Raising Groundwater Awareness – A Rural Ontario Case Study

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Raising Groundwater Awareness – A Rural Ontario Case Study

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ABSTRACT

A lack of community interest and involvement is a significant limiting factor when implementing local groundwater protection strategies. This is particularly evident where the rural community has been asked to change farm and home activities to protect what has been portrayed as a rural source of groundwater for an urban water supply. The lack of community interest is significant because changing daily activities around the home and farm are likely more effective for protecting groundwater than the most comprehensive strategy. Unfortunately, most groundwater protection strategies limit awareness and education to the traditional community consultation approach. The traditional approach typically involves talking to the rural community about groundwater protection efforts, but does not help the community members understand how they can help protect groundwater.

An alternative approach is to view the rural community as a group of potential partners who can implement groundwater protection activities by changing their activities around the home and farm. This involves a considerable philosophical shift for agency or government from the traditional approach, and requires an understanding of how individual community members' process and act on information. Some concepts important from an agency or governmental perspective, such as aquifer protection, need to be replaced by messages relevant to the community members: such as protecting their water supply quality. Further, the message must be delivered so that it catches the community's attention. It needs to be meaningful, memorable, and must indicate clearly what can be done to protect groundwater.

The use of such an alternative approach is demonstrated by a case study from the Regional Municipality in Ontario, Canada. To address the lack of rural community interest, representatives from a variety of rural agencies and stakeholder groups came together to cooperatively develop the objectives, content and delivery of a Rural Groundwater Awareness Program (RGAP) during 1995 and 1996. The objectives or core messages of the program were selected based on known concerns of the rural community – specifically, protecting family health and increasing economic benefits by changing household and agricultural activities, thereby protecting groundwater quality. The content was developed around a number of best management practices that could readily be implemented around the rural home and farm, many of which could also be implemented by the urban community. The program messages were delivered to the rural community using a series of eye-catching brochures and public presentations – at

public events such as rural fairs, schools, and public libraries. The RGAP messages and materials were then pilot-tested in 1997 by distributing them to 200 rural households, along with a voucher for a free bacteria and nitrate water quality test. This was followed up with a questionnaire designed to determine if the program was useful, if it could be improved, and to learn more about the households and their information needs.

Twenty-four percent of the households took advantage of free bacteria and nitrate testing of water samples. Of these, 91% had nitrate concentrations below the Ontario Drinking Water Objective of 10 mg/L. Approximately 19% of the questionnaires were returned. Of these 78 percent indicated that the information packages could be remembered, 68% found them useful, and 49% stated that actions had been taken as described in the materials. Approximately 50% of respondents either lived or worked on a farm. Of these 52% were aware of, had undertaken or completed an Ontario Environmental Farm Plan. All respondents concluded that the RGAP program and materials were useful and important. This paper presents a detailed summary and evaluation of the sampling and questionnaire results, and their importance for groundwater awareness and education efforts.

INTRODUCTION

Public awareness and education is often an important part of most comprehensive municipal groundwater protection programs. Jaffe and DiNovo (1987) state that public awareness programs can have a number of benefits:

1. Help local officials and the broader community understand the need to protect groundwater resources;
2. Build support for protection efforts in sensitive groundwater areas such as wellhead protection areas (WHPAs) and regional recharge areas;
3. Overcome opposition from homeowners and business to protection efforts in areas where controls may affect their economic interests;
4. Create an alert and informed community that may be helpful in promoting protection programs amongst neighbours; and
5. Encourage individuals to implement voluntary remedial measures, such as reducing the risk of land use practices (i.e., taking hazardous household wastes to municipal collection centres instead of disposal of materials into septic systems).

Special education efforts may be developed to increase the awareness and education of specific groups whose activities may pose a unique groundwater pollution risk (Jaffe and DiNovo, 1987). For instance, it may be prudent to educate rural residents in sensitive groundwater areas that their land use practices (i.e., disposal of hazardous household wastes into septic systems) may be a potential source of groundwater contamination that could affect their drinking water supply. Use of a regulatory tool (e.g., zoning controls) would provide little groundwater protection benefit in this situation, whereas use of non-regulatory tools such as an awareness and education program could help reduce this undesirable practice.

