WELLHEAD PROTECTION PLAN

October 2021

Forward

This document presents a comprehensive wellhead protection plan for the City of Madison that will help provide for an adequate and safe drinking water supply for our drinking water community residents.

A review and assessment of various data elements as determined by DWSMA vulnerability as per MDH wellhead protection rules must be completed for each DWSMA. This process must address existing and historical aspects of the 1) physical environment, 2) land uses, 3) water quantity and 4) water quality. The data assessment process conducted by the City of Madison wellhead protection team supports both the delineation and vulnerability report (part one) and assists in the identification of potential impacts the data elements may have on the source water and how the water supplier can address potential impacts (part two). Appendix A contains detailed assessments of all applicable data elements for the DWSMA.

The City of Madison has two wells that contribute source water to the City's system. Each well has undergone an extensive groundwater modeling process as part of wellhead protection planning. The modeling results are presented in a 'part one' report which is located in Appendix B with the report containing the 1) delineation of the wellhead protection area, 2) delineation of the drinking water supply management area (DWSMA), and 3) the assessments of well and drinking water supply management area vulnerability. The part one report was approved by the Minnesota Department of Health (MDH) before the second part of the plan was prepared.

The remainder of the wellhead protection plan is referred to as 'part two' and contains procedures for conducting an potential contaminant source inventory (PCSI) and the development of goals, objectives and measures that the City of Madison will take to offset the risk that potential contamination sources present to the public water supply system.

The identification of potential contaminant sources within the DWSMA is a fundamental element of wellhead protection. A PCSI is needed to assign meaningful priorities to management measures and to effectively monitor the effectiveness of implementation of the WHP plan. This is an ongoing process that entails inventorying present and past land uses and periodically updating the PCSI as land uses change within the DWSMA. The extent of potential contaminant inventory conducted within a DWSMA is determined by the vulnerability of the public water supply wells and the DWSMA. The City of Madison wellhead protection team has conducted a thorough inventory of potential contaminant sources within the DWSMA which is shown on a map and table in Appendix C.

The wellhead protection team discussed and listed any expected changes to the physical environment, land use, surface and groundwater that may impact the aquifer serving the public water supply wells in the DWSMA. Chapter 5 discusses this subject in greater detail to clarify expected changes and how those changes may impact the source water used by the City of Madison.

A WHP plan must identify water use, land use issues, problems and opportunities related to the aquifer serving the public water supply wells, the well water and in the DWSMA. The wellhead protection team needs this process to define the nature and magnitude of contaminant source management issues within the DWSMA. The identification of issues, problems and opportunities that may exist in the DWSMA enables the City of Madison to 1) take advantage of opportunities that may be available to make effective use of existing resources, 2) set priorities for management of contaminants listed, and 3) request support for implementing specific management strategies. Chapter 6 provides further discussion and tables of issues, problems and opportunities identified by the City of Madison wellhead protection team.

Finally, the core of a WHP plan is the identification and implementation of effective management strategies that will protect the public water supply wells from contamination. These management strategies or measures, may range from nonregulatory activities such as public education, to regulatory activities such as adoption by federal, state or local units of government to control specific types of contaminant sources. The City of Madison wellhead protection team has selected measures and prioritized each measure that should effectively address local land and water uses as well as resource needs.

Factors the team considered include:

- contamination of a public water supply well;
- quantities of potential contaminant sources and their proximity to a public water supply well;
- capability of the geologic material to absorb a contaminant;
- existence and effectiveness of existing official controls;
- time required to obtain cooperation; and
- administrative, legal, technical and financial resources needed.

The long range goals, objectives and measures assigned to the DWSMA by the City of Madison wellhead team is discussed and itemized in Chapter 8 and Appendix D.

When both parts of the plan are approved by the MDH, the Public Water Supplier has met all requirements that are contained in Minnesota Rules Chapter 4720, parts 4720.5100 to 4720.5590 for preparing an amended wellhead protection plan.

Wellhead Protection Plan Co-Managers

Dean Broin, Madison Water Department and Val Halvorson, Madison City Manager

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Glossary of Terms

Drinking Water Supply Management Area (DWSMA) means the surface and subsurface areas surrounding a public water supply well, including the WHP area, that must be managed by the entity identified in the WHP plan. (MR4720.5 100, subpart 13). This area is delineated using identifiable landmarks that reflect the scientifically calculated WHPA boundaries as closely as possible.

Emergency Response Area (ERA) means the part of the WHP area that is defined by a one- year time of travel within the aquifer that is used by the public water supply well (MR4720.5250, Subpart 3). It is used to set priorities for managing potential contamination sources within the DWSMA.

Inner Wellhead Management Zone (IWMZ) means the land that is within 200 feet of a public water supply well (MR4720.5 100, subpart 19). The public water supplier must manage the IWMZ to help protect it from sources of pathogen sources or chemical contamination that may cause an acute health effect.

Primary Water Supply Well means a well that is regularly pumped by a public water supply system to provide drinking water.

Vulnerability refers to the likelihood that one or more contaminants of human origin may enter either 1) a water supply well that is used by the public water supplier or 2) an aquifer that is a source of public drinking water. Very high or high vulnerability indicates that vertical recharge to the source water aquifer occurs over a time period of weeks to years. Low vulnerability indicates that vertical recharge to the source water aquifer occurs over a time period of several decades to a century.

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

Wellhead Protection Area (WHPA) 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 (Minnesota Statutes, Part 103I.005, Subdivision 24).

WHP Plan Goal means an overall outcome of implementing the WHP plan, e.g., ensuring a safe and adequate drinking water supply.

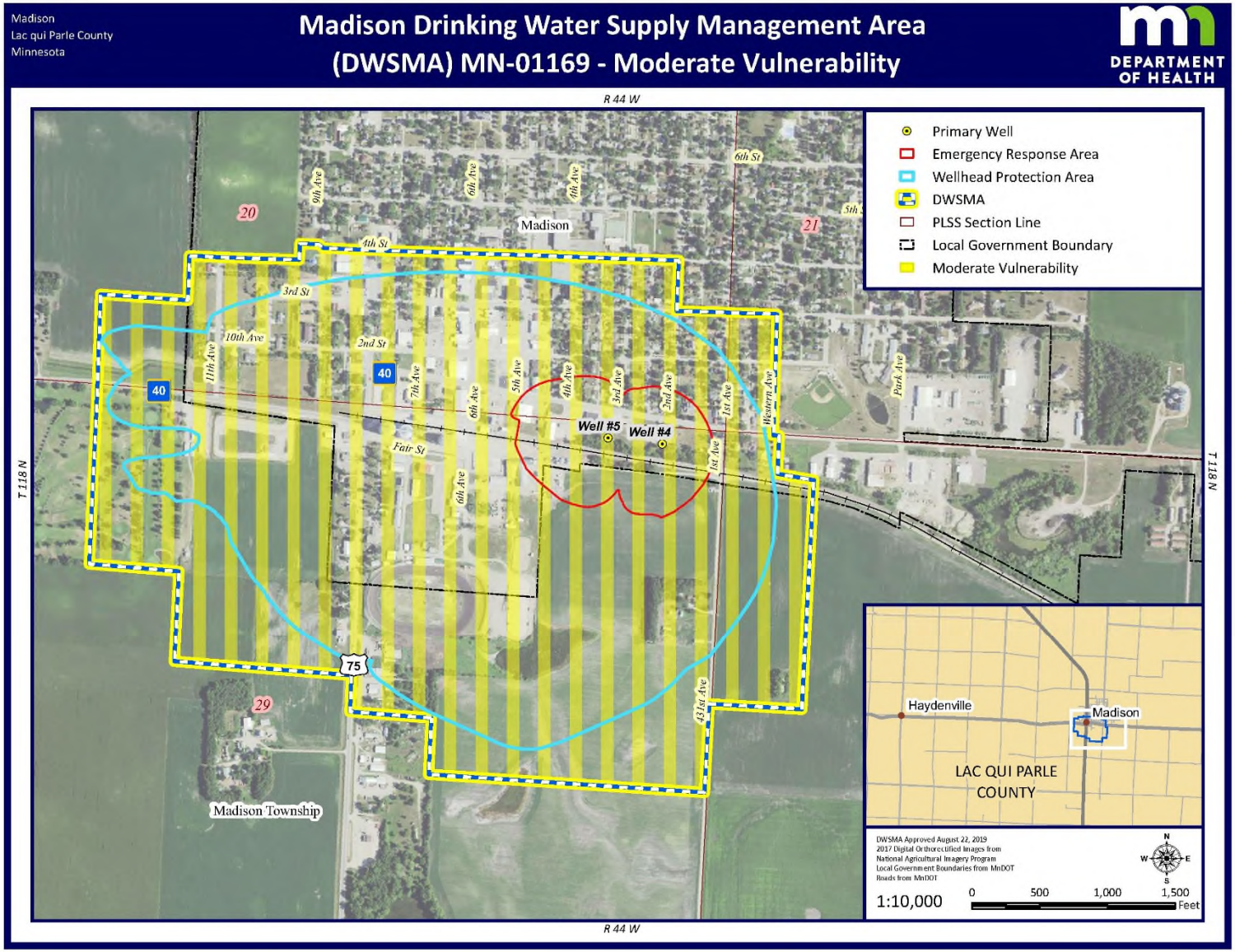
WHP Measure means a method adopted and implemented by a public water supplier to prevent contamination of a public water supply, and approved by the Minnesota Department of Health under Minnesota Rules parts 4720.5110 to 4720.5590.

WHP Plan Objective means what the public water supplier intends to do to achieve the related WHP goals, e.g., implementing WHP measures to address high priority potential contamination sources within 8 years.

Acronyms

BWSR – Board of Water and Soil Resources
DNR – Minnesota Department of Natural Resources
MDH – Minnesota Department of Health
MPCA – Minnesota Pollution Control Agency
MRWA—Minnesota Rural Water Association
UMVRDC – Upper Minnesota Valley Regional Development Commission
SWCD – Lac qui Parle Soil and Water Conservation District
USEPA – United States Environmental Protection Agency

Figure 1
Madison Water Supply Drinking Water Supply Management Area and Vulnerability Assessment



Chapter 1: Introduction

1.1 Background

The wellhead protection (WHP) plan for the City of Madison (City) was prepared by the City Water Department in cooperation with the Minnesota Department of Health (MDH). It contains specific actions that the city will take to fulfill WHP requirements that are specified under Minnesota Rules, part 4720.5100 to 4720.5590. Also, the support that Minnesota state agencies, federal agencies, Lac Qui Parle County, and others will provide is presented to identify their roles in protecting the City's drinking water supply. The plan is effective for 10 years after the approval date specified by MDH and the City is responsible for implementing its WHP plan of action, as described in Chapter 9 and Appendix D of this report. Furthermore, the City will evaluate the status of plan implementation at least every two-and-one-half years to identify whether its WHP plan is being implemented on schedule.

Wellhead protection (WHP) is an ongoing process and WHP plans need to be periodically reviewed and updated. Land and groundwater uses within a drinking water supply management area (DWSMA) are likely to change over time and the WHP plan must be modified to reflect those changes. A public water supplier is required to review and update an approved WHP plan every ten years to ensure the plan reflects current conditions with individual DWSMAs.

1.2 General Description of the City of Madison Public Water Supply

The following provides a summary of characteristics of the DWSMA that is part of the City's source water system.

City of Madison DWSMA – The City's DWSMA is located within the Lac qui Parle River watershed located in the central part of Lac qui Parle County and covers about 388 acres (~0.6 square miles). The DWSMA (Figure 1) has two production wells which produce combined, on a five-year average, about 63 million gallons per year (MGY) from a sand and gravel aquifer buried beneath a layer of clay-rich sediments (Table 1-1). Source water from the City wells exhibits <0.4 mg/l of nitrate-nitrogen in the raw water. Arsenic is present in low levels (2.86 ug/l) in Well #5, however, treatment to reduce this concentration is not required due to the low level. Both wells exhibit higher levels of naturally-occurring iron, manganese and sulfate which the City treats to reduce the impacts these minerals have on taste or appearance. All drinking water delivered to consumers meet all state and federal drinking water standards.

Table 1-1
City of Madison Water Supply Well Information

Local Well ID	Unique Number	Use/ Status[1]	Casing Diameter (inches)	Casing Depth (feet)	Well Depth (feet)	Date Constructed/ Reconstructed	Aquifer
4	603829	P	12	98	118	1997	Sand & Gravel
5	603830	P	12	90	110	1998	Sand & Gravel

[1] Denotes Primary Well

Additional information regarding the physical setting and how the DWSMA delineation and vulnerability assessments was determined are found in the Part 1 report (Appendix B). See Appendix A for the complete Consumer Confidence Report and Chapter 3 for a detailed discussion regarding vulnerability of the City's public wells and DWSMA.

1.3 Plan Appendices

Much of the technical information that was used to prepare this plan is contained in the appendices but is summarized in the main body of this plan. In particular:

- Appendix A contains documents and discussion regarding the data elements used for this plan.
- Appendix B contains the delineation of the wellhead protection area (WHPA), the drinking water supply management area (DWSMA), and the vulnerability assessments for the public water supply wells and the DWSMA. This part of the plan is summarized in Chapter 3.
- Appendix C contains the inventory of potential contamination sources. This inventory is discussed in Chapter 4 in terms of assigning risk to the City's water supply, and Chapter 6 relating to issues, problems, or opportunities.
- Appendix D contains Wellhead Protection Plan Implementation Measures.
- Appendix E contains supporting documents.

Chapter 2: Identification and Assessment of the Data Elements Used to Prepare the Plan

The data elements included in this amended wellhead protection plan document the need for WHP measures that will be implemented to help protect the City's water supply from potential sources of contamination. The City met with representatives from MDH on two occasions to discuss the data elements that are specified in Minnesota Rules, part 4720.5400, for preparing a WHP plan.

A scoping meeting (scoping 1) held on September 20, 2016 identified the data elements required to support the delineation and vulnerability assessment of the WHPA, the DWSMA and municipal wells (Part 1 of the WHP plan, Appendix B). The Part 1 plan was approved by the MDH on August 22, 2019.

A second scoping meeting (scoping 2) held on October 23, 2019 discussed the data elements required to complete the remainder of the WHP plan. The second scoping meeting utilizes the completed Part 1 delineation and vulnerability report to select additional data elements which 1) identify potential risks to the public water supply and 2) develop effective management strategies to protect the public water supply relative to each well and DWSMA vulnerability. This becomes the basis for the "remainder of the WHP plan". The results of each meeting were communicated to the City by MDH through a formal scoping decision notice and is included in Appendix A.

Appendix A also contains an assessment of each data element identified in the MDH scoping 2 documents for its present and future impact on:

- The use of the public water supply wells,
- Delineation of the WHPAs,
- The quality and quantity of water supplying the public water supply wells, and
- Land and groundwater uses within the DWSMA.

Availability of information relating to each data element that is used in this plan was evaluated by staff from the MDH and the City. If the evaluation process determines that information pertaining to a particular data element may be considered an issue, concern or opportunity, the City can then address identified issues, concerns and opportunities in this plan. In Chapter 6, Table 6-1 lists the issues, concerns and opportunities identified by the city of Madison WHP team. Measures identified to address deficiencies found during the data element assessment process in either the quality or quantity of data are included in the plan of action (Chapter 8 and Appendix D).

The data elements specified by the MDH relating to the **physical environment** used in the development of the WHP plan are considered sufficient to provide an adequate assessment. The City's DWSMA is within the minor watershed of the West Branch of the Lac qui Parle River which flows eastward toward the main stem of the Lac qui Parle River and hence to the Minnesota River. No part of the DWSMA is designated as a flood zone. No concerns or issues have been identified with the physical environment data elements. Appendix A contains additional information regarding water resources.

Assessment of the data elements specified by MDH relating to **land use** identified issues or concerns regarding the long-term management of the DWSMA. The following items summarize these land use topics that will be addressed in Appendix A of this WHP plan:

- The City's current comprehensive plan and zoning controls adequately address infrastructure and growth.

- The City's population is generally stable and land cover categories within the DWSMA are not expected to change significantly.

Finally, the data elements specified by the MDH relating to **water quantity and quality** used in the development of the WHP plan are considered sufficient to provide an adequate assessment. The city depends on two wells (Well #4 - unique #603829 and Well #5 – unique #603830). Groundwater quality and quantity information is 1) used during the WHPA delineation and water well and DWSMA vulnerability process and 2) assessed to determine the influence land uses may have on the city water wells. The MDH has conducted an assessment of well construction and water quality monitoring from the two wells which results in a designation of moderate vulnerability to the DWSMA. See Appendix B for additional information regarding the ground water hydrology and assessments of individual well and DWSMA vulnerability.

Appendices A and B contain supporting documents (maps, tables, exhibits, etc.) that are required by the MDH scoping 2 documents to be included in the WHP plan.

Chapter 3: Delineation of the Wellhead Protection Area, Drinking Water Supply Management Area and Vulnerability Assessments

3.1 WHPA and DWSMA Delineation

Figure 1 shows the boundaries of the Emergency Response Area (ERA), the Wellhead Protection Area (WHPA), and the DWSMA and vulnerability assessment of the DWSMA. The City requested that a MDH State of Minnesota-licensed geoscientist do the work of groundwater modeling utilizing computer simulations of groundwater movement and individual City primary well groundwater capture zones to delineate an ERA and WHPA for each primary well and well field.

The DWSMA boundary for the well field was designated using the following criteria:

- Center-lines of highways, streets, or roads
- Public Land Survey coordinates
- Parcel boundaries
- Political boundaries

3.2 Well Vulnerability Assessment

The Part 1 report for the DWSMA (Appendix B) include a vulnerability assessment for each primary well used by City. The vulnerability assessments are used to help define what types of potential contaminant sources within the DWSMA that require inventorying and to select appropriate measures to reduce the risk a potential contaminant may present to the public drinking water supply. The MDH has produced guidance in determining well vulnerability based on geologic sensitivity mapping, casing integrity, casing depth, pumping rate, isolation distance from any known contaminant source and chemical and isotopic information. The following are excerpts from the Part 1 report:

1. Well construction for both wells meet current State Well Code specifications meaning that the wells themselves should not provide pathways for contaminants to enter the aquifer used by the public water supplier.
2. The geologic conditions at the well site include a cover of clay-rich geologic materials over the aquifer, however it is not sufficient to completely prevent 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. Tritium was detected in a sample taken from Well #5 (603830) in 2014, confirming the vulnerable nature of the well. However, the tritium is quite low in concentration and is likely either the result of a small amount of recharge through a leaky portion of the clay confining unit or a well casing defect. Additionally, there have been no nitrate detections to date. This suggests that the two primary wells do have some geologic protection.

Based on the above factors, the MDH assigns a ‘vulnerable’ rating to the City’s two primary wells.

3.4 DWSMA Vulnerability Assessment

The vulnerability of the City’s DWSMA (Figure 1) was determined by using geologic, soils, and groundwater chemistry information. A review of geologic information and groundwater quality data for the aquifer within the DWSMA indicate the following:

1. Isotopic and water chemistry data from wells located within the DWSMA indicate that the aquifer contains water that has detectable levels of tritium.
2. Review of the geologic logs contained in the CWI database, geological maps, and reports indicate that the aquifer exhibits a low geologic sensitivity throughout most of the DWSMA, with one area directly up gradient from the City's wells exhibiting moderate sensitivity.
3. Naturally-occurring contaminants have been found in the City's aquifer. Arsenic has been detected in the water from public water supply Well #5 (603830). Additionally, sulfate has been found at concentrations exceeding the 250 mg/L secondary drinking water standard. This secondary standard is based on aesthetic concerns and does not represent a health threat. The presence of naturally-occurring contaminants does not indicate that there is a direct pathway between the aquifer and potential contamination sources that occur at or near the land surface.

In summary, the vulnerability of the City's DWSMA has been determined to be moderately vulnerable due to the presence of tritium in Well #5. This suggests that water and contaminants may travel from the land surface to the City's aquifer within a time span of years to decades. This rating reflects uncertainty about the pathway for young water reaching Well #5. Although this may be the result of a well casing problem, for the time being it is assumed that the clay-rich sediments that overlie the City's aquifer are leaky.

Moderately vulnerable aquifers are prone to a variety of contaminant threats, including petroleum and chemical storage tanks and abandoned wells which can provide conduits for contaminants to quickly reach the City's aquifer. See Appendix B for a detailed hydrogeology report of the DWSMA.

Chapter 4: Inventory of Potential Contamination Sources, Establishing Priorities and Assigning Risk to Potential Contamination Sources

Background

The City's DWSMA covers much of the southwestern portion of the city including the majority of the commercial and industrial areas in or near the city. Areas of cropland abutting the county fairgrounds constitutes the remainder of the DWSMA (Appendix A, Exhibit C1). The majority of roads within the DWSMA are residential streets, however, two major highways intersect within the WHPA and a railroad siding and tracks intersects the ERA and WHPA. A natural gas transmission pipeline terminates in the eastern part of the DWSMA (Appendix A, Exhibit D). Linear features such as roads or pipelines are not required to be inventoried, but do present the potential for accidental spills of petroleum-based products or other liquid forms of potential contaminants.

Potential Contaminant Source Inventory Requirements

Results of the vulnerability assessment of the DWSMA and well vulnerability (Appendix B) and the absence of human-caused contaminants in the source water were used as a base to guide the WHP team in conducting a risk assessment of various potential sources of contamination (PCS).

Scoping documents contained in Appendix A, Exhibit A provide details of the various categories of PCS required by MDH to be inventoried in the DWSMA based on geologic vulnerability and well water quality sampling. Further, the data element assessment process as described in Appendix A was used in assigning what impact or level of risk the various potential sources of contamination that are inventoried may have on City's drinking water supply in the DWSMA.

The PCSI within the DWSMA must include;

- Wells,
- Certain types of Environmental Protection Agency Class V wells,
- Other types of boreholes or excavations that may reach the aquifer used by the City,
- Above ground and underground storage tanks and current or past leaking tank sites,
- Potential contamination sites and contaminant of concern sites, and
- Storage or preparation areas for chemicals, fertilizers, fuels, etc.

MDH WHP rules require a PCSI must address all land parcels within a DWSMA and land use information must be included in the inventory. Parcel data for the DWSMA and each PCS are included in geographic information system (GIS)-based data submitted to the MDH (Appendix C). Parcel data is available to the public on the Lac qui Parle County website.

4.1 Conducting the Potential Contaminant Sources Inventory

Conducting the PCSI is a multi-phased process. Various local, state and federal data bases are reviewed to determine 1) if the types of PCS as listed in MDH scoping documents for the DWSMA may be present and 2) verification of the location of each PCS. GIS-based mapping techniques are used to display preliminary PCS data on aerial photo base map and an associated PCSI spreadsheet for the DWSMA. The WHP team then reviews each data point to determine if the location and associated data for each PCS is accurate. A map number is assigned to each PCS in the DWSMA.

As a start point in the inventory process, the MDH and DNR provided the City with information about wells from the Minnesota Well Index and other data bases. These data sources included wells with known locations and unknown locations and well sealing records that were systematically reviewed by the WHP team to determine if any of the documented wells were located within the DWSMA. Historical photos were also reviewed for possible wells or other potential contaminant locations. The WHP team also reviewed public water supply well files provided by the MDH to determine 1) the location of any City wells within the DWSMA, and 2) what the current status of any unused public wells may be (active, inactive, sealed or unknown). Because the City's DWSMA is mostly located within the City's municipal boundaries, Sanborn Fire Insurance maps were available to assist the WHP team in searching for old wells.

State, federal and local data bases were examined for listings of other types of potential contaminant sources (storage tanks, leak sites, etc.) listed in the MDH scoping documents for the City's DWSMA (Appendix A). The same data review procedures as described in the previous paragraph were employed by the WHP team to expand or reduce the PCS list.

4.2 Contaminants of Concern

The Hydrogeologic Assessment report (Appendix B) states that 'none of the contaminants for which the Safe Drinking Water Act has established health-based standards is found above maximum allowable levels in the city's water supply'. However, arsenic, a naturally-occurring contaminant, has been detected at low levels in Well #5. Sulfate, which is also naturally-occurring, exceeds the secondary drinking water standard of 250 mg/L, but this standard is based on aesthetic and not health concerns.

The WHP team reviewed the potential contaminant source inventory and considered certain types of potential contaminant sources such as abandoned or unsealed wells, active storage tanks and suspected contaminated sites as presenting a greater possible risk to groundwater quality from petroleum, chemicals or other potential contaminants. A number of sites within the DWSMA had underground storage tanks that had been used for petroleum products. Most of these tank sites have experienced leaks. Underground fuel tanks that were found to be leaking have been removed but remain on the PCSI denoted as a historical leaky tank site. Tanks with a capacity of less than 1100 gallons are not required to be inventoried. No federally-regulated Class V wells were inventoried in the City's DWSMA.

All water distributed by the City is disinfected with chlorine to ensure potability and meets all state and federal drinking water standards. See the 2020 Consumer Confidence Report (Appendix A – Exhibit E2) for additional details regarding source water quality for the City's public water system.

The current water quality in City production wells does not appear to be impacted by human activities; this is very important to the public water users served by the City. It is essential to stress the need to continue or expand protective measures that preserve the good quality of this aquifer. Preservation is more cost effective than restoration.

4.3 Inventory Results and Risk Assessment

A thorough search for wells was completed by referencing information from the Minnesota Well Index (MWI), a MDH public well disclosure database, MDH Old Municipal Well Inventory report, DNR water appropriation data and City records or local knowledge. The MDH Old Municipal Well Report (Appendix C) indicates there are possibly three old, unused City wells within the DWSMA. The well inventory conducted in the DWSMA reflects private and public wells with known locations. Unfortunately, records of older wells

may not provide sufficient information to easily locate some wells. In addition, not all of the wells inventoried have complete data regarding depth or type of construction.

The WHP team was also required to determine locations of potential Class V wells within the protection area, at request of the USEPA Region 5. After consulting EPA records, no such wells are thought to be located in the DWSMA.

Assigning Risk

All sources of potential contamination were assessed by the WHP team and assigned a level of risk the various PCS categories may have on the aquifer used by the city of Madison. The level of risk assigned to each type of PCS addresses 1) the number of units inventoried, 2) its proximity to a public water supply well, 3) the capability of local geologic conditions to absorb a contaminant (geologic vulnerability), 4) the effectiveness of existing regulatory controls, 5) the areal extent of a land use, and 6) the time required for the of city of Madison to obtain cooperation from governmental agencies that regulate a potential contaminant. Assigned risk categories are defined by the WHP team to mean the following:

- 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 **moderate (M)** risk potential implies that the potential source type has a moderate likelihood to negatively impact the city of Madison's water supply and should receive a medium priority for management.
- A **low (L)** risk potential implies that a potential source type may have a marginal or negligible impact on the City's water supply and should receive a low priority for management.

Tables are used to present the PCSI and land cover data and associated assigned risk of each PCS and land cover category within the DWSMA.

Results of Inventorying of Point Sources of Potential Contamination

A source of potential contamination can be defined as a stationary location or fixed facility from which pollutants are discharged or emitted or any single, identifiable discharge point of potential pollution, such as a well, a tank or storage area. The following table (Table 4-1) provides a brief overview of the sources of potential contamination inventoried in the City's DWSMA.

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Table 4-1
Potential Contamination Sources and Assigned Risk

Potential Contaminant Type	Number of PCS Within ERA[1], WHPA[2] and Remainder of DWSMA and Assigned Risk					
	Total Number	ERA	WHPA	Remainder of DWSMA	Activity Status[3]	Risk
Municipal Wells (Active and Inactive)	3	2	1	0	2 – A 1 - I	L
Other wells (WEL)	13	0	11	2	8 – A 5 - U	L H
Above Ground Storage Tank (AST)	2	0	2	0	A	M
Underground Storage Tank (UST)	1	0	1	0	A	M
Leaking Underground Storage Tank (LUST)	9	0	8	1	C	L
Brownfield, Petroleum (BMS)	2	0	1	1	C	L
Voluntary Investigative Cleanup (VIC)	1	0	0	1	C	L
Suspected Contaminant of Concern (SCC)	2	0	1	1	A	M
Storage or Preparation Area (STOR)	1	1	0	0	A	M
Totals	34	3	25	6		

1. Emergency Response Area (1 year time of travel area).
2. Wellhead Protection Area (10 year time of travel area).
3. A = Active; I = Inactive; C = Closed; U = Unknown

Within the DWSMA, in addition to the three City wells, there are thirteen private wells that are listed in the MDH's Minnesota Well Index (MWI) as 'located' wells, however, five of these wells will require additional information to determine exact locations and/or status. Because of the absence of verifiable information regarding the status of these five private wells, these wells are ranked as a high priority to determine status of these wells and potential sealing if no longer used. The following is additional information regarding wells and other potential contaminant sources within the DWSMA.

- The MDH Old Municipal Well Report states there are three old City wells that may be located within the DWSMA. One well is noted in a 1916 HDH report as being 425 feet deep with a location in the 'city water and light plant'. The other two wells are referenced in the 1932 MDH report, each 145 feet deep and located in the 'Pumping station in the central part of the city '. There are no sealing records for these three wells, therefore, the city can request assistance from MDH to determine if the location and status of these old wells may be verified.
- MWI well records indicate an old (1906) railroad well located near the old Minneapolis and St. Louis Railroad depot. The well log for this well indicates it is finished in the same aquifer as the City wells but current status and specific location of this well is unknown. There is no sealing record, therefore,

the City can request assistance from MDH and current landowners to determine if location and status of this old well may be verified.

- MPCA records indicate there where a number of underground storage tanks (petroleum) historically located within the DWSMA. Those records also state these sites where also 'leaky' tank sites (leaking underground storage tanks – LUST). All of these sites have undergone remediation and are now considered 'closed sites'. These sites remain on the PCSI denoted as a historical leaky tank site as a precaution to any party planning on drilling a new well on one of these old contaminated sites. This is also the situation for four sites (brownfields, clean ups, site assessments) in the DWSMA that had past contaminants spilled or leaked into the soil.
- An active salvage yard and a closed brownfield site are located within the WHPA.
- There are no known EPA - classified Class V wells within the DWSMA.
- Sanborn fire insurance maps are available for the City of Madison to assist in locating abandoned wells.

A map and table describing the types and locations of potential contaminant sources (wells, tanks, etc.) located within the DWSMA is presented in Appendix C.

Land Cover Inventory and Sources of Potential Contamination

The following table (Table 4-2) lists the different types of land cover in the DWSMA. Each land cover type has been assessed and assigned a risk level by the WHP team based on 1) geologic vulnerability, and 2) the potential of contaminating the aquifer with accidental spills or leakage from tanks or storage sites that may be associated with each land cover category. Land cover data is derived from a digitized 2016 national land cover data base.

City of Madison DWSMA Land Cover

The total area of the City's DWSMA is 387 acres. See Appendix A – Exhibit C1 for a map illustrating the City's land cover in the DWSMA and a description of land cover categories as presented in Table 4-2.

