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THE MICHIGAN WELLHEAD PROTECTION PROGRAM:
A COMPARATIVE ANALYSIS OF ITS ADOPTION
AND IMPLEMENTATION IN FOUR COMMUNITIES

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Ruth Kline-Robach

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THE MICHIGAN WELLHEAD PROTECTION PROGRAM: A COMPARATIVE ANALYSIS OF ITS ADOPTION AND IMPLEMENTATION IN FOUR COMMUNITIES

By

Ruth Kline-Robach

A THESIS

Submitted to
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ABSTRACT

THE MICHIGAN WELLHEAD PROTECTION PROGRAM: A COMPARATIVE ANALYSIS OF ITS ADOPTION AND IMPLEMENTATION IN FOUR COMMUNITIES

By

Ruth Kline-Robach

The purpose of this study was to explore the process by which Michigan communities commit to and implement a local Wellhead Protection (WHP) program. Although the WHP program provides the opportunity for municipalities to take an active role in protecting their local drinking water supplies, only a small percentage of eligible communities are currently involved in the WHP planning process, and the success rate of those that have undertaken WHP program implementation has varied.

Through a comparative analysis of four communities whose WHP programs have been approved by the Michigan Department of Environmental Quality, this study identified the characteristics of successful WHP communities and examined barriers to WHP implementation success. Based on the study results, a set of recommendations is offered for improving the diffusion process of the statewide program in order to increase the adoption rate among non-participating communities. Suggestions for facilitating the successful implementation of local programs are also provided.

ACKNOWLEDGEMENTS

I wish to express my deepest appreciation to the members of my guidance committee, including Dr. Scott G. Witter, my major professor, for his sage advice and patience in guiding me through the research process; Dr. Eckhart Dersch, for his practical contributions to this project; and Dr. David P. Lusch, for his valuable guidance and direction, as well as his collegiality and friendship over the many years that we have collaborated on Michigan groundwater protection projects.

Special thanks are extended to my dearest friend and husband, Jim Robach, for his eternal optimism, incredible support and encouragement and unconditional love.

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LIST OF ABBREVIATIONS

EPA ..... Environmental Protection Agency

GEM .....Groundwater Education in Michigan

MDEQ..... Michigan Department of Environmental Quality

MDNR.....Michigan Department of Natural Resources

PWSS..... Public Water Supply System

SDWA.....Safe Drinking Water Act

WHP ..... Wellhead Protection

WHPA..... Wellhead Protection Area

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INTRODUCTION

Almost half of Michigan's nine million residents rely on groundwater as their sole source of drinking water, and the majority of public water supply systems utilize groundwater. While Michigan generally is blessed with ample supplies of safe groundwater, numerous contamination incidents over the years have highlighted the vulnerability of this resource.

Prior to 1986, no state or federal program existed to proactively protect community groundwater supplies. The Wellhead Protection (WHP) program, mandated through amendments to the federal Safe Drinking Water Act, offered a tool for communities to take an active role in designing a locally based groundwater pollution prevention initiative.

Michigan's WHP program is voluntary in nature. The Michigan Department of Environmental Quality, charged with promoting and administering the program at the state level, is interested in encouraging all community groundwater supplies to initiate a WHP program. However, the rate of adoption and implementation of the program has been relatively low.

Utilizing a case study approach, this research project identifies characteristics of communities that may lead to the success or failure of local WHP programs, and offers recommendations for promoting and facilitating the program statewide.

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Chapter 1

CONTEXT AND OBJECTIVES

Statement of the research problem

While a number of federal and state regulations exist to ensure that public drinking water meets quality standards through ongoing monitoring requirements, prior to 1986 no program existed to proactively protect public groundwater supplies. The development of the Wellhead Protection (WHP) program at the federal level offered communities a process for initiating locally driven, proactive drinking water protection programs.

Although an increasing number of Michigan communities are beginning the process of developing a local WHP program, the program is facing some challenges. First, there are many communities that rely on groundwater that are not currently pursuing the development of a WHP program. Second, of the communities that are in the process of developing a local program, relatively few currently have approved programs in place. Finally, a number of community programs that are in place are considered to be unsuccessful by Michigan Department of Environmental Quality (MDEQ) staff and other WHP experts. Therefore, this study will, through a comparative analysis of four WHP communities in Michigan, seek to explore the characteristics of successful and less successful WHP communities in order to identify opportunities for improving

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the diffusion of the program at the state level as well as the rate of adoption and successful program implementation at the community level.

Introduction

Groundwater is a critical natural resource. The availability of high quality groundwater is essential for industries, agricultural producers, communities and individuals who depend on it for their water supplies. Nearly half of Michigan's nine million residents rely on groundwater as their sole source of drinking water (MDEQ 1999), and the majority of public water supply systems (PWSS) rely on groundwater (MDNR and MDPH 1994).

The complex glacial geology of Michigan presents challenges for protecting groundwater supplies. Many community groundwater supplies are drawn from drift aquifers consisting of highly permeable soils overlying vulnerable bedrock formations (MDEQ 1996). These aquifers are susceptible to contamination from a variety of land uses. More than 200 chemicals have been identified in groundwater throughout the nation. In addition, it is estimated that approximately ten percent of public groundwater supplies exceed federal drinking water standards for biological contamination (EPA 1993). Groundwater contamination is particularly troublesome, as remediation is often difficult to accomplish, very expensive, and sometimes impossible.

In Michigan, numerous public water supplies have been contaminated. Within the last decade, for example, the City of Grand Ledge faced contamination of its water supply by leaking underground fuel storage tanks from a gasoline station. Cleanup costs have exceeded $1 million. The City of

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Kalamazoo has spent $7 million to remove solvents from its public water supply. A local manufacturing facility contaminated a number of private water wells in the Village of Pinckney, forcing that community to install a public water supply at a cost of more than $1 million (HRWC 1997).

Federal and state agencies charged with developing drinking water protection programs have realized that successful pollution prevention programs are those that are planned and implemented locally. One such program is the WHP program. WHP is a planning and management approach for protecting community groundwater supplies. Communities begin the WHP process by identifying the land surface that supplies water to public wells over a specified period of time, through a detailed delineation study. That land area is then inventoried for existing and potential sources of contamination, and management strategies are implemented to protect the water supply from contamination. The program was created to meet the requirements of Section 1428 of the 1986 amendments to the federal Safe Drinking Water Act (SDWA).

The WHP planning process requires coordination among local, state and federal agencies. Because water resources respect no political jurisdictions, intergovernmental cooperation at the local level is a critical component of the WHP program. Although the program development process is complex, communities throughout the U.S. have recognized that a WHP program can prevent contamination, thereby safeguarding public health and protecting the community's investment in the public drinking water supply (EPA 1993).

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Michigan groundwater protection laws and regulations

As part of the federal requirement to develop a comprehensive state groundwater protection program, Michigan in 1994 established its groundwater protection strategy, which emphasized three major goals (MDEQ 1996):

1) Protect public health and environment by preventing future degradation of groundwater and restoring to productive use groundwater that has already been contaminated;
2) Manage and protect groundwater as part of overall water management, recognizing the inter-relationship between groundwater and surface water; and
3) Create a cooperative management environment that encourages and rewards groundwater protection. Encourage communication and cooperation between all levels of government, businesses and citizen organizations.

The authorization for WHP was provided by the federal SDWA. However, because a successful WHP program requires the participation of all levels of government, a combination of state and local groundwater-related laws and regulations exist that serve to augment the federal requirements.

More than eight Michigan state agencies, offices and divisions administer programs that provide groundwater protection benefits. Since no overriding groundwater protection regulation serves to prevent groundwater contamination, and because state agency staff and resources are limited, significant gaps exist in the regulatory programs across the state (MSPO 1995). However, two pieces

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of legislation are considered most important for implementing WHP programs (MDEQ 1994).

The Michigan Safe Drinking Water Act (Act 399) was enacted in 1976 and enables the MDEQ to maintain primacy, or state authority, over the state's drinking water program. Under this authority, the MDEQ controls PWSSs throughout the state. In addition to setting criteria for monitoring water supplies, the act establishes isolation distances from contamination sources and defines construction requirements for different classes of PWSSs. The requirements detailed in this act mirror those established in the federal SDWA.

In addition, Part 31 of the Natural Resources and Environmental Protection Act (NREPA – Act 451 of 1994), formerly the Michigan Water Resources Commission Act, provides broad protection for the state's water resources, including groundwater. The state's goals for groundwater protection are highlighted in Section 6(a) of Part 31, which reads:

> "It shall be unlawful for any persons directly or indirectly to discharge into the waters of the state any substance which is or may become injurious to the public health, safety or welfare; or which is or may become injurious to domestic, commercial, industrial, agricultural, recreational, or other uses which are being or may be made of such waters..."

Through this act, the state is able to address potential contamination sources within a delineated wellhead protection area. For example, in 1981 a Kalamazoo Circuit Court ordered an industry in Southwest Michigan to pay civil penalties, litigation and cleanup costs for improperly discharging several

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pollutants on its property. The contaminants were later detected in drinking water supplies and soil samples (MDEQ 1996). Additional regulatory programs under Part 31 address groundwater discharge permits, storm water management, oil storage, and operations dealing with floor drains that receive wastewater.

Other Michigan laws and regulatory programs that address groundwater protection include the following:

Part 83 of NREPA (Pesticide Control Act) requires the registration of all pesticides used in Michigan, and regulates distribution, labeling and application practices.

Part 87 of NREPA (Groundwater and Freshwater Protection Act) establishes a cost-share and educational outreach program for users of pesticides and nitrogen fertilizers to prevent groundwater contamination.

Part 111 of NREPA (Hazardous Waste Management Act) regulates the storage, treatment and disposal of hazardous waste at business facilities.

Part 115 of NREPA (Solid Waste Management Act) regulates the construction and operation of landfills for the disposal of solid waste, not including hazardous substances.

Part 201 of NREPA (Environmental Response Act) outlines the legal framework for dealing with sites of environmental contamination. The act has undergone several revisions, most recently in 1995. Those amendments provide for "appropriate" remedial action for cleanup of contaminated sites, and establish cleanup standards based on land use categories.

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Part 211 of NREPA (Underground Storage Tank Regulatory Act) provides for the regulation of underground storage tanks, including inspections to ensure proper installation and maintenance.

Part 213 of NREPA (Leaking Underground Storage Tank Act) establishes corrective actions at sites that have been contaminated by leaking underground storage tanks.

Part 615 of NREPA (Supervisor of Wells Act) regulates oil and gas drilling operations.

In addition to state laws and regulations, local regulatory programs and services work to ensure groundwater protection. These include water well and sewage permitting programs, well abandonment requirements, sanitary survey requirements for real estate transactions, the use and maintenance of county-specific computerized groundwater databases, household hazardous waste collection programs and groundwater compliance inspections at businesses and industries. Local planning and zoning restrictions are also a critical component of many WHP programs.

Regulatory framework for wellhead protection

The WHP program was mandated by the 1986 Amendments to the federal Safe Drinking Water Act (SDWA). The SDWA was established in 1974, and gave the Environmental Protection Agency (EPA) responsibility for establishing and enforcing drinking water quality standards nationwide.

PWSSs supplying potable water from both surface and groundwater sources must meet national primary drinking water standards, which set

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maximum contaminant levels (MCLs) for a variety of contaminants. The MCL is the highest permissible level of a contaminant allowed in a drinking water supply. The SDWA also regulates underground injection of wastes and designates sole source aquifers (EPA 1993).

The EPA, working through its regional offices, is responsible for reviewing state WHP programs and encouraging communications among the states. EPA Region 5 staff work with the Great Lakes states (Michigan, Wisconsin, Indiana, Minnesota, Illinois and Ohio) on the development and implementation of state programs. Considerable differences exist among the state WHP programs. In general, however, a state agency is designated and given responsibility for overseeing the development of local programs, and supplying guidance and support to the communities as needed.

The Michigan WHP program was developed by the Michigan Departments of Public Health and Natural Resources, and received program approval from the EPA in 1994. The program was transferred to the newly created MDEQ by executive order in 1996.

Amendments to the SDWA in 1996 expanded the scope of state drinking water programs by requiring states to develop Source Water Assessment (SWA) programs. These amendments require states to identify all areas that supply public tap water, including both surface and groundwater sources, inventory contaminants and assess the susceptibility of those areas to contamination. Michigan's SWA program was approved by the EPA in October 1999. The

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program is administered by the Drinking Water and Radiological Protection Division of the MDEQ.

The SWA program addresses both community and non-community water supplies, and calls for the completion of all assessments by 2003. Under the Michigan program, an approved community WHP program will serve as a completed source water assessment for a community water supply. Thus, it is the intent of the MDEQ to encourage all community systems to develop a WHP program within the next several years (MDEQ 1999).

However, since Michigan's WHP program is voluntary at the local level, it is anticipated that some communities will choose not to develop local programs. For community water supplies that choose not to develop a WHP program, the MDEQ will complete a SWA by identifying the wellhead protection area (WHPA) based on a fixed radius surrounding the wellhead. A 200- and 2000- foot minor and major isolation distance will be used. Although these assessments will satisfy the federal SDWA requirements for a state SWA program, they will not include long-term management measures for the groundwater resource. Therefore, it is the intent of the MDEQ to promote the development of as many local WHP programs as possible (MDEQ 1999).

Michigan's approach to WHP

Michigan's WHP program was approved by the EPA in 1994, and is administered by the MDEQ Drinking Water and Radiological Protection Division, Groundwater Supply Section staff, who are housed within the Wellhead Protection Unit. In contrast to many states in the U.S., Michigan's program was

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designed to be voluntary in nature. This decision was made due to the complexity of developing a WHP plan, and the high costs necessary to implement a comprehensive program.

The MDEQ directs the statewide WHP program. This includes setting the criteria for local programs, providing technical assistance and available data to the communities (e.g., GIS maps depicting land uses, sites of environmental contamination and other pertinent information), reviewing and providing comments on draft local program documents, reviewing and approving the wellhead protection area (WHPA) delineation study, and approving final WHP plans. The department also coordinates its work with other state agencies to ensure that the state WHP program is linked with other environmental regulatory programs. A matching grants program was initiated by the MDEQ in 1998 to assist communities with WHP planning and implementation.

Local governments, working in cooperation with the public water supplier, are responsible for implementing and sustaining the community WHP program. Many of the management strategies include developing land use regulations to protect the water supply, which is the responsibility of local entities.