Unfortunately, groundwater protection programs are often limited to awareness and education efforts using the traditional community consultation approach. The traditional approach typically involves talking to the rural community about the need for groundwater protection, because it does not actively involve community members and help them understand how they can help protect groundwater (Howard and Baker, 1984). This form of communication is usually not very successful, especially where the rural community is being asked to change farm and home activities to protect what has been portrayed as a rural source of groundwater for an urban water supply. Encouraging the community to change its practices is significant because changing daily activities around the home and farm are likely more effective for protecting groundwater than the most elegant strategy.

An alternative approach is to view the rural community as a group of potential partners who can implement groundwater protection activities by changing their activities around the home and farm. This involves a considerable philosophical shift for agency or government from the traditional approach, and requires an understanding of how individual community members' process and act on information. Some concepts important from an agency or governmental perspective, such as aquifer protection, need to be replaced by messages relevant to the community members: such as protecting their water supply quality. Further, the message must be delivered so that it catches the community's attention. It needs to be meaningful, memorable, and must indicate clearly what can be done to protect groundwater.

The purpose of this paper is to describe the how such an alternative approach was used to develop, implement and evaluate a Rural Groundwater Awareness Program in the Regional Municipality of Waterloo, Ontario, Canada. This case study demonstrates how an effective awareness program can be developed when rural agency and organization representatives are involved in the process from the outset. This involvement facilitated rural representatives to bring their knowledge of existing resources and community needs to be incorporated into the program, and to develop a set of awareness resources to meet the information needs of the rural community. In this way the common concern of groundwater protection can be presented to the community in a way that can be readily understood.

CASE STUDY

The Regional Municipality of Waterloo (Region) is located in southern Ontario, Canada as shown in Figure 1. The municipal water supply for residents located in urban centres is provided by an integrated groundwater and surface water system. The water supply for rural residents, and urban residents not connected to the municipal system, is provided through a series of private and communal wells. A number of municipal wells, most private and communal wells, and recharge areas for these wells, are located in rural areas of the Region.

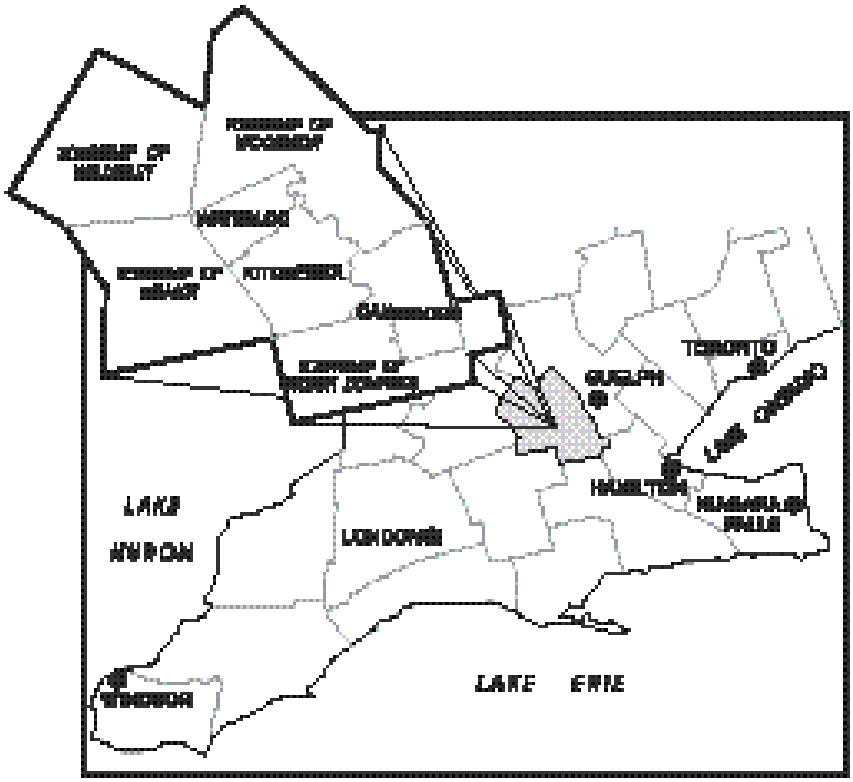

Figure 1 The location of the Regional Municipality of Waterloo, in southern Ontario, Canada

The Region initiated work on a surface water and groundwater protection program in 1990 in response to concerns about potential water supply contamination. A Water Resources Protection Strategy (WRPS) report was completed in 1992. The objectives of the strategy included limiting the risk to water resources from historic and existing land use practices, and minimizing the risk to water resource from future land uses (Murray, 1994).

