Wellhead Protection Plan Part II

Deerwood, Minnesota

SEH No. DEERW 125461

October 29, 2014

Team Members

NAME	REPRESENTING	EMAIL	PHONE
Patrick Radtke	City of Deerwood Public Works	deerwoodpublicworks@yahoo.com	218.534.3152
Brian Nelson	City of Deerwood Public Works	deerwoodpublicworks@yahoo.com	218.534.3152
Debby Leonard	City of Deerwood Council Member	Leon0005@charter.net	218.534.3152
Jeff Turk	City of Deerwood Clerk/Treasurer	jeffturk@cityofdeerwood.com	218.534.3152
Dave Neiman	Minnesota Rural Water Association	dave.neiman@mrwa.com	218.820.0595
Chad Katzenberger	SEH Consultant	ckatzenberger@sehinc.com	218.855.1720

Public Water Supply Profile

The following persons are the contacts for the Deerwood Wellhead Protection Plan:

Public Water Supply

City of Deerwood
PO Box 187
Deerwood, MN 56444-0187

Telephone: 218.534.3152
E-mail: deerwoodpublicworks@yahoo.com

Wellhead Protection Manager/Public Water Supply Contact

City of Deerwood Public Works Department
Patrick Radtke
PO Box 187
Deerwood, MN 56444-0187

Telephone: 218.534.3152
E-mail: deerwoodpublicworks@yahoo.com

Wellhead Protection Consultant

Chad T. Katzenberger
SEH
416 South 6th Street Suite 200
Brainerd, MN 56401

Telephone: 218.855.1720
Email: ckatzenberger@sehinc.com

Foreword

This report is Part II of the Wellhead Protection Plan for The City of Deerwood. In general, the creation of this wellhead protection plan includes the development of a Potential Containment Source Inventory (PCSI), goals, objectives, plan of action, evaluation program, and contingency plan such that reliable and safe water service can be provided to the residents of Deerwood for years to come.

This plan includes the following:

- A review of the data elements.
- The results of the potential contaminant source inventory.
- A review of changes, issues, problems, and opportunities related to the public water supply and the identified potential contaminant sources.
- A detailed discussion of the potential contaminant source management strategies and corresponding goals, objectives, and action plans.
- A review of the wellhead/source water protection evaluation program.
- An alternative water supply contingency strategy.

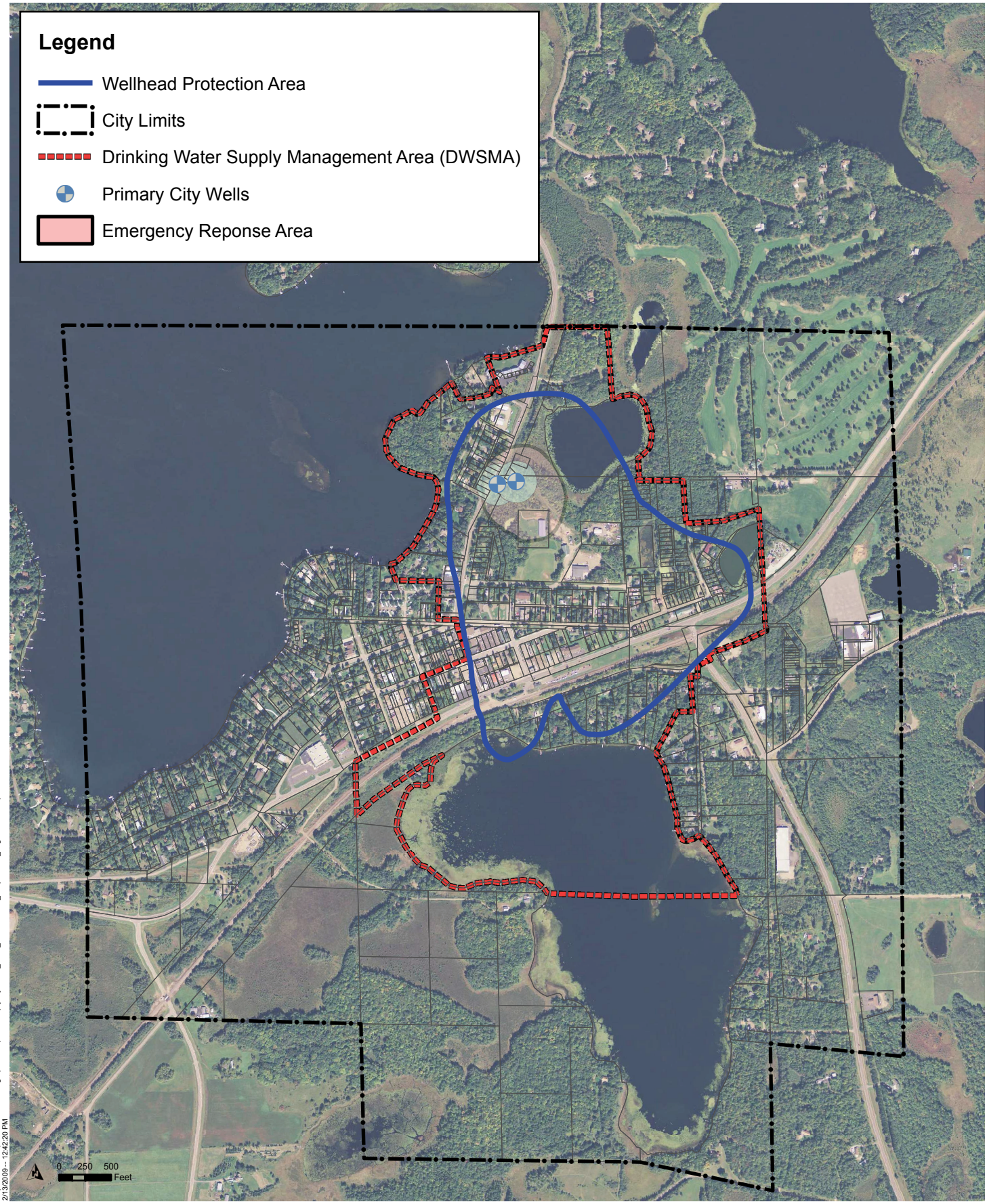
Part I of the plan was completed in February 2013. In Part I of the plan (available in Appendix A), the Wellhead Protection Area (WHPA) and Drinking Water Supply Management Area (DWSMA) were delineated, and vulnerability assessments of the wells and corresponding DWSMA were developed based on updated data available on the source water aquifer used by the municipal wells. The source water aquifer within the DWSMA was determined to be moderately vulnerable to contamination from the ground surface in some portions due to the absence of overlying geologic confining units in those locations.

The information and data contained in Sections 1-5 of this plan provide support and a basis for the approaches taken in addressing and managing the identified potential contaminant sources. Section 6 of this plan is composed of actions that the City's Wellhead Protection Team intends to implement over the ten year life of this plan.

The City's Wellhead Protection Program is designed to optimize the use of resources to protect the City's water supply. Efforts include further collection of data related to aquifer water quality and surface water interaction, refinement of information known about potential sources of contamination, and public education to promote safe management of potential sources of contamination of the groundwater aquifer supplying the City's wells. The inclusion of these items in this plan, as well as the County Water Plan, could open up funding opportunities through existing programs to assist the City with activities to protect the water supply.

Documentation List

Scoping 2 Meeting Held	May 29, 2013
MDH Scoping Decision Letter Received	June 26, 2013
Inventory of Potential Source Contamination Sources	November 2013
Management Portion of Plan[1]	April 2014
Submit Plan to LUGs	June 4, 2014
Consider Comments Received by LUGs[2]	August 12, 2014
Public Hearing Held	October 29, 2014
Submit Plan to MDH	November 6, 2014
*MDH Review	
*MDH Approval	
Provide Notice to LUGs About Plan Approval	
Begin Plan Implementation	



Map Document: (L:\Resources\Cartographic\Templates\EmptyLayouts\A_ANSI_8x11P\8x11P_Simple2Line_LegendBox.mxd)
2/13/2009 -- 12:42:20 PM

Project Number: DEERW 125461
Print Date: 00/00/0000

Map by: CTK
Projection: CWC County Coord.
Source: City, MDH

WELLHEAD PROTECTION PLAN
City of Deerwood, Mninnesota

FIGURE 1
Location Map

Table of Contents

Table of Contents (Continued)

List of Tables

List of Appendices

Wellhead Protection Plan Part II

Prepared for City of Deerwood, Minnesota

1.0 Data Elements and Assessment (4720.5200)

In accordance with Minnesota Rules Chapter 4720.5200 and the Second Scoping Decision Notice provided by MDH, the following subsections discuss the required data elements and their assessment as they relate to the Deerwood wellhead protection program.

1.1 Required Data Elements

1.1.1 Physical Environment Data Elements

1.1.1.1 Geology

The surficial geology of the Deerwood study area generally consists of clay till intermixed with pockets of sand, gravel & hardpan clay. The City's primary well, Well No. 2, terminates at an approximate depth of 145 feet. The City's wells pull water from lower sand and gravel layers just above the shale bedrock surface, which begins at a depth of approximately 163 feet. Clay till and hardpan layers generally cap the lower sand and gravel aquifer. While this clay layer is thought to provide some level of protection for the aquifer, the inconstant layer profiles may provide channels for the aquifer to be influenced by foreign elements.

Though the City's water source is pulled from a confined aquifer, the City's wells have been classified as being vulnerable and the DWSMA as moderately vulnerable. This was determined in Part I of the Wellhead Protection Plan.

1.1.2 Land Use Data Elements

1.1.2.1 Land Use

The land use history of the DWSMA was discussed with City staff and other members of the Wellhead Protection Team during the development of this plan. A historical fire insurance map was located and is included in the appendix. Land use history was discussed in the context of the development and refinement of the Potential Contaminant Source Inventory (PCSI) for this plan. That inventory reflects what is known about historical current and future land uses that might impact the municipal public water supply wells.

The City of Deerwood is approximately 2 square miles in size and is located on the Southeastern shores of Serpent Lake. State Highways 210 and 6 as well as Crow Wing County Highway 12 converge within the City. The City's predominant existing land use is residential and commercial. Much of the City's core land mass has been developed will little room for additional development.

Commercial businesses are located along The State Highways 210 and 6 corridors, as well as the core business district. Central businesses are located close to the sidewalk in a traditional “Main Street” pattern. Businesses include a small variety of service and retail establishments, as well as light manufacturing.

Maps included in Appendix D show the current zoning and land uses in the City of Deerwood. In the moderately vulnerable portions of the DWSMA, the land use is primarily residential, park land as well as some business/industry land. This includes most of the Emergency Response Area for both wells. The wells are located near TH 6 which bisects the inner well management zone (IWMZ). The potential for contamination from a highway vehicle transporting hazardous materials exists if such a vehicle were to leave the roadway and overturn. For this reason, additional consideration from this intermittent threat must be considered.

Commercial land uses are most concentrated along the TH 6 and TH 210 corridors. Some businesses which do light manufacturing are located on the west side of the City, but are not located within the DWSMA.

Commercial and industrial land uses often include fuel stations and other businesses that store or use chemicals that are hazardous to human health in drinking water. The potential contaminant source inventory discussed in more detail in Section 1.1.3 attempts to identify and locate those facilities that pose a potential threat to the water supply, in order to develop management strategies to prevent contamination events.

One of the goals of this Wellhead Protection Plan is to raise awareness of the need to protect the City’s source of drinking water. Information from this plan, including DWSMA vulnerability boundaries and the potential contaminant source inventory, will be provided to the City’s Updated comprehensive plan. The City will consider wellhead protection efforts in future community planning activities.

1.1.3 Potential Contaminant Source Inventory (PCSI)

The management strategies selected and documented in Section 6 of this plan focus on land use activities that have the highest potential to impact the aquifer the City is using for its drinking water supply.

The entire DWSMA is classified as moderately vulnerable. In the moderately vulnerable DWSMA’s, only potential contaminant sources that pose high risk of contamination, or that penetrate the protective clay layer over the City’s aquifer, need to be considered. These include chemical storage tanks, solid waste management sites, chemical storage or preparation areas, pipeline facilities, leaking underground storage tanks, potential contamination sites, spills, private wells, and Class V injection wells.

In addition, recent water chemistry investigations conducted by the MDH indicate that the City’s wells are likely being impacted by outside influences. Therefore, the Wellhead Protection Team has placed additional priority on understanding the influence of Cranberry Lake, Serpent Lake, and the potential for contamination to enter the City’s wells by that route.

Information and data pertaining to land uses and activities were compiled from various state agency databases, City records, and field observations. This data was reviewed with the Wellhead Protection Team and refined based on local knowledge of current and historical activity. Appendix B documents each of the PCSI activities identified within the DWSMA as well as corresponding map ID information and additional attributes. The PCSI map in Appendix B depicts the locations of these sites listed in the corresponding PCSI table. There are multiple location/items that are listed in this table, which after further investigation were found to be located outside of DWSMA. However, these items we included for future reference and identified as such.

Beyond information provided by state databases for potential contamination sources, wells within the area were analyzed and inventoried as available. Wells that included location information from the County Well Index (CWI) were plotted on the map as shown in PCSI Map (Appendix B). Un-located wells were reviewed with the Wellhead Protection Team. The majority of the wells were easily identified due to local knowledge of City staff and team members and found to be outside of the DWSMA. Those un-located wells which were found to be inside this area were located in the PCSI map and table. Furthermore, due to local knowledge, it was found that there was a series of known wells within the DWSMA that were not located or inventoried in the CWI. As a result a field effort was made to verify additional private well locations and include in the PCSI inventory.

Historical records also led to the discovery of an old municipal well. Historical documents noted a municipal dug well, existing on the shores of Serpent Lake. While location information was vague, a historical City Plan map included a small 60-foot x 60-foot lot located on the shores of Serpent Lake, near the original core City. This location is document on the PCSI map and noted as old municipal well. While the City is not certain that this is the exact location of the old well, the geometrical location of the well including the location/lot size is consistent with other similar old municipal wells in the region. Similar installations were found in neighboring communities and have nearly identical lot sizes and location proximities. This original small lot is now part of a larger private residential parcel; as a result, the City will continue to maintain this record for future investigations as needed upon a positive identification of the old municipal well, the City will seek assistance to properly abandon the well.

This plan attempts to prioritize potential contaminant sources based on their location or the threat posed by the source. For this reason, the potential contaminant sources summarized in PCSI table (Appendix B) are categorized by the type of activity, whether they are active sites and include material and facility codes where applicable.

The addresses affiliated with these sites have been cross-referenced with Parcel Identification Numbers where feasible to verify the locations of the potential contaminant sources. Those locations that could not be verified to date are identifiable in Appendix B as such.

The MPCA defines the methodology for locating sites within their GIS files. There are a variety of methods that the MPCA employs to locate sites. Those used for sites within the search area for this report include: address matching house number, digitized map tool, digitized DOQ, digitized DRG, interpolation unknown, and GPS. The MPCA considers the reliability of all of the methods listed as good to very good with the exception of “interpolation unknown”.

1.1.4 Pipelines

There are no gas, chemical, or petroleum pipelines located within the DWSMA; however, the City does maintain sanitary sewer collection, force mains, water mains, and storm water pipes.

1.1.5 Public Utility Services

Maps of each the Water Distribution System, Sanitary Sewer System and Stormwater systems are included in Appendix D.

Public utilities can impact the management of the DWSMA from a total City perspective.

Storm sewers can provide a conduit for surface contaminants, and therefore, infiltration and ponding areas are potential sources of contamination to the aquifer. There is also an indication of surface water interaction with groundwater used for the City's wells based on preliminary monitoring by MDH. The City's wells are likely pulling water from Cranberry Lake and/or Serpent Lake in some proportion. Therefore, storm water discharges to the lake could influence future water quality in the aquifer. The Deerwood storm sewer system is mapped in Appendix D.

Sanitary sewer leakage in close proximity to the wells could also be a concern. The City has aging sanitary sewer infrastructure and though breakage and leakage may be a threat in the future, it has yet to be a major issue. The Deerwood sanitary sewer system is mapped in Appendix D.

The location of water and sanitary sewer systems are also often used to identify likely locations for private wells and septic systems that can be sources of groundwater contamination. There are known to be 6 - 8 homes on the North Shore of Lake Reno which are not served by City utilities and have private septic systems.

Municipal water supply wells that are no longer in use have also been reviewed for this plan. MDH provided a list of inactive municipal wells from their records as a starting point for discussion.

1.1.6 Water Quality Data Elements

1.1.6.1 Groundwater Quality

The public water supply for Deerwood is tested routinely as required under the federal Safe Drinking Water Act. The public water supply is in compliance with all applicable rules, regulations, standards, and limits.

The City does not filter its water supply, but does add fluoride for dental health, polyphosphate for sequestering iron, and manganese and sodium hypochlorite for disinfection.

There is evidence of a possible hydraulic connection between the sand and gravel aquifer used by the City's wells, and the surrounding lakes. Results from one sampling event (May 2011) of the city wells, Serpent Lake and Cranberry Lake indicate a degree of groundwater/surface water interaction. The initial results indicate some contribution of surface water to the City's wells. Reno Lake was not sampled as part of this initial monitoring effort. Additional sampling of the lakes and City wells for phosphorus and chlorides should allow for a more accurate assessment of the relationship between local surface water features and the sand and gravel aquifer serving the City's wells.

Furthermore, the elevated chlorides in the City wells (sampled in May 2011) indicate a strong connection between the wells and land use activities. The source(s) of the chlorides has not been identified; the chlorides could be resulting from road salts, septic or wastewater discharge, storm water, or even from the surface water features themselves. A possibility of the elevated level of chlorides may be from Cranberry Lake, which was once used as the City's primary sanitary treatment system. Additional sampling of the chloride levels may help to better understand which existing activities are impacting the wells.

1.2 Assessment of the Data Elements

1.2.1.1 Use of The Well

The City of Deerwood uses two wells for water service. Well No. 2 is utilized for regular water supply, while Well No. 1 is relied upon as a backup. Both wells have similar water quality, however, the existing chemical feed equipment is set up to flow pace with Well No. 2, as a result, this well is used regularly. Well No. 1 is operated on occasion to assure it will be ready and available as needed. Table 1 below documents average daily water used from each well over the previous 10 years.

Table 1
Well Water Use

Well Number	Unique Well No.	Depth (ft)	10-year Average Pumped (MG/yr)	10-year Average Pumped (gpd)
1	232353	181	0	0
2	455781	140	18.6	51,000

Source: MNDNR Pumping Records

In the future, the City may choose to update chemical feed systems such that either well may be operated equally.

Besides a handful of small capacity domestic wells, there are not any major wells in the DWSMA. Additional well records are located in Appendix D. Currently, there are not any known well interference issues affecting the City well.

1.2.2 Wellhead Protection area Delineation Criteria

The following data inputs were used in determining the boundaries of the wellhead protection area: Time of Travel - 10-Years, Flow Boundaries, Daily Volume, Groundwater Flow Field & Aquifer Transmissivity.

A more thorough discussion regarding the delineation is found in Part 1 of this plan, which was completed by MDH and is included in Appendix A.

1.2.3 Quality & Quantity of Water Supplying the PWS Wells

The City pumps an average of 18.6 MG of water per year from Well No. 2. Existing water quality testing has revealed no violations under the Federal Safe Drinking Water Act. However, other constituents such as phosphorus and chloride will continue to be monitored which are indicators of outside influence on the aquifer.

Furthermore, if and when the City modifies well operations, each well would then be relied upon to supply roughly half of the water supply, or 9 MGY per well. This would reduce the stress on each well and may have an impact on groundwater flow profiles since Well No. 1 would draw water from a deeper depth in the aquifer.

1.2.4 The Land Use and Groundwater use in the DWSMA

The land use within the DWSMA is primarily residential and commercial. The majority of this land mass has been developed and is being utilized according to the nature of development. A change in use is not expected; therefore major changes are not expected.

2.0 Impact of Changes on Public Water Supply Well (Minnesota Rules 4720.5220)

2.1 Changes Identified In:

2.1.1 Physical Environment

There are no expected changes to the physical environment of the DWSMA within the next ten years.

2.1.2 Land Use

There is a potential for development to occur on the City's east side in the vicinity of the Cuyuna Golf Club. This development is not within the DWSMA and is not anticipated to impact the DWSMA.

In general, the land use within the DWSMA is not expected to change substantially in the next ten years.

Beyond ten years, there is the potential for mining activity to occur in the surrounding communities. The geologic formations within the City of Deerwood do not have any identified minerals that are desired for mining purposes. However, it would be likely that businesses within the City of Deerwood would participate in providing support services for mining.

2.1.3 Surface Water

The City of Deerwood expects to improve water quality flowing through the DWSMA through the use of Best Management Practices (BMPs) over the next ten years. Initiatives enacted to improve the quality of water in Serpent Lake will influence BMPs selected for water quality on Cranberry Lake, Crystal Lake, and Reno Lake.

Cranberry Lake is in need of water quality improvements. Prior to being taken out of service in 1989, Cranberry Lake was used by the City as their waste water lagoon in conjunction with their waste water treatment facility. Elevated levels of phosphorus are present in this water body. It is possible that this lake is influencing both Serpent Lake as well as the City's municipal wells. Efforts to identify and remediate issues will continue.

The City of Deerwood does not own the majority of the storm sewer system that is located within City limits. The City of Deerwood owns and maintains culvert crossings throughout the City while the Minnesota Department of Transportation and Crow Wing County own the remaining storm sewer system (buried pipe and manholes etc.). City staff will notify the responsible party in the event issues are observed. The City of Deerwood will also recommend storm water improvements to the responsible party when street improvements are made within City limits.

2.1.4 Ground Water

There are no anticipated new high capacity wells within the DWSMA. However, outside influences on the City's existing municipal wells continues to be monitored through sampling and testing. Results from one sampling event, taken in May 2011, indicate an elevated level of chlorides in the City's wells. This represents a degree of groundwater to surface water interaction. Elevated chlorides are usually a result of wastewater discharge, road salt, or storm water. Additional sampling is needed to determine the degree of interaction and the surface water responsible for recharging the City's aquifer. A possible cause for the elevated levels of chlorides is from water softener salt being discharged into the City's wastewater system prior to 1989 when Cranberry Lake was used as the City's wastewater lagoon. Another possible source may be road salts utilized to control snow and ice on local roads and highways.

2.2 Impact of Changes

2.2.1 Expected Changes in Water Use

The City of Deerwood does not expect a major increase in water consumption within the next ten years. In the last ten years, the City has experienced a relatively consistent average daily water use ranging from 42,000 gpd (gallons per day) to 58,000 gpd with an average of 51,000 gpd. Major water use from existing or new private wells is also not expected.

2.2.2 Influence of Existing Water and Land Government programs and regulations

The DWSMA is within Deerwood's City limits, as a result, the City has the ability to more closely monitor and support regulations to maintain existing water quality. It is anticipated that the Planning and Zoning committee will utilize this document and the updated comprehensive plan when reviewing future applications.

Furthermore, regulation of liquid chemical storage tanks, private wells, and other potential contaminant sources is currently under the control of MPCA, MDH, and other state or federal agencies. The City will be dependent upon the enforcement of these regulations by outside entities. However, the City will continue to be cognizant of possible threats to the City's valuable water supply. As possible threats are identifies, the City will maintain communication with agencies to ensure that enforcement is being carried out where there is a potential for impact to the water supply

2.2.3 Administrative, Technical, and Financial Considerations

The City of Deerwood has been supportive of the wellhead protection efforts. A wellhead protection committee has been formed and actively involved in preparation of this plan.

The City has identified a wellhead protection manager to implement the recommendations of this plan. The committee will continue to meet annually to review the implementation progress. Protection of the City's water supply is a priority and the City will continue to support this initiative to assure a safe and reliable water supply in the future.

The City intends on providing funding and means to implement the fundamental goals of their plan. The City will also seek grant funding to finance the more costly action plan items.

3.0 Establishing Priorities and Assigning Risk to Potential Contamination Sources

The various types of potential contamination sources that may exist within the DWSMA were compiled from the information collected to satisfy the data element requirements. The impact assigned to each data element as part of the assessment process (Table 3) was used to assess the types of potential contamination sources that may present a risk to the City's drinking water supply. The moderate vulnerability assessment for the DWSMA indicates that, generally, wells, other types of boreholes, excavations that may reach the aquifer, certain types of Environmental Protection Agency Class V Wells, spills, transportation corridors and petroleum storage tanks have a potential to impact the City wells.

3.1 Contamination Potential

None of the human-caused contaminants regulated under the federal Safe Drinking Water Act have been detected at levels indicating that the well itself serves to draw contaminants into the aquifer as a result of pumping.

3.2 Inventory Results & Risk Management

A description of the locations of potential contamination sources is presented in Appendix B. A summary of the results for the IWMZ, as listed in Table 2 and Table 3, presents these results for the remainder of the DWSMA. The priority assigned to each type of potential contamination source addresses 1) the number inventoried, 2) its proximity to a City well, 3) the capability of local geologic conditions to absorb a contaminant, 4) the effectiveness of existing regulatory controls, 5) the time required for the City of Deerwood to obtain cooperation from governmental agencies that regulate it, and 6) the administrative, legal, technical, and financial resources needed. A high (H) risk potential implies that the potential source type has the greatest likelihood to negatively impact the City's water supply and should receive highest priority for management. A low (L) risk potential implies that a lower priority for implementing management measures is assigned.

Table 2
Potential Contaminant Sources & Risk for the IWMZ

	Inside of IWMZ	
Potential Source by Type	**Quantity**	**Risk**
Transportation Routes	1	H
Stormwater Runoff (General)	G	H

**Notes: H= High, M=Medium, L=Low

Table 3
Potential Contaminant Sources & Risk For DWSMA

Potential Source by Type	Total Number	Within Emergency Response Area		Outside Emergency Response Area & Within DWSMA	
		Quantity	Risk	Quantity	Risk
Domestic Wells (From CWI)	5	0	-	5	H
Non CWI Domestic Wells	14	0	-	14	H
Un-located Wells – Field Verified	2	0	-	2	H
Old Municipal Wells	1	0	-	1	M
ISTS systems	4	0	-	4	L
Class V Injection Wells	0	0	H	0	H
Transportation Routes	3	1	H	3	M
Leak Sites	1	0	-	1	M
Tank Sites	5	0	-	5	M
Stormwater Runoff (General)	G	G	H	G	M

**Notes: H= High, M=Medium, L=Low

4.0 Issues, Problems, and Opportunities (Minnesota Rules 4720.5230)

4.1 Identification of Issues, Problems, and Opportunities

A number of potential issues related to the protection of the City's source water have been raised during the drafting of this plan, and Section 6 of this plan includes action items to address the most important of those. In addition, opportunities exist for the City to tap into existing resources to assist in the implementation of this plan. Broader issues addressed by this plan, along with related opportunities and resources for the City to utilize in plan implementation, are discussed in this section.

4.1.1 Implementation of Plan (Flexibility and Resources)

The City recognizes this is a 10-year plan and that issues, problems, and opportunities can change, from current status, which can impact the implementation strategies. The City must have the flexibility to address changing situations as needed to achieve goals. The City, local and state governments have existing controls in place to address most issues as they occur. The City, local and state governments are continually updating land use controls as new issues, new problems and new opportunities occur.

Also, The City has limited resources to implement all of the management strategies contained within this WHP Plan. With limited resources the implementation of the WHP Plan will be a challenge to the City. The City will strive to achieve all goals with available resources and will seek additional resources as needed

4.1.2 Surface Water Interaction

Results from one sampling events (May 2011) of the City wells, Serpent Lake, and Cranberry Lake indicate a degree of groundwater/surface water interaction. The initial results indicate some contribution of surface water to the City's wells. Reno Lake was not sampled as part of this initial monitoring effort. Additional sampling of the lakes and City wells should allow for a more accurate assessment of the relationship between local surface water features and the sand and gravel aquifer serving the City's wells.

MDH has stated their interest in continuing to evaluate water quality in the wells and neighboring surface water bodies in order to better understand the interaction of surface waters and groundwater used by the municipal wells. The City has the opportunity to use MDH resources such as laboratory analysis and evaluation of data collected to improve understanding of potential risks from surface water infiltration to the aquifer. This understanding could lead to better protection of the City's water supply.

4.1.3 Impact of Land Use on Water Quality

The elevated chlorides in the City wells (sampled in May 2011) indicates a strong connection between the wells and land use activities. The source(s) of the chlorides has not been identified; the chlorides could be resulting from road salts, septic or wastewater discharge, stormwater, or even from the surface water features themselves. Additional sampling of the chloride levels may help to better understand which existing activities are impacting the wells.

4.1.4 Future Land Use

Land use within the DWSMA has essentially remain unchanged for the past 10 years and is not expected to change substantially in the near future. However there may be ways to help improve overall water quality in the future. As potential road and utility projects take place within the City, stormwater management measures should be encouraged.

4.1.5 Stormwater Management

Coordinating management activities between wellhead protection and the current storm water reduction efforts may allow the City to tap into additional funding sources related to storm water management. There is currently an effort in place to secure funding from the State Clean Water Legacy Funding program to address storm water runoff in the Cities of Deerwood and Crosby. The Goal of this funding is to reduce storm water runoff into Serpent Lake thereby improving water quality. It is understood that there is a link between the City's groundwater supply and Serpent Lake. Improvement to lake water quality would be in the best interest of the City's water supply. Therefore encouraging storm water improvements would be beneficial.

The Serpent Lake Association and County Soil & Water District have also identified potential improvements to Cranberry Lake as part of an overall improvement funding request. Alum treatment of Cranberry Lake has been proposed to hold existing phosphorous in suspension. While this appears to be a temporary fix, it would be an improvement to this water feature and if it is the best option, it should be supported.

As part of the Wellhead protection team meetings additional ideas were discussed related to Cranberry Lake and the elevated levels of phosphorus. One potential option would be to collaborate with the nearby golf course and encourage the facility to use water from Cranberry Lake for irrigation. This would allow for some of the phosphorus in the lake to be consumed and encourage water turn over in the lake. While this idea is in its infancy, it can be explored in the future and possibly provide a mutual benefit to the golf course by:

- Supplying nutrient rich water to the golf course for irrigation,
- support the county and Serpent Lake Association Efforts by reducing phosphorous levels in the lake
- Benefit the City by reducing demand stress on the aquifer in that the golf course would be using less well water.

4.1.6 Existing Municipal Wells

The City of Deerwood has sufficient water for the projected water demands over the next 10 years. Future alternation of City well use is assumed to have limited impact on the WHPA since the wells are located in the same vicinity.

However, the location of the existing wells does pose an issue related to their proximity to State Highway 6. A fuel or chemical spill near the wells could have a direct impact on water quality. Furthermore, a well could be damaged by a vehicle if it were to leave the roadway and collide with the well casing.

There is also a suspected Old municipal well located in the City, somewhere near the shores of Serpent Lake, which is described in historical records. The geographical location is not noted, however City Staff has reviewed old City maps and have an understanding of a possible location for the this old well. The approximate assumed location is noted on the PCSI map. Confirming this assumption and assuring the proper abandonment of this well will be a priority for the City as it relates to the well head protection plan.