While the 1986 amendments required each state to develop a WHP program and submit it to the EPA for approval, considerable flexibility was given to the states in designing their individual programs. This allowed the states to craft programs that best address their local situations.

State programs are required, however, to address seven program elements (MDNR and MDPH, 1994), including:

1) Determining roles and responsibilities

2) Delineating the wellhead protection area

3) Conducting a contaminant source inventory

4) Developing management strategies

5) Developing contingency plans

6) Siting new wells

7) Encouraging public education and participation

These elements, which are required for all approvable WHP programs in Michigan, are discussed below.

Roles and responsibilities

The purpose of this element is to ensure that duties of the state agencies, local government representatives and PWSS staff are predetermined as part of the WHP plan. In guidance issued to the states, EPA defines "duties" as any roles, responsibilities, authorities and functions of each entity working on the development of the WHP program.

While the MDEQ is charged with overall program facilitation, local entities are responsible for preparing the WHP plan in accordance with state guidelines, providing the public with the opportunity for review and comments, and implementing the program. Successful local programs depend on the involvement of many local agencies and organizations. The state program

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requires the development of a WHP team, which directs the local initiative. The team is responsible for both planning and implementing the community WHP program plan.

At a minimum, the MDEQ requires that the team include the superintendent of the local water supply and a representative of the local municipality in which the water supply is located. Other potential team members include representatives from the local or regional health department, local fire department, business and industry, agriculture, education, planning organizations, environmental organizations and the general public. For communities with WHPAs that extend into neighboring jurisdictions, the team should also include representatives of those adjacent municipalities (MDEQ 1999).

Wellhead protection area delineation

A key distinction for the Michigan WHP program is the requirement for a full delineation study of the land surface that is supplying water to the public wells, which is known as the Wellhead Protection Area (WHPA). The WHPA delineation defines the area of land that will contribute water to the community wells within a ten-year period of time, known as the Time of Travel (TOT). This area is considered the most crucial in order to protect the community groundwater supply.

Many states have opted to allow an arbitrary or calculated "fixed radius" approach for the delineations. In these delineations, a predetermined distance surrounding the public well is identified (typically one mile). That area is

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considered the WHPA, and management programs are designed to address only those potential contaminants within that area. While this method requires little technical expertise, is inexpensive and is relatively easy to implement, it does not consider hydrogeologic principles, and in many cases may not accurately assess the contributing land area.

Due to Michigan's complex geologic conditions, the MDEQ chose to require full hydrogeologic delineations of the WHPA. This method utilizes numeric or analytical modeling techniques that simulate an aquifer's three-dimensional characteristics. Because they rely on substantial field data, and because they are able to consider complex hydrogeologic conditions, these modeling techniques provide a high degree of accuracy. They also allow the user to determine the aquifer's response to various management options.

The delineations require highly trained individuals. Communities usually hire a qualified hydrogeologist or work with local universities to complete their delineation study. Detailed delineations are expensive to complete. The average cost range for a delineation in Michigan is $20,000 to $50,000 (HRWC 1997).

For communities whose wells are naturally protected by substantial confining geologic materials, a waiver from the full delineation requirements may be granted. This is determined by testing the community water supply for the presence of tritium, a naturally occurring radioactive isotope of hydrogen. During nuclear weapons testing that began in 1954, excess tritium was released into the

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atmosphere. By analyzing levels of tritium in groundwater, the relative vulnerability of the system can be addressed.

Groundwater systems that have been recharged by atmospheric water prior to the 1950s will exhibit tritium levels of less than one tritium unit (TU). These water supplies are considered to be relatively "old" (i.e., the water they contain has not been exposed to the atmosphere in approximately 50 years). In these "low-tritium communities," a different delineation and management approach is utilized. These communities are authorized to map a one-mile fixed radius surrounding each wellhead. Management options within those areas generally consist of plugging abandoned wells, which can act as a direct conduit for surface contamination into the confined aquifer system.

Potential sources of contamination

The SDWA requires that state WHP programs "shall, at a minimum...identify within each wellhead protection area all potential anthropogenic sources of contaminants which may have an adverse effect on the health of all persons." Potential sources include both sites and activities that might cause a pollution incident, as well as existing sources of contamination.

The inventory of potential contaminants is sometimes accomplished by dividing the WHPA into different land use categories, and prioritizing the inventory based on the threats posed by the various categories. Activities that may pose a threat to the groundwater are also identified, and both land uses and activities ranked according to the degree of threat that they pose. A map of

these potential sources is produced, and is used to help develop the management strategy for the WHPA.

Wellhead protection area management

The development and implementation of the WHP management strategy serves as the most critical component of local programs. Management strategies are typically divided into two broad areas: regulatory and non-regulatory controls.

Regulatory controls for WHP include laws and ordinances that specifically address activities that will be allowed within the WHPA. For example, zoning restrictions might establish groundwater protection "overlay" districts, prohibit certain land uses, require special permits, authorize the transfer of development rights, or mandate construction performance standards.

Health regulations are another form of regulatory control. These may include prohibitions of underground storage tanks within the WHPA, requirements for septic system upgrades and maintenance, regulations for toxic and hazardous materials handling, or requirements for private water well protection activities.

Non-regulatory management options include land transfer and voluntary restrictions, groundwater quality monitoring within the WHPA, hazardous waste collection programs, and a variety of public outreach and education programs. Communities typically design a management strategy that includes both regulatory and non-regulatory components.

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Contingency plans

The WHP contingency element involves planning for both short- and long-term alternative water supplies in the event of a pollution incident that compromises the quality of the public drinking water. This might include a plan for providing bottled water to community members in the short term, or tapping into neighboring water lines in the event of a larger contamination problem.

Contingency plans also contain emergency response procedures that will be implemented in the event of a contamination incident. These procedures include the identification of emergency responders and necessary equipment, as well as a plan of action for responding to emergencies quickly and effectively.

Plan for new wells

This component requires communities to consider locations and a process for siting new wells should additional capacity be required, or should an existing well go out of service due to contamination or an inadequate water supply. Communities are required to identify the proposed location and depth of the new wells and to describe how and when the new wells will be incorporated into the WHP program.

Public education and participation

Communities are encouraged to engage citizens in the WHP planning process by designing outreach programs for them and encouraging them to play a role in the planning process. Local citizen organizations and stakeholders have played an increasing role in groundwater protection programs over the past decade (MDEQ 1994). Public participation has been recognized for improving

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WHP approval process

Local WHP programs are developed around the seven elements described above, and the plans are sent to the MDEQ office for review and approval. The overall process that communities must follow when seeking an approved WHP program includes the following:

1) Communicate desire to develop a WHP program to MDEQ staff;
2) Develop a work plan;
3) Complete field work for the WHPA delineation;
4) Submit delineation report for MDEQ approval;
5) Identify methods to be used to inventory potential sources of contamination; and
6) Submit the final program plan for agency review.

Michigan WHP program status

Approximately 1,250 community systems throughout Michigan rely on groundwater and should develop a WHP program, according to MDEQ staff. When Michigan's WHP program was launched, three pilot programs, funded by the EPA, were developed to test the WHP planning process. Based on those case studies, lessons learned were identified and documented to assist additional communities in developing their programs. The Groundwater Education in Michigan (GEM) program also initially helped to move the state

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WHP program forward. This grassroots, multi-million dollar program, funded from 1988-1998 by the W.K. Kellogg Foundation, provided technical and outreach assistance for a variety of groundwater protection activities. GEM grantees assisted approximately 15 communities in developing their local WHP programs.

The state program received an additional boost when significant WHP financial incentives were made possible through funding provided by the 1996 SDWA amendments to support state drinking water programs. Utilizing these funds, Michigan began a matching grant program for WHP in 1998. Communities are currently eligible to receive between $7,500 and $50,000 for implementing their local programs, depending upon the population served and the number of wells in the PWSS. Communities are required to provide 50 percent in matching funds. Approximately $1 million are available per year from this matching grant program.

The funds have been critical for helping communities to complete their WHPA delineations, which in the past had been considered cost-prohibitive. Communities with approved delineations are using the funds to further refine and implement the activities in their plans. The WHP grants program has significantly bolstered involvement in the WHP program. During the first round of grant funding in March 1999, 54 communities received grants totaling $1,012,746. In August, 1999, 62 grants totaling $1,080,390 were awarded (MDEQ 2000a).

As of June 2000, 223 communities had begun the process of developing a local WHP program. Of these, approximately 126 had completed the delineation

of the WHPA, and 28 program plans had been approved by the MDEQ (MDEQ 2000b).

The MDEQ has set a goal for more than 500 WHP programs to be in place by the end of 2003 (MDEQ 1999). In order to reach this goal, all of the communities currently involved in the WHP planning process will have to receive program approval, and nearly 300 additional communities will have to initiate and complete the WHP process within the next three years.

MDEQ administrators acknowledge that program accomplishments in terms of numbers of involved communities are low. However, although the numbers are low, the MDEQ feels confident that the program is on the right track, and that the program requirements will lead to the best positive net effect for Michigan's groundwater supplies over the long term (W. Elgar Brown, MDEQ, personal communication, March 2000).

Michigan's program is considered by EPA staff to be one of the strongest in the region. In fact, Minnesota's WHP program, which MDEQ staff members look to as a model for program efficiency, currently has less completed programs in place than does Michigan. Thus far, only 21 delineations have been completed (compared to more than 100 in Michigan), and only five communities, or less than one percent of all community groundwater supplies, have approved programs in place. Indiana, the only other program that is mandated by a state WHP rule, currently has just one approved program in place (Kathy Shroer, EPA Region 5, personal communication, March 2000).

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Past research studies on WHP barriers and opportunities

Past research suggests that the low numbers of approved programs and lack of progress within some local WHP programs can be attributed to a number of real and perceived barriers. Several state and national studies have been completed to identify strengths and weaknesses of local WHP programs and to offer suggestions for improving the programs. These studies have identified some of the obstacles and important components of local implementation and institutionalization of WHP programs.

An evaluation of Michigan's WHP communities conducted by Kreuger (1997) concluded that a primary obstacle to program implementation was the lack of staff time to devote to the effort. Of the required program elements, the least progress was reported to be in the public participation and education component. When asked what types of services or materials would assist them in moving forward with their activities, a majority of communities requested ideas for educating the public in order to develop support for their programs.

Additional barriers to WHP implementation and institutionalization were identified by MDEQ in 1996. These included a concern that, in many communities, the local leadership was not convinced of the value of the program, which led to a lack of long-term commitment necessary to sustain the activities over time. The communities' perception that the plan would be a short-term effort also hindered the success of the programs. Inadequate public education and outreach was again highlighted as a problem for the communities.

A national study and evaluation of WHP communities conducted by the Groundwater Foundation in 1999 found that during the first year of the program,

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local teams tended to be highly motivated, but that interest waned over time, necessitating the need for creative activities and projects. The study also cited the importance of strong leadership, a necessary component of any action-oriented program. Community education emerged as the dominant theme of successful communities. The outreach component is particularly important as community leaders and other team members move out of the community. Educated citizens will help to sustain the program activities over time, and will also be able to make informed decisions about local drinking water issues.

In a Plan B research study, Scrimger (1998) examined WHP program implementation in several Michigan communities. Among the study's conclusions was the fact that communities face difficulties institutionalizing program activities due to high staff turnover and management strategies that have not been fully incorporated into the job descriptions of staff charged with WHP responsibilities. The study also cited strong leadership to inspire team members and influence local officials as a critical component for WHP program success.

A report published by the EPA in 1992 described innovative WHP programs across the U.S., and acknowledged that, while each local program is necessarily unique, the most successful programs were those with aggressive, ongoing public education efforts in place.

Research objectives

The primary objective of this study will be to examine the adoption and implementation process of WHP programs within four Michigan communities in

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order to 1) assess the characteristics of the local programs that may contribute to their success or failure and 2) determine whether the perception of MDEQ and other expert staff matches the actuality of the success or failure of the community WHP. This will be accomplished by examining the extent to which each community meets a set of generally accepted criteria for successful local WHP programs.

A second objective of the study will be to specifically explore the factors within each community that are believed to most often contribute to the success or failure of community WHP programs, in order to determine the validity of those claims and to identify factors that may stall a community's WHP implementation efforts. These factors include a lack of local leadership for WHP, inadequate education and outreach efforts, and attrition of program effort over time. Several research questions were posed to address this objective. These include:

Question 1: Are communities that have developed a WHP program with the assistance of an outside facilitator less likely to implement successful programs than those that implemented the program without external assistance?

Question 2: Will communities that under-perform in outreach efforts have less successful programs in place than communities with aggressive outreach campaigns?

Question 3: Will communities that have received program approval within the past year have more successful programs in place than those that have had their programs in place for a longer time period?

Benefits of the study

This study can lead to positive change within Michigan's WHP program by identifying the attributes of successful community programs and factors that are likely to lead to long-term institutionalization of them. Outcomes will include a set of recommendations for MDEQ staff and others who promote WHP for 1) encouraging additional communities to begin the process of developing a local WHP program; 2) helping communities address common barriers to successful program implementation; and 3) providing suggestions for more effectively facilitating the implementation and institutionalization of locally-based programs. It is hoped that the recommendations for refining and enhancing the state program will ultimately result in a greater number of successfully implemented and institutionalized local WHP programs throughout Michigan.

Chapter 2

LITERATURE REVIEW

Overview of the literature search

The goal of this study was to explore the characteristics of WHP communities in order to identify opportunities for improving the diffusion of the program at the state level as well as the success rate of program implementation at the community level. Therefore, the literature review focused on the diffusion and adoption of innovations, organizational change and the implementation of innovations within organizations.

Major themes

The literature search included an examination of research studies and methodological reports that reviewed the theory of the preceding themes as well as specific factors that influence the processes of program adoption and implementation. The literature included two primary thrusts. The first addressed topics directly related to the diffusion of innovations literature, about which a great deal of research has been conducted. This literature was sound in its scientific methods and was clearly rooted in diffusion of innovations theory. The literature addressed the initial adoption, implementation, and institutionalization of innovations.

The remaining focal area dealt with ensuring the success of innovations that had been adopted by an organization. This literature points to various

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facilitation and support functions that may be necessary not only for program adoption, but also for the implementation of successful programs over the long term.

