



UNIVERSITY OF
ALBERTA

Alberta Water Well Survey



**A Report Prepared for Alberta
Environment**

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Executive Summary

Introduction

The University of Alberta was commissioned by Alberta Environment to undertake the Alberta Water Well Survey to investigate the water well stewardship practices of private water well owners in Alberta. Approximately 400,000 to 450,000 Albertans rely upon privately owned water wells for their household needs.¹ Research projects on private water well quality across Canada suggest that about 20 - 40 percent of private wells fall outside of safe drinking water guidelines.² In a 1997 study of water wells on rural farmsteads in Alberta, more than 32 percent of wells tested exceeded at least one health related contaminant, with 14 percent having total coliform bacteria exceeding limits and six percent showing presence of fecal coliforms.³

Assessing the overall health impact from the contamination of private water wells across a population is a difficult, if not impossible task. However, with a large proportion of wells falling outside of safe drinking water guidelines, it is reasonable to assume that there is an influence on the number of cases of short and long term illnesses in the province. Biological contaminants are most frequently associated with acute gastrointestinal illnesses, whereas chemical contaminants in wells are more frequently associated with illnesses such as cancer and Parkinson's disease.^{4,5,6}

Health risks that result from well contamination by biological and manmade chemicals are often the result of poorly constructed or poorly maintained wells, or the result of high concentrations of surface contaminants that have overwhelmed natural attenuation⁷ processes. These risks from well water can be substantially reduced through the implementation of relatively inexpensive precautionary water well stewardship measures by private water well owners. Such private water well stewardship includes the actions and behaviours taken by individuals to protect their private groundwater supply. This includes:

- ensuring that water wells are properly sited and constructed;
- undertaking regular well maintenance and monitoring (e.g., water well testing, shock chlorination);
- proper decommissioning of abandoned wells; and,
- source water protection through managing potential contaminants in the local area.

While water well construction, well decommissioning, and some elements of source water protection are governed by provincial regulations, the effectiveness of these regulations depends a great deal upon willing and active compliance by domestic well owners. The responsibility for maintenance, monitoring, and local source water protection falls entirely upon well owners.

¹ This estimate was developed using an approach employed by Statistics Canada (see Statistics Canada, *Human Activity and the Environment: Annual Statistics* (2003, 25) using Municipal Use Database (MUD) data from 1996. Statistics Canada extrapolated MUD data for municipally delivered water and then assumed that the population not covered was rural and that 90% of this population is reliant upon groundwater from private sources. This figure given here was updated using 2004 data from MUD.

² G. van der Kamp and G. Grove, "Well water quality in Canada: An overview," in *An Earth Odyssey, Proceedings of the 54th Canadian Geotechnical Conference, September 16-19, 2001*, edited by M. Mahmoud, R. van Everdingen and J. Carss (Calgary, AB, Canada, 2001), 39-41.

³ D.A. Fitzgerald et al., "Alberta Farmstead Water Quality Survey", Canada-Alberta Environmentally Sustainable Agriculture Water Quality Monitoring Committee (Edmonton, AB, 1997), 78.

⁴ N.M Gatto et al, "Well Water Consumption and Parkinson's Disease in Rural California", National Institutes of Health, U.S. Department of Health and Human Services. 2009.

⁵ J.D. Ayotte, "Bladder cancer mortality and private well use in New England: an ecological study", *Journal of Epidemiology and Community Health* 2006; 60:168-172.

⁶ J. Colli et al., "Bladder cancer incidence and mortality rates compared to ecologic factors in the United States" *J Urol.*, 2009: 181,

⁷ Attenuation processes include biological, chemical, and mechanical activities that reduce harmful substances in water as it percolates through strata.

Education is a non-regulatory approach used to encourage well owners to properly manage their wells and protect groundwater supplies. Several Canadian provinces, including Alberta, have education programs and resources for water well owners. In Alberta, the Working Well program has been developed to provide well owners with the information and tools they need to properly care for their wells. The overarching goal of the program is to ensure safe and secure groundwater supplies for private water well users in Alberta.

To establish relevant, effective education programs, it is important to understand the factors that may influence private water well stewardship. The goals of the Alberta Water Well Survey were to:

- Learn more about the stewardship practices of well owners in Alberta.
- Investigate the factors that encourage or discourage well owners to properly maintain their well and protect their water supply.
- Identify the beliefs of well owners with regards to groundwater flow and the functioning of water wells.
- Identify the beliefs of well owners with regards to potential risks in using private water wells.
- Identify the sources that water well owners turn to for information about private water well stewardship.

The results will help determine how to best engage well owners with regards to the stewardship of private wells.

Methods

The Alberta Water Well Survey was mailed to a random sample of water well owners in Alberta. This sample was selected from the Alberta Environment Groundwater Information System and mailing addresses were updated using the Alberta Land Titles Spatial Information System. Of the 3,600 survey questionnaires distributed, 1,014 completed surveys were returned. Additionally, 511 surveys were returned as undeliverable (14.2 percent of the distributed surveys). This resulted in a total response rate (for delivered surveys) of 34.4 percent. Of the completed questionnaires, 48 were returned blank⁸ or without the required consent check-box checked on the front page. The total number of completed surveys, with participant consent, included in data analysis was 1,014. The survey was successful in collecting responses from a representative sample of water wells in Alberta. Respondents came from diverse educational backgrounds, property types (farms, acreages, summer cabins, towns and villages, and other), and municipalities throughout the province.

Data analysis was performed at the University of Alberta using the Statistical Package for Social Sciences. Following the development of descriptive statistics for the data, bivariate analysis was undertaken to identify any meaningful and statistically valid relationships between variables.

⁸ Respondents were asked to return the survey blank if they did not wish to fill it out or if it was not relevant to them.

Key Findings

Key Finding #1: Survey respondents demonstrated a low level of participation in well maintenance and stewardship practices.

Only 10.7 percent of respondents test water quality on an annual basis (or more frequently), only 30.1 percent regularly shock chlorinate their well, and only 36 percent of respondents with an abandoned well have properly decommissioned it.

Key Finding #2: Most respondents demonstrated a low level of knowledge with regards to the source of their well water and the functioning of their well.

Much of the existing knowledge of well owners appears to be rooted in longstanding 'folk' beliefs about groundwater. For example, more than three quarters of respondents believed that their well water reached their well by travelling many kilometres in underground rivers. This is highly unlikely as the vast majority of private wells draw water from slow moving aquifers that have local recharge areas. Such beliefs can be a barrier to engaging well owners in stewardship practices. For example, a well owner that believes groundwater flows in underground rivers may not recognize the importance of managing contaminants in the area surrounding their well.

Key Finding #3: Most survey respondents have a false sense of security regarding the risks posed by their well and unjustified confidence in their knowledge of their water supplies.

Many respondents expressed confidence in the safety of their wells; despite having no water quality test results and failing to undertake any preventative maintenance. The vast majority of respondents also indicated that they are confident in their understanding of their well. As indicated in Key Finding #2, this confidence is unwarranted as respondents generally demonstrated a lack of knowledge.

Key Finding #4: Awareness of well stewardship practices was not sufficient to motivate many survey respondents.

Many respondents who indicated an awareness of the need to undertake stewardship practices indicated that they failed to do so. For example, 71.4 percent of people indicated that they believed annual chlorination of their well was a good practice; however only 29 percent of all respondents indicated that they chlorinate their well at least once every two years. Many identified procrastination and forgetfulness as reasons why they failed to undertake stewardship practices. This is similar to the failure of many people to replace smoke alarm batteries or to do preventative maintenance on their car.

Key Finding #5: Health and aesthetic concerns and a desire to follow good practice were key motivators for engaging in water well stewardship practices.

Of the well owners that have adopted stewardship practices, many identify health or aesthetic concerns as a key motivation for doing so. For example, more than 80 percent of individuals suggested that health concerns were a motivating factor in deciding to chlorinate their well; whereas more than 70 percent indicated that they were motivated by issues of nuisance bacteria that cause smells and stains. Additionally, the desire to follow social norms⁹ was a strong motivating factor with 61 percent of people indicating a desire to follow proper maintenance procedures. This message was also strongly represented within qualitative elements of the survey.

⁹ Social norms are the behavioural expectations and cues within a society or group. People often decide what behaviours are appropriate by observing those around them.

Key Finding #6: Financial costs are not a significant barrier in undertaking well stewardship practices.

Procrastination and lack of knowledge of how to undertake stewardship practices are more prominent than financial costs as barriers to stewardship. Individuals who practice water well stewardship are distributed geographically, across age brackets, education levels, and property types. No one group is more or less 'stewardlike' than others to any significant degree.

Key Finding #7: Many respondents indicated the need for more information on how to undertake proper well stewardship practices.

More than one in three respondents indicated that they would take the time to attend a water well workshop if one were held in their community. When respondents were informed about the Water Wells that Last for Generations manual, 78.2 percent indicated they would access a copy of it.

Key Finding #8: Respondents indicated that they would likely seek information from a number of sources if they had questions about their water well.

Eighty-nine percent of respondents indicated that they perceive water well contractors as key sources of information that they might turn to with regards to water wells. Seventy-seven percent of respondents indicated that they might turn to members of their community including friends and neighbours. Additionally, more than half of respondents indicated that they might utilize the internet, contact a government agency, or contact a health clinic to seek information.

Conclusion

The Alberta Water Well Survey was successful in identifying many of the current practices and beliefs of well owners in Alberta. The majority of well owners in Alberta are not taking basic precautionary measures or implementing water well stewardship practices. This exposes them to unnecessary risk of gastrointestinal illnesses and contaminant related diseases.

The root causes of this behaviour appear to be a lack of awareness about groundwater flows, the functioning of wells, and the risks of contamination. Additionally, there are issues of procrastination and a lack of knowledge about how to carry out stewardship activities. Other barriers, such as the costs involved in stewardship, appear to be less significant overall relative to the attitudes and knowledge of the well owners.

There is a need for continued and expanded education efforts to promote well stewardship amongst private well owners. The challenge involved in changing longstanding beliefs and practices should not be underestimated. Ongoing, persistent outreach efforts will be required. With such effort, changes in public beliefs and behaviour should occur in an incremental fashion with some individuals adopting new approaches while other lag behind.

There is evidence that suggests change is possible, and there is an important role for education and outreach efforts. Respondents from across Alberta indicated they are willing to participate in education activities (e.g. workshop). Some Albertans are already acting as good water well stewards. These individuals can act as examples for others. There are opportunities to work with water well contractors who already are accepted in rural communities as sources of knowledge with regards to water well maintenance. The Working Well program has a good start on these efforts and through continued and expanded efforts, there is great opportunity to shift the beliefs and practices of Albertans so that they can reduce the risks they face from their own water wells.

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ALBERTA WATER WELL SURVEY

1.0 Introduction

The University of Alberta was commissioned by Alberta Environment to undertake the Alberta Water Well Survey to investigate the water well stewardship practices of private water well owners in Alberta.

1.1 Background

Approximately 400,000 to 450,000 Albertans rely upon privately owned water wells for household needs.¹⁰ Research projects on private water well quality across Canada suggest that about 20 - 40 percent of private wells fall outside of safe drinking water guidelines.¹¹ In an Alberta study of water wells on rural farmsteads, more than 32 percent of wells tested exceeded at least one health related contaminant, with 14 percent having total coliform bacteria exceeding limits, and six percent showing presence of fecal coliforms.¹²

Some elements of water well quality are the result of the geological media that the wells are constructed in (most mineral contamination for example). However, contamination by biological and manmade chemicals are often the result of poorly constructed or poorly maintained wells, or the result of high concentrations of surface contaminants that have overwhelmed natural attenuation¹³ processes. Additionally, the presence of natural pathways (such as surficially exposed fractures) or manmade pathways (such as abandoned wells) that bypass attenuation processes can result in groundwater contamination.

Assessing the overall health impact from the contamination of private water wells across a population is a difficult, if not impossible task. However, with a large proportion of wells falling outside of safe drinking water guidelines, it is reasonable to assume that there is an influence on the number of cases of short and long term illnesses in the province. Biological contaminants are most frequently associated with acute gastrointestinal illnesses, whereas chemical contaminants in wells are more frequently associated with illnesses such as cancer and Parkinson's disease.^{14,15,16}

Private water well stewardship includes the actions and behaviours taken by individuals to protect their private groundwater supply and the natural environment. This includes actions to ensure proper well construction, maintenance, decommissioning, water quality testing, and source water protection. While water well construction, well decommissioning, and some elements of source water protection are governed by provincial

¹⁰ This estimate was developed using an approach employed by Statistics Canada (see Statistics Canada, *Human Activity and the Environment: Annual Statistics* [2003, 25]) using Municipal Use Database (MUD) data from 1996. Statistics Canada extrapolated MUD data for municipally delivered water and then assumed that the population not covered was rural and that 90% of this population is reliant upon groundwater from private sources. This figure given here was updated using 2004 Data from MUD.

¹¹ G. van der Kamp and G. Grove, "Well water quality in Canada: An overview," in *An Earth Odyssey, Proceedings of the 54th Canadian Geotechnical Conference, September 16-19, 2001*, edited by M. Mahmoud, R. van Everdingen and J. Carss (Calgary, AB, Canada, 2001), 39-41.

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¹⁴ N.M Gatto et al, "Well Water Consumption and Parkinson's Disease in Rural California", National Institutes of Health, U.S. Department of Health and Human Services. 2009

¹⁵ J.D. Ayotte, "Bladder cancer mortality and private well use in New England: an ecological study", *Journal of Epidemiology and Community Health* 2006; 60:168-172

¹⁶ J. Colli, et al, "Bladder cancer incidence and mortality rates compared to ecologic factors in the United States" *Journal of Urology*,. 2009; 181: 165

regulations, the responsibility for maintenance, testing, and local source water protection are the responsibility of the individual homeowner.

Several Canadian provinces have education and outreach programs to encourage well owners to properly manage their wells and protect groundwater supplies. In Alberta, the Working Well program has been developed to provide well owners with the information and tools they need to care for their wells. The overarching goal of the program is to ensure safe and secure groundwater supplies for well owners.

1.2 Purpose

In order to establish relevant, effective education programs, it is important to understand the factors that influence private water well stewardship. The goals of the Alberta Water Well Survey are to:

- Learn more about the stewardship practices of well owners in Alberta.
- Investigate the factors that encourage or discourage well owners to properly maintain their well and protect their water supply.
- Identify the beliefs of well owners with regards to groundwater flow and the functioning of water wells.
- Identify the beliefs of well owners with regards to potential risks in using private water wells.
- Identify the sources that water well owners turn to for information about private water well stewardship.

The results will help determine how to best engage well owners in taking responsibility for proper well management.

1.3 Processes of Water Well Stewardship

The Government of Alberta defines stewardship as: “an ethic whereby citizens, industry, communities, and governments work together to responsibly care for and manage Alberta’s natural resources and environment.”¹⁷ Private water well stewardship is used in this document to refer collectively to the following elements:

Well Siting – Locating a well away from potential sources of contamination such as septic systems or chemical storage areas provides more opportunity for attenuation of contaminants from water before it enters the water well. In Alberta, provincial regulations outline minimum separation distances from many sources of contamination. Well owners can act to ensure that these are respected when wells are sited and also when sources of potential contamination are established in situations where wells are already in place.

Construction – An improperly constructed well can facilitate the movement of contaminants from the surface into the aquifer (and the well itself). Water well construction practices are regulated by the provincial government, and water well contractors in Alberta must be licenced. Homeowners seldom construct their own wells, but if they are informed about construction techniques and the licensing of water well contractors, they can be vigilant to ensure that their well is properly constructed.

Water Quality Testing – The Water Wells that Last for Generations manual (WWLG) published by Alberta Environment and Alberta Agriculture and Rural Development recommends that private well owners have a bacterial test done every year. In a 2001 study by Environment Canada¹⁸, 10.8 percent of farms in Alberta tested their water once or more a year and an additional 13.7 percent tested their water every two years. This left 75.4 percent of farms without regular testing, the highest rate of all Canadian Provinces.

¹⁷ CESC, “A Review of Stewardship Programs and Activities in Canada’s Provinces and Territories”, report prepared by The Centre for Environmental Stewardship and Conservation Inc. (CESC) for Alberta Environment (2009).

¹⁸ FEMS, “Farm Environmental Management Survey for the Year 2001” (Agriculture and Agri-food Canada and Statistics Canada, 2001).

Maintenance – Maintenance includes practices such as: regular shock chlorination to prevent the build-up of nuisance bacteria and to reduce the risk of the presence of harmful bacteria; regular visual inspections of the well and system to identify and correct potential problems; and, the practice of keeping good records of the well.

Well Decommissioning – Abandoned wells that are no longer in use can act as a contaminant pathway that allows water to flow into an aquifer. Abandoned water wells are required to be properly reclaimed in a manner that prevents vertical movement of water.

1.4 Decision Making and Behaviour

Understanding and successfully modelling human decision making and behaviour has been a key area of research in the social sciences, and is an area in which there has been a great deal of progress made in recent years. Ostrom's theories on *collective action and natural resource management*¹⁹, Stern's theories on *values beliefs and norms in environmentally significant behaviour*²⁰, and Fishbein and Ajzen's²¹ *theory of reasoned action and planned behaviour* are approaches that have been demonstrated to be effective in modeling human behaviour in regards to environmental and risk related issues. The key strength of these approaches is that they integrate individual factors of decision making and group or social factors of decision making; whereas, many earlier models are centered only upon one of the two.²² This section explores some of concepts in the literature and presents them as the framework that was used to guide the research.

1.4.1 Decision Making

Individuals face a myriad of options about what to do with their time and resources. Should they spend the afternoon getting a water sample from their well and delivering it to a lab for a water quality test, or should they instead take their family to a movie. When a water well owner chooses to undertake good water well stewardship practices by getting a water test done, he or she gives up both time and money that could have been used on other pursuits (such as the movie). The integrated models discussed above draw from psychology and economics to understand human decision making. The following are some important concepts that they employ.

Cost/Benefit Analysis (Rational Choice)²³ – One of the key models that has been used in the social sciences to explain behaviour for more than two centuries is based upon the notion that individuals weigh the costs and benefits of available options then make a decision that leads to the optimal net benefit.

Possible Relevance to Stewardship Behaviour: Stewardship tasks involve both time and financial commitments. Reducing costs such as well testing lab fees, the cost of chlorine, and professional help to abandon wells may lead more individuals to undertake stewardship behaviour. Providing low cost access to information and assistance may encourage more people to learn about stewardship. In theory, costs could be increased by developing regulations that punish those who do not undertake stewardship, however enforcement would be difficult.

Imperfect Beliefs (Imperfect Knowledge) – In the 1940's when the cost/benefit approach to understanding human behaviour was the key principle of behaviour models, a young political scientist, Herbert Simon, began to point out its limitations and failings. He eventually won the Nobel Prize in Economics for his work on decision making and behaviour. Simon identified two factors that added complexity to this model.²⁴ First, he noted that humans make

¹⁹ Elinor Ostrom, *Governing the Commons: The Evolution of Institutions for Collective Action* (New York: Cambridge University Press, 1991).

²⁰ Paul C. Stern, "Toward a Coherent Theory of Environmentally Significant Behavior", *J. Soc. Issues* 56.4:519 (2000): 407-424.

²¹ M. Fishbein and I. Ajzen, *Understanding Attitudes and Predicting Behaviour* (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1980)

²² Mark Lichbach, *Is Rational Choice All of Social Science?* (Ann Arbor: University of Michigan Press, 2002).

²³ A. Diekmann and P. Preisendorfer, "The behaviour effects of environmental attitudes in low cost and high cost situations," *Rationality and Society* 15.4 (2003):441-472.

²⁴ Herbert Simon, *Models of Man, Social and Rational: Mathematical Essays on Rational Human Behavior in a Social Setting*. (New York: Wiley, 1957).

decisions with *incomplete and imperfect knowledge* – i.e. they do not have all of the information available for decision-making, therefore some of their beliefs are imperfect or incorrect. Simon explained that even if humans undertake a perfect process of cost/benefit analysis, they will often make imperfect decisions because the information being used to make decisions is incorrect or incomplete. When making decisions humans rely upon what they believe to be true – in other words, their **beliefs**. When considering whether or not to do a water quality sample on a well, an individual would draw upon many beliefs. If the individual believed that there was absolutely no possibility of the well being contaminated, they would not do the test because there would be no benefit. Individuals who believe that their well might be contaminated will have more incentive to undertake the water quality test.

Possible Relevance to Stewardship Behaviour: Individuals that have inaccurate beliefs about wells may choose not to undertake stewardship. The discussion about changing beliefs is complex and is presented in section 1.4.2.

Limited Cognitive Capacity – The second issue Simon raised with regards to humans and decision making is that humans have *Limited Cognitive Capacity (limited brain power)* and as such cannot fully consider all aspects of all decisions. While the human brain has astounding abilities in some methods of processing information, it is inherently weak and slow in others. As a result of these weaknesses, doing a comprehensive cost-benefit analysis for each and every decision would be immensely time consuming. When humans face important decisions, such as quitting a job or buying a new house, they often spend days agonizing over the costs and benefits of the choices they face as their brains awkwardly and inefficiently weigh the costs and benefits. If the same level of cognitive effort were placed upon daily decisions, such as what to eat for lunch or when to shock chlorinate a well, it would be impossible to live life. Simon recognized that humans do not do a full cost benefit analysis as predicted by earlier models, but rather they use a process of mental short cuts to save time and to avoid unnecessary cognitive strain when making decisions. These mental shortcuts generally serve us well and result in good decisions, though not perfectly optimal decisions. There are, however, some imperfections in our decision making process that can cause difficulties including: i. the way we *satisfice*, ii. the way that we assess risk, and iii. the processes that lead us to procrastinate.

Satisficing²⁵ – In many cases, humans are satisfiers, meaning that we follow the first course of action that is deemed satisfactory as it enters our mind (as opposed to continuing to seek out the optimal behaviour). This limits our willingness to seek out further knowledge or to further consider an issue because a satisfactory situation has already presented itself. Once a situation is considered satisfactory, it is set aside and no additional thought is given to it until some event stimulates the individual to re-consider their satisfaction with the situation.

Possible Relevance to Stewardship Behaviour: Individuals who are currently satisfied with their water well have little motivation to seek out new information or even consider alternative behaviours. Well owners who do not undertake stewardship practices, but are satisfied with their current water supply situation will need to be motivated to change their behaviour. Raising awareness of the health risks of poor stewardship is one approach to increasing the salience of the issue. Another approach is advertising or other methods that prompt individuals to think about the issue of concern. The use of the annual time change as a reminder to check batteries in smoke alarms is an example of raising the salience of an issue through a promotional effort. There may be similar opportunities in water well stewardship.

²⁵ Ibid

Risk Assessment^{26,27,28} – Risk is a factor of probability and costs. Humans tend to be poor at calculating risk, particularly risks with low probability of occurrence and high costs if they occur. Our abilities are further hampered when the cause and effect of the risk involves unobservable processes (such as illness or groundwater movement). In such cases, there is a tendency to rely upon inaccurate heuristics (mental models) that grossly overestimate some risks and underestimate others. Studies have demonstrated that framing of the issue can really impact the perceptions of individuals.

Possible Relevance to Stewardship Behaviour: The potential risk associated with private water wells is difficult for homeowners (and experts) to assess because gastrointestinal illness tends to be attributed to causes other than water supply. As a result, homeowners seldom ever relate water and illness. Risk calculations are made more difficult because there are multiple levels of possible consequences with varying levels of risk frequency. This complexity may result in well owners using poor heuristics, such as personal experience, in estimating well risk. If they have not observed an illness or death connected to a household well, then they may consider water wells to pose no risk. If individuals underestimate the risks that they face from their private water well supply they may fail to adopt stewardship practices. This study will provide insight into how people are viewing risk. This should assist in future efforts regarding how to frame information to promote an appropriate level of concern amongst well owners.

Procrastination^{29,30,31} – Humans tend to undervalue things that happen in the distant future and overvalue things in the present. This can, and often does, lead to people forgoing preventative approaches for reactive ones. Related to this is the propensity for individuals to develop habits of behaviour. Habits are a very useful element of human behaviour because they allow individuals to move through their daily processes while engaging in very little cognitive effort. Unfortunately, habits have been demonstrated to act as a significant barrier to change. These two aspects of human behaviour tend to result in individuals failing to do things that they have identified as things they would like to see done. So, the problem is no longer beliefs, but rather habitual behaviour.

Possible Relevance to Stewardship Behaviour: Individuals who believe in stewardship practices may be failing to actually undertake them. This would mean that in addition to changing people's beliefs, outreach efforts must find ways to **motivate** people to undertake stewardship activities.

1.4.2 Beliefs and Behaviours

As Simon indicated, when examining the behaviour of people in the real world context, it is important to understand their beliefs. To change behaviour, it is often necessary to change beliefs. Doing so can be a challenging endeavour.

'Normal' Beliefs and Behaviours – Despite the prevalence of scientific knowledge, beliefs are significantly influenced by traditional/local knowledge, people's personal experiences, religious belief systems, and by other sources. Each belief and value is interwoven into a complete belief system that individuals use to interpret the world around them. There are many prevalent beliefs in society that do not mesh well with scientific understandings of the world. These beliefs persist for a number of reasons, the most important of which is a

²⁶ J. Flynn, P. Slovic and P.K. Mertz, "Gender, race, and perception of environmental health risks," *Risk Analysis* 14.4 (1994): 1101-1108.

²⁷ W.R. Freudenburg, "Perceived risk, real risk: Social science and the art of probabilistic risk assessment," *Science* 242.4875 (1988): 44-49.

²⁸ A. Tversky and D. Kahneman, "The framing of decisions and the psychology of choice," *Science* 211.4519 (1981): 453-458

²⁹ T. O'Donoghue and M. Rabin, "The economics of immediate gratification," *Journal of Behavioral Decision Making* 13.2 (2000): 233-250.

³⁰ Acquisti Alessandro and Jens Grossklags, "Privacy and Rationality in Individual Decision Making," *IEEE Security and Privacy* 3.1 (2005): 26-33.

³¹ W. Jager, "Breaking Bad Habits: a dynamical perspective on habit formation and change" in

Human Decision-Making and Environmental Perception – Understanding and Assisting Human Decision-Making in Real Life Settings, edited by L. Hendrick, Wander Jager and L. Steg, (Libor Amicorum for Charles Vlek, Groningen: University of Groningen, 2003).

natural resistance to change, which is supported by a system of social norms.³² *Norms* are the range of beliefs, behaviours, and attitudes that are considered normal in the community. If individuals deviate from the accepted range, they will face punishment. If, for example, in modern times someone were to profess that they believed that the Sun circled the earth, they would lose a great deal of respect and perhaps even face ridicule. In Galileo's time the opposite was true. Norms can act as a means to protect culture and resist changes.

Possible Relevance to Stewardship Behaviour – Norms can be very narrowly defined (i.e. a stringent and narrow definition of acceptable behaviour and beliefs), or very permissive (i.e. a wide range of beliefs and behaviours accepted by a community). Given what is known about well owner behaviour from past surveys, it is likely that there is a wide range of acceptable beliefs and behaviours regarding household wells. Some people may believe that wells carry risk and others may believe that there is no risk. Well owners face little social pressure to engage in good stewardship practices because other practices are still acceptable. A key goal of education and outreach efforts is to have increasing numbers of people believe that **stewardship practices are the norm** and that practices in contravention to these are, in fact, undesirable. This has happened somewhat in society with efforts to reduce impaired driving, violence in society, and the prevalence of smoking.

Early Adopters/Key Influencers³³ – Evidence suggests that beliefs most often change within communities through a process of diffusion. Individuals known as *early adopters* become aware of a particular belief or value and adopt it (a process known as internalization). They introduce the new idea to others, who evaluate it and choose to internalize it, or to reject it and retain their pre-existing belief or value. Evidence has found that some community members, known as *key influencers*, are highly effective at promoting changes to the beliefs and values of a community. Typically, these are individuals who are respected, trusted, and well liked by others in the group. At the same time, outsiders and particularly figures of authority from outside the group often face significant resistance when efforts are made to change beliefs or values. Working in partnership with the target community is much more effective than patriarchal approaches.³⁴

Possible Relevance to Stewardship Behaviour – Along with broad cultural messages that reach out to the masses of water well owners, targeted efforts at smaller groups may have residual affects as these individuals go forth and influence the attitudes of other members. Every individual that adopts stewardship practices is an important ally in spreading the message. There is a multiplier effect, particularly if key influencers can be identified and brought into the process as a partner. This justifies targeting resources on smaller more targeted approaches (which are relatively high cost) because they will have residual effects.

Societal Level Shifts Matter^{35,36} – In addition to direct actors encouraging the adoption of new ideas, many researchers have suggested that larger scale cultural shifts in society also have a significant influence on the successful diffusion and adoption of new ideas. Buttel³⁷, for example, described how the propensity for farmers to adopt new environmentally friendly farm practices was predominantly rooted in national scale cultural, political, and economic influences.

Possible Relevance to Stewardship Behaviour: Broad shifts in attitudes regarding environmentalism, preventative health, and general preventative behaviour may result in an increasingly receptive population to stewardship.

³² M. Fishbein and I. Ajzen, *Understanding Attitudes and Predicting Behaviour*. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1980.

³³ Halpern, David and Clive Bates, *Personal Responsibility and Changing Behaviour: the state of knowledge and its implications for public policy*, Prime Minister's Strategy Unit, London: Admiralty Arch, 2004

³⁴ A. Bandura, "Self-efficacy: Toward a unifying theory of behavioral change," *Psychological Review* 84.2 (1977): 191-215.

³⁵ P.J. Nowak, "Adoption and diffusion of soil and water conservation practices," *The Rural Sociologist* 3.2 (1983), 83-89.

³⁶ Scott N. Duff et al., "Soil conservation behavior and attitudes among Ontario farmers toward alternative government policy responses," *Journal of Soil and Water Conservation* 46.3 (1991): 215-219.

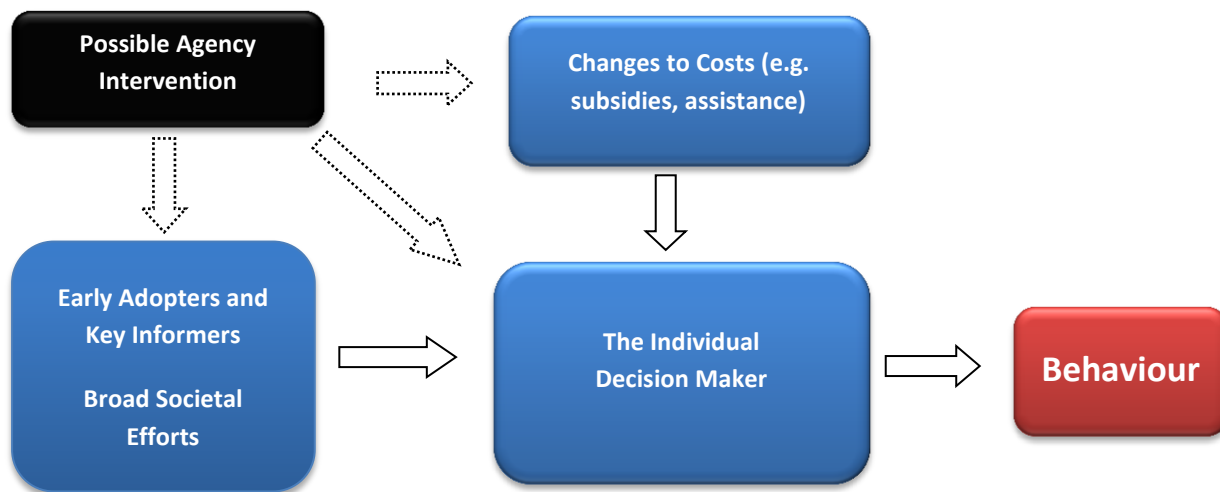
³⁷ F.H. Buttel, "Agriculture, environment, and social change: Some emergent issues." In *The Rural Sociology of the Advanced Societies*, edited by F.H. Buttel and H. Newby. (Montclair, New Jersey; Allangeld, Osmun and Co. Publishers, Inc., 1980.), 453-488.

Efforts to promote water well stewardship could be integrated into these larger shifts through broad promotional efforts targeted at populations who are likely to rely upon wells. This could include advertising, pamphlets, websites, and other broadly targeted material.

1.5 Possible Points of Agency Influence

Figure 1-1 illustrates three key pathways that can be used to reach private well owners. The first is through direct contact with an individual. The second and third are changes to the costs of stewardship and changes to the beliefs of others in society either in a targeted or broad manner.

Figure 1-1: Model of Behaviour Process with Possible Agency Intervention



2.0 Methodology

A flow chart and timeline of the survey methodology is outlined in Appendix One. It involved four key stages: survey design, sample selection, data collection, and data analysis.

2.1 Survey Design

2.1.1 Survey Questionnaire

An initial draft of the survey questionnaire was prepared in August-September 2008. It was designed to fulfill the information requirements of Alberta Environment, and to complement a similar survey of water well owners in Ontario conducted by University of Guelph researchers in 2008/09.

The initial draft was submitted to Alberta Environment for review and feedback in September 2008. During November 2008, a pilot survey was undertaken with rural residents in the Edmonton Region. A revised survey questionnaire was finalized in December 2008 (Appendix Three).

2.1.2 Online Survey

In addition to the survey questionnaire, an electronic survey was also made available to participants online. The electronic survey was designed and conducted using Survey Gizmo online survey.

2.1.3 Ethics Approval

All research conducted at the University of Alberta that involves human participants must be reviewed and approved by the university's Research Ethics Board (REB) before research commences. An application for ethics approval for the survey was submitted to the Arts, Science, Law Research Ethics Board (ASL REB) on October 1, 2008. It outlined the procedures to be followed to inform recipients of the project goals, data access and usage, and the procedures that would be used to ensure participant anonymity and confidentiality of data. A certificate of ethics approval was received on October 28, 2008 (see Appendix Two).

2.2 Sample Selection

2.2.1 Sample Frame

The survey was distributed to a random sample of water well owners in Alberta. The sampling frame used to select the sample was sourced from the Alberta Environment Groundwater Information System (<http://www.environment.alberta.ca/01314.html>). This system contains information about water wells, and was used to identify people who have wells used for domestic purposes. An initial sampling frame of 127,242 records was extracted based on the following criteria:

- type of drilling work listed was the construction of a new well;
- date of the drilling work was not older than January 1, 1968; and,
- the intended purpose of the well included a domestic use component.