4.1.7 Wells

It is known that some properties in the DWSMA have wells that may or may not currently be used or sealed. These wells can serve as a potential conduit for groundwater contamination if not properly maintained or sealed.

The City has taken measures to identify documented and un-documented wells. Through this effort the City will encourage owners of unused wells to have them sealed. If grant funds are available, the City will collaborate with well owners to match them with appropriate funds to accomplish the sealing of wells.

4.1.8 Class V injection wells

Though no known Class V wells are known to be located in the City, possible un-located injection wells could pose a threat and therefore continue to be searched for.

4.1.9 Tank Sites

Multiple actives as well as historical tank sites exist within the DWSMA. Improper management of these sites has the potential to impact existing City Wells.

4.1.10 ISTS Systems (Septic Systems)

There are currently ISTS systems within the DWSMA. Contaminants from improperly installed or maintained septic systems can impact local water quality

4.1.11 Transportation Corridors

Currently two state highways, a well traveled County Highway and a major railway all pass through the DWSMA. If a vehicle or rail car carrying hazardous materials were to overturn and spill, there would be a potential for contamination of the aquifer. This would be especially troublesome near the existing municipal wells where a major highway passes within the IWMZ.

4.2 Summary of Issues, Problems, and Opportunities

Table 4
Summary of Issues, Problems & Opportunities

Identified Issue	Impacted Feature	Problem Associated with the Identified Issue	Opportunity Associated with the Identified Issue	Adequacy of Existing Resources to Address the Issue
The City recognizes this is a 10-year plan and that issues, problems, and opportunities can change, from current status, which can impact the implementation strategies.	Public Health, Aquifer, DWSMA and Well Water Quality	The City must have the flexibility to address changing situations.	The City has the opportunity to address those issues, problems and opportunities that may change over the next 10 years.	The City, local and state governments have existing controls in place to address most issues as they occur. The City, local and state governments are continually updating land use controls as new issues, new problems and new opportunities occur.
The City has limited resources to implement all of the management strategies contained within this WHP Plan.	DWSMA	With limited resources the implementation of the WHP Plan will be a challenge to the City.	Form working partnerships with local units of government, state agencies and cooperators that have regulatory authority and/or programs to help with implementation.	City has limited staff, time, and resources for implementation. Apply for MDH SWP Implementation Grants to help with financial issues.
Sampling of the aquifer, conducted in 2011, showed an elevated Tritium level which correlates to relatively young water being produced by the wells.	Aquifer DWSMA	Potential exists regarding relatively quick realization of recharge water in the aquifer, heightening the perceived risk of contamination.	If the opportunity presents during well maintenance or rehabilitation, video log both wells to determine any potential casing defects, then retest for tritium after 5 years.	Apply for MDH SWP Implementation Grants to help with financial issues.
Surface water impact on the aquifer from area lakes and other surface waters.	Aquifer DWSMA	Need to better define the understanding of the surface-groundwater interaction in the area.	With assistance from the MDH hydrologist, and subject to the availability of funding, prepare and implement a groundwater and surface water monitoring plan.	Apply for MDH SWP Implementation Grants to help with financial issues.
MDH has stated their interest in continuing to evaluate water quality in the wells and neighboring surface water bodies in order to better understand the interaction of surface waters and groundwater used by the municipal wells.	Aquifer DWSMA	There is link between area surface water and well water quality which indicates some level of aquifer vulnerability. More should be done to understand this relationship	The City has the opportunity to use MDH resources such as laboratory analysis and evaluation of data collected to improve understanding of potential risks from surface water infiltration to the aquifer.	Continue to work with MDH to sample wells and further the understanding of the wells.

Table 4
Summary of Issues, Problems & Opportunities

Identified Issue	Impacted Feature	Problem Associated with the Identified Issue	Opportunity Associated with the Identified Issue	Adequacy of Existing Resources to Address the Issue
The raw well water used by the City exhibits traces of Chlorides	Aquifer Well Water Vulnerability	These vulnerability indicators in the groundwater aquifers generally point to a connection with the earth's surface and/or surface waters.	With the assistance of the MDH SWP Unit and others, initiate sampling procedures to identify potentials.	The MGS, MDH Hydrologist, and the MDH Well Management Unit can be of assistance. MDH SWP Implementation Grant Program.
Future Road Improvements	Aquifer DWSMA	Road grades near the existing municipal wells expose wellheads to potential runoff.	As future projects develop, encourage the improvement of drainage in the area of the municipal wells to re-direct runoff,	Work with MnDOT and MDH as key improvements are made in the area to encourage re-grading of improve runoff.
Storm water drainage	Aquifer, Well Water quantity and quality, DWSMA	Runoff from roadways and commercial property can impact area surface water quality.	The city can work with the state highway department and property owners to control, redirect, or reduce runoff.	Cooperate with MnDOT & Crow Wing County area storm water management programs. Apply for SWP Implementation grant.
Cranberry Lake Phosphorous Levels	Aquifer DWSMA	This lake was once the site of the City's sanitary waste treatment. Its close proximity to City wells may prove a risk in the future.	There are preliminary plans in place through CWC Soil & Water to treat Cranberry Lake with Alum to address the high level of Phosphorous. The City can support these efforts or encourage and support additional options (i.e. irrigate golf course with lake water to consume	Support Cranberry Lake treatment efforts though CWC soil and water, explore alternative treatment options though golf course irrigation. Apply for SWP Implementation grant.
Location of municipal well in highway ROW.	Public Health, Aquifer, DWSMA and Well Water Quality	The potential exists for the well to be physically damaged.	Explore the option to provide fencing, enclosure or other well security to prevent damage from vehicles, plows, etc.	Work with MnDOT, and apply for MDH SWP Implementation Grants to help with financial issues.
Though no unused and unsealed wells on residential properties have been identified, a possibility exists that there may be some.	Aquifer Well water quality DWSMA	The city needs to attempt to identify and assess which wells present a threat to the aquifer based upon their depth, construction, and state of repair.	If unused/unsealed wells are found, the city can partner with Crow Wing County to help property owners pay for the costs of properly sealing unused wells. Utilize MDH SWP Grant Program.	The city does not have authority to require that unused wells be properly sealed. The MDH has authority to require well sealing.

Table 4
Summary of Issues, Problems & Opportunities

Identified Issue	Impacted Feature	Problem Associated with the Identified Issue	Opportunity Associated with the Identified Issue	Adequacy of Existing Resources to Address the Issue
There are numerous private wells on properties within the DWSMA.	Aquifer Well Water Quality DWSMA	The City should continue to locate private wells, and assess which wells present a threat to the aquifer based upon their depth, construction, use, and state of repair.	The City can furnish owners of active wells with private well management information. The City can partner with Crow Wing county and the MDH SWP Grant Program to help property owners pay for the costs of properly sealing unused/unsealed wells. Apply for MDH SWP Grant funds.	The City does not have authority to require that unused wells be properly sealed. The City should review, and consider adopting, proposed private well management ordinance language being developed by LMC. The Minnesota Department of Health may be able to assist with the sealing of unused wells.
Old City Well.	Public Health Safety	The original city well may present a public health and safety hazard.	With the assistance of MDH Well Management, explore options for locating and sealing this well.	Apply for MDH SWP Implementation Grants to help with financial issues to seal the well, if practical.
Class V Underground Injection wells	Aquifer, Well water quality, public health	Though no known Class V wells are known to be located in the City, possible un-located injection wells could pose a threat and therefore continue to be searched for,	Continue to search for, and identify, potential Class V Wells and work with the US EPA and the owner to have them properly sealed.	US EPA UIC Program. MDH SWP Implementation Grant Program.
Tank Sites	Aquifer Well Water Quality DWSMA	Multiple active as well as historical tank sites exist within the DWSMA. Improper management of these sites have the potential to impact existing City Wells	Work with MPCA and request information regarding the status of old tank sites.	MPCA has jurisdiction.
ISTS Subsurface sewage treatment systems.	Aquifer DWSMA Well Water Quality	Contaminants from improperly installed or maintained septic systems can impact local water quality.	Utilize MDH SWP Grant funds to provide University of Minnesota Extension SEPTIC SYSTEM OWNERS GUIDE to property owners utilizing on-site sewage treatment systems.	Crow Wing County has local control and regulation of on-site sewage treatment systems outside the city limits. MDH SWP Implementation Grant Program.
Vehicular & rail transportation routes through the DWSMA.	Aquifer DWSMA Well Water Quality	Potential spills and leaks from vehicles and accidents.	The City will work with local first-responders, Crow Wing County, BNSF and MNDOT to develop an emergency response measures to address contaminant releases. Utilize SWP Grant funds.	Crow Wing County Emergency Management Department is responsible for coordinating County emergency preparedness.

5.0 Wellhead Protection Goals (Minnesota Rules 4720.5240)

Goals define the overall purpose for the WHP plan, as well as the end points for implementing objectives and their corresponding actions. The WHP team identified the following goals after considering the impacts that 1) changing land and water uses have presented to drinking water quality over time and 2) future changes that need to be addressed to protect the community's drinking water:

1. Maintain high water quality within the City to ensure all State and Federal Water Quality Standards are maintained or exceeded and maintain a safe and adequate drinking water supply for residents, visitors and neighbors;
2. Support ongoing data collection efforts to develop a better understanding and support the protection of the City's wells and groundwater.
3. Prevent contaminants from reaching levels that present a risk to people's health;
4. Provide area businesses and residents with educational materials and other resources to assist with implementation of drinking water protection measures:
   - Private well use, maintenance and sealing assistance;
   - Maintenance and operation of above and below-ground storage tanks;
   - Transportation corridor and spill emergency preparedness plan;
   - On-site sewage treatment systems;
   - Storm water management;
   - Class V wells;
   - Inner Wellhead Management Zone;
   - Continuing data collection;
   - Scheduled WHP Plan evaluation

6.0 Objectives & Plan of Action (Minnesota Rules 4720.5250)

The DWSMA for Deerwood has **moderate vulnerability** as described in Section 1.1.3, due to evaluation concluded by Part 1 of the Wellhead Protection Plan. In prioritizing wellhead protection activities, vulnerability will be used as one criterion, with potential contaminant sources within the highly vulnerable portion of the DWSMA receiving higher priority.

The City of Deerwood considered the following issues in determining the priority of potential contaminant sources:

- Any substance that exceeds the maximum contaminant level specified in Code of Federal Regulations, title 40, part 141 (1995 and as subsequently amended); and
- Collect additional data to support
- A quantifiable level of a contaminant in the well water resulting from human activity; and
- The frequency at which each source category of the potential contaminant source inventory may occur
- Proximity of potential contaminants to the municipal wells. The Emergency Response Area for each well represents a 1-year time of travel for groundwater to reach the well. Potential contaminant sources within these Emergency Response Areas will be given special consideration due to the potential for contamination to reach the wells undetected in a short period of time.
- The ability of the aquifer to reduce the impact of Potential Contaminant Sources
- The ability of existing controls to mitigate threats.
- The time required to secure cooperation from other agencies and government bodies.

- The amount of resources needed including but not limited to: funding staff time, expertise and legal obligations.

Special consideration will also be given to the location of the exiting production wells due to their proximity to major highway. As a result, the Inner Well Management Zone will be considered a high priority.

6.1 Objectives

The Following objectives have been identified to support the goals of the WHPP set fourth for the City of Deerwood. Objectives are considered actions that support the goals set forth in this plan.

1. Create public awareness and general knowledge about the importance of WHP for maintaining an adequate and safe drinking water supply.
2. Collect additional data to substantiate information contained within this Plan, and to provide more detail for future Plan amendments.
3. Provide landowners with best management practices and other information to assist with management of private property located within the DWSMA.
4. Provide direction to City and local planning bodies regarding future land use and development of property within the DWSMA.
5. Address issues associated with potential spills and leaks of hazardous materials on, or near, vehicular routes through the DWSMA.
6. Provide emergency response coordination for any impact to, or endangerment of, the water supply system.
7. Conduct regular evaluations of Plan implementation and effectiveness.

6.2 Measures & Action Plan

Based upon the factors, the WHP team has identified WHP measures that will be implemented by the city over the 10-year period that its WHP plan is in effect. The objective that each measure supports is noted as well as:

1. The lead entity and others who may lend assistance.
2. The anticipated resources required for implementing the measure.
3. A summary of the proposed schedule.

The following categories are used to further clarify the focus that each WHP measure provides, in addition to helping organize the measures listed in the action plan:

- Monitoring, Data Collection and Assessment.
- IWMZ Management.
- Land Use Planning.
- Potential Contamination Source Management.
- Public Education and Outreach.
- Reporting and Evaluation.
- Water Use and Contingency Strategy.

6.3 Developing Priorities

The primary purpose of the Wellhead protection plan is identification and implementation of strategies that are effective and feasible and will maintain water quality of the City of Deerwood for generations to come. The following Measures have been identified and will be implemented over the next 10-years as funding may be available.

WHP measures reflect the administrative, financial, and technical requirements needed to address the risk to water quality or quantity presented by each type of potential contamination source. Not all of these measures can be implemented at the same time, so the WHP team assigned a priority to each. A number of factors must be considered when WHP action items are selected and prioritized (part 4720.5250, subpart 3):

- Contamination of the public water supply wells by substances that exceed federal drinking water standards.
- Quantifiable levels of contamination resulting from human activity.
- The location of potential contaminant sources relative to the wells.
- The number of each potential contaminant source identified and the nature of the potential contaminant associated with each source.
- The capability of the geologic material to absorb a contaminant.
- The effectiveness of existing controls.
- The time needed to acquire cooperation from other agencies and cooperators.
- The resources needed, i.e., staff, money, time, legal, and technical resources.

The City of Deerwood WHP Team defines priority for implementing a WHP measure as starting with those potential contaminant sources that pose the most significant risk to the water supply and working through to those posing the least amount of risk. The following table lists each measure that it will implement over the ten year period the city's WHP plan is in effect as well as the priority that it has assigned to each measure. Goals: Represent Long Term plans

6.4 Management Strategies

Table 5
WHP Action Plan – Monitoring, Data Collection & Assessment

Measure	Priority	Description	Objective	*Project Leader & partners	Resources Required	Implementation Schedule									
						2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
1	M	Pending available grant funding, contact MDH Hydrologist to prepare a groundwater and surface water monitoring plan to assess the relationship between the aquifer used by the city's wells and potential sources of surface water recharge, including Serpent Lake, Reno Lake and Cranberry Lake. The monitoring plan should consider water quality, and the connectivity between the lakes and the city's wells. The monitoring planning team should also assess whether additional funding or resources are needed to implement the monitoring plan.	2	*WHP Manager, MDH Hydrologist, Crow Wing County, SWCD	Staff Time		X	X							
2	M	Coordinate with MDH staff and local partners in the implementation of the groundwater and surface water monitoring plan, including the collection of water samples and assessment of the results (4 samples/yr).	2	*WHP Manager, MDH Hydrologist, Crow Wing County	City staff time. The analytical cost for samples run through the MDH lab will be covered by MDH.		X	As needed							
3	M	Coordinate a meeting with the WHP Team, and MDH Hydrologist and Planner to assess the results of the groundwater analysis and surface water monitoring study. Identify: 1) how the results can be applied to help further protect the city's aquifer and water supply, 2) activities that can be completed as part of current plan implementation efforts, and 3) activities that will need to be incorporated into the city's wellhead plan amendment in 2023.	2	*WHP Manager, MDH, SWCD, Other Resource Partners, Crow Wing County	Staff Time				X	X					
4	M	Investigate whether the occurrence of elevated chlorides in the city wells is seasonal. Pending the results, assess likely land use activities contributing to the occurrence of chlorides in the city wells, if any.	2	*WHP Manager, Crow Wing County, SWCD, MDH	Staff Time, Coordinate with Measure No. 2		X	As needed							

Table 5
WHP Action Plan – Monitoring, Data Collection & Assessment

Measure	Priority	Description	Objective	*Project Leader & partners	Resources Required	Implementation Schedule									
						2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
5	M	Request MDH to provide information to the wellhead team regarding new well constructions and any “un-located” wells in the Deerwood area. Work with local well drillers and request summary of new wells drilled in the area. Pending available funding, work with partners to field locate new wells. Information from these wells can be used to map aquifer boundaries and the vulnerability areas of the DWSMA when the plan is amended. Collect additional well log information as available in the area, specifically wells that are greater than 50’ deep.	2	*WHP Manager, MDH, Well Drillers	Staff Time, Letter preparation costs					X	X	X			
6	M	Meet with the owner of the golf course to 1) accurately locate the well(s), 2) request well record information, and 3) request annual use records. This information will be used in the groundwater flow model when the plan is amended.	2	*WHP Manager, Golf Course	Staff Time							X	X		
7	M	Continue to identify and update information about any known or suspected Class V injection wells in the DWSMA. Contact MDH Planner for assistance working with a suspected owner of a Class V injection well.	2	*City, MRWA, MDH, EPA	Staff Time	As Needed									
8	M	Update the well inventory (spreadsheet and map) every 5 years. Review the status of existing wells and add new wells identified in the DWSMA.	2	*City, MRWA, MDH	Staff Time					X					

Table 6
WHP Action Plan – Inner Wellhead Management Zone & Well Management

Measure	Priority	Description	Objective	*Project Leader & partners	Resources Required	Implementation Schedule									
						2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
9	H	Monitor and maintain the 200' radius around the wells to insure that setback distances for new potential contaminant sources are met.	4	*City	Staff Time	Yearly									
10	H	Review and update the IWMZ (200 foot radius) survey form for all wells in the system every 5 years.	4							X					
11	M	Explore options for MDH implementation grant dollars to install fencing or protective enclosure around the wells and explore options to protect the entire well site help isolate it from trespassers and damage from vehicles or equipment.	5	*City	$8,000 per well		X	X							

Table 7
WHP Action Plan – Land Use Planning

Measure	Priority	Description	Objective	*Project Leader & partners	Resources Required	Implementation Schedule									
						2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
12	M	As the City's Comprehensive Land Use Plan is updated work with Planning commission to guide future development and growth within the City and DWSMA.	4	*City, CWC	Staff Time	X									
13	M	Update current City Land Use Controls, Zoning Ordinances and Subdivision Ordinance to include references to the DWSMA and groundwater water quality concerns.	4	*City	Staff Time			X							
14	H	Explore the development of an ordinance that prevents the use of new Private wells within the DWSMA if end user is within proximity to City water supply	4	*City, League of MN Cities	Staff Time			X							
15	H	Request planning & zoning staff review the zoning districts and their allowed uses within the Emergency Response Area for the introduction of potential contaminant sources.	4	*City		X									
16	M	Work with local planning staff to adopt an ordinance that requires new developments be connected to the public water supply system.	4	*City				X							
17	H	Work with city planning staff to adopt an ordinance that prohibits Class V automotive injection wells within a DWSMA	4	*City, Crow Wing County				X							
18	M	Explore options for adding a backflow prevention ordinance.	4	*City, MDH, League of MN Cities				X							
19	M	Hold an annual meeting with local planning staff to discuss any changes in land use or zoning near the city wells or in the DWSMA. Review compliance yearly	7	*City		X	X	X	X	X	X	X	X	X	X
20	M	The City Council should carefully review and comment on any proposed land use changes being considered in the DWSMA, for potential impact on groundwater quality or quantity, and use land-use control options to minimize potential impact to the aquifer used by the city (require hookup to city utilities).	4	*City, MDH, MRWA, County	Staff Time	As Needed									

Table 8
WHP Action Plan – Potential Contaminant Source Management

Measure	Priority	Description	Objective	*Project Leader & partners	Resources Required	Implementation Schedule									
						2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
21	M	Research the location and status of the old dug municipal well and verify that it has been properly sealed, if not pursue grant funding to seal well.	2	*City	Staff Time	As Needed									
22	H	Send a letter to request that MDH & DNR inform the City of Deerwood when permits are granted for new wells, maintenance of existing wells, when existing wells are disclosed during property transfer, or when private wells are sealed.	2	*City, MDH	Staff Time, Letter costs	X								X	
23	H	Notify MDH and/or DNR about any new or proposed High-Capacity wells located within two (2) miles of the DWSMA boundaries.	2	*City, MDH	Staff Time	As Needed									
24	H	Provide information on unused, unsealed wells and the proper management and sealing of them to landowners located in the DWSMA and why this is important. Utilize the City of Deerwood website	3	*City, MRWA	*City Time	On Going									
25	H	If any unsealed wells are found in the City, assist well owner with securing funding and apply for SWCD & SWP grants to seal the well	3	*City, MRWA	City Time	As Needed									
26	H	If any unused/abandoned storage tanks are found in the City, assist tank owner with securing funding and apply for grants to properly remove the tank	3	*City, MRWA, MPCA	City Time	As Needed									

Table 9
WHP Action Plan – Education & Outreach

Measure	Priority	Description	Objective	*Project Leader & partners	Resources Required	Implementation Schedule									
						2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
27	M	Prepare an annual summary of wellhead protection activities for release to the public in a City newsletter, on the City website or post in public locations.	1	*City	City Staff Time	X	X	X	X	X	X	X	X	X	X
28	M	Prepare and distribute a handout, describing WHP activities and the status of Plan implementation, at community events. Distribute the MN Rural Water "Where Does My Drinking Water Come From?" brochure to landowners in the DWSMA	1	*City	City Staff Time	As Needed									
29	M	Install SWP informational signs around perimeter of DWSMA	1	*City	$ For Signs, City Staff Time		X								
30	M	Provide information to property owners about the hazards of unused wells and options for correctly managing them by having them properly sealed or returning them to operating condition.	3	*City	City Staff Time	X	X	X	X	X	X	X	X	X	X
31	M	Brief the mayor and city council about the potential for unused wells in the DWSMA and status of well sealing efforts. Describe resources needed and available to complete this effort	1	*City	City Staff Time	On Going									
32	M	Explore the option of publishing information regarding Wellhead protection activities	1	*City	City Staff Time	On Going									

Table 10
WHP Action Plan – Reporting & Evaluation

Measure	Priority	Description	Objective	*Project Leader & partners	Resources Required	Implementation Schedule									
						2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
33	H	Complete an Evaluation Report every 3 years that evaluates the progress of plan of action and the impact of any contaminant release on the aquifer supplying the water supply wells.	7	*City, MRWA, MDH	City Staff Time			X			X			X	
34	H	Summarize all WHP Plan implementation efforts in a report to MDH.	7	*City	City Staff Time									X	
35	M	Hold meetings, as needed, with the WHP Team, local resource partners, and City Management, to discuss WHP Plan implementation activities, budget needs and pursue MDH SWP Grant funds to help with implementation efforts. Annually coordinate an internal meeting with the city clerk, administrator, public works director, mayor or appropriate staff to discuss WHP Plan implementation and coordination. Discuss funding needs and pursuit of SWP Grant funds to help implement activities identified in the WHP Plan.	7	*City	City Staff Time	Annually									
36	H	Maintain a WHP Folder or binder that contains records and documentation of all WHP activities the City has completed.	7	*City	City Staff Time	On Going									
37	M	It is difficult to foresee or plan for the future. The City will use its planning and management capabilities within this plan to respond to and new/unknown source water protection issues that may impact the quality or quantity of its drinking water in the future.	1	*City, MDH	TBD	On Going									
38	M	Attend County Water Plan Committee meetings to represent public drinking water and groundwater concerns. Help integrate WHP activities in with other water resource efforts in the county	1	*City	City Staff Time	As Needed									

Table 11
WHP Action Plan –Water Use & Contingency Planning

Measure	Priority	Description	Objective	*Project Leader & partners	Resources Required	Implementation Schedule									
						2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
39	H	Meet with City Fire Department to make them aware of drinking water vulnerability issues, so they can consider the DWSMA vulnerability when responding to fires or contaminant spills; specifically identify the impacts that firefighting or cleanup procedures may have on contaminant movement to city wells or the aquifer.	6	*City	City Staff Time	X				X					
40	H	Distribute the City's WHP Contingency Strategy Plan to identified cooperators. Review every 5 years and update if necessary. Coordinate emergency response initiatives with Crow Wing County.	6	*City, Crow Wing County	City Staff Time	X				X					
41	M	Pending available funding, complete exploratory work to identify future will site for a redundant water supply well.	2	*City, MDH	$10,000 to $30,000 for exploration swell drilling	As Funding is Available									

7.0 Evaluation Program (Minnesota Rules 4720.5270)

The ability to successfully manage Potential Contaminants will require regular review and measurement such that the plan is useful in providing a value to the City of Deerwood. As a result, the Wellhead Protection program must be routinely evaluated in order to determine whether the plan is actually accomplishing the intentions of the City.

Some of the goals of evaluations are to:

- Track the implementation of the management strategies identified in Section 5.0 of this plan
- Evaluate the effectiveness of specific management strategies regarding the protection of the public water supply
- Identify possible changes to these strategies which may improve their effectiveness
- Determine the adequacy of financial resources and staff availability to carry out the management strategies planned for the coming year.

In order to meet these evaluation goals, the following activities will be implemented:

1. Require the Wellhead Protection Team to meet on an as-needed basis, with a minimum of one meeting per year, to review the results of each strategy implemented during the previous plan year. The Wellhead Protection Team will identify and discuss whether modifications are needed for those strategies, and whether additional strategies are necessary for the coming year.

2. The Wellhead Protection Manager will make a biannual written report to the Wellhead Protection Team regarding progress in implementing the wellhead protection management objectives of this plan. The biannual reports will be compiled and used to review the overall progress in implementing management strategies when the Deerwood Wellhead Protection Plan is updated in 10 years. A copy of the report will be sent to the MDH Source Water Protection Unit and another copy will be placed in the City's wellhead and source water protection file.

8.0 Alternative Water Supply & Contingency Strategy

The City of Deerwood was not required to develop and Emergency and Conservation Plan under Minnesota Statue 186 and Minnesota Rules, Part 6115.0770 since the population of the City is below 1,000 persons. In lieu of this plan, the City worked with Minnesota Rural water and SEH to develop a Water Supply & Contingency Plan. This Document is located in Appendix C.

9.0 Abbreviations and Terms

CERCLA COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT - see Superfund.

CERCLIS COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY INFORMATION SYSTEM is a database maintained by the US Environmental Protection Agency. CERCLIS contains information such as the current status of cleanup efforts, cleanup milestones reached, and amounts of liquid and solid media treated at sites on the National Priorities List, which is a list of Superfund Sites with high priority for remediation activity.

CWI COUNTY WELL INDEX is a database maintained by MDH with location and summary information for wells and boreholes in Minnesota.

DWSMA DRINKING WATER SUPPLY MANAGEMENT AREA is the area delineated using identifiable land marks that reflects the scientifically calculated wellhead protection area boundaries as closely as possible. The boundaries of the DWSMA can be 1) the center lines of highways, streets, roads, or railroad right-of ways; 2) section, half-section quarter-section, quarter-quarter section, or other fractional section lines of the United State public land survey; or 3) property lines.

GIS GEOGRAPHIC INFORMATION SYSTEMS is a computerized mapping method utilized in the compilation of data for the Wellhead Protection Plan.

IWMZ INNER WELLHEAD MANAGEMENT ZONE is the area within 200 feet of a public water supply well.

LGU LOCAL GOVERNMENT UNIT is a statutory or home rule charter city, town, county, soil and water conservation district, water shed district, organization formed for the joint exercise of powers under Minnesota Statutes, section 471.59, local health board, or other special purpose district or authority with local jurisdiction in water and related land resources management.

MDA MINNESOTA DEPARTMENT OF AGRICULTURE

MDH MINNESOTA DEPARTMENT OF HEALTH

MNDNR MINNESOTA DEPARTMENT OF NATURAL RESOURCES

MPCA MINNESOTA POLLUTION CONTROL AGENCY

PCSI POTENTIAL CONTAMINANT SOURCE INVENTORY is a database being compiled as part of this Wellhead Protection Plan, including potential point sources of contamination of the public water supply.

SUPERFUND THE COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT of 1980, known as Superfund, was enacted to address abandoned hazardous waste sites in the U.S.

SWUDS STATE WATER USE DATA SYSTEM is a database maintained by the MN DNR that includes location and summary information on high capacity wells (greater than 10,000 gallons per day) and other water withdrawal permits in Minnesota.

USGS UNITED STATES GEOLOGICAL SURVEY

VIC VOLUNTARY INVESTIGATION AND CLEANUP The Voluntary Investigation and Cleanup (VIC) Program allows buyers, sellers, developers or local governments to voluntarily investigate and, if necessary, clean up contaminated land to facilitate its sale, financing or redevelopment. Voluntary parties that complete investigation and/or cleanup activities under MPCA oversight can receive liability assurances that protect them from future Superfund liability.

WHPA WELLHEAD PROTECTION AREA is the surface and subsurface area surrounding a well or well field that supplies a public water system, through which contaminants are likely to move toward and reach the well or well field. This definition is the same for the federal Safe Drinking Water Act (40 Code of Federal Regulations, Section 1428) and the Minnesota Groundwater Protection Act (Minnesota Statute 103I).

WIMN WHAT'S IN MY NEIGHBORHOOD refers to databases maintained by the MPCA and MDA that locate and provide summary information about potential contamination sources in Minnesota.

Appendix A

Wellhead Protection Plan Part 1

Wellhead Protection Plan

Part I

Wellhead Protection Area Delineation
Drinking Water Supply Management Area Delineation
Well and Drinking Water Supply Management Area Vulnerability Assessments

For

City of Deerwood

February 2013

Gail Haglund, P.G., Hydrologist
Minnesota Department of Health

Review copy pending MDH approval.

Table of Contents

List of Tables

Table of Contents - Continued

Glossary of Terms

Data Element. A specific type of information required by the Minnesota Department of Health to prepare a wellhead protection plan.

Drinking Water Supply Management Area (DWSMA). The area delineated using identifiable land marks that reflects the scientifically calculated wellhead protection area boundaries as closely as possible (Minnesota Rules, part 4720.5100, subpart 13).

Drinking Water Supply Management Area Vulnerability. An assessment of the likelihood that the aquifer within the DWSMA is subject to impact from land and water uses within the wellhead protection area. It is based upon criteria that are specified under Minnesota Rules, part 4720.5210, subpart 3.

Emergency Response Area (ERA). The part of the wellhead protection area that is defined by a one-year time of travel within the aquifer that is used by the public water supply well (Minnesota Rules, part 4720.5250, subpart 3). It is used to set priorities for managing potential contamination sources within the DWSMA.

Inner Wellhead Management Zone (IWMZ). The land that is within 200 feet of a public water supply well (Minnesota Rules, part 4720.5100, subpart 19). The public water supplier must manage the IWMZ to help protect it from sources of pathogen or chemical contamination that may cause an acute health effect.

Wellhead Protection (WHP). A method of preventing well contamination by effectively managing potential contamination sources in all or a portion of the well's recharge area.

Wellhead Protection Area (WHPA). The surface and subsurface area surrounding a well or well field that supplies a public water system, through which contaminants are likely to move toward and reach the well or well field (Minnesota Statutes, section 103I.005, subdivision 24).

Well Vulnerability. An assessment of the likelihood that a well is at risk to human-caused contamination, either due to its construction or indicated by criteria that are specified under Minnesota Rules, part 4720.5550, subpart 2.

