western Shore had high frequencies of iron and low reports of both types of bacteria. East Chester had medium reports of coliform, arsenic and iron and low reports of saltwater intrusion. Simms Settlement reported arsenic with a high frequency along with low frequencies of iron, uranium, bacterial coliform, and hard water. The other communities of Martins River,

Martins Point, Gold River, Chester Grant, Marriott's Cove, Windsor Road, Canaan, East River, Hubbards, Fox Point, Mill Cove, Deep Cove, The Lodge, Northwest Cove, Aspotogan, Bayswater, and Blandford all reported various issues on the low to medium frequency scale (Figure 28).

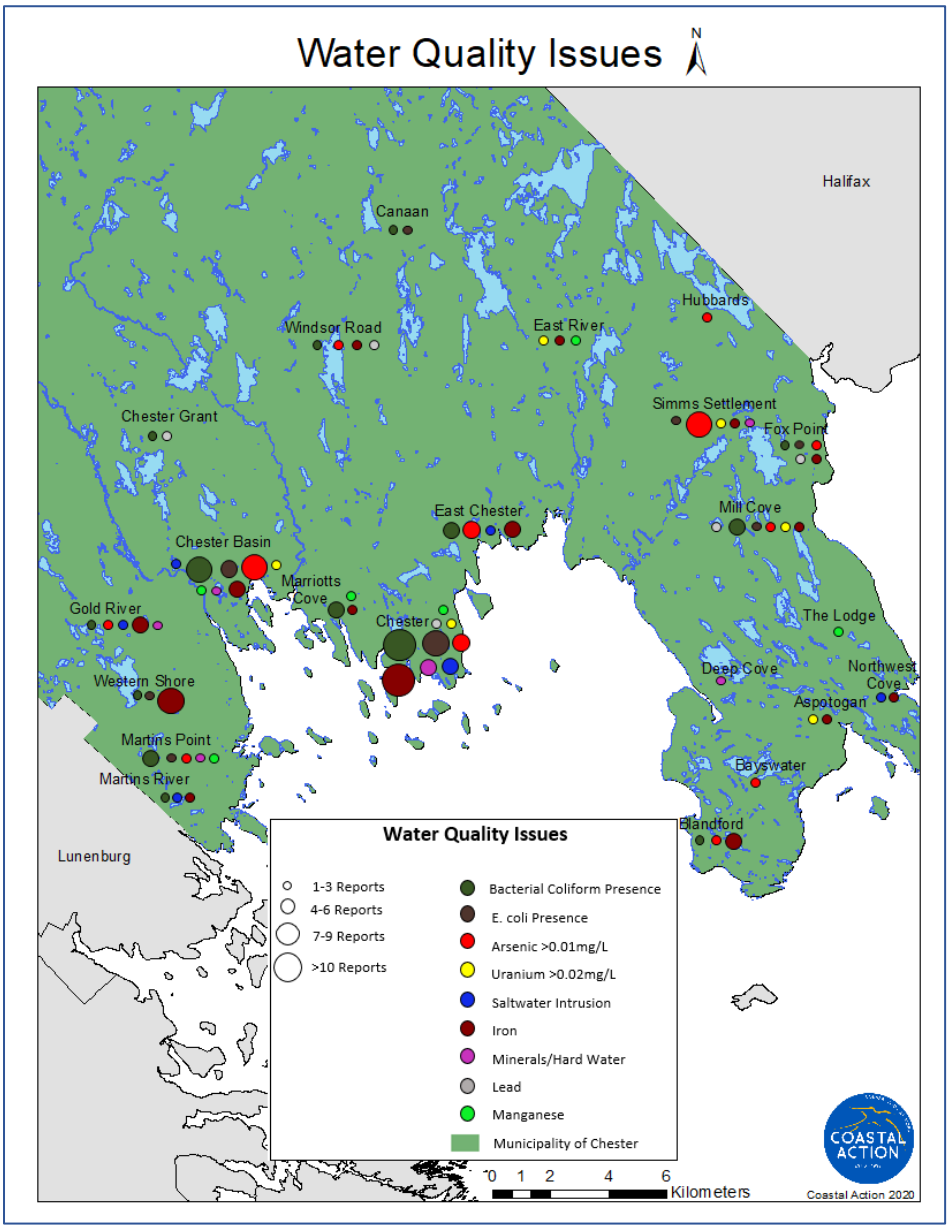

Figure 28. Map showing the type, frequency, and location of known water quality issues as reported by survey participants. Aesthetic parameters were omitted in favor of mapping only issues of higher concern.

