CITY OF HOLLAND
HOLLAND BOARD OF PUBLIC WORKS
SURFACE WATER INTAKE PROTECTION PLAN
APRIL 2010

PHOTOS FROM ORIGINAL 42-INCH INTAKE CONSTRUCTION - 1955

City of Holland

Holland Board of Public Works

Source Water Intake Protection Program

April 2010

MICHIGAN DEPARTMENT OF NATURAL RESOURCES & ENVIRONMENT
WATER BUREAU (DRINKING WATER & ENVIRONMENTAL HEALTH SECTION)

GUIDANCE FOR SOURCE WATER PROTECTION PROGRAMS
SURFACE WATER INTAKE PROTECTION PLAN (SWIPP)

Since the source water assessments have been completed, the state is developing guidance for communities for development of Surface Water Intake Protection Programs (SWIPP). Michigan has a SWIPP protection program (WHPP) that has been approved by the USEPA. The Michigan Department of Natural Resources & Environment is developing the Surface Water Intake Protection Programs for surface water systems using that same logic. A Surface Water Intake Protection Program should have the same basic seven elements as the SWIPP Protection Programs.

These are:

___ Defining roles and duties of government units and water supply agencies

___ Delineating a source water protection area for each water supply source based on the state's defined source water area.

___ Identifying potential contaminant sources within each source water protection area.

___ Utilizing management approaches for protection of source water, including but not limited to Education and regulatory approaches.

___ Creating contingency plans for public water supply sources including the location of alternate drinking water sources.

___ Assuring proper siting on new water sources to minimize potential contamination.

___ Encouraging public participation.

This guidance document is intended to assist communities with surface water systems in developing an approvable SWIPP program. Communities may add other items as appropriate, and are encouraged to submit a work plan for review before proceeding with development of their SWIPP program.

PROGRAM ELEMENTS

Basic information about the water supply system and community

___ Community location and population

___ Present service area (geographic area and population served)

___ System capacity

___ Local program goals for SWIPP program

Defining roles and duties of government units and water supply agencies

___ Identification of all people, local, county, or state agencies, or public water supply agencies that have significant responsibilities for carrying out the local SWIPP program

___ Brief description of the roles and responsibilities for each person or agency

___ Intergovernmental agreements, memoranda, or ordinances which set forth procedures or responsibilities related to SWIPP (COUNTY)

___ Agency, person and/or team responsible for the periodic update of the local SWIPP program

___ Schedule for quarterly meetings of SWIPP team

Delineating a source water protection area for each water supply source based on the state's defined source water area

___ Map that shows or describes the area that contributes water to your source. This is described in your source water assessment that was completed by the state. This will be very site specific and may be very general for some systems, i.e. a Great Lake source extending far into the lake versus an inland river intake with a defined watershed (Use of a U.S. Geological Survey quadrangle map as a base is recommended)

___ Small watershed boundaries and/or surface water runoff patterns, if appropriate for SWIPP

___ Storm water drainage system and facilities, including storm water basins if relevant to the SWIPP

Identifying potential sources of contamination within the SWIPP area

NOTE: This will take some judgment since there may be numerous potential contamination sources. It may be necessary to describe them both specifically for significant ones and generally for those that are relatively common. For example; there are numerous underground tanks, but fewer large industrial complexes.

___ Record searches to identify potential sources of contamination and land uses that have a potential to impact the surface water source

___ General surveys to identify potential sources of contamination and land uses that have a potential to impact the surface water source

___ Record searches to identify historical land uses that have a potential to impact the surface water source

___ Map which displays potential sources of contamination within the SWIPP

___ Description of the process used to identify potential sources of contamination, including the sources of information

___ Comprehensive listing of potential sources of contamination within the SWIPP area

Utilizing management approaches for protection of source water, including but not limited to education and regulatory approaches

___ Description of the local management program for SWIPP. Examples of local management program elements include:

- Zoning ordinance provisions for SWIPP
- Facility inspection or hazardous material survey program
- Information to businesses concerning state and county requirements
- Environmental permits checklist for new businesses
- Strategic monitoring within the SWIPP area
- Inter-agency coordination and communication
- Other SWIPP protection program elements developed by the local agency
- Identification of partnerships or agreements with county or state agencies which will help implement the local SWIPP program
- Development and implementation of best management practices that reduce the risk of surface water contamination
- On-site inspections for the purpose of improving facility management of potential sources of contamination
- Incorporation of SWIPP into a municipality's master plan or other regional land use planning program

___ Timetable for management plan implementation

Creating contingency plans for public water supply sources including the location of alternative drinking water sources

___ Plans for how the community would deal with a major threat to the intake

___ Response protocol in the event of a hazardous substance spill or other emergency

___ Emergency water supplies (bottled, bulk, etc.)

___ Policies and procedures related to water supply replacement

Assuring siting of new water sources to minimize potential contamination

___ General procedure that would be employed if a new source was developed

___ Proposed method for incorporating new sources into SWIPP program

Encouraging public participation

___ Description of the methods used to involve and educate the public during the SWIPP planning and implementation process, examples include:

- Local meetings
- Newsletters
- Newspaper articles
- School presentations
- Brochures
- Website
- SWIPP signage
- Hazardous waste collection activities
- Other_____

This is general guidance and each program will be site specific. It is suggested the community develop a draft outline for review before any detailed SWIPP program is developed.

Source Water Protection

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City of Holland-Holland Board of Public Works
Ottawa and Allegan Counties, Michigan

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Source Water Protection

General Program Description

City of Holland-Holland Board of Public Works
Ottawa and Allegan Counties, Michigan

SECTION 1 GENERAL PROGRAM DESCRIPTION

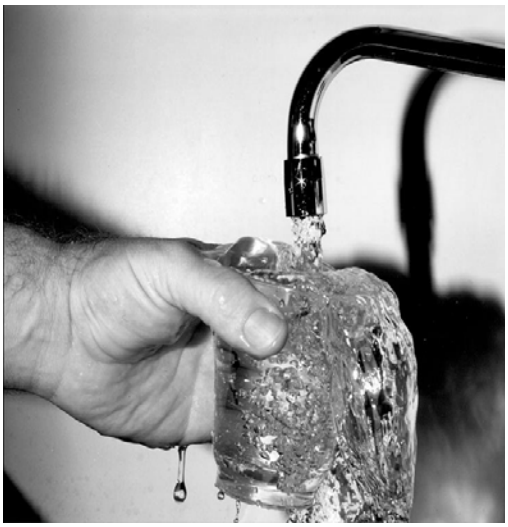
1.1 BACKGROUND INFORMATION

For many years, there have been major discussions over the issue of protecting the nation's drinking water sources. This issue was eventually addressed in 1996 when the federal Safe Drinking Water Act was reauthorized adding legislation that requires source water assessments be performed on all sources of public drinking water supplies.

A source water assessment provides not only an understanding of current conditions, but also serves as a predictive tool for source water management and protection efforts. This information will be used as a basis for building voluntary, community-based barriers to drinking water contamination (i.e., Surface Water Intake Protection Programs).

The Michigan Department of Natural Resources & Environment (MDRNE) has completed assessments on almost 12,000 public water supplies with an estimated 18,000 sources. Of these, approximately 10,650 are non-community public water supplies with groundwater as the source. There are approximately 1,250 community systems, including 650 systems using groundwater sources and supplies that purchase water. These assessments are of the raw water quality, not the finished water compliance. Departments of Agriculture, agricultural extension programs, soil and water conservation boards, local governments, water systems and the Michigan Rural Water Association were all key partners in completing the source water assessment program.

Michigan has 60 water supplies that use surface-water sources. These supplies provide drinking water to over 55 percent of the State's population, or about 6 million people. Inland lake and river intake assessments show eight (8) municipal supplies in Michigan. Great Lakes and Great Lakes Connecting Channels intake assessments account for the remaining 52 surface water supplies.



The United States Geological Survey (USGS) prepared a Source Water Assessment Program (SWAP) for the City of Holland under contract to the MDNRE. The final report was completed in November 2003 and is included as Appendix A.

The Michigan Surface Water Intake Protection Program (SWIPP) is a voluntary effort encouraged by the USEPA and MDNRE. Its purpose is to utilize the information provided by the mandatory Source Water Assessment Program in order to allow regional participation of communities to protect their drinking water sources. Once potential contaminant sources are identified, the communities can then implement measures to safeguard against future contamination. The Source Water Intake Protection Plan will outline the implementation measures that each community can perform. The plan will also outline a contingency plan in order to assure adequate drinking water is available to the communities in case of a contamination event or a disruption of their normal water supply.

1.2 OVERVIEW OF THE SOURCE WATER ASSESSMENT AND PROTECTION PROGRAM

To expand the benefits realized from Wellhead Protection Program (WHP) efforts, 1996 Safe Drinking Water Act reauthorization requires (under Section 1453 P.L. 104-182) States to develop a Source Water Assessment and Protection (SWAP) Program. The SWAP program requires complete assessments for all Public Water Systems (PWS^S). By definition, public water systems in Michigan are separated into three classifications, Type I, II, and III:

- Type I systems serve 15 or more homes, or other residential living units
- Type II systems serve 25 or more people a day for 60 or more days a year
- Type III systems are any public water systems that do not meet the definition of Type I or II.

The SWAP program requires complete assessments for all Public Water Systems (PWS^s) utilizing ground and/or surface water which include:

- Designating of the ***Intake Protection Area*** (SWIPPA), the portion of a watershed or ground water area that may contribute pollution to the water supply.
- Identification of all significant potential sources of drinking water contamination within the SWIPPA. The resulting ***contamination source inventory*** must describe the sources (or categories of sources) of contamination either by specific location or by area.
- Determination of the water supply's susceptibility to contamination from identified sources. The ***susceptibility determination*** can be either an absolute measure of the potential for contamination of the PWS or a relative comparison between sources within the SWIPP Areas.
- ***Distribution*** of the source water assessment results to the public. Assessments are not considered completed until results are communicated to the public.

The Michigan Department of Natural Resources & Environment established the plan to assess Intake Protection Areas. *These assessments are of the raw water quality, not the finished water compliance*. Michigan Rural Water Association, Departments of agriculture, agricultural extension programs, soil and water conservation boards, local governments and water systems were all key partners in completing the source water assessment program.

A source water assessment provides not only an understanding of current conditions, but also serves as a predictive tool for source water management and protection efforts. This information will be used as a basis for building voluntary, community-based barriers to drinking water contamination (i.e., source water protection program).

1.3 OVERVIEW OF THE SOURCE WATER PROTECTION PROGRAM

The Michigan Source Water Protection Program is a voluntary effort encouraged by the USEPA and MDNRE. Its purpose is to utilize the information provided by the mandatory source water assessment program in order to allow regional participation of communities to protect their drinking water sources. Once potential contaminant sources are identified, the communities can then implement measures to safeguard against future contamination. The Source Water Protection Plan will outline the implementation measures that each community can perform. The plan will also outline a contingency plan in order to assure adequate drinking water is available to the communities in case of a contamination event or a disruption of their normal water supply.

The Drinking Water and Radiological Protection Division of the MDNRE have established guidelines for the Source Water Protection Program. The Source Water Protection Program being developed for the City of Holland is based on these MDNRE Guidelines.

- Defining roles and duties of government units and water supply agencies.
- Designating an Intake Protection Area for each water supply source based on the state's defined source water area.
- Identifying potential contaminant sources within each Intake Protection Area.
- Utilizing management approaches for protection of source water, including but not limited to education and regulatory approaches.
- Creating contingency plans for public water supply sources including the location of alternate drinking water sources.
- Assuring proper siting on new water sources to minimize potential contamination.
- Encouraging public participation and education.

This written Source Water Intake Protection Plan (SWIPP) details the above-mentioned seven elements for the City of Holland Plan. This document was developed, with the input by members of the Holland Source Water Protection Management Team, for approval by the MDNRE.

The purpose of the Source Water Protection Plan is to protect the long-term viability of City of Holland drinking water supply by reducing the potential risk of surface and subsurface contamination from influencing the Source Water Intake Protection Areas (SWIPP Areas). The Holland SWIPP Areas are defined as the current area that contributes surface water to Holland's water treatment plant intake and extended areas to include potential new drinking water sources. As such, the City of Holland recognizing the need to protect the long-term use of this drinking water resource, has implemented long-term source water protection efforts.

Implementation of this SWIPP will help to raise public awareness regarding source water protection and will assist the City of Holland in giving appropriate future consideration for zoning and land use activities located within the SWIPP Areas.

As part of the SWIPP, the City of Holland, Holland Charter Township, City of Zeeland, Laketown Township, Park Township and Counties of Allegan and Ottawa should consider drafting resolutions and environmental impact reviews authorizing local zoning authorities to consider source water protection when issuing new building permits or recommending changes in land use within the SWIPP Areas. A sample resolution is presented in Appendix P.

1.4 INTRODUCTION

This document presents the Surface Water Intake Protection Program (SWIPP) for the City of Holland's water system (Ottawa and Allegan Counties, Michigan). This document was developed, in accordance with the Michigan Department of Natural Resources & Environment's Water Bureau guidance dated August 5, 2004. This document was developed using a watershed protection approach with input by members of the Holland Source Water Protection Steering Committee, for approval by the MDNRE.

The Purpose of the SWIPP is to protect the long-term viability of Holland's drinking water supply by reducing the potential risk of surface and subsurface contamination from affecting the Intake Protection Areas (SWIPP Areas). The Holland SWIPP Areas are divided into three distinct zones (1) the Critical Assessment Zone (CAZ), (2) the Buffer Zone and (3) the Macatawa Watershed district. These SWIPP areas were defined by using geographic information system (GIS) software to map parts of the watershed that have the potential to affect source water at the Holland water plant intake.

Implementation of this SWIPP will help to raise public awareness regarding surface water protection and will assist the communities within the SWIPP areas in giving appropriate future consideration for zoning and land use activities in those areas.

Due to the prolific and extensive nature of this water source, a watershed protection approach will be utilized. Using a watershed protection approach is a strategy for effectively protecting and restoring aquatic ecosystems and protecting human health. This strategy has as its premise that many water quality and ecosystem problems are best solved at the watershed level rather than at the individual water body or discharger level. Major features of a watershed protection approach are targeting priority problems, promoting a high level of stakeholder involvement, integrated solutions that make use of the expertise and authority of multiple agencies, and measuring success through monitoring and other data gathering.

1.5 PURPOSE AND SCOPE

The City of Holland, City of Zeeland, Laketown Township, Park Township, Holland Charter Township, Ottawa County, and Allegan County recognize the possibility of potential threats to Holland's water supply. In an effort to address, the potential problems that could affect the source water, the City of Holland acting by and through its Board of Public Works, with guidance from the Michigan Department of Natural Resources & Environment (MDNRE) and the Michigan Rural Water Association (MRWA) established a Source Water Protection Management Team. This team will make recommendations to the major stakeholders within the SWIPP Areas.

1.5.1 Source Water Protection Plan Development

Surface Water Intake Protection plans are necessary for the protection of the system's drinking water source from contaminants that are difficult and costly to treat through normal means. The plan is intended to:

- Clearly identify actual and potential sources of contamination to the source.
- Effectively allow Holland to educate the public on the importance of their drinking water source.
- Serve as the first step for long-term sustainable planning for the future of the community.
- Provide a comprehensive action plan in case of an emergency.

1.5.2 Source Water Protection Plan Affiliation

This Surface Water Intake Protection program was developed by the City of Holland acting by and through its Board of Public Works (BPW). Partners in the SWIPP program include the City of Holland, City of Zeeland, Laketown Township, Park Township, Holland Charter Township, Ottawa County agencies, Allegan County agencies, Macatawa Area Coordinating Council, Hope College, 911/Emergency Management, Holland Area Community Schools and the Michigan Department of Natural Resources & Environment.

1.5.3 SWIPP Steering Committee and Public Participation

Contacts for the Holland SWIPP Steering Committee consist of several key individuals possessing a wide variety of background, education and experience. Individuals who are community residents, educators, local business owners and local government officials are encouraged to volunteer their time and efforts as members of the SWIPP team.

Table 1.5.3.a Source Water Protection Steering Committee

Name	Organization	Telephone	Email Address
Jim Van De Wege*	Holland BPW	616.355.1698	jvandewege@hollandbpw.com
Joel Davenport*	Holland BPW	616.355.1539	jdavenport@hollandbpw.com
Dave Koster	Holland BPW	616.355.1562	dkoster@hollandbpw.com
Dan Sorek*	Holland BPW	616.355.1644	dsorek@hollandbpw.com
John Van Uffelen	Holland BPW	616.355.1642	jvanuffelen@hollandbpw.com
Judy Visscher*	Holland BPW	616.355.1210	jvisscher@hollandbpw.com
Linda Brown	Ottawa County Drain Commission	616.994.4530	
Adeline Hambley	Ottawa County Health Department	616.846.8360	ahambley@miottawa.org
Mary Fales	MACC	616.395.2688	mfales@the-macc.org
Peggy Weick	Ottawa County Conservation District	616.846.8770	Peggy.weick@mi.nacdnet.net

***Depicts additional duties and/or responsibilities**

Table 1.5.3.b Committee Member Additional Responsibilities and/or Duties

Name	Role	Title	Representing
Jim Van De Wege	**Committee Chair**	WTP Superintendent	Holland BPW
	Contingency Planning		
	Program Management		
	Public Education		
Joel Davenport	**Secretary/Vice Chair**	Planning Engineer	Holland BPW
Dan Sorek	Contaminant Source Inventory	W/WW Services Superintendent	Holland BPW
	GPS/GIS Mapping		
Judy Visscher	Point/Non-Point Inventory	Environmental & Regulatory Specialist	Holland BPW

1.5.4 SWIPP Steering Committee Goals

The main goal of the Holland SWIPP is to provide a continuously safe and clean supply of drinking water to residents. This will be accomplished in large part through maintaining regulatory compliance with the Michigan Safe Drinking Water Act, 1976 P.A. 399, as amended. To ensure compliance with drinking water standards, the SWIPP Steering Committee will meet on a regular basis to promote and raise public awareness of source water protection, to provide public education regarding source water protection, and to periodically update the elements of the Source water protection plan (such as the contingency plan, contaminant source inventory, SWIPP Areas, etc.). This SWIPP was developed to be a flexible, working document that allows for the easy assimilation of future data and information.

Table 1.5.4.a Steering Committee Roles & Responsibilities

Management Strategy	Responsible Agency/Individual
Administer zoning ordinance(s)	Zoning Administrator (Varies by governmental jurisdiction)
Implement education program	SWIPP Steering Committee
Participate in education program	Participating Entities (*planned*)
Administer FFRTK inspections	Local Fire Departments
Inform businesses about ground water protection requirements	Local Fire Departments and Holland BPW
Emergency response	Local Fire Departments
Update inventory	City BPW – Jim Van De Wege
Assist with inventory update	Local Fire Departments
Share SWIPP experiences with other municipalities	SWIPP Steering Committee
Participate in Advisory Committee	All local governments in SWIPP Areas and other interested parties
Provide advice on groundwater education and intergovernmental coordination	Macatawa River Watershed Council, County Conservation Districts
Inform new businesses about floor drain prohibition	County Health Departments
Maintain well log data	County Health Departments
Provide technical asst. regarding environmental health, planning, emergency response	County Health Departments
Provide advice regarding SWIPP	Source Water Protection Unit, MDNRE
Keep City updated in water quality monitoring requirements	Source Water Protection Unit, MDNRE
Provide inspections upon request from Fire Dept.	Environmental Response Division, MDNRE
Inform potentially responsible parties regarding contaminated sites	Environmental Response Division, MDNRE

1.5.5 Steering Committee Objectives

The main goal of the Holland SWPP is to assist the City of Holland to provide a continuously safe and clean supply of drinking water to residents. This will be accomplished in large part through maintaining regulatory compliance with the Michigan Safe Drinking Water Act, 1976 P.A. 399, as amended. To ensure compliance with drinking water standards, the SWPP Steering Committee will meet on a regular basis to promote and raise public awareness of source water protection, to provide public education regarding source water protection, and to periodically update the elements of the Source water protection plan (such as the contingency plan, contaminant source inventory, SWPAs, etc.). SWPP Steering Committee progress reports will be presented in the Management Section. These forms can be utilized to report and record the periodic progress of the SWPP team to the DNRE and others.

1.6 Goals and Objectives

This section presents the mission statement and goals for the City of Holland Source Water Intake Protection (SWIPP) Areas, which are to be considered and used as guidelines when making decisions concerning matters affecting the SWIPP Areas.

1.6.1 Mission Statement for Holland's Surface Water Intake Protection Program

Holland will ensure a safe drinking water source for residents by identifying historical, existing, and future threats; by formulating appropriate strategies to those threats, by educating residents by encouraging support and participation in the creation and implementation of the program; and by promoting intergovernmental cooperation to assure protection of water resources.

1.6.2 Goal #1 - Promote the identification, prevention and cleanup of contamination within the Source Water Intake Protection Areas.

Ways to Accomplish Goal #1

1. Identify sites of historical environmental significance through periodic update to the contaminant source inventory.
2. Encourage recycling and proper storage of chemicals through the use of best management practices (BMP).
3. Encourage fast, effective remediation of contaminated sites discovered within SWIPP Areas.
4. Support redevelopment of Brownfield sites within the SWIPP Areas.

1.6.3 Goal #2 -Educate the public on the need to protect surface water and groundwater sources within the SWIPP Areas.

Ways to Accomplish Goal #2

1. Produce and distribute education materials.
2. Offer special demonstrations, seminars and other activities that promote source water protection to the public.
3. Place road signs at the SWIPP Areas points of entry.