Acronyms

CWI - County Well Index

DNR - Minnesota Department of Natural Resources

EPA - United States Environmental Protection Agency

FSA - Farm Security Administration

MDA - Minnesota Department of Agriculture

MDH - Minnesota Department of Health

MGS - Minnesota Geological Survey

MnDOT - Minnesota Department of Transportation

MnGEO - Minnesota Geospatial Information Office

MPCA - Minnesota Pollution Control Agency

NRCS - Natural Resource Conservation Service

SWCD - Soil and Water Conservation District

UMN - University of Minnesota

USDA - United States Department of Agriculture

USGS - United States Geological Survey

1. Introduction

The Minnesota Department of Health (MDH) developed Part I of the wellhead protection (WHP) plan at the request of the city of Deerwood (PWSID 1180012). The work was performed in accordance with the Minnesota Wellhead Protection Rule, parts 4720.5100 to 4720.5590.

This report presents delineations of the wellhead protection area (WHPA) and drinking water supply management area (DWSMA), and the vulnerability assessments for the public water supply wells and DWSMA. Figure 1 shows the boundaries for the WHPA and the DWSMA. The WHPA is defined by a 10-year time of travel. Figure 1 also shows the emergency response area (ERA), which is defined by a 1-year time of travel. An inner wellhead management zone (IWMZ), which is the area within a 200-foot radius around the well, serves as the wellhead protection area for emergency wells and is not displayed in this report. Definitions of rule-specific terms that are used are provided in the "Glossary of Terms."

This report also documents the technical information that was required to prepare this portion of the WHP plan in accordance with the Minnesota Wellhead Protection Rule. Additional technical information is available from MDH.

The wells included in the WHP plan are listed in Table 1.

Table 1 - Water Supply Well Information
City of Deerwood

Local Well ID	Unique Number	Use/ Status[1]	Casing Diameter (inches)	Casing Depth (feet)	Well Depth (feet)	Date Constructed/ Reconstructed	Aquifer	Well Vulnerability
1	232353	E	8	140	148	1917/1957	Glacial Deposits	Vulnerable
2	455781	P	8	120	140	1988	Glacial Deposits	Vulnerable

Note: 1. Primary (P), Emergency Backup (E).

2. Assessment of the Data Elements

MDH staff met with representatives of the city of Deerwood on October 26, 2010, for a scoping meeting that identified the data elements required to prepare Part I of the WHP plan. Table 2 presents the assessment of these data elements relative to the present and future implications of planning items that are specified in Minnesota Rules, part 4720.5210.

Table 2 - Assessment of Data Elements

Data Element	Present and Future Implications				Data Source
	Use of the Well (s)	Delineation Criteria	Quality and Quantity of Well Water	Land and Groundwater Use in DWSMA	
Precipitation	M	M	M	M	MN Climatology Office
Geology					
Maps and geologic descriptions	M	H	H	H	MGS and DNR
Subsurface data	H	H	H	H	MGS, MDH, DNR
Borehole geophysics	L	L	L	L	None
Surface geophysics	L	L	L	L	None
Maps and soil descriptions					
Eroding lands					
Water Resources					
Watershed units	L	L	L	M	DNR, USGS
List of public waters	L	L	L	L	DNR
Shoreland classifications					
Wetlands map					
Floodplain map					
Land Use					
Parcel boundaries map	L	H	L	L	Crow Wing County
Political boundaries map	L	H	L	L	Crow Wing County
PLS map	L	H	L	L	MnGEO
Land use map and inventory					
Comprehensive land use map					
Zoning map					
Public Utility Services					
Transportation routes and corridors	M	H	M	M	Crow Wing County
Storm/sanitary sewers and PWS system map	L	L	L	L	City
Oil and gas pipelines map					
Public drainage systems map or list	M	M	M	M	MnGEO
Records of well construction, maintenance, and use	H	H	H	H	City, CWI, MDH files
Surface Water Quantity					
Stream flow data	M	M	L	L	DNR, USGS
Ordinary high water mark data	M	M	M	M	DNR
Permitted withdrawals					
Protected levels/flows					
Water use conflicts	M	M	M	M	DNR, City (none found)
Groundwater Quantity					
Permitted withdrawals	H	H	H	H	DNR

Data Element	Present and Future Implications				Data Source
	Use of the Well (s)	Delineation Criteria	Quality and Quantity of Well Water	Land and Groundwater Use in DWSMA	
Groundwater use conflicts	H	H	H	H	DNR
Water levels	M	M	L	L	DNR, MPCA, MDH, City
Surface Water Quality					
Stream and lake water quality management classification					
Monitoring data summary					
Groundwater Quality					
Monitoring data	H	H	H	H	MPCA, MDH, MDA, DNR
Isotopic data	H	H	H	H	DNR, MDH
Tracer studies	M	M	M	L	None
Contamination site data	M	M	M	M	MPCA, MDA
Property audit data from contamination sites					
MPCA and MDA spills/release reports	M	M	M	L	MPCA, MDA

Definitions Used for Assessing Data Elements:

High (H) - the data element has a direct impact

Moderate (M) - the data element has an indirect or marginal impact

Low (L) - the data element has little if any impact

Shaded - the data element was not required by MDH for preparing the WHP plan

Acronyms used in this report are listed on page ii, after the "Glossary of Terms."

3. General Descriptions

3.1 Description of the Water Supply System

The city of Deerwood obtains its drinking water supply from one primary well and one emergency backup well. Table 1 summarizes information regarding them.

3.2 Description of the Hydrogeologic Setting

The description of the hydrogeologic setting for the aquifer used to supply drinking water is presented in Table 3.

Table 3 - Description of the Hydrogeologic Setting

Attribute	Descriptor	Data Source
Aquifer Material	Sand	County Well Index
Porosity Type and Value	Primary - 20%	Literature reference (Fetter, 1988) and Ironton Part I WHP Plan (Walsh, 2010).
Aquifer Thickness	Representative aquifer thickness = 33 feet as determined from Well 2 (455781) driller's record	County Well Index. Aquifer thickness is likely variable; the variable nature was addressed as part of the uncertainty analysis.
Stratigraphic Top Elevation	1,155 feet	County Well Index.
Stratigraphic Bottom Elevation	1,122 feet	County Well Index.
Hydraulic Confinement	Confined	County Well Index.
Transmissivity	Range of Values: 1,910 to 4,600 ft^2/day	A range of transmissivity values was used to reflect changes in aquifer composition and thickness as well as uncertainties related to the quality of existing aquifer test data. See Table 4 for the reference value.
Hydraulic Conductivity	Range of Values: 58 to 140 ft/day	The range of values was derived from the range of transmissivity values determined from production test information at the Well 2 (455781) and from specific capacity data obtained from well records of higher capacity wells in the area.
Groundwater Flow Field	See Figure 2 - Ambient Groundwater Flow Field	Defined by using static water level elevations from well records in the CWI database and the *Geologic atlas of Crow Wing County*, Part B (Petersen, T.A., and Solstad, J. A., 2007).

Figures 3, 4, and 5 show the distribution of the aquifers and their stratigraphic relationships with adjacent geologic materials. They were prepared using well record data that is contained in the CWI database. The geological maps and studies that were used to further define local hydrogeologic conditions are provided in the "Selected References" section of this report.

4. Delineation of the Wellhead Protection Area

4.1 Delineation Criteria

The boundaries of the WHPA for the city of Deerwood are shown in Figure 1. Table 4 describes how the delineation criteria that are specified under Minnesota Rules, part 4720.5510, were addressed.

Table 4 - Description of WHPA Delineation Criteria

Criterion	Descriptor	How the Criterion was Addressed
Flow Boundary	Surface Water Features	The major features of regional discharge were included in the groundwater flow model. The Mississippi River, a far field feature, was represented using linesinks. Lakes and nearby creeks were represented using resistance varel elements. Vertical recharge to the confined aquifer was represented using given varel elements.
Flow Boundary	Other High-Capacity Wells Table 6	The pumping amounts were determined using the same approach used for the public water supply well.
Daily Volume of Water Pumped	See Table 5	Pumping information was obtained from the Department of Natural Resources (DNR), Appropriations Permit No. 1985-3080, and was converted to a daily volume pumped by a well.
Groundwater Flow Field	See Figure 2	The model calibration process addressed the relationship between the calculated versus observed groundwater flow field.
Aquifer Transmissivity (T)	Reference Value: 1,910 ft^2/day	The aquifer test plan was approved on November 18, 2011, and T was determined from both production test data and specific capacity information. Uncertainty regarding aquifer transmissivity was addressed as described in Section 4.4.
Time of Travel	10 years	The public water supplier selected a 10-year time of travel.

Information provided by the public water supplier was used to identify the maximum volume of water pumped annually by its primary well over the previous five-year period, as shown in Table 5. Additionally, the estimated pumping for the next five years is shown. Previous pumping values have been reported to the DNR, as required by the public water supply's Groundwater Appropriation Permit No. 1985-3080. The maximum daily volume of discharge used as an input parameter in the model was calculated by dividing the greatest annual pumping volume by 365 days.

Table 5 - Annual Volume of Water Discharged from Water Supply Well

Well Name	Unique No.	2007	2008	2009	2010	2011	5-Year Projection	Daily Volume (cubic meters)
Well 2	455781	19,066,000	17,748,000	18,273,000	15,159,000	18,667,000	**20,200,000**	209.5

(Expressed as gallons. Bolding indicates greatest annual pumping volume.)

In addition to the wells used by the public water supplier, Table 6 shows other high-capacity wells that were included in the delineation to account for their pumping impacts on the capture areas for the public water supply well. According to city staff, Deerwood Well 1 (232353) pumps approximately 300,000 gallons each year; it was included in the delineation because of its close proximity to Well 2

(455781). The Cuyuna Country Club has a DNR water appropriations permit (1990-3483) for irrigation purposes. The water use at the golf course is seasonal in nature; with pumping occurring six months or less each year. The permit lists two irrigation wells. One of the wells (496446) was sealed in 1999 (H158345), however, the second well (469600) is active. Well record information indicates that the wells were screened in a buried sand unit that is stratigraphically higher (between 1192 to 1232 feet above mean sea level) than the buried sand aquifer serving the city wells. For this reason, the existing golf course irrigation well was not included in the simulations used to determine the capture zone boundaries for the city's well.

Table 6 - Other Permitted High-Capacity Wells

Unique Number	Well Name	DNR Permit Number	Aquifer	Use	Annual Volume of Water Pumped (gallons)	Daily Volume (gallons)
232353	Deerwood W1	1985-3080	Glacial Drift	Emergency Backup	300,000	822

4.2 Method Used to Delineate the Wellhead Protection Area

The WHPA for the city of Deerwood's primary well was determined using an analytic element computer model called MLAEM (Version 5.1.08). The MLAEM Code was selected because it is a quantitative method capable of simulating both simple and complex groundwater flow processes, including the influence of vertical infiltration and the pumping influence of multiple high-capacity wells, if necessary.

The aquifer serving Deerwood Well 2 (455781) is a confined sand aquifer. It is assumed to be persistent throughout the 10-year contribution area to the city's wellfield. Well records indicate alternating sequences of glacial till and outwash sands between the land surface and bedrock. Where the land surface elevation is higher (such as east of Serpent Lake), information from drillers' logs indicates a sequence of glacial till overlying a buried sand and gravel outwash unit, then a second layer of clay till overlying a lower sand aquifer (Figure 4). This lower sand aquifer is the same aquifer serving the city's wellfield. It is difficult to estimate the thickness of the lower sand aquifer because few wells in the area extend to the depth of this lower sand layer. For the purposes of the delineation, the aquifer was assumed to be 33 feet thick, which is the thickness interpreted from the record of Well 2 (455781). Glacial deposits of this nature, however, are often variable in both thickness and composition; the variable nature of the outwash aquifer was addressed as part of the uncertainty analysis.

The groundwater model that was used to delineate the WHPA for the city of Ironton (Walsh, 2010) served as a beginning framework for the model developed for this delineation project. Detail was added to the Ironton groundwater flow model to refine it for the hydrogeologic setting in the Deerwood area. The model was then calibrated using information specific to the aquifer serving the Deerwood public well. Many local lakes were added, and Lidar data was used to assign surface water elevations. Serpent Lake, Cranberry Lake, and Reno Lake were important surface water features for this delineation and were modeled using resistance varel elements. Shallower lakes were assumed to be less connected to the buried drift aquifers and were initially assigned higher resistances compared to deeper lakes, such as Serpent Lake. Small ponds and wetlands were initially assumed not to be in direct connection with buried drift aquifers. Table 7 summarizes the model input parameters. Additional information regarding the model parameters and element layout are available from MDH.

Table 7 - MLAEM Model Input Parameters

MLAEM: Initial Model Parameters	Initial Value	Source
Base Elevation	342 meters	Estimated from local well records.
Aquifer Permeability	17.7 meters/day --- 42.7 meters/day	Low range estimate using specific capacity. --- High range estimate using production test data.
Aquifer Thickness	10 meters	Estimated from local well records.
Mississippi River: Head specified line sinks.	Head = River Elevation	River elevations derived from USGS topographic quadrangles and LiDar data (DNR, 2012).
Serpent, Cranberry, Reno, Black, Cascade, Rice, Portage, Hamlet and small local shallow lakes: Varel elements with specified head and resistance.	Head = Water Level Elevation Resistance = 50-500 days	Water level elevations derived from USGS topographic quadrangles and LiDar data (DNR, 2012). Resistance values derived from professional judgment.
Vertical Infiltration	Predominately till area; eastern half of model- 1.5 inches/year (.0001044 m/d) Predominately outwash area; western half of model- 3.5 inches/year (.0002436 m/d)	Rates from the calibrated Ironton groundwater flow model. Original recharge estimated from Delin, et al (2007).
Porosity	0.20	Conservative estimate for outwash sand (Fetter, 1988).

4.3 Results of Model Calibration and Sensitivity Analysis

Model calibration is a procedure that compares the results of a model based on estimated input values to measured or known values. This procedure can be used to define model validity over a range of input values, or it helps determine the level of confidence with which model results may be used. As a matter of practice, groundwater flow models are usually calibrated using water elevation or flux. This model was calibrated to static water levels from 32 wells obtained from the CWI database. The wells were selected based on their construction information and the likelihood that they were screened in the same buried sand aquifer serving the Deerwood municipal well. The calibration was performed using a manual trial-and-error procedure by changing hydraulic conductivity and recharge values and then comparing modeled versus measured water levels.

With the base case scenario using the lower global hydraulic conductivity value of 17.7 m/d (estimated from specific capacity data), the root mean square error (RMSE) was about 2.5 m. The RMSE improved slightly (=2.2 M) when the higher hydraulic conductivity value of 42.7 m/d was used.

These RMSE results represent about 14 percent of the observed range in head values of the lower buried drift aquifer in the refined model.

The best calibration was achieved using the higher hydraulic conductivity value. However, in both cases, the configuration of the potentiometric surface was fairly well simulated, matching the flow direction and gradient interpreted from observed values. In both model scenarios, the well capture zones extend to the locations of two local lakes, Cranberry Lake and Reno Lake. In the case of Reno Lake, the travel time to the location of the lake was longer than 10 years for the base-case low hydraulic conductivity scenario. Both of these lakes are shallow and overlie at least one layer of glacial till between the lakebed and the buried sand aquifer serving the city well (Figure 4 and 5). A conjunctive delineation approach was not used because it is assumed that the lakebed materials and the till confining layer(s) provide an assimilative capacity boundary between these surface water features and the city's well. Limited sampling of Cranberry Lake and Well 2 (455781) in May 2011 supports the effectiveness of the assimilative capacity boundary. Specifically, the total organic carbon (TOC) measured in Cranberry Lake was five times higher than what was measured in the city's well. In addition, the stable isotope signatures plotted at different locations off of the meteoric water line. The sampling results are provided in Appendix A.

The model also shows that the city well capture zone extends to Serpent Lake. In the groundwater flow model, it is assumed that the buried sand aquifer extends beneath the lake, but the model doesn't take into account the vertical time of travel from the lake through the till confining unit. However, the stable isotope results for Well 2 (455781) plots off of the meteoric water line, indicating that the aquifer is receiving at least a portion of its water from surface water. It is important to note that it is not possible from one sampling round to estimate the probable lag time between when surface water travels vertically downward to the buried sand aquifer and then horizontally to the city's well. For this delineation, it is assumed that the lakebed sediments and the glacial till confining layer overlying the aquifer provide an assimilative capacity boundary and a certain degree of natural protection to the city's well. The TOC measured in Serpent Lake was higher than what was measured in the city's well, although the contrast was not as striking as with Cranberry Lake.

Future monitoring of the surface water features (Serpent, Cranberry, and Reno lakes) and the city's well, should help to provide a better understanding of the relative contribution of surface water to the city's water supply. Monitoring efforts should include a year-long program of quarterly sampling for the stable isotopes of oxygen and hydrogen, total organic carbon, chloride, bromide, and field parameters such as temperature and conductivity. It would also be helpful to analyze lake water for enriched tritium for comparison purposes to Well 2 (455781). The tritium results (6.3 TU) from the city's well may be suggesting either a mix of young and older water, or perhaps a residence time along the order of years (versus months). Over the course of wellhead plan implementation and with MDH assistance, the city is encouraged to explore other geochemical approaches to better assess the age of the source water serving the city's well. SWP grant resources should be considered to fund a more sophisticated age dating approach. This additional information should allow for a more accurate assessment of the relationship of the surface water features and the aquifer used by the city well.

Model sensitivity is the amount of change in model results caused by the variation of a particular input parameter. Because of the simplicity of the MLAEM model, the direction and extent of the modeled capture zone may be very sensitive to any of the input parameters:

- The pumping rate directly affects the volume of the aquifer that contributes water to the well. An increase in pumping rate leads to an equivalent increase in the volume of aquifer within the capture zone, proportional to the porosity of the aquifer materials. However, the

pumping rate is based on the results presented in Table 5 and; therefore, is not a variable factor that will influence the delineation of the WHPA.

- The direction of groundwater flow determines the orientation of the capture area. Variations in the direction of groundwater flow will not affect the size of the capture zone but are important for defining the areas that are the source of water to the well. The ambient groundwater flow field that is defined in Figure 2 provides the basis for determining the extent to which each model run reflects the conceptual understanding of the orientation of the capture area for a well.
- The aquifer thickness, hydraulic conductivity, porosity and recharge rate influence the size and shape of the capture zone. A decrease in either thickness or porosity causes a linear, proportional increase in the areal extent of the capture zone; whereas permeability defines the relative proportions of the capture zone width to length. A decrease in permeability decreases the length of the capture zone and increases the distance to the stagnation point, making the capture zone more circular in shape and centered around the well.

The sensitivity of the Deerwood model was evaluated relative to hydraulic conductivity and was shown to be sensitive to hydraulic conductivity. Although not expressly a delineation criteria, the sensitivity of the model was also evaluated relative to the resistance values assigned to the varel elements located near the city well. The model was determined to be sensitive to resistance values assigned to local lakes.

4.4 Addressing Model Uncertainty

Using computer models to simulate groundwater flow necessarily involves representing a complicated natural system in a simplified manner. Local geologic conditions may vary within the capture area of the public water supply wells, but the amount of existing information that is needed to accurately define this degree of variability is often not available for portions of the WHPA. In addition, the current capabilities of groundwater flow models may not be sufficient to represent the natural flow system exactly. However, the results are valid within a range defined by the reasonable variation of input parameters for this delineation setting.

For this delineation, several model scenarios were assessed as part of the uncertainty analysis (Figure 6). Uncertainty of aquifer hydraulic conductivity was evaluated for both the low (K=17.7 m/d) and high (K= 42.7 m/d) values estimated from pumping test and specific capacity information. In these base case scenarios, many of the smaller ponds and lakes in the Deerwood area were not included. It was assumed that they were not hydraulically connected to the lower buried sand aquifer. Some of the smaller upgradient lakes have significantly higher elevations in contrast to the larger lakes in the area. In a few cases, the higher surface water elevation is also reflected in the static water elevations of nearby wells indicating that the water body is not perched and may be connected to the groundwater flow system. The overall degree of impact these small lakes have on the ambient groundwater flow field for Deerwood Well #2 (455781), however, is uncertain. To address this uncertainty, the smaller lakes and ponds were added to the model as varel elements using relatively high resistance values (= 500 days). The resulting simulation showed a fairly significant impact on the well capture zone locations; a nearly 45 percent shift to the east in the longer time of travel zones (five to ten years).

One and ten year capture areas were developed for both the low and high values of hydraulic conductivity. Capture zones were also developed for model scenarios that included the smaller lakes and ponds. As the model code uses constant input values for each run, several runs were required to

include all variations in input parameters. Table 8 documents the variables used to address MLAEM model uncertainty. The capture zones for each of the scenarios were composited to form the WHPA boundaries (Figure 6).

Table 8 - Model Parameters Used in MLAEM Uncertainty Runs

Well Name	File Name	Discharge (m^3/day)	Hydraulic Conductivity (m/day)	Aquifer Thickness (meters)	Seasonal High Capacity Wells	Addition of Smaller Ponds & Wetlands	Remarks
Well 2	basecase	209.5	17.7	10	No	No	
Well 2	base_highK	209.5	42.7	10	No	No	10-year capture zone is longer and extends to Reno Lake
Well 2	BC_plus	209.5	17.7	10	No	Yes	Significant eastward shift of 10-year capture zone
Well 2	HighK_plus	209.5	42.7	10	No	Yes	Significant eastward shift of 10-year capture zone

5. Delineation of the Drinking Water Supply Management Area

The boundaries of the Drinking Water Supply Management Area (DWSMA) were defined by the city of Deerwood using the following features (Figure 1):

- Highways, streets and roads,
- Public Land Survey coordinates, and
- Property (parcel) lines.

For this project, property parcel information was provided by Crow Wing County (acquired in 2009). This information was very useful for delineating the boundaries of the DWSMA.

6. Vulnerability Assessments

The Part I wellhead protection plan includes the vulnerability assessments for the city of Deerwood's wells and DWSMA. These vulnerability assessments are used to help define potential contamination sources within the DWSMA and select appropriate measures for reducing the risk that they present to the public water supply.

6.1 Assessment of Well Vulnerability

The vulnerability assessments for each well used by the city of Deerwood are listed in Table 1 and are based upon the following conditions:

1) Well construction meets current State Well Code specifications (Minnesota Rules, part 4725), meaning that the well itself should not provide a pathway for contaminants to enter the aquifer used by the public water supplier.

2) The geologic conditions at the well site for Well #2 (455781) includes a cover of clay till geologic materials over the aquifer that is sufficient to provide a moderate degree of protection and may serve to retard the vertical movement of contaminants.

3) None of the human-caused contaminants regulated under the federal Safe Drinking Water Act, have been detected at levels indicating that the well itself serves to draw contaminants into the aquifer as a result of pumping.

4) Water samples were collected from both wells in May 2011 and were analyzed for tritium, chloride, bromide, and nitrate (Table 9). Tritium was detected in both of the city's wells confirming their vulnerable nature. In addition, the chloride and bromide results confirm that the wells have been impacted by land-use activities (Mullaney, et.al, 2009). Nitrate-nitrogen was not detected in either well. Additional chemistry results are provided in Appendix A.

Table 9 - Isotope and Water Quality Results (May 2011)

Well	Tritium (TU)	Chloride/Bromide ratio	Chloride (mg/L)	Bromide (mg/L)	Nitrate (mg/L)
2 (455781)	6.3	651	15.7	0.0241	< 0.05
1 (232353)	10.2	939	30.6	0.0326	< 0.5

6.2 Assessment of Drinking Water Supply Management Area Vulnerability

The vulnerability of the DWSMA is shown in Figure 7 and is based upon the following information:

1) Water chemistry and isotopic data from the city wells located within the DWSMA indicate that the aquifer contains young water that has been impacted by chloride from human activity; and

2) Review of the geologic logs contained in the CWI database indicates that the aquifer exhibits a geologic sensitivity that predominately ranges from low to moderate throughout the DWSMA. This vulnerability is not predictable and, as a result, a vulnerability rating of moderate has been applied throughout the DWSMA.

7. Selected References

Delin, G.N., Healy, R.W., Lorenz, D.L., and Nimmo, J.R. (2007), *Comparison of local- to regional-scale estimates of ground-water recharge in Minnesota,* Journal of Hydrology, Vol. 334, No. 1-2, p. 231-249.

Fetter, C.W. (1988), *Applied hydrogeology,* Merrill Publishing Company, Columbus, Ohio, 592 p.

Geologic Sensitivity Project Workgroup (1991), Criteria and guidelines for assessing geologic sensitivity of ground water resources in Minnesota, Minnesota Department of Natural Resources, Division of Waters, St. Paul, Minn., 122 p.

Knaeble, A.R., Meyer, G.N., and Hobbs, H.C. (2004), Surficial geology, in *Geologic atlas of Crow Wing County, Minnesota,* Setterholm, D.R., (Project mgr.), County Atlas Series, C-16, Part A, Plate 3, Minnesota Geological Survey, St. Paul, Minn., scale 1:100,000.

Minnesota Department of Natural Resources (2012), Crow Wing County LiDar data, acquired in October, 2012.

Mullaney, J.R., Lorenz, D.L., and Arntson, A.D. (2009), *Chloride in groundwater and surface water in areas underlain by the glacial aquifer system, northern United States,* Scientific Investigations Report, 2009-5086, U.S. Geological Survey, Reston, Va., 41 p.

Petersen, T.A., and Solstad, J.A. (2007), *Geologic atlas of Crow Wing County, Minnesota,* County Atlas Series, C-16, Part B, Minnesota Department of Natural Resources, Division of Waters, St. Paul, Minn., 4 plates, scale 1:125,000 and smaller.

Strack, O.D.L. (1999), A *multi-layer analytic element model,* Version 5.1.08.