Records older than January 1, 1968 were not included in the sampling frame as a high percentage of older records were likely to be unreliable and in many cases, wells will have been replaced by newer wells or other sources of water. Despite this, responses were received from some individuals who indicated wells older than this. This could be the result of respondents passing surveys to others if they were not applicable to them (if they had no well for example) or it may have been the result of address changes after the information was entered into the Alberta Environment Groundwater Information System.

The initial sampling frame was then processed to generate a revised sampling frame. To reduce the size of the sampling frame, 6,000 records were randomly selected. Duplicate property identifiers and well owners (based on owner name and address) were then removed. In each case, the most recent record was retained. In addition, the well owner name and address information on all records older than 1993 were cross-checked and updated using the Alberta Land Titles Spatial Information System (SPIN2 - <https://alta.registries.gov.ab.ca/spinii/logon.aspx>). This process eliminated 561 records that had incomplete name and address information, leaving a revised sampling frame of approximately 5,493 records. The process of address correction was very resource intensive and many addresses could not be improved due to improper recording of land locations in the initial water well record or changes in the land location due to subdivision following the construction of the well.

2.2.2 Sample

The final sample of water well owners included in the survey was selected following a pilot mail out of the survey. The pilot mail out was used to determine the sample size that would be needed to collect a minimum of 800 completed survey questionnaires. By using a pilot survey mail out, the percentage of undeliverable surveys that could be expected in the main mail out, as well as the approximate rate of return could be ascertained. This was done due to concern over the integrity of the water well database as a source of a sampling frame. As noted above, the database was prone to errors in both addressing and land locations.

The pilot mail out was distributed on January 23, 2009. It included 150 randomly selected well owners. In total, 16 surveys were undeliverable (11 percent), while 42 completed surveys were returned, representing a total rate of 31 percent of *delivered* surveys for the pilot. Based on these numbers, it was determined that a total sample of 3,600 would be sufficient. From the revised sampling frame, 3,450 well owners were randomly selected to be included in the main mail out. Together with the 150 well owners included in the pilot survey mail out, this provided a total number of 3,600 surveys sent out.

2.3 Data Collection

2.3.1 Distribution of survey questionnaire

The process for distributing the survey questionnaire was the same in both the pilot and main survey mail outs.

Survey packages were collated for mail-out at the University of Alberta. Surveys were distributed by the University of Alberta Distribution Services. Survey packages included:

- the 12 page survey questionnaire;
- a personally-signed cover letter;
- a business reply-paid envelope; and,
- a pen inscribed with the project name and the website address for the online version of the survey.

An information sheet was also included that asked survey recipients who no longer had a water well used for domestic purposes to forward the survey to family or neighbours that did. This was done to counter the challenges posed by the database.

In total, 3,600 survey questionnaires were distributed. 150 were distributed in the pilot mail out on January 19, 2009. 3,450 were distributed in the main survey mail-out on February 9, 2009. In addition to the initial survey package, recipients were also sent a reminder letter (excluding intended recipients for whom undelivered surveys were returned by Canada Post). Recipients were also provided with an email address and contact telephone numbers to request assistance in completing the survey. 27 people requested some type of assistance or further information.

An online survey was available from January 25 to March 20, 2009. It was accessed via a University of Alberta website address linked to a secure site.

2.3.2 Survey Collection

In total, 1,062 surveys were returned. 1,014 were returned via mail, and 48 were completed online. Additionally 511 surveys were returned as undeliverable (14.2 percent of the distributed surveys). This resulted in a total response rate (for delivered surveys) of 34.4 percent. Of the completed questionnaires, 48 were either returned

blank³⁸ or without the required consent check-box checked on the front page. The total number of completed surveys with participant consent that were included in data analysis was 1,014.

2.3.3 Data Entry

All survey responses were entered into a single Microsoft Access database. Six graduate and undergraduate students entered the data, all of whom signed confidentiality statements prior to handling the surveys. A numerical coding frame was used to convert survey responses into coded data that could be analyzed statistically. A sample of the entered data was also randomly checked to ensure accuracy of data entry.

2.4 Data Analysis

Data analysis was performed at the University of Alberta using the Statistical Package for Social Sciences (SPSS) V.15. Following the development of descriptive statistics for the data, bivariate analysis was undertaken to identify any meaningful and statistically valid relationships. Given that the majority of the data being analysed was Normative or Ordinal in nature and that the primary goal of the analysis was to identify significant differences between groups of respondents, contingency tables were developed with chi square tests run for measures of significance. Chi square values and related measures of association were reported for all tests that had a meaningful result (including those tests where the demonstration of no statistical relationship being found was a meaningful result). Data tables are presented in Appendix Four.

³⁸ Respondents were asked to return the survey blank if they did not wish to fill it out or if it was not relevant to them.

3.0 Findings and Discussion

The research findings and discussion are presented in five sections: Demographics, Well Characteristics, Respondent Beliefs, Stewardship Practices, and Sources of Information for Respondents.

3.1 Demographics

The survey collected basic household data on participating households. This data was used to categorize groups of respondents (e.g., by age, property type) for comparative analysis purposes. Throughout this report, any instances of statistical and meaningful significance where demographics impact other relevant variables will be identified.

In this section, the basic descriptive data from respondents is presented. Inferential data regarding potential relationships with behaviour is addressed later in the document.

As can be seen in Figure 3-1, responses to the survey came from a diverse group of households, with almost half coming from working farms.³⁹

The survey asked respondents to identify the age of the oldest member of the household. As indicated in Figure 3-2, the survey respondents demonstrate a wide spectrum of ages. In Figure 3-3 it can be seen that survey respondents also present a diverse educational background.

Figure 3-1: Property Type

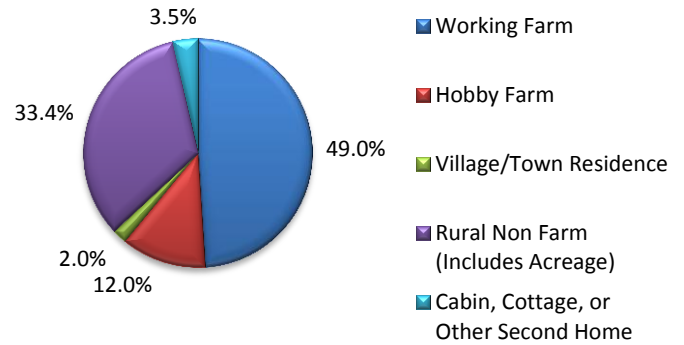


Figure 3-2: Age of Oldest Member of Household

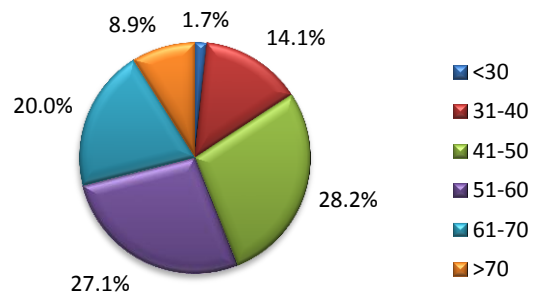
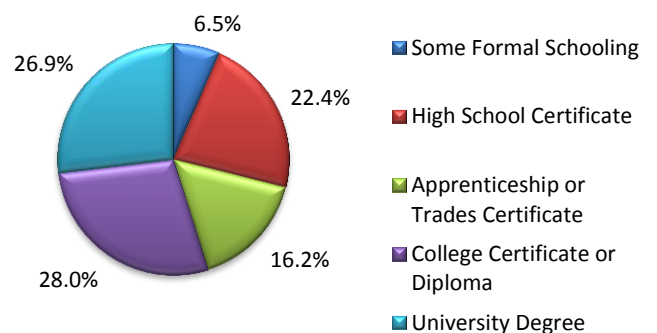


Figure 3-3: Highest Level of Education Attained



³⁹ Though respondents were free to interpret the terminology for this question as they liked, working farms are those residences where individuals earn a significant portion of their income from farming, whereas hobby farms are considered to be situations where farming income is not a major source of household income. Rural, non-farm properties are mostly made up of properties in rural subdivisions (often referred to colloquially as acreages).

Survey responses came from across the province in a manner representative to the density of water wells within the province (Figure 3-4). Survey response location was identified by respondents. Responses were reclassified into County/Municipal District level and plotted on the map.

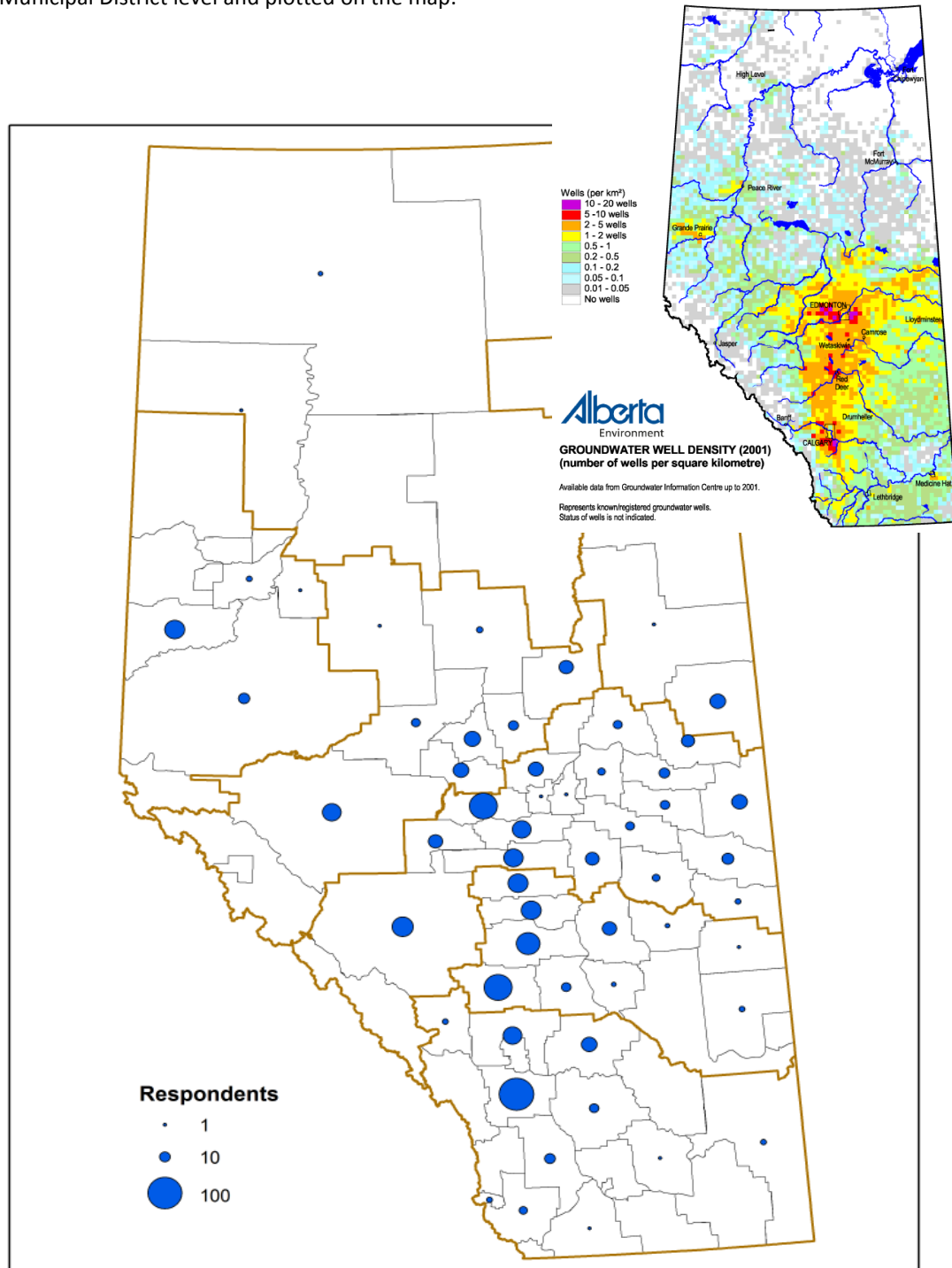


Figure 3-4: Location of Survey Respondents by County/Municipal District⁴⁰

⁴⁰ Alberta Environment, Groundwater Well Density, [map] Scale not given. "State of the Environment – Water" (2001)

3.2 Well Characteristics

Respondents were asked to focus on the well that provides water to their household. Well characteristics are important to demonstrate the diversity of wells represented and to assist with the analysis of other data. As can be seen in Figure 3-5, about six percent of the wells are large diameter wells.⁴¹ Figure 3-6 shows that the majority of survey respondents (58.3 percent) have a well that is less than ten years old, yet some respondents are relying upon wells of much greater age, with the oldest being 120 years old.

Figure 3-5: Well Diameter

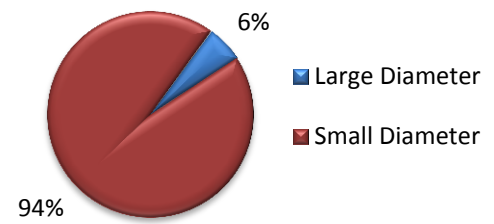


Figure 3-6: Age of Well

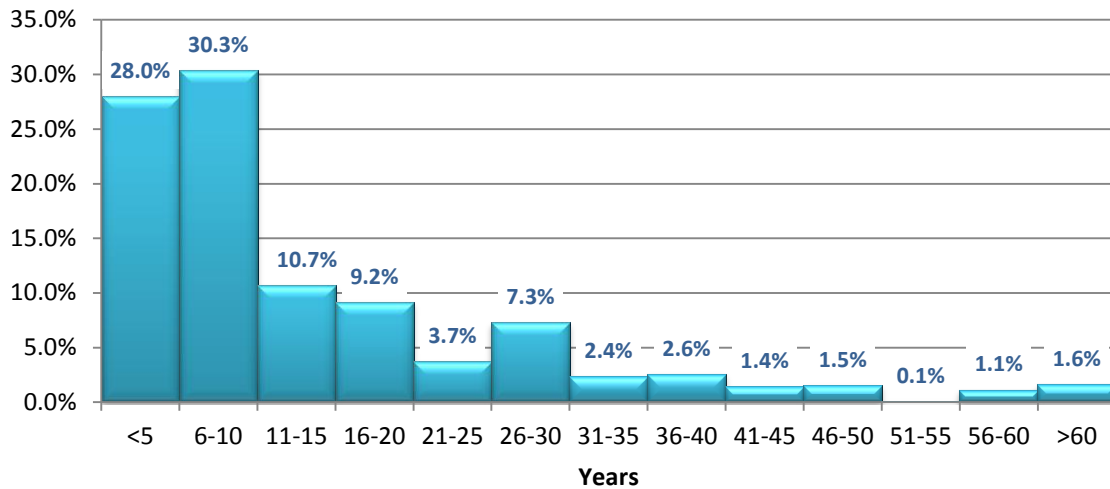


Figure 3-7, compares the survey respondents’ reported depths with the original sampling frame of 127,242 wells from the Groundwater Information System database. This was one of many tests run to identify if there was congruence between the sample and the sampling frame. Statistically, the respondent’s wells did differ from the Groundwater Information System database, but with large numbers of cases involved chi square tests are very sensitive to minor differences. The Cramer’s V value of 0.13 suggests only a small difference between the respondent’s wells and the wells in the Groundwater Information System database sampling frame. It can be seen that there are fewer shallow wells in the survey than the sampling frame. This could be explained by the tendency for wells constructed in recent years to be deeper than many of the wells in the 1960s and 1970s.⁴² While wells as old as 1968 were included in the sampling frame, many of those households may have replaced their wells and responded to the survey regarding their newer well. Given the similarity between the sampling frame and the respondent date, it appears likely that sampling and return process did not contain any meaningful bias.

⁴¹ Large diameter wells are typically bored wells, although some could be ‘dug’ wells. These are wells with a diameter greater than 12” in diameter. Most are shallow and used in low producing aquifers. The large diameter creates a cistern for the incoming water so that there is a reservoir for the household.

⁴² In the Groundwater Information System database sampling frame, the average depth of wells from 1968-2008 was 168.2 feet, but from 1998 to 2008 the average depth increased to 176.7 feet. This is very close to the average for the respondents of 178.9 feet.

Figure 3-7: Well Depth: GIC Database vs Respondents

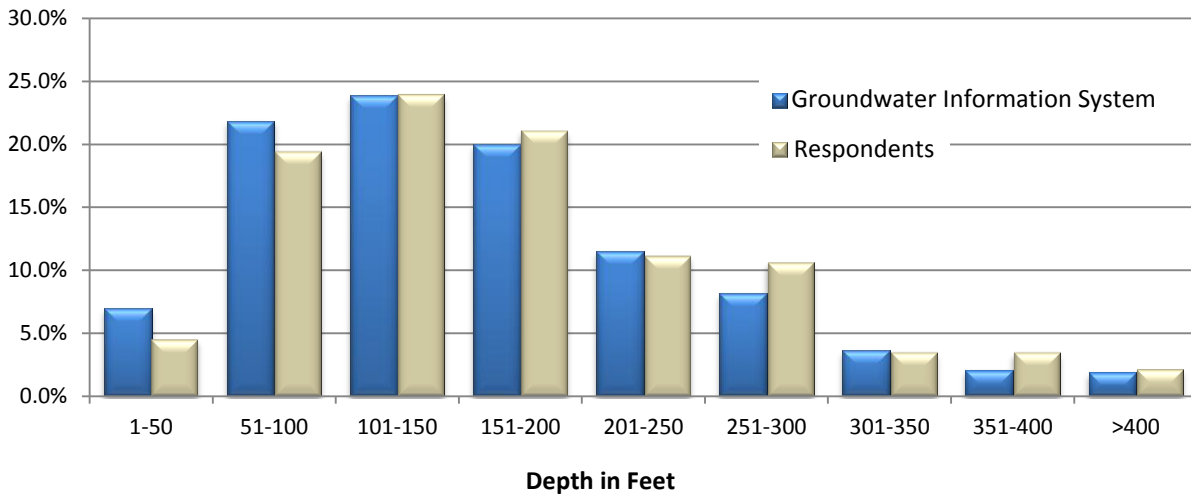
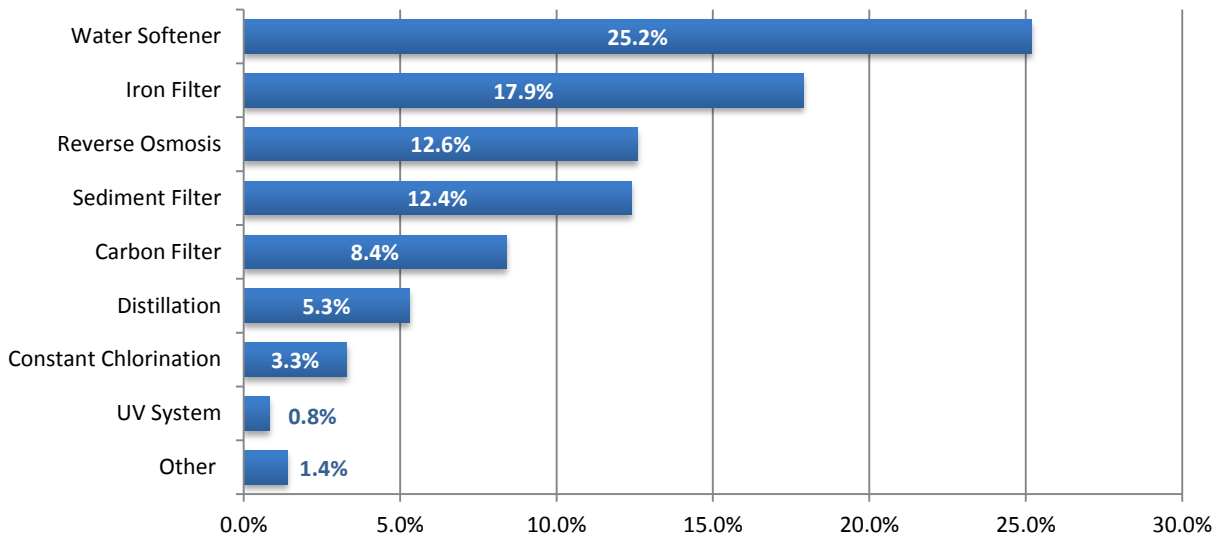


Figure 3-8: Prevalance of Treatment



It was found that 59 percent of wells had some form of water treatment system. Figure 3-8 outlines the prevalence of different types of treatment systems. The data represents the percentage of households that have the specific type of treatment system listed. For example, approximately one in four households have a water softener. Many wells have more than one treatment system.

3.3 Well and Groundwater Knowledge/Beliefs

This section presents the findings of a number of questions that explored individual beliefs and attitudes with regards to water wells and groundwater. At the end of this section is a brief discussion regarding the relevance of this data for encouraging stewardship. This data will also be used throughout the remainder of the document to explore factors that influence stewardship.

Figure 3-9: Water Preferences and Safety Perceptions of Respondents

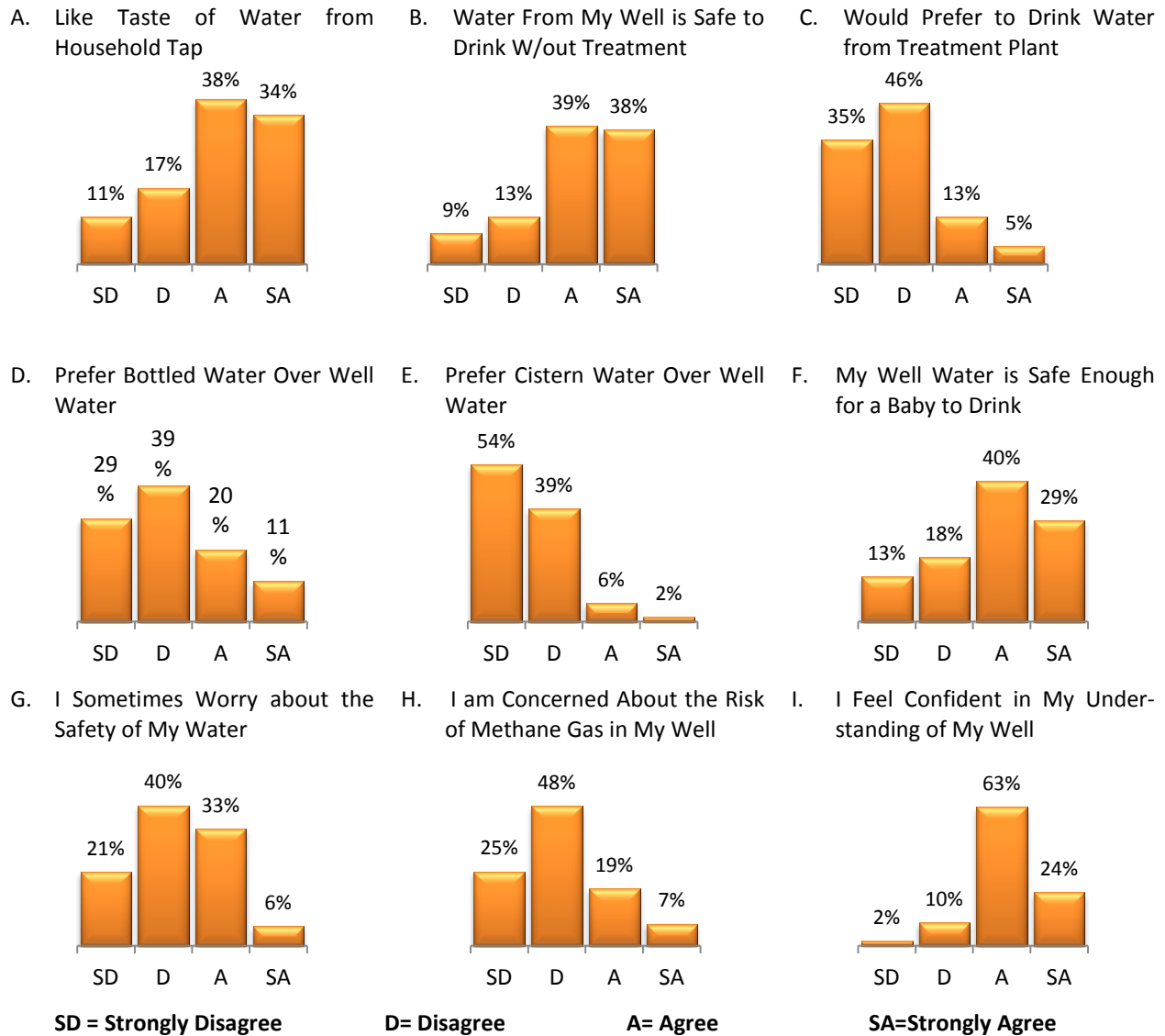


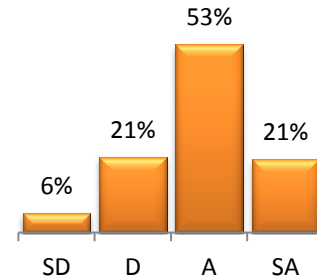
Figure 3.9 explores responses to a number of Likert-like scale items that were presented in the questionnaire. The response to many of the questions indicate that about 60 to 80 percent of respondents are satisfied with their water and feel that it is safe. There is also an indication that most respondents feel confident in their understanding of their own well.

In examining age and education levels against the information presented above (through contingency tables and chi square measures), no meaningful and significant relationships were found. There was however one striking difference between property types. Both hobby farms and working farms were half as likely as non-farm residents

to dislike their water or feel unsafe with it. At the same time farms were far less likely to prefer other sources of water over well water.⁴³

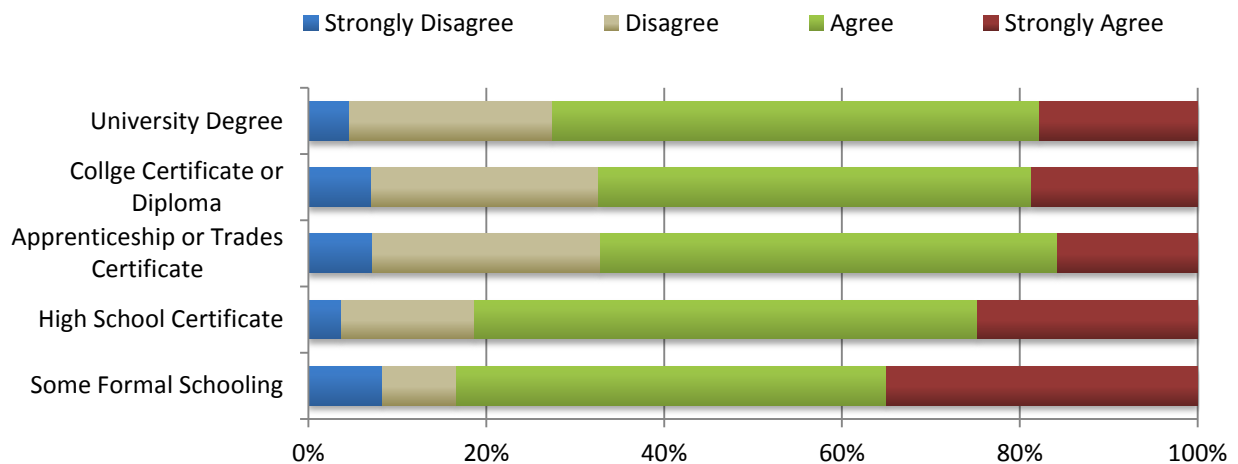
A core goal of the Alberta Water Well Survey was to assess factors that influence the stewardship behaviours of respondents. One of the fundamental elements is the simple question of whether preventative maintenance is considered to be valuable to undertake. Almost three quarters of survey respondents (74 percent) indicated that they believed that their well should be left alone unless they have a problem (see Figure 3-10). This is a particularly important constraining factor for encouraging stewardship. It indicates that there are a substantial number of individuals who have beliefs about their own situation that are directly in contrast with the principles of preventative maintenance.

Figure 3-10: It is best to leave my well alone unless something is wrong with it.



Cross tabulations were run against this finding to determine if age, education levels, property type, or location within the province made any significant difference in attitudes regarding the need for preventative maintenance. The only relationship that is statistically significant is a moderate strength relationship between education levels and the belief that wells should be left without preventative maintenance (Figure 3-11). Those with apprenticeship or trades certificates are the most likely to believe that preventative maintenance is good practice, while those with only some formal schooling are least likely to believe in preventative maintenance. It should be emphasized here that this is only a moderate influence and that the groups are more similar than they are different. There was no relationship between geographic location and these beliefs.

Figure 3-11 - Wells are Best Left Without Preventative Maintenance



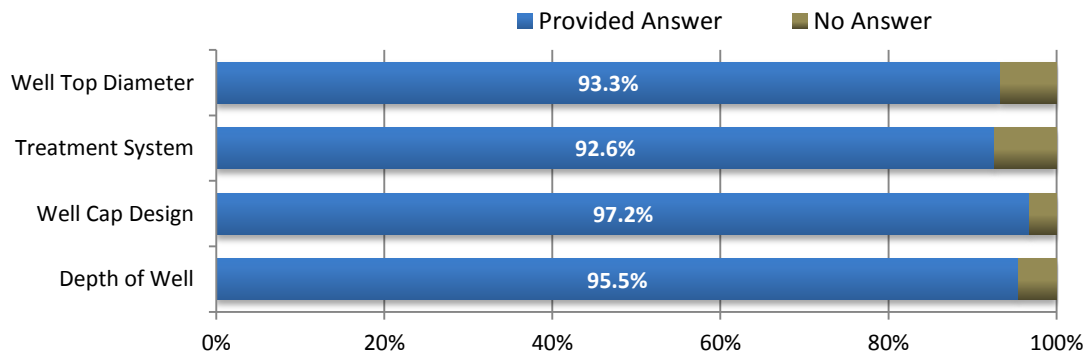
$\chi^2 = 24.63, D.F.=8, p=0.001$ Cramer's V = 0.136

⁴³ For example in comparing these groups for preference to drink water from a treatment plant, 11.7 percent of working farms preferred treated water versus 24.0 percent of non farm residents. $\chi^2=87.98, df=4, p<0.00, Cramer's V=0.31$

3.3.1 Knowledge Regarding Own Well

The survey asked a number of questions regarding the respondents' wells. Respondents were free to choose "I don't know" or to simply leave a question blank if they were not able or willing to answer it. As can be seen in Figure 3-12, most respondents were willing and able to answer questions about their wells with regards to depth, diameter, the well cap, and any treatment systems. These are basic facts about the well and it is important that all households are aware of them.

Figure 3-12: Able and Willing to Answer



Upon completion of the construction of a new well, water well contractors are required to provide the owner and the Government of Alberta with a copy of their water well drilling report. Respondents were asked if they had a copy of this report for the household well. Just over half of respondents noted that they did have such a report. As these requirements have changed over time and reports were not required until the 1970's, the data for wells less than ten years old was also reviewed. Figure 3-13 shows that almost 9.4 percent of respondents do not have a water well drilling report for their well and another 7.4 percent don't know if they have a copy of the report.

Figure 3-13: Respondent Has Copy of Driller's Report

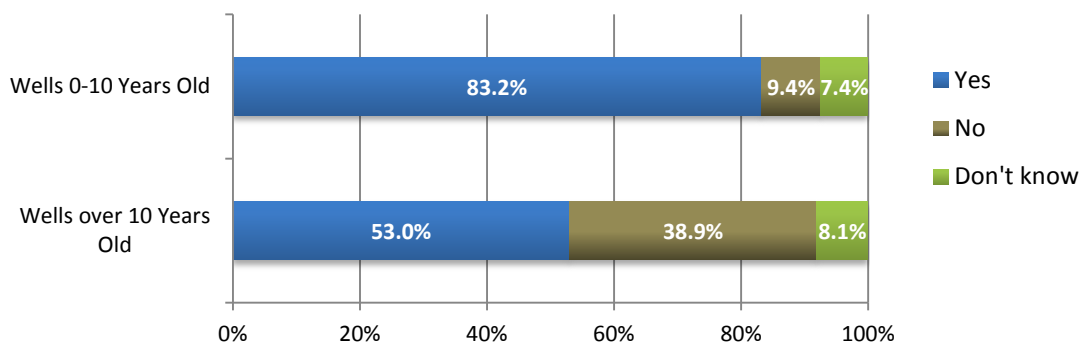
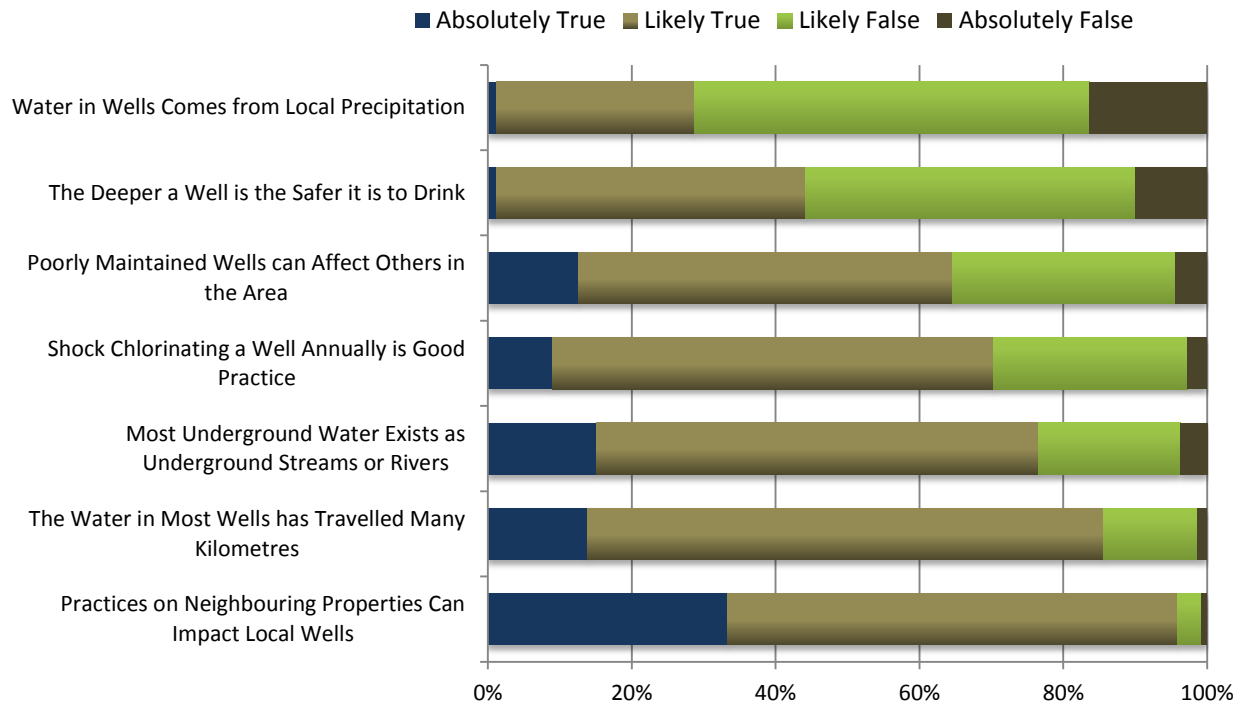


Figure 3-14: Beliefs about Wells and Groundwater



Respondents were asked to respond to various statements and indicate whether they thought the statements were true or false. As they were encouraged to give their *opinion, preference, or best guess* they were also able to express a sense of the strength of confidence in their beliefs through using the qualifier ‘absolutely’ or ‘likely’ in front of true or false. Figure 3-14, demonstrates that most respondents chose to answer with the less certain response of ‘likely true’ or ‘likely false’. This suggests that for most of the questions, respondents felt at least some uncertainty in responding. This is despite 87 percent of respondents indicating that they ‘feel confident in their understanding of their water well’ (see Figure 3-9). So, it may be that respondents feel a general level of confidence in their understanding of their well itself, but are less certain when it comes to specifics of the source of their water. Individuals may draw their confidence from their knowledge about well specifics as discussed on the previous page.