Shortcomings

Although a wide variety of diffusion and adoption studies have been published since the early 1940s, the research was initially rooted in rural sociology, focusing primarily on agricultural extension. While some environmentally based studies were identified, the majority of articles focused on the diffusion and adoption of innovations related to agricultural extension, education, computer technology and human health issues.

Business-focused literature dominated much of the implementation and institutionalization literature. However, a number of researchers have stated that the theories presented in the reviewed literature are transferable across a broad range of social science disciplines.

Definition of terms

Because some of the terms in the diffusion of innovations literature are often confused, clarifications must be made. Dearing and Meyer (1994) define *communication* as an exchange of information among participants in order to achieve understanding and reduce uncertainty. *Diffusion* is a communications process by which an innovation is communicated through certain channels over time among members of a social system (Rogers 1995). *Transfer* is essentially the communication of information.

An *innovation* is a new technology that allows an individual to interact with his environment in a different way. *Technology* is knowledge or information that can refer to very specific tools and procedures or generic concepts. Technology can also refer to social technologies such as educational or social programs. For purposes of this study, the innovation will be considered the community-based WHP program, and the terms technology and innovation will be used interchangeably.

A *social system* is defined as a set of interrelated units that are engaged in joint problem solving to accomplish a common goal. An *organization* is a group of individuals who work together to achieve common goals through a hierarchy of ranks and a division of labor (Rogers 1995). For purposes of this study, a community that is considering a local WHP program will be considered an organization.

Adoption occurs when an individual or organization decides to make full use of an innovation (Rogers 1995). *Implementation* occurs when the innovation is put into place. Eveland (1987) defines implementation as making productive use of a technology or idea. *Institutionalization* is the state within an organization where an innovation is accepted as a standard part of the organization's ongoing operations. Implementation is sometimes referred to as initial adoption, while institutionalization is considered the final adoption of the innovation.

Diffusion of innovations research

Diffusion is the broad spreading of an innovation among many possible adopters (Dearing and Meyer 1994). Diffusion research has long been used to

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study the process of communication and adoption of innovations, and the diffusion paradigm has relevance for many disciplines (Rogers 1995). Effective diffusion is usually a prerequisite for the widespread adoption of an innovation, although it does not guarantee that adoption. By examining why a new idea is or is not being accepted by an individual or organization, researchers can determine the social and political factors that are influencing adoption rates, and offer strategies for facilitating the future acceptance of the innovation.

The diffusion process is useful in helping to understand the adoption of innovations within a variety of social science disciplines. Valente and Rogers (1995) traced the origins and development of the diffusion of innovations paradigm. Beginning with studies in rural sociology aimed primarily at farmers' adoption of agricultural innovations, diffusion studies broadened to include the social processes of a variety of interdisciplinary fields in the 1960s. Some of these include communications, marketing, human health, geography and education.

Some research pertaining to environmental issues has been completed. For example, research conducted by Pampel and van Es in 1977 considered the diffusion and adoption of agricultural practices designed to protect the environment rather than commercial agricultural practices specifically designed to improve farm profit. Dearing et. al. (1994) conducted a study of outreach mechanisms used by researchers engaged in hazardous waste remediation projects. Results included implications for both university-based technology transfer activities and the diffusion of innovations.

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Concerns with the diffusion of innovations theory

Several problems have been identified regarding the diffusion of innovations process. First, diffusion studies tend to include a pro-innovation bias. There is a presumption on the part of the agency promoting the innovation that the innovation will benefit the organization, without considering whether or not the innovation is a good fit with the organization.

An individual blame bias can occur when social factors that might influence the adoption rate of an innovation are not considered in the research study. Instead, individuals within the social system are considered responsible for the problems that they are facing.

Finally, diffusion research methodology includes recall problems and issues of causality. Fliegel (1993) stresses that relying on recall data from respondents is troublesome both for assessing the time of adoption as well as assessing information flows. Determining the most influential source of information about the innovation is heavily dependent on the respondent's ability to recall past events. The complex inter-relationships that are involved in diffusion studies also create challenges in determining clear-cut cause and effect relationships that may influence adoption decisions.

Stages in the innovation decision process

Diffusion success can be defined as the extent to which a technology passes into general use (Baer et. al. 1977). Rogers (1995) states that people will adopt an innovation if they feel it has high utility and that it is compatible with the way that they currently operate. Rather than an instantaneous act, an

individual's decision about an innovation develops as part of a process. Within organizations, no one person is responsible for the entire adoption decision process. Rather, it is the complex inter-working among various individuals that will lead to either the acceptance or rejection of the innovation.

When considering whether to adopt a new technology or innovation, individuals and organizations progress through a series of stages (Rogers 1995). These include:

1) Knowledge Stage - includes the recall of information and comprehension of messages relating to the innovation. Individuals tend to expose themselves to ideas that are in alignment with their specific interests and needs.
2) Persuasion Stage - the individual forms a positive or negative attitude toward the innovation.
3) Decision Stage - the individual or organization engages in activities, such as seeking additional information about the innovation, which will ultimately lead to the choice of whether to accept or reject the innovation.
4) Implementation Stage - the innovation is put into use, and overt behavior change occurs.
5) Confirmation Stage - the individual recognizes the benefits of using the innovation and integrates it into his daily routine. The innovation is then promoted to others in the social system.

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Factors that influence adoption decisions

Factors that affect the diffusion and adoption process include the characteristics of the innovation itself, the availability and use of different communication channels, characteristics of the potential adopters and the characteristics of the existing social system.

Innovation attributes

Diffusion research considers attributes of the innovation that will help to predict whether or not it will be adopted. Eveland (1987) stresses that a critical determinant in the acceptance of a new technology is functionality - that individuals will do things that reward them. Rogers (1995) identified five perceived attributes of an innovation that will influence whether or not it will be adopted, including:

1) Relative advantage - including cost, status, design and dependability
2) Compatibility - with existing values and beliefs and social structures
3) Trialability - whether the innovation can be tested on a temporary basis
4) Observability - the visibility of the results of the innovation
5) Complexity - the less complex the innovation, the higher the likelihood of adoption

To these, Dearing and Meyer (1994) included two additional attributes believed to be important in the diffusion of environmental innovations:

6) Applicability - the innovation having more than one use
7) Reliability - the degree to which the innovation has consistent results

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Communication channels

In the innovation decision process, awareness precedes adoption of an innovation (Valente and Rogers 1995). Because of this, diffusion networks are important, since individuals inevitably depend on the experiences of peers who have already adopted an innovation.

Rogers (1995) believes that interpersonal channels are a critical component in persuading an individual to adopt a new idea. This is especially true if the individuals are near-peers.

Interpersonal channels include the influence of opinion leadership (an individual who is able to informally influence the attitudes or behavior of other individuals) and the change agent (an individual who influences the innovation decision of an agency's client).

Opinion leadership plays an important role in encouraging the diffusion of innovations. Weimann (1994) identified four methods of identifying opinion leaders to assist in this effort. These include:

1) Sociometric - asking individuals whom they meet and talk with
2) Informants' ratings - asking key informants who the opinion leaders are
3) Self designation - asking respondents whether they see themselves as influential to others
4) Observation

Change agents can also play a critical role in facilitating the diffusion of innovations. An individual who strives to influence a client's innovation decision in a direction deemed desirable by the change agency for whom he works, the

change agent is typically heterophilous from his client. Because of this, Rogers (1995) determined that change agent success to a large degree depends on the extent that he works through opinion leaders within a given social system.

Organizational adoption decisions are often influenced by the active efforts of an "innovation champion" within the organization (Strang and Soule 1998). External influences that encourage the organization to adopt include the mass media and change agents, while internal influences include such factors as prestige that may stem from adopting the innovation and spatial proximity to others within the organization that have adopted the innovation.

Adopter categories

Adopter categories include innovators, early adopters, early majority, late majority and laggards (Rogers 1995). Early adopters have a shorter innovation-decision period because they are less resistant to change.

Characteristics of existing social system

The diffusion process is driven to a large degree by uncertainty and social pressure. Social pressure is an important component in diffusion strategy, and will lead to more successful outcomes than efforts that do not include this component. The cumulative result of social pressure can be referred to as the "diffusion effect." (Dearing 1997).

Strategies to encourage the adoption of innovations

In a study that focused on the diffusion of innovations among health professionals, Becker (1970) offered strategies for increasing the initial adoption of innovations within an organization. These include:

1) Ensure that opinion leaders are exposed to sources of information early in the diffusion process
2) To the extent possible, decrease the risks associated with adoption and increase the prestige value of the proposed innovation
3) Ensure that all members within the communications network learn about the actions of the early adopters.

Implementation of innovations

Initial adoption is only the first step toward successful implementation of an innovation. Dearing (1994) emphasizes that it is what the potential users of an innovation do with that innovation – the successful implementation and institutionalization of the innovation - that is the most critical component of the change process. Leonard-Barton (1988) defines implementation as a dynamic process of mutual adaptation between the technology and its environment.

The implementation phase of planned change has received much less attention than issues such as research and development activities. Creators of the innovation are generally reluctant to pursue implementation planning, and assume that the users will effectively implement the innovation. As a result, gaps exist between the diffusion of the innovation and its use, which is referred to as the implementation gap (Roberts-Gray and Gray 1983).

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Stages of implementation

Managers who plan and carry out the implementation of an innovation bear much responsibility for the degree to which it is fully accepted by the targeted users (Leonard-Barton 1988).

Roberts-Gray and Gray (1983) identified three stages of implementation, which include:

1) Orientation - the awareness building stage where leadership is encouraged to endorse the innovation
2) Initiation - putting the innovation into place
3) Integration - building the innovation into normal organizational channels

Implementation characteristics

Johnson (1997) believes that a successful implementation is one that is responsive to external stakeholders. It is considered to be the effective routinization and incorporation of the innovation into the ongoing processes within the organization. Leonard-Barton (1988) cites several implementation characteristics of a new technology:

1) Transferability - the ability to incorporate the innovation into multiple organizations
2) Complexity - the degree of difficulty involved with implementing the innovation
3) Divisibility - allowing a trial adoption of the innovation

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While these characteristics will influence the probability of implementation success or failure, other, more specific factors may determine the outcome of the implementation attempt. Roberts-Gray and Gray (1983) reviewed studies that were conducted of failed implementation efforts. Reasons that were cited for the failures included:

- Lack of clarity of the program
- Lack of capability to perform the required tasks
- Lack of necessary materials
- Incompatibility of the innovation within the organization
- Lack of user motivation
- Excessive resource demands
- Lack of implementation planning

Change within an organization

The decision to adopt at the organization level has less to do with the actual technology and more to do with finance, personnel, scheduling and resource management issues (Eveland 1987). In other words, the change process is more important than the content of the technology that is being implemented. The innovation process in organizations includes agenda setting, matching, redefining/restructuring, clarifying and routinizing (Rogers 1995).

If initial adoption and long-term implementation of a technology or innovation is the goal, agencies would be well served to focus more on how individuals think about the change process than what is actually changing.

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Rather than convincing organizations to adopt an innovation that the agency believes will be beneficial, successful diffusion activities help organizations make appropriate choices and assist them in understanding the implications of those choices.

Individual commitment to the innovation is also an important component of successful organizational change: Sternberg (1995) states that some organizations desire change, while others may desire the appearance of change without any change at all.

Stages of organizational change

When organizations are considering a change, the individuals within it will go through a succession of changes that ultimately lead to the long-term implementation of the innovation, including pre-contemplation, contemplation, preparation, action and maintenance. Specific stages of organizational change include the following:

1) Awareness - where a problem is recognized and defined. Solutions to the problem are sought and analyzed.
2) Selection - different options are considered.
3) Adoption - when action is initiated. Policies are formulated and resources for instituting the change are allocated.
4) Implementation - the change is put into place, resulting in reactions from individuals involved in the change process

5) Institutionalization - the program becomes a regular part of the organization, and new goals and values are internalized. This stage is also referred to as routinization.

Facilitating successful organizational change

A number of strategies can be utilized to facilitate change within an organization, including:

1) Offering technical and financial assistance
2) Providing education and training opportunities
3) Putting into place rules or sanctions to force the implementation and
4) Using persuasion to foster personal commitment to the innovation.

Depending on where the organization is in the implementation process, different facilitation techniques can be utilized by agencies. In the awareness stage, agencies should seek out management and opinion leaders within the organization to raise awareness of and build support for the innovation. At the adoption stage, providing additional information will help the potential implementers understand what the adoption process will entail. Technical assistance should be considered in the implementation phase. Once the institutionalization stage begins, the agency should work with the opinion leaders within the organization to address any obstacles that are being encountered and develop strategies for integrating the innovation into the organizational structure.

The use of an outside consultant to assist the organization through the implementation process may be beneficial. Positive aspects include a more

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objective perspective of the proposed change and the lack of accountability to a superior within the organization. However, because the consultant will likely be unfamiliar with the organization, a longer time period will be required to familiarize him with the organizational structure. In addition, costs will be higher to implement the innovation.

Conclusion

Diffusion of innovations research can help agencies better understand how decisions to adopt an innovation are made. By examining the factors that influence adoption decisions, strategies can be developed for encouraging organizations to accept and adopt an innovation.

To successfully diffuse environmental information and educational programs, agencies must build upon existing networks and levels of knowledge (O'Keefe and Shepard 1999). Working through opinion leaders within the organization and change agents to develop messages for the target audiences will open the interpersonal networks that are critical to diffusion success.

Agencies will be better equipped to design assistance activities for organizations that are attempting to implement an innovation if they explore the factors that may hinder the implementation of the innovation and examine how organizations move through the change process. This will help to ensure the successful institutionalization of innovations.

Evaluative criteria and processes are also very important for long-term success of organizational change. Rogers (1995) stresses the need for

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continued reinforcement and self-evaluation to ensure that the new behavior or innovation continues to be beneficial to the organization.

The diffusion of innovations and organizational implementation literature is appropriate for use in this study, since WHP can be considered an innovative process that may represent a departure from the way that a community typically conducts local programs. By applying the theories and concepts of this literature base to the WHP program, it is hoped that recommendations can be made for improving the program adoption rate among local entities as well as the successful implementation and institutionalization of the program among communities that have already made the decision to accept the program.

