City of Ramsey
Agenda
Public Works Committee
Tuesday, May 19, 2026
5:30 pm
Lake Itasca Room, 7550 Sunwood Drive NW

Remote Attendance available at www.cityoframsey.com/meetings.
Those joining remotely and requesting to speak are asked to use a webcam when speaking.

1. Call to Order

2. Citizen Input

3. Approve Agenda

4. Approve Minutes

1. Approve the following meeting minutes.
   1. Public Works Committee meeting dated April 21, 2026

5. Committee Business

1. Consider Recommending City Council Approve Plans and Specifications and Authorize Advertisement for Bids for Riverside West Street Reconstructions, Improvement Project #26-06
2. Consider Recommending City Council Authorization to Prepare Plans and Specifications for 2027 Pavement Management Program Projects
3. Consider Recommendation to City Council Authorizing Well Siting Study Requests for Proposals for Wells #9 and #10
4. Receive Updates on Improvement Projects, Studies and Items of Interest
5. Review Future Topics Calendar

6. Committee/Staff Input

7. Adjournment

Our Mission: To work together to responsibly grow our community, and to provide quality, cost-effective, and efficient government services

Public Works Committee

Meeting Date: 05/19/2026

Primary Strategic Plan Initiative: Not Applicable

Title:

Approve the following meeting minutes.
1. Public Works Committee meeting dated April 21, 2026

Purpose/Background:

The purpose of this case it to review and approve the attached April 21, 2026, meeting minutes.

Time Frame/Observations/Alternatives:

Staff anticipate this case will take less than 5 minutes.

Recommendation:

To review and approve meeting minutes dated April 21, 2026.

Outcome/Action:

Motion to approve meeting minutes dated April 21, 2026

Attachments

PWC Minutes 042126

Form Review

Inbox	Reviewed By	Date
Brian Hagen	Brian Hagen	05/14/2026 01:47 PM
Form Started By: Marsha Weidner		Started On: 05/01/2026 08:03 AM
Final Approval Date: 05/14/2026		

PUBLIC WORKS COMMITTEE
CITY OF RAMSEY
ANOKA COUNTY
STATE OF MINNESOTA

The Public Works Committee conducted a regular meeting on Tuesday, April 21, 2026, at the Ramsey Municipal Center, 7550 Sunwood Drive NW, Ramsey, Minnesota.

Members Present:	Chairperson Chris Riley Councilmember Michael Olson Councilmember Dan Specht
Also Present:	City Engineer/Public Works Director Bruce Westby Assistant City Engineer Joe Feriancek

1. CALL TO ORDER

Chairperson Riley called the regular meeting of the Public Works Committee to order at 5:30 p.m.

2. CITIZEN INPUT

There was none.

3. APPROVE AGENDA

Motion by Councilmember Specht, seconded by Councilmember Olson, to approve the agenda, as presented.

Motion carried. Voting Yes: Chairperson Riley, Councilmembers Specht and Olson. Voting No: None.

4. APPROVE MINUTES

4.01: Approve February 17, 2026, Meeting Minutes

Motion by Councilmember Dan Specht, seconded by Councilmember Olson, to approve the following minutes:

Regular Meeting Minutes dated February 17, 2026

Motion carried. Voting Yes: Chairperson Riley, Councilmembers Olson and Specht. Voting No: None.

5. COMMITTEE BUSINESS

5.01: Consider Recommending City Council Approval to Adjust the Scope of Improvement Project 25-08 to Include Planned 2029 Concrete Repairs to Sunwood Drive and Rhinestone Street, and to Move the Project to 2027

Assistant City Engineer Feriancek presented the staff report and the recommendation to recommend City Council approval to adjust the scope of Improvement Project 25-08 to include the planned 2029 concrete repairs to Sunwood Drive and Rhinestone Street per the 2026-2035 Capital Improvement Plan, and adjust the project timeline to 2027.

The Committee agreed that it makes sense to combine these projects together as proposed.

Councilmember Specht asked about the current condition of the crosswalks and whether they could be postponed an additional year.

City Engineer/Public Works Director Westby confirmed that staff would patch them for 2026.

Motion by Councilmember Specht, seconded by Councilmember Olson, to recommend City Council approval to adjust the scope of Improvement Project 25-08 to include the planned 2029 concrete repairs to Sunwood Drive and Rhinestone Street per the 2026-2035 Capital Improvement Plan, and adjust the project timeline to 2027 construction season.

Motion carried. Voting Yes: Chairperson Riley, Councilmembers Specht and Olson. Voting No: None.

5.02: Consider Recommending City Council Approving Plans and Specifications and Authorizing Advertisement for Bids for Carol-Rose Acres & Sports Haven Street Reconstruction, Improvement Project #26-03

Assistant City Engineer Feriancek reviewed the staff report and recommendation to recommend City Council approval of plans and specifications and authorize advertisement for bids for Carol-Rose Acres and Sports Haven Street Reconstructions, Improvement Project #26-03.

Motion by Councilmember Olson, seconded by Councilmember Specht, to recommend City Council approve plans and specifications and authorize advertisement for bids for Carol-Rose Acres and Sports Haven Street Reconstructions, Improvement Project #26-03.

Motion carried. Voting Yes: Chairperson Riley, Councilmembers Olson and Specht. Voting No: None.

5.03: Consider Recommending City Council Approval of Plans and Authorization to Solicit Quotes for 2026 Pavement Skim Patching Contracted Services, Maintenance Project #26-53

City Engineer/Public Works Director Westby reviewed the staff report and recommendation for City Council approval of plans and authorization to solicit quotes for 2026 Pavement Skim Patching Contracted Services, Maintenance Project #26-53.

City Engineer/Public Works Director Westby stated staff identified streets in 7 residential areas that would benefit greatly from 2026 skim patching improvements but funds are only available to skim patch 3 to 5 of the areas. Staff therefore proposes to solicit base quotes for areas 1 through 3, and to solicit alternate quotes for areas 4 and 5, thereby allowing the city to spend as much available funding as possible.

Chairperson Riley asked how all identified project areas could be funded.

City Engineer/Public Works Director Westby replied that he would need to speak with the Finance Director to determine how that could be funded.

Chairperson Riley recognized that these would not all be identified if they did not need the work done, so he would like to find a way to fund all identified 2026 skim patching project areas.

City Engineer/Public Works Director Westby replied that areas one through four would be $19,000 over the budgeted amount. He provided the cost estimates for areas five through seven, which would add an additional $85,000, leaving a short-fall of over $100,000.

Chairperson Riley asked and received confirmation that if the work is not completed this year, it will become a top priority for the next year.

Councilmember Olson asked if they are catching up on this, falling behind, or just maintaining.

City Engineer/Public Works Director Westby stated that he would not say they are falling behind, as they are just trying to hold roads together until they can be repaired. He stated that overall, we are catching up with road repair needs through the Pavement Management Plan, but we cannot repair all roads that need repairs in the short term. He commented that the skim patching is providing good results and has been holding up well to plowing and traffic.

Chairperson Riley stated that he would like to do all the work, but realized there are budget constraints.

Councilmember Specht asked about the current bidding climate.

Assistant City Engineer Feriancek stated that they have received good bid pricing so far this year, but would expect that they would eventually start to climb up a bit with the increase in fuel costs.

City Engineer/Public Works Director Westby commented that he could speak with the Finance Director to determine if they could increase the funding. He asked if there would be a desire to increase that item within the annual budget in order to complete more skim patching each year.

Chairperson Riley commented that he would agree with proposing a $50,000 increase to the budget line item for 2027. He stated that he would also support increasing the budget for the item this year, to the extent possible, to complete as much of the work as possible.

Motion by Councilmember Olson, seconded by Councilmember Specht, to recommend City Council approval of plans and authorization to solicit quotes for 2026 Pavement Skim Patching Contracted Services, Maintenance Project #26-53, with direction for staff to look for additional funding to complete all or most of the identified 2026 skim patching work, and to increase the 2027 budget line item for skim patching work by $50,000.

Motion carried. Voting Yes: Chairperson Riley, Councilmembers Olson and Specht. Voting No: None.

Councilmember Specht left the meeting.

5.04: Consider Recommendation for City Council Authorization to Prepare Plans and Agreements for Street Lighting Improvements for Riverdale Drive and Highway 10 North Frontage Roads

City Engineer/Public Works Director Westby reviewed the staff report and recommendation to recommend City Council authorization for Connexus Energy to prepare plans and agreements for street lighting improvements for unlit segments of Riverdale Drive and Highway 10 North Frontage Roads.

Chairperson Riley asked if it would be Connexus or staff determining the placement of the lights.

City Engineer/Public Works Director Westby replied that staff would decide on the light placement and Connexus would complete the plans. He confirmed that staff would propose minimal lighting, mainly at intersections, mid-block trail crossings, and potentially for sidewalks and trails.

Motion by Councilmember Olson, seconded by Chairperson Riley, to recommend City Council authorization for Connexus Energy to prepare plans and agreements for street lighting improvements for unlit segments of Riverdale Drive and Highway 10 North Frontage Roads.

Motion carried. Voting Yes: Chairperson Riley and Councilmember Olson. Voting No: None.

6. COMMITTEE / STAFF INPUT

6.01: Receive Updates on Improvement Projects, Studies, and Items of Interest

City Engineer/Public Works Director Westby provided an update on current and proposed City, County, and MnDOT improvement projects and studies, and on other items of interest to the Committee.

Chairperson Riley commented that he believed they were purchasing a prefabricated building for The Waterfront waterplay park.

City Engineer/Public Works Director Westby commented that he had the same general understanding, but that was not the case. He confirmed that it is not causing a delay in the schedule or impacting the budget. He reported that the Water Treatment Plant is running well with no hiccups. He noted that they will soon stop testing for manganese, as only trace amounts of manganese are being detected during testing. He stated an updated article will be included in an upcoming issue of the *Ramsey Resident* to inform readers that the plant is working well and is removing iron and manganese to only trace residual amounts.

Assistant City Engineer Feriancek noted the previous reconstruction of Andre Street/164th Avenue in 2016 and stated staff has observed increased pavement cracking this spring, much more than was expected. He noted that the roadway missed the window when a sealcoat would have been done, and staff reviewed a few others that fell within that same window. He stated that staff are proposing to do a further review of Andre Street to determine why it is failing in this way, as the other roads within that window are not in the same condition. He commented that they would do some pavement cores to gain more information.

Chairperson Riley commented that he has seen the condition of the roadway and agrees that this makes sense to do further review. He noted an area of pavement that needs attention, on Sunwood Drive in the turn lane next to Chipotle.

City Engineer/Public Works Director Westby commented that he had not noticed that, but staff will review that area.

6.02: Review Future Topics Calendar

City Engineer/Public Works Director Westby provided additional details on the asset management item marked for quarter two and the reason it continues to be pushed out.

7. ADJOURNMENT

Motion by Councilmember Olson, seconded by Chairperson Riley, to adjourn the Public Works Committee meeting.

Motion carried.

The regular meeting of the Public Works Committee adjourned at 6:36 p.m.

Respectfully submitted,

____

Bruce Westby
City Engineer/Public Works Director

Drafted by Amanda Staple
TimeSaver Off Site Secretarial, Inc.

Public Works Committee

Meeting Date: 05/19/2026

Primary Strategic Plan Initiative: Address infrastructure needs.

Title:

Consider Recommending City Council Approve Plans and Specifications and Authorize Advertisement for Bids for Riverside West Street Reconstructions, Improvement Project #26-06

Purpose/Background:

Purpose:
The purpose of this case is to consider recommending City Council Approve final plans and specifications and authorize advertisement for bids for Riverside West Street Reconstructions, Improvement Project #26-06.

Background:
The 2026 – 2035 Capital Improvement Plan (CIP) identifies the streets within the Riverside West subdivision for street reconstruction in 2026. A street segment summary for the project is attached to this case.

Project History

- On April 22, 2025, the Ramsey City Council adopted Resolution #25-082, accepting and awarding a proposal to Bolton & Menk for topographic survey of the project area.
- May 13, 2025, the Ramsey City Council adopted Resolution #25-101, accepting and awarding a proposal to Independent Testing Technologies for a geotechnical report of the project area.
- June 17, 2025, the Ramsey Public Works Committee recommended City Council order plans and specifications for said improvements.
- June 24, 2025, the Ramsey City Council adopted Resolution #25-140, ordering plans and specifications for said improvements.
- April 22, 2026, staff held a public open house for said improvements.

Project Scope

This project proposes to reconstruct 137th Avenue and Dolomite Street within the Riverside West subdivision. Additionally, the project proposes to mill and overlay Ebony Street, which is located in this same subdivision but constructed 13 years after the original streets. This project is generally located between Riverdale Drive and the Mississippi River, on the previously mentioned cross streets.

Existing Pavement Conditions

137th Avenue and Dolomite Street were constructed in 1992. Pavement maintenance has included crack seal / seal coat improvements in 2003 and 2011, as well as skim patching in 2024. The skim patching has held up well. Ebony Street was constructed in 2005. Pavement maintenance has included crack seal / seal coat improvements in 2011 and crack seal improvements in 2021. The streets are 31-foot-wide urban section with surmountable concrete curb and gutter, totaling 0.48 miles in length. Sidewalk exist along Ebony Street, but not 137th Avenue and Dolomite Street. There is a trail crossing on 137th Avenue which leads to Riverdale Park. Anoka County reconstructed this trail south of 137th Avenue in 2025, including updating the pedestrian ramp. The ramp on the north side of 137th Avenue was not reconstructed, and is not up to current ADA standards. Municipal water and sewer, as well as storm sewer exist in the project area. The storm sewer outlets to the Mississippi River from 137th Avenue at the intersections with both Ebony and Dolomite Street. The Ebony Street outlet already has a hydro-dynamic separator structure, similar to what has been retro-fit on recent projects including the Dickenson's Mississippi Estates Reconstruction and the Bowers Drive Overlay Improvements. Because a sanitary sewer lift station is adjacent to the storm sewer at the intersection of Dolomite Street, there is not enough space to retro-fit a structure near the roadway for this second, smaller outlet.

Proposed Improvements
This project is proposed to be a full-depth reclamation (FDR) on 137th Avenue and Dolomite Street, which includes grinding up the existing bituminous and aggregate base, hauling off excess material, and placing new bituminous pavement. The existing pavement section is sufficient to allow for 3.5-inches of new bituminous pavement over 5-inches of aggregate base, which will be made of the recycled reclamation material. Spot concrete curb and gutter replacements will occur, which will require spot driveway end replacements. The majority of the concrete curb and gutter and driveways will remain in-place. The utilities were tested during design, no repairs were found to be necessary in the reconstruction area. Catch basins will be adjusted and/or grouted as part of the project, but no additional structures or full replacements will be necessary.

Ebony Street will receive a 2-inch mill and overlay as part of this project. Ebony Street was originally included in the 2026 Neighborhood Overlay project, but moved to this project due to project location. Staff anticipates this will result in an overall cost savings for the city by reducing mobilization costs. Utility testing did find 1 length of storm sewer pipe which will require replacement as part of the project.

The project will include pedestrian ramp improvements at the intersection of Ebony Street and 137th Avenue, as well to the trail crossing on the north side of 137th Avenue. This improvements will bring the pedestrian ramps up to current ADA standard.

Restoration of the impacted boulevards will include a minimum of 4-inches topsoil and hydroseed with a residential turf seed mix.

Preliminary Schedule Remaining

- Council approves plans and specifications / authorizes ad for bids
  - May 26, 2026
- Staff Receives Bids
  - July 7, 2026
- Council Awards Contract to the Lowest Responsible Bidder
  - July 14, 2026
- Contractor Begins Construction
  - Late Summer 2026
  - Detailed construction schedule will not be known until project is awarded and pre-construction meeting is held with the contractor
- Contractor Substantially Completes Construction
  - New bituminous pavement in-place, topsoil and seed in-place
  - October 2, 2026
- Contractor Final Completion
  - Verify final restoration; punch list created
  - October 31, 2026 (may extend into spring of 2027)

Final plans are not attached to this case to prevent potential bidders from downloading plans attached to the case to prepare and submit their bids, rather than purchasing the plans through QuestCDN, the electronic bidding software used by the City of Ramsey. This ensures all bidders are bidding off the same set of plans, and all bidders are notified of any plan revisions (addenda) issued during the bidding process. Attached is the title sheet showing the scope of the improvements, as well as a plan sheet showing the typical section, which includes information on the proposed pavement section. Plans are available upon request from the City Engineer.

Notification:

Notification is not required for this case. Staff will update the project webpage, to keep residents informed on the progress of the project.

Time Frame/Observations/Alternatives:

Timeframe:
Staff anticipates up to 15 minutes will be required to present this case and respond to questions.

Observations:
Staff held the public open house for this project on Wednesday, April 22, 2026. The open house was attended by 3 residents impacted by these improvements. No alternative improvements to the project were requested, however, all 3 residents did request staff consider the addition of a street light at the corner of 137th Avenue and Dolomite Street.

Alternatives:
Alternative #1 – Motion recommending City Council approve final plans and specifications and authorize advertisement for bids for Riverside West Street Reconstructions, Improvement Project #26-06.

Alternative #2 – Motion of other.

Funding Source:
Funding for this improvement is proposed to come from Pavement Management Funds and Storm Water Utility Funds. Amounts shown below include 23-percent indirect costs for administrative, engineering, finance, and legal costs.

Pavement Management Funds	$313,899
Storm Water Utility Funds	$11,710
Total Project Costs	**$325,609**

CIP level estimated project costs are $293,875 ($260,865 Pavement Management Funds, $33,010 Storm Water Utility Funds). The final project costs may change depending upon bid prices and actual construction quantities.

Recommendation:
Staff recommends Alternative #1.

Outcome/Action:
Motion recommending City Council approve final plans and specifications and authorize advertisement for bids for Riverside West Street Reconstructions, Improvement Project #26-06.

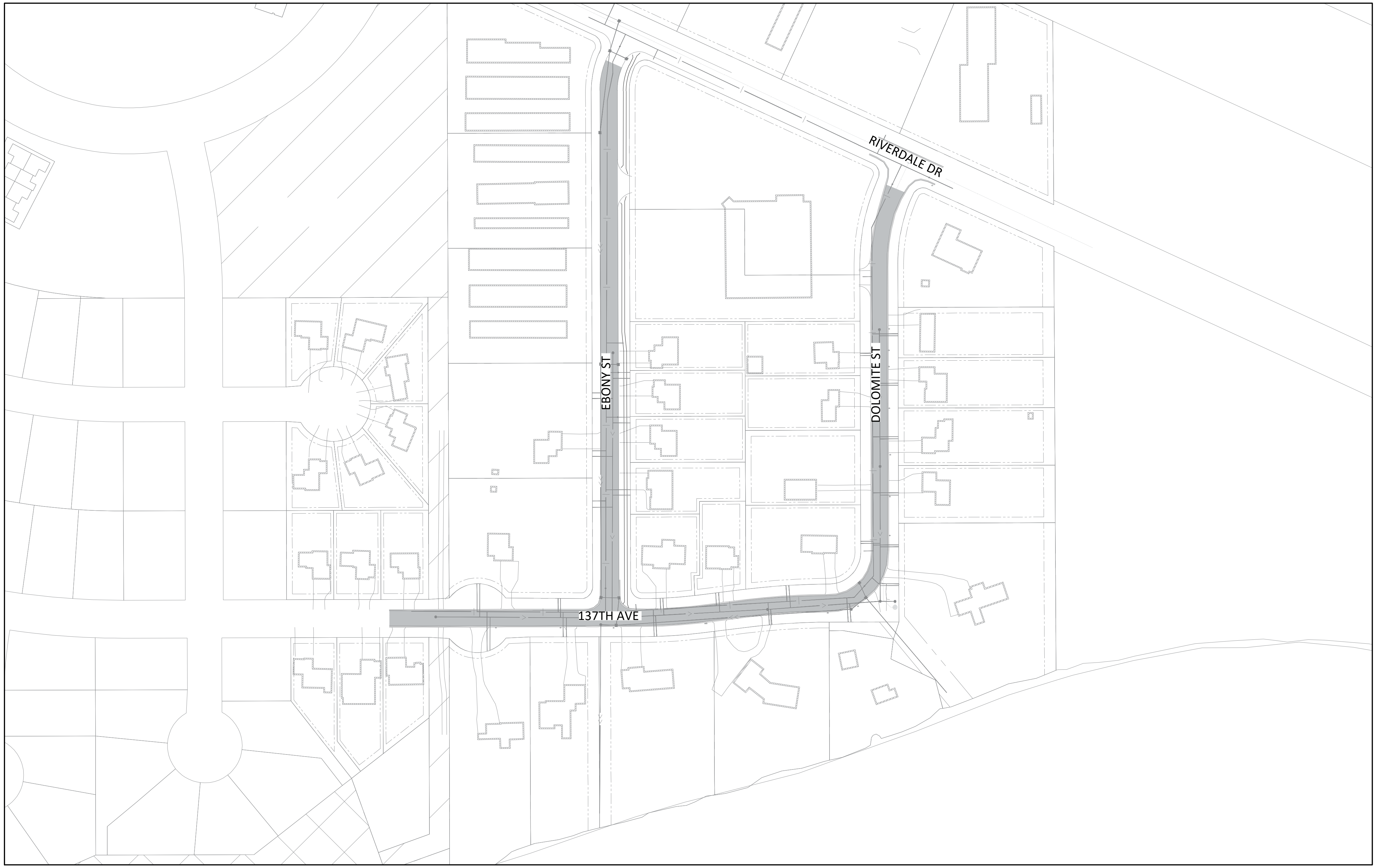
Attachments

26-06 Title Sheet
26-06 Street Summary
26-06 Typical Section

Form Review

Inbox	Reviewed By	Date
Bruce Westby	Bruce Westby	05/13/2026 03:18 PM
Brian Hagen	Brian Hagen	05/13/2026 03:44 PM
Form Started By: Joe Feriancek		Started On: 05/12/2026 03:31 PM
Final Approval Date: 05/13/2026		

CITY OF RAMSEY
RIVERSIDE WEST STREET RECONSTRUCTIONS
CITY IMPROVEMENT PROJECT NO. 26-06



GOVERNING SPECIFICATIONS

THE 2025 EDITION OF THE MINNESOTA DEPARTMENT OF TRANSPORTATION "STANDARD SPECIFICATIONS FOR CONSTRUCTION" SHALL GOVERN.

THE 2023 EDITION OF THE CITY ENGINEERS ASSOCIATION OF MINNESOTA "STANDARD SPECIFICATIONS" SHALL GOVERN FOR UTILITY INSTALLATIONS.

ALL FEDERAL, STATE AND LOCAL LAWS, REGULATIONS AND ORDINANCES SHALL BE COMPLIED WITH IN THE CONSTRUCTION OF THIS PROJECT.

ALL TRAFFIC CONTROL DEVICES AND SIGNING SHALL CONFORM TO THE MINNESOTA MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES, INCLUDING THE FIELD MANUAL FOR TEMPORARY TRAFFIC CONTROL ZONE LAYOUTS.

SHEET INDEX

THIS PLAN CONTAINS 30 SHEETS

LEGEND

SANITARY MANHOLE	EASEMENT - DRAINAGE & UTILITY
STORM SEWER MANHOLE	SECTION LINE
CATCH BASIN MANHOLE	LOT LINE
CATCH BASIN	ELECTRIC LINE
CULVERT END SECTION	ELECTRIC LINE - BURIED
HYDRANT	ELECTRIC LINE - OVERHEAD
VALVE	GAS LINE
TREE - CONIFEROUS	TELECOMMUNICATION LINE
TREE - DECIDUOUS	TELECOMM - OVERHEAD
SHRUB	FIBER OPTIC LINE
LIGHT POLE	TREE LINE
SIGN	LANDSCAPE
MAILBOX	RETAINING WALL
PEDESTAL - TELECOM	TREE SAVE FENCE
PEDESTAL - ELECTRIC	SILT FENCE
HAND HOLE	WATERMAIN
BITUMINOUS PAVEMENT	SANITARY SEWER
DRIVE - BITUMINOUS	STORM SEWER
DRIVE - CONCRETE	DRAIN TILE
DRIVE - GRAVEL	LANDSCAPE - ROCK
CONCRETE WALK	LANDSCAPE - MULCH
VALLEY GUTTER	LANDSCAPE - RIP RAP
SEEDING AREA	
MILL BITUMINOUS PAVEMENT	
CURB & GUTTER	
SAWCUT FULL DEPTH	
FULL-DEPTH RECLAMATION	
REMOVE PAVEMENT BITUMINOUS	
REMOVE PAVEMENT CONCRETE	
REMOVE GRAVEL	
REMOVE CONCRETE CURB & GUTTER	
REMOVE BITUMINOUS CURB & GUTTER	

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

JOE FERIANCEK, P.E.
ASSISTANT CITY ENGINEER

57095 LIC. NO. DATE 04/27/26

DATE	REVISION

0 100 200 300
SCALE (FEET)

N

CITY OF RAMSEY
7550 SUNWOOD DRIVE
RAMSEY, MN 55303
(763) 427-1410 FAX (763) 433-9898

THE SUBSURFACE UTILITY INFORMATION IN THIS PLAN IS UTILITY QUALITY LEVEL D. THIS QUALITY LEVEL WAS DETERMINED ACCORDING TO THE GUIDELINES OF CI/ASCE 38-02, ENTITLED "STANDARD GUIDELINES FOR THE COLLECTION AND DEPICTION OF EXISTING SUBSURFACE UTILITY DATA."

NOTE: EXISTING UTILITY INFORMATION SHOWN ON THIS PLAN HAS BEEN PROVIDED BY THE UTILITY OWNER. THE CONTRACTOR SHALL FIELD VERIFY EXACT LOCATIONS PRIOR TO COMMENCING CONSTRUCTION AS REQUIRED BY STATE LAW. NOTIFY GOPHER STATE ONE CALL 1-800-252-1166 OR 651-454-0002

Call before you dig
811
651 454-0002 Metro
800 252-1166 Outstate
www.gopherstateonecall.org

May 01, 2026 - 2:04pm
G:\Engineering\AutoCad Dwgs\Projects N-Z\Riverside West 26-06\Plan Drawings\26-06 Title & SEQ.dwg

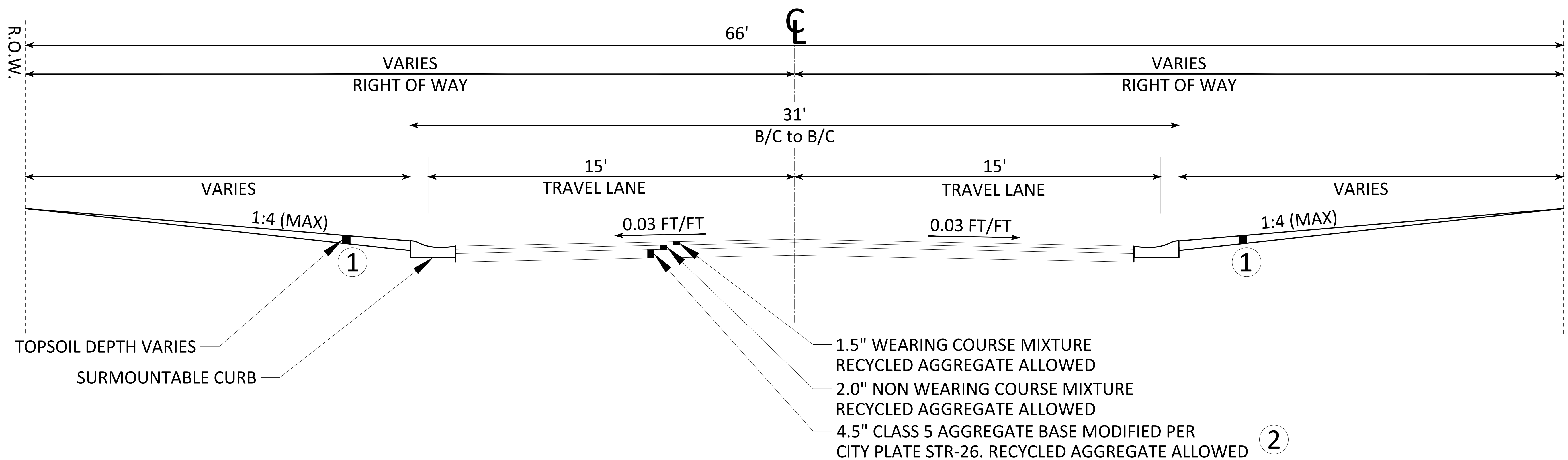
IP 26-06
Riverside West Street Reconstructions
Street Segment Summary

Subdivision	Street	Segment Description	Length (feet)	Section (Urban / Rural)	Curb (Bit / Conc.)	2025 PASER	Year Built	Maint. 1	Maint. 2	Maint. 3	Maint. 4	Maint. 5	Avg HMA (inches)	Avg Agg. Base (inches)	Avg Section (inches)
Riverside West	137th Avenue	Dolomite Street / W EOP	726	Urban	Conc.	5	1992	SC 1996	SC 2003	SC 2011	SP 2024		2.3	5.8	8.1
	Dolomite Street	Riverdale Drive / 137th Avenue	773	Urban	Conc.	4	1992	SC 1996	SC 2003	SC 2011	SP 2024		3.9	5.2	9.1
	Ebony Street *	Riverdale Drive / 137th Avenue	1034	Urban	Conc.	6	2005	SC 2011	CS 2021				3.4	7.2	10.6
	Riverside West Total		**2533**	**0.48 mi.**											

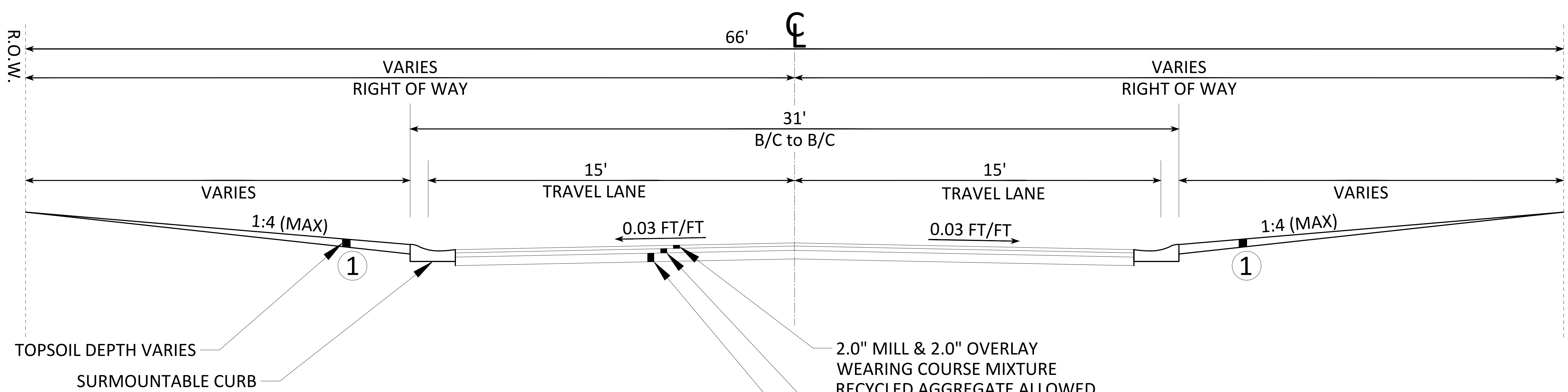
* MILL & OVERLAY IMPROVEMENT ONLY

NOT TO SCALE

TYPICAL SECTION (137TH AVE & DOLOMITE ST)



TYPICAL SECTION (EBONY ST)



REFERENCE NOTES:

1. GRADE TO MATCH EXISTING GROUND. ESTABLISH TURF USING MINIMUM 4" TOPSOIL AND HYDROSEED WITH MNDOT TURFGRASS SEED MIXTURE.
2. SCARIFY 12" OF SUBSOIL. RECLAMATION MATERIAL IS ACCEPTABLE AS AGGREGATE BASE IF IT MEETS MODIFIED CLASS 5 SPEC.

DATE	REVISION

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

JOE FERIANCEK
Date 04/27/26 Lic. No. 57095

DESIGNED BY:	LWC		
DRAWN BY:	LWC	DATE:	04/27/26
CHECKED BY:	JJF	FILE:	26-06

City of RAMSEY

CITY OF RAMSEY
7550 SUNWOOD DRIVE
RAMSEY, MN 55303
(763) 427-1410 FAX (763) 433-9898

TYPICAL SECTION

RIVERSIDE WEST STREET RECONSTRUCTIONS
CITY PROJECT NO. 26-06
CITY OF RAMSEY, MINNESOTA

Public Works Committee

Meeting Date: 05/19/2026

Primary Strategic Plan Initiative: Address infrastructure needs.

Title:

Consider Recommending City Council Authorization to Prepare Plans and Specifications for 2027 Pavement Management Program Projects

Purpose/Background:

Purpose:
The purpose of this case is to consider recommending City Council authorization to prepare plans and specifications for 2027 Pavement Management Program Projects.

Background:
The current 2026 – 2035 Capital Improvement Plan (CIP) identifies five (5) street reconstruction improvements, two (2) pavement overlay improvements, and one (1) gravel road replacement improvement for 2027.