An interesting finding from these questions relates to the source of groundwater. There is the widely held belief that groundwater travels mostly in underground streams or rivers (76.6 percent suggest this is true). There is also a wide belief (85.6 percent) that it usually travels many kilometres prior to reaching the well. Lastly, there is a distrust of the opposing statement that indicates that water in wells usually comes from local precipitation. The perceptions of the respondents suggest that they have a poorly informed understanding of groundwater flows. In the vast majority of cases, water does not flow in underground streams or rivers. Yet, this belief appears to be widely held. It is something that is supported by the traditional beliefs in water divining/witching, which was mentioned by a large number of respondents in the discussion of locating their wells.

Interestingly enough, the belief in underground rivers has not seemed to discourage people from believing that local practices in neighbouring yards (95.9 percent) and with neighbouring wells (64.6 percent) can have a significant impact upon the local water supply. So, while it may seem as though the traditional beliefs in underground rivers and streams originating a great distance away is incongruent with concern over local practices, the survey does not bear that out.

There were no meaningful relationships between these variables and demographic factors (age, property type, education level) or with geographic region.

3.3.2 Respondent's Well Use

The survey investigated some of the elements of well use, particularly with regards to the decision to drink water from the well or not. As will be seen later, this provides insight into some of the factors behind stewardship behaviour.

Figure 3-15: Use of Well for Drinking Water

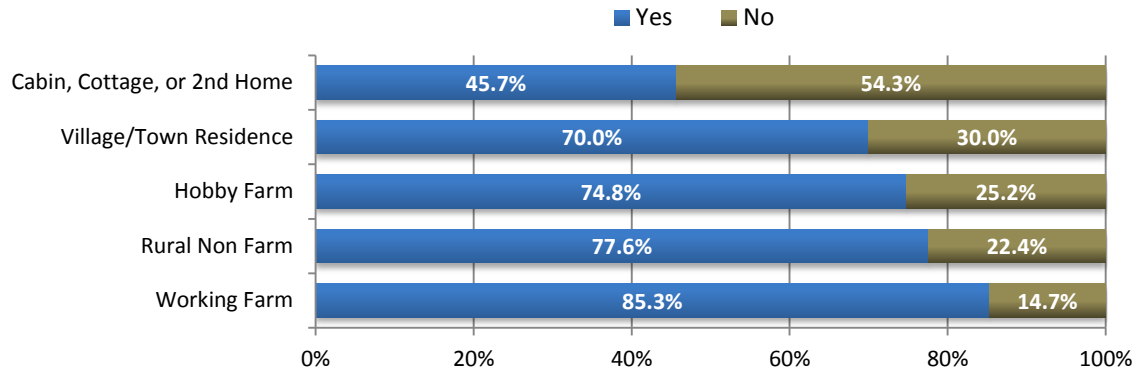


Figure 3-15, demonstrates some differences in which households choose to use water from their well for drinking purposes. Relative to the other property types, those individuals making use of cabins, cottages, or second homes are less likely to make use of their water source for drinking.⁴⁴ In a separate comparison between working farms, hobby farms, and rural non-farm residences, it was found that working farms are slightly more likely to depend upon their well as a source for drinking water than the other two types of residents.⁴⁵ This corresponds to data presented earlier suggesting that farm owners were more likely than others to prefer their well water over other options.

Figure 3-16: Relationships Between Perceptions of Safety & Taste or Use of Well for Drinking Water

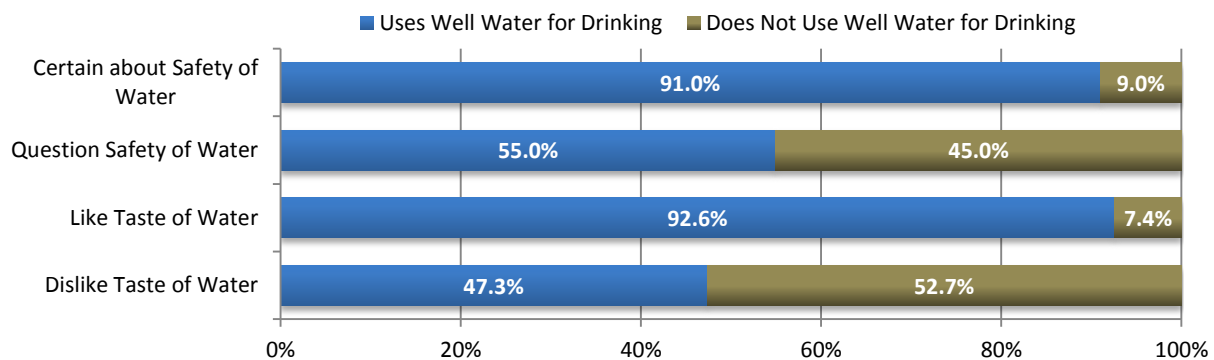


Figure 3-16 was developed by comparing questions regarding respondent's trust in their water supply and questions regarding respondent's taste and relating these to the household's use or non use of their water well as a drinking water source.⁴⁶ There was a strong relationship between taste and the use of water for drinking⁴⁷ and a

⁴⁴ $\chi^2=26.52$, $df=1$, $p=0.00$, $\phi=0.19$

⁴⁵ $\chi^2=11.37$, $df=2$, $p=0.03$, Cramer's $V=0.11$

⁴⁶ Note: These tests used Questions 11a and 11f from the survey and amalgamated responses into agree or disagree. Similar results were found for q11b.

⁴⁷ $\chi^2=256.08$, $df=1$, $p<0.000$, $\phi=0.507$

moderately strong relationship between safety concerns and use of the well for drinking.⁴⁸ Other factors relating to demographics and beliefs and values regarding wells (q22⁴⁹) found no relationship with whether or not households used their well as a source of drinking water.

3.3.3 Discussion

A number of key points stand out from this section. They are organized below by some of the relevant concepts discussed earlier. Many of these points will be revisited in later sections.

Satisficing, Risk Perception, and Procrastination

The majority of individuals who rely upon their well as a source of drinking water are currently *satisfied* with their situation. Most indicated that their water is safe without treatment and a majority indicated that their water would be safe for a baby to drink. Given that studies in Alberta and elsewhere have demonstrated that 20 - 40 percent of private water wells produce water that falls outside of safe drinking water standards, such certainty by well owners can only be justified if individuals undertake regular testing of wells. Alternatively, this may be a case of satisficing where owners have simply adopted a particular belief about their well without giving it adequate consideration and without developing a strong enough knowledge base to accurately make their assessment.

Most individuals (87 percent) are confident about their understanding of their well. However, most also demonstrated some significant shortcomings in their knowledge of some basic elements of water wells, maintenance, and groundwater flow. Again, this level of self satisfaction with their own level of knowledge suggests that respondents are satisficing by accepting a particular level of personal knowledge.

It was found that almost three quarters of individuals *believe* that it is best to leave their well alone unless they have a problem with it. The predominance of this belief crosses all spectrums of property types, geographic locations, age groups, and education levels. This, however, is countered by other responses, such as almost 70 percent believing that annual shock chlorination in general is likely good for wells. This suggests that individuals have difficulty identifying personal risk, but may be much better at identifying the risk facing other individuals. It may also indicate the prevalence of procrastination preventing people from doing what is in their own best interests. All of this will be explored later in this document when actual behaviour is considered.

These issues of satisficing amongst respondents pose a challenge for education and outreach efforts. It may suggest that most well owners are not actively looking to learn more about their wells and well stewardship. This means that education and outreach efforts must do more than improve access to information; it must also develop ways to reach well owners who may not be currently seeking more information. Thus, there is a role for promotion of stewardship alongside the role of providing instructional information.

Normal Beliefs and Behaviours

For many issues, there are a wide range of beliefs amongst respondents. Furthermore, opinions on issues are not that strongly held (with a few exceptions). In most of the questions specifically dealing with knowledge about wells and groundwater, less than 15 percent of respondents indicated *absolute confidence* in their answers. This suggests that the societal belief system is fairly permissive at present and that there is a breadth of acceptable beliefs regarding things like groundwater flow and the benefits (or lack of) of preventative maintenance. Today, if the same type of question were asked about the linkage between smoking and cancer, it is very likely that respondents would indicate a much greater level of confidence. The smoking-cancer link is an example where a

⁴⁸ $\chi^2=171.45$, $df=1$, $p<0.000$, $\phi=0.415$

⁴⁹ Note: These numbers refer to the questionnaire in Appendix Three.

much narrower range of beliefs exists. The goal for programs like Working Well, is to narrow the range of prevalent beliefs and behaviours regarding water wells to be more congruent with the principles of good stewardship.

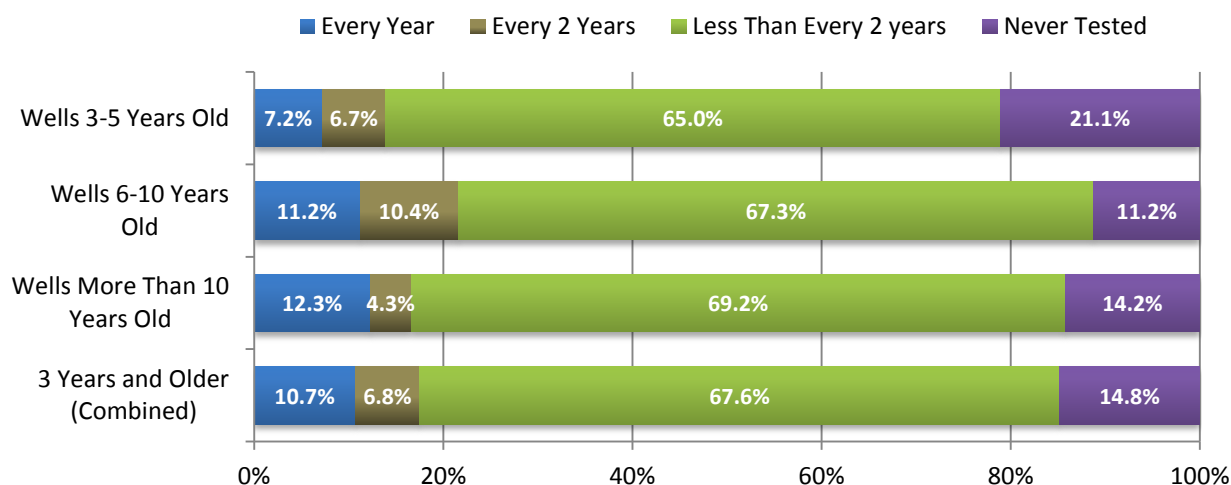
3.4 Stewardship Practices of Respondents

A key element of the research was to identify household behaviours with regards to preventative maintenance, a core component of good stewardship.

3.4.1 Water Quality Testing

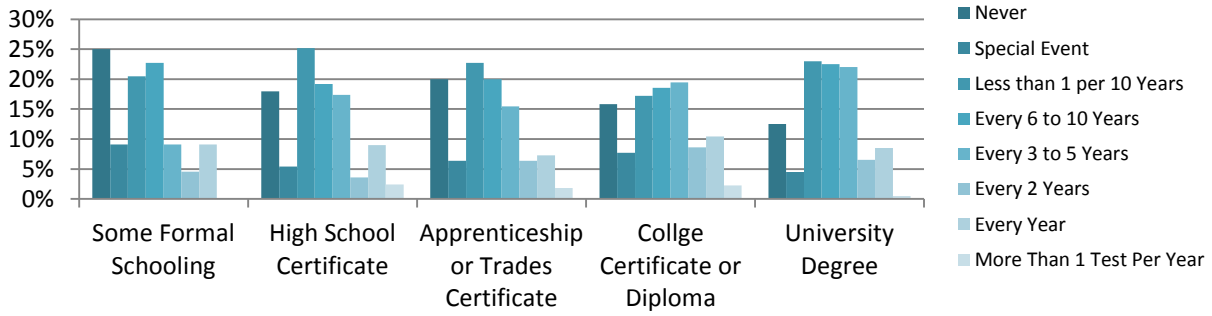
The WWLG manual recommends that homeowners send in a water sample from their well for bacterial analysis every year and for chemical analysis every three years. Our survey found that 84 percent of respondents had tested their water at least once and that another ten percent have considered having their water tested. The frequency of water testing was explored for wells that were three years of age or older. It can be seen that 10.7 percent of respondents are testing their water on an annual basis as recommended by the WWLG manual. Another 6.8 percent are testing their wells approximately every two years. As can be seen in Figure 3-17, the age of household wells does not seem to have a meaningful impact on the behaviour of households with regards to water quality testing. Owners of new wells are no more likely to test their water than those with an older well. This suggests that there could be improvements made in contractor messaging to well owners when wells are constructed.

Figure 3-17: Frequency of Water Quality Testing



The frequency of water testing by households was unrelated to most of the other measured factors in the study. There was no relationship found between demographic factors (farm type, age, education level) and testing. Figure 3-18 is an example of the similarity of behaviours across different groups. There was also no relationship to beliefs about well maintenance (q11j), sense of safety regarding their well water (q11b, q11f, q11m), preference for different types of water (q11c, q11d, q11d), or with regards to their beliefs and knowledge about how wells function (q11n, q22a, q22b, q22d, q22e, q22f and q22g). This lack of a relationship between testing and an individual's beliefs again suggests that other factors (e.g. norms, habits) are more important than specific beliefs with regards to behaviour.

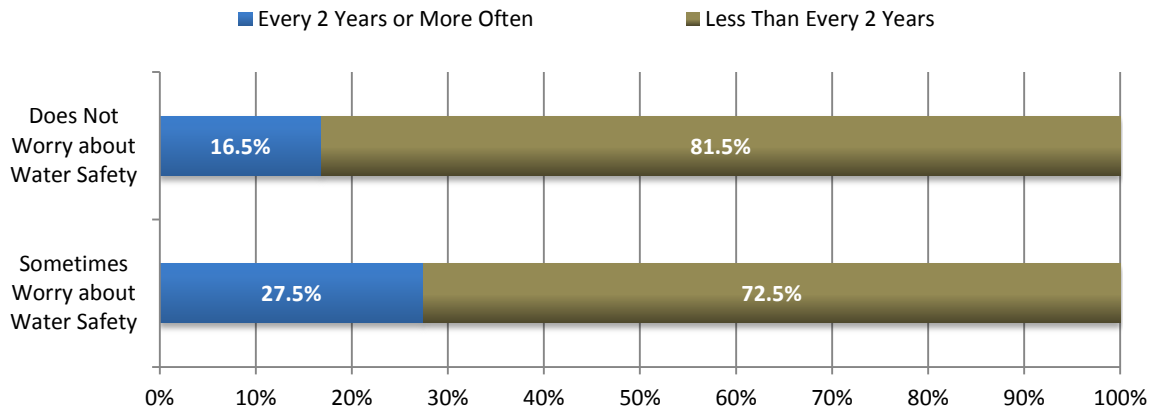
Figure 3-18: Water Testing Frequencies by Education



$\chi^2 = 24.316, D.F.=28, p=0.665$

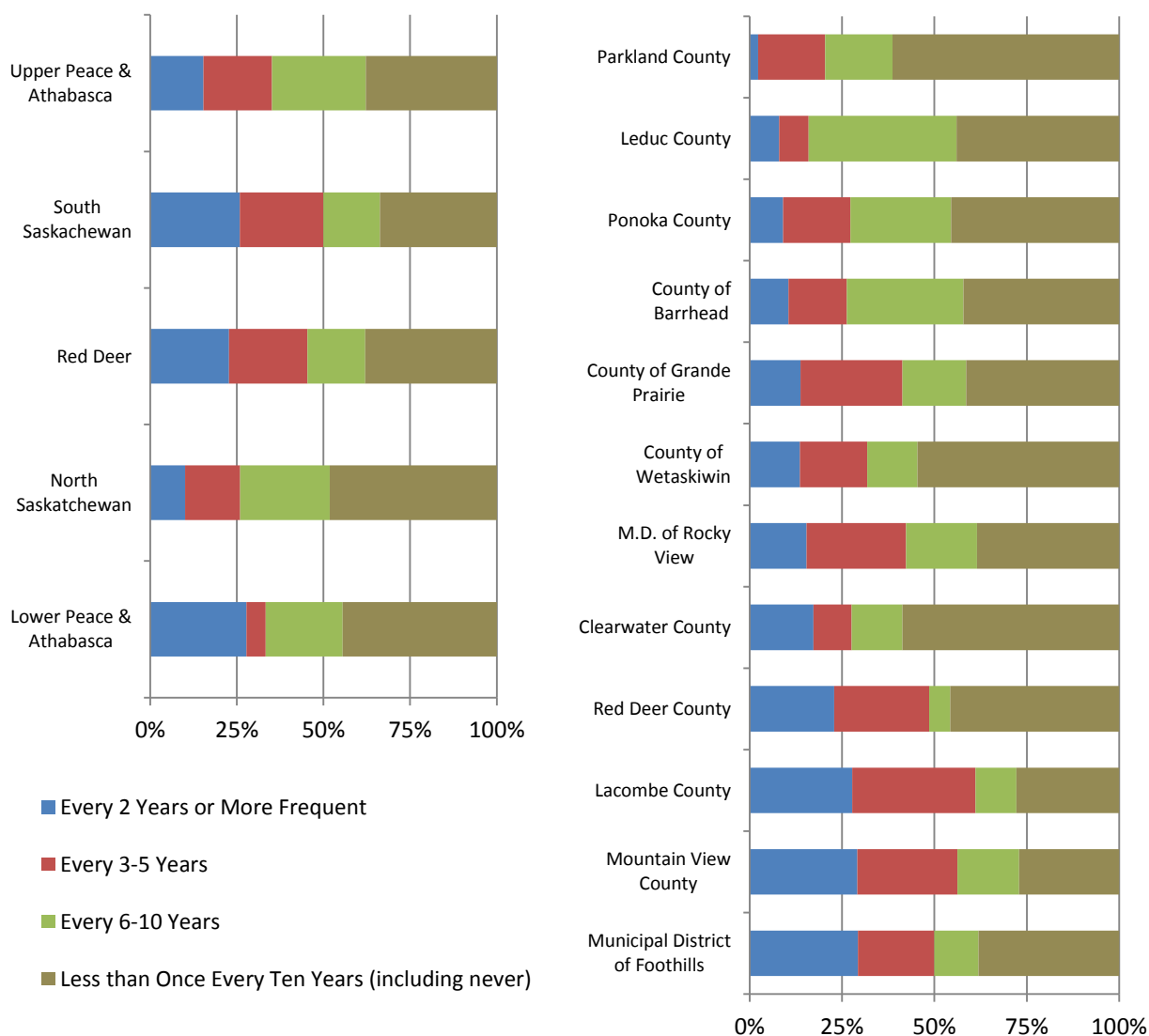
A statistically significant relationship was found between regular water quality testing and individuals who suggested that they sometimes “worry about the safety of their water”. These individuals were about twice as likely to test regularly. As such, health concerns regarding water can influence individuals to test their well water. This relationship is shown in Figure 3-19 and is discussed further in Section 3.4.2. This indicates that a primary factor influencing water quality testing is concern regarding the safety of water. Yet, even amongst this group only 27.5 percent test their water on a bi-annual basis or more frequently.

Figure 3-19: Water Quality Testing Relative to Concern Over Health Issues



$\chi^2=13.02, df=2, p=0.001, \text{Cramer's } V=0.147$

Figure 3-20: Testing of Well by Region and by County/M.D.



Note: Geographically smaller communities have been included within the County/M.D. that surrounds/borders them. Only those areas with more than 20 respondents having wells more than five years of age are included in this chart. Sample size is too small at County level to undertake statistical testing to determine significance.

The regional analysis shown in Figure 3-20 also demonstrated a statistically significant relationship. This suggests a difference between testing practices among regions.⁵⁰ The North Saskatchewan region saw fewer individuals undertaking regular testing (one or more tests every two years) than other regions. This is further demonstrated by the map displaying municipal level data (Figure 3-21). The municipalities presented here were not tested as inclusive cross tabulations for statistical significance as a whole due to limited sample size. However, when compared to one another, many municipalities do demonstrate significant differences. Comparing the two areas with the highest number of surveys returned, Parkland County (n=49) and the M.D. of Foothills (n=90) demonstrates a moderately strong relationship.⁵¹ This suggests that there may be geographic factors influencing the practice of water quality testing though the small sample size makes it difficult to be certain. It may be worth undertaking further investigation to identify if causes can be identified for the differences observed.

⁵⁰ $\chi^2 = 35.81$ DF= 12 p <0.000 Cramer's V=0.14

⁵¹ $\chi^2 = 13.59$ DF= 3 p <0.004 Cramer's V=0.321

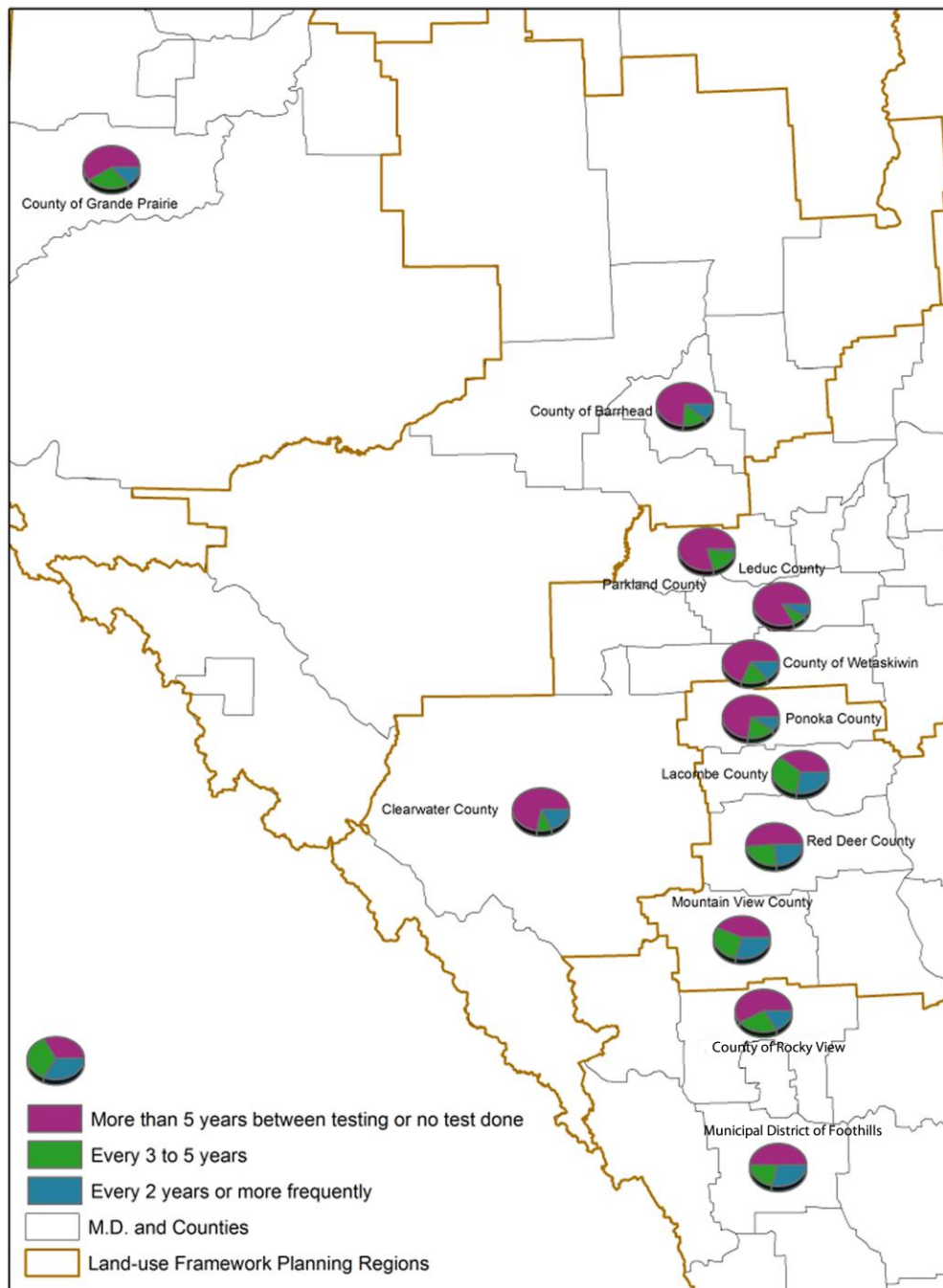
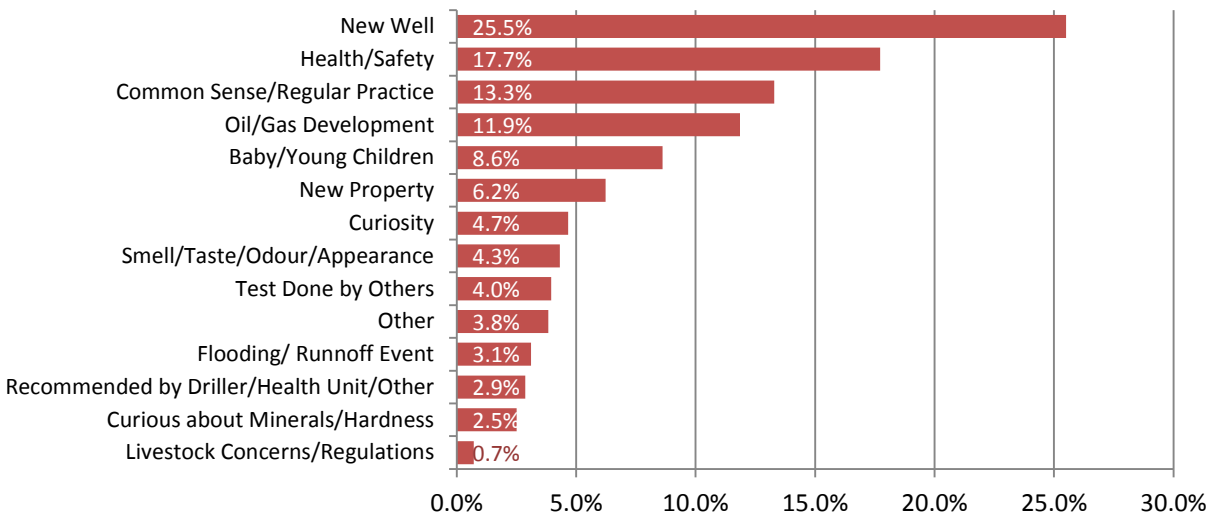


Figure 3-21: Survey Respondent's Frequency of Testing by County/Municipal District

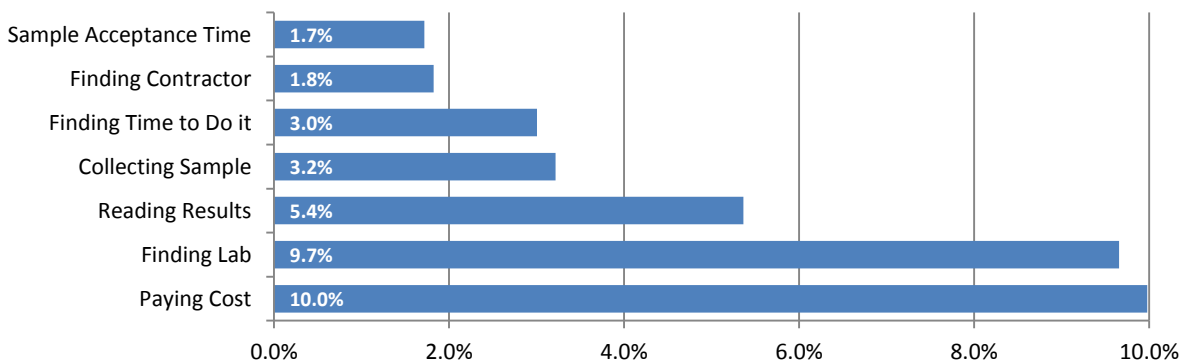
Figure 3-21 shows the frequency of testing for counties with greater than 20 respondents that have wells greater than five years of age. Regions surrounding Edmonton appear to have a fewer number of regular testers of water than those in the southern regions of the province.

Figure 3-22: Motivation for Well Water Testing



Respondents were asked, in an open ended question, what motivated them to test their water (Figure 3-22). Responses were coded by keyword without additional interpretation imposed. Thus, while health and safety was a response provided by 17.7 percent of respondents, it is very likely that respondents indicating Baby/Young Children (8.6 percent) are also concerned about health and safety. There are a number of primary influences that were given; with most fitting into concerns regarding health, the notion that regular testing is simply common sense, a general desire for information about the water quality, and concern over events nearby including flooding and oil and gas developments.

Figure 3-23: Difficulties Faced in Getting Water Tested



The survey asked those respondents who have tested their well water and those who have considered testing it to identify any problems they have faced (see Figure 3-23). Twenty five percent of respondents faced one or more difficulties. The chart shows the percentage of people who listed each of the difficulties presented. The most common difficulty was paying the cost of testing followed closely by the difficulty of finding a lab to get testing done. Survey respondents were also asked if they knew where to get their water tested and 93 percent of all respondents indicated that they did know where to go.

3.4.2 Discussion

The number of respondents testing on a frequent basis (at least once every two years) is lower than it was in the 2001 Farm Environmental Management Survey. The majority of wells were either not tested or only tested when the well was drilled. When this information is considered, along with the level of comfort respondents have with their water supply, it suggests respondents believe that their wells are safe without actually having adequate information to justify that belief. It could be suggested that there is a false sense of security amongst well owners. Some specific factors relating to this are examined below.

3.4.2.1 Geographic Influences

Belief and behaviours frequently have geographic characteristics. This study examined how the geography of respondents related to their behaviours. For most beliefs and values there was little difference, but there were significant differences when water quality testing was examined.

Some municipalities, such as the M.D. of Foothills, have much higher rates of testing than some other areas, such as the County of Parkland. It may be valuable to identify if this is due to some specific efforts in those municipalities. It could be that the water well contractors in those areas are giving different advice, or it could be that health units are using different approaches to raise the awareness of the need for testing. Further investigation could be undertaken to identify if there are causal factors behind this difference.

3.4.2.2 Concern over Health Risk as a Motivating Factor to Undertake Water Quality Testing

The purpose of promoting regular water quality testing is to identify potential problems and reduce the risk that private well owners are exposed to. Such an approach represents a scientific evaluation of the risk posed and an economic consideration of the costs of testing. In other words, from the view of education and outreach programs, regular water testing would appear to be a logical thing for most well owners to do.

Concern over the potential health risks faced when using a public well was found to be a significant factor that influenced whether or not people get their wells tested. This was demonstrated in Figures 3-19 and 3-22. The written responses presented in Figure 3-22 suggest that concern about health risk was the most important factor motivating well owners to undertake water quality testing. Considerations regarding the promotion of water testing are considered in Table 3-1 and the ensuing discussion.

Table 3-1: Frequency of Water Testing for Wells vs. Concern over Safety of Water

Frequency of Testing ⁵²	I Sometimes Worry About the Safety of My Water	
	Agree	Disagree
Tests Water Regularly (more than once every two years)	Group 1 59 Respondents 9.3%	Group 2 72 respondents 11.3%
Does not Test Water Regularly	Group 3 164 Respondents 25.8%	Group 4 340 Respondents 53.5%

⁵² Note that the statistics here differ from that presented earlier in Figure 3-9 because this table only includes those households that use their water well as a source of drinking water. Figure 3-9 included those households that use other sources for drinking water.

As can be seen in Table 3-1, respondents can be classified into four groups. Group 1 sometimes worries about the safety of their water and chooses to test on a regular basis. Group 2 does not worry about their water and tests on a regular basis. It is likely that the regular testing of their water provides a sense of comfort with it. Group 3 sometimes worries about the safety of their water and does not test and group 4 does not worry about the safety of their water and does not test.

Group 3 individuals have beliefs that support stewardship behaviour but fail to implement that behaviour. It could be that they are lacking information about testing, that the costs of testing are prohibitive, or that they are simply lacking the individual initiative and are procrastinating. The influence of these barriers are explored later in this discussion section.

Group 4 members, who make up more than half of all respondents, do not test and never have concerns about the health risks posed by their private water well. For this group, the most important barrier to testing is the belief that there is no need to test. They are satisfied with their situation because their *beliefs* indicate that their water supply does not pose a *risk* to them. Successful efforts to reach those in group 4 will require a shift in beliefs about the risks posed by their private water well.

3.4.2.3 Other factors Influencing Water Quality Testing

Costs/Benefits

Only one in ten respondents reported cost of testing as a potential barrier. As such, its importance as a barrier should not be overemphasized.

Others reported costs were time-related (e.g. time barriers, getting time off work). Such issues are difficult to address and only affected a small number of people so they will not be addressed further here.

Information

Ten percent of respondents indicated that they had difficulty finding a laboratory for the water tests. Improving public knowledge with regards to accessing water quality testing could help address the concerns of these individuals.