In evaluating potential threats to the water supply, Region staff determined that three criteria should be used to rank contaminant sources, and to priorize the allocation of resources in the development of policies and programs:

1. They should address contamination sources with the highest potential to contaminate municipal groundwater supplies;
2. They should be as proactive as possible; and
3. They should be within the jurisdiction of the Region to implement.

It was determined using these criteria that rural non-point contamination sources, along with current and future urban point sources, presented the highest threat.

Region staff concluded that a rural groundwater awareness and education program could help protect both municipal and private water supplies by encouraging the rural community to implement best management practices around the home and farm. In 1995, the Rural Non-Point Source (RNPS) Working Group was organized to provide direction on the development of rural groundwater policy and programs. This group had membership from rural-based agencies including the Grand River Conservation Authority, the Ontario Ministry of Agriculture, Food and Rural Affairs, the Waterloo Region Resource Stewardship Network, and farm stakeholder groups and organizations including the Waterloo Federation of Agriculture and the Ontario Soil and Crop Improvement Association. This purpose of this group was to help Region staff understand the needs of the rural community, and assist with the development of programs and materials.

The RNPS Working Group concluded that a local rural groundwater awareness program was important for rural non-point contamination source management. It was concluded that the Rural Groundwater Awareness Program (RGAP) should incorporate the following points in order to be successful:

1. Two primary messages should be delivered to the rural community
    - Promotion of homestead and farm water well protection, emphasizing the benefits of family health rather than aquifer protection;
    - Publicize the economic benefits of best management practices to farm businesses;
2. The program should include the entire rural community, but the message should be directed at persons with wells located in sensitive groundwater areas;
3. The messages should be advertised through the rural media (radio and press) and direct mailings; and
4. The messages should be delivered through existing services and presented at activities and events such as fall fairs that are popular with the rural community.

It was determined that delivery of a rural groundwater awareness program should be delivered to the rural farm and non-farm communities both inside and outside municipal wellhead protection areas and regional recharge areas. It was hoped that this would generate direct and indirect support for groundwater protection and promote broader environmental stewardship in areas of concern such as wellhead protection areas (WHPAs) and recharge areas.

EXISTING RESOURCES

To avoid duplication, the group identified and evaluated existing resources that could be used for a rural awareness and education program. A number of the group members had been involved with several excellent rural educational resources that had been developed (i.e., the Ontario Environmental Farm Plan), or were under development at a provincial scale (i.e., Water Wells Best Management Practices Book), for water resource protection.

The Ontario Environmental Farm Plan (EFP) is a risk assessment tool and an educational process that encourages farmers to incorporate best environmental practices into all their farming activities (Ontario Farm Environmental Coalition, 1996). The risk assessment

tool helps farmers evaluate potential environmental impacts specific to their individual farms using worksheets that address 23 key environmental issues. The EFP is a highly successful partnership involving farm organizations and federal and provincial government agencies with responsibilities relating to agriculture, natural resources and environment. EFP worksheets were written by OMAFRA staff, and the EFP is delivered locally by the Ontario Soil and Crop Improvement Association (OSCIA) in partnership with the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA).

The Water Wells Best Management Practices (BMP) Book was under development at this time by a team of farmers, researchers, extension staff and agribusiness professionals coordinated by OMAFRA staff. Several NPS Working Group members were part of the Water Wells BMP Book development team, and were able to provide insight into the content and scope of this publication. This 56-page book provided detailed information concerning the water cycle, groundwater contamination sources and pathways, and how to implement well construction, maintenance and abandonment BMPs (Agriculture Canada and Ontario Ministry of Agriculture, Food and Rural Affairs, 1997).

A detailed review of the EFP, and discussions with the members of the Water Wells BMP Book development team, indicated that these two resources were written for an audience who understood the need for groundwater protection. This required that the local rural community must first be made aware of the need to undertake water resource protection activities. The group members observed that this lack of awareness materials might be partially responsible for the limited local uptake of the EFP, which had not been as great as other parts of the province.

These observations led the group to conclude that the rural community was likely unaware of the role they could play in groundwater protection, and how important their actions were in maintaining the quality of local drinking water supplies. This suggested that the key focuse of the RGAP should be to increase awareness of the local rural community about the need for water resource protection activities, especially groundwater protection. The increased awareness could prepare the local community to then take advantage of existing and forthcoming education opportunities.