Table 4-2
City of Madison DWSMA Land Cover and Assigned Risk
of Potential Contamination from Potential Contaminant Sources
(Source: 2016 NLCD Land Cover Data)

Land Cover Categories	Acres	Percent of DWSMA	Assigned Risk
Developed, open space	55.6	14.3	L
Developed, low intensity	62.7	16.2	L
Developed, medium intensity	50.0	12.9	L
Developed, high intensity	34.6	8.9	L
Barren land (rock/sand/clay)	0.7	<0.2	L
Cultivated crops	174.9	45.2	L
Hay/Pasture	3.6	0.9	L
Emergent herbaceous wetlands	5.4	1.4	L
Total	387.5	100.0	

Table 4-2 Summary - Within the DWSMA, about 46 percent of the land cover is cultivated lands and pasture or hay lands. About 22 percent is designated low, medium and high intensity cover. These types of land cover are described as the amount of impervious surface within an area – the higher the impervious cover, the higher the intensity ranking. Single-family homes are considered low and medium density with apartment complexes and commercial/industrial areas ranking as high intensity. Wetlands and barren land combined represent about 2.5 percent of the DWSMA.

Inner Well Management Zone

A survey was conducted to identify specific categories of PCS that may occur within 200 feet of each primary public water supply well. This area is referred to as the inner well management zone (IWMZ). The Minnesota State Well Code, administered by the MDH, defines the various categories of contaminants inventoried and establishes required setbacks from public water supply wells for each category of PCS. The IWMZ inventory was conducted by MDH Source Water Protection and City staff with risk prioritization assigned by the MDH. The production wells located in a commercial zoning district are generally isolated from potential sources of point contamination.

The following table identifies the type of PCS that is located within 200 feet of each City production well.

Table 4-3
Potential Contaminant Source Inventory within the
Inner Well Management Zone for City of Madison Production Wells

City of Madison Well No.	Unique Number	Potential Contaminant Within IWMZ
Well #4	603829	1 operating well; 2 each of buried sanitary sewers and stormwater sewers; 1 each of water treatment backwash holding basin or surge tank and water treatment backwash disposal area; 1 each of a monitoring well and pit.
Well #5	603830	1 agricultural chemical/fertilizer storage area; 1 sanitary sewer.

To summarize the inventory of the inner well zone, there is a monitoring well which is typically used for tracking aquifer static water levels and in some instances source water quality. The potential contaminant sources inventoried near Well #4 and Well #5 meet MDH state well code setback requirements. These types of wells and potential contaminant sources are assigned a low risk to the primary wells because of known construction, purpose, limited access and meeting state well code setbacks.

The detailed IWMZ inventory forms for each City production well are on file at the City Water Superintendent's office in Madison, MN. The MDH and City staff review and update as needed the IWMZ form for each production well on a regularly scheduled basis.

Summary of PCSI and Land Cover

City of Madison's source water is derived from a sand and gravel aquifer utilizing two wells in close proximity to each other. The DWSMA can be characterized as generally developed with residential,

commercial and industrial lands uses within municipal boundaries. Row crop agriculture is dominant in the remainder of the DWSMA. The entire DWSMA is defined as moderately vulnerable due to geologic conditions in the WHPA and the presence of tritium in one of the City wells. The following is a summary of the potential contaminant source inventory and land cover determinations conducted in the City DWSMA.

City of Madison DWSMA

- About 52 percent of the DWSMA is developed as residential, commercial, industrial and open spaces. The majority of the potential contaminant sources are within the municipal boundaries.
- Cultivated crop coverage is about 45 percent of the DWSMA with three wells being the only potential contaminant sources in this land cover category.
- Linear-shaped features such as major and minor roads and a railroad yard are present in the DWSMA. These transportation features are considered a potential contaminant source due to the potential of petroleum or chemical releases accidentally occurring. There is one natural gas pipeline that terminates in the eastern portion of the DWSMA.

Conclusions

There are no significant human-caused water quality issues for the City's public water system. Water quality data collected by MDH and city of Madison staff (Appendix A) indicate:

- In the City's DWSMA, long-term yearly water monitoring indicates no nitrate-nitrogen presence in the aquifer used.
- Naturally-occurring arsenic is present in the aquifer at low levels and therefore, no treatment is required. However, manganese, iron and sulfate concentrations are elevated in the source water and are addressed by water treatment processes.
- The dominant potential contaminants in the WHPA are unused wells, leaky petroleum storage tanks and a salvage yard.

Preservation-orientated measures to protect the source water aquifer used by the City of Madison makes economic sense and are reasonable to maintain the current good water quality of the moderately vulnerable aquifer.

Chapter 5: Impact of Land and Water Use Changes on the Public Water Supply Wells

The City estimates that the following changes to the physical environment, land use, surface water, and groundwater may occur over the ten-year period that the WHP plan is in effect. This exercise is necessary to determine whether new potential sources of contamination may be introduced in the future and to identify future actions for addressing these anticipated sources. Land and water use changes may introduce new contamination sources or result in changes to groundwater use and quality. Any anticipated changes within the municipal boundary would be controlled by the City. Changes of land or water usage within those portions of the DWSMA that are not within the city jurisdiction are subject to Lac qui Parle County's applicable land use ordinances. It will be important to continue to work with Lac qui Parle County in protecting the source water used by both the City's customers and private well owners within the DWSMA.

Day to day administrative duties will be the responsibility of the wellhead protection manager.

The following table (Table 5-1) describes the anticipated changes to the physical environment, land use, and surface water or groundwater in relationship to 1) the influence that existing governmental land and water programs and regulations may have on the anticipated change, and 2) the administrative, technical, and financial considerations of both the City and property owners within the DWSMA.

Table 5-1
Expected Land and Water Use Changes

Expected Change (Physical Environment, Land Use, Surface Water, Groundwater)	Impact of the Expected Change On the Source Water Aquifer	Influence of Existing Government Programs and Regulations on the Expected Change	Administrative, Technical, and Financial Considerations Due to the Expected Change
Physical Environment: No major change of the physical environment within the DWSMA is anticipated.	No impact anticipated.	No changes, therefore, existing programs or regulations are adequate.	No additional administrative, technical or financial considerations required.
Land Use: 1) No change in current land use within the DWSMA is anticipated.	No impact anticipated in the short term.	No rapid changes to current land uses anticipated, therefore, existing programs or regulations are adequate.	No additional administrative, technical or financial considerations required.
Surface Water:	Not Applicable	Not Applicable	Not Applicable
Groundwater: The city does not anticipate an increase in water use in the DWSMA area.	No change expected in demand in the short term.	No changes in water use anticipated in the short term. Therefore, existing programs or regulations are adequate to address permitting and construction to improve water supply infrastructure.	City Council will consider technical needs and funding options prior to implementing any plan to revise public water infrastructure. No additional administrative considerations required because overall water demand is not likely to change in the short term.

5.1 Summary of Expected Land and Water Use Changes in the City of Madison DWSMA

- There are no anticipated major changes in the physical environment within the DWSMA.
- Land uses are not expected to change. Adoption of nutrient management, conservation tillage practices and use of soil health practices will likely increase on those croplands within the DWSMA.
- No changes anticipated in surface water features in any of the DWSMA.
- The City does not anticipate an overall increase in water usage from the DWSMA aquifer.

Chapter 6: Issues, Problems, and Opportunities

6.1 Identification of Issues, Problems and Opportunities

The City has identified water and land use issues, problems and opportunities related to 1) the aquifer used by City water supply wells, 2) the quality of the well water, or 3) land or water use within the DWSMA. The City assessed 1) input from public meetings and written comments that it received, 2) the data elements identified by MDH during the scoping meetings, and 3) and the status and adequacy of local units of government official controls and plans on land use and water uses, as well as those of local, state, and federal government programs. The results of this effort are presented in the following table (Table 6-1) which defines the nature and magnitude of contaminant source management issues in the City's DWSMA.

Identifying the issues, problems and opportunities as well as resource needs enables the City to: 1) take advantage of opportunities that may be available to make effective use of existing resources, 2) set meaningful priorities for source management, and 3) solicit support for implementing specific source management strategies.

Table 6-1 contains the issues, problems and opportunities identified by the WHP team for the moderately vulnerable DWSMA.

Table 6-1
Issues, Problems and Opportunities

Issue Identified	Impacted Feature	Problem Associated with the Identified Issue	Opportunity Associated with the Identified Issue	Adequacy of Existing Controls to Address the Issue
1. There may be unidentified, unused, unlocated or poorly maintained wells within the DWSMA.	These types of wells could potentially impact water quality within the aquifer used by the City or private wells within the DWSMA.	Unused/unsealed or poorly maintained wells may provide a direct route for contaminants to reach an aquifer the City uses for water supply.	The City can work with the MDH to continue to inventory and prioritize wells within or near the DWSMA. The City can apply for a MDH-SWP grant for assistance in locating and sealing wells that are determined to be abandoned or unused within the DWSMA.	The City doesn't have any local controls to track existing wells, new wells or unused or abandoned wells. Therefore, the City can work with land owners, MDH and county to locate wells and promote proper sealing of any abandoned or unused wells located within the DWSMA.
2. DWSMA boundaries are within multiple jurisdictions: the City of Madison and Madison Township.	Aquifers, Well Water Quantity, Well Water Quality, Lower DWSMA	The City will need to rely on the Lac qui Parle county to administer land use controls and regulate potential contaminant sources in the area of the DWSMA outside the City of Madison's jurisdiction.	The City of Madison can work with Lac qui Parle County and the surrounding township to protect the aquifer serving the DWSMA.	The two governmental units should continue to collaborate in administering land use controls to protect the City of Madison's water supply.
3. The City has limited staff and financial resources to implement the wellhead protection plan.	DWSMA	With limited resources implementing the WHP plan could be a challenge for the City of Madison.	The City could partner with the county and state agencies that may have regulatory authority or programs to assist the City in WHP implementation.	A MDH-SWP grant program is available to a public water supplier with an approved WHP plan to implement the WHP plan.
4. Class V drainage wells may be present within the DWSMA.	Aquifer, water well quality and DWSMA.	Auto/truck repair-related businesses within the DWSMA with a Class V drainage well may allow oil, grease and other auto-related pollutants to infiltrate into the soil and/or groundwater.	The City can provide the public and owners of such businesses with educational materials regarding Class V drainage wells. The City could adopt rules to control the use of Class V wells within municipal boundaries.	Federal EPA rules ban Class V drainage wells associated with auto/truck-related businesses in all WHP areas.
5. The City of Madison has unused municipal wells that have been out of service for many years but remain unsealed.	Aquifer, DWSMA and potentially well water quality.	Unused/unsealed or poorly maintained wells may provide a direct route for contaminants to reach an aquifer the city uses for water supply.	The City can apply for MDH for assistance in locating old municipal wells and request grants to seal old wells once locations are verified.	The City council has administrative controls to address this issue. MDH has authority to require well sealing.

Issue Identified	Impacted Feature	Problem Associated with the Identified Issue	Opportunity Associated with the Identified Issue	Adequacy of Existing Controls to Address the Issue
6. It is important to educate the citizens within the DWSMA and newly-elected City officials and other local or state agencies about the City's WHP program.	Aquifer, water well quality and quantity and DWSMA	Periodic turnover in elected officials and staff from various agencies can be a challenge to maintain continuity and momentum in future WHP plan implementation efforts.	City staff can work with MDH SWP or MRWA staff to provide WHP-related information to elected officials, citizens and other local or state technical staff. This keeps decision-makers informed of the importance and need for effective WHP plan implementation as they relate to the city's drinking water supply.	The City can formally request assistance from MDH or MRWA to provide appropriate educational materials related to WHP.
7. Transportation corridors such as major and minor highways, a pipeline and a railroad that cross the WHPA within the DWSMA.	Aquifers, well water quality.	Accidental spills of various liquid products from trucks, pipelines, or trains could contaminate the aquifer.	The City can work with the city's fire department, state and county emergency teams, and pipeline and railroad companies to a) increase awareness of the DWSMA boundaries and geological conditions, and b) promote spill response training for local responders.	The City can continue to work with MN Dept. of Transportation, Lac qui Parle County and the LQP Regulatory Railroad Authority to increase communications between all parties about the potential impact that spills may have on the City's source water.
8. Low levels of tritium are present in Well #5.	Aquifer, well water quality and DWSMA.	The presence of tritium in the aquifer suggests that water and contaminants may travel from the land surface to the city's aquifer within a time span of years to decades. This may be due to surface water seeping into abandoned wells, or 'leaky' well casings and/or local geology.	Resample Well #5 and sample Well #4 for tritium. If tritium is not present in Well #4 but is still present in Well #5, a well downhole video inspection of Well #5 can be conducted to look for possible damage to the well casing. MDH SWP grants could be eligible to offset costs of sampling and video inspection.	The City can apply for MDH-SWP grant funding to conduct tritium sampling of city Well #4 and Well #5 and a video investigation of Well #5.
9. Any new high capacity well(s) constructed within or near the DWSMA may alter WHPA boundaries, impact aquifer static water levels and/or provide a pathway for pollutants to enter the aquifer.	Aquifer, DWSMA, and potentially water well quantity and quality.	A large capacity well could potentially impact the ability of the City's municipal water supply wells to supply sufficient quantities of water. The city doesn't have any local controls regarding use or placement of a new high capacity well or pumping rates.	The City will need to work closely with the MDH-SWP, DNR-Waters, and Lac qui Parle County to identify any new high capacity wells which may be drilled within or near the DWSMA. MDH & DNR can assist the City in determining if a new high capacity well may influence the capture area of City wells.	DNR & MDH consider quantity of water being requested and potential impact on a DWSMA prior to permitting.

6.2 Summary of Issues, Opportunities and Problems associated with City of Madison DWSMA

A. Identified issues within the City DWSMA.

- The vulnerability of the City's aquifer throughout the DWSMA is based on the geologic sensitivity ratings of wells and their monitoring data. Based on this information, MDH has assigned a moderate vulnerability to the DWSMA.
- None of the contaminants for which the Safe Drinking Water Act has established health-based standards is found above maximum allowable levels in the City's water supply. Nitrate levels are <0.05 mg/l in both city production wells.
- Transportation (regional and local highways, bridges crossing streams) corridors may be a source of accidental spills that could impact the DWSMA aquifer.
- The moderately vulnerable aquifer used by the City may be impacted by potential sources of contaminant sources like unused or abandoned wells or liquid storage tanks if not properly managed.
- Class V injection wells may impact the source water used by the City.
- High capacity wells (new or existing) may impact size or shape of a DWSMA.
- The DWSMA is relatively small in size, overlapping the City and adjacent township. Land use and/or environmental regulations of each entity vary, thereby creating a need to collaborate in the management of the DWSMA.
- A WHP/groundwater-orientated educational plan should be developed for citizens and elected officials in those areas served by the City.

The City has access to a good quality source of drinking water which is very meaningful for the public being served by the City. With no human-caused contaminants in these aquifers, water treatment costs are lower to public water users. Regulating potential sources of contamination (i.e. management of petroleum storage tanks and unused or abandoned wells) can pose a challenge to the City and local and state governmental units to maintain current high groundwater quality in the DWSMA aquifer.

The WHP team has considered all of the issues, problems and opportunities presented in Table 6-1 resulting in a variety of goals, objectives and implementation actions (Chapters 8 and Appendix D) to address these concerns.

6.3 Comments Received

There have been several occasions for local governments, state agencies and the general public to identify issues and comment on the City of Madison's WHP plan. At the beginning of the planning process, local units of government were notified that the City was going to develop its WHP plan and were given the opportunity to identify issues, as well as to comment. A public information meeting was held to review the results of the delineation of the WHP area, DWSMA and the vulnerability assessments. A public hearing was held before the completed WHP plan was sent to the MDH for state agency review and approval. The City did not receive any written or verbal comments at the public hearing.

Chapter 7: Existing Authority and Support Provided by Local, State and Federal Governments

The City of Madison has legal authority to control land uses or to develop and implement regulatory programs for those areas of the DWSMA that are within municipal boundaries. However, in those areas of the DWSMA that are outside of municipal boundaries the City of Madison will have to rely upon partnerships formed with other local units of government. State and federal agencies with regulatory controls or resource management programs in place can assist in the implementation of the WHP plan within the entire DWSMA. The level of support that a local, state or federal agency can provide to help offset the risk that is presented by a potential contamination source will depend up on its legal authority as well as the resources that are available to local governments.

7.1 Existing Controls and Programs of City of Madison

City of Madison has identified the following controls and/or programs that can be used to support the management of potential contamination sources within the DWSMA.

Table 7-1
Controls and Programs of the City of Madison

Type of Control or Program	Program Description
The City of Madison enforces Title V: Public Works, Chapter 53 Water Regulations.	Chapter 53 addresses private and public water supplies – hook ups, cross-connections and well abandonment, rates and fees and many other aspects of managing the public water supply.
The City of Madison enforces Title V: Public Works, Chapter 54 Stormwater Drainage Utility.	Chapter 54 regulates the usage of the public stormwater drainage system and establishes a fee for such services based on land uses and associated runoff.
The City of Madison, as an organization or in partnership with others, can apply for grants or loans from federal or state agencies and/or private organizations to assist in funding drinking water protection efforts.	Most grants are typically targeted toward mitigating identified environmental issues impacting groundwater. Grants may also be available to assist in developing efficient data management practices. Federal or state loans may be available to address infrastructure needs (water treatment, distribution, etc.)

7.2 Local Government Controls and Programs

The following departments or programs within Lac qui Parle County may be able to assist the City with issues relating to potential contamination sources that 1) have been inventoried or 2) may result from changes in land and water use within the DWSMA.

Table 7-2
Controls and Programs of Local Agencies

Government Unit	Name of Control/Program	Program Description
Lac qui Parle County Environmental Office Emergency Management	1. Implementation and Enforcement of the Lac qui Parle County Land Use Ordinance and Comprehensive Plan. a. Zoning/conditional use permits b. Shoreland regulations c. Feedlots & manure storage facilities d. Subsurface sewage treatment systems (SSTS) e. Solid Waste Programs f. Floodplain Management 2. County Water Planning 3. Emergency Management	a. Sets standards and orderly growth of various land uses within a County and allows a County to apply permit conditions to land uses they deem necessary. b. Sets standards and orderly growth within Shoreland. districts adjacent to designated public waters. c. Administers federal floodplain rules. d. Administers standards for animal feedlots within a county. e. Administers standards for SSTS within a county. f. Provides education regarding solid waste and a household hazardous waste. 2. Collaborates with Yellow Medicine Watershed District and Lac qui Parle SWCD in development and administration of County Water Plan. 3. Emergency response to man-made or natural disasters.
Lac qui Parle Soil and Water Conservation District	Agricultural BMPs Wetland management Well sealing State Cost-Share programs WHP Reinvest in Minnesota Conservation Resource Enhancement Program Partner Protection Grants Clean Water Land and Legacy grants	The SWCD promotes the protection of water and soil resources in the counties through educational programs, providing technical assistance to property owners, cost-sharing and collaboration with other local, state and federal natural resource agencies.

7.3 State Agency and Federal Agency Support

MDH will serve as the contact for enlisting the support of other state agencies on a case-by-case basis regarding technical or regulatory support that may be applied to the management of potential contamination sources. Participation by other state agencies and the federal government is based on legal authority granted to them and resource availability.

The following table (Table 7-3) identifies specific regulatory programs or technical assistance that state and federal agencies may provide to the City to support implementation of its WHP plan. It is likely that other opportunities for assistance may be available over the ten-year period that the plan is in effect due to changes in legal authority or increases in funding granted to state and federal agencies. Therefore, the table references opportunities available once the City's WHP plan is approved by MDH.

Table 7-3
State and Federal Agency Controls and Programs
Supporting WHP Plan Implementation

Government Unit	Type of Program	Program Description
MN Dept. of Health (MDH)	State Well Code (MR Chapter 4725) Source Water Protection	MDH has authority over the construction of new wells and sealing of wells. MDH staff in the Well Management Program offers technical assistance for enforcing well construction, maintaining setback distances for certain contamination sources, and well sealing. MDH can provide technical and financial assistance to the City for WHP activities and also help identify technical and financial support that other governmental agencies can provide.
MN Dept. of Natural Resources (DNR)	Water Appropriation Permitting (MR Chapter 6115) Public Waters (lakes, wetlands, streams - zoning and buffer requirements)	DNR controls permitting of new high capacity wells and requests to increase pumping rates for an existing groundwater or surface water appropriation permit. Establishes special requirements for land uses, vegetative cover and soil disturbances within shore land areas adjacent to protected waters.
MN Pollution Control Agency (MPCA)	Feedlot Rules; Registered Storage Tank; Storm water management; Subsurface Soil Treatment Systems	MPCA regulates minimum state-wide standards for county feedlot regulations and regulates feedlots >1000 animal units and manure storage facilities. Also administers programs addressing liquid storage tanks, septic systems and storm water management.
MN Dept. of Agriculture (MDA)	Nitrogen Management; Chemical Storage and Preparation facilities; Chemical and fertilizer spills	MDA administers programs which regulate the storage and application of nutrients (fertilizers) and chemicals (pesticides and herbicides) and provide financial and technical assistance programs to producers.
MN Board of Water and Soil Resources (BWSR)	1 Watershed, 1 Plan Local Water Planning Conservation Implementation Wetland Programs Partner Protection Grants	BWSR programs provide financial and technical assistance to county soil and water districts to implement local conservation programs. Also promotes local and regional watershed planning and wetland reestablishment/restoration efforts.
U.S. Dept. of Agriculture (USDA)	FSA - Federal Farm Bill Programs (EQIP, CRP, CSP, CGP, etc.); NRCS - Soil health, soil and water conservation BMP programs; Wetland restoration; Rural Development - Funding for clean and reliable drinking water systems.	The local USDA Service Center (FSA and NRCS) can provide technical and financial support for qualifying individual property owners and farmers through the current federal Farm Bill programs. Long term, low interest loans for drinking water sourcing, treatment, storage and distribution.
Environment Protection Agency (EPA)	Shallow Disposal Well Program	EPA has the regulatory authority over Class V Injections Well or also known as Shallow Disposal Wells.

7.4 Support Provided by Nonprofit Organizations

The Minnesota Rural Water Association will assist City of Madison with implementing its WHP plan by providing 1) reference education and outreach materials for landowners, 2) technical support for implementing specific individual WHP action items listed in the plan, and 3) assisting the City with assessing the results of plan implementation.

Chapter 8: Goals, Objectives and Measures

8.1 Goals

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. **Improve system resilience and the ability to provide a safe and adequate water supply.**

2. **Protect the aquifer from which the City of Madison draws its drinking water.**

3. **Educate public officials, land owners and the general public about the importance of protecting public drinking water supplies.**

8.2 Objectives

Objectives provide the focus for ensuring that the goals of the WHP plan are met and that priority is given to specific actions that support multiple outcomes of plan implementation. Both the objectives and the wellhead protection measures (actions) that support them are based on assessing 1) the data elements (Chapter 2 and Appendix A); 2) the potential contaminant source inventory (Chapter 4 and Appendix C); 3) the impacts that changes in land and water use present (Chapter 5); and 4) issues, problems, and opportunities referenced to administrative, financial, and technical considerations (Chapter 6).

The following objectives have been identified to support the goals of the WHP plan for City of Madison:

1. Communicate with the public about wellhead protection.
2. Utilize community involvement to protect drinking water.
3. Identify and engage with partners to define aquifer preservation needs.
4. Manage wells that are owned and operated by City of Madison.
5. Provide guidance to private property owners to properly manage potential contaminant sources.
6. Collect, monitor and evaluate data necessary to support WHP Plan implementation.

8.3 WHP Plan Measures

The identification and implementation of WHP 'measures' or management strategies, is a significant part of a WHP plan and is the key to preventing contamination of a public water supply source or well. The process and factors considered by the City's WHP team that influenced the selection of WHP measures to be implemented over the course of this WHP plan, and a complete listing of the measures are detailed in Appendix D.

When a water supplier has completed all **measures** contained within a specific **objectives** statement, a portion of the overall **goals** of the WHP Plan will have been accomplished.

Chapter 9: Evaluation Program

Evaluation is used to support plan implementation and is required under Minnesota Rules, part 4720.5270 prior to amending City of Madison's WHP plan. Plan evaluation is specified under Chapter 8.2, Objective 6 and provides the mechanism for determining whether WHP action items are achieving the intended result or whether they need to be modified to address changing administrative, technical, or financial resource conditions within the DWSMA. The City has identified the following procedures that it will use to evaluate the success with implementing its WHP plan.

1. The WHP team will meet, at a minimum, every two-and-one-half years to assess the status of plan implementation and to identify issues that impact the implementation of action steps throughout the DWSMA; and
2. City of Madison will prepare a written report that documents how it has assessed plan implementation and the action items that were carried out over the life of this WHP plan. The report will be presented to MDH at the first scoping meeting held with the City to begin amending the WHP plan.

Chapter 10: Contingency Strategy

The WHP plan includes a contingency strategy that addresses disruption of the water supply caused by either contamination or mechanical failure. The City of Madison has a contingency water supply plan in effect that was approved by the Minnesota Department of Natural Resources in 2020 and fulfills the contingency planning requirements for wellhead protection. A copy of this plan is available for public review during regular business hours at the City of Madison Public Works office and is referenced in this section. Appendix E contains the DNR approval letter.

APPENDICES

Appendix A

DWSMA Scoping Documents and Assessment of Data Elements

Appendix B

WHPA and DWSMA Delineation/Vulnerability Reports (Part 1 of the WHP Plan)

Appendix C

Potential Contaminant Source Inventory

Appendix D

WHP Plan Implementation Measures for the DWSMA

Appendix E

Supporting Documents

Appendix A

Assessment of Data Elements

for the

City of Madison
Drinking Water Supply Management Area

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Assessment of Data Elements Used to Prepare This Plan

Forward

By Minnesota Department of Health (MDH) rule 4720.5200 subparts 1 and 2, a wellhead protection (WHP) plan must assess the present and future implications of the data elements stated in the Scoping Decision Notices presented to City of Madison (City) at the Scoping 1 and Scoping 2 meetings.

This appendix addresses the assessments of data elements required by MDH for the Drinking Water Supply Management Area (DWSMA) for the following criteria:

A. The use of the wells;
B. WHP delineation criteria as stated in the Scoping 1 documents;
C. The quality and quantity of water supplying the public water supply wells; and
D. The land and groundwater uses in the individual DWSMA.

The DWSMA has a Scoping 2 document (Exhibit A). The scoping document contains data elements specific to the DWSMA. Due to the geologic vulnerability of the City's DWSMA, this WHP plan needs to assess a complement of data elements assigned for a moderately vulnerable DWSMA. The scoping document is included in this appendix and associated figures and tables to support the assessments.

The following data elements were identified by the MDH to be used in the WHP plan (Plan) and were specified in the scoping decision notices that were presented to the City. The selection of a data element for inclusion in the plan is based on 1) the hydrogeological setting 2) vulnerability of the wells used by the City, and 3) vulnerability of the DWSMA known at the time that each scoping meeting was held. Each data element is assessed for its impact on 1) the use of the public water supply well, 2) delineation of the WHPA, 3) the quality and quantity of water supplying the public water supply well, and 4) land and groundwater uses within the moderately vulnerable DWSMA.

All figures and tables referenced in this document are located in exhibits at the end of this document unless stated otherwise.

PHYSICAL ENVIRONMENT DATA ELEMENTS

Geology

This data element has been addressed in the Part I portions of the Plan (Appendix B). The DWSMA map (Figure 1 in the Plan) illustrates the vulnerability of the well water capture area. A complete description of the geological conditions present in the City's DWSMA is on file with the MDH.

The following are excerpts from the *Hydrogeologic Assessment of the Drinking Water Source and Wells for the City of Madison – 2019*. "The city of Madison has two primary wells screened in a sand and gravel aquifer that is buried beneath a layer of clay-rich sediment. Such aquifers are known generically as Quaternary Buried Artesian Aquifers. The city's aquifer is about 22-24 feet thick and the top of the aquifer is between 73 and 96 feet below land surface in the area surrounding the city. Sediments overlying the aquifer are mostly clay to sandy clay till, which serve as a somewhat leaky confining unit. Both city wells meet construction standards. The wells are considered vulnerable to contamination due to a small amount of tritium being detected in the well water. Detectable tritium indicates the presence of young (post-1953) water. The vulnerability of the city's aquifer throughout the DWSMA is based on the geologic sensitivity ratings of wells and their monitoring data. Based on this information, MDH has assigned a moderate

vulnerability to the DWSMA. Moderately vulnerable aquifers are prone to a variety of contaminant threats, including chemical storage tanks and abandoned wells which can provide conduits for contaminants to quickly reach the city's aquifer."

Water Resources

- There are no public surface water features within the DWSMA.
- The DWSMA is in an 'area of minimal flood hazard – Zone X' according to the Federal Emergency Management Agency Panel #27073C0225C effective date: 3/16/2006.
- A required map of major (Lac qui Parle River – HUC 07020003) and minor watershed boundaries is located in Exhibit B of this Appendix.

At present, none of the contaminants for which the Safe Drinking Water Act has established health-based standards is found above maximum allowable levels in the city's water supply, nor are any present at one-half of those levels. Arsenic has been detected in the water from public water supply Well #5 (603830). Additionally, sulfate has been found at concentrations exceeding the 250 mg/L secondary drinking water standard. This secondary standard is based on aesthetic concerns and does not represent a health threat. The presence of naturally-occurring contaminants does not indicate that there is a direct pathway between the aquifer and potential contamination sources that occur at or near the land surface.

Assessments of the Physical Environment Data and Their Impact on the Following:

Use of the PWS Wells

Geology in the City's DWSMA influences vertical recharge of precipitation to the aquifer. Factors such as rainfall intensity, soil type, slope, vegetation, thickness of soil cover over the aquifer influence the rate and amount of precipitation or surface water that infiltrates to the aquifer. The groundwater capture area for Well #4 and Well #5 is designated as moderately vulnerable. As stated in the Part 1 report (Appendix B), "This suggests that water and contaminants may travel from the land surface to the city's aquifer within a time span of years to decades. This rating reflects uncertainty about the pathway for young water reaching Well #5. Although this may be the result of a well casing problem, for the time being it is assumed that the clay-rich sediments that overlie the city's aquifer are leaky".

Delineation of the WHPA

Geologic information was used to address aquifer transmissivity and hydrologic boundaries delineation criteria and combined with groundwater monitoring data, was the principal information used to assess DWSMA vulnerability, which was determined to be moderately vulnerable within the protection area.

Quality and Quantity of Water Supplying the PWS Wells

Groundwater quality information was obtained from the Public Water Supply Program and Well Management Program at MDH and the Public Water Supplier. Information that summarizes groundwater quality is used to assess the pathways that recharge takes to the aquifer and this may impact the selection of methods that are used to delineate the WHPA and to assess well and DWSMA vulnerability. The presence of human-made contaminants is used to 1) calibrate a groundwater flow model by providing a means of checking travel time distance from the source of a contaminant to a public water supply well and 2) assess the vulnerability of the well and the DWSMA. The presence of naturally occurring contaminants is used to assess the extent that the source water aquifer is isolated from surface water recharge. The presence of either human-made or naturally occurring contaminants may influence pumping of the public water supply well because pumping may impact the rate at which contamination may be moving into the aquifer. Due to the presence of low levels of tritium in Well #5 MDH has assigned the DWSMA as moderately vulnerable.

The DNR is the principle source of water quantity information. Water quantity information affects the 1) delineation of a WHPA because the pumping amounts are used to calculate the daily well discharge which is a WHPA delineation criterion, 2) use of the public water supply well because a maximum annual amount for the public water supply system is specified under the DNR appropriations permit, and 3) land and water use within a DWSMA because pumping may impact whether other wells or existing land uses may cause contamination of the aquifer or contamination to move toward the public water supply well. It may indirectly affect the future quantity and quality of the water from the public water supply well.