When asked if they practiced water conservation measures, only 20 participants skipped the question. Of those that did answer, 84.4% of respondents said yes, they do practice some method of water conservation in the home. Conversely, 15.6% of respondents answered that they do not. Respondents

that answered "yes" were able to select all the water conservation practices that applied to them. Water conservation methods varied widely, with the most common practice being general water conscientious actions (82.0%). These included: short showers; turning water off when it is not in use; and refraining from watering the lawn. Fixing water leaks when they occur was the next most common action (80.3%). These were followed by the use of low-flow devices such as low-flow shower heads (69.2%) and low-flow taps/aerators (52.5%). Less commonly used were water-reducing appliances such as front-loading washers (39.5%), efficient dishwashers (38.8%), and dual flush toilets (31.7%). Finally, other practices used were rain barrels (33.8%), water collection to reuse (7.4%) and other (7.1%) (Figure 29). "Other" responses were sorted into categories and coded, with most of the responses already falling under above actions such as use of rain barrels and cisterns, efficient appliances, collection for reuse, and general conscientious actions. Responses that did not apply to the above categories included: intermittent toilet flushing, absence of appliances that use water, good gardening practices, shared baths, good laundry practices, and a small portion which were not considered water saving measures.

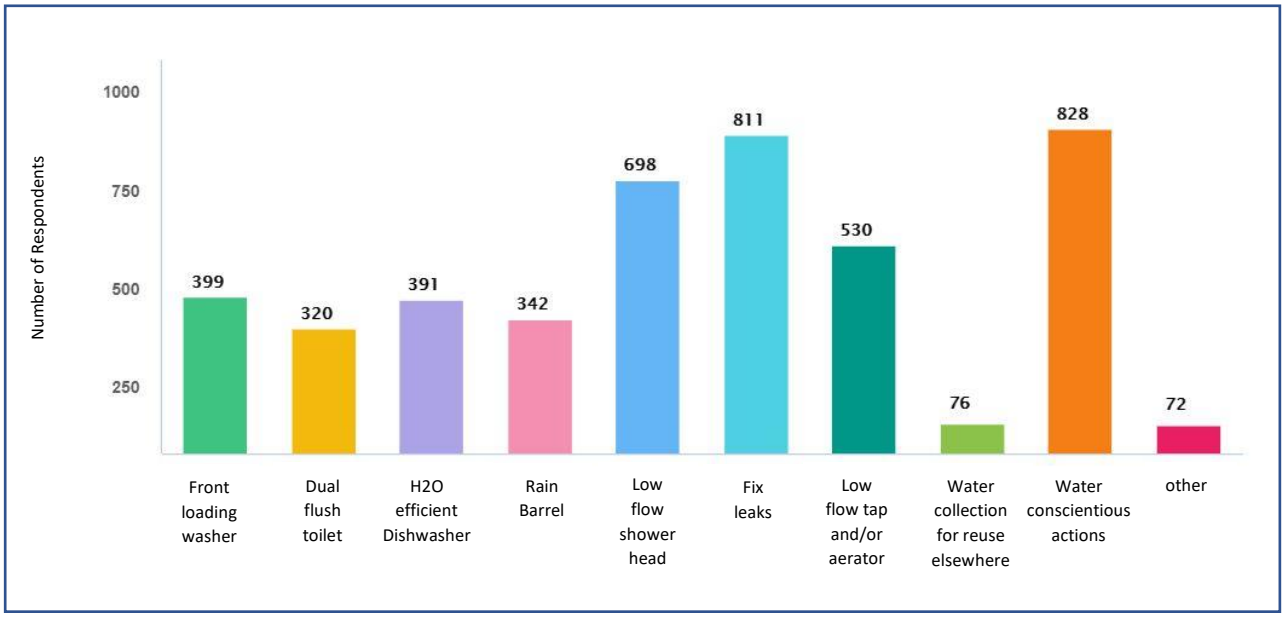

Figure 29. Most common water conservation practices used by survey participants.

3.6 Barriers to Conservation

If participants selected "no" they do not practice water conservation measures, they were asked why. One-hundred sixty-five participants answered the question, which is only 14.7% of overall survey participants. The largest response was "other" (36.3%) with most people not conserving water because they had ample supply, or they did not think it was necessary. Other views expressed were that respondents were renters, they did not use much water, and that low-flow devices and appliances do not work. The main barriers following the "other" category included respondents who have never considered implementing conservation practices (35.8%) and 29.0% who do not feel as if conservation is a priority (Figure 30).