1.6.4 Goal #3 - Promote and facilitate intergovernmental cooperation to ensure protection of the water resources within the SWIPP Areas.

Ways to Accomplish Goal #3

1. Seek, review and evaluate information from local government agencies to identify issues that may potentially affect the SWIPP Areas.
2. Seek active participation of local government officials as part of the SWIPP.
3. Schedule regular SWIPP management team meetings and invite local representatives of government and other entities that have a stake in SWIPP Areas.
4. Incorporate SWIPP Areas in local and regional planning and zoning.

Source Water Protection Area

City of Holland - Holland Board of Public Works
Ottawa and Allegan Counties, Michigan

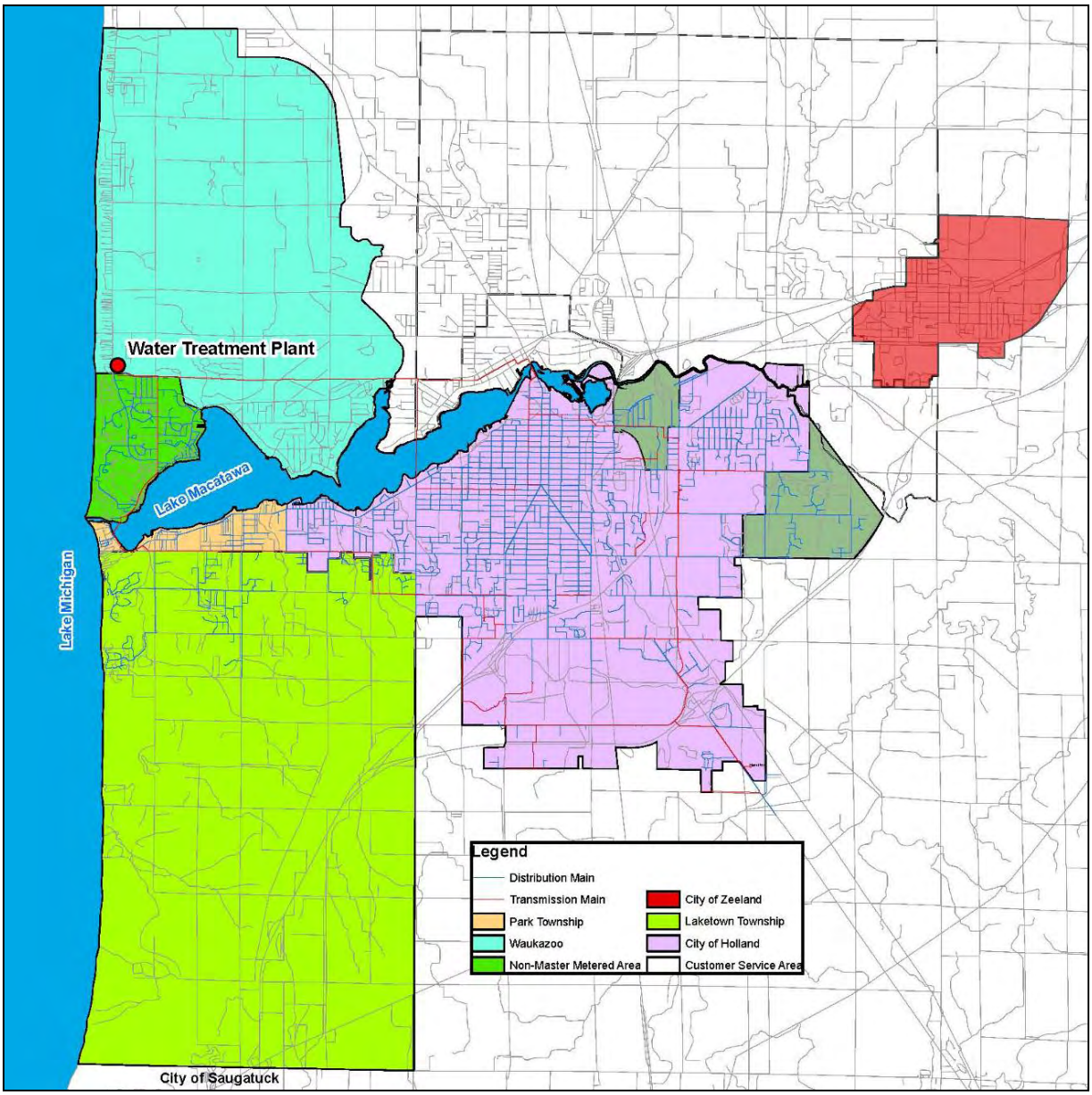
SECTION 2 SOURCE WATER PROTECTION AREA

2.1 Community Overview

The City of Holland is located in both the southwest corner of Ottawa County and the northwest corner of Allegan County. The City is surrounded by Laketown and Fillmore Townships to the south and Park and Holland Townships to the north.

The Holland Water System is a Type I public supply serving several communities in Ottawa and Allegan Counties. The service area includes the City of Holland, City of Zeeland, Laketown Township, and portions of Park Township and Holland Township. A regional location map showing the water supply service area is shown in Figure 2-1.

Figure 2-1: Holland Water Supply Service Area



The Holland Water System currently serves a population of approximately 57,484 in Ottawa and Allegan Counties. Table 2.1.a provides a breakdown of the customers by service area.

Table 2.1.a: Holland Water System Customers

Service Area	Customer Type	Service Connections	Estimated Population1
Holland BPW	Owner	10,854	35,048
Holland Township	Retail	562	1,613
Laketown Township	Retail	951	2,530
Park Township (Southside)	Retail	519	1,490
Waukazoo (Park Township Northside)	Wholesale	3,252	9,333
Zeeland BPW	Wholesale	2,668	7,470
		Total Population Served	**57,484**

2.2 Water Supply Overview

The Holland water supply is operated by the Holland Board of Public Works and was originally a ground-water supply. In 1954, construction was begun on a surface water intake and water treatment plant (WTP) which went on line in 1957 with a capacity of 14 million gallons per day (MGD). The facility was expanded in 1970 to 28 MGD and again in 1998 to its current capacity of 38.5 MGD.

The intake structure consists of an upturned, funnel-shaped crib, approximately 22.5 ft in diameter and submerged approximately 40 feet depending on lake level. The intake pipe consists of a single 42-inch diameter, reinforced concrete cylinder with rubber gasket steel joints that extends approximately 4,450 feet into Lake Michigan where it joins the aforementioned intake crib. The design involves siphon action where the intake pipe connects into an airtight manhole in the low lift pumping station. A vacuum priming system is connected to the airtight manhole to aid the siphon action.

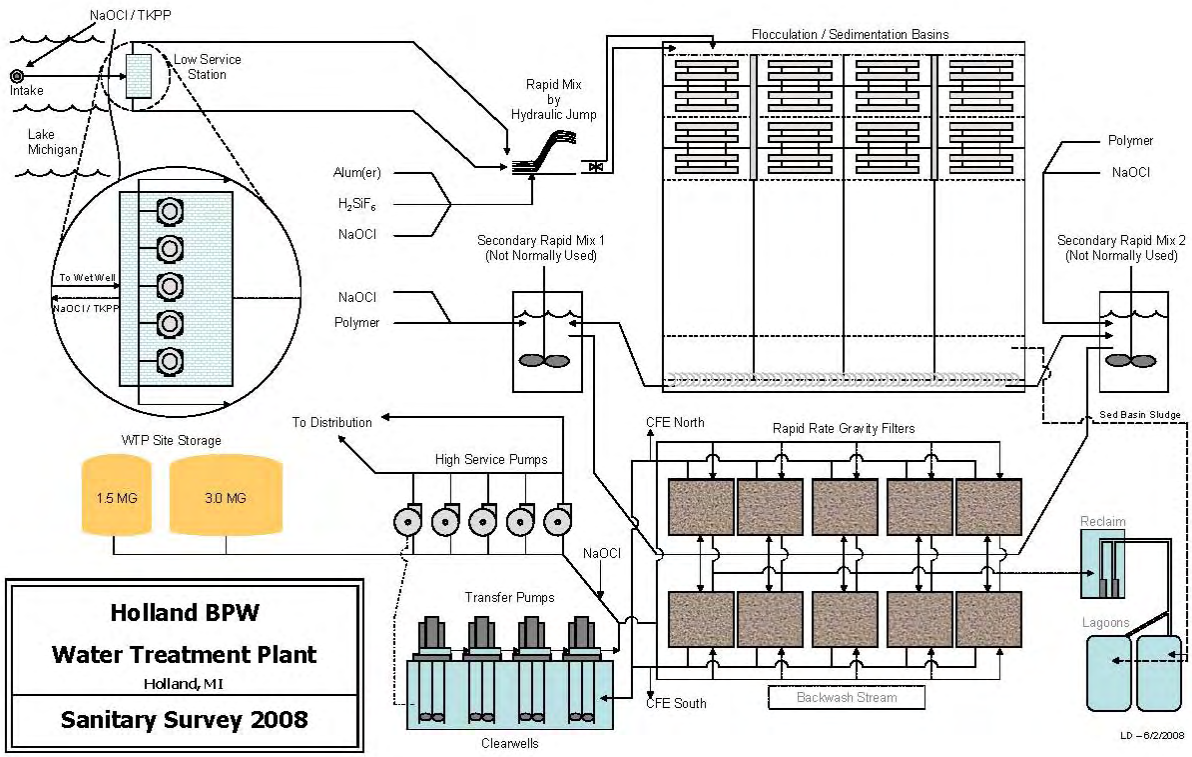
The intake pipe was designed for a capacity of 42 MGD. However, a 2-inch chemical feed line installed in 1990 within the 42-inch pipe for the purpose of adding chlorine to prevent the growth of zebra mussels has reduced the intake capacity by approximately 4%. Hydraulic tests conducted on the intake system have concluded that the current capacity of the line is approximately 38.5 mgd. The intake crib and pipe are inspected annually to evaluate the condition and growth of zebra mussels and zebra mussels are removed from the crib at least biannually.

The 42-inch raw water intake line enters a chamber in the wet well at the low service pumping station. The low service pump building is located in Tunnel Park, on the shore of Lake Michigan, about a quarter mile west of the WTP. Five low-service pumps deliver raw water from the wet well to the WTP.

The WTP employs conventional water treatment utilizing chlorine for disinfection, alum for coagulation along with the processes of flocculation, sedimentation and filtration. Fluoride is added for dental health and polymers are used to improve coagulation. A process flow diagram for the Holland WTP is included as Figure 2-2.

1 Michigan Department of Environmental Quality, Water Bureau, Grand Rapids District Office, "Holland Board of Public Works Water System Sanitary Survey", 2008.

Figure 2-2: Holland WTP Process Flow (Reproduced from 2008 Sanitary Survey)



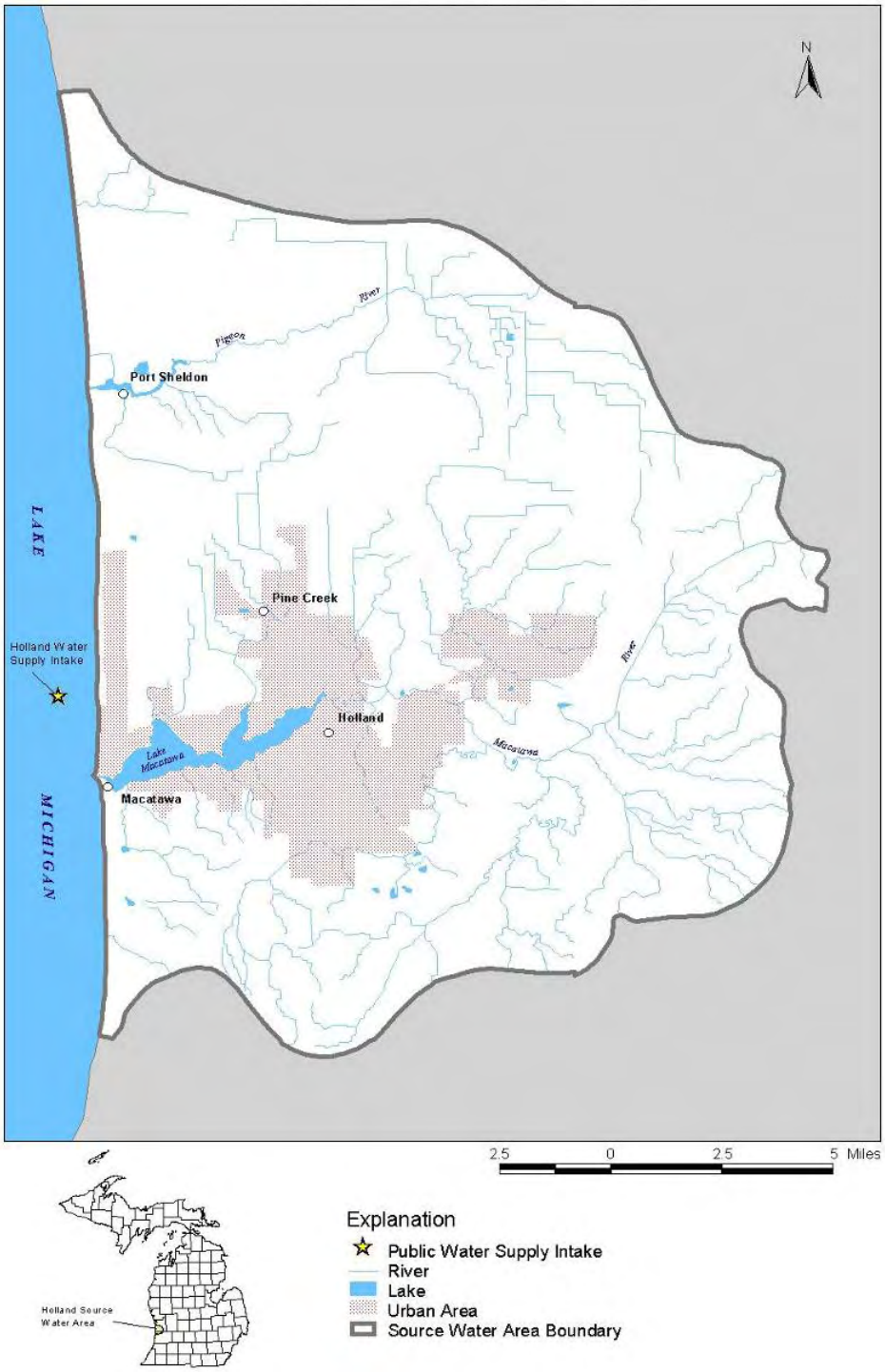
2.3 Source Water Assessment

The United States Geological Survey (USGS), Water Resources Division, Michigan District prepared a Source Water Assessment for the City of Holland water supply under contract to the Michigan Department of Environmental Quality (MDEQ), Water Division. The final report was completed in November 2003 and is included as Appendix A of this document.

The overall intent of the assessment was to provide background information for the community to use in developing a local source water protection program. To this effect, it delineated a Source Water Area (SWA) using Geographic Information System (GIS) software to map watershed(s) that have the potential to affect source water at the intake.

Under ambient conditions, currents in Lake Michigan are typically from the south-southwest and pass over the Holland Water Treatment Plant (WTP) intake. Water from the Macatawa River (about 2 miles south of the intake) flows north from its mouth, and may influence water quality and chemistry at the intake. Water from the Kalamazoo River (about 9 miles south of the intake) also flows north from its mouth, and may influence water quality and chemistry at the intake as well. In addition, sustained strong winds from the west often affect lake currents, causing increases in near shore turbidity, and, possibly, increased coliform concentrations. Sustained winds from the northwest through northeast can occasionally cause the flow of the Pigeon River (7 miles north of the intakes) and possibly the Grand River (about 18 miles north of the intakes), to pass over the intake, causing changes in water quality and chemistry at the intake. Based on this information the USGS delineated a SWA for Holland that is included as Figure 2-3 for reference.

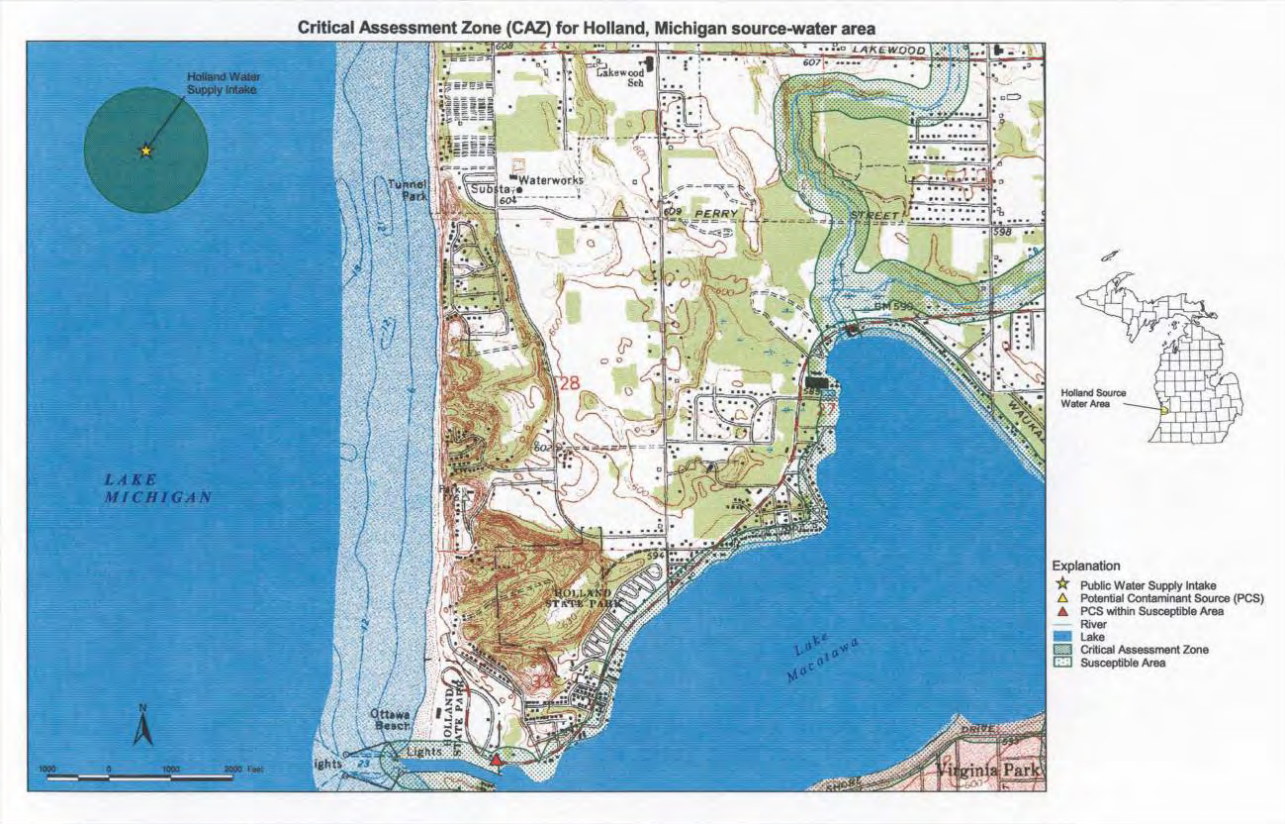
Figure 2-3: Holland Water Supply Source Water Area (Reproduced from USGS Source Water Assessment)



In addition to defining the SWA, USGS also defined the Critical Assessment Zone (CAZ) for the Holland WTP intake using the Great Lakes Protocol and Holland water supply information. The CAZ is the most susceptible area within the SWA where releases to the environment are most likely to impact the Holland water intake. As such, this is the area where USGS recommends focusing management strategies and resources to benefit the drinking water resources.

The CAZ for the Holland water system encompasses a 1,000 foot diameter area centered over the intake as shown in Figure 2-4 from the USGS Source Water Assessment. The area is calculated based upon the length and depth of the intake. It should be noted that the CAZ does not intersect the shoreline as there is no shoreline susceptible area.