Satisficing, Poor Risk Perception, and Procrastination

Given that most of Group 3 respondents did not indicate any specific barriers to testing, it is possible that *satisficing* and *procrastination* may play a role. As such, the challenge is to identify ways to motivate these well owners. This could be done by attempting to strengthen their existing concerns over water safety. It could also be done with more frequent reminders to test their wells. This latter approach is similar to reminder cards used by dentists for checkups or perhaps the approach used by fire awareness campaigns that tie battery checking in smoke detectors to the biannual time change.

Normal Practice

Another important factor identified by residents who did undertake testing (Groups 1 and 2) was the belief that testing is a part of regular practice – it is simply common sense. This indicates that for a certain part of the population, testing their water was seen as being *normal behaviour* and that not doing so was abnormal behaviour (even if they were aware that such behaviours were common). This is an important element to build upon. A key part of successful outreach is to shift the perception of what is ‘normal’ behaviour among well owners. This is similar to campaigns that have been undertaken to de-normalize drinking and driving.

The early adopters identified in Groups 1 and 2 in Table 3-1 are of significant value to education and outreach efforts as they can be used to demonstrate that, for a portion of the population, the testing of water is normal behaviour. The fact that one in five water well owners (of those who use their well for drinking water) tests their water on a regular basis could be promoted to help establish this as normal behaviour for many people. When this behavioural norm is attached to an injunctive norm (i.e. something that is perceived as being good to do) it should create a powerful message to well owners. An example statement might be: **“One in five well owners in Alberta test their well water quality on a regular basis. This is an easy and important way in which they protect their own health and the health of their family.”**

Demographic Factors

Demographic factors were not found to be a significant influence on behaviour. This suggests that practices of water testing are similar across diverse groups of respondents.

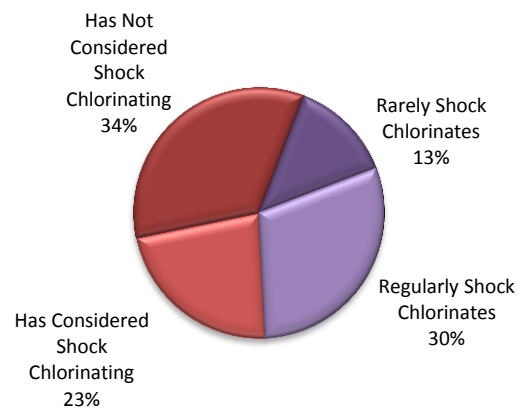
3.4.3 Shock Chlorination

The WWLG manual recommends that households shock chlorinate their well once or twice a year. As can be seen in Figure 3-24, only 43 percent of respondents with wells over three years old have ever shock chlorinated their well (excluding the initial shocking by the drilling contractor). Only 30 percent of respondents indicated that shock chlorinating their well was something they did on a regular basis.⁵³ Another 23 percent of respondents have considered shock chlorination, but have not done so. Most respondents (78.4 percent) who shocked their well did it themselves while the remainder hired contractors.

Respondents were asked to identify reasons for shock chlorinating their well. As can be seen in Figure 3-25, the primary motivation given was bacteria and health concerns.

The second most common motivation was nuisance bacteria such as iron bacteria. Respondents were also asked to indicate any barriers to shock chlorinating their wells (Figure 3-26). The most common barrier identified was finding information on the shock chlorination process.

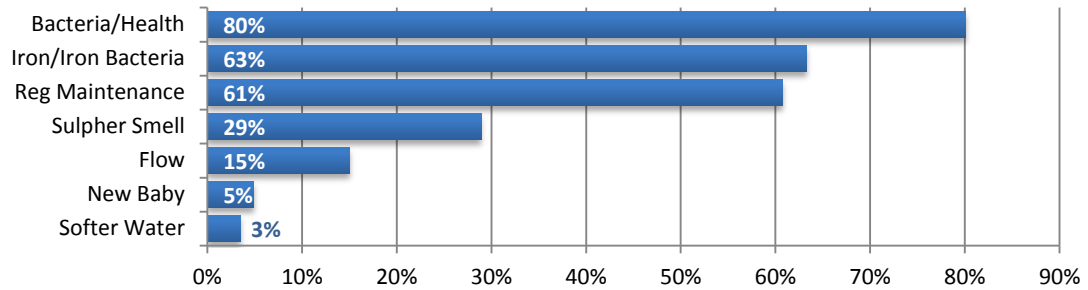
Figure 3-24: Shock Chlorination Practices For Wells Three Years and Older



⁵³ The question was open ended. The term regular practice here refers to people who responded with terms such as ‘regularly’ and ‘frequently’ and those that responded with frequencies greater than once every four years.

Figure 3-25: Motivations for Shock Chlorinating Well

Figure 3-25: Motivations Indicated for Shock Chlorinating Well



Tests were run to identify other factors related to the practice of shock chlorination. Again, there was no relationship between demographic factors. The level of similarity among groups is striking and graphs have been provided in Figures 3-27 and 3-28 to demonstrate how demographics are not a factor related to shock chlorination. Similarly, there was no meaningful relationship identified between geographic locations and the practice of shock chlorination.

Figure 3-26: Difficulties Faced With Regards to Shock Chlorination

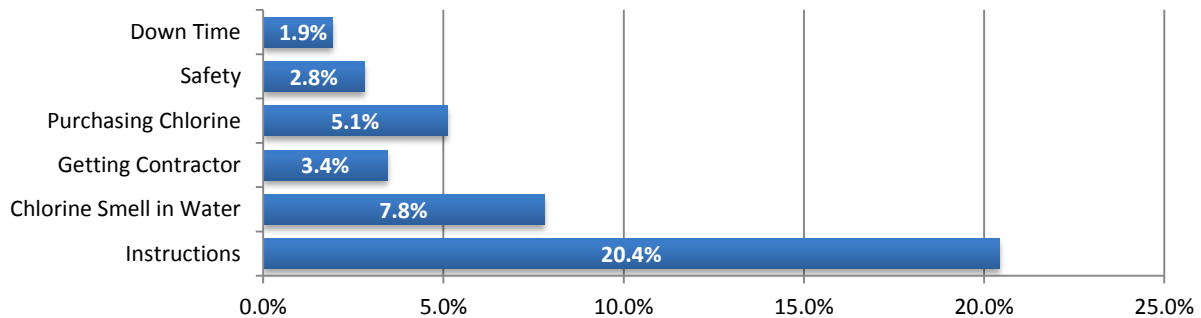
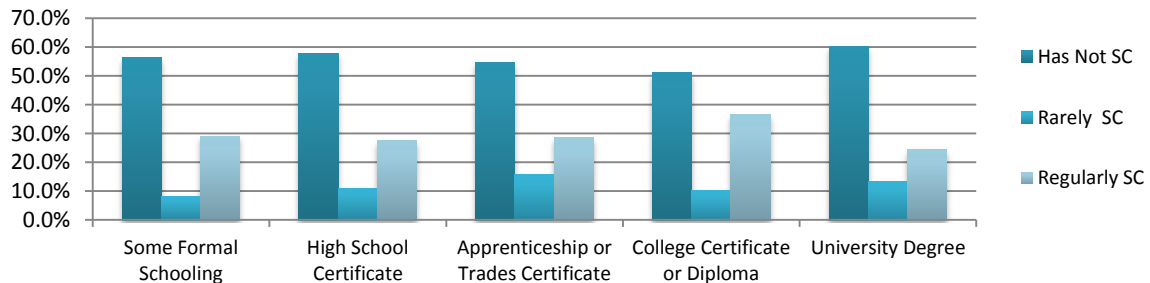
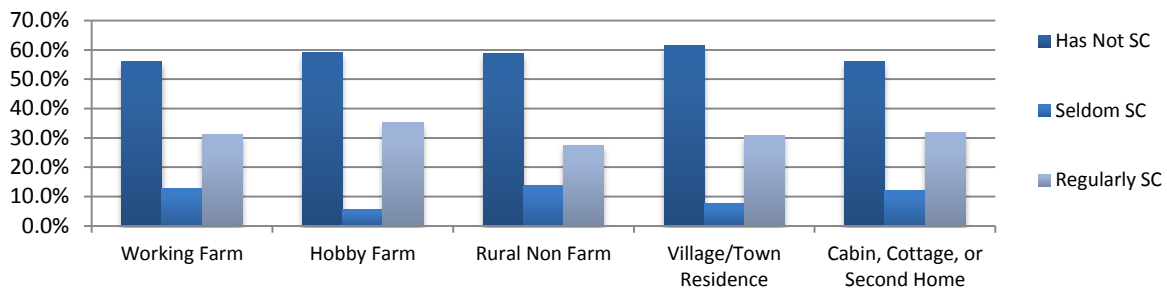


Figure 3-27: Shock Chlorination Frequencies by Education



$\chi^2 = 15.96, D.F. = 12, p = 0.193$

Figure 3-28: Shock Chlorination Frequencies by Property Type



$\chi^2 = 5.48, D.F. = 8, p = 0.706$

Tests were also run to see if there were any relationships between people’s beliefs about groundwater and well functioning (q22a, q22b, q22d, q22e, q22f, and q22g) and these did not show any relationship. Again, this indicates that beliefs about the functioning of wells and groundwater are not significantly related to stewardship behaviour. It was also found that respondents with treatment systems (including UV systems, R/O systems, and constant chlorination systems) were no more or less likely to regularly shock chlorinate their well than those without such systems. There were weak relationships between chlorination practices and health concerns such as how safe individuals felt drinking their water or providing that water to a baby.

The strongest relationships found regarding shock chlorination were related to beliefs about general maintenance, and beliefs about shock chlorination. Those individuals who felt that it was best not to undertake preventative maintenance (q11j) were less likely to regularly chlorinate their wells.⁵⁴ Those individuals who believed that shock chlorination was good for the well (q22c) were much more likely to do so than those that did not believe this.⁵⁵

3.4.4 Discussion

3.4.4.1 Well Owner Practices

The practices of most respondents fall short of recommended guidelines for shock chlorination. Less than one in three respondents shock chlorinate their wells on a regular basis. This suggests that education and outreach efforts are required to improve shock chlorination practices in Alberta.

3.4.4.2 Health Concerns and Concerns over Nuisance Bacteria

The most frequent factor identified by respondents who had shock chlorinated their well was a concern over health risks (biological contamination); this was closely followed by concerns over nuisance bacteria that cause taste and staining issues. As with water quality testing, outreach efforts could likely seek to raise awareness of the risks that are faced when using private wells and the approaches that can be used to mitigate such risks (such as shock chlorinating).

3.4.4.3 Beliefs Regarding the Benefits of Shock Chlorination

The survey directly asked respondents if they believed annual shock chlorination was good for wells. As can be seen in Table 3-2, this belief did not translate into action for many respondents.

⁵⁴ $\chi^2 = 37.17, df = 1, p < 0.000, \phi = 0.230$

⁵⁵ $\chi^2 = 104.76, df = 1, p < 0.000, \phi = 0.363$

Table 3-2: Frequency of Chlorination vs. Beliefs About Shock Chlorination (for Wells 3 Years or Older)

Shock Chlorination Practices	Shock Chlorinating your Well Every Year is Good For it	
	True	False
Regular Practice (at least once every two years)	Group 1 231 Respondents 29.0%	Group 2 11 Respondents 1.4%
Not Regular Practice (including Never)	Group 3 330 Respondents 41.4%	Group 4 225 Respondents 28.2%

In Table 3-2, Group 1 believe shock chlorination is good for a well and who regularly do so. Group 2 do not believe it is good for their well, but still do it as a regular practice. The 11 respondents in this group appear to either have misinterpreted the question or perhaps feel that it is best to only shock the well every two years (it is difficult to know). Group 3 are those that believe regular shock chlorination is good for the well, but do not regularly do it. Group 4 are those that do not believe regular shock chlorination is good for the well and choose not to do so.

Groups 1 and 2 are an important element that can be used to promote stewardship. Presenting the fact that 30.4 percent of well owners regularly shock chlorinate their wells may be a way of *normalizing* the practice. Group 4, with 28.2 percent of respondents, is a group that will require a change in *beliefs* about shock chlorination for individuals to adopt recommended stewardship behaviour. As mentioned in the previous section on water quality testing, this group is the most challenging to reach. It may be worth undertaking further research to identify why almost one third of people believe that shock chlorination is not good for water wells.

3.4.4.4 Other Factors Influencing Shock Chlorination Behaviour

The high number of people in Group 3 suggests that other factors such as costs, lack of information, satisficing, and procrastination may play a role in discouraging good stewardship.

Costs/Benefits

Cost was not identified by any respondents as a barrier to shock chlorination.

Information

More than one in every five respondents indicated that a lack of information regarding how to shock chlorinate their well was a difficulty that they have or would face. This is a good example of an area where increased access to information may result in an improvement in stewardship behaviour.

Satisficing and Procrastination

As with water quality, many people are satisfied with the state of their well. Some think that shock chlorination is a good idea, but fail to do so. Again, in addition to the provision of information, outreach programs may wish to make efforts at promotion (reminders and other approaches to raise the salience of the issue for well owners). Perhaps a reminder program based upon specific events, such as ‘going on vacation’ could be used to promote shock chlorination practices.

3.4.5 Unused and Abandoned Wells

Respondents were asked about any unused or abandoned wells⁵⁶ on their property. Abandoned wells pose a risk of acting as contaminant pathways from the surface or from other aquifers into aquifers of good quality. While there are many specific procedures involved in proper abandonment, the most critical element is to prevent the vertical movement of water.

Figure 3-29: Abandoned Well Status

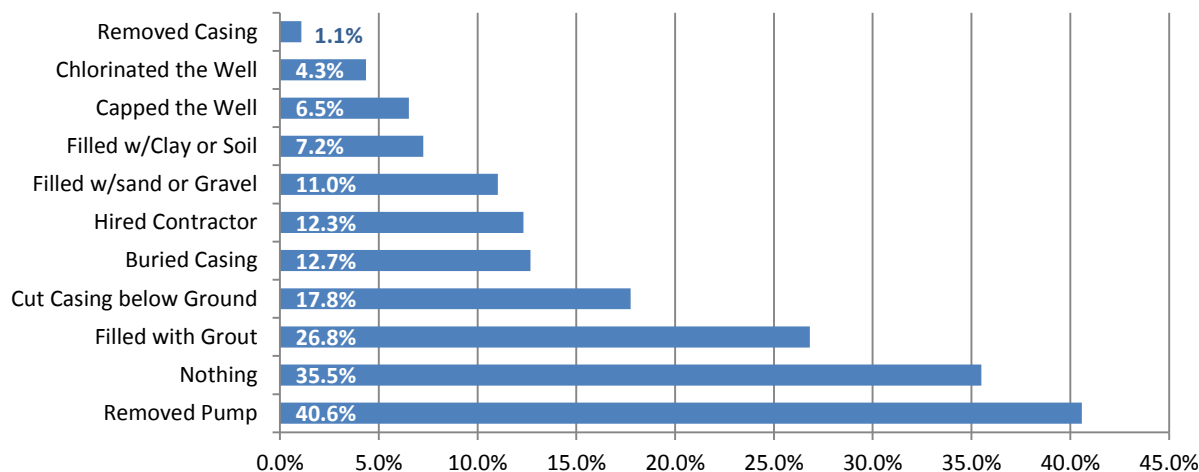
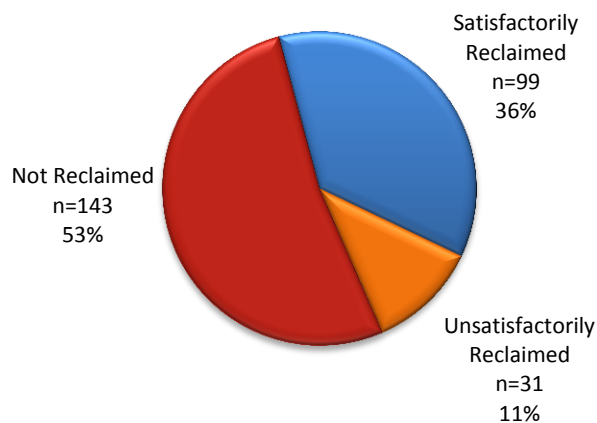


Figure 3-29, demonstrates the activities which people have taken to address existing abandoned wells on their property. Figure 3-30, was developed through undertaking a review of each abandoned well in the survey and labelling it as being one of satisfactorily reclaimed, unsatisfactorily reclaimed, or not reclaimed.

The standards used in the analysis to identify a well as being satisfactorily reclaimed center upon the well being abandoned by a contractor (with the assumption that it was done properly), filled with some form of bentonite product or natural clay, and with the casing either removed or capped in some fashion. Those labelled as unsatisfactorily reclaimed were filled with porous material. Those labelled as not reclaimed were either open to the surface or were an open pipe that has been capped and buried.

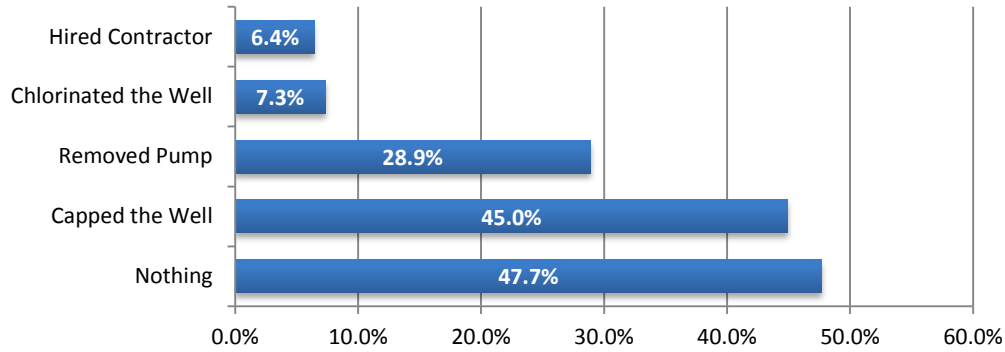
Respondents were asked to identify any difficulties or uncertainties they have faced or might face in reclaiming an abandoned well. Only a small number of respondents indicated difficulties here. Thirteen respondents identified the cost of reclaiming the well as being prohibitive (all statistics here are out of a total of 273 respondents who indicated that they had abandoned wells on their property). Twelve indicated that they did not have enough knowledge or information about how to go about reclaiming the well. Another 10 indicated specific technical problems they faced. Lastly, a small number indicated that they had difficulty finding a contractor (5) or finding bentonite products to fill the well with (2).

Figure 3-30: Abandoned/Reclaimed Well Status



⁵⁶ The phrase 'unused wells' is used here to refer to wells that are currently not in use, but that are expected to be in use in the future. The phrase abandoned wells are wells that are no longer in use and that the households do not expect to use again in the future.

Figure 3-31: Unused Wells



In addition to abandoned wells, survey results indicate that 218 wells were not currently being used, but were expected to be used again. Respondents were asked about the status of these wells. Almost half of respondents indicated that they had done nothing to their unused wells (Figure 3-31). Many of those respondents indicated they were keeping the well in case of a future need. It can be anticipated that many of the wells in this category differ little from those in the abandoned category and may become potential contaminant pathways.

3.4.6 Discussion

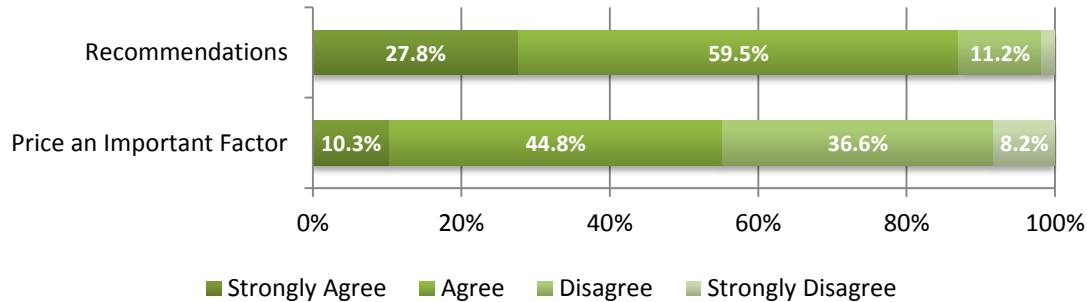
The findings in the section demonstrate that more than one in six respondent households have an abandoned well that has not been properly dealt with. While some are simply left to sit, others have been reclaimed improperly. This strongly suggests that more education and outreach efforts are required with regards to abandoned wells.

The primary barrier appears to be related to a sense of satisfaction with the abandoned wells as they are. This could be linked with general practices of procrastination. This suggests that individuals are not aware of the risks posed by abandoned wells to aquifers and their household water source (if they are using another well as their source). Without an awareness of the risk, there is no incentive for them to act. This suggests that Alberta could use further efforts to educate rural Albertans about the risks posed by abandoned wells and the approaches used to properly reclaim them.

3.5 Well Construction

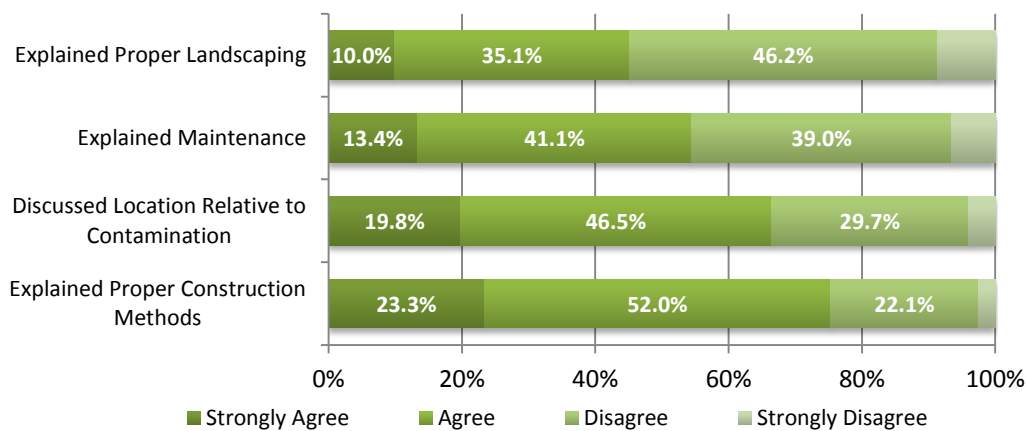
One of the most important factors in keeping wells safe is related to construction. Water wells must be designed in a way that makes them resistant to contamination. This involves a proper seal of the annular space (space outside of the casing), well capping, connections for water piping to the household, disinfecting of the well upon completion, and landscaping of the completed well. This section investigates well owner experiences with having wells constructed for them.

Figure 3-32: Strength of Respondent Agreement Regarding Importance of Factors in Choosing a Contractor



Respondents were asked about factors that influenced their selection of a water well contractor. Respondents were mixed on the importance of price being a factor, with just over half identifying price as being important (55.2 percent) (see Figure 3-32). Recommendations from others (e.g. neighbours, family) were seen as being far more influential with 87.3 percent of respondents agreeing that they were important in deciding who to hire to construct their well.

Figure 3-33: Strength of Respondent Agreement Regarding Contractor Practice



Respondents who hired a contractor to drill their well were asked if the contractor took time to explain their new well (see Figure 3-33). Over three quarters (75.3 percent) of respondents agreed that their water well contractor took the time to explain the importance of proper construction methods. About two thirds (66.3 percent) agreed that the contractor took time to discuss well location relative to possible sources of contamination. Just over half of respondents (54.5 percent) agreed that their contractor discussed proper maintenance of wells with them, and just under half (45.1 percent) indicated that their contractor explained proper landscaping techniques around their well.

Figure 3-34: Contractor Status (All Wells)

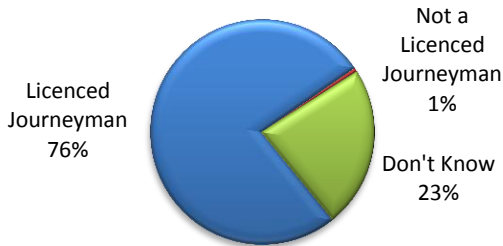


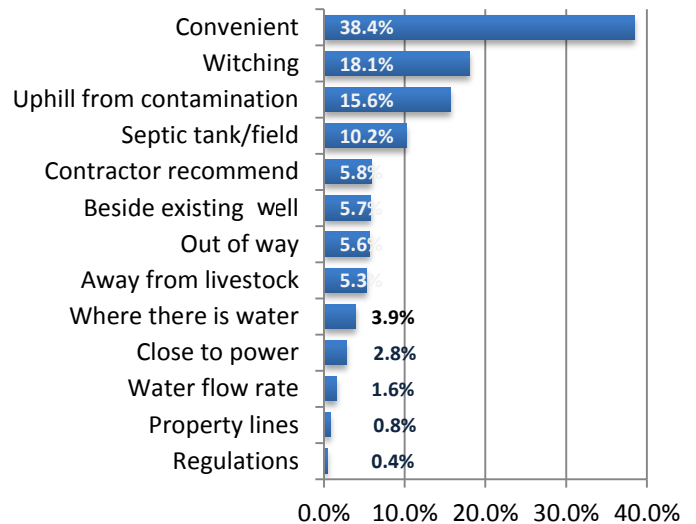
Figure 3-35: Contractor Status (Wells <6 Years Old)



Respondents were also asked to indicate if their contractor was a licensed journeyman (Figure 3-34). The findings indicate that there are very few cases where unlicensed contractors were knowingly hired, but in just under one quarter of all cases (23 percent), the respondents were unaware of the status of their contractor. The data was also analysed for only those wells that were drilled in the last five years (Figure 3-35). The results were very similar with 22 percent of respondents indicating that they were unaware of whether the contractor that constructed their well was a licensed journeyman.

Respondents were also asked to indicate how they located their well through the use of an open ended question “Please describe any factors that you considered in deciding where to locate the well”. This approach was used because it was felt that a check box type of question would have been too leading. Only a small number of respondents listed sources of contamination as a concern, yet almost one in five identified witching/dowsing as an influence (see Figure 3-36).

Figure 3-36: Location Factors for New Well



3.5.1 Discussion

The findings suggest that there is room for improved efforts by contractors to communicate information about water well stewardship to homeowners. Perhaps a role for stewardship groups and programs such as Working Well is to work with the Alberta Water Well Drilling Association (AWWDA) to develop and provide information packages to each new well owner.

Interestingly, a large number of respondents believe in water witching or divining as a method to find water. This belief is very much counter to scientific research and understanding with regards to the flow of groundwater. As was indicated earlier, most people believe that water flows in underground streams, as opposed to the scientific understanding that suggests that most groundwater flows in large ‘flat’ aquifers. The prevalence of water witching demonstrates that **traditional knowledge systems** regarding wells continue to have a strong influence upon beliefs. As was discussed earlier though, these belief systems do not seem to have a negative effect on stewardship and as such should not be a major concern. In fact, attempting to correct traditional knowledge with scientific knowledge may create further barriers between advocates and target audiences and negatively impact education efforts.

3.6 Respondent Sources of Information

A key element of outreach efforts is to know where the target audience seeks out information. As can be seen in Figure 3-37, respondents identified many sources of information relating to water wells. Water well contractors are the most likely source of information, with the second most likely source being the internet. More than half of respondents also indicated that they would be highly or somewhat likely to turn to health clinics, neighbours and friends, government agencies (all levels), and the AWWDA.

Further information was collected with regard to the effectiveness of the internet as a means to provide information. Respondents were asked: “Would the internet be a useful way to make information about wells available?” This information is shown below with property type, age, and education (see Figure 3-38). In all three cases significant relationships were found. Farms were less likely to answer yes to this question than other property types. There was a strong relationship demonstrating that older respondents were less likely to make use of the internet to get information than younger respondents. Lastly, those with lower levels of education were less likely to consider the internet as a source of information.

Figure 3-37: Likely Sources of Information/Advice Relating to Water Wells

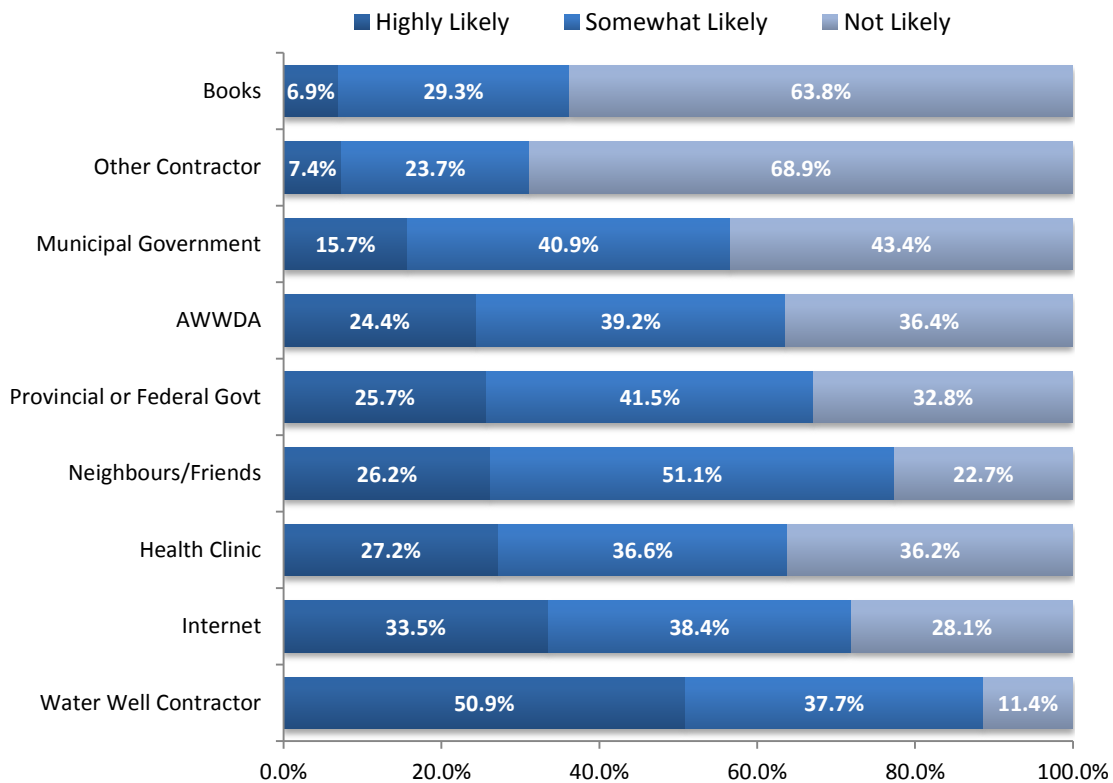
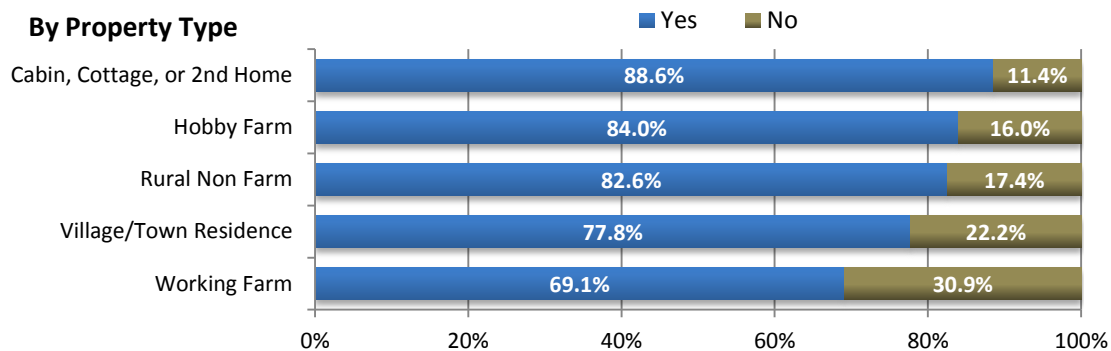
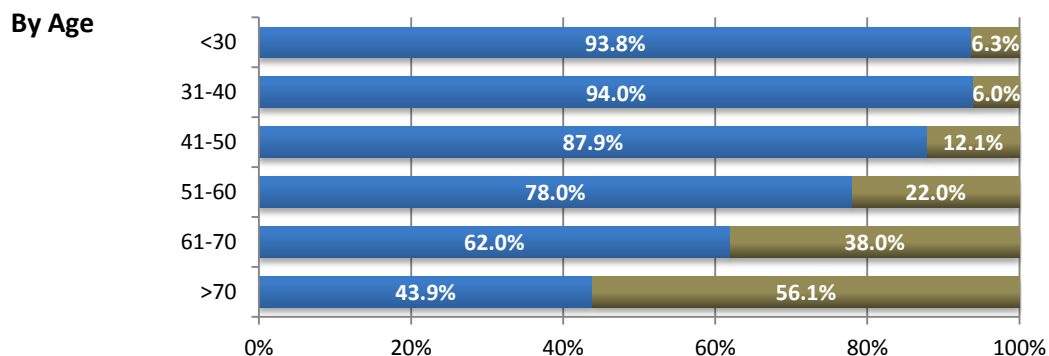


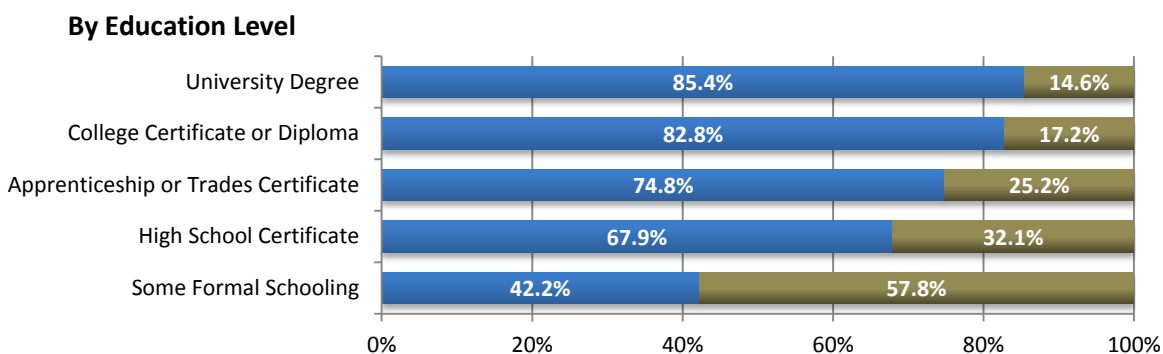
Figure 3-38: Respondent Considers Internet a Convenient Source of Information



$\chi^2 = 27.44$, D.F.=4, $p < 0.000$, Cramer's V = 0.168



$\chi^2 = 116.84$, D.F.=5, $p < 0.000$, Cramer's V=0.355



$\chi^2 = 68.19$, D.F.=4, $p < 0.000$, Cramer's V=0.265

Note: Data was also run comparing the usefulness of the internet as a means to make information available to geographic locations and no significant or meaningful relationships were found.