- IP 27-01 MSA 142nd Avenue & Juniper Ridge Drive Reconstruction
- IP 27-02 2027 MSA Pavement Overlay Improvements
- IP 27-03 Deerwood Street Reconstructions
- IP 27-04 Hall-Anderson Acres & Oakwood Hills Street Reconstructions
- IP 27-05 Sorteberg's 6th & Windsorwood Street Reconstructions
- IP 27-06 Windemere Woods 1st & 2nd Street Reconstructions
- IP 27-07 2027 Neighborhood Pavement Overlay Improvements
- IP 27-08 Itasca Heights Street Construction

City Council ordered plans and specifications for Improvement Project #25-08 Sunwood Drive & Rhinestone Street Crosswalk Repairs on June 10, 2025, with Resolution #25-122. Public Works recommended including the remaining concrete repairs and moving the project to 2027 on April 21, 2026.

The 2027 Draft Pavement Management Program Project Map is attached to this case for reference.

<u>Preliminary Design:</u>

- March 24, 2026, City Council adopted Resolution #26-080 ordering requests for proposals for topographic surveys, geotechnical evaluations and utility testing for 2027 Pavement Management Program Projects.
- April 28, 2026, City Council adopted Resolution #26-099 awarding the topographic survey proposal from Hakanson Anderson for said improvements.
    - Hakanson Anderson has started performing the topographic surveys, and will complete their work during the summer of 2026.
- May 12, 2026, City Council adopted Resolution #26-106 awarding the geotechnical services proposal from Haugo Geotechnical Services for said improvements.
    - Haugo Geotechnical Services will complete their work during the summer of 2026.
- Staff is currently drafting a sewer cleaning and televising request for proposal, which is anticipated to go to City Council in June 2026 for award.

<u>Anticipated Project Scopes:</u>

Street segment summaries including existing pavement section information, construction and subsequent maintenance types and years, and street lengths, are attached to this case for reference.

IP 27-01 MSA 142nd Avenue & Juniper Ridge Drive Reconstructions
This project proposes to reconstruct two (2) Municipal State Aid (MSA) street segments on the east side of Ramsey; 142nd Avenue between Saint Francis Boulevard (TH 47) and Xkimo Street, and Juniper Ridge Drive between 156th Lane and Roanoke Street. The segments were combined due to their relatively small size and close proximity. 142nd Avenue is 0.07 miles of urban section including concrete curb and gutter, municipal water and sewer, and storm sewer. Juniper Ridge Drive is 0.37 miles of urban section including bituminous curbing and storm sewer inlets, but no municipal water and sewer.

These streets will be reconstructed to meet MSA 10-ton pavement design standards and minimum lane widths. 142nd Avenue is anticipated to be a full-depth reclamation (FDR). Juniper Ridge Drive is generally anticipated to be an FDR with the addition of replacing the bituminous curbing with concrete curb and gutter. Because Juniper Ridge Drive includes an outlet to the Rum River, staff will evaluate if a retro-fit hydrodynamic separator storm structure would be appropriate.

Permitting will require review and approval by the MnDOT MSA office prior to bidding these improvements. Staff will coordinate improvements at the intersection of 142nd Avenue and Saint Francis Boulevard (TH 47). The current expectation is for MnDOT to overlay TH 47 and include the trail improvements between 142nd Avenue and Xkimo Street. If trail improvements, including updated pedestrian ramps to current ADA standards is required, staff will need to additionally work through a MnDOT right of way permit.

Juniper Ridge Drive is within the 2040 MUSA. The closest stub is located on Waco Street approximately 200 feet south of Juniper Ridge Drive. This stub could service the immediate area, but does not have the depth to service all the project area. To date, staff has not received inquires from residents, but could explore city service extensions if given direction to by the Committee.

The CIP level project costs are $539,784 ($469,377 MSA Funds, $70,407 Storm Water Utility Funds).

IP 27-02 2027 MSA Overlay Pavement Overlay Improvements
This project proposes to mill and overlay numerous MSA street segments within the south half of the COR, totaling 1.61 miles in length.

- Rhinestone Street bituminous pavement between Veterans Drive and Bunker Lake Boulevard
- Sunwood Drive bituminous pavement between Armstrong Boulevard and Ramsey Boulevard
- Veterans Drive between Zeolite Street and Rhinestone Street
- Zeolite Street between Sunwood Drive and Veterans Drive

All the street segments in this project are urban sections, including concrete curb and gutter, municipal sewer and water, and storm sewer. The streets will need to meet MSA 10-ton pavement design standards and be marked to meet MSA lane width standards as well. Staff will evaluate if pavement markings must be modified to meet current standards, which will include the various turn lanes along Sunwood Drive that have been modified several times due to past and current development.

In general, the improvements are proposed to include a 2-inch mill and overlay, with spot curb replacements and ADA pedestrian ramp replacements.

Staff would like input from the committee if there is a desire to complete missing sidewalk segments (Veterans Drive VA Medical Center to Rhinestone Street, Rhinestone Street between Veterans Drive and Sunwood Drive, south side of Sunwood Drive between Rhinestone Street and O'Reilly Auto Parts).

The CIP level project costs are $785,169 ($747,780 MSA Funds, $37,389 Storm Water Utility Funds).

IP 27-03 Deerwood Street Reconstructions
This project proposes to reconstruct the streets within the Deerwood subdivision, generally located along Gibbon

Street and Eland Street, north of 173rd Avenue. The streets are a 24-foot-wide rural section, totaling 1.13 miles in length. Drainage is handled through street crossing culverts and drainage swales which generally carry storm water to existing wetlands throughout the subdivision.

In 2016, significant time was spent reviewing the drainage of this subdivision, particularly around the possibility of adding storm sewer to lower the wetland levels and reduce basement flooding of residences along Gibbon Street. A feasible solution was not found, and subsequent time was spent researching grant opportunities for flood relief. Staff has not received inquiries for assistance from residents in the last several years.

At this time no stormwater or soil correction improvements are anticipated for this subdivision, other than replacing existing street crossing culverts. This will be further explored during project design and review of the geotechnical report. The reconstruction is proposed to be an FDR. This will be further explored during project design.

Municipal utilities do not exist in the subdivision, which is outside the 2040 MUSA.

CIP level project costs are $803,091 ($698,340 Pavement Management Funds, $104,751 Storm Water Utility Funds).

IP 27-04 Hall-Anderson Acres & Oakwood Hills Street Reconstructions
This project proposes to reconstruct the streets within the Hall-Anderson Acres (except TH 47 frontage road), Oakwood Hills, and Rambosek Red Oak Estate subdivisions, generally located west of TH 47 to Wolfram Street between 159th Lane and 160th Lane. The streets are a 24-foot-wide rural section, totaling 2.25 miles in length. Drainage is handled through street crossing culverts and drainage swales adjacent to the roadways, which generally carry storm water runoff to existing wetlands throughout the subdivision.

At this time no stormwater or soil correction improvements are anticipated for this subdivision, other than replacing existing street crossing culverts. This will be further explored during project design and review of the geotechnical report. The reconstruction is proposed to be an FDR. This will also be further explored during project design. Because the existing street section is less than our current design standards (3.5-inches bituminous over 6-inches aggregate base), there will likely be a need to over excavate the subbase material to create space for the new pavement section.

Municipal utilities do not exist within this subdivision, which is outside the 2040 MUSA.

CIP level project costs are $1,606,182 ($1,396,680 Pavement Management Funds, $209,502 Storm Water Utility Funds).

IP 27-05 Sorteberg’s 6th & Windsorwood Street Reconstructions
This project proposes to reconstruct the streets within the Sorteberg’s 6th and Windsorwood subdivisions. Sorteberg’s 6th, generally located along Rabbit Street and Puma Street between 173rd Avenue and 174th Avenue, is a 30-foot-wide urban section street with bituminous curbing, totaling 0.62 miles in length. Drainage is handled along the bituminous curbing to curb cuts, which carry stormwater runoff to an existing low area in the center of the plat. Windsorwood, generally located along 178th Avenue between Baugh Street and Vicuna Street, is a 24-foot-wide urban section street, totaling 0.62 miles in length. These subdivisions were combined due to their proximity and size. Though Deerwood is relatively close to these subdivisions, it was kept separate to avoid making the project too large and complex.

At this time, no stormwater or soil correction improvements are anticipated for these subdivisions, though Sorteberg’s 6th will require an in-depth review of the drainage. Sorteberg’s 6th will require a full reconstruction, including replacing the bituminous curbing with concrete curb and gutter. The drainage review will include determining if catch basin inlets are appropriate replacements for the existing curb cuts and drainage swales. Windsorwood is proposed to be reconstructed using the FDR method, though this will be further explored during project design and review of the geotechnical report.

Municipal utilities do not exist in these subdivisions, which are outside the 2040 MUSA.

CIP level project costs are $1,329,009 ($1,155,660 Pavement Management Funds, $173,349 Storm Water Utility Funds).

IP 27-06 Windemere Woods 1st & 2nd Street Reconstructions
This project proposes to reconstruct the streets within the Windemere Woods 1st & 2nd subdivision, generally located north of Bunker Lake Boulevard southeast of Emerald Pond Park. The streets are a 31-foot-wide urban section including concrete curb and gutter, municipal sewer and water, and storm sewer. There are approximately 0.75 miles of streets in total. Drainage is handled through the gutters to catch basin inlets, which outlet into the existing wetland west of Magnesium Street, north of Bunker Lake Boulevard, and south of Emerald Pond Park.

The project is proposed to be a combination of FDR and full reconstruction; the concrete curb and gutter along Magnesium Street is in very poor condition and will all have to be replaced. During project design, staff will review the remaining curb and determine if a full replacement is required. The parking lot for Emerald Pond Park is not specifically called out for pavement replacement in the CIP, but because this parking lot serves as the cul-de-sac for the west end of 142nd Avenue, and is in very poor condition, staff is proposing to include it as part of this project. The existing pavement section in this subdivision is below current design standards. This project will require over excavating subsoil material to make space for the thicker proposed pavement section.

Municipal utilities exist within this project area. Currently, there is a gap in the watermain along Magnesium Street between Bunker Lake Boulevard to approximately 300 feet south of 141st Lane. Staff request direction from the Committee to loop this watermain (approximately 700 feet) at an estimated cost of $50,000. There are approximately 75 properties on city water that would benefit from this looped connection. This water connection is not included in the current CIP.

CIP level project costs are $757,488 ($658,685 Tax Increment Fund #2, $98,803 Storm Water Utility Funds).

IP 27-07 2027 Neighborhood Pavement Overlay Improvements
This project proposes to mill and overlay numerous neighborhood street segments across the city, totaling 3.17 miles in length.

- Brookfield
- Estates of Silver Oaks
- Rivers Bend
- Rivers Bend 2nd
- Rivers Bend Plaza

In general, the improvements are proposed to include a 2-inch mill and overlay, with spot curb replacements and ADA pedestrian ramp replacements.

CIP level project costs are $1,030,980 ($981,847 Pavement Management Funds, $49,133 Storm Water Utility Funds).

IP 27-08 Itasca Heights Street Construction
This project proposes to construct (convert the existing gravel road section to bituminous pavement) the streets within the Itasca Heights subdivision, generally located on Beatty Avenue and Collins Drive, south of Highway 10. The existing gravel streets total 0.24 miles in length. Drainage is currently handled through swales adjacent to the road, which generally carry stormwater runoff to an existing low area on 9118 Collins Drive and from there southeast through backyards and eventually to the Mississippi River.

The new streets are proposed to be constructed to the city’s current rural street section design, which is a 24-foot-wide pavement (3.5-inches bituminous over 6-inches aggregate base) with maximum 4:1 slope ditches adjacent to the pavement. Rural section streets are also typically built with a 2-foot-wide gravel shoulder. Staff will need to perform an extensive storm water review to determine if ponding will be required, and if an outlet to the Mississippi River will be necessary. Staff will need to do some coordination with MnDOT due to the proposed 2027 mill and overlay of Highway 10, which may include obtaining a MnDOT right of way permit for this work. Staff anticipates this project will require a Lower Rum River WMO Permit as well, but this will be determined during design. The existing cul-de-sacs are smaller than standard at approximately 60 feet in diameter. There appears to be sufficient right of way to build cul-de-sacs at or near the city's standard dimension of 100 feet in diameter. However, staff will need to review the topographic survey to determine how the grades will match-in for any increase in size. There may also be other features such as drainage, landscaping and existing trees to consider when making this determination.

Municipal utilities do not exist within this project area, which is in the 2040 MUSA. The closest city sewer and water lines are located at the north end of Bowers Drive, approximately 1,400 feet east of Beatty Avenue. The project does not propose to extend sewer and water to this subdivision; staff is not aware of a desire for municipal utilities from the residents.

CIP level project costs are $280,000 ($250,000 Tax Increment Fund #2, $30,000 Storm Water Utility Funds).

Project Timelines

City staff is proposing to prepare plans and specifications for 2027 pavement management program projects in-house, as part of their normal duties. The following are the proposed general project timelines:

May 26, 2026	City Council Authorization to prepare plans and specifications
Summer 2026 / Winter 2027	Staff prepares plans and specifications
Fall 2026 / Winter 2027	City Council approve plans, authorize bidding
Winter 2027	Bid opening, City Council award contracts
Spring 2027	Begin Construction
Summer / Fall 2027	Finish Construction

Staff proposes to bid projects separately, but to bid and award projects as close together as practical, which generally allows for a better bidding environment for the City.

Notification:

Notification is not required for this case.

Time Frame/Observations/Alternatives:

Timeframe:

Staff anticipates this case will take approximately 30 minutes to present and respond to questions.

Observations:

Estimates are CIP level and will be updated during the design process.

Alternatives:

Alternative #1: Motion to recommend City Council authorization to prepare plans and specifications for 2027 Pavement Management Program projects.

Alternative #2: Motion of other.

Funding Source:

Funding for these projects is proposed to be a combination of Pavement Management Funds, Municipal State Aid Funds, Tax Increment Fund #2 and Storm Water Funds as identified in this case and within the current 2026 – 2035 Capital Improvement Program.

Recommendation:

Staff recommends alternative #1.

Outcome/Action:

Motion to recommend City Council authorization to prepare plans and specifications for 2027 Pavement Management Program projects.

Attachments

Draft 2027 PMP Map

2027 PMP Street Summaries

2027 PMP CIP Sheets

Form Review

Inbox	Reviewed By	Date
Bruce Westby	Bruce Westby	05/14/2026 09:27 AM
Brian Hagen	Brian Hagen	05/14/2026 12:37 PM
Form Started By: Joe Feriancek		Started On: 05/12/2026 03:32 PM
Final Approval Date: 05/14/2026		


IP 27-03
DEERWOOD
STREET RECONSTRUCTIONS
IP 27-05
SORTEBERG'S 6TH & WINDSORWOOD
STREET RECONSTRUCTIONS
IP 27-07
2027 NEIGHBORHOOD OVERLAYS
BROOKFIELD
IP 27-07
2027 NEIGHBORHOOD OVERLAYS
ESTATES OF SILVER OAKS
IP 27-01
MSA JUNIPER RIDGE DRIVE
RECONSTRUCTIONS
IP 27-04
HALL-ANDERSON ACRES & OAKWOOD HILLS
STREET RECONSTRUCTIONS
IP 25-08
SUNWOOD DRIVE & RHINESTONE STREET
CONCRETE REPAIRS
IP 27-08
ITASCA HEIGHTS
2027 GRAVEL ROAD ELIMINATION PROGRAM
IP 27-07
2027 NEIGHBORHOOD OVERLAYS
RIVERSBEND 1ST, 2ND, PLAZA
IP 27-02
2027 MSA PAVEMENT OVERLAY IMPROVEMENTS
RHINESTONE / SUNWOOD / VETERANS / ZEOLITE
IP 27-06
WINDEMERE WOODS 1ST & 2ND
STREET RECONSTRUCTIONS
IP 27-01
MSA 142ND AVENUE
RECONSTRUCTIONS
Legend
2027 MSA Recon.
2027 MSA Overlay
2027 Overlay
2027 Reconstruction
2027 GREP
Concrete Repairs
Streets
MuniBndry
ScoutCamp
Golf_Courses
Parks
Rivers
Lakes_Ponds
Creeks
DRAFT 2027
Pavement Management Program Projects

IP 27-01
MSA 1422nd Avenue Juniper Ridge Drive
Street Segment Summary

Subdivision	Street	Segment Description	Length (feet)	Section (Urban / Rural)	Curb (Bit / Conc.)	2025 PASER	Year Built	Maint. 1	Maint. 2	Maint. 3	Maint. 4	Maint. 5	Maint. 6	Avg HMA (inches)	Avg Agg. Base (inches)	Avg Section (inches)
MSA 142nd Avenue	142nd Avenue	TH 47 / Xkimo Street	373	Urban	Conc.	6	1985	SC 1988	SC 1995	OL 2010				5.4	5.0	10.4
	142nd Avenue Total		373	0.07 mi.												
MSA Juniper Ridge Drive	Juniper Ridge Drive	Roanoke Street / 156th Lane	1939	Urban	Bit.	4	1976	SC 1981	SC 1991	OL 2002	SC 2009	SC 2017	SP 2024	4.0	4.2	8.2
	Juniper Ridge Drive Total		1939	0.37 mi.												
	MSA 142nd Avenue & Juniper Ridge Drive Total		**2312**	**0.44 mi.**												

* Per As-Built, GPR not available
** No Base Visible, GPR Data not available
*** No Wear Course Pavement; Rehabilitation Project

IP 27-02
2027 MSA Pavement Overlay Improvements
Street Segment Summary

Subdivision	Street	Segment Description	Length (feet)	Section (Urban / Rural)	Curb (Bit / Conc.)	2025 PASER	Year Built	Maint. 1	Maint. 2	Maint. 3	Avg HMA (inches)	Avg Agg. Base (inches)	Avg Section (inches)
MSA Rhinestone Street	Rhinestone Street	E. Ramsey Parkway WB / Bunker Lake Boulevard	845	Urban	Conc.	7	2004	SC 2010	SC 2018		5.0*	6.0*	11.0*
	Rhinestone Street	Veterans Drive / Sunwood Drive	821	Urban	Conc.	7	2007	SC 2016	CS 2023		5.0*	6.0*	11.0*
	Rhinestone Street Total		1666	0.32 mi.									
MSA Sunwood Drive	Sunwood Drive	Armstrong Boulevard / Zeolite Street	1561	Urban	Conc.	7	2004	SC 2010	SC 2017	CS 2024	4.0*	6.0*	10.0*
	Sunwood Drive	Peridot Street / Ramsey Boulevard	720	Urban	Conc.	7	2004	SC 2010	SC 2017	CS 2024	6.5*	6.0*	12.5*
	Sunwood Drive	Rhinestone Street / Peridot Street	677	Urban	Conc.	7	2004	SC 2010	SC 2017	CS 2024	6.5*	6.0*	12.5*
	Sunwood Drive Total		2958	0.56 mi.									
MSA Veterans Drive	Veterans Drive	Saphire Street / Rhinestone Street	1131	Urban	Conc.	7	2007	SC 2016	CS 2023		5.0	7.8	12.8
	Veterans Drive	Zeolite Street / Rhinestone Street	2301	Urban	Conc.	7	2005	SC 2016	CS 2023		5.0	7.8	12.8
	Veterans Drive Total		3432	0.65 mi.									
MSA Zeolite Street	Zeolite Street	Sunwood Drive / Veterans Drive	456	Urban	Conc.	6	2005	SC 2016	CS 2023		4.4	n/a**	n/a**
	Zeolite Street Total		456	0.09 mi.									
	2027 MSA Overlay Total		**8512**	**1.61 mi.**									

* Per As-Built, GPR not available
** No Base Visible, GPR Data not available

IP 27-03
Deerwood Street Reconstructions
Street Segment Summary

Subdivision	Street	Segment Description	Length (feet)	Section (Urban / Rural)	Curb (Bit / Conc.)	2025 PASER	Year Built	Maint. 1	Maint. 2	Maint. 3	Maint. 4	Maint. 5	Avg HMA (inches)	Avg Agg. Base (inches)	Avg Section (inches)
Deerwood	176th Lane	Eland Street / E EOP	319	Rural	n/a	4	1982	SC 1988	OL 1998	SC 2004	SC 2012		3.6	5.1	8.7
	176th Lane	Gibbon Street / Eland Street	591	Rural	n/a	3	1982	SC 1988	OL 1998	SC 2004	SC 2012		3.6	5.1	8.7
	177th Avenue	E EOP / Eland Street	308	Rural	n/a	4	1982	SC 1988	OL 1998	SC 2004	SC 2012		4.2	n/a**	n/a**
	177th Avenue	Eland Street / Gibbon Street	590	Rural	n/a	3	1982	SC 1988	OL 1998	SC 2004	SC 2012		4.2	n/a**	n/a**
	177th Avenue	Gibbon Street / Gibbon Street	206	Rural	n/a	3	1982	SC 1988	OL 1998	SC 2004	SC 2012		4.2	n/a**	n/a**
	Eland Street	176th Lane / 177th Avenue	440	Rural	n/a	3	1982	SC 1988	OL 1998	SC 2004	SC 2012		4.5	2.4	6.9
	Gibbon Street	176th Lane / 177th Avenue	654	Rural	n/a	3	1982	SC 1988	OL 1998	SC 2004	SC 2012		3.9	2.6	6.5
	Gibbon Street	177th Avenue / CDS	522	Rural	n/a	3	1982	SC 1988	OL 1998	SC 2004	SC 2012		3.9	2.6	6.5
	Gibbon Street	CR 63 / 176th Lane	2311	Rural	n/a	3	1982	SC 1988	OL 1998	SC 2004	SC 2012	SP 2024	3.9	2.6	6.5
		Deerwood Total	**5941**	**1.13 mi.**											

** No Base Visible, GPR Date not available

IP 27-04
Hall-Anderson Acres Oakwood Hills Street Reconstructions
Street Segment Summary

Subdivision	Street	Segment Description	Length (feet)	Section (Urban / Rural)	Curb (Bit / Conc.)	2025 PASER	Year Built	Maint. 1	Maint. 2	Maint. 3	Maint. 4	Avg HMA (inches)	Avg Agg. Base (inches)	Avg Section (inches)
Hall-Anderson Acres	159th Lane	Sodium Street / Cul-de-sac	2106	Rural	n/a	5	1980	SC 1986	SC 1996	OL 2006	SC 2011	3.3	3.1	6.4
	160th Lane	West EOP / TH 47	3017	Rural	n/a	4	1980	SC 1986	SC 1996	OL 2006	SC 2011	3.5	3.3	6.8
	Neon Street	160th Lane / Cul-de-sac	340	Rural	n/a	5	1980	SC 1986	SC 1996	OL 2006	SC 2011	3.7	2.9	6.6
	Osmium Street	159th Lane / 160th Lane	1118	Rural	n/a	5	1980	SC 1986	SC 1996	OL 2006	SC 2011	3.1	5.1	8.2
	Potassium Street	159th Lane / Osmium Street	716	Rural	n/a	4	1980	SC 1986	SC 1996	OL 2006	SC 2011	3.6	4.0	7.6
	Radium Street	159th Lane / 160th Lane	884	Rural	n/a	5	1980	SC 1986	SC 1996	OL 2006	SC 2011	3.3	3.0	6.3
	Sodium Street	South EOP / 160th Lane	1095	Rural	n/a	5	1980	SC 1986	SC 1996	OL 2006	SC 2011	3.1	3.6	6.7
	Hall-Anderson Acres Total		**9276**	**1.76 mi.**										
Oakwood Hills	160th Lane	Wolfram Street / East EOP	1046	Rural	n/a	4	1989	SC 2004				2.5	3.5	6.0
	Xenon Street	Nowthen Boulevard / Cul-de-sac	542	Rural	n/a	5	1989	SC 1998	SC 2007			2.8	3.8	6.6
	Oakwood Hills Total		**1588**	**0.3 mi.**										
Rambosek Red Oak Estate	Wolfram Street	160th Lane / North EOP	1039	Rural	n/a	4	1989	SC 1998	SC 2004			2.3	3.6	5.9
	Rambosek Red Oak Estate Total		**1039**	**0.2 mi.**										
IP 27-04 Total			11903	**2.25 mi.**										

IP 27-05
Sorteberg's 6th Windsorwood Street Reconstructions
Street Segment Summary

Subdivision	Street	Segment Description	Length (feet)	Section (Urban / Rural)	Curb (Bit / Conc.)	2025 PASER	Year Built	Maint. 1	Maint. 2	Avg HMA (inches)	Avg Agg. Base (inches)	Avg Section (inches)
Sorteberg's 6th	174th Lane	Rabbit Street / Cul-de-sac	940	Urban	Bit.	3	1990	SC 1995	SC 2004	2.2	3.8	6.0
	Puma Street	174th Lane / 173rd Avenue	908	Urban	Bit.	3	1990	SC 1995	SC 2004	2.2	3.8	6.0
	Rabbit Street	173rd Avenue / North EOP	1445	Urban	Bit.	3	1990	SC 1995	SC 2004	2.3	3.6	5.9
		Sorteberg's 6th Total	**3293**	**0.62 mi.**								
Windsorwood	178th Avenue	Baugh Street / NW PC Vicuna Street & 178th Avenue	2249	Rural	n/a	3	1990	SC 1996	SC 2004	2.1	4.4	6.5
	178th Circle	178th Avenue / Cul-de-sac	613	Rural	n/a	3	1990	SC 1996	SC 2004	2.6	7.0	9.6
	Vicuna Street	NW PC Vicuna Street & 178th Avenue / South EOP	417	Rural	n/a	3	1990	SC 1996	SC 2004	2.7	3.5	6.2
		Windsorwood Total	**3279**	**0.62 mi.**								
IP 27-05 Total			6572	**1.24 mi.**								

IP 27-06
Windemere Woods 1st and 2nd Street Reconstructions
Street Segment Summary

Subdivision	Street	Segment Description	Length (feet)	Section (Urban / Rural)	Curb (Bit / Conc.)	2025 PASER	Year Built	Maint. 1	Maint. 2	Maint. 3	Maint. 4	Maint. 5	Avg HMA (inches)	Avg Agg. Base (inches)	Avg Section (inches)
Windemere Woods	141st Lane	Magnesium Street / West EOP	448	Urban	Conc.	6	1992	SC 1998	SC 2005	SC 2013			2.9	3.1	6.0
	142nd Avenue	East EOP / Magnesium Street	101	Urban	Conc.	5	1992	SC 1998	SC 2005	SC 2013			3.2	3.0	6.2
	142nd Avenue	Magnesium Street / Neon Street	531	Urban	Conc.	5	1992	SC 1998	SC 2005	SC 2013			3.2	3.0	6.2
	Magnesium Street	141st Lane / 142nd Avenue	296	Urban	Conc.	5	1992	SC 1998	SC 2005	SC 2013			2.8	3.3	6.1
	Magnesium Street	141st Lane / Cul-de-sac	299	Urban	Conc.	4	1992	SC 1998	SC 2005	SC 2013			2.8	3.3	6.1
	Neon Street	142nd Avenue / North EOP	226	Urban	Conc.	6	1992	SC 1998	SC 2005	SC 2013			2.8	0.0**	2.8**
	Windemere Woods Total		**1901**	**0.36 mi.**											
Windemere Woods 2nd	142nd Avenue	Neon Street / West EOP	745	Urban	Conc.	5	1992	SC 1998	SC 2005	SC 2013			3.2	3.0	6.2
	Neon Street	South EOP / 142nd Avenue	509	Urban	Conc.	6	1992	SC 1998	SC 2005	SC 2013			2.8	0.0**	2.8**
	Windemere Woods 2nd Total		**1254**	**0.24 mi.**											
Section 26 Unplatted	Magnesium Street	Bunker Lake Boulevard / S EOP Windemere Woods	828	Urban / Rural	Conc.	8	1984	SC 1990	SC 2005	RC*** 2011	SC 2013	CS 2021	4.0	4.6	8.6
	Section 26 Unplatted Total		**828**	**0.16 mi.**											
IP 27-06 Total			3983	**0.75 mi.**											

** GPR No Base Detected
*** Turn Lane added with Bunker Lake Boulevard Improvements

IP 27-07
2027 Neighborhood Pavement Overlay Improvements
Street Segment Summary

Subdivision	Street	Segment Description	Length (feet)	Section (Urban / Rural)	Curb (Bit / Conc.)	2025 PASER	Year Built	Maint. 1	Maint. 2	Maint. 3	Maint. 4	Maint. 5	Avg HMA (inches)	Avg Agg. Base (inches)	Avg Section (inches)
Brookfield	169th Lane	Garnet Street / West EOP	449	Urban	Conc.	7	2007	SC 2012	CS 2019				3.5*	4.0*	7.5*
	170th Avenue	Nowthen Boulevard / Roundabout	472	Urban	Conc.	6	2007	SC 2012					3.5*	4.0*	7.5*
	170th Avenue	Roundabout / Cul-de-sac	298	Urban	Conc.	7	2007	SC 2012	CS 2019				3.5*	4.0*	7.5*
	170th Trail	Garnet Street / Cul-de-sac	408	Urban	Conc.	7	2007	SC 2012	CS 2019				3.5*	4.0*	7.5*
	170th Trail	Garnet Street / West EOP	740	Urban	Conc.	7	2007	SC 2012	CS 2019				3.5*	4.0*	7.5*
	Feldspar Street	Garnet Street / South EOP	685	Urban	Conc.	7	2007	SC 2012	CS 2019				3.5*	4.0*	7.5*
	Garnet Street	169th Lane / Roundabout	413	Urban	Conc.	7	2007	SC 2012	CS 2019				3.5*	4.0*	7.5*
	Garnet Street	Feldspar Street / South EOP	308	Urban	Conc.	7	2007	SC 2012	CS 2019				3.5*	4.0*	7.5*
	Garnet Street	Roundabout / 170th Trail	519	Urban	Conc.	7	2007	SC 2012	CS 2019				3.5*	4.0*	7.5*
	Brookfield Total		4292	0.81 mi.											
Estates of Silver Oaks	160th Lane	TH 47 / Iodine Street	536	Urban	Conc.	6	2007	SC 2012	CS 2019				3.5*	4.0*	7.5*
	162nd Crossing	Iodine Street / Lithium Court	819	Urban	Conc.	7	2007	SC 2012	CS 2019				3.5*	4.0*	7.5*
	162nd Lane	Iodine Street East EOP	514	Urban	Conc.	7	2007	SC 2012	CS 2019				3.5*	4.0*	7.5*
	162nd Lane	Junkite Street / Lithium Street	451	Urban	Conc.	7	2007	SC 2012	CS 2019				3.5*	4.0*	7.5*
	162nd Lane	Lithium Court / Lithium Street	225	Urban	Conc.	7	2007	SC 2012	CS 2019				3.5*	4.0*	7.5*
	Iodine Street	160th Lane / 162nd Crossing	831	Urban	Conc.	7	2007	SC 2012	CS 2019				3.5*	4.0*	7.5*
	Iodine Street	160th Lane / Cul-de-sac	521	Urban	Conc.	7	2007	SC 2012	CS 2019				3.5*	4.0*	7.5*
	Junkite Street	162nd Crossing / 162nd Lane	387	Urban	Conc.	6	2007	SC 2012	CS 2019				3.5*	4.0*	7.5*
	Lithium Court	162nd Crossing / 162nd Lane	379	Urban	Conc.	7	2007	SC 2012	CS 2019				3.5*	4.0*	7.5*
	Lithium Court	162nd Crossing / Cul-de-sac	464	Urban	Conc.	7	2007	SC 2012	CS 2019				3.5*	4.0*	7.5*
	Lithium Street	162nd Lane / North EOP	316	Urban	Conc.	7	2007	SC 2012	CS 2019				3.5*	4.0*	7.5*
	Estates of Silver Oaks Total		5443	1.03 mi.											