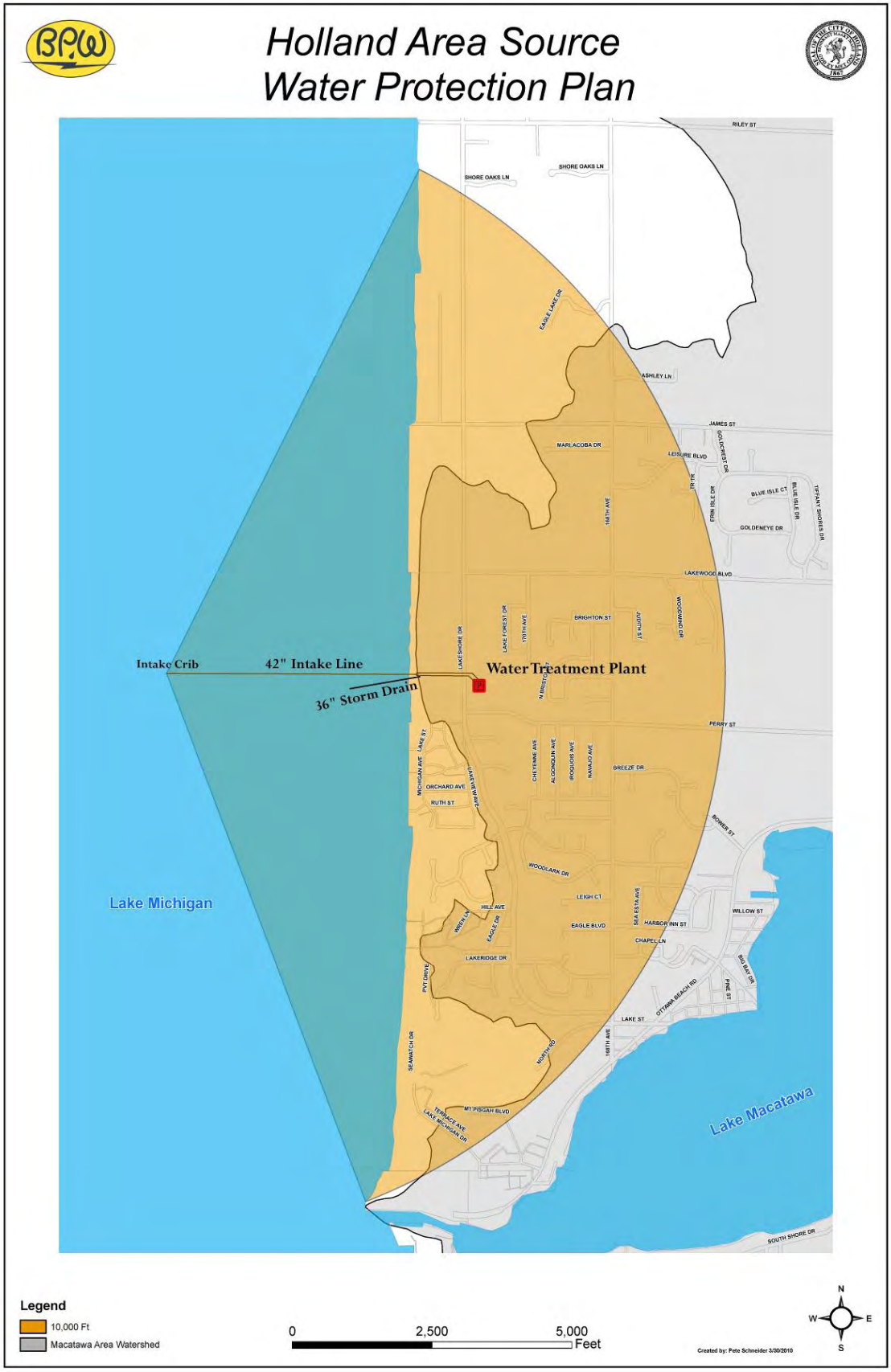
Figure 2-4: Holland Water Supply Critical Assessment Zone (Reproduced from USGS Source Water Assessment



2.4 Buffer Zone

Using the SWA and CAZ defined in the Source Water Assessment prepared by USGS, the Holland Source Water Protection Management Team delineated a Source Water Protection Buffer Zone. This is the area where Holland plans to focus management strategies and resources to protect. A map showing the buffer zone as delineated is included as Figure 2-5. The zone encompasses a 10,000 foot diameter area centered over the intake and then extended inland as shown in Figure 2-5 and provides a factor of safety of 10 over the CAZ delineated in the Source Water Assessment.

Figure 2-5: Holland Source Water Protection Buffer Zone



2.5 Additional Influences

While only a portion of the Macatawa watershed is included in the buffer zone as previously defined, it is acknowledged that flows from Lake Macatawa have a noticeable influence on the water quality and chemistry at the intake. This influence is most pronounced during large storm events or thermal inversions when the water from the Macatawa watershed has increased quantities of sediment and detritus. These materials enter the WTP through the intake and may cause treatment difficulties. Operational staff is trained on steps to be taken for poor intake water quality conditions but this accentuates the potential influence of the Macatawa watershed on the raw water quality.

The Macatawa Area Coordinating Council (MACC) currently overseas the Macatawa Watershed Project which works with local units of government, farmers, homeowners, developers, educators, and other members of the community to increase awareness of how they impact the Macatawa watershed. The project was created in 1999 to address a Total Maximum Daily Load (TMDL) submitted by the Michigan Department of Environmental Quality (MDEQ) for phosphorus in Lake Macatawa to the U.S. Environmental Protection Agency (EPA). The Lake Macatawa Phosphorus TMDL was approved by the EPA in April 2000. The TMDL mandates a reduction in the amount of phosphorus entering Lake Macatawa from 138,500 lbs per year (1997 level) to 55,000 lbs per year.

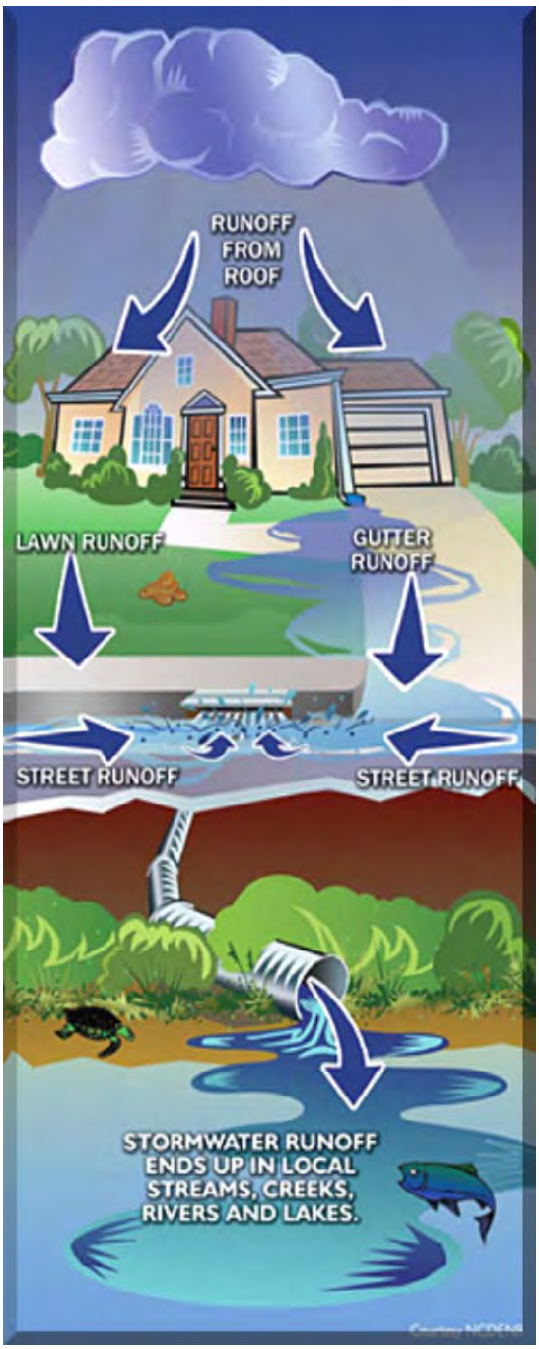
In October of 2000, a cooperative agreement was reached among the MACC, MDEQ and the point source representatives to meet this commitment. The cities of Holland and Zeeland, and the townships of Holland, Zeeland, Fillmore, Laketown, and Park are included in this Macatawa Watershed Phosphorus Reduction Loading Agreement. This local agreement is part of an overall effort to:

- Increase the awareness of water quality issues among Allegan and Ottawa County stakeholders
- Increase the involvement of Allegan and Ottawa Country stakeholders in the Macatawa Watershed Phosphorus Reduction Implementation Plan (Appendix C)
- The MACC agreed to oversee a comprehensive watershed project aimed at reducing the level of phosphorus in the Macatawa Watershed by 70% through public awareness, education, and Best Management Practices (BMP).

While the Macatawa Watershed Project focuses primarily on phosphorus reduction in the watershed, many of its goals and tools (public awareness, education, BMP) accomplish the same goals as the Source Water Protection Program. As such, a representative from the MACC has been included in Holland's Source Water Protection team and the two groups plan to work closely together to accomplish the shared goal of protection of the Macatawa watershed and Lake Michigan water quality.

POTENTIAL SOURCES OF CONTAMINATION

City of Holland-Holland Board of Public Works
Ottawa and Allegan Counties, Michigan



SECTION 3 POTENTIAL SOURCES OF CONTAMINATION

Disclaimer: The information contained in this "Plan" is limited to that available from public records and the water supplier. Other "potential contamination sites" or threats to the water supply may exist in the Intake Protection Areas that are not identified in this "Plan". Identification of a site as a "potential contamination site" should not be interpreted that this site has or will cause contamination of the water supply.

3.1 Introduction

The goal of this element is to identify existing and potential sources of contamination within the Holland Source Water Intake Protection Areas. A potential contaminant source is simply a location where there is an activity having the potential to release contaminants into the environment at a level of concern. The activity may be associated with a business, industry, agriculture, wastewater discharge or operation involving the use, transport, storage, or manufacture of the potential contaminants.

Surface water supplied from Lake Michigan is currently the primary water resource for the community. At this time, Surface water is the most economically feasible source of water for the community. There is an abundance of surface water with the capability to meet the present and future demands.

Identification of a business, industry or operation as a potential contaminant source does not mean that the business, industry or operation is out of compliance with any local, state, or federal regulation, and it does not necessarily mean that the business, industry or operation has or will cause contamination.

What it does mean is that the potential for contamination (or pollution as it is sometimes called) exists due to the nature of the business, industry, or operation. An inventory of potential contaminant sources can:

1. Provide an effective means of educating the public about potential contaminants;
2. Provide information on the locations of potential sources, especially those that present the greatest risks to the water supply; and
3. Provide a reliable basis for developing a local management plan to reduce the risks of contamination to the water supply.

The identification of potential or existing sources of contamination within the Holland Source Water Intake Protection Areas was completed and confirmed. The identification of existing sources of contamination have been compiled using on-site inspections and information from various state agencies and programs which include Sites of Environmental Contamination, The Underground Storage Tank List, Oil and Gas Site, federal database searches and other sites.

The City of Holland obtains their drinking water from Lake Michigan that is influenced by the Macatawa Watershed in Ottawa and Allegan Counties. This is currently the primary water resource for the community. The contaminant source inventory will assist Holland in the identification, planning and management of potential impacts to its water supply. An understanding of the types of contamination issues that may occur will also enable planning for necessary improvements in treatment capabilities or allow time to remediate the source of contamination.

3.2 Contaminants of Concern

Contaminants of concern within the Holland SWIPP Areas are nonpoint source pollution from storm water runoff, agriculture activities and other nonpoint source pollutants in the Buffer Zone and Macatawa Watershed that can directly affect the quality of the raw water intake. In addition, animal feedlots and bulk storage of fertilizers or herbicides/pesticides also poses potential threat to the source water.

Underground storage tanks, storm water drainage pipes, and bare soils may be conduits by which contaminants can easily reach the drinking water source. Leaking tanks (above ground and below the ground), spills, wash water runoff, and improperly stored hazardous substances also can contaminate the source water. Pathways that are applicable to this program include the following:

- Non-point source pollution
- Storm water runoff from streets and lawns
- Farms that apply pesticides and fertilizers
- Point source pollution
- Municipal, residential or commercial septic systems
- Underground or above-ground fuel storage tanks and gas stations
- Railroad yards and other railroad-related work sites
- Manufacturing plants and machine shops that uses any type of cleaning solvents
- Landfills, sludge disposal sites, chemical waste storage facilities, incinerator
- Forestry activities

Of most concern to the water quality of the Macatawa River is, pollutants that get into water from both rural and urban activities. The main six types of pollutants that affect the source water quality are.

- **Sediment** (Wind and water erosion of soils)
- **Nutrients** (Fertilizer, animal wastes, sewage treatment plants)
- **Animal Wastes** (Fecal coliform from livestock and septic systems)
- **Pesticides** (Herbicides, insecticides, fungicides, etc...)
- **Salt** (Mostly from applied road salt)
- **Toxics** (Manufactured and refined products like oil, paints, anti-freeze)

When evaluating the risk associated with potential contaminants the Holland SWIPP team has identified three different areas of concern. In order of importance/risk the areas are: 1) Critical Assessment Zone; 2) Buffer Zone; and 3) Macatawa Watershed.

3.2.1 Critical Assessment Zone (CAZ)

The Critical Assessment Zone was identified by USGS as part of the Source Water Assessment Program (SWAP) and is defined as the most susceptible area where releases to the environment are most likely to impact the Holland water intake. As such, this is the area where USGS recommends focusing management strategies and resources to benefit the drinking water resources.

The CAZ for the Holland water system encompasses a 1,000 foot diameter area centered over the intake. The area is calculated based upon the length and depth of the intake. It should be noted that the CAZ does not intersect the shoreline and there is no shoreline susceptible area.

3.2.2 Buffer Zone

The Buffer Zone encompasses a 10,000 foot diameter area centered over the intake and provides a factor of safety of 10 over the CAZ delineated in the SWAP. This is the area where Holland plans to focus the majority of the management strategies and resources to protect.

3.2.3 Macatawa Watershed Drainage Area

While only a portion of the Macatawa watershed is included in the Buffer Zone previously defined, it is acknowledged that flows from Lake Macatawa have a noticeable influence on the water quality and chemistry at the intake. This influence is most pronounced during large storm events or thermal inversions when the water from the Macatawa watershed has increased quantities of sediment and detritus. These materials enter the WTP through the intake and may cause treatment difficulties.

The Macatawa Area Coordinating Council (MACC) currently overseas the Macatawa Watershed Project which works with local units of government, farmers, homeowners, developers, educators, and other members of the community to increase awareness of how they impact the Macatawa watershed. As such, a representative from the MACC has been included in Holland's Source Water Protection team and the two groups plan to work closely together to accomplish the shared goal of protection of the Macatawa watershed and Lake Michigan water quality.

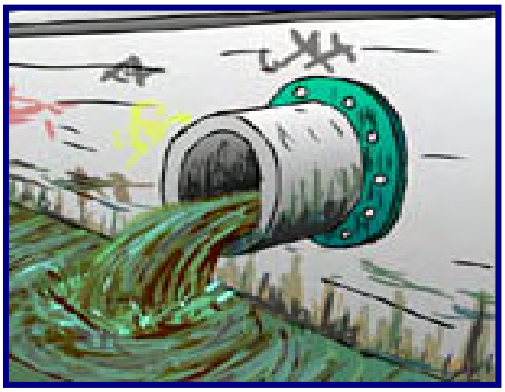
3.3 Contaminant Pathways

Contaminants can enter a water source through direct, piped and channeled discharges these are called *point sources*, or they can enter lakes, or streams from *nonpoint sources*. These pollutants are categorized in two ways:

1. The manner in which pollutants enter the water
2. The way pollutants can be treated and removed from water

3.3.1 Point Source Pollution

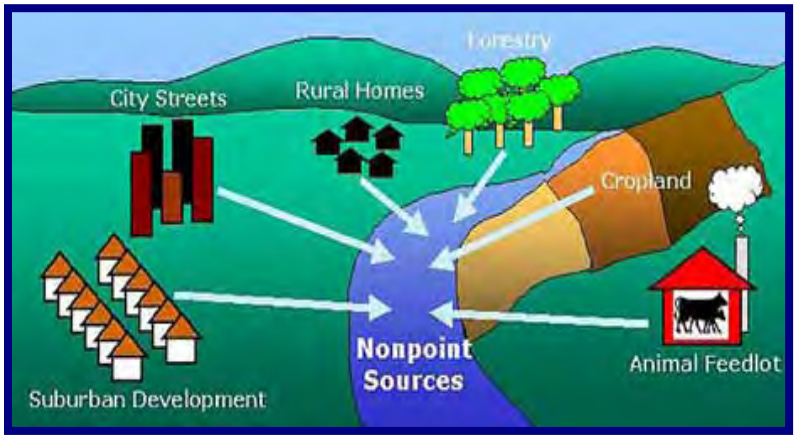
Pollutants can enter source water through direct, piped and channeled discharges these are called point sources. Anyone discharging, or proposing to discharge, waste or wastewater into the surface waters of the State is required by law to obtain a National Pollutant Discharge Elimination System (NPDES) permit. The NPDES program is intended to control direct discharge into the surface waters of the State by imposing effluent limits and other conditions necessary to meet State and federal requirements.



The NPDES program regulates pollutants discharged directly into waterways from wastewater sources. Indirect dischargers (those who discharge to a municipal treatment facility via a sanitary sewer) are not required to have an NPDES permit. Discharge to a storm sewer does not go to a municipal treatment facility, and is considered a direct discharge. Discharge to a municipal treatment facility may require a permit from the municipality under the Industrial Pretreatment Program. Holland has an extensive Industrial Pretreatment Program, details of which are provided in Appendix D.

3.3.2 Non-Point Source Pollution

Nonpoint sources considered to be major contributors to surface water pollution are: runoff from paved streets and parking lots, agricultural lands and construction sites; soil erosion from road cuts, streams and logging or farm operations; and atmospheric deposition of acidic or toxic air pollutants.



Transported soil can be both a pollutant itself and a vehicle for carrying other pollutants that become attached to soil particles. For example, the soil contains phosphorus, but much of the phosphorus added to soil through the use of fertilizers also is bound to the soil particles. When soil is disturbed (erosion), it may be transported by rivers and streams to the lake. The soil particles themselves may be considered a pollutant because they cause the lake water to become turbid. The phosphorus in the transported soil may later become available to aquatic plants. Particles may also protect microbes from harm in nature or in disinfection of drinking water.

Non-point sources are described as dispersed contamination from many sources such as soil erosion, on-lot septic systems, storm water discharges, agricultural activities, and pollution associated with resource extraction. The most significant contamination associated with non-point sources is nitrates associated with the use of manure, fertilizer, and pesticides that drain into streams and infiltrate into ground water. Household hazardous and commercial/industrial waste (e.g., ammonia, chlorides, paint, paint thinners, waste oil, antifreeze, solvents, etc.), which are sometimes discharged into on-lot septic systems, are also sources of non-point pollution. The potential risk from non-point sources is medium for the Intake Protection Areas.

It has been demonstrated that nonpoint source pollution from storm water runoff, agriculture activities and other nonpoint source pollutants in the Macatawa Watershed can directly affect the quality of the raw water intake. Despite cases of total and fecal coliforms, organic and inorganic compounds, and microorganisms found in the raw drinking water, the Holland Water Treatment Plant has effectively treated the source to meet drinking water standards.

To educate the community about non-point source pollution, the SWIPP Team recommends the installation of Water Supply Area signs, purchase and distribution of non-point source pollution prevention educational materials, and working with local school districts to design a curriculum that includes source water protection materials.

3.3.3 Potential Future Sources

Undeveloped land areas represent the potential for future contamination sources. There are some large areas of undeveloped land in the northern portion of the Source Water Buffer Zone. These lands are primarily zoned low density residential or rural estates residential. Therefore, based on the zoning within the Buffer Zone, the risk associated with future contamination sources is relatively low.

However, there are substantial areas within the Macatawa Watershed that are undeveloped and these areas include residential, industrial, agricultural and commercially zoned land. While these areas provide less potential risk to the intake, they still should be considered.

This area will be targeted by:

- Providing specific education and outreach materials for local planning and zoning agencies.
- Recommending the usage of environmental information forms to assist planning, zoning and building permits offices with decision making.

3.4 Types of Potential Contaminants Listed by Land Use

Land use activities can pose a wide range of pollution threats to a water supply. Table 3.4.a highlights potential contaminants and the associated land use activities that could generate them. A computerized database search and field study of the Holland Source Water Protection areas was completed in March/April 2010 to identify potential contaminate sources. The following sections discuss those sources.

Table 3.4.a: Potential Sources of Contamination and Associated Land Use Activities

CONTAMINANT	ACTIVITY
Biological Contaminants	Manure spread/pits
	Wells
	Landfills
	Wastewater treatment plants
	Septic Systems
	Storm water
	Grazing/feeds lots/livestock enterprises
	Cemeteries/funeral homes
	Reuse irrigation
	Sewer system overflows/bypasses/pumping
	Transfer stations
	RCRA sites
Volatile Organic Chemicals (VOCs)	Marinas
	Gas stations
	Petroleum products production, storage and distribution centers
	Dry cleaners
	Landfills
	UST facilities
	Superfund sites
	Septic systems
	Liquid petroleum gas storage, production and distribution
	Junkyards/salvage yards
	Recycling centers
	RCRA sites
Synthetic Organic Chemicals (SOCs)	Golf courses
	Agriculture
	Crop dusting/cropland
	Manufacture and storage of pesticides and herbicides
	Superfund sites
	RCRA sites
Inorganic Chemicals (IOCs)	Metal electroplating
	Landfills
	Foundries
	Superfund sites
	Pharmaceuticals
	Junkyards/salvage yards
	Transfer stations
	RCRA sites
Radiochemicals	Radioactive wastes
	Natural occurring geological deposits
	RCRA sites

3.4.1 Residential

Every day over 57,000 residents rely upon surface water for vital domestic necessities. Because we use surface water every day, protection of this resource is vital. Most citizens are unaware of the effects of numerous potential contaminants stored, used, and disposed of from residential homes.

<u>The potential contaminants include:</u>

- Household Chemicals
- Lawn/Garden Chemicals
- On-Site Septic/Sand Mound Systems
- Automotive Products
- Paints/Solvents
- Abandoned Wells
- Fuel Storage Systems

3.4.1.a Household Hazardous Waste Collection Programs

Numerous programs exist within the communities encompassing the Source Water Protection Areas to promote proper household hazardous waste collection and recycling. The SWIPP team promotes the continuation and expansion of such programs. Examples of existing programs include:

- **Household Hazardous Waste Disposal**

  The Ottawa County Health Department provides free disposal of household hazardous waste to County residents at its four Resource Recovery Centers. One of these centers is conveniently located in Holland Charter Township to serve the residents of Ottawa County. Wastes collected include used motor oil and filters, anti-freeze, old gasoline, computers, car batteries, aerosols, oil based paint, pesticides, garden chemicals, household cleaners, mercury, drain cleaners, solvents, paint thinner & stripper, pool & spa chemicals, and fluorescent light bulbs.