Figures

⊙ Deerwood Primary Well

Emergency Response Area

Wellhead Protection Area

Drinking Water Supply Management Area

N

Feet

0 500 1,000 2,000

1:12,000

MINNESOTA MDH DEPARTMENT of HEALTH

Figure 1
Wellhead Protection and
Drinking Water Supply Management Areas

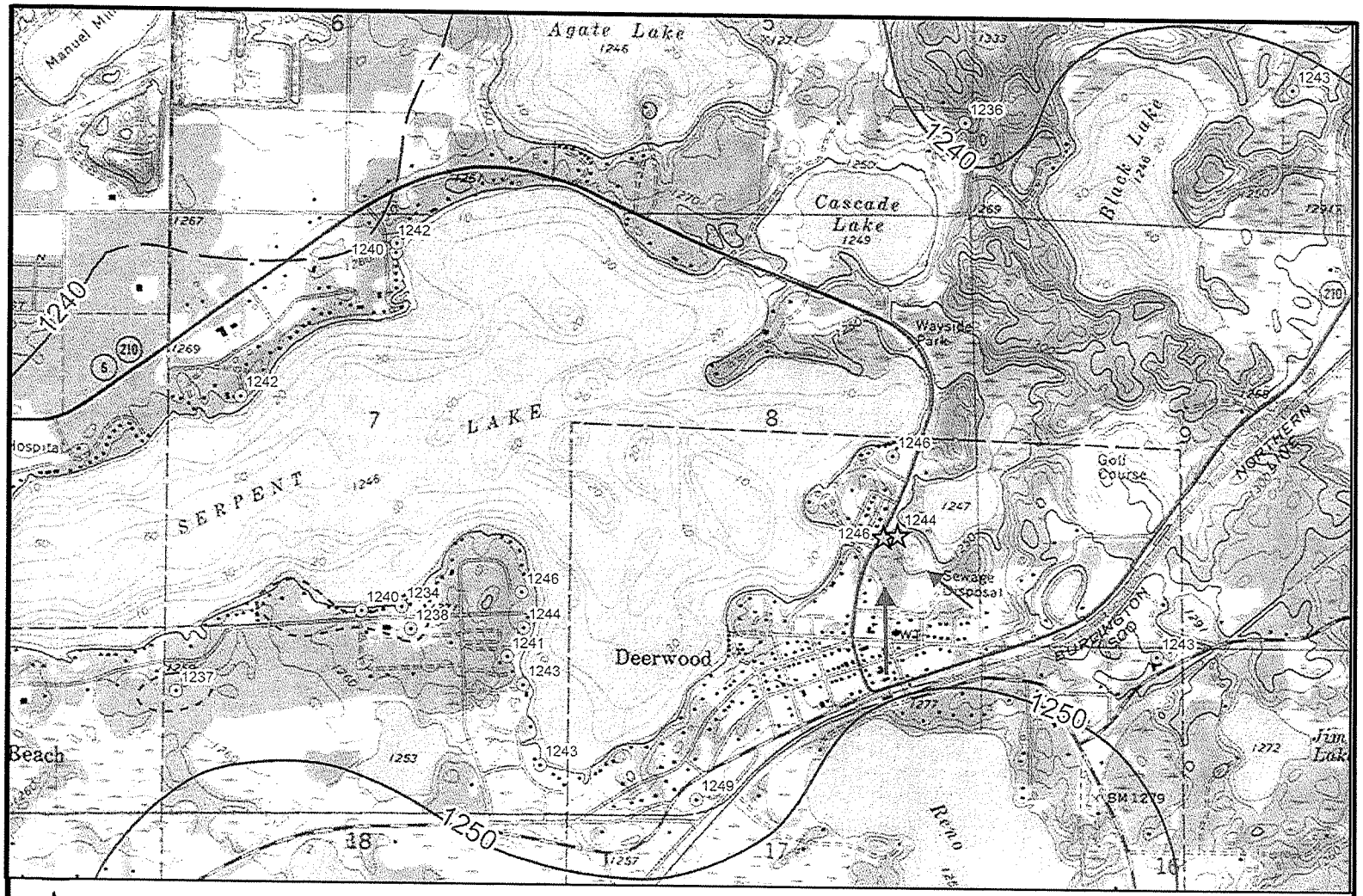


Figure 2
Ambient Groundwater Flow Field
of the Lower Drift Aquifer

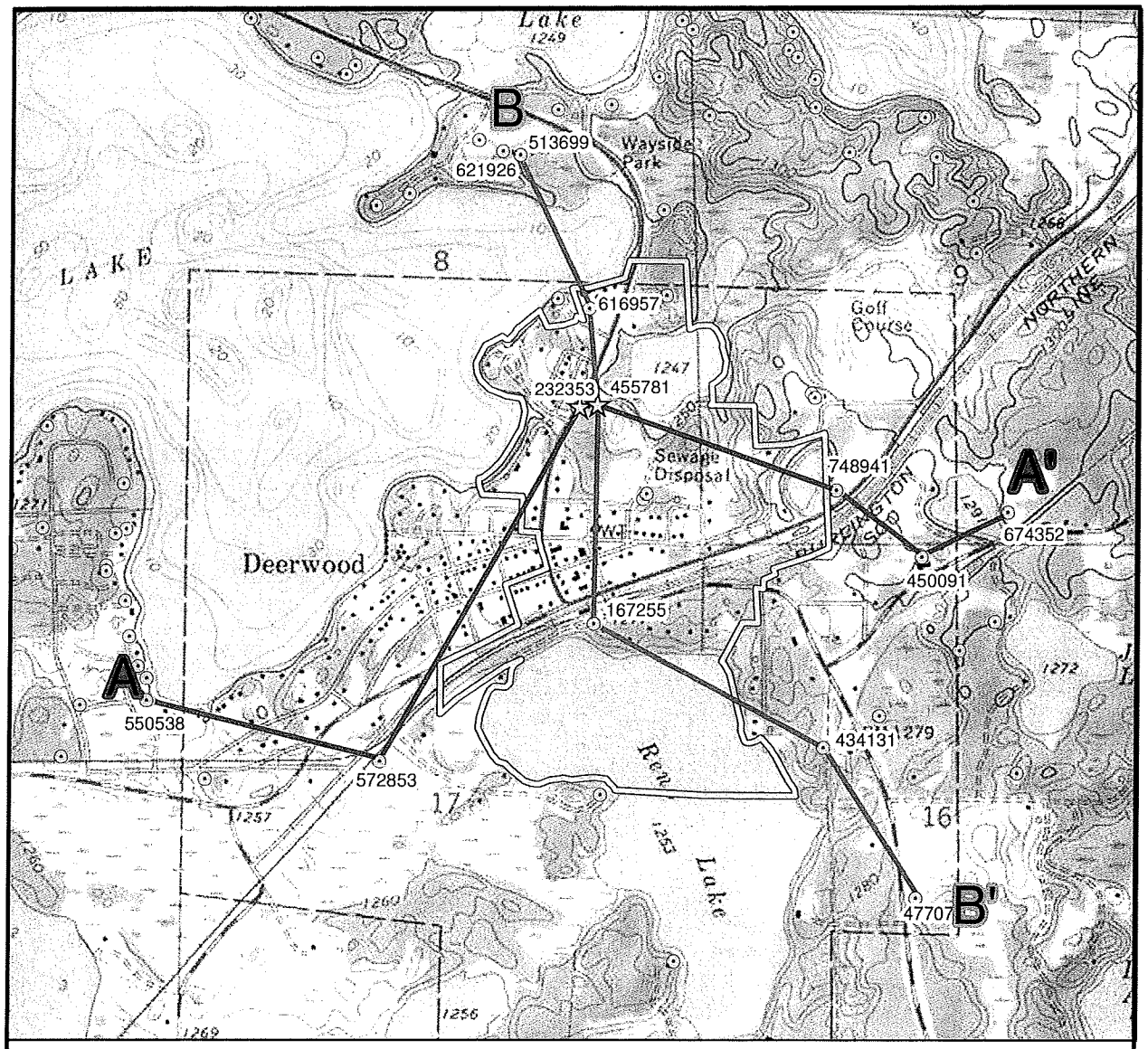
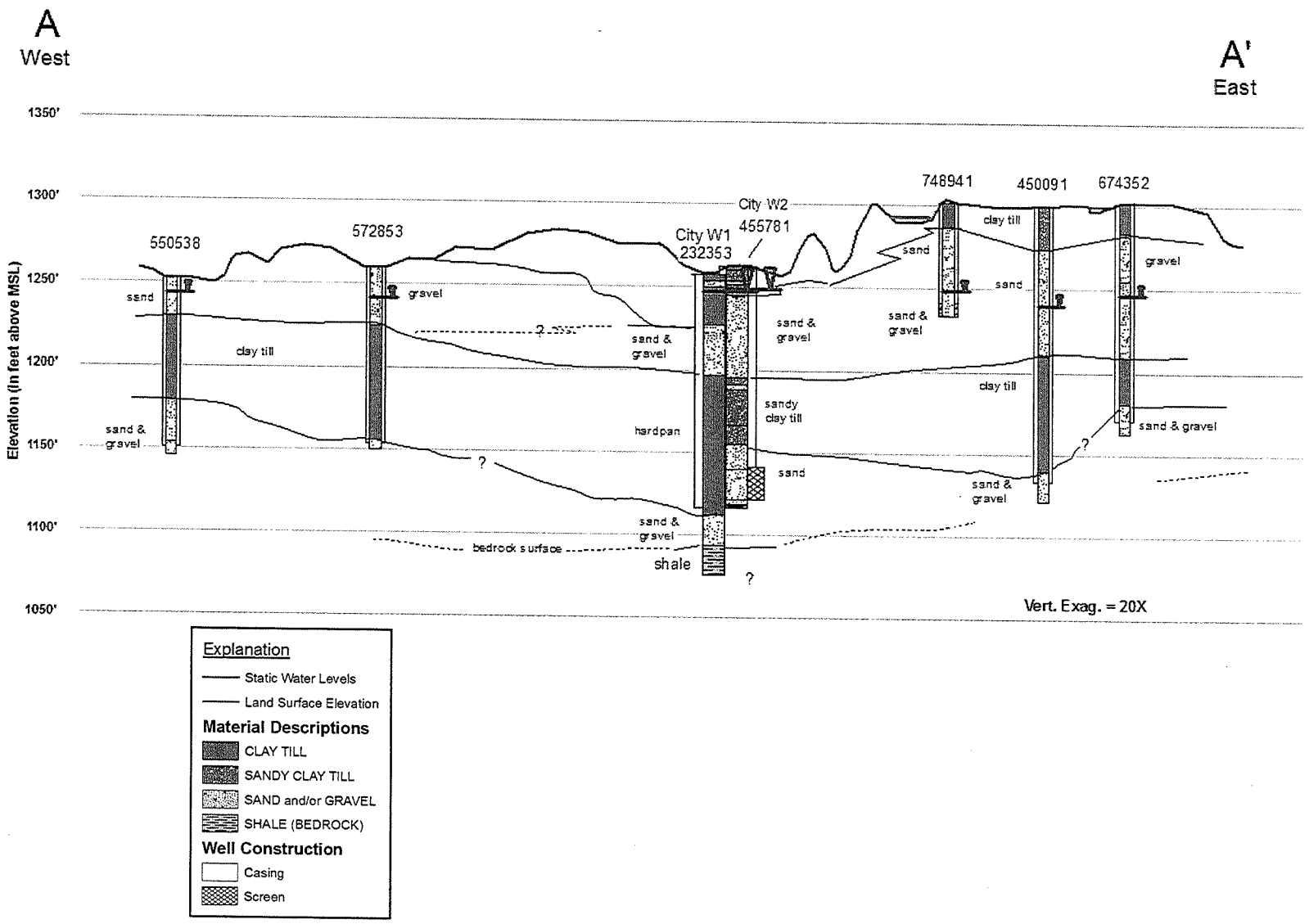
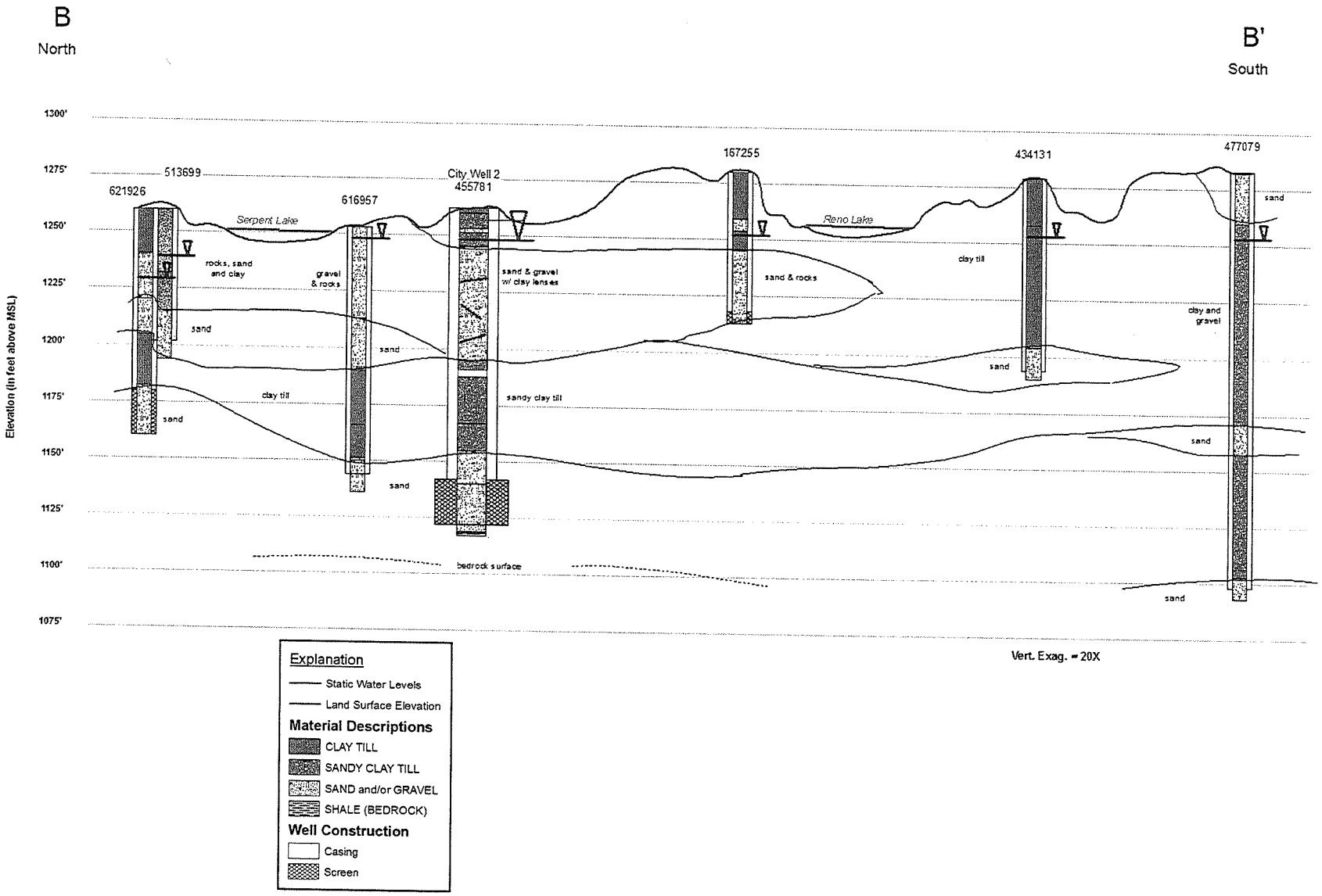


Figure 3
Database Map and Trends of Cross-Sections
City of Deerwood



MINNESOTA MDH DEPARTMENT OF HEALTH

Figure 4
Geologic Cross-Section A-A'

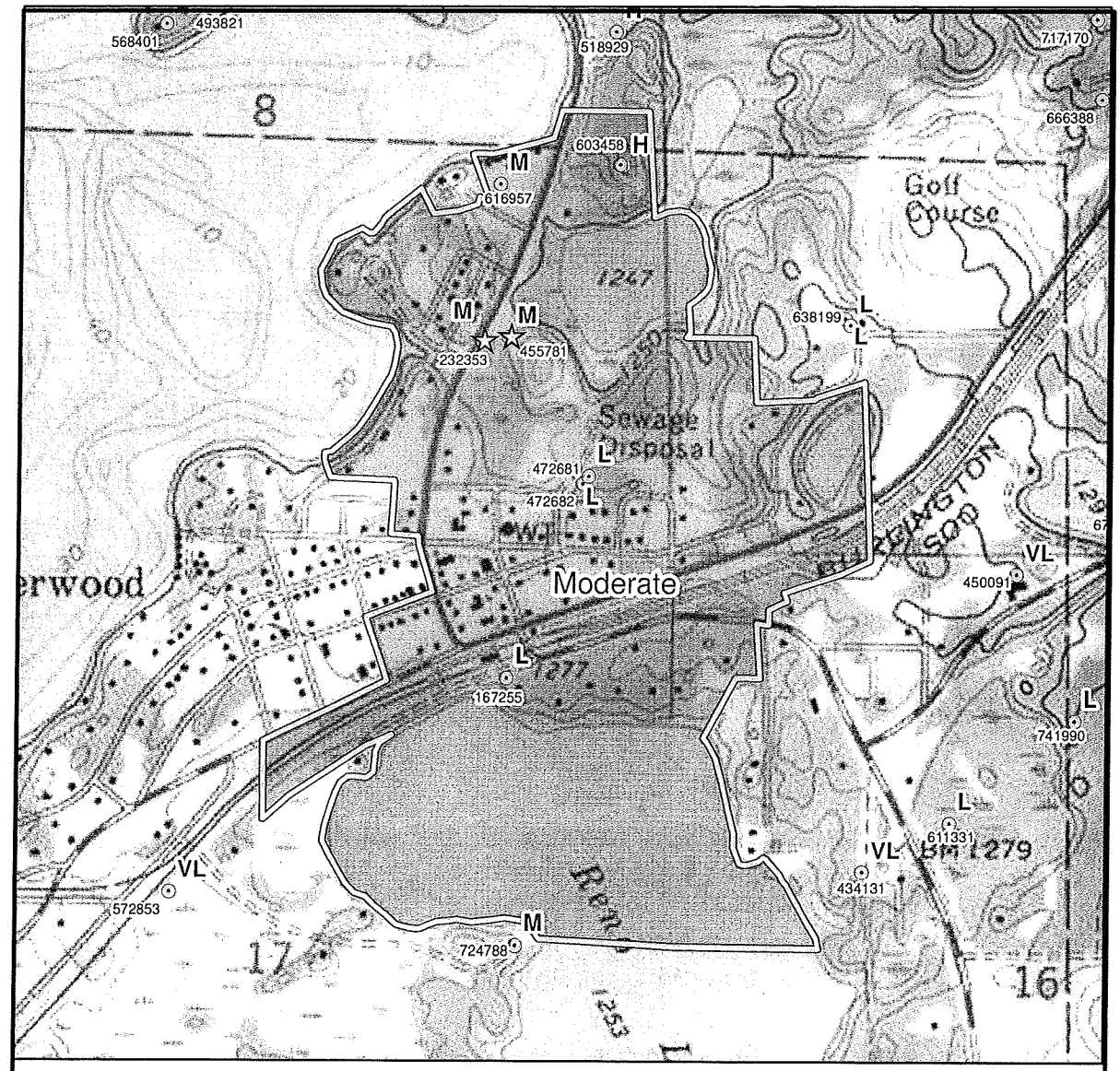


MINNESOTA MDH DEPARTMENT OF HEALTH

Figure 5
Geologic Cross-Section B-B'

MINNESOTA MDH DEPARTMENT of HEALTH

Figure 6
Uncertainty Analysis: 10-Year Capture Zone Results



☆ City Wells

572853 - uniq well no.

⊙ Wells & Borings with Geologic Sensitivities

L - geologic sensitivity (ranging very low, low, moderate and high)

Moderate

DWSMA Boundary

N

0 500 1,000 2,000 Feet

1:12,000

MINNESOTA MDH DEPARTMENT of HEALTH

Figure 7
Drinking Water Supply Management Area Vulnerability

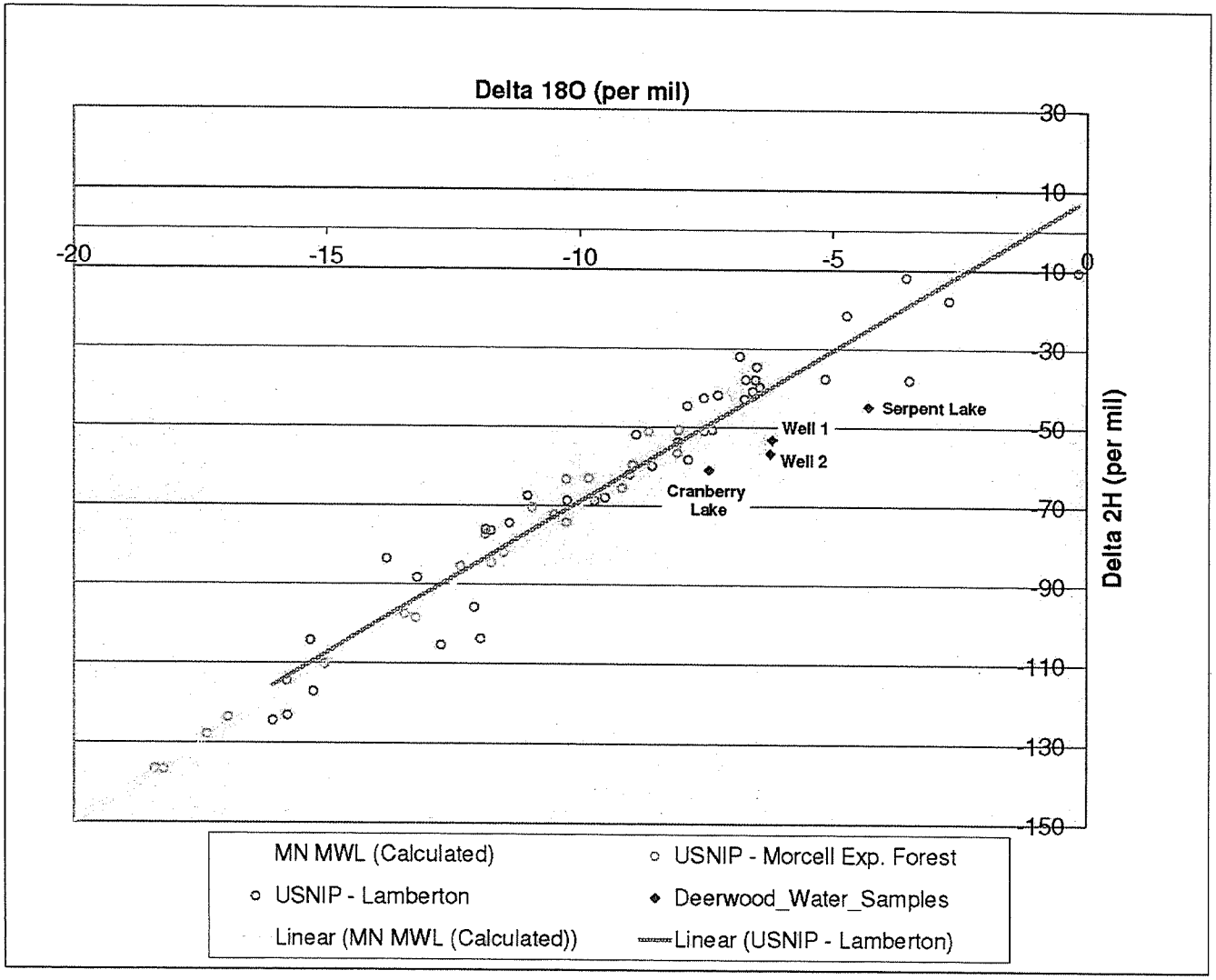
Appendix A

City of Deerwood
Cl/Br, TOC and Isotope Results
May 11, 2011

Name	Chloride (mg/l)	Bromide (mg/l)	Chloride/ Bromide (Cl/Br) ratio	Total Organic Carbon (TOC) (mg/l)	Nitrate (mg/l)	Ammonia (mg/l)	Stable Isotopes (per mil) Sept. 2010		Tritium (TU)
							Delta 18O	**Delta 2H**	
Well 2 (455781)	15.7	0.0241	651	2.6	ND	0.6	-6.24	-56.61	6.3
Well 1 (232353) [emergency well]	30.6	0.0326	939	3.0+ [8/2011]	ND	1	-6.2	-53.12	10.2
Serpent Lake	17.1	0.0083	2060	4.8	ND	NS	-4.29	-44.73	NS
Cranberry Lake	22.5	0.01	2250	14	0.1	NS	-7.45	-60.84	NS

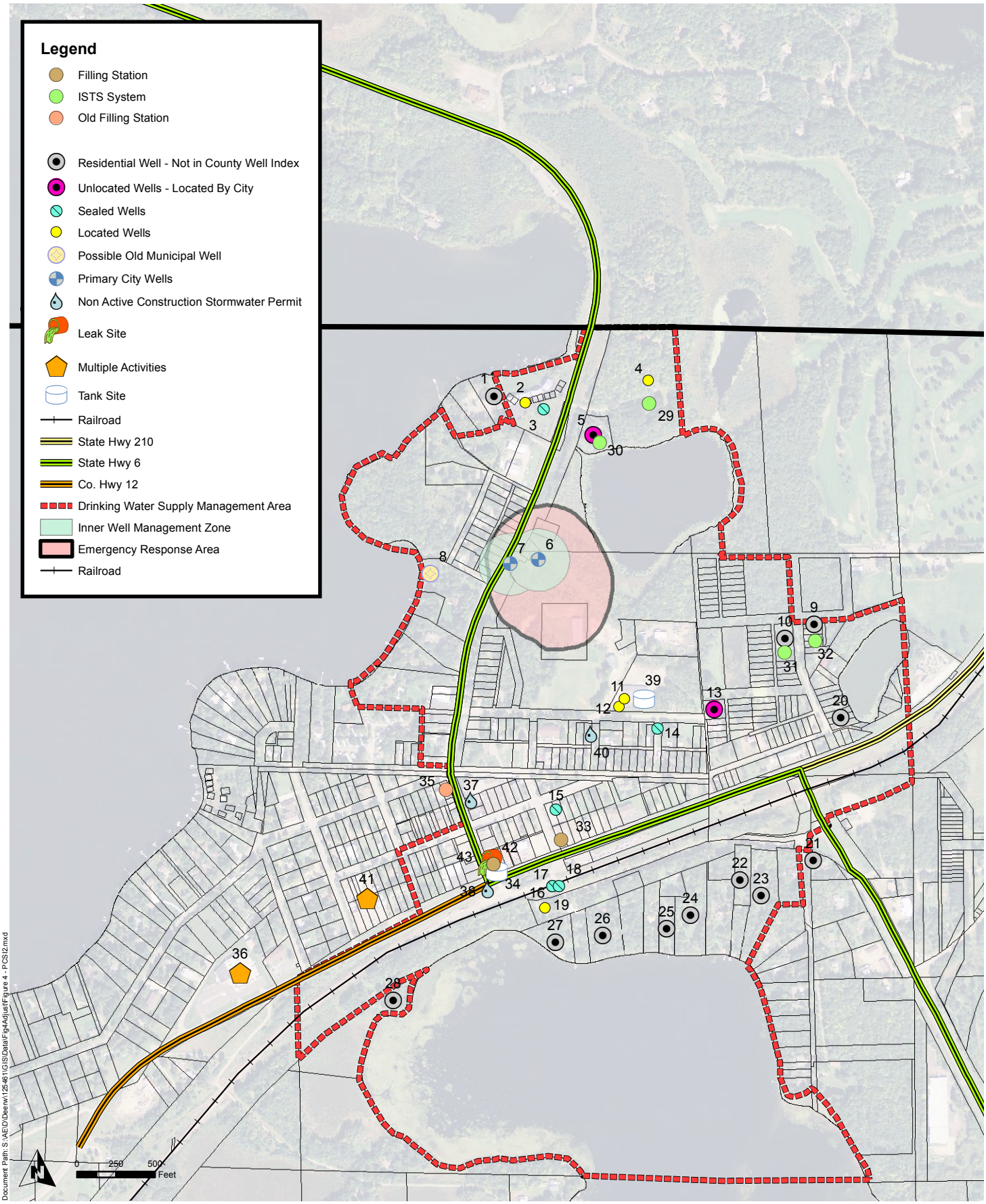
Notes: 1) + Well 1 (232353) was not sampled for TOC during this sampling event; however it was sampled in August 2011.
2) ND - not detected.
3) NS - not sampled.

City of Deerwood
Stable Isotope Results
May 11, 2011



Appendix B

Potential Containment Source Inventory



Document Path: S:\AE\D\Deerw\125461\GIS\Data\Fig4Adjust\Figure 4 - PCSI2.mxd

Project Number: DEERW 125461
Print Date: 12/09/2013

Map by: CTK
Projection: CWC County Coord.
Source: City, MDH

WELLHEAD PROTECTION PLAN
City of Deerwood, Mninnesota

Appendix B
Potential Contaminant Source Inventory

TABLE A - POTENTIAL CONTAMINATE SOURCE INVENTORY INDEX

FEATURE ID	FID NAME	TYPE	PCSI CODE	MATERIAL CODE	FACILITY CODE	UNIQUE ID	PIN	COMMENTS
1	TRENDA, DOUGLAS D & JEAN L & CARROL	WELL	WEL	N/A	1100-01	NONE	20106000002F009	Residential Well Located By City Staff - Not in CWI
2	NELSON, HUB	WELL	WEL	N/A	1100-01	00616957	206000010030009	
3	WHITE PINE BAY ESTATES TOWNHOMES	SEALED WELL	WEL	N/A	1100-01	H000144530	206000010110009	
4	MILLER, CHARLES	WELL	WEL	N/A	1100-01	00603458	200084104A00009	
5	COLLIGNON, RICHARD C & PHYLLIS	WELL	WEL	N/A	1100-01	NONE	200084104B00009	Residential Well Located By City Staff - Not in CWI
6	DEERWOOD 2	WELL	WEL	N/A	4330	00455781	200084405JAA009	
7	DEERWOOD 1	WELL	WEL	N/A	4330	00232353	200084405JAA009	
8	OLD MUNCIPAL WELL	WELL	WEL	N/A	1100-01	NONE	200084405AAA009	
9	GAVIN, KENNETH JOSEPH	WELL	WEL	N/A	1100-01	NONE	201040070060009	Residential Well Located By City Staff - Not in CWI
10	CUMMINGS, JAMES L & STEPHANIE A	WELL	WEL	N/A	1100-01	NONE	20104006011Z009	Residential Well Located By City Staff - Not in CWI
11	UNITED TELEPHONE	WELL	WEL	N/A	1100-01	00472681	200084405L00009	
12	UNITED TELEPHONE	WELL	WEL	N/A	1100-01	00472682	200084405L00009	
13	ADAMS, JUDY F & JACK H REV TRUST AG	WELL	WEL	N/A	1100-01	NONE	20104003012Z009	Residential Well Located By City Staff - Not in CWI
14	NIXON, THOMAS J & HEATHER L	SEALED WELL	WEL	N/A	1100-01	H000123377	20100001005Z009	
15	DEERBROOKE, LLC	SEALED WELL	WEL	N/A	1100-01	H000108871	201020020100009	
16	BNSF RAILROAD	SEALED WELL	WEL	N/A	1100-01	0000662122	200170000000009	
17	BNSF RAILROAD	SEALED WELL	WEL	N/A	1100-01	0000662120	200170000000009	
18	BNSF RAILROAD	SEALED WELL	WEL	N/A	1100-01	H000114714	200170000000009	
19	AULIE, BERGER	WELL	WEL	N/A	1100-01	00167255	200162200A00009	
20	WASSERZIEHER, BRIAN E JR	WELL	WEL	N/A	1100-01	NONE	201040120020009	Residential Well Located By City Staff - Not in CWI
21	SROCK, TRACY D & TRACEY R	WELL	WEL	N/A	1100-01	NONE	20102000918D009	Residential Well Located By City Staff - Not in CWI
22	PETERSON, DENNIS M & LINDA K	WELL	WEL	N/A	1100-01	NONE	20102000917Z009	Residential Well Located By City Staff - Not in CWI
23	AULIE, MICHAEL F & ROXANNE M	WELL	WEL	N/A	1100-01	NONE	20102000917Y009	Residential Well Located By City Staff - Not in CWI
24	SEVERSON, MARK A & MALLORY K	WELL	WEL	N/A	1100-01	NONE	200171101A00009	Residential Well Located By City Staff - Not in CWI
25	BERG, KAREN J	WELL	WEL	N/A	1100-01	NONE	200171101CA0009	Residential Well Located By City Staff - Not in CWI
26	CROOKS, BARBARA M & RODNEY	WELL	WEL	N/A	1100-01	NONE	200171101E00009	Residential Well Located By City Staff - Not in CWI
27	ANDERSON, JAMES D & SHARON	WELL	WEL	N/A	1100-01	NONE	200171101FB0009	Residential Well Located By City Staff - Not in CWI
28	ALTERGOTT, THOMAS M & LINDA D	WELL	WEL	N/A	1100-01	NONE	20102000905A009	Residential Well Located By City Staff - Not in CWI
29	MILLER, CHARLES W & ANGELINE	ISTS SYSTEM	N/A	N/A	1100-01	NONE	200084104A00009	ACTIVE ON SITE SEPTIC
30	COLLIGNON, RICHARD C & PHYLLIS	ISTS SYSTEM	N/A	N/A	1100-01	NONE	200084104B00009	ACTIVE ON SITE SEPTIC
31	CUMMINGS, JAMES L & STEPHANIE A	ISTS SYSTEM	N/A	N/A	1100-01	NONE	20104006011Z009	ACTIVE ON SITE SEPTIC
32	GAVIN, KENNETH JOSEPH	ISTS SYSTEM	N/A	N/A	1100-01	NONE	201040070030009	ACTIVE ON SITE SEPTIC
33	HOLLAND, MARILYN L TRTEE OF HOLLAND	TANK SITE	UST	F000	2116	NONE	201020020080009	ACTIVE FILLING STATION - SUPERAMERICA
34	DEERWOOD HOLIDAY LLC	TANK SITE	UST	F000	2116	NONE	20102003006A009	ACTIVE FILLING STATION
35	ROTH, GARY & JOHN BAYERLEE	TANK SITE	UST	F000	2130	NONE	20102008016A009	OLD FILLING STATION
36	MAGNUM MACHINING INC	MULTIPLE ACTIVITIES	STOR	W000	3000	NONE	20102000903F009	NOT IN DWSMA
37	SALEM LUTHERAN CHURCH - DEERWOOD	CONSTRUCTION STORMWATER	N/A	N/A	6000	NONE	20102009007D009	INACTIVE
38	SP 1801-19 (TH6) AND SP 1806-69 (TH210)	CONSTRUCTION STORMWATER	N/A	N/A	4000	NONE	200170000000009	INACTIVE
39	UNITED TELEPHONE WAREHOUSE	TANK SITE	UST	F000	4000	NONE	200084405L00009	INACTIVE
40	2011 WATER IMPROVEMENTS	CONSTRUCTION STORMWATER	N/A	N/A	4000	NONE	20100002005Y009	INACTIVE
41	NELSON INC	MULTIPLE ACTIVITIES	STOR	F000	2110-01	NONE	201020050060009	NOT IN DWSMA
42	DEERWOOD SELF SERVE/CITGO	TANK SITE	UST	F000	2116	NONE	200170000000009	ACTIVE
43	DEERWOOD 76	LEAK SITE	LUST	F000	2116	NONE	20102003008A009	INACTIVE

Appendix C

Contingency Plan

Appendix C

WATER SUPPLY CONTINGENCY PLAN

CITY OF DEERWOOD, MN

Table of Contents

Annual Plan Review

Date Reviewed	*Reviewer*	*Comments*

Plan Distribution

Person	*Organization*	*Plan Location*

Prepared By: Jeff Turk & Pat Radtke

A. PURPOSE

The purpose of this Contingency Plan is to establish, provide and keep updated, certain emergency response procedures and information for the City of Deerwood public water supply system, which may become vital in the event of a partial or total loss of public water supply services.