IP 27-07
2027 Neighborhood Pavement Overlay Improvements
Street Segment Summary

Subdivision	Street	Segment Description	Length (feet)	Section (Urban /	Curb (Bit /	2025 PASER	Year Built	Maint. 1	Maint. 2	Maint. 3	Maint. 4	Maint. 5	Avg HMA	Avg Agg. Base	Avg Section
Rivers Bend	142nd Lane	Waco Street / Cul-de-sac	1322	Urban	Conc.	7	1985	SC 1988	SC 1995	OL 2010	SC 2016	CS 2023	4.2	4.8	9
	146th Circle	Waco Street / Cul-de-sac	178	Urban	Conc.	7	1985	SC 1988	SC 1995	OL 2010	SC 2016	CS 2023	4.3	2.9	7.2
	Waco Street	142nd Lane / South EOP	296	Urban	Conc.	7	1985	SC 1988	SC 1995	OL 2010	SC 2016	CS 2023	3.9	3.8	7.7
	Waco Street	Sunwood Drive / 142nd Lane	4397	Urban	Conc.	7	1985	SC 1988	SC 1995	OL 2010	SC 2016	CS 2023	3.7	n/a**	n/a**
	Rivers Bend Total		6193	1.17 mi.											
Rivers Bend 2nd	Waco Street	South EOP / North EOP	497	Urban	Conc.	7	1985	SC 1988	SC 1995	OL 2010	SC 2016	CS 2023	3.9	3.8	7.7
	Rivers Bend 2nd Total		497	0.09 mi.											
Rivers Bend Plaza	142nd Avenue	Xkimo Street / Waco Street	306	Urban	Conc.	7	1985	SC 1988	SC 1995	OL 2010	SC 2016	CS 2023	5.4	5.0	10.4
	Rivers Bend Plaza Total		306	0.06 mi.											
	2027 Neighborhood Overlays Total		**16731**	**3.17 mi.**											

* Per As-Built, GPR not available
** No Base Visible, GPR Data not available

IP 27-08
Itasca Heights Gravel Roads Elimination Program
Street Segment Summary

Subdivision	Street	Segment Description	Length (feet)	Section (Urban / Rural)	Curb (Bit / Conc.)	2025 PASER	Year Built	Maint. 1	Avg HMA (inches)	Avg Agg. Base (inches)	Avg Section (inches)
Itasca Heights	Beatty Avenue	U.S. Highway 10 / Collins Drive	360	Rural	n/a	n/a	n/a	n/a	n/a	6.0**	6.8**
	Collins Drive	Northwest EOP / Cul-de-sac	927	Rural	n/a	n/a	n/a	n/a	n/a	7.2**	7.2**
		Itasca Heights Total	**1287**	**0.24 mi.**							

** Average Aggregate Surface thickness per borings 9/12/2024

Project #	21-STR-021
Project Name	MSA 142nd Avenue Street Reconstruction

Total Project Cost	$90,563	Department	Street Improvements
Type	Improvement	Category	Street Improvement
Priority	1-Existing Obligation (High)	Status	Active
Useful Life	60 years		

Description
Reconstruction of MSA Street 142nd Avenue between TH 47 and Xkimo Street.

Justification
In accordance with the City's Pavement Management Program, each paved street within the City is scheduled to receive preventative maintenance on a regularly scheduled basis including reconstruction at the end of its useful life, which is estimated to be 60 years based on the City's predominant sand subgrades.

Expenditures	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	Total
Improvements Other than Building Cost	0	90,563	0	0	0	0	0	0	0	0	**90,563**
Total	**0**	**90,563**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**90,563**

Funding Sources	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	Total
MSA	0	78,750	0	0	0	0	0	0	0	0	**78,750**
Storm Water Utility Fund	0	11,813	0	0	0	0	0	0	0	0	**11,813**
Total	**0**	**90,563**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**90,563**

Project #	21-STR-018
Project Name	MSA Juniper Ridge Dr Street Reconst

Total Project Cost	$449,222	Department	Street Improvements
Type	Improvement	Category	Street Improvement
Priority	1-Existing Obligation (High)	Status	Active
Useful Life	60 years		

Description
Reconstruction of MSA street Juniper Ridge Drive between 156th Avenue and Roanoke Street.

Justification
In accordance with the City's Pavement Management Program, each paved street within the City is scheduled to receive preventative maintenance on a regularly scheduled basis including reconstruction at the end of its useful life, which is estimated to be 60 years based on the City's predominant sand subgrades.

Expenditures	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	Total
Improvements Other than Building Cost	0	449,222	0	0	0	0	0	0	0	0	**449,222**
Total	**0**	**449,222**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**449,222**

Funding Sources	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	Total
MSA	0	390,628	0	0	0	0	0	0	0	0	**390,628**
Storm Water Utility Fund	0	58,594	0	0	0	0	0	0	0	0	**58,594**
Total	**0**	**449,222**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**449,222**

Project #	12-STRM-001
Project Name	Stormwater Drainage Improvements

Total Project Cost	$695,000	Department	Stormwater Utility
Type	Improvement	Category	Storm Water Utility Improvement
Priority	1-Existing Obligation (High)	Status	Active
Useful Life	50 years		

Description
This project will address stormwater drainage problems reported in 2011.

Justification
These projects will add storm sewer pipe, clean ditches and address standing water concerns. - 156th and Armstrong, clean ditch or add storm sewer 2031: $175,000 - 156th Lane and Juniper Ridge Drive, install pipe to relieve water backing up in existing pipes 2027: $350,000 (Tied to 21-STR-018)

Prior	Expenditures	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	Total
170,000	Improvements Other than Building Cost	0	350,000	0	0	0	175,000	0	0	0	0	**525,000**
	Total	**0**	**350,000**	**0**	**0**	**0**	**175,000**	**0**	**0**	**0**	**0**	**525,000**

Prior	Funding Sources	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	Total
170,000	Storm Water Utility Fund	0	350,000	0	0	0	175,000	0	0	0	0	**525,000**
	Total	**0**	**350,000**	**0**	**0**	**0**	**175,000**	**0**	**0**	**0**	**0**	**525,000**

Project #	21-STR-016
Project Name	2027 MSA Overlays

Total Project Cost	$785,169	Department	Street Improvements
Type	Improvement	Category	Street Improvement
Priority	1-Existing Obligation (High)	Status	Active
Useful Life	60 years		

Description

Overlaying of MSA Streets: Rhinestone Street (Veterans Drive/Sunwood Drive); Sunwood Drive (CR 83/Zeolite Street); Sunwood Drive (Rhinestone Street/CR 56); Veterans Drive (Zeolite Street/ Rhinestone Street); Zeolite Street (Sunwood Drive/Veterans Drive); Rhinestone Street (E. Ramsey Pkwy/CR 116)

Justification

In accordance with the City's Pavement Management Program, each paved street within the City is scheduled to receive preventative maintenance on a regularly scheduled basis including reconstruction at the end of its useful life, which is estimated to be 60 years based on the City's predominant sand subgrades.

Expenditures	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	Total
Improvements Other than Building Cost	0	785,169	0	0	0	0	0	0	0	0	**785,169**
Total	**0**	**785,169**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**785,169**

Funding Sources	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	Total
MSA	0	747,780	0	0	0	0	0	0	0	0	**747,780**
Storm Water Utility Fund	0	37,389	0	0	0	0	0	0	0	0	**37,389**
Total	**0**	**785,169**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**785,169**

Capital Improvement Plan

Ramsey, MN

Project #	23-STR-028
Project Name	Deerwood Street Reconstruction

Total Project Cost	$803,091	Department	Street Improvements
Type	Improvement	Category	Street Improvement
Priority	1-Existing Obligation (High)	Status	Active
Useful Life	60 years		

Description

Reconstruction of the streets within the Deerwood subdivision

Justification

In accordance with the City's Pavement Management Program, each paved street within the City is scheduled to receive preventative maintenance on a regularly scheduled basis, including reconstruction at the end of its useful life, which is estimated to be 60 years based on the City's predominant sand subgrades.

Expenditures	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	Total
Improvements Other than Building Cost	0	803,091	0	0	0	0	0	0	0	0	**803,091**
Total	**0**	**803,091**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**803,091**

Funding Sources	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	Total
Pavement Management Fund	0	698,340	0	0	0	0	0	0	0	0	**698,340**
Storm Water Utility Fund	0	104,751	0	0	0	0	0	0	0	0	**104,751**
Total	**0**	**803,091**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**803,091**

Project #	23-STR-012
Project Name	Hall-Anderson Acres Street Reconstruction

Total Project Cost	$1,250,832	Department	Street Improvements
Type	Improvement	Category	Street Improvement
Priority	1-Existing Obligation (High)	Status	Active
Useful Life	60 years		

Description
Reconstruction of streets within the Hall-Anderson Acres subdivision except the TH 47 service road.

Justification
In accordance with the City's Pavement Management Program, each paved street within the City is scheduled to receive preventative maintenance on a regularly scheduled basis, including reconstruction at the end of its useful life, which is estimated to be 60 years based on the City's predominant sand subgrades.

Expenditures	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	Total
Improvements Other than Building Cost	0	1,250,832	0	0	0	0	0	0	0	0	**1,250,832**
Total	**0**	**1,250,832**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1,250,832**

Funding Sources	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	Total
Pavement Management Fund	0	1,087,680	0	0	0	0	0	0	0	0	**1,087,680**
Storm Water Utility Fund	0	163,152	0	0	0	0	0	0	0	0	**163,152**
Total	**0**	**1,250,832**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1,250,832**

Project #	23-STR-013
Project Name	Oakwood Hills & Rambosek Red Oak Estates St Recon

Total Project Cost	$355,350	Department	Street Improvements
Type	Improvement	Category	Street Improvement
Priority	1-Existing Obligation (High)	Status	Active
Useful Life	60 years		

Description

Reconstruction of the streets within the Oakwood Hills & Rambosek Red Oak Estates subdivision.

Justification

In accordance with the City's Pavement Management Program, each paved street within the City is scheduled to receive preventative maintenance on a regularly scheduled basis, including reconstruction at the end of its useful life, which is estimated to be 60 years based on the City's predominant sand subgrades.

Expenditures	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	Total
Improvements Other than Building Cost	0	355,350	0	0	0	0	0	0	0	0	**355,350**
Total	**0**	**355,350**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**355,350**

Funding Sources	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	Total
Pavement Management Fund	0	309,000	0	0	0	0	0	0	0	0	**309,000**
Storm Water Utility Fund	0	46,350	0	0	0	0	0	0	0	0	**46,350**
Total	**0**	**355,350**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**355,350**

Capital Improvement Plan

Ramsey, MN

Project #	17-STR-007A
Project Name	Reconstruction Streets: Sortebergs 6th

Total Project Cost	$881,268	Department	Street Improvements
Type	Improvement	Category	Street Improvement
Priority	1-Existing Obligation (High)	Status	Active
Useful Life	60 years		

Description

Reconstruction of streets in Sortebergs 6th Addition including 174th Lane, Puma Street and Rabbit Street.

Justification

Each paved street within the City is scheduled to receive preventative maintenance on a regularly scheduled basis including reconstruction at the end of its useful life, which is estimate to be 60 years based on the City's predominant sand subgrades.

Expenditures	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	Total
Improvements Other than Building Cost	0	881,268	0	0	0	0	0	0	0	0	**881,268**
Total	**0**	**881,268**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**881,268**

Funding Sources	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	Total
Pavement Management Fund	0	766,320	0	0	0	0	0	0	0	0	**766,320**
Storm Water Utility Fund	0	114,948	0	0	0	0	0	0	0	0	**114,948**
Total	**0**	**881,268**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**881,268**

Project #	19-STR-016
Project Name	Reconstruction Streets: Windsorwood

Total Project Cost	$447,741	Department	Street Improvements
Type	Improvement	Category	Street Improvement
Priority	1-Existing Obligation (High)	Status	Active
Useful Life	60 years		

Description
Reconstruction of streets in Windsorwood: 178th Avenue, 178th Circle and Vicuna Street

Justification
These streets are in poor condition and require reconstruction. The pavement has deteriorated beyond the point where an overlay could be applied.

Expenditures	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	Total
Improvements Other than Building Cost	0	447,741	0	0	0	0	0	0	0	0	**447,741**
Total	**0**	**447,741**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**447,741**

Funding Sources	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	Total
Pavement Management Fund	0	389,340	0	0	0	0	0	0	0	0	**389,340**
Storm Water Utility Fund	0	58,401	0	0	0	0	0	0	0	0	**58,401**
Total	**0**	**447,741**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**447,741**

Project #	22-STR-008
Project Name	Windemere Woods Street Reconstruction

Total Project Cost	$757,488	Department	Street Improvements
Type	Improvement	Category	Street Improvement
Priority	1-Existing Obligation (High)	Status	Active
Useful Life	60 years		

Description

Reconstruction of Streets within the Windemere Woods 1st & 2nd subdivisions and Magnesium Street to Bunker Lake Boulevard

Justification

In accordance with the City's Pavement Management Program, each paved street within the City is scheduled to receive preventative maintenance on a regularly scheduled basis including reconstruction at the end of its useful life, which is estimated to be 60 years based on the City's predominant sand subgrades.

Expenditures	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	Total
Improvements Other than Building Cost	0	757,488	0	0	0	0	0	0	0	0	**757,488**
Total	**0**	**757,488**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**757,488**

Funding Sources	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	Total
Tax Increment Fund #2	0	658,685	0	0	0	0	0	0	0	0	**658,685**
Storm Water Utility Fund	0	98,803	0	0	0	0	0	0	0	0	**98,803**
Total	**0**	**757,488**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**757,488**

Project #	21-STR-017
Project Name	2027 Neighborhood Overlays

Total Project Cost	$1,030,980	Department	Street Improvements
Type	Improvement	Category	Street Improvement
Priority	1-Existing Obligation (High)	Status	Active
Useful Life	60 years		

Description

Overlaying of streets within the following subdivisions: Brookfield; Estates of Silver Oaks; Riversbend (non-2018 Recon); Riversbend 2nd; Riversbend Plaza (142nd Avenue)..

Justification

In accordance with the City's Pavement Management Program, each paved street within the City is scheduled to receive preventative maintenance on a regularly scheduled basis including reconstruction at the end of its useful life, which is estimated to be 60 years based on the City's predominant sand subgrades.

Expenditures	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	Total
Improvements Other than Building Cost	0	1,030,980	0	0	0	0	0	0	0	0	**1,030,980**
Total	**0**	**1,030,980**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1,030,980**

Funding Sources	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	Total
Pavement Management Fund	0	981,847	0	0	0	0	0	0	0	0	**981,847**
Storm Water Utility Fund	0	49,133	0	0	0	0	0	0	0	0	**49,133**
Total	**0**	**1,030,980**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1,030,980**

Project #	26-STR-001
Project Name	GREP Area F/Beatty & Collins

Total Project Cost	$280,000	Department	Street Improvements
Type	Improvement	Category	Street Improvement
Priority	2-New Addition (High)	Status	Active
Useful Life	60 years		

Description

Convert existing gravel road section of Beatty Avenue and Collins Drive South of Hwy 10 to bituminous pavement sections. This is Area F in the Gravel Road Elimination Program (GREP).

Justification

Gravel roads require frequent ongoing maintenance using a motor grader to repair wash boarding and to fill potholes. The City currently owns a 1999 John Deere motor grader that is not programmed for replacement in the CIP.

Expenditures	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	Total
Improvements Other than Building Cost	30,000	250,000	0	0	0	0	0	0	0	0	**280,000**
Total	**30,000**	**250,000**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**280,000**

Funding Sources	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	Total
Tax Increment Fund #2	30,000	250,000	0	0	0	0	0	0	0	0	**280,000**
Total	**30,000**	**250,000**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**280,000**

Public Works Committee

Meeting Date: 05/19/2026

Primary Strategic Plan Initiative: Address infrastructure needs.

Title:

Consider Recommendation to City Council Authorizing Well Siting Study Requests for Proposals for Wells #9 and #10

Purpose/Background:

Purpose:
The purpose of this case is to consider a recommendation to City Council to authorize the solicitation of Requests for Proposals for a Well Siting Study for proposed municipal groundwater wells #9 and #10.

Background:
The City of Ramsey's existing municipal wellfields are comprised of 8 wells. Wells 1 and 2 are located in the southeastern portion of city limits, while Wells 3 through 8 are located in the south-central portion of the City. All 8 wells draw water from the Tunnel City-Wonewoc aquifer and range in depth between 316 and 390-feet.

Attached is a copy of the 2021 Feasibility Study containing detailed information on the city's existing water supply system and groundwater aquifers. The following italicized text copied from pages 24 and 25 of the study confirm the city's source water aquifer is anticipated to continue to produce potable water to meet present and foreseeable future demands, and that the city should plan additional well sites to ensure static water levels will remain sufficiently above top of aquifers to meet MnDNR thresholds.

At present, there is no reason to assume that the current source water aquifer for the City of Ramsey will not be able to supply potable water for the foreseeable future. The City of Ramsey's source water aquifer and wells are able to meet present day demand and appear to have a noticeable but temporary radius of influence on the surrounding aquifer. The wells are able to support high pumping rates with specific capacity showing acceptable drawdown alongside the aquifer's ability to recharge to static levels within a day of pumping.

The City of Ramsey will need to balance water demand with drawdown to meet Minnesota Department of Natural Resources drawdown thresholds described in MN Rule 6115.0630 Definitions Subps.15 and 16. Two thresholds are in place and regulate that wells must not drawdown MnDNR assigned static water levels to within 50-percent and 25-percent to the top of aquifer. These threshold values are set by a MnDNR observation well and would typically be enforced if long term issues are observed. Thresholds for the City of Ramsey could become a concern if there is extended pumping within a single well or pumping by multiple wells in close proximity.

In summary, it is SEH's opinion that there is a 95% to 99% certainty that the source water aquifer for the City of Ramsey will continue to produce potable water to meet present and foreseeable future demands; however, the City of Ramsey should plan additional well sites to ensure static water levels remain sufficiently above top of aquifers to meet MnDNR thresholds.

Single well pumping for the City of Ramsey, as depicted by Well 5 in May, 2019 saw approximately 90 to 100 feet of temporary drawdown. This observed drawdown nears the

MnDNR 50-percent threshold; however, the pumping extended multiple days and recharged within the same time period back to static levels. This supports the ability of the wells to supply continued water and ability to stay within prescribed State Statute.

A single well also creates a radius of influence drawing down adjacent water levels. The zone of influence for a single well was observed and modeled to be approximately two to three thousand feet, meaning that a single well pumping at approximately 800 feet will not cause a significant drawdown in another well. When multiple wells are being utilized such as under heavy day demand or under 2040 conditions the modeled and observed drawdown in nearby wells sees a substantial drop in static water levels from that of a single well pumping. Modeled drawdown during present heavy day conditions depict 30-40 feet of drawdown approximately 1,500 feet around the wellfield. After pumping stops, the aquifer will recharge to static levels within one or two days. In general, it appears new well sites should be spaced at least 1,500 to 2,000 feet away from existing wells to ensure a pumping scheme that gives the aquifer sufficient time to recharge.

Future well sites should attempt to balance the City's current economics, well spacing, and take into account the underlying geology. The City of Ramsey should continue to utilize the current source water aquifer for both a water quantity and a water quality standpoint. The source water aquifer is underneath protective "confining" units that appear to inhibit the influence of new water from brining contaminants to the City's wells and will likely produce consistent water quality unlikely unconfined sources such as surface water that may have a highly variable water quality.

Additional considerations for well Sites should take into account the thickness of the two hydrogeologic units that make up the source water aquifer. The Tunnel City aquifer is not as prolific an aquifer as the Wonewoc aquifer, meaning that the Wonewoc aquifer is a more economical source of water. Figure 15 in Appendix D depicts three potential well sites taking into account these issues. Well Site Area A has Tunnel City aquifer thickness ranging from 100 to 150 feet and Wonewoc thickness ranging from 45 to 60 feet. Well Site Area B has Tunnel City aquifer thickness ranging from 0 to 80 feet and Wonewoc thickness ranging from 35 to 100 feet. Well Site Area C has Tunnel City aquifer thickness ranging from 90 to 100 feet and Wonewoc thickness ranging from 15 to 35 feet. All of these sites have potential for potable water sources, but a test well will need to be installed to confirm their viability. As opportunities to investigate these well sites present themselves the City should consider these as potential well sites.

Figure 15 in Appendix D of the Feasibility Study identifies two potential municipal well sites that will be explored in greater detail as part of the Well Siting Study.

In alignment with the Feasibility Study findings and recommendations, staff proposes to solicit Requests for Proposals from engineering consultants with significant experience in siting wells for municipal water supply systems to assist the city in determining the most desirable site(s) for two new municipal wells and the supporting wellhouses currently programmed for construction in 2027 and 2030.

Notification:

Notifications are not required at this time.

Time Frame/Observations/Alternatives:

Timeframe:

Staff estimates this case will take up to 15 minutes to present and discuss.

Observations:

Detailed information on the geology of soils underlying the City of Ramsey can be found in the Anoka County Geologic Atlas, which can be viewed through links on the University of Minnesota Digital Conservancy website at https://conservancy.umn.edu/items/1d10e060-80aa-4db0-af8f-5514b14c0192. Other websites include significant detail on this subject, such as the Know the Flow website at https://knowtheflow.us/2016/12/geologic-atlas-reveals-whats-under-the-surface/.

Attached is a copy of Anoka County Atlas Plates 3 and 4 that show the Surficial Geology and Quaternary Stratigraphy across Anoka County, which can be used by the selected engineering consultant to select the best location for the city's next two municipal wells.

The engineering consultant will also utilize the Metropolitan Council's groundwater model to ensure the new wells will have sufficient groundwater volumes for the city's needs both now and in the foreseeable future.

Other attached reference materials include;

- 44-page 2020 Metropolitan Council Report "Water Supply Planning in the Twin Cities Metropolitan Area (2005-2020)"
- 4-page summary of the 2020 Metropolitan Council Report "Water Supply Planning in the Twin Cities Metropolitan Area (2005-2020)"

Tentative project schedule:

- May 19th – Public Works Committee recommends City Council authorization to solicit Requests for Proposals for a Well Siting Study for proposed municipal groundwater wells #9 and #10.
- May 26th – City Council authorizes solicitation of Well Siting Study Requests for Proposals.
- May 27th – Staff solicits Well Siting Study Requests for Proposals from applicable engineering consultants.
- July 21st – Public Works Committee recommends City Council acceptance of Well Siting Study Proposals and award of contract to the lowest responsible proposer.
- July 28th – City Council accepts Well Siting Study Proposals and awards contract to the lowest responsible proposer.
- July 29th - December 18th – Well Siting Study completed

Alternatives:

Alternative #1: Motion recommending City Council authorization to solicit Requests for Proposals for a Well Siting Study for proposed municipal groundwater wells #9 and #10.

Alternative #2: Motion of other.

Funding Source:

Copies of the associated 2026 – 2035 Capital Improvement Plan sheets, sheets 295 and 296, are attached for reference. As noted, the CIP level cost estimate for the study is $50,000. All costs for the study will be paid from Water Funds.

Recommendation:

Staff recommends alternative #1 to ensure an adequate supply of water is maintained for municipal water supply system users.

Outcome/Action:

Motion recommending City Council authorization to solicit Requests for Proposals for a Well Siting Study for proposed municipal groundwater wells #9 and #10.

Attachments

WTP Feasibility Study

Anoka Co Atlas Plate 3

Anoka Co Atlas Plate 4

2020 MC Water Supply Report

2020 MC WS Report Summary

CIP sheets

Form Review

Inbox	Reviewed By	Date
Brian Hagen	Brian Hagen	05/14/2026 12:36 PM
Form Started By: Bruce Westby		Started On: 04/15/2026 09:01 AM
Final Approval Date: 05/14/2026		

Feasibility Study

Water Treatment Plant

City of Ramsey, Minnesota

RAMSY 154354 | March 4, 2021

Building a Better World
for All of Us®

Engineers | Architects | Planners | Scientists

Feasibility Study

Water Treatment Plant
City of Ramsey, Minnesota

SEH No. RAMSY 154354

March 4, 2021

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

Miles B. Jensen, P.E.

Date: March 4, 2021 License No.: 19869

Short Elliott Hendrickson Inc.
3535 Vadnais Center Drive
St. Paul, MN 55110-3507
651.490.2000

SEH

Executive Summary

The City of Ramsey has eight water supply wells with concentrations of manganese ranging from 0.02 mg/L to 0.37 mg/L. The Minnesota Department of Health (MDH) has established a Health Based Value (HBV) for manganese of 0.100 mg/L. Four of Ramsey's eight water supply wells exceed the MDH HBV for manganese. MDH has recommended to the City that they develop plans to address the manganese. In addition to the potential health concerns with manganese, Ramsey's drinking water also exceeds the Secondary Standards for iron and manganese. Water with concentrations of iron and manganese above the Secondary Standard causes aesthetic problems including red and black staining of plumbing fixtures and laundry and taste complaints.

The City of Ramsey currently utilizes groundwater from the Tunnel City-Wonewoc (TCW) aquifer as its exclusive source of drinking water. An evaluation was conducted of the TCW aquifer which determined that the TCW should be able to continue to produce potable water to meet present and foreseeable future demands.

The most cost-effective method for removing manganese and iron from drinking water is chemical oxidation followed by sand filtration. These processes require construction of a water treatment plant. Based upon an analysis of Ramsey's 2040 water demand, the initial capacity of the water treatment plant should be 10 million gallons per day (MGD), with the ability to expand to 20 MGD.

Four water treatment plant sites were evaluated including the Fire Station site, Public Works site, Water Shop site, and Vacant City property site. The Public Works site would be the least expensive to construct because it could share garage space, a generator, and security infrastructure with the onsite Public Works facility. The Public Works site also offers operational efficiencies because it is on the same site as the new Public Works facility. In January of 2020, the City of Ramsey's Planning Commission, Economic Development Authority, and Public Works Committee all voted unanimously to recommend City Council approval to construct the water treatment plant on the Public Works site.

This study evaluated two treatment process alternatives including gravity filtration and pressure filtration. With gravity filtration, the water flows by gravity through concrete filter cells into a holding tank (clearwell). The water is then pumped into the distribution system. With pressure filtration, the water is pumped from the wells through steel pressure filters and directly into the distribution system.

Report level project and life cycle cost opinions for the two alternatives are included below. The project costs include the capital cost plus 10-percent contingency, 1-percent administration, and 12-percent engineering costs. Life cycle costs represent the total cost of owning and operating the water treatment plant for 50 years and include capital cost, equipment replacement, labor, gas, chemicals, insurance, electricity, and annual equipment repair.

	Project Cost	**50 Year Life Cycle Cost**
Gravity Filter Treatment Plant	$32,400,000	$71,880,000
Pressure Filter Treatment Plant	$30,780,000	$75,440,000

As the table indicates, the gravity filter treatment plant has a slightly higher project cost, but a lower overall life cycle cost. The pressure filter treatment plant has a higher life cycle cost due to the expense of painting and maintaining the steel filters; whereas concrete gravity filters require very little maintenance.

In addition to having lower life cycle costs, gravity filters have other advantages over pressure filters including: (1) more treatment options including aeration and detention without requiring another pumping step, (2) water from the gravity filters does not go immediately into the distribution system so if problems occur with treatment processes operators have time to react, (3) gravity filters are open to view and access, and (4) gravity filtration systems have a greater amount of operational flexibility including the ability to treat surface water.

A gravity filter treatment plant is the recommended alternative due to the advantages it offers at a comparable cost.

If the City elects to proceed with a water treatment plant project, the proposed project schedule could be as follows:

Item	Completion Date
Public Involvement	March 2021 – April 2021
Preparation of Plans	May 2021 – September 2021
Ad for Bid	October 2021
Bid Opening	November 2021
Construction Start	December 2021
Construction Complete	June 2023

However, Anoka County is planning “interim” improvements to Bunker Lake Boulevard between Armstrong Boulevard and Sunfish Lake Boulevard in 2021 to improve operations and safety in anticipation of traffic volumes doubling while planned improvements to Highway 10 are constructed between 2022 and 2025. Therefore, to construct the raw and finished watermain associated with the water treatment plant project as cost-effectively as possible, plans and specifications for the raw and finished watermain improvements are recommended to be prepared and bid in conjunction with Anoka County’s proposed improvements to Bunker Lake Boulevard.

Operating the water treatment plant is not anticipated to require additional Staff. While Staff will need to visit the plant on a daily basis to operate and maintain it, this time will generally be offset by the time Staff currently spends operating and maintaining the six municipal wells and three pump houses within The COR.

If a water treatment plant project is pursued, immediate distribution water quality improvements should not be expected. The water treatment plant will produce water free of iron and manganese; however, it takes time for the iron and manganese deposits in the distribution system to dissipate and overall water quality to improve.

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Water Treatment Plant

Prepared for City of Ramsey

1 Existing Water Infrastructure

1.1 Overall System Description

The City of Ramsey's water system dates back to 1985 when a well, pressure tank storage, and distribution piping was constructed. Today, Ramsey's water system provides drinking water to approximately 4,400 residences and approximately 340 businesses. The existing water system consists of the following major components:

- Eight municipal wells
- Four pump houses
- Chemical feed systems in each pump house to add chlorine, fluoride, and polyphosphate
- Over 83 miles of watermain
- Over 900 fire hydrants
- Three water towers with a combined storage of 4 million gallons (MG)

The wells pump water to their respective pump houses, with Wells No. 1 and 2 pumping to Pump House 1, Wells No. 3 and 4 pumping to Pump House 2, Wells No. 5 and 6 pumping to Pump House 3, and Wells No. 7 and 8 pumping to Pump House 4. Following chemical addition at the Pump Houses, water is pumped directly into the distribution system.

1.2 Raw Water Supply

The City of Ramsey operates eight (8) municipal wells finished in the Tunnel City-Wonewoc (TWC) aquifer. Table 1 provides a summary of each well. Figure 1 in Appendix A shows the Ramsey distribution system map that identifies the locations of the wells, as well as the towers.

Table 1 – Well Data

Well No.	Year Constructed	Formation	Depth	Casing Depth (ft)	Casing Size (in)	Capacity (gpm)
1	1984	Ironton-Galesville	320	243	14	700
2	1987	Ironton-Galesville	320	240	14	220
3	1997	Ironton-Galesville	345	222	30	1,450
4	1998	Ironton-Galesville	321	191	30	850
5	2000	Ironton-Galesville	316	215	30	850
6	2005	Ironton-Galesville	390	282	30	900
7	2007	Ironton-Galesville	332	216	30	850
8	2007	Ironton-Galesville	354	245	30	1,400
Notes: Well No. 2 used exclusively for irrigation of River's Bend Park.						

The combined capacity of all of the wells is 7,220 gallons per minute (gpm) which is equivalent to 10.4 million gallons per day (MGD). The firm capacity (capacity with the largest well out of service) is 5,770 gpm or 8.3 MGD.

If a centralized water treatment plant is constructed, Wells No. 1 and 2 would not initially be connected to the water treatment plant due to the significant expense required to extend trunk watermain to the water treatment plant. The firm capacity without considering Wells No. 1 and 2 is 4,850 gpm or 7.0 MGD.

All of the wells are located in the southern part of the City north of U.S. Highway 10, with Wells No. 1 and 2 located in the south-eastern portion of Ramsey, and Wells No. 3 through 8 located in the south-central portion of Ramsey.

Maintenance records indicate that the wells, pumps, and motors are inspected and repaired on a routine basis. The condition of the wells, pumps, and motors system-wide appears to be good.

1.3 Current Water Treatment

Chlorine is added to the well water to provide a disinfectant residual in the distribution system. The City utilizes a free chlorine residual in the distribution system rather than chloramine, which is a less powerful disinfecting agent created when chlorine is mixed with ammonia. The City does have low levels of naturally occurring ammonia in their well water, although chlorine is fed past the breakpoint to completely oxidize the ammonia.

Polyphosphate is added to the water to sequester iron and manganese. Sequestering of iron and manganese keeps the metals in solution and prevents them from precipitating to form oxides, and thus preventing aesthetic water quality issues such as color, taste, and sedimentation. Sequestration does not remove iron or manganese, and polyphosphate degrades over time which may cause aesthetic issues at dead-ends and outer ends of the distribution system.

In accordance with Minnesota State Statute, fluoride is also added to the treatment process to promote strong teeth.

The chemicals are added to the raw water from the wells in each of the pump houses prior to being pumped into the distribution system.

1.4 Existing Water Towers

The City of Ramsey currently has three water towers with storage capacities of 0.5 MG (tower 1), 1.5 MG (tower 2), and 2.0 MG (tower 3). Towers 1 and 2 are located in the south-eastern and south-central parts of the City respectively, while tower 3 is located in the north-eastern part of the City. The 0.5 MG tower is a spheroid style steel water tower constructed in 1989, while the 1.5 MG and 2.0 MG towers are fluted column steel water towers constructed in 2000 and 2010, respectively.

2 Distribution System Modeling

A hydraulic computer model was generated to evaluate the performance of the City's current water distribution system, as well as evaluate the system into the future as the water system expands, experiences increasing demands, and utilizes a water treatment plant instead of individual wells pumping into the system. The model used the most recent GIS information for the City's water system assets, and was created using WaterGEMS®, a pipe network program developed by Bentley®. Flow testing was conducted within the distribution system in October 2019 to calibrate and help verify the accuracy of the computer model. A summary of the flow test results and locations are listed in Table 2.

The water model allows the water system to be examined, while adding proposed features to the system. This provides an indication as to what pressures and flows would be available in the water system with the various proposed features. The model also allows for the examination of component operation within the system such as water tank filling cycles. There are many other exercises that the model can be used for in the future in relation to water system operations and planning. The water model can continue to be an operations and planning tool for the expanding water system.