  The Allegan County Health Department has a similar program for its residents with two Resource Recovery Centers. General hazardous waste materials are to be disposed of at their center in the City of Allegan. Pharmaceutical and laboratory chemicals are handled at a facility in Plainwell.

- **Mercury Recycling**

  Starting in 2004, the Holland Board of Public Works began a program that made digital thermometers available in exchange for old mercury thermometers. Additionally the BPW has provided educational literature about the dangers of mercury, common household items that might contain mercury and how to properly dispose of the items. The exchange has been promoted via the distribution of a news release, a television interview, and the running of a news announcement on local cable television. Residents are able to trade thermometers during working hours at the BPW's Customer Service.

Starting in January 2005, the utility began offering the exchange to local businesses. Holland Board of Public Works' staff go to a company's site, set up a table in a high traffic flow area, and exchange thermometers during a lunch break or shift change. Area churches have also been invited to participate, via a local Parish Nurse Network. Thirty-three such exchanges, representing over 15,000 employees and church members, have been held to date. To date over 72 pounds of mercury have been collected so far, represented by over 1,200 fever thermometers, over 100 lab thermometers, approximately 50 thermostats, and approximately 60 mercoid switches.

Latex paint can be disposed of by taking off the lid and letting it dry. Kitty litter can be added to the paint to accelerate the drying process. Dried latex paint cans are then put in the regular garbage.

3.4.1.b Residential Development Best Management Practices

The Holland Surface Water Intake Protection Buffer Zone is located within a residential area with many potential sources of contamination. There is a potential for more residential development in this Buffer Zone. This area is primarily served by Municipal and on-lot septic systems. The Holland SWIPP Team plans to distribute materials (by mail) to all residences in the Buffer Zone for the household hazardous waste collection program. The Holland SWIPP Team will also work with the Macatawa Area Coordinating Council to distribute educational materials by mail as appropriate to residences in the Macatawa Watershed District.

Improperly applied chemicals such as pesticides, fungicides and fertilizers can leach through the soil or runoff into the water supply and can present a contamination threat to drinking water supply. When stored in containers, there is the potential of leaks from the storage area onto the ground. There are sizeable agricultural areas within the Macatawa Watershed. As a whole, the threat to this supply from agricultural sources is considered to be a moderate risk.

3.4.2 Agriculture and Water Quality

Eliminating impacts of agriculture on water quality is as critical to the future viability of agriculture as ensuring adequate water supplies. Potential water quality impacts include point-source pollution (such as discharge of wastewater from confined animal feeding operations and dairies) and non point-source pollution (such as nutrient loading of drainage water and sediment and pesticide loading of winter runoff).

Agricultural practices may also have negative impacts on water quality. Agricultural methods may elevate concentrations of nutrients, fecal coliforms, and sediment loads. Increased nutrient loading from animal waste can lead to eutrophication of water bodies which may eventually damage aquatic ecosystems. Animal waste may also introduce toxic fecal coliforms which threaten public health. Lastly, grazing and other agriculture practices may intensify erosion processes raising sediment input to nearby water sources. Increased sediment loads make drinking water treatment more difficult while also affecting fish and macroinvertebrates.

3.4.2.a Agriculture Waste Management

Pesticides and fertilizers can contaminate waterbodies by several routes, including spillage, improper storage, application too near or into ditches and streams, leaching from soils, or washed away in runoff. Agricultural operations, if not properly managed, can discharge a wide range of contaminants, including those from manure, fertilizers, pesticides, and eroded soil particles. The most worrisome contaminants are ammonia, nutrients, pathogens, and sediments. Ammonia is toxic to fish, while nutrients can impair water quality. Manure is a significant source of nitrogen, phosphorus, biochemical oxygen demand, and waterborne diseases. Proper management is required to avoid adverse effects to water supplies and human health. Environmentally sound use of manure from farms is a constant challenge in the agricultural industry.

Producers are finding new ways to capture nutrients while reducing manure rates and the potential for manure to contaminate surface waters. Land application of manure is the oldest and most sustainable method of livestock and crop farming. But land application comes with positive and negative consequences, sometimes within the same practice (Rector and Harrigan, MSU Extension).

The main goals are to keep the manure nutrients in the root zone which, reduces odors, retains nitrogen, saves money and decreases the risks of manure reaching surface waters. Actions to reduce the risk of manure reaching surface waters by Holland the *Generally Accepted Agricultural and Management Practices for Manure Management and Utilization* practices will form the foundation of a site-specific manure land application plan.

3.4.2.b Concentrated Animal Feed Operations

In agriculture, a **Concentrated Animal Feeding Operation** (**CAFO**) is a farm that raises livestock and seeks to maximize production by making highly efficient use of space and other resources. Operating a CAFO is sometimes referred to as factory farming, though the term is now officially used to recognize most commercial animal growing operations, even those that are quite small.

INTERIOR OF A HOG CONFINEMENT BARN

CAFOs can hold large numbers (some up to hundreds of thousands) of animals, often indoors. These animals are typically cows, hogs, turkeys, or chickens. The distinctive characteristics of a CAFO are the concentration of livestock in a given space. Food is supplied in place, and artificial methods are often employed to maintain animal health and improve production, such as therapeutic use of antimicrobial agents, vitamin supplements and growth hormones.

The designation CAFO, used in the US, resulted from the 1972 Federal Clean Water Act, which was enacted to protect and restore surface water—lakes and rivers—to a "fishable, swimmable" quality. The United States Environmental Protection Agency (EPA) identified certain animal feeding operations (AFOs), along with many other types of industry, as point source polluters. These operations were designated as CAFOs and subject to special anti-pollution regulation. So far, 139 large concentrated animal feeding Operations (CAFOs) have been verified under the voluntary Michigan Agriculture Environmental Assurance Program (MAEAP). While no CAFO facilities exist within the Holland Source Water Buffer Zone there are several within the Macatawa Watershed. The facilities are listed among the National Pollutant Discharge Elimination System (NPDES) permitted facilities in Appendix O.

3.4.2.c CAFO Waste Management

The U.S. Department of Agriculture and the Environmental Protection Agency recently released a proposal that they hope will lessen the effects livestock and poultry farms could have on water quality and public health. "The basic proposal is that all farmers that have animals will be required to have what they call Comprehensive Nutrient Management Plans. Producers are finding new ways to capture nutrients while reducing manure rates and the potential for manure to contaminate surface waters. Land application of manure is the oldest and most sustainable method of livestock and crop farming. But land application comes with positive and negative consequences, sometimes within the same practice (Rector and Harrigan, MSU Extension).

The main goals are to keep the manure nutrients in the root zone which, reduces odors, retains nitrogen, saves money and decreases the risks of manure reaching surface waters. Actions to reduce the risk of manure reaching surface waters by reading the *Generally Accepted Agricultural and Management Practices for Manure Management and Utilization* practices will form the foundation of a site-specific manure land application plan.

3.4.2.d Field Crops

Another potential source of contamination is the chemical run-off from cropland within the Macatawa Watershed. As a result one of the desires of the project would be to reduce agricultural chemical levels in the watershed. Allowing cover to remain on the land will have an immediate effect upon water quality related to sediment loading into the waterways. It follows that if runoff events can be slowed down, reduced, or eliminated, amounts of nutrients and chemicals entering the water system will be reduced.

Table 3.4.2.d: Field Crops in 2001, Ottawa County, Michigan

Crop	Planted (1,000 acres)	Harvested (1,000 acres)	Yield per harvested acre (bushels)	Production (1,000 bushels)
Barley	0.8	0.8	44.0	33.0
Corn	5.7	4.4	48.0	210.0
Oats	5.7	4.4	48.0	210.0
Soybeans	0.9	0.8	16.0	13.0
Wheat, All	3.4	3.3	70.0	230.0
Wheat, Winter	3.4	3.3	70.0	230.0

Source: National Agricultural Statistics Service

3.4.2.e Targeting Agriculture Water Quality

Holland SWIPP Team is planning to work with the Macatawa Area Coordinating Council and County Conservation Districts to achieve maximum agricultural pollution prevention. Resources will be targeted towards priority concerns, priority areas and priority farms. One risk in not prioritizing is that resources would be spread so thinly that there would be no observable effect. Targeting will require a process that:

- within priority areas articulates the goals for water quality as a priority concern
- within priority areas, identifies those farming practices that are the probable major contributors to sourcewater concerns
- provides a concerted, coordinated effort tailored to the individual farm situation to overcome any barriers so that these farms can change their farming systems and reduce or prevent sourcewater pollution
- within priority areas provide education and technical assistance tailored to meet farm-specific situations

3.4.2.f Manure Storage Facilities

Farmers store animal manure so they can spread manure when crops need the nutrients. They save money because they do not need to purchase as much fertilizer. Accumulating manure in a concentrated area, however, can be risky to the environment and to human and animal health. Poorly designed or mismanaged manure storage systems can allow contamination of drinking water sources by the nutrients and disease-causing organisms contained in animal wastes.

Facilities, which store manure in liquid form on the homestead, may leak or burst, releasing large volumes of pollutants. Manure in earthen pits usually forms a semi-impervious seal of organic matter that does limit leaching potential, but seasonal filling and emptying can cause the seal to break down. Short-term solid manure storage and abandoned storage areas can also be sources of nitrate contamination.

If nitrate concentrations in drinking water are greater than federal and state drinking water standards of 10 mg/L,* nitrate-nitrogen can pose health problems for infants younger than 6 months of age, including the condition known as methemoglobinemia (blue baby syndrome) water supply may prove harmful, especially in combination with high concentrations (1,000 ppm) of nitrate-nitrogen from feed sources.

Microorganisms in animal manure can contaminate source water, causing such infectious diseases as dysentery, typhoid, and hepatitis. Organic materials that lend an undesirable taste and odor to drinking water are not known to be dangerous to health, but their presence suggests that other contaminants can be flowing into the drinking water source.

The SWIPP Committee will investigate working with the Ottawa and Allegan County Conservation Districts utilizing the Farm-A-Syst program to achieve agricultural pollution prevention. The targeted programs will promote source water education and site-specific inventorying of potential source contaminants as the main pollution prevention program.

3.4.3 Industrial

Industrial operations commonly use toxic substances as part of manufacturing, warehousing, and/or distribution. Materials such as chemicals, petroleum, cleaning supplies, machinery, metals, electronic products, asphalt, and others pose a potential threat to Holland's water supply and must be managed.

The Holland contaminant source inventory shows several known and potential sources of contamination within the delineated Intake Protection Areas (Buffer Zone and Macatawa Watershed). Potential Environmental contamination within the SWIPP includes disposal areas, utility stations, agricultural and residential areas, and transportation routes. There are also some known sources of contamination that lie near but outside the Intake Protection Areas

3.4.4 Commercial

Many commercial operations use toxic and hazardous materials in their processes. The storage, use, and disposal of chemicals required by these operations can pose a potential threat to water since even small amounts of the hazardous materials can contaminate large amounts of surface or ground water. Storing quantities of the materials can also create a serious problem if they are not contained and stored properly. Leaks and spills from storage tanks and pipes can contaminate water, rendering the water unfit for consumption.

The Source Water Protection Team would like to install Water Supply Area signs, develop community education packets, and provide speakers and demonstrations at schools, civic and business meetings, and fairs to raise awareness about source water protection.

3.5 Pollutants

Pollutants can be classified by treatment technology as conventional, non-conventional or toxic.

3.5.1 Conventional Pollutants

Bacteria associated with the intestinal tract of humans (fecal bacteria, as indicated by the coliform group) are conventional pollutants and can easily be destroyed by disinfection with chlorine, ozone or ultraviolet light.

3.5.2 Non-Conventional Pollutants

Non-conventional pollutants include excessive levels of nutrients, such as nitrogen and phosphorus, which require more advanced treatment to be removed for drinking water. These substances may come from many sources, including fertilizers, atmospheric deposition, and sewage.

3.5.3 Toxic Pollutants

Toxic pollutants such as heavy metals (chromium, lead), inorganic chemicals (salts, acids), and organic chemicals (pesticides, solvents) can damage human health, aquatic organisms, and the overall health of the ecosystem. Toxic effects can be acute, causing immediate death or impairment, or chronic, causing subtle damage that may not emerge until years after exposure. Toxics often persist in the environment, collecting either in water or in Lake Bottom sediments. Toxics can bioaccumulate in the tissues of organisms after repeated intake or exposure.

3.5.4 Superfund Projects

Years ago, people were less aware of how dumping chemical wastes might affect public health and the environment. On thousands of properties where such practices were intensive or continuous, the result was uncontrolled or abandoned hazardous waste sites, such as abandoned warehouses and landfills. Citizen concern over the extent of this problem led Congress to establish the Superfund Program in 1980 to locate, investigate, and clean up the worst sites nationwide. The EPA administers the Superfund program in cooperation with individual states and tribal governments. The office that oversees management of the program is the Office of Superfund Remediation Technology Innovation (OSRTI).

There are no superfund sites in the immediate buffer zone but two exist within the Macatawa Watershed. Details of the Superfund program projects: **WASTE MANAGEMENT OF MICHIGAN (HOLLAND LAGOONS) EPA ID# MID060179587**, and **SOUTHWEST OTTAWA COUNTY LANDFILL EPA ID# MID980608780** are provided in Appendix I of this document.

3.6 Municipal Storm Water Management

Surface water flows within the watershed occur as overland runoff and as stream flow. Overland flow, or storm water as it is commonly called, is generated when the capacity of the soils and vegetation to absorb water from precipitation is exceeded and water runs across the surface of the land. In clay-rich soils, the water-retention capacity is low and runoff from these soils is generated quickly. In sandy soils, a larger portion of the precipitation infiltrates the land surface and recharges the underlying groundwater system, resulting in less runoff.

Since precipitation-generated runoff is the major transport mechanism for non-point source pollution, a direct relationship exists between the timing and magnitude of precipitation events and the resulting level of non-point source pollution. Factors that affect the rate at which precipitation becomes runoff include the soil moisture conditions at the time of the precipitation event, vegetation type and density, and urbanization with its associated impervious surfaces. Clearly, larger and more intense rain events carry more pollutants from the watershed into down gradient waters.

3.6.1 Urban Developments

Urbanized land contributes large amounts of contamination to water bodies via storm water runoff. Urban areas are characterized by a higher percentage of impervious surface coverage; thus, the ability of storm water runoff to transport more pollutants is magnified.

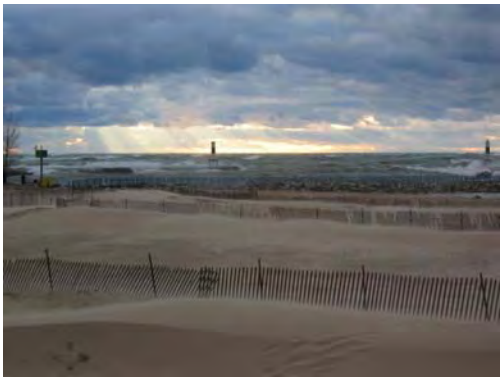
Urban developments tend to encroach on natural resources as well, allowing more and more people the opportunity to use lakes, rivers, beaches, and wetlands. Each natural habitat use has a one-time impact and a cumulative effect – many small impacts add up over time. Water-quality degradation caused by development also fragments existing habitats, restricting the territory available to plant and animal species and eliminating buffers between them and human use areas. Precipitation can carry increasing amounts of inorganic contaminants and sediments to surface waters, particularly from heavily developed areas.

3.6.2 Storm Water System

All storm water from the City of Holland eventually enters the Macatawa River and Lake Michigan. There are industrial storm water NPDES (Point Source Section) discharge permits in the Macatawa Watershed and these storm water permits require the facility to submit a storm water pollution prevention plan and focus more on site management than point source treatment (NMS Web Inquiry System).

3.6.3 Storm Water Systems Maintenance and Repairs

The City of Holland Transportation Services Department maintains and repairs the storm system within the City rights-of-way. The County drain and road commissions are responsible for storm water systems outside of the city. This includes cleaning the tops of the catch basins to allow for maximum intake of the catch basin structures, repairing failing manhole and basin structures and installing new systems, as they are deemed necessary.



As stewards for the Clean Water Act, City and County employees monitor storm sewers for illegal deposits of environmentally harmful materials; such as any automotive fluids, waste from RV's, etc. Illegal discharges items into a catch basin should be reported to the 24 hour Pollution Emergency Alert System (PEAS) at 1-800-292-4706.

Authority varies based on jurisdiction over the design and construction of structural facilities that convey and treat storm water runoff that will be generated from a site as a result of its design. Jurisdictional rules will govern the design of such management facilities with the following objectives:

- Incorporate design standards that control both water quantity and quality
- Encourage innovative storm water management practices that meet the criteria contained within these rules
- Place greater emphasis on the maintenance of facilities
- Make the safety of facilities a priority
- Strengthen the protection of natural features
- Encourage more effective soil erosion and sedimentation control measures

Storm water management technologies are rapidly developing and improving and storm water rules provide minimum standards to be complied with by proprietors.

3.6.4 Storm Water Overview

Storm water pollution from point sources and nonpoint sources is a challenging water quality problem. Unlike pollution from industry or sewage treatment facilities, which is caused by a discrete number of sources, storm water pollution is caused by the daily activities of people everywhere. Rainwater and snowmelt run off streets, lawns, farms, construction and industrial sites and pick up fertilizers, dirt, pesticides, oil and grease, and many other pollutants on the way to our rivers, lakes, and coastal waters.

Storm water runoff is our most common cause of water pollution. Because storm water pollution is caused by so many different activities, traditional regulatory controls will only go so far. Education and outreach are key components to any successful storm water program. The primary method to control storm water discharges is through the use of Best Management Practices, or BMP.

3.6.5 Phase II NPDES Requirements

In response to the growing need for storm water quality protection, the Environmental Protection Agency (EPA) developed a phased storm water control program; Phase I targeting large Municipal Separate Storm Sewer Systems (MS4) operators, and Phase II targeting approximately 5,000 small to medium-sized MS4 operators and as many as 200,000 construction sites (1 to 5 acres). Several communities within the Macatawa Watershed are designated as a small to medium-sized MS4 and have the new Storm Water Phase II NPDES requirements to comply with Stormwater Phase II EPA Final Rule. These size designations were based on the 2000 Census Urbanized Area Map.

The EPA controls storm water and sewer overflow discharges through its National Pollutant Discharge Elimination System (NPDES). NPDES provides guidance to municipalities and state and federal permitting authorities on how to meet storm water pollution control goals as flexibly and cost-effectively as possible. In Michigan, the state permitting authority is the Michigan Department of Natural Resources and Environment.

In March 2003, regulated MS4 operators in the Lake Macatawa watershed were required to obtain authorization to discharge storm water under the Stormwater Watershed Based General Permit MIG619000 Stormwater Discharges from MS4s Subject to Watershed Plan Requirements. This permit, valid for 5 years, expired April 1, 2008. The permittees in the Macatawa Watershed have applied for coverage under the new permit, MIG610000.

Communities with Phase II Stormwater Permit:

- Allegan County (Road Commission and Drain Office)
- Ottawa County (Road Commission and Drain Office)
- City of Holland
- City of Zeeland

In response to these new regulations, these communities began developing a plan for compliance in 2000 by creating a Stormwater Committee that was comprised of representatives of all communities in the watershed. Together, this committee worked on developing the application and associated plans required for submittal to the MDEQ in March 2003. In November of 2003, the above communities became Permittees after their applications were approved and they received their Certificates of Coverage for discharging stormwater under NPDES General Permit MIG619000.

The Macatawa Watershed Project has been a member of this committee representing the goals of the watershed for water quality issues, in addition to assisting with public education and participation.

Some general requirements of the General Permit include:

- IDEP – Illicit Discharge Elimination Plan
- PEP – Public Education Plan
- WMP – Watershed Management Plan
- SWPPI – Storm Water Pollution Prevention Initiative
- PPP – Public Participation Process

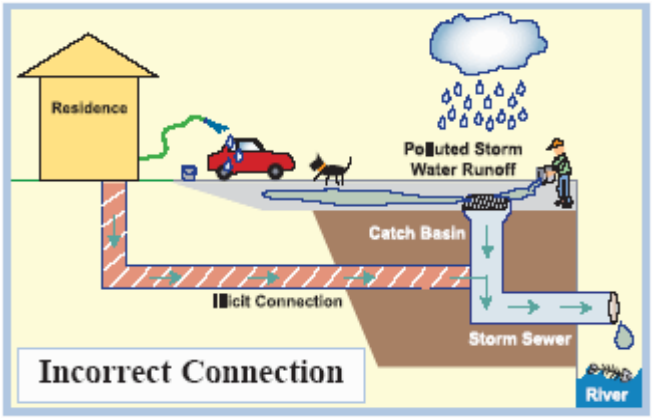
For more detailed information about municipal storm water permitting go to the MDNRE Storm Water Website.