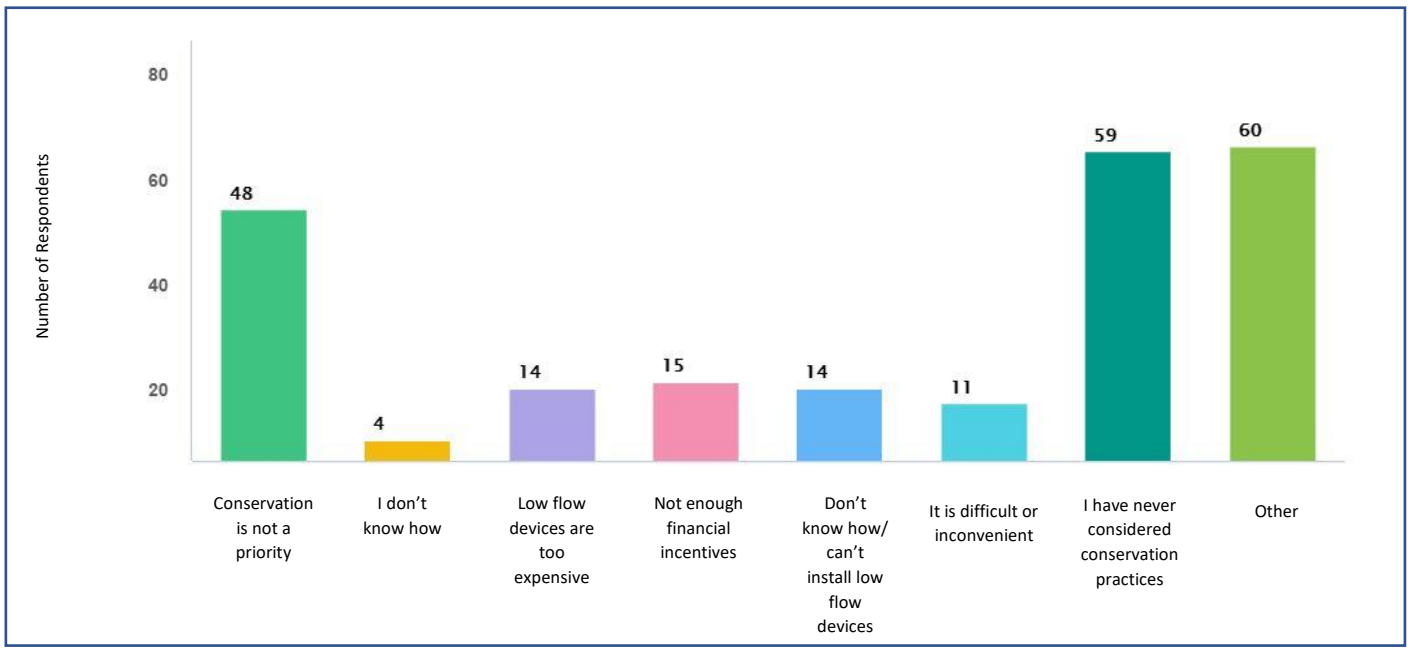

Figure 30. Most common barriers for household water conservation reported by respondents who indicated they did not practice any conservation measures.

Following this question, 148 respondents indicated what would make them willing to employ conservation practices. Most participants stated that they would be willing to practice conservation measures, with the largest driver being financial incentives (36.4%). This was followed by 35.1% answering "other". The coded responses were reflective of the previous question, with most saying they did not feel conservation was necessary, they had ample supply or they would be willing to conserve if there was a shortage or if they felt they needed to. Just over 30% said they would be willing if they had more information about how and only a small proportion of respondents stated that they would not be willing to practice water conservation measures at all (10.8%) (Figure 31).