Table 2 – Hydrant Flow Test Results

Flow Test	Location	Field Hydrant Flow (gpm)	Pressure Differential Field Results (psi)	Pressure Differential Model Results (psi)	Pressure Differential (psi)
1	Olivine St. NW south off of 147th Ln. NW	1,171	2	1	-1
2	Dead-end on Vanadium St. NW	1,123	4	2	-2
3	Dead-end on 140th Ave. NW	1,205	8	10	2
4	Dead-end on 142nd Ln. NW	984	26	42	16
5	Corner of Tonto St. NW and Alpine Dr. NW	1,188	4	6	2
6	Dead-end on 152nd Ave. NW	1,047	9	7	-2
7	Corner of 157th Ave. NW and Krypton St. NW	1,152	7	9	2
8	Dead-end on Lithium St. NW	1,047	7	8	1
9	Dead-end of east end of 167th Ln. NW	1,197	4	2	-2
10	Dead-end of new cul-de-sac off of 159th Ave. NW	1,078	6	7	1

Flow Test	Location	Field Hydrant Flow (gpm)	Pressure Differential Field Results (psi)	Pressure Differential Model Results (psi)	Pressure Differential (psi)
11	Current dead-end on 149th Ave. NW	1,234	5	5	0
12	West dead-end on 147th Ln. NW	1,123	3	8	5
13	Dead-end on 137th Ave. NW	1,188	11	10	-1
14	East dead-end on Rivlyn Ave. NW	1,031	10	10	0

During the calibration process of the Ramsey water system hydraulic model, pumping rates, customer demands, and tower water levels were set to the conditions recorded during the field testing. Individual pipe roughness coefficients (C-factors) were adjusted until the calibrated system model closely simulated field test data as indicated in Table 2. As indicated from Tests 4 and 12, the model was unable to be calibrated to match the field tests. For Test 4, it is believed there was an error when measuring during the field test. The age and size of the pipe on 142nd Ln. NW is the same as the pipe on 140th Ave. NW (Test 3), which the model calibrated closely with. It is believed that the pipe roughness coefficient used for the pipe on 142nd Ln. NW is accurate. For Test 12, it is believed that there is another pipe off of Bunker Lake Blvd. that connects to the new development along 147th Ln. NW that is not yet geo-located, because when adding an additional pipe, the model calibrates closely with the field data. The pipe along 147th Ln. NW is a new 8" pipe, so it is believed that the pipe roughness coefficient used for the pipe is accurate. Additionally, Test 10 was conducted on hydrants in a new development. Previously, this area was at a lower elevation than it is currently. This caused the model to not correlate well with the field-testing data. The elevations of the hydrants in the model were adjusted to more closely correlate with the field data, and as the pipe in the development is new, it is believed that the pipe roughness coefficient used for the pipe is accurate.

Once the computer water model was constructed and calibrated, the model was used to calculate the operating conditions in the water distribution system.

2.1 Existing System Static Pressures

Water system pressure is primarily a function of elevation with some degree of pressure loss as water flows across the system. Static pressures throughout the distribution system as determined by the water model are shown in Figures 1-3 in Appendix B for average day demand (ADD), maximum day demand (MDD), and Peak Hour Demand. Low pressures generally occur in areas where the elevations are relatively high compared to the overflow elevation or hydraulic grade line (HGL) of the system.

As you can see in Figures 1-3 in Appendix B, the pressures across the system are generally consistent, and are approximately the same between the three demand scenarios. All areas of the system are within the range of 50 to 80 psi as you can see in Table 3.

Table 3 – Water System Static Pressures

	Average Day Demand	Maximum Day Demand	Peak Hour Demand
Minimum Pressure (psi)	56	56	56
Average Pressure (psi)	68.5	68.1	67.5
Maximum Pressure (psi)	77	77	76
Demand (gpm)	1,221	3,330	5,498

All three demand scenarios were done with the towers at an HGL of 1,031 feet. No wells were running during the model simulation.

2.2 Existing System 24-Hour Simulation

A 24-hour extended period simulation was run for average day demand (ADD) and maximum day demand MDD to model how the existing system performs in terms of pressure, velocity, and tank levels. System pressures are recommended to be in the range of 35 psi to 80 psi, and pipe velocities are recommended to not exceed 5 feet per second. For an average day demand, 1.72 MGD was assumed, and for maximum day demand, a maximum day peaking factor of 2.73 was assumed to get a maximum day demand of 4.7 MGD. For both demand scenarios, diurnal demand curves were used, and were developed by analyzing SCADA operation data documenting system water tower levels, as well as using industry standards and previous experience. These diurnal demand curves are shown in Figures 1 and 2 and were used for all modeling simulations. The operating range of Tower 1 was assumed to be 6 feet where wells would initially turn on when the HGL of Tower 1 went below 1,025 feet, and the wells would turn off when the HGL of Tower 1 went above 1,031 feet. Figures 4-5 in Appendix B show the operation of the wells and towers for both demand scenarios.

The pressures across the system were generally consistent throughout the 24-hour simulation for both demand scenarios. As can be seen in Figures 6-7 in Appendix B, at no point did pressures drop below 50 psi, and at no point did pipe velocities exceed 3 feet per second for the ADD simulation or exceed 5 feet per second for the MDD simulation. In fact, only one segment of pipe exceeded 4 feet per second during the MDD simulation.

Figure 1 – ADD Diurnal Curve

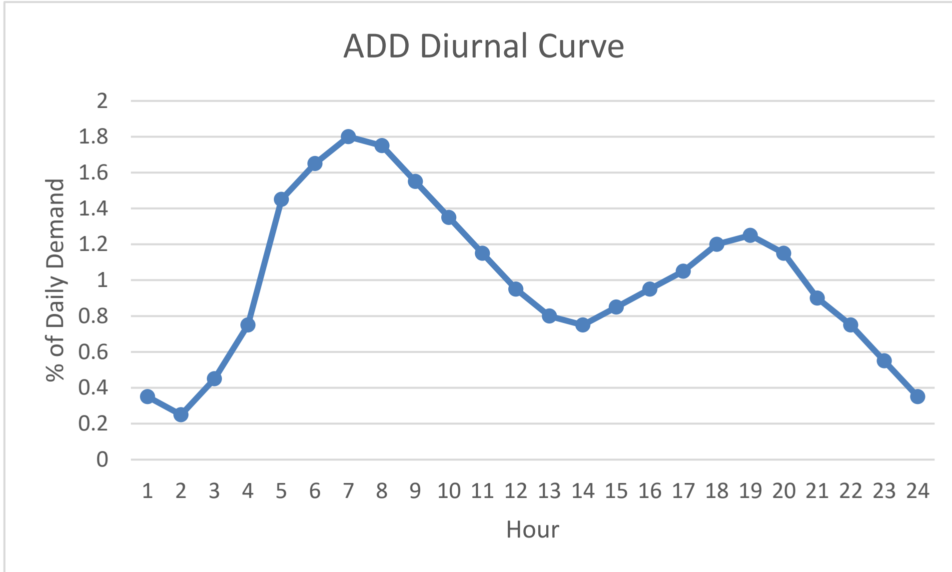
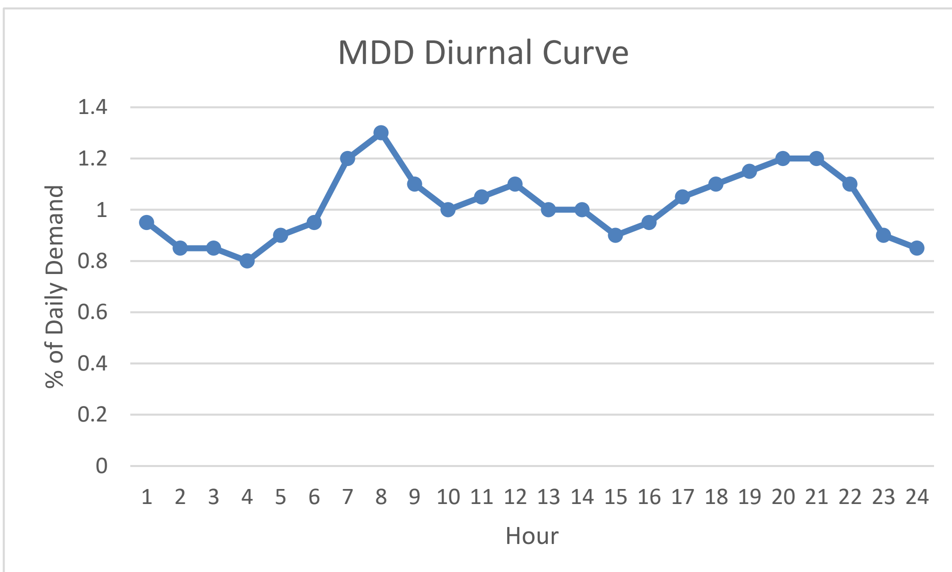


Figure 2 – MDD Diurnal Curve



2.3 Existing System Available Flow for Fire Protection

Designing a water system to provide adequate fire protection is an important consideration. Adequately sized watermain is an important consideration to supply desired fire flows. Guidelines for determining fire flow requirements are provided by the ISO. ISO is the insurance service organization responsible for evaluating and classifying municipalities for fire insurance rating purposes. Available fire flow for fire protection (fire flow) in this report is defined as the flow capacity at a point in the water distribution system which causes the pressure to fall to 20 psi (residual pressure). A map of the fire flow analysis for the distribution system under a maximum day demand is shown in Figure 8 in Appendix B. Note that the fire flow analysis for the distribution system was done for junctions (watermain intersections and at dead-ends) instead of hydrants, so the fire protection in some areas may be better than shown as a hydrant may be nearby on a larger sized watermain. In general, low fire flows occur where normal pressures are already low, and in areas with small diameter watermains, or in areas with older watermains. Dead-ends typically have noticeably weaker fire flows than looped watermain as well.

To determine if the water system is deficient in available fire flow, a basis for fire protection must be established. For planning purposes, the minimum fire protection requirement can be based on land use according to Table 4.

Table 4 – Minimum Fire Flows

Land Use	Flow (gpm)
Park	500
Single-Family	1,000
R-1 Low-Density Single Family	1,000
Two-Family	1,000
Multi-Family	1,500
High-Density Multi-Family	1,500
Service Office	1,500
Community Commercial	2,500
General Commercial	2,500
Industrial	3,500
Mixed Use-Neighborhood	2,000
Mixed Use-Community	2,000
Mixed Use-Regional	2,000

In general, the City is well protected with over 98% of the distribution system having fire flows of 1,500 gpm or higher. When comparing available fire flows with the City's existing land use map there are a few areas where the available fire flow may be deficient. Specifically, a small industrial land use area north of Highway 10 and south of the southern dead-end of Jaspar Street NW, as well as the dead-end of 142nd Lane NW in the southeastern part of the City.

2.4 Existing System 24-Hour Simulation – Treatment Plant

Similar to the existing system 24-Hour simulation, a 24-hour extended period simulation was run for ADD and MDD demands to model how the existing system performs in terms of pressure, velocity, and tank levels with a treatment plant as the sole source of water. With a single source versus wells spaced throughout town, the worry is that the furthest points from the treatment plant may experience lower pressures due to headloss through the distribution system. An ADD of 1.72 MGD and a MDD of 4.7 MGD were assumed.

Figures 9-10 in Appendix B show the operation of the treatment plant high service pumps and towers for both demand scenarios, and Figures 11-12 in Appendix B show the minimum pressures for both demands scenarios. Pressures across the system were generally consistent throughout the 24-hour simulation for both demand scenarios, and at no point did the pressure drop below 50 psi during both demand scenarios, and at no point did velocities exceed 5 feet per second. Modeling of both demand scenarios show that the existing system performs very well with a treatment plant as the sole source of water.

2.5 2040 System 24-Hour Simulation

By 2040, Ramsey's estimated average day demand is expected to increase to 3.5 MGD, and the maximum day demand is expected to increase to 10.3 MGD. With this increased demand, it is important to ensure that the distribution system and storage facilities are adequately sized to meet the future demand. The storage capacity of the current water system is 4 MG, which will still meet the Minnesota Department of Health's recommendation of having enough storage to meet or exceed the ADD, so additional storage will not be required through 2040.

Although it is impossible to know where future watermain will be required, future watermain was added and sized according to previous reports, which can be seen in Figures 15-16 in Appendix B. Future demands were allocated based on locations future pipes and future development areas.

Figures 13-14 in Appendix B show the operation of the treatment plant and towers for both demand scenarios, and Figures 15-16 in Appendix B show the minimum pressures for both demands scenarios of the 2040 24-hour simulation. Again, the pressures across the system were generally consistent throughout the 24-hour simulation for both demand scenarios, and at no point did the pressure drop below 50 psi during the ADD scenario. Pressures did drop to as low as 37 psi during the MDD scenario in some areas in the future north development between 173rd Ave NW and 181st Ave NW due to the higher elevations, although this can be alleviated by keeping the towers at a higher level. Velocities were kept below 5 feet per second, although a short segment of 16" pipe on Bunker Lake Blvd NW approached around 5.5 feet per second during the MDD scenario for a short period of time, although this is not a concern.

2.6 Distribution Modeling Conclusions and Recommendations

Modeling of Ramsey's water system shows that it performs well currently and with a treatment plant now and in the future. If the City chooses to build a water treatment plant, raw watermain will be needed to bring the well water to the treatment plant. Currently there is raw watermain for bringing well water to the pumphouses, which can be utilized for the treatment plant, although additional and bigger sized raw watermain will be required. The raw watermain required is shown in Figure 1 in Appendix I and was assumed in the modeling. Of note, the 16" watermain along Bunker Lake Blvd NW should be used as finished watermain and was assumed to be in the modeling.

As the population grows, and thus the water demand, there are a few recommendations for improving the water system to be able to operate efficiently with 2040 demands. First, it is recommended that the 16" watermain along Bunker Lake Blvd NW be tied into the 12" watermain along E Town Center Drive. Modeling did not assume this, although it may be advantageous to do so beyond 2040 if the private well owners in the center of town go on city water. The models did assume that the 16" watermain along Bunker Lake Blvd NW ties into the 8" and 12" watermain along Rhinestone Street NW.

Second, with the proposed treatment plant location being on the west side of town, it may be beneficial depending on future demands to extend the 12" watermain along Armstrong Blvd NW to Bunker Lake Blvd, and to extend the 16" watermain along Bunker Lake Blvd NW to E Town

Center Drive. The extensions of those pipes was assumed in the 2040 modeling analysis and prevented additional pipes in the area from exceeding a velocity of 5 feet per second.

Third, as can be seen in Figure 19 in Appendix B, the water level in Tower 2 approached and stayed at an HGL of 1,033 feet. This was done by utilizing an altitude valve in the model for the tower. Due to Tower 2's close proximity to the treatment plant, there is a risk of the tower to overflow, especially during a MDD scenario, as the treatment plant pumps into the system to fill Tower 1. Because of this, an altitude may have to be installed in the future

3 Drinking Water Quality

The City of Ramsey's water is tested on a regular basis by the City and by Minnesota Department of Health (MDH). The following sections discuss Primary and Secondary test results for the City's wells and distribution system.

3.1 Primary Drinking Water Standards

Primary Standards are legally enforceable standards that public water suppliers are required to meet. Primary standards protect public health by regulating the levels of certain contaminants in public water supplies. The United States Environmental Protection Agency (US EPA) establishes maximum contaminant levels (MCLs) for primary standard constituents. Regulated constituents include microorganisms, disinfectants, disinfection byproducts, inorganic chemicals, organic chemicals and radionuclides. A few primary contaminants have been detected in Ramsey's water as shown on Table 5; however, the contaminants detected well below their respective MCLs.

Table 5 – Water Quality - Primary Drinking Water Standards

Contaminant	Highest Average or Highest Single Test Result	Range of Detected Test Results	MCL	90% of Results Were Less Than	EPA Action Level
Lead	-	-	-	1.9 ppb	90% of homes less than 15 ppb
Copper	-	-	-	0.82 ppm	90% of homes less than 1.3 ppm
Barium	0.11 ppm	-	2 ppm	-	-
Arsenic	1.49 ppb	-	10.4 ppb	-	-
2,4-D	0.03 ppb	-	70 ppb	-	-
Combined Radium	2.2 pCi/l	-	5.4 pCi/l	-	-
Total Trihalomethanes (TTHMs)	2.1 ppb	1.70 – 2.10 ppb	80 ppb	-	-
Total Chlorine	1.14 ppm	0.77 – 1.64 ppm	4.0 ppm	-	-
Fluoride	0.81 ppm	0.59 – 1.00 ppm	4.0 ppm	-	-
Notes: Data from Ramsey's Consumer Confidence Report					

3.2 Manganese

According to the Minnesota Department of Health (MDH), too much manganese in drinking water can have negative health effects for babies under one year old. At high concentrations, manganese can also have negative health effects for children and adults. To protect bottle-fed infants, MDH recommends manganese levels of less than 0.100 mg/L. To protect children and adults, a manganese level of less than 0.300 mg/L is recommended. To ensure that all residents are protected, MDH has established a Health Based Value (HBV) for Manganese of 0.100 mg/L.

Manganese also has a secondary standard of 0.05 mg/L where levels above can cause color, staining, and taste issues.

Recently, manganese was included as a contaminant to be monitored under the Fourth Unregulated Contaminant Monitoring Rule (UCMR4), which is discussed in later in this chapter. The City of Ramsey conducted UCMR4 sampling in 2019 which included sampling for manganese. As shown in Table 6, Wells No. 1, 3, 4, and 8 tested above the MDH HBV. Due to the high levels of manganese, MDH has recommended to the City that they develop short-, mid-, and long-term plans to address the high levels. In response to the high levels, the City began using wells with the lowest levels of manganese, and when required to use more wells during higher demand times, the City developed a plan to mix the water from the low level wells with the high-level wells. As a long-term plan, the City is in the process of determining the best option, but are considering:

- Mixing water from different wells to lower manganese wells;
- Drilling new drinking water wells;
- Installing City filtration systems;
- Constructing a water treatment plant; and
- Using water from neighboring municipal water systems.

Table 6 – Manganese in Ramsey Wells

Well	Manganese (mg/L)	MDH HBV (mg/L)
Well 1	**0.320**	0.100
Well 3	**0.229**	0.100
Well 4	**0.371**	0.100
Well 5	0.022	0.100
Well 6	0.023	0.100
Well 7	0.052	0.100
Well 8	**0.223**	0.100
Note: Well 2 used exclusively for irrigation		

3.3 Secondary Drinking Water Standards

Secondary Standards are non-enforceable guidelines for contaminants that cause aesthetic or cosmetic effects, such as taste, odor and color, and can cause problems with piping. The Secondary Standard for manganese is discussed in Section 3.2. Table 7 presents the iron and hardness data for Ramsey's wells.

Table 7 – Iron and Hardness in Ramsey Wells

Well	Iron (mg/L)	Hardness (mg/L $CaCO_3$)
Well 1	0.551	256
Well 3	0.529	280
Well 4	0.240	-
Well 5	0.801	-
Well 6	0.787	211
Well 7	0.818	225
Well 8	0.704	-

3.3.1 Iron

The secondary standard for iron is 0.3 mg/L where iron concentrations above the secondary standard can cause a rusty color to the water, sediment build-up, a metallic taste, and reddish or orange staining. As shown on Table 2, the drinking water from the Ramsey wells consistently exceeds the Secondary Standard for iron with concentrations ranging from 0.240 mg/L to 0.818 mg/L.

3.3.2 Hardness

Hardness, which is a measurement of multivalent cations, such as calcium and magnesium, is an aesthetic issue due to its ability to cause scaling and build-up on fixtures, as well as its reaction with soaps producing a sticky and gummy deposit. Although not included as a secondary standard, water with a hardness above 120 mg/L as $CaCO_3$ is considered hard water.

As shown on Table 2, the drinking water from Ramsey's wells is considered hard with a hardness ranging from 211 mg/L to 280 mg/L.

3.4 Emerging Contaminants

The US EPA uses the Contaminant Candidate List (CCL) and the Unregulated Contaminant Monitoring Rule (UCMR) to screen potential contaminants for further regulation. The CCL and UCMR are discussed in the following sections.

3.4.1 Contaminant Candidate List

The US EPA maintains a Contaminant Candidate List (CCL) for contaminants that may need to be regulated, which is published every five years. The current CCL includes 97 chemicals or chemical groups and 12 microbiological contaminants and can be seen in Appendix C along with the other published CCLs. The list includes chemicals used in commerce, pesticides, biological toxins, disinfection byproducts, and waterborne pathogens. The contaminants on the list are not currently regulated by existing Primary drinking water standards. It should also be noted that the US EPA reviews existing regulated contaminants. If existing standards are modified, they are typically lowered (i.e. arsenic) and not raised.

3.4.2 Unregulated Contaminant Monitoring Rule

Along with the CCL, UCMR is used by the EPA to collect data for contaminants that are suspected to be present in drinking water, but do not have health-based standards set under SDWA. Occurrence data are then used to determine whether particular contaminants should be regulated in the interest of protecting public health. Monitoring under UCMR is conducted every five years for no more than 30 contaminants and is required for all community water systems over 10,000 people, and for a representative sample of systems with populations less than or equal to 10,000 people. Selection of contaminants to be monitored is determined through existing prioritization processes, including contaminants previously monitored under UCMR, and the CCL. Other contaminants of interest may also be chosen. Since the promulgation of UCMR, there have been four rounds of sampling with the fourth round (UCMR4) currently underway. Among the four rounds of UCMR sampling, some of the contaminants include:

- Pesticides
- Volatile Organic Compounds (VOCs)
- Synthetic Organic Compounds (SOCs)
- Metals
- Hormones
- Flame Retardants

- Perfluorinated Compounds (PFAS)
- Disinfection Byproducts
- Cyanotoxin Chemicals
- Other chemicals used in industrial and manufacturing practices

The majority of these contaminants are from anthropogenic, or human activity, sources, and thus necessitates the need to be vigilant in protecting City wells from pollution. As discussed further in Chapter 5, the City's wells are well protected from anthropogenic pollution, but continued safeguarding of the wells will be crucial in preventing a new contaminant in the City's drinking water supply that requires treatment.

Although it isn't possible to predict what contaminants will be regulated in the future, having flexibility in a treatment system is important to provide treatment options for possible future contaminations, new regulations for contaminants, and as testing abilities continue to improve.

4 Water Demand

Ramsey's average daily water demand from 2009 to 2019 ranged from 1.6 to 1.9 million gallons (MGD). The maximum daily demand, usually occurring during summer months due to lawn watering and other non-consumptive use, ranged from 4.1 to 5.5 MGD.

The projected annual average water demand for the City is expected to increase to 3.5 MGD and up to a projected daily maximum of 10.3 MGD in the year 2040. A list of future water projections from the City's Water Supply Plan is included below.

Table 8 – Projected Water Demands

Year	Projected Total Population	Projected Population Served	Projected Average Daily Demand (MGD)	Projected Maximum Daily Demand (MGD)
2020	27,550	13,921	1.8	5.3
2025	30,450	18,547	2.4	7.0
2030	33,350	22,987	3.0	8.7
2040	39,150	26,988	3.5	10.3

4.1 Adequacy of Existing Water Supply

As discussed in Section 1.2, if a centralized water treatment plant is constructed, Wells No. 1 and 2 would not initially be connected to the water treatment plant due to the significant expense required to extend trunk watermain to the water treatment plant. The existing firm capacity without considering Wells No. 1 and 2 is 4,850 gpm or 7.0 MGD. Table 8 predicts that Ramsey has sufficient firm capacity without Wells No. 1 and 2 through the year 2025. When maximum day demands reach 7.0 MGD, Ramsey should consider drilling another well.

By the year 2040, Ramsey will need 10.3 MGD in firm capacity. To provide this capacity without using Wells 1 and 2, an additional 3 wells will be needed by 2040 (assuming 850 gpm per well).

5 Groundwater Availability

The City of Ramsey currently utilizes groundwater as its exclusive source of drinking water. For planning purposes, the City needs to understand whether groundwater can continue to provide existing and future water demands.

5.1 Description of the Hydrogeological Setting

The following sections describe the hydrogeology (groundwater) in Ramsey.

5.1.1 Surficial Hydrogeological Setting

The surficial geology in the region is primarily associated with erosional and depositional glacial events during the Quaternary Period. Surficial aquifers throughout this region have highly variable aquifer properties. The Metropolitan Council classifies these as having a moderate to high water yield for potable use; however, it is often challenging to identify the locations for the most productive units with some areas providing little or no yield for water supply. Depending on the location, the presence of finer grained units that can act as confining layer will affect water recharge rates to these aquifers and limit the quantity of water these aquifers can supply. Surficial aquifers are often the first aquifer to be recharged and thus can be more vulnerable to contamination. Therefore, the overall water quantity and quality is described by the Metropolitan Council as variable.

5.1.2 Bedrock Hydrogeologic Setting

The bedrock underlying the City of Ramsey and surrounding areas consists of Precambrian to Ordovician age Paleozoic sedimentary strata overlying Precambrian age basement rock. While variation and extent of bedrock aquifers occur, in general five regional aquifers are described and support much of the potable water for the Twin Cities region, from oldest to youngest: (1) Mt Simon-Hinckley (2) Tunnel City-Wonewoc (3) Prairie du Chien-Jordan (4) St. Peter, and (5) Quaternary aquifers. These aquifers are hydrologically disconnected by a variety of interbedded confining layers. Regional aquifers can also be subdivided further; for example, the Tunnel City-Wonewoc Aquifer maybe be hydraulically disconnected if the Lone Rock Formation (of the Tunnel City Group) acts as a confining unit. Primary lithology, and hydrogeologic designations are summarized in the table below, from oldest to youngest, for the area.

Table 9 – Bedrock Aquifers

Geologic Formation	Age	Primary Hydrogeologic Designation	Approximate Thickness	Primary Regional Lithology
Hinckley Sandstone	Pre-Cambrian	Aquifer	Not Available	Quartzose sandstone overlying the Precambrian bedrock
Mt Simon Sandstone	Middle Cambrian	Aquifer	~200 to 336 ft	Quartz sandstone that contains interbedded siltstone and very fine sand.
Eau Claire Formation	Middle to Upper Cambrian	Confining	~60 to 90 ft	Fine grained sandstone, siltstone and shale.
Wonewoc Sandstone	Upper Cambrian	Aquifer	~ 50 to 60 ft	Very fine to very coarse grained Sandstone.
Tunnel City Group	Upper Cambrian	Aquifer / Confining	~ 150 to 180 ft	Lower is massively bedded very fine to fine-grained sandstone; upper is coarse grained sandstone.
St Lawrence Formation	Upper Cambrian	Confining	~ 38 to 59 ft	Dolomitic siltstone with interbedded very fine-grained sandstone and shale.
Jordan Sandstone	Upper Cambrian	Aquifer	~ 85 to 100 ft	Upward sequence of fine to coarser grained sandstone.

Regionally other bedrock aquifers exist that are not listed above, the following are aquifers present within the City of Ramsey area. These aquifers are discussed in detail in the following sections. Throughout the City of Ramsey, The Tunnel City group is the uppermost Bedrock unit meaning the St Lawrence and Jordan Sandstone is only sparsely present. Above these Bedrock units are unconsolidated sediment discussed in sections above.

5.1.2.1 Jordan Aquifer

The Jordan Aquifer is generally considered to be hydrologically connected to the Prairie Du Chien Unit. However, as evident from the geologic bedrock map (Figure 2 in Appendix D) the Prairie Du Chien Unit was either not deposited or has been entirely eroded through much of this area. The thickness and presence of this aquifer through this area is scarce and laterally disconnected. Where present, Within the City of Ramsey, the Jordan Sandstone thickness is minimal at around 20-30 feet and appears heavily eroded. Quaternary deposits directly overlay this unit and the Jordan Sandstone is likely recharged by these deposits.

5.1.2.2 Wonewoc / Tunnel City Group

The Tunnel City Group and the underlying Wonewoc Sandstone (formerly known as the Franconia-Ironton-Galesville Aquifer) supply water for much of the Northwest Metro region. Presence and thickness of the Tunnel City is depicted on Figure 6 in Appendix D, and for the Wonewoc on Figure 8 in Appendix D. Areas where the Aquifer is not present primarily occur within bedrock valleys where previous streams and surface water features carved away the bedrock unit. A large unconformity of the Wonewoc Sandstone is depicted within Anoka County where heavy erosion of this unit appears to have taken place prior to the deposition of the Tunnel City Aquifer. This area is depicted where the Wonewoc aquifer thickness thins or is not present

(Figure 8 in Appendix D). Potentiometric surfaces of this units are depicted on Figures 7 in Appendix D for the Tunnel City and Figure 9 in Appendix D for the Wonewoc Sandstone. Potentiometric surfaces were created by the Minnesota Geologic Survey and provide a rough estimate for water elevations for a proposed well within these units and their groundwater flow direction.

The Metropolitan Council generally describes the productivity of the Tunnel City – Wonewoc Aquifer as variable. Yields tend to be moderate to low with some of the highest yields reported where bedrock units are highly fractured.

5.1.2.3 Mt. Simon-Hinckley Aquifer

The Mount Simon-Hinckley Aquifer is generally described by the Metropolitan Council as a high to moderate yield aquifer. New high-capacity wells are generally not permitted by the Minnesota Department of Natural Resources as use has been restricted by Minnesota Law, therefore it is not discussed in this report in greater detail.

5.1.3 Ramsey Municipal Wells

The City of Ramsey wellfields are comprised of 8 wells. Wells 1 and 2 are located in the southeastern portion of city limits, while Wells 3 through 8 are located in the south-central portion of the City. The City of Ramsey currently receives all of its potable water from the Tunnel City-Wonewoc aquifer. The well locations are depicted on Figure 1 in Appendix D. These wells are detailed in the table below.

Table 10 – Ramsey Well Data

Well No.	Unique Well No.	Date Constructed	Aquifer	Total Depth (ft)	Casing Depth (ft)	Casing Diameter (in)
1	161441	1984	Tunnel City Group	323	243	14
2	416183	1987	Tunnel City Group	320	240	14
3	580306	1997	Tunnel City-Wonewoc	345	222	30 x 24
4	580313	1998	Tunnel City-Wonewoc	321	191	30 x 24
5	593672	2000	Tunnel City-Wonewoc	316	215	30 x 24
6	706840	2005	Tunnel City-Wonewoc	390	282	30 x 24
7	743832	2007	Tunnel City-Wonewoc	332	216	30 x 24
8	743833	2007	Tunnel City-Wonewoc	354	245	30 x 24

5.1.4 Daily Volume of Water Pumped

The Minnesota Department of Natural Resources (MnDNR) permits high-capacity wells and records total water use within wells deemed to be high capacity. All of the City of Ramsey wells are considered high-capacity wells with an approved MnDNR appropriation permit. All yearly water use is recorded within MnDNR's Water Permitting and reporting system (MPARS). Additionally, The City of Ramsey has an approved Water Supply Plan (Third Generation for 2018-2028).

The City of Ramsey currently preferentially utilizes wells from their south-central well field that includes wells 3 through 8. City Wells 1 and 2 are to the southeast of the primary well field and has a decreasing utilization rate. Well locations are depicted on Figure 1 in Appendix D.

As discussed in Section 4, the average daily water demand from 2007 to 2017 ranged from 1.62 to 1.92 million gallons (MGD). The maximum daily demand ranged from 4.1 to 5.5 MGD. The projected annual average water demand for the City is expected to increase to 3.5 MGD and up to a projected daily maximum of 10.2 MGD in the year 2040.

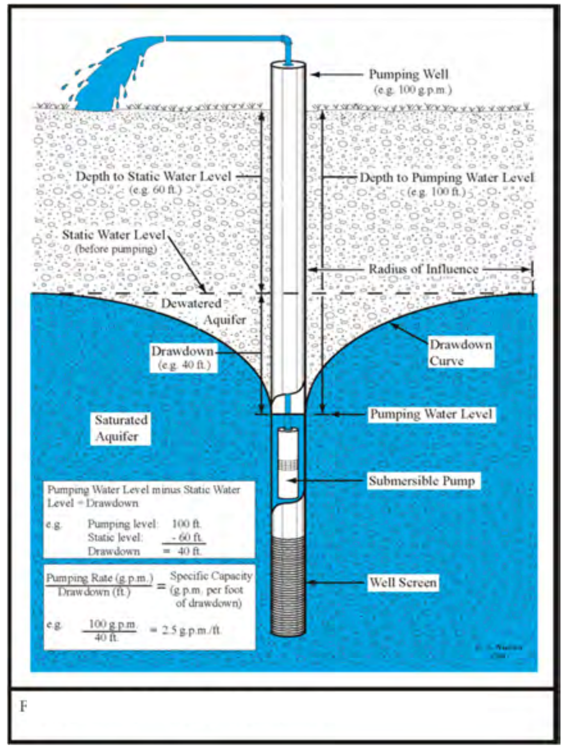
5.1.5 Aquifer Response to Well Pumping

Aquifer response to well pumping can be measured in many ways. The most common and observable measurement within a well is through measurement of the drawdown, or change in static water levels, and also through calculating the well specific capacity. These measurements help to quantify water use within a well. As a well continues to pump it creates a radius of influence where nearby water is drawn down into what is called a cone of depression. This correlates to well interference and can have a combining effect when multiple high capacity wells are pumping. These terms are discussed in the Minnesota Department of Health publication, "A Guide to the Rules Relating to Wells and Borings" (Minnesota Rules, Chapter 4725). The adjacent image from the handbook describes this terminology. The following sections will discuss these terms in detail.