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Chapter 3

STUDY METHODOLOGY

The objective of this research study was to examine the adoption and institutionalization of local WHP programs with an emphasis on the process used by the communities in adopting and implementing their individual program plans. Through a comparative analysis of four WHP communities in Michigan, the ultimate goal of the study was to explore the characteristics of successful WHP communities in order to identify opportunities for improving the administration and diffusion of the program at the state level and for increasing the success rate of local program implementation.

Qualitative research approach

In order to deal with the multiple social and environmental factors that are inherent in locally based environmental protection initiatives such as WHP, a qualitative research approach was used for this study. Qualitative research allows the investigator to focus on the research topic as a holistic entity, with an emphasis on the interactions of each component of the topic being studied. Rather than relying on empirical formulas, qualitative researchers strive to identify the individual's perspective through observation and detailed examination (Denzin and Lincoln 2000).

Qualitative research provides an opportunity for the investigator to study and understand complex social issues and interactions. However, because

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qualitative research is by its very nature interpretative research, the researcher's biases, values and judgment may influence the study conclusions (Creswell 1994). While it may be difficult to establish the reliability of the qualitative research results, Merriam (1998) argues that qualitative research should be judged as credible and confirmable. Although challenges with generalizability exist with this mode of research, the benefits associated with qualitative research substantiate its use.

Research strategies in qualitative research often involve designing case studies and observing participants in the field, while data collection methods include interviewing and observing individuals and analyzing documents and records related to the issue being examined.

Case study research

A comparative case study approach was utilized for this study. An integral component of qualitative research, the case study offers the opportunity for intensive study of a case, including its background, the physical setting and other contextual issues. By employing a case study method, researchers are able to provide insight into an issue and to develop generalizations about the study topic (Stake 2000). Because case studies emphasize the context around which the issue is framed, the researcher is able to develop rich descriptions of the cases being studied. This research method also provides a great deal of research flexibility, which allows the researcher to concentrate on exploration, rather than prediction.

Disadvantages to case study research also exist. Because case studies rely on personal interpretation of the research findings, the researcher may introduce bias and subjectivity into the research report. In addition, it may be difficult to test the validity of the results.

Study objectives and related research questions

In order to address the concerns with the state's WHP program that were discussed in Chapter 1, the following objectives were proposed for this study:

The first objective was to examine the characteristics of the four selected communities and compare them to criteria that are considered by experts to be indicators of WHP program success, in order to determine the extent to which the perception of MDEQ and other expert staff matches the actuality of the success or failure of the community WHP.

The second objective of the study was to specifically explore the factors within each community that are believed to most often contribute to the success or failure of community WHP programs, in order to determine the validity of those *claims*. Several research questions were developed to address this objective, including:

1) Are communities that have developed a WHP program with the assistance of an outside facilitator less likely to implement successful programs than those that implemented the program without external assistance?

2) Will communities that under-perform in outreach efforts have less successful programs in place than communities with aggressive outreach campaigns?
3) Will communities that have received program approval within the past year have more successful programs in place than those that have had their programs in place for a longer time period?

Procedures used in this investigation

Face-to-face interviews

Interviews were used as the primary data collection strategy for this study. The principal advantage of interviews is that they allow the researcher to focus directly on the case study topic, and provide depth to the research findings. However, bias can be introduced via poorly designed questions, and inaccuracies may result due to poor recall.

Structured interviews utilize a series of pre-established questions with a limited set of response categories, while the unstructured interview is designed to provide a greater depth and breadth of understanding (Fontana and Frey 2000). Semi-structured interviews were conducted for this study, whereby a series of questions were developed that allowed for some categorization of answers as well as open-ended responses.

Review of archival documentation

Reviewing documentation to augment information obtained through the interview process has several advantages. The process is unobtrusive, and

allows the researcher to work at his own pace to collect and analyze the information. The stability of the information allows it to be repeatedly viewed, and a broad array of information can be tapped. Disadvantages of this data collection method include the possibility that bias may be introduced through selectivity, and access to particular records may be deliberately blocked.

Methods utilized to ensure validity of the data

The process of triangulation was employed in this study to help ensure the validity of the research results. This process relies on multiple modes of data collection in order to overcome any inherent biases in the data sources, the investigator or the research method (Creswell 1994). Data collection and analysis methods used in this study included interviews with individuals from the WHP communities, discussions with state, regional and national WHP experts, personal observation within the communities, review of archival documentation, and peer consultation, in which the researcher consulted with professional colleagues regarding the validity of the research results.

How criteria for successful WHP programs were developed

After reviewing past studies of WHP program implementation, a set of criteria deemed to be necessary for successful local programs was developed. The criteria were designed based upon the required WHP program elements, and were divided into the following categories: 1) team membership, 2) local government support, 3) management strategies and 4) education and outreach activities.

The initial list of criteria for successful programs was developed based upon a review of past WHP implementation studies, program guidance disseminated by the MDEQ, and a review of WHP literature. The criteria were then reviewed, through individual meetings and telephone conversations, with various experts in the WHP field. These experts included: staff from the MDEQ Wellhead Protection Unit; current and past WHP facilitators who participated in the statewide GEM Program; staff from EPA Region 5, which oversees state WHP programs in the Midwest region; and staff from the Groundwater Foundation, a national foundation that promotes community-driven groundwater protection initiatives, including WHP programs.

The final list of criteria for successful WHP programs is presented below:

<u>WHP Team</u>

Strong facilitation and leadership with a broad membership including:

- PWSS superintendent
- Municipality
- Local health department
- Fire department
- Business/industry
- Agriculture
- Education
- Planning authorities

- Environmental groups
- Citizens
- Adjacent municipalities

Designated roles and responsibilities for each team member; adequate contributions from each team member; team stability; plan for addressing staff turnover; one or more enthusiastic team members with a strong commitment to the program goals.

Local Government Support

County Board of Commissioners: aware of the WHP program; actively promote it; offer financial support. *Twp/Village/City Board or Council*: aware of the program; actively promote it; offer financial support; approve a groundwater protection and/or WHP Ordinance; incorporate WHP into the Master Plan; support an active FFRTK program; request ongoing surveys of sites with hazardous materials; link FFRTK activities with the WHP program; include the FFRTK responsibilities in a groundwater protection ordinance. *Local or Regional Health Department*: actively engaged in well and septic permit programs; inspections of environmentally sensitive sites; maintenance of a county groundwater database; abandoned well demolition permits program.

Coordination with neighboring jurisdictions: if the WHPA extends into neighboring jurisdictions, they are aware of the WHP; representatives participate as members of the WHP team; publicly support the WHP efforts; adopt the WHP ordinance; use the environmental permits checklist, and/or engage in the same management strategies.

Management Strategies

Broad range of management strategies, including: use of environmental permits checklist; zoning ordinance provisions for WHP including overlay zoning; site plan review; new building inspections; linkages with FFRTK program; facility inspection or hazardous material survey program; inter-jurisdictional agreements; information to businesses about state and county requirements and WHP; information to residents within the WHPA about the program; strategic monitoring within the WHPA; abandoned well search and decommissioning; hazardous waste collection/Clean Sweep/recycling programs.

Education and Outreach

A variety of outreach activities with: team members who are designated with responsibility for the outreach efforts; identified target audiences and needs assessment for each. Community-specific outreach materials used in conjunction with other, existing groundwater education materials and broadly distributed within the community.

Media coverage: Ongoing relationships with local media representatives; ongoing coverage of WHP efforts in local media outlets.

Joint programming: relationships with area schools and K-12 programs in place; partnerships with existing organizations on education and outreach efforts; ongoing joint activities; collaboration with neighboring jurisdictions in the outreach and education efforts; program plan for continuing the outreach efforts into the future.

Overall WHP Program

Periodic review of and updates to the WHP plan; acceptance of the program by the community; continual groundwater protection activities over the long term.

After consensus was reached regarding the criteria for successful local programs, a set of open-ended interview questions was developed that mirrored the criteria list. Additional questions regarding background information about the community and overall WHP implementation were also included. A complete set of interview questions can be found in the Appendix.

Community selection process

As of June 2000, 28 community WHP plans had received program approval from the MDEQ Wellhead Protection Unit (MDEQ 2000c). The first step in the research process was to review the written program plans for each of these communities, in order to assess commonalities and differences.

The communities were then clustered according to: population served; number of wells serving the community; relative vulnerability of the groundwater supply; date of program approval; whether or not a facilitator was used during the development of the program; and the perception of the success of each community program by MDEQ and other individuals considered to be experts in the WHP field. Each of these elements is discussed briefly below.

Population served

Michigan communities that utilize groundwater provide drinking water to populations ranging from less than 100 to more than 150,000. However, the majority of Michigan's public groundwater supply communities serve between 3,000 and 10,000 individuals. For this reason, communities outside of this range were excluded from the study pool.

Number of wells and well fields

The number of water wells serving each community averaged approximately four wells. Because the number of water supply wells within a community and the spatial distribution of those wells influences the breadth of management activities that are necessary for a successful WHP program, the communities that were selected have between two and four wells located in no more than one well field.

Relative groundwater vulnerability

A number of communities utilize groundwater that is considered to be not vulnerable to contamination due to protective geologic formations, such as a significant clay layer, or as a result of tritium testing. Of the 208 Michigan communities currently working on a local program, 45 are considered "not vulnerable" systems, based on tritium analyses (MDEQ 2000c). Because the WHP management strategies for communities that are considered not vulnerable differ significantly from those of more vulnerable community supplies, these communities were automatically excluded from the study pool.

Date of program approval

The MDEQ approved the first WHP program plans in 1994. Four communities were chosen for the case study research. Since it is assumed that significant differences exist between communities that have been involved with WHP for a longer period of time and those that have received recent approval, two communities were selected that received program approval at the onset of the state program. Two additional communities were chosen that received program approval in April and June 2000.

Type of facilitator

Many of the communities with approved programs in place have relied on the assistance of an external, professional facilitator to assist them with the development and implementation of their WHP program. They include staff from private consulting firms, representatives of nonprofit organizations that deal with water quality issues, and individuals employed by organizations that promote WHP as part of their primary mission. Some communities have chosen not to utilize the assistance of an outside facilitator. The communities chosen for this study included several of these categories.

Perception of program success

Several communities have been generally recognized as having exemplary WHP programs in place. These communities are regularly highlighted throughout the state as outstanding examples of community WHP success. Because a goal of the study was to develop and test criteria for successful programs, two of the communities that were chosen were viewed to have

exemplary programs in place in the opinion of experts from MDEQ and other organizations. One of these "exemplary" communities received early program approval, while one received approval in April 2000.

After the communities were analyzed and clustered according to the preceding criteria, four communities were selected for this research study. They included: the City of Coldwater in Branch County, the Village of Milford in Oakland County, the Village of Oxford in Oakland County and the City of Portland in Ionia County.

Description of communities

City of Coldwater

The City of Coldwater, located in Branch County, provides a population of 9,600 with drinking water drawn from dual aquifers that represent both unconfined and semi-confined conditions. Because of this, the groundwater is considered susceptible to contamination. Land use in the area is primarily agricultural, with some large livestock operations.

The City's four wells are located within 1000 feet of each other in a single, fairly compact well field. The wells have an average depth of 130 feet. Average water use is 2.3 million gallons per day, with thirty-five percent of the demand coming from residential use and sixty-five percent from industrial and commercial use.

The Coldwater WHP program received approval from the MDEQ in October 1994, and was the second to be approved in Michigan. The MDEQ considers the Coldwater WHP program to be exemplary. As a founding WHP

community, the program has been lauded as an example of a successful program initiated solely by the local community. Coldwater has received awards from both the state and national American Water Works Associations for its WHP efforts.

Although an engineering consultant was hired to write and compile the plan, primary leadership has come from the Coldwater Board of Public Utilities (CBPU). A municipal entity that provides water and electric service to the City's residents, the CBPU is a self-supporting enterprise, with policies and rates set by a five-member board of directors. The utility continues to coordinate and maintain the City's WHP program.

The WHPA is located outside the city limits in Coldwater Township. The size of the WHPA is relatively small, covering about two to three square miles. Lying within the WHPA is a major gravel mining operation, an interstate highway and several businesses that use or sell oil and hazardous substances. The majority of the WHPA is yet undeveloped, so the potential for growth exists.

Village of Milford

Located in southwest Oakland County, the Village of Milford includes about 5,500 residents. Water is drawn from a high yielding artesian aquifer. The aquifer consists of fine gravel, and is considered partially confined, making it vulnerable to contamination. Land use in the area is primarily residential, with some industrial and commercial use.

The majority of the village population relies on drinking water from the Village, although some private wells are still in operation. The Village's

Department of Public Services maintains two wells that are located in the same well field. The wells are 114 feet deep. Average usage for the Village's peak month is two million gallons per day.

The WHP planning process was initiated in the Village in 1992; however, the delineation of the WHPA was not completed until 1999. Final program approval was issued by the MDEQ in April 2000. The Village of Milford WHP program is considered by MDEQ staff to be one of the most successful local programs in Michigan, due to its emphasis on public involvement and extensive community outreach activities, as well as its strong leadership by local government staff. The village received a groundwater protection award from the Michigan Society of Planning Officials in 1995 for its groundwater protection activities.

The Village began the WHP process when it was approached by the Huron River Watershed Council to participate in their planning effort as part of a GEM grant that focused on WHP facilitation in three southeast Michigan communities. While the HRWC served as the facilitator of the program initially, leadership was eventually transferred to the Village Department of Public Services and remains there currently.

Milford's WHPA extends into portions of Highland and Milford Townships. The WHPA is located in end moraines of coarse textured till. The soil is predominantly sandy clay loam, sandy loam or loamy sand, ranging from 30 to 100 feet thick.

Village of Oxford

The Village of Oxford is located in north central Oakland County, ten miles north of Pontiac and 15 miles south of Lapeer. The village has a population of approximately 3,000 people. The area is made up of porous, sandy soils, making the groundwater highly vulnerable to contamination. Land use in Oxford includes residential, commercial and service establishments and industrial. Gravel mining is a significant land use in both the village and the adjoining township. Approximately ten percent of the village land is vacant and zoned for residential use, although there are some undeveloped industrial parcels.

The municipal water system provides all residents and businesses within the village limits with drinking water. The Village's groundwater supply is drawn from three wells that have an average depth of 83 feet. They are located in a single well field. Daily water use is approximately .6 million gallons.