There are no known well interference problems and water use conflicts within the City's DWSMA. Well interference and water use conflicts are used (if they exist) to delineate the WHPA because they document hydrologic boundaries that must be included. Also, they indicate areas where aquifer recharge is insufficient to meet pumping demands and this condition 1) limits groundwater use in the DWSMA and 2) may impact land uses such as agricultural irrigation or industry that rely on high capacity wells.

Land and Groundwater Uses in the DWSMA

The geologic information was used to determine the vulnerability of the aquifer to contamination from land use activities in the DWSMA. For a moderately vulnerable DWSMA an inventory of chemical/petroleum storage tanks and wells - both presently occurring and historical should be included (Exhibit A). Management strategies developed in this plan address the level of risk, as determined by the wellhead protection team, to the groundwater supply posed by each relevant potential contaminant source identified. Water resources information affects the use of land and water resources within the DWSMA because it defines regulations that are in place to assist with managing 1) the uses for surface water and 2) potential contamination sources that may contribute contaminants to the aquifer used by the City.

LAND USE DATA ELEMENTS

Land Use:

The location and numbers of potential contaminant sources and land uses past and present identifies what are the greatest potential risks to the well and the aquifer. This is subsequently used to develop and prioritize actions or measures. The land ownership information and political and public land surveys helps to locate potential contaminant sources (Appendix C). Those land owners and government units identified in the DWSMA can assist with implementing management strategies and actions. The Forward section of the main body of the WHP plan illustrates political boundaries and public land survey information (Figure 1).

Land cover data and a map, along with a comprehensive land use and zoning map provide the background for evaluating current and future land uses and the compatibility of these with protecting the PWS wells and aquifer.

A review of land cover located in Chapter 4 (Table 4-2) of the WHP plan indicates the DWSMA has a total area of approximately 388 acres. About 204 acres (~53%) are various types of development ranging from commercial/industrial areas to residential and open space. About 175 acres (~45%) are used for agriculture. The city wells are located within commercial or light industrial areas that typically contain storage tanks which may pose groundwater impacts. Continued efforts to protect city wells and source water is important for the long-term protection of groundwater and drinking water quality. See Exhibit C1 for more detail of land cover categories and extent. Land use controls within the Madison DWSMA are administered and reside with the City of Madison and Lac qui Parle County.

No significant changes from existing land uses present in the DWSMA is anticipated in the foreseeable future. County and City zoning maps covering the DWSMA are in Exhibit C2. The aquifer used by City is susceptible to potential contamination from storage tanks typically located in commercial or industrial zones and wells within the DWSMA that may be unused or improperly sealed.

Public Utility Services:

All of the utility data elements, except the PWS distribution system, can affect land and water uses because they can be potential sources of contamination. As such, they may limit future land and groundwater uses because of historical contamination releases or the risk that they may present to public health. Construction and maintenance records on wells within the DWSMA provides information on whether these wells may serve as pathways for contaminants into the aquifer.

U.S. Highway 75, MN Highway 40, city and county roads and a railroad transect parts of the DWSMA. Because the aquifer serving the city is moderately vulnerable, management of spills and accidental discharges are of concern. According to the National Pipeline Mapping System (Pipeline & Hazardous Materials Safety Administration) there is one natural gas pipeline that terminates in the east part of the DWSMA (Exhibit D). There are no public drainage ditch systems located in the DWSMA. The City maintains public storm lines, sanitary sewer lines and public water distribution in the portion of the DWSMA that is within municipal boundaries (Exhibit D).

Potential Contaminant Source Inventory:

A map of transportation routes is shown in Figure 1 of the wellhead plan. Records of how the public water supply wells are constructed or used are on record with the City and MDH. Information regarding other wells is limited to that displayed in the publically accessible Minnesota Well Index.

With the assistance of MDH, the City's Wellhead Protection Team conducted an inventory of known potential contaminant sources (PCS) located within the DWSMA (Appendix C). Several categories of point and nonpoint PCS are currently found within the DWSMA and are discussed in greater detail in Chapter 4 of this Wellhead Protection Plan. Also, Appendix C provides detailed maps and a list of specific point sources of potential contaminant sources.

Management of the DWSMA will involve strategies to address all categories of identified PCSI. See Chapters 4 and 8 and Appendix D.

Assessments of Land Use Data and Their Impact on the Following:

Use of the PWS Wells:

Information relating to the parcel boundaries, public land survey coordinates, center lines of roads have no direct impact on the use of the public water supply wells.

Priorities assigned to the action steps in the plan are based on information relating to the comprehensive land use and zoning maps and can impact the use of the City's wells by using the information as a tool to direct land use activities that can either increase, or decrease the amount of water required to be produced by the City wells.

Information relating to the potential contaminant sources within the DWSMA has the ability to impact the use of a PWS well in the event that the sources begin to contribute contaminants to the ground water aquifer that begin appearing in ground water monitoring results. Groundwater contamination of the aquifer

that the City utilizes for their drinking water may result in the necessity to limit use of a well, or discontinue the use of a well altogether.

The distribution of the public water supply system, specifically the amount of water storage and treatment capabilities, affects the amount of pumping that is needed to meet water supply needs and to maintain potable water standards.

Delineation of the WHPA:

Information relating to the parcel boundaries, public land survey coordinates, and centerlines of roads have no impact on the delineation of the WHPA.

The public water supply distribution system influences the number of wells that must be pumped to meet water demands of the public, which affects the boundaries of the WHPA and emergency response area (ERA).

The pumping of the City's wells affects the delineation of the WHPA because the pumping amount is a delineation criterion.

Quality and Quantity of Water Supplying the Wells:

Information relating to the parcel boundaries, public land survey coordinates, and center lines of roads have no impact on the quality and quantity of water supplying the City wells.

The information in Appendix A relating to the comprehensive land use and zoning maps provides the basis for defining the types of potential contamination sources that may or do impact the quantity and quality of the well water used by the public water supply.

Information about land uses and the PCSI is important to the quality of the water supplying the City's wells because it includes locations and data about potential contaminant sources within the DWSMA that could introduce contaminants into the drinking water aquifer that City uses as its drinking water source. The moderately vulnerable DWSMA is more susceptible to contamination from certain categories of land use activities, and therefore increased potential impact on the quality of City's drinking water.

The information related to the transportation routes and corridors can all be considered potential contaminant sources from accidental spills or releases and proximity to the ERA and WHPA. These types of PCS have the ability to impact the City's drinking water quality and quantity.

Land and Groundwater Uses in the DWSMA:

Information relating to the parcel boundaries, public land survey coordinates, and center lines of roads have impact on the land and groundwater uses in the DWSMA because they define where the WHP plan will be implemented.

The comprehensive land use and zoning maps affect land and water use within the DWSMA because they provide a basis for limiting future land uses that may be incompatible with ordinances or planning goals. As such, they may be used for denying new potential contamination sources or imposing performance standards that affect the use of existing or new public water supply wells and the quantity and quality of the well water used by the City. The effective use of these tools will be most critical in the moderately vulnerable area of the DWSMA where the aquifer being used for the City's drinking water source may be more susceptible to contamination from land uses.

Information about the potential contaminant sources located within the various land uses is important to land and groundwater uses within the DWSMA because the inventory identifies locations of various land uses that have potential to contribute to ground water contamination. The City is able to use the inventory, in conjunction with city and county land use controls, to reduce the likelihood of seeing an impact to their drinking water from these potential contaminant sources. In the moderately vulnerable area of the DWSMA where land use activities have a higher potential to impact public drinking water, the City can adopt additional zoning controls, or utilize existing city zoning controls to disallow certain land uses, or direct land use activities to areas that will reduce potential impact to groundwater quality, or place restrictions on land use permits in order to prevent contamination from activities to occur.

The transportation routes or corridors all represent potential contamination sources. As such, they may limit future land and groundwater uses because of potential spill or releases or the risk that they may present to public health and safety.

WATER QUANTITY DATA ELEMENTS

Groundwater Quantity:

Pumping of high capacity wells may affect the movement of contamination toward or away from another well and should be considered when managing contamination already in an aquifer. The continued use of a contaminated well or how much an uncontaminated well can be pumped before it affects the movement of contamination to other wells needs to be considered in managing the DWSMA. Pumping may impact groundwater levels when recharge is less than withdrawal such as during times of drought. Therefore, pumping may impact water use within a DWSMA and may impact land uses such as for recreational or agricultural purposes. The pumping limits for most community public water supply wells and private high capacity wells are set under a DNR appropriations permit.

Data collected for Part 1 indicates there are city-owned wells and one private well with active state groundwater appropriation permits within the DWSMA (Exhibit E1). Groundwater levels and quantity are adequate for the amounts that the City is currently permitted by a groundwater appropriation that is administered by the DNR. Presently, there appears to be sufficient groundwater quantity based upon existing pumping capacity of all wells completed in the aquifer used by the City. The City will continue to work with the MDH and DNR to identify any new high capacity wells in the area that may affect the City's public water supply or alter the current WHPA delineation. There are no known well interference or groundwater use conflicts near the City of Madison. Exhibit E1 contains additional information regarding groundwater quantities.

Assessments of the Water Quantity Data and Its Impact on the Following:

Use of the PWS Wells:

Groundwater quantity data impacts the use of the public water supply (PWS) well because a maximum annual amount for the public water supply system is specified under the DNR appropriations permit. Information related to the pumping of high-capacity wells in or near a DWSMA may impact the use of the City's wells because the use of high-capacity wells has the ability to influence the direction of flow of groundwater as well as existing contaminant plumes in an area. If an area near the City's wells becomes contaminated, the City may be required to change the current use of the wells to slow the progression of a plume toward the City's wells, or prevent a contaminant plume from entering the drinking water supply.

Delineation of the WHPA:

Water quantity (both surface and groundwater) data impacts the WHPA delineation because the pumping amounts are used to calculate the daily well discharge, which is a WHPA delineation criterion.

Data relating to the high, mean and low flow rates of streams (if available) affects the delineation of the WHPA because it can be used to 1) determine the interconnectivity between surface water and the aquifer used by the City's wells, and 2) calibrate the groundwater model that was used to delineation the WHPA. Also, the interaction between surface water and the aquifer that is used as the source of drinking water affects the vulnerability of the wells and DWSMA. Information related to the pumping of high-capacity wells is used for the delineation of the WHPA because it may present a flow boundary (which is a delineation criterion), and may affect the movement of groundwater flow in an area.

Quantity of Water Supplying the Wells:

Water quantity (both surface and groundwater) may only indirectly affect the future quantity of the water from the public water supply wells, if at all.

The data related to the pumping of high-capacity wells in or near the DWSMA has the ability to impact the quality and quantity of water supplying the City's wells because 1) the amount of water being pumped by these high-capacity wells may have the ability to affect the static water levels of the aquifer, and 2) the pumping of these wells can influence the direction of ground water flow and the direction of flow of existing contaminant plumes.

Land and Groundwater Uses Within the DWSMA:

Water quantity (both surface and groundwater) data impacts the land and groundwater uses within a DWSMA because pumping may impact whether other wells or existing land uses may cause contamination of the aquifer or contamination to move toward the public water supply wells.

Land and groundwater uses within the DWSMA may be influenced by the pumping of high- capacity wells in or near the DWSMA when recharge is less than withdrawal, such as during times of drought. The result of this would require that the City enact stricter water conservation measures for its system users, or the DNR may limit certain types of water uses within its jurisdiction in order to ensure that higher priority water users' demands are satisfied.

WATER QUALITY DATA ELEMENTS

Groundwater Quality:

Groundwater quality data is used to evaluate the current water quality condition and sustainability of the PWS aquifer, and to identify potential sources of contamination or land uses that pose greater risk to the PWS aquifer. These potential sources of contamination or land uses should receive higher priority when assigning management strategies in the plan. Groundwater quality information throughout the DWSMA can be used to assess the pathways of recharge to the aquifer and therefore provides information for prioritizing areas within a DWSMA that need land management measures.

The extent that groundwater quality may already be impaired by previous land and groundwater use practices can be indicated in studies, spill reports, and property audits. This information can assist in developing priority actions for managing land and groundwater uses within a DWSMA. These reports and studies may also indicate the rate that a contamination plume is moving towards or into the aquifer used by the PWS, as

well as the likelihood that the PWS may need to consider implementing water treatment methods in the future.

Well water quality from the City's wells is of good quality. Presently, no contaminant levels have been reported that exceed maximum contaminant levels set by the Federal Safe Drinking Water Standards. The 2020 Consumer Confidence Report is located in Exhibit E2.

There have been a number of identified spill or release sites within the DWSMA that occurred in the past. The majority of these sites were associated with leaky fuel storage tanks that have been remediated and are considered "closed" sites. These sites are listed in the current PCSI as historical 'leaky' underground storage tanks.

Exhibit E2 contains additional information regarding groundwater quality.

Assessments of the Water Quality Data and Its Impact on the Following:

Use of the PWS Wells:

The presence of human-made or naturally occurring contaminants may influence pumping of the public water supply well because pumping may impact the rate at which contamination may be moving into the aquifer. Furthermore, the level of contamination may require that the water be treated for potable use or be blended with other water to reduce contaminant levels to drinking water standards.

Delineation of the WHPA:

Information related to ground water quality is used to assess the pathways that recharge takes to an aquifer which may impact the selection of methods that are used to delineate the WHPA and to assess well and DWSMA vulnerability. The presence of human-made contaminants is used to 1) calibrate a groundwater flow model by providing a means of checking travel time distance from the source of a contaminant to a public water supply well, and 2) assess the vulnerability of the well and the DWSMA. The presence of naturally occurring contaminants is used to assess the extent that the source water aquifer is isolated from surface water recharge.

Quality of Water Supplying the Wells:

Site studies and water quality analyses of known areas of groundwater contamination, property audit results, reports of contamination spills and releases by the Minnesota Pollution Control Agency and Minnesota Department of Agriculture provide basic information that is used to determine the extent that groundwater quality may already be impaired by previous land and groundwater-use practices. This information is used to assess the vulnerability of the wells and the DWSMA, which affects 1) the scope, and direction of the inventory of potential contamination sources and 2) the resulting priorities that are assigned to objectives and actions for managing land and groundwater uses within a DWSMA. Also, the hydrogeologic information contained in the reports is used to refine the understanding of local groundwater conditions that affects the delineation of the WHPA. There are no known areas of contamination within the aquifer used by the City.

Land and Groundwater Uses in the DWSMA:

The aquifer supplying drinking water to the City is generally free of human made contaminants as indicated by groundwater monitoring. The City will place a high priority on the development of actions in this plan that focus on working with property owners to manage the different forms of potential contaminant sources (Appendix C) within the DWSMA to reduce the risk of impact to the drinking water aquifer.

Exhibits

Exhibit A - Scoping Documents
Exhibit B - Physical Environment Data Elements
Exhibit C - Land Use Data Elements
Exhibit D - Public Utility Service Data Elements
Exhibit E - Water Quantity and Quality Data Elements

See Appendix E for a list of resources utilized in Appendix A.

Exhibit A

Scoping 2 Notice Documents

for the

City of Madison DWSMA

DEPARTMENT OF HEALTH

Protecting, Maintaining and Improving the Health of All Minnesotans

November 5, 2019

Ms. Valerie Halvorson, Manager
Mr. Dean Broin, Superintendent
City of Madison
404 Sixth Avenue North
Madison, Minnesota 56256

Subject: Scoping 2 Decision Notice and Meeting Summary – Name of Madison – PWSID 1370004

Dear Ms. Halvorson and Mr. Broin:

This letter provides notice of the results of a scoping meeting held with both of you on October 23, 2019, at Madison City Hall regarding wellhead protection (WHP) planning. During the meeting, we discussed the data elements that must be compiled and assessed to prepare the part of the WHP plan related to the management of potential contaminants in the approved drinking water supply management area. The enclosed Scoping 2 Decision Notice lists the data elements discussed at the meeting. We also discussed a summary of planning issues and recommendations that were identified during the Part 1 WHP Plan development process which should be considered for inclusion in your Part 2 WHP Plan.

The city of Madison has met the requirements to distribute copies of the first part of the WHP plan to local units of government and hold an informational meeting for the public. The city of Madison will have until October 31, 2021, to complete its WHP plan.

MDH understands a consultant, unknown at this time, will be working with you to develop a draft of the remainder of the WHP plan. I will be contacting you to review the progress of the development of Part 2 of your plan. Upon request, the Technical Assistance Planner can provide a glossary of terminology, identification of information sources for the required Data Elements, and other technical assistance documents. If you have any questions regarding the enclosed notice, contact me by email at Amanda.Strommer@state.mn.us or by phone at 507-476-4241.

Sincerely,

Amanda Strommer

Amanda Strommer, Planner
Environmental Health Division
1400 East Lyon Street
Marshall, Minnesota 56258-2529

AS:ds-b

Enclosures
cc: John Bloome, MDH Engineer, Marshall District Office
Luke Stuewe, Minnesota Department of Agriculture

Date: November 5, 2019

Name of Public Water Supply: City of Madison

PWSID: 1370004

Name of the Wellhead Protection Co-Managers: Ms. Valerie Halvorson, Manager and Mr. Dean Broin, Superintendent

Address: 404 Sixth Avenue North

City: Madison

Zip: 56256

Phone: 320-598-7373

Primary Unique Well Numbers: 603829 (Well #4), and 603830 (Well #5)

DWSMA Vulnerability: ☐ Low ☒Moderate

The purpose for the second scoping meeting, as required by Minnesota Rules, part 4720.5340, is to discuss the information necessary for preparing Part 2 of a Wellhead Protection Plan. The Part 1 Plan identifies the area that provides the source of drinking water for the public water supply (PWS) and assesses how vulnerable that area is to contamination. The PWS can utilize that information to develop land use and management practices that protects their groundwater resource from contamination.

The wellhead rule (Minnesota Rules, part 4720.5340) refers to the information required for wellhead planning as data elements. This notice lists the data elements that are stated in Minnesota Rules, part 4750.5400 and are selected for the PWS because of the vulnerability of the drinking water supply management area (DWSMA) as determined in Part 1.

Scoping 2 Data Elements Needed for the Part 2

Data Elements are pieces of information in the form of a map, a list, records, tables and inventories. Where appropriate, they should be reviewed and assessed in terms of their present and/or future implications on the 1) use of the well(s), 2) quality and quantity of water supplying the public water supply wells(s), and 3) land and groundwater uses in the DWSMA. It is important to discuss the relevance of the data elements to management of the DWSMA. Check the technical assistance comments for guidance on reviewing the data elements and conducting these assessments. Clearly identify in the plan which data elements are associated with which tables/figures. If a data element does not exist, state that in the narrative.

Submit –

The following information MUST be submitted in the Part 2 by including it in the plan narrative and/or appendix. An asterisk* with red text indicates information that MUST be contained in the Part 2.

- ☐ *A map that indicates the vulnerability and includes the DWSMA, WHP Area, and Emergency Response Area must be included in the Part 2. This map with vulnerability is a product of the Part 1 and provides a basis for planning activities in Part 2. SWP Planner can provide the DWSMA figure.

DATA ELEMENTS ABOUT THE LAND USE –

Land Use

- ☐ *An existing map of political boundaries.
- ☐ *An existing map of public land surveys including township, range, and section.

Technical Assistance Comments: A map or maps showing updated political boundaries and township, range, section with labels is required for determining land use authorities for the land within the DWSMA. DWSMA figure map provided by SWP Planner will also contain political boundaries with township, range, and section. Determine and discuss how the various land use authorities may affect the management of the DWSMA.

- A map and an inventory of the current and historical agricultural, residential, commercial, industrial, recreational, and institutional land uses and potential contaminant sources.
  - ☐ *The Potential Contaminant Source Inventory (PCSI) data in both a table and map format must be created and included in the Part 2. Include potential contaminant sources as listed on the PCSI attachment provided for each existing vulnerability within the DWSMA.
    - If DWSMA contains moderate vulnerability inventory all wells.
    - The inventory should include your community wells but not include any wells that are known to have been sealed according to the Minnesota Well Code (MN Rules 4725).
  - ☐ *A land use/land cover map and table. SWP Planner can provide a land cover map and data/table from federal sources. This data set should be used unless an alternative electronic data set that is more current and detailed is available. Assess and discuss changes in land use that could impact management of the DWSMA.

- ☐ *An inventory of the Inner Wellhead Management Zone (IWMZ). A recent IWMZ inventory (within six years) for each primary well with management recommendations on the MDH form, or a table that summarizes the number and type of contaminant sources with the management recommendations must be included. Incorporate or reference the recommendation(s) from the IWMZ into the Part 2. IWMZ will be completed by the SWP Planner with assistance from the PWS staff. A copy will be provided to the PWS.

Technical Assistance Comments: This section encompasses the Potential Contaminant Source Inventory known as the PCSI. See the Scoping 2 Decision Notice Potential Contaminant Source Inventory Requirement Attachment(s) and endorsement procedures/fact sheets for further information. Utilize the PCSI geodatabase attribute template provided by SWP Planner. Management strategies must be developed for potential sources of contamination that pose a risk to the drinking water supply.

- ☐ *An existing comprehensive land-use map.
- ☐ *An existing zoning map.

Technical Assistance Comments: This information can indicate areas in the DWSMA where growth or the addition of potential contaminant sources is likely to occur. Furthermore, the review of local zoning and comprehensive land-use maps facilitates the evaluation of the degree of compatibility current and future land uses have with the PWS goals of protecting the drinking water wells and aquifer.

Public Utility Services

- ☐ *An existing map of transportation routes or corridors.

Technical Assistance Comments: Highway and railroad corridors can be used to move hazardous materials. These corridors should be evaluated to determine the level of risk they pose for spills in the DWSMA, considering their proximity to the wells, the local topography, and geologic conditions.

- ☐ *An existing map of storm sewers, sanitary sewers, and public water supply systems.

Technical Assistance Comments: Storm sewer systems and sanitary systems can be sources of contamination. Storm sewers are generally considered a public utility element designed to convey storm water runoff and use constructed features such as pipes and ponds. Evaluate the integrity and condition (age, type of material, any investigative work, etc.) of these systems in the DWSMA, noting the location of the water supply system and public water supply wells in relation to these potential contaminant sources. It is not necessary to include a map of your public water supply system in the Part 2 if you believe it would pose a threat to the security of your system.

☐ *An existing map of the gas and oil pipelines used by gas and oil suppliers.

Technical Assistance Comments: Petroleum pipelines can be sources of contamination (excluding liquefied natural gas pipelines). If possible, describe what is generally known about the condition of these pipelines in the DWSMA, and the readiness of the PWS to respond to an emergency. It is not necessary to include a map in the Part 2 if you believe it would pose a security threat.

Required to be discussed in plan-

The following information (if existing) MUST be reviewed and discussed in the development of the Part 2. The Part 2 narrative must contain a description identifying whether/how the information may influence the management of the DWSMA. The data element may be located in the public domain. While the map or document reviewed is not required to be included in the Part 2, the source of the data element must be provided in the plan narrative by indicating a web address or reference to its location.

DATA ELEMENTS ABOUT THE PHYSICAL ENVIRONMENT –

Water Resources

- An existing map of the boundaries and flow directions of major watershed units and minor watershed units.

Technical Assistance Comments: Identify/list the major and minor watershed(s) in the Part 2 in order to become aware of local water planning efforts such as One Watershed One Plan (1W1P), Watershed Restoration and Protection Strategies (WRAPS), and/or Groundwater Restoration and Protection Strategies (GRAPS).

- An existing map showing those areas delineated as floodplain by existing local ordinances.

Technical Assistance Comments: Assess and describe any issues and management needed in the DWSMA based on the Federal Emergency Management Agency (FEMA) Floodplain 100-year FIRM (Flood Insurance Rate Map) and (or) other State and local floodplain or flooding information. Consult with the WHP Manager to evaluate any potential or historical flooding impacts on the public water supply wells or aquifer. The Inner Well Management Zone report and Sanitary Survey may be used to identify flooding issues and impacts.

DATA ELEMENTS ABOUT THE LAND USE –

Land Use

- An existing map of parcel boundaries.

Technical Assistance Comments: Parcel boundaries may have been used for delineation of the DWSMA in Part 1. In Part 2, parcel identification information must be included or linked and must be used for education or targeting activities or practices in addressing potential contaminants. In the narrative indicate if parcel data is available from the public domain (i.e. county GIS or associated website such as Beacon).

Part 1 -

The following information was reviewed and assessed in Part 1. The Part 1 should be used as a data source for the Part 2. The technical assistance comments provide the requirements for how this information must be discussed and/or included in the Part 2. Include relevant excerpts or summaries from the Part 1 where indicated. Or, if the Part 1 is included in the appendix that can be referenced.

DATA ELEMENTS ABOUT THE PHYSICAL ENVIRONMENT –

- An existing geologic map and a description of the geology, including aquifers, confining layers, recharge areas, discharge areas, sensitive areas as defined in Minnesota Statutes, section 103H.005, subdivision 13, and groundwater flow characteristics.
- Existing records of the geologic materials penetrated by wells, borings, exploration test holes, or excavations, including those submitted to the department.
- Existing borehole geophysical records from wells, borings, and exploration test holes.
- Existing surface geophysical studies.

Technical Assistance Comments: Provide a summary in the plan narrative (few sentences/paragraph) of the Description of the Hydrologic Setting from Part 1. Provide the conclusions regarding the Well and DWSMA Vulnerabilities related to the geologic conditions and how these conditions influence the management of the DWSMA.

DATA ELEMENTS ABOUT THE LAND USE –

Public Utility Services

- An existing record of construction, maintenance, and use of the public water supply well and other wells within the DWSMA.

Technical Assistance Comments: Well construction records indicate what is known about the well(s) and can indicate if the well(s) have structural integrity or groundwater protection issues. Briefly summarize in the plan narrative what is discussed about each well from the Assessment of Well Vulnerability in Part 1.

DATA ELEMENTS ABOUT WATER QUANTITY –

Groundwater Quantity

- An existing list of wells covered by state appropriation permits, including amounts of water appropriated, type of use, and aquifer source.
- An existing description of known well interference problems and water use conflicts.
- An existing list of state environmental bore holes, including unique well number, aquifer measured, years of record, and average monthly levels.

Technical Assistance Comments: This information, if known, was incorporated into the Part 1 and was used to assist in determining hydrologic boundary conditions and area static water levels. In Part 2, information about Department of Natural Resources appropriation permit holders and any known well interference problems or water use conflicts must be discussed, including how this information could affect the management of the DWSMA.

DATA ELEMENTS ABOUT WATER QUALITY –

Groundwater Quality

- An existing summary of water quality data, including: 1. bacteriological contamination indicators; 2. inorganic chemicals; and 3. organic chemicals.
- An existing list of water chemistry and isotopic data from wells, springs, or other groundwater sampling points.
- An existing report of groundwater tracer studies.

Technical Assistance Comments: This information, if known, was incorporated into the Part 1. Provide a summary of the assessment of well vulnerability and/or any relevant chemistry and isotopic composition data available from PWS wells and other wells/sources.

- An existing site study and well water analysis of known areas of groundwater contamination.
- An existing property audit identifying contamination.
- An existing report to the Minnesota Department of Agriculture and the Minnesota Pollution Control Agency of contaminant spills and releases.

Technical Assistance Comments: This information, if known, was incorporated into the Part 1. Discuss whether there are groundwater contamination areas that could pose a risk to the public water supply well(s) now or in the future. Include any relevant data and how this information may affect the management of the DWSMA.

Revised: 04/2019

City of Madison Scoping 2 Meeting

Wellhead Protection (WHP) Planning Issues Summary

NOTE: This document is intended to be a summary of issues identified to date and is **not intended to replace the required data elements identified in the Scoping 2 Decision Notice** nor is it intended to be an exhaustive list of all potential drinking water issues.

Drinking Water Protection Issues Identified to Date:

- The city of Madison has two primary wells screened in a sand and gravel aquifer that is buried beneath a layer of clay-rich sediment. Such aquifers are known generically as Quaternary Buried Artesian Aquifers. The city's aquifer is between approximately 87 and 119 feet below the ground surface. Regionally, groundwater flow is to the east.
- Well construction meets current State Well Code specifications at Well #4 and Well #5, meaning that the wells themselves should not provide a pathway for contaminants to enter the aquifer used by the public water supplier.
- MDH has assigned a moderate vulnerability to the DWSMA, a rating consistent with water and contaminants originating at the land surface reaching the city's aquifer within a time span of years to decades. The moderate vulnerability rating reflects uncertainty about the pathway for young water reaching Well #5 (603830). Although this may be the result of a well casing problem, for the time being it is assumed that the clay-rich sediments that overlie the city's aquifer are leaky. Moderately vulnerable aquifers are prone to a variety of contaminant threats, including chemical storage tanks and abandoned wells, which can provide conduits for contaminants to reach the city's aquifer.

Water Quality Detections and Implications:

- Water samples were collected from city wells and were analyzed for tritium, nitrate, chloride and bromide. Detectable tritium indicates the presence of some young (post-1953) water within the aquifer. However, arsenic, a naturally-occurring contaminant, has been detected at low levels in Well #5 (603830). Sulfate, which is also naturally-occurring, exceeds the secondary drinking water standard of 250 mg/L, but this standard is based on aesthetic and not health concerns.

Old Municipal Well Information:

The Minnesota Department of Health has compiled historical information for use in the planning process.

Sanborn Maps:

☒ Sanborn/Fisher Maps are available for this area

☐ Sanborn Maps are not available for this area.

Recommended WHP Measures:

1. Well Locating: If wells are constructed within two miles of the city or one mile of the DWSMA, their locations should be verified. This information may allow a better understanding of the extent and thickness of the city's aquifers, and could result in a more refined WHPA in the future.

2. Water Quality Monitoring: The standard assessment monitoring package should be analyzed during year two or three to confirm the presence of young water in Well #5 (603830) and determine the age of water in Well #4 (603829). Sampling should include both primary wells, contingent on funding assistance from MDH for sampling and analysis. Additional sampling should occur just prior to amending the plan in year seven for all primary wells. The city may need to collect the samples and ship them to MDH. Information generated by this sampling will be used to refine vulnerability assessments for the next amendment.

3. Optional Well Downhole Inspection for Well #5 (603830): If tritium is again found in Well #5 but is not found in Well #4, then a video inspection of Well #5 may reveal whether a casing breach could be responsible for the tritium detection noted at this well. This could be eligible for a Source Water Protection Implementation Grant if this measure is included in the city's wellhead protection plan. If such an investigation is to occur, MDH should be contacted in advance in the event additional downhole investigations can be conducted while the well is open.

Scoping 2 Decision Notice Attachment

Potential Contaminant Source Inventory Requirements

Moderately Vulnerable DWSMA

The following current and historical potential contaminant sources and related codes, materials and related codes, and activity status and related codes are required to be included in the potential contaminant source inventory. In cases where a materials identification is required, a materials designation and code must be assigned. All potential contaminant sources must be assigned an activity status and related code using state program descriptors or local knowledge.