5.1.5.1 Well Drawdown

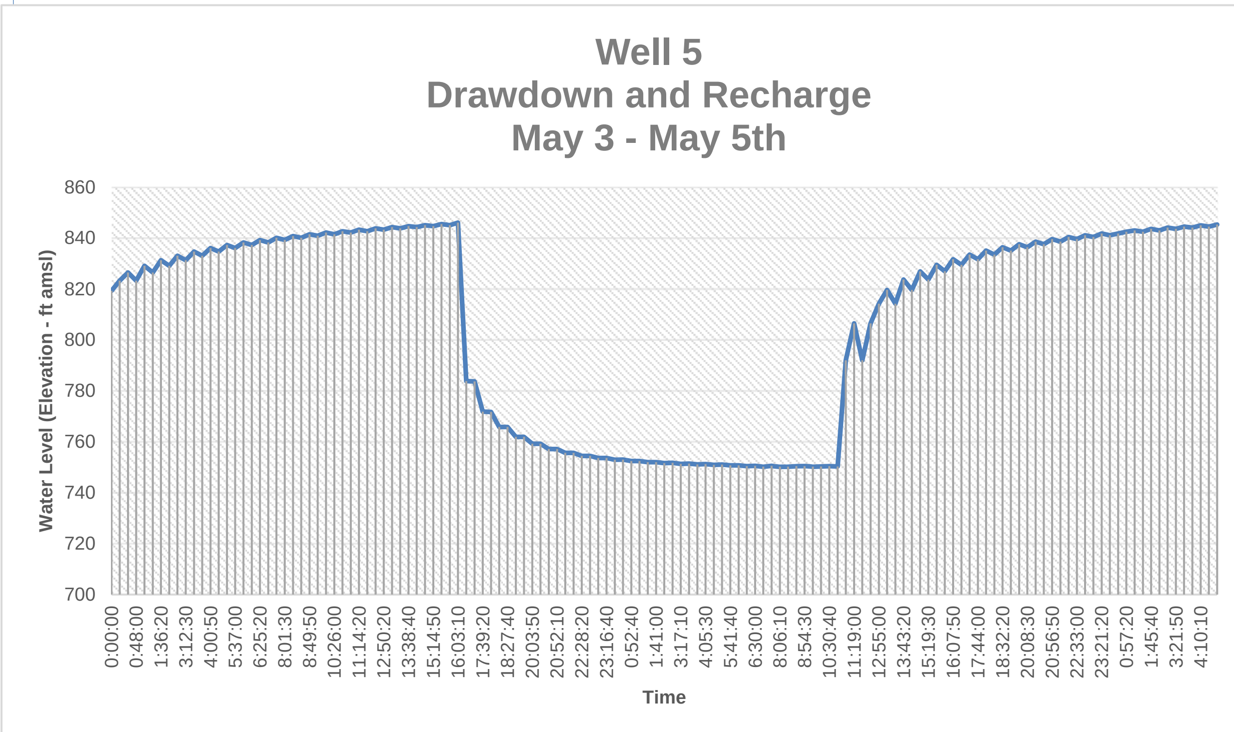
Well drawdown is the decrease of water from the baseline static water level. It can also be described as a decrease in water elevation, potentiometric surface, or water head. As a well is pumped, drawdown is induced by the removal of a volume of water from the aquifer. As the well continues to operate it can also create an area around the well where water is drawdown. This area of drawdown is known as a cone of depression or the area of Influence from a pumping well.

Figure 3 – Terms Relating to Well Performance



When a well discontinues pumping, water from surrounding aquifers will flow into the area and bring water levels back to static levels. Pumping temporary creates an area of low potentiometric water pressure, and when the well is shut off water will flow into the area to balance out that change in potentiometric surface. This is known as recharge, or recovery. The recovery period like the drawdown is determined by the hydrogeological properties of the aquifer. Drawdown observed in the City of Ramsey wells are typical for Twin Cities bedrock aquifers. The following chart depicts a drawdown and recover of Well 5 during a 2-day period starting May 3rd to May 5th in 2019.

Figure 4 – Well 5 Drawdown and Recharge



At the start of this period, Well 5 water levels were recovering to static at approximately 23 feet below ground surface. Pumping commenced at 15:15 on May 3rd and continued for the next 18 hours. Initial drawdown or instantaneous drawdown is depicted by the step increase in drawdown from 16:51 to 18:27. Water levels over this period fell 80 feet. Water levels over the following 18 hours decreased another 40 feet. The well ceased pumping at 10:30 on May 3rd and recharge to the aquifer took 17 hours to return to static water levels.

Current well pumping and rates of recharge appear good with the aquifer being able to recharge water to static in a relatively low period of time.

5.1.5.2 Well Drawdown and Available Head

Water levels from the source water aquifer, the Tunnel City-Wonewoc Aquifer, are much higher than the topographic elevation of the top of bedrock. This scenario is known as a confined aquifer, where the potentiometric surface, or water head, is higher than the topographic location of the aquifer.

Presently, water quantity throughout the region is good and there are no regulations actively being enforced on pumping levels within a well. Well interference and long-term groundwater trends through pumping/drawdown is conducted on a case by case basis by the Minnesota DNR if a problem arises.

Typically, it is not a good idea to drawdown water levels in a confined aquifer below the top of bedrock as it can introduce oxygen into the formation. Additionally, water levels should stay sufficiently above the specifications of the water pump design.

For confined aquifers, the Minnesota DNR has established a two-tiered aquifer protection threshold system to ensure the long-term viability of the pumped aquifer and to prevent exceedance of the aquifer safe yield as defined by MN Rule 6115.0630 Definitions Subps.15 and 16. These thresholds allow for appropriation from the aquifer but establishes minimum water level elevations to be maintained as a safeguard to protect the structural integrity of the aquifer itself. Threshold elevations are set in observation wells completed in the source aquifer and not pumped wells.

- The first threshold is set at an elevation that is 50% of the pre-pumping available head above the top of the aquifer. If water levels drop to the 50% threshold, pumping will need to be evaluated and a possible reduction in rate and volume may be required.
- The second is a water level elevation associated with 25% of the pre-pumping available head above the aquifer. At the 25% threshold, pumping would need to cease to prevent exceeding the safe yield for the artesian aquifer.
- If more than one aquifer is impacted by pumping, then thresholds are set similarly in the other aquifers.

The table below depicts the static water level and the approximate available head above top of aquifer in the City of Ramsey's current municipal wells taking account the Minnesota DNR 50% and 25% thresholds.

Table 11 – Drawdown in Ramsey Wells

Well No.	Unique Well No.	Total Depth (ft)	Casing Depth (ft)	Static Water Level Depth (ft)	Approximate Drawdown to Top of Aquifer (ft)	Approximate Drawdown to 50% threshold (ft)	Approximate Drawdown to 25% threshold (ft)
1	161441	323	243	9.5	233.5	116.75	175.1
2	416183	320	240	9.5	230.5	115.25	172.8
3	580306	345	222	26	196	98	147
4	580313	321	191	18	173	86.5	129.7
5	593672	316	215	25	190	95	142.5
6	706840	390	282	37	245	122.5	183.7
7	743832	332	216	25	191	95.5	143.2
8	743833	354	245	15	230	115	172.5

These MnDNR threshold values are approximate as an observation well has to be established by the MnDNR for baseline water elevations; however, the table above provides an estimate for which the city should manage water levels.

5.1.5.3 Well Specific Capacity

Well specific capacity is the rate of pumping per unit of drawdown expected. This is generally expressed as gallons per minute (GPM) per foot of drawdown. All of the City of Ramsey wills experience a sharp initial displacement of water as the wells are turned on (as seen in Well 5 drawdown examples above). For the purpose of this report, this initial displacement was not considered in the calculations for Well Specific Capacity in order to give a more accurate depiction of how the aquifer will respond once stabilized to various pumping rates.

Well Specific Capacity for the City of Ramsey was determined to be approximately 30 to 40 GPM / ft after initial displacement. This indicates a 30 to 40 GPM increase in pumping rate will increase total drawdown by 1 foot. The Specific Capacity was established analyzing the following recent results from pumping.

5.1.6 Bedrock Hydrogeologic Sensitivity to Pollution

Water quality for bedrock aquifers are generally a function of recharge rates for water originating from surficial waters, or percolation from direct precipitation, that may carry contaminants. Aquifers generally flow from areas of high potentiometric conditions to areas of low potentiometric conditions which can be influenced by surface topography, bedrock topography, Well Influence, and the hydraulic properties of the geologic units.

The areas of higher potentiometric conditions often correspond to recharge areas or where water enters the aquifer and, as a result, are the most susceptible to distributing such contamination to the bedrock aquifer. Recharge areas may have variable recharge rates and may even decrease because of the properties of the material in which it flows. Confining units, formations primarily made up of fine-grained material, reduce groundwater flow rates and provide more geologic protection. Geologic protection can be described in categories as to how quickly water can percolate from the surface to the bedrock from ‘Low’ to ‘High’.

Figure 4 in Appendix D depict bedrock protection ‘Geologic Sensitivity’ for Anoka County. While the majority of the bedrock aquifers exhibit a low geologic sensitivity, some areas are depicted with a high sensitivity. The areas of high sensitivity do not appear to correspond to specific bedrock geologic conditions. Instead, high sensitivity is more likely related to where confining units have been removed and where coarse-grained Quaternary sediment overlies the bedrock surface.

Figure 5 in Appendix D depicts tritium samples taken within the City of Ramsey. Tritium is a radioactive isotope of hydrogen that can be used to indicate water age. MDH classifies young (post-1953) water, as indicated by the presence of 1 TU or greater in the well water. Tritium results for these samples depict a mixed result. This mixed result reflects uncertainty about the pathway for young water (containing tritium) to reach the deeper bedrock aquifers. Although the presence of tritium may be the result of a compromised well casing allowing surface water seepage, conservatively, it is assumed that some pathways may exist.

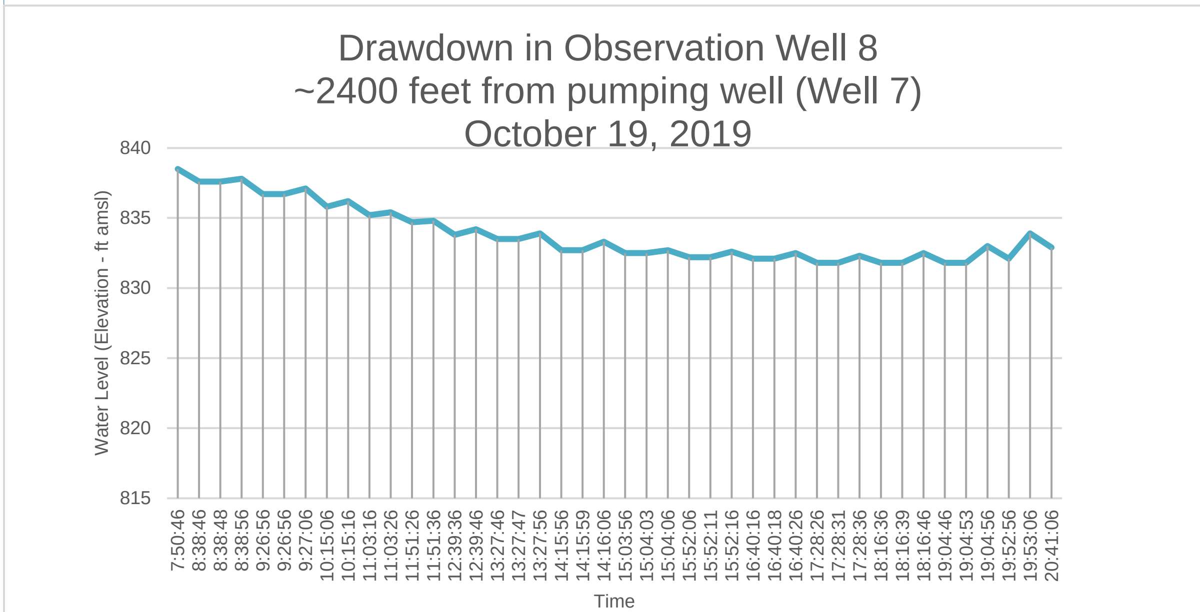
5.1.7 Well Spacing

Determining the proper spacing of wells in Artesian Aquifers is a balance of well drawdown, the ability of the surrounding formation to recharge, and further economic considerations (USGS 1961). In general, the farther apart high-capacity wells are from one another, the less mutual interference will occur on the wells. Additionally, the economics of well spacing needs to be weighed against the potential drawdown of the wells.

The USGS in 1961 developed a method utilizing the Theis equation for hydraulics to determine expected well drawdown and the surrounding cone of depression. Calculations using this equation were completed to understand the hydrogeology of this aquifer system.

The following example depicts drawdown in well 8 over the course of 12-hour period while well 7 was pumping at an Average of 800 GPM.

Figure 5 – Drawdown in Observation Well 8



During the course of Well 7 pumping, Well 8 at a distance of 2,400 feet observed approximately 6 to 9 feet of drawdown.

The Theis equation predicts a cone of depression approximately 2,448 feet from pumping well 7.

Theis Equation for the City of Ramsey		
Time =	0.5	days
Theis W(u) Function	0.752	unitless
Drawdown =	6	ft
Transmissivity =	11493	gpd/ft
Pumping Rate =	800	gpm
Theis u variable =	0.390	unitless
r^2 = 4Ttu 4S		
Storativity =	0.0002	unitless
Radius rounded for map	2400	ft

These results indicate that a single well pumping at current well field spacing does not induce mutual well interference. This 6-foot cone of depression is depicted on Figure 11.

However, complexities arise as present-day conditions see the use of 3 to 5 concurrent wells, and a 2040 demand increasing up to a projected 500% daily maximum demand. In order to model these scenarios and their resulting cone of depressions a groundwater model was developed.

5.1.8 Model

The groundwater flow and cone of depression calculation for the City of Ramsey were determined using an existing regional MODFLOW model that was developed by Barr Engineering Company for the Metropolitan Council (Metro Council, 2014). MODFLOW is a 3D, cell-centered, finite difference, saturated flow model developed by the U.S. Geological Survey (McDonald and Harbaugh, 1988; Harbaugh et al., 2000).

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 Metro Model consists of nine layers that represent the major aquifers and aquitards within the seven-county metropolitan area. These layers represent, from top to bottom (youngest to oldest), the following units: (1) surficial aquifer of glacial deposits; (2) St. Peter Sandstone or Quaternary Buried Artesian Aquifer; (3) Prairie du Chien Group; (4) Jordan Sandstone; (5) St. Lawrence Formation (aquitard); (6) Tunnel City Group; (7) Wonewoc Aquifer, (8) Eau Claire Formation (aquitard); and (9) Mt. Simon Sandstone. The regional groundwater model was calibrated to steady-state water levels and river base flows. Model parameter development and error is discussed in the Metro Model report.

A local model limited to an approximate radius around the city limits was extracted from the regional seven-county model using telescopic mesh refinement with the Groundwater Vistas software. Constant and general head boundaries around the limits of the model along with wells, rivers and lakes, and infiltration, provided the model boundary conditions.

The model grid was refined around the City of Ramsey wells. Variable grid spacing was used, ranging from approximately 2 meters near the City of Ramsey wells to approximately 500 meters at the edge of the grid.

Prior to their use in the delineations, the following modifications were incorporated in the refined models:

- Local areas of modified horizontal conductivity were included in the model.
- The pumping rates for baseline (no pumping), maximum present-day use, and projected 2040 demand were inputted into scenarios of the model.

To determine the water contours of the aquifer and the resulting cone of depressions multiple model runs using multiple flow rates were inputted into the city wells. Baseline conditions were established creating a model that input no pumping from the City wells. This represents static aquifer water levels without influence of the City wells. Water elevations from this baseline condition is depicted on Figure 12 in Appendix D. The results from this model run are verified and match MnDNR hydrogeologic atlas potentiometric surface predictions depicted in Figure 7 and Figure 9 in Appendix D.

The second model run input pumping values from June 12, 2019 to predict the cone of depression caused from 8 hours of pumping 4 wells. The resulting head values from this model were subtracted from the baseline model. Results from this calculation are shown in Figure 13 in Appendix D. This Figure depicts the cone of depression created on June 12, 2019. To check accuracy of the model results Well 3 a non-pumping observation well saw water levels drop approximate 12-15 feet from baseline conditions, essentially matching modeled results.

The third model run adjusted June 12, 2019 pumping wells to be increased to projected 2040 demand. The resulting cone of depression is depicted on Figure 14 in Appendix D. Results indicated almost double the drawdown depicted from the second model run. Well 3 was again input as a non-pumping observation well and would observe 40 feet of drawdown under these conditions.

5.1.8.1 Model Calibration

A qualitative evaluation of the calibration can be made by comparing the simulated potentiometric surface (Figure 12 in Appendix D) with observed water level targets obtained from the MWI database and Minnesota Department of Natural Resources Potentiometric Surfaces (Figure 7 and Figure 9 in Appendix D). 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 MWI 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 (RMS) and the maximum observed head difference of the calibration dataset. The calibration dataset included water level information from wells in an approximate 16-mile radius of the city's wells. The root mean square residual of the calibration for layers 6 and 7 for the model was approximately 5.15 meters with a Normalized Root Mean Squared of 5.0 percent. It is noted that this error is less than the calibration target of 15 percent (Anderson et al., 2015).

5.2 Groundwater Modeling Conclusions

The Source water aquifer that the City of Ramsey currently utilizes is a deep-confined aquifer comprised of two geologic units, the Tunnel City and Wonewoc Aquifers. Throughout the region, numerous other unconsolidated and bedrock aquifers exist along with substantial surface water bodies such as the Mississippi River. Overall, the area surrounding the Twin Cities has substantial surface and groundwater resources to support present and long term portable water.

At present, there is no reason to assume that the current source water aquifer for the City of Ramsey will not be able to supply potable water for the foreseeable future. The City of Ramsey's source water aquifer and wells are able to meet present day demand and appear to have a noticeable but temporary radius of influence on the surrounding aquifer. The wells are able to support high pumping rates with specific capacity showing acceptable drawdown alongside the aquifer's ability to recharge to static levels within a day of pumping.

The City of Ramsey will need to balance water demand with drawdown to meet Minnesota Department of Natural Resources drawdown thresholds described in MN Rule 6115.0630 Definitions Subps.15 and 16. Two thresholds are in place and regulate that wells must not drawdown MnDNR assigned static water levels to within 50-percent and 25-percent to the top of aquifer. These threshold values are set by a MnDNR observation well and would typically be enforced if long term issues are observed. Thresholds for the City of Ramsey could become a concern if there is extended pumping within a single well or pumping by multiple wells in close proximity.

In summary, it is SEH's opinion that there is a 95% to 99% certainty that the source water aquifer for the City of Ramsey will continue to produce potable water to meet present and foreseeable future demands; however, the City of Ramsey should plan additional well sites to ensure static water levels remain sufficiently above top of aquifers to meet MnDNR thresholds.

Single well pumping for the City of Ramsey, as depicted by Well 5 in May, 2019 saw approximately 90 to 100 feet of temporary drawdown. This observed drawdown nears the MnDNR 50-percent threshold; however, the pumping extended multiple days and recharged within the same time period back to static levels. This supports the ability of the wells to supply continued water and ability to stay within prescribed State Statute.

A single well also creates a radius of influence drawing down adjacent water levels. The zone of influence for a single well was observed and modeled to be approximately two to three thousand feet, meaning that a single well pumping at approximately 800 feet will not cause a significant drawdown in another well. When multiple wells are being utilized such as under heavy day demand or under 2040 conditions the modeled and observed drawdown in nearby wells sees a substantial drop in static water levels from that of a single well pumping. Modeled drawdown during present heavy day conditions depict 30-40 feet of drawdown approximately 1,500 feet around the wellfield. After pumping stops, the aquifer will recharge to static levels within one or two days. In general, it appears new well sites should be spaced at least 1,500 to 2,000 feet away from existing wells to ensure a pumping scheme that gives the aquifer sufficient time to recharge.

Future well sites should attempt to balance the City's current economics, well spacing, and take into account the underlying geology. The City of Ramsey should continue to utilize the current source water aquifer for both a water quantity and a water quality standpoint. The source water aquifer is underneath protective "confining" units that appear to inhibit the influence of new water from brining contaminants to the City's wells and will likely produce consistent water quality unlikely unconfined sources such as surface water that may have a highly variable water quality.

Additional considerations for well Sites should take into account the thickness of the two hydrogeologic units that make up the source water aquifer. The Tunnel City aquifer is not as prolific an aquifer as the Wonewoc aquifer, meaning that the Wonewoc aquifer is a more economical source of water. Figure 15 in Appendix D depicts three potential well sites taking into account these issues. Well Site Area A has Tunnel City aquifer thickness ranging from 100 to 150 feet and Wonewoc thickness ranging from 45 to 60 feet. Well Site Area B has Tunnel City aquifer thickness ranging from 0 to 80 feet and Wonewoc thickness ranging from 35 to 100 feet. Well Site Area C has Tunnel City aquifer thickness ranging from 90 to 100 feet and Wonewoc thickness ranging from 15 to 35 feet. All of these sites have potential for potable water sources, but a test well will need to be installed to confirm their viability. As opportunities to investigate these well sites present themselves the City should consider these as potential well sites.

6 Regional Water Supply Study

Metropolitan Council Environmental Services in conjunction with the Cities of Ramsey, Dayton, Rogers, and Corcoran prepared a study in 2020 that looked at various options for a regional water system. SEH was the consulting engineer on the project. The *Northwest Metro Area Regional Water Supply System Study* (Study) evaluated four approaches to water supply:

- Approach 1: Regional Surface Water Treatment Plant
- Approach 2: Regional Lime Softening Groundwater Treatment Plant
- Approach 3: Regional Conjunctive Use System (Surface Water Augmented with Groundwater)
- Approach 4: Status Quo (communities construct individual lime softening groundwater treatment plants)

So that similar treated water qualities were being evaluated, Approach 2 and Approach 4 assumed that the communities would construct lime softening groundwater treatment plants. A potential driver ultimately requiring lime softened groundwater or the use of surface water is a chloride discharge limit in wastewater.

A finding in the report as it relates to surface water treatment in the vicinity of Ramsey was that *"The Mississippi River has sufficient water quantity to serve the Northwest Metro communities. The water quality in the Mississippi River appears to be acceptable for a conventional surface water treatment plant. St. Could, St. Paul, and Minneapolis utilize the Mississippi River as their source of drinking water."*

The capital cost of a surface water treatment plant is significantly higher than an iron and manganese groundwater treatment plant. Based on costs presented in the report, the project cost for a 10 MGD surface water treatment plant would be $50 million or more. In addition, the Operation and Maintenance costs of treating surface water is approximately twice as high as iron and manganese treatment.

It should be noted that a surface water treatment plant could provide softened water to the residents of Ramsey; whereas an iron and manganese treatment plant would not provide softened water. However, residents that are concerned about hard water are likely already softening their water with a home softener.

As of the preparation of this report, the Study was still in draft form. When the Study is complete, it will be available to the public on the MCES website. The citation for the report is: *Metropolitan Council. 2020. Northwest Metro Area Regional Water Supply System Study. Prepared by Short Elliott Hendrickson Inc. Metropolitan Council: Saint Paul*.

Because it has been demonstrated that Ramsey should have sufficient groundwater available to meet future demands, a surface water treatment plant is not recommended at this time. A potential Ramsey groundwater treatment plant will be located close enough to the Mississippi River that it could be converted to a surface water treatment plant in the future if it became necessary. It is recommended that surface water features be designed into a potential water treatment plant. The additional cost of the surface water features is approximately $250,000.

7 Water Treatment

To remove manganese, iron, or hardness from Ramsey's drinking water, a centralized water treatment plant should be constructed. Adding the necessary processes to treat the water supply at each pump house would not be cost-effective.

7.1 Current and Future Treatment Needs

Many of Ramsey's wells are high in manganese, which has necessitated a solution to reduce the levels due to its health concerns. Ramsey's water is also high in iron and hardness. Ramsey's water otherwise meets all of the primary and aesthetic drinking water standards.

Manganese and iron can be removed with oxidation and sand filtration as discussed in the pilot study in Appendix E. Hardness removal options are discussed in Section 7.5.

Future treatment requirements will depend upon the class of contaminant being treated. Volatile chemicals can typically be removed using an aerator (i.e. gasoline constituents, trichloroethylene [TCE], radon, hydrogen sulfide, etc.). Some organic chemical may be removed using granular activated carbon (potential taste and odor causing contaminants). It may also be possible to add chemical feed systems to remove new contaminants using sand filters (i.e. arsenic, radium). If it is not possible to remove the contaminants by volatilization, carbon filtration, or sand filtration, membrane filters could be necessary (i.e. reverse osmosis). It should be noted that sand filtration is typically required ahead of membrane filters because iron and manganese causes fouling on the membranes.

In addition to potential future contaminants, a water treatment plant could be designed with features that would allow it to be converted to a surface water treatment plant in the future. One of these features would be filter-to-waste piping and valves. Filter-to-waste piping is required for surface water treatment, but is not generally used with groundwater treatment.

Ultimately, having a treatment facility that is flexible and can be retrofitted to meet new potential requirements is very important.

7.2 Treatment Capacity

As discussed in Chapter 4, the maximum day demand ranged from 4.1 to 5.5. MGD in the last 10 years. While the overall maximum day water demand has been flat in the last 10 years, the maximum day demand nearly triples the average day demand. The projected 2040 maximum day water demand is 10.3 MGD.

The recommended capacity of a water treatment plant for Ramsey is 10 MGD under normal conditions with the ability to operate up to 15 MGD for shorter periods. This will allow the City to comfortably treat maximum days through 2040 and possibly beyond.

7.3 Manganese and Iron Removal Options

The most common and most cost effective option for manganese and iron removal is chemical oxidation followed by sand filtration. In groundwater, the manganese and iron ions are in solution. When a strong oxidant is added to the water, it converts the manganese and iron to filterable solids.

The oxidant that is added for iron oxidation is typically oxygen via aeration or chlorine. The chemical oxidant that is added for manganese oxidation is typically sodium permanganate. Chlorine is a less expensive chemical oxidant, but the reaction with manganese is too slow to be used in a filtration process. Options for gravity and pressure filtration are presented later in this chapter.

Other options for iron and manganese removal are chemical oxidation followed by membrane filtration or reverse osmosis. Both of these options are very expensive from a capital cost and operations and maintenance standpoint and are not being considered further.

7.4 Hardness Removal

Hardness in water is caused by excess calcium and magnesium ions in the water. Hard water causes scaling on fixtures and can plug pipes. Hardness can be removed from water on a municipal scale by lime softening or ion exchange softening.

7.4.1 Lime Softening

Lime softening involves adding lime to water to raise the pH to a point where the calcium carbonate is no longer soluble in the water. By forming calcium carbonate precipitate; the calcium can be removed by filtration. A lime softening water treatment plant requires sedimentation, clarification, and filtration and is very expensive. The capital cost of a lime softening water treatment facility for Ramsey could be as much as $50 million. The operation and maintenance (O&M) of a lime softening water treatment facility would also be significantly more than an iron and manganese removal water treatment facility. Higher O&M for a lime softening plant is due to a larger facility and more chemical processes. It should be noted that a lime softening water treatment plant would also remove manganese and iron, and would not require a separate treatment process.

Due to the high capital and O&M costs associated with a lime softening water treatment plant, it is not recommended for the City of Ramsey.

7.4.2 Ion Exchange Softening

Ion exchange softening involves exchanging calcium and magnesium ions for sodium ions with an ion exchange resin. This is exactly the same process that is used in a home water softener. To regenerate an ion exchange softener, the resin is flushed with a concentrated solution of brine. This regeneration process uses large quantities of salt. A municipal ion exchange water softening system treating 3.5 MGD (Ramsey's 2040 average day demand) would use as much as 6 tons of salt every day.

The capital cost of adding an ion exchange water softening treatment process to a new water treatment facility would be approximately $5 million. This cost would be in addition to an iron and manganese removal water treatment plant.

The operation cost for salt and wasted water for an ion exchange softening process is approximately $500 per million gallons of water treated. This is independent of whether it is done by the City or by a resident.

An ion-exchange softening process would add approximately 3 tons of chloride to the wastewater system which is ultimately discharged to the Mississippi River. While the MCES Metro Wastewater Treatment Plant currently meets its discharge limits, chlorides have received more regulatory scrutiny recently. Operating a municipal scale ion exchange softening process may become less feasible in the future due to chlorides in wastewater. In addition, municipal scale ion exchange softening might not be considered environmentally responsible. Due to the higher operation and maintenance costs, potential future regulations, and environmental responsibility, an ion-exchange softening process is not recommended.

7.5 Pilot Study Results

A pilot study was performed by John Thom of SEH of Ramsey's water in January 2020. The Pilot Study Report is included in Appendix E. The objectives of the pilot study were to evaluate the effectiveness of detention time prior to filtration, and to determine the optimal filter media.

The pilot study found no significant difference between direct filtration and utilizing 30 minutes of detention time prior to filtration, and found no significant difference between the silica sand/anthracite and greensand/anthracite filter media. Because the manganese oxide coating on manganese greensand filters is helpful for manganese removal, greensand/anthracite filter media is recommended.

7.6 Filter Sizing

The required filter area is determined by dividing the nominal filtration capacity by a flux rate (filtration rate). Ten States Standards requires sand filtration rates from 2 to 4 gpm / ft^2. Because the required filtration capacity is 10 MGD under normal operating conditions, the facility will be designed for 10 MGD at 2 gpm / ft^2. Therefore, if 15 MGD is necessary for short periods of time, the filtration rate will still be in the acceptable range. With a capacity of 10 MGD and a filtration rate of 2 gpm / ft^2, it is necessary to have 3,200 ft^2 of filter media. To have reasonable backwash rates and operational flexibility, this will be broken into eight filters.

7.7 Operator Input

Ramsey operators and City Staff toured existing water treatment plants in Andover and Brooklyn Center as part of this feasibility study. Operator feedback from the tours was gathered and incorporated into the building layouts discussed in the following sections.

7.8 Treatment Alternative 1 - Gravity Filter Layout

7.8.1 General

In an iron and manganese gravity filtration system, water to be filtered is pumped, under low pressure, to the treatment facility where it flows by gravity through the various treatment processes. Following the oxidation process, the water flows through the filter cells from top to bottom. As the water passes through the filter media, the insoluble particles of iron and manganese are removed.

As more and more water is filtered, the restriction to flow, created by the accumulation of iron and manganese solids on the media, steadily increases. In a gravity facility, this restriction to flow, called head, is measured in feet of water depth in the filter cells. As the solids accumulate, the depth of water in the filter cells increases. Due to the physical nature of a gravity filter, when the depth of water in a cell reaches its maximum designed head (high water level) backwashing is required. Failure to backwash at the proper time could result in the filter overflowing or poor effluent water quality being produced. Gravity filters are typically constructed of concrete or steel. Steel filters are generally found in smaller water systems. Because of the large size of the filters required for Ramsey, steel filters are not being considered.

The advantages to gravity filtration systems are:

1. Gravity filters provide for more treatment options including aeration and detention without requiring another pumping step. If regulations change or the water becomes contaminated, additional treatment steps can be added to gravity filters.
2. Water from the gravity filters does not go immediately into the distribution system. If problems with the filters occur or if sodium permanganate is overfed (causing pink water), operators have time to react and correct the problem.
3. Gravity filters are open to view and access. This is advantageous in that it enhances the observation, operation and maintenance of the filter functions and components.
4. Gravity filtration systems have a greater amount of flexibility with less disruption during normal maintenance procedures.

The disadvantages to gravity filtration systems are:

1. The facilities tend to have more capital cost than pressure type facilities.
2. Typically requires the facility to be constructed on two floor levels.
3. Provides for less available headloss than pressure facilities which can result in shorter filter run times. Shorter filter run times result in more backwashing which takes a filter out of service.

7.8.2 Building Layout/General Sequence

Gravity filter building layouts are included in Appendix F. The chemical rooms are located on the east side of the building, with exterior doors accessible for deliveries. The electrical, mechanical, high service pump room, and generator rooms are located in close proximity to each other to allow for short conduit runs to motor controls.

The gravity filter layout occurs on two levels to allow for filter height to provide head for the filtering process. The raw water enters the building through the high service pump room where chlorine and potassium permanganate are added. The water travels through the filters by gravity to the clearwell. The water travels from the clearwell to the high service pump chamber where it is pumped into the distribution system. Fluoride, chlorine, and phosphate will be added to the finished water.

7.8.3 Main Level

7.8.3.1 Chemical Rooms

Chemical rooms are clustered on the east side of the building with exterior doors to allow easy access for chemical deliveries. It is expected that chemical rooms will be required for chlorine gas, sodium permanganate, fluoride, phosphate, and possibly polymer to aid in backwash settling.

7.8.3.2 High Service Pump Room

The high service pump room contains the pumps that pump treated water from the clearwell into the distribution system. Because most of the electrical load is located in the high service pump room, it is in close proximity to the electrical room and generator room.

7.8.3.3 Electrical Room

The electrical room contains the motor control equipment and electrical panels. The location of this room in close proximity to the high service pump room, mechanical room, and generator room provide for short conduit and wire runs.

7.8.3.4 Mechanical Room

This room contains the make-up air, dehumidification, and HVAC equipment. The location of this room on an outside wall provides space for air louvers.