Oxford's plan was the first to be approved by the MDEQ, in February 1994. The Village began the WHP planning process in November 1990, after it was asked by the MDEQ to serve as a state pilot and demonstration project. The Clinton River Watershed Council received a grant from EPA Region 5 to provide leadership for the WHP effort and demonstrate ongoing WHP planning and implementation. As the first municipality to attempt the WHP process, Oxford also received technical assistance from both the Michigan Department of Natural Resources and Michigan Department of Public Health, the agencies that were leading the state program at the time.

Because of its status as a Michigan demonstration project, Oxford has served as a resource to other communities. Although initially viewed as a highly successful demonstration project, some MDEQ staff members have in recent years expressed concerns about the ongoing program. The concerns stem primarily from a high rate of turnover among the village's administrative staff.

The WHPA spans the majority of the village area, a large portion of Oxford Township and land in Addison Township. The WHPA includes surface water drainage from about 60% of the village. It also includes substantial areas of land that are currently in residential use. Agriculture is not a major land use in the area.

City of Portland

The City of Portland, located in Ionia County, serves approximately 3,800 individuals with drinking water. The water is drawn from an unconfined aquifer that is considered highly vulnerable to contamination. The City draws its water supply from three municipal wells located in a single well field. The wells average a depth of 72 feet.

The City began the WHP planning process in early 1999, and received program approval in June 2000. Leadership for the WHP program rests with the City's administrative staff, although an engineering consulting firm has been responsible for writing the plan and coordinating much of the effort to date. Some MDEQ staff members have expressed concerns about the program, which stem primarily from leadership issues and turnover of local government staff.

The WHPA covers the west-central portion of the City and extends into Portland, Orange and Sedewa Townships. Residential and agriculture are the primary land uses within the WHPA. There is substantial developable land remaining in the WHPA.

Data collection strategies

Prior to interviewing the individuals within each of the selected communities, the approved WHP plans were reviewed for background information. Semi-structured, open-ended interviews were conducted with a variety of individuals involved with the local WHP programs in order to address the research questions. The interview questions were designed to assess the extent to which each community is meeting the criteria for a successful WHP program, and to analyze the perceptions of team members from the selected communities regarding the process that was used by their community to develop and implement their local program.

Interviewees included: the leaders or chairpersons of the community WHP team; the external professional WHP program facilitator, if applicable; and team members from the local WHP teams. Face-to-face interviews were utilized for the program facilitators and team leaders, who were asked a more extensive set of interview questions, including background information about the community, while telephone interviews were utilized for the remaining team members.

Interviews were conducted between June and August 2000. The average length of each face-to-face interview was one hour and thirty minutes, while the average duration of the telephone interview was 20 minutes in length. The

researcher personally conducted all interviews. The format used for the interviews included a brief introductory statement of research goals and objectives and a review of the categories of interview questions that would be asked. At the conclusion of the interview, respondents were given the opportunity to provide general comments regarding Michigan's WHP program and the implementation process that was used by their community.

Individuals were assured confidentiality. For this reason, results of the interviews are attributed to the community as a whole, rather than to individual respondents.

Following the interviews, additional archival information was obtained and reviewed. Archival data was collected and analyzed between June and September 2000. This data included team meeting minutes, education and outreach materials developed by the community programs, media clippings and other pertinent documents that were available from the communities' files, including zoning ordinances and groundwater resolutions adopted by the local units of government. Correspondence between the community and the MDEQ staff was also reviewed.

Chapter 4

RESULTS AND DISCUSSION

The study information that was collected during the interview process, through a review of archival documentation and from discussions with MDEQ staff is summarized below. The results have been organized to follow the criteria for successful programs that were developed early in the research process and that are outlined in Chapter 3. The components include: background and history of the local program; makeup and evolution of the local team; local government support and involvement; WHP management approaches; education and outreach activities; and program summary.

City of Coldwater

Background and history of local program

The Coldwater WHP program received approval in October 1994, and is considered to be exemplary by the MDEQ. The program was initiated by the Coldwater Board of Public Utilities (CBPU), which recognized the clear stake that it had in protecting the municipal water supply. According to the WHP project leader, the Director of the utility at that time heavily promoted the development of the WHP program, citing the estimated replacement cost for a new production center should the water supply be compromised (approximately $500,000), and the fact that Coldwater has traditionally been a leader in environmental issues.

No serious contamination of the water supply had occurred prior to the initiation of the program. The Coldwater WHP program has been and continues to be funded solely by the utility through user fees.

Makeup and evolution of the local team

The CBPU is the lead agency for the Coldwater WHP program, and continues to be responsible for its long-term maintenance. No formal WHP committee was in place when the planning process began. Rather, the CBPU staff provided leadership and worked with an engineering consultant who was hired to write the program plan.

The WHP plan that was approved by the MDEQ called for a committee to be formed at a later date. The plan states:

> "It is assumed that the committee will be chaired by the CBPU president, with active members consisting of the CBPU water/sewer superintendent, a representative(s) of the City Council, and a representative(s) of Coldwater Township."

An official WHP team was formed in 1996, when the CBPU made the decision to participate in the Groundwater Guardian Program. A national program administered by the Groundwater Foundation in Lincoln, Nebraska, Groundwater Guardian recognizes communities for continued groundwater protection activities, and requires the formation of a local team.

In response to the Groundwater Guardian requirement, the WHP program leader contacted individuals who he knew were interested in environmental

issues and invited them to participate as committee members. The group included representatives from the city, business, agriculture, education, adjoining township and a local citizen.

The project leader requested that other team members not be contacted for this study. He acknowledges that the committee members do not have designated roles and responsibilities, and that they are in place primarily for program support if needed. The committee has not met since 1996.

Local government support and involvement

Several local units of government publicly stated their support for the WHP program. In October 1995 the City of Coldwater adopted a WHP Policy Statement. In November of that year, Coldwater Township adopted a Groundwater Protection Policy Statement, followed several months later by the adoption in Quincy Township of its own Groundwater Protection Policy Statement. These resolutions acknowledge the importance of groundwater to the community and the need to protect the resource.

According to Coldwater's WHP plan, it is the responsibility of the CBPU to initiate contacts with state and other local agencies in order to foster intergovernmental coordination in support of the program. Because the WHPA extends beyond the political boundaries of the city, the plan acknowledged that cooperation among the utility, the city and Coldwater Township would be critical to the success of the program. The plan called for the CBPU to send letters to each of the local governmental units annually, and to schedule a yearly meeting with them to discuss the WHP plan. Instead, each year the project manager

visits with the township and county commissioners to review the WHP program status.

In the submitted plan, local government entities were given responsibilities for the WHP program. These included the following:

- The CBPU was to maintain the program, provide public education and awareness opportunities, update the contaminant source inventory, promote management practices, site new wells as needed and continue the used oil collection program that was developed by the utility in 1985.
- The Branch County Health Department was determined to be responsible for enforcing septic system and groundwater protection regulations in the WHPA. The county Extension office was to provide educational and environmental training opportunities, and the county building inspector was to report conditions that could threaten the aquifer.
- Coldwater Township was to be responsible for inspecting new and existing buildings, upholding site plan review standards and land use restrictions and educating township citizens about groundwater and WHP.
- The City of Coldwater was to inspect new and existing buildings, uphold site plan review standards and land use restrictions, ensure that WHP principles that were incorporated into the Master Plan were implemented and educate citizens.

Although the local units of government are aware of the city's WHP program, representatives have not served on the WHP team.

WHP management approaches

The Coldwater WHPA covers a relatively small area in neighboring Coldwater Township. The existing land use is primarily agriculture, with a low potential for non-agricultural growth in the WHPA. The CBPU stated in its WHP plan that the best choice of management tools would be to create specific zoning ordinances and amendments to the site plan review process. However, while Coldwater Township does have zoning regulations in place, the county reviews the zoning of the townships. According to the project manager, the county voiced much concern about adopting land use regulations. If restrictions were put into place, the county would not endorse the program. As a result, land use controls outside the city limits have been minimal.

The goal of the WHP plan was to initially submit and implement a basic plan to establish the fundamentals of the program and evolve to a more complex set of strategies. Initial management strategies included:

- Continue the CBPU residential waste oil collection program, which was started by the utility in 1985. The program collects used oil, antifreeze and oil filters on a regular basis.
- Continue the CBPU wastewater treatment plant industrial surveillance program. The goal of this program is to protect the wastewater plant.

- Put into place zoning ordinance standards and site plan review for groundwater protection, followed by a Master Plan update that addresses WHP concepts.
- Include the delineated WHPA on all maps prepared by the city, township and county
- Install city and county WHP road signage

At the onset of the program development process, the CBPU developed a set of standards for groundwater protection, and adopted a WHP policy statement. The WHP program was to be integrated into the city Master Plan. This has not yet occurred. However, the city does have environmental guidelines for zoning in place, and utilizes the environmental permits checklist for new development.

The city also has a site plan review process in place to regulate new land uses. The process addresses hazardous materials storage and containment. Site plans are required for all land uses except single and two-family units on individual lots, residential and agricultural accessory buildings. Provisions include:

- Sites with hazardous substances shall be designed to prevent spills and discharges
- Secondary containment shall be provided for above ground storage of hazardous substances
- General purpose floor drains will be approved only if connected to a public sewer or holding tanks or regulated by a state discharge permit

- State and federal requirements for storage and disposal of hazardous substances shall be met

The city currently has a FFRTK program in place, but inspections that are conducted for this program have not been linked to the WHP program. The CBPU conducts inspections of industries, including searching for floor drains and secondary containment.

In 1997, the CBPU received a grant from the EPA to decommission 50 abandoned wells located throughout the WHPA and surrounding area. The utility has also continued its Utility Pollution Recycling and Reduction Initiative to recycle oil, antifreeze, and paper. During the 2000 program year 750 gallons of antifreeze, 3500 gallons of oil, 500 oil filters, and 3000 pounds of paper were collected. In addition, the CBPU developed a recycling program for fluorescent and mercury bulbs to reduce the threat of potential PCB and mercury contamination.

Education and outreach activities

The Coldwater WHP plan acknowledges that public participation and education is the most critical element of the program. Individual meetings with representatives from the city, county and township as well as to service clubs have focused on the importance of the program. Other outreach activities have included:

- A copy of the WHP plan was placed in the county library, and bill stuffers were sent to all customers with information about environmental protection and the proper use and disposal of chemicals.
- A video that describes the abandoned well closure process was developed and aired on the local public access cable channel in 1997. Although the overall WHP program has not been covered in the media, the media was contacted for the abandoned wells program (newspapers, radio station and public access cable channel).
- As part of the Groundwater Guardian program activities, the CBPU has worked with a local school to promote Water Awareness Week activities during the month of May.
- Most recently, signs that acknowledge the city's Groundwater Guardian status has been erected on the outskirts of town, and WHP signs have been installed along the perimeter of the WHPA.

Program summary

The Coldwater WHP plan has not been updated since its approval. Since there has been no major growth in the WHPA, the CBPU has not felt the need to review or consider changes to the plan. Overall, they feel that the program has been a success because it has created awareness about groundwater among the local governing bodies. The utility has heard positive comments from elected officials about the proactive approach that it has taken to ensure the safety of the water supply.

The program has instituted a number of positive projects to safeguard the community water supply. It is also actively involved in groundwater protection activities, even though the WHP effort began years ago. However, it is clearly a program of the public utility, and the active participation of neighboring jurisdictions and stakeholders has been minimal. Resistance to land use controls on the part of the county has made it difficult to implement strong regulatory management options.

Continued recognition of the community's groundwater protection efforts has been realized through involvement in the Groundwater Guardian program. The utility wishes to remain involved with the program, but has expressed concern that they have completed everything that can be done and are running out of project ideas.

Village of Milford

Background and history of local program

Milford realized the vulnerability of its water supply when contamination of its wells was discovered in 1989. Trace levels of TCE and DCE were found, although they were below the health standards. Two years later, trace amounts of MTBE were found. The contamination was subsequently traced to a nearby industry when contaminants were discovered in monitoring wells located a half-mile north of the village wells.

The village began the WHP planning process in the winter of 1992, when it was asked to serve as a WHP demonstration project for the Huron River Watershed Council (HRWC). The HRWC, with funding from the W.K. Kellogg

Foundation was providing facilitation support to three WHP communities. Prior to beginning the WHP process, no groundwater activities had been undertaken in the village.

One team member stressed the role that a Michigan Rural Water Association (MRWA) representative played in convincing the village to begin the WHP planning process. The MRWA is an organization that provides support to water supplies serving less than 10,000 residents. Promoting and facilitating WHP is a major thrust of the state association.

By 1996 the committee had completed all elements of the WHP program except for the WHPA delineation. The delineation was approved in December 1999, and final program approval was obtained from the MDEQ in April 2000.

Makeup and evolution of the local team

Milford's initial WHP planning committee included a diverse group of between twelve and fifteen individuals who attended regular meetings that were chaired by the HRWC.

The WHP program has rotated team members through different phases of the plan development and implementation process. The committee is currently made up of the Village Manager and Treasurer, Director of the Department of Public Services, a township resident, a staff member from the HRWC, a village resident, and representatives from the fire department, adjoining townships and the industry that has been implicated in the contamination of the municipal wells.

At the end of the HRWC grant period, the village successfully transitioned the leadership for the program to its staff members. The group is currently led

by the village manager. Although the HRWC is no longer in a facilitative role, staff members remain active team members.

Local government support and involvement

The village WHPA extends into parts of neighboring Highland and Milford Townships. Both of these adjoining townships serve on the WHP team and have officially signed on as cooperating municipalities. The offices of the Village of Milford and Milford Township are co-located within the same building, which has facilitated the communications process between the two entities. WHP management strategies have been adopted by Milford Township, and Highland Township is currently working on the development of its own WHP program.

In 1992 the Village of Milford adopted a WHP resolution. A village staff member provides leadership for the WHP team, and the WHP team keeps the village council apprised of their progress by forwarding copies of the team's meeting minutes.

The County Board of Commissioners has been made aware of the village's WHP activities. In addition, the Oakland County Health Department is active in a number of groundwater protection related programs that help to support the WHP program goals.

WHP management approaches

In 1995 village-wide zoning for groundwater protection was adopted. It is accomplished through a hazardous substances overlay zone. A groundwater protection ordinance for site plan review is also in place. Since a number of households within the village limits utilize private wells for their drinking water,

the site plan review ordinance covers the entire village rather than just the delineated WHPA. Milford Township has enacted similar site plan review provisions.