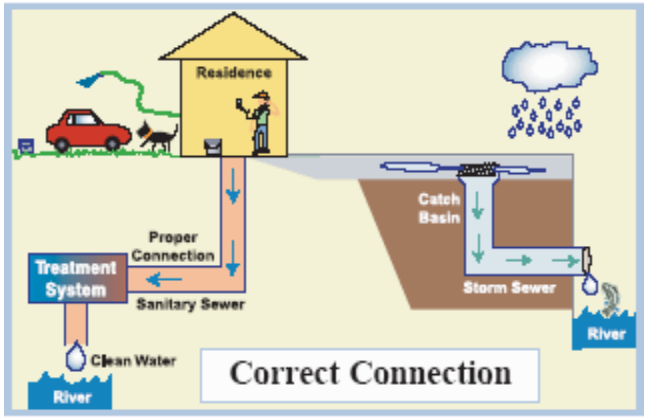
3.7 National Pollutant Discharge Elimination System (NPDES)

The Clean Water Act of 1972 set up the NPDES. The NPDES program required communities around the country with urbanized areas to begin tackling the issue of storm water pollution. In recent years, several communities in Local Counties were required to develop an illicit discharge elimination program (IDEP). The IDEP was required to include an investigation of the waters of the state to identify, and eventually eliminate, illicit discharges and connections to the storm sewer.

3.7.1 Spotting an Illicit Discharge or Connection

- Look for makeshift pipes or hoses that lead to a storm drain or body of water.
- Watch for stains, unusual odors, structural damage to streets or gutters, and abnormal vegetative growth in nearby lakes and streams.
- If you see illicit discharges or connections, REPORT IT to your community. Ordinances adopted by the communities in the SWIPP Areas give them legal authority to inspect and sample discharge, as well as enforce violations.





Source: ght.org/Community/StormWater.htm

3.8 Transportation Routes

There are many highway spills reported in Michigan each year. Chemicals, from accidental spills, are often diluted with water; potentially washing the chemicals into the soil or nearby surface water and increasing the potential for contamination. Oil spills can create plumes that travel with runoff water flow for long distances. Additionally, de-icing compounds used on transportation routes can contaminate water.

Highway Accidents Involving Tank Trucks or Spills are outlined in the Ottawa County Emergency Management Disaster Operations Plan. This plan outlines the contacts for any emergencies related to spill or tank truck accidents. Highway spills likely represent one of the greatest threats to any drinking water source in the Intake Protection Areas. US-31 and I-196 which is located within the Holland Source Water Intake Protection Area could present a risk of potential contamination.

3.9 Waste Management (Waste Data System)

Michigan Department of Natural Resources & Environment (DEQ) Waste Management Division (WMD) administers a diverse number of prevention programs to protect the environment and the public's health through proper management of solid, liquid, and hazardous waste. The division is organized into six sections: Hazardous Waste, Sourcewater, Solid Waste, Enforcement, Field Operations, and Administration.

The Waste Data System (WDS) tracks activities at facilities regulated by the Solid Waste, Scrap Tire, Hazardous Waste, and Liquid Industrial Waste programs. WDS provides information on ownership and operation of the facility; the status of any required permits, licenses, registrations, or certifications; compliance status; authorized transporters; shipments of hazardous or liquid industrial waste (manifest); and user fees. The WMD staff in the Hazardous Waste Inspection Program maintained twelve different databases and two Federal for tracking program activity. The objective of this project is to develop an integrated database to house all the information relative to the Waste Inspection program and combining the State and Federal database into one system.

US-31 and I-196 which is located within the Holland Source Water Intake Protection Areas and could present a risk of potential contamination. Highway Accidents Involving Tank Trucks or Spills are outlined in the Ottawa County Emergency Management Disaster Operations Plan. This plan outlines the contacts for any emergencies related to spill or tank truck accidents. Highway spills represent one of the many threats to any drinking water source.

3.10 Underground Storage Tanks

Although modern USTs meet federal and state regulatory requirements, they still represent a potential source of groundwater contamination. Small leaks, sometimes too small to detect, can develop and allow gasoline, oil or chemicals to reach the source water (Appendices J & K).

Source Water

Priorities, Management Tools and Options

City of Holland – Holland Board of Public Works

Ottawa and Allegan Counties, Michigan

SECTION 4 MANAGEMENT APPROACHES FOR CONTROLLING POTENTIAL SOURCES OF CONTAMINATION WITHIN THE SOURCE WATER PROTECTION AREA

4.1 Mission Statement for Holland's Surface Water Intake Protection Program

Holland will ensure a safe drinking water source for residents by identifying historical, existing, and future threats; by formulating appropriate strategies to those threats, by educating residents by encouraging support and participation in the creation and implementation of the program; and by promoting intergovernmental cooperation to assure protection of water resources.

4.2 Introduction

Surface water in Holland is the primary water resource for water supply. It is the most economically feasible source of water for the community. This surface water has the capability to easily meet the present and future demands of the community.

Several factors will influence the types of management approaches that Holland will utilize with this plan; some of these factors are:

1. Land Use

2. The potential for intergovernmental cooperation among the City, Townships and County will be pivotal as it relates to enforceable restrictions other than those enforced by the State or Federal agencies. This will be especially important for updating the Master Plan and its success in incorporating source water protection principles.

The City of Holland SWIPP Management Plan is designed to protect the municipal water supply from contamination or disruption of the supply. The City of Holland is the local agency with the primary responsibility for overseeing the development and implementation of the Plan. They have chosen to utilize a volunteer and community based management strategy. This approach brings together the people within the source water protection areas to address those activities, regardless of existing political boundaries; it also results in solutions that respect the community's unique social, economic, and environmental conditions and values.

The Holland Surface Water Intake Protection Plan encourages the involvement of local stakeholders. Their participation creates a sense of commitment to resolve identified problems, develop solutions and thus ensuring long-term support for resulting management plans.

The SWP Management Plan Consist of:

1. Resolutions-City and County

2. Environmental land use survey form

3. Updating the inventory database of all hazardous chemicals within SWPAS- C.S.I. is up-to-date and working with local and state agencies to maintain a current inventory status.

4. Managing potential sources of contamination (Interagency coordination to incorporate source water protection language into regional response procedures)

5. Managing potential physical threats to the intake and raw water pumping systems

6. Establishing protocol for notifying and responding to potential source water contamination incidents. (meet with the local emergency response teams)

7. Implementing a contingency (emergency action) plan (meet with the County 911 & County Emergency Response Teams to incorporate source water protection contingency language into regional response procedures)

8. Monitoring use of fertilizers and pesticides (work with County Conservation Districts to distribute best management practices brochures)

9. Notifying property owners in the Surface Water Intake Protection Area-Developing outreach program utilizing mailings

10. Educating owners of potential contaminant sources (education & outreach)

11. Increasing public awareness- Developing outreach program working with local school districts, utilizing public resources (i.e. local cablevision station, newspaper and mailings)

12. Participating in city and county site plan reviews

13. Promoting the Household Hazardous Waste Collection Programs

4.3 Management Tools and Options

The Holland Surface Water Intake Protection Plan encourages the involvement of local stakeholders, their participation creates a sense of commitment to resolve identified problems and develop solutions, thus ensuring long-term support for resulting management plans.

4.4 State and Local Cooperative Responsibilities for Source Water Protection

4.4.1 Local Agencies

City of Holland, acting by and through its Board of Public Works (BPW) is the agency with the primary responsibility for overseeing the development and implementation of the source water protection program. The Holland BPW is the local agency responsible for updating the Surface Water Intake Protection Management Plan. BPW staff will work with consultants and local stakeholders to institute required management activities.

The Local Planning and Zoning Agencies are responsible for administering the zoning within the Surface Water Intake Protection Areas. The SWIPP Team will work with the local zoning and planning agencies to recommend Surface Water Intake Protection language for land use and zoning planning.

The Water Treatment Plant Superintendent will provide guidance and oversight throughout the program development and implementation.

City Transportation Services Department and the Ottawa and Allegan County Road Commissions will notify the proper authority of any highway related hazardous waste spills within the Intake Protection Areas.

Ottawa and Allegan County Health Departments will administer sewage permits, administer drinking water well permits and well abandonment outside the municipal system.

Ottawa and Allegan County Emergency Services Coordinators are responsible for administering emergency responses. The Coordinators will notify the BPW of potential spills that may result in source water contamination. Local emergency/fire departments should have an up-to-date list of hazardous chemicals identified during site inspections.

Ottawa and Allegan County Conservation Districts will continue to work with agricultural landowners to inventory of potential sources of contamination and education on source water protection.

4.4.2 State Agencies

Michigan Department of Transportation will notify the proper authority of any highway related hazardous waste spills.

MDNRE - Drinking Water Division will provide guidance, review, approval and assistance with siting, permitting, monitoring and regulating public water supply systems.

MDNRE Storage Tank Division will regulate underground and above ground storage tank systems.

MDNRE Environmental Response Division will work with emergency response team on reported spills within the Source Water Protection Areas.

MDNRE Remediation and Redevelopment Division will provide guidance relative to Brownfield and Superfund sites within the Source Water Protection Areas.

Michigan Department of Agriculture will regulate pesticide and fertilizer storage and use practices.

4.4.3 Management Activities

Interagency coordination and communication

A user-friendly source water protection management plan requires coordination between city departments as well as adjacent jurisdictions, local agencies and state agencies.

This SWIPP partnership includes: City of Holland, Holland Charter Township, City of Zeeland, Laketown, Park, Allegan and Ottawa County Agencies, Macatawa Area Coordinating Council, Hope College, 911/Emergency Management, Holland Area Community Schools, the Michigan Department of Natural Resources & Environment. This SWIPP was developed to be a flexible, working document that allows for the easy assimilation of future data and information.

4.5 Intake Protection Area Commitment, Priorities, Management Tools and Options

The Holland Surface Water Intake Protection Committee recommends the following for City of Holland, Holland Charter Township, City of Zeeland, Laketown, Park, and portions of Allegan and Ottawa County's Planning Commissions and Committees where applicable in the Surface Water Intake Protection Area. The list is prioritized in the order of importance to the Planning Team.

4.5.1 Education/Outreach

The education and outreach program is a critical component to provide long-term protection of municipal and private drinking water supplies. The program's target audience will be homeowners, industrial and commercial businesses, and area schools.

The goals of the educational and outreach program include:

- Distribute SWIPP information brochures
- Design and install new "Drinking Water Protection Area" signs
- Deliver SWIPP presentations to local government and civic organizations
- Work with local school districts to educate students on SWIPP
- Develop and distribute miscellaneous materials to homeowners in the City and surrounding Townships (i.e. household hazardous waste material disposal sites, etc.)
- Utilize Public cablevision station for SWIPP videos and interviews
- Use City, Township, Holland BPW and MACC websites for posting up-to-date information concerning SWIPP

4.5.2 Industrial, Commercial & Agricultural Business Program

Within the Buffer Zone, businesses that use or generate hazardous waste present the greatest potential threat to the municipal water supply. It is the goal of this program to minimize potential negative impacts while encouraging a healthy business environment. To this extent, the effort that will focus on providing protection without greatly increasing regulations and operating costs.

- Update hazardous materials information from the firefighter's right to know inventory program.
- Assist businesses that use or generate hazardous substances to develop BMP program.
- Assist small businesses utilizing small quantities of hazardous materials develop BMP program.

4.6 Zoning and Land Use

While there are many, state and federal laws governing environmental protection, the first line of responsibility falls to local government. Unquestionably, land use planning and zoning is the most suitable place for local government to institute regulations that will protect water resources.

The SWIPP Team encourages agencies reviewing site plans to make sure local standards address hazardous materials storage and containment. Some suggested considerations during the site plan review process include:

- Sites at which hazardous substances are stored, used or generated be designed to prevent spills and discharges to source waters
- Secondary containment for aboveground areas where hazardous substances are stored or used be provided
- General purpose floor drains should only be allowed if they are approved by the responsible agency
- No discharges to surface or groundwater, including direct or indirect discharges, without required permits and approvals from State and Federal Agencies
- Include State and federal requirements for storage, spill prevention, record keeping, emergency response, transport and disposal of hazardous substances
- Utilize the MDNRE Environmental Survey and Hazardous Waste Reporting forms
- Develop compatible land uses and standards within the Intake Protection Areas

4.6.1 Water Supply Area Signs

The Drinking Water Supply Area signs, available to communities with a MDNRE-approved local SWIPP program, notify the traveling public that they will be traveling through a water supply area, the number of miles they will be traveling through this area, and the spill response number to call if there is a hazardous spill or accident. The SWIPP Team recommends that signs be located along major routes within the established Buffer Zone.

4.7 Emergency Operations Plan

4.7.1 Revisions to System Emergency Operations Plan

The City of Holland BPW will continue to review and update their Community Water Supply Emergency Response Plan on an annual basis. This will include adding provisions for the Surface Water Intake Protection Plan.

4.7.2 Revisions to the County Emergency Operations Plan

The SWIPP Team will make the SWIPP Plan available to county agencies for updating their Emergency Operation Plan.

Source Water Protection

Vulnerability Summary and Contingency Plan

City of Holland-Holland Board of Public Works
Ottawa and Allegan Counties, Michigan

SECTION 5 VULNERABILITY SUMMARY AND CONTINGENCY PLAN

5.1 Holland Vulnerability Assessment Summary

The City of Holland acting by and through its Board of Public Works completed a Vulnerability Assessment of the potable water system to meet the requirements of the 2002 Bioterrorism Preparedness and Response Act. The intent of the assessment was to provide a balanced review of the existing assets, policies, and procedures and offer recommendations for security improvements with the goal of balancing risk across all system elements.

It is important to be aware of the fact that risk cannot be eliminated. Threats can be identified and, in most situations, physical protection systems can be enhanced to reduce the risk. In some cases, physical protection system enhancements may not be feasible or may conflict with other important goals and objectives of the community. In these cases, it may be necessary for the Utility to accept the risk and put in place countermeasures to respond to the resulting potential malevolent act.

In general, the critical assets in the Utility's potable water system are reasonably well protected with regard to industry standards. The security measures put in place go a long way towards reducing risk. There are, however, a few significant vulnerabilities that should be addressed. The critical assets to protect include the following:

- all chemical feed systems and chemical storage tanks, including chemical deliveries
- pumping and metering stations
- filtration capacity
- high service pumps
- ground storage reservoirs
- transmission system piping
- elevated storage tanks
- SCADA system and related servers

Overall, Holland's success or failure depends on management's attitude toward security. Management must support the security program and set policies that are adhered to and enforced. The security policies need to be dynamic and change with the ever-changing nature of the risks that develop over time.

5.2 Contingency Plan Introduction

The goals and management strategies of the drinking water protection plan focus on proactive efforts that will protect the drinking water supply. In a sense, the purpose of developing management strategies is to reduce the likelihood of ever having to use the contingency portion of the Drinking Water Protection Plan. However, in the event that a contamination problem should ever occur, the City of Holland needs to be prepared to deal with this emergency. The purpose of this Contingency Plan is to design a response to the contamination or disruption of Holland's water supply. This plan focuses on:

- The identification of the primary potential threats to the water supply and
- Developing procedures to be followed should the threats materialize

5.3 Potential Threats to the Drinking Water Supply

Primary threats to the City of Holland's drinking water system are related to an interruption of water delivery or contamination of the surface water supply. The most likely types of events that could cause an interruption in delivery and/or contamination of the water supply include:

A. Mechanical problems: power outage, broken main, pump failure
B. Detection of a contaminant at the intake
C. Ice damage
D. Frazil Ice
E. Zebra Mussels
F. Low lake levels
G. Loss of intake Rip Rap
H. Poor Water quality
I. Changes in Lake bottom topography
J. Intake chemical feed system failure
K. Shipping Traffic/Anchor

5.4 Procedures for Incident Response

This section details the appropriate response for the most likely potential threats listed in the above section.

5.4.1 A/J/K - Mechanical-related interruptions

- Rely on reservoir capacity
- Utilize natural gas pumping unit (Le Roi Operational Procedures)
- Utilize Interconnections
- Implement Water Use Restriction Procedures

5.4.2 B - Detection of a contaminant at the intake

Response to the detection of a contaminant at the intake depends on whether the substance reaches or exceeds the maximum contaminant level (MCL) measured during the monitoring process. The MCL is considered to be the maximum concentration that a contaminant can be in drinking water without posing a significant health risk.

The MDNRE must be notified if a contaminant is recorded as being at elevated levels yet still is below the MCL for that substance, then additional monitoring should occur to track any changes in the contamination level at the intake and determine that the contaminant remains below the MCL.

If the confirmed concentration exceeds the MCL, the following procedures should be followed by City of Holland:

- Determine if reservoir is contaminated
- Send news release to local media.
- Notify residents and businesses about water use restriction measures needed to be taken. Implement Water Use Reduction Plan (see Appendix B).
- Cooperate with agencies investigating the suspected contaminant.

5.4.3 C – Ice Damage

The movement of ice can damage intake structures. This includes main intake and emergency intake riser. Divers perform annual inspections of all intake structures. Repairs are scheduled as needed.

5.4.4 D – Frazil Ice

Frazil ice is a collection of loose, randomly oriented needle-shaped ice crystals in water. It resembles slush and has the appearance of being slightly oily when seen on the surface of water. Its formation on the intake crib could inhibit the ability to draw water into the intake. It develops rapidly under optimum conditions. Frazil ice formation may occur whenever the following conditions are present:

- Lack of ice cover over the intakes
- Water temperatures near 32 degrees
- Cold clear nights (generally under 20 degrees)
- Wind is considered an essential requirement to promote surface cooling and promote downward movement of the super- cooled water to the intake.

Begin monitoring when conditions are favorable for Frazil Ice formation. Follow WTP Frazil Ice Operating Procedures (see Appendix B).

5.4.5 E – Zebra Mussels

Maintain a chlorine intake residual of 0.5 ppm when water temperatures are greater than 54 F.

5.4.6 F – Low lake Level

If lake levels fall below 577 feet, remove the blind flange from the emergency intake riser. Flow into the plant is increased by 4.5 mgd with the riser open. This work will be performed by divers. (Note: 0.75 mgd/foot of lake level change)

5.4.7 G – Loss of Rip Rap

Rip Rap is the intake's protective structure. It is comprised of large boulders placed around the entire intake crib. The barrier should be replaced as soon as possible to prevent damage to the structure.

5.4.8 H – Water Quality

The intake water quality is variable. Lake thermals, wind, runoff, water currents and Lake Macatawa can all have an impact on incoming water quality. Operational Staff is trained on steps to be taken for poor intake water quality conditions.

5.4.9 I - Lake Bottom Movement

The movement of Lake Michigan's sandy bottom can impact the ability to utilize the emergency intake riser. Divers would be mobilized if the emergency intake riser becomes unusable due to sand movement.

5.5 Notification Procedures

The Holland Board of Public Works has a Communications & Public Notifications Plan for the purpose of notifying the public should the water system become compromised in any manner.

Should there be a possibility of contamination or incident of the drinking water source; the impact on the water system will be evaluated.

Only trained persons should approach a fire or a spill. Attempt to identify material involved, hopefully with warning label information. Owner/operator of the facility or activity from which the spill originated should then be located and notified immediately. It is appropriate and beneficial for local authorities to make this contact. The owner/operator should be able to supply accurate information about the substance involved and to deploy initial spill counter-measures on short notice.

Necessary information for notification of the State will be gathered (See checklist in Appendix B for information needed).

Local Coordinator must then notify the Chemical Spill Emergency Management Division, Michigan State Sheriff - The Emergency Management Division is the lead state agency for responding to all hazard emergency and disaster incidents. The EMD is responsible for maintaining and implementing the Michigan Emergency Management Plan. Determination should be made if necessary to notify the: National Response Center at (800) 424-8802. (24 hr.) Michigan Emergency Response Center (mentioned above) has trained and experienced personnel.

Determination should be made if necessary to notify the:

The Michigan Department of Natural Resources, Environmental Response Division at (800) 292-4706 or (517) 373-7660

U.S. Environmental Protection Agency (Region 5) - The U.S. EPA serves as the Federal On-scene Coordinator for all inland environmental emergencies in the Great Lakes region.

5.5.1 Key Personnel and Development of a Notification Roster

In the event of an emergency situation, that threatens the water supply, key people must be notified and response procedures coordinated between city, county, and state personnel. A successful response also greatly depends on coordination and clear role definitions between local personnel from the Sheriff, Fire, and Public Works Departments.

If a call is received by 911, the Fire Chief or the Sheriff Department is the first to be dispatched in the event of an emergency spill. The nature of the incident determines who is dispatched. If the incidence involves a vehicle accident, the Sheriff Department is often the first to be notified. If the event is non-vehicle related and a spill reported, the Fire Department is normally the first to be notified by the 911 Dispatch Center. Both fire and sheriff will be notified if a contaminant is known to be present. If the 911-call taker can determine the nature of the contaminant by information provided at the time, dispatch will determine whether a HAZMAT Team is the appropriate responder. However, the Dispatch Center often does not have adequate information to make this determination.

During an emergency spill event, an incident command center is established to adequately and safely control the situation. The incident command system is dynamic, meaning that as events unfold, roles and responsibilities of personnel may change as the situation progresses. The person in charge of the situation may also change depending on who responds first. For example, Sheriff may be the first on the scene and in control of the situation until the Fire Department personnel arrive. In general, the Park Township Fire Chief has overall responsibility and authority for a contamination event in the Source Water Buffer Zone. If a spill occurs within the source water protection areas, the General Manager should be notified as soon as possible. Sheriff and Public Works personnel are responsible for aiding the Fire Chief in adequate, appropriate, and safe actions.

Key personnel and their roles are listed below:

County Sheriff personnel are often the first to be dispatched and respond to an emergency event. The Sheriffs are in charge of public safety until Fire District personnel arrive. Once the Fire Chief arrives at the scene, incident command control is relinquished to the Fire Chief. At the direction of the Fire Chief, the Sheriff's Department is responsible for keeping the area secured and providing support help.