One of the key efforts of the Working Well program has been the delivery of workshops in rural communities across Alberta. Similar workshops have been delivered in the past through partnerships between the federal and provincial governments. Respondents were asked if they had attended a water well workshop in their region and seven percent indicated that they had (see Figure 3-39). They were also asked if a water well workshop were held in their area, would they be likely to attend. More than one third (37 percent) indicated that they would be willing to attend (see Figure 3-40).

Figure 3-41 illustrates that age could be a factor in who would attend a workshop and who would not.

Figure 3-39: Have Attended a Working Well Workshop

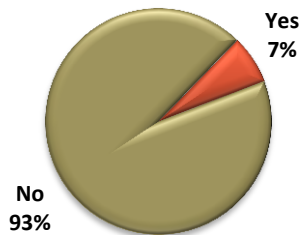
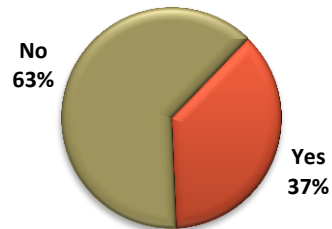
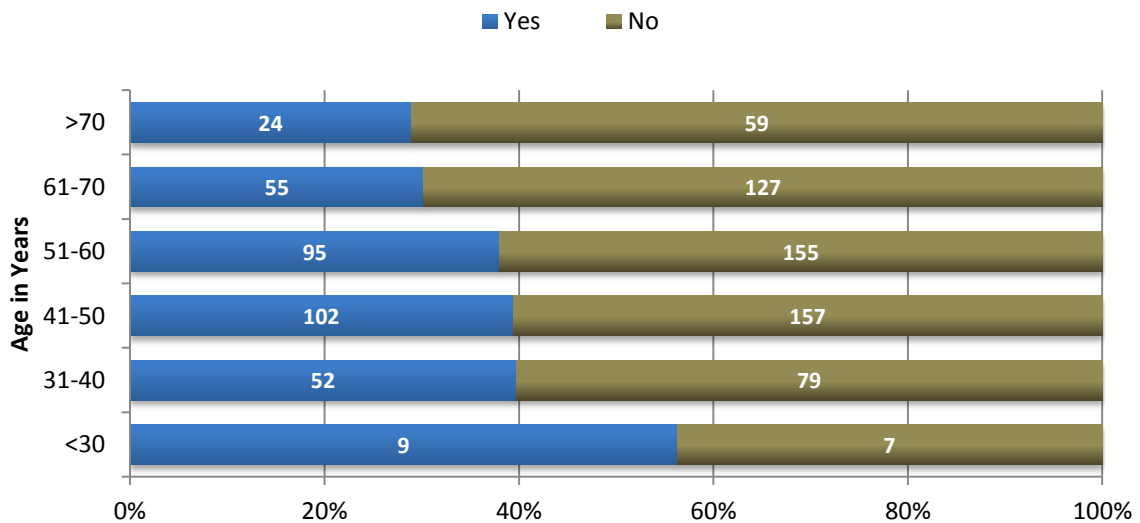


Figure 3-40: Would Attend a Working Well Workshop



In Figure 3-41, it can be seen that there is an element of age differentiation between who would attend a workshop and who would not.

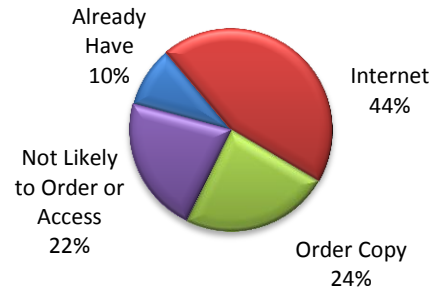
Figure 3-41: Would Attend a Working Well Workshop



$\chi^2 = 9.58$, $D.F. = 5$, $p = 0.088$, $Cramer's V = 0.103$ / $Kendall's Tau C = 0.097$, $p = 0.006$

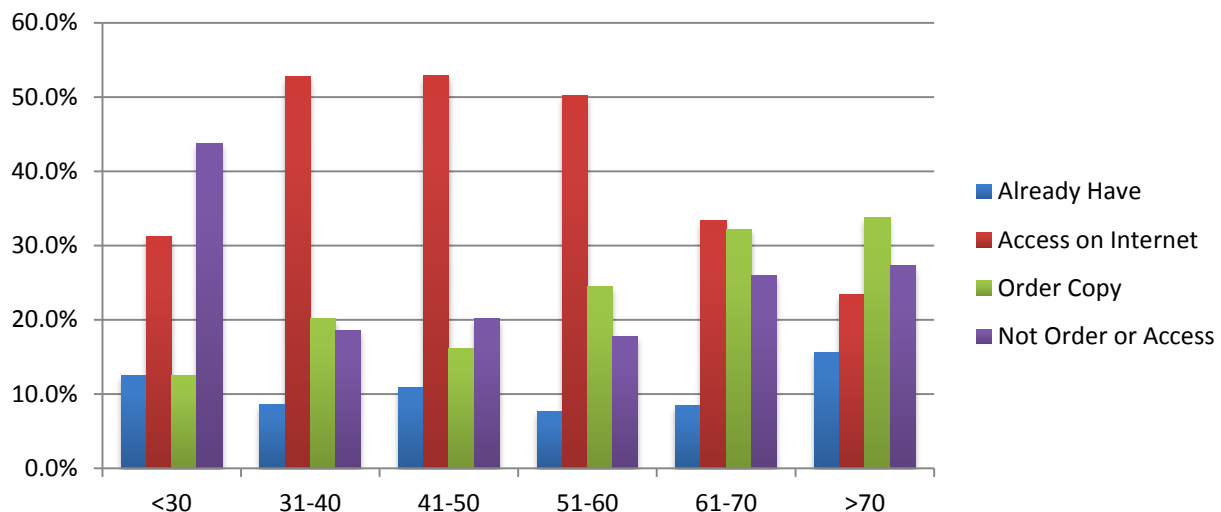
Respondents were also given information regarding the availability of the Water Wells that Last for Generations manual (WWLG). As shown in Figure 3-42, a small number of respondents already had a copy and 68 percent noted they would access the manual online or order a copy. Just over one fifth of respondents indicated they were not likely to order or access this free resource.

Figure 3-42: Water Wells that Last for Generations Manual



Cross tabulations were run on all categories of respondents, and only age group demonstrated any meaningful difference in behaviour (see Figure 3-43). Individuals over the age of 30 were more likely to access or order the manual than those under 30. Respondents between the ages of 30-60 were most likely to access it online, while those over the age of 60 were equally as likely to access it online as there were to order it.

Figure 3- 43: Water Wells that Last for Generations



3.6.1 Discussion

The findings suggest there are many existing pathways to reach well owners.

3.6.1.1 Water Well Contractors as Key Informers

Water well contractors (both as individuals and as an association) were identified as a very important source of information for well owners. This suggests that water well contractors are a key informer with regards to water wells and stewardship. Water well contractors are perceived as good sources of knowledge regarding wells, and they tend to be community insiders. As such, they are seen as more trustworthy than outside sources (such as government agents). Water well contractors act as a bridge between the professional/technical communities and the local community.

Yet, as was reported in the previous section, there is room for improvement in the efforts of water well contractors to inform new well owners about stewardship practices. This suggests that there is an opportunity to enhance the role that contractors play in promoting stewardship. This could be facilitated through collaborative efforts between the government and the AWWDA. Collaborative efforts could involve the development of future manuals and other printed materials and joint effort in on-line initiatives. Additionally, the AWWDA and government agencies could partner in developing or delivering information seminars for water well contractors with regards to recent developments in well stewardship. Water well contractors are an important source of information for the public and that efforts should be made to assist them in that responsibility.

3.6.1.2 Early Adopters and the Diffusion of Beliefs and Behaviours.

The second most important source of information identified was friends and neighbours. This supports the assertion made earlier about diffusion of information and the importance of social networks as sources of beliefs. It also emphasizes the potential for a multiplier effect to stewardship efforts. Every person affected by outreach efforts carries the potential to impact others. As the beliefs and behaviours of early adopters changes as a result of outreach efforts such as workshops or online manuals, the practices of stewardship will become increasingly normalized in communities. If these adopters become strongly convinced that stewardship is a necessary practice (as opposed to optional), they will become advocates for change and will act to narrow the acceptance of non stewardship-like behaviour. This process is a relatively organic one so it is difficult to identify and track; however, it does reflect how diffusion occurs in communities. Every effort to encourage stewardship has an influence beyond the immediate individuals impacted.

3.6.1.3 The Internet as an Outreach Tool

As mentioned above, the internet was identified as a key source of information by a wide range of respondents. Given its wide reach and the popularity as indicated by respondents, there may be merit in placing significant resources into developing and delivering on-line information to respondents.

3.6.1.4 Outreach Through Free Publications

Lastly, the majority of respondents who learned about the WWLG Manual noted they would either access it online or order a hard copy. This behaviour was followed through for at least some individuals because there was an increase in the number of manuals requested from Alberta Environment. Such a high response rate suggests that despite the general satisfaction amongst well owners, when provided with a very low cost opportunity to learn more about stewardship, many individuals will be receptive to the offer. This suggests that despite a relative sense of satisfaction with the status quo amongst well owners, there remains good potential to reach them.

4.0 Additional Comments from Respondents

The survey provided respondents with two opportunities to provide additional comments about household water wells and water not included elsewhere in the survey: **Question 12, Part A: Your Water and Well**, and **Part G: Your Comments, Concerns and Questions** (see Box 1 below). Thirty-three percent of respondents (350) chose to answer Question 12 and 29 percent (309) chose to provide additional comments in Part G.

BOX 1: Survey questions providing opportunity for respondents to raise issues

Question 12, Part A: Your Water and Well – *“Is there anything else you would like to tell us about your household water or well?”*

Part G: Your Comments, Concerns and Questions – *“Please provide any recommendations and/or questions that you have for Alberta’s water well drillers, for us as academic researchers, and for those working at Alberta Environment to assist well owners with the stewardship of their wells.”*

Respondents’ comments in each of these questions (hereafter “Q12” and “Part G”), were analyzed to identify the key comments raised. This involved systematically assigning thematic codes (e.g. categories) to each comment based on the type of issues or needs it raised. In this way, issues or needs that were raised repeatedly by a number of respondents were easily identified.

An overview of the key issues and needs raised in each question is presented below. This is followed by a discussion of five themes identified across both questions, and comments made about the survey itself. Illustrative selections of quoted comments made by respondents are included in text boxes. Expanded selections of quoted comments are also provided in corresponding Appendices. Responses were quantified so that it is easy to see the number of individuals that made particular comments.

An important aspect of analysing open ended qualitative questions is that they are most suited to identifying possible issues of concern or possible trends. They are limited in their ability to provide insight into the actual strength of prevalence of a trend because it is difficult to interpret non-responses when the question is so open ended.

All identifying information has been removed to ensure respondent anonymity as well as that of local drillers, neighbours, and so on (e.g. personal and business names, property locations). Where similar comments were made by a number of respondents (e.g. comments regarding high sodium content in water), only a representative selection of the comments was included in Appendices to avoid excessive repetition. In addition, some comments that provided details of particular events or locations were excluded because they contained a large amount of specific information that meant the respondent’s anonymity could not be ensured.

4.1 Key needs and issues raised in Question 12

In question 12 (Q12), seven categories of needs and issues were provided by respondents (see Figure 4-1).^{57,58} Fifty-two percent of the Q12 comments (182) were related to *water quality*, 18 percent (64) related to *maintenance practices* used, 17 percent (61) referred to the *impact of the oil/gas industry* on water quality and flow (quantity), and 15 percent (51) raised *water flow* issues. Less prevalent issues raised were the *need for information* (including direct questions asked in the survey) (six percent, 20 comments), the *impact of neighbours* and *neighbouring farms* on water quality and flow (five percent, 19 comments), and *government actions or regulations* (three percent, 9 comments).

⁵⁷ In Figure 4-1, the number of times key issues mentioned in Q12 add up to more than the total number of Q12 answers because some respondents referred to more than one issue.

⁵⁸ The data tables for all Figures included in this section are provided in Appendix Five.

Figure 4-1: Key issues raised in Q12

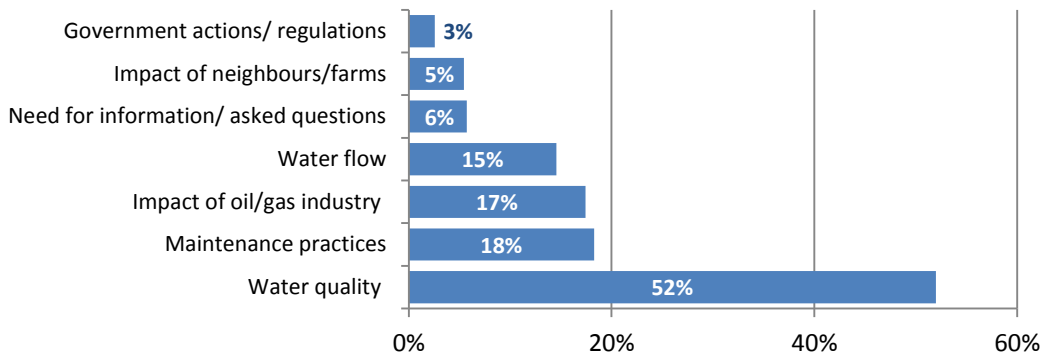
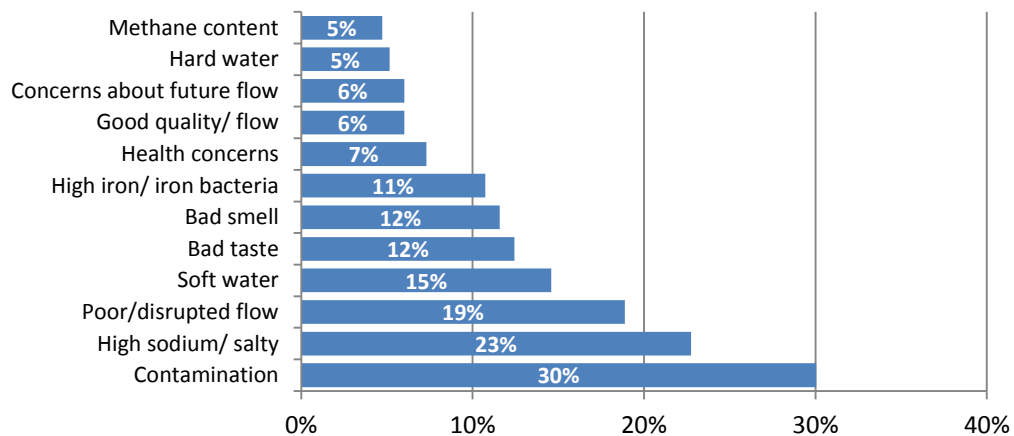


Figure 4-2: Water quality/ flow issues raised in Q12



A breakdown of the types of comments made about water quality and flow issues is provided in Figure 4-2, below. In total, water quality and flow issues were mentioned 233 times.⁵⁹

- The majority of comments about water quality and flow issues (82 percent, 191) mentioned different aspects of the quality of well water including: high sodium content (23 percent, 53), soft/hard water (15 percent, 34 and five percent, 12 mentions, respectively), bad taste/smell (12 percent, 29 and 12 percent, 27, respectively), high iron/bacteria content (11 percent, 25), and methane (five percent, 11).
- Thirty percent (70) of comments referred to experiences with or concern over possible water contamination. Of these, half (36) referred to experiences with or concerns over water contamination due to activities of the oil/gas industry. Additional sources of contamination mentioned were: neighbours’ activities; inadequate well casing/ capping; the drilling of new water wells; uncapped, abandoned wells; and well location.
- Twenty-five percent (58) of respondents referred to poor/disrupted water flow (19 percent, 44), or concerns over future water flow (six percent, 14) due to activities of the oil/gas industry or overuse/poor management of water by government and/or well owners.
- Seven percent (17) mentioned health concerns related to high sodium or fluoride content.
- Six percent (14) made reference to the good quality and/or flow of household well water.

⁵⁹ The counts provided in Figure 4-2 add up to more than 233 because some respondents mentioned more than one issue in the same comment, and because some categories refer to overlapping issues (e.g. contamination and health concerns).

An example of comments made by respondents about water quality and flow issues is provided below in Box 2.⁶⁰

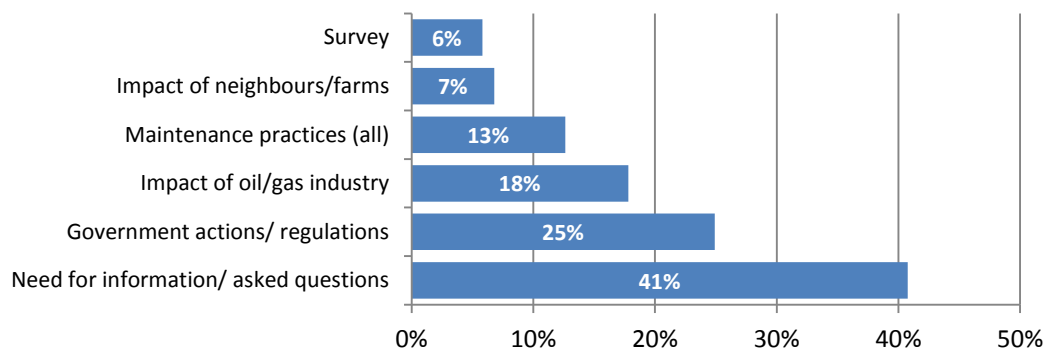
Box 2: Water quality/ flow issues

- ◆ *“We have spring quality water; we have done extensive testing on the water. We also have enough quantity to supply a small town.”*
- ◆ *“I am mostly neutral about the well as it has been reliable, it provides good quality water, and services all our needs more than adequately for household and livestock use. In drought years I think about “what if” the well dries up... Hasn’t happened as yet and hope never will... But I do think about it.”*
- ◆ *“This water is high in sodium (very soft) and highly above the drinking water standards.”*
- ◆ *“Our water has methane gas and higher concentrations of sodium. We have a holding tank to release the methane gas but use no other treatment to reduce sodium. Our water tastes great but knowing the sodium content is why we use bottled water for cooking and drinking.”*
- ◆ *“I am very concerned about the effect of the drilling and piping of oil and gas in this vicinity in regards to contamination of aquifers and/ or ground water.”*
- ◆ *“We do not have iron in our water well but we do chlorinate it on a regular basis to get rid of iron bacteria. If we use very little water we have a fairly strong sulphur smell at the house water taps.”*
- ◆ *“The water in the well is terrible, smells, and stinks. The water is eating the plumbing. The toilet and bath are rust covered. Hard to remove. The water from the tap is terrible when cold and hot water is almost unbearable to wash clothes, dishes.”*
- ◆ *“It took me a couple of months to become accustomed to the taste of our water. Not 100% comfortable letting my baby drink our water. We have VERY hard water. Dislike that it stains everything rust.”*

4.2 Key needs and issues raised in Part G

In Part G, six key categories of needs and issues were raised by respondents (see Figure 4-3).⁶¹ Forty-one percent (126) mentioned the *need for information* (including direct questions asked in comments), 25 percent (77) suggested *government actions/regulations* needed, 18 percent (55) referred to the *impact of the oil/gas industry* on water quality and flow, 13 percent (39) indicated problems with and ways to improve *maintenance practices* amongst well owners and drillers, seven percent (21) referred to the impacts of neighbours and neighbouring farms, and six percent (18) made comments about the survey.

Figure 4-3: Key issues raised in Part G



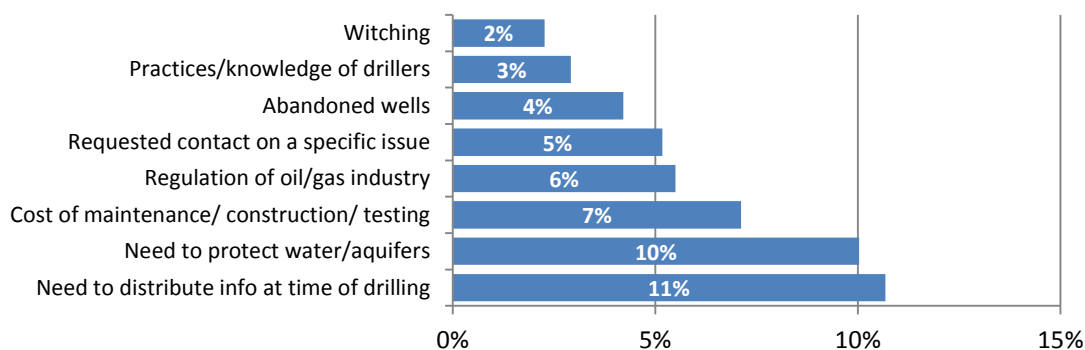
⁶⁰ See also Appendix Six.

⁶¹ The number of times key issues were mentioned adds up to more than the total number of respondents that provided comments in Part G because of multiple issues raised and overlapping issues.

Within these key categories of issues, eight sub-issues were particularly prevalent (see Figure 4-4, below):

- The need to distribute information to well owners at the time of drilling new wells (11%, 33 comments);
- The need for government and well owners to protect water and aquifers (10%, 31 comments);
- Prohibitive costs of well maintenance, construction, reclamation and/or water testing (including comments about the value of free water testing that is currently available) (7%, 22 comments);
- The need to increase regulation of the oil/gas industry to control its impact on groundwater (6%, 17 comments);
- Requests/offers for direct contact from researchers or Alberta Environment regarding a specific issue, including contact details (5%, 16 comments);
- The need to improve practices and government support for proper well abandonment (4%, 13 comments);
- The need to improve driller's training or knowledge (3%, 9 comments), and;
- The value and use of water witching (divining) (2%, 7 comments).

Figure 4-4: Sub-issues raised in Part G



4.3 Major Issues

Amongst the various issues raised in question 12 and Part G outlined above, four major needs and issues were identified:

1. Information needs of well owners;
2. The negative impact of the oil/gas industry on water quality and/or flow;
3. The negative impact of neighbours and neighbouring farms; and,
4. Well construction and abandonment; and maintenance costs;

1. Information Needs of Well Owners

The most common issue raised by respondents was the need for well owners to have more information about groundwater and well maintenance.⁶²

Some respondents expressed that there was a general need for well owners to have better knowledge and/or more information about groundwater and water wells. Others suggested ways that the government could make information available to well owners (see Box 3). Suggestions included: improving internet access, running well

⁶² See Appendix Nine for expanded selections of quoted comments.

workshops, mailing pamphlets and maintenance reminders, including information with municipal mail-outs, continuing the current Environmental Farm Plan workshops, and publishing user manuals.

Box 3: General Information need and access

- ◆ *“Perhaps fliers mailed out to alert “well users” to the risks, hazards and benefits of well maintenance. Include well site for details.”*
- ◆ *“I would like to know more about my well and will order the manual.”*
- ◆ *“There is a County of Grande Prairie paper put out once a year. This would be a good place to put water wells do's and don'ts.”*
- ◆ *“The Environmental Farm Plan was a good tool to upgrade wells that are being used and abandon old wells. Thanks to our government the program was cancelled. Should bring it back again.”*
- ◆ *“I have worked with well water for more than 50 years. There is a great deal of ignorance about aquifers, quality of water recharge rates, recharge sources and other aspects.”*
- ◆ *“I've attended a meeting on wells in Edson and found it informative. I own 3 properties with wells and appreciate being able to get information. Keep up the good work!!”*
- ◆ *“It would be great to have a simple publication that informs homeowners how often a well's water should be tested and by whom, as well as a guide for proper maintenance on a well. Internet access to this would be awesome.”*
- ◆ *“As most wells are drilled for rural use, along with wells comes onsite wastewater systems. Education is needed for homeowner. The risk of poorly designed and neglected maintenance of the sewer system. This can lead to contaminated ground water in turn contaminating their well.”*
- ◆ *“Water well owners need to be more informed about the right up-keep of water well and the water system connected to them. This would help them to both protect this valuable resource and manage it more efficiently. Also, maybe some hints on how to conserve and protect the environment around them. Being uninformed about such an important resource is very dangerous to say the least. Ignorance now-a-days is no excuse.”*

A prevalent theme was the need for well owners to receive information at the time that new wells were constructed and/or new properties with wells were purchased (see Box 4 below).

Box 4: Need for information at time of well construction/purchase

- ◆ *“When purchasing a property with a well, it would be nice to have a government brochure telling how to care for the well and a certificate of inspection to ensure the safety of drinking the water.”*
- ◆ *“Have a booklet that well drillers can leave after drilling the well for a reference manual or for regular maintenance instructions.”*
- ◆ *““Part D” made us realize we could have been better prepared to ask questions of our driller. Perhaps the drillers should give well owners a printed format for the care of wells. The chemical treatments are highly controversial... Lots of opinions that are confusing.”*
- ◆ *“Prior to drilling a water well, drilling contractors should have to review critical information with the land owner. The information should include a pamphlet, information reviewed should include, location considerations, proper set up and maintenance. A check sheet should be signed off by land owner and contractor and submitted with drillers report.”*

Two additional themes were: comments about accessing well data (see Box 5); and requests for information about specific issues (See Box 5). A number of these comments indicated that some well owners were not aware of the Alberta Environment Groundwater Information System that is currently available via the internet

(<http://www.environment.alberta.ca/01314.html>). In addition, a small number of comments suggested that currently available internet data needed to be improved/updated.

Box 5: Accessing Well Data

- ◆ *“Test wells at different depths in different communities would be helpful with results to the public so that people about to drill wells know approximately how far to drill down for water. So that drilling doesn't have to be done more than once for the best water.”*
- ◆ *“I noticed that drilling reports are publicly available on the Alberta Environment website, however, it does not seem to be comprehensive. I know of neighbours who have wells but they are not listed on the GIS maps. Furthermore, if a major service or upgrade is done on a well, the well report is not updated with new information.”*
- ◆ *“I think you should visit some of the residences or farmers in each area and talk to them face to face to find out more.”*

Box 6: Requests for specific information

- ◆ *“We would like to know more accurately where water exists in the area, and if this information is available, how do we get it?”*
- ◆ *“Are there any grants for upgrading a well?”*
- ◆ *“How often should you have water tested and when is best?”*
- ◆ *“Why do I have to register/license my well when I have it drilled by qualified tradesmen? Why is this license only good for a limited time period? Where do I access a list of qualified contractors to plug old wells?”*
- ◆ *“Let us know how much water is going to remain available to us. How is the constant construction of new homes and subsequent drilling going to affect the quantity of water available?-Will our wells run dry?”*
- ◆ *“Can things from farmers that live around me (herbicides, pesticides) get into my water table?”*
- ◆ *“Impact on supply and quality from global warming vs. my aquifer?”*
- ◆ *“If the well driller introduces iron bacteria into the well, does the owner have any recourse?”*
- ◆ *“More information on pumps and pressure systems would be handy.”*
- ◆ *“I would like more info on water purification so I can feel totally safe drinking my well water.”*
- ◆ *“Please publish information about the effects of seismic blasting and drilling for oil and gas on rural water supplies.”*
- ◆ *“Are there grants to assist when a well goes dry?”*

2. Impact of the Oil/Gas Industry

The survey responses indicated a high level of concern amongst well owners about the impact of the oil/gas industry on water quality and flow.⁶³

A number of well owners reported experiencing adverse impacts on their water quality or flow from the drilling of oil/gas wells, seismic activity, and water use by the oil industry (see Box 7).

⁶³ See also Appendix Seven.

Box 7: Experiences with impact of oil/gas industry

- ◆ *“The last well I had was perfect for 12 years and then seismic came through my land but was outside of “minimum distance”. My well turned bad, very sour. They would do nothing.”*
- ◆ *“Oil company drilled well 1/2 mile south. We had water problems for about two months (mud in water).”*
- ◆ *“We have a problem with the coal mines by us as the water table is dropping and we have already lost a spring that was very reliable as a water source. I feel it is only a matter of time before our wells begin having problems and Alberta Environment has been unwilling to care or help us.”*
- ◆ *“Oil well drilled 2-3 years ago have caused my well to smell and taste like petroleum”*
- ◆ *“I have a severe allergy to sulphur and cannot drink it for this reason. As more oil and gas wells were drilled in the surrounding area, the sulphur has gotten stronger so now I no longer use it for cooking or drinking and have to buy drinking water.”*

In addition, a number of respondents expressed concern over the current and/or future impacts of these industries, without reference to specific experiences (see Box 8).

Box 8: Concerns about the current/future impact of oil/gas industry

- ◆ *“I am concerned about our underground water becoming contaminated or our well going dry due to oil or gas exploration.”*
- ◆ *“Clean water is the most important “thing” we need from the ground on Earth. More important than oil-gas-coal, etc. We can exist without oil-gas but not with no water.”*
- ◆ *“Very conscious of seismic and gas well drilling in the local neighbourhood. I don't like the idea of acid bracing used in gas wells.”*
- ◆ *“I have heard that drilling of oil/gas wells in my area can ruin a good water well. That does concern me.”*
- ◆ *“We have water tested before and after gas drilling in the vicinity and keep the reports.”*
- ◆ *“I am very concerned about the effect of the drilling and piping of oil and gas in this vicinity in regards to contamination of aquifers and/or ground water.”*

In general, respondents indicated that current government regulation of the oil/gas industry did not sufficiently protect aquifers from oil/gas activity, or provide well owners with ways to protect their water from this activity and seek resolution of conflicts or adverse impacts (see Box 9).

Box 9: Government regulation of oil/gas industry

- ◆ *“Would like to see limited use of water by oil companies. Greater testing radius of water wells around drilling wells.”*
- ◆ *“Energy explorations should be closely monitored so that there is no contamination or other affects to local well water.”*
- ◆ *“I feel that the government regulations are too lax and allow too many gray areas for oil and gas industries to get away with polluting our water resources. The few studies that have been done do not go back to be used as written in stone practices.”*
- ◆ *“I am most concerned that oil-well drilling in my area could pollute the water aquifer. The companies do a fair job in testing to protect the potable water but stricter regulations and supervision wouldn't hurt.”*

3. Impact of Neighbours/Farms

The impact of neighbours and neighbouring farms also emerged as an important issue for respondents (Box 10 below).⁶⁴ The key concerns were overuse of aquifers due to residential development (e.g. subdivision), and contamination from chemical run-off from nearby farms and industry. Some respondents suggested that government should increase monitoring of and/or limit water use in heavily developed areas.

Box 10: Impact of neighbours/farms

- ◆ *“My biggest concern is in regards to the amount of herbicides and fertilizers used on the land. The users I’ve talked with believe it is impossible to farm without it. They also close a blind eye as to what it may be doing to the natural watershed.”*
- ◆ *“We live in an area of increasing growth. We need our water protected. I think we need to know aquifer capacities so the M.D. doesn't over-develop the area.”*
- ◆ *“My concern is the amount of water people in the area use for excessively watering plants, lawns, yards, etc. The same aquifer is used by quite a few people.”*
- ◆ *“I'm concerned about the heavy development surrounding Pigeon Lake. County of Wetaskawin and Leduc have approved development plans which would add 10,000 new properties drawing on aquifer. Lake level has dropped as development goes up. Lake has 100 years turnover for fresh water. Oil recovery is also using potable water resulting in less of the H₂O that will never be recovered.”*

4. Well Construction, Abandonment, and Maintenance Costs

The last of the four major themes in respondent’s comments were actually a collection of smaller, specific issues regarding well construction and abandonment as well as the cost of well maintenance (including water testing).⁶⁵

Regarding well construction, most comments were about the practices and knowledge of drillers and the quality of constructed wells (see Box 11). In general, respondents indicated a need for consistency in drilling practices, greater education and/or training of drillers, and difficulty in selecting good drillers. At the same time, a number of respondents also commented on the good quality and service of specific drilling companies.

Box 11: Well construction

- ◆ *“Drilling company [name omitted] drilled our last well and tested our well when an oil company drilled a well nearby. Very professional organisation!”*
- ◆ *“We researched three water well drillers in our area and basically found only one to be informative, honest, and professional [name omitted]. I wonder whether the province requires certification and if their business practices are regulated or reviewed???”*
- ◆ *“I wish drillers had a uniform method of drilling and standards and parts used. No well is the same in our subdivision, and parts for piping were difficult to match. A standardized system would be helpful!”*
- ◆ *“There should be government monitors for the companies doing the drilling and mandatory information given for the consumer about the wells. The well driller should be responsible for a certain time period after the well is drilled (up-keep, maintenance, etc).”*
- ◆ *“More rigorous training and education for water well drillers - skill level with regard to H₂O quality, understanding aquifers is highly variable and mostly weak.”*
- ◆ *Make sure driller backfills bored well with clean pea gravel. E-coli got in water from pea gravel. Had to remove gravel with hydrovac and install new pea gravel to fix well, and then stock treat two times.*

⁶⁴ See also Appendix Eight.

⁶⁵ See Appendix Ten for expanded selections of quoted comments.

Also related to well construction, a small number of respondents also indicated that witching (water diving) is also a common and potential useful practice for locating a new well (see Box 12).

Box 12: Witching (water divining)

- ◆ *“Information on where to best drill a well on your property is lacking. Using a well “witcher” is an uneasy feeling but is all there is that I’m aware of.”*
- ◆ *“I strongly recommend the use of water well witchers for locating underground sources for well drilling. In my opinion, this should be strongly recommended by the water well drillers and association. Otherwise, it is a complete ‘shot in the dark’ when it comes to finding water. We had three successful wells dug this way.”*

Regarding well abandonment, a small number of respondents felt there was a need to improve the procedures for ensuring that abandoned wells were reclaimed correctly, including greater government involvement (see Box 13).

Box 13: Well abandonment

- ◆ *“I believe that “new” wells are properly drilled today. There should be no reason they aren’t. However, old existing unused or abandoned wells need further attention. Many of these were dug back in the early 1900’s and do show up from time to time.”*
- ◆ *“Of great concern - the number of old abandoned wells that are not sealed or capped.”*
- ◆ *“I think it would be good to have a government program to fund capping and monitoring old water wells. It is quite an expense to do on your own.”*

Regarding maintenance and water testing costs, a small number of respondents indicated the need to provide (or continue to provide) free or affordable options for water testing and/or maintenance (see Box 14).