The zoning ordinance for the village follows the site plan review standards for groundwater protection. Components include protection requirements for sites which use or store hazardous substances, secondary containment for above ground areas and general purpose floor drain restrictions. An environmental attorney for a local business reviewed the language of the zoning ordinance prior to its adoption and suggested changes that helped to strengthen the ordinance and make it fair and legally defensible.

The environmental permits checklist is utilized within the village, and the use of the hazardous substances reporting form for site plan review is also required for businesses.

The Milford Township Volunteer Fire Department services both the village and township. Groundwater protection and WHP goals have been incorporated into the FFRTK requirements. Inspections are conducted in the village and township as part of the program. The FFRTK program is funded through fees paid by businesses located within the village and township.

The village recently collaborated with the Michigan Groundwater Stewardship Program (MGSP) to obtain funds for decommissioning abandoned wells. The WHP team plans to identify and plug wells that exist within the WHPA, with the costs paid jointly by the MGSP and the village.

In 1993, the village hosted its first household hazardous waste collection day. The annual event is co-sponsored by the village and township. Curbside recycling is also available in both the village and the township.

Education and outreach activities

The primary target audiences for the Milford WHP program's education and outreach campaign are children, the business community and the general population. The village has partnered with the HRWC, MSU Extension, the MGSP and a local church to expand the impact of its education programs.

Early in the program, a survey of village residents was conducted to assess the knowledge level and beliefs of local residents. The survey results were used to design the educational program strategy. Likewise, a survey of area businesses was completed. Those results were shared with the local fire department, and the results drawn upon to design the outreach activities aimed at local businesses.

The WHP program, with assistance from the HRWC, developed a small business guide to pollution prevention. This was distributed to businesses within the village limits along with a letter from the WHP team offering a voluntary waste assessment of their business.

Additional education and outreach materials and activities that have been developed and implemented include:

- An introductory WHP program brochure was distributed to all village residents.
- A WHP display, created by the HRWC, is housed in the township library the month prior to the annual household hazardous waste collection day. During the remainder of the year it is placed in the foyer of the village and township office building.
- A "Welcome to Milford" educational packet is mailed to new village residents. It includes information about the water supply and water conservation and a calendar of events.
- A village calendar is produced annually that includes dates of meetings, the household hazardous waste collection day and annual river cleanup day. Each monthly sheet also includes general environmental and community information.
- Tip cards covering lawn care, storm drains, household hazardous waste and water conservation have been jointly developed with other jurisdictions. They have been mailed on a quarterly basis to village residents.
- Tours of the village services and offices are offered to schoolchildren throughout the year.
- Placemats featuring water facts and games are periodically distributed to area restaurants.
- The village distributes water related coloring books to children who visit the office on Halloween.

- The water supply's consumer confidence report includes WHP information. Copies are made available at the library and the village office.

The WHP team has developed an ongoing education and outreach calendar. It includes a monthly schedule for implementing the outreach activities described above. By using this calendar, the village is able to provide continual outreach and education activities to the community throughout the year.
The HRWC provided the village with a collection of various outreach materials such as fact sheets and brochures. The village has copied and distributed some of these materials and utilized others as prototypes for developing their own materials. The materials have been sent to residents in tax bills and given to customers visiting the village offices.

As part of a 319 nonpoint source watershed project, the HRWC developed a series of public service advertisements dealing with lawn care, water conservation and household hazardous waste. These were printed in the local newspaper.

Relationships with the media have not been aggressively pursued by the WHP team, due to concerns with accuracy of the local media outlets. However, the local WHP effort has been periodically publicized in the community newspaper.

Milford received a WHP grant from the MDEQ to support its outreach and education efforts. The team is currently working on obtaining and installing WHP

signs around the perimeter of the WHPA and attempting to identify abandoned wells that are located within the WHPA through letters sent to village residents.

Program summary

The Milford WHP program has received a good deal of facilitation support from the HRWC, and acknowledges the importance of their assistance in establishing the program. Several team members have emphasized the importance of the initial organizational support that was provided by the HRWC. The logistical duties that they performed, including meeting organization and planning as well as ensuring follow up of action items, were extremely important in keeping the team on task.

The team feels positive about the leadership that is currently being exhibited by the village staff members. Funding has been allocated in the village water operations budget to support WHP strategies in the future.

Team members would like to encourage additional volunteers to become involved with the program, and recognize that they will need to actively seek this participation and identify specific tasks for the new members. The program has successfully developed joint programs with several organizations and has garnered external funding to implement some of its activities.

Village of Oxford

Background and history of local program

Oxford was one of the first Michigan communities to begin the WHP planning process, and the first to receive program approval, which was issued by

the MDEQ in 1994. Although the program was considered a successful demonstration project, concerns about the program have been expressed by MDEQ staff, primarily due to a high rate of turnover among village staff.

The village was approached by the MDEQ and asked to serve as a state pilot and demonstration project in 1990. Although there were no serious water quality problems in the village, two years prior to the start of the WHP planning process Oxford was selected as the site for a county solid waste landfill. Village officials argued that since groundwater was the only viable source of water in the area it was not an appropriate location for this land use. The landfill was not sited, and the process helped to raise awareness of the groundwater resource among village residents.

In addition, the largest gravel mining operation in Michigan is located in the village, and much mining occurred throughout the area historically. There was heightened concern about storm drains in the late 1970s due to the development of abandoned gravel pit lakes.

Makeup and evolution of the local team

An interagency workgroup was formed late in 1990 to develop the program. Consisting of representatives from the Michigan Department of Natural Resources, Michigan Department of Public Health, Oakland County Health Department, Clinton River Watershed Council, Village of Oxford, Oxford Emergency Safety Authority and Oxford Township, the workgroup met quarterly for the first two years of the project.

Oxford received facilitation support from the Clinton River Watershed Council (CRWC), which was funded by a grant from EPA Region 5 to provide leadership for the WHP effort and demonstrate ongoing WHP planning and implementation. The village also benefited from technical assistance provided by the Michigan Department of Natural Resources and Michigan Department of Public Health.

CRWC staff members planned and coordinated initial work group meetings. The assistant village manager chaired the meetings. Due to high turnover of village management, for the past two years the water plant superintendent has provided leadership to the team. This individual has been a member of the team since the beginning of the WHP planning process, and has provided stability to the team as well as a historical perspective of the program's evolution.

Team membership has evolved over the course of the program development process. The new team members were identified to provide for a broad representation of community interests. Currently the team includes the Oxford Village manager and fire chief, representatives from a gravel mining company, MSU Extension and CRWC, the assistant superintendent of Oxford Schools, and a resident of the village. The group meets monthly, and the public is invited to attend the meetings.

Local government support and involvement

The village council has actively promoted the WHP program, and provides base funding for program activities. Since ninety percent of the WHPA is located

outside of the village limits, in portions of Oxford and Addison Townships, inter-jurisdictional cooperation is imperative.

County commissioners are aware of the WHP program, but have not promoted it publicly. The Oakland County Health Department maintains strong groundwater protection programs that support the WHP program goals, including well and septic permit programs, maintenance of a groundwater database and abandoned well demolition permits. Due to an active site of environmental contamination on the outskirts of town, there are ongoing monitoring efforts of some private wells.

While communications are maintained about projects, Oxford Village and Oxford Township are separate municipalities with separate boards, planning commissions and administrative staff. Oxford Township officially recognized the village's WHP goals. They are currently working on developing their own WHP program. According to one team member, Addison Township is riddled with political difficulties and has not been involved in the WHP process.

Management strategies

Site plan review requirements for groundwater protection are in place in both Oxford Village and Oxford Township. Zoning ordinances were modified for this purpose. The zoning ordinances were amended prior to the approval of the WHP program, even though the WHPA had not yet been delineated.

In 1991, the village amended its zoning ordinance to incorporate groundwater protection standards for new industrial and commercial developments. It also included provisions for hazardous substance containment

and storage and added the word groundwater to the "purposes" section. The hazardous substances reporting form and the environmental permits checklist were also adopted by the village for use in the site plan review process.

Oxford Township zoning ordinance standards were modified to include a section dealing with hazardous substances by adding provisions for groundwater protection standards and aboveground storage. The township also utilizes the environmental permits checklist form.

WHP has been incorporated into the village's Master Plan. Oxford Township's land use plan, updated in 1988, states that the township will favor land uses that do not pollute air, soils or water. The plan does not specifically include a WHP component, however.

The Oxford Fire Department, which has jurisdiction in both the township and village, conducts hazardous materials surveys and inspections. FFRTK inspections have been liked to the WHP program.

In the original WHP plan, it was suggested that the village and township consider amending their ordinances to include the goal of waste reduction – this has not yet occurred.

Early in the WHP process, the CRWC conducted a lawn chemical use survey in a village subdivision. On-site visits were also made to publicly owned vehicle maintenance garages to assess their management activities and potential for groundwater contamination.

The WHP team plans to present the recently updated environmental permits checklist to the village council for its adoption. The team would also like to see more specific language in the zoning ordinances pertaining to WHP.

A golf course has been sited for the area, and team members are considering collaborating with the Michigan Turfgrass Environmental Stewardship Program to promote best management practices for the course.

The team is currently exploring the development of a program for businesses, which would include charging a small fee to co-develop best management practices and assist them in identifying changes that they can make to save money while also protecting the environment. Team members are currently discussing the concept with other states that have implemented similar programs.

Education and outreach activities

The village's outreach program targets homeowners, businesses, village and township officials and students. A number of activities have been conducted.

Oxford Township recently collaborated with a local landfill on a hazardous waste collection day, which included the collection of pesticides and herbicides. The village has curbside recycling in place.

A WHP program web site has been developed and is maintained by the village clerk. The annual consumer confidence report is used to discuss WHP, and is distributed to the local newspaper, restaurants, apartment buildings, area businesses and via the web site.

A four part video series on WHP was developed and sent to community organizations. Groundwater public service announcements have aired on the public access cable channel. Promotional materials have been developed to highlight the program, including an informational brochure, WHP magnets and doorknob signs. Groundwater flow models were donated to four elementary schools. An abandoned well search was conducted with assistance from the county health department. Other outreach activities have included:

- Storm drain stenciling
- Press releases and media information package
- Library display
- Teacher training in local schools
- Presentations to civic groups
- Groundwater protection articles in the local newspaper

Collaboration with other organizations has allowed the village to increase the number of outreach activities that it implements. For example, MSU Extension has provided training programs on groundwater protection, Lake-a-Syst (for riparian homeowners) and Home-a-Syst (for homeowners), septic system management and household hazardous waste.

The superintendent of schools provides staff time for an information coordinator who helps to compile and send informational packets. Working through the CRWC, the program is developing an environmental curriculum for area schools. CRWC staff members have also provided support for Earth Day

programs in the schools. Early in the WHP planning process, a brochure packet developed by the CRWC was distributed to local businesses.

Participation in the Groundwater Guardian program has provided recognition for the WHP program efforts, with the added benefit of garnering additional media attention to announce the annual designation of the village as a Groundwater Guardian Community.

Program summary

Overall, the WHP team feels that Oxford's WHP program has been successful, since residents are recycling, are aware of their drinking water source and how to protect. In addition, they have confidence in the water supply.

The team would like to see more specific WHP goals incorporated into the Master Plan and ordinances, as well as more enforcement of the ordinances and site plan review process. They would also like to foster a better working relationship with the township.

Team members acknowledge that the time commitment for planning and organizing meetings is substantial, and that in the early years the team greatly benefited from the CRWC leadership. They were instrumental to the initial success of the program, and kept the group together.

The project leader would like to encourage more citizen involvement with the team. He stresses that the team members don't necessarily need technical expertise, but rather a genuine concern for and interest in the water supply.

The evolution of the WHP team has been a success for the program. Despite high staff turnover and the need to transition from a group that was

facilitated by an external organization, the team remains diverse and active. The participation of external partners such as MSU Extension and the CRWC has been important to the success of the program. By sharing their expertise, they have helped to expand the impact of the educational programs offered as part of the WHP program.

City of Portland

Background and history of local program

In its 1993 revisions to its master plan, the City of Portland highlighted the desire to protect its groundwater and surface water resources. Contamination of one of the city's wells had been discovered prior to that time, which raised awareness of the vulnerability of the water supply.

While the city was interested in developing a WHP program, the startup was delayed until grant funding became available from the MDEQ. The city received funding during the first round of grant distribution. Portland's WHP team was formed in early 1999, and program approval was received from the MDEQ in June 2000.

Makeup and evolution of the local team

Portland's WHP team members were identified by the former city manager, and were asked to serve on the team for a one-year period. The team officially includes the municipal water supply superintendent, city manager, planning department representative from Portland Township, and representatives

from the city fire department, industry, education, agriculture and the general public.

The team has made the commitment to meet once per year. However, not all team members have attended the initial planning meetings, and a number of team members declined to be interviewed for this study.

Although the city manager is responsible for providing leadership to the program and for coordinating the program's outreach and education activities, the position was recently vacated. The new city manager has not yet become fully familiarized with the status of the program. As a result, the consulting engineer who was hired to facilitate the program development process is serving in a quasi-leadership position. MDEQ staff members have expressed some concern that team commitment to the program may be inadequate.

Local government support and involvement

The City of Portland adopted a WHP resolution that highlighted its desire to implement a local program. The Ionia County Board of Commissioners chairperson was informed of the Portland WHP via a telephone call, and a copy of the WHP plan was distributed to the county health department.

The Portland WHPA extends into the townships of Portland, Sedewa and Orange. Those local governments were provided with a copy of the WHP plan. A representative from Portland Township was asked to participate as a WHP team member, and the supervisor of Portland Township has been provided with team meeting minutes.

WHP Management approaches

The city's master plan was revised in 1993 to include a groundwater and surface water protection component. The WHP team hopes that future master plan updates will include specific WHP goals.

The city's zoning ordinance includes hazardous substance provisions for protecting surface and groundwater. In May 2000 the City Council approved the use of an overlay zoning ordinance for WHP. An industry representative reviewed the ordinance and offered edits prior to its adoption.

The City Council also approved the use of the environmental permits checklist. The WHP program has not been incorporated into the FFRTK program. However, a fire department representative serves on the WHP team. The WHP team is currently designing an abandoned well program to identify wells that will be targeted for decommissioning.