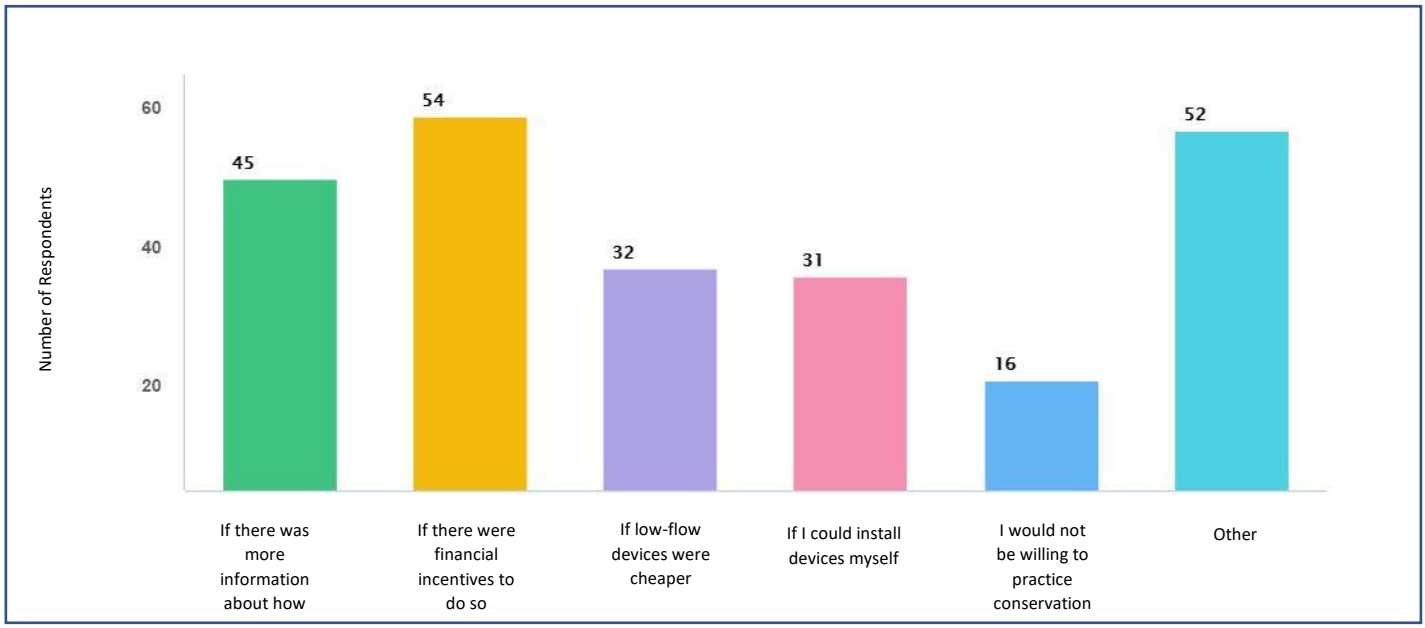

Figure 31. Breakdown of ways to remove barriers to water conservation measures, reported by respondents who indicated they did not practice water conservation.

3.7 Level of Support for Municipal Water Strategy and Action Plan

The cover letter of the survey described how it would be used to inform the creation of a comprehensive Municipal Water Strategy and help to generate a baseline understanding of the state of water resources within the Municipality, along with public opinions and perceptions of those resources. The question was answered by over 90% of survey participants and the majority showed a strong (29.8%) or somewhat strong (17.0%) level of support for implementing a water strategy. Fewer were strongly opposed (10.3%), with 16% who did not know and 15% who took a neutral stance (Figure 32).

The median value for level of support was two (somewhat support). A non-parametric Kruskal-Wallis test was performed and found that there was no difference in the level of support across all Districts in the Municipality at a 95% confidence interval ($p = 0.23$).

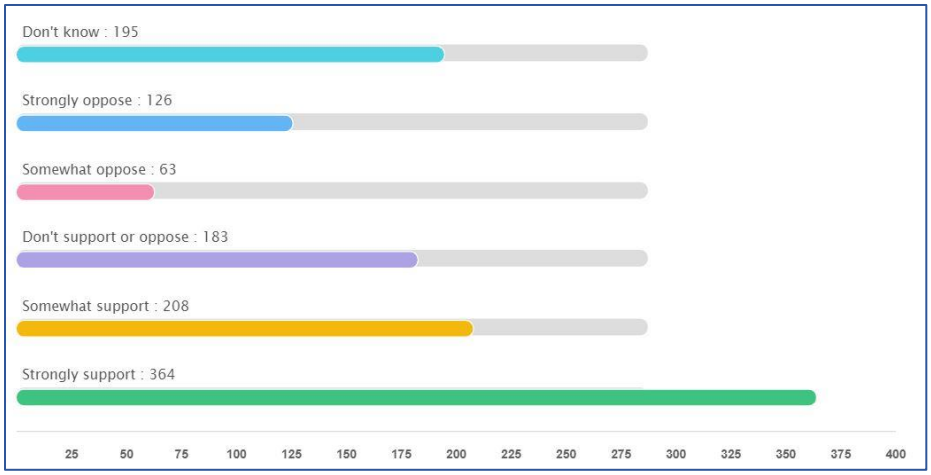

Figure 32. Level of support of all respondents for a Municipal Water Strategy and Action Plan.

Residents were also asked to what extent financial considerations impact decisions related to quality and quantity of their water supply. Results were varied, with most respondents stating that finances had somewhat of an impact (26.3%), a high impact (23.2%), or no impact (23.0%) (Figure 33).