For incidents in the Buffer Zone, the Park Township Fire Chief will be the person responsible for determining if local personnel can adequately and safely, respond to a spill event. The Fire Chief will contact the Hazmat Response Team if the situation and/or contaminant are beyond local equipment and personnel capabilities. If it is determined that a local response is adequate, the Fire Chief is the Incident Commander and determines and directs what is needed from Sheriff and other City personnel.

The City of Holland Water Superintendent coordinates necessary actions, making any decisions regarding the operation of the water system. The Water Superintendent provides technical assistance and any back-up support directed from the Incident Commander.

It is this person's responsibility to inform the Incident Commander of the spills location within the drinking water protection area and suggest any additional precautionary measures that need to be considered. This person also works with the county to prepare a press release to affected residents. Having a general draft of a press release in place will expedite this. Other local officials will also be notified by the local coordinator or someone else designated by the local coordinator.

The County Sheriff and Emergency Response Coordinators should be notified and will in turn inform the County Public Health Department and the Michigan Emergency Response System who in turn notifies other appropriate state agencies. Usually, the Fire Chief notifies the County Coordinator if the event requires county resources for response. However, if the County Coordinator is notified first, the Holland Water Superintendent will have a previously established arrangement with the County Coordinator to ensure that the City is notified when a spill emergency occurs within the source water protection areas. The Water Superintendent will also inform the County Coordinator of the location of the drinking water protection area.

The General Manager is responsible for notifying the BPW Board and determining if a full Board or subcommittee meeting should be called. The City Council will determine the level of water conservation measures to be taken if the water supply is reduced in an emergency.

5.6 Contaminant Cleanup

5.6.1 Responsibility

Responsibility to determine if the cleanup and contaminant is adequate is the Michigan Department of Natural Resources and Environment and the Environmental Protection Agency on the Federal Level.

If the responsible party is unknown or, not on scene Local and/or State representative should take charge of on scene operations. During the critical initial phase of response, it is imperative that the local coordinator, ranking local law enforcement official, and ranking fire officer be recognized.

If any person, company, agency responsible for the occurrence of the incident, or their appointed agent, has arrived on-scene and has assumed responsibility for all contaminant and cleanup operations, this person should be in charge of on-scene operations. Local and State agencies on scene should volunteer their services and assistance. The Michigan Department of Natural Resources and Environment is responsible for monitoring all removal operations and coordinating all State activities. Release of information to the news media will be coordinated with the Local Coordinator, Chief of Sheriff or designee, City Manager and Michigan Department of Natural Resources Environmental.

5.6.2 Disaster Declaration

If a disaster declaration necessary, this will be done by executive order or proclamation of the governor if it has been found that a disaster has occurred or that the threat of disaster is imminent. Such an order activates the recovery and rehabilitation phase of the State of Michigan Emergency Management Plan.

5.6.3 Disposal

Disposal of hazardous waste substances will be in an environmentally safe manner consistent with applicable State and Federal Laws and regulations.

5.6.4 Logistical and Financial Resources

City of Holland and the Holland Board of Public Works should participate in an emergency response situation only to the extent of providing assistance and information regarding the water system and the particular needs of the community. The City should not attempt any cleanup efforts on their own, although containment may be appropriate. The responsible party is legally obligated to report and clean up chemical releases. Appropriate cleanup measures will be dependent on the type and quantity of chemical released. The City may need to finance contamination cleanup and/or treatment if the responsible party is unknown or is the City itself. Potential funding sources include:

- Apply for State and Federal Emergency funds
- Increase City cash reserves
- Have a surcharge on water bills
- Collect fines for violating water conservation standards
- A bond measure for replacement, treatment, or cleanup needs

5.7 Emergency Response Tools

5.7.1 Prioritization of Water Usage

This element prioritizes community needs in case the water supply is interrupted and/or a replacement supply is necessary. Prioritization of the user groups who would be allowed limited supply of water use from highest to lowest is as follows:

1. Fire Department
2. Hospitals
3. Senior residential centers
4. Other residential care facilities
5. Industrial/Commercial
6. Schools
7. RV parks and other parks
8. Car washing, gardens, lawns, and
9. Agriculture using city intake water

5.7.2 Short-Term and Long-Term Replacement of Water Supply

In the event of an emergency, the minimum water needs of the community must be met, and this supply must meet applicable health standards. Short-term options are those where the alternative supply is needed for a few hours or days. Long-term options are considered for a permanent alternative supply.

Potential short-term drinking water:

- Utilize onsite and offsite storage

Intermediate-term:

- Open Interconnects

Long-term:

- Open Interconnects
- Initiate Water Use Restriction Plan

5.7.3 Short-Term and Long-Term Conservation Measures

Conservation of water use will lessen demands on Holland's public water ystem in the event of an emergency. The Holland Board of Public Works has developed a Water Use Restriction Plan which would be implemented, as needed, to address both short and intermediate water needs. The extent of Water Use Restriction Plan necessary will depend upon the nature and extent of the emergency. Generalized conservation practices that can be applied across land uses are identified below, followed by specific measures that can be applied for the different user groups.

- Provide water for drinking purposes only
- Administer fines to violators of water misuse or overuse in the event of a water shortage emergency (an ordinance needs to be in place for this action)

- Drop the water pressure so that overuse is unlikely
- Restrict car washing and lawn watering
- Develop an odd/even day water usage plan
- Review commercial/industrial use on a case-by-case basis to determine the amount of use and critical need.
- Encourage businesses to establish their own conservation/supply strategy prior to an emergency
- Educate people about the emergency and necessary actions

Holland City offices and Parks: Will not be irrigated if a water usage reduction is necessary

Schools: Schools can reduce water use primarily by eliminating grounds irrigation. In a temporary emergency, tankers for drinking water and other essential functions should be stationed at the school facility to keep them in operation.

Industry/Commercial: Many businesses already have a contingency plan in place that identifies water conservation practices in the event of a water shortage. Businesses should be informed that in the event of an emergency, their water intake may be reduced and that it is in their best interest to develop a conservation plan if they do not already have one.

Resident: Common conservation measures for residential use include limiting practices such as, lawn and car washing, laundry use, and installing conservation devices such as low flow showerheads. The Michigan Department of Natural Resources and Environment (MDNRE) publish a variety of informational pamphlets letting residential users know how to reduce water. Education should be conducted prior to an emergency.

Fire Department: In the event of a fire during a water supply emergency, the fire department has top priority in water usage. The Holland Fire Department must be notified when a conservation program is going into effect and should identify alternative sources of water or fire response services to ensure fire protection.

5.8 Plan Testing, Review, and Update

This contingency plan's efficacy will be evaluated, reviewed, and updated using an annual review and mock exercise. The Water Superintendent will review any personnel or situational changes and make adjustments to the Plan at least annually. The most effective way to test the Plan's ability to design an appropriate and adequate response is through a mock exercise. A simulated emergency will allow emergency responders to make necessary adjustments to the plan. Mock exercises will also serve as an educational tool for local citizens, reminding the community of the importance of protecting the source water and the conservation measures that would be put into place in the event of an emergency situation. The Sheriff, Fire Chief, BPW and Water Superintendent should prepare and conduct a mock drill of an emergency spill event.

5.9 Personnel Training

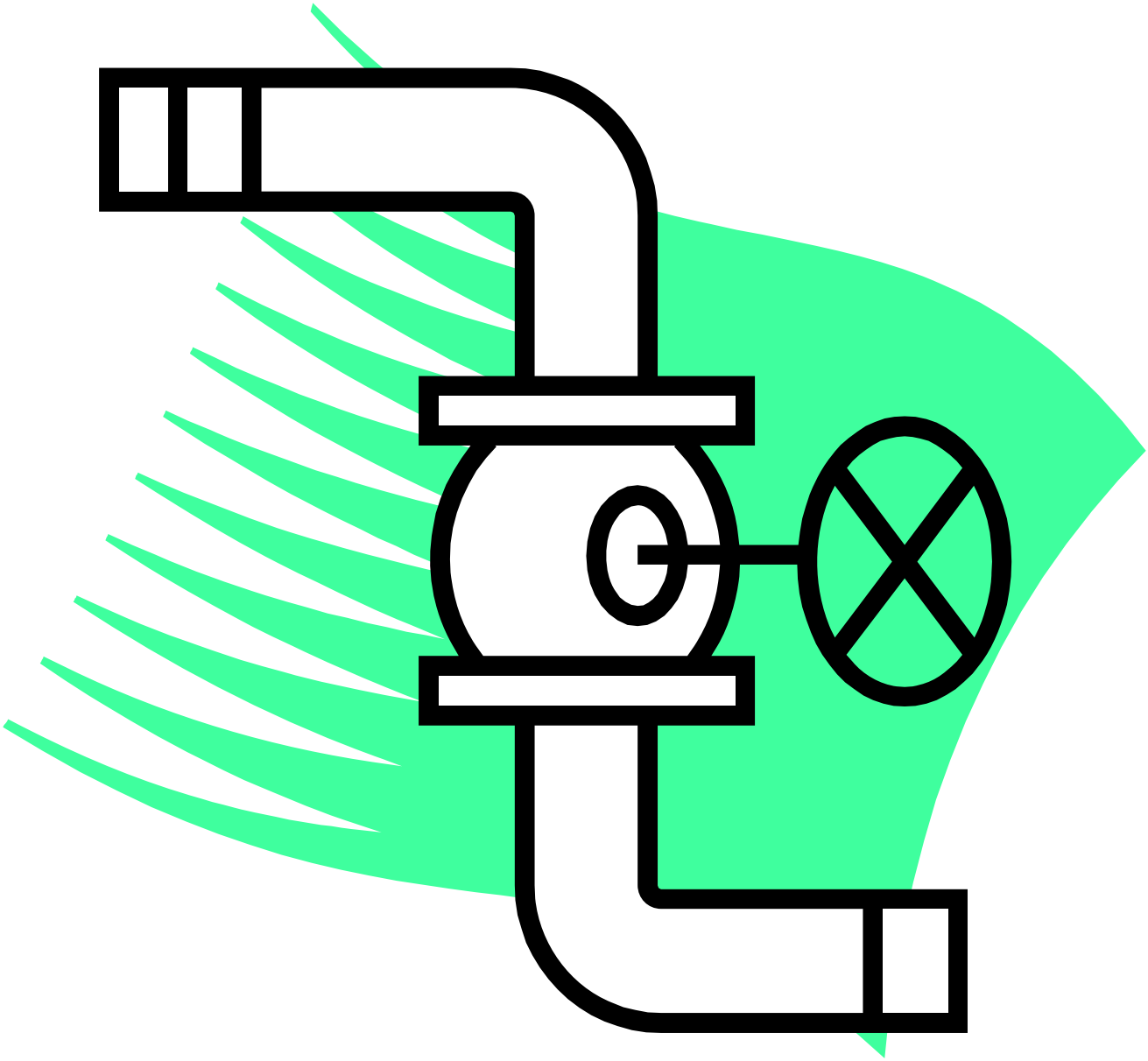
To be effective, contingency plans must rely on properly trained people operating within an intake-organized and effective system with up-to-date information. County and state emergency responders have been professionally trained to deal with hazmat responses. Local personnel should also be trained in initial hazmat response since they could be the first to arrive on site. Sheriff Officers receive basic hazmat response training as part of their officer-training program. With a basic level of training, local personnel will also able to adequately and appropriately identify and contain many hazardous materials.

5.10 Provisions for Public Education

Educational materials build and maintain support for the SWIPP and can encourage assistance and understanding when contingency planning is put into effect. Management strategies for Holland's Plan have a strong educational component that satisfies part of this contingency element. However, there are other educational components directly related to contingency planning that must be implemented to make the contingency elements effective emergency response tools. Before an emergency occurs, local residents and business owners must be knowledgeable about appropriate conservation measures that they will be expected to apply. Informational brochures on water conservation will be purchased/developed and distributed in advance of a water supply interruption or contamination.

Alternate Water Sources

City of Holland - Holland Board of Public Works
Ottawa and Allegan Counties, Michigan



SECTION 6 ALTERNATIVE WATER SOURCES

6.1 Introduction

This section outlines the water sources available in the event of a problem with the Holland Water Treatment Plant intake. For contingency plans outlining the procedures for utilizing these alternate water sources please refer to Section 5.

6.2 Standby (Emergency) Intake

The 42-inch reinforced concrete intake line extends approximately 4,450 feet into Lake Michigan where it joins a steel fabricated intake crib. The intake crib is submerged approximately 45 feet depending on lake level. In 1996, engineering consultant Fishbeck Thompson Carr & Huber (FTC&H) conducted tests and analyzed the intake's capacity. They concluded that the intake capacity is 38.5 mgd at the average lake level of 580.03. Their analysis also concluded that for every 1 foot of variance in lake level, the intake capacity is affected by 1 mgd. Based on historical variations in lake level, the capacity of the intake ranges from 34.5 mgd at minimum lake level to 42.0 mgd at maximum lake level.

An 8-inch diameter emergency access riser with blind flange is located near the midpoint of the pipe, approximately 2,250 feet into Lake Michigan. The line has been sized so that when open under minimum lake level, an additional 4.5 mgd of capacity is available. The line is normally left open during summer months to assure a capacity of 38.5 mgd for all lake level conditions. This riser similarly provides a limited source of water in the event of flow constraints due to physical damage to the crib or upstream intake line. However, it does not provide a source of water in the event of contamination since there is no way to isolate it from the main intake and it would likely be subjected to any contamination plume impacting the normal intake.

6.3 Emergency Interconnections

In the event that the intake is unavailable due to physical or mechanical failures and/or if contamination has occurred and has not reached the distribution system, emergency interconnections with the Holland Township Water System (supplied by City of Wyoming) may be utilized. The Holland Water System is equipped with three emergency interconnections for this purpose. The location and associated main sizes are summarized in Table 6-1.

Table 6-3: Emergency Interconnects

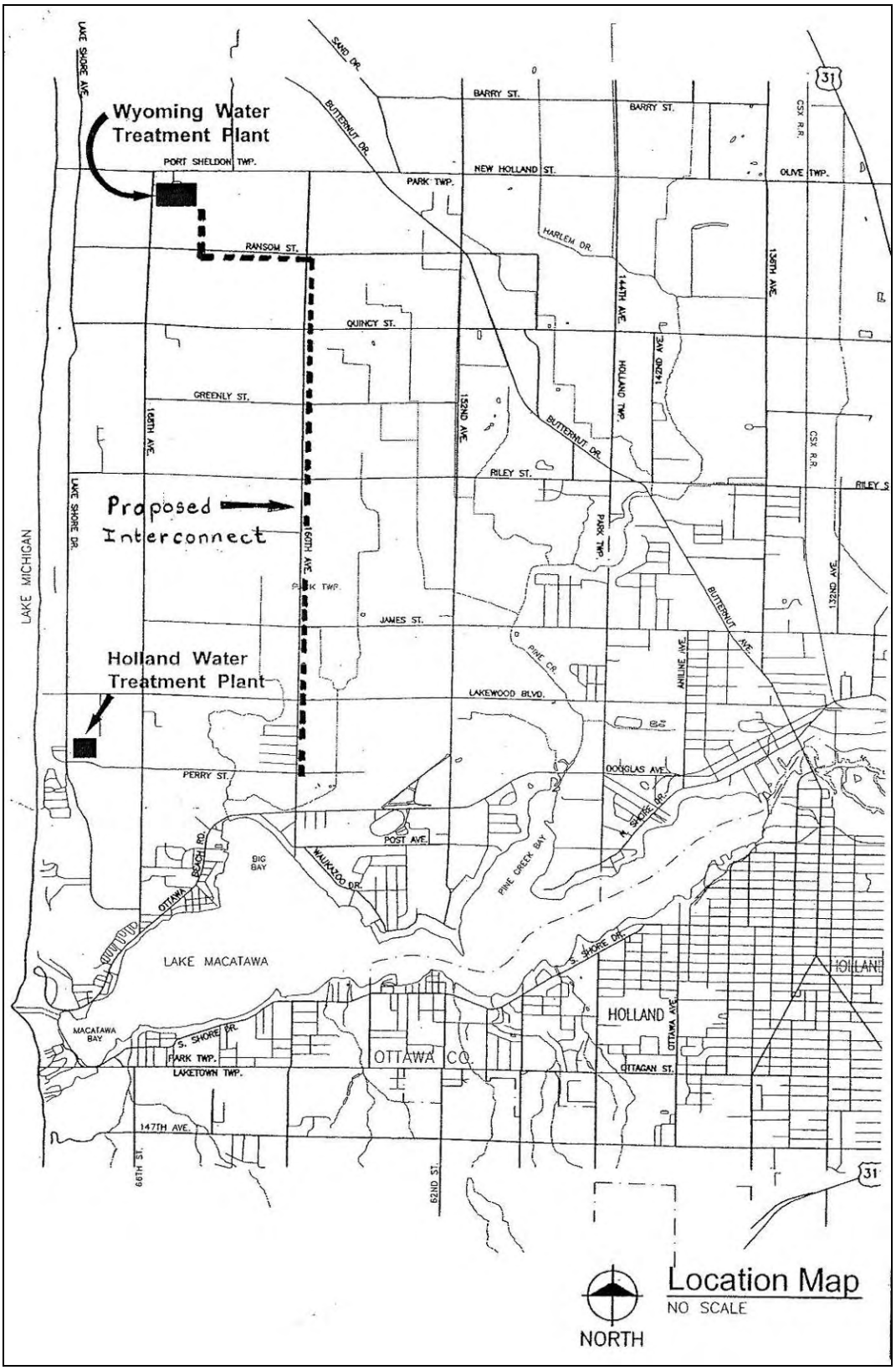
Location	Holland Main Size (inches)	Holland Township Main Size (inches)
Douglas and HEMCO	36	8
Douglas and Aniline	36	12
Douglas and Madison	36	12

In addition to the interconnections available on the Holland Water System, the City of Zeeland has a 12-inch interconnect with Holland Township (supplied by City of Wyoming) off of the 20-inch transmission line along Chicago Drive that supplies water from Holland to Zeeland and four other interconnections within the Zeeland distribution system. In the event of an emergency with the Holland water supply, Zeeland can close the water feed from the Holland system and open the Holland Township interconnects. This mode of operation reduces the demands of the Holland system during emergency events. The possibility also exists to use the interconnections as a means to back feed water from the Zeeland Water System to the Holland Water System. The interconnection on Chicago Drive provides a direct feed to the Holland Water System via the Zeeland transmission main. The distribution interconnects can also feed the Holland Water System by bypassing (i.e. reversing flow thru) the Zeeland pumps to feed Zeeland's storage tanks which are hydraulically connected to the Holland Water System via the Chicago Drive transmission main.

6.4 Future Emergency Interconnection

In 2005 the City of Holland reached an agreement with Park Township that would allow the BPW to run a large diameter transmission main through the Township to connect to the City of Wyoming's water system. Holland BPW staff is also currently in negotiations with the City of Wyoming to finalize an agreement to finance and construct the proposed interconnect through the Township. The planned project would include a 30" interconnect that would run North along Perry Street from Holland's 36" transmission main at the corner of Perry Street and 160th Avenue to the Wyoming Water Treatment Plant. At the Wyoming plant, the interconnect would be connected to both the 42" transmission main that runs east on Ransom Street and the finished water storage tanks. The interconnect is currently anticipated for construction in calendar year 2011 or 2012 and will provide a means of supplying as much as 20 mgd of water to either system in an emergency situation.