Because Ionia County is not zoned, challenges exist for inter-jurisdictional cooperation for WHP. However, discussions are occurring among a number of local government offices about trying to institute zoning at the county level. Neighboring jurisdictions have not yet adopted WHP ordinances.

During the WHP planning process, the team identified a number of management options that were deemed too difficult to complete. Perceived difficulties included options that they felt were too complex or expensive to administer or too difficult to implement due to the coordination of activities that would be required between communities, given the differences in land use regulations and zoning administration. The primary focus for the time being is on

land use controls within the city, identifying and decommissioning abandoned wells and implementing the outreach and education program.

Education and outreach activities

A WHP informational brochure was distributed to all city residents. In addition, a general WHP brochure was developed and is available in city offices. In the future it will be distributed to both city and township residents who are located in the WHPA. A mailing list of property owners is currently being compiled for this purpose.

Portland's WHP program includes plans to place various WHP related articles in the local newspaper, but none have been published to date. The annual consumer confidence report will also be used to highlight the city's WHP efforts.

Copies of the WHP program have been delivered to Portland, Orange and Sedewa Townships. A copy of the WHP program was also delivered to the county health department, along with a request that health department personnel consider the WHPA in future permitting decisions.

Groundwater flow models and several groundwater-related videos have been distributed to area schools. Other outreach activities that are planned for the future include erecting road signs along the perimeter of the WHPA, designing an educational program for small businesses that highlights best management practices for water resources protection, and purchasing and distributing WHP placemats for distribution to area restaurants.

Program summary

The Portland WHP program is still early on in the implementation process. The team has worked through the program development phase in a relatively short time period. Team members feel that with the adoption of the ordinance, the city now has a tool for protecting groundwater. New staff members will need to orient themselves and make a commitment to the goals of the program if the program is to succeed into the future.

While the city has adopted a number of proactive management approaches to further the goals of the WHP program, the lack of zoning outside the city limits and the lack of inter-jurisdictional cooperation among the different local units of government create challenges for the Portland WHP program. Team members acknowledge that the program's overall success will depend on future outreach and education efforts and the ability to work with neighboring jurisdictions.

Discussion

Possible problems with study results

Because of the small size of the study pool and the inherent differences among community traits and situations, it may be difficult to generalize the results of this study to the larger population of communities involved in the WHP planning and implementation process. However, it is hoped that suggestions and ideas can be drawn from the experiences of the four communities in this study

that will help to strengthen the Michigan WHP program at both the local and state levels.

Although an attempt was made to conduct the interviews uniformly, respondent answers may have been affected due to the fact that the researcher has been involved professionally with the statewide WHP program and knows several of the study respondents. In addition, while most of the respondents were very candid in the interviews, individuals who are or were funded to facilitate a WHP program may have been reluctant to discuss negative aspects of the local program. Further, some conflicting information, such as disagreements about particular aspects of program implementation, surfaced when talking to WHP team members. In these cases, attempts were made to corroborate the conflicting information with additional team members and with MDEQ staff members.

Several of the communities have experienced staff turnover since the beginning of the WHP planning process. To ensure that the historical perspective of the planning process was considered, former team members were contacted if available. In addition, program files, including community WHP plans and past correspondence, were reviewed. However, the possibility exists that a complete picture of the program planning process may not have been obtained.

Study results and addressing the research questions

The primary objective of this study was to examine the adoption and implementation process of WHP programs within the four selected communities

in order to assess the characteristics of the local programs and determine the extent to which the perception of MDEQ and other expert staff matches the actuality of the success of the community WHP program.

A second objective was to specifically explore the factors within each community that are believed to most often contribute to the success or failure of community WHP programs, in order to identify factors that may stall a community's WHP implementation efforts. The research questions that addressed this objective include:

Question 1: Are communities that have developed a WHP program with the assistance of an outside facilitator less likely to implement successful programs than those that implemented the program without external assistance?

Question 2: Will communities that under-perform in outreach efforts have less successful programs in place than communities with aggressive outreach campaigns?

Question 3: Will communities that have received program approval within the past year have more successful programs in place than those that have had their programs in place for a longer time period?

These objectives and research questions have been applied to the study results, and are addressed below.

Community adoption process

Based on the interview results, it appears that the impetus for beginning a WHP program varies widely among communities depending on local situations. Early adopters, such as Coldwater, may recognize the inherent benefits that result from implementing a pollution prevention program, and seek out information of their own accord. Others, like Oxford and Milford, can benefit from facilitator support and encouragement to begin a local program. Portland was encouraged to begin the process at the urging of a local opinion leader.

In Oxford's case, serving as a pilot project and being able to access federal funds and state technical assistance helped tremendously in launching the program. Milford benefited from the support of the HRWC, which received financial support from the W.K. Kellogg Foundation to assist local WHP programs. The MRWA played a change agent role in encouraging the community to commit to the development of the WHP. Other communities such as Portland may recognize the benefits of beginning a WHP program, but choose to wait for incentives such as financial support before initiating their local program.

MDEQ perception of program success

Based on the criteria for successful WHP programs that were outlined in chapter three, it would appear that the most successful programs from this study pool are the Villages of Oxford and Milford. This conclusion is based primarily on the broad range of management options that have been put into place, the diversity and active involvement of team members, the broad array of ongoing

educational activities and local government support and commitment to the WHP effort. It should be noted, however, that the City of Portland is still in the early phases of its program, and many activities have not yet gotten underway.

These results suggest that MDEQ staff may not be fully aware of the status of the local programs once final approval of the community WHP plan has been issued.

Local program implementation considerations

It is important to note that there are some management strategies that may not be options within certain communities, however. For example, Ionia County is currently not zoned, which severely limited the strategies that could be considered by the City of Portland to protect the WHPA outside the city limits. Likewise, Branch County's vociferous concerns over land use restrictions limited the options that could be considered by the City of Coldwater. Although none exist in this study pool, some communities are unable to fund an active FFRTK program, which would render that management option unavailable in those communities.

Compliance with the regulatory management strategies must also be considered when evaluating local WHP programs. For example, in Oxford, although the presence of WHP standards in the zoning ordinances of the township and village provide the legal basis for reviewing new developments, according to some team members, the provisions are too generic and lack the power to effectively curtail undesirable land uses.

The active efforts of a diverse team are critical to the success of local WHP programs. Several respondents expressed concern over potential team member burnout. The willingness of a community to encourage the evolution of the team and to rotate leadership periodically may be the key to program success over time.

The Coldwater WHP team members have expressed some concern that they feel their program is complete because they have implemented all of the projects that they initially planned. While they would like to continue putting new programs into place, they are finding it difficult to identify new projects. This perspective may be the result of a non-functioning team and leadership burnout. By establishing an active team with diverse backgrounds and expertise, the program might experience a welcome rejuvenation.

WHP program facilitation

Research question 1 asks whether communities that have developed a WHP program with the assistance of an outside facilitator are less likely to implement successful programs than those that implemented the program without external assistance.

The study communities included those with very little facilitator support (Coldwater), those with support that transitioned to a community-led effort (Oxford and Milford), and those that are being facilitated primarily by an external consultant (Portland). Oxford and Milford expressed the belief that the facilitation provided by the watershed councils in their respective communities proved invaluable to the success of the program. Based on the WHP criteria that these

communities meet, they appear to have the most successful programs in place of the communities in this study pool.

These observations suggest that a facilitator who plays a supporting role can be very beneficial to community programs, as long as overall leadership stands with the municipality or as long as a plan is in place for transition to that local leadership early in the WHP planning process. In other words, strong community leadership with the assistance of an external facilitator can be a winning combination for local WHP programs.

Based on the study results, the answer to Question 1 is no. Communities who develop their local programs with the assistance of a facilitator may indeed realize successful implementation of their program.

WHP education and outreach activities

Research question 2 asks whether communities that under-perform in outreach efforts will have less successful programs in place than communities with aggressive outreach campaigns.

The most successful programs in this study do have a wide variety of ongoing outreach and education programs in place, and have established partnerships with external organizations to assist in the outreach effort. By tapping into a broad range of expertise and diversifying the funding sources, more complete and long-term outreach programs can be implemented.

For example, the Village of Milford's educational strategy initially relied on assistance from the HRWC. Village staff then built a resource base of outreach materials that they used to develop an ongoing educational program that is

organized by month. Collaboration with a regional 319 watershed program and the Michigan Groundwater Stewardship Program has resulted in an expanded community effort with increased impact and more diverse program accomplishments. Similarly, Oxford's relationships with MSU Extension, the Michigan Groundwater Stewardship Program, the CRWC and the local school district have allowed the village to provide a broad range of programs and materials at minimal cost to the village. While both Coldwater and Portland are currently implementing some outreach activities, they have not established similar types of partnerships for their efforts, and have lower numbers of activities currently in place. Based on this information, the answer to Question 2 is yes. Communities that are under-performing in outreach efforts are more likely to have less successful programs in place.

WHP approval date

Research question 3 asks whether communities that have received program approval within the past year will have more successful programs in place than those that have had their programs in place for a longer period of time.

The length of time that the community WHP program has been underway appears to have less to do with program success than the establishment of a strong and diverse team that includes local government support. While the City of Portland has been involved in the WHP process for a relatively short time period, the program has experienced a somewhat sluggish start. This might be attributed to a number of factors, including staff turnover and difficulties

in establishing inter-jurisdictional cooperation due to the local political climate. In contrast, although Oxford's program was one of the first to be initiated, the team continues to meet regularly and plan and implement programs. Coldwater, however, has experienced frustration in keeping its program actively moving forward – which may in part be the result of the long period of time that the program has been in existence.

Many factors may influence the intensity with which a community approaches its WHP implementation process and, based on this study, the length of time that the community has been involved in the WHP process, may play a role. However, the results are conflicting among the study communities. For this reason, Question 3 cannot be definitively answered. Further research will be required to make any conclusive statements regarding this research question.

Chapter 5

CONCLUSIONS AND RECOMMENDATIONS

The development of the Michigan WHP program has provided a structured process whereby communities can actively take steps to protect their local drinking water supplies. While the voluntary, proactive nature of the program provides the opportunity to develop positive, long-term groundwater protection efforts, many communities have not yet made the decision to begin a local program, and many of the communities that have been working on the development of a program have not successfully institutionalized them.

In order to meet its self-imposed goal of having 500 approved WHP plans in place by 2003, the MDEQ should seriously consider how the program is being diffused statewide and examine the process that communities are using when they decide whether or not to adopt the program. In addition, while more than 200 communities have adopted the concept of WHP and are in the process of developing a local program, less than 30 communities currently have approved programs in place. The MDEQ would be well served to examine factors that may be impeding the progress of community WHP programs and institute steps to address these barriers.

The results of this study may assist the agency as it considers these issues. A summary of the conclusions from this study and suggestions for agency consideration are offered below.

Summary of study conclusions

This study has confirmed that communities that most closely meet the criteria for successful local programs are indeed more likely to have successful WHP programs in place. Specifically, successful community WHP programs exhibit the following characteristics:

Diverse, active and evolving WHP teams

Successful communities draw from a broad range of expertise and backgrounds when forming the local WHP team. A combination of individuals with technical expertise and enthusiasm for meeting the goals of the program may result in the most effective team. As one respondent in this study stated "It's not the technological knowledge that's important, but rather an interest and commitment to the goals of the program." An energized community citizen can serve to keep the team moving forward and accomplishing program goals.

Team members in successful communities understand the value of their input to the team and have been assigned specific roles and responsibilities that will help to meet the program's objectives.

Successful programs are also flexible enough to accept the inevitability of the evolution of the team over time. Team members may change over the course of the WHP program planning and implementation process, depending on current program goals and levels of expertise. In one of the study communities, members rotated on and off throughout the entire planning process – a factor that core team members believed helped to ensure success.

External facilitators who play a supporting rather than a leadership role

External facilitation of the local WHP program can be an important factor in its success, provided that primary leadership for the program remains with the community. Communities in this study emphasized the importance of the role that was played by external facilitators in their programs, including handling meeting logistics, recording the progress of the group and providing follow-up for specific action items. External facilitation, when combined with strong local leadership, can lead to highly successful programs.

Local government support and involvement

Early commitment and involvement of the local governing bodies is a critical component of WHP program success. Communities that actively encourage local government representatives to participate on the WHP team and who keep the local governmental offices apprised of the WHP program activities are more likely to experience program success. In addition, because many WHPAs lie outside the political boundaries of the entity undertaking the WHP planning process, taking the time to nurture relationships with neighboring jurisdictions early in the planning process is important.

Political support for the WHP program from the local governmental bodies can pave the way for additional WHP management options and help to ensure long-term institutionalization of the program. Local governmental representatives who are familiar with the program and its goals are more likely to support land use controls such as overlay zoning, and are more likely to financially support the

program. For example, several communities in this study have obtained ongoing local funding for their WHP efforts from the local governmental body.

Diverse management strategies

Successful WHP communities implement a broad range of regulatory and non-regulatory management options. If, due to local situations such as political constraints, one management strategy is not practical or feasible within the community, then concentrating on other more viable options may be the key to program success.

Ongoing outreach and education activities

Planning for continual outreach and education activities will help to ensure local WHP program success. As one study respondent commented, "Community education is a continual process. You cannot assume that one direct mailing or two training sessions will satisfy the educational needs in your community."

Successful WHP programs design outreach activities that are targeted toward their priority audiences and offered on an ongoing basis. They also work to develop partnerships with other organizations and agencies. These partnerships serve to:

1) Expand their idea base for new and innovative programs;
2) Draw upon additional expertise that may not be available within the core WHP team; and
3) Leverage both financial and human resources in order to maximize the impact of their programs.

Recommendations for enhancing WHP adoption and implementation

The Michigan WHP program can be strengthened by drawing from the diffusion of innovations and organizational implementation literature and applying it to what is known about the characteristics of successful communities. The question to be addressed, then, is:

Given what we know about successful WHP communities, how can the MDEQ encourage the further adoption and help ensure the successful implementation and institutionalization of local WHP programs in Michigan? Suggested answers to this question are presented below.