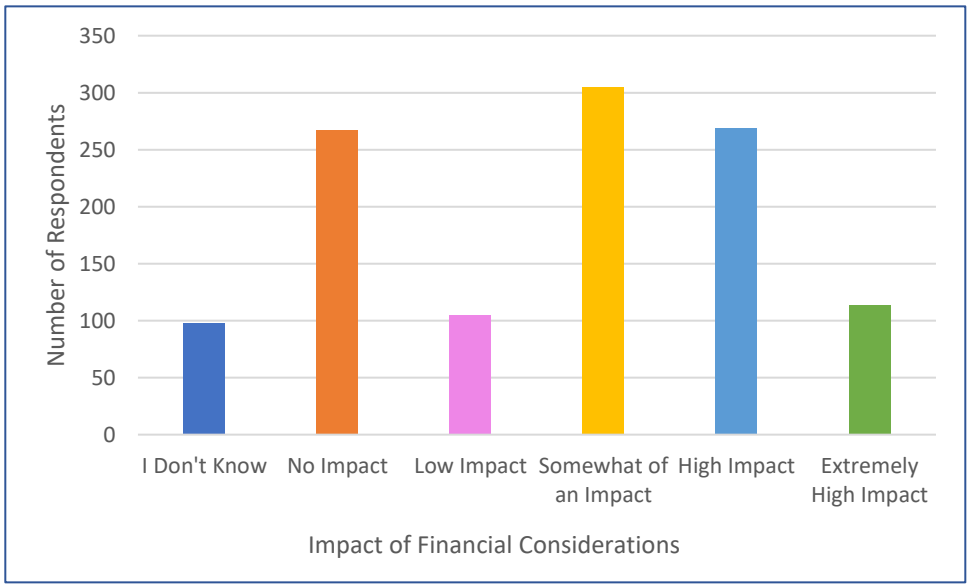

Figure 33. How much financial considerations impact decisions related to the quality and quantity of respondent's water supply.

Survey participants were asked how much they are willing to pay to have an adequate quality and quantity of water to meet their needs. Over half of respondents stated that they would not be willing to pay anything for their water (51.8%) followed by 22.3% who would be willing to pay between $1-$299 (Figure 34).

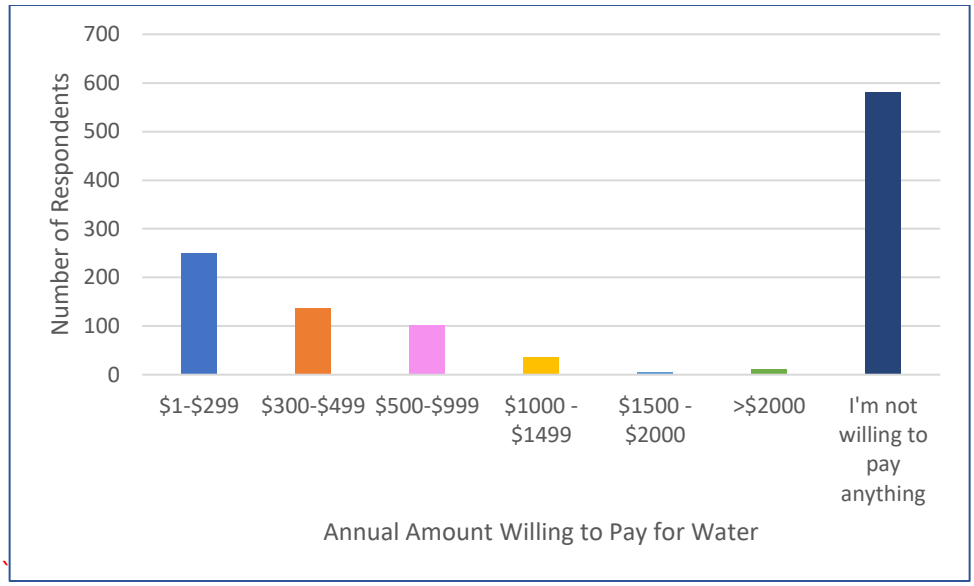

Figure 34. Amount that survey participants are willing to pay for access to adequate quality and quantity of water to meet their needs.

A Kruskal Wallis test was performed to determine if there was a difference in willingness to pay for water between each of the Districts. No significant differences were found between the Districts (p=0.47). The largest proportion of respondents in all Districts answered that they would not be willing to pay for their water. This was followed by respondents indicating that they would be willing to pay between $1-$299. In most Districts, small proportions of respondents fell into the other five willing to pay categories, with declining numbers as the amount increased (Figure 35).