Figure 6-4: Proposed Holland-Wyoming Interconnection Route

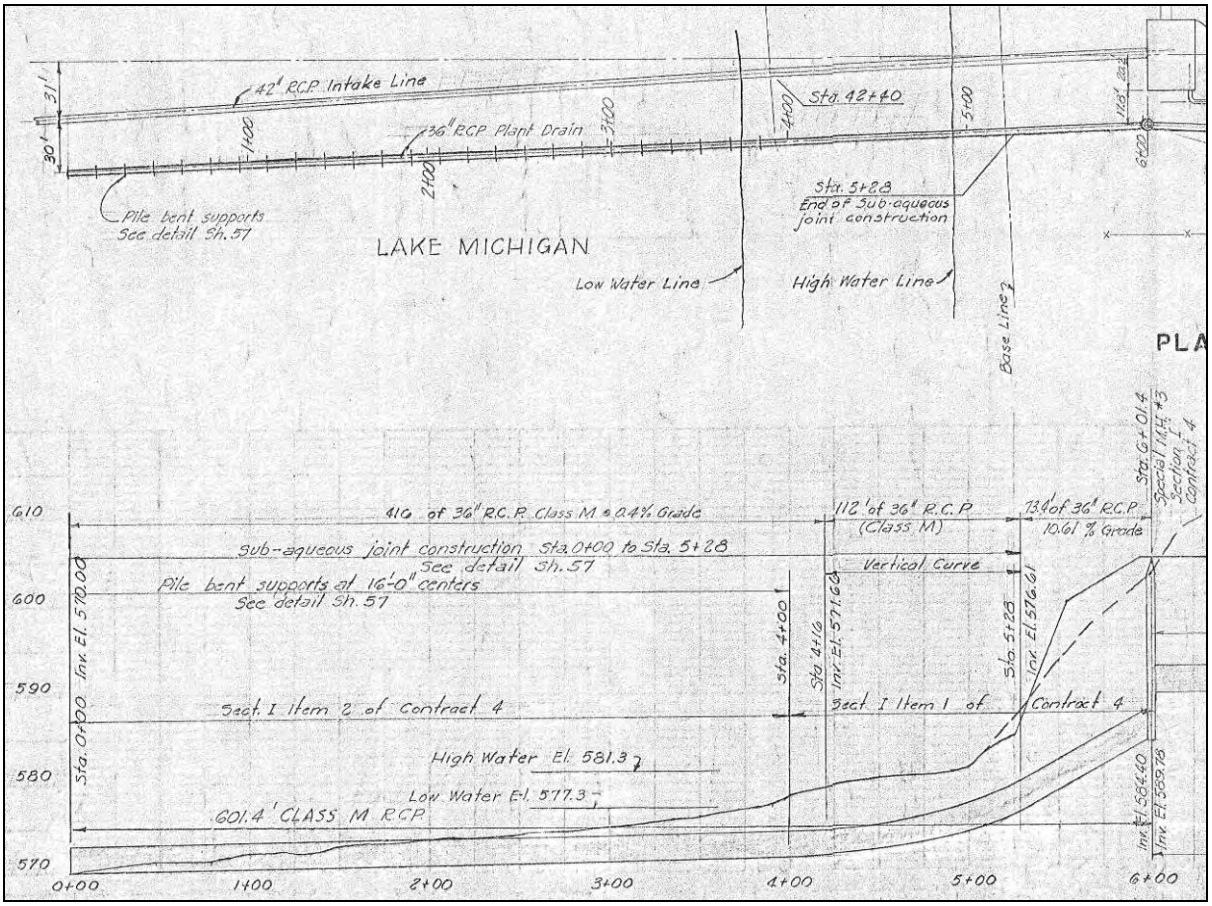


6.5 Secondary Emergency Intake

In the event of a catastrophic failure of the 42-inch reinforced concrete intake the possibility exists to utilize the adjacent 36-inch reinforced concrete drain line from the Water Treatment Plant. The drain line runs parallel to the intake line and extends approximately 500 feet into Lake Michigan. Review of the construction plans for the intake and drain line show that they were laid at approximately the same depth along the shoreline. As a result of the similar depth and proximity of the two lines, the possibility exists to provide an interconnection between them with appropriate valving to allow for the drain line to serve as an emergency intake. Due to the shallow depth the emergency intake would likely be unavailable during times of icing. Additionally the depth and proximity to shore would likely make the water from the emergency intake more susceptible to water quality variation and/or contamination. As a result, if this alternative were ever to be realized, Water Treatment Plant staff would need to develop special operating procedures for its usage.

Holland BPW staff will continue to explore the feasibility and permitability of this emergency intake alternative. If improvements to construct this interconnect are undertaken in the future, the Source Water Protection Plan will be updated to incorporate any contingency plans for its usage.

Figure 6-5: Holland Water Treatment Plant Drain Line



New Water Sources

City of Holland - Holland Board of Public Works
Ottawa and Allegan Counties, Michigan

SECTION 7 NEW WATER SOURCES

7.1 Introduction

This guideline encourages the City of Holland to be proactive in siting alternative water sources and new intakes rather than reactive when problems develop. Thoroughly evaluating a proposed intake site beforehand, including delineating a protection area, conducting a contaminant source inventory, and developing a management strategy for the area, will help identify any potential problems that may arise or determine that the proposed site is not suitable and an alternate site should be selected.

7.2 Planning for New Source Water

The Holland Board of Public Works (BPW) completed an expansion of the Holland Water Treatment Plant in 1998, increasing the rated capacity from 28 mgd to 38.5 mgd. The expansion allowed the facility to utilize the full capacity of the existing 42-inch intake. As such, the next expansion of capacity will require essentially a complete supply system including a water intake, treatment plant, and transmission system. Three primary alternatives have been identified to date for future capacity and are actively being pursued by the BPW for this purpose. The alternatives include: 1) Building a new plant on the existing plant site in Park Township; 2) Building a satellite water plant in Laketown Township; and 3) Purchasing supplemental water from the City of Wyoming. This section discusses the alternatives in detail, including all steps taken to date in anticipation of future supply needs.

7.2.1 New Plant at Existing Park Township Site

The existing Water Treatment Plant property has adequate land available for an additional 20 to 40 mgd of water treatment capacity. However, expansion of the existing plant would require a new water intake pipe, pumping station, and transmission system.

7.2.2 Laketown Township Satellite Plant

In anticipation of the future need for additional capacity, BPW staff has kept an eye on possible shoreline acreage that could be purchased and developed as a treatment plant site. In 1999, BPW staff identified available property (known as the Rosenberg property) and purchased the property for $1.5 million after an evaluation of expansion possibilities by engineering consultant FTC&H concluded that a new plant in the area was feasible.

In addition to the Rosenberg property, the BPW has explored land swaps with Laketown Township and/or the State of Michigan for property that is more suitable for development of a water treatment plant. Discussions are ongoing as the BPW continues to put the Holland Water System in position for expansion in the coming years.

7.2.3 Supplemental Water from City of Wyoming

Holland BPW and City of Wyoming representatives have been discussing a new large diameter emergency interconnect between the respective water systems for several years. Steps taken to date include a preliminary engineering report that recommends a route and sizing for the new interconnect. Additionally, both communities have agreed in principal to the construction of the improvement and preparation of a formal agreement between Wyoming and Holland relative to usage and payment is underway. Simultaneously planning for the financing and construction of the project is also underway. Construction is currently anticipated for calendar year 2011 or 2012. Once constructed, the new interconnection will have the ability to provide as much as 20 million gallons per day of water to either system.

Wyoming is also currently in the process of a large expansion and expects to be complete prior to the construction of the interconnect. Water suppliers typically have excess capacity during the years immediately following an expansion. This means that the emergency interconnect with Wyoming could also be used as a supplemental water source if an agreement between the two communities for that usage were reached. Usage of the interconnect in this manner could delay an expansion of the Holland Water Treatment Plant for several years.

7.3 Incorporating New Sources into SWP Program

Any new water source will need to be incorporated into this Source Water Protection Plan. The method of incorporation will vary according to the new source of water per the methodologies outlined below:

7.3.1 New Plant at Existing Park Township Site

Any new sources for expansion of the existing plant would be sited along Lake Michigan at a location where the Critical Assessment Zone (CAZ) identified by United States Geological Survey (USGS) in Holland's Source Water Assessment (SWA) report could be easily modified to evaluate the new source. While it is anticipated that the CAZ and Source Water Protection Buffer Zone would be very similar to the existing intake, this SWP would be updated to reflect the new intake and any concerns associated with its specific location, depth and configuration.

7.3.2 New or Satellite Plant

Any new intake located away from the current treatment site will be subject to different source water threats than those identified for the current intake. As an example, a satellite facility in Laketown Township would likely decrease the influence of the Macatawa River which normally flows north from its mouth and increase the influence of the Kalamazoo River. As such, any new intake would require delineating a protection area, conducting a contaminant source inventory, and developing a management strategy specific for that area.

7.3.3 Supplemental Water from City of Wyoming

Any water purchased wholesale from the City of Wyoming would be evaluated under future Source Water Protection efforts by the Wyoming staff. However, due to the proximity of intakes and relationship relative to emergency interconnections and potential wholesale purchases/sales it may be very advantageous for the communities to work closely together in the creation and implementation of their Source Water Protection Plans.

7.4 Taking Steps Before a Problem Arises

Taking steps before a problem arises has the added advantage of avoiding disruptions to existing land uses and potential legal challenges. As another example of this proactive approach, areas may be designated and managed as potential Source Water Protection Areas (SWPAs) if they are logical sites for future drinking water sources. As a part of the planning for new water sources, Holland should work to identify potential SWPAs for future uses.

Potential contaminant sources (PCS) that lie within these potential SWPAs may then be identified and managed in a manner similar to that applied to potential sources that lie within the existing SWPAs. Identification of the PCSs could then assist in the final siting of future water intakes.

7.5 Public Participation

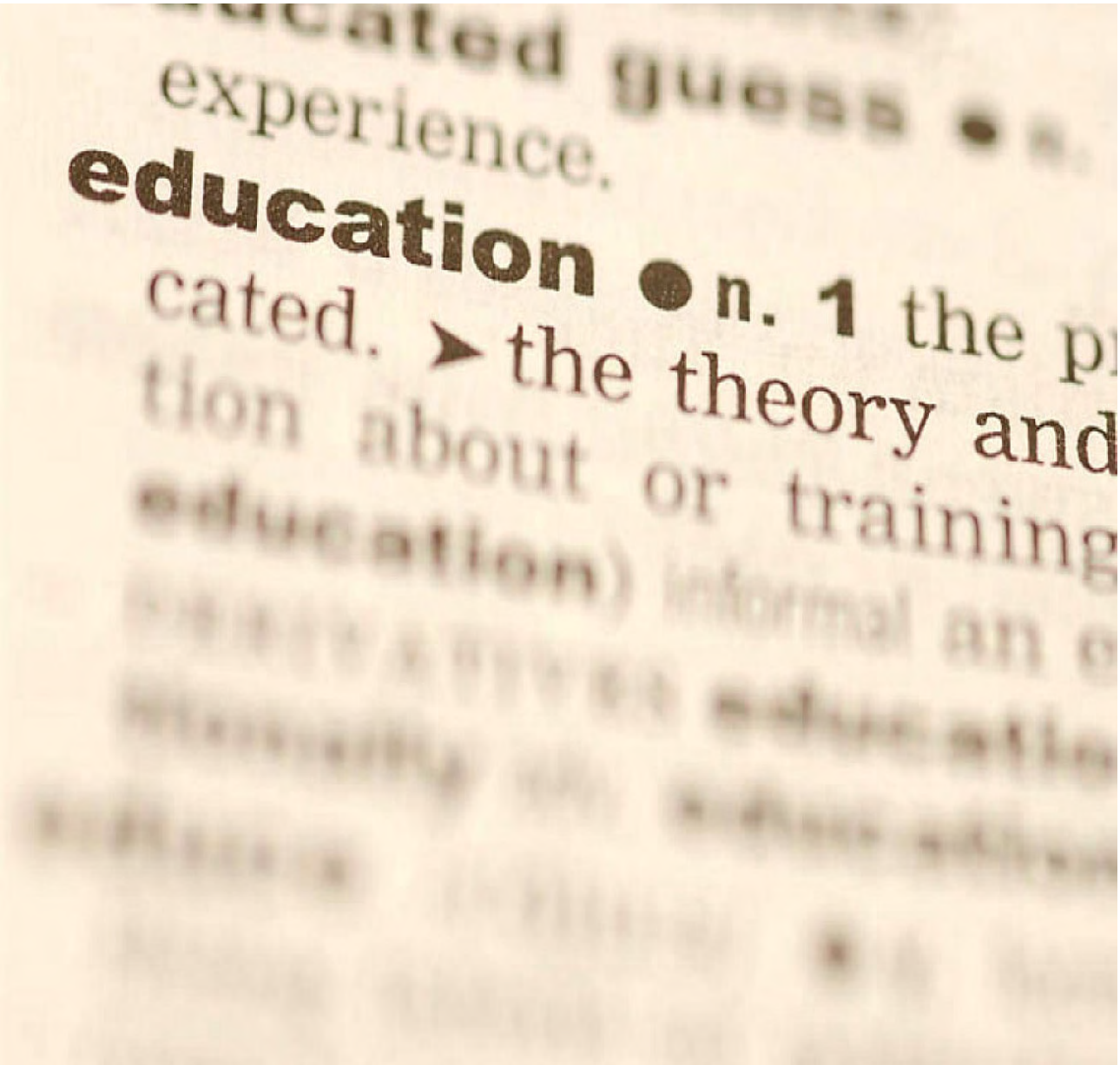
Public participation is an essential component of water supply planning. The expansion of Source Water Protection Areas due to increasing demand or the creation of additional SWPAs may be of concern to businesses and residents located within SWPAs. To foster responsible water supply practices at the local level, public hearings on water development plans and source management approaches are strongly encouraged.

Source Water Protection

Education and Outreach

City of Holland – Holland Board of Public Works

Ottawa and Allegan Counties, Michigan



SECTION 8 PUBLIC EDUCATION

8.1 Introduction

Public education programs are designed to increase public awareness of water quality conditions and provide opportunities for participation and involvement. Printed materials such as brochures, booklets and posters, as well as permanent educational displays, also are part of the educational efforts of the City of Holland BPW and SWIPP Team.

8.2 Public Education

The City of Holland and the Source Protection Team encourages the development of education and outreach programs, some examples of which are:

8.2.1 Purchasing and Install Sign

Purchase and install "Drinking Water Supply Area" signs along all major roads within the source water Buffer Zone that identify when you are entering the protection area.

8.2.2 Develop Educational Materials

Develop and/or purchase educational materials that describe the major components of Holland's SWIPP protection program and distribute to residents within the source water protection areas.

Develop community education by purchasing and distributing best management practices and pollution and prevention materials.

Work with local school district to educate students about the source water protection efforts. This may include the development of a water based curriculum that includes source water protection materials.

Publish a series of newspaper and/or newsletter articles about source water protection.

8.2.3 Household Hazardous Waste Collection and Recycling Program

The City and counties have existing programs for household hazardous waste collection and recycling. The SWIPP Team encourages the continuation and expansion of these programs.

8.2.4 Welcome Packet

As new residents move in the area many communities provide a general information packet about the community. SWIPP Team recommends working with local communities within the source water protection areas to include information regarding water conservation and protecting the water supply in these informational packets.

8.2.5 Bill Stuffers

Develop brief educational materials that can be inserted into water bills to the residents that show lawn care tips, explain why we should protect our storm drains, give reasons why hazardous waste should be disposed of properly, and why saving water saves you money, etc.

8.2.6 Tours

The Water and Wastewater Treatment Plant currently offer tours. This practice should be continued to better educate the community about the water cycle.

8.2.7 Materials, Fact Sheets, and Brochures

The Holland SWIPP team will collect fact sheets, brochures, and other education materials that may be copied, re-created, or used as guides in developing their own materials for distribution. Handouts will be provided to the public and local schools as appropriate.

8.2.8 Source Water Enviroscape Model

A source water model may be purchased through the MDNRE /WHP grant funds if they become available.

Complete Source Water Glossary Terms and Abbreviations

City of Holland – Holland Board of Public Works
Ottawa and Allegan Counties, Michigan

SECTION 9 Glossary

A

Aeration zone: The zone immediately below the land surface where the pores contain both water and air, but are not totally saturated with water. Plant roots can capture the moisture passing through this zone, but it cannot provide water for wells. Also known as the unsaturated zone or vadose zone.

Aggrade:- to fill and raise the level of a stream bed by deposition of sediment.

Alluvium: - sediment deposited by flowing rivers and consisting of sands and gravels.

Aquiclude: Impermeable beds of geologic material that hinder or prevent groundwater movement.

Aquifer: An underground geological formation able to store and yield water.

Aquifer storage and retrieval (ASR): Use of a well or series of wells to inject surface water into an aquifer during wet weather or low demand periods for purposes of withdrawal and use during drought and/or high demand periods.

Artesian aquifer: See confined aquifer.

Artesian well: A well tapping a confined aquifer. Water in the well rises above the top of the aquifer under artesian pressure, but does not necessarily reach the land surface; a flowing artesian well is a well in which the water level is above the land surface.

Artificial recharge: Putting water back into groundwater storage from surface water supplies such as irrigation, or induced infiltration from streams or wells. Includes aquifer storage and retrieval (ASR).

B

Bankfull discharge - that discharge of stream water that just begins to overflow in the active floodplain. The active floodplain is defined as a flat area adjacent to the channel constructed by the river and overflowed by the river at recurrence interval of about 2 years or less. Erosion, sediment transport, and bar building by deposition are most active at discharges near bankfull. The effectiveness of higher flows, called over bank or flood flows, does not increase proportionally to their volume above bankfull in a stable stream, because overflow into the floodplain distributes the energy of the stream over a greater area. See also channel-forming and effective discharge.

Baseflow: Streamflow coming from groundwater seepage into a stream or river. Groundwater flows underground until the water table intersects the land surface and the flowing water becomes surface water in the form of springs, streams/rivers, lakes and wetlands. Baseflow is the continual contribution of groundwater to rivers and is an important source of flow between rainstorms.

Best Management Practices (BMP): Structural, nonstructural, and managerial techniques recognized to be the most effective and practical means to reduce surface water and groundwater contamination while still allowing the productive use of resources.

Brackish: Mixed fresh and salt water.

C

Capillary water: Just above the water table, in the aeration zone, is capillary water that moves upward from the water table by capillary action. This water can move slowly and in any direction. While most plants rely upon moisture from precipitation that is present in the unsaturated zone, their roots may also tap into capillary water or into the underlying saturated zone.

Channel-forming Discharge - a theoretical discharge which would result in a channel morphology close to the existing channel. See also effective and bankfull discharge.

Collection site: A stream, lake, reservoir, or other body of water fed by water drained from a watershed.

Condensation: The process in the hydrologic cycle by which a vapor becomes a liquid; the opposite of evaporation.

Cone of depression: The zone around a well in an unconfined aquifer that is normally saturated, but becomes unsaturated as a well is pumped, leaving an area where the water table dips down to form a cone shape. The shape of the cone is influenced by porosity and the water yield or pumping rate of the well. The land surface overlying the cone of depression is referred to as the area of influence.

Confined aquifer: (also known as artesian or pressure aquifers) exist where the groundwater is bounded between layers of impermeable substances like clay or dense rock. When tapped by a well, water in confined aquifers is forced up, sometimes above the soil surface. This is how a flowing artesian well is formed.

Confining layer: Geologic material with little or no permeability or hydraulic conductivity. Water does not pass through this layer or the rate of movement is extremely slow.

Conservation: The use of water-saving methods to reduce the amount of water needed for homes, lawns, farming, and industry, and thus increasing water supplies for optimum long-term economic and social benefits.

Consolidated rock: Tightly bound geologic formation composed of sandstone, limestone, granite, or other rock.

Consumptive use: The use of a resource that reduces the supply (removing water from a source like a river, lake or aquifer without returning an equal amount). Examples include the intake of water by plants, humans, and other animals and the incorporation of water into the products of industrial or food processing.

Contaminant: Any substance that when added to water (or another substance) makes it impure and unfit for consumption or an intended use.

Critical Areas - the geographic portions of the watershed contributing the majority of the pollutants and having significant impacts on the waterbody.

Critical Depth - depth of water for which specific energy is a minimum.

Curve Number - see Runoff Curve Number.

D

Darcy's Law: Groundwater movement equation developed by Henry Darcy in the mid-1800's.

Depletion: The loss of water from surface water reservoirs or groundwater aquifers at a rate greater than that of recharge.

Design Flow - projected flow through a watercourse which will recur with a stated frequency. The projected flow for a given frequency is calculated using statistical analysis of peak flow data or using hydrologic analysis techniques.

Detention - practices which store stormwater for some period of time before releasing it to a surface waterbody. See also retention.

Dimensionless Hydrograph - a general hydrograph developed from many unit hydrographs, used in the Soil Conservation Service method.

Diffusion: The movement of a substance from an area of high concentration to an area of low concentration.

Direct Runoff Hydrograph - graph of direct runoff (rainfall minus losses) versus time.

Discharge: An outflow of water from a stream, pipe, groundwater aquifer, or watershed; the opposite of recharge.

Discharge area: The area or zone where groundwater emerges from the aquifer. The outflow maybe into a stream, lake, spring, wetland, etc.

Drainage Divide - boundary that separates subbasin areas according to direction of runoff.

Drawdown: A lowering of the groundwater level caused by pumping.

Drought: An extended period with little or no precipitation; often affects crop production and availability of water supplies.

E

Effective Discharge - the calculated measure of channel forming discharge. This calculation requires long-term water and sediment measurements, although modeling results are sometimes substituted. See also channel-forming and bankfull discharge.

Ephemeral Stream - a stream that flows only during or immediately after periods of precipitation. See also intermittent and perennial streams.

Erosion: The wearing down or washing away of the soil and land surface by the action of water, wind, or ice.

Evaporation: The conversion of a liquid (water) into a vapor (a gaseous state) usually through the application of heat energy during the hydrologic cycle; the opposite of condensation.

Evapotranspiration: The loss water from the soil through both evaporation and transpiration from plants.

Filtering: The soil's ability to attenuate substances by retaining chemicals or dissolved substances on the soil particle surface, transforming chemicals through microbial biological processing, retarding movement, and capturing solid particles.

F

Field Capacity - the amount of water held in soil after gravitational water is drained.

First Flush - the first part of a rainstorm that washes off the majority of pollutants from a site. The concept of first flush treatment applies only to a single site, even if just a few acres, because of timing of the runoff. Runoff from multiple or large sites may exhibit elevated pollutant concentrations longer because the first flush runoff from some portions of the drainage area will take longer to reach the outlet.

Flashiness - has no set definition but is associated with the rate of change of flow. Flashy streams have more rapid flow changes.

Flood Hazard Zone - area that will flood with a given probability.

Flow rate: The time required for a volume of groundwater to move between points. Typically groundwater moves very slowly—sometimes as little as inches per year.

Flux - the volume of fluid crossing a unit cross-sectional surface area per unit time.

Fresh water: Water with less than 0.5 parts per thousand dissolved salts.

G

Gaining stream: A stream in which groundwater discharges contribute significantly to the streamflow volume. The same stream could be both a gaining stream and a losing stream, depending on the conditions.

Gas (gaseous): See vapor.

Gray water: Domestic wastewater composed of wash water from household sinks, tubs, and washers.

Groundwater: Water found in the spaces between soil particles and cracks in rocks underground (located in the saturation zone). Groundwater is a natural resource that is used for drinking, recreation, industry, and growing crops.