Box 14: Maintenance costs

- ◆ *“Reasonable or no charge for testing water is very important as this could result in poor water use.”*
- ◆ *“A test kit should be made available to acreage owners from the county and at a fair price. “*
- ◆ *“Please ensure that local health units still have funding in the future for rural water well sample analysis. This is a valuable program for farmers to keep a close eye on the household water quality.”*
- ◆ *“You should offer free assistance on how to maintain your well as well as offer affordable solutions to keeping harmful bacteria and other elements out of our wells.”*

4.4 The Survey

Amongst those respondents that commented on the survey itself, almost all were positive. Most felt the survey was a valuable means for collecting information about water wells and well owners' needs. However, a small number were also concerned about how the information collected in the survey would be used (see Box 15).

Box 15: Comments about the survey

- ◆ *"This is a good exercise. Water is far more important than oil and gas. Please do all that is essential to protect this important resource."*
- ◆ *"Thank you for survey."*
- ◆ *"This is a good idea to do - survey - as it is important to have a supply of fresh water. "*
- ◆ *"Thanks for the survey, hadn't thought about the health of our well."*
- ◆ *"This is long overdue. Please educate younger generations on water conservation."*
- ◆ *"I think the survey is a good idea but get the impression your survey is about the knowledge and stewardship of well owners. I believe most of the water problems here are due to the many methane gas wells. I would suggest more effort be put into investigating and regulating these wells."*
- ◆ *"Thank you for this opportunity to complete your survey. "*
- ◆ *"I look forward to your report. Thank you."*
- ◆ *"This is a good way to get feedback on water wells. Because the internet for us is not a place that we are very familiar with."*
- ◆ *"Results of the survey should be made available to participants."*
- ◆ *"Good Survey! "*
- ◆ *"The hope is that the information obtained from this survey is NOT used to regulate wells or "charge" for their use. Responsible stewardship is the onus of the land owner, and cannot be enforced through regulations or lands."*
- ◆ *"Keep up your effort. In order to provide for the future fresh and clean water, the trees and fauna and flora in Kananaskis should remain. "*
- ◆ *"I felt obligated to fill out this survey out of concern for a safe water supply for generations to come. We NEED to take care of this MOST VALUABLE resource!!"*
- ◆ *"Will this survey in any way be used to assist the provincial government in obtaining the well rights to any or all of these private wells?"*

5.0 Conclusions

The Alberta Water Well Survey was successful in identifying many of the current practices and beliefs of well owners in Alberta. The majority of well owners are not taking basic precautionary measures or implementing water well stewardship practices. This exposes them to unnecessary risk of gastrointestinal illnesses and contaminant related diseases.

The root causes of this behaviour appear to be a lack of awareness about groundwater flows, the functioning of wells, and the risks of contamination. Additionally, there are issues of procrastination and a lack of knowledge about how to carry out stewardship activities. Other barriers, such as the costs involved in stewardship, appear to be less significant overall relative to the attitudes and knowledge of the well owners.

There is a need for continued and expanded education and outreach efforts to promote well stewardship amongst private well owners. The challenge involved in changing longstanding beliefs and practices should not be underestimated. Ongoing, persistent efforts will be required. With such effort, changes in public beliefs and behaviour should occur in an incremental fashion with some individuals adopting new approaches while others lag behind.

There is evidence that suggests that change is possible and that there is an important role for education and outreach efforts. Respondents from across Alberta indicated that they are willing to participate in outreach activities. Some Albertans are already acting as good water well stewards. These individuals can act as examples for others. There are opportunities to work with water well contractors who already are accepted in rural communities as sources of knowledge with regards to water well maintenance. The Working Well program has a good start on these efforts and through continued and expanded efforts, there is great opportunity to shift the beliefs and practices of Albertans so that they can reduce the risks they face from their own water wells.

Below are the key findings from the survey.

Key Finding #1: Survey respondents demonstrated a low level of participation in well maintenance and stewardship practices

Only 10.7 percent of respondents test water quality on an annual basis (or more frequently), only 30.1 percent regularly shock chlorinate their well, and only 36 percent of respondents with an abandoned well have properly decommissioned it.

Key Finding #2: Most respondents demonstrated a low level of knowledge with regards to the source of their well water and the functioning of their well

Much of the existing knowledge of well owners appears to be rooted in longstanding 'folk' beliefs about groundwater. For example, more than three quarters of respondents believed that their well water reached their well by travelling many kilometres in underground rivers. This is highly unlikely as the vast majority of private wells draw water from slow moving aquifers that have local recharge areas. Such beliefs can be a barrier to engaging well owners in stewardship practices. For example, a well owner that believes groundwater flows in underground rivers may not recognize the importance of managing contaminants in the area surrounding their well.

Key Finding #3: Most survey respondents have a false sense of security regarding the risks posed by their well and unjustified confidence in their knowledge of their water supplies

Many respondents expressed confidence in the safety of their wells despite having no water quality test results and failing to undertake any preventative maintenance. The vast majority of respondents also indicated that they are confident in their understanding of their well. As indicated in Key Finding #2, this confidence is unwarranted as respondents generally demonstrated a lack of knowledge.

Key Finding #4: Awareness of well stewardship practices was not sufficient to motivate many survey respondents

Many of the respondents who agreed with the need for stewardship practices indicated that they failed to do so. For example, 71.4 percent of people said they believed annual chlorination of their well was a good practice; however only 29.0 percent of all respondents indicated that they shock chlorinate their well at least once every two years. Many identified procrastination and forgetfulness as reasons why they did not undertake stewardship practices. This is similar to the failure of many people to replace smoke alarm batteries or to do preventative maintenance on their car.

Key Finding #5: Health and aesthetic concerns and a desire to follow good practice were key motivators for engaging in water well stewardship practices

Of the well owners that have adopted stewardship practices, many identify health or aesthetic concerns as a key motivation for doing so. For example, more than 80 percent of individuals suggested that health concerns were a motivating factor in deciding to chlorinate their well; whereas more than 70 percent indicated that they were motivated by issues of nuisance bacteria that cause smells and stains. Additionally, the desire to follow social norms⁶⁶ was a strong motivating factor with 61 percent of people indicating a desire to follow proper maintenance procedures. This message was also strongly represented within qualitative elements of the survey.

Key Finding #6: Financial costs are not a significant barrier in undertaking well stewardship practices

Procrastination, lack of belief in the need for stewardship, and lack of knowledge of how to undertake stewardship practices are more significant barriers than financial costs. Individuals who practice good stewardship are distributed geographically, across age brackets, education levels, and property types. No one group is more or less 'stewardlike' than others to any significant degree.

Key Finding #7: Many respondents indicated the need for more information on how to undertake proper well stewardship practices

More than one in three respondents indicated that they would take the time to attend a water well workshop if one were held in their community. When respondents were informed about the Water Wells that Last for Generations manual, 78.2 percent indicated they would access a copy of it.

Key Finding #8: Respondents indicated that they would likely seek information from a number of sources if they had questions about their water well

Eight-nine percent of respondents indicated that they perceive water well contractors as key sources of information with regards water wells, while 77.3 percent of respondents indicated that they might turn to members of their community including friends and neighbours. Additionally, more than half of respondents indicated that they might utilize the internet, contact a government agency, or contact a health clinic to seek information.

⁶⁶ Social norms are the behavioural expectations and cues within a society or group. People often decide what behaviours are appropriate by observing those around them.

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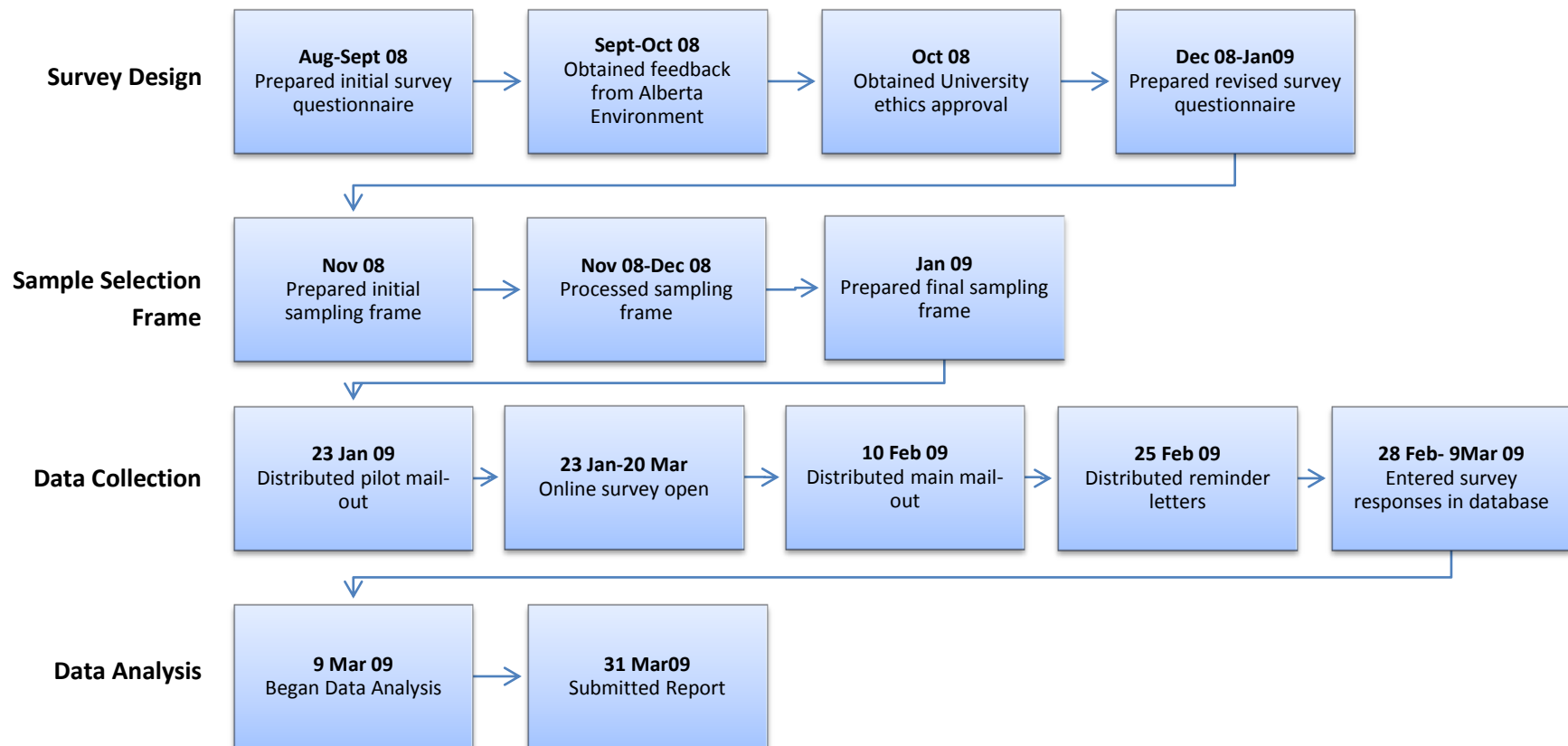
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7.0 Appendices



Appendix One: Methodology Flow-Chart

Appendix Two: Copy of Certificate of Ethics Approval from the University of

Arts, Science & Law Research Ethics Board (ASL REB)
Certificate of REB Approval for Fully-Detailed Research Project

Applicant: Robert Summers
Supervisor (if applicable): N/A
Department / Faculty: Earth and Atmospheric Sciences, Faculty of Science
Project Title: Alberta Household Water Well Study

Grant / Contract Agency (and number): N/A
Application number (ASL REB member) 1906 (CLG08-10-03)
Renewal? If yes, what was the previous number? _____
Approval Expiry Date: 28-Oct-2009

CERTIFICATION of ASL REB Approval

I have reviewed your application for ethics review of your human subjects research project and conclude that your project meets the University of Alberta standards for research involving human participants (GFC Policy Section 66). On behalf of the *Arts, Science & Law Research Ethics Board (ASL REB)*, I am providing expedited approval for your project.


Expedited research ethics approval allows you to continue your research with human participants, but is conditional on the full ASL REB approving my decision at its next meeting (*Nov 24, 2008*). If the full ASL REB reaches a different decision, requests additional information, or imposes additional research ethics requirements on your study, I will contact you immediately.

If the full ASL REB reverses my decision, and if your research is grant or contract funded, the Research Services Office (RSO) will also be informed immediately. The RSO will then withhold further funding for that portion of your research involving human participants until it has been informed by the ASL REB that research ethics approval for your project has been granted.

This research ethics approval is valid for one year. To request a renewal after 28-Oct-2009 please contact me and explain the circumstances, making reference to the research ethics review number assigned to this project. Also, if there are significant changes to the project that need to be reviewed, or if any adverse effects to human participants are encountered in your research, please contact me immediately.

ASL REB member (name & signature): Christina L. Gagné

Date: 28-Oct-2008



Alberta Water Well Survey



Participation in this survey is voluntary and you may choose to skip any of the questions. The responses to the survey are anonymous. No individuals, households or properties will be identified.

In order to comply with the University of Alberta's requirements for conducting survey research, we ask you to please formally indicate your willingness to participate in this survey by checking the box below:

I understand that I am agreeing to participate in a scientific research study, and I give my consent for the researchers to use my responses to the survey questions for the purposes of the Alberta Water Well Survey (AWWS).

Please have one of the adults in the household complete the survey and return it to us in the postage paid envelope provided **OR** you may fill out the survey online at www.eas.ualberta.ca/awws.

For assistance in completing the survey, please contact us at 780-248-1701, or by email at waterstudy@ualberta.ca. If you have any questions or comments about this research project, you may also contact us directly:

Dr. Robert Summers

Assistant Professor

Phone: (780) 492-0342

E-mail: robert.summers@ualberta.ca

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Part A: Your Water and Well – Please answer the following questions for any one property that you own. For most respondents this will either be their primary home or a cabin/cottage. If you have both, please answer for the location where you make use of the well most often.

Note: In the following questions “household” can refer to your primary home or to a cabin/cottage.

1 What do you use as your household sources of drinking water?

Please check all that apply.

	<i>Drinking Water</i>	<i>Other Household Use</i>
Water from a well	<input type="checkbox"/>	<input type="checkbox"/>
Water hauled in a truck to a cistern	<input type="checkbox"/>	<input type="checkbox"/>
Bottled or Store Bought Water	<input type="checkbox"/>	<input type="checkbox"/>
Other (please describe): _____	<input type="checkbox"/>	<input type="checkbox"/>

2 How old, approximately, is the well that provides water to your household?

_____ Years or I don't know how old it is

3 How deep, approximately, is the well?

_____ Feet or _____ Meters I don't know how deep it is

4 How big is the well at the top of the casing?

Note: a pie plate is used here to indicate a size of about 10 inches across.

Bigger than a pie plate Smaller than a pie plate I am not certain

5 Describe the cap on your well:

Please check ***only one*** of the following.

- No well cap (the well has an open top)
- A well cap that can be removed without tools or a key
- A well cap that requires tools or a key to remove
- I do not know if it requires tools or a key to remove
- Other (please describe) _____
- I don't know if my well has a cap or not

6 Do you have a copy of the drillers report (well log) for your household well?

Yes

No

I don't know

7 Please check off any treatment systems that you use on the well(s) that provide water to your household:

We do not use any water treatment

UV System

Carbon Filter (Including 'Brita' type Filters)

Constant Chlorination

Water Softener

Water Distillation

Iron Filter

Other (please describe)

Sediment Filter

_____ I do not know if we use any water treatment

Reverse Osmosis (R/O Unit)

8 Have you ever attended a workshop on water wells in your municipality or region?

Yes

No

9 If a workshop on water wells was offered in a community near you, would you attend?

Probably would not attend

Probably would attend

10 You can order a free copy of the manual "*Water Wells that Last for Generations*" from the Alberta Government and you can also access this document on the internet (refer to the last page of this survey for instructions on how to order or access it).

Now that you are aware of this, please select one of the following that best applies to you:

I have a copy already

I will order a manual

I will access it on the internet

I will probably not order or access the manual

11 Please select a value from one to four regarding how strongly you agree with the following statements.

	<i>Strongly Disagree</i>	<i>Disagree</i>	<i>Agree</i>	<i>Strongly Agree</i>
a. I really like the taste of the water from my well as it comes from the tap (may include water treatment).	1	2	3	4
b. I would feel safe drinking water straight out of my well without any form of treatment.	1	2	3	4
c. I would prefer to drink water that has gone through a treatment plant (town/city water) instead of well water.	1	2	3	4
d. I would prefer to drink bottled water instead of well water.	1	2	3	4
e. I would prefer to drink water from a cistern (storage tank refilled by hauling water from a town or city) instead of well water.	1	2	3	4
f. I would feel comfortable allowing the water from my well to be used for a baby (in formula, food, or drink).	1	2	3	4
g. My water sometimes smells like rotten eggs (sulfur).	1	2	3	4
h. My water sometimes tastes 'irony' or metallic.	1	2	3	4
i. I try to avoid using too much well water in a short period of time in order to protect my well.	1	2	3	4
j. I think it's best to leave my well alone unless I have a problem with it.	1	2	3	4
k. I sometimes worry about the safety of my water.	1	2	3	4
l. I know where I could go to get my water tested for health concerns.	1	2	3	4
m. I am concerned about the risk of methane gas in my well.	1	2	3	4
n. I feel confident in my understanding of my water well.	1	2	3	4

12 Is there anything else you would like to tell us about your household water or well?

This might include anything that did not fit within the above questions or any concerns you have about water wells and water supply.

Water Testing

13 Have you ever tested the water from the well for bacteria or harmful chemicals and minerals? (Includes tests by a health unit or laboratory but not by water treatment sales companies for hardness and iron.)

- Yes (please continue to the next question)
- No, but I have considered doing so (please skip to question 17)
- No, I have never considered doing so (please skip to question 18)
- I don't know (please skip to question 18)

14 What was your well water tested for? Please check all that apply.

- Bacteria
- Nuisance chemicals and minerals (iron, hardness, etc)
- Harmful chemicals and minerals (lead, nitrates, etc)
- I don't know/I am not certain

15 What motivated you to get the well tested? _____

16 Please describe how often you test your water:

Example: "Every year" or "Only when the well was first drilled in 1965"

17 Which of the following has presented or currently presents a difficulty in getting your water tested? Please check all that apply.

- Finding a laboratory or agency to do the testing
- Collecting the water sample
- Paying the cost to have the sample analyzed
- Finding a contractor who would collect the sample and arrange to have it tested
- Reading the results of the testing
- Others (please describe) _____
- I have had no difficulty getting my water tested

Shock Chlorination

18 Other than when it was first drilled, have you ever had your well shock chlorinated?

- Yes (please continue to the next question)
- No, but I have considered doing so (please skip to question 21)
- No, I have never considered doing so (please skip to Part B on the next page)
- I don't know (please skip to Part B on the next page)

19 Please describe your general practices of shock chlorination:

Examples: *"I do it myself every few years"* or *"I had a contractor do it once"*

20 Why have you shock chlorinated your well?

Please check all that apply.

- To reduce sulfur smell (rotten egg smell)
- Birth of a baby who will rely on the well
- To reduce iron/iron bacteria in my water (which often causes staining in household fixtures)
- To improve the flow of my well
- To prevent harmful bacteria from growing in my well
- To provide softer water for the household
- I believe that it is part of regular maintenance
- Other (please describe) _____

21 Which of the following has presented or currently presents a difficulty getting your well shock chlorinated?

Please check all that apply.

- I was worried about the safety of handling the chlorine
- Purchasing the chlorine to shock the well
- Finding out how to properly shock chlorinate the well
- Finding a contractor to do it
- Getting rid of the chlorine smell from the water
- Others (please describe) _____
- I have had no difficulty getting my well shock chlorinated

Part B: Preferences and Beliefs about Groundwater and Wells - We want to learn about people's opinions regarding water wells. Please provide *your opinion, preference or best guess* about the following. If you cannot answer a question, feel free to leave it blank.

22 Please circle the answer that reflects *your best guess* about the following statements:

<i>Example</i> - Bill Gates is richer than Oprah Winfrey	<i>Absolutely False</i>	<i>Likely False</i>	Likely True	<i>Absolutely True</i>
a. The water in most wells has travelled many kilometers underground before reaching the well	<i>Absolutely False</i>	<i>Likely False</i>	<i>Likely True</i>	<i>Absolutely True</i>
b. The deeper a well is, the safer the water in the well is to drink	<i>Absolutely False</i>	<i>Likely False</i>	<i>Likely True</i>	<i>Absolutely True</i>
c. Shock chlorinating your well every year or so is good for the well	<i>Absolutely False</i>	<i>Likely False</i>	<i>Likely True</i>	<i>Absolutely True</i>
d. The water in most wells comes from rain/snow in the local area	<i>Absolutely False</i>	<i>Likely False</i>	<i>Likely True</i>	<i>Absolutely True</i>
e. A poorly maintained well can impact the quality of water in other wells in the area	<i>Absolutely False</i>	<i>Likely False</i>	<i>Likely True</i>	<i>Absolutely True</i>
f. What happens on neighbouring properties can impact the quality of groundwater in a well	<i>Absolutely False</i>	<i>Likely False</i>	<i>Likely True</i>	<i>Absolutely True</i>
g. Most groundwater exists as underground streams or rivers.	<i>Absolutely False</i>	<i>Likely False</i>	<i>Likely True</i>	<i>Absolutely True</i>

23 If you wanted *advice* or *information* relating to water wells, how likely is it that you would do the following?

	<i>Not Likely</i>	<i>Somewhat Likely</i>	<i>Highly Likely</i>
a. Talk to neighbours or friends	1	2	3
b. Contact a local health clinic	1	2	3
c. Contact the Alberta Water Well Drilling Association	1	2	3
d. Search on the Internet	1	2	3
e. Contact a water well contractor	1	2	3
f. Contact a contractor in a related business (such as home builder or plumber)	1	2	3
g. Find books on the subject (library or bookstore)	1	2	3
h. Contact the Municipal Government (County, Town, City, etc.)	1	2	3
i. Contact a Provincial or Federal government agency (Environment, Agriculture and Rural Development, etc)	1	2	3

Part C: Having a Well Constructed - In this section we are interested in learning about the types of things people have considered when having a well constructed. This can relate to any well that you have had constructed on this or any other property.

If you have never had a contractor install or construct a well, you can skip ahead to Part D on page 8.

24 Please select a value from one to four regarding how strongly you agree with the following statements:

	<i>Strongly Disagree</i>	<i>Disagree</i>	<i>Agree</i>	<i>Strongly Agree</i>
a. Price was an important factor for me when choosing someone to drill my well	1	2	3	4
b. Recommendations from other people were important factors for me when choosing someone to drill my well	1	2	3	4
c. The contractor I hired took the time to explain to me the importance of proper well construction methods for producing a safe and reliable well	1	2	3	4
d. The contractor I hired discussed the importance of well location relative to possible sources of contamination.	1	2	3	4
e. The contractor I hired spent time explaining water well maintenance to me	1	2	3	4
f. The contractor I hired explained proper landscaping techniques around a well	1	2	3	4

25 The contractor who constructed my well was a licensed journeyman: Yes No I don't know

26 Please describe any factors that you considered in deciding where to locate the well:

Part D: Unused Wells and Well Abandonment - We would like to know about people's experiences in dealing with unused wells.

If you do not have an unused well or a reclaimed (plugged) well on your property you can skip to Part E on page 9.

27 Do you have any wells that you expect to use again in the future, but that are currently not in use (summer wells, seasonal wells etc)?

<input type="checkbox"/> Yes	→	Please indicate anything you have done to the well:
<input type="checkbox"/> No		<input type="checkbox"/> I have not done anything to the well
		<input type="checkbox"/> Employed a water well contractor to put the well in unused status
		<input type="checkbox"/> Removed pumping equipment
		<input type="checkbox"/> Poured chlorine into the well
		<input type="checkbox"/> Put a well cap on the well
		<input type="checkbox"/> Other (please describe) _____

28 Do you have any wells on your property that you do not expect to use again (including reclaimed/plugged/buried wells)?

<input type="checkbox"/> Yes	→	Please indicate anything you have done to the well:
<input type="checkbox"/> No		<input type="checkbox"/> I have not done anything to the well
		<input type="checkbox"/> Employed a water well contractor to reclaim the well
		<input type="checkbox"/> Removed pumping equipment (or attempted to)
		<input type="checkbox"/> Filled the well with sand and/or gravel
		<input type="checkbox"/> Filled the well with clay and/or soil
		<input type="checkbox"/> Filled the well with bentonite chips or powder, or cement
		<input type="checkbox"/> Poured chlorine into the well
		<input type="checkbox"/> Cut the casing off or bent the casing over under the ground level
		<input type="checkbox"/> Buried the casing
		<input type="checkbox"/> Other (please describe) _____

29 Please describe any difficulties/uncertainties that you have faced in the past or that you might expect to face in the future when reclaiming (plugging) an unused well:

Part E: Household Information - We would appreciate some information about your household to help us categorize the survey responses.

30 Please tell us the name of the Municipality that you live within:
(County, MD, City, Town, etc.)

31 Which of the following best describes the property where this well is located?

- Working Farm
- Hobby Farm
- Rural Non-Farm Residence (acreage)
- Village/Town Residence
- Cabin, Cottage, or Second Home
- Other (please describe) _____

32 How long have you lived on or visited (in the case of a cabin or other summer home) the property where your well is located?

33 Would putting information about water wells on the Internet be a useful way to make this information available to you?

- Yes No


34 What are the highest levels of education that the adult members of the household have completed?

Please check any that apply.

- Some formal schooling
- High school certificate or equivalent
- Apprenticeship or trades certificate
- College certificate or diploma
- University degree
- Other (please describe) _____

35 In what year was the oldest member of the household born? 19_____

Part G: Your Comments, Concerns and Questions - Please provide any recommendations and/or questions that you have for Alberta's water well drillers, for us as academic researchers, and for those working at Alberta Environment to assist well owners with the stewardship of their wells. Feel free to add additional pages if you like.



Thank you for completing the survey.

Information gathered from this survey will be available in Spring 2009 from Alberta Environment by calling 780-427-2700 (dial 310-0000 for toll free).

You can also obtain a copy of the manual "*Water Wells that Last for Generations*" (Catalogue # ENV-56-OP) by calling the above number or online at: <http://environment.gov.ab.ca/info/>

On completion, please remember to return the survey to us in the postage paid envelope provided.

Appendix Four: Data Tables

Respondent Property Type Frequency

Property Type	Frequency	%	Valid %	Cumulative %
Working Farm	483	47.5%	48.9%	48.9%
Hobby Farm	119	11.7%	12.1%	61.0%
Rural Non Farm (Includes Acreage)	330	32.4%	33.4%	94.4%
Village/Town Residence	20	2.0%	2.0%	96.5%
Cabin, Cottage, or Other Second Home	35	3.4%	3.5%	100.00%
Sub-Total	989	97.0%	100%	
No Response	27	1.9%		
Total	1014	100.0%		

Age of Oldest Member of Household

Age (years)	Frequency	%	Valid %	Cumulative %
<30	16	1.6	1.7	1.7
31-40	133	13.1	14.1	15.8
41-50	266	26.2	28.2	44.0
51-60	256	25.2	27.1	71.1
61-70	189	18.6	20.0	91.1
>70	84	8.3	8.9	100.0
Sub-Total	944	93.1	100.0	
No Response	70	6.9		
Total	1014	100.0		

Highest Level of Education Attained

Education Level	Frequency	%	Valid %	Cumulative %
Some Formal Schooling	64	6.3	6.5	6.5
High School Certificate	221	21.8	22.4	28.9
Apprenticeship or Trades Certificate	160	15.8	16.2	45.2
College Certificate or Diploma	276	27.2	28.0	73.2
University Degree	264	26.0	26.8	100
Sub-Total	685	97.1	100	
No Response	29	2.9		
Total	1014	100.0		

Length of Time on Property

Years	Frequency	%	Valid %	Cumulative %
<5	184	18.1	18.9	18.9
6-10	171	16.9	17.6	36.5
11-15	130	12.8	13.4	49.9
16-20	92	9.1	9.5	59.4
21-25	59	5.8	6.1	65.5
26-30	76	7.5	7.8	73.3
31-35	53	5.2	5.5	78.8
36-40	58	5.7	6.0	84.8
41-45	26	2.6	2.7	87.5
46-50	39	3.8	4.0	91.5
51-55	19	1.9	2.0	93.5
56-60	22	2.2	2.3	95.8
61-65	16	1.6	1.6	97.4
66-70	9	0.9	0.9%	98.3
71-75	2	0.2	0.2	98.5
>76	15	1.5	1.5	100.0
Sub-Total	971	95.8	100	
No Response	43	4.2		
Total	1014	100.0		

Well Diameter

	Frequency	%	Valid %	Cumulative %
1	53	5.2	5.6	5.6
2	17	1.7	1.8	7.5
3	869	85.2	92.5	100.0
Sub-Total	939	92.1	100.0	
No Response	75	7.9		
Total	1014	100.0		

Age of Well

Age (years)	Frequency	%	Valid %	Cumulative %
<5	272	26.8	28.0	28.0
6-10	295	29.1	30.3	58.3
11-15	104	10.3	10.7	69.0
16-20	89	8.8	9.1	78.1
21-25	36	3.6	3.7	81.8
26-30	71	7.0	7.3	89.1
31-35	23	2.3	2.4	91.5
36-40	25	2.5	2.6	94.1
41-45	14	1.4	1.4	95.5
46-50	15	1.5	1.5	97.0
51-55	1	0.1	0.1	97.1
56-60	11	1.1	1.1	98.2
61-65	4	0.4	0.4	98.6
66-70	2	0.2	0.2	98.8
71-75	1	0.1	0.1	98.9
>75	9	0.9	0.9	100.0
Sub-Total	972	96.0	100.0	
No Response	41	4.0		
Total	1013	100.0		

Depths of Wells

	Frequency	%	Valid %	Cumulative %
1-25	12	1.2	1.2	1.2
26-50	32	3.2	3.3	4.5
51-75	79	7.8	8.2	12.7
76-100	109	10.9	11.3	24.0
101-125	106	10.5	11.0	35.0
126-150	126	12.4	13.0	48.0
151-175	85	8.4	8.8	56.8
176-200	119	11.7	12.3	69.1
201-225	51	5.0	5.3	74.4
226-250	57	5.6	5.9	80.3
251-275	37	3.6	3.8	84.1
276-300	66	6.5	6.8	90.9
301-325	23	2.3	2.4	93.3
326-350	11	1.1	1.1	94.4
351-375	19	1.9	2.0	96.4
376-400	15	1.5	1.5	97.9
401-425	7	0.7	0.7	98.6
426-450	1	0.1	0.1	98.7
451-475	0	0	0	98.7
476-500	4	0.4	0.4	99.1
>501	9	0.9	0.9	100.0
Sub-Total	968	95.5%	100%	
No Response	46	4.5%		
Total	1014	100.0%		

Well Depth GIC Database vs. Respondents

	1-50	51-100	101-150	151-200	201-250	251-300	301-350	351-400	>400	
Water Well Information Database	8884	27754	30367	25448	14596	10335	4606	2642	2406	127038
	7.0%	21.8%	23.9%	20.0%	11.5%	8.1%	3.6%	2.1%	1.9%	
Respondents	44	188	232	204	108	103	34	34	21	968
	4.5%	19.4%	24.0%	21.1%	11.2%	10.6%	3.5%	3.5%	2.2%	

$\chi^2=28.70$ df=8, p<0.000 Cramer's V=0.013

Location of Survey Respondents by Provincial Watershed Planning Region

Municipal District/County	Frequency	%	Valid %	Cumulative %
Beaver County	7	0.7	0.7	0.7
Birch Hills County	3	0.3	0.3	1.0
Brazeau County	19	1.9	2.0	3.0
Camrose County	17	1.7	1.7	4.7
Cardston County	1	0.1	0.1	4.8
Clearwater County	40	3.9	4.1	8.9
County of Athabasca	19	1.9	2.0	10.9
County of Barrhead	23	2.3	2.4	13.2
County of Grande Prairie	34	3.4	3.5	16.7
County of Minburn	8	0.8	0.8	17.6
County of Paintearth	2	0.2	0.2	17.8
County of St. Paul	15	1.5	1.5	19.3
County of Stettler	18	1.8	1.8	21.1
County of Thorhild	4	0.4	0.4	21.6
County of Vermilion River	21	2.1	2.2	23.7
County of Wetaskiwin	32	3.2	3.3	27.0
County Two Hills	10	1.0	1.0	28.0
Cypress County	3	0.3	0.3	28.3
City of Edmonton	1	0.1	0.1	28.4
Flagstaff County	5	0.5	0.5	29.0
Kneehill County	8	0.8	0.8	29.8
Lac La Biche County	2	0.2	0.2	30.0
Lac Ste. Anne County	22	2.2	2.3	32.2
Lacombe County	34	3.4	3.5	35.7
Lamont County	5	0.5	0.5	36.2
Leduc County	31	3.1	3.2	39.4
M.D. of Big Lakes	1	0.1	0.1	39.5
M.D. of Bighorn	3	0.3	0.3	39.8
M.D. of Bonnyville	21	2.1	2.2	42.0
M.D. of Foothills	106	10.5	10.9	52.9
M.D. of Greenview	11	1.1	1.1	54.0
M.D. of Lesser Slave River	4	0.4	0.4	54.4
M.D. of Northern Lights	1	0.1	0.1	54.5
M.D. of Pincher Creek	6	0.6	0.6	55.1
M.D. of Provost	3	0.3	0.3	55.4
M.D. of Smoky River	1	0.1	0.1	62.8
M.D. of Taber	1	0.1	0.1	62.9
M.D. of Wainwright	13	1.3	1.3	64.3
M.D. of Willow Creek	10	1.0	1.0	65.3
M.D. of Mackenzie	2	0.2	0.2	65.5
M.D. of Ranchland	3	0.3	0.3	72.7
Mountain View County	67	6.6	6.9	72.4

Parkland County	68	6.7	7.0	79.7
Parkland County	1	0.1	0.1	79.8
Ponoka County	35	3.5	3.6	83.4
Red Deer County	48	4.7	4.9	88.3
Rocky View County	71	7.0	7.3	62.7
Smoky Lake County	7	0.7	0.7	89.0
Special Area No. 2	4	0.4	0.4	89.4
Special Area No. 3	3	0.3	0.3	89.7
Special Area No. 4	1	0.1	0.1	89.8
Starland County	2	0.2	0.2	90.0
Strathcona County	1	0.1	0.1	90.1
Sturgeon County	20	2.0	2.1	92.2
Vulcan County	8	0.8	0.8	93.0
Westlock County	9	0.9	0.9	93.9
Wheatland County	22	2.2	2.3	96.2
Woodlands County	7	0.7	0.7	96.9
Yellowhead County	30	3.0	3.1	100.0
Sub-Total	971	96.1	100	
No Response	40	3.9		
Total	1014	100.0		