7.8.3.5 Blower Room

The blower room contains the filter backwash blower. The backwash blower provides air which is used to help clean the filter media during a backwash.

7.8.3.6 Office/Control Room/Lab

An office/control room/lab is provided for operators to have a SCADA computer to monitor and control the water system. A lab sink and desktop analyzer will be provided to allow operators to monitor water quality. The office is located in the front of the building next to the entrance, and has lots of windows for natural light.

7.8.3.7 Generator Room

A standby generator will be located in the generator room. The generator is capable of running the water treatment plant in the event of a power outage or possibly for peak shaving (peak shaving requires additional emissions compliance). The service entrance and automatic transfer switch are located in this room. Two exterior walls are provided for intake and exhaust louvers.

7.8.4 Upper Level

The upper level is depicted on the Upper Level Floor Plan in Appendix F. The upper level consists of filters and walkways. Windows will be provided in the filter room to allow for natural lighting. Walkways will be provided around the filters to allow the plant operator to inspect the operating conditions of the filters. Control panels (fixed or mobile) will be provided to allow the operators to manually initiate backwashes from the upper level.

7.8.5 Clearwell

A clearwell is located adjacent to the gravity filter treatment facility. The clearwell provides storage and operational flexibility (the box shown on Figure 1A in Appendix F represents 1 million gallons of underground storage). This storage is necessary to (1) maintain a volume of water for backwashing filter cells, (2) to provide the flexibility to treat water at a rate different than the raw water pumping rate, and (3) to provide additional storage for the distribution system.

To provide operational flexibility and to supplement system storage, a 1 million gallon clearwell is the minimum size recommended.

7.9 Treatment Alternative 2 – Pressure Filter Layout

7.9.1 General

In an iron and manganese pressure filtration system, water to be filtered is pumped directly to, and through, the facility's components under pressure. Oxidation occurs inside the pipelines and filter vessels upstream of the filter media. Following the oxidation process, the water flows through the filter vessels from top to bottom. As the water passes through the filter media, the insoluble particles of iron and manganese are removed from the flow.

As more and more water is filtered, the restriction to flow, created by the accumulation of iron and manganese solids on the media, steadily increases. In a pressure facility, this restriction to flow, called head, is measured in pounds per square inch (psi). As the solids accumulate, the headloss, or difference in pressures between the top and bottom sides of the filter media, increases. Due to the design and construction of pressure filters, headloss can be driven as high as 15 psi, although 5 to 6 psi is the preferred upper limit to ensure water quality.

The advantages to pressure filtration systems are:

1. The facilities tend to have less capital cost than gravity facilities.
2. Plants are typically constructed on one floor level.
3. Provide for greater available headloss than gravity facilities which can result in longer filter run times than a comparably sized gravity facility. Longer filter run times require less backwashing which keeps a filter in service longer.

The disadvantages to pressure filtration systems are:

1. Pressure filter systems have less ability to add additional treatment processes (aeration, detention) if regulations or water quality changes.
2. Closed from view and difficult to access internally. This prevents observation of the systems operation. Condition of the filter media and flow distribution during a backwash cycle cannot be readily monitored.
3. Pressure filters are constructed out of steel and require periodic blasting and painting.
4. Inspection of the pressure filters requires entry into a confined space which is a safety hazard.

7.9.2 Building Layout/General Sequence

Pressure filter building layouts are included in Appendix G. The chemical rooms are located on the east side of the building, with exterior doors accessible for deliveries. The electrical, mechanical, and generator rooms are located in close proximity to each other to allow for short conduit runs and motor controls.

The pressure filter layout occurs on one level. The raw water enters the building in pressure pipe and chlorine and permanganate are added. The water goes directly through the filters under pressure where the iron and manganese are removed. Fluoride, chlorine, and phosphate will be added to the finished water.

7.9.3 Main Level

7.9.3.1 Chemical Rooms

Chemical rooms are clustered on the east side of the building with exterior doors to allow easy access for chemical deliveries. It is expected that chemical rooms will be required for chlorine gas, sodium permanganate, fluoride, phosphate, and possibly polymer to aid in backwash settling.

7.9.3.2 Electrical Room

The electrical room contains the motor control equipment and electrical panels. The location of this room in close proximity to the mechanical room and generator room provide for short conduit and wire runs.

7.9.3.3 Mechanical Room

This room contains the make-up air, dehumidification, and HVAC equipment. The location of this room on an outside wall provides space for air louvers.

7.9.3.4 Blower Room

The blower room contains the filter backwash blower. The backwash blower provides air which is used to help clean the filter media during a backwash.

7.9.3.5 Office/Control Room/Lab

An office/control room/lab is provided for operators to have a SCADA computer to monitor and control the water system. A lab sink and desktop analyzer will be provided to allow operators to monitor water quality. The office is located in the front of the building next to the entrance, and has lots of windows for natural light.

7.9.3.6 Generator Room

A standby generator will be located in the generator room. The generator is capable of running the water treatment plant in the event of a power outage or possibly for peak shaving (peak shaving requires additional emissions compliance). The service entrance and automatic transfer switch are located in this room. Two exterior walls are provided for intake and exhaust louvers.

7.10 Backwash Alternatives

Sand filters (gravity and pressure) require periodic backwashing to remove solids from the filters. Backwashing one of the filters (either gravity or pressure) will consume between 40,000 and 70,000 gallons of water. After a backwash, the solids are allowed to settle and the clear water is recycled back to the filters. This can be done with backwash tanks or lamella plate settlers as discussed below.

7.10.1 Backwash Alternative 1 – Backwash Tanks

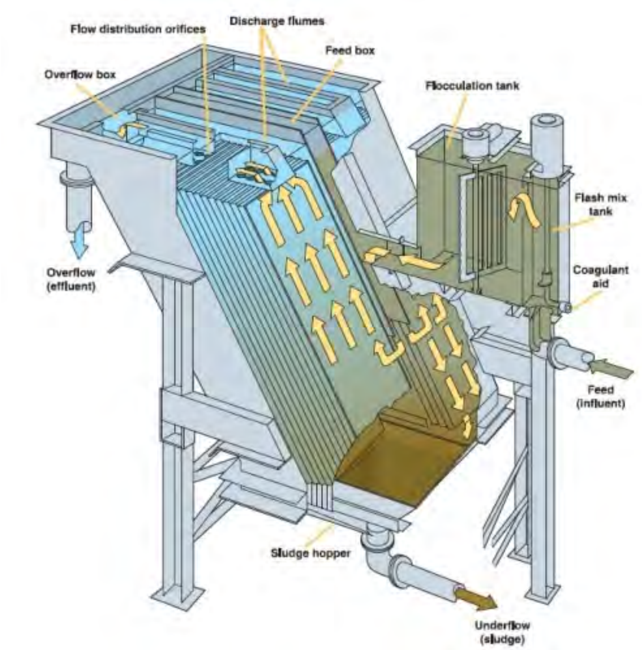
Backwash tanks simply involve discharging the backwash water to a tank where the water is allowed to settle for a period of time (typically 8 hours). Clear water is decanted from the backwash tank and recycled to the beginning of the treatment process. A backwash polymer may be utilized to increase settling efficiency.

To allow for more than one filter to be backwashed in one day, multiple backwash tanks are required. To provide for efficient operation, three backwash tanks are recommended.

7.10.2 Backwash Alternative 2 – Lamella Plate Settlers

Lamella settling is a process that receives continuous flow from the backwash tank, and provides high rate thickening of the sludge, and reclaims decanted clear water to the beginning of the treatment train. High rate inclined plate settlers typically thicken backwash sludge to approximately 0.5 to 1.5% solids prior to discharging to either a sludge storage tank for further thickening, or directly to the sanitary sewer.

Backwash waste water is pumped from the backwash tank directly into the gravity settler, alleviating settling time. A coagulant is added immediately, as the water flows through a flash mixer and into a flocculation tank. The coagulated sludge then flows into a series of inclined plates, the surfaces which collect the sludge and direct it to a sludge hopper. The clear effluent flows out the overflow and is recycled to the raw water. The inclined orientation of the plates allows for more surface area for the solids to settle upon, while limiting the total space taken up by the equipment.



As with treatment process equipment in general, redundancy is recommended so that in the event that one lamella settler is down, settling operations can continue seamlessly. Therefore, one single lamella settler is not recommended.

7.10.3 Backwash Alternative Comparison

The advantages of lamella plate settlers is that they do not require settling time prior to recycling the backwash water. This eliminates the need for batch processing of backwash water from backwash tanks and provide significant operational flexibility. Backwash tanks can dictate when and if a filter can be backwashed.

Lamella plate settlers waste between 60 and 900 gallons per million gallons of water treated, depending upon whether a sludge holding tank is utilized. Backwash tanks waste between 750 and 5,000 gallons of water per million gallons of water treated.

Because lamella plate settlers provide significantly more operational flexibility and waste less water, lamella plate settlers are recommended for Ramsey.

8 Architectural Design

The City of Ramsey's goal for the water treatment facility is to provide a building that fits with adjacent structures, includes cost effective sustainable design features, is operator friendly, and provides a civic presence to the public.

The water treatment functions of the building will be constructed of poured in-place concrete foundations with masonry, brick, and stone façade. A glass atrium is proposed as an architectural feature and to provide additional natural light. Architectural features from adjacent structures will be incorporated into the design.

For walls that are less visible to the public, cost-effective insulated load bearing precast wall panels will be use. The roof will be constructed of precast concrete double 'T's for the roof structure of the filter room which allows for a greater clear spans and more daylighting.

Sustainable architectural features will include natural daylighting throughout including the filter room, low maintenance poured-in-place and plant precast concrete structure and wall panels, building insulation which surpasses the current energy code. Rain gardens and low maintenance landscaping features can be included in the site design.

An architectural rendering that further demonstrates the design concept for the Fire Station Site is included in Appendix H. If the water treatment plant is constructed elsewhere the architectural treatments will be modified to fit with the adjacent structures.

9 Utility Space Needs Evaluation

City staff was solicited for additional space needs and features in the water treatment plant building in addition to the necessary filters and process rooms. The additional features requested in the building included a training room, and a separate laboratory. An optional 8,000 square foot garage is also included in some of the building layouts.

10 Water Treatment Plant Site Alternatives and Evaluation

Four alternatives for a new water treatment plant site were provided by the City. These alternatives include the Fire Station Site, Public Works Site, Water Shop Site, and Vacant City Property Site. These sites are shown on Figure 1 in Appendix I and are discussed below.

The watermain costs in the following sections assume that watermain is primarily installed within public utility easements, City-owned properties, or in County/City right-of-way next to roads, either in the boulevard or under paved trails.

The costs shown in this section are for purposes of comparing alternatives and do not contain contingency or indirect costs. The costs for the selected alternative are incorporated into the overall project costs presented in Section 12 where contingency and indirect costs are added.

10.1 Fire Station Site

The Fire Station Site is currently private property and would need to be acquired by the City. It was determined that a 3.2-acre site would be sufficient for the water treatment plant and a future expansion to 20 MGD. Portions of the water treatment plant would be constructed on the existing City-owned Fire Station property. A water treatment plant layout for the Fire Station Site is shown on Figure 4 in Appendix I.

10.1.1 Raw Watermain and Costs – Fire Station Site

The raw watermain required to construct a water treatment plant at the Fire Station Site is shown on Figure 2 in Appendix I. The water main and site acquisition costs are included in Table 12. Because the Fire Station Site is remote from other City garage facilities, it is assumed that a water treatment plant garage is needed.

Table 12 – Fire Station Site Costs

Item	Unit	Est. Quantity	Unit Price	Cost[1]
24" Raw Watermain	LF	3950	$230	$908,500
24" Road Crossing (Armstrong and Bunker Lake Blvd) - Jacked Casing	LF	400	$525	$210,000
16" Raw Watermain (Bunker Lake Blvd) - Jacked Casing	LF	100	$425	$42,500
12" Raw Watermain	LF	1850	$125	$231,250
Land Purchase	LS	1	$750,000	$750,000
Garage	LS	1	$1,450,000	$1,450,000
			Total	**$3,592,250**

[1] Costs are for comparison of alternatives and are not meant to represent the full project costs.

10.2 Public Work Site

The City is in the process of constructing a new Public Works Facility on a 19.9-acre parcel shown on Figure 1 in Appendix I. The proposed water treatment plant site is a 3.5-acre portion in the northeast corner of the Public Works Site. The northwest corner of the Public Works Site will remain available for other uses or development as it offers the best visibility and has access to both 143rd Avenue and Jasper Street. In addition, constructing the water treatment plant in the northeast corner of the Public Works Site will allow the City to control access to the existing cemetery on the site. A water treatment plant layout for the Public Works Site is shown on Figure 5 in Appendix I.

10.2.1 Raw and Finished Watermain Costs – Public Works Site

The raw and finished watermain required to construct a water treatment plant at the Public Works Site is shown on Figure 3 in Appendix I. The watermain costs are included in Table 13. Because a new Public Works building is being constructed on the Public Work Site, it is assumed that a new garage is not needed with the water treatment plant.

Table 13 – Public Works Site Costs

Item	Unit	Est. Quantity	Unit Price	Cost[1]
24" Raw Watermain	LF	7300	$230	$1,679,000
24" Road Crossing (Ramsey Blvd and Bunker Lake Blvd) - Jacked Casing	LF	400	$525	$210,000
24" Finished Watermain	LF	3800	$230	$874,000
20" Raw Watermain	LF	1300	$185	$240,500
16" Raw Watermain	LF	1750	$165	$288,750
16" Raw Watermain (Armstrong Blvd) - Jacked Casing	LF	100	$425	$42,500
Well 8 Meter Vault	LS	1	$90,000	$90,000
			Total	**$3,424,750**

[1] Costs are for comparison of alternatives and are not meant to represent the full project costs.

10.3 Water Shop Site

The Water Shop Site for the water treatment plant is City-owned property on the west side of Jasper Street, across the street from the new Public Works Facility. The water treatment plant would require approximately 3.5 acres of land. The current City water operations shop is located on this site. Construction of the water treatment plant on the Water Shop Site would require demolition of the existing water operations shop and abandonment of 142nd Ave NW. A water treatment plant layout for the Water Shop Site is shown on Figure 6 in Appendix I.

10.3.1 Raw and Finished Watermain Costs – Water Shop Site

The raw and finished watermain required to construct a water treatment plant at the Water Shop Site is shown on Figure 3 in Appendix I. The water main costs are included in Table 14. Because a new Public Works building is being constructed across the street from the Water Shop Site, it is assumed that a new garage is not needed with the water treatment plant. Costs to demolish the existing water operations shop are not included in Table 14.

Table 14 – Water Shop Site Costs

Item	Unit	Est. Quantity	Unit Price	Cost[1]
24" Raw Watermain	LF	8627	$230	$1,984,210
24" Road Crossing (Ramsey Blvd and Bunker Lake Blvd) - Jacked Casing	LF	400	$525	$210,000
24" Finished Watermain	LF	3800	$230	$874,000
20" Raw Watermain	LF	1300	$185	$240,500
16" Raw Watermain	LF	1750	$165	$288,750
16" Raw Watermain (Armstrong Blvd) - Jacked Casing	LF	100	$425	$42,500
Well 8 Meter Vault	LS	1	$90,000	$90,000
			Total	**$3,729,960**

[1] Costs are for comparison of alternatives and are not meant to represent the full project costs.

10.4 Vacant City Property Site

The City owns a vacant 4.1-acre parcel located on the east side of Ramsey Blvd NW, west of the Public Works Site shown on Figure 1 in Appendix I. The 4.1-acre parcel would be sufficient to construct Ramsey's water treatment plant. A water treatment plant layout for the Vacant City Property Site is shown on Figure 7 in Appendix I.

10.4.1 Raw and Finished Watermain Costs – Vacant City Property Site

The raw and finished watermain required to construct a water treatment plant at the Vacant City Property Site is shown on Figure 3 in Appendix I. The water main and garage costs are included in Table 15. Because the Vacant City Property Site is not on or adjacent to the new Public Works Site, it is assumed that a garage is needed.

Table 15 – Vacant City Property Site Costs

Item	Unit	Est. Quantity	Unit Price	Cost[1]
24" Raw Watermain	LF	9288	$230	$2,136,240
24" Road Crossing (Ramsey Blvd and Bunker Lake Blvd) - Jacked Casing	LF	400	$525	$210,000
24" Finished Watermain	LF	3800	$230	$874,000
20" Raw Watermain	LF	1300	$185	$240,500
16" Raw Watermain	LF	1750	$165	$288,750
16" Raw Watermain (Armstrong Blvd) - Jacked Casing	LF	100	$425	$42,500
Well 8 Meter Vault	LS	1	$90,000	$90,000
Garage	LS	1	$1,450,000	$1,450,000
			Total	**$5,331,990**

[1] Costs are for comparison of alternatives and are not meant to represent the full project costs.

10.5 Water Treatment Plant Site Evaluation and Recommendation

The City had previously planned to locate a surface water treatment plant at the Fire Station site. Some of the raw watermain is in place and it is convenient for metering Well 8. However, the Fire Station site is remote from other Public Works facilities, would have operational inefficiencies, and would require building a garage. The Fire Station site would also require the City to purchase land. Due to the construction of the garage and purchasing land, the Fire Station site is more expensive than the Public Works site.

The Public Works site requires more new raw and finished watermain than the Fire Station site, but because it is on the site of the Public Works Facility that is currently under construction it would not require a garage and could share an emergency generator and security infrastructure with the Public Works Facility. Having multiple public works facilities on the same site also increases operational efficiencies. The Public Works Site is already owned by the City and doesn't require the purchase of private property. If a garage is not included with the water treatment plant, the Public Works Site is the least expensive option.

The Water Shop site requires more new raw and finished watermain than the Fire Station or Public Works sites. It also requires that the existing water operations shop be demolished and 142nd Ave NW be removed and abandoned. Because it is adjacent to the Public Works Site, a garage would not be necessary at the Water Shop Site. Due to the additional watermain and a reduced ability to share an emergency generator and security infrastructure, the Water Shop site is more expensive than the Public Works Site.

The Vacant City Property Site requires more new finished and raw watermain than the Water Shop Site, and more yet than the Public Works Site. In addition, the Vacant Property Site doesn't offer the ability to share an emergency generator or security infrastructure as the Public Works Site does, and doesn't offer operational efficiencies. A garage would also be necessary. The Vacant City Property Site is the most expensive of the four sites evaluated.

Table 16 – Alternate Site Cost Comparison

Alternate WTP Sites Considered	Cost[1]
Fire Station Site	$3,592,250
Public Works Site	$3,424,750
Water Shop Site	$3,729,960
Vacant Property Site	$5,331,990

[1] Costs are for comparison of alternatives and are not meant to represent full project costs.

In January of 2020, the City of Ramsey's Planning Commission, Economic Development Authority, and Public Works Committee all voted unanimously to recommend City Council approval to construct the water treatment plant on the Public Works site. Stall also recommends the Public Works Site because it offers the least expensive overall construction cost, and also offers the greatest operational efficiencies, which in turn will reduce future operational costs.

11 Impacts to Nearby Properties

The water treatment plant is proposed to be constructed on the new Public Works Site as shown on Figure 5 in Appendix I. The Public Works site is in an industrial area of Ramsey and will already be used for a municipal public works building. Opposition from the neighboring properties to a new water treatment plant is not anticipated.

Water treatment plants are quiet neighbors with relatively little traffic. A standby generator will be part of the water treatment plant project, but it is proposed to be located inside the building and will have sound attenuation. Sound complaints from neighbors are not anticipated.

The operators will visit the plant daily and chemical deliveries will likely be made approximately once per week. Construction complaints are not expected since the water treatment plant is in an industrial neighborhood.

12 Capital Cost Opinions

Feasibility level opinions of probable cost (OPC) broken down by construction category were prepared for the gravity and pressure filtration alternatives. A breakdown of these costs by division are included in Appendix J. Tables 17 and 18 present the capital costs for the gravity and pressure filter treatment plants.

Table 17 – Capital Cost Opinion Summary
Gravity Filter Water Treatment Plant

Item	Cost
Water Treatment Plant:	$26,060,000
Construction Contingency (10%):	$2,606,000
Preliminary Construction Cost:	**$28,670,000**
Engineering/Construction Admin (12%)	$3,440,000
Legal/Admin (1%)	$287,000
Total Estimated Project Cost:	**$32,400,000**

Table 18 – Capital Cost Opinion Summary
Pressure Filter Water Treatment Plant

Item	Cost
Water Treatment Plant:	$24,766,000
Construction Contingency (10%):	$2,477,000
Preliminary Construction Cost:	**$27,240,000**
Engineering/Construction Admin (12%)	$3,268,800
Legal/Admin (1%)	$272,000
Total Estimated Project Cost:	**$30,780,000**

An optional 8,000 square foot garage could be added to either water treatment plant alternative for a project cost of approximately $1.64 million.

13 Life Cycle Cost Opinions

Life cycle costs represent the total cost of owning the treatment plants for 50 years and include capital cost, equipment replacement, labor, gas, chemicals, insurance, electricity, and annual equipment repair. Detailed life cycle cost tables are included in Appendix K.

The life cycle costs presented in Table 19 and Table 20 assume a 20-year financing period on the capital costs with 2% interest rates and 2.75% inflation.

Operating the water treatment plant is not anticipated to require additional Staff. While Staff will need to visit the plant on a daily basis to operate and maintain it, this time will generally be offset by the time Staff currently spends operating and maintaining the six municipal wells and three pump houses within The COR.

Table 19 – 50-Year Life Cycle Cost Summary
Gravity Filter Water Treatment Plant

Item	50-Year Life Cycle Cost	Annual Cost
Capital Project Costs	$32,400,000	$1,981,478
Equipment Replacement	$9,694,858	$308,522
Labor	$6,488,398	$110,000
Gas	$1,179,709	$20,000
Chemicals	$6,488,398	$110,000
Insurance	$1,769,563	$30,000
Electricity	$6,783,325	$115,000
Equipment Repair	$7,078,253	$120,000
Total 50 Year Life Cycle Cost	**$71,880,000**	

Table 20 – 50-Year Life Cycle Cost Summary
Pressure Filter Water Treatment Plant

Item	50-Year Life Cycle Cost	Annual Cost
Capital Project Costs	$30,780,000	$1,882,404
Equipment Replacement	$13,985,687	$445,069
Labor	$6,488,398	$110,000
Gas	$1,179,709	$20,000
Chemicals	$6,488,398	$110,000
Insurance	$589,854	$10,000
Electricity	$6,193,471	$105,000
Equipment Repair	$9,732,597	$165,000
Total 50 Year Life Cycle Cost	**$75,440,000**	

14 Alternative Evaluation & Recommendation

The two options for removing manganese from Ramsey's drinking water that have been evaluated include gravity filters and pressure filters.

The capital cost of the pressure filter treatment plant is slightly less than the gravity filter treatment plant ($30.8 million versus $32.4 million). However, the life cycle cost of the pressure filter treatment plant is more than the gravity filter treatment plant ($75.4 million versus $71.9 million). The pressure filter treatment plant has a higher life cycle cost due to the expense of painting and maintaining the steel filters; whereas concrete gravity filters require very little maintenance.

In addition to having lower life cycle costs, gravity filters have other advantages over pressure filters including:

- Gravity filters provide for more treatment options including aeration and detention without requiring another pumping step. If regulations change or the water becomes contaminated, additional treatment steps can more easily be added to gravity filters.
- Water from the gravity filters does not go immediately into the distribution system. If problems with the filters occur or if sodium permanganate is overfed (causing pink water), operators have time to react and correct the problem.
- Gravity filters are open to view and access. This enhances the observation, operation and maintenance of the filter functions and components.
- Gravity filtration systems have a greater amount of flexibility with less disruption during normal maintenance procedures.
- Gravity filters could potentially be converted from groundwater to surface water in the future if it became necessary.

A gravity filter treatment plant is the recommended alternative due to the advantages it offers at a comparable construction cost and reduced life-cycle cost.

15 Funding

Water treatment plant projects are commonly funded using general obligation bonds or loans and paid for using water rates. The following sections describe a low interest loan program and example grants opportunities. Another option would be to request bonding through the State.

15.1 Drinking Water Revolving Fund Loan

The Minnesota Drinking Water Revolving Fund (DWRF) loan program provides low interest loans to communities that qualify. DWRF loans typically have interest rates that are lower than other loans or bonds available to communities.

To qualify for a drinking water revolving fund loan, a proposal is written to place the project on the Project Priority List (PPL). The PPL ranks projects by factors including the type of project, a community's financial need, and primary contaminant exceedances. Once a City has a project on the PPL and intends to proceed with construction, the project is placed on the Intended Use Plan (IUP). Projects on the IUP are funded based upon their ranking. Not all projects on the IUP are funded.

Based upon Ramsey's financial status discussed in Section 16, the DWRF program may not be desirable based upon the fact that the City could likely receive a lower interest rate on its own, and due to the administrative requirements and loan restrictions.

15.2 Grants

Grants are available for some water projects but are most commonly given to communities that have a financial hardship. The City of Ramsey would likely not qualify.

One potential grant program that is not tied to financial need is the Clean Water Fund Grant administered through the Minnesota Board of Water and Soil Resources. Clean Water funds may only be spent to protect, enhance, and restore water quality in lakes, rivers, and streams and to protect groundwater from degradation. A total of $2,158,000 in grants was awarded in FY2020 for 10 projects related to source water protection. All of the recipient organizations were counties, watershed districts, or conservation districts.

A smaller grant opportunity through the Clean Water Fund is a Source Water Protection grant that is administered through the Minnesota Department of Health. A Source Water Protection Grant is typically tied to a goal in a Community's Wellhead Protection Plan. A Source Water Protection Grant has a maximum value of $10,000.

16 Effect on Water Rates

The City of Ramsey currently has a minimum quarterly water rate of $42.15. This rate covers the first 15,000 gallons of water used per quarter. After the first 15,000, the cost per 1,000 of water used gets progressively more expensive. This is referred to as a conservation water rate because it discourages the use of more water.

According to the Ramsey Finance Director, the City of Ramsey has approximately $25 million set aside for a water treatment plant project, which was collected from Municipal water users for this specific purpose. The City of Ramsey currently raises its water rates 2.5% per year. If the City were to bond for the remainder of the water treatment plant project costs, the City would need to explore water rate impacts. For instance, if water rates were raised at a rate of 5% per year for 4 years, the resulting minimum quarterly rate in 2025 would be $51.23. This could also pay for additional operation and maintenance costs.

17 Public Involvement

Having informed and engaged residents is important to the success of a major municipal project. To engage residents, the following public involvement activities are recommended:

- Publish information describing the water issues and proposed water treatment plant project on the City's website in March 2020, and in the March-April edition of the Ramsey Resident.
- Send information mailers to residents in March 2020 describing the water issues and proposed water treatment plant project. Consider including discussion about municipal scale water softening, the respective costs to the public, and the fact that many people already own in-home water softeners.

18 Schedule

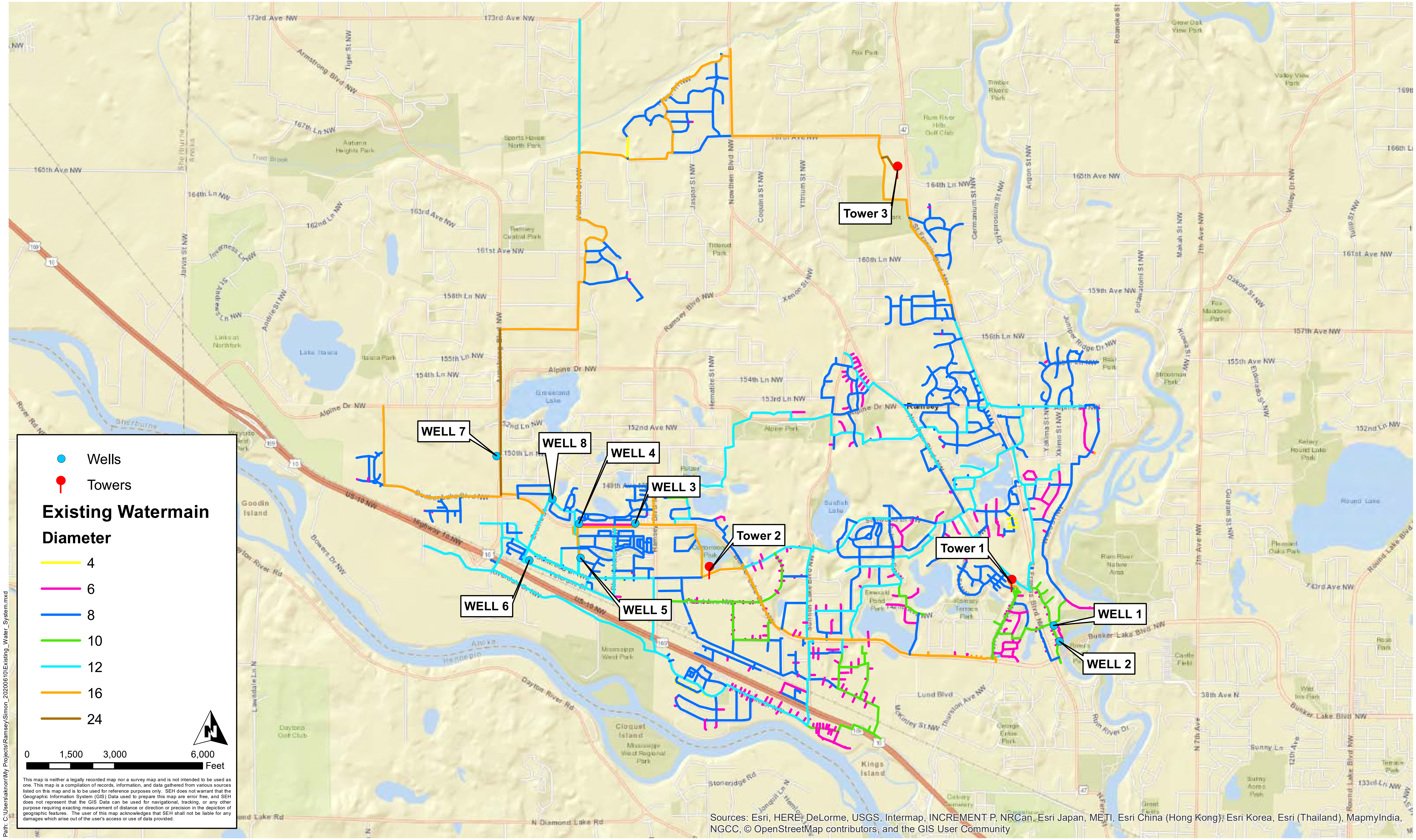
If the City elects to proceed with a water treatment plant project, the proposed project schedule could be as follows:

Item	Completion Date
Public Involvement	March 2021 – April 2021
Preparation of Plans	May 2021 – September 2021
Ad for Bid	October 2021
Bid Opening	November 2021
Construction Start	December 2021
Construction Complete	June 2023

However, Anoka County is planning “interim” improvements to Bunker Lake Boulevard between Armstrong Boulevard and Sunfish Lake Boulevard in 2021 to improve operations and safety in anticipation of traffic volumes doubling while planned improvements to Highway 10 are constructed between 2022 and 2025. Therefore, to construct the raw and finished watermain associated with the water treatment plant project as cost-effectively as possible, plans and specifications for the raw and finished watermain improvements are recommended to be prepared and bid in conjunction with Anoka County’s proposed improvements to Bunker Lake Boulevard.