POTENTIAL CONTAMINANT SOURCES (PCS)	PCS CODES
MATERIAL CODES	MATERIAL
Above-Ground Storage Tank - Greater than 1100 gallons	AST
Chemicals	C000
Fertilizers	A050
Fuels, gases, and oils	F000
Hazardous substances	C001
Solvents and coatings	S000
Waste	W000
Agricultural Drainage Well (potential Class V)	ADW
Disposal Well (potential Class V)	DISWLL
Industrial Drainage Well (potential Class V)	INDW
Large Capacity Cesspool (potential Class V)	CVLCC
Large Capacity Waste Water Disposal Site (potential Class V)	CVWWD
Leaking Underground Storage Tank	LUST
Misc. Injection Well (potential Class V)	INJWLL
Motor Vehicle Waste Disposal Well (potential Class V)	CVMVW
Pipeline Facility	PLFAC
Potential Contamination Site[1]	PCS
Recharge Well (potential Class V)	RWLL
Reinjection Well (potential Class V)	RIWLL
Solid Waste Management Site	SWMS
Special Drainage Well (potential Class V)	SPDW
Spills	SPL

Potential Contaminant Sources (PCS)	**PCS Codes**
Material	**Material**
Codes	
Storage or Preparation Area	STOR
Chemicals (include RMP facilities here)	C000
Fertilizers	A050
Fuels, gases, and oils	F000
Hazardous substances (include TRIS facilities here)	C001
Solvents and coatings	S000
Waste	W000
Stormwater Basin	SWB
Stormwater Injection Well (potential Class V)	SWI
Stormwater Outlet	SROUT
Suspected Contaminant of Concern	SCC
Chemical	C000
Food, agricultural, and consumer products	A000
Fuels, gases, and oils	F000
Materials and minerals	M000
Pathogens	P000
Solvents and coatings	S000
Waste	W000
Underground Storage Tank	UST
Chemicals	C000
Fertilizers	A050
Fuels, gases, and oils	F000
Hazardous substances	C001
Solvents and coatings	S000
Waste	W000
Wells	WEL

Footnotes:

[1]Potential Contamination Sites (PCS) include the following:

Brownfields (BMS)
Delisted State Superfund Sites (DPLP)
Federal Superfund Sites (NPL)
Hazardous Waste Investigative/cleanup (HWIC)
No Further Remedial Action Planned (NFRAP)
State Superfund Sites (PLP)
Suspected Hazardous Waste Site (CERCL)
Voluntary Investigative Cleanup (VIC)

Activity Status; Codes; and Descriptions

Status	Code	Description
Active	A	PCS is operative or in use. Examples: Animal feedlot is active. Well is in use or has maintenance permit.
Closed	C	PCS is inactive and is not open from a regulatory viewpoint. Example: Leaking storage tank site or landfill is closed.
Inactive	I	PCS is present but not currently active. Examples: Gravel pit is inactive. Well is un-used.
Removed	R	PCS has been removed. Example: Underground storage tank has been removed.
Unknown	U	Activity status of the PCS is not known definitely or has not been evaluated. Examples: Class V site status unknown. Well is thought to be sealed, but no official sealing record has been identified.

Exhibit B

Physical Environment Data Elements

Water Resources

City of Madison DWSMA

Figure B-1 - Major and Minor Watershed Boundary Map

Source: Lac qui Parle Local Water Management Plan
www.lacquiparleswcd.org/local-water-management

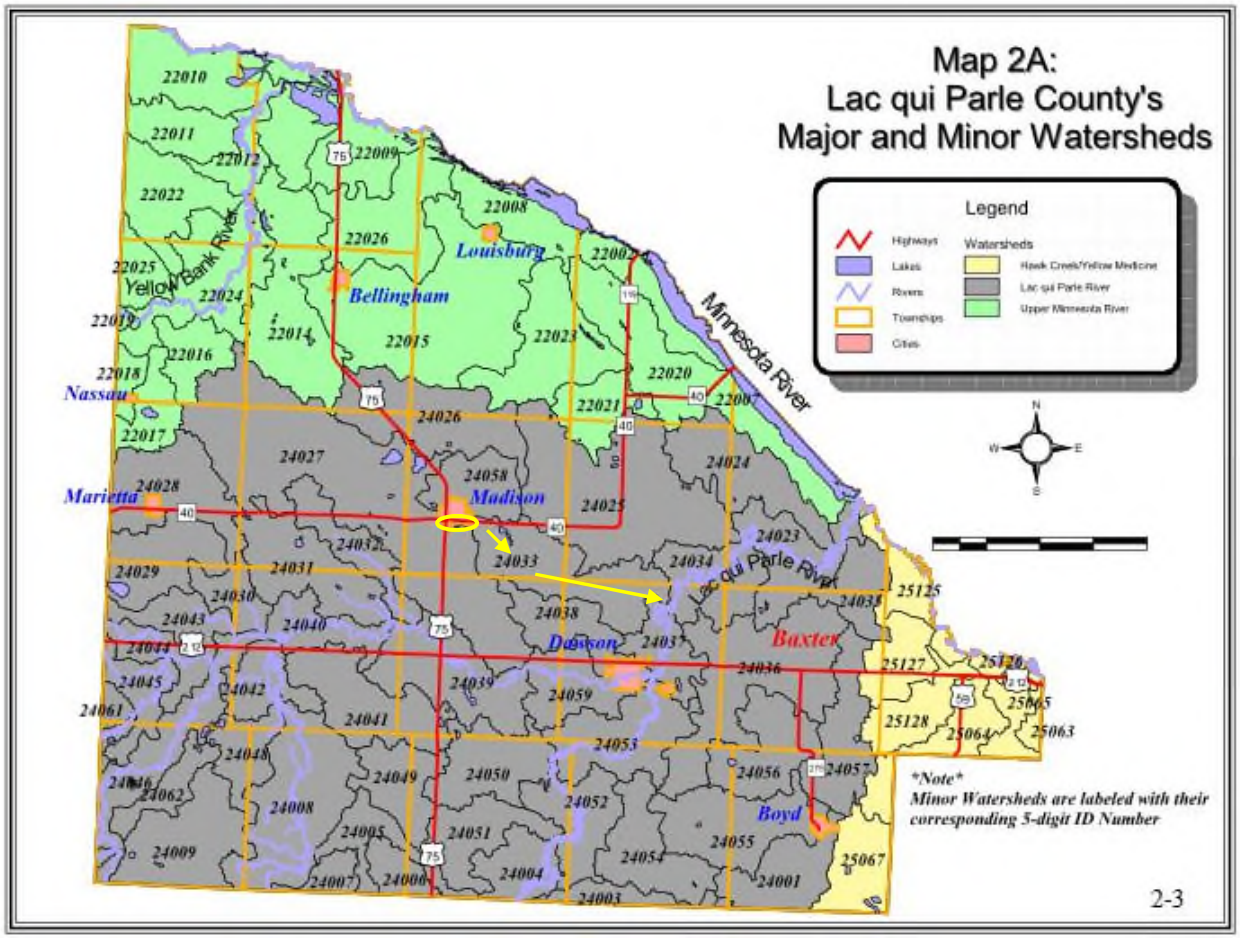


Figure B-1

Major and Minor Watershed Boundaries near Madison DWSMA

Note:

1. **DWSMA and flow direction shown in yellow.**
2. **Major watershed is Lac qui Parle River, HUC #07020003.**
3. **Minor watersheds within DWSMA are: 24027, 24033 and 24058, all flowing southeasterly or east toward the Lac qui Parle River.**

Exhibit C

Land Use Data Elements

for the

City of Madison DWSMA

Exhibits

Exhibit C1 – Madison DWSMA Land Cover Map and Table

Exhibit C2 – Comprehensive Land Use Plan, County Water Plan and County and City Zoning Map

Exhibit C1

Madison DWSMA Land Cover Map and Table

Figure C1-1 - Madison DWSMA Land Cover

Table C1-1 - Madison DWSMA Land Cover Table

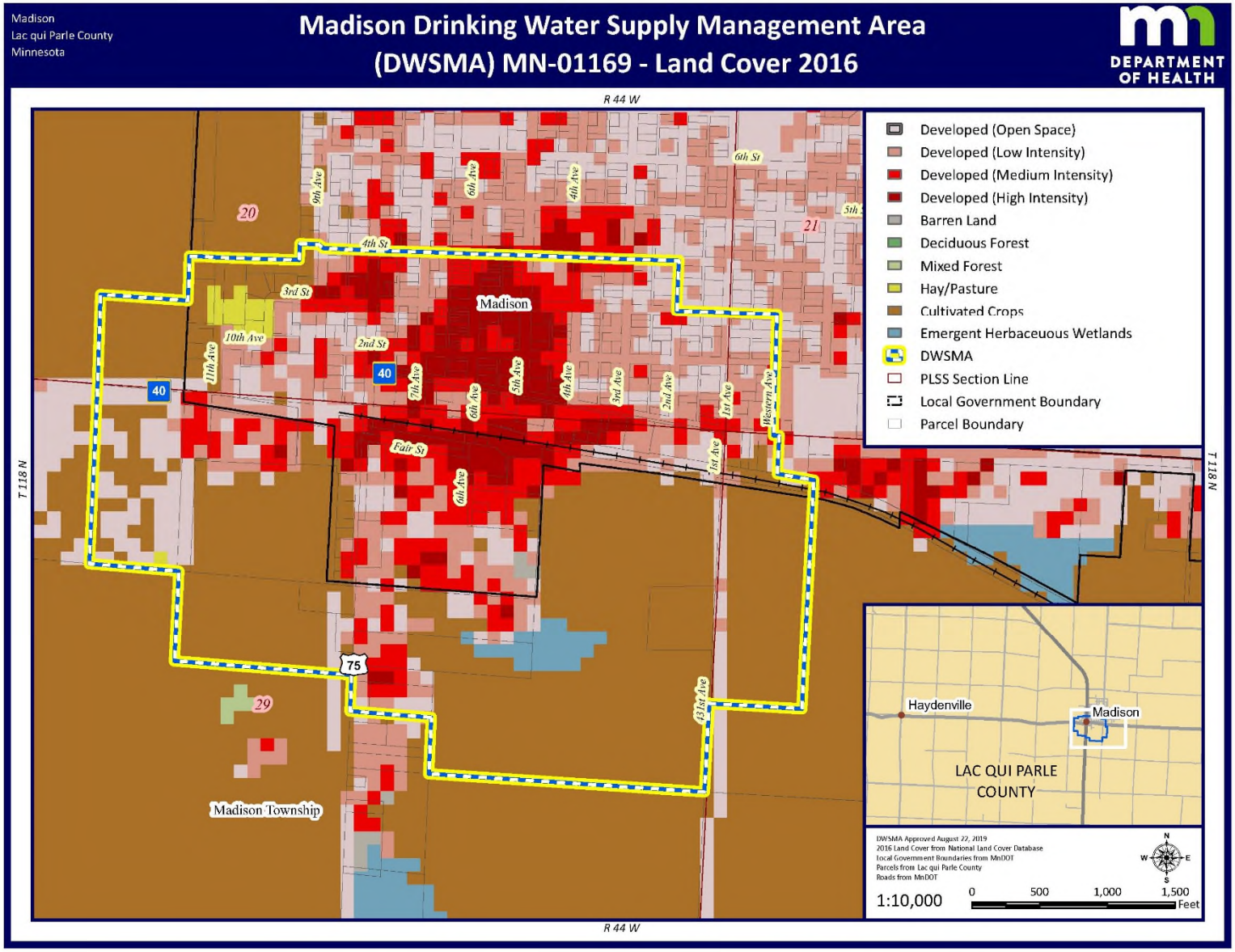


Figure C1-1

Madison DWSMA Land Cover Map

Table C1-1

Madison DWSMA Land Cover Table

Land Cover Category	Acreage	Percent of DWSMA
Developed, Open Space	55.56	14.34
Developed, Low Intensity	62.70	16.19
Developed, Medium Intensity	49.98	12.90
Developed, High Intensity	34.58	8.93
Barren Land (Rock/Sand/Clay)	0.67	0.17
Pasture/Hay	3.57	0.92
Cultivated Crops	174.94	45.16
Emergent Herbaceous Wetlands	5.36	1.38
Total	387.4	99.99

Note:
Source of 2016 National Land Cover Data Set for Madison DWSMA:
http://www.mngeo.state.mn.us/chouse/land_use.html
https://www.mrlc.gov/
https://www.mrlc.gov/data/legends/national-land-cover-database-2016-nlcd2016-legend

Exhibit C2

Lac qui Parle County
Comprehensive Land Use Plan and Local Water Plan
(Selected Portions)

Figures

Figure C2-1 - City of Madison Zoning Map
Figure C2-2 – Madison Township Land Use Map

Exhibits

Exhibit C2-1 – Lac qui Parle County Comprehensive Plan and Zoning
Exhibit C2-2 – Lac qui Parle County Local Comprehensive Water Plan

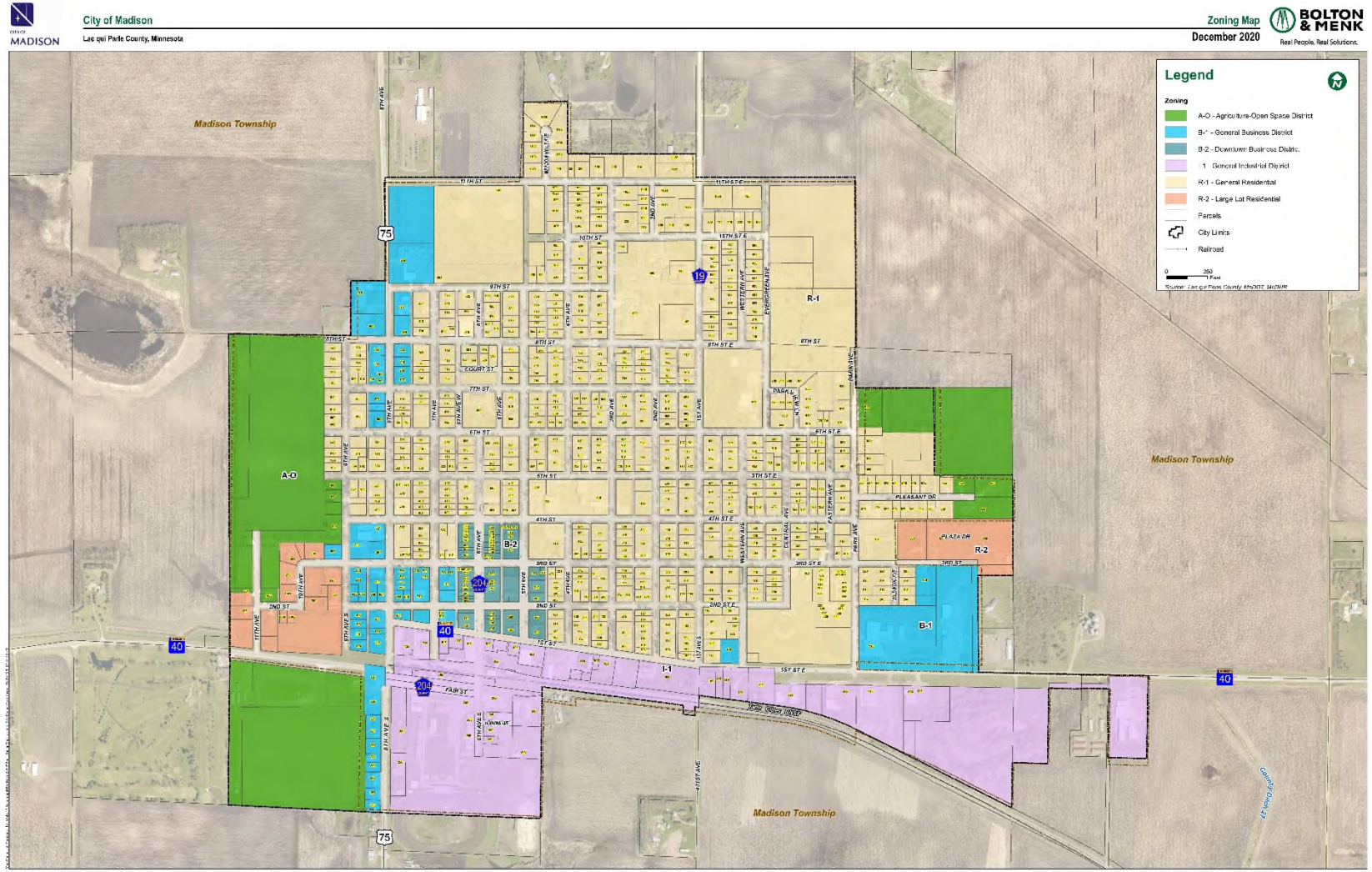


Figure C2-1

City of Madison Zoning Map

Exhibit C2-1

Lac qui Parle County Comprehensive Plan and Zoning

Lac qui Parle County

Comprehensive Plan

"Lac qui Parle County: Where the Lake Speaks"

September 2002

Prepared by the
Upper Minnesota Valley
Regional Development Commission
323 West Schlieman Avenue
Appleton, MN 56208
320.289.1981

Excerpt from Lac qui Parle Comphrensive Plan, Chapter 2 – Natural Resources

Wellhead Protection [quoted from Source Water Protection (SWP) materials]

Wellhead protection is a means of protecting public water supply wells by preventing contaminants from entering the area that contributes water to the well or well field over a period of time. The wellhead protection area is determined by using geologic and hydrologic criteria, such as the physical characteristics of the aquifer and the effects which pumping has on the rate and direction of ground water movement. A management plan is developed for the wellhead protection area that includes inventorying potential sources of ground water contamination, monitoring for the presence of specific contaminants, and managing existing and future land and water uses that pose a threat to ground water quality. The goals of a wellhead protection are to
reduce the use of costly treatment facilities, avoid the drilling of new wells, and to avoid the need to clean up contaminated ground water.

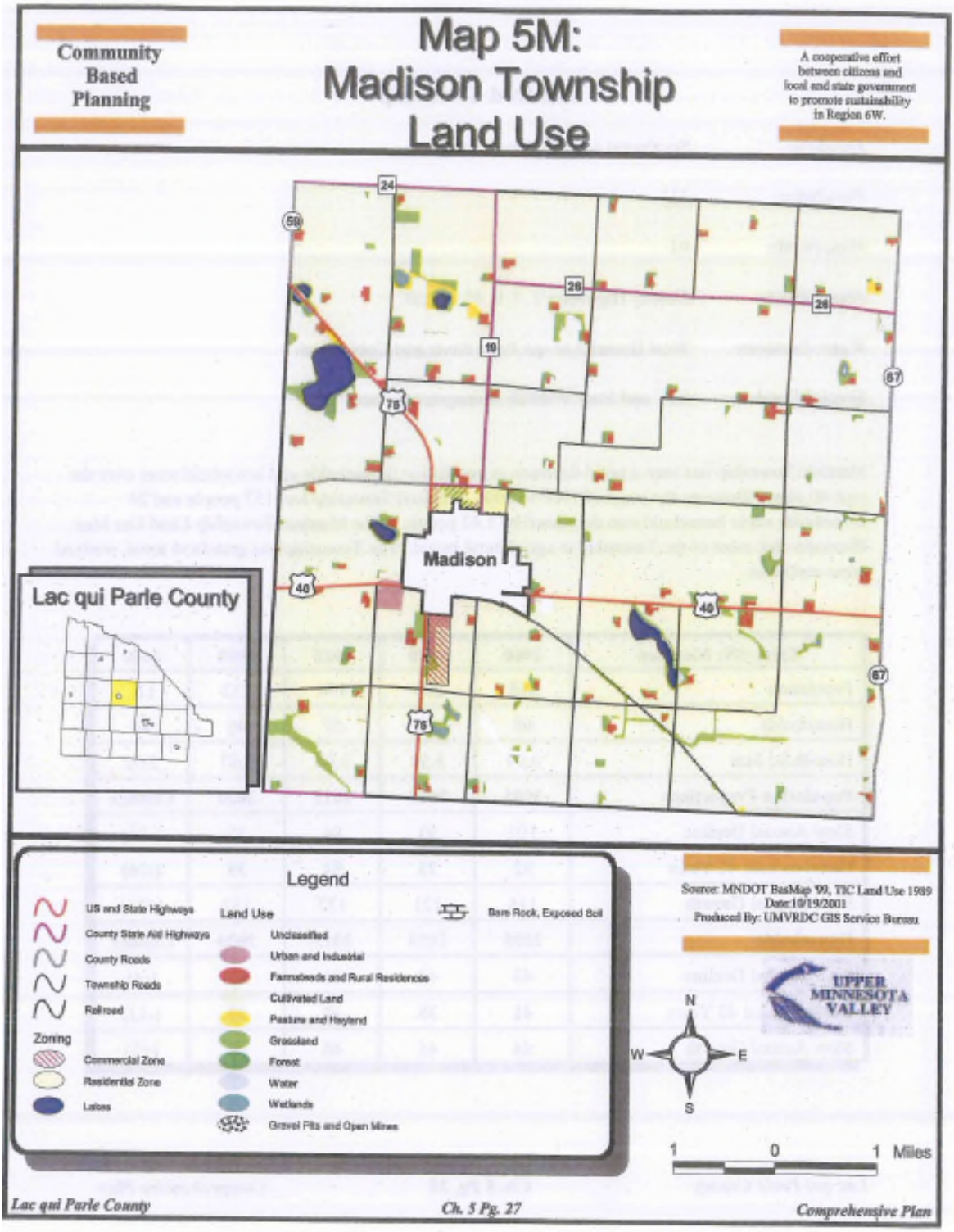


Figure C2-2

Madison Township Land Use Map

Note: A large format Lac qui Parle County zoning map is available for viewing at the Lac qui Parle County Environmental Service office in Madison, Minnesota.

Exhibit C2-2

Lac qui Parle County Local Comprehensive Water Plan

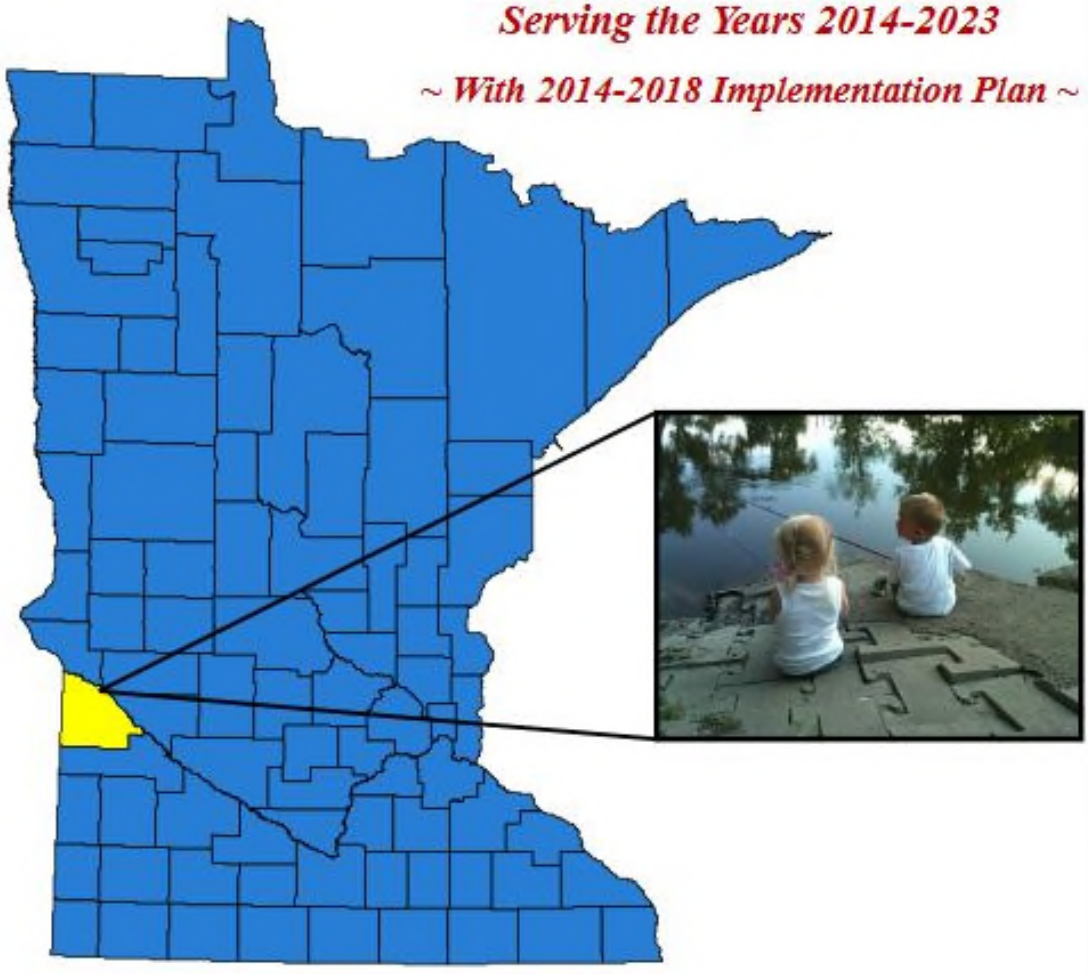
(Excerpts)

Lac qui Parle County

Local Water Management Plan

Serving the Years 2014-2023

~ With 2014-2018 Implementation Plan ~



Prepared by

The Lac qui Parle County Resource Commission,

with assistance from Midwest Community Planning, LLC

B. A Description of Lac qui Parle County's Priority Concerns

The Lac qui Parle County Resource Commission met on August 14, 2012, to review the Water Plan Survey results and the Priority Concerns Input Forms received (Appendix A contains a copy of the Sign in Sheets). Based upon the survey results, the comments received during the Water Plan Public Meeting, and the comments received in the Priority Concerns Input Forms, the Resource Commission identified the following as Lac qui Parle County's priority water planning issues (note: these issues are not ranked):

1. Surface Water Management
    a. Agricultural Drainage
    b. Stormwater Management
    c. Wetlands and Water Storage/Retention
    d. Flooding

2. Reducing Priority Pollutants ~ Surface Water Quality
    a. TMDL Implementation
    b. Feedlot/Livestock Management
    c. Subsurface Sewage Treatment Systems
    d. Erosion and Sediment Control

3. Groundwater Quality & Quantity
    a. Wellhead Protection Areas
    b. Irrigation
    c. Drinking Water Quality

4. Plan Administration
    a. Watershed Focus
    b. Stakeholder Cooperation
    c. Raising Public Awareness

C. Summary of Goals, Objectives, Action Steps, and Estimated Costs

Goal 2: Groundwater Quantity and Quality Initiatives

The second goal area focuses on addressing groundwater quality and quantity issues. Objectives were developed for drinking water quality and groundwater quantity BMPs. Implementation steps include a wide range of the following groundwater Best Management Practices (BMPs):

- **Wellhead Protection Areas (WPA).** Participate in the preparation and implementation of wellhead protection plans for public water suppliers. Communities of Dawson, Madison, and Boyd are scheduled to be phased into the Wellhead Protection Program in 2017; targeting groundwater BMPs in Drinking Water Supply Areas (DWSAs) and WPAs; and sealing abandoned wells.

- **Safe Drinking Water.** Securing funding to provide technical assistance for the installation of BMPs; working with MN Geological Society and DNR to develop a hydrogeologic assessment as part of the County Geologic Atlas Program for Lac qui Parle County; conducting annual nitrate testing clinics; and holding annual pesticide and household hazardous waste collection days.

- **Groundwater Quantity.** Assist with groundwater quantity monitoring efforts and promote the adoption of measures to protect groundwater supplies; secure funding to cost share conversion of conventional irrigation systems to conservation systems; and seek funding to develop a County Water Conservation Plan.

Exhibit D

Public Utility Services

for the

City of Madison DWSMA

Figures

Figure D1-1

City of Madison Sanitary and Stormwater Sewers and Public Water Distribution Map

Figure D1-2 – Natural Gas Pipeline Map

Note:
There is natural gas pipeline located in the City of Madison DWSMA south of the intersection of County Road 19 and Minnesota State Highway 40. (Source: https://www.npms.phmsa.dot.gov/)

Figure D1-1

City of Madison Sanitary and Stormwater Sewers and Public Water Distribution Map

Pipeline and Hazardous Materials Safety Administration

NATIONAL PIPELINE MAPPING SYSTEM

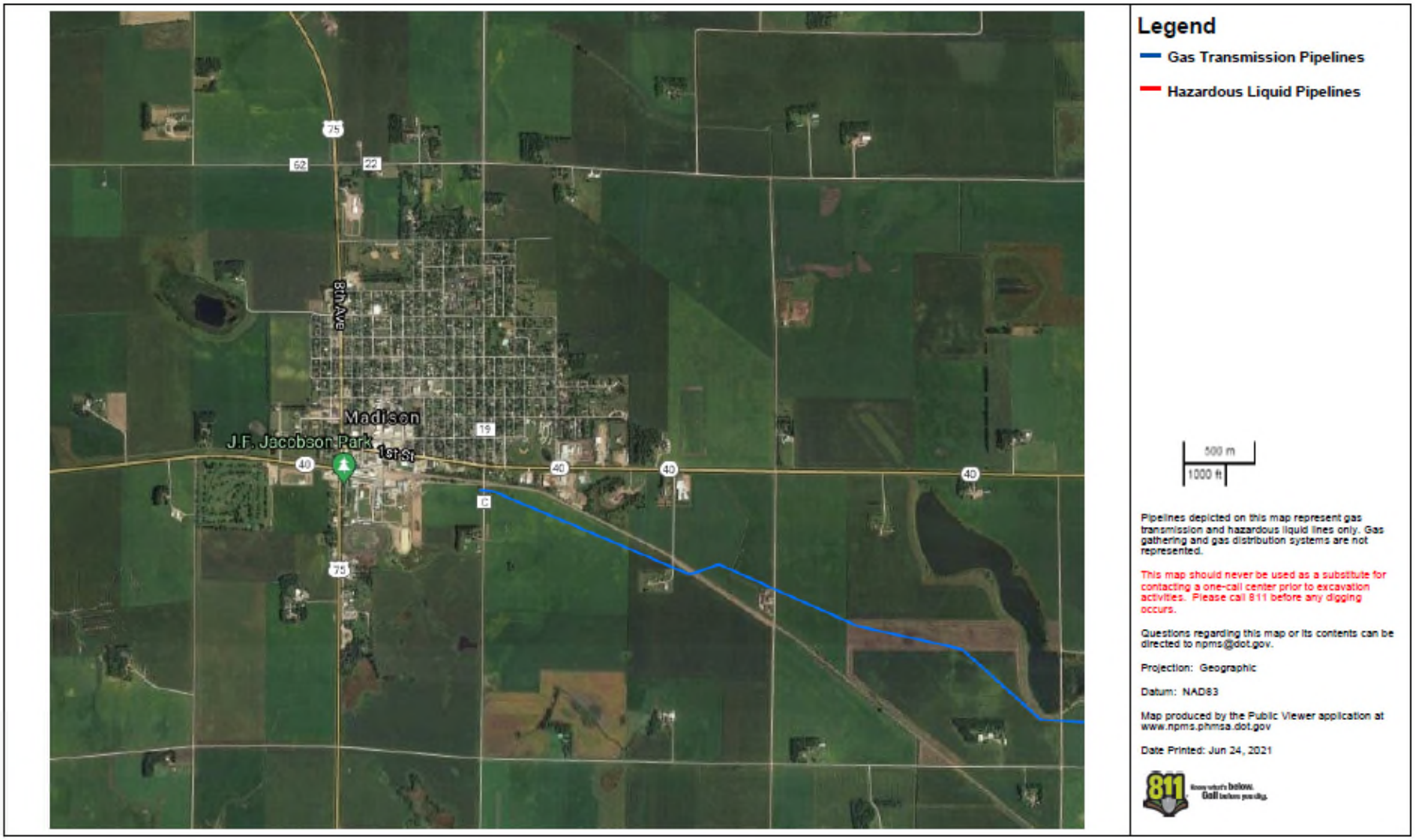


Figure D1-2

Natural Gas Pipeline Map

Exhibit E

Water Quantity and Water Quality Data

for the

City of Madison DWSMA

Exhibits

Exhibit E1 – Groundwater Quantity

Exhibit E2 – Groundwater Quality

Exhibit E1

Groundwater Quantity

DNR Source Water Protection Features near Madison

Prepared by Brent Beste, District Appropriation Hydrologist

Water Appropriation Permits

- 3 Active Groundwater Appropriation Permits
    - 1 Municipal Water Supply – City of Madison (Authorized 108 mgy)
    - 1 Golf Course Irrigation (13.3 mgy)
    - 1 Landscape Irrigation – (Authorized 1.5 mgy)

Water use has been decreasing within the Wellhead Protection Area since 1988, with a dramatic drop in the mid- 2000's.