Groundwater basin: The underground area from which groundwater drains. The basins could be separated by geologic or hydrologic boundaries.

Groundwater divide: The boundary between two adjacent groundwater basins, which is represented by a high point in the water table.

Groundwater under the direct influence (UDI) of surface water: A groundwater source located close enough to nearby surface water, such as a river or lake, to receive direct surface water recharge. Since a portion of the groundwater source's recharge is from surface water, the groundwater is at risk of contamination from pathogens such as *Giardia lamblia* and viruses, which are not normally found in groundwater.

H

Headwater Stream - the system of wetlands, swales, and small channels that mark the beginnings of most watersheds.

Hydrogeology: The study of the interrelationships of geologic materials and processes with water, especially groundwater.

Hydrologic Analysis - an evaluation of the relationship between stream flow and the various components of the hydrologic cycle. The study can be as simple as determining the watershed size and average stream flow, or as complicated as developing a computer model to determine the relationship between peak flows and watershed characteristics, such as land use, soil type, slope, rainfall amounts, detention areas, and watershed size.

Hydrograph - graph of discharge versus time.

Hydrologic cycle: (also known as the water cycle) The paths water takes through its various states--vapor, liquid, solid--as it moves throughout the oceans, atmosphere, groundwater, streams, etc.

Hydrology - the occurrence, distribution, and movement of water both on and under the earth's surface. It can be described as the study of the hydrologic cycle.

Hyetograph - graph of rainfall intensity versus time.

I

Impermeable layer: A layer of material (such as clay) in an aquifer through which water does not pass.

Impervious - a surface through which little or no water will move. Impervious areas include paved parking lots and roof tops.

Induced recharge: The recharge to an aquifer that occurs when a pumping well creates a cone of depression that lowers an adjacent water table below the level of a stream or lake, causing the stream or lake to lose water to the adjacent groundwater aquifer.

Infiltration: Flow of water from the land surface into the subsurface.

Infiltration Capacity - rate at which water can enter soil with excess water on the surface.

Infiltration rate: The quantity of water that enters the soil surface in a specified time interval. Often expressed in volume of water per unit of soil surface area per unit of time.

Injection well: A well constructed for the purpose of injecting treated water, often wastewater, directly into the ground. Water is generally forced (pumped) into the well for dispersal or storage into a designated aquifer. Injection wells are generally drilled into aquifers that are not used as a drinking water source, unused aquifers, or below freshwater levels.

Integrated management: Any combination of physical, technical, administrative, and legal practices relating to surface water and groundwater in a manner designed to increase combined benefits or achieve a more equitable apportionment of benefits from both sources. Also referred to as conjunctive use.

Interflow: Water that travels laterally or horizontally through the aeration zone during or immediately after a precipitation event and discharges into a stream or other body of water.

Intermittent Stream - a stream that flows only during certain times of the year. Seasonal flow in an intermittent stream usually lasts longer than 30 days per year. See also ephemeral and perennial streams.

Irrigation: The controlled application of water to cropland, hay fields, and/or pasture to supplement that supplied by nature.

Invert - bottom of a channel or pipe.

J

K

Karst: A geologic formation of irregular limestone deposits with sinks, underground streams, and caverns.

Knickpoint - a point of abrupt change in bed slope. If the streambed is made of erodible material, the Knickpoint, or downcut, may migrate upstream along the channel and have undesirable effects, such as undermining bridge piers and other manmade structures.

L

Lag Time - time from the center of mass of the rainfall to the peak of the hydrograph.

Leachate: Liquids that have percolated through a soil and that carry substances in solution or suspension.

Leaching: The process by which soluble materials in the soil, such as salts, nutrients, pesticide chemicals, or contaminants, are washed into a lower layer of soil or are dissolved and carried away by water.

Liquid: The part of the hydrologic cycle in which molecules move freely among themselves but do not separate like those in a vapor/gaseous state.

Losing stream: A stream that is losing water to (or recharging) the groundwater system. The same stream could be both a gaining stream and a losing stream, depending on the conditions.

Losses - Rainfall that does not runoff, i.e. rainfall that infiltrates into the ground or is held in ponds or on leaves, etc.

Low Flow - minimum flow through a watercourse which will recur with a stated frequency. The minimum flow for a given frequency may be based on measured data, calculated using statistical analysis of low flow data, or calculated using hydrologic analysis techniques. Projected low flows are used to evaluate the impact of discharges on water quality. They are, for example, used in the calculation of industrial discharge permit requirements.

M

Maximum contaminant level (MCL): Designation given by the U.S. Environmental Protection Agency (EPA) to drinking water standards promulgated under the Safe Drinking Water Act. A MCL is the greatest amount of a contaminant allowed in drinking water without causing a risk to human health.

Mining: See overwithdrawal

Monitoring well: A non-pumping well, generally of small diameter, that is used to measure the elevation of a water table or water quality. A piezometer, which is open only at the top and bottom of its casing, is one type of monitoring well.

Morphology - the study of the form and structure of a river, stream, or drain.

Municipal water system: A network of pipes, pumps, and storage and treatment facilities designed to deliver potable water to homes, schools, businesses, and other users in a city or town and to remove and treat waste materials.

N

Nonpoint source (NPS) pollution: Pollution discharged over a wide land area, not from one specific location. These are forms of diffuse pollution caused by sediment, nutrients, organic and toxic substances originating from land use activities which are carried to lakes and streams by surface runoff. Nonpoint source pollution is contamination that occurs when rainwater, snowmelt, or irrigation washes off plowed fields, city streets, or suburban backyards. As this runoff moves across the land surface, it picks up soil particles and pollutants, such as nutrients and pesticides.

O

Overland Flow - see Runoff.

Overwithdrawl: Withdrawal of groundwater over a period of time that exceeds the recharge rate of the supply aquifer. Also referred to as overdraft or mining the aquifer.

P

Parallel flow paths: Layers of groundwater flow that do not mix with other flow layers because groundwater movement is too slow to create sufficient turbulence to cause mixing to occur. This becomes an important factor in the location and movement of contaminants that enter the groundwater.

Peak Flow - maximum flow through a watercourse which will recur with a stated frequency. The maximum flow for a given frequency may be based on measured data, calculated using statistical analysis of peak flow data, or calculated using hydrologic analysis techniques. Projected peak flows are used in the design of culverts, bridges, and dam spillways.

Perched aquifer: Localized zone of saturation above the main water table created by an underlying layer of impermeable material.

Perennial Stream - a stream that flows continuously during both wet and dry times. See also ephemeral and intermittent streams.

Percolation: (1) The movement of water through the openings in rock or soil. (2) The entrance of a portion of the streamflow into the channel materials to contribute to groundwater replenishment.

Permeable/Permeability: Capable of transmitting water (porous rock, sediment, or soil); the rate at which water moves through rocks or soil.

Permeable layer: A layer of porous material (rock, soil, unconsolidated sediment); in an aquifer, the layer through which water freely passes as it moves through the ground.

Plume: In groundwater a plume is an underground pattern of contaminant concentrations created by the movement of groundwater beneath a contaminant source. Contaminants spread mostly laterally in the direction of groundwater movement. The source site has the highest concentration, and the concentration decreases away from the source.

Point source pollution: Pollutants discharged from any identifiable point, including pipes, ditches, channels, sewers, tunnels, and containers of various types.

Pollution: An alteration in the character or quality of the environment, or any of its components, that renders it less suited for certain uses. The alteration of the physical, chemical, or biological properties of water by the introduction of any substance that renders the water harmful to use.

Pore space: Openings between geologic material found underground. Also referred to as void space or interstices.

Porosity: The ratio of the volume of void or air spaces in a rock or sediment to the total volume of the rock or sediment. The capacity of rock or soil to hold water varies with the material. For example, saturated sand contains about 20% water; gravel, 25%; and clay, 48%.

Potable water: Water of a quality suitable for drinking.

Potentiometric surface: The potential level to which water will rise above the water level in an aquifer in a well that penetrates a confined aquifer; if the potential level is higher than the land surface, the well will overflow. See artesian well and confined aquifer.

Precipitation: The part of the hydrologic cycle when water falls, in a liquid or solid state, from the atmosphere to Earth (rain, snow, sleet).

Q

R

Rating Curve - relationship between depth and amount of flow in a channel.

Recharge: Water added to an aquifer. For example: when rainwater seeps into the ground. Recharge may occur artificially through injection wells or by spreading water over groundwater reservoirs.

Recharge rate: The quantity of water per unit of time that replenishes or refills an aquifer.

Recharge zone or area: An area where permeable soil or rock allows water to seep into the ground to replenish an aquifer.

Recession Curve - portion of the hydrograph where runoff is from base flow.

Reclaimed wastewater: Treated wastewater that can be used for beneficial purposes, such as irrigating certain plants.

Recycled water: Water that is used more than one time before it passes back into the natural hydrologic system.

Remediation: Containment, treatment or removal of contaminated groundwater. May also include containment, treatment or removal of contaminated soil above the water table.

Residence time: Period of time that groundwater remains in an aquifer.

Retention - practices which capture stormwater and release it slowly though infiltration into the ground. See also detention.

Return flow: (1) That part of a diverted flow that is not consumptively used and returned to its original source or another body of water. (2) Irrigation water that is applied to an area and which is not consumed in evaporation or transpiration and returns to a surface stream or aquifer.

Ridge lines: Points of higher ground that separate two adjacent streams or watersheds; also known as divides.

Riparian - pertaining to the bank of a river, pond, or small lake.

Runoff: Precipitation that flows over land to surface streams, rivers, and lakes.

Runoff Coefficient - ratio of runoff to precipitation.

Runoff Curve Number - parameter developed by the Natural Resources Conservation Service (NRCS) that accounts for soil type and land use.

S

Safe yield: The annual amount of water that can be taken from a source of supply over a period of years without depleting that source beyond its ability to be replenished naturally in "wet years."

Salinization: The condition in which the salt content of soil accumulates over time to above normal levels; occurs in some parts of the world where water containing high salt concentration evaporates from fields irrigated with standing water.

Salt marsh: A low coastal grassland frequently inundated by the tide.

Salt water: Water that contains a relatively high percentage (over 0.5 parts per thousand) of salt minerals.

Salt water intrusion: Process by which an aquifer is overdrafted creating a flow imbalance within an area that results in salt water encroaching into fresh water supply.

Saturated thickness: Total water-bearing thickness of an aquifer.

Saturated Zone - (1) those parts of the earth's crust in which all voids are filled with water under pressure greater than atmospheric; (2) that part of the earth's crust beneath the regional water table in which all voids, large and small, are filled with water under pressure greater than atmospheric; (3) that part of the earth's crust beneath the regional water table in which all voids, large and small, are ideally filled with water under pressure greater than atmospheric.

Scarp - the sloped bank of a stream channel.

Sediment - soil fragmental material that originates from weathering of rocks and is transported or deposited by air, water, or ice.

Seepage: (1) The slow movement of water into or out of a body of surface or subsurface water. (2) The loss of water by infiltration into the soil from a canal, ditch, lateral, watercourse, reservoir, storage facility, or other body of water, or from a field.

Septic system: Used to treat household sewage and wastewater by allowing the solids to decompose and settle in a tank, then letting the liquid be absorbed by the soil in a drainage field. Septic systems are used when a sewer line is not available to carry wastes to a sewage treatment plan. Also called an onsite wastewater treatment system.

Simulation Model - model describing the reaction of a watershed to a storm using numerous equations.

Sinuosity - the ratio of stream length between two points divided by the valley length between the same two points.

Soil - unconsolidated earthy materials which are capable of supporting plants. The lower limit is normally the lower limit of biological activity, which generally coincides with the common rooting of native perennial plants.

Soil moisture: Water contained in the aeration or unsaturated zone.

Soil Moisture Storage - Volume of water held in the soil.

Sole source aquifer: An aquifer that supplies 50% or more of the drinking water of an area.

Source water assessment: A process in which the land area that impacts a public drinking water source is delineated, possible sources of contaminants that could impact that drinking water source are identified, and a determination of the likelihood that the contaminants will reach the drinking water source is made. The federal Safe Drinking Water Act requires states to provide each public water system with a source water assessment. Public water systems are then required to make the assessments available to the public. A community may verify, refine or expand the list of potential contaminants. See source water protection.

Source water protection: Voluntary action taken to prevent the pollution of drinking water sources, including groundwater, lakes, rivers, and streams. Source water protection is developing and implementing a plan to manage land uses and potential contaminants. To be effective, source water protection should be directed to major threats to the drinking water source identified in the source water assessment. As part of the source water protection plan, a contingency plan for use in the event of an emergency is developed. Source water protection for groundwater is also called wellhead protection. See source water assessment.

Spring: The emergence of groundwater at the land surface, usually at a clearly defined point; it may flow strongly or just ooze or seep out.

Static water level: (1) Elevation or level of the water table in a well when the pump is not operating. (2) The level or elevation to which water would rise in a tube connected to an artesian aquifer or basin in a conduit under pressure.

Stochastic - model that contains a random component.

Storage Delay Constant - parameter that accounts for lagging of the peak flow through a channel segment.

Storage-Discharge Relation - values that relate storage in the system to outflow from the system.

Storm drain: Constructed opening in a road system through which runoff from the road surface flows into an underground system.

Stratum, *pl.* **strata:** A layer within the earth's crust that generally consists of the same kinds of soils or rock material.

Stream Corridor - generally consists of the stream channel, floodplain, and transitional upland fringe.

Subbasins - hydrologic divisions of a watershed that are relatively homogenous.

Sublimation: The transition of a substance from the solid phase directly to the vapor phase, or vice versa, without passing through an intermediate liquid phase.

Subsidence: A depression of the land surface as a result of groundwater being pumped. Cracks and fissures can appear in the land. Subsidence is virtually an irreversible process.

Sustainable yield: See safe yield.

Substrate: A layer of material beneath the surface soil.

Surface water: Water above the surface of the land, including lakes, rivers, streams, ponds, floodwater, and runoff.

Synthetic Design Storm - rainfall hyetograph obtained through statistical means.

Synthetic Unit Hydrograph - unit hydrograph for ungaged basins based on theoretical or empirical methods

T

Temporary wetland: A type of wetland in which water is present for only part of the year, usually during wet or rainy seasons; also known as vernal pools.

Thalweg - the "channel within the channel" that carries water during low-flow conditions.

Thermal spring: Heated groundwater that naturally flows to the land surface.

Time of Concentration - time at which outflow from a basin is equal to inflow or time of equilibrium.

Transmissivity: A measure of the capability of the entire thickness of an aquifer to transmit water. Also known as coefficient of transmissivity.

Transpiration: The process by which water absorbed by plants (usually through the roots) is evaporated into the atmosphere from the plant surface (principally from the leaves).

Tributary - a river or stream that flows into a larger river or stream.

Turbidity: A cloudy condition in water due to suspended silt or organic matter.

U

Unconfined aquifers: An aquifer in which the water table is at or near atmosphere pressure and is the upper boundary of the aquifer. Because the aquifer is not under pressure the water level in a well is the same as the water table outside the well.

Unconsolidated rock: Loosely bound geologic formation composed of sands and gravel.

Unit Hydrograph - graph of runoff versus time produced by a unit rainfall over a given duration.

Unsaturated Zone - the zone between the land surface and the water table which may include the capillary fringe. Water in this zone is generally under less than atmospheric pressure, and some of the voids may contain air or other gases at atmospheric pressure. Beneath flooded areas or in perched water bodies, the water pressure locally may be greater than atmospheric.

V

Vapor: The state of water in the hydrologic cycle in which individual molecules are highly energized and move about freely; also known as gas/gaseous.

W

Wastewater: Water that contains unwanted materials from homes, businesses, and industries; a mixture of water and dissolved or suspended substances.

Wastewater treatment: Any of the mechanical or chemical processes used to modify the quality of wastewater in order to make it more compatible or acceptable to humans and the environment.

Water (H2O): An odorless, tasteless, colorless liquid made up of a combination of hydrogen and oxygen. Water forms streams, lakes, and seas, and is a major constituent of all living matter.

Water-bearing rocks: Several types of rocks can hold water, including: sedimentary deposits (sand and gravel), channels in carbonate rocks (limestone), lava tubes or cooling fractures in igneous rocks, and fractures in hard rocks.

Water cycle: See hydrologic cycle.

Water quality: The chemical, physical, and biological characteristics of water with respect to its suitability for a particular use.

Water quality standards: Recommended or enforceable maximum contaminant levels of chemicals or materials (such as chlorobenzene, nitrate, iron, arsenic) in water. These levels are established for water used by municipalities, industries, agriculture, and recreationists.

Watershed: The land area from which surface runoff drains into a stream, channel, lake, reservoir, or other body of water; also called a drainage basin.

Watershed Delineation: determination of watershed boundaries. These boundaries are determined by reviewing USGS quadrangle maps. Surface runoff from precipitation falling anywhere within these boundaries will flow to the water body.

Water Surface Profile - plot of the depth of water in a channel along the length of the channel.

Water Table - the surface of a groundwater body at which the water pressure equals atmospheric pressure. Earth material below the groundwater table is saturated with water.

Water treatment plants: Facilities that treat water to remove contaminants so that it can be safely used.

Well: A bored, drilled or driven shaft, or a dug hole whose depth is greater than the largest surface dimension and whose purpose is to reach underground water supplies to inject, extract or monitor water.

Well closure: The process of sealing a well that is no longer being used to prevent groundwater contamination and harm to people and animals.

Well field: An area in which productive wells are drilled.

Well siting: Location of a well placed to best protect water quality, access adequate water quantity, and allow for allow for inspection and maintenance of the well.

Wellhead protection area: A protected surface and subsurface zone surrounding a well or well field supplying a public water system to keep contaminants from reaching the well water.

Wetlands: Lands where water saturation is the dominant factor in determining the nature of soil development and the types of plant and animal communities. Other common names for wetlands are sloughs, ponds, and marshes.

Withdrawal: Water removed from a surface or groundwater source for use.

X

Xeriscaping: An environmentally friendly form of landscaping that uses a variety of indigenous and drought-tolerant plants, shrubs, and ground cover.

Y

Yield - peak flow divided by drainage area

Z

SECTION 10 CONTAMINATION ABBREVIATIONS AND ACRONYMS

10.1 Chemical Abbreviations

2,4-D	2,4-Dichlorophenoxyacetic acid
2,4,5-T	2,4,5-Trichlorophenoxyacetic acid
BOD	Biochemical Oxygen Demand
BEHP	Bis (2-ethylhexyl)phthalate
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
C-46	Hexachlorobutadiene
C-56	Hexachlorocyclopentadiene
C-58	Octachlorocyclopentane
C-66	Hexachlorobenzene
CN	Cyanide
Carbon Tet	Carbon tetrachloride
DCA	Dichloroethane
DCB	Dichlorobenzene
DCE	Dichloroethylene
DCP	Dichloropropane
DCPA	Dimethyl 2,3,5,6, tetrachloroterephthalate
DDD	Dichlorodiphenyldichloroethane
DDE	Dichlorodiphenyldichloroethylene
DDT	Dichlorodiphenyltrichloroethane
DMA	Dimethylaniline
Hcl	Hydrochloric acid
MEK	Methyl ethyl ketone
MIBK	Methyl isobutyl ketone
MOCA, MBOC	4,4'-methylene(bis)2-chloroaniline
MTBE	Methyl tertiary butyl ether
OCDD	Octachlorodibenzodioxin
PAH	Polynuclear Aromatic Hydrocarbons
PBB	Polybrominated biphenyl
PCB	Polychlorinated biphenyl
PCE	Perchloroethylene, Tetrachloroethylene
PCH	Polychlorinated hydrocarbons
PCB	Pentachlorophenol
PERC	Perchloroethylene, Tetrachloroethylene
TCA	Trichloroethane
TCDD	Tetrachlorodibenzodioxin
TCDF	Tetrachlorodibenzofuran
TCE	Trichloroethylene
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbons
VOCs	Volatile Organic Compounds

10.2 Metal Abbreviations

As	Arsenic
Ba	Barium
Cd	Cadmium
Cr	Chromium
Cu	Copper
Pb	Lead
Hg	Mercury
Ni	Nickel
Se	Selenium
Zn	Zinc

10.3 Acronyms/Abbreviations/Descriptions

F	Indicates site is owned by the Federal Government
L	Indicates site is owned by Local Government
S	Indicates site is owned by the State Government
DEQ	Department of Environmental Quality
DNRE	Department of Natural Resources and Environment
ERD	Environmental Response Division, DEQ
GSD	Geological Survey Division, DEQ
Status	Any of the seven classes in which sites are required to be placed by the Act. A category shall be one of the following: 1. No Action Taken 2. Evaluation/Interim Response - Fund 3. Evaluation/Interim Response - PRP/Other 4. Final Cleanup - Fund 5. Final Cleanup - PRP/Other 6. Operation and Maintenance - Fund 7. Operation and Maintenance - PRP/Other
Location Code	An alphanumeric code by which the location may be determined from maps that reference the township and range coordinate system. The location code consists of a county number, township, range, section number, quarter section, and quarter-quarter section. Location codes do not specify areas smaller than 40-acres parcel. Consequently, the codes are approximate locations only and not all property within the coded area is necessarily a site of environmental contamination.
OLPS	Office of Litigation and Program Services, DNR
SAM	Site Assessment Model
SAM Score	Numerical risk assessment score determined by application of Site Assessment Model
SWQD	Surface Water Quality Division, DEQ
WMD	Waste Management Division, DEQ
USTD	Underground Storage Tank Division, DEQ