The group concluded that the RGAP should be built on and promote the benefits of existing programs such as the Ontario Environmental Farm Plan EFP) to farmers and homeowners. Specific examples from the EFP, consistent with program messages, should be incorporated into the RGAP materials. This would help accelerate the transition to the more detailed educational resources such as EFP. The program should be coordinated and delivered through agencies and organizations that are involved in the rural community, and are interested in delivering rural programs such as the EFP;

DEVELOPING AWARENESS MATERIALS

The NPS Working Group concluded that an important function of RGAP, in addition to raising awareness about rural groundwater protection, should be to help promote and prepare the local rural community to use more detailed educational resources. Given that

existing programs had received limited success with the local community, the RGAP materials should focus on raising awareness about the need for groundwater protection and provide links to detailed educational resources.

The group concluded that information concerning the family health benefits were of interest to both the farm and non-farm communities. The first core message should include information about the drinking water quality benefits of properly constructing, maintaining and abandoning (i.e., plugging) wells. This message should also include promoting the safe handling of chemicals in the home and on the farm, and describe how improper handling of chemicals can impact drinking water quality.

It was believed that information concerning the farm best management practices (BMPs) were of interest to the farm community. The second core message should include information about BMPs, and provide examples of how farm operating costs can be reduced through the adoption of BMPs. The farm community should be encouraged generally to participate in the EFP program, which provides excellent examples of how to assess the need for and implement BMPs. The RGAP materials should draw particular attention to BMPs that promote groundwater protection.

A review of literature concerning how information is processed and understood provided some insight regarding the format of the RGAP materials. Miller (1988) states that the ability of a person to learn is strongly related to the following four elements of intuitive learning:

1. **Preparation**, where an individual gathers information relevant to the problem or project (i.e., they are given information that links the possible adverse impact of inappropriate land use practices on well water quality;
2. **Incubation**, where the individual relaxes and does not make an effort to work consciously (i.e., they do not make the connection between land use and well water quality);
3. **Illumination**, where a solution to a problem occurs spontaneously (i.e., they make the connection that inappropriate land uses may adversely impact the well water supply for their family), and
4. **Verification**, where the individual puts an idea into use and consciously works with the idea in a more detailed manner (i.e., they take some action to protect their well water supply such as repairing their well).

Preparation and incubation can be enhanced through the use of visual experiences, whereas logic is more useful in enhancing the elements of illumination and verification. An important aspect of awareness building is the use of repetition to reinforce messages, and directing information to the community from as many different directions as possible (Miller, 1988). This information suggests that for awareness building the messages are best received using highly visual material. For awareness impact, the messages should be frequent, short and snappy, and offered in a variety of formats.

Three learning stages were then identified, from a public awareness perspective, based on Miller's intuitive learning model:

1. Initial Awareness Building Stage (Preparation): During this stage the attention of the community needs to be caught through a series of short and frequent messages, and promoted in areas where the community has the greatest concern about groundwater quality.
2. Awareness-Education Transition Stage (Illumination): During this stage the community needs to be provided with examples of how to protect groundwater around the home and farm.
3. Education Empowerment Transition Stage (Illumination and Verification): During this stage the community moves from needing information about the need and means for groundwater protection to actively seeking information and involvement in groundwater protection efforts.

Based on the above information it was concluded that the two primary messages should address the requirements of initial awareness building stage. The messages should focus on making the majority of the community aware that they need to protect their water supply. The RGAP materials could also provide some limited attention to the awareness-education transition stage by providing some detailed information about how the community can protect its water supply. In this way the program can be flexible enough to start to provide the more detailed information associated with the subsequent education-empowerment stage, while still providing awareness building information for those who have not yet received the initial information.

THE RGAP MATERIALS

Based on the above conclusions, several awareness type materials were developed to support the program. These included a poster and brochure to support each of the two core messages. The posters and brochures presented their respective messages in the context of groundwater protection and the "Water Ours To Protect" theme that was developed for the program. The messages were presented primarily in a visual format to enhance the intuitive elements of preparation and incubation that are central to the awareness building process. A number of short action statements were included to build on but not distract from the visual experiences supporting each of the two program messages. The posters and brochures also referred the community to the EFP for more detailed information. Copies of the brochures can be viewed in Appendix A of this paper.