Rare/Natural Features of Concern

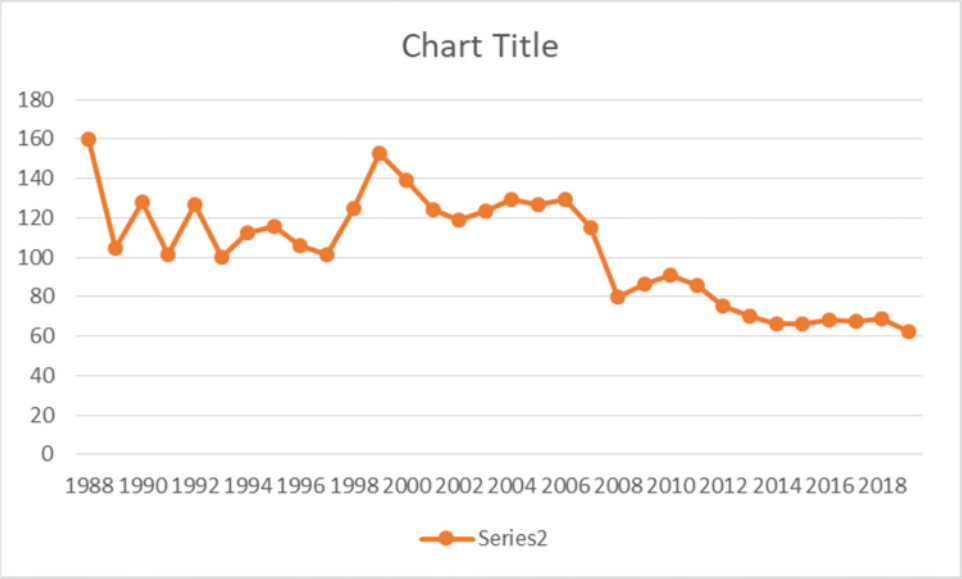
- No known calcareous fens are found in or around the Madison DWSMA

Protected Elevation

- N/A

Water Use Conflicts/Well Interferences

- No known well interference or water use conflicts near Madison



MNDNR Appropriated Groundwater Withdrawal in Madison DWSMA, 1988 – 2018

(Source: MNDNR)

Exhibit E2

Groundwater Quality Information

for the

City of Madison

Exhibits

Exhibit E2-1 – Groundwater Quality

Exhibit E2-2 – 2020 Consumer Confidence Report for the City of Madison

Exhibit E2-1

Groundwater Quality

Excerpts from the *Hydrologic Assessment of the Drinking Water Source and Wells for the City of Madison, 2019*. See Appendix B for the complete report.

Table 2 - Isotope and Water Quality Results

Unique Number (Well Name)	Tritium	Nitrate (mg/L)	Chloride (mg/L)	Bromide (mg/L)	Chloride/ Bromide Ratio	Arsenic (ug/L)
603829 (Well #4)	--	< 0.05 (8/18/2014)	6.15 (6/21/2012)	0.1 (6/21/2012)	61.5 (6/21/2012)	< 1 (6/21/2012)
(603830 (Well #5)	1.01 (3/17/2014)	< 0.05 (8/18/2014)	7.61 (6/21/2012)	0.0856 (6/21/2012)	88.9 (6/21/2012)	2.86 (6/21/2012)

Assessment of Well Vulnerability

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. Tritium was detected in a sample taken from Well #5 (603830) in 2014, confirming the vulnerable nature of the well (Alexander and Alexander, 1989). However, the tritium is quite low in concentration and is likely either the result of a small amount of recharge through a leaky portion of the clay confining unit or a well casing defect. Additionally, the chloride concentration and chloride/bromide ratio are quite low, and there have been no nitrate detections to date. This suggests that the two primary wells do have some geologic protection (Table 2).

Assessment of Drinking Water Supply Management Area Vulnerability

1. Isotopic and water chemistry data from wells located within the DWSMA indicate that the aquifer contains water that has detectable levels of tritium.
2. Review of the geologic logs contained in the CWI database, geological maps, and reports indicate that the aquifer exhibits a low geologic sensitivity throughout most of the DWSMA, with one area directly upgradient from the city's wells exhibiting moderate sensitivity.
3. Naturally-occurring contaminants have been found in the city's aquifer. Arsenic has been detected in the water from public water supply Well #5 (603830). Additionally, sulfate has been found at concentrations exceeding the 250 mg/L secondary drinking water standard. This secondary standard is based on aesthetic concerns and does not represent a health threat. The presence of naturally-occurring contaminants does not indicate that there is a direct pathway between the aquifer and potential contamination sources that occur at or near the land surface.

Water Quality Concerns

At present, none of the contaminants for which the Safe Drinking Water Act has established health-based standards is found above maximum allowable levels in the city's water supply, nor are any present at one-half of those levels. However, arsenic, a naturally-occurring contaminant, has been detected at low levels in Well #5 (603830). Sulfate, which is also naturally-occurring, exceeds the secondary drinking water standard of 250 mg/L, but this standard is based on aesthetic and not health concerns.

Exhibit E2-2

2020 Consumer Confidence Report for the City of Madison

Madison 2020 Drinking Water Report

This report contains important information about your drinking water. Have someone translate it for you, or speak with someone who understands it.

Información importante. Si no la entiende, haga que alguien se la traduzca ahora.

Making Safe Drinking Water

Your drinking water comes from a groundwater source: two wells ranging from 110 to 118 feet deep, that draw water from the Quaternary Buried Artesian aquifer.

Madison works hard to provide you with safe and reliable drinking water that meets federal and state water quality requirements. The purpose of this report is to provide you with information on your drinking water and how to protect our precious water resources.

Contact Christine Enderson, City Clerk, at (320) 598-7373 or christine.enderson@ci.madison.mn.us if you have questions about Madison's drinking water. You can also ask for information about how you can take part in decisions that may affect water quality.

The U.S. Environmental Protection Agency sets safe drinking water standards. These standards limit the amounts of specific contaminants allowed in drinking water. This ensures that tap water is safe to drink for most people. The U.S. Food and Drug Administration regulates the amount of certain contaminants in bottled water. Bottled water must provide the same public health protection as public tap water.

Drinking water, including bottled water, may reasonably be expected to contain at least small amounts of some contaminants. The presence of contaminants does not necessarily indicate that water poses a health risk. More information about contaminants and potential health effects can be obtained by calling the Environmental Protection Agency's Safe Drinking Water Hotline at 1-800-426-4791.

Madison Monitoring Results

This report contains our monitoring results from January 1 to December 31, 2020.

We work with the Minnesota Department of Health to test drinking water for more than 100 contaminants. It is not unusual to detect contaminants in small amounts. No water supply is ever completely free of contaminants. Drinking water standards protect Minnesotans from substances that may be harmful to their health.

Learn more by visiting the Minnesota Department of Health's webpage Basics of Monitoring and testing of Drinking Water in Minnesota (https://www.health.state.mn.us/communities/environment/water/factsheet/sampling.html).

How to Read the Water Quality Data Tables

The tables below show the contaminants we found last year or the most recent time we sampled for that contaminant. They also show the levels of those contaminants and the Environmental Protection Agency's limits. Substances that we tested for but did not find are not included in the tables.

We sample for some contaminants less than once a year because their levels in water are not expected to change from year to year. If we found any of these contaminants the last time we sampled for them, we included them in the tables below with the detection date.

We may have done additional monitoring for contaminants that are not included in the Safe Drinking Water Act. To request a copy of these results, call the Minnesota Department of Health at 651-201-4700 or 1-800-818-9318 between 8:00 a.m. and 4:30 p.m., Monday through Friday.

Explaining Special Situations for the Highest Result and Average

Some contaminants are monitored regularly throughout the year, and rolling (or moving) annual averages are used to manage compliance. Because of this averaging, there are times where the Range of Detected Test Results for the calendar year is lower than the Highest Average or Highest Single Test Result, because it occurred in the previous calendar year.

Definitions

- **AL (Action Level)**: The concentration of a contaminant which, if exceeded, triggers treatment or other requirements which a water system must follow.
- **EPA:** Environmental Protection Agency
- **MCL (Maximum contaminant level)**: The highest level of a contaminant that is allowed in drinking water. MCLs are set as close to the MCLGs as feasible using the best available treatment technology.
- **MCLG (Maximum contaminant level goal)**: The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety.
- **MRDL (Maximum residual disinfectant level):** The highest level of a disinfectant allowed in drinking water. There is convincing evidence that addition of a disinfectant is necessary for control of microbial contaminants.
- **MRDLG (Maximum residual disinfectant level goal)**: The level of a drinking water disinfectant below which there is no known or expected risk to health. MRDLGs do not reflect the benefits of the use of disinfectants to control microbial contaminants.
- **N/A (Not applicable)**: Does not apply.
- **ppb (parts per billion)**: One part per billion in water is like one drop in one billion drops of water, or about one drop in a swimming pool. ppb is the same as micrograms per liter (µg/l).
- **ppm (parts per million)**: One part per million is like one drop in one million drops of water, or about one cup in a swimming pool. ppm is the same as milligrams per liter (mg/l).
- **PWSID**: Public water system identification.

Monitoring Results – Regulated Substances

LEAD AND COPPER – Tested at customer taps.

Contaminant (Date, if sampled in previous year)	**EPA's Ideal Goal** (MCLG)	**EPA's Action Level**	**90% of Results Were Less Than**	**Number of Homes with High Levels**	**Violation**	**Typical Sources**
Lead (07/17/18)	0 ppb	90% of homes less than 15 ppb	<2 ppb	0 out of 10	NO	Corrosion of household plumbing.
Copper (07/17/18)	0 ppm	90% of homes less than 1.3 ppm	0.61 ppm	0 out of 10	NO	Corrosion of household plumbing.

INORGANIC & ORGANIC CONTAMINANTS – Tested in drinking water.

Contaminant (Date, if sampled in previous year)	**EPA's Ideal Goal** (MCLG)	**EPA's Limit** (MCL)	**Highest Average or Highest Single Test Result**	**Range of Detected Test Results**	**Violation**	**Typical Sources**
Nitrate	10 ppm	10.4 ppm	0.98 ppm	N/A	NO	Runoff from fertilizer use; Leaching from septic tanks, sewage; Erosion of natural deposits.

CONTAMINANTS RELATED TO DISINFECTION – Tested in drinking water.

Substance (Date, if sampled in previous year)	**EPA's Ideal Goal** (MCLG or MRDLG)	**EPA's Limit** (MCL or MRDL)	**Highest Average or Highest Single Test Result**	**Range of Detected Test Results**	**Violation**	**Typical Sources**
Total Trihalomethanes (TTHMs)	N/A	80 ppb	6 ppb	N/A	NO	By-product of drinking water disinfection.
Total Haloacetic Acids (HAA)	N/A	60 ppb	4.1 ppb	N/A	NO	By-product of drinking water disinfection.
Total Chlorine	4.0 ppm	4.0 ppm	0.59 ppm	0.29 - 0.74 ppm	NO	Water additive used to control microbes.

Total HAA refers to HAA5

OTHER SUBSTANCES – Tested in drinking water.

Substance (Date, if sampled in previous year)	**EPA's Ideal Goal** (MCLG)	**EPA's Limit** (MCL)	**Highest Average or Highest Single Test Result**	**Range of Detected Test Results**	**Violation**	**Typical Sources**
Fluoride	4.0 ppm	4.0 ppm	1.3 ppm	1.20 - 1.30 ppm	NO	Erosion of natural deposits; Water additive to promote strong teeth.

Some People Are More Vulnerable to Contaminants in Drinking Water

Some people may be more vulnerable to contaminants in drinking water than the general population. Immuno-compromised persons such as persons with cancer undergoing chemotherapy, persons who have undergone organ transplants, people with HIV/AIDS or other immune system disorders, some elderly, and infants can be particularly at risk from infections. The developing fetus and therefore pregnant women may also be more vulnerable to contaminants in drinking water. These people or their caregivers should seek advice about drinking water from their health care providers. EPA/Centers for Disease Control (CDC) guidelines on appropriate means to lessen the risk of infection by *Cryptosporidium* and other microbial contaminants are available from the Safe Drinking Water Hotline at 1-800-426-4791.

Learn More about Your Drinking Water

Drinking Water Sources

Minnesota's primary drinking water sources are groundwater and surface water. Groundwater is the water found in aquifers beneath the surface of the land. Groundwater supplies 75 percent of Minnesota's drinking water. Surface water is the water in lakes, rivers, and streams above the surface of the land. Surface water supplies 25 percent of Minnesota's drinking water.

Contaminants can get in drinking water sources from the natural environment and from people's daily activities. There are five main types of contaminants in drinking water sources.

- **Microbial contaminants,** such as viruses, bacteria, and parasites. Sources include sewage treatment plants, septic systems, agricultural livestock operations, pets, and wildlife.
- **Inorganic contaminants** include salts and metals from natural sources (e.g. rock and soil), oil and gas production, mining and farming operations, urban stormwater runoff, and wastewater discharges.
- **Pesticides and herbicides** are chemicals used to reduce or kill unwanted plants and pests. Sources include agriculture, urban stormwater runoff, and commercial and residential properties.
- **Organic chemical contaminants** include synthetic and volatile organic compounds. Sources include industrial processes and petroleum production, gas stations, urban stormwater runoff, and septic systems.
- **Radioactive contaminants** such as radium, thorium, and uranium isotopes come from natural sources (e.g. radon gas from soils and rock), mining operations, and oil and gas production.

The Minnesota Department of Health provides information about your drinking water source(s) in a source water assessment, including:

- How Madison is protecting your drinking water source(s);
- Nearby threats to your drinking water sources;
- How easily water and pollution can move from the surface of the land into drinking water sources, based on natural geology and the way wells are constructed.

Find your source water assessment at Source Water Assessments (https://www.health.state.mn.us/communities/environment/water/swp/swa) or call 651-201-4700 or 1-800-818-9318 between 8:00 a.m. and 4:30 p.m., Monday through Friday.

Lead in Drinking Water

You may be in contact with lead through paint, water, dust, soil, food, hobbies, or your job. Coming in contact with lead can cause serious health problems for everyone. There is no safe level of lead. Babies, children under six years, and pregnant women are at the highest risk.

Lead is rarely in a drinking water source, but it can get in your drinking water as it passes through lead service lines and your household plumbing system. Madison is responsible for providing high quality drinking water, but it cannot control the plumbing materials used in private buildings.

Read below to learn how you can protect yourself from lead in drinking water.

1. **Let the water run** for 30-60 seconds before using it for drinking or cooking if the water has not been turned on in over six hours. If you have a lead service line, you may need to let the water run longer. A service line is the underground pipe that brings water from the main water pipe under the street to your home.
    - You can find out if you have a lead service line by contacting your public water system, or you can check by following the steps at: https://www.mprnews.org/story/2016/06/24/npr-find-lead-pipes-in-your-home
    - The only way to know if lead has been reduced by letting it run is to check with a test. If letting the water run does not reduce lead, consider other options to reduce your exposure.
2. **Use cold water** for drinking, making food, and making baby formula. Hot water releases more lead from pipes than cold water.
3. **Test your water.** In most cases, letting the water run and using cold water for drinking and cooking should keep lead levels low in your drinking water. If you are still concerned about lead, arrange with a laboratory to test your tap water. Testing your water is important if young children or pregnant women drink your tap water.
    - Contact a Minnesota Department of Health accredited laboratory to get a sample container and instructions on how to submit a sample:
      Environmental Laboratory Accreditation Program
      (https://eldo.web.health.state.mn.us/public/accreditedlabs/labsearch.seam)
      The Minnesota Department of Health can help you understand your test results.
4. **Treat your water** if a test shows your water has high levels of lead after you let the water run.
    - Read about water treatment units:
      Point-of-Use Water Treatment Units for Lead Reduction
      (https://www.health.state.mn.us/communities/environment/water/factsheet/poulead.html)

Learn more:

- Visit Lead in Drinking Water (https://www.health.state.mn.us/communities/environment/water/contaminants/lead.html)
- Visit Basic Information about Lead in Drinking Water (http://www.epa.gov/safewater/lead)
- Call the EPA Safe Drinking Water Hotline at 1-800-426-4791.To learn about how to reduce your contact with lead from sources other than your drinking water, visit Lead Poisoning Prevention: Common Sources (https://www.health.state.mn.us/communities/environment/lead/sources.html).

Help Protect Our Most Precious Resource – Water

The Value of Water

Drinking water is a precious resource, yet we often take it for granted.

Throughout history, civilizations have risen and fallen based on access to a plentiful, safe water supply. That's still the case today. Water is key to healthy people and healthy communities.

Water is also vital to our economy. We need water for manufacturing, agriculture, energy production, and more. One-fifth of the U.S. economy would come to a stop without a reliable and clean source of water.

Systems are in place to provide you with safe drinking water. The state of Minnesota and local water systems work to protect drinking water sources. For example, we might work to seal an unused well to prevent contamination of the groundwater. We treat water to remove harmful contaminants. And we do extensive testing to ensure the safety of drinking water.

If we detect a problem, we take corrective action and notify the public. Water from a public water system like yours is tested more thoroughly and regulated more closely than water from any other source, including bottled water.

Conservation

Conservation is essential, even in the land of 10,000 lakes. For example, in parts of the metropolitan area, groundwater is being used faster than it can be replaced. Some agricultural regions in Minnesota are vulnerable to drought, which can affect crop yields and municipal water supplies.

We must use our water wisely. Below are some tips to help you and your family conserve – and save money in the process.

- Fix running toilets—they can waste hundreds of gallons of water.
- Turn off the tap while shaving or brushing your teeth.
- Shower instead of bathe. Bathing uses more water than showering, on average.
- Only run full loads of laundry, and set the washing machine to the correct water level.
- Only run the dishwasher when it's full.
- Use water-efficient appliances (look for the WaterSense label).
- Use water-friendly landscaping, such as native plants.
- When you do water your yard, water slowly, deeply, and less frequently. Water early in the morning and close to the ground.
- Learn more
  - Minnesota Pollution Control Agency's Conserving Water webpage (https://www.pca.state.mn.us/living-green/conserving-water)
  - U.S. Environmental Protection Agency's WaterSense webpage (https://www.epa.gov/watersense)

Home Water Treatment

The Pros and Cons of Home Water Softening

When considering whether to use a water softener, contact your public water system to find out if you have hard water. Many systems treat for hardness, making water softeners unnecessary.

Water softeners are a water treatment device. They remove water hardness (dissolved calcium and magnesium). Water softeners must be installed and maintained properly to be safe and effective. Learn more at Home Water Softening (https://www.health.state.mn.us/communities/environment/water/factsheet/softening.html).

The benefits of soft water include:

- Increased efficiency for soaps and detergents.
- Reduction in mineral staining on fixtures and in pipes.
- A potential increase in the lifespan of water heaters.

The drawbacks of soft water include:

- Operation and maintenance costs.
- More sodium. People on low-sodium diets should consult a doctor if they plan to regularly consume softened water.
- The production of salt brine as a byproduct. This can have negative effects at wastewater treatment plants and on ecosystems. Reduce the amount of salt brine used or install a salt-free system.

Appendix B

Part 1 - Wellhead Protection Plan
City of Madison

Hydrogeologic Assessment of the Drinking Water source and Wells for the City of Madison

Delineation - Wellhead Protection Area and Drinking Water Supply Management Area

Vulnerability Assessments - Wells and Drinking Water Supply Management Area Vulnerability Assessment.

(June 5, 2019, by Yarta Clemens-Billaigbakpu and Tracy Lund, MDH)

Hydrogeologic Assessment of the Drinking Water Source and Wells for the City of Madison

DELINEATIONS – WELLHEAD PROTECTION AREA AND DRINKING WATER SUPPLY MANAGEMENT AREA

VULNERABILITY ASSESSMENTS – WELLS AND DRINKING WATER SUPPLY MANAGEMENT AREA

June 5, 2019

Hydrogeologic Assessment of the Drinking Water Source and Wells for the City of Madison

Public Water Supply ID: 1370004

City of Madison
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Madison, Minnesota 56256
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madison@ci.madison.mn.us
https://ci.madison.mn.us

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Signature: _____ Date: _____

Printed Name: Tracy Lund License Number: 50716

I hereby certify that this plan, document or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Geologist under the laws of the State of Minnesota.

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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

MODFLOW - Three-Dimensional Finite-Difference Groundwater Model

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

Summary

Protection Areas - The recharge area for the wells is known as the wellhead protection area, or WHPA, and represents the area that contributes water to the city's wells within a 10-year time period. The area that contributes water within a one-year time period is known as the emergency response area, or ERA. Practical reasons require the designation of a management area that fully envelops the wellhead protection area, called the drinking water supply management area, or DWSMA. Each of these areas is shown in Figure 1.

Geology and Groundwater Flow – The city of Madison has two primary wells screened in a sand and gravel aquifer that is buried beneath a layer of clay-rich sediment. Such aquifers are known generically as Quaternary Buried Artesian Aquifers (QBAA). The city's aquifer is between approximately 87 and 119 feet below the ground surface (Table 1). Regionally, groundwater flow is to the east.

Table 1 - Water Supply Well Information

Local Well ID	Unique Number	Use/ Status	Casing Diameter (inches)	Casing Depth (feet)	Well Depth (feet)	Date Constructed	Aquifer	Well Vulnerability
Well #4	603829	Primary	12	98	118	1997	QBAA	Vulnerable
Well #5	603830	Primary	12	90	110	1998	QBAA	Vulnerable

Well Vulnerability - The vulnerability of each well has been assessed based on 1) well construction details, especially conformance with standards required by the state well code, 2) the geologic sensitivity of the aquifer, and 3) past monitoring results. Both wells meet construction standards. The wells are considered vulnerable to contamination due to a small amount of tritium being detected in the well water (Table 2). Detectable tritium indicates the presence of young (post-1953) water. However, low-level results like the one seen at Well #5 reflect that most of the water in the aquifer is pre-1953 in age.

Table 2 - Isotope and Water Quality Results

Unique Number (Well Name)	Tritium	Nitrate (mg/L)	Chloride (mg/L)	Bromide (mg/L)	Chloride/ Bromide Ratio	Arsenic (ug/L)
603829 (Well #4)	--	< 0.05 (8/18/2014)	6.15 (6/21/2012)	0.1 (6/21/2012)	61.5 (6/21/2012)	< 1 (6/21/2012)
(603830 (Well #5)	1.01 (3/17/2014)	< 0.05 (8/18/2014)	7.61 (6/21/2012)	0.0856 (6/21/2012)	88.9 (6/21/2012)	2.86 (6/21/2012)

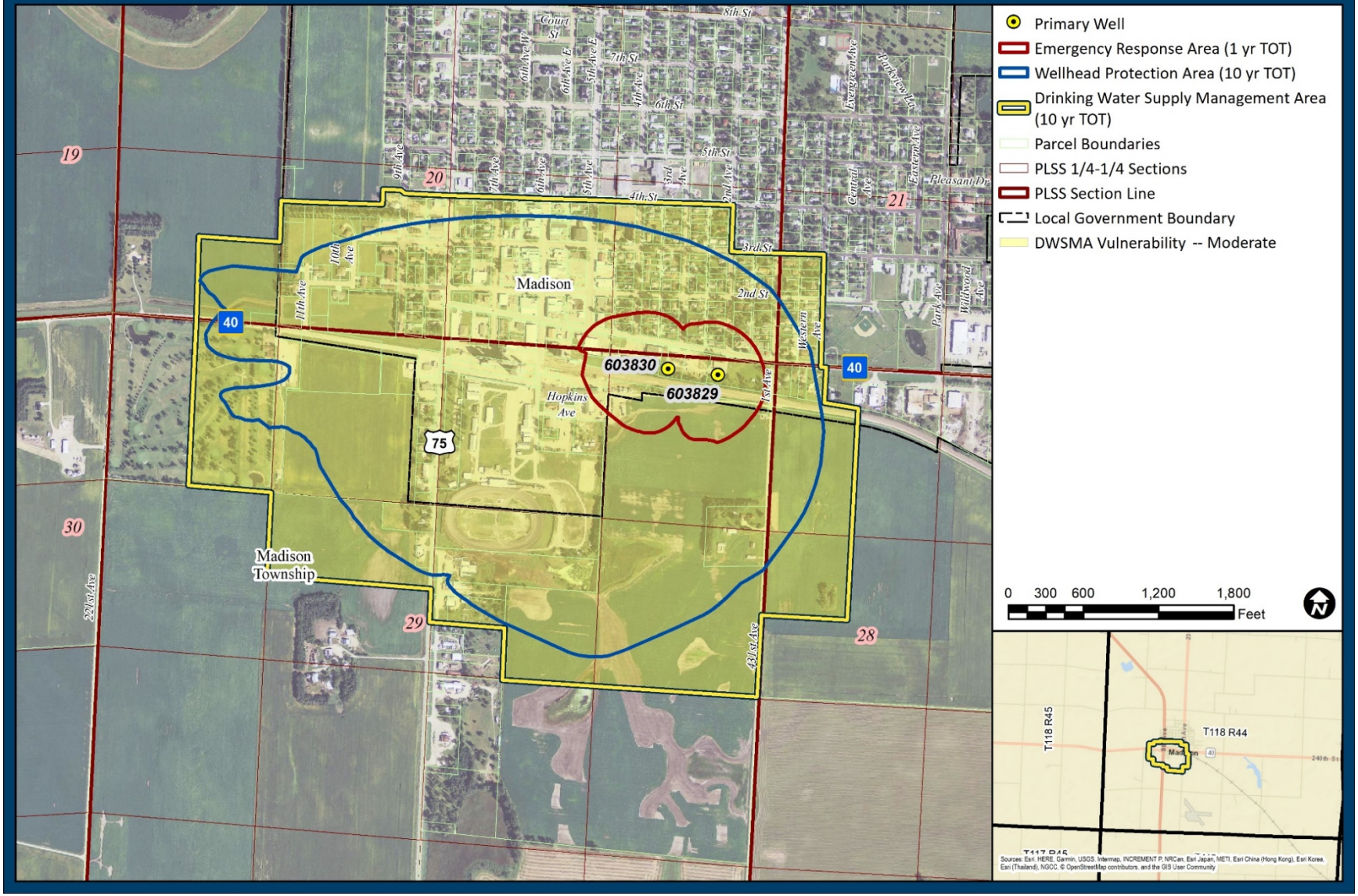
DWSMA Vulnerability - The vulnerability of the city's aquifer throughout the DWSMA is based on the geologic sensitivity ratings of wells and their monitoring data (Table 2). Based on this information, MDH has assigned a moderate vulnerability to the DWSMA. This suggests that water and contaminants may travel from the land surface to the city's aquifer within a time span of years to decades. This rating reflects uncertainty about the pathway for young water reaching Well #5 (603830). Although this may be the result of a well casing problem, for the time being it is assumed that the clay-rich sediments that overlie the city's aquifer are leaky. Moderately vulnerable aquifers are prone to a variety of contaminant threats, including chemical storage tanks and abandoned wells which can provide conduits for contaminants to quickly reach the city's aquifer.

Water Quality Concerns - At present, none of the contaminants for which the Safe Drinking Water Act has established health-based standards is found above maximum allowable levels in the city's water supply, nor are any present at one-half of those levels. However, arsenic, a naturally-occurring contaminant, has been detected at low levels in Well #5 (603830). Sulfate, which is also naturally-occurring, exceeds the secondary drinking water standard of 250 mg/L, but this standard is based on aesthetic and not health concerns.

Recommendations - Recommendations have been generated to improve future delineations and vulnerability assessments and should be considered for inclusion as management strategies in the city's wellhead protection plan. These activities include: well locating, water quality monitoring, and well downhole inspection. Further details can be found in the Recommendations section of this report.

Lac Qui Parle County
Minnesota

Figure 1
Drinking Water Supply Management Area and Vulnerability
City of Madison



Technical Report

Discussion

The Minnesota Department of Health (MDH) developed Part I of the wellhead protection (WHP) plan at the request of the city of Madison (PWSID 1370004). 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 one-year time of travel. Definitions of rule-specific terms used are provided in the "Glossary of Terms."

In addition, this report documents the technical information required to prepare this portion of the WHP plan in accordance with the Minnesota Wellhead Protection Rule. Additional technical information is available from MDH.

Table 1 lists all the wells in the public water supply system. Only wells listed as primary are required to be included in the WHP plan.

Assessment of the Data Elements

MDH staff met with representatives of the city of Madison on September 20, 2016, for a scoping meeting that identified the data elements required to prepare Part I of the WHP plan. Appendix A presents the assessment of these data elements relative to the present and future implications of planning items specified in Minnesota Rules, part 4720.5210.

General Descriptions

Description of the Water Supply System

The city of Madison obtains its drinking water supply from two primary wells. Table 1 summarizes information regarding them.

Description of the Hydrogeologic Setting

The city of Madison draws groundwater from the Quaternary Buried Artesian Aquifer. The *Lac Qui Parle County Geologic Atlas* has not yet been published, but a satisfactory amount of well data is available here. The city's aquifer is about 22-24 feet thick and the top of the aquifer is

between 73 and 96 feet below land surface in the area surrounding the city. The aquifer is primarily sand and gravel, and is found just above the Cretaceous sedimentary bedrock in the area. Sediments overlying the aquifer are mostly clay to sandy clay till, which serve as a somewhat leaky confining unit. Local groundwater flow is eastward, toward the Minnesota River. The aquifer appears to be somewhat limited in lateral extent, however other similar sand and gravel units exist at similar depth throughout the modeled domain. Porosity within the aquifer is likely similar to other sand and gravel aquifers in the area, ranging between 20 and 30 percent.

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

Table 3 - Description of the Local Hydrogeologic Setting

Attribute	Descriptor	Data Source
Aquifer Material	Sand and gravel	CWI
Porosity Type and Value	Primary: 25 percent	Fetter, 2001
Aquifer Thickness	Between 16 and 53 feet thick in wells in close proximity to the city, 22 to 24 feet thick in the city's wellfield	CWI
Stratigraphic Top Elevation	Between 977 – 1,010 feet AMSL in wells in close proximity to the city, 992 – 1,008 in logs from the city's wells.	CWI
Stratigraphic Bottom Elevation	Between 957 – 976 feet AMSL where the aquifer has been through-drilled. 966 – 976 feet AMSL in logs from the city's wells.	CWI
Hydraulic Confinement	Confined to leaky confined	CWI
Transmissivity	Range of Values: 2,700-8,100 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: 120-360 ft/day	The range of values was derived using specific capacity data obtained from local public water supply well records and results of an aquifer test conducted on the city's wells.
Groundwater Flow Field	Groundwater flow is toward the east near the city wells, with an approximate compass direction of 75-85˚ and gradient of 0.0015 (Figure 2).	Defined by using static water level elevations from well records in the CWI database and documents listed in the "Selected References" section of this report.