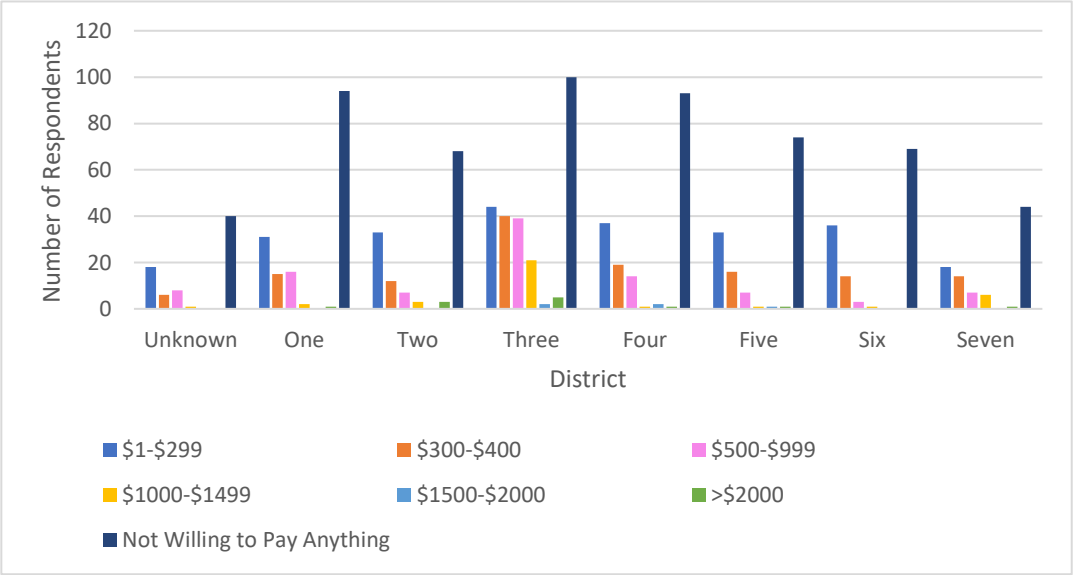

Figure 35. Breakdown of how much respondents are willing to pay based on the District in which they live. There were no significant differences between the District's willingness to pay.

4.0 Discussion & Recommendations

The Resident Water Survey was administered to all 6,100 addresses within the Municipality of Chester and obtained a 20% return rate after a survey period of approximately eight weeks. This is quite successful, as many untargeted, broad topic surveys struggle with response rates (Lee, 2009). This survey performed well in capturing input from long-term, full-time residents of the Municipality. However, due to the time of year it was administered and complications due to COVID-19 travel, it likely missed many of the seasonal residents, who are typically here in the summer months. None of the analyses were broken up between commercial and residential respondents, as due to the very low sample size from businesses in the Municipality, results would not be comparable. However, the large sample size spread among all Districts was optimal for comparison between respondents from varying geographical areas.

Most respondents were very certain about the source of their household water, with most reporting either drilled or dug wells. Just over half of the respondents treated their water, but either there was a high level of uncertainty, or an unwillingness to report the type of treatment used. Septic tanks with a distribution field and central sewer were the most common types of septic systems in use within the survey area, and a high level of respondents follow the provincial guidelines for septic pumping every three to five years (Nova Scotia Environment, n.d.).

Public perceptions and knowledge levels of residents were assessed by asking about their drinking water quality, quantity, and the factors that impact them. There was a high level of certainty about the quality and quantity of participant's household drinking water and both parameters were ranked highly overall. Participants also indicated that water issues were of importance to them, which is unsurprising, as we can infer that they would be less likely to complete the survey if they were indifferent to these issues. All Districts within the Municipality rated underlying geology as the largest threat to water quality, which aligns with Nova Scotia Environment information, as certain bedrock formations and geologic materials in the province can influence groundwater quality (Kennedy, 2020). This was followed by residential development being the next most important factor in all Districts, except for Five and Six, which listed recreation and forestry respectively as the secondary concerns. This is likely an accurate assessment, as many areas within the Districts are continuing to be developed, primarily for residential purposes. District Six contains the most rural communities, where forestry is a key industry.

There was a broad consensus about the factors that impact water quantities within the Districts, with climate change and drought listed as either the primary or secondary factor in each area. These factors are both linked; however, Nova Scotia is expecting increased precipitation with climate change. This is coupled with higher evaporation rates, leading to a decline in water levels and lower water tables overall. Household consumption or residential development were listed as the tertiary concerns in all Districts. These factors are also linked and are both expected to place additional strain on water quantity within the province (Nova Scotia Environment, n.d.). These results indicate that residents are aware and there is a consensus about the primary threats to water quality and quantity.

Respondents were less certain when asked about water bodies of concern within the Municipality. Although many reported general concerns that were not specifically linked to any particular body of water, many also skipped the question. Over 40 water bodies were mentioned during the survey. In general, the most frequent mentions were of those that are busy recreational areas, have existing water quality monitoring programs, or are under consideration for sources of Municipal water. This trend could

be because these are the water systems that residents in the area have heard most about, but it also shows a genuine concern and knowledge about the health of these systems.

Fox Point Lake was an area of high concern, with over 15 mentions. Coastal Action has conducted a water quality monitoring program on Fox Point Lake since 2015 in partnership with the Municipality of Chester. There has been annual water quality monitoring on Sherbrooke Lake, which was an area of medium concern, since 2017, in partnership between Coastal Action, the Municipality of Chester, and the Municipality of the District of Lunenburg. Coastal Action is also currently delivering two small-scale monitoring programs for the Municipality of Chester at Bayswater Beach and at Rafuse Cove in Martins Point. Among the water bodies of high and medium concern that are not monitored regularly were Middle River, Spectacle Lake, Gold River, the East River Watershed, and Stanford Lake.