EVALUATING THE MATERIALS

To evaluate the efficacy of the program materials an information package containing the posters and brochures were distributed as part of a pilot study to 200 rural households. The pilot study area was located within a broad recharge area that contributes water to both municipal and private wells, and included a mix of rural farm and non-farm land uses.

The information package also included information about programs that could be accessed around the home and farm to minimize the potential for groundwater contamination. For instance, information promoting a free program for the proper disposal of household hazardous waste materials was provided. The information package also include sample bottles for free testing of water samples for bacteria and nitrate within a specified time period, and some promotional material concerning the EFP.

The pilot study included two specific objectives. The first was to provide 200 households with an opportunity for water sample analysis for bacteria and nitrate at no charge. The importance of water well testing sampling was reinforced in the program materials. The second was to distribute a follow-up questionnaire to the households to determine if the residents received or remembered receiving the package, if the information was useful, and if the materials and program could be improved. These two initiatives are discussed below.

Private Water Well Testing

48 households submitted water quality samples for nitrate analysis. This was 24 percent of the households to which sample bottles were delivered. The distribution of the sample results for nitrate are summarized in Table 1. Of the nitrate samples submitted, 43 (90%) had concentrations that were less than the Ontario Drinking Water Standard (ODWS) of 10 mg/L, and 5 (10%) exceeded the ODWS for nitrate. This demonstrates that of the wells sampled, the majority of the wells had water containing little or no nitrate.

Table 1 – Water Well Nitrate Concentrations

Water Sample Nitrate Concentration Range[1]	Number of Samples	Percentage of Samples
< 0.05 mg/L	20	42
0.05 to 2.5 mg/L	9	19
2.5 to 5.0 mg/L	10	21
5.0 to 7.5 mg/L	4	8
7.5 to 10.0 mg/L	0	0
10.0 to 12.5 mg/L	1	2
12.5 to 15.0 mg/L	2	4
> 15.0 mg/L	2	4

[1] Ontario Drinking Water Standard for Nitrate is 10 mg/L

Information collected about the wells indicated that well construction may have been a factor in the presence or absence of groundwater nitrate. Of the wells sampled, all 5 of the wells with nitrate concentrations exceeding the ODWS were dug wells, and 3 of the 4 wells with nitrate concentrations greater than 5 mg/L and less than 10 mg/L were dug wells.

This information suggests that despite the location of these wells in a regional recharge area, which is potentially sensitive to groundwater contamination, that the number of wells with nitrate concentrations that exceeded the ODWS was relatively small. The information also indicated that only dug wells had nitrate concentrations that exceeded the ODWS. Dug wells are typically shallower and more susceptible to entry and seepage of surface water and contaminants than drilled wells. Well water quality surveys over the past 50 years in Ontario have determined that dug wells are more likely to have nitrate concentrations that exceed the ODWS than drilled wells (Simpson, 2001).

Questionnaire

The purpose of the questionnaire was to determine if the residents received or remembered receiving the package, if the information was useful, and if the materials and program could be improved. The questionnaire also contained questions concerning three basis aspects of the Rural Groundwater Awareness Program (RGAP):

1. About the RGAP materials
   - Did the household receive the RGAP materials?
   - Were they understandable and useful? and
   - Were any actions undertaken as result of reading the materials?
2. About the RGAP Program
   - How would the household like to receive information?
   - What information format is best?
   - Is the RGAP important? And
   - What else should be included as part of the RGAP?

3. About the Household
   - Is the household involved in farming?
   - Are they aware of the Ontario Environmental Farm Plan (EFP)?
   - Have they started or completed an EFP?
   - Have they tested their water quality in the last 5 years?
   - Would they test their water quality at their own cost?
   - Is groundwater protection information important to them? And
   - Would they like more groundwater protection information?

Survey questionnaires were distributed approximately six months after the information packages to the same 200 addresses. Householders were asked to complete their questionnaire and return it in the attached stamped envelope within two months. A total of 37 (19%) fully or partially completed surveys were returned. One survey contained a hand written note complimenting the RGAP program.

About the RGAP Materials

Of the 37 surveys returned, 29 (78%) stated that they received the information package and 8 (22%) stated that they had not received the package. Of these respondents, 25 (68%) stated that the information summarized in the brochures was useful and two (5%) stated that it was not. This suggests that most of the respondents received the information and found it useful. The moderate response to the survey suggested that there may be more effective ways to distribute information to the rural community and promote the messages they contain.