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

Delineation of the Wellhead Protection Area

Delineation Criteria

The boundaries of the WHPA for the city of Madison are shown in Figure 1. Table 4 describes how the delineation criteria 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	Ditches and shallow ponds in near field	Data was obtained from MnGEO and features were simulated in the flow model.
Flow Boundary	West Lac Qui Parle and Lac Qui Parle Rivers	Data was obtained from MnGEO, USGS, and DNR and features were simulated in the flow model.
Flow Boundary	Other High Capacity Wells	Two additional high-capacity wells were input into the model, the pumping volumes for which are listed in Table 6.
Daily Volume of Water Pumped	See Table 5	Pumping information was obtained from the DNR, Appropriations Permit Number 1984-4175, and was converted to a daily volume pumped by each well.
Groundwater Flow Field	Groundwater flow is toward the east near the city wells, with an approximate compass direction of 75-85˚ and gradient of 0.0015 (Figure 2).	The groundwater flow field was determined from local well data and rivers and ditches that were input into MODFLOW. Capture zones were calculated based on the model flow field.
Aquifer Transmissivity	Reference Value: 5,400 ft^2/day	The aquifer test plan was approved on April 24, 2019, and T was determined from an aquifer test, with some comparison to area specific capacity tests. Uncertainty regarding aquifer transmissivity was addressed as described in the "Addressing Model Uncertainty" section.
Time of Travel	10 years	The public water supplier selected a 10-year time of travel.

Pumping data was obtained from the DNR Permit and Reporting System (MPARS) for the public water supply's Appropriations Permit Number 1984-4175. These values, confirmed by the public water supplier, were used to identify the maximum volume of water pumped annually by each well over the previous five-year period, as shown in Table 5. An estimate of the pumping

for the next five years is also shown. 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. Note that the values as reported in MPARS have been split equally between the two wells.

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

Well Name	Unique Number	2013	2014	2015	2016	2017	Future Pumping	Daily Volume (cubic meters)
Well #4	603829	**31.967**	29.989	31.258	31.401	31.615	No change	331.3
Well #5	603830	**31.967**	29.989	31.258	31.401	31.615	No change	331.3
System Total		**63.934**	59.979	62.515	62.801	63.229	No change	662.6

(Expressed as millions of 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 included in the flow model to account for their pumping impacts on the capture areas for the public water supply wells. Pumping data was obtained from the DNR MPARS database.

Table 6 - Other Permitted High-Capacity Wells

Unique Number	Well Name	DNR Permit Number	Aquifer	Use	Annual Volume of Water Pumped (millions of gallons)	Daily Volume (cubic meters)
409993	Madison Country Club	1984-4223	QBAA	Golf Course Irrigation	Maximum: 6.2 (2014) Average: 4.5	46
269277	City of Madison	2013-0318	QUUU	Landscaping/ Athletic Field Irrigation	Maximum: 1.1 (2017) Average: 0.8	12

Method Used to Delineate the Wellhead Protection Area

The WHPA for the city of Madison's wells was determined using the software code MODFLOW (McDonald and Harbaugh, 1988; Harbaugh et al., 2000; Harbaugh, 2005). The resulting WHPA boundaries are a composite of the capture zones calculated from several different model scenarios (Figure 1).

MODFLOW was developed by the United States Geological Survey and is publicly available. The specific software code used for this delineation was MODFLOW-2005 (Harbaugh, 2005). The program has been thoroughly documented, is widely used by consultants, government

agencies, and researchers and consistently accepted in regulatory proceedings. MODFLOW is also an extremely versatile program capable of simulating groundwater flow in up to three dimensions while offering a variety of boundary condition options, confined or unconfined aquifer conditions, and allowing for vertical discretization through the use of layering.

The numerical groundwater model that was constructed consisted of 119 rows, 229 columns, and three layers. The model incorporates a variable areal grid spacing ranging from two meters near the city's wells and grading to 500 meters at the boundaries of the model domain. Layer tops and bottoms were derived from CWI logs within the model domain.

Hydraulic conductivity was modeled as zones, with zone values determined through analysis of well logs throughout the model domain. These zones were assigned values representing clay, silt, fine sand, and gravel. Representative, literature-derived hydraulic conductivity values were assigned to the clay, silt and fine sand zones; the reference value cited in Table 3 was used for the gravel zone. Layer 1 geology was interpreted as mostly clay zones, with smaller discreet silty zones. Layer 2 geology is zoned mostly as clay and silt in and around the city's wellfield, with fine sand and gravel zones mostly to the west. Layer 3, which contains the city's aquifer, is mostly zoned as fine sand and gravel, with some isolated clay and silt zones in the far-field throughout the model domain. The city wells are both in a gravelly zone, however a sandy zone was modeled near the wells, as per well log data around the city.

River head boundaries represent cells where water is flowing both into and out of the aquifer and were used to simulate the many lakes and rivers within the model domain within Layer 1. Drain head boundaries represent cells where water is flowing out of the aquifer and were used to simulate most of the ditches within the model domain in Layer 1. Vertical recharge was applied to Layer 1 of the model using modified values published by the U.S Geological Survey (Delin et al., 2007).

The Lac qui Parle and West Lac qui Parle Rivers are both in the domain as river cells. Two apparently unnamed ditches and creeks to the west of Madison were also expressed as rivers; all other ditches were modeled as drains. The variation was due to questions about how well connected the ditches actually are to deep groundwater, as they were constructed to drain agricultural land. Wetlands and ponds near the city were also expressed as river cells. Recharge was assigned as 0.2 inches per year in the model, which represents 10-20% of the recharge values published by Delin et al. (2007). General head boundaries were imposed at the edges of the model domain to facilitate flow into and out of the model in the West Lac qui Parle and Lac qui Parle Rivers; all three of these boundaries are sufficiently far from the city's wells to ensure that they have no impact on the flow field around the wellfield.

To determine the WHPA, the groundwater flow model was used along with a particle tracking program called MODPATH (Pollock, 2012). MODPATH is used to evaluate advective transport of simulated particles moving through the simulated flow system. A series of 50 particles were launched at each well. A porosity of 25 percent was used and a reverse time of travel was calculated at 10 years.

Representative aquifer parameters were used in the base case model scenario. Additional modeling scenarios using MODFLOW were then simulated using reasonable estimations of parameters to demonstrate model sensitivity and to reflect uncertainty conditions, which are addressed in the next section. The model parameters for all model runs are listed in Table 7.

The combined output of all model results were composited to create the final WHPA (Figure 6).

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 and/or flux. The sensitivity analysis quantifies the differences in model results produced by the natural variability of a particular parameter. Uncertainty analysis addresses the effects of poor data quality (lack of local detailed information or deficiencies in the data) on the model results. Together, sensitivity and uncertainty analyses are commonly used to evaluate the effects that natural variability and uncertainties in the hydrogeologic data have on the size and shape of the capture zones. In regards to the WHPA delineation, these analyses are used to document that the delineation is optimal, conservative, and protective of public health based on existing information.

Model Calibration

A qualitative evaluation of the calibration can be made by comparing the simulated potentiometric surface (Figure 7) with observed water level targets obtained from the CWI database. Upon review the calibrated flow model generally captures the major features of the groundwater flow system along with the elevation, shape, magnitude, and gradient of the CWI database observed flow field.

A quantitative measure by which to evaluate the success obtained during calibration is to compare the root mean square of the residuals (RMSE) and the maximum observed head difference of the calibration dataset. The calibration dataset included water level information from wells throughout the model domain. The residual root mean square (RMS) error of the calibration well set was approximately 2.78 meters with a normalized RMSE of 9.2 percent. It is noted that this error is less than the calibration target of 15 percent (Anderson et al., 2015) and conforms with current MDH guidance on model calibration (MDH, 2018). The calibration targets (wells) with the greatest residual difference between measured and simulated heads were generally at locations beyond the contribution area to the city's wells.

Sensitivity Analysis

Model sensitivity is the amount of change in model results caused by the variation of a particular input parameter. Because of the relative simplicity of this particular MODFLOW 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 and an expanded capture zone, proportional to the porosity of the aquifer materials.

  How Addressed and Results – The pumping rate is based on the results presented in Table 5 and, therefore, is not considered a variable factor that will influence the delineation of the WHPA. The modeled pumping rate is based on the largest annual pumping during the last five years of record, as shown in Table 5, and therefore the sensitivity of the delineation to this parameter is assumed to be minimal when compared with the other parameters discussed below.

- The **direction of groundwater flow** determines the orientation of the capture zone. 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 contributing water to the well.

  How Addressed and Results – General flow direction was determined based upon static water levels of similarly screened wells in the area of the model. Overall, the sensitivity of the WHPA to the direction of groundwater flow should not be significant, given the current knowledge of the hydraulic head distribution in the aquifer.

- The **hydraulic gradient** (along with aquifer hydraulic conductivity) determines the rate at which water moves through the aquifer materials.

  How Addressed and Results – The flow field shown 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 each well. The regional model has been calibrated to hydraulic heads. The sensitivity of the WHPA to the hydraulic gradient should not be significant given the current knowledge of the hydraulic head distribution in the aquifer.

- The **hydraulic conductivity** influences the size and shape of the capture zone. A decrease in hydraulic conductivity 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 on the well.

  How Addressed and Results – Initial hydraulic conductivity was calculated from an aquifer test conducted on the city's wells. The values were combined with literature values for other geologic materials found in the area to fully characterize the geologic materials throughout the model domain. Four additional model runs were performed wherein the hydraulic conductivities of the sand and gravel zones in the city's aquifer were decreased/increased by 50 percent to account for uncertainty in this parameter. These additional model runs were conducted to address the uncertainty that the close proximity of a

more sand-dominated zone of the aquifer may impart on the capture zone. This resulted in slight changes to the well capture zones, which were composited together with the base case to create the city's WHPA.

- The **aquifer porosity** influences the size and shape of the capture zone.

  How Addressed and Results – Decreasing the porosity causes a linear, proportional increase in the areal extent of the capture zone. A literature value of 25 percent was used for the delineation and this value was not varied (Fetter, 2001).

- The **aquifer thickness** influences the size and shape of the capture zone.

  How Addressed and Results – Final aquifer thicknesses used in this model were the result of a multi-step statistical analysis. A cross-sectional analysis was done to determine the thicknesses of the aquifer at well points throughout the modeled extent. Layer thicknesses were interpolated between wells and unrealistic values were identified and disposed of at all steps by comparing with adjacent well data, where available, and by using hydrogeologic judgment. As a result, the model layering closely follows the overall stratigraphy through the region.

Addressing Model Uncertainty

Using computer models to simulate groundwater flow involves representing a complicated natural system in a simplified manner. Local geologic conditions may vary within the capture areas of the public water supply wells, but the amount of existing information 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.

The steps employed for this delineation to address model uncertainty were:

1. Pumping Rate – For each well, a maximum historical (five-year) pumping rate or an engineering estimate of future pumping, whichever is greater (Minnesota Rules, part 4720.5510, subpart 4).
2. Aquifer Hydraulic Conductivity – Hydraulic conductivity was adjusted plus and minus 50 percent for both the sand and gravel textured zones in the city's aquifer.

Capture areas were developed for a range of hydraulic conductivities and times of travel of one and 10 years (Figure 6). As the model code uses constant input values for each run, several runs were required to include all variations in input parameters. Table 7 documents the variables used to address MODFLOW uncertainty.

Table 7 - Model Parameters Used in MODFLOW Base Case and Uncertainty Runs

File Name	Proximal to City Wells Hydraulic Conductivity in Layer 3 (m/day)	Porosity (%)	Remarks
Mad_3.gwv	82.3 in gravel (Zone 4) 50 in sand (Zone 3)	25	Calibrated steady-state model used as base case scenario
Mad_3.gwv	41.1 in gravel (Zone 4) 50 in sand (Zone 3)	25	Calibrated steady-state model with Zone 4 Kx, Ky, and Kz multiplied by 0.5
Mad_3.gwv	41.1 in gravel (Zone 4) 25 in sand (Zone 3)	25	Calibrated steady-state model with Kx, Ky, and Kz for Zones 3 and 4 multiplied by 0.5
Mad_3.gwv	123.4 in gravel (Zone 4) 50 in sand (Zone 3)	25	Calibrated steady-state model with Zone 4 Kx, Ky, and Kz multiplied by 1.5
Mad_3.gwv	123.4 in gravel (Zone 4) 75 in sand (Zone 3)	25	Calibrated steady-state model with Kx, Ky, and Kz for Zones 3 and 4 multiplied by 1.5

Conjunctive Delineation

The vulnerability of the DWSMA is moderate. Therefore, according to current guidance there is no need for a conjunctive delineation for this DWSMA.

Delineation of the Drinking Water Supply Management Area

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

- Center-lines of highways, streets, or roads
- Public Land Survey coordinates
- Property or fence lines
- Political boundaries

Vulnerability Assessments

The Part I wellhead protection plan includes the vulnerability assessments for the city of Madison'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.

Assessment of Well Vulnerability

The vulnerability assessments for each well used by the city of Madison 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 wells themselves should not provide pathways for contaminants to enter the aquifer used by the public water supplier.
2. The geologic conditions at the well site include a cover of clay-rich geologic materials over the aquifer, however it is not sufficient to completely prevent 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. Tritium was detected in a sample taken from Well #5 (603830) in 2014, confirming the vulnerable nature of the well (Alexander and Alexander, 1989). However, the tritium is quite low in concentration and is likely either the result of a small amount of recharge through a leaky portion of the clay confining unit or a well casing defect. Additionally, the chloride concentration and chloride/bromide ratio are quite low, and there have been no nitrate detections to date. This suggests that the two primary wells do have some geologic protection (Table 2).

Assessment of Drinking Water Supply Management Area Vulnerability

The vulnerability of the DWSMA is shown in Figure 8 and is based upon the following information:

1. Isotopic and water chemistry data from wells located within the DWSMA indicate that the aquifer contains water that has detectable levels of tritium.
2. Review of the geologic logs contained in the CWI database, geological maps, and reports indicate that the aquifer exhibits a low geologic sensitivity throughout most of the DWSMA, with one area directly upgradient from the city's wells exhibiting moderate sensitivity.
3. Naturally-occurring contaminants have been found in the city's aquifer. Arsenic has been detected in the water from public water supply Well #5 (603830). Additionally, sulfate has been found at concentrations exceeding the 250 mg/L secondary drinking water standard. This secondary standard is based on aesthetic concerns and does not represent a health threat. The presence of naturally-occurring contaminants does not indicate that there is a direct pathway between the aquifer and potential contamination sources that occur at or near the land surface.

Therefore, given the information currently available, it is prudent to assign a moderate vulnerability rating to the DWSMA, in accordance with the Minnesota Wellhead Protection Rule (parts 4720.5100 to 4720.5590).

Recommendations

The following recommendations have been generated to inform the next amendment of the city of Madison's Wellhead Protection Plan.

1. Well Locating: If wells are constructed within two miles of the city or one mile of the DWSMA, their locations should be verified. This information may allow a better understanding of the extent and thickness of the city's aquifers, and could result in a more refined WHPA in the future.
2. Water Quality Monitoring: The standard assessment monitoring package should be analyzed during year two or three to confirm the presence of young water in Well #5 (603830) and determine the age of water in Well #4 (603829). Sampling should include both primary wells, contingent on funding assistance from MDH for sampling and analysis. Additional sampling should occur just prior to amending the plan in year seven for all primary wells. The city may need to collect the samples and ship them to MDH. Information generated by this sampling will be used to refine vulnerability assessments for the next amendment.
3. Optional Well Downhole Inspection for Well #5 (603830): If tritium is again found in Well #5 but is not found in Well #4, then a video inspection of Well #5 may reveal whether a casing breach could be responsible for the tritium detection noted at this well. This could be eligible for a Source Water Protection Implementation Grant if this measure is included in the city's wellhead protection plan. If such an investigation is to occur, MDH should be contacted in advance in the event additional downhole investigations can be conducted while the well is open.
4. Optional Water Chemistry Trend Tracking: As of June 2019, there are preliminary discussions occurring with the DNR regarding pumping of Wells 6 (750558) and 7 (750559) for sales of water to the Lincoln-Pipestone Rural Water System. If these sales do occur, the increased pumping of the city's aquifer could induce or increase the leakage of young water through the clay-rich sediments overlying the city's aquifer. If water sales begin, periodic sampling for assessment monitoring parameters in all of the city's wells should occur to trace water quality trends in the aquifer. This sampling would be contingent on funding assistance from MDH for sampling and analysis, however the city may need to collect the samples and ship them to MDH.

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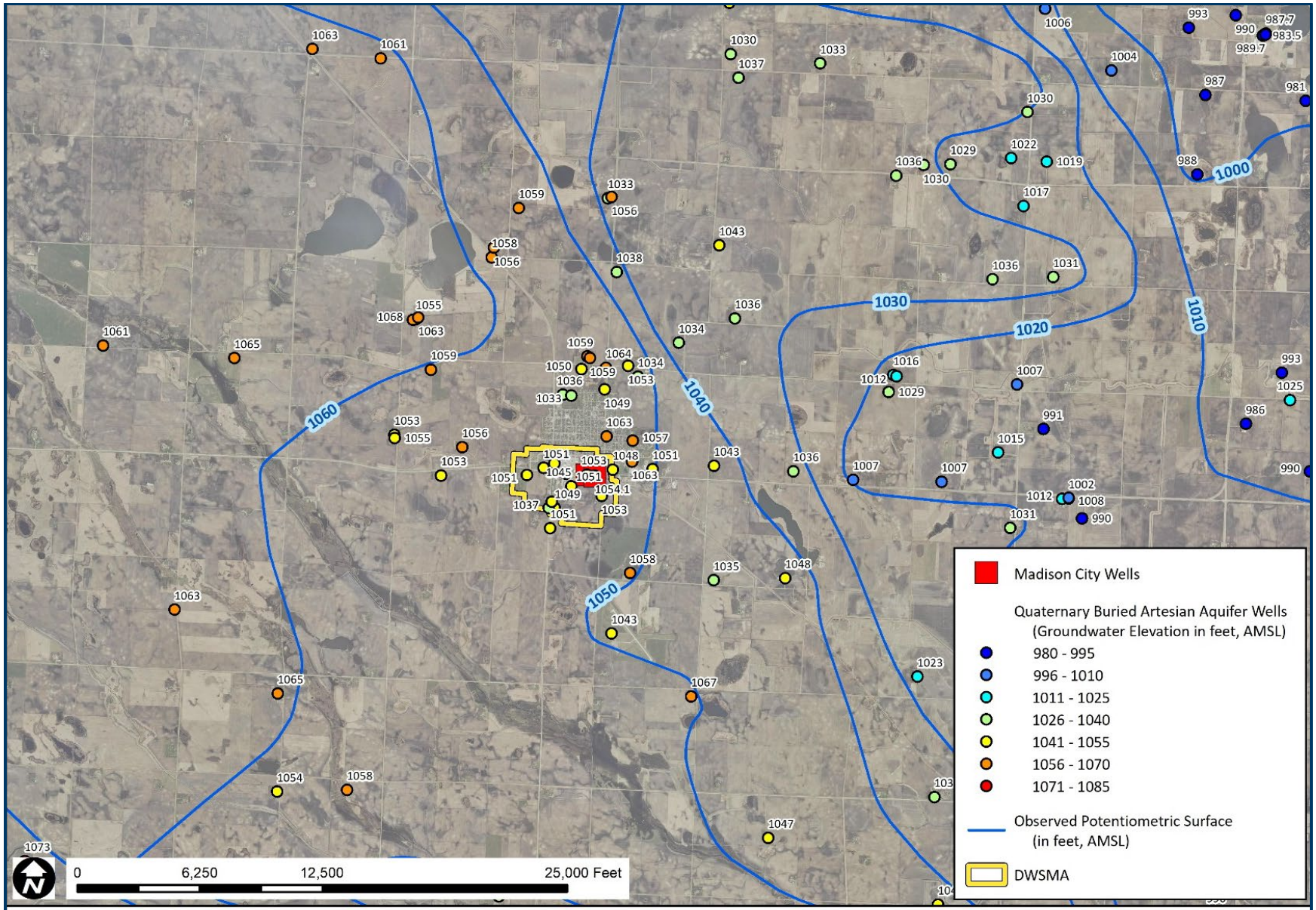
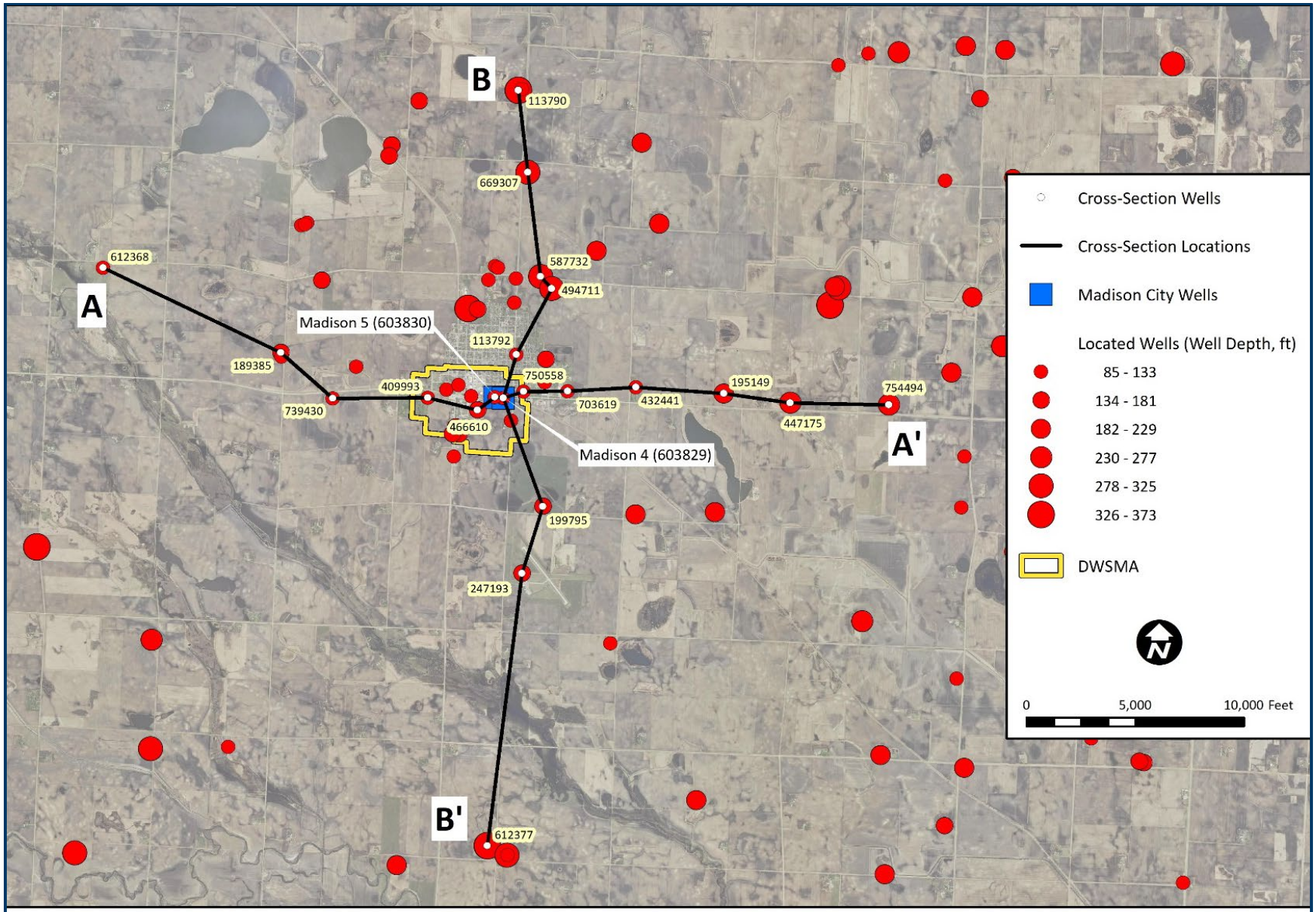
Figures



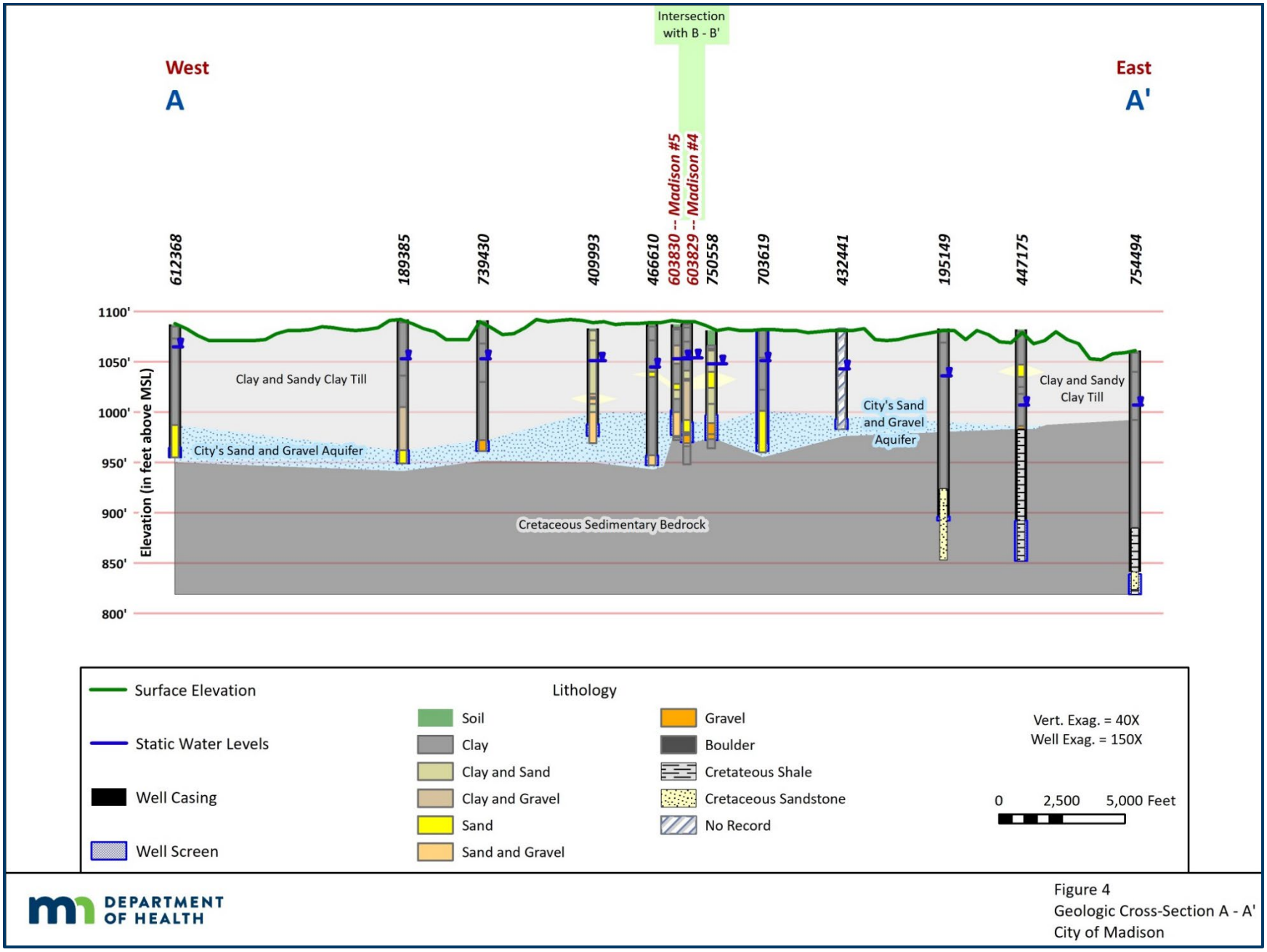
DEPARTMENT OF HEALTH

Figure 2
Observed Flow Field
City of Madison



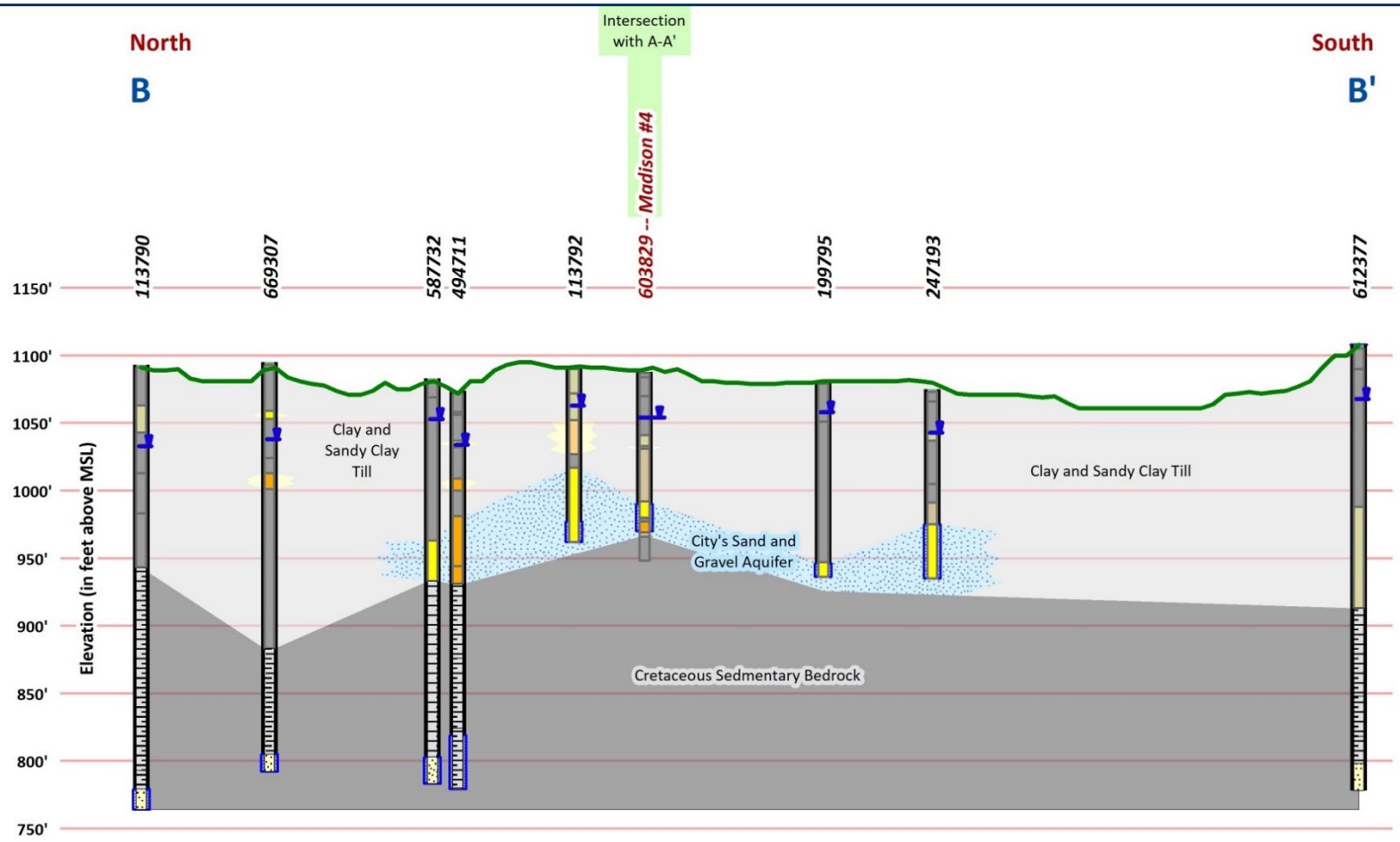
DEPARTMENT OF HEALTH

Figure 3
Trends of Geologic Cross-Sections
City of Madison



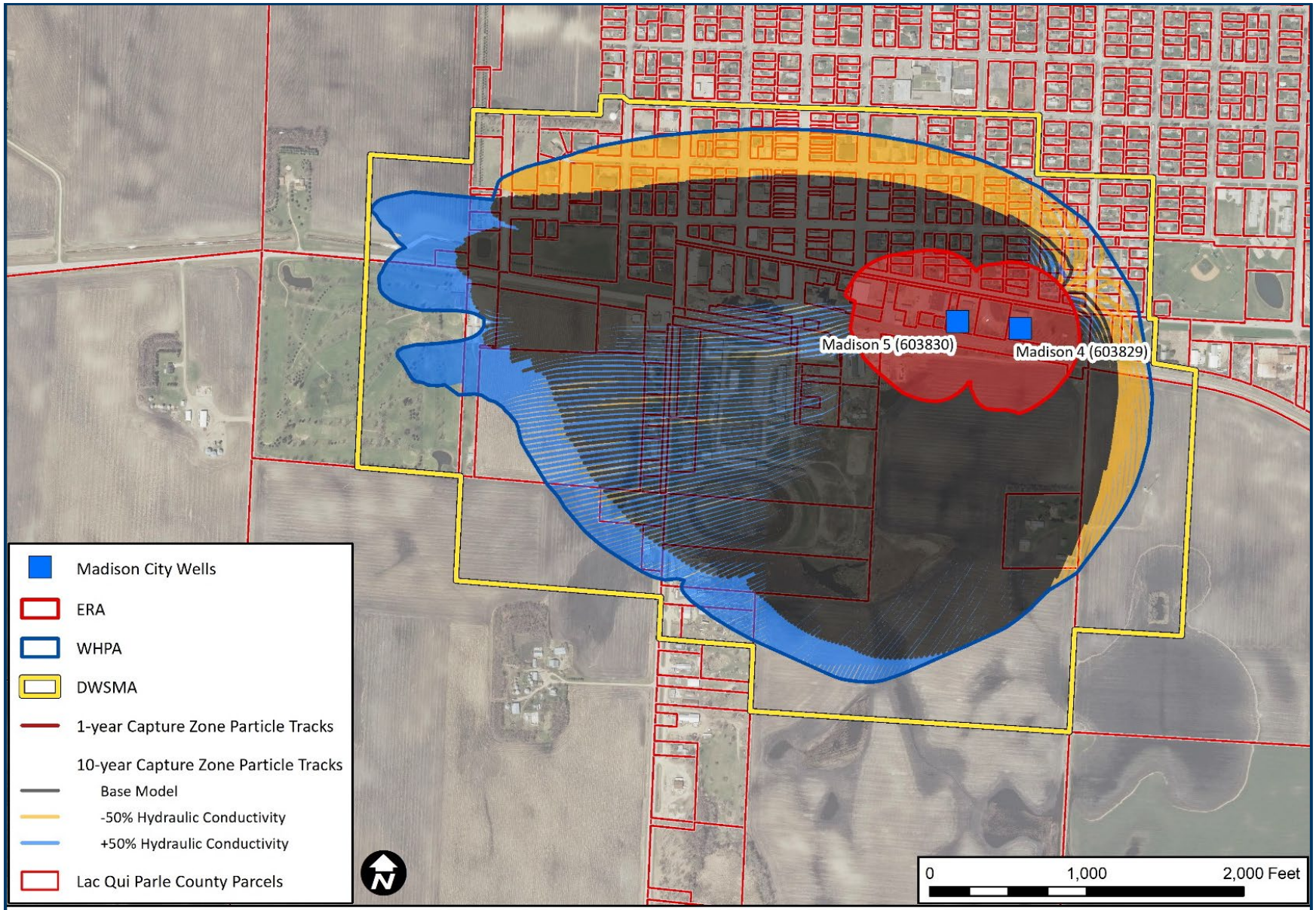
DEPARTMENT OF HEALTH

Figure 4
Geologic Cross-Section A - A'
City of Madison



DEPARTMENT OF HEALTH

Figure 5
Geologic Cross-Section B - B'
City of Madison



DEPARTMENT OF HEALTH

Figure 6
Capture Zones from MODFLOW Used in the Delineations of the WHPA and ERA
City of Madison