B. PUBLIC WATER SUPPLY CHARACTERISTICS

1. Current Supply Source - Ground

	Well Number 1	Well Number 2
MDH Well Number	Ground	Ground
Well Depth (ft.)	148’	140’
Well Diameter (in.)	8”	8”
Latitude of Well	46° 28” 44’	46° 28” 44’
Longitude of Well	93° 54” 0’	93° 53” 57’
Well Capacity (gpm)	175	250
Well Production (gpm)	175	250

2. Treatment – The only form of treatment is through the injection of chemical at the existing well house via metering pumps. Fluoride injected for dental health, phosphate for the sequestering of iron/manganese and liquid bleach for disinfection

3. Storage and Distribution – 50,000 gallon elevated storage tank

4. Maps/Plans – Available at Public Works Building , City Hall and SEH Brainerd

C. PRIORITY OF WATER USERS DURING WATER SUPPLY EMERGENCY

Table C-1 - Water Use Priority Grouping

Priority Group and Rank	Maximum Daily Use (gpd)	Minimum Daily Use (gpd)
Residential--#1	18,000	15,000
Institutional--#2	NA	NA
Commercial--#3	12,000	9,000
Industrial--#4	11,000	7,000
Irrigation--#5	1,000	400
Unaccounted	8,000	8,000
Wholesale	0	0

Triggers for implementing water supply reduction/allocation procedures: Water-use restrictions may be implemented by determination of the City Council, following natural or manmade disasters, contamination of the water supply, water supply shortages, or major mechanical failure.

D. ALTERNATIVE WATER SUPPLY OPTIONS

1. Surface water sources and treatment needs –
    a. **Requests for Assistance from the MN National Guard:** All requests for National Guard equipment and/or staff must be initiated at the local law enforcement level. Police and sheriff departments have process and procedures to request support.

        i. MN National Guard Emergency Surface Water Treatment Option: The MN National Guard has the ability to provide emergency treatment of surface waters for human consumption. The MN National Guard has the ability to provide Reverse Osmosis Water Purification Units capable of supplying up to 1500 gallons-per-hour, or 25 gallons-per-minute of potable water. The ROWPU units may not be housed at Camp Ripley and are available, through a call-up of the National Guard, to any city in the state.

        ii. MN National Guard Emergency Transportation of Potable Water: The Minnesota National Guard can furnish equipment capable of hauling up to 2,000 gallons of potable water from another water supply to a city distribution point or facility in an emergency (see above for the notification process).

2. Bottled water supplies, delivery and distribution –Culligan 218.829.5137

3. System interconnects with other water supplies - NA

4. New well - NA

5. Emergency or backup wells - Well No. 1 in Deerwood

6. Emergency treatment of water system.

7. Source Management (blending).

8. Other

E. INVENTORY OF AVAILABLE EMERGENCY EQUIPMENT AND MATERIALS

Table E-1 contains a list of services, equipment and supplies that are available to the public water supply system to respond to a disruption in the water system. It is believed that the items contained in Table E-1 would be adequate to respond to most (if not all) water system emergencies.

Table E-1

Description	Owner	Telephone	Location	Acquisition Time
Well Repair	LTP	320.587.4400	Fargo, ND	120 min
Pump Repair	LTP	320.587.4400	Fargo, ND	120 min
Electrician	Holden	218.571.4759	Baxter, MN	20 min
Plumber	Godfrey	218.820.3089	Deerwood, MN	5 min
Backhoe	City of Deerwood	218.270.0607	Deerwood, MN	20 min
Chemical Feed	Hawkins	715.392.5121	Superior, WI	60 min
Meter Repair	Mid West Meter	763.561.7681	Brooklyn Center, MN	50 min
Generator	NA	NA	NA	NA
Valves	Public Works	218.270.0607	Deerwood, MN	20 min
Pipe & Fittings	Public Works	218.270.0607	Deerwood, MN	20 min

F. EMERGENCY IDENTIFICATION PROCEDURES

Table F-1 Procedural Operations

Emergency Response Coordinator:

Name:	Patrick Radtke
Address:	17382 Paradise Shores Road Brainerd, MN 56401
Cell Phone:	218.270.0607
Home Phone:	218.534.3152
E-mail contact:	deerwoodpublicworks@yahoo.com

Alternate 1:

Name:	Jeff Turk
Address:	City of Deerwood PO Box 187 Deerwood, MN 56444-0187
Home Phone:	218.534.3152
E-mail contact:	jeffturk@cityofdeerwood.com

Alternate 2:

Name:	Brian Nelson
Address:	21176 Lake Road Ironton, MN 56455
Cell Phone:	218.838.6149
Home Phone:	218.534.3152
E-mail contact:	deerwoodpublicworks@yahoo.com

The duties of the response coordinator or the alternate are listed in the following table.

Duties of the Emergency Response Coordinator or the Alternate

Incident	Response Procedure & Comments
Identify Disruption (Mechanical Failure or Contamination)	Identifies the nature of the water supply disruption and communicates this information to the city government, the alternate response coordinator, and members of the emergency oversight committee.
Notify Response Personnel	Notifies city staff and others who will be responding to the water supply emergency about the disruption and coordinates their efforts to correct it.
Incident Direction and Control	Identifies the actions that are needed to correct the water supply emergency and directs responders to implement corrective actions.
Internal Communication	Communicates the status of response efforts to the primary spokesperson and the emergency oversight committee as needed to keep these parties informed of progress.
Assess Incident Response on Continual Basis	Assesses the efforts to correct the water supply disruption on a continual basis so that the emergency oversight committee can take additional corrective actions and the city government and public are updated on issues and progress.
Define the Extent of a Contamination Disruption	Coordinates efforts to define the extent and level of the contamination with local, state, and federal agencies. This may continue after initial corrective actions have been implemented.
Define the Extent of a Mechanical Disruption	Coordinates efforts to define the cause(s) of the mechanical failure and the equipment, data, and expertise that are needed to correct it. Identifies measures for reducing the likelihood that a similar mechanical failure will not occur in the future.
Identify Need for an Alternate Water Supply	Evaluates the need to obtain an alternate water supply, the time period it is needed before the water supply emergency is corrected, and the actions that are needed to achieve it.

G. NOTIFICATION PROCEDURES

1. Agency Notification

Table G-1 contains the names and telephone numbers for contacts at various local and state agencies that may be notified in the event of a public water supply system emergency. Based on the nature of the emergency and the information available, various representatives from this listing will be selected by the response coordinator to be part of the ***emergency oversight committee,*** which will then meet throughout the duration of the emergency to aid in decision-making and positive outcomes.

Table G-1. Agency Emergency Contact Listing

Personnel	Name	Home Telephone	Work Telephone
Mayor/Board Chair	Mike Aulie	763.598.2997	218.534.3794
Council Members	Tom Nixon	218.838.3985	
Council Members	Jessica Richau	320.309.8071	
Council Members	Debby Leonard	612.718.5971	
Council Members	Mark Severson	218.527.0111	
Response Coordinator	Patrick Radtke	218.270.0607	
Alt. Response Coordinator	Brian Nelson	218.838.6149	
State Incident Duty Officer			800-442-0798
County Emergency Director	John Bowen	218.829.4749	
Fire Chief	John Taylor	218.330.6091	
Sheriff	Todd Dahl	218.829.4749	
Police Chief	Harry Gotch	218.820.5147	
System Operator	Patrick Radtke	218.270.0607	
Alt. System Operator	Brian Nelson	218.838.6149	
School Superintendent	Jamie Skjeveland	218.545.8801	
Ambulance	Cuyuna Lake Medical	218.546.7000	
Hospital	Cuyuna Lake Medical	218.546.7000	
Doctor or Medical Facility	Dr. David Goodwin	218.546.7000	
Power Company	OMN Power	800.307.6937	
Highway Department	Rob Hall	218.824.1110	
Telephone Company	CTC	218.454.1234	
Neighboring Water System	City of Crosby	218.546.5021	
MRWA Technical Services	Dave Neiman	218.820.0595	
MDH District Engineer	Steve Klem	651.201.4503	
MDH Source Water Protection	George Minerich	320.223.7314	

2. Critical Response Personnel

Table G-2

Title	Name	Address	Telephone	Response Assignment
Response Coordinator	Patrick Radtke	17382 Paradise Shores Road Brainerd, MN 56401	218.270.0607	
Alternate Response Coordinator	Brian Nelson	21176 Lake Road Ironton, MN 56455	218.838.6149	
Water Operator	Patrick Radtke	17382 Paradise Shores Road Brainerd, MN 56401	218.270.0607	
Alternate Water Operator	Brian Nelson	21176 Lake Road Ironton, MN 56401	218.838.6149	
Public Relations	Jeff Turk	City of Deerwood PO Box 187 Deerwood, MN 56444	218.534.3152	
Alternate Public Relations	Mike Aulie, Mayor	City of Deerwood PO Box 187 Deerwood, MN 56444	763.498.2997	
Public Health/Medical	CWC Health Office	304 Laurel St Brainerd, MN 56401	218.829.4749	
Alternate Public Health/Medical	Cuyuna Medical Center	320 E Main St Crosby, MN 56441	218.546.7000	

3. Public Information Plan

a) Public relations center: Deerwood Auditorium

Public information center location during emergency: Deerwood Police Dept.

Times available: 24/7

b) Information checklist to be conveyed to the public and media: To be determined at time of incident.

Name of water system: City of Deerwood Water Dept.

Contaminant of concern and date:

Source of contamination:

Public health hazard:

Steps the public can take:

Steps the water system is taking:

Other information:

c) Media contacts:

Media	Name	Telephone	Address
Newspaper	Crosby Ironton Courier	218.546.5029	12E Main Street Crosby, MN 56441
Television	Lakeland Public Telivision	888.292.0922	422 NW 3rd Street Brainerd, MN 56401
Radio	KKIN 94.3 FM	218.927.2100	37208 US 169 Aitkin, MN 56431
Shopper	N/A		
Other	Police Department / Sheriff	911	

H. MITIGATION AND CONSERVATION PLAN

1. Mitigation:
   a. Infrastructure maintenance/upgrades/maps: Public Works Department / City Hall
   b. Regular inspection of tower, well(s), pump house: Regular daily visual inspection completed by City staff. Companies providing additional services include
      a. Water Tower - Maguire Iron – 605.334.9749
      b. Wells - LTP Enterprises - 701.232.8928
   c. Staff emergency training: Conjunction with Fire Dept.
   d. System security analysis: N/A
   e. Site new backup well(s): N/A
   f. System valving to isolate problems: Consult maps, Public Works Staff, City Engineers
   g. Sanitation procedures for construction/repairs: Public Works Staff / Contractors
   h. Other:
2. Conservation:
   a. Water meters: All services are metered, HD Supply, Eden Prairie, MN, 952.937.9666

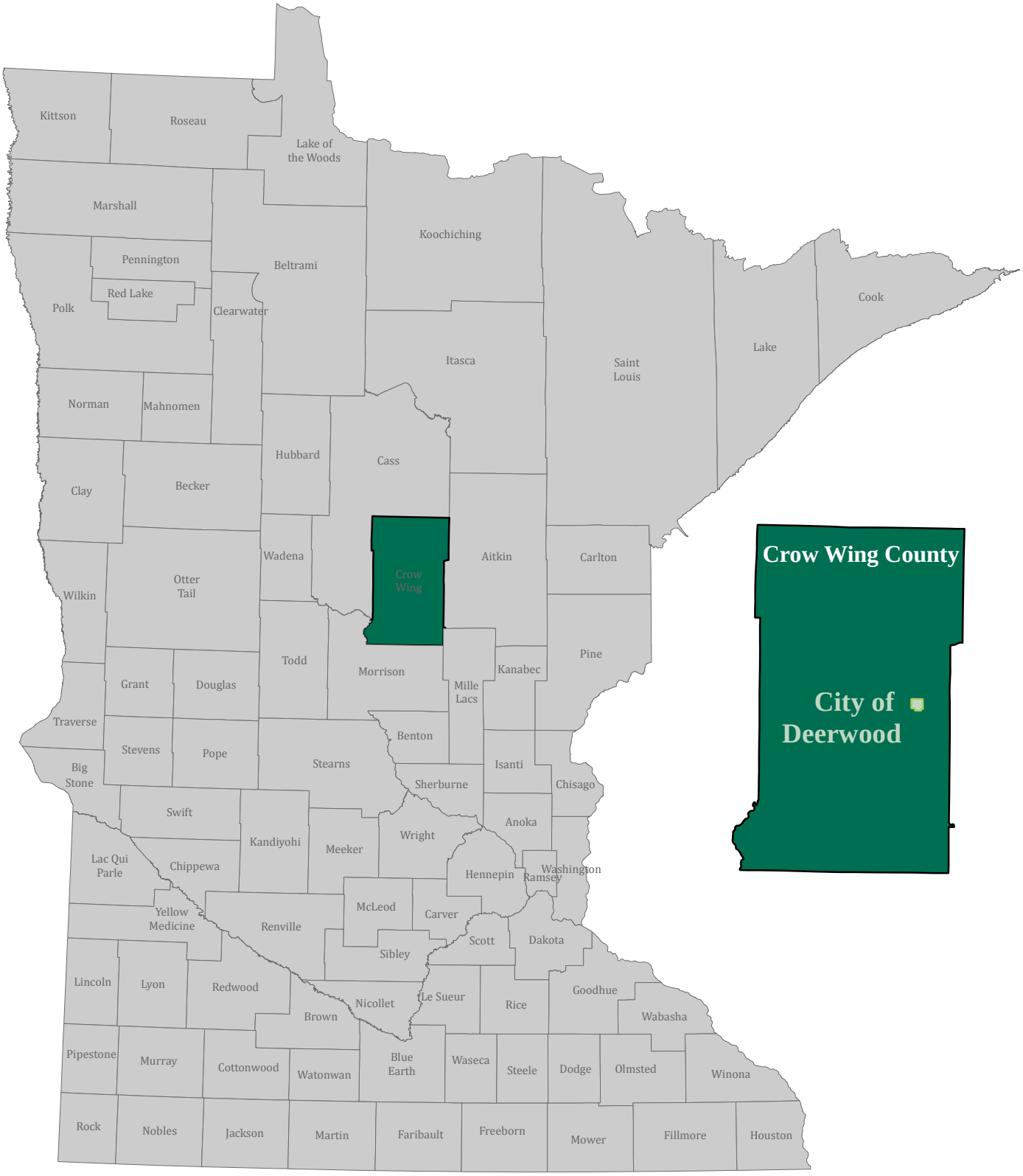
b. Public education: Consumer Confidence Report

c. Rate structure: $9.72 per thousand gallons (flat rates)

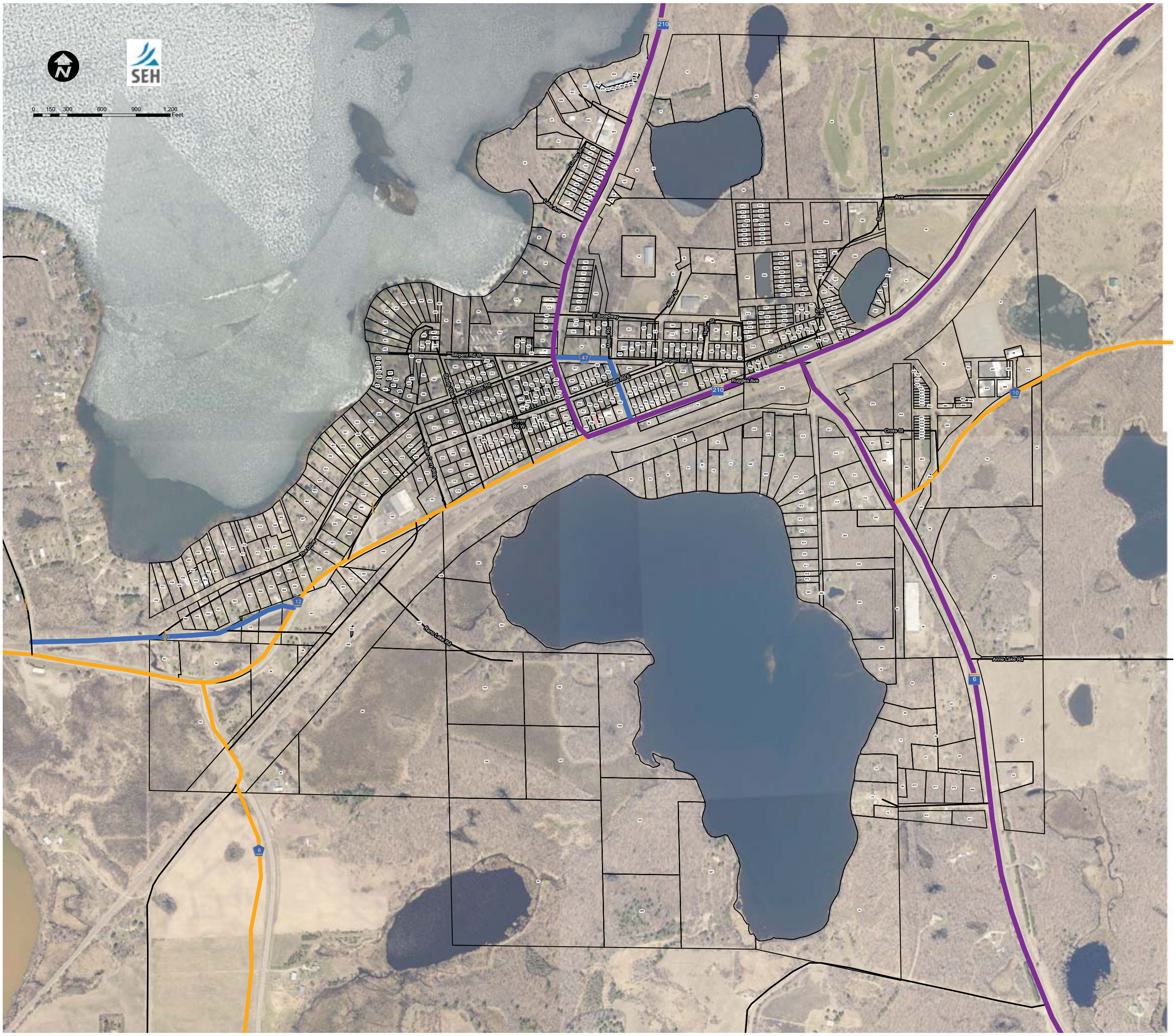
d. Other: $50 per load wholesale out of public hydrant