Eighteen (49%) of the questionnaires stated that steps outlined in the brochures had been taken, where 11 (30%) stated that no action had been taken. The steps taken ranged from taking water samples, as a result of increased from reading the brochures, to taking steps such as improving drainage around a well and extending a well casing above ground. These results were encouraging for two reasons. First, the brochures had been successful in encouraging approximately one-half of the respondents to take some action to protect their groundwater. Second, many of those responding that no action had been taken indicated that they saw no need to take action rather than they did not care about the issue. This suggested that with additional awareness and education, and some time to let the message sink in (i.e., illumination element) that these residents might come to understand the need for action to protect their groundwater supply.

Twenty-one (57%) households submitted water samples for bacterial analysis and 19 (51%) households submitted water samples for nitrate analysis. A total of six (16%) of households did not submit water samples for either bacterial or nitrate analysis. Reasons given for not taking advantage of the free analysis included recent testing of well, missed deadlines for the program, difficulty in taking and submitting sample within 24 hours, and no time or interest to take advantage of the opportunity. These results indicated that approximately one-half of the responding households took advantage of the program – it

might be possible to increase future uptake by extending the program length or making sample drop-off more accessible.

About the RGAP Program

The preferred method for delivering the program information was the mail (91%), followed by television, newspapers, and newsletters (46%). The least preferred methods were radio and the library (35%). Other suggested modes included information distribution through municipal offices and by direct contact. Newsletters were the most popular format for delivering information (84%), followed by pamphlets (70%), short articles (65%) and video (62%). These least popular format for delivering information were books (46%). Other suggested formats for delivering information were schools and 4H clubs, and personal contact. Although they may be biased by personal preferences, these responses suggests that the respondents preferred information formats that could be delivered directly into their homes (i.e., mail versus the library) and could be reviewed quickly (i.e., newsletters versus books).

There were some broader interest groundwater issues that were not addressed through the RGAP. These included services (i.e., well inspections, free testing, yearly water level sampling), public education (i.e., alternative farming chemicals, alternate urban water supplies, urban water efficiency), regulation (i.e., no commercial pumping, runoff control to groundwater and streams), and financial support for farm-based environmental programs.

All 37 respondents stated that a rural groundwater protection program was important for protecting their own and their neighbours' drinking water supply. This response suggests that the RGAP program provided information that is important to the rural community. The responses also suggested that there was an broader interest in groundwater issues that were outside the scope of the RGAP, but could be addressed by some future initiative(s).

About the Household

Nineteen (51%) of the respondents either lived or worked on a farm, compared to 15 (41%) who were not involved with a farm. Of the farm-related respondents, 10 were aware of the EFP, and two of these had completed and one had started an EFP. These responses show that approximately one-half of the farm-related respondents were aware of the EFP, and that a relatively small number of these had started or completed this program. This indicated that there is an opportunity to increase awareness and involvement of the local farm community in the EFP program.

Thirty-three (89%) of respondents had tested their water in the past 5 years, of which 29 (78%) had tested for bacteria and 22 (59%) had tested for nitrate. Other testing included iron, pesticides, recovery and flow of a well, and one had tested for unspecified parameters as part of a house purchase. The responses likely reflect the general concern with the safety of groundwater supplies for drinking water. The majority tested for bacteria, which is understandable because bacteria are a recognized source of rural well

water contamination, and the Ministry of Health and Long-Term Care provides bacterial testing free of charge. The lower response for nitrate may be related to the nominal cost for this testing, and because nitrate problems have not been as publicized as widely or for as long as bacteria. The testing of some wells for efficiency reflects some local concern with reliability of wells, particularly dug wells, in the rural community.

Thirty-five (95%) of the respondents stated that knowing more about their groundwater was important to them. Twenty-nine (78%) of the respondents were willing to have their water quality analyzed again through a program like RGAP pilot program, and 17 (46%) were willing to pay for this analysis themselves. These results indicate that most respondents wanted more information on how to protect their groundwater supply, and most were willing to test their water supply either on their own or as part of the municipal program. This suggests that the RGAP program has value to the rural community.