Extent of Treatment Systems

	% of All Wells	% of Wells used for Drinking Water	Total
No Treatment	415 (41.0%)	333 (41.2%)	748
Carbon Filter	85 (8.4%)	79 (9.8%)	164
Water Softener	255 (25.2%)	205 (25.3%)	460
Iron Filter	181 (17.9%)	148 (18.3%)	329
Sediment Filter	126 (12.4%)	103 (12.7%)	229
Reverse Osmosis	128 (12.6%)	128 (15.8%)	256
UV System Constant	8 (0.8%)	8 (1.0%)	16
Chlorination	33 (3.3%)	28 (3.5%)	61
Distillation	54 (5.3%)	54 (6.7%)	108
Other	14 (1.4%)	11 (1.4%)	25

Total	964 (40.2%)	809 (33.8%)	2396 (100%)
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Well Used for Drinking Water By Property Type

	Strongly Agree	Agree	Disagree	Strongly Disagree	No Response	Total
Like Taste of water from household tap	339 (34.1%)	375 (37.7%)	173 (17.4%)	108 (10.9%)	19 N/A	
Water from my well is safe to drink w/out treatment	383 (38.4%)	394 (39.5%)	134 (13.4%)	87 (8.7%)	16 N/A	

Well Used for Drinking Water By Property Type

Property Type	Yes	No	Total
Working Farm	412 (85.3%)	71 (14.7%)	483
Hobby Farm	89 (77.6%)	30 (22.4%)	119
Rural Non Farm (Includes Acreage)	256 (74.8%)	74 (25.2%)	330
Village/Town Residence	14 (70.0%)	6 (30.0%)	20
Cabin, Cottage, or Other Second Home	16 (45.7%)	19 (54.3%)	35
Total	787 (79.7%)	200 (20.3%)	987 (100%)

$\chi^2=26.52$, $df=1$, $p=0.00$, $\phi=0.19$

$\chi^2=11.37$, $df=2$, $p=0.03$, Cramer's $V=0.11$

Would prefer to drink water from treatment plant	51 (5.2%)	132 (13.5%)	450 (45.9%)	347 (35.4%)	34 N/A
Prefer bottled water over well water	109 (11.5%)	194 (20.4%)	368 (38.8%)	278 (29.3%)	65 N/A
Prefer cistern water over well water	15 (1.5%)	61 (6.2%)	377 (38.5%)	526 (53.7%)	35 N/A
My well water is safe enough for a baby to drink	287 (28.8%)	399 (40.0%)	183 (18.4%)	128 (12.8%)	17 N/A
I sometimes worry about safety of my water	55 (5.6%)	330 (33.4%)	395 (40.0%)	208 (21.1%)	26 N/A
I am concerned about the risk of methane gas in my well	74 (7.4%)	193 (19.4%)	476 (47.8%)	252 (25.3%)	19 N/A
I feel confident in my understanding of my well	240 (24.3%)	625 (63.3)	103 (10.4%)	20 (2.0%)	26 N/A
Total					

I think it's best to leave my well alone unless I have a problem with it

	Frequency	%	Valid %	Cumulative %
Strongly Agree	83	8.2	8.4	8.4
Agree	278	27.4	28.1	36.5
Disagree	372	36.7	37.6	74.1
Strongly Disagree	256	25.2	25.9	100.0
Sub-Total	989	97.5	100	
No Response	25	2.5		
Total	1014	100.0		

Well Should be Left Alone Unless They Have a Problem By Education

Education Level	Strongly Agree	Agree	Disagree	Strongly Disagree	Total
University Degree	46 (17.8%)	142 (54.8%)	59 (22.8%)	12 (4.6%)	259
College Certificate or Diploma	50 (18.7%)	130 (48.7%)	68 (25.5%)	19 (7.1%)	267

Apprenticeship or Trades Certificate	24 (15.8%)	78 (51.3%)	39 (25.7%)	11 (7.2%)	152
High School Certificate	53 (24.8%)	121 (56.5%)	32 (15.0%)	8 (3.7%)	214
Some Formal Schooling	21 (35.0%)	29 (48.3%)	5 (8.3%)	5 (8.3%)	60
Total	194 (20.4%)	500 (52.5%)	203 (21.3%)	55 (5.8%)	952 (100%)

$\chi^2 = 24.63$, $D.F. = 8$, $p = 0.002$ Cramer's $V = 0.136$

Testing of Well Water

	Frequency	%
Has Tested Water	835	83.7
Has Considered Testing	103	10.3
Has Not Considered Testing	60	6.0
Total	998	100.0

Frequency of Water Testing for Wells 3-5 Years Old

	Frequency	%
Not tested	38	19.3
>1 per year	2	1.0
Every year	11	5.6
Every 2 Years	12	6.1
Only Once	117	59.4
Unknown	17	8.6
Total	197	100.0

Frequency of Water Testing for Wells 6-10 Years Old

	Frequency	%
Not tested	28	4.8
>1 per year	3	0.5
Every year	25	4.3
Every 2 Years	26	4.5

Every 3-5 Years	55	9.5
Only Once	114	19.7
Unknown	30	5.2
Total	578	100.0

Frequency of Water Testing for Wells More than 10 Years Old

	Frequency	%
Not tested	50	13.0
>1 per year	8	2.1
Every year	35	9.1
Every 2 Years	15	3.9
Every 3-5 Years	72	18.7
Every 6-10 Years	49	12.8
< 1 per 10 Years	122	31.8
Unknown	33	8.6
Total	384	100.0

Estimated Frequency of Water Testing By Age (wells over 4 years of age)

Age Classification	0	>1 per year	Annually	Every second year	Two to five years	Six to ten years	More than 10 years	Special event	Total
<35	9 (19.0%)	1 (2%)	6 (13%)	2 (4%)	11 (23%)	8 (17%)	9 (19%)	2 (4%)	48
36-50	42 (16%)	4 (2%)	25 (10%)	23 (9%)	50 (19%)	57 (22%)	41 (16%)	19 (7%)	261
51-65	50 (18%)	4 (1%)	21 (7%)	15 (5%)	45 (16%)	56 (20%)	75 (27%)	15 (5%)	281
>65	19 (15%)	1 (1%)	12 (9%)	8 (6%)	26 (20%)	22 (17%)	32 (25%)	10 (8%)	130
Total	120	10	64	48	132	143	157	46	720

$\chi^2 = 18.549$, D.F. = 21, $p = 0.614$

Estimated Frequency of Water Testing By Education (wells over 4 years of age)

Education Level	0	>1 per year	annually	Every second year	Two to five years	Six to ten years	More than 10 years	Special event	Total
Some Formal Schooling	11 (25%)	0 (0%)	4 (9%)	4 (9%)	10 (23%)	9 (20%)	4 (9%)	2 (5%)	44
High School Certificate	30 (18%)	4 (2%)	15 (9%)	29 (17%)	32 (19%)	42 (25%)	9 (5%)	6 (4%)	167
Apprenticeship or Trades Certificate	22 (20%)	2 (2%)	8 (7%)	17 (15%)	22 (20%)	25 (23%)	7 (6%)	7 (6%)	110
College Certificate or Diploma	35 (16%)	5 (2%)	23 (10%)	43 (19%)	41 (19%)	38 (17%)	17 (8%)	19 (9%)	221
University Degree	25 (13%)	1 (1%)	17 (9%)	44 (22%)	45 (23%)	46 (23%)	9 (5%)	13 (7%)	200
Total	123	12	67	137	150	160	46	47	742

$\chi^2 = 24.316$, D.F. = 28, $p = 0.665$

Estimated Frequency of Testing Vs. Property Type (wells over 4 years of age)

Property Type	0	>1 per year	Annually	Every second year	Two to five years	Six to ten years	More than 10 years	Special event	Total
Working Farm	57 (14.5%)	7 (6.9%)	37 (9.4%)	70 (17.8%)	79 (20.1%)	90 (22.9%)	27 (6.9%)	26 (6.6%)	393
Hobby Farm	15 (17.0%)	1 (1.1%)	6 (6.8%)	18 (20.5%)	15 (17.0%)	19 (20.5%)	8 (9.1%)	6 (6.8%)	88
Rural Non Farm (Includes Acreage)	42 (19.1%)	1 (0.5%)	18 (8.2%)	43 (19.5%)	47 (21.4%)	44 (20.0%)	12 (5.5%)	13 (5.9%)	220
Village/Town Residence	1 (7.1%)	2 (14.3%)	3 (21.4%)	3 (21.4%)	3 (21.4%)	1 (7.1%)	0 (0.0%)	1 (7.1%)	14
Cabin Cottage, or Other Second Home	6 (24.0%)	0 (0.0%)	2 (8.0%)	4 (16.0%)	6 (24.0%)	4 (16.0%)	0 (0.0%)	3 (12.0%)	25
Total	121	11	66	138	150	158	47	49	740

$\chi^2 = 33.154$, D.F. = 28, $p = 0.230$

Frequency of Testing of Well by Region

	Every 2 Years or more	Every 3-5 years	Every 6-10 years	Less than once every ten years (including never)	Total
Lower Peace and Athabasca	5 (28%)	1 (6%)	4 (22%)	8 (44%)	18
North Saskatchewan	22 (10%)	35 (16%)	57 (26%)	106 (28%)	220
Red Deer	34 (23%)	34 (23%)	25 (17%)	57 (38%)	150
South Saskatchewan	46 (26%)	43 (24%)	29 (16%)	60 (34%)	178
Upper Peace and Athabasca	17 (15%)	22 (20%)	30 (27%)	42 (38%)	111
Total	124	135	145	273	677

$X^2 = 35.81$ DF= 12 p <0.000 Cramer's V=0.14

Frequency of Testing of Well by Municipality (Foothills and Parkland)

Region	Every 2 years or more	Every 3-5 years	Every 6-10 years	Less than once every ten years (including never)	Total
M.D. of Foothills	26 (28.9%)	18 (20.0%)	11 (12.2%)	35 (38.9%)	90
Parkland County	1 (2.4%)	8 (19.0%)	9 (21.4%)	24 (57.1%)	42
Total	27	26	20	59	132

$X^2 = 13.59$ DF= 3 p <0.004 Cramer's V=0.321

Frequency of Testing of Well by Municipality (All Counties and MDs)

	Every 2 years or more	Every 3-5 years	Every 6-10 years	Less than once every ten years (including never)	Total
Beaver County	1	0	2	1	4
Birch Hills County	0	0	1	0	1
Brazeau County	3	3	2	4	12
Camrose County	0	2	2	9	13
Clearwater County	5	3	4	18	30
County of Athabasca	1	3	2	5	11

County of Barrhead	2	3	6	7	18
County of Grande Prairie	4	8	5	13	30
County of Minburn	0	2	1	2	5
County of Paintearth	0	0	0	1	1
County of St. Paul	1	4	5	4	14
County of Stettler	1	2	4	3	10
County of Thorhild	0	0	1	0	1
County of Vermilion River	2	2	7	6	17
County of Wetaskiwin	3	4	3	12	22
County of Two Hills	1	0	1	3	5
Cypress County	0	0	0	1	1
Flagstaff County	0	0	2	1	3
Kneehill County	5	0	0	0	5
Lac Ste. Anne County	4	3	2	6	15
Lacombe County	5	6	2	6	19
Lamont County	0	1	0	1	2
Leduc County	2	2	10	10	24
M.D. of Big Lakes	0	1	0	0	1
M.D. of Bighorn	2	0	0	0	2
M.D. of Bonnyville	4	1	3	8	16
M.D. of Foothills	26	18	11	35	90
M.D. of Greenview	1	1	4	4	10
M.D. of Lesser Slave River	0	1	2	1	4
M.D. of Northern Lights	1	0	0	0	1
M.D. of Pincher Creek	1	1	1	2	5

M.D. of Provost	0	0	0	2	2
M.D. of Smoky River	1	0	0	0	1
M.D. of Taber	0	0	1	0	1
M.D. of Wainwright	2	1	1	2	6
M.D. of Willow Creek	2	2	2	0	6
M.D. of MacKenzie	0	0	1	0	1
M.D. of Ranchland	1	0	1	0	2
Mountain View County	12	13	8	15	48
Parkland County	1	8	9	24	42
Ponoka County	2	4	6	10	22
Red Deer County	8	8	2	18	36
County of Rocky View	8	14	10	19	51
Smoky Lake County	1	0	1	2	4
Special Area No. 2	1	1	1	1	4
Special Area No. 3	0	0	1	2	3
Starland County	0	0	1	0	1
Sturgeon County	0	2	6	5	13
Vulcan County	0	0	1	2	3
Westlock County	2	0	2	2	6
Wheatland County	5	8	2	1	16
Woodlands County	0	1	1	2	4
Yellowhead County	3	2	5	2	12
Total	128	139	154	287	708

Difficulty with Water Well Testing

	Frequency	%
Identified Difficulty	236	25.3%
No Difficulty	696	74.7%
Total	932	100.0%

Frequency of Shock Chlorination for Wells >4 Years Old

	Frequency	%	Valid %	Cumulative %
Considered SC	159	20.3	20.6	20.6
Not Considered SC	266	34.0	34.5	55.1
Rarely SC	92	11.7	11.9	67.0
Regularly SC	236	30.1	30.6	97.6
SC with no Indication of Frequency	18	2.3	2.3	100.0
Sub-Total	771	98.4	100.0	
No Response	12	1.5		
Total	783	100.0		

Shock Chlorination Frequency by Age

Age (years)	Has Not SC	Rarely SC	Regularly SC	Total
<30	7 (63.6%)	0 (0%)	4 (36.4%)	11
31-40	47 (57.3%)	11 (13.4%)	24 (29.3%)	82
41-50	125 (60.1%)	22 (10.6%)	61 (29.3%)	208
51-60	111 (56.1%)	21 (10.6%)	66 (33.3%)	198
61-70	86 (58.9%)	20 (13.7%)	40 (27.4%)	146
>70	34 (48.6%)	15 (21.4%)	21 (30.0%)	70
Total	410	89	216	715

$\chi^2 = 9.92$ DF= 10 p = 0.447

Shock Chlorination Frequency by Property Type

Property type	Has Not SC	Rarely SC	Regularly SC	Total
Working Farm	219 (56.2%)	50 (12.8%)	121 (31.9%)	390
Hobby Farm	52 (59.1%)	5 (5.7%)	31 (35.2%)	88
Rural Non Farm (Includes Acreage)	132 (58.7%)	31 (13.8%)	62 (27.6%)	225
Village/Town Residence	8 (61.5%)	1 (7.7%)	4 (30.8%)	13
Cabin, Cottage, or Other Second Home	14 (56.0%)	3 (12.0%)	8 (32.0%)	25
Total	425	90	226	741

$\chi^2 = 5.48$ DF = 8 p = 0.706

Strength of Respondent Agreement Regarding Importance of Factors in Choosing Contractor

	Strongly Agree	Agree	Disagree	Strongly Disagree	No Response	Total
Price an Important Factor	93 (10.3%)	403 (44.8%)	329 (36.6%)	74 (8.2%)	115 N/A	
Recommendations an Important Factor	248 (27.7%)	531 (59.3%)	100 (11.2%)	16 (1.8%)	119 N/A	
Total						

Strength of Respondent Agreement Regarding Contractor Practice

	Strongly Agree	Agree	Disagree	Strongly Disagree	No Response	Total
Explained Proper Construction Methods	208 (23.3%)	463 (52.0%)	197 (22.1%)	23 (2.6%)	123 N/A	
Discussed Location Relative to Contamination	175 (19.8%)	411 (46.5%)	262 (28.7%)	35 (4.0%)	131 N/A	
Contractor Explained Maintenance	118 (13.4%)	363 (41.1%)	344 (39.0%)	58 (6.6%)	131 N/A	
Contractor Explained Landscaping	87 (10.0%)	307 (35.1%)	404 (46.2%)	76 (8.7%)	140 N/A	
Total						

Frequency of Contractor Status (All Wells)

	Frequency	%	Valid %	Cumulative %
Licensed Journeyman	693	68.3	76.2	76.2
Not a Licensed Journeyman	5	0.5	0.6	76.8
Don't Know	211	20.8	23.2	100.0
Sub-Total	1013	89.6	100.0	
No Response	105	10.4		
Total	1014	100		

Appendix Five: Data Tables for Figures included in Section 4.0: Issues Raised by Respondents

Key issues raised in Question 12		
Total number of responses: 350		
Issues	No.	%
<i>Water quality</i>	182	52%
<i>Maintenance practices</i>	64	18%
<i>Impact of oil/gas industry</i>	61	17%
<i>Water flow</i>	51	15%
<i>Need for information/ asked questions</i>	20	6%
<i>Impact of neighbours/farms</i>	19	5%
<i>Government actions/ regulations</i>	9	3%

Water quality/ flow issues raised in Question 12		
Total number of responses: 233		
Issues	No.	%
<i>Contamination</i>	70	30%
<i>High sodium/ salty</i>	53	23%
<i>Poor/disrupted flow</i>	44	19%
<i>Is soft</i>	34	15%
<i>Bad taste</i>	29	12%
<i>Bad smell</i>	27	12%
<i>High iron/ iron bacteria</i>	25	11%
<i>Health concerns</i>	17	7%
<i>Good quality/ flow</i>	14	6%
<i>Concerns about future flow</i>	14	6%
<i>Is hard</i>	12	5%
<i>Methane content</i>	11	5%

Key issues raised in responses to Part G		
Total number of responses: 309		
Issues	No.	%
<i>Need for information/ asked questions</i>	126	41%
<i>Government actions/ regulations</i>	77	25%
<i>Impact of oil/gas industry</i>	55	18%
<i>Maintenance practices (all)</i>	39	13%
<i>Impact of neighbours/farms</i>	21	7%
<i>Survey</i>	18	6%

Sub-issues raised in Part G		
<i>Issues</i>	<i>No.</i>	<i>%</i>
<i>Need to distribute information at time of drilling</i>	33	11%
<i>Need to protect water/aquifers</i>	31	10%
<i>Cost of maintenance/ construction/ testing</i>	22	7%
<i>Regulation of oil/gas industry</i>	17	6%
<i>Requested contact re. specific issue</i>	16	5%
<i>Abandoned wells</i>	13	4%
<i>Practices/knowledge of drillers</i>	9	3%
<i>Witching</i>	7	2%

Appendix Six: Selected Respondent Comments about Water Quality/Flow (Q12)

Municipal District/County	Comments
Brazeau County	We have a new well test slightly higher in sodium than we would prefer. Very soft water.
Camrose County	Our well is in a coal seam and will carry coal particles thru the system choking off valves and pipes. We sometimes shock it with chlorine. I would prefer naturally filtered well water, to town water.
Clearwater County	Has a high content of sodium. Contains gas which is siphoned off to outside. Contains a fair amount of fluoride.
Clearwater County	We have only "shocked" our well once in 16 years. Our water is extremely hard so soap doesn't work that well (have to use large amounts). I do feel fortunate that our water tastes good and is safe right from tap.
County of Athabasca	Not sure how to treat lake water as a substitute for our non-potable well-water.
County of Athabasca	We drink bottled water as our well water is high in mineral content and tastes foul! We would actually prefer to drink well water.
County of Athabasca	My well water is very clear; it is good for cooking, washing clothes, etc.
County of Barrhead	Our well water has a lot of sodium in it so we use bottled water for fresh coffee.
County of Barrhead	Our water is salty! I have soft water without a water-softener.
County of Barrhead	Contains sodium and minerals that leave a whitish residue and clog appliances.
County of Grande Prairie	More water used the better the smells and tastes gets. Well is also used for 100 cattle year around for water at the same time as household.
County of Grande Prairie	It has been indicated that if our well had been drilled slightly deeper, we wouldn't even need to treat our well water for iron/hardness.
County of St. Paul	We drink some bottled water because we have iron bacteria in the well and don't like to drink softened water. When the softener is not working, we really like the taste of our water.
County of Two Hills	The smell of rotten eggs and metallic is the untreated H ₂ O from the outside tap which I use for gardening, etc.
County of Two Hills	Our well has high solids, sodium and iron, we use it for everything but drinking. Even with the filter system we have the water is not recommended for drinking.
County of Vermilion River	Our well water is very safe and good. We feel very lucky to have this type of water and also a good amount of it.
County of Wetaskiwin	If no water is used for about a week there is a strong smell from it.
City of Edmonton	Strong odour when hot water used. Hot water is also "black" in color. We have to regularly flush the hot water tank.
Kneehill County	The water in the well is terrible, smells and stinks. The water is eating the plumbing. The toilet and bath are rust covered. Hard to remove. The water from the tap is terrible when cold and hot water is almost unbearable to wash clothes, dishes.
Lac Ste. Anne County	I am mostly neutral about the well as it has been reliable, it provides good quality water, and services all our needs more than adequately for household and livestock use. In drought years I think about "what if" the well dries up. Hasn't happened as yet and hope never will... But I do think about it.
Lacombe County	our water has some iron - we have installed a sand filter + salt bath to reduce the iron
Lamont County	Water is dark and has a very unpleasant odour after the well has not been used for a few days. It can leave an oily film and smells of gas.
Leduc County	There is a small amount of iron in my well but not enough to worry about. I chlorinate my well 2-3 times a year for slight odour.
Leduc County	The reason I drink bottled water is because the well water sometimes has a hint of an odour. All I have to do is let it sit for 5 min, then it's fine.
M.D of Bighorn	Everyone who comes to my house cannot believe how good my water tastes.
M.D. of Bonnyville	After we are away the hot water, especially, has an extremely foul odour until we have used up the stagnant hot water by emptying the tank with household use.
M.D. of Foothills	We do not use our well because of iron and smell.
M.D. of Foothills	About 2006-2007 we had trouble growing vegetables in a small greenhouse we have. Had soil tested and then water tested and company [name omitted] indicated high salinity, quality - "Ionic". We use the well to water gardens outside and use it in household for washing, laundry, etc but distil the water to use and buy bottled water to drink. Use rain water or from another source to water greenhouse.

M.D. of Foothills	We have spring quality water; we have done extensive testing on the water. We also have enough quantity to supply a small town.
M.D. of Foothills	Our water is unfit for human consumption 3800 ppm TDS, sodium, etc. We use it to shower and flush toilets
M.D. of Foothills	I have lots of water 35 gal per min, water is safe, has been tested. But smells, has iron, rust everything unless treated with bleach
M.D. of Foothills	I have a very good supply of water and I have recently had it tested. It passes all government recommendations for human consumption.
M.D. of Foothills	Although we feel our water is safe, it doesn't taste great and the treated (softened) water is not preferable. We drink our neighbour's well water. We fill up the large blue jugs. We use our own water for everything except plain-straight-drinking water.
M.D. of Greenview	Reason we do not drink well water or cook with it - very high sodium content.
Mountain View County	Our water is great! We love the taste over any water and feel confident using it for anything. We feel very lucky in this regard!!
Mountain View County	I answered the questions pertaining to the water from my water well. My answers for c to g would be agree if I was referring to some other water from wells in our area that appears dirty or smells.
Mountain View County	We use filtered water for drinking or making coffee/tea etc. Our non-filtered water has had high coliform counts but treating it with hydrogenated water has solved that. We do have extremely high sodium levels (above acceptable) in our unfiltered water so it is only for washing and other household uses and for outside use. Our answers to Question 11 deal mainly with UNFILTERED water.
Mountain View County	Sulphur smell is hot water only - our hot water heater is over-sized and the water sits too long and gets stale.
Mountain View County	This water is high in sodium (very soft) and highly above the drinking water standards.
Mountain View County	I find that during summer when well use is high, water quality greatly increases. Shock chlorination also improves water quality.
Parkland County	We lived on an acreage elsewhere [name omitted] which was considerably worse in water quality - sulphates primarily. The water here is easier to treat.
Parkland County	Our water has methane gas and higher concentrations of sodium. We have a holding tank to release the methane gas but use no other treatment to reduce sodium. Our water tastes great but knowing the sodium content is why we use bottled water for cooking and drinking.
Parkland County	I like our well water - wife doesn't like taste. Only reason I use bottle is colder-quicker (convenience).
Parkland County	Well has slight petroleum smell to it.
Parkland County	I used my water with no treatment for the first 3.5 yrs, but added a reverse osmosis system recently because lately green organic material grows in it at room temperature. I may shock it and see if it helps.
Ponoka County	We have no iron or bacteria, smell etc. in our well. We have very soft water.
Ponoka County	My well is only 1.5 years old but good drilling practice was used and the well is staying very good with soft water without any sign of odour.
Red Deer County	The water is not the same as when well was first drilled. Now sometimes smells like sulphur and rusty. We now have water from another location to drink.
Red Deer County	The only concern is the hardness of the water.
Red Deer County	I had the water tested and was advised that the Fluoride level was too high for domestic consumption. The well is only used to water horses / cattle.
Rocky View County	I prefer my well water to bottled water others in my house hold feel different but I must admit my well water does make a shitty cup of coffee.
Rocky View County	Our well water is very good as it is.
Rocky View County	My well has high sodium and hard to remove.
Rocky View County	The well is wonderful. The water level hardly varies whether 100 cows are using it or none at all.
Rocky View County	I feel safe using well water that has not been run through the reverse osmosis system to cook with (example: in soup or sauces). Because it will be boiled or cooked first, I would feel safe feeding a baby this water in her food or formula. We consider ourselves lucky to have quite clean water, my family drinks RO water but guests frequently drink straight from the tap and consider the water good. I would drink it if I had to, without fear, but for long term ingestion we drink RO simply as a precaution.
Special Area No. 2	It has a high sodium and methane gas content. For drinking purpose we use reverse osmosis.
Sturgeon County	We do not have iron in our water well but we do chlorinate it on a regular basis to get rid of iron

	bacteria. If we use very little water we have a fairly strong sulphur smell at the house water taps.
Sturgeon County	Water is twice as salty as recommended level.
Thorhild County	We have good water and a good supply. Some people in this area are not so lucky.
Wheatland County	My main concern is dissolved solids (salt) so I try to drink half well and half distilled.
Woodlands County	Our well has too much fluoride + a bit too much sodium. That's why we use reverse osmosis.
Yellowhead County	We use this well on a seasonal basis - i.e. We use it from April to September. So in the spring we let it run for several hours at a time for a couple of days. Then the water tastes fine all summer.
Yellowhead County	It took me a couple of months to become accustomed to the taste of our water. Not 100% comfortable letting my baby drink our water. We have VERY hard water. Dislike that it stains everything rust.
Yellowhead County	Fairly high iron content. I had to put in a filtering system. Strong smell.

Appendix Seven: Selected Comments about the Impact of Oil/Gas Industry on Water Quality and Flow (Q12 and Part G)

Experiences with Impact of Oil/Gas Industry

Municipal District/County	Comments
Beaver County	Seismic work, gas wells and coal mining concerns me. We have lost a water well to seismic activity in the past.
Clearwater County	The last well I had was perfect for 12 years and then seismic came through my land but was outside of "minimum distance". My well turned bad, very sour. They would do nothing.
County of Grande Prairie	Oil company drilled well 1/2 mile south. We had water problem for about 2 months (mud in water).
Kneehill County	The water on the acreage was real good water and it was soft water. The one well was drilled in 1925 and water was good until the oil company came around and ruined 2 wells. The first water well was ruined about two years ago. I think we drilled (contractor) the second well and the oil company ruined it in a year. Water is impossible to drink and dogs and cats were very sick. The vet animal doctor said the water is poison (beaver fever) and said do not use water. The oil company will not do anything to clean up. The farmers got money for their well and we got the cost of trying to fix things (well) and it is eating the plumbing. You should go and see for yourself. Cats and dogs were very sick and vets are not cheap.
Lacombe County	Our well did not have sulphur smell at all until seismic activity on property approx. 3 years ago.
Leduc County	There is an oil well about 1 1/2 miles NW of my yard, and every time they work ... I get gas in my well and lots of it. If you turn the tap on you can ignite the gas with a lighter and it will burn. They told me that since I'm over a mile away I don't qualify for monitoring my well when they work over the oil well.
M.D. of Willow Creek	I do not believe oil and seismic companies have strict enough rules when drilling for oil and gas. I had an oil company wanting to drill for gas, and where they chose to drill was on a water aquifer. I convinced them to move finally, but they said they could cement around the pipe. How do they know what goes on 40-200 feet underground? To my relief they abandoned drilling the well.
Parkland County	Oil and Gas development and seismic activity by oil and gas companies has had a huge impact and its time industry and government quit denying its impact on our wells. We had tested our water through the health unit and then seismic went by our property, our water changed so we sent it for testing again. We contacted the seismic company who denied their activity had impact but sent someone to test our water. They did not know we had had our own testing done. They showed us the results they had - we showed them ours which were significantly different. They became quite hostile, bullying and belittling us to cover up their "fudged" water test results. We hired a lawyer and it was settled BUT we often wondered what would have happened had we not conducted our own pre (which was sheer luck that we had done this) and post seismic tests.
Parkland County	We have a problem with the coal mines by us as the water table is dropping and we have already lost a spring that was very reliable as a water source. I feel it is only a matter of time before our wells begin having problems and Alberta Environment has been unwilling to care or help us.
Ponoka County	Within the first 4 years of the well, I would have answered differently. Then PetroCanada started drilling for gas and the taste went sour.
Red Deer County	Our well water is also monitored by a local oil company.
Rocky View County	Oil well drilled 2-3 years ago have caused my well to smell + taste like petroleum.
Rocky View County	Well was very good (high volume, very soft, a little sulphur smell) then an oil-gas well drilled in area. Water unfit to drink.
Yellowhead County	I have a severe allergy to sulphur and cannot drink it for this reason. As more oil and gas wells were drilled in the surrounding area, the sulphur has gotten stronger so now I no longer use it for cooking or drinking and have to buy drinking water.

Yellowhead County	Seismic activities have caused numerous wells in the area to collapse. My elderly parents also had their well collapse and then had to fight to get it re-drilled. This took several months. The well was fine for over 40 years, until the seismic crew came along the county road. My parents barely had enough water to flush the toilet, and not enough to have a bath, or shower. They had to haul water from another well, for several months. They were finally able to get some help through the farmer's advocate. We are all very concerned about what will happen if coal bed methane production gets approval in our area. We do not use chemicals on our property or pesticides. We believe in protecting our environment and know how important our water quality is. We also know about spills that are covered up by drilling companies and other borderline unsafe/illegal activities by some of these companies. There needs to be more monitoring of these activities.
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Concerns about Current/Future Impact of Oil/Gas Industry

Municipal District/County	Comments
<i>Not supplied</i>	Our concern is the disturbing of our wells by all the oil and gas wells in the field around us and in our field too.
<i>Not supplied</i>	In the area in which I live there is no close activity of oil, gas drilling therefore I have no immediate need of worry. But would be concerned in the event of exploration activity.
<i>Not supplied</i>	I am concerned with all the sour gas wells being drilled within a 4 km distance from my well. There have been 4 in the last 3 years.
Beaver County	I am becoming more concerned about seismic and drilling activity causing problems with well water.
Brazeau County	We have a lot of seismic drilling and activity around us. This has caused a lot of problems for neighbouring old wells. We are good. Survey should include questions about oil field problems.
Camrose County	I am concerned about our underground water becoming contaminated or our well going dry due to oil or gas exploration.
Clearwater County	I am concerned about drilling rigs being allowed to drill wells to supply their water for drilling a gas or oil well. They use large quantities daily and I feel this should NOT be allowed.
County of Barrhead	Drilling surface hole on oil and gas wells can contaminate underground water and destroy underground streams.
County of Grande Prairie	I have had my water tested or it was fit for human consumption. I am more concerned about seismic and well drilling ruining my well.
County of Grande Prairie	I am concerned with over use of our aquifer, i.e.: oil companies using fresh water.
County of Grande Prairie	Concern about oil and gas company.
County of St. Paul	I have heard that drilling of oil/gas wells in my area can ruin a good water well that does concern me.
County of St. Paul	We are very concerned about the effects of oil + gas exploration + drilling, especially coal bed methane drilling!
County of St. Paul	I think it would be useful to land owners like myself that use the wells for household, livestock and general agriculture purposes to have the information about the specific formation we derive our water from. ... A lot of this information is very difficult to find. It should be public knowledge. I have been involved in the oil/gas industry for the [many] years. ... I want to know where the water is flowing in the formations we are testing. ... I am not into politics what so ever but if whoever reads this could give me a name of a person I could talk to about my concerns I would be very appreciative. I'm sure everything is just fine and in order. I'm just curious. When I talk to people whom I work with in the energy sector I receive vague answers. When I approach the agriculture sector I find the people are more negative towards the energy sector. Like this is our water and nobody should use it. Oil - Pollution versus Agriculture - Husbandry manner. Now you can see my concern in regards to honest answers. I happen to be in both. Thank you for your time.
County of Stettler	We have water tested before + after gas drilling in the vicinity + keep the reports.