WHP Program Diffusion

Examining the reasons that a local community chooses to adopt the WHP program can help to determine how to ensure the program's successful diffusion statewide. Dearing and Meyer (1994) and Rogers (1995) identified perceived attributes of an innovation that will likely influence its adoption or rejection. These include:

1) Relative advantage - including cost, status, design and dependability
2) Compatibility - with existing values and beliefs and social structures
3) Trialability - whether the innovation can be tested on a temporary basis
4) Observability - the results of the innovation are visible
5) Complexity - the less complex the innovation, the higher the likelihood of adoption

6) Applicability - the innovation having more than one use

7) Reliability - the degree to which the innovation has consistent results

Based on the results of this study, some of these factors play a larger role than others in determining whether a community will adopt the WHP program. Communities will adopt the program when they can identify a clear relative advantage to initiating the program, either through ensuring the safety of the water supply over time, and thus avoiding remediation expenses, or providing positive recognition to their community by adopting a voluntary, proactive pollution prevention program.

Communities in this study were also more likely to adopt the WHP program if they had been involved historically with environmental initiatives. This suggests that compatibility is also an important issue in the WHP adoption decision process.

Some study respondents expressed concern at the initial stages of the process about the overwhelming nature of the program, which would suggest that perceived complexity of the WHP program also influences the adoption rate.

Recommendations for WHP diffusion messages

The MDEQ should consider the preceding factors when framing outreach messages for communities that are still weighing whether or not to begin a local program. Highlighting the positive aspects of the WHP program (such as community support for the public water supply system and positive press coverage for the local program); stressing the potential long-term cost savings;

and emphasizing the step-by-step nature of the WHP implementation process to diminish its perceived complexity are examples of the types of messages that might be crafted.

Communication channels for diffusion activities

Communication channels that are important in the adoption decision process include opinion leaders, peer networks, and change agents. Becker (1970) offered the following suggestions for increasing adoption rates within organizations, including:

- Ensure that opinion leaders are exposed to sources of information early in the diffusion process
- To the extent possible, decrease the risks associated with adoption and increase the prestige value of the proposed innovation
- Ensure that all members within the communications network learn about the actions of the early adopters.

Communities in this study were persuaded to begin the WHP planning process through the encouragement of individuals within organizations such as regional watershed councils and through local leaders who were clearly committed to environmental initiatives historically. Based on this, suggestions for promoting the program to new communities include:

Providing peer networking opportunities

Peer networking opportunities should be made available to increase the adoption rate of the WHP program. As Dearing (1997) states, social pressure is

an important component in the innovation diffusion process. Many communities are new to groundwater protection issues, and should be offered the opportunity to network with "experienced" communities, who could share their positive experiences with the program. This information sharing could also provide communities with new and innovative ideas for management options, outreach materials development and program implementation.

Apprising change agents and program facilitators of WHP status

Keeping potential change agents and program facilitators apprised of the statewide WHP program status so that they can encourage its adoption across the state is another potential diffusion strategy. Groups such as watershed councils, the American Water Works Association, the Michigan Rural Water Association, former Groundwater Education in Michigan (GEM) grantees, and representatives from MSU Extension and local environmental organizations could all be utilized to promote the program to local communities.

Identifying and programming to local opinion leaders

Although a more time-consuming process, it may be possible for the MDEQ to work with change agents and facilitators who are based within the community to identify opinion leaders and target promotional messages toward those individuals. Change agent success is to a large degree dependent on the ability to work through opinion leaders in a community (Rogers 1995).

Prioritizing the public water supplies according to relative vulnerabilities

Since it is important for many communities to identify a clear relative advantage in adopting a WHP program, a system of prioritization that considers the vulnerability of the water supply might be explored by the MDEQ. Except for targeting some communities to serve as initial pilot and demonstration projects, the MDEQ has not to date attempted to prioritize communities. The agency may be well served to tie the WHP recruitment process into the results from the Source Water Assessment program, which will identify more vulnerable water supply systems throughout the state. Since communities with more vulnerable systems may be more easily convinced of the advantages of adopting a WHP program, the rate of program adoption may increase.

Promoting the WHP grants program

Financial incentives are important to the WHP adoption decision process. The WHP grants program should be more aggressively marketed to encourage new communities to apply for grant funds. Although all of the available funds were allocated in the second round of funding, all approved grant proposals that were submitted were funded at the amount requested, and a number of communities received funding in both the first and second rounds of grant making. This suggests that new communities should be applying for these funds.

Emphasizing non-financial incentives

Other incentives, such as recognition and awards, should also be stressed to encourage a positive adoption decision. Currently, the MDEQ hosts an annual recognition luncheon for approved programs. This type of program can be very

beneficial in helping the community remain committed to the WHP program goals. The Groundwater Guardian Program should be broadly promoted to the communities as a non-financial incentive. The program can serve as a simple and inexpensive method of gaining positive recognition for community groundwater protection efforts.

WHP program implementation

For communities that have already adopted the WHP program and made the commitment to implement it, the MDEQ should consider how it might assist them in realizing program approval and successful institutionalization of their plans.

Addressing WHP barriers

In a study of unsuccessful implementation efforts, Roberts-Gray and Gray (1983) cited reasons that were given for implementation failures, which included:

- Lack of clarity of the program
- Lack of capability to perform the required tasks
- Lack of necessary materials
- Incompatibility of the innovation within the organization
- Lack of user motivation
- Excessive resource demands
- Lack of implementation planning

Communities in this study cited implementation barriers that paralleled those listed above, including the excessive time commitment required for the

WHP planning process, funding concerns, lack of government buy-in, lack of strong local leadership for championing the program, difficulties in encouraging inter-jurisdictional cooperation where WHPAs cross political boundaries, and the challenge of maintaining local programs given the high staff turnover within local government and public water supplies. Suggestions for agency strategies to address these barriers include:

- Provide additional correspondence, either through direct mailings to public water supplies, articles in trade journals or presentations at regional meetings and conferences that reviews the WHP planning process and the steps needed for communities to begin a program.
- Offer regional training sessions that provide a clear outline of the requirements for an approvable WHP program and that encourage communities to tap into available facilitation support
- Broadly distribute available resources. A number of outreach materials, including guidance documents, WHP worksheets, videos and training manuals have been developed by MDEQ and various outreach organizations statewide. A comprehensive, step-by-step workbook for WHP planning has also been developed. Communities have stressed the value of these materials, but have also indicated a need for additional training on their use as well as training opportunities regarding the development and implementation of local WHP plans.
- Promote the WHP grants program and share examples of how communities have leveraged resources to finance their program activities

Recommendations for WHP program implementation support activities

In addition to addressing barriers to WHP program implementation, the characteristics of successful communities should be reviewed in order to develop additional implementation support activities. These include:

Team process - statewide training that focuses on team process skills, including how to select and nurture a local team, defining roles and responsibilities and holding effective meetings should be considered.

Facilitation support - Because WHP grant funding is now available and more communities are hiring outside consultants to facilitate their programs, MDEQ should consider offering training and education programs targeted to the consultant community that stress the need for carefully defining their role and the services that they provide in order to maintain leadership within the community. Examples of successful implementation strategies could also be shared.

Local government support and involvement - written materials or training sessions could be provided to communities that stress the importance of the active support of local governmental entities from the beginning of the WHP planning process. Examples of how communities have garnered this support or have encouraged specific support activities such as the adoption of WHP resolutions should be included.

Management strategies - because local situations vary dramatically, training should be offered on different WHP management techniques that can be instituted, including examples of strategies that have been implemented in successful communities.

Education and outreach - examples of outreach materials and programs that have been developed by various communities should be widely shared in order to jumpstart the outreach efforts in communities that are just beginning the implementation process. This could be accomplished through regional roundtable discussions, an annual, statewide networking conference or by distributing written materials via mail. Examples should include how communities have successfully partnered with other organizations in their education efforts.

Finally, follow-up activities for communities that have received program approval should be considered. Currently, once the MDEQ has approved a local program, no additional interaction is initiated with the community. As O'Keefe and Shepard (1999) emphasize, continuing evaluation of local environmental programs is critical.

Since some local WHP programs tend to become "plans that sit on a shelf," an effort should be made to contact approved WHP communities periodically in order to follow their progress and share new program ideas, summaries of activities from other communities and statewide program updates to maintain the visibility of WHP within the community. Ongoing communiqué between the agency and the communities with approved programs in place may also provide valuable feedback for assisting other communities in implementing successful programs.

By addressing these types of issues within the WHP program, the MDEQ can help to better ensure the successful implementation of community programs.

Recommendations for future research

Because it is statewide, proactive, locally-led, and still in the early stages of adoption and implementation, the Michigan WHP program offers numerous opportunities for future research that may lead to positive change within the program. These are listed below.

- Since the MDEQ is interested in increasing the number of WHP communities, a study that examines non-adopting communities to determine the factors that are influencing their decision to reject the program would be useful.
- A comparison of community characteristics between non-adopting and adopting communities would also provide valuable insight.
- A study that follows several communities over time to document the entire process of initial adoption, implementation and institutionalization of the WHP program could offer additional suggestions for facilitating communities through the various stages of the WHP process.
- A survey of all communities that are currently involved in the process of implementing a WHP program would help to better assess barriers that are being encountered in the implementation process.
- In-depth studies of the individual elements of community WHP programs, such as team building, management strategies and local government support, could lead to valuable suggestions for supporting these program components.

- A larger study comparing recently adopting communities to those that have had program approval for a longer period of time would help to clarify some of the inconclusive results of the present study.
- Finally, a more comprehensive study of all communities that have received program approval would help to refine the conclusions and recommendations that have been developed through this study.

APPENDIX

Michigan Wellhead Protection Program
Community Interview Questions
June 2000

A. Context Elements

1. How long has the team been involved in the WHP planning process?
2. What was the impetus for starting a WHP program within your community?
3. Is the groundwater utilized in your community considered vulnerable to contamination?
4. Were groundwater protection activities underway in your community prior to the development of the WHP program? If so, what?
5. What are the primary land uses within your WHPA?
6. Is there developable land remaining within the WHPA?
7. Is the community zoned? If so, who is responsible for it (i.e., how is it implemented)?

B. WHP Team:

Facilitation:

1. Who leads the WHP effort?
2. How long have they been in this position?
3. Has the program been assisted by an outside facilitator (e.g., MRWA, consultant, GEM group?)
4. If so, how important has this facilitation been to the efforts of the team?
5. Overall, do you think the program leadership has been strong?

Team members:

6. Which of the following are represented on the WHP team?

    - PWSS superintendent
    - Municipality
    - Local health department
    - Fire department
    - Business/industry

- Agriculture
- Education
- Planning authorities
- Environmental groups
- Citizens
- Adjacent municipality

7. What are their designated responsibilities?
8. Have they adequately contributed to the development of the WHP plan? If not why?
9. How did the team develop?
10. Has the team been stable?
11. Is a plan in place to deal with staff turnover?
12. Has any one member played a particularly significant role in the development of the WHP program?

C. Local Government Support:

County Board of Commissioners:

1. Is the Board aware of the WHP program?
2. Have they promoted WHP in any way?
3. Have they been asked to financially support the WHP program? If so, did they comply?

Twp/Village/City Board or Council:

4. Has the board or council promoted WHP?
5. Have they passed a groundwater protection and/or WHP Ordinance?
6. Has the program been incorporated into the Master Plan?
7. Is an active FFRTK program in place? Does the fire marshal or chief survey sites with hazardous materials?
8. Are the FFRTK activities linked with WHP?
9. Does the twp. or city include the FFRTK responsibilities in a groundwater protection ordinance?
10. How are the WHP activities currently funded?
11. What is the plan for funding activities in the future?

Local or Regional Health Department:

12. Which of the following programs are in place within the community?
    - Well and septic permit programs
    - Inspections of environmentally sensitive sites
    - Maintenance of a county groundwater database
    - Abandoned well demolition permits program

Coordination with neighboring jurisdictions:

13. Does the WHPA extend into neighboring jurisdictions?
14. Are the neighboring townships/counties aware of your WHP program?
15. Have representatives participated as members of the WHP team?
16. Have they publicly supported your WHP efforts? (what degree of support?)
17. Has or will the neighboring jurisdiction(s) adopt the WHP ordinance, use the environmental permits checklist, and/or engage in the same management strategies?

D. Management Strategies:

1. Which of the following have you incorporated into the WHP plan?
   - Environmental permits checklist
   - Zoning ordinance provisions for WHP (please describe) and site plan review
   - New building inspections – do you obtain info from FFRTK?
   - Facility inspection or hazardous material survey program
   - Information to businesses about state and county requirements and WHP
   - Information to residents within the WHPA about the program
   - Strategic monitoring within the WHPA (if this monitoring is in place, is it continually updated?)
   - Abandoned well search
   - Hazardous waste collection program/Clean Sweep/Recycling

2. Which of the management strategies above have been successfully implemented so far?
3. Have you encountered any unexpected difficulties?
4. For those that have not yet been implemented, do you foresee any difficulty in doing so?

E. Education and Outreach:

Outreach activities:

1. Who is responsible for the outreach efforts of the WHP program?
2. Who are your primary target audiences for your program's outreach efforts?
3. What programs have you developed and/or implemented to reach these audiences?
4. How successful do you feel these programs have been? Why?

Outreach materials:

5. Have you developed community-specific outreach materials for your WHP program?
6. Have you utilized other, existing groundwater education materials? If so, which ones?
7. How have outreach materials been distributed within your community?

Media coverage:

8. Have you worked to develop relationships with local media representatives?
9. Have the WHP efforts been covered by the media?
10. If so, how extensive has the media coverage been?

K-12 Education:

11. Does your WHP program have a connection with the local schools?
12. If so, what is the nature of it (i.e., what activities have been undertaken)?

Joint Programming:

13. Have you partnered with existing organizations on education and outreach efforts?
14. If so, what activities were completed?
15. Were they considered successful? Why or why not?
16. Have the neighboring jurisdictions collaborated in the outreach and education efforts?
17. Is there a plan in place for continuing the outreach efforts into the future?

F. Overall WHP Program:

1. Has the WHP plan been reviewed and updated since it received state approval?
   If yes, what process was used?
   If the plan has not been updated, why not?
2. In general, how successful do you feel the program has been to date? Why?
3. What would you do differently if you were to begin this process anew?
4. Has the program been accepted by the community? Have you heard any comments from citizens?

5. Do you think that the groundwater protection activities will continue into the future - say five or ten years from now? Why or why not?
6. Do you have any other comments about the WHP implementation process?
7. Are there other team members who might be willing to be interviewed?

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