Appendix A

Existing Water System Map



Project Number: RAMSY 154354
Print Date: Print Date: 3/4/2021

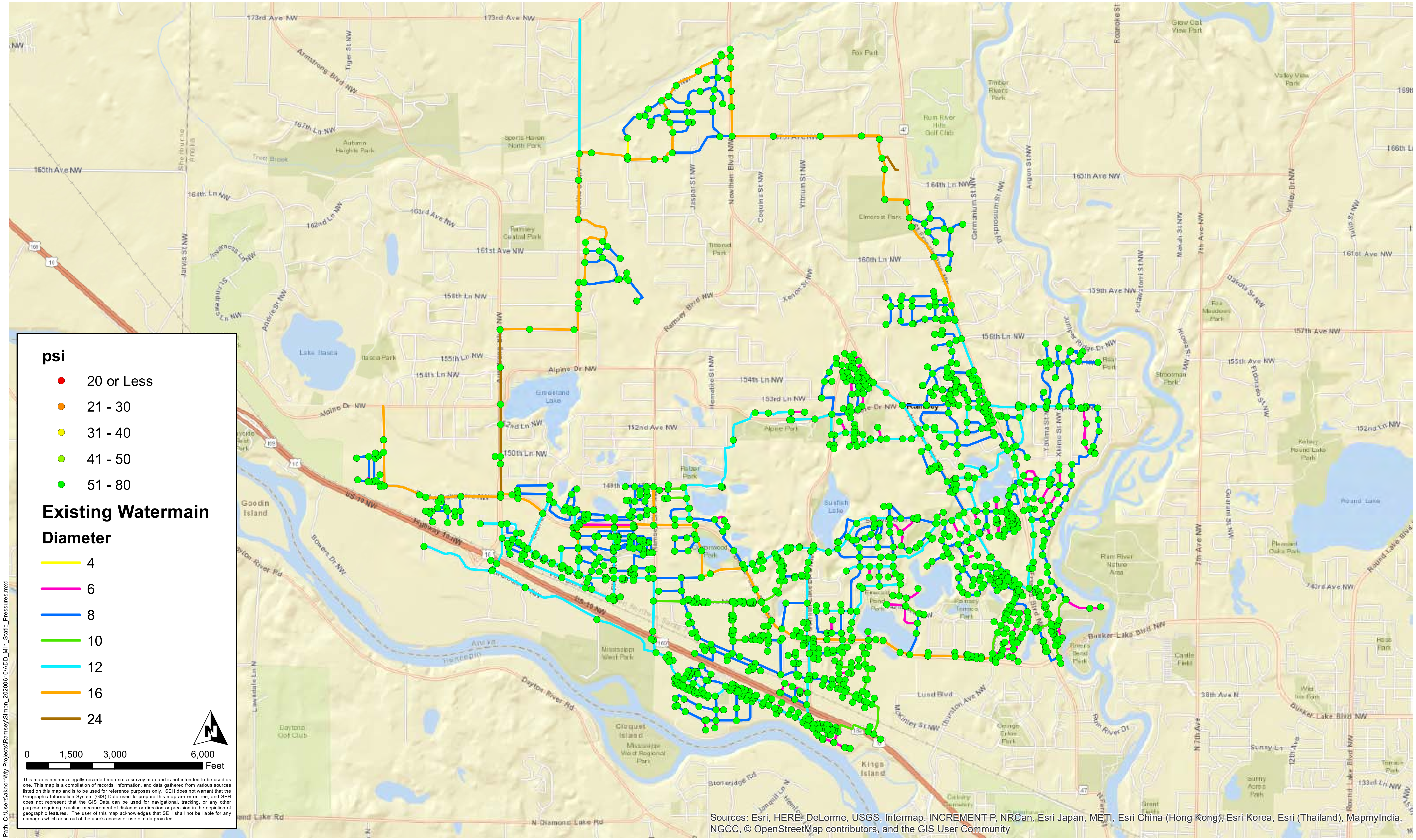
SEH

EXISTING WATER SYSTEM
Ramsey, Minnesota

FIGURE 1
Existing Water System

Appendix B

Modeling

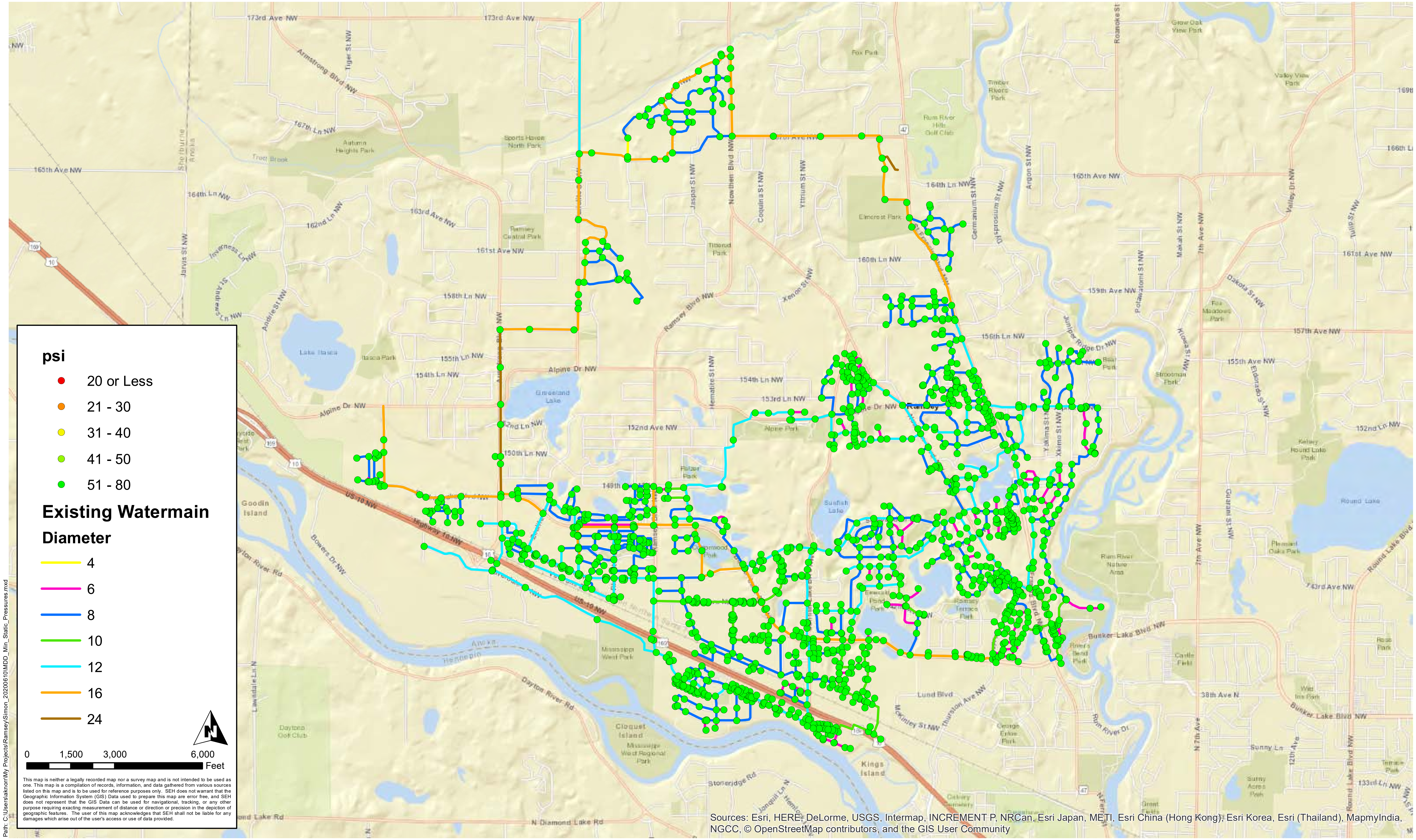


Path: C:\Users\aknorr\My Projects\Ramsey\Simon_20200610\ADD_Min_Static_Pressures.mxd

Project Number: RAMSY 154354
Print Date: Print Date: 3/4/2021

EXISTING ADD STATIC PRESSURE
Ramsey, Minnesota

FIGURE 1
Minimum Pressures



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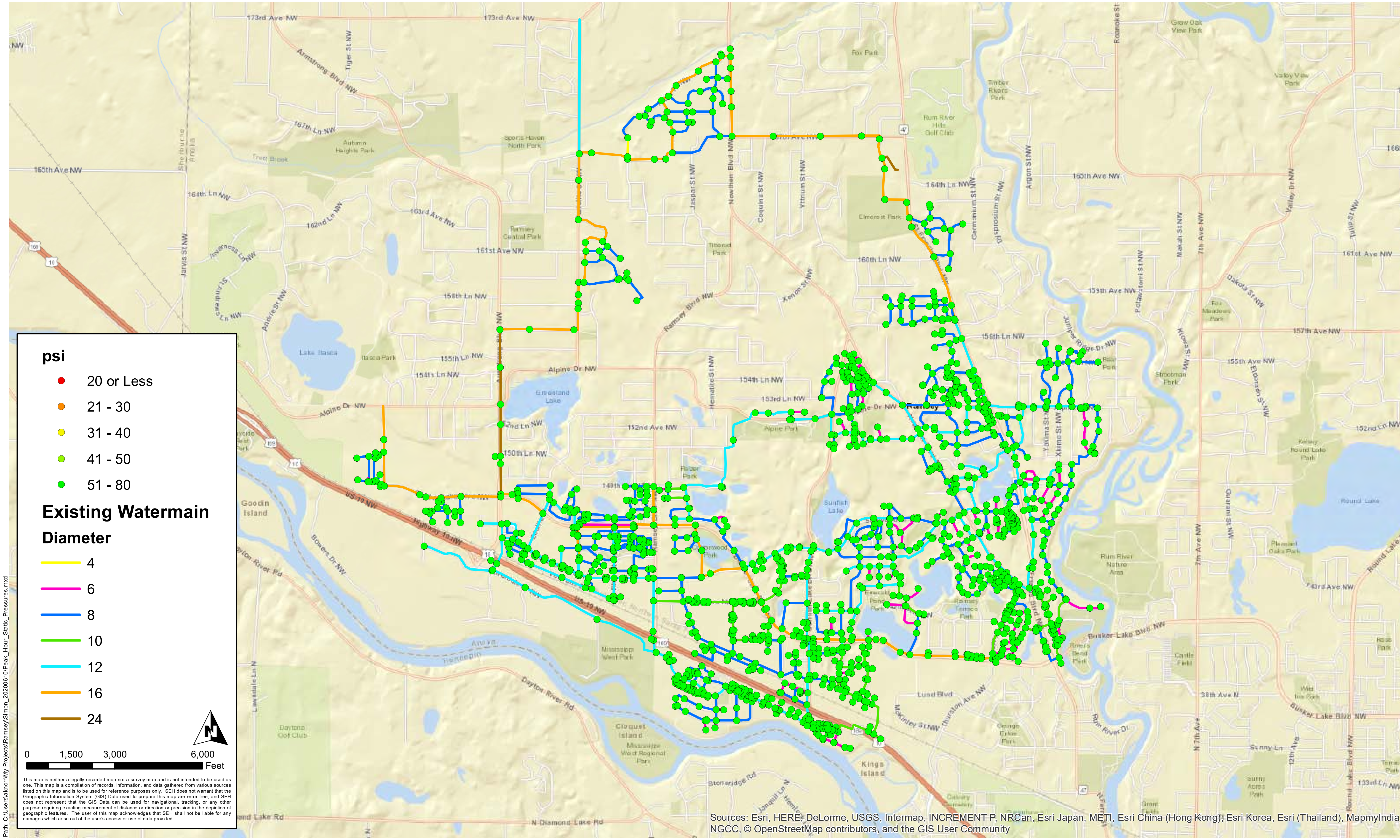
Project Number: RAMSY 154354
Print Date: Print Date: 3/4/2021

EXISTING MDD STATIC PRESSURE
Ramsey, Minnesota

FIGURE 2
Minimum Pressures



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Print Date: Print Date: 3/4/2021

EXISTING PEAK HOUR STATIC PRESSURE
Ramsey, Minnesota

FIGURE 3
Minimum Pressures

FIGURE 4

Existing System ADD 24-Hour Simulation

Well and Tower Operation

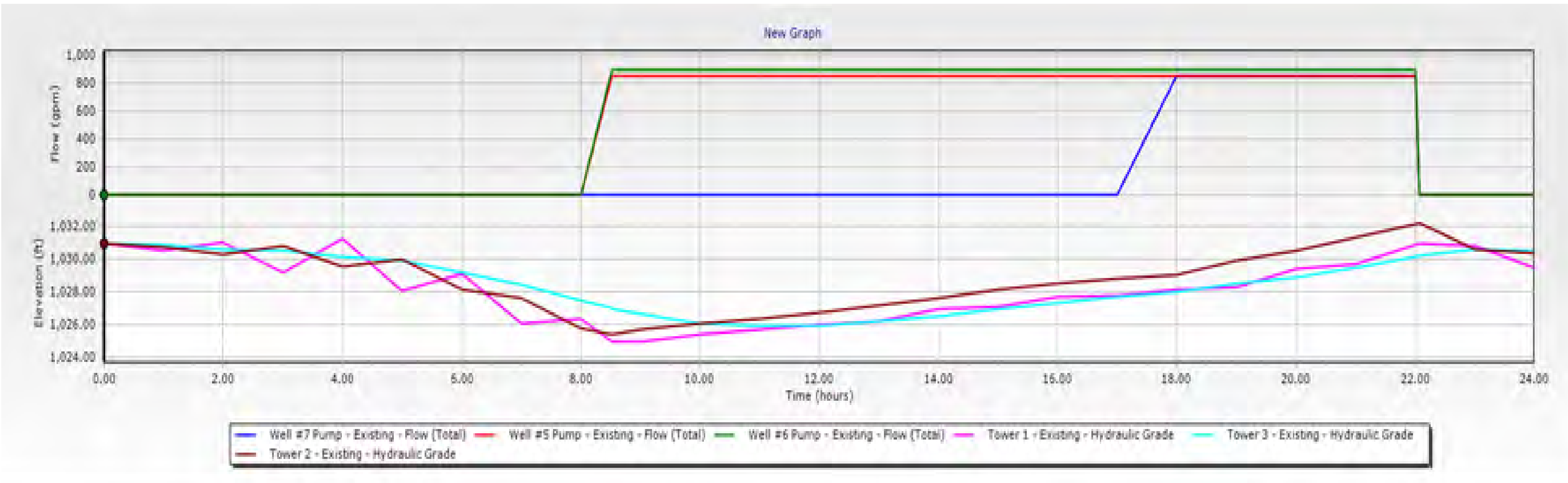
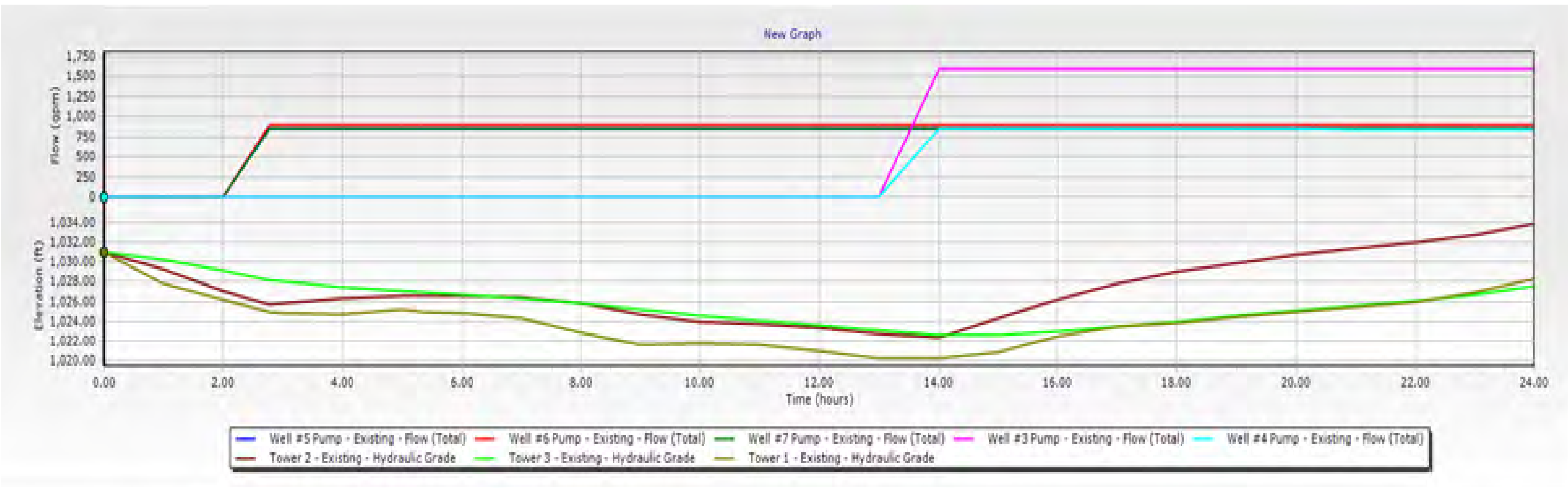
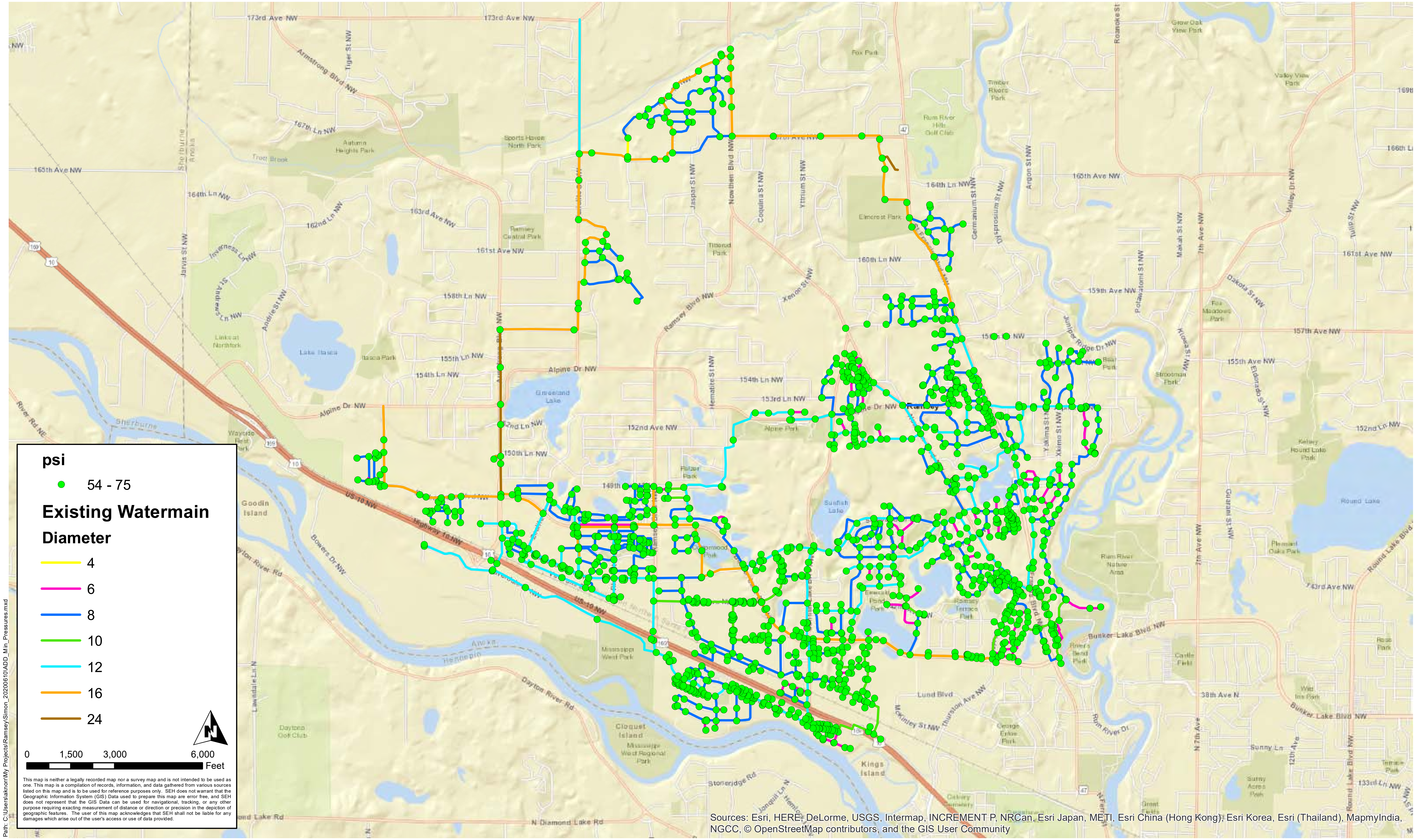


FIGURE 5

Existing System MDD 24-Hour Simulation

Well and Tower Operation





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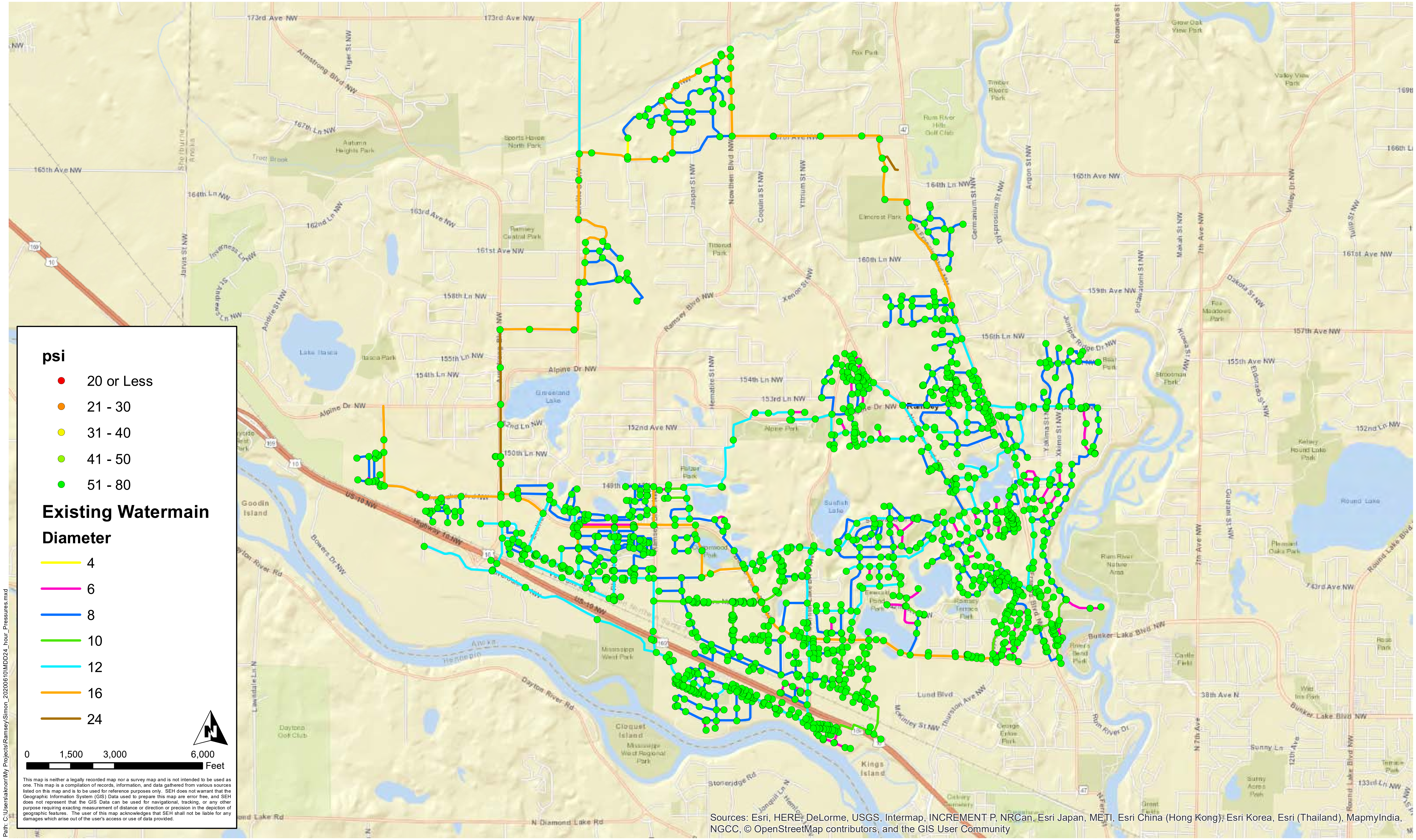
Project Number: RAMSY 154354
Print Date: Print Date: 3/4/2021

EXISTING ADD 24 HOUR EPS MINIMUM PRESSURES
Ramsey, Minnesota

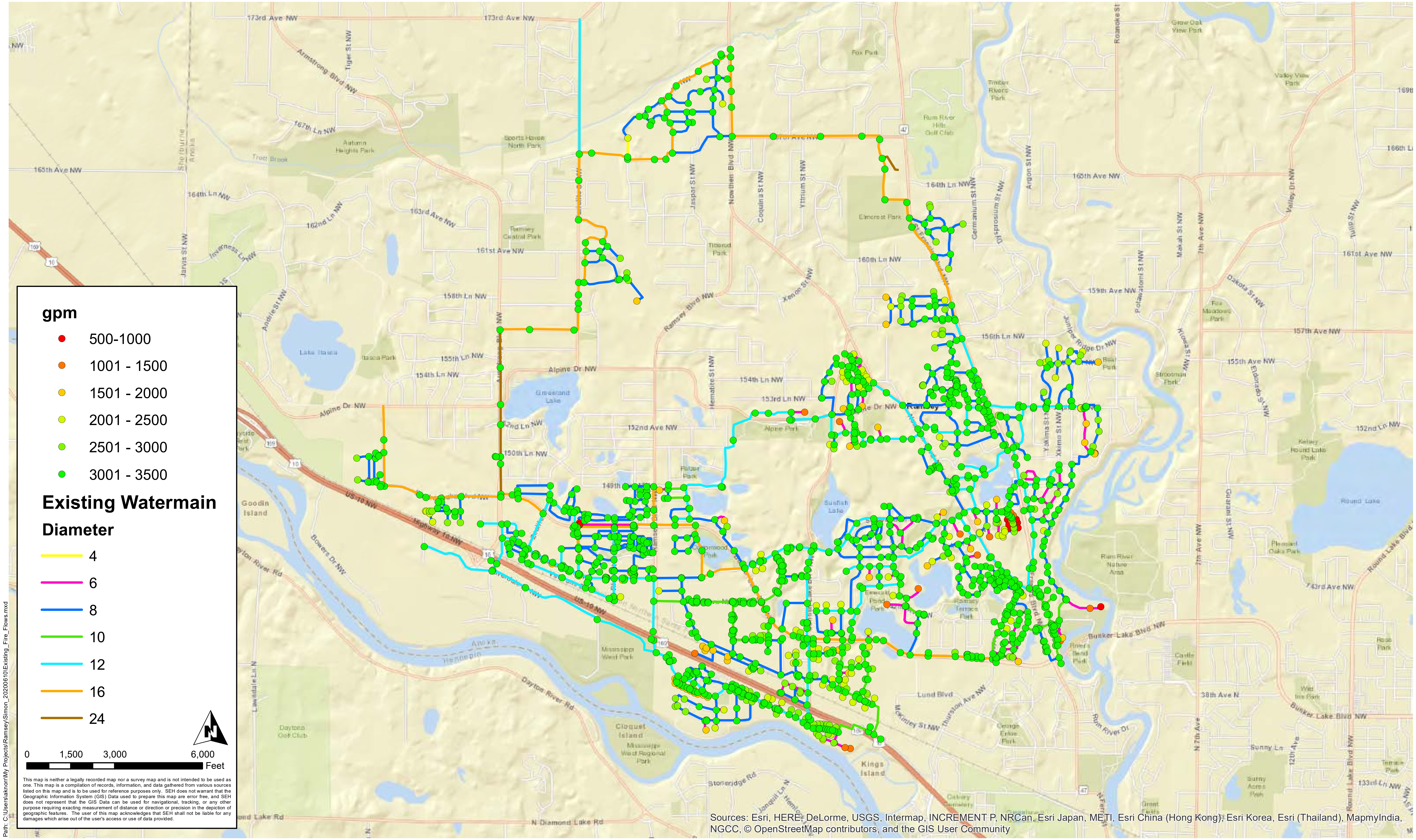
FIGURE 6
Minimum Pressures



Project Number: RAMSY 154354
Print Date: Print Date: 3/4/2021

EXISTING MDD 24 HOUR EPS MINIMUM PRESSURES
Ramsey, Minnesota

FIGURE 7
Minimum Pressures



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Project Number: RAMSY 154354
Print Date: Print Date: 3/4/2021

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EXISTING AVAILABLE FIRE FLOWS
Ramsey, Minnesota

FIGURE 8
Available Fire Flows

FIGURE 9

Existing System with Treatment Plant ADD 24-Hour Simulation

High Service Pump and Tower Operation

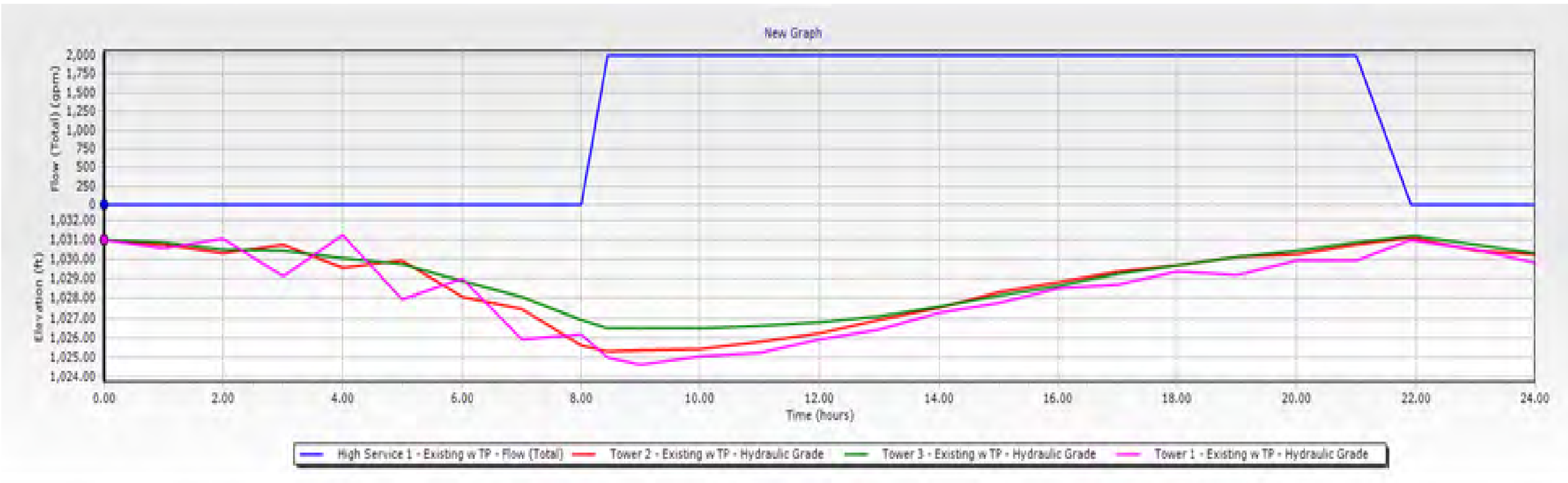
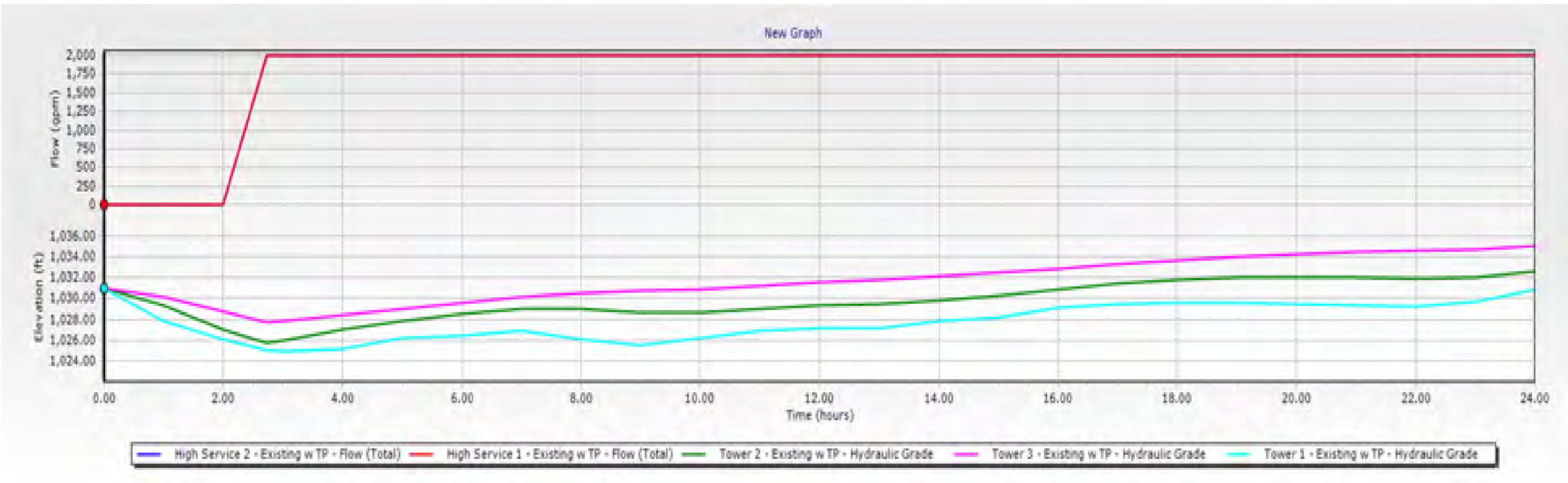
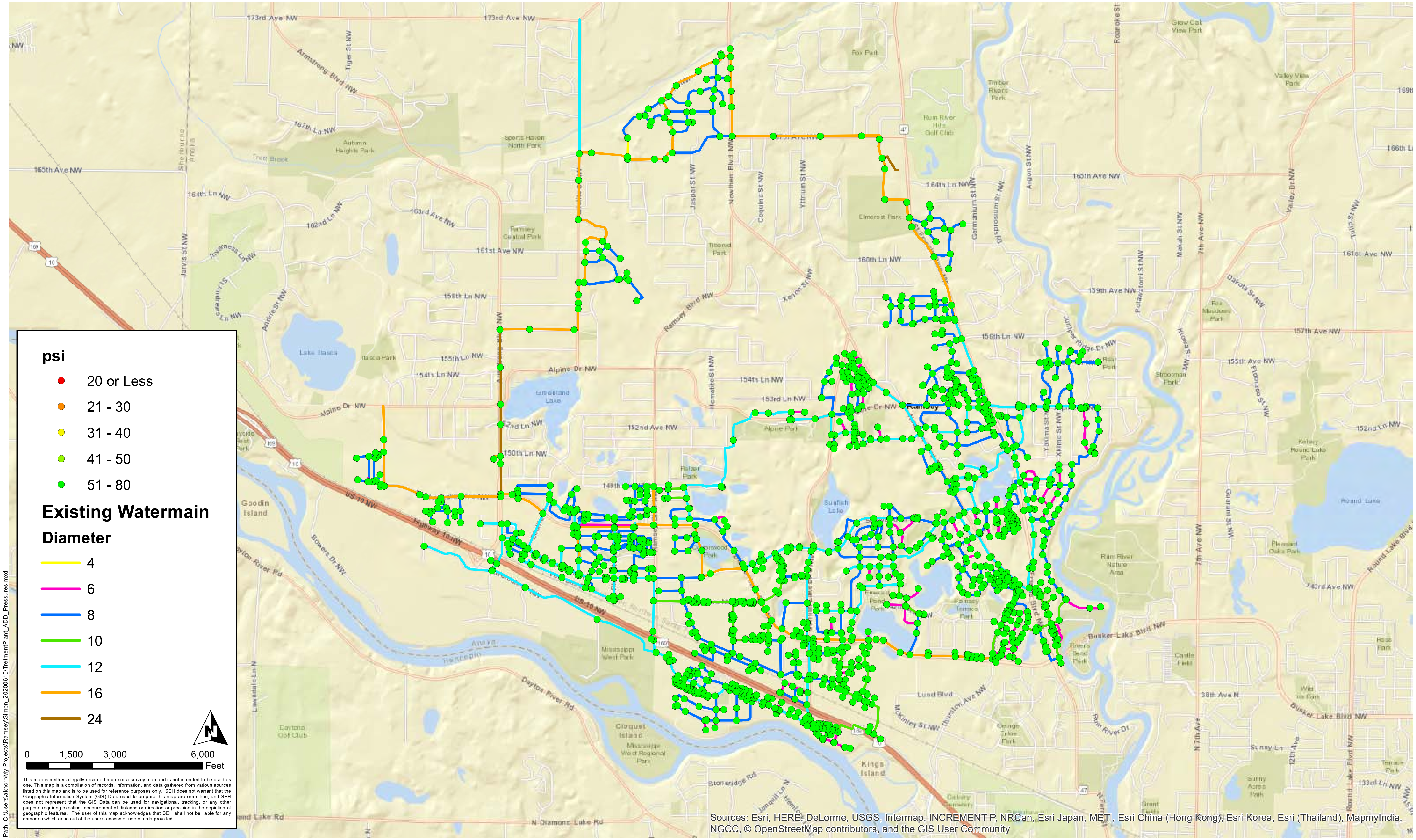