Appendix D

Maps, Figures, and Supporting Documentation



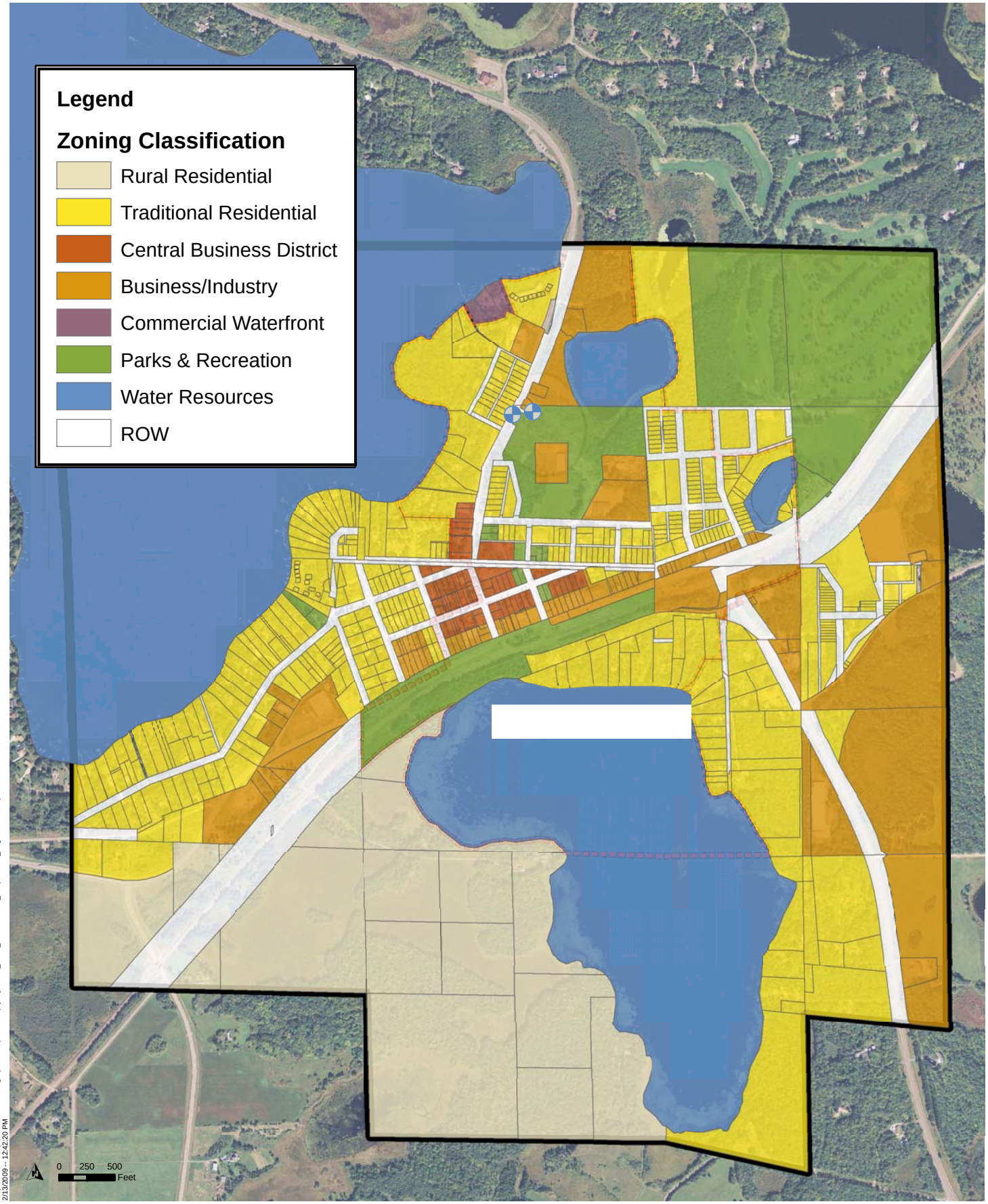
GENERAL LOCATION MAP



SEH Label	Owner Name	SEH Label	Owner Name	SEH Label	Owner Name	SEH Label	Owner Name	SEH Label	Owner Name	SEH Label	Owner Name	SEH Label	Owner Name	SEH Label	Owner Name	SEH Label	Owner Name
16	MILLER, CHARLES W & ANGELINE	92	FLETCHER, SHANE & TINA DUGAN	167	LABORDE, MITCHELL D	247	CHRISTENSEN, ROGER D & OLIVIA	325	HUNTER, JAMES J	400	SPALJ, NATALIE G	477	ALLGUIRE, ROBERT M	552	ADAMS, JUDY F & JACK H REV TRUST AG	639	MOHS FAMILY REVOCABLE LIVING TRUST
17	COLLIGNON, RICHARD C & PHYLLIS	93	SANDER, CASSIE J	168	LABORDE, MITCHELL D	248	ADDISON, ADAM J	326	HUNTER, JAMES J	401	SPALJ, NATALIE G	478	ALLGUIRE, ROBERT M	553	CUMMINGS, JAMES L & STEPHANIE A	640	MOHS FAMILY REVOCABLE LIVING TRUST
18	TAX FORFEITED	94	CROW WING COUNTY	169	SHARP, JEFFERY P	249	ADDISON, ADAM J	327	HUNTER, JAMES J	402	SPALJ, NATALIE G	479	HUNT, RONALD & LISABETH	554	CHRISTENSEN, RONALD W & MARY LEE	641	MOHS FAMILY REVOCABLE LIVING TRUST
19	TAX FORFEITED	95	BERG, LESTER O	170	SHARP, JEFFERY P	250	CITY OF DEERWOOD	328	WILLIAMS, ROBERT A & BRITA A	403	GORMAN, MICHAEL L & PATRICIA A	480	HUNT, RONALD & LISABETH	555	CHRISTENSEN, RONALD W & MARY LEE	642	MOHS FAMILY REVOCABLE LIVING TRUST
20	GEER, THOMAS M	96	MONTGOMERY, WILLIAM S & CINDY K	171	REINECK, ROBERT	251	DAGEN, JERRY C & CHRISTINA M	329	HERRON, SHELLY L	404	HELLICKSON, BRENT K & ROXANNE M	481	GANNON, JAMES P & JOAN D	556	CHRISTENSEN, RONALD W & MARY LEE	643	CITY OF DEERWOOD
21	KEMPER, AARON J	97	MONTGOMERY, WILLIAM S & CINDY K	172	REINECK, ROBERT	253	DAGEN, JERRY C & CHRISTINA M	330	STURM, JEFFREY J	405	CONNEY, FRANK P JR & JOANN C	482	REDPATH, DENNIS J REV TRUST 6/23/95	557	CHRISTENSEN, RONALD W & MARY LEE	644	CITY OF DEERWOOD
22	DZUBNAR, JACK P & NANCY J	98	MONTGOMERY, WILLIAM S & CINDY K	173	REINECK, ROBERT	254	DEERWOOD HOLIDAY LLC	331	HARTMAN, LARRY & PEGGY	406	DEAR, BRIAN H & JULIE DAHLEEN &	483	REDPATH, DENNIS J REV TRUST 6/23/95	558	GAVIN, KENNETH JOSEPH	645	ISLE, KELLY H
23	SPALJ, JOHN R JR & JANE M	99	NIXON, THOMAS J & HEATHER L	174	ROCK, JOHN W & JEAN M	255	DEERWOOD HOLIDAY LLC	332	HARTMAN, LARRY & PEGGY	407	HENRICHS, LARRY L & CHARLOTTE R	484	WALSH, KERRY M & CARMEN SHEARING-WA	559	GAVIN, KENNETH JOSEPH	646	ISLE, KELLY H
24	GOODWIN, DAVID D & MONICA L	100	HANN, BENJAMIN H & MARTHA M	175	NORTHLAND SMILES LLC	256	CUMMINGS, KENNETH F	333	TAYLOR, JOHN V & SANDRA K	408	CHENEVERT, JOHN D & FLORETTE M	485	FREEMAN, JOHN R JR	560	GAVIN, KENNETH JOSEPH	647	ISLE, KELLY H
25	SULLIVAN, DANIEL C & BEATRICE I	101	DAKJAM INVESTMENTS LLC	176	NORTHLAND SMILES LLC	257	CUMMINGS, KENNETH F	334	TAYLOR, JOHN V & SANDRA K	409	CHENEVERT, JOHN D & FLORETTE M	486	FREEMAN, JOHN R JR	561	GAVIN, KENNETH JOSEPH	648	ISLE, KELLY H
26	LEONARD, WADE J & DEBBY K	102	DAKJAM INVESTMENTS LLC	178	TAX FORFEITED	258	CUMMINGS, KENNETH F	335	TAYLOR, JOHN V & SANDRA K	410	SHANKLE, RAYMOND LEE & RITA K	487	SPALJ, JOHN R JR & JANE M	562	GAVIN, KENNETH JOSEPH	649	MOHS FAMILY REVOCABLE LIVING TRUST
27	SOLHEIM, JOHN H & MARIA J	103	BLACK RIDGE BANK	180	KARNOWSKI, JEFFREY W	259	CUMMINGS, KENNETH F	336	ROTH, GARY G	411	POSPECK, LACEY L	488	SPALJ, JOHN R JR & JANE M	563	GAVIN, KENNETH JOSEPH	650	RICHAU, DOUGLAS W & JESSICA A
28	BROOK, PETER R JR	104	BLACK RIDGE BANK	181	IKOLA, JAMES A & KAREN K	260	FIRST NATIONAL BANK DEERWOOD	337	ROTH, GARY G	412	HUGHES, MICHAEL R & MARY C	489	MAHONEY, DANNO F & BARBARA	564	CUYUNA COUNTRY CLUB	651	TRENDA, DOUGLAS D & JEAN L
29	KREGER, VICTORIA L	105	BLACK RIDGE BANK	182	LUECK, TYLER E & JESSICA M	261	FIRST NATIONAL BANK OF DEERWOOD	338	ROTH, GARY G	413	NELSON FAMILY REV LIVING TRUST	490	MAHONEY, DANNO F & BARBARA	565	SKONE, E TERRY REVOCABLE TRUST	652	TRENDA, DOUGLAS D & JEAN L & CARROL
30	GANNON, JAMES P & JOAN D	106	CHRISTENSEN, JOHN A	183	OBERG FENCING, INC	262	FIRST NATIONAL BANK DEERWOOD	339	HEROLD, DALE R & JULIE A	414	NELSON, GILBERT H	491	MAHONEY, DANNO F & BARBARA	566	SKONE, E TERRY REVOCABLE TRUST	653	KUKOWSKI, TODD
31	NORTHLAND SMILES LLC	107	CHRISTENSEN, JOHN A	184	CUYUNA NORTHERN, RAILROAD CO	263	ST JOSEPHS CHURCH	340	HEROLD, DALE R & JULIE A	415	LANG, JOAN M REV TRUST 7-6-06	492	MAHONEY, DANNO F & BARBARA	567	SKONE, E TERRY REVOCABLE TRUST	654	MIRAU, MARY LOU REV TRUST AGR
32	DENTAL CONSULTANTS LLC	108	HORST, DENNIS L & SUSAN M	185	MCCARVILL, JAMES P	264	ST JOSEPHS CHURCH	341	HEROLD, DALE R & JULIE A	416	DURAND, ALEXS	493	RAYMOND, LOUIS A & MILKA	568	SKONE, E TERRY REVOCABLE TRUST	655	BALTZER, BERNICE E LIVING TRUST
33	HOWER, SHELDON W & LINDA	109	JOHNSON, DWAYNE M & KATHY E	186	PORTWOOD, FRANCIS	265	ST JOSEPHS CHURCH	342	HEROLD, DALE R & JULIE A	417	SCHULTZ, NATHAN J & SHELLY	494	RAYMOND, LOUIS A & MILKA	569	SKONE, E TERRY REVOCABLE TRUST	656	HENRICKSON, EVERETT C & LINA M
34	WELLS FARGO BANK NA	110	JOHNSON, DWAYNE M & KATHY E	187	DEERWOOD HOUSING INC	266	ST JOSEPHS CHURCH	343	WALTER SCOTT, ERICKSON AMERICAN LEG	418	SCHULTZ, NATHAN J & SHELLY	495	WEBER, DIANE E	570	SKONE, E TERRY REVOCABLE TRUST	657	MORK, MARCUS J & MARILYN H
35	CITY OF DEERWOOD	111	J T DAGEN INC	188	RYDHOLM, SVEN EARL & NORMA P	267	ST JOSEPHS CHURCH	344	WALTER SCOTT, ERICKSON AMERICAN LEG	419	TOOHEY, JAMES E & LORRAINE	496	HAMILTON, DOLORES	571	SKONE, E TERRY REVOCABLE TRUST	658	HAUSKER, CHARLES J TRUST 8-10-01
36	SERPENT LAKE, SANITARY SEWER DIST	112	J T DAGEN INC	189	PARKER PROPERTIES, INC	268	VANG, OLIVER & PATRICIA	345	AMERICAN LEGION POST, #557	420	VANHEEL, RALPH P & LORRAINE M TRTEE	497	HAMILTON, DOLORES	572	SKONE, E TERRY REVOCABLE TRUST	659	SMREKAR, WILLIAM J & BARBARA TRUST
37	GEER, THOMAS M	113	DEGEN, MICHAEL	190	ROTH, GARY G	269	VANG, OLIVER & PATRICIA	346	AMERICAN LEGION POST, #557	421	GUJER, MARK W & TRACI	498	DEERWOOD IMPROVEMENT, CO	573	SKONE, E TERRY REVOCABLE TRUST	660	OTT, KEVIN A
38	KUKOWSKI, ADOLPH A & CARROLL	114	DIMARTINO, DAVID JOEL	191	RYDHOLM, SVEN EARL & NORMA P	270	SKONE, E TERRY REVOCABLE TRUST	347	NOVAK, ROBERT	422	MCDEVITT, PATRICK J & ANNETTE J	499	MID MINNESOTA FEDERAL CREDIT UNION	574	SKONE, E TERRY REVOCABLE TRUST	661	BONSTROM, RONALD A & THERESE M
39	CITY OF DEERWOOD	115	DIMARTINO, DAVID JOEL	192	ALTERGOTT, THOMAS M & LINDA D	271	VANG, OLIVER & PATRICIA	348	NOVAK, ROBERT	423	GUJER, MARK W & TRACI	500	MID MINNESOTA FEDERAL CREDIT UNION	575	SKONE, E TERRY REVOCABLE TRUST	662	HIGHUM, MARLENE L
40	STIREWALT, RICHARD G & BRENDA	116	DIMARTINO, DAVID J & LAURA D	193	REEM, BRETT & MOLLY M MOORE	272	VANG, OLIVER & PATRICIA	349	NOVAK, ROBERT	424	GUJER, MARK W & TRACI	501	MID MINNESOTA FEDERAL CREDIT UNION	576	SKONE, E TERRY REVOCABLE TRUST	663	NORBY, BRUCE C & PATRICIA A
41	UNITED TELEPHONE CO OF MN	117	DIMARTINO, DAVID J & LAURA D	194	YOUNG, BRANDON & EMILY	273	VANG, OLIVER & PATRICIA	350	ANDERSON, PAUL L & JULIE ANN	425	GUJER, MARK W & TRACI	502	MID MINNESOTA FEDERAL CREDIT UNION	577	SKONE, E TERRY REVOCABLE TRUST	664	BLACKWELL, PAUL E JR & SHELIA E &
42	TOWNLINE AUTO AND TOWING, LLC	118	ANDERSON, PAUL L & JULIE ANN	195	BRAUN, LORRAINE K	274	EDMUNDSON, EARL J & LAVONNE A	351	KNEELAND, DAVID MICHAEL	426	BERG, BRIAN L & BRENDA J ANDREWS &	503	HEISE, MICHAEL R & JENNIFER	578	SKONE, E TERRY REVOCABLE TRUST	665	PUGH, BRADFORD & MICHELE S
43	CUYUNA COUNTRY CLUB	119	ANDERSON, PAUL L & JULIE ANN	196	YOUNG, BRANDON & EMILY	275	EDMUNDSON, EARL J & LAVONNE A	352	KNEELAND, DAVID MICHAEL	427	TAX FORFEITED	504	HEISE, MICHAEL R & JENNIFER	579	SKONE, E TERRY REVOCABLE TRUST	666	RAFFENSPARGER, LARRY R & KATHLEEN
44	CUYUNA COUNTRY CLUB	120	ANDERSON, PAUL L & JULIE ANN	197	BRAUN, LORRAINE K	276	EDMUNDSON, EARL J & LAVONNE A	353	KNEELAND, DAVID MICHAEL	428	GUJER, MARK W & TRACI	505	TAX FORFEITED	580	SKONE, E TERRY REVOCABLE TRUST	667	LADD, LARRY J & LINEYA M
45	SKONE, E TERRY REVOCABLE TRUST	121	DEERWOOD HOUSING INC	198	BRAUN, LORRAINE K	277	STIREWALT, CLARENCE J & BETTY E	354	KNEELAND, DAVID MICHAEL	429	GUJER, MARK W & TRACI	506	WASSERZIEHER, BRIAN E JR	581	SKONE, E TERRY REVOCABLE TRUST	668	SUMMER PLACE ASSOCIATION INC
46	TAX FORFEITED	122	CITY OF DEERWOOD	199	TAMBORNINO, G JANE	278	AMERICAN LEGION POST, #557	355	KNEELAND, DAVID MICHAEL	430	LARSON, JANET & CHARLES TORGERSON	507	WASSERZIEHER, BRIAN E JR	582	SKONE, E TERRY REVOCABLE TRUST	669	NOVAK, KATHLEEN L
47	DEERWOOD RICE & GRAIN PROCESSING	123	CITY OF DEERWOOD	200	TAMBORNINO, G JANE	279	AMERICAN LEGION POST, #557	356	KNEELAND, DAVID MICHAEL	431	LARSON, JANET & CHARLES TORGERSON	508	WASSERZIEHER, BRIAN E JR	583	SKONE, E TERRY REVOCABLE TRUST	670	NOVAK, KATHLEEN L
48	DEERWOOD RICE & GRAIN PROCESSING	124	CITY OF DEERWOOD	201	TAMBORNINO, G JANE	280	AMERICAN LEGION POST, #557	357	ROTH, GARY & JOHN BAYERLEE	432	LARSON, JANET & CHARLES TORGERSON	509	WASSERZIEHER, BRIAN E JR	584	CUYUNA COUNTRY CLUB	671	NOVAK, KATHLEEN L
49	CUYUNA COUNTRY CLUB INC	125	CITY OF DEERWOOD	202	SANVIG, LEROY J & YVONNE	281	AMERICAN LEGION POST, #557	358	AITKIN DEERWOOD, TELEPHONE CO	433	BURGSTALER, HEIDI M & DANIEL R	510	CHRISTENSEN, RONALD W & MARY LEE	585	CUYUNA COUNTRY CLUB	672	NOVAK, KATHLEEN L
50	TRADITIONS MINI-GOLF LLC	126	ANDERSON, PAUL L & JULIE ANN	203	HUNT, RONALD & LISABETH	282	GODFREY, AUDREY E TRUSTEE AUDREY GO	359	VILLAGE OF DEERWOOD	434	THOMAS, STEVEN R & JOANNE & CHRISTI	511	CHRISTENSEN, RONALD W & MARY LEE	586	WASSERZIEHER, BRIAN E JR	673	NOVAK, KATHLEEN L
51	TRADITIONS MINI-GOLF LLC	127	ANDERSON, PAUL L & JULIE ANN	204	SKINNER, MARVIN E FAM LIV TRUST 1/2	283	VANG, OLIVER & PATRICIA	360	VILLAGE OF DEERWOOD	435	BIEVER, THOMAS & CAROL	512	CHRISTENSEN, RONALD W & MARY LEE	587	WASSERZIEHER, BRIAN E JR	674	EDMUNDSON, MATTHEW J
52	MOHS FAMILY REVOCABLE LIVING TRUST	128	ANDERSON, PAUL L & JULIE ANN	205	PATTERSON, MICHAEL J ET UX	284	SKONE, E TERRY REVOCABLE TRUST	361	SALEM LUTHERAN CHURCH OF DEERWOOD	436	CASSADY, RENEE L	513	CHRISTENSEN, RONALD W & MARY LEE	588	WASSERZIEHER, BRIAN E JR	675	LEET, DOUGLAS JON & JUDITH ANN
54	DEERWOOD RICE & GRAIN PROCESSING	129	DOOYEMA, LEAH L	206	HUNT, RONALD & LISABETH	285	SKONE, E TERRY REVOCABLE TRUST	362	SALEM LUTHERAN CHURCH OF DEERWOOD	438	DOYLE, TONY & MARY HELEN	514	CHRISTENSEN, RONALD W & MARY LEE	589	WASSERZIEHER, BRIAN E JR	676	PUGH, RICHARD J & BARBARA N
55	MOHS, TRAVIS & JULIE HOLMVIG	130	LINDROTH, GARY W & DIANE L	207	SNO-SERPENTS INC	286	ST ONGE, PAUL D	363	SALEM LUTHERAN CHURCH OF DEERWOOD	439	DOYNE, TONY & MARY HELEN	515	CHRISTENSEN, RONALD W & MARY LEE	590	WASSERZIEHER, BRIAN E JR	677	FEDERAL NATIONAL MORTGAGE ASSOC
56	CITY OF DEERWOOD	131	LINDROTH, GARY W & DIANE L	208	LUECK, DANIEL L & LUCY K	287	ST ONGE, PAUL D	364	SALEM LUTHERAN CHURCH OF DEERWOOD	440	PARKER-HANNIFIN, CORP C/O TAX DEPAR	516	ADAMS, JUDY F & JACK H REV TRUST AG	591	WASSERZIEHER, BRIAN E JR	678	HEALY-LIMING, ANNE M
57	RUSH, JOYCE A	132	LINDROTH, GARY W & DIANE L	209	LUECK, DANIEL L & LUCY K	288	ST ONGE, PAUL D	365	SALEM LUTHERAN CHURCH OF DEERWOOD	441	PARKER-HANNIFIN, CORP C/O TAX DEPAR	517	ADAMS, JUDY F & JACK H REV TRUST AG	592	WASSERZIEHER, BRIAN E JR	679	HIBERNIAN GROUP LLC
58	KAYFES, GREGORY G & KIMBERLY	133	CITY OF DEERWOOD	210	HINMAN, DUSTIN G	289	H S N INC	366	EDMUNDSON, LAVONNE & EARL J	442	PARKER-HANNIFIN, CORP C/O TAX DEPAR	518	ADAMS, JUDY F & JACK H REV TRUST AG	593	WASSERZIEHER, BRIAN E JR	680	PALLAS, JOHN C TRUST U/A 1-31-07
59	MAGNUM MACHINING INC	134	CITY OF DEERWOOD	211	ABEAR, HELEN ELAINE	290	H S N INC	367	SALEM LUTHERAN CHURCH OF DEERWOOD	443	PARKER-HANNIFIN, CORP C/O TAX DEPAR	519	ADAMS, JUDY F & JACK H REV TRUST AG	594	WASSERZIEHER, BRIAN E JR	681	GILMER, MELVIN & MARION REV TRUST
60	SKINNER, MARVIN E FAM LIV TRUST 1/2	135	MAHOWALD, ALAN G & BRANDI L	212	NORTHERN MINI-STORAGE LLC	291	H S N INC	368	SALEM LUTHERAN CHURCH OF DEERWOOD	444	PARKER-HANNIFIN, CORP C/O TAX DEPAR	520	CHRISTENSEN, RONALD W & MARY LEE	595	WASSERZIEHER, BRIAN E JR	682	RUCINSKI, JAMES H & SUSAN K OLSON
61	PETERSON, ALICE & SANDRA & BRUCE SW	136	MAHOWALD, ALAN G & BRANDI L	213	OSTROWSKI, ERIC M & GINA M	292	H S N INC	369	BOLEI, DAVID W & CONNIE JO	445	PARKER-HANNIFIN, CORP C/O TAX DEPAR	521	CHRISTENSEN, RONALD W & MARY LEE	596	CUYUNA COUNTRY CLUB	683	ELGETHUN, DAVID S & RENEE D
62	TOWNSHIP OF DEERWOOD	137	MAHOWALD, ALAN G & BRANDI L	214	MEYER, GARY ALAN	293	H S N INC	370	SALEM LUTHERAN CHURCH OF DEERWOOD	446	JOHNSON, A DALE & REBECCA H	522	CHRISTENSEN, RONALD W & MARY LEE	597	TRADITIONS MINI-GOLF LLC	684	ALLEN, PERRY W & JANE
63	HOLMVIG, JASON W & AMBER R	138	MAHOWALD, ALAN G & BRANDI L	215	TAYLOR, MARK & AMBER	294	H S N INC	371	HAMLIN, WILLIAM A & LORI K	447	ALERY, RICHARD E & MARILYN A	523	CHRISTENSEN, RONALD W & MARY LEE	598	TRADITIONS MINI-GOLF LLC	685	WHITE PINE BAY ESTATES TOWNHOMES
64	HOLMVIG, JASON W & AMBER R	139	WHITE, TAMMI L	216	SMITH, MURRAY A & SHANNON M SMITH	295	H S N INC	372	STEECE, ARTHUR & MANUAL HIRDLER	448	JOHNSON, A DALE & REBECCA H	524	CHRISTENSEN, RONALD W & MARY LEE	599	TRADITIONS MINI-GOLF LLC	686	BURLINGTON NORTHERN SANTA FE RR CO
65	SCHILLING, JAMES & MARY	140	WHITE, TAMMI L	218	AULIE, MICHAEL F & ROXANNE M	296	H S N INC	373	KIVISTO, MARI E	449	D W JONES INC	525	CHRISTENSEN, RONALD W & MARY LEE	600	TRADITIONS MINI-GOLF LLC		
66	BOYD, DANIEL D & DEANNA L BAUER	141	WHITE, TAMMI L	219	PETERSON, DENNIS M & LINDA K	297	H S N INC	374	THORSON, JAMES PERRY	450	NORTHERN LIGHTS OF , CROSBY	526	CHRISTENSEN, RONALD W & MARY LEE	601	TRADITIONS MINI-GOLF LLC		
67	ABEAR, JONATHAN WILLIAM	142	MCLAUGHLIN, LINDA R	221	SROCK, TRACY D & TRACEY R	298	H S N INC	375	THORSON, JAMES PERRY	451	HENRIKSON, RALPH A & BETTY	527	CHRISTENSEN, RONALD W & MARY LEE	602	DEERWOOD RICE & GRAIN PROCESSING		
68	HARRINGTON, FLORENCE	143	MCLAUGHLIN, LINDA R	222	MILES ENTERPRISES LLC	299	H S N INC	376	BENEKE, ROSALYN T	452	HENRIKSON, RALPH A & BETTY	528	CHRISTENSEN, RONALD W & MARY LEE	603	CARR, IRVING J		
69	JENKINS, MARK R & JENNIFER L	144	LINDROTH, JOANN M REV TRUST(1/2 INT	224	MINNESOTA POWER AND LIGHT	300	ISLE, LUANN	377	BENEKE, ROSALYN T	453	OLSON, THEODORE D & DONALD L & KAR	529	CHRISTENSEN, RONALD W & MARY LEE	604	CARR, IRVING J		
70	SKINNER, MARVIN E FAM LIV TRUST 1/2	145	NORTHLAND SMILES LLC	225	TAX FORFEITED	301	ISLE, LUANN	378	PIETZ, NATHAN J & KARILEE B	454	OLSON, THEODORE D & DONALD L & KAR	530	CHRISTENSEN, RONALD W & MARY LEE	605	CHRISTENSEN, HARVEY		
71	SEVERSON, ERIK & RACHEL	146	STATE OF MINNESOTA ADMIN BLDG	226	JOHNSON, BONNIE J & GERALD	302	ISLE, LUANN	379	PIETZ, NATHAN J & KARILEE B	455	ENGSTROM, LARRY & RICHARD & DENNIS&	531	CHRISTENSEN, RONALD W & MARY LEE	606	CHRISTENSEN, HARVEY		
72	COUSINS, GAYLE R REV LIFETIME TRUST	147	GOLDENEYE I LLC	227	JOHNSON, BONNIE J & GERALD	303	CARLISLE, MICHAEL E & KAREN B	380	STEECE, ARTHUR & MANUAL HIRDLER	456	MIDDLETON, C MARK	532	CHRISTENSEN, RONALD W & MARY LEE	607	DEERWOOD RICE & GRAIN PROCESSING		
73	GERBERDING, DONNA K & DAVID A HARRI	148	ROGERS, CHARLAMAINE M	228	JOHNSON, BONNIE J & GERALD	304	CARLISLE, MICHAEL E & KAREN B	381	HOEKSTRA, WARREN D	457	ENGSTROM, LARRY & RICHARD & DENNIS&	533	CHRISTENSEN, RONALD W & MARY LEE	608	DEERWOOD RICE & GRAIN PROCESSING		
74	HARRIS, DAVID A & GERBERDING DONNA	149	ROGERS, CHARLAMAINE M	229	JOHNSON, BONNIE J & GERALD	305	JOHNSRUD, KASEY	382	HOEKSTRA, WARREN D	458	MIDDLETON, C MARK	534	CHRISTENSEN, RONALD W & MARY LEE	609	DEERWOOD RICE & GRAIN PROCESSING		
75	PANKONIN, PHYLLIS & ROGER	150	ELLING, SHEILA M	230	JOHNSON, BONNIE J & GERALD	306	BARLAGE, ROBERT L & MARILYN	383	HORST, DENNIS L & SUSAN M	459	ABEAR, TERRY W	535	CHRISTENSEN, RONALD W & MARY LEE	618	DEERWOOD RICE & GRAIN PROCESSING		
76	BNSF RAILROAD	151	ELLING, SHEILA M	231	DAKJAM INVESTMENTS LLC	307	STURM, TIMOTHY P	384	TAX FORFEITED	460	ABEAR, TERRY W	536	CHRISTENSEN, RONALD W & MARY LEE	619	DEERWOOD RICE & GRAIN PROCESSING		
77	SEVERSON, MARK A & MALLORY K	152	MCKEE, WESLEY ERIN & LISA ANN	232	ANTONSEN, THOMAS & MARY	309	SWEDISH BAPTIST CHURCH OF DEERWOOD	385	TAX FORFEITED	461	ABEAR, TERRY W	537	CHRISTENSEN, RONALD W & MARY LEE	624	CHRISTENSEN, HARVEY		
78	IVERSON, DONALD F	153	KAPITZKE, DAVID L	233	JOHNSON, BONNIE J & GERALD	310	DEERWOOD BAPTIST CHURCH	386	KALEVIK, DENISE J	462	ANDERSON, JESSE	538	CHRISTENSEN, RONALD W & MARY LEE	625	TAX FORFEITED		
79	BERG, KAREN J	154	KAPITZKE, DAVID L	234	DAKJAM INVESTMENTS LLC	311	MILLSOP, JEREMY P	387	BROWN, ROBERT & DEANNA INVEST LLC	463	HABIGHORST, ALFRED & JANICE	539	CHRISTENSEN, RONALD W & MARY LEE	626	MOHS FAMILY REVOCABLE LIVING TRUST		
80	MINGUS, DOUGLAS & BETTY LOU	155	MELENICH, MIKEL R & MICHELLE R	235	DAKJAM INVESTMENTS LLC	312	RAYMOND FAMILY REV INTER VIVOS TRST	388	CITY OF DEERWOOD	464	HOFFSTEAD, SANDRA L	540	CHRISTENSEN, RONALD W & MARY LEE	627	MOHS FAMILY REVOCABLE LIVING TRUST		
81	MAY, RONALD N & DEBORAH	156	DOONAN, JUDY MILDRED	236	DAKJAM INVESTMENTS LLC	313	NOVOTNY, ALBERT H & CAROL M	389	PUGH, BRADFORD & MICHELE S	465	HOFFSTEAD, SANDRA L	541	ADAMS, JUDY F & JACK H REV TRUST AG	628	MOHS FAMILY REVOCABLE LIVING TRUST		
82	CROOKS, BARBARA M & RODNEY	157	DOONAN, JUDY MILDRED	237	EDMUNDSON, LAVONNE & EARL J	314	BUCKMAN, PEARL & HARRY W	390	VILLAGE OF DEERWOOD	466	HOFFSTEAD, SANDRA	542	ADAMS, JUDY F & JACK H REV TRUST AG	629	MOHS FAMILY REVOCABLE LIVING TRUST		
83	OLSON, MARY & GLENN	158	DOONAN, JUDY MILDRED	238	SKONE, E TERRY REVOCABLE TRUST	316	EDMUNDSON, LAVONNE & EARL J	391	CITY OF DEERWOOD	468	SMITH, MURRAY A & SHANNON M SMITH	543	CHRISTENSEN, RONALD W & MARY LEE	630	MOHS FAMILY REVOCABLE LIVING TRUST		
84	ANDERSON, JAMES D & SHARON	159	LIBERA, GEORGE A II	239	SKONE, E TERRY REVOCABLE TRUST	317	NORDEAN, GARY H & MARY ANN	392	GOODMANSON, DUANE A & CHRISTINA J	469	PETERSON, DENNIS M & LINDA K	544	CHRISTENSEN, RONALD W & MARY LEE	631	MOHS FAMILY REVOCABLE LIVING TRUST		
85	ROTH, GARY G	160	LIBERA, GEORGE A II	240	HOLLAND, MARILYN L TRTEE OF HOLLAND	318	BLOOD, KRISTINA	393	LUTZ, GERALD RICHARD	470	MAY, RONALD N & DEBORAH A	545	CHRISTENSEN, RONALD W & MARY LEE	632	MOHS FAMILY REVOCABLE LIVING TRUST		
86	ROTH, GARY G	161	CORNISH, ANGELA K	241	HOLLAND, MARILYN L TRTEE OF HOLLAND	319	BLOOD, KRISTINA	394	KUEHNE, JOHN R & TERESA M	471	SEVERSON, PAUL A & THERESA	546	CHRISTENSEN, RONALD W & MARY LEE	633	MOHS FAMILY REVOCABLE LIVING TRUST		
87	MAY, RONALD N & DEBORAH A	162	VOSS, GUY M & MELISSA RHEA	242	DEERBROOKE, LLC	320	HENDRICKSON, ERIC D & DEANNE M	395	HIMMELRIGHT, ROBERT & LINDA	472	SEVERSON, PAUL A & THERESA	547	CHRISTENSEN, RONALD W & MARY LEE	634	MOHS FAMILY REVOCABLE LIVING TRUST		
88	PARKS, DANIEL N	163	VOSS, GUY M & MELISSA RHEA	243	DEERBROOKE, LLC	321	HENDRICKSON, ERIC D & DEANNE M	396	BOECKERMANN, DAVID J & ELEANOR	473	SEVERSON, PAUL A & THERESA	548	CHRISTENSEN, RONALD W & MARY LEE	635	MOHS FAMILY REVOCABLE LIVING TRUST		
89	GODFREY, EDWARD P & SHERRI M	164	VOSS, GUY M & MELISSA RHEA	244	DEERBROOKE, LLC	322	CHRISTENSEN, RONALD W & MARY LEE	397	TREFETHEN, JOHN W	474	SCHOENIKE, MARVIN A & MARY JO	549	CHRISTENSEN, RONALD W & MARY LEE	636	MOHS FAMILY REVOCABLE LIVING TRUST		
90	PARKS, DANIEL N	165	VOSS, GUY M & MELISSA RHEA	245	CHRISTENSEN, ROGER D & OLIVIA	323	CHRISTENSEN, RONALD W & MARY LEE	398	TREFETHEN, JOHN W	475	PATTERSON, MICHAEL J ET UX	550	CHRISTENSEN, RONALD W & MARY LEE	637	MOHS FAMILY REVOCABLE LIVING TRUST		
91	GODFREY, EDWARD P & SHERRI HOLMVIG	166	LABORDE, MITCHELL D	246	CHRISTENSEN, ROGER D & OLIVIA	324	HUNTER, JAMES J	399	TREFETHEN, JOHN W	476	PATTERSON, MICHAEL J ET UX	551	ADAMS, JUDY F & JACK H REV TRUST AG	638	MOHS FAMILY REVOCABLE LIVING TRUST		

PROPERTY OWNER MAP

Friday, January 17, 2014



Map Document: (L:\Resources\Cartographic\Templates\EmptyLayouts\A_ANSI_8x11P\8x11P_Simple2Line_LegendBox.mxd)
2/13/2009 -- 12:42:20 PM

Project Number: DEERW 125461
Print Date: 00/00/0000

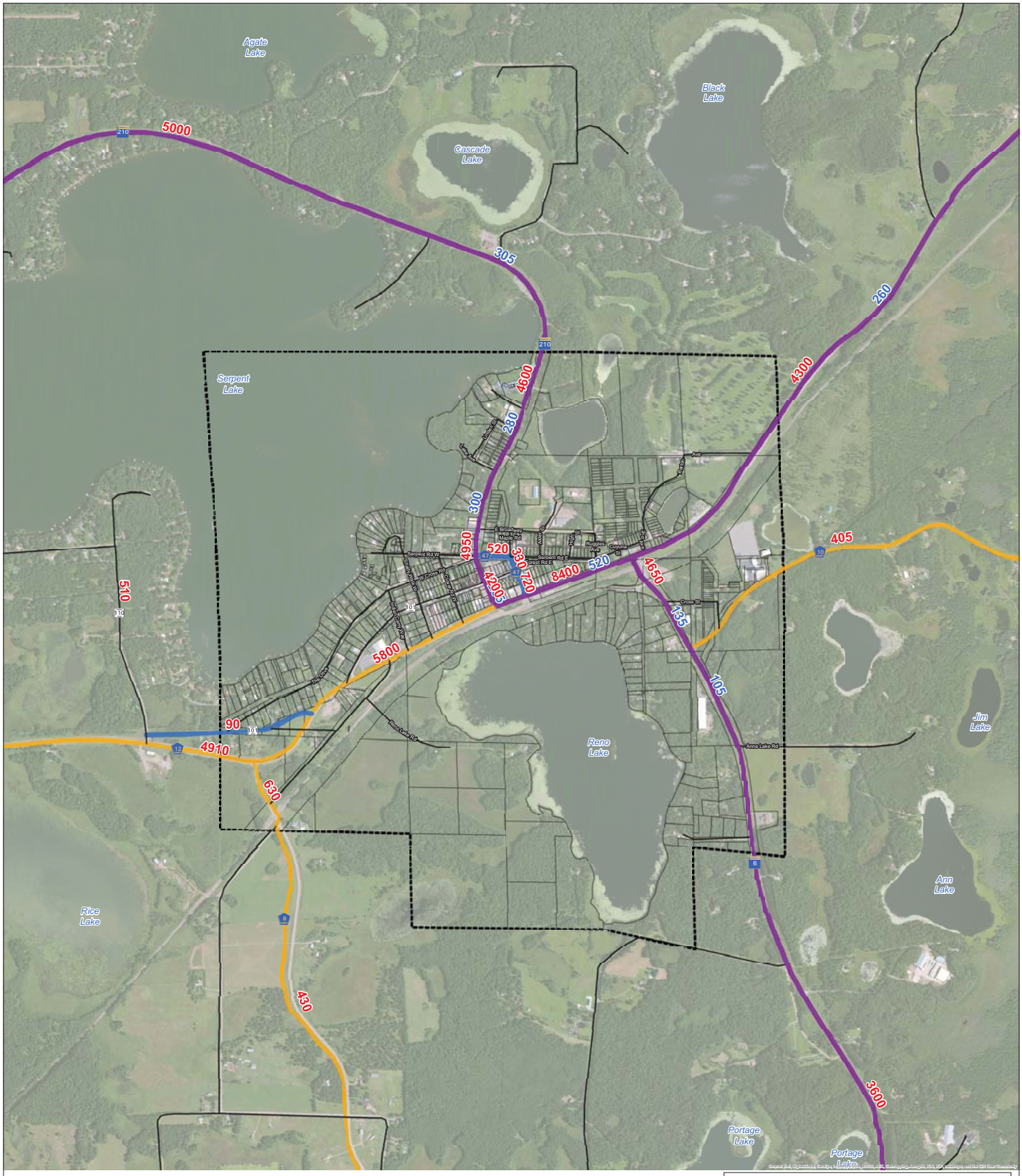
Map by: CTK
Projection: CWC County Coord.
Source: City, MDH