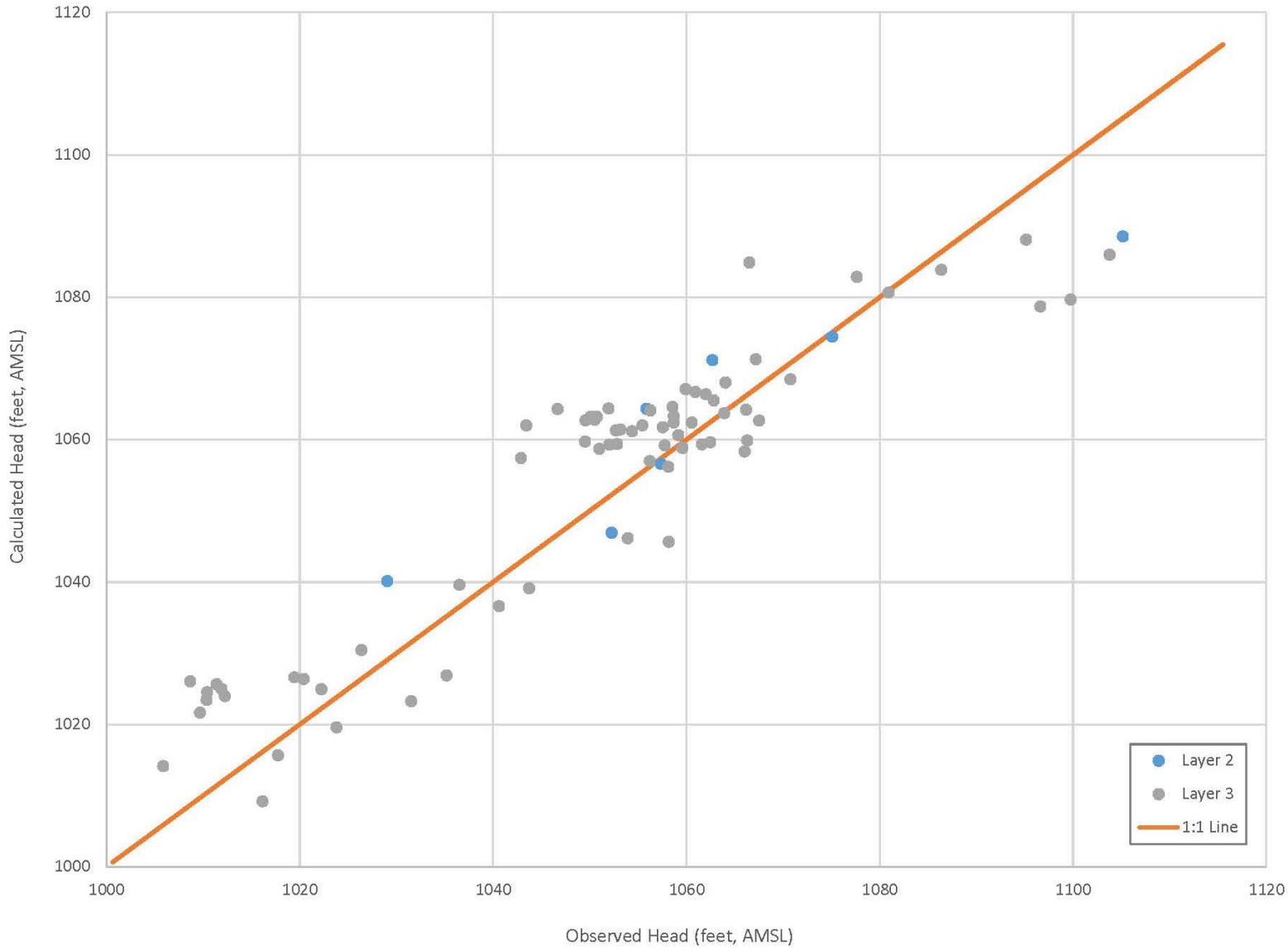
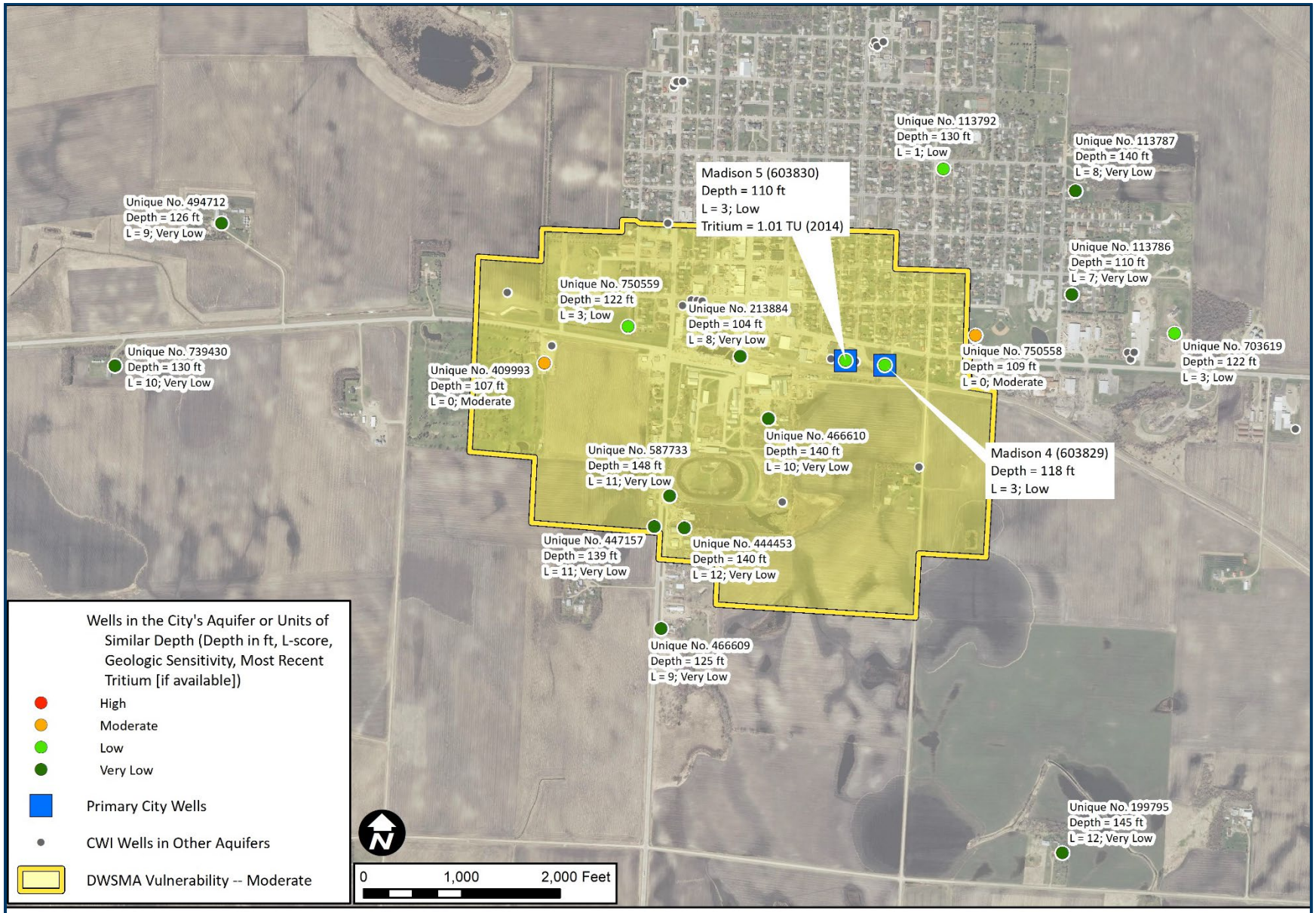


Figure 7: Comparison of observed versus calculated heads for wells (n = 79) in the model domain.



DEPARTMENT OF HEALTH

Figure 8
DWSMA Vulnerability
City of Madison

Appendix A: Data Elements Assessment

Data Type	Data Element	Use of the Well(s)	Delineation Criteria	Quality and Quantity of Well Water	Land and Groundwater Use in DWSMA	Data Source
Climate	Precipitation	H	H	H	H	MN Climatology Office, USGS
Geology	Maps and geologic descriptions	M	H	H	H	MGS
Geology	Subsurface data	M	H	H	H	MGS, MDH
Geology	Borehole geophysics	M	H	H	H	None available
Geology	Surface geophysics	L	L	L	L	None available
Soils	Maps and soil descriptions	L	H	M	L	NRCS
Soils	Eroding lands					
Water Resources	Watershed units	L	H	L	L	MnGEO, DNR
Water Resources	List of public waters	L	H	L	L	MnGEO, DNR
Water Resources	Shoreland classifications					
Water Resources	Wetlands map					
Water Resources	Floodplain map					
Land Use	Parcel boundaries map	L	H	L	L	Lac qui Parle County
Land Use	Political boundaries map	L	H	L	L	MnGEO
Land Use	Public Land Survey map	L	H	L	L	MnGEO
Land Use	Land use map and inventory					
Land Use	Comprehensive land use map					
Land Use	Zoning map					
Public Utility Services	Transportation routes and corridors	L	L	L	L	MnGEO
Public Utility Services	Storm/sanitary sewers and PWS system map	L	M	L	L	City of Madison (no relevant data found)
Public Utility Services	Oil and gas pipelines map					
Public Utility Services	Public drainage systems map or list	L	H	L	L	MnGEO
Public Utility Services	Records of well construction, maintenance, and use	H	H	H	H	CWI
Surface Water Quantity	Stream flow data	L	H	H	H	USGS (no relevant data found
Surface Water Quantity	Ordinary high water mark data	L	H	L	L	DNR (no relevant data found)
Surface Water Quantity	Permitted withdrawals	L	H	L	L	DNR (no relevant data found)
Surface Water Quantity	Protected levels/flows	L	H	L	L	DNR (no relevant data found)
Surface Water Quantity	Water use conflicts	L	H	L	L	DNR (no relevant data found)

Data Type	Data Element	Use of the Well(s)	Delineation Criteria	Quality and Quantity of Well Water	Land and Groundwater Use in DWSMA	Data Source
Groundwater Quantity	Permitted withdrawals	H	H	H	H	DNR
Groundwater Quantity	Groundwater use conflicts	H	H	H	H	DNR (no relevant data found)
Groundwater Quantity	Water Levels	H	H	H	H	CWI
Surface Water Quality	Stream and lake water quality management classifications					
Surface Water Quality	Monitoring data summary	L	H	L	L	MDH, MPCA (no relevant data found)
Groundwater Quality	Monitoring data	H	H	H	H	MDH
Groundwater Quality	Isotopic data	H	H	H	H	MDH
Groundwater Quality	Tracer studies	H	H	H	H	None available
Groundwater Quality	Contamination site data	M	M	M	M	MPCA, MDA (no relevant data found)
Groundwater Quality	Property audit data from contamination sites					
Groundwater Quality	MPCA and MDA spills/release reports	M	M	M	M	MPCA (no relevant data found)

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 this delineation

Acronyms used in this report are listed after the Glossary of Terms.

Appendix C

Potential Contaminant Source Inventory

for the

City of Madison DWSMA

Exhibit C1 – City of Madison DWSMA PCSI Map and Table

Exhibit C2 - Inner Well Management Zone Inventory

Exhibit C3 - MDH Public Water Supply Well Inventory

Exhibit C4 - Sealed Wells within DWSMA

Exhibit C1

Potential Contaminant Source Inventory (PCSI)
for the
City of Madison

Figure C1 – City of Madison DWSMA PCSI Map

Table C1 – City of Madison DWSMA PCSI Table

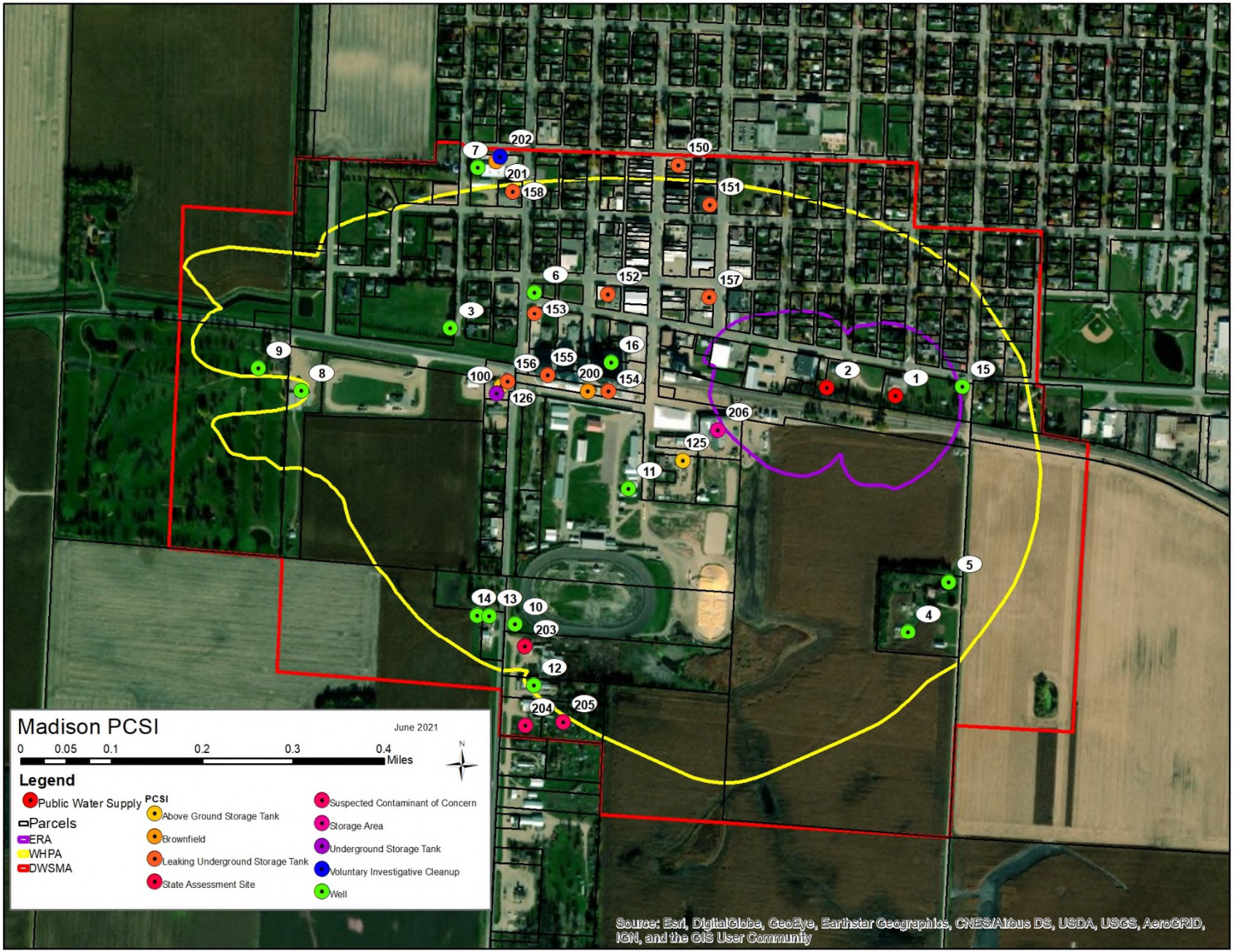


Figure C1

City of Madison DWSMA Potential Contaminant Source Inventory Map

Table C1 – City of Madison DWSMA Potential Contaminant Source Inventory

PCSI ID	PIN	FAC NAME	ADDRESS	CITY	ZIP CODE	PCS	STATUS	PROGRAM ID	TOTAL	COMMENT
1	54-0642-902	City of Madison	201 First Avenue	Madison	56256	WEL	A	603829	1	Madison #4
2	54-0670-000	City of Madison	201 First Avenue	Madison	56256	WEL	A	603830	1	Well #5
3	54-0640-900	City of Madison	201 First Avenue	Madison	56256	WEL	I	750599	1	Well #7; inactive; well located within ROW of 9th Ave
4	26-0138-010	Daniel & Knutson, Gloria Wright	3125 Zenith Ave N	Madison	56256	WEL	A		1	Private Well?
5	26-0138-010	Daniel & Knutson, Gloria Wright	3125 Zenith Ave N	Madison	56256	WEL	A	821951	1	Domestic well
6	54-0396-000	Flags of Honor	104 8th Ave	Madison	56256	WEL	U	113783	1	Site of old city water plant; Well log indicates an old auto service station 'Clyde's Skelly'
7	54-0615-000	Hopper Peat, Joan Family Trust	274 Frederick St.	San Francisco	94117	WEL	U	401719	1	Former Dollar General; May be sealed - No sealing record; Site address is 315 8th Ave.
8	54-0664-010	Madison Golf Course	Box 154 W Hwy 40	Madison	56256	WEL	A	409993	1	10" irrigation well
9	26-0149-000	Madison Golf Course	Box 154 W Hwy 40	Madison	56256	WEL	U	213855	1	4" dia. 'commercial' well on golf course site; location per NURE document
10	26-0142-900	Lac qui Parle Fair Board	PO Box 122	Madison	56256	WEL	A	587733	1	Well located on fair grounds but owned or leased by Dove Ag Services, 2340 Hwy 75, Madison, MN
11	54-0649-900	Lac qui Parle Fair Board	PO Box 122	Madison	56256	WEL	A	466610	1	County fairgrounds - Wildlife Building
12	26-0142-000	Dennis & Carol Siedschlag	2368 Hwy 75	Madison	56256	WEL	A	444453	1	Need to verify location
13	26-0146-000	Michael Bendel	2371 Hwy 75	Madison	56256	WEL	A	447157	1	Domestic Well
14	26-0149-000	Matthew & Brenda Bormann	2353 Hwy 75	Madison	56256	WEL	U		1	Need to verify location
15	54-0642-902	MNDNR	201 First Avenue	Madison	56256	WEL	A	843380	1	Ob well for Madison #1
16	54-0684-900	LQP Reg. Railroad Authority	702 Fair St	Madison	56256	WEL	U	213884	1	Originally well owned by Mpls. & St. Louis Railroad; 1965 record indicates well is located at the only RR building on site; unable to locate.

Table C1 – City of Madison DWSMA Potential Contaminant Source Inventory (continued)

PCSI ID	PIN	FAC NAME	ADDRESS	CITY	ZIP CODE	PCS	STATUS	PROGRAM ID	TOTAL	COMMENT
100	54-0656-000	Lac Qui Parle Coop Oil Co	127 8th Ave S	Madison	56256	UST	A	110645	1	Underground Tanks
125	54-0651-900	Lac Qui Parle County Hwy Shop	601 Hopkins St	Madison	56256	AST	A	110643	1	Aboveground Tanks; no underground tanks, but 3 above ground tanks with containment
126	54-0656-000	Lac Qui Parle Coop Oil Co	127 8th Ave S	Madison	56256	AST	A	110645	1	Aboveground Tanks (7 Tanks); no containment
150	54-0245-000	Thomas Chester	112 1st Ave.	Madison	56256	LUST	C	110215	1	Petroleum Remediation, Leak Site; tanks removed, site closed 1-6-2011; Stan's Standard, once called Tom's Standard - located at 324 6th Ave.
151	54-0236-900	Minnesota National Guard	20 W. 12th St. Veteran's Service Bldg.	St. Paul	55155	LUST	I	11190	1	Petroleum Remediation, Leak Site; site closed 3-15-2004; Madison TACC armory at 504 3rd St.
152	54-0394-900	Madison Municipal Utilities	109 7th Ave	Madison	56256	LUST	C	100730	1	Petroleum Remediation, Leak Site; site closed 11-20-2003; Madison Muni Utilities (former Light Plant at 106 7th Ave.)
153	54-0666-000	Paul Moriarty Living Trust	PO Box 572	Brookings	57006	LUST	C	122207	1	Petroleum Remediation, Leak Site; Was formerly 'Gas N Grub' at 112 8th Ave., now USDA Service Center; UST tanks have been removed, Site closed 1-7-2008
154	54-0647-000	Cargill Inc - Madison	PO Box 5626	Minneapolis	55440	LUST	C	36265	1	Petroleum Remediation, Leak Site; site closed 6-17-2015; site located at 702 Fair St.
155	54-0684-900	Cargill Inc - Madison	PO Box 5626	Minneapolis	55440	LUST	C	206930	1	Petroleum Remediation, Leak Site, tank removed; site closed 11-5-2007; site located at 702 Fair St.
156	54-0656-000	Lac Qui Parle Coop Oil Co	127 8th Ave S	Madison	56256	LUST	C	110645	1	Petroleum Remediation, Leak Site; 13 tanks removed; site closed 8-5-1994
157	54-0384-000	State of Minnesota	502 W 2nd St	Madison	56256	LUST	C	193085	1	Petroleum Remediation, Leak Site, Madison TACC armory; site closed 8-14-2013
158	54-0616-000	Erickson Chevrolet	307 8th Ave	Madison	56256	LUST	C	187440	1	Petroleum Remediation, Leak Site; site closed 10-8-2014; formerly Kuehl Motors

Table C1 – City of Madison DWSMA Potential Contaminant Source Inventory (continued)

PCSI ID	PIN	FAC NAME	ADDRESS	CITY	ZIP CODE	PCS	STATUS	PROGRAM ID	TOTAL	COMMENT
200	54-0647-000	Cargill Madison Facility Expansion	PO Box 5626	Minneapolis	55440	BMS	C	197569	1	Brownfields, Petroleum Brownfield (PB4553); site closed 6-17-2015; site located at 702 Fair St.
201	54-0615-000	Hopper Peat, Joan Family Trust	274 Frederick St.	San Francisco	94117	BMS	C	186185	1	Brownfields, Petroleum Brownfield (PB4798); site closed 1-26-2016; Was Dollar General store at 315 8th Ave.
202	54-0615-000	Hopper Peat, Joan Family Trust	274 Frederick St.	San Francisco	94117	VIC	C	186185	1	Voluntary Investigation and Cleanup (VP32680); site closed 1-29-2016; Was Dollar General store at 315 8th Ave.
203	26-0140-000	LQP County Agricultural Society	Hopkins St. PO BOX 122	Madison	56256	SAS	I	195896	1	Site Assessment (SA0007943); site closed 5-11-1999; Formerly Duetz & Crow Demolition; Fair board purchased this property and cleared all buildings
204	26-0142-020	Robert and Dorothy Buer	2366 Hwy 75	Madison	56256	SCC	A		1	Bob's Body Shop; auto salvage yard
205	26-0142-010	Robert and Dorothy Buer	2366 Hwy 75	Madison	56256	SCC	A		1	Bob's Body Shop; auto salvage yard
206	54-0654-000	FieldCrest Fertilizer Plant	210 5th Ave S	Madison	56256	STOR	A		1	Fertilizer and chemical storage

Exhibit C2

Inner Well Management Zone Forms

for

Primary Wells

Well #4 (603829)

Well #5 (603830)

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	1370004 **COMMUNITY**
NAME	Madison
ADDRESS	Madison Water Superintendent, 616 A Street, Madison, MN 562561265

FACILITY (WELL) INFORMATION

NAME	Well #4
FACILITY ID	S04
UNIQUE WELL NO.	603829
COUNTY	Lac Qui Parle

IS THERE A WELL LOG OR ADDITIONAL CONSTRUCTION INFORMATION AVAILABLE?

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

PWS ID / FACILITY ID	1370004 S04	**UNIQUE WELL NO.**	603829

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		

PWS ID / FACILITY ID	1370004 S04	UNIQUE WELL NO.	603829

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				
*GW1	Gray-water dispersal area	50	50	100	N		
LC1	Large capacity cesspools (Class V well - illegal)[2]	75	75	150	N		
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		N		
SB2	Sewer, buried, collector, municipal, serving a facility handling infectious or pathological wastes, open-jointed or unapproved materials	50	50		Y	110	Y
SB2	Sewer, buried, collector, municipal, serving a facility handling infectious or pathological wastes, open-jointed or unapproved materials	50	50		Y	168	Y
*WB1	Water treatment backwash holding basin, reclaim basin, or surge tank with a direct sewer connection	50	50		Y	120	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		Y	160	Y
SD1	Storm water drain pipe, 8 inches or greater in diameter	50	20		Y	175	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.		Y	23	N
WEL	Operating well	record dist.	record dist.		Y	56	
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		

PWS ID / FACILITY ID	1370004 S04	UNIQUE WELL NO.	603829

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				
*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		
*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		Y	130	Y
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	Y	165	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	1370004 S04	UNIQUE WELL NO.	603829

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.

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

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

INSPECTOR	Strommer, Amanda	DATE	5 - 20 - 2020

PWS ID / FACILITY ID	1370004 S04	UNIQUE WELL NO.	603829

RECOMMENDED WELLHEAD PROTECTION (WHP) MEASURES	WHP MEASURE IMPLEMENTED? Y or N	DATE VERIFIED
Any sewer lines that are observed to be leaking, cracked, or deteriorated, should be replaced.		
The well on your property that does not provide drinking water to the public should be properly managed. Management practices include: locating potential sources of contamination away from the well, sealing unused wells, maintaining the well casing and cap in good repair, and testing the water periodically. Additional information can be found at www.health.state.mn.us/divs/eh/wells.		
The stormwater pipe should be managed to insure optimal performance. Information on stormwater management can be found on the Minnesota Pollution Control Agency website .		

COMMENTS

The monitoring well (550184) is located at the 'MON' point.The WB1 point has a gap and does not have a direct sewer connection.

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	1370004 **COMMUNITY**
NAME	Madison
ADDRESS	Madison Water Superintendent, 616 A Street, Madison, MN 562561265

FACILITY (WELL) INFORMATION

NAME	Well #5
FACILITY ID	S05
UNIQUE WELL NO.	603830
COUNTY	Lac Qui Parle

IS THERE A WELL LOG OR ADDITIONAL CONSTRUCTION INFORMATION AVAILABLE?

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

PWS ID / FACILITY ID	1370004 S05	**UNIQUE WELL NO.**	603830

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		Y	195	Y
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		

PWS ID / FACILITY ID	1370004 S05	UNIQUE WELL NO.	603830

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				
*GW1	Gray-water dispersal area	50	50	100	N		
LC1	Large capacity cesspools (Class V well - illegal)[2]	75	75	150	N		
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		N		
SB2	Sewer, buried, collector, municipal, serving a facility handling infectious or pathological wastes, open-jointed or unapproved materials	50	50		Y	110	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.		N		
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		

PWS ID / FACILITY ID	1370004 S05	UNIQUE WELL NO.	603830

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				
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		
*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	1370004 S05	UNIQUE WELL NO.	603830

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.