The attitudes and levels of concern of survey respondents were assessed by asking participants which parties they viewed as most responsible for managing water quality and quantity. There was a great deal of uncertainty about this, with many skipped and "I don't know" responses. Overall, the Municipal Government, Provincial Government, and citizens were listed as the top three parties most responsible. Participants were also unsure of how well each group fulfilled their responsibilities. Of the participants who were certain enough to answer, the performance of all three of the groups was generally rated low, with citizens scoring higher overall than the two levels of government. In general, District Three had differing views from the other areas, rating overall performance of Municipal and Provincial Government more poorly and citizens better than many of the other Districts.

Gaps in reporting of the water shortages to the Municipal Dry Well Inventory were identified when compared against survey results. Although survey results were compiled from 2014 onward and the inventory only began in 2016, there were more than 200 dry wells that did not get reported to the Municipality. It is unlikely that the majority of these were reports from 2014 and 2015, as the summer of 2016 saw widespread drought throughout much of the province. The survey under-reported shortages in Western Shore, Beech Hill, and East River Point, but identified new reports in the communities of New Ross, East Chester, Bayswater, Northwest Cove, Martins River, and Martins Point. There were several comments in the open-ended sections of the survey that indicated respondents had never heard of the inventory. Finally, the survey reported significantly more water shortages in drilled wells than the inventory, which suggests that many water shortages within the Municipality go unreported.

Issues with the aesthetic qualities of water (staining, odour, sediment, cloudiness, and smell) were among the most common problems with water quality, although reports of bacterial coliform presence and arsenic above acceptable levels were also prevalent. Twenty-two communities in total identified water quality concerns outside of aesthetic parameters. The highest number of concerns were clustered around the coastal communities as opposed to inland areas. This is likely in part due to the greater population density and number of respondents in these areas. However, it was noted that no community in District Six reported any concerns, with exception of purely aesthetic objectives. Furthermore, District Six was found to have the largest proportion of respondents who do not test their water regularly or at all, lending support for a lack of education about water testing. The New Ross area, which is encompassed by District Six is particularly prone to high levels of uranium (Kennedy, 2020) which is colourless, odourless, and tasteless, and could not be detected without the proper testing. In addition to this, less than 50% of survey respondents across all Districts tested on a semi-regular basis (with the exception of District Three's

rate of bacteria testing) and even fewer met the provincial guidelines for frequency of water quality testing. This lends further support for the suggestion that more education is needed.

Barriers were assessed by targeting respondents who do not test their water at all. They were quite varied, but the main reasons were the mindset that testing is unimportant, followed by the expense of conducting tests. Some also pointed to a lack of education about what to test for and fears of the result. In the follow-up question, very few indicated that they were not willing to test, and a combination of making it cheaper, easier and providing education about what to test for and how to test would make them more willing to do so.

Assessments of water conservation measures and barriers preventing them were conducted, with the overwhelming majority of residents indicating that they do practice water conservation in their home. It was noted during the data entry phase of the paper survey that many respondents answered "no" that they did not implement any water conservation practices; however, in the following question, several proceeded to select the practices that they employed. The online survey was designed with branching questions and skip logic that would not ask respondents about the type of measures they use if they selected "no" to practicing conservation. This discrepancy between actual and perceived conservation measures supports the idea that citizens may lack education about what constitutes a water conservation measure. Also, due to the branching of the online survey, the number of "yes" responses may be overstated in comparison to what participants actually selected, in order to properly capture water conservation measures that are used. This is a source of error between the paper and online version of the survey and indicates a possible knowledge gap by residents. The most common practices were general water conscientious actions, low-flow tap aerators, and low-flow shower heads. The actions that require a greater investment either financially, or in the form of participant time were used less often. This includes more expensive appliances, water collection in the home to reuse elsewhere and rain barrels for watering gardens.

In terms of barriers, there was the general view among respondents that did not employ conservation measures that it was not important to them. This was captured in responses such as: ample water supply; not necessary; not a priority; and have not considered doing it. Nonetheless, most said they would be willing to practice conservation measures, providing there was a financial incentive, a water shortage, if they felt they needed to, or they had more information about how.

The final objective was to determine the level of support for the Municipal Water Strategy and Action Plan. The greatest proportion of respondents indicated that there is a strong level of support for this plan, with a median value showing it is somewhat supported. This view was the same across all Districts in the Municipality and very few participants were strongly opposed to its implementation.