WELLHEAD PROTECTION PLAN
City of Deerwood, Mninnesota

Appendix D
Zoning Map

USGS LOCATION MAP

CROW WING COUNTY MINNESOTA



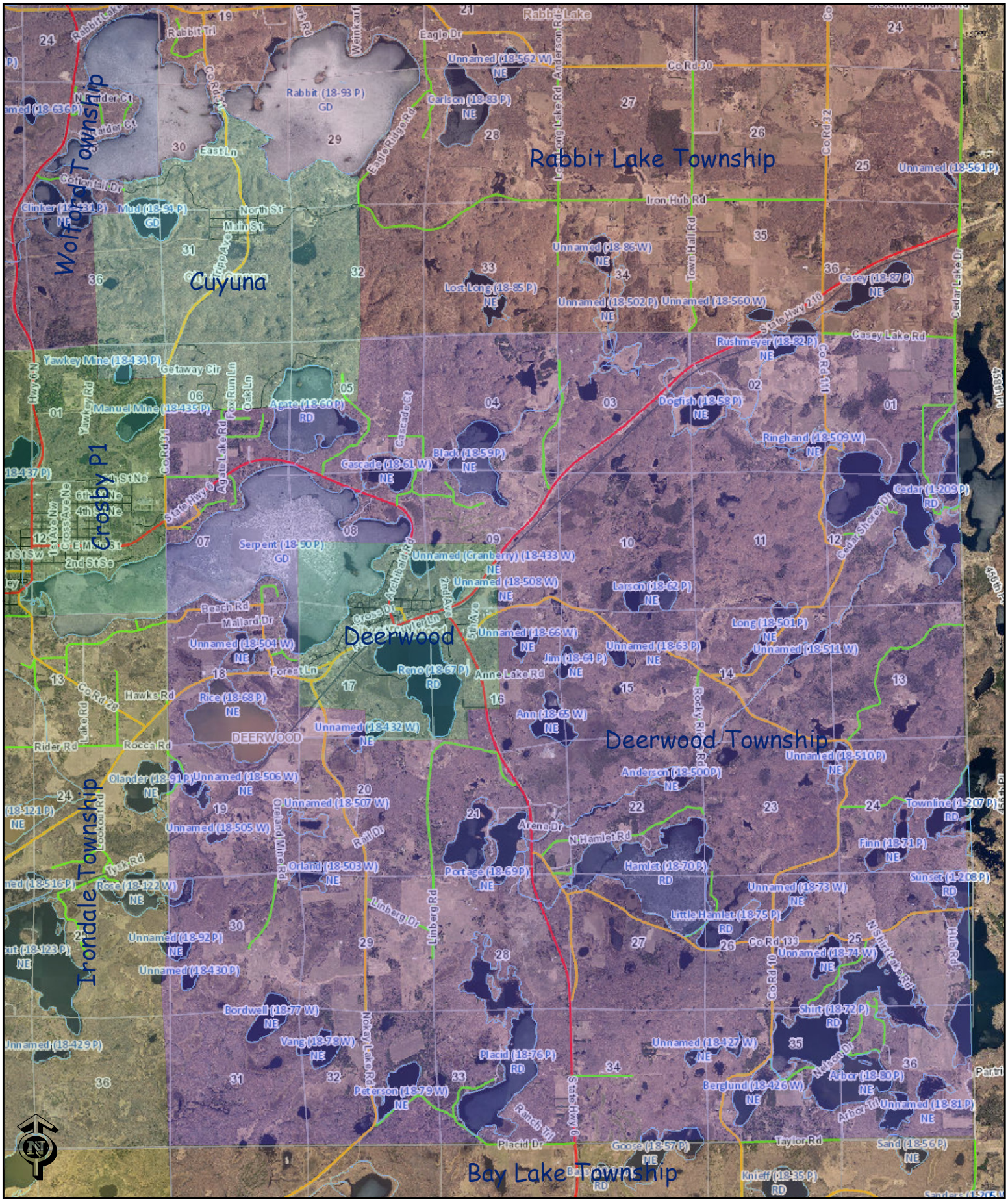
FUNCTIONAL CLASSES SOURCE:
CROW WING 2013-2017 HIGHWAY IMPROVEMENT PLAN

Path: S:\MC\Deerwood\125411\GIS\Maps\Transportation_Map.mxd
Date: 2/10/2014

City of Deerwood
Comprehensive Plan

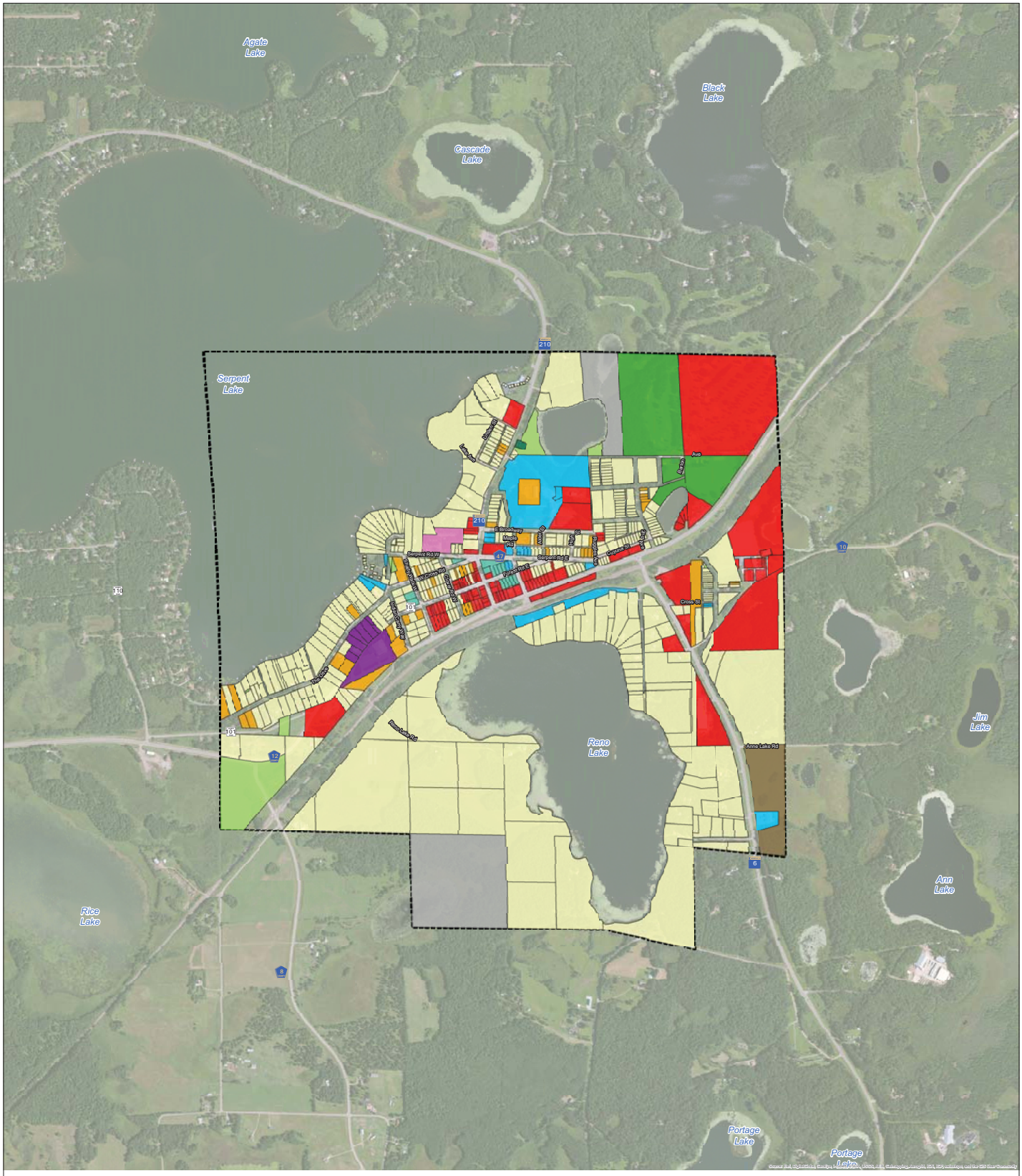
TRANSPORTATION MAP

Monday February 10, 2014



Deerwood City Limits

CROW WING COUNTY MINNESOTA



Legend

Revised Classification Parcels

Land Classification from Parcels

- Single Family Residentiall
- Multi Family Residential
- Manufactured Home Park
- Vacant
- Agricultural
- Church
- Commercial
- Industrial
- Public
- County Property
- Golf Course
- State Wildlife Management Areas/PILT
- Deerwood City Boundary

0 250 500 1,000 1,500 2,000 Feet

LANDUSE SOURCE: 2014 CROW WING COUNTY PARCELS

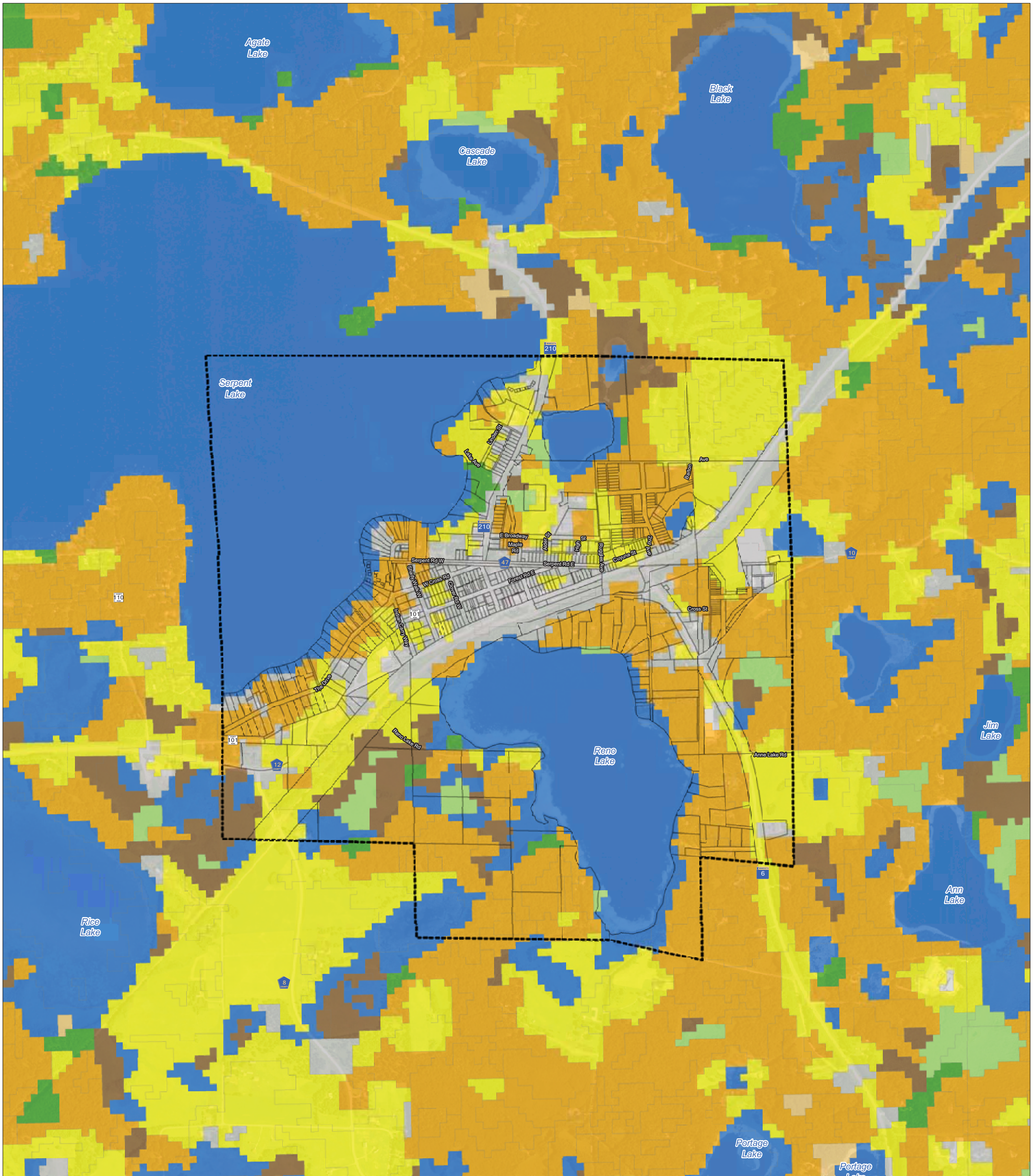
Path: S:\BD\Deerwood\GIS\Maps\ExistingLandUse.mxd
Date: 2/10/14

City of Deerwood Comprehensive Plan

EXISTING LAND USE

SEH

Monday February 10, 2014



Legend

- Deerwood City Boundary
- Parcels
- Aquatic Environments
- Crop/Grass
- Lowland Conifer Forest
- Upland Conifer Forest
- Lowland Deciduous Forest
- Upland Deciduous Forest
- Non-Vegetated
- Shrubland

0 250 500 1,000 1,500 2,000 Feet

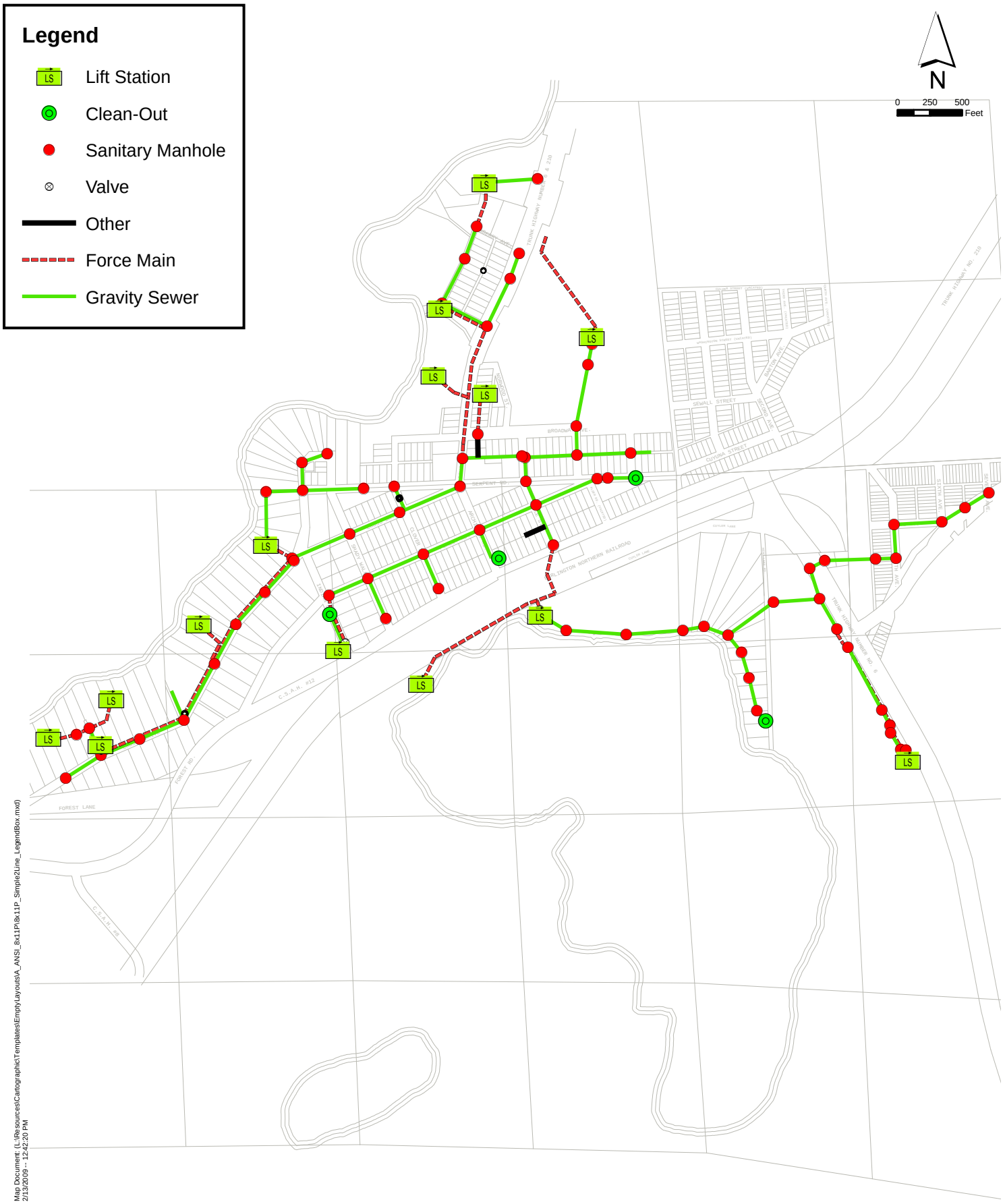
Landcover Source: GAP - MnDNR

City of Deerwood
Comprehensive Plan

EXISTING LAND COVER

SEH

Monday February 10, 2014



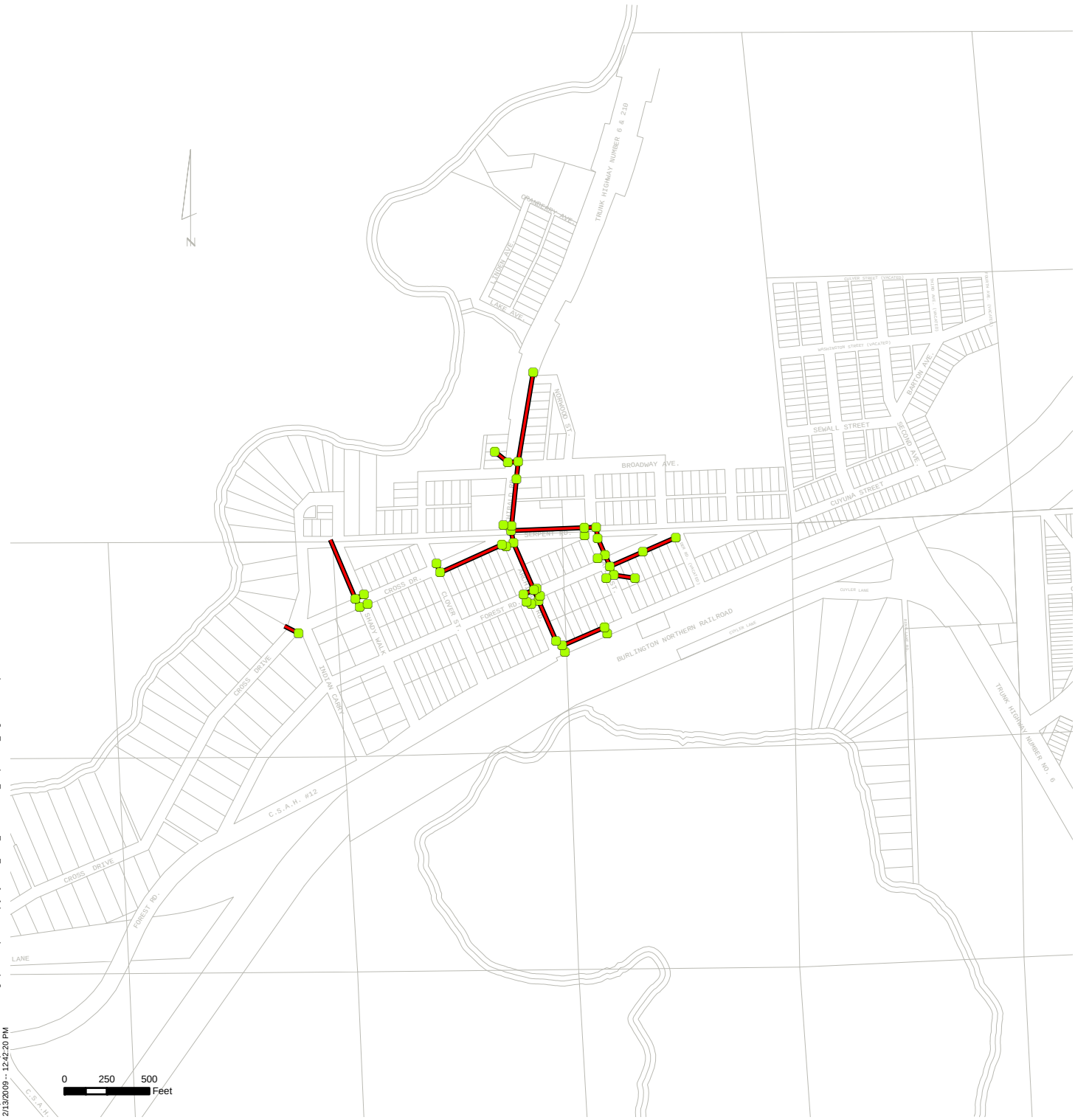
Map Document: (L:\Resources\Cartographic\Templates\Empty\Layouts\A_ANSI_8x11P\8x11P_Simple2Line_LegendBox.mxd)
2/13/2009 -- 12:42:20 PM

Project Number: DEERW 125461
Print Date: 00/00/0000

Map by: CTK
Projection: CWC County Coord.
Source: City, MDH

WELLHEAD PROTECTION PLAN
City of Deerwood, Mninnesota

Appendix D
Sanitary Sewer System Map



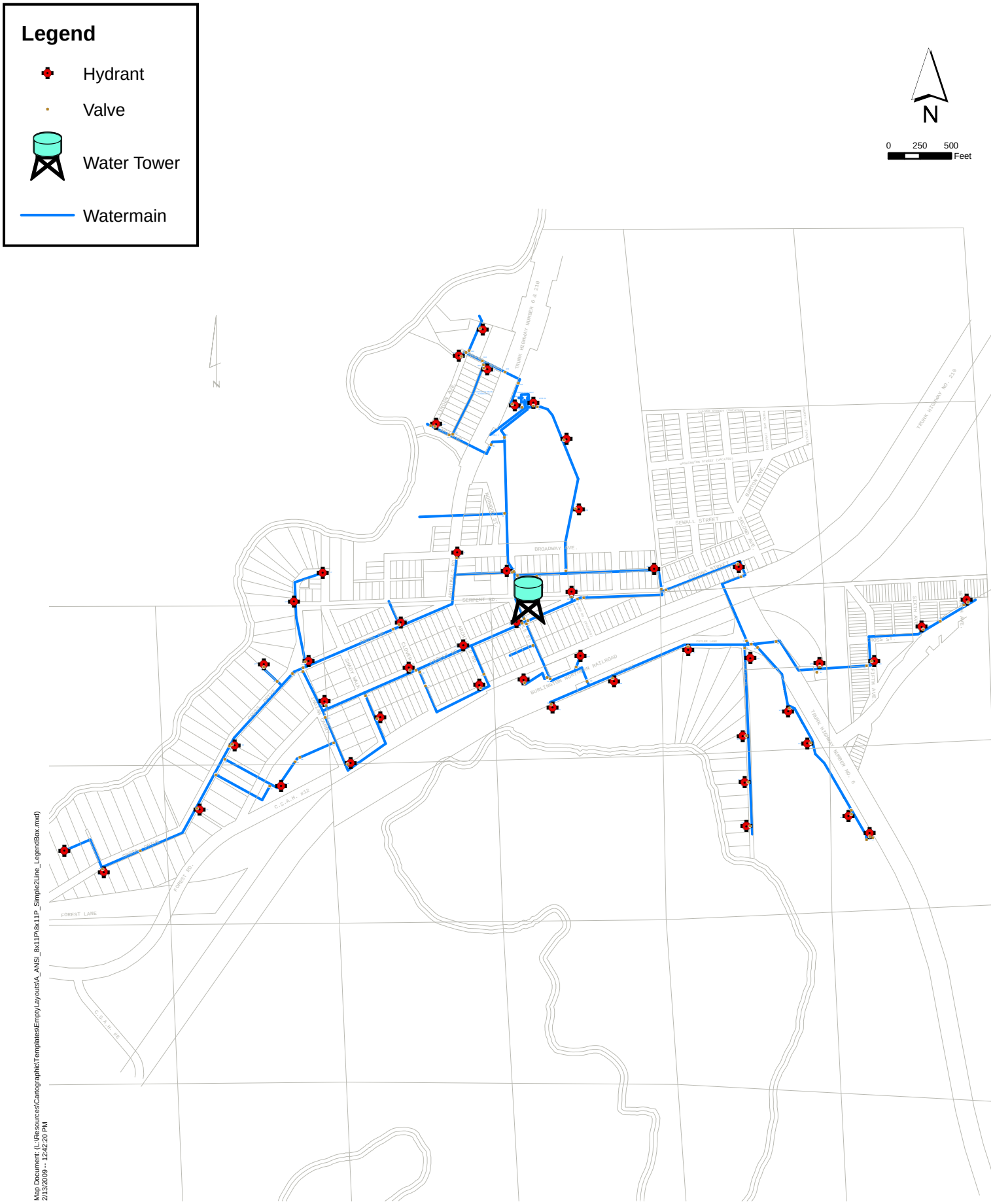
Map Document: (L:\Resources\Cartographic\Templates\Empty\Layouts\A_ANSI_8x11P\8x11P_Simple2Line_LegendBox.mxd)
2/13/2009 -- 12:42:20 PM

Project Number: DEERW 125461
Print Date: 00/00/0000

Map by: CTK
Projection: CWC County Coord.
Source: City, MDH

WELLHEAD PROTECTION PLAN
City of Deerwood, Mninnesota

Appendix D
Existing Storm Sewer Map



Map Document: (L:\Resources\Cartographic\Templates\Empty\Layouts\A_ANSI_8x11P\8x11P_Simple2Line_LegendBox.mxd)
2/13/2009 -- 12:42:20 PM

Project Number: DEERW 125461
Print Date: 00/00/0000

Map by: CTK
Projection: CWC County Coord.
Source: City, MDH

WELLHEAD PROTECTION PLAN
City of Deerwood, Mninnesota

Appendix D
Water System Map

Minnesota Unique Well No. **455781**

County Crow Wing
Quad Crosby
Quad ID 210B

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 103I

Entry Date 07/24/1992
Update Date 03/10/2014
Received Date

Well Name DEERWOOD 2

Township Range Dir Section Subsections Elevation 1262 ft.

46 28 W 8 DACCDD Elevation Method 7.5 minute topographic map (+/- 5 feet)

Well Depth	Depth Completed	Date Well Completed
145 ft.	140 ft.	09/08/1988

Drilling Method Non-specified Rotary

Well Address

DEERWOOD MN 55644

Drilling Fluid Bentonite

Well Hydrofractured? ☐ Yes ☐ No From Ft. to Ft.

Use Community Supply PWS ID 1180012 Source S02

Casing Type Steel (black or low carbon) Joint Welded Drive Shoe? ☐ Yes ☐ No Above/Below 2 ft.

Casing Diameter	Weight	Hole Diameter
8 in. to 120 ft.	28.55 lbs./ft.	12.3 in. to 140 ft.

Open Hole from ft. to ft.

Screen YES Make JOHNSON WIRE WOUND Type

Diameter	Slot/Gauze	Length	Set Between
12	12	20	120 ft. and 140 ft.

Geological Material	Color	Hardness	From	To
CLAY W/ROCKS	RED		0	2
SANDY CLAY W/COARSE SAND LENSESQ	RED		2	9
SAND RED-COLORED			9	11
SANDY CLAY	RED		11	13
SAND & GRAVEL	VARIED		13	14
SAND CLAY W/ROCK	GRAY		14	17
SAND & GRAVEL W/SMALL CLAY LENSES	VARIED		17	67
SANDY CLAY	GRAY		67	71
SAND & GRAVEL	GRAY		71	74
SANDY CLAY	GRAY		74	95
SANDY CLAY W/SMALL SAND LENSES	GRAY		95	107
SAND	GRAY		107	122
SAND	GRAY		122	140
ROCK W/LENSES OF SAND	VARIED		140	143
SANDY CLAY	BLUE		143	144
ROCK			144	145

Static Water Level
14 ft. from Land surface Date Measured 04/19/1988

PUMPING LEVEL (below land surface)
85.8 ft. after 24 hrs. pumping 300 g.p.m.

Well Head Completion
Pitless adapter manufacturer MONITOR Model
☐ Casing Protection ☐ 12 in. above grade
☐ At-grade (Environmental Wells and Borings ONLY)

NO REMARKS

Grouting Information Well Grouted? ☑ Yes ☐ No ☐ Not Specified

Grout Material: Neat Cement from 10 to 100 ft. 1.5 yrds.

Located by: Minnesota Department of Health

Method: GPS SA Off (averaged)

Unique Number Verification: Info/GPS from data source

Input Date: 11/17/2010

System: *UTM - Nad83, Zone15, Meters*

X: 430973 Y: 5147673

Nearest Known Source of Contamination
__feet __direction __type
Well disinfected upon completion? ☑ Yes ☐ No

Pump ☐ Not Installed Date Installed 09/08/1988
Manufacturer's name BERKELY Model number 652A14-6 HP 25 Volts 230
Length of drop Pipe 105 ft. Capacity 250 g.p.m
Type Submersible Material Steel (black or low carbon)

Abandoned Wells Does property have any not in use and not sealed well(s)? ☐ Yes ☑ No

Variance Was a variance granted from the MDH for this well? ☐ Yes ☐ No

First Bedrock E.Proterozoic rocks und.
Last Strat E.Proterozoic rocks und.
Aquifer Quat. Buried Artes. Aquifer
Depth to Bedrock 144 ft.

Well Contractor Certification

License Business Name	Lic. Or Reg. No.	Name of Driller
Ltp Enterprises	91353	WIEDERHOLT, D

Minnesota Unique Well No. **232353**

County Crow Wing
Quad Crosby
Quad ID 210B

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 103I

Entry Date 07/24/1992
Update Date 03/10/2014
Received Date

Well Name DEERWOOD 1

Township Range Dir Section Subsections Elevation 1257 ft.

46	28	W	8	DDBBBA	Elevation Method	7.5 minute topographic map (+/- 5 feet)

Well Depth	Depth Completed	Date Well Completed
181 ft.	148 ft.	00/00/1917

Drilling Method Cable Tool

Well Address

DEERWOOD MN 56444

Geological Material	Color	Hardness	From	To
CLAY			0	4
GRAVEL			4	7
HARDPAN			7	30
SAND AND GRAVEL			30	60
HARDPAN			60	145
SAND AND GRAVEL			145	163
SHALE			163	181

Drilling Fluid --

Well Hydrofractured? ☐ Yes ☐ No
From Ft. to Ft.

Use Community Supply **PWS ID** 1180012 **Source** S01

Casing Type Steel (black or low carbon) **Joint** No Information **Drive Shoe?** ☐ Yes ☐ No **Above/Below** ft.

Casing Diameter	Weight	Hole Diameter
8 in. to 140 ft.	lbs./ft.	
10 in. to ft.	lbs./ft.	

Open Hole from ft. to ft.

Screen YES **Make** **Type**

Diameter	Slot/Gauze	Length	Set Between

Static Water Level
10 ft. from Land surface Date Measured 00/00/1917

PUMPING LEVEL (below land surface)
ft. after hrs. pumping 250 g.p.m.

Well Head Completion
Pitless adapter manufacturer Model
☐ Casing Protection ☑ 12 in. above grade
☐ At-grade (Environmental Wells and Borings ONLY)

REMARKS
GAMMA LOGGED & TV 6-10-1987.
WELL WAS LINED WITH 8 IN. CASING IN 1957.
DEPTH AT TIME OF TV WAS 148 FEET.
SCREEN STARTS AT 140 FEET.

Grouting Information Well Grouted? ☐ Yes ☐ No ☑ Not Specified

Located by: Minnesota Department of Health
Method: GPS SA Off (averaged)

Unique Number Verification: Info/GPS from data source
Input Date: 11/17/2010

System: *UTM - Nad83, Zone15, Meters*
X: 430917 **Y:** 5147666

Nearest Known Source of Contamination
__fect __direction __type
Well disinfected upon completion? ☐ Yes ☐ No

Pump ☐ Not Installed Date Installed
Manufacturer's name Model number__ HP_ Volts
Length of drop Pipe _ft. Capacity _g.p.m Type Material

Abandoned Wells Does property have any not in use and not sealed well(s)? ☐ Yes ☐ No

Variance Was a variance granted from the MDH for this well? ☐ Yes ☐ No

Borehole Geophysics Yes
First Bedrock weathering residuum unc.age
Last Strat weathering residuum unc.age
Aquifer Quat. Buried Artes. Aquifer
Depth to Bedrock 163 ft.

Well Contractor Certification

Mccarthy Well Co.	27022	
License Business Name	Lic. Or Reg. No.	Name of Driller

Environmental Health Division
Drinking Water Protection Section
P.O. Box 64975
St. Paul, Minnesota 55164-0975

INNER WELLHEAD MANAGEMENT ZONE (IWMZ) - POTENTIAL CONTAMINANT SOURCE INVENTORY (PCSI) REPORT

PUBLIC WATER SYSTEM INFORMATION

PWS ID	1180012
NAME	Deerwood
ADDRESS	Deerwood Water Superintendent, P.O. Box 187, Deerwood, MN 56444

COMMUNITY

FACILITY (WELL) INFORMATION

NAME	Well #1
FACILITY ID	S01
UNIQUE WELL NO.	232353
COUNTY	Crow Wing

IS THERE A WELL LOG OR ADDITIONAL CONSTRUCTION INFORMATION AVAILABLE?