County of Wetaskiwin	I am very concerned about the effect of the drilling and piping of oil and gas in this vicinity in regards to contamination of aquifers and/ or ground water.
County of Wetaskiwin	I am strongly concerned about what oil and gas companies can do to the aquifer that my water is drawn from.
County of Wetaskiwin	Oil recovery is also using potable water resulting in loss of the H ₂ O that will never be recovered.
Flagstaff County	Am concerned about potential contamination to aquifers in the area due to the excessive oil/gas facilities.
Lac Ste. Anne County	Clean water is the most important "thing" we need from the ground in Earth. More important that oil-gas-coal, etc. We can exist without oil-gas but not with no water.
Lacombe County	Why is good potable water ever used in extraction of oil? Is this water not lost for future use forever?
Leduc County	Wonder about impact of seismic blasting and coal methane activities.
Leduc County	We're concerned about oil well-drilling activity, extracting methane gas from coal beds with the danger of polluting water wells; the vast number of pipelines throughout the province, many of them decades old, eventually eroding and releasing their contents into the ground waters; sour gas wells drilled adjacent to dwellings and water wells; flaring, contributing to air, soil and water pollution by acid rain; enormous quantities of fresh water contaminated for all time by oil discovery activities; wasteful practices of water use, e.g. irrigation systems.
Minburn County	Very conscious of seismic and gas well drilling in the local neighbourhood. I don't like the idea of acid bracing used in gas wells.
Mountain View County	Fresh water shouldn't be used to increase oil well production anymore. Water is too valuable to be used this way.
Mountain View County	I am concerned with widespread purchasing of H ₂ O by oil and gas companies in our area and the removal of that volume forever more from our cycle of water. Sure hope we don't lose our well water due to increased depletion and/or drilling activity in the area, esp since our water witcher only found there to be one underground stream supplying our 1/4 section and we're currently tapped into that. Living during a 3 yr drought sure emphasized the value and absolute necessity of water. Can't do without it!
M.D. of Bonnyville	Concerned about the effects of chemical contamination from oil and gas production that is constantly increasing in the area.
M.D. of Foothills	Recognize that the dewatering seams contribute to gasification of water wells beyond what agriculture and domestic users can contribute. Dewatering deeper water can release gas upward through to surface water. We need to understand contamination better. Better methods of maintenance of existing wells in a positive step. Lost circulation of drilling fluids for O&G can have serious consequences for surface users of water. Bracing production zones of wells with acids and chemicals has serious consequences and risks are unaddressed. This is large scale contamination when things go wrong.
M.D. of Willow Creek	I worry about oil companies and seismic activity affecting the quality and quantity of my water.
M.D. of Willow Creek	I am very worried that seismic blasting or drilling for oil or gas in this area might ruin my water or even divert the flow of underground water so that I might lose all of my water supply.
Parkland County	Oil and gas drilling and seismic impacts to water wells is much more damaging than everyone thinks.
Rocky View County	A lot of the water aquifers have been ruined because of oil drilling and cracking the formations where water runs gets contaminated with sulphur and other contaminants. But these university-degreed people will not accept a layman's experience with the water problems over the years.
Special Area No. 2	Our farm is located in a natural gas field and we strongly feel the water wells should be tested before any other distilling is done in the area.
Yellowhead County	Concerns due to oil wells or other. How will this affect the present - future of our water system?

Government Regulation of Oil/Gas Industry

Municipal District/County	Comments
Brazeau County	Our well is drilled through a corner of an old oil field remote sump. Alberta Environment won't look into it.
Clearwater County	Would like to see limited use of water by oil companies. Greater testing radius of water wells around drilling wells.
County of Two Hills	The government should realise that water is the most precious of resources, and quit bending to the will and when of the largest polluters, the oil industry, which despite commercial, is the largest user and water of it.
County of Vermilion River	I am most concerned that oil well drilling in my area could pollute the water aquifer. The Co's do a fair job in testing to protect the potable water but stricter regulations and supervision wouldn't hurt.
M.D. of Foothills	My only concern with my well is coal bed methane gas development in the area as this has ruined many water sources already and our government seems unwilling to address it.
M.D. of Foothills	Seismic activity has no regard for water wells. Recent activity was gentler than previous dynamite seismic which did damage to our well. No responsibility upon seismic companies, non government, municipalities.
M.D. of Foothills	The MD of Foothills, provincial government does not take any responsibility for protecting private farm water wells from seismic activity or any other o/s damaging sources. The MD actually encourages seismic activity in the area.
M.D. of Smoky River	I feel that the government regulations are too lax and allow too many gray areas for oil and gas industries to get away polluting our water resources. The few studies that have been done do not go back to be used as written in stone practices. We need info dating back 100 years or more and only Hudson Bay fur trading posts kept logs on water ways and rivers, those records should be used as some guidelines when needed, and not only computer models of some 10-20 years!
M.D. of Willow Creek	Alberta Environment took the side of the oil company in our case. They never even came out to talk to us or look at our farm. It is certified organic and would never have surface chemical from nitrates or fertilizer to cause problems. But it was easier to brush us off! Why would we be absolved of all costs to fix the well? It was abandoned.
Mountain View County	Water is more important than oil! We can't live without it! Seismic blasting has caused problems on our land causing flowing wells which were difficult to plug off. Oil well drilling too has caused water to transfer from one aquifer to another at another level and mixed the water and caused iron bacteria to move. Any energy activity nearby – get your well tested before & after, so if there is a problem the energy company can have a new water well drilled for you without a hassle. Make sure people know to have water available by a driller well before they purchase land and build a house in rural areas. Some counties are allowing 2 acre parcels- not enough for a well and a septic field. Water should be available by pipeline to some rural areas
Parkland County	Energy explorations should be closely monitored so that there is no contamination or other affects to local well water.
Ponoka County	What should be done about water wells is stop the shallow gas wells from being dug. Facing (?) these shallow gas wells is wrecking our water. The government doesn't give a damn as long as they are collecting money. Makes good for higher wages at the top.
Rocky View County	We need to watch the oil and gas industry closely. The EUB is a joke! When oil and gas collapsed my well environment was very good to work with, if not for them I would have been left holding the bag.
Special Area No. 2	Start monitoring oil and gas industry closer. Isotope testing, etc.
Strathcona County	The damage to ground water and over consumption by the oil and gas industry is an abomination and the Alberta government in their protection/ support of the industry regardless of the consequences, is deplorable. Having a robust environment is more important than lining our pockets with the riches of the oil revenues particularly when they (oil resources) are being squandered and essentially gifted to large oil interests (but that is a different course of discussion).
Sturgeon County	Please: Do not attempt to recover methane gas in our area...
Wheatland County	The rules for drilling oil and gas wells need to be tighter in regards to water wells.
Wheatland County	The EUB is doing their job on protecting water wells and surface water; more guidelines are needed for gas and oil.
Yellowhead County	I would like to see surface wells not used in oil and gas wells drilling or to replace the gas and oil. A number of surface well have dropped in volume in this area.

Appendix Eight: Selected Comments about Impact of Neighbours/Farms on Well Water (Q12 and Part G)

Municipal District/County	Comments
Camrose County	My biggest concern is in regards to the amount of herbicides and fertilizers used on the land. The users I've talked with believe it is impossible to farm without it. They also close a blind eye as to what it may be doing to the natural watershed.
County of Barrhead	I continue to have concerns overall. I know there are areas in the county where open discharge runs close to wells because they were "grandfathered" in. Also, Barrhead County does not take responsibility for regulating the safety of wells. Alberta Permit Pro checks sewage systems long after they've been installed because of back logs. We had people out from the government. When we had problems, everyone seemed to say it as the "other guy's" responsibility. Ultimately it comes to "buyer beware" and it was our responsibility. However, in trying to do everything correctly, we still found it hard to get the people we needed here - ensuring safety.
County of Grande Prairie	Increase monitoring and prosecution of industries that damage or pollute all sources of fresh drinking water. We only have so much - don't we?
County of St. Paul	I am concerned that the water supply may diminish as more wells are drilled in the development of more lake lots.
County of Stettler	It appears that industry and intensive farming will see the end of our drinking water and future reliance on depleting river sludge c/w treatment.
County of Stettler	All industry (including intensive livestock and crop farmers) should be made liable to pay the freight of testing of all household wells in Alberta every 5 years. The results should be returned to the well owners within 30-60 days of test, with comparisons and recommendations by the independent lab doing the testing. You say - how about the EASTER BUNNY; SANTA CLAUS etc?
County of Thorhild	This is in the New Brook area. They are looking at putting in MEGA pump (waste management) in the general area. This scares the Hell out of me, my well and my health!
County of Wetaskiwin	Transfer via aquifer of iron bacteria – 5 people shocked wells at same time to eliminate after driller of new well caused contamination.
County of Wetaskiwin	I'm concerned about the heavy development surrounding Pigeon Lake. County of Wetaskiwin and Leduc have approved development plans which would add 10,000 new properties drawing on aquifer. Lake level has dropped as development goes up. Lake has 100 years turnover for fresh water. Oil recovery is also using potable water resulting in less of the H ₂ O that will never be recovered.
Flagstaff County	I believe there should be mandatory safety guidelines that all privately owned water wells should adhere to. This is to ensure that aquifers are not damaged or contaminated.
Lac Ste. Anne County	As this area increases in the number of residences we think about the effect more households on wells will have on our water supply. We haven't had any problems yet, but anticipate that more demand and draw from our water source may influence our volume available.
Lacombe County	My concern is the amount of water people in the area use for excessively watering plants, lawns, yards, etc. The same aquifer is used by quite a few people.
Leduc County	My wife and I are very concerned about the possibility of too much development around Pigeon Lake. We are very concerned as well with the blue-green algae and the health of the lake itself.
Mountain View County	We have an excellent water well and want to keep it that way. Nearby oil and gas has had no effect. I think the government should inspect septic systems and well locations occasionally. Avoiding high density developments is important. Instead well spaced large acreages would be better.
M.D. of Foothills	Water flow continues strong, however we now have 3 stables on our 1 km long cul-de-sac, supporting many horses. They draw a lot of water - it is a concern. Is there any law governing the amount of water that one acreage can draw from the aquifer?
M.D. of Foothills	With 28 wells on this 1/4 section (5 acre subdivision), we have some concerns that a shortage might occur. Would like to see some method of limiting amount used.

M.D. of Foothills	I am concerned that additional users of ground water in my area will reduce or contaminate my source.
M.D. of Foothills	We live in an area of increasing growth. We need our water protected. I think we need to know aquifer capacities so the M.D. doesn't over-develop the area.
M.D. of Foothills	The MD should inform owners of land by mail if subdivisions, new acreage etc. that drill new wells close to their res. will have any impact on their own water wells. Same for surface contamination.
M.D. of Ranchland	As a small country residential developer I have had to meet sub-division requirements with hydrology studies that proved water availability without sacrificing the flows in neighbouring wells. This is good. However, I wonder if enough is being done to save our watersheds (big and small). These are charge areas, are key to sustainable ground water sources.
Red Deer County	As a land owner, I appreciate the increased regulation of water licenses for grading water and surface water use. I am concerned, however, of the degree of enforcement. Alberta Agriculture was helpful.
Red Deer County	Concern about large cattle herds that do not face the same servicing [?] on water usage that intensive livestock operations face but use as much or more water.
Rocky View County	More acreages, i.e. homes, are being built in our area. There are concerns for the disruption of the soil and possibly more H ₂ S or minerals in our well water.
Rocky View County	Large feedlot operation straining aquifers. Using wells for subdivision projects is irresponsible!! Not allowing use of ground water for irrigation of plants in green house not fair when custom cattle feeders can use all they want!!
M.D. of Wainwright	I'm concerned with the change our water goes through in the spring due to the fertilizer (Ag) company that is close to our farm.
Westlock County	Our acreage borders are used for crop production. Always concerned about leaching chemicals (pesticides) into our water source because it is very deep.
Wheatland County	We live within a mile of 3 feedlots. One feedlot manured their land every year for at least the last 12-15 years. The last test on the well showed fecal content unfit for human consumption. Test performed in 2008. A new well 1/2 mile west of us also indicated fecal content.
Woodlands County	I am concerned with increased development impacting the water aquifer.

Appendix Nine: Selected Comments about Information Needs of Well Owners (Q12 and Part G)

General Information Need and Access

Municipal District/County	Comments
Clearwater County	Tests done to discover hydrogen sulphide and other emissions settling and leaching into aquifers. One can see the effect on aspen/birch (blotchy bark/tops dying).
County of Grande Prairie	There is a county of GP paper put out once a year. This would be a good place to put water well do's and don'ts.
County of Grande Prairie	Information on effective water treatments would be helpful.
County of St. Paul	Continual education and enforcement of water wells and watershed societies around the lake. Continual monitoring of lake levels and contamination by animals of the lake water.
Lacombe County	Making the public aware of any environmental updates as to water well drilling.
Lacombe County	It seems that very few people maintain their water wells. It also seems it is very difficult to convince people they should learn more about aquifers and water wells. I work at a government agency [name omitted] and during discussions about water wells I am often amazed by how little people know about their water wells.
Lacombe County	Would be nice to have water well information mailed out to acreages and farms, seems to be no source for this type of info.
Leduc County	Our well is from an artesian source, and we do not know (understand) the lifetime of such a well. There are several neighbours with similar wells, some of whom allow the water to flow constantly.
M.D. of Bonnyville	Perhaps fliers mailed out to alert "well users" to the risks, hazards and benefits of well maintenance. Include well site for details.
M.D. of Bonnyville	I think people with wells should be more informed about ground water. Also well maintenance. Schedule maintenance.
M.D. of Bonnyville	We require more information on the types of contaminants we should be testing our water for. It seems like a hit-or-miss approach now.
M.D. of Foothills	Government advice on treatment where required. Suitably of marginal water for human and or animal use.
M.D. of Foothills	The present system is adequate. Location maps showing depths of zones, year drilled and tests would be useful for big land owners or those looking at purchasing lands. I have about 3,000 acres. There are 6 houses, several barns and riding areas. There are swells serving these facilities and 3 inactive wells.
M.D. of Foothills	I would like to know more about my well and will order the manual.
M.D. of Foothills	I feel that people who understand how to service and maintain their own water system are not at risk and think a local workshop should be run!
M.D. of Foothills	The environmental farm plan was an excellent 2 day course - a good eye opener for good husbandry of the land for farmers.
M.D. of Foothills	Some acreage owners pump well water into a pond!! Some wells on farms are in sloppy livestock areas. Get ownership info on internet. MD should be more proactive in maintenance rather than Q20-Q20-Q20. There's more than just Q20.
M.D. of Foothills	As suggested elsewhere would be a good idea to somehow educate acreage owners as to the need to curtail the amount of water used.
M.D. of Wainwright	Water well owners need to be more informed about the right up keep of water well and the water system connected to them. This would help them to both protect this valuable resource and manage it more efficiently. Also, maybe some hints on how to conserve and protect the environment around them. Being uninformed about such an important resource is very dangerous to say the least. Ignorance now-a-days is no excuse.
Mountain View County	A standard package on well maintenance as well as threshold limits for biological and mineralogical results
Mountain View County	Local governments (especially planning departments) are profoundly ignorant about wells and options for rural water treatment & distribution. Potential acreage dwellers need more info - realtors usually know nothing.

Mountain View County	Making the information easily accessible on the Net: When I first looked up this info it was in many different places. It's getting much better. A central repository – maybe a specific, separate website – might be helpful.
Parkland County	I've attended a meeting on wells in Edson and found it informative. I own 3 properties with wells and appreciate being able to get information. Keep up the good work!!
Parkland County	It appears most information is word of mouth. When I searched shock chlorination on the web, only the government of Saskatchewan had anything official.
Parkland County	There are way too many people promoting and selling water treatment solutions that are inappropriate. E.g. Water softener for wells without calcium.
Parkland County	Mailed maintenance reminders and local well information would be great.
Parkland County	There are way too many people promoting and selling water treatment solutions that are inappropriate. E.g. Water softener for wells without calcium.
Ponoka County	I would welcome information about well water and plan to order your manual.
Ponoka County	Ensure guidelines re: maintenance of well, how to chlorine (shock) well, information re enhancing life of well. Thank you.
Red Deer County	It would be great to have a simple publication that informs homeowners how often a well's water should be tested and by whom, as well as guide for proper maintenance on a well. Internet access to this would be awesome.
Rocky View County	The chemical treatments are highly controversial... Lots of opinions that are confusing.
Rocky View County	Our biggest concerns are the impact of water wells on the environment, water tables, ground reserves etc and water conservation. It would be good if government pamphlets or programs or education would focus on these issues in addition to user convenience or safety. Teach us how to use water with the least amount of impact on the environment, like land stewardship, but for water as well. There are often many factors that affect our water which are out of our hands, such as herbicide and pesticide use by others and such things as the 'divine right' of the oil industry. As landowners we feel helpless much of the time with regards to property right of ways and crown rights. Any suggestions on what we can do to help maintain water quality and availability would be useful. Also it would be helpful to better understand how whatever we do above ground affects the water beneath it. Most people have only a rudimentary idea, in-depth knowledge would be good but it is hard to know what sources may be trusted, even environmentalists have an agenda, Simple, honest information is needed, it seems logical that a university would be able to provide it, inasmuch as current scientific knowledge allows.
Sturgeon County	I've worried about not shocking our well but have assumed if all runs well it may not be necessary. I don't know the importance of shocking a well.
Sturgeon County	Due to the fact that water is a very important commodity I think the Provincial Government should make information on water wells readily available to all rural people, especially the care and maintenance of water wells.
Vulcan County	As most wells are drilled for rural use, along with wells comes onsite wastewater systems. Education is needed for homeowner. The risk of poorly designed and neglected maintenance of the sewer system. This can lead to contaminated ground water in turn contaminating there well.
Wheatland County	With the danger of contamination of wells perhaps a database developed that could be accessed through the internet. How to go about to put pressure on individuals who are contaminating our underground streams.
Wheatland County	If something needs to be done yearly or even monthly to well to keep them working and lasting a long time. Maybe reminders could be sent out. I myself am very forgetful.
Yellowhead County	I rely heavily on the "if it ain't broke don't fix it" cliché in regards to my well. And am very uninformed and very naive as to the workings of my wells. Please help!

Need for Information at Time of Well Construction/ Property Purchase

Municipal District/County	Comments
<i>Not supplied</i>	When purchasing a property with a well, it would be nice to have a government brochure telling how to care for the well and a certificate of inspection to ensure the safety of drinking the water.
Clearwater County	Need more information when drilling. More awareness of information available in maintaining a well. Most people don't have any idea what to ask for or who to ask.
County of Grande Prairie	Have a booklet that well drillers can leave after drilling the well for a reference manual or for regular maintenance instructions.
Lac Ste.Anne	The companies that drill your well should give you information about them. This should be mandatory.
M.D. of Willow Creek	Drillers should supply more information on how to properly care for and maintain wells. I also think seminars in local towns should be held as more people would attend to receive info on well maintenance.
M.D. of Foothills	When a well is drilled it would be helpful to supply literature on how a well works, underground, etc. If a casing is supposed to be sealed how do you seal PVC into bedrock as it will shatter. Ours was not sealed and so started caving in resulting in us having to drill another well nearby.
Mountain View County	A handbook on how to care for your well after it has been drilled including places to take your water to be tested.
Mountain View County	A handbook on how to care for your well after it has been drilled including places to take your water to be tested.
Parkland County	Make information easily available as contractors don't necessarily provide the information.
Parkland County	A package of information on maintenance, shocking and well testing facilities would be great to get after having a well drilled.
Rocky View County	"Part D" - made us realize we could have been better prepared to ask questions of our driller. Perhaps the drillers should give well owners a printed format for the care of wells. The chemical treatments are highly controversial... Lots of opinions that are confusing.
Sturgeon County	All well drillers should provide a written package on well maintenance when a well is completed (i.e. how to flush and shock your well).
Wheatland County	We need better info at the time of drilling and chlorinating to maintain our well. More info on ways of dealing with minerals in well water, i.e., iron, sodium, etc.
Woodlands County	Prior to drilling a water well, drilling contractors should have to review critical information with the land owner. The information should include a pamphlet, information reviewed should include, location considerations, proper set up and maintenance. A check sheet should be signed off by land owner and contractor and submitted with drillers report.

Accessing Well Data & Monitoring

Municipal District/County	Comments
<i>Not supplied</i>	All used and unused should be checked from an experienced/educated person (government).
<i>Not supplied</i>	I recommend that someone from Health Canada or Alberta Health do actual on site testing of water wells to better educate us of what actually takes place below the surface deep into our wells. Thank you for your survey.
<i>Not supplied</i>	With our computer age- all wells drilled in Alberta should be entered- depth, location, flow rate, samples, etc. Access to this should be made available to anyone.
Clearwater County	Tests be done to discover hydrogen sulphide and other emissions settling and leaching into aquifers. One can see the effect on aspen/birch (blotchy bark/tops dying).

County of Stettler	It would be nice to have an accurate record of wells, including info such as depth, and other relevant info. When we drilled our new well about 7 years ago, such info was obtained by me from former well drillers, minds of old-timers in the community, etc. There is some info available from government records, but very spotty: This info would be very helpful to someone like me, who had little info about the well on the farm and the former owner had died. My neighbour, who is skilled at researching, and he managed to get 50 gal/min by drilling 1000' from his yard. I couldn't have planned it that well. Government doesn't have to do everything for us, but someone should.
County of Vermilion River	To better protect and maintain our water resources, drillers reports and water use registrations should be available for the land owner to view on the internet.
Lacombe County	I recommend mandatory annual well testing along with monitoring. I would like to know the conditions of my well - anytime. I would like to see and have access to a library with all the well conditions in my surrounding areas!
Mountain View County	Water wells should be provincially inspected as are other disciplines like electrical + plumbing, at completion of drilling.
M.D. of Bonnyville	Comprehensive tests should be carried out by provincial authorities on all water sources and it should be done routinely so that problems with water flow and quality can be identified.
M.D. of Foothills	Update GPM on internet when wells are "retested" make all info current & mandatory for well drillers & labs. Results to Alberta Environment website.
Parkland County	Test wells at different depths in different communities would be helpful with results to the public so that people about to drill wells know approx. how far to drill down for water. So that drilling doesn't have to be done more than once for the best water.
Parkland County	The Alberta ground water web site for locating wells and well driller's reports need work (new u/i). It is very difficult to use.
Rocky View County	It would benefit researchers to discuss well drilling with reputable well drillers that know the areas they service over a long period of time.
Smoky Lake County	It would be nice if there was a proper surface survey (magnetic/induction) would be conducted for the entire province to well drilling selection could be based on a good surface site location.
Sturgeon County	I noticed that drilling reports are publicly available on the Alberta Environment website, however, it does not seem to be comprehensive. I know of neighbours who have wells but they are not listed on the GIS maps. Furthermore, if a major service or upgrade is done on a well, the well report is not updated with new information. I believe that a proper log should be comprehensive for active and reclaimed wells and they should be publicly available. Even dated raw water test results should be logged on the file and disclosed on the well reports.
Woodlands County	I think you should visit some of the residences or farmers in each area and talk to them face to face to find out more.

Requests for Specific Information

Municipal District/County	Comments
Clearwater County	Are there any grants for upgrading a well?
County of Barrhead	Why is there a big difference between provinces regulations? In Quebec, a well less than 30 feet is considered a surface well and not a good one. A proper well as to be at least 200 feet.
County of St. Paul	How safe is tannin for consumption? Any effects on adults with high nitrates in well water?
County of Wetaskiwin	Help to correctly maintain healthy wells and decommission abandoned wells would be appreciated.
County of Wetaskiwin	We don't know why we still have sediment above normal levels.
County of Wetaskiwin	Information on ways to provide improvement on water quality. Removal of sediment. Removal of Iron, sulfur, etc.
Flagstaff County	I would like information about aquifer and streams in our area. Chemical use seeping into ground water (seismic activity and deep oil rigs). Impact on our water supply and quality - increased brushing of marshes is impacting ground water supply.
Kneehill County	Why do I have to register/license my well when I have it drilled by qualified tradesmen? Why is this license only good for a limited time period? Where do I access a list of qualified contractors to plug old wells?
Lac Ste. Anne County	Let us know how much water is going to remain available to us. How is the constant construction of new homes and subsequent drilling going to affect the quantity of water available- will our wells run dry?
Lacombe County	Are there regulations in place on type of well casing? Casing depth? Is there any information on how far away a methane well has to be from a water well?
Lacombe County	How does seismic testing influence water wells? I am sure I lost my old well because of seismic testing.
Lacombe County	Can things from farmers that live around me (herbicides pesticides) get into my water table?
Leduc County	I have a well that has two (2) water streams it yields 4 1/2 gallons of water at first after a while I lost some amount of water, I think the bottom stream sanded off. Can I get a water truck with a load of clean water and pump it down the well to open up that bottom stream?
Leduc County	Do we have an inspection to ensure that seismic crews properly plug holes?
M.D. of Bonnyville	We would like to know more accurately where water exists in the area, and if this information is available, how do we get it? For example, this past summer my daughter tried to have a well drilled, the contractor drilled 300' and found no water. It seems to be a hit or miss situation without the information.
M.D. of Foothills	Impact on supply and quality from global warming vs. my aquifer?
M.D. of Foothills	How often should you have water tested and when is best?
M.D. of Foothills	When a well is drilled it would be helpful to supply literature on how a well works, underground, etc. If a casing is supposed to be sealed how do you seal PVC into bedrock as it will shatter? Ours was not sealed and so started caving in resulting in us having to drill another well nearby.
M.D. of Foothills	How can I get our well to stop omitting rust as it deposit itself on all tubs, toilets. I smell sulphur, unless bleach is placed in well, 2 cup per week, would like answers if available. Thank you.
M.D. of Greenview	How do we find reasonably priced, environmentally friendly water treatment methods (related specifically to your water sample test) suggested by organizations NOT AFFILIATED with the people that make profits from those very methods?
M.D. of Wainwright	What zone? Best size of casing for area? How many screens? How big of pump?
M.D. of Wainwright	I would like more info on water purification so I can feel totally safe drinking my well water.

M.D. of Wainwright	I wonder now if our well should be chlorinated every year. I'll have to ask someone?
M.D. of Willow Creek	Please publish information about the effects of seismic blasting and drilling for oil and gas on rural water supplies. I would like to see blasting banned in the foothills where it could cause serious problems for land owners.
Parkland County	Is there anything in well water that could affect the water when going through a hot water tank or an instant-heat hot water system?
Parkland County	Is there any way to determine life expectancy of a well depending on mineral content? Etc.
Ponoka County	If the well driller introduces iron bacteria into the well, does the owner have any recourse?
Ponoka County	How can I protect my water well from surrounding digging, drilling activities?
Ponoka County	Do government programs exist for periodical testing of well water to monitor for bacteria/turbidity/TDS etc?
Red Deer County	Can you print the depth of the well on the well cap when drilled??
Red Deer County	Would like to know how to best to locate the water before drilling.
Red Deer County	More information on pumps and pressure systems would be handy.
Rocky View County	We would like more information about methane in water wells.
Woodlands County	Are there grants to assist when a well goes dry? Our well went dry a couple months ago and now we haul water from Town. We wonder if it is a result of low water tables affecting the aquifer.

Appendix Ten: Selected Comments about Well Construction and Abandonment; and Maintenance Costs (Q12 and Part G)

Well Construction

Municipal District/County	Comments
<i>Not supplied</i>	Drilling company [<i>name omitted</i>] drilled our last well and tested our well when an oil company drilled a well nearby. Very professional organisation!
Beaver County	Our driller [<i>name omitted</i>] did a good and professional job - and quickly.
Brazeau County	As a landowner (myself knowingly) that the drilling company [<i>name omitted</i>] drilled my second well through an old sump (oil field). Alberta Environment won't do anything about it. They told us to do all the research to prove that there is an old sump there. Why should I have to prove this? Isn't it their job to do so?
Clearwater County	Make all water well drillers go into course to refresh well drilling and just where to stop there wells they are in the right spot (sandstone etc).
County of Barrhead	In my experience the driller's report isn't worth the paper it's written on.
Camrose County	Rural households in need of services are limited to using the local well drillers, even though they know some of these drillers are mediocre or incompetent service. There are fewer drillers available, and they are not inclined to travel far distances to service wells outside their region. In my situation, I live in one county [<i>name omitted</i>] and had to seek a competent well driller from another county [<i>name omitted</i>] and had to wait several weeks. There is a shortage of properly trained water well drillers in this province. Provincial registry and training is needed.
County of Grande Prairie	We would have appreciated the proper testing of water for household health by the driller. Otherwise we have been satisfied.
County of Grande Prairie	We researched 3 water well drillers in our area and basically found only one to be informative, honest, and professional [<i>name omitted</i>]. I wonder whether the province requires certification and if their business practices are regulated or reviewed???
County of Grande Prairie	Use only well-experienced drill crew who are experienced in the area of new well.
County of Grande Prairie	I wish drillers had a uniform method of drilling standards and parts used. No well is the same in our subdivision, and parts for piping were difficult to match. A standardized system would be helpful!
County of Stettler	I am an oil-field driller we run all our cutting over a shaker so we can look at our sample of the cutting. Water wellers only use a gravy strainer (this way they do not know what they are really drilling through).
County of Stettler	Make sure driller backfills bored well with clean pea gravel. E-coli got in water from pea gravel. Had to remove gravel with hydrovac and install new pea gravel to fix well, and then stock treat two times.
Lacombe County	It would be nice if well drillers touch base to see how things are going after a well is drilled, say once every 3-5 years.
Lac Ste. Anne County	There should be government monitors for the companies doing the drilling--mandatory information given for the consumer about the wells. The well driller should be responsible for a certain time period after the well is drilled. (upkeep, maintenance, etc).
M.D. of Foothills	Drillers should make a better effort to fill in the report accurately and honestly.
M.D. of Pincher Creek	Our well driller was hired by the Alberta Government to do a large contract in SE Alberta to stop aquifer loss so we have full confidence in his activity.
M.D. of Wainwright	The drillers will not go beyond 400 ft in our area as they can hit salt water. Across the road in early years the neighbour has a well drilled and moved to another quarter because of very salty water, but was not drilled by a credible driller in those years.
Mountain View County	More rigorous training and education for water well drillers - skill level with regard to H ₂ O quality, understanding aquifers is highly variable and mostly weak.
Mountain View County	I would recommend if I were to drill another well, do more research on the driller and get someone local.

Mountain View County	Water wells should only be drilled by those knowledgeable and licensed to do so.
Parkland County	When I drilled my well there were a lot of shady operators that would not seal surface water from flowing into deeper water flows. I know of some water well drillers that would perforate casing to allow surface water to flow into the well to increase the overall water well flow. Water well drillers need to be regulated to a greater degree.
Ponoka County	My well is only 1.5 years old but good drilling practice was used and the well is staying very good with soft water without any sign of odour.
Red Deer County	Well drillers need to learn their trade relating to different soil types to avoid drilling dry wells.; i.e. drilling too fast for the rate of water infiltration.
Red Deer County	I believe residential or all wells should be sealed like commercial wells are regardless of the extra cost.
Rocky View County	The use of well casing perforation is big with us, as our well installer didn't understand our low-flow needs (slowly filling a cistern), and installed a casing that's good for high-flow (and for surface contamination). Well drillers need better understanding of our needs.
Rocky View County	Our well water was great, but the well casing is perforated too high (20'), so we have surface H ₂ O contamination. (measured as total coliform count 70). We need to seal the top 20' of well casing better, perhaps with bentonite.
Rocky View County	All well drillers (company) should be licensed and bonded More accessible test paid for by health board at least 2x a year and follow up after shock chlorination has been done.
Special Area No. 3	Clean equipment so as not to bring bacteria to newly drilled wells.
Yellowhead County	How can a well owner know when drilling a new well if the driller is on the up and up when it comes to how deep a well needs to be to get good water? The well owner needs to take the word of a driller (who gets paid by the cased foot) on whether or not we have good water at 100 feet or "we have to go deeper for softer water".

Witching (Water divining)

Municipal District/County	Comments
Beaver County	Do you believe in well witchers?
M.D. of Foothills	I am surprised that you did not enquire about "well witching" in choosing a well location, and "dry holes" encountered.
Leduc County	Information on where to best drill a well on your property is lacking. Using a well "witcher" is an uneasy feeling but is all there is that I'm aware of.
Red Deer County	Don't drill 500 ft hole when you know there is no water. I was asked by water well driller [<i>name and location omitted</i>] to witch a water well for a dairy. He had drillers drill 3 wells [<i>at large depths</i>]. Cost well owner \$13,000. I found him a good water at 70 ft.
Rocky View County	Why didn't you include a category on witching? Probably 90% or more of all wells drilled are witched.
Rocky View County	Always witch for wells as the streams are the only way to get water or watch natural growth of water weed on natural landscapes there is water there.
Rocky View County	I strongly recommend the use of water well witchers for locating underground sources for well drilling. In my opinion, this should be strongly recommended by the water well drillers and association. Otherwise, it is a complete 'shot in the dark' when it comes to finding water. We had three successful wells dug this way.

Well Abandonment

Municipal District/County	Comments
<i>Not supplied</i>	Too many old water wells are left and not being properly reclaimed
Camrose County	Old wells should be cemented off to prevent ground water contamination.
County of Athabasca	I believe that "new" wells are properly drilled today. There should be no reason they aren't. However, old existing unused or abandoned wells need further attention. Many of these were dug back in the early 1900's and do show up from time to time.
Kneehill County	I think that the government should supply a work to abandon wells properly. I should be able to call them and they come and look at the job and then plan to do it. Then they should do the work and register the work done for a minimal cost so people gladly use this crew and abandon wells properly.
Leduc County	Of great concern - the number of old abandoned wells that are not sealed or capped.
M.D. of Foothills	All well pits should be properly decommissioned, with the help of govt funds.
Mountain View County	Make sure old not used wells are abandoned right.
Rocky View County	I think it would be good to have a government program to fund capping and monitoring old water wells. It is quite an expense to do on your own.
Smoky Lake County	Government should have program and people to properly abandon wells on old farms, as they were dug all over at one time even by hand.

Maintenance Costs

Municipal District/County	Comments
<i>Not supplied</i>	Reasonable or no charge for testing water very important-as this could result in poor water use.
Brazeau County	The drillers should provide booklets on the information about the wells they drill and the labs should test for free when requested for further information. That would give the homeowner the tools to go further.
Clearwater County	Funding for water well drilling (farm) and local assistance for shock chlorination (county) is needed to offset drilling, decommissioning and protecting.
County of Stettler	Please ensure that local health units still have funding in the future for rural water well sample analysis. This is a valuable program for farmers to keep a close eye on the household water quality.
County of Wetaskiwin	Free onsite water testing once per year would be nice.
Kneehill County	Is the government eventually going to charge us for use of own water from our wells? I sure hope not!! I have an Environmental Farm Plan!!
Lac Ste. Anne County	A test kit should be made available to acreage owners from the county and at a fair price.
Lamont County	Please make it easier without cost for us to get samples analyzed at least once every two years or so, through labs or health units.
M.D. of Foothills	The local MD makes you prove water supply before allowing subdivision. However after you prove adequate water supply the rest of the process takes 2 years plus over twenty thousand dollars. This is forcing wells to be left undeveloped.
Wheatland County	You should offer free assistance on how to maintain your well as well as offer affordable solutions to keeping harmful bacteria and other elements out of our wells.
Wheatland County	Well water testing has been free of charge the last time that we tested but to test the water from our R/O system is at a cost. I would recommend that it should not matter if the test is performed from the well water or the water that is used for home consumption. Although we maintain our R/O system regularly, it would give us an added sense of comfort to know that the water we are actually consuming is safe. I'm sure that more households would like to test their household consumption water as well.