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

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

INSPECTOR	Strommer, Amanda	DATE	5 - 20 - 2020

PWS ID / FACILITY ID	1370004 S05	UNIQUE WELL NO.	603830

RECOMMENDED WELLHEAD PROTECTION (WHP) MEASURES	WHP MEASURE IMPLEMENTED? Y or N	DATE VERIFIED
Any sewer lines that are observed to be leaking, cracked, or deteriorated, should be replaced.		
An emergency response plan should be adopted for hazardous material spills; it should include contacting the Minnesota Duty Officer at 1-800-422-0798 or 651-649-5451.		
Others within 200 feet of the well could be encouraged to properly handle, store, and dispose of hazardous materials. Information is available from the Minnesota Pollution Control Agency (www.pca.state.mn.us/programs/bau_p.html or 1-800-657-3864).		
Review and revise processes and procedures for the proper handling, storage, and mixing of agricultural chemicals necessary to minimize the potential for contamination of the water supply or the source water.		
Others within 200 feet of the well could be encouraged to properly handle, store, and dispose of agricultural chemicals. Information is available from the Minnesota Department of Agriculture (http://www.mda.state.mn.us/en/protecting/waterprotection/drinkingwater.aspx or 1-800-967-2474).		

COMMENTS

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

Exhibit C3

Minnesota Department of Health
Public Water Supply Well Inventory

The Minnesota Department of Health Water Supply Inventory (aka The Old Municipal Well file) exhibit provides information on those public water supply wells the City of Madison 1) currently use for primary and emergency sources in flow, 2) public water supply wells that have been removed from flow and 3) unverified wells that provide information about wells whose existence has not yet been confirmed.

These records indicating current and past wells the City of Madison have owned or used can be useful in locating these old wells and developing a prioritization process to locating and sealing abandoned wells. Only the first three pages of this 49 page report is included in this Appendix. The complete Old Municipal Well File covers a period from March 15, 1919 to October 20, 1982. and is on file with the City Water Department.

Comments Regarding the Old Municipal Well File

1. Three wells have been 'Removed from Flow' – Records indicate Well #1, Well #2 and Well #3 have been sealed.

DEPARTMENT OF HEALTH

Protecting, Maintaining and Improving the Health of All Minnesotans

Old Municipal Well Report for Madison

PWSID: 1370004

MDH

March 2019

DEPARTMENT OF HEALTH

Minnesota Department of Health
Environmental Health in Minnesota

MDH Public Water Supply Sources Report

PWSID: 1370004
PWS Name: **Madison**
PWS Type: **Community**
PWS Status: **Active**

Public Water Supply Sources: Information from MNDWIS and CWI (sorted by Sample Point ID)
Source Type Codes: **GW** = Ground water; **SW** = Surface water; **GUI** = Ground water under influence
Location Source: **MGS** = digitized by the MN Geological Survey; * indicates imcomplete records
O* = duplicate in Old Municipal Well Data; **R*** = duplicate in MNDWIS PWS Sources Removed from Flow; **S*** = duplicate in MNDWIS PWS Sources in Flow;

MNDWIS PWS SOURCES IN FLOW

Source Info							MNDWIS Data				CWI Data			
Sample Point ID	Name	Type	Availability	Status	Well No. (link to Well Log (s))	Location Info (link to Map)	Drill Year	Depth (in feet)	Case Depth (in feet)	Case Diam. (in inches)	Drill Date	Depth Completed (in feet)	Case Depth (in feet)	Case Diam. (in inches)
S04	**Well #4**	GW	Primary	Active	603829	08/22/2016 (A. Strommer)	1997	118	98	12	12-12-1997	118	98	12
S05	**Well #5**	GW	Primary	Active	603830	08/22/2016 (A. Strommer)	1998	110	90	12	05-01-1998	110	90	12
S06	**Well #6**	GW	Pending	Inactive	750558	09/21/2016 (Y. Clemens-Billaig	2007	109	84		07-19-2007	109	84	12
S07	**Well #7**	GW	Pending	Inactive	750559	04/11/2007 (R. Nielsen)	2007	122	87		07-19-2007	122	87	12

MNDWIS PWS SOURCES REMOVED FROM FLOW

Source Info							MNDWIS Data				CWI Data			
Sample Point ID	Name	Type	Availability	Status	Well No. (link to Well Log (s))	Location Info (link to Map)	Drill Year	Depth (in feet)	Case Depth (in feet)	Case Diam. (in inches)	Drill Date	Depth Completed (in feet)	Case Depth (in feet)	Case Diam. (in inches)
S01	**Well #1**	GW	Sealed	Inactive	241009 **O***	12/13/1999 (J. Blomme)	1939	110	0	0	00-00-1939	110		8
S02	**Well #2**	GW	Sealed	Inactive	241010 **O***	12/13/1999 (J. Blomme)	1939	110	0	0	00-00-1939	110	0	10
S03	**Well #3**	GW	Sealed	Inactive	241011 **O***	02/09/2007 (B. Olsen)	1970	**110**	0	0	00-00-1970	**117**	0	8

MNDWIS and CWI data value discrepancies in preceding tables are shown in **RED** (0 or null values excepted).

Old Municipal Wells

The following tables show information on wells whose existence (or previous existence) has not yet been confirmed.

OLD MUNICIPAL Well Data

Well Search Reference	Name (s)	Unique Well Number	Drilled Depth (ft.)	Completed Depth (ft.)	Depth Cased (ft.)	Casing Diameter (in.)	Year Constructed	Construction Type	Year Out of Service	Sealing Record?	Year Sealed	Location Info	Comments
Well A			425					Rotary/Drilled				City water and light plant	Report in 1916, no initial year stated
Well B			145					Rotary/Drilled				Pumping station in the central part of the city.	Report in 1932, no initial year stated
Well C			145					Rotary/Drilled				Pumping station in the central part of the city.	Report in 1932, no inital year stated
Well D	Well No. 1	241009 R*	110	110	96	8	1939	Rotary/Drilled				Block 50 original plat. Situated in the western part of the city at the power plant. South side of the plant. Inside treatment building.	Sealed. Recontructed in 1960 from 96 ft to 110 ft. January 1970 reports Well No. 1 54 ft, located in the filter building.
Well E	Well No. 2	241010 R*	110	110	96	10	1939	Rotary/Drilled				Block 50 original plat. Situated in the western part of the city at the power plant. South side of the plant. Inside treatment building.	Sealed. Recontructed in 1960 from 96 ft to 110 ft. January 1970 reports Well No. 2 72 ft, located in the filter building.
Well F			104			121	1957	Rotary/Drilled				Suitable site within the city athletic grounds.	Not normally operated as part of the municipal supply. Mentioned as Well No. 3 until 1970
Well G	Well No. 3	241011 R*	117	117	117	8	1970	Rotary/Drilled				Immediately to the south of the treatment building.	Sealed.

Databases Searched	Remarks
County Well Index (1-mile radius); MDH DWP Microfiche; MDH 1988-2002 Muni Well Inventory (1Suite); Biennial Report of the MN State Dairy and Food Commissioner-1907; Minnesota Geological Survey City Well File Folders; MGS Bulletin (22, 27, 31, or 32); MDH DWP MNDWIS; MN Historical Soc.- Fire Underwriters Insp. Bureau (Fisher) historical map ; Sanborn Fire Insurance Maps; MDH WELLS	

Source: MN Dept. of Health - 3/4/2019

Exhibit C4

Sealed Wells in the City of Madison DWSMA

Records accessed from the Minnesota Department of Health (MDH) indicate at least forty (40) wells have been sealed within the City of Madison DWSMA (1993 to 2014). There may be additional wells that have been properly sealed but for various reasons are not currently on file with the MDH.

The well sealing records include test wells, monitoring wells and old production wells that were owned by the City. In the private sector, there are numerous shallow monitoring wells associated with leaky storage tanks and/or accidental spills. A small number of private, domestic wells have also been sealed.

A well sealing record is often a multi-page document and therefore, the records have not been included in this wellhead protection plan. However, an electronic copy of identified well sealing records reviewed in the PCSI process are on file with the City of Madison Water Superintendent.

Appendix D

WHP Plan Implementation Measures

for the

City of Madison DWSMA

Appendix D

Wellhead Protection Plan Implementation Measures

Table of Contents

Tables

Appendix D

WHP Implementation Measures

Introduction

Appendix D contains specific management strategies (measures) which address the issues, concerns and opportunities identified in Chapter 6 of the City of Madison WHP plan. As discussed in Chapter 8 of the WHP plan, the City of Madison WHP team has identified short and long-term goals and objectives for the wellhead protection plan. Implementation of the measures contained in this appendix are the approaches to achieving the stated goals and objectives.

Priorities

Priorities of this wellhead plan as stated in Chapter 4 of the WHP plan are: 1) verify the vulnerability rating of the DWSMA, 2) educate the public about wellhead protection and potential contaminant sources, and 3) determine locations of abandoned or unused wells, especially within the 10 year time of travel area (WHPA).

There have been a number of instances where petroleum tanks (above ground or buried) have leaked fuels into soils within the moderately vulnerable DWSMA. Therefore, storage tanks and the sealing of unused or abandoned wells located in the DWSMA are of concern. Transportation (federal and state highways, and railroad) corridors may be a source of accidental spills that could impact the DWSMA aquifer. Cultivated cropland covers about 45 percent of the DWSMA, however, nitrate nitrogen has not historically been a contaminant of concern for the public water supply wells in the City of Madison DWSMA.

Therefore, management strategies that focus on 1) locating and sealing of abandoned or unused wells, 2) WHP education, 3) spill response, and 4) working with MDH to verify the moderate vulnerability rating of the DWSMA should be assigned a high priority in implementing this wellhead protection plan. Addressing the various categories of potential contaminants inventoried in the DWSMA and the implementation of measures that provide protection, preservation and long-term sustainability of the aquifer used by the City of Madison is prudent.

The City has access to a good quality source of drinking water which is very meaningful for the public being served by the City. With no human-caused contaminants detected in these aquifers, water treatment costs are lower to public water users. Regulating potential sources of contamination (i.e. management of petroleum storage tanks and unused or abandoned wells) can pose a challenge to the City and local and state governmental units to maintain current high groundwater quality in the DWSMA aquifer. Preservation-orientated measures to protect the source water aquifer used by the City of Madison makes economic sense and are reasonable to maintain the current good water quality of the moderately vulnerable aquifer.

Objectives

Each table of measures identifies which objectives of this WHP plan the measure applies to. The objectives are listed as follows:

1. Communicate with the public about wellhead protection.
2. Utilize community involvement to protect drinking water.
3. Identify and engage with partners to define aquifer preservation needs.
4. Manage wells that are owned and operated by City of Madison.
5. Provide guidance to private property owners regarding management of potential contaminant sources.
6. Collect, monitor and evaluate data necessary to support WHP Plan implementation.

Measure Tables

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:

Table A - Education and Outreach
Table B - Potential Contaminant Source Management
Table C - Water Resource Planning
Table D - WHP Coordination, Evaluation and Reporting
Table E - Monitoring, Data Collection and Assessment
Table F - Security and Emergency Planning

The tables for each of the above categories lists each measure that will be implemented over the 10-year period that City of Madison's WHP plan is in effect, including the priority assigned to each measure. Unless otherwise specified, all efforts to implement identified measures listed in Appendix D must be summarized by the eighth year after WHP approval to coincide with the beginning of the formal process to amend this current version of the WHP plan.

Measures applicable to cropland/conservation management or groundwater studies will rely on collaboration between state and federal agency staff, local resource management professionals and citizens. For example, it will fall upon the interested cropland/conservation management groups to determine which types of crop management or other soil and water conservation practices might be most suitable for a specific site. Likewise, the development and implementation of a comprehensive approach to determine potential, future public drinking water sources will require multiple agency resource staff collaboration and unknown costs at this time. Therefore, specific programs, technical personnel assistance and costs will be determined by local and state resource staff and the City of Madison.

Dates noted in the tables are a target date to implement the WHP measure and may be modified to fit the schedule of City of Madison or cooperators. The cost for each action is an estimate and could vary significantly from what is indicated; **an asterisk (*) associated with a measure indicates implementation of this measure is dependent on availability of grants or other financial resources**. The notation 'Staff Time' means that the City of Madison is already conducting a related activity and the action is carried out as an item already budgeted through normal City activity (an in-kind cost).

The WHP Manager is the lead responsible party for implementing all measures and tracking such actions. The City of Madison fully intends to implement all actions listed in Appendix D, however, completion of the action items are subject to the availability of resources sufficient to complete them.

Local Governmental Units and State Agency Support

The City of Madison has official controls or programs in place to implement the measures listed in Appendix D. The City will also depend upon appropriate working relationships with neighboring local governmental units and state or federal agencies that have the authority and/or resources to assist the City of Madison in successfully implementing this wellhead protection plan.

Primary local partners are the local governments of Lac qui Parle County emergency management and environmental offices and the Lac qui Parle Soil and Water Conservation District. The City of Madison will coordinate with these local government units in implementing measures that bring benefit to both private groundwater users and public water suppliers. The City will continue to maintain communications with the surrounding township and county government within the DWSMA regarding the aquifer used by residents in the area.

State agencies also provide WHP implementation assistance to the City of Madison. Technical assistance from the MDH and DNR in structuring a comprehensive approach to better understand aquifer water quality and quantity is

an example. MDH also provides financial support for the implementation of a public water supplier's WHP plan. MDA works with the SWCD and other interests in promoting nitrogen management or other agricultural crop management products with local producers and agricultural businesses. BWSR works closely with SWCD in providing financial support for many of the soil and water conservation projects local agencies and landowners are engaged in. The MPCA provides regulatory, technical and financial support to address the management of some of the potential contaminant sources inventoried in the DWSMA (storage tanks, etc.) and can provide assistance in groundwater quality protection projects.

The Minnesota Rural Water Association is a nonprofit organization that has a significant role in providing wellhead protection related educational and outreach to residents in a DWSMA.

To successfully achieve the goals and objectives of this wellhead protection plan, the City of Madison will need to meet with the various local and state entities described above to discuss potential partnership opportunities.

Table D1 - Acronyms Used in Measure Tables and Implementation Partners

CITY	City of Madison
DNR	Minnesota Department of Natural Resources
LGU	Local Governmental Unit – Lac qui Parle County and/or Lac qui Parle Township
MDA	Minnesota Department of Agriculture
MDH	Minnesota Department of Health
MPCA	Minnesota Pollution Control Agency
MRWA	Minnesota Rural Water Association
SWCD	Lac qui Parle Soil and Water Conservation District

Table D2 provides an overview of the role cooperating state and local agencies play in assisting the City of Madison in implementing WHP measures.

Table D2 - Cooperators and Associated Measures

Cooperating Agency	Education & Outreach	Potential Contaminant Source Management	Water Resource Planning	WHP Coordination, Evaluation and Reporting	Monitoring, Data Collection and Assessment	Security and Emergency Planning
CITY	All Measures					
DNR	-	Table B	-	-	Table E	-
LGU	-	Table B	Table C	-	-	Table F
MDA	-	Table B	-	-	-	-
MDH	Table A	Table B	-	-	Table E	-
MPCA	-	Table B	-	-	-	-
MRWA	Table A	Table B	-	-	Table E	-
SWCD	-	-	Table C	-	-	-

Note: In the following tables, an asterisk (*) indicates implementation of the measure is dependent on grant funding availability.

Table A

Education and Outreach

Education and Outreach																	
Action	Priority	Description	Objective Addressed	Cooperators	Cost ($)	Implementation Time Frame											
						2022	2023	2024	2025	2026	2027	2028	2029	2030	2031		
Action 1	High	**Measure:** Distribute or post educational materials to residents about wellhead protection.	1	CITY, MRWA	Staff	•				•				•			
Action 2	High	**Measure:** Post information on water conservation practices on the City of Madison's website or other means to reach customers (i.e. billings, CCR, etc.)	1, 2, 3	CITY, MRWA	Staff	•				•				•			
Action 3	Medium	**Measure:** Post the City's wellhead protection plan on the City's website.	1	CITY	Staff	•											

Table B

Potential Contaminant Source Management

Potential Contaminant Source Management Measures																	
Action	Priority	Description	Objective Addressed	Cooperators	Cost ($)	Implementation Time Frame											
						2022	2023	2024	2025	2026	2027	2028	2029	2030	2031		
Action 4	Medium	**Hazardous Wastes** **Measure:** Promote county information about proper handling, storage and disposal of household hazardous waste collection services.	1, 2, 5	CITY, LGU, MRWA, MPCA	Staff	Coordinate with Lac qui Parle County's Hazardous Waste event schedules.											
Action 5	Medium	**Tanks** **Measure:** Provide information to regulated storage tank owners about proper management and the importance of spill prevention in the DWSMA.	1, 2, 5	CITY, MRWA, MPCA	Staff	•				•				•			
Action 6	High	**Wells** **Measure:** Work with MDH and landowners within the DWSMA to identify unused, unsealed wells on their property and provide information on financial assistance.	1, 2, 5	CITY, MDH, MRWA	Staff	On Going											
Action 7	High	**Measure:** Apply for MDH grants to seal unused private or public wells located within the DWSMA.	2, 4	CITY, MDH	Staff, MDH	On An As-Needed Basis											
Action 8	Medium	**Measure:** Notify MDH source water protection planner for your area if a Class V well is identified in the DWSMA.	6	CITY, MDH	Staff	On An As-Needed Basis											
Action 9	Medium	**Measure:** Identify any new high-capacity wells that are proposed for construction in or within one mile of the DWSMA and notify the MDH Planner or Hydrologist.	3, 6	CITY, MDH, DNR	Staff	On An As-Needed Basis											
Action 10	High	**Measure:** Request MDH staff assistance to determine location and status of unused, unsealed municipal well(s) that may exist.*	4, 6	CITY, MDH	Staff, MDH		•										
Action 11	High	**Measure:** Request MDH staff to conduct a magnetometer survey in the area of an unused railroad well.*	1, 2, 5	CITY, MDH	Staff , MDH		•										
Action 12	Medium	**Agricultural Storage and Handling** **Measure:** Request MDA promote storage and handling practices to growers, co-ops and commercial handlers of pesticide and agricultural chemicals within the DWSMA	1, 2, 5	CITY, MDA	Staff	•				•							
Action 13	Medium	**Potential Contaminant Source** **Measure:** Request Lac qui Parle County review land use permits for compliance in county zoning Commercial-Industrial (C1-1) district located within the City of Madison DWSMA.		CITY, LGU	Staff			•									

Table C

Water Resource Planning

Water Resource Planning Measures																
Action	Priority	Description	Objective Addressed	Cooperators	Cost	Implementation Time Frame										
						2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Action 14	Low	**Local Water Resource Planning** **Measure:** Work with local and state governmental units in the development of the Lac qui Parle-Yellow Bank One Watershed One Plan to include the Madison DWSMA map and identified WHP issues in the plan.	2, 3	CITY, LGU, SWCD	Staff	As Needed									
Action 15	Medium	**Measure:** Consider impacts to drinking water when reviewing zoning, land use changes or reviewing permits within the City.	2	CITY	Staff	As Needed									

Table D

WHP Coordination, Evaluation and Reporting

WHP Coordination, Evaluation and Reporting																
Action	Priority	Description	Objective Addressed	Cooperators	Cost	Implementation Time Frame										
						2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Action 16	Low	**WHP Coordination** **Measure:** Request Lac qui Parle County to include drinking water protection in their comprehensive land use plan.	2, 3	CITY, LGU	Staff	•		•							
Action 17	Low	**Measure:** Request to be notified by Lac qui Parle County zoning authorities of any proposed land use permits or zoning changes near or within the DWSMA that are outside of city jurisdiction.	2, 3	CITY	Staff	•									
Action 18	High	**Evaluation and Reporting** **Measure:** Maintain a "WHP folder" that contains dates and documentation of WHP activities you have completed.	6	CITY	Staff	On Going									
Action 19	High	**Measure:** Complete an Evaluation Report every 2.5 years that evaluates the "progress of plan of action and the impact of any contaminant release on the aquifer supplying the public water supply well" MN WHP Rule 4720.5270.	6	CITY	Staff			•			•				•

Table E

Monitoring, Data Collection and Assessment

Monitoring, Data Collection and Assessment																
Action	Priority	Description	Objective Addressed	Cooperators	Cost	Implementation Time Frame										
						2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Action 20	High	**Data Collection** **Measure:** Update the inventory of potential contaminant sources.	6	CITY	Staff								•		
Action 21	Medium	**Measure:** Mark correct locations of new wells constructed within 1 mile of the DWSMA or 2 miles of the municipal boundaries using a map provided by the MDH.	6	CITY, MDH	Staff								•		
Action 22	High	**Measure:** Work with MDH to conduct and analyze a standard assessment monitoring package to confirm the presence of tritium in Well #5 and determine the age of water in Well #4.*	6	CITY, MDH	Staff, MDH		•	•							
Action 23	High	**Measure:** Dependent on tritium sampling (Action #21), video log Well #5 (603830) casing to determine its construction and state of repair, or complete geophysical logging to collect geologic information to substantiate well vulnerability issues.*	6	CITY, MDH	Staff, MDH		•	•							
Action 24	High	**Measure:** Work with MDH to conduct a standard assessment monitoring package for primary wells in preparation for a plan amendment.	6	CITY, MDH	Staff, MDH							•			
Action 25	Low	**Inner Well Management Zone** **Measure:** Assist source water protection planning staff complete or update the Inner Wellhead Management Zone inventory.	4, 6	CITY, MDH, MRWA	Staff					•					•
Action 26	High	**Measure:** Implement measures identified in the Inner Wellhead Management Zone report and recommendations as identified in the Sanitary Survey reports.	4, 6	CITY, MDH	Staff	On an As-Needed Basis									
Action 27	High	**Measure:** Make sure setback distances are met for new potential contaminant sources in the Inner Wellhead Management Zone.	4,6	CITY, MDH	Staff	On Going									
Action 28	High	**Monitoring** **Measure:** Apply for a MDH SWP grant to purchase a data logger to be installed in a DNR observation well and/or city well(s) within the DWSMA.*	6	CITY, MDH, DNR	Staff		•								

Table F

Security and Emergency Planning

Security and Emergency Planning																	
Action	Priority	Description	Objective Addressed	Cooperator(s)	Cost	Implementation Time Frame											
						2021	2022	2023	2024	2025	2026	2027	2028	2029	2030		
Action 29	Medium	**Measure:** Provide local fire departments, county emergency manager, county and state highway departments and a railroad company with a DWSMA map and WHP information.	2, 3	CITY, LGU	Staff	•											
Action 30	Low	**Measure:** Review and update the Emergency Contingency Supply Plan as changes occur.	4	CITY	Staff	As Needed											

Appendix E

Supporting Documents

Exhibits

Exhibit E1 – City of Madison Emergency Response Plan

Exhibit E2 – Excerpts from the City of Madison Code of Ordinances

Exhibit E3 - Resources

Exhibit E1

City of Madison Emergency Response Plans

The City of Madison has an approved Minnesota Department of Natural Resources Water Supply Plan which is on file with the City of Madison. The DNR approval letter is included in this Exhibit.

The City has also worked with the Minnesota Rural Water Association in completing a Security Vulnerability & Emergency Response Plan Self- Assessment for Small Water Systems. This effort is designed to help small water systems determine possible vulnerable components and identify security measures that should be considered. Contact the City of Madison for additional information regarding the assessment.

DEPARTMENT OF NATURAL RESOURCES

Ecological and Water Resources
1400 East Lyon St
Marshall, MN 56258
(507) 537-6637

JUNE 30, 2020

CITY OF MADISON
DEAN BROIN, WATER SUPERINTENDENT
404 6TH AVENUE NORTH
MADISON, MN 56256

RE: Water Supply Plan Approval, City of Madison, Lac qui Parle County

Dear MR. BROIN:

Our office has completed the review of your Water Supply Plan for public water supply authorized under DNR Water Appropriation Permit #1984-4175. I am pleased to advise you that in accordance with Minnesota Statutes, Section 103G.291, Subdivision 3, and on behalf of the Commissioner of the Department of Natural Resources, I hereby **approve your Water Supply Plan**. We encourage cities to complete the attached "Certification of Adoption" form. Please upload the form to MPARS-Water Supply Plan tab as soon as the city officially adopts the Plan.

The DNR and Minnesota Rural Water Association encourage the city to educate its customers on how they can reduce household water use. As mentioned at the Water Supply Planning Workshops, the DNR will be contacting you periodically about progress the city has made on their water conservation goals. We encourage you to keep records of your success.

Thank you for your efforts in planning for the future of the City of Madison water supply and for conserving the water resources of the State of Minnesota. If you have any questions or need additional assistance with the city's water appropriation permit, please contact Area Hydrologist Ryan Bjerke at 320-839-3823.

Sincerely,

Jim Sehl

Jim Sehl
District Manager

Ec: Carmelita Nelson, DNR
Ryan Bjerke, DNR Area Hydrologist
Chessa Frahm, Lac qui Parle County SWCD
Trudy Hastad, Lac qui Parle – Yellow Bank Watershed District
Minnesota Permitting and Reporting System (MPARS)

Exhibit E2

Excerpts from the City of Madison Code of Ordinances

Title V: Public Works

Chapter 53 – Water Regulations

GENERAL PROVISIONS

§ 53.01 GENERAL OPERATION.

The city does hereby make provision for the establishment of a municipal water system (hereinafter called the water system) to be operated as a public utility.

§ 53.02 USE OF WATER SERVICE.

No person other than a city employee shall uncover or make or use any water service installation connected to the city water system except in the manner provided by this chapter. No person shall make or use any installation contrary to the regulatory provisions of this chapter.

Penalty, see § 10.99

§ 53.03 USE TO CIRCUMVENT CHAPTER PROHIBITED.

No person shall permit water from the water system to be used for any purpose to circumvent this chapter.

Penalty, see § 10.99

§ 53.04 DAMAGE TO WATER SYSTEM.

(A) No unauthorized person shall remove or damage any structure, appurtenance, or part of the water system or fill or partially fill any excavation or move any gate valve used in the water system.

(B) No person shall make any connection of an electrical welder to the city water main, appurtenance or service or use an electric welder for the purpose of thawing frozen water mains, appurtenances or services.

Penalty, see § 10.99

§ 53.05 CONNECTIONS BEYOND CITY BOUNDARIES.

Where water mains of the city are in any street or alley adjacent to or outside the corporate limits of the city, the City Council may issue permits to the owners or occupants of properties adjacent or accessible to the water main to make proper water service pipe connections with the water mains of the city and to be supplied with water in conformity

with the applicable provisions of this chapter and subject to any contract for the supply of water between the city and any other city.
Penalty, see § 10.99

§ 53.06 CONNECTION TO SYSTEM REQUIRED; USE OF PRIVATE WELLS.

(A) Except where municipal water is not available, it shall be unlawful to construct, reconstruct, or repair any private water system which is designed or intended to provide water for human consumption. Private wells, to provide water for other than human consumption, may be constructed, maintained and continued in use after connection is made to the water system; provided, there is no means of cross- connection between the private well and municipal water supply at any time. Hose bibs that will enable the cross-connection of the two systems are prohibited on internal piping of the well system supply. Where both private and city systems are in use, outside hose bibs shall not be installed on both systems.

(B) All new homes or buildings shall connect to the municipal water system if water is available to the property. At the time as municipal water becomes available to existing homes or buildings, a direct connection shall be made to the public system within a period of time as determined by the City Council. If the connection is not made pursuant to this chapter, a charge shall be made in an amount established by Ch. 50.

(C) Where new homes or buildings do not have water available to the property, the city shall determine whether and under what conditions the municipal water system will be extended to serve the property.

(D) If the well is not to be used after the time a municipal water connection is made:

(1) The well pump and tank shall be disconnected from all internal piping;

(2) The casing shall be filled with sandy soil from the bottom to a point eight feet from the top;

(3) The remaining eight feet shall be filled with concrete to the floor level and the well casing cut off as close to the floor level as possible;

(4) Within 30 days after the municipal water connection is made, the owner or occupant must advise the City Public Works/Utilities Superintendent that the well has been sealed.

(5) Notwithstanding the foregoing, all well abandonment shall be done in accordance with M.S. §§ 103I.301 to 103I.345 and Minn. Rules Ch. 4725, Wells and Borings, as it may be amended from time to time.
Penalty, see § 10.99

§ 53.07 USE OF WATER FROM FIRE HYDRANTS; TEMPORARY CONNECTIONS.

(A) Use of fire hydrants. Except for extinguishment of fires, no person, unless authorized by the Public Works Director or Public Utilities Department, shall operate fire hydrants or interfere in any way with the water system without first obtaining a permit to do so from the city as follows:

(1) A permit to use a fire hydrant shall be issued for each individual job or contract and for a minimum of 30 days and for the additional 30 day period as the city shall

determine. The permit shall state the location of the hydrant and shall be for the use of that hydrant and none other.

(2) The user shall make an advance cash deposit to guarantee payment for water used and to cover breakage and damage to the hydrant and meter, which shall be refunded upon expiration of the permit, less applicable charges for use.

(3) The user shall relinquish the use of the hydrant to authorized city employees in emergency situations.

(4) The user shall pay a rental charge as established pursuant to Ch. 34 or Ch. 50 for each day including Sundays and legal holidays, and a fee as established by the Ordinance Establishing Fees and Charges, and which may be stated in § 34.01, as may be amended from time to time for each 100 gallons of water used.

(B) Temporary connection to fire hydrants. Private connections to fire hydrants is strongly discouraged. However, when special circumstances warrant an owner of a private water system may make a temporary above ground connection to a fire hydrant, subject to the time periods, conditions, and payment specified in Ch. 50. In addition, the method of connection to the private system shall conform to all existing requirements of this chapter and city ordinance and the type of meter used shall meet the approval of the Public Works/Utilities Superintendent.

Penalty, see § 10.99

§ 53.08 WATER DEFICIENCY, SHUT OFF AND USE RESTRICTIONS.

The city shall not be liable for any deficiency or failure in the supply of water to consumers, whether occasioned by shutting the water off for the purpose of making repairs or connections or from any other cause whatsoever. In case of fire, or alarm of fire, or in making repairs of construction of new works, water may be shut off without notice at any time and kept off as long as necessary. In addition, the City Council shall have the right to impose reasonable restrictions on the use of the city water system in emergency situations. For non-payment of charges, water service may be discontinued according to the procedures established in Ch. 50.

Exhibit E3

Resources Used in the Development of this WHP Plan

1. City of Madison - https://www.ci.madison.mn.us/
2. Federal Emergency Management Agency – Flood Map Center https://msc.fema.gov/portal/home
3. Lac qui Parle County http://lqpco.com/
4. Lac qui Parle Soil and Water District https://www.lacquiparleswcd.org/
5. Minnesota Department of Natural Resources – Public Waters https://www.dnr.state.mn.us/waters/watermgmt_section/pwi/download.html
6. Minnesota Department of Health - Source Water Protection https://www.health.state.mn.us/communities/environment/water/swp/index.htm
7. Minnesota Department of Health - Minnesota Well Index https://www.health.state.mn.us/communities/environment/water/mwi/index.html
8. Minnesota Department of Agriculture - "What's in my Neighborhood" http://www.mda.state.mn.us/chemicals/spills/incidentresponse/neighborhood.aspx
9. Minnesota IT Services, Geospatial Information Office https://www.mngeo.state.mn.us/
10. Minnesota State Climatology Office http://climate.umn.edu/
11. Minnesota Pollution Control Agency – "What's in my Neighborhood" https://www.pca.state.mn.us/data/whats-my-neighborhood
12. Minnesota Pollution Control Agency - water quality and water use information https://www.pca.state.mn.us/water/water-quality-data
13. Multi-Resolution Land Characteristics Consortium, National Land Cover Database, 2016 http://www.mrlc.gov/index.php
14. National Pipeline Mapping System https://www.npms.phmsa.dot.gov/