☐ **YES** (Please attach a copy)
☐ **NO** ☐ **UNDETERMINED**

PWS ID / FACILITY ID	1180012 S01	**UNIQUE WELL NO.**	232353

PCSI CODE	ACTUAL OR POTENTIAL CONTAMINATION SOURCE	ISOLATION DISTANCES (FEET)				LOCATION	
		Minimum Distances		Sensitive Well[1]	Within 200 Ft. Y / N / U	Dist. from Well	Est. (?)
		Community	Non-community				
Agricultural Related							
*AC1	Agricultural chemical buried piping	50	50		N		
*AC2	Agricultural chemical multiple tanks or containers for residential retail sale or use, no single tank or container exceeding, but aggregate volume exceeding 56 gal. or 100 lbs. dry weight	50	50		N		
ACP	Agricultural chemical tank or container with 25 gal. or more or 100 lbs. or more dry weight, or equipment filling or cleaning area without safeguards	150	150		N		
ACS	Agricultural chemical storage or equipment filling or cleaning area with safeguards	100	100		N		
ACR	Agricultural chemical storage or equipment filling or cleaning area with safeguards and roofed	50	50		N		
ADW	Agricultural drainage well[2] (Class V well - illegal[3])	50	50		N		
AAT	Anhydrous ammonia tank (stationary tank)	50	50		N		
AB1	Animal building, feedlot, confinement area, or kennel, 0.1 to 1.0 animal unit (stockyard)	50	20	100/40	N		
AB2	Animal building or poultry building, including a horse riding area, more than 1.0 animal unit	50	50	100	N		
ABS	Animal burial area, more than 1.0 animal unit	50	50		N		
FWP	Animal feeding or watering area within a pasture, more than 1.0 animal unit	50	50	100	N		
AF1	Animal feedlot, unroofed, 300 or more animal units (stockyard)	100	100	200	N		
AF2	Animal feedlot, more than 1.0, but less than 300 animal units (stockyard)	50	50	100	N		
AMA	Animal manure application	use discretion	use discretion		N		
REN	Animal rendering plant	50	50		N		
MS1	Manure (liquid) storage basin or lagoon, unpermitted or noncertified	300	300	600	N		
MS2	Manure (liquid) storage basin or lagoon, approved earthen liner	150	150	300	N		
MS3	Manure (liquid) storage basin or lagoon, approved concrete or composite liner	100	100	200	N		
MS4	Manure (solid) storage area, not covered with a roof	100	100	200	N		
OSC	Open storage for crops	use discretion	use discretion		N		
SSTS Related							
AA1	Absorption area of a soil dispersal system, average flow greater than 10,000 gal./day	300	300	600	N		
AA2	Absorption area of a soil dispersal system serving a facility handling infectious or pathological wastes, average flow 10,000 gal./day or less	150	150	300	N		
AA3	Absorption area of a soil dispersal system, average flow 10,000 gal./day or less	50	50	100	N		
AA4	Absorption area of a soil dispersal system serving multiple family residences or a non-residential facility and has the capacity to serve 20 or more persons per day (Class V well)[2]	50/300/150[4]	50/300/150[4]	100/600/300[4]	N		
CSP	Cesspool	75	75	150	N		
AGG	Dry well, leaching pit, seepage pit	75	75	150	N		
*FD1	Floor drain, grate, or trough connected to a buried sewer	50	50		N		
*FD2	Floor drain, grate, or trough if buried sewer is air-tested, approved materials, serving one building, or two or less single-family residences	50	20		N		
*GW1	Gray-water dispersal area	50	50	100	N		
LC1	Large capacity cesspools (Class V well - illegal)[2]	75	75	150	N		

PWS ID / FACILITY ID	1180012 S01	UNIQUE WELL NO.	232353

PCSI CODE	ACTUAL OR POTENTIAL CONTAMINATION SOURCE	ISOLATION DISTANCES (FEET)				LOCATION	
		Minimum Distances		Sensitive Well[1]	Within 200 Ft. Y / N / U	Dist. from Well	Est. (?)
		Community	Non-community				
MVW	Motor vehicle waste disposal (Class V well - illegal)[2]	illegal	illegal		N		
PR1	Privy, nonportable	50	50	100	N		
PR2	Portable (privy) or toilet	50	20		N		
*SF1	Watertight sand filter; peat filter; or constructed wetland	50	50		N		
SET	Septic tank	50	50		N		
HTK	Sewage holding tank, watertight	50	50		N		
SS1	Sewage sump capacity 100 gal. or more	50	50		N		
SS2	Sewage sump capacity less than 100 gal., tested, conforming to rule	50	20		N		
*ST1	Sewage treatment device, watertight	50	50		N		
SB1	Sewer, buried, approved materials, tested, serving one building, or two or less single-family residences	50	20		Y	80	N
SB1	Sewer, buried, approved materials, tested, serving one building, or two or less single-family residences	50	20		Y	180	N
SB2	Sewer, buried, collector, municipal, serving a facility handling infectious or pathological wastes, open-jointed or unapproved materials	50	50		N		
*WB1	Water treatment backwash holding basin, reclaim basin, or surge tank with a direct sewer connection	50	50		N		
*WB2	Water treatment backwash holding basin, reclaim basin, or surge tank with a backflow protected sewer connection	20	20		N		
Land Application							
SPT	Land spreading area for sewage, septage, or sludge	50	50	100	N		
Solid Waste Related							
COS	Commercial compost site	50	50		N		
CD1	Construction or demolition debris disposal area	50	50	100	N		
*HW1	Household solid waste disposal area, single residence	50	50	100	N		
LF1	Landfill, permitted demolition debris, dump, or mixed municipal solid waste from multiple persons	300	300	600	N		
SVY	Scrap yard	50	50		N		
SWT	Solid waste transfer station	50	50		N		
Storm Water Related							
SD1	Storm water drain pipe, 8 inches or greater in diameter	50	20		N		
SWI	Storm water drainage well[2] (Class V well - illegal[3])	50	50		N		
SM1	Storm water pond greater than 5000 gal.	50	35		N		
Wells and Borings							
*EB1	Elevator boring, not conforming to rule	50	50		N		
*EB2	Elevator boring, conforming to rule	20	20		N		
MON	Monitoring well	record dist.	record dist.		N		
WEL	Operating well	record dist.	record dist.		Y	183	
UUW	Unused, unsealed well or boring	50	50		N		
General							
*CR1	Cistern or reservoir, buried, nonpressurized water supply	20	20		N		
PLM	Contaminant plume	50	50		N		
*CW1	Cooling water pond, industrial	50	50	100	N		
DC1	Deicing chemicals, bulk road	50	50	100	N		
*ET1	Electrical transformer storage area, oil-filled	50	50		N		
GRV	Grave or mausoleum	50	50		N		
GP1	Gravel pocket or French drain for clear water drainage only	20	20		N		
*HS1	Hazardous substance buried piping	50	50		N		
HS2	Hazardous substance tank or container, above ground or underground, 56 gal. or more, or 100 lbs. or more dry weight, without safeguards	150	150		N		
HS3	Hazardous substance tank or container, above ground or underground, 56 gal. or more, or 100 lbs. or more dry weight with safeguards	100	100		N		
HS4	Hazardous substance multiple storage tanks or containers for residential retail sale or use, no single tank or container exceeding 56 gal. or 100 lbs., but aggregate volume exceeding	50	50		N		
HWF	Highest water or flood level	50	N/A		N		
*HG1	Horizontal ground source closed loop heat exchanger buried piping	50	50		N		
*HG2	Horizontal ground source closed loop heat exchanger buried piping and horizontal piping, approved materials and heat transfer fluid	50	10		N		
IWD	Industrial waste disposal well (Class V well)[2]	illegal[3]	illegal[3]		N		
IWS	Interceptor, including a flammable waste or sediment	50	50		N		

PWS ID / FACILITY ID	1180012 S01	UNIQUE WELL NO.	232353

PCSI CODE	ACTUAL OR POTENTIAL CONTAMINATION SOURCE	ISOLATION DISTANCES (FEET)				LOCATION	
		Minimum Distances		Sensitive Well[1]	Within 200 Ft. Y / N / U	Dist. from Well	Est. (?)
		Community	Non-community				
OH1	Ordinary high water level of a stream, river, pond, lake, reservoir, or drainage ditch (holds water six months or more)	50	35		N		
*PP1	Petroleum buried piping	50	50		N		
*PP2	Petroleum or crude oil pipeline to a refinery or distribution center	100	100		N		
PT1	Petroleum tank or container, 1100 gal. or more, without safeguards	150	150		N		
PT2	Petroleum tank or container, 1100 gal. or more, with safeguards	100	100		N		
PT3	Petroleum tank or container, buried, between 56 and 1100 gal.	50	50		N		
PT4	Petroleum tank or container, not buried, between 56 and 1100 gal.	50[5]	20		N		
PU1	Pit or unfilled space more than four feet in depth	20	20		N		
PC1	Pollutant or contaminant that may drain into the soil	50	50	100	N		
SP1	Swimming pool, in-ground	20	20		N		
*VH1	Vertical heat exchanger, horizontal piping conforming to rule	50	10		N		
*VH2	Vertical heat exchanger (vertical) piping, conforming to rule	50	35		N		
*WR1	Wastewater rapid infiltration basin, municipal or industrial	300	300	600	N		
*WA1	Wastewater spray irrigation area, municipal or industrial	150	150	300	N		
*WS1	Wastewater stabilization pond, industrial	150	150	300	N		
*WS2	Wastewater stabilization pond, municipal, 500 or more gal./acre/day of leakage	300	300	600	N		
*WS3	Wastewater stabilization pond, municipal, less than 500 gal./acre/day of leakage	150	150	300	N		
*WT1	Wastewater treatment unit tanks, vessels and components (Package plant)	100	100		N		
*WT2	Water treatment backwash disposal area	50	50	100	N		
Additional Sources (If there is more than one source listed above, please indicate here).							
Potential Contamination Sources and Codes Based on Previous Versions of this Form							
	none found within 200' of this well.						

* New potential contaminant source.

[1] A sensitive well has less than 50 feet of watertight casing, and which is not cased below a confining layer or confining materials of at least 10' in thickness.

[2] These sources, known as Class V underground injection wells, are regulated by the federal U.S. Environmental Protection Agency.

[3] These sources are classified as illegal by Minnesota Rules, Chapter 4725.

[4] Isolation distance is determined by average flow per day or if a facility handles infectious or pathological wastes.

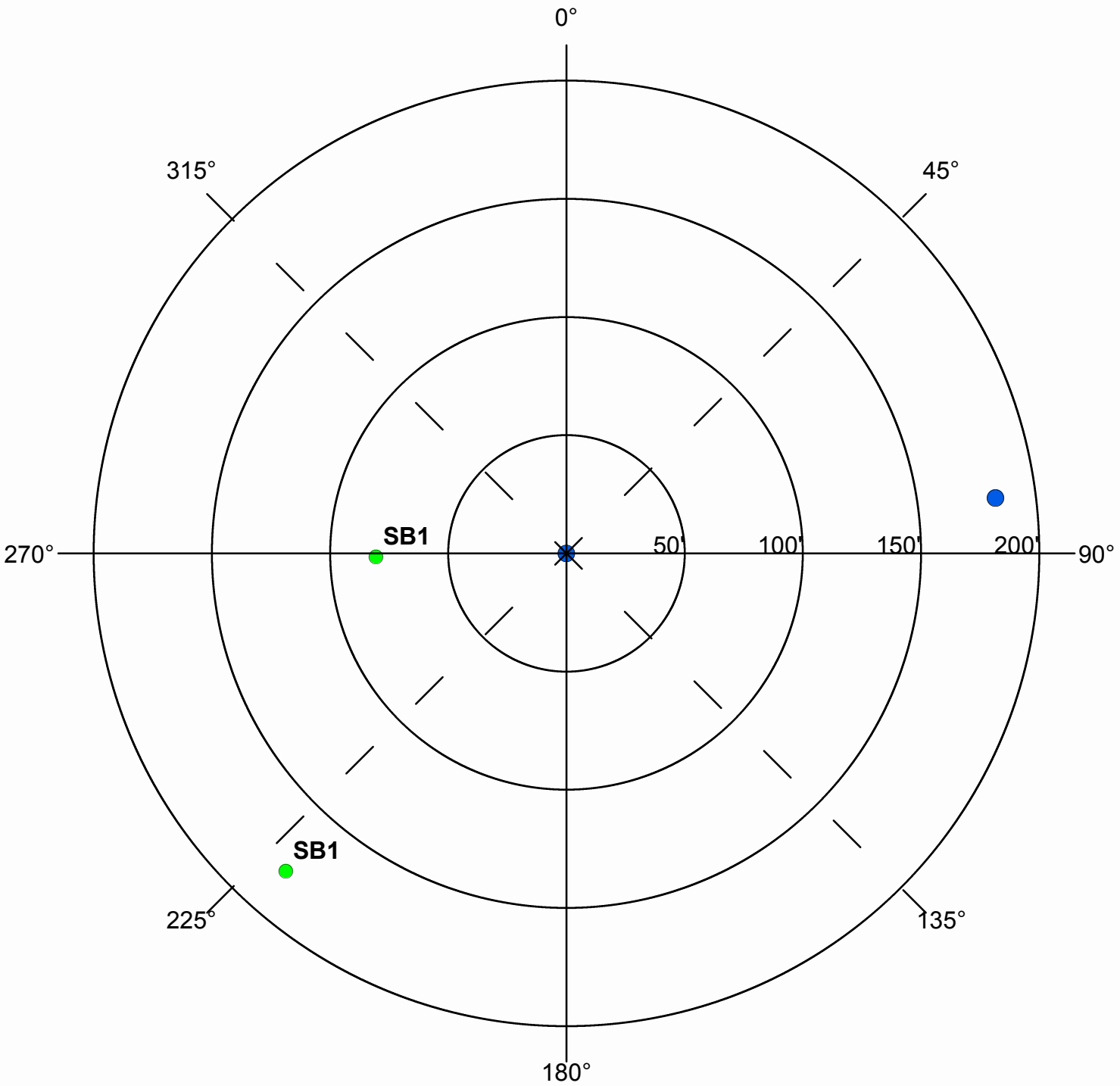
[5] A community public water-supply well must be a minimum of 50 feet from a petroleum tank or container, unless the tank or container is used for emergency pumping and is located in a room or building separate from the community well; and is of double-wall construction with leak detection between walls; or is protected with secondary containment.

This form is based on the new isolation distances in Minnesota Rules, Chapter 4725, related to wells and borings adopted August 4, 2008, and Minnesota Rules, Chapter 4720, related to wellhead protection.

PWS ID / FACILITY ID	1180012 S01	UNIQUE WELL NO.	232353

SETBACK DISTANCES	All potential contaminant sources must be noted on sketch.

Record the distance and approximate compass bearing of each potential contaminant source from the well, and identify the source using the "Source Code". Unlabeled points on the map are unsealed wells.



Were the isolation distances maintained for the new sources of contamination?	Y	N	N/A
Is the system monitoring existing nonconforming sources of contamination?	Y	N	N/A

Reminder Question: Were the wellhead protection measure(s) implemented?

INSPECTOR	Neiman, Dave	DATE	11 - 7 - 2013

PWS ID / FACILITY ID	1180012 S01	UNIQUE WELL NO.	232353

RECOMMENDED WELLHEAD PROTECTION (WHP) MEASURES	WHP MEASURE IMPLEMENTED? Y or N	DATE VERIFIED

COMMENTS

9/7/2003 - Location for PCSI Type OHW (bearing = 0, distance = 0 , inventory date: 8/18/1998) could not be determined.
9/7/2003 - Location for PCSI Type SBM (bearing = 0, distance = 0 , inventory date: 8/18/1998) could not be determined.

For further information, please contact:

Minnesota Department of Health
Drinking Water Protection Section
Source Water Protection Unit
P.O. Box 64975
St. Paul, Minnesota 55164-0975

Section Receptionist: 651-201-4700
Division TDD: 651-201-5797 or MN Relay Service @ 1-800-627-3529 and ask for 651-201-5000

Environmental Health Division
Drinking Water Protection Section
P.O. Box 64975
St. Paul, Minnesota 55164-0975

INNER WELLHEAD MANAGEMENT ZONE (IWMZ) - POTENTIAL CONTAMINANT SOURCE INVENTORY (PCSI) REPORT

PUBLIC WATER SYSTEM INFORMATION

PWS ID	1180012
NAME	Deerwood
ADDRESS	Deerwood Water Superintendent, P.O. Box 187, Deerwood, MN 56444

COMMUNITY

FACILITY (WELL) INFORMATION

NAME	Well #2
FACILITY ID	S02
UNIQUE WELL NO.	455781
COUNTY	Crow Wing

IS THERE A WELL LOG OR ADDITIONAL CONSTRUCTION INFORMATION AVAILABLE?

☐ **YES** (Please attach a copy)
☐ **NO** ☐ **UNDETERMINED**

PWS ID / FACILITY ID	1180012 S02	**UNIQUE WELL NO.**	455781

PCSI CODE	ACTUAL OR POTENTIAL CONTAMINATION SOURCE	ISOLATION DISTANCES (FEET)				LOCATION	
		Minimum Distances		Sensitive Well[1]	Within 200 Ft. Y / N / U	Dist. from Well	Est. (?)
		Community	Non-community				
Agricultural Related							
*AC1	Agricultural chemical buried piping	50	50		N		
*AC2	Agricultural chemical multiple tanks or containers for residential retail sale or use, no single tank or container exceeding, but aggregate volume exceeding 56 gal. or 100 lbs. dry weight	50	50		N		
ACP	Agricultural chemical tank or container with 25 gal. or more or 100 lbs. or more dry weight, or equipment filling or cleaning area without safeguards	150	150		N		
ACS	Agricultural chemical storage or equipment filling or cleaning area with safeguards	100	100		N		
ACR	Agricultural chemical storage or equipment filling or cleaning area with safeguards and roofed	50	50		N		
ADW	Agricultural drainage well[2] (Class V well - illegal[3])	50	50		N		
AAT	Anhydrous ammonia tank (stationary tank)	50	50		N		
AB1	Animal building, feedlot, confinement area, or kennel, 0.1 to 1.0 animal unit (stockyard)	50	20	100/40	N		
AB2	Animal building or poultry building, including a horse riding area, more than 1.0 animal unit	50	50	100	N		
ABS	Animal burial area, more than 1.0 animal unit	50	50		N		
FWP	Animal feeding or watering area within a pasture, more than 1.0 animal unit	50	50	100	N		
AF1	Animal feedlot, unroofed, 300 or more animal units (stockyard)	100	100	200	N		
AF2	Animal feedlot, more than 1.0, but less than 300 animal units (stockyard)	50	50	100	N		
AMA	Animal manure application	use discretion	use discretion		N		
REN	Animal rendering plant	50	50		N		
MS1	Manure (liquid) storage basin or lagoon, unpermitted or noncertified	300	300	600	N		
MS2	Manure (liquid) storage basin or lagoon, approved earthen liner	150	150	300	N		
MS3	Manure (liquid) storage basin or lagoon, approved concrete or composite liner	100	100	200	N		
MS4	Manure (solid) storage area, not covered with a roof	100	100	200	N		
OSC	Open storage for crops	use discretion	use discretion		N		
SSTS Related							
AA1	Absorption area of a soil dispersal system, average flow greater than 10,000 gal./day	300	300	600	N		
AA2	Absorption area of a soil dispersal system serving a facility handling infectious or pathological wastes, average flow 10,000 gal./day or less	150	150	300	N		
AA3	Absorption area of a soil dispersal system, average flow 10,000 gal./day or less	50	50	100	N		
AA4	Absorption area of a soil dispersal system serving multiple family residences or a non-residential facility and has the capacity to serve 20 or more persons per day (Class V well)[2]	50/300/150[4]	50/300/150[4]	100/600/300[4]	N		
CSP	Cesspool	75	75	150	N		
AGG	Dry well, leaching pit, seepage pit	75	75	150	N		
*FD1	Floor drain, grate, or trough connected to a buried sewer	50	50		N		
*FD2	Floor drain, grate, or trough if buried sewer is air-tested, approved materials, serving one building, or two or less single-family residences	50	20		N		
*GW1	Gray-water dispersal area	50	50	100	N		
LC1	Large capacity cesspools (Class V well - illegal)[2]	75	75	150	N		

PWS ID / FACILITY ID	1180012 S02	UNIQUE WELL NO.	455781

PCSI CODE	ACTUAL OR POTENTIAL CONTAMINATION SOURCE	ISOLATION DISTANCES (FEET)				LOCATION	
		Minimum Distances		Sensitive Well[1]	Within 200 Ft. Y / N / U	Dist. from Well	Est. (?)
		Community	Non-community				
MVW	Motor vehicle waste disposal (Class V well - illegal)[2]	illegal	illegal		N		
PR1	Privy, nonportable	50	50	100	N		
PR2	Portable (privy) or toilet	50	20		N		
*SF1	Watertight sand filter; peat filter; or constructed wetland	50	50		N		
SET	Septic tank	50	50		N		
HTK	Sewage holding tank, watertight	50	50		N		
SS1	Sewage sump capacity 100 gal. or more	50	50		N		
SS2	Sewage sump capacity less than 100 gal., tested, conforming to rule	50	20		N		
*ST1	Sewage treatment device, watertight	50	50		N		
SB1	Sewer, buried, approved materials, tested, serving one building, or two or less single-family residences	50	20		Y	60	N
SB2	Sewer, buried, collector, municipal, serving a facility handling infectious or pathological wastes, open-jointed or unapproved materials	50	50		N		
*WB1	Water treatment backwash holding basin, reclaim basin, or surge tank with a direct sewer connection	50	50		N		
*WB2	Water treatment backwash holding basin, reclaim basin, or surge tank with a backflow protected sewer connection	20	20		N		
Land Application							
SPT	Land spreading area for sewage, septage, or sludge	50	50	100	N		
Solid Waste Related							
COS	Commercial compost site	50	50		N		
CD1	Construction or demolition debris disposal area	50	50	100	N		
*HW1	Household solid waste disposal area, single residence	50	50	100	N		
LF1	Landfill, permitted demolition debris, dump, or mixed municipal solid waste from multiple persons	300	300	600	N		
SVY	Scrap yard	50	50		N		
SWT	Solid waste transfer station	50	50		N		
Storm Water Related							
SD1	Storm water drain pipe, 8 inches or greater in diameter	50	20		N		
SWI	Storm water drainage well[2] (Class V well - illegal[3])	50	50		N		
SM1	Storm water pond greater than 5000 gal.	50	35		N		
Wells and Borings							
*EB1	Elevator boring, not conforming to rule	50	50		N		
*EB2	Elevator boring, conforming to rule	20	20		N		
MON	Monitoring well	record dist.	record dist.		N		
WEL	Operating well	record dist.	record dist.		Y	183	
UUW	Unused, unsealed well or boring	50	50		N		
General							
*CR1	Cistern or reservoir, buried, nonpressurized water supply	20	20		N		
PLM	Contaminant plume	50	50		N		
*CW1	Cooling water pond, industrial	50	50	100	N		
DC1	Deicing chemicals, bulk road	50	50	100	N		
*ET1	Electrical transformer storage area, oil-filled	50	50		N		
GRV	Grave or mausoleum	50	50		N		
GP1	Gravel pocket or French drain for clear water drainage only	20	20		N		
*HS1	Hazardous substance buried piping	50	50		N		
HS2	Hazardous substance tank or container, above ground or underground, 56 gal. or more, or 100 lbs. or more dry weight, without safeguards	150	150		N		
HS3	Hazardous substance tank or container, above ground or underground, 56 gal. or more, or 100 lbs. or more dry weight with safeguards	100	100		N		
HS4	Hazardous substance multiple storage tanks or containers for residential retail sale or use, no single tank or container exceeding 56 gal. or 100 lbs., but aggregate volume exceeding	50	50		N		
HWF	Highest water or flood level	50	N/A		N		
*HG1	Horizontal ground source closed loop heat exchanger buried piping	50	50		N		
*HG2	Horizontal ground source closed loop heat exchanger buried piping and horizontal piping, approved materials and heat transfer fluid	50	10		N		
IWD	Industrial waste disposal well (Class V well)[2]	illegal[3]	illegal[3]		N		
IWS	Interceptor, including a flammable waste or sediment	50	50		N		
OH1	Ordinary high water level of a stream, river, pond, lake, reservoir, or drainage ditch (holds water six months or more)	50	35		N		

PWS ID / FACILITY ID	1180012 S02	UNIQUE WELL NO.	455781

PCSI CODE	ACTUAL OR POTENTIAL CONTAMINATION SOURCE	ISOLATION DISTANCES (FEET)				LOCATION	
		Minimum Distances		Sensitive Well[1]	Within 200 Ft. Y / N / U	Dist. from Well	Est. (?)
		Community	Non-community				
*PP1	Petroleum buried piping	50	50		N		
*PP2	Petroleum or crude oil pipeline to a refinery or distribution center	100	100		N		
PT1	Petroleum tank or container, 1100 gal. or more, without safeguards	150	150		N		
PT2	Petroleum tank or container, 1100 gal. or more, with safeguards	100	100		N		
PT3	Petroleum tank or container, buried, between 56 and 1100 gal.	50	50		N		
PT4	Petroleum tank or container, not buried, between 56 and 1100 gal.	50[5]	20		N		
PU1	Pit or unfilled space more than four feet in depth	20	20		N		
PC1	Pollutant or contaminant that may drain into the soil	50	50	100	N		
SP1	Swimming pool, in-ground	20	20		N		
*VH1	Vertical heat exchanger, horizontal piping conforming to rule	50	10		N		
*VH2	Vertical heat exchanger (vertical) piping, conforming to rule	50	35		N		
*WR1	Wastewater rapid infiltration basin, municipal or industrial	300	300	600	N		
*WA1	Wastewater spray irrigation area, municipal or industrial	150	150	300	N		
*WS1	Wastewater stabilization pond, industrial	150	150	300	N		
*WS2	Wastewater stabilization pond, municipal, 500 or more gal./acre/day of leakage	300	300	600	N		
*WS3	Wastewater stabilization pond, municipal, less than 500 gal./acre/day of leakage	150	150	300	N		
*WT1	Wastewater treatment unit tanks, vessels and components (Package plant)	100	100		N		
*WT2	Water treatment backwash disposal area	50	50	100	N		
Additional Sources (If there is more than one source listed above, please indicate here).							
Potential Contamination Sources and Codes Based on Previous Versions of this Form							
	none found within 200' of this well.						

* New potential contaminant source.

[1] A sensitive well has less than 50 feet of watertight casing, and which is not cased below a confining layer or confining materials of at least 10' in thickness.

[2] These sources, known as Class V underground injection wells, are regulated by the federal U.S. Environmental Protection Agency.

[3] These sources are classified as illegal by Minnesota Rules, Chapter 4725.

[4] Isolation distance is determined by average flow per day or if a facility handles infectious or pathological wastes.

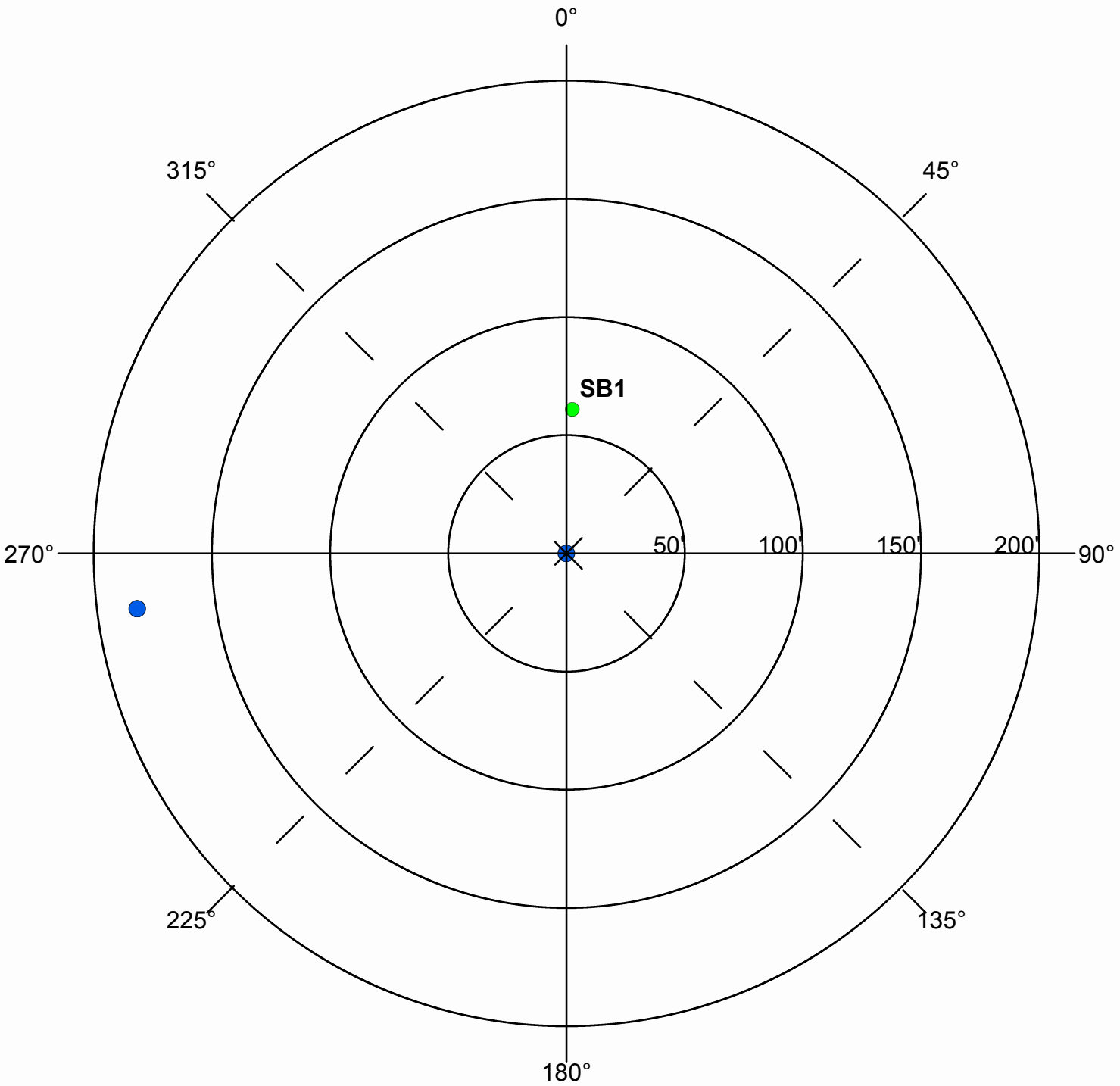
[5] A community public water-supply well must be a minimum of 50 feet from a petroleum tank or container, unless the tank or container is used for emergency pumping and is located in a room or building separate from the community well; and is of double-wall construction with leak detection between walls; or is protected with secondary containment.

This form is based on the new isolation distances in Minnesota Rules, Chapter 4725, related to wells and borings adopted August 4, 2008, and Minnesota Rules, Chapter 4720, related to wellhead protection.

PWS ID / FACILITY ID	1180012 S02	UNIQUE WELL NO.	455781

SETBACK DISTANCES	All potential contaminant sources must be noted on sketch.

Record the distance and approximate compass bearing of each potential contaminant source from the well, and identify the source using the "Source Code". Unlabeled points on the map are unsealed wells.



Were the isolation distances maintained for the new sources of contamination?	Y	N	N/A
Is the system monitoring existing nonconforming sources of contamination?	Y	N	N/A

Reminder Question: Were the wellhead protection measure(s) implemented?

INSPECTOR	Neiman, Dave	DATE	11 - 7 - 2013

PWS ID / FACILITY ID	1180012 S02	UNIQUE WELL NO.	455781

RECOMMENDED WELLHEAD PROTECTION (WHP) MEASURES	WHP MEASURE IMPLEMENTED? Y or N	DATE VERIFIED

COMMENTS

9/7/2003 - Location for PCSI Type OHW (bearing = 0, distance = 0 , inventory date: 8/18/1998) could not be determined.
9/7/2003 - Location for PCSI Type SBM (bearing = 0, distance = 0 , inventory date: 8/18/1998) could not be determined.

For further information, please contact:

Minnesota Department of Health
Drinking Water Protection Section
Source Water Protection Unit
P.O. Box 64975
St. Paul, Minnesota 55164-0975

Section Receptionist: 651-201-4700
Division TDD: 651-201-5797 or MN Relay Service @ 1-800-627-3529 and ask for 651-201-5000