CONCLUSIONS

The limited uptake of the free sampling program and low return rate of the questionnaires suggests that direct mailings should only be part of the overall approach to increase awareness. Questionnaire responses suggested it could also be effective to direct the RGAP through Region newsletters, local newspapers and through school and community based programs. The questionnaire also indicated that existing resources such as the EFP needed to be promoted more intensively in the local rural community.

It was concluded that vouchers for free bacteria and nitrate analysis would sent out to residents in the future rather than mailing out sample bottles. This change would reduce the cost and labour required to package and distribute information packages. For instance, the cost of postage of a voucher was approximately seventy cents per unit whereas the cost of postage for sample bottles was greater than two dollars per unit. Inserting a voucher in with the information materials would also require much less time than inserting sample bottles in an envelope.

Overall, the questionnaire responses suggested that RGAP materials were useful and memorable. Approximately 5000 of each of the two posters and 10,000 of each of the two brochures have been distributed to date. An unexpected benefit was the popularity of the brochures with many individuals within the local urban community. The continued distribution of these materials should lead to greater awareness and protection of groundwater supplies shared by the local urban and rural communities.

The popularity of the two brochures, and to a lesser extent the two posters, also went well beyond the local community. It was discovered that many of the brochures and posters made there way into urban and rural agencies located outside the Region. This interest outside the Region indicates that there is a province-wide need for this type of rural groundwater awareness materials.

ACKNOWLEDGEMENTS

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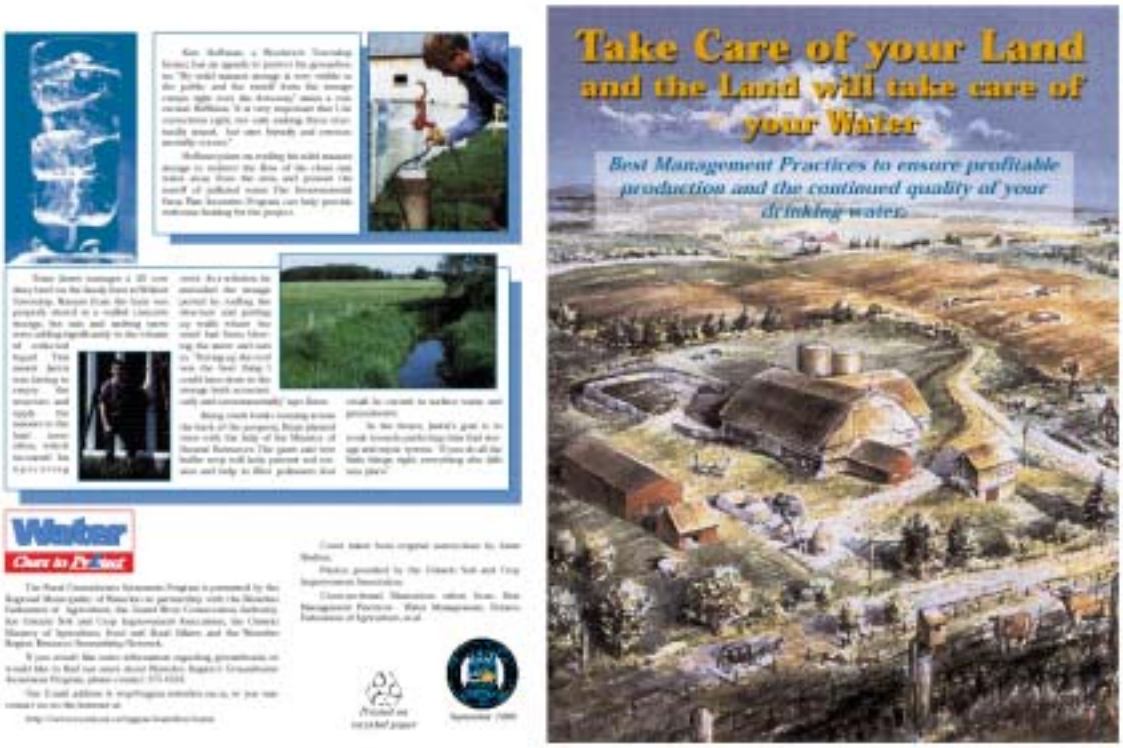
APPENDIX A – RURAL GROUNDWATER AWARENESS PROGRAM MATERIALS

FARMSTEAD BROCHURE



HOMESTEAD BROCHURE