Finally, respondents were asked how much they would be willing to pay for access to an adequate quality and quantity of water to meet their needs and most indicated they would not be willing to pay anything. This aligns with views expressed around financial barriers to water testing and conservation. However, many residents indicated they would not be willing to pay, but in previous questions had indicated that they already pay for treatment and/or water supply. This discrepancy shows a general lack of understanding about water resources and responsibilities. As soon as there is a financial implication, many people have the perception they are unwilling to pay for something even if it is not true.

4.1 Recommendations

Based on the above analysis, Coastal Action recommends three broad initiatives to the Municipal Water Steering Committee, including actionable steps which can be implemented as part of the Water Strategy and Action Plan.

Broad Recommendation #1: Increased promotion of ongoing water initiatives currently being undertaken by the Municipality, along with advertising of both Municipal and Provincial water education resources and initiatives. This can include the following actions:

- Promotion and advertising of the Municipal Dry Well Inventory to increase response rates and gather more accurate data and to continue to monitor the quantity of water resources in the Municipality. Communicate to residents the benefits of sharing this data and how it will be used to inform water strategies.
- Report results of ongoing water quality programs in real time. Monthly public statements or water quality report cards would help to inform the public about the state of water bodies of concern, particularly those who are using them frequently for recreational purposes. This will also help to showcase MOC's ongoing role in monitoring water quality within the Municipality.

Broad Recommendation #2: Education campaign focusing on source water protection, water testing, and water conservation in the home.

- Employ various Community-Based Social Marketing techniques aimed at identifying current behaviors and barriers to change. Tools such as prompts, social norms, and public commitments can lead to significant behavioral changes, provided they are targeting the appropriate barriers as opposed to perceived or assumed issues.
- Based on knowledge gaps identified during the survey, an education campaign can work to emphasize the importance of regular water testing, along with facilitation of this testing through removal of educational and financial barriers. Reporting of water quality results to the Municipality can allow quality issues to be tracked across communities.
- Emphasis can be placed on the importance of water conservation practices now and into the future, along with the nature of groundwater aquifers and collective responsibility in maintaining healthy water resources for all members of the community.
- Healthy water practices and water conservation methods can be taught and incentivized through rebates, provision of low-flow devices, and assistance with installation.

Broad Recommendation #3: Investigation of sources of contamination and water monitoring in water bodies of concern throughout the Municipality, beginning with highest level of concern.

- Gold River and Stanford Lake were identified as areas of high concern by survey participants and they do not currently have water quality monitoring programs in place. Through previous studies of Stanford Lake as a potential source for the Chester drinking water supply, it was noted that water quality was insufficient, therefore lending support for a more regular testing program (Municipality of the District of Chester, n.d.).
- Development of more widespread water quality monitoring programs targeting water bodies of concern within the Municipality, particularly those used heavily for recreation, or those that have high conservation value.

5.0 Acknowledgements

Coastal Action would like to thank the Water Strategy and Action Plan Steering Committee, all others who provided guidance and assisted with the Resident Water Survey, in particular, Jonathan Meakin (MOC); Jennifer Webber (MOC), and Tara Maguire (MOC).

6.0 References

Dillman DA. 1978. Mail and telephone surveys: the total design method. New York: John Wiley & Sons.

Hoddinott, S and Bass, M. 1986. The Dillman Total Design Survey Method: A Sure-Fire way to Get High Survey Return Rates Can. Fam. Physician Vol. 32.

Kennedy, GW. *Map of Uranium in Groundwater from Bedrock Aquifers in Nova Scotia.* Nova Scotia Department of Energy and Mines Geoscience and Mines Branch - Geological Survey, 2020. https://novascotia.ca/natr/meb/data/mg/ofm/pdf/ofm_2020-001_dp.pdf

Lee, T. 2009. A Survey of Public Perceptions and Attitudes Towards Water in Wheatland County, Miistakis Institute.

Municipality of the District of Chester. "Drilling Down…Background." Fact Sheet. n.d. https://www.voicesandchoices.ca/chester-water. Accessed 12 August 2020.

Municipality of the District of Chester. *Water Supply Upgrade and Lending Program. n.d.* https://chester.ca/water-sewer/water-supply-upgrade-lending-program. Accessed 12 August 2020.

Nova Scotia Environment – Climate Change Unit. *Water Impacts.* 2014. https://climatechange.novascotia.ca/adapting-to-climate-change/impacts/water. Accessed 10 August 2020.

Nova Scotia Environment. "The Drop on Water." Fact Sheets. Government of Nova Scotia. Nova Scotia, Canada. n.d. Web. https://novascotia.ca/nse/water/thedroponwater.asp. Accessed 13 August 2020.

Statistics Canada. 2017. Chester, MD *[Census subdivision], Nova Scotia and Nova Scotia [Province] (table*). Census Profile. 2016 Census. Statistics Canada Catalogue no. 98-316-X2016001. Ottawa. Released November 29, 2017. https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/index.cfm?Lang=E (accessed August 18, 2020).