FIGURE 10

Existing System with Treatment Plan MDD 24-Hour Simulation

High Service Pump and Tower Operation





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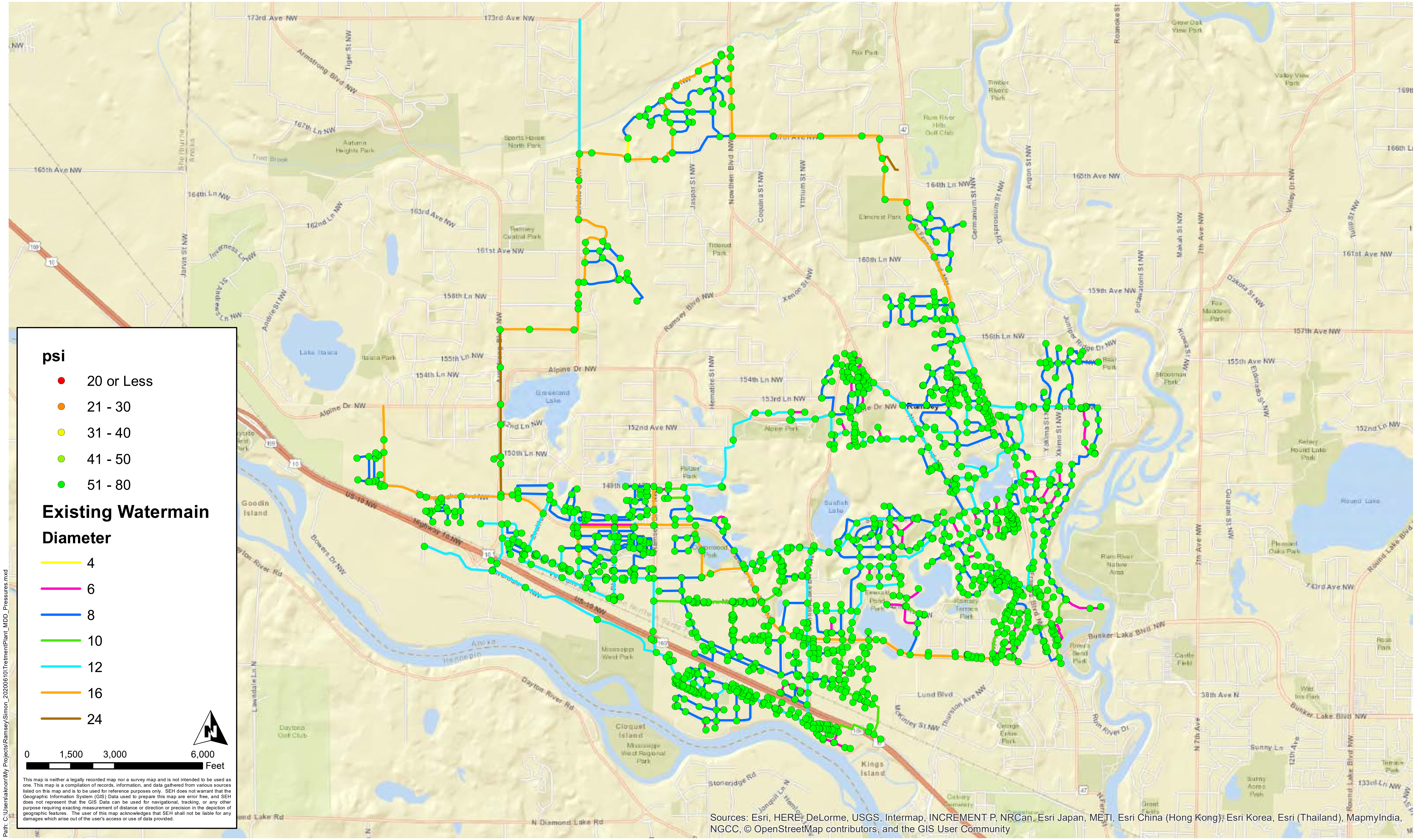
Project Number: RAMSY 154354
Print Date: Print Date: 3/4/2021

TREATMENT PLANT WITH EXISTING ADD 24 HOUR EPS MINIMUM PRESSURES
Ramsey, Minnesota

FIGURE 11
Minimum Pressures



Project Number: RAMSY 154354
Print Date: Print Date: 3/4/2021

TREATMENT PLANT WITH EXISTING MDD 24 HOUR EPS MINIMUM PRESSURES
Ramsey, Minnesota

FIGURE 12
Minimum Pressures

FIGURE 13

2040 System ADD 24-Hour Simulation

High Service Pump and Tower Operation

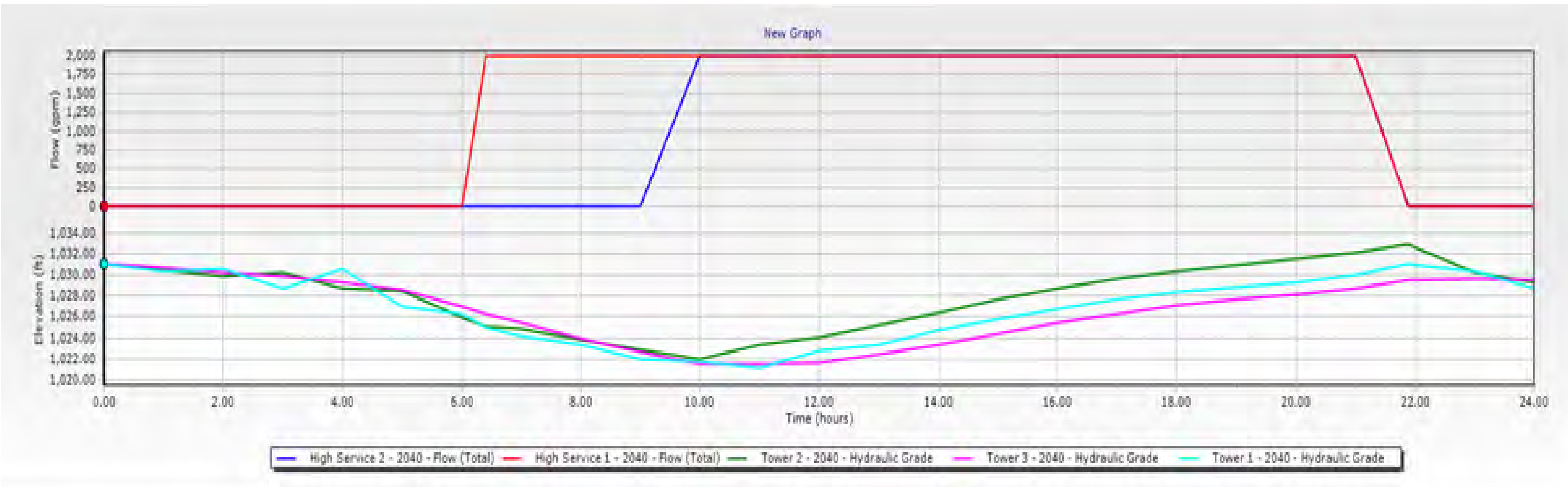
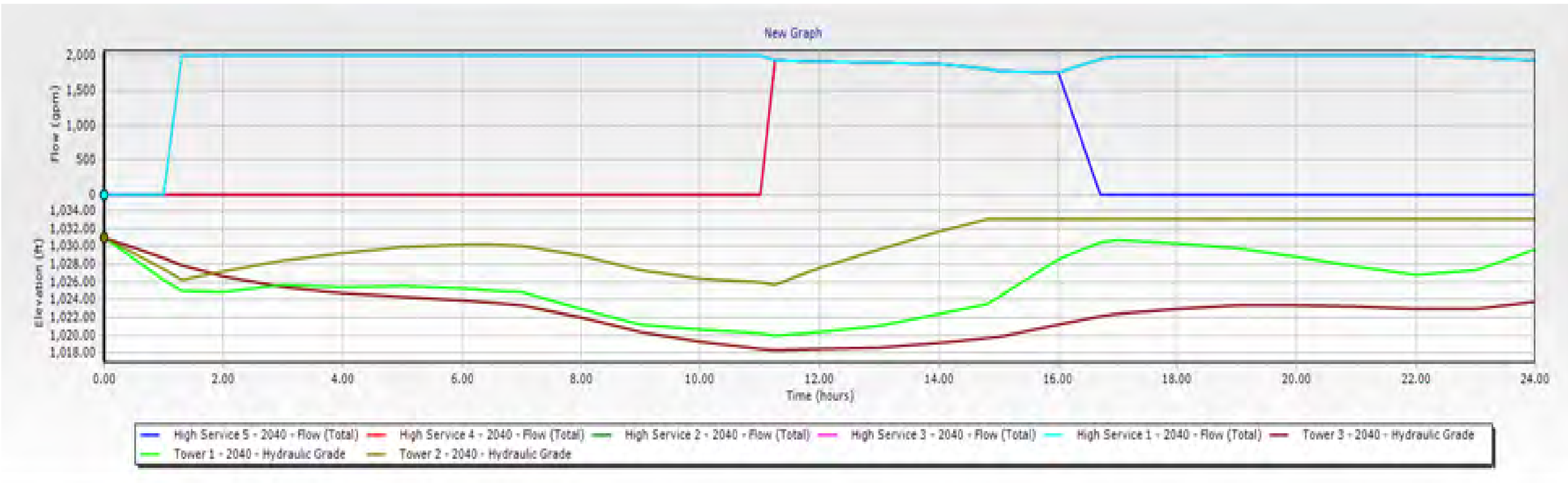
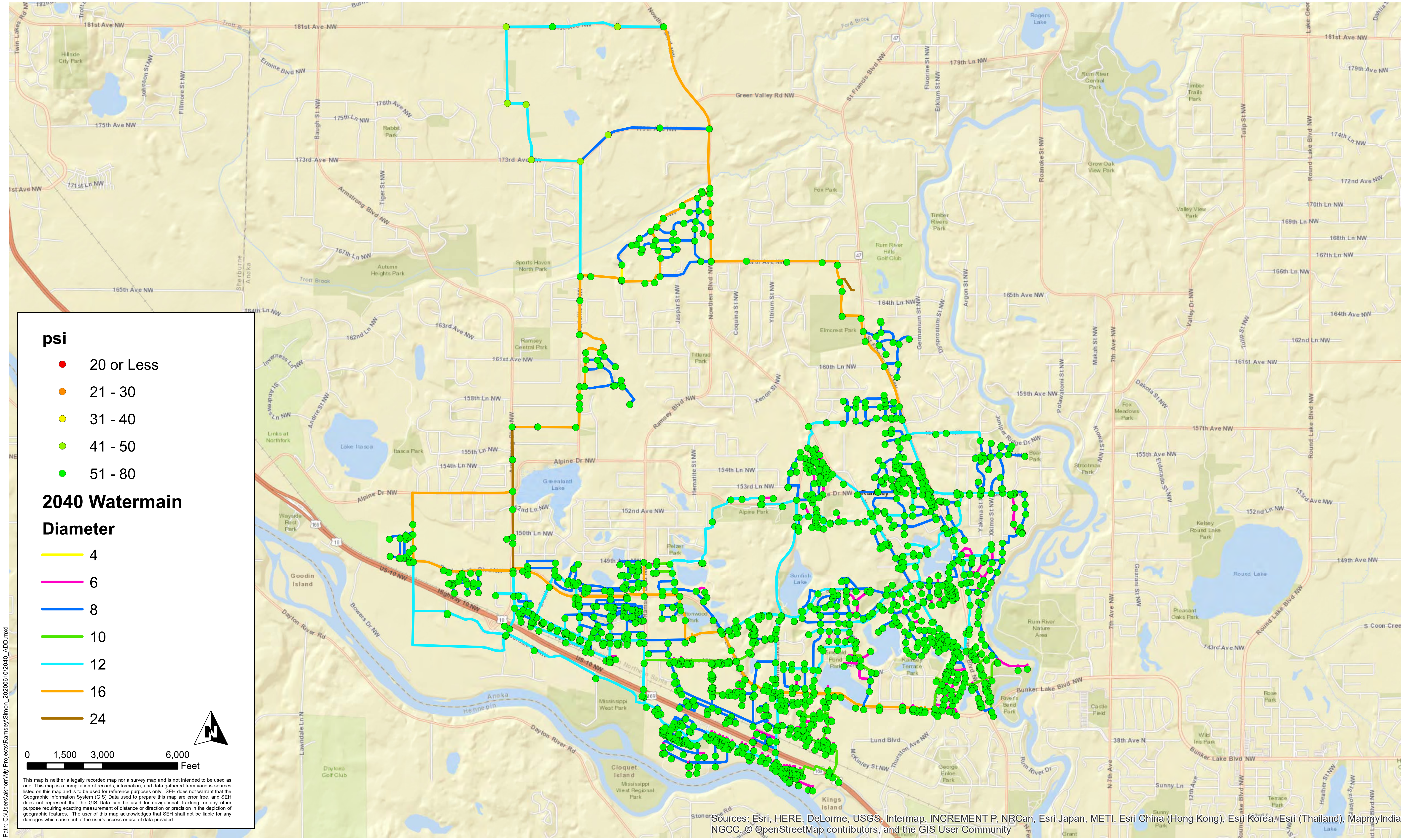


FIGURE 14

2040 System MDD 24-Hour Simulation

High Service Pump and Tower Operation





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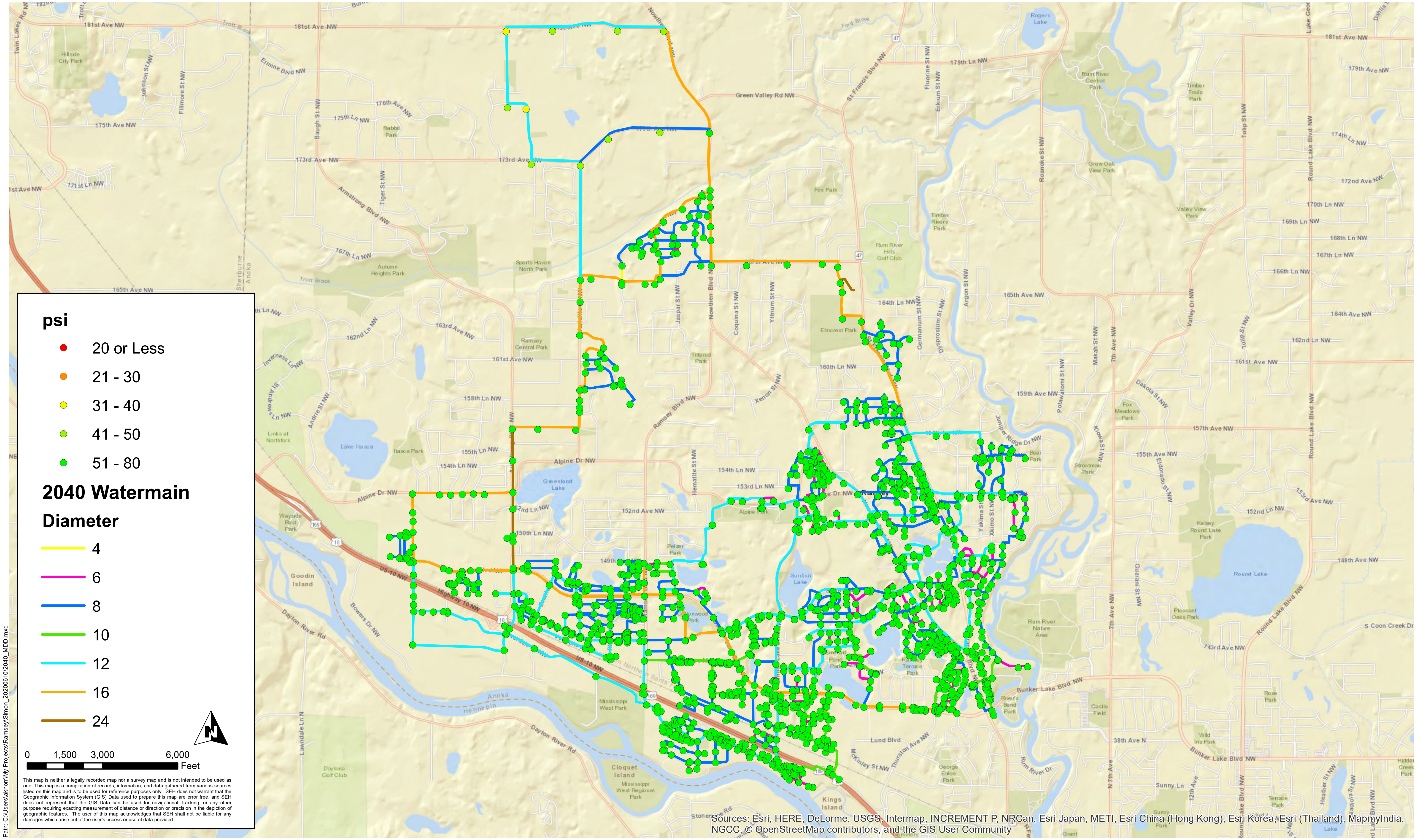
Project Number: RAMSY 154354
Print Date: Print Date: 6/15/2020

2040 ADD 24 HOUR EPS MINIMUM PRESSURES
Ramsey, Minnesota

FIGURE 15
Minimum Pressures



Path: C:\Users\aknorr\My Projects\Ramsey\Simon_20200610\2040_MDD.mxd

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Project Number: RAMSY 154354
Print Date: Print Date: 6/15/2020

2040 MDD 24 HOUR EPS MINIMUM PRESSURES
Ramsey, Minnesota

FIGURE 16
Minimum Pressures

Appendix C

CCL

CCL 4

Contaminant	Contaminant Type
Adenovirus	Virus
Caliciviruses	Virus (includes Norovirus)
Campylobacter jejuni	Bacteria
Enterovirus	Viruses including polioviruses, coxsackieviruses and echoviruses
Escherichia coli (0157)	Bacteria
Helicobacter pylori	Bacteria
Hepatitis A virus	Virus
Legionella pneumophila	Bacteria
Mycobacterium avium	Bacteria
Naegleria fowleri	Protozoan
Salmonella enterica	Bacteria
Shigella sonnei	Bacteria
1,1-Dichloroethane	It is an industrial solvent and an intermediate in the synthesis of other compounds.
1,1,1,2-Tetrachloroethane	It is an industrial solvent and used in the synthesis of other chlorinated compounds.
1,2,3-Trichloropropane	It is an industrial solvent, cleaning and degreasing agent as well as an intermediate in the synthesis of the other
1,3-Butadiene	It is used in the production of rubber and plastics.
1,4-Dioxane	It is used as a solvent for cellulose formulations, resins, oils, waxes and other organic substances. It is also used in wood pulping, textile processing, degreasing, in lacquers, paints, varnishes, and stains; and in paint and varnish removers.
17alpha-estradiol	It is an estrogenic hormone found in some pharmaceuticals.
1-Butanol	It is a solvent and used in production of other chemicals. compounds. It is present in a number of commercial products such as perfumes.
2-Methoxyethanol	It is used in a number of consumer products, such as synthetic cosmetics, perfumes, fragrances, hair preparations, and skin lotions.
2-Propen-1-ol	It is used in the production of other chemicals.
3-Hydroxycarbofuran	It is a pesticide degradate, the parent, carbofuran, is used as an insecticide.
4,4'-Methylenedianiline	It is used in the production of polyurethanes foams, glues, rubber and spandex fiber.
Acephate	It is an insecticide.
Acetaldehyde	It is a disinfection byproduct from ozonation; it is used in the production of other chemicals.
Acetamide	It is used as a solvent and plasticizer.
Acetochlor	It is an herbicide for weed control on agricultural crops.
Acetochlor ethanesulfonic acid (ESA)	Acetochlor ESA is an environmental degradate of acetochlor.
Acetochlor oxanilic acid (OA)	Acetochlor OA is an environmental degradate of acetochlor.

Acrolein	It is used as an aquatic herbicide, rodenticide and industrial chemical.
Alachlor ethanesulfonic acid (ESA)	Alachlor ESA is an environmental degradate of the pesticide alachlor (an herbicide for weed control on agricultural crops).
Alachlor oxanilic acid (OA)	Alachlor OA is an environmental degradate of alachlor.
alpha-Hexachlorocyclohexane	It is a component of benzene hexachloride (BHC) and was formerly used as an insecticide.
Aniline	It is used as an industrial chemical, as a solvent, in the synthesis of explosives, rubber products and in isocyanates.
Bensulide	It is an herbicide.
Benzyl chloride	It is used in the production of other substances, such as plastics, dyes, lubricants, gasoline and pharmaceuticals.
Butylated hydroxyanisole	It is used as a food additive (antioxidant).
Captan	It is a fungicide.
Chlorate	Chlorate compounds are used in agriculture as defoliants or desiccants and may occur in drinking water because of use of disinfectants such as chlorine dioxide and hypochlorites.
Chloromethane (Methyl chloride)	It is used as a foaming agent and in the production of other substances.
Clethodim	It is an herbicide.
Cobalt	It is a naturally-occurring element and was formerly used as cobaltous chloride in medicines and as a germicide. It is a part of the vitamin B12 molecule
Cumene hydroperoxide	It is used as a catalyst is used in the production of other substances.
Cyanotoxins	Toxins naturally produced and released by cyanobacteria ("blue-green algae"). The group of cyanotoxins includes, but is not limited to: anatoxin-a, cylindrospermopsin, microcystins, and saxitoxin.
Dicrotophos	It is an insecticide.
Dimethipin	It is an herbicide and plant growth regulator.
Diuron	It is an herbicide.
Equilenin	It is an estrogenic hormone used in hormone replacement therapy.
Equilin	It is an estrogenic hormone and is used in hormone replacement therapy.
Erythromycin	It is used an antibiotic.
Estradiol (17-beta estradiol)	It is an isomer of estradiol found in some pharmaceuticals.
Estriol	It is a weak estrogenic hormone used in veterinary pharmaceuticals.
Estrone	It is a precursor of estradiol used in veterinary and human pharmaceuticals.
Ethinyl estradiol (17-alpha ethynyl estradiol)	It is an estrogenic hormone and is used in veterinary and human oral contraceptives.
Ethoprop	It is an insecticide.
Ethylene glycol	It is used as antifreeze, in textile manufacturing and is a cancelled pesticide.

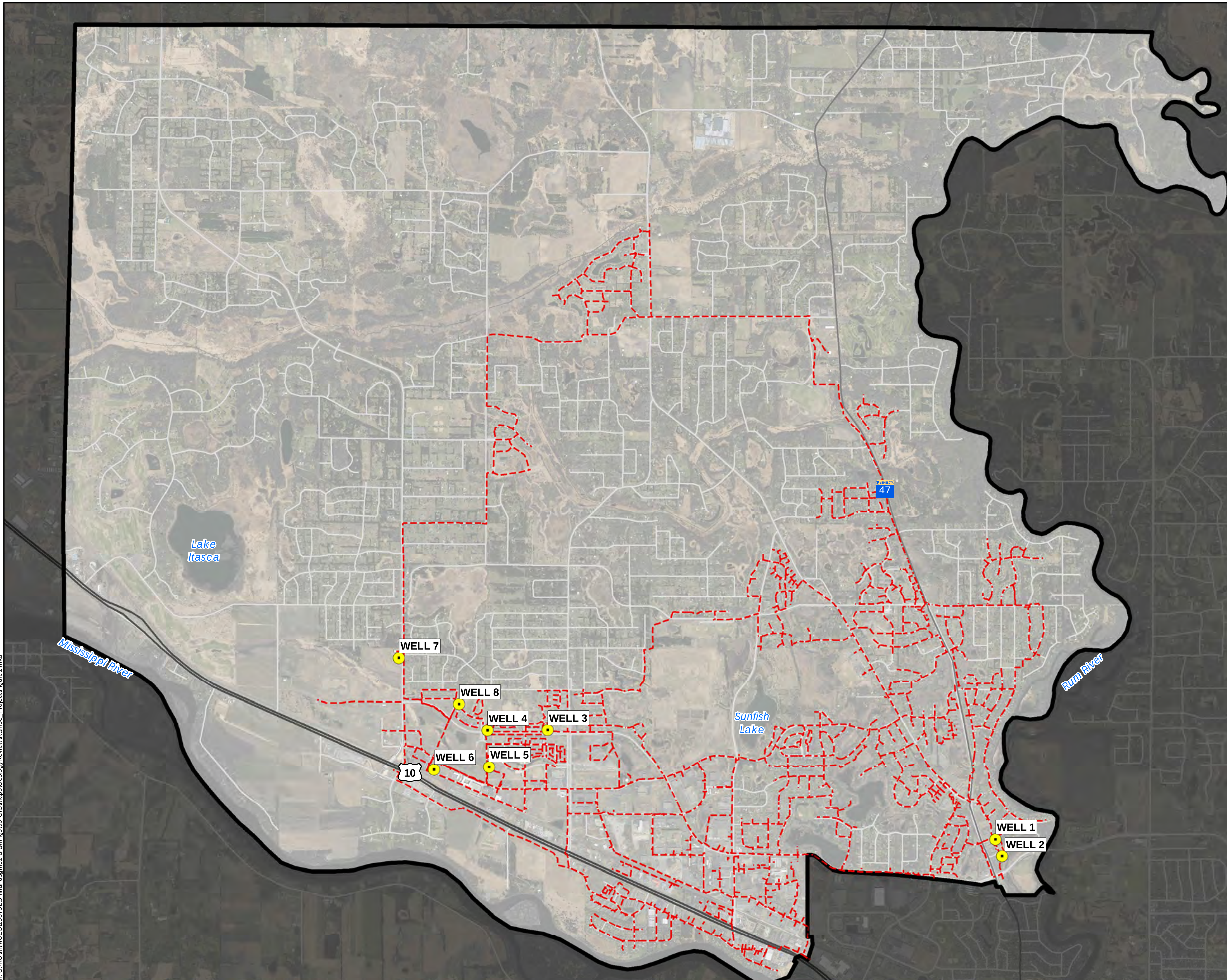
Ethylene oxide	It is a fungicidal and insecticidal fumigant.
Ethylene thiourea	It is used in the production of other substances, such as for vulcanizing polychloroprene (neoprene) and polyacrylate rubbers and is a metabolite of some fungicides.
Formaldehyde	It is an ozoneation disinfection byproduct, can occur naturally and has been used as a fungicide.
Germanium	It is a naturally-occurring element and is commonly found as germanium dioxide in phosphors, transistors and diodes, and in electroplating. In some cases it has been sold as a dietary supplement.
HCFC-22	It is used as a refrigerant, as a low-temperature solvent, and in fluorocarbon resins, especially in tetrafluoroethylene polymers.
Halon 1011 (bromochloromethane)	It is used as a fire-extinguishing fluid and to suppress explosions, as well as a solvent in the manufacturing of some pesticides. May also occur as a disinfection by-product in drinking water.
Hexane	It is a component of gasoline and used as a solvent.
Hydrazine	It is used as an ingredient in the production of other substances, such as rocket propellants. It is also used in the production of plastics.
Manganese	It is a naturally-occurring element used in a variety of applications including use in steel production to improve hardness, stiffness and strength. It is an essential nutrient found in vitamin/mineral supplement and in fortified foods.
Mestranol	It is a precursor to ethinylestradiol used in veterinary and human pharmaceuticals.
Methamidophos	It is an insecticide.
Methanol	It is used as an industrial solvent, a gasoline additive and as an anti-freeze ingredient.
Methyl bromide (bromomethane)	It has been used as a fumigant and fungicide.
Methyl tert-butyl ether (MTBE)	It is used as an octane booster in gasoline, in the manufacturing of isobutene and as an extraction solvent.
Metolachlor	It is an herbicide for weed control on agricultural crops.
Metolachlor ethanesulfonic acid (ESA)	Metolachlor ESA is an environmental degradate of metolachlor.
Metolachlor oxanilic acid (OA)	Metolachlor OA is an environmental degradate of
Molybdenum	It is a naturally-occurring element and is commonly found as molybdenum trioxide. It is used as a steel alloy. It is an essential dietary nutrient found in foods and nutritional supplements.
Nitrobenzene	It is used in the production of aniline, and also as a solvent in the manufacturing of paints, shoe polishes, floor polishes, metal polishes, explosives, dyes, pesticides and drugs (such as acetaminophen).,

Nitroglycerin	It is used in the production of explosives, and in rocket propellants. It is also a pharmaceutical for the treatment of angina.
N-Methyl-2-pyrrolidone	It is a solvent in the chemical industry, and is used in the formulation of pharmaceuticals for oral and dermal delivery.
N-nitrosodiethylamine (NDEA)	It is a nitrosamine used as an additive in gasoline and in lubricants, as an antioxidant and as a stabilizer in plastics. It is formed in cured foods and during high temperature cooking of meats and fish, and may be a disinfection byproduct.
N-nitrosodimethylamine (NDMA)	It was formerly used in the production of rocket fuels, anti-oxidants and softeners for copolymers. It is formed in cured foods and during high temperature cooking. It may be a leachate from rubber gaskets and fittings and may form as a disinfection byproduct.
N-nitroso-di-n-propylamine (NDPA)	It is formed in cured foods and during high temperature cooking of meats and fish and may be a disinfection byproduct. It is a contaminant in dinitrofluralin herbicides.
N-Nitrosodiphenylamine	It is used in the vulcanization of rubber and as an inhibitor of polymerization in the production of polystyrene. It may be a disinfection byproduct.
N-nitrosopyrrolidine (NPYR)	It is used in rubber production. It is formed in cured foods and during high temperature cooking of meats and fish and may be a disinfection byproduct.
Nonylphenol2	The main use of nonylphenol is in the manufacture of nonylphenol ethoxylates, which have been used in a wide range of industrial applications and consumer products including laundry detergents, cleaners, degreasers, paints and coatings and other uses. Several other CASRNs are associated with nonyphenol due to varying chemical structures including: 104-40-5, 84852-15-3, 91672-41-2, and 139-84-4.
Norethindrone (19-Norethisterone)	Norethindrone is a synthetic hormone used in oral contraceptives and for hormone replacement therapy.
n-Propylbenzene	It is a constituent of asphalt and naptha and used in the manufacture of methyl styrene. It is a solvent for printing and dying of textiles.
o-Toluidine	It is used in the production of dyes, rubber, pharmaceuticals and pesticides.
Oxirane, methyl	It is an industrial chemical used in the production of other substances. It is a registered pesticide.
Oxydemeton-methyl	It is an insecticide.
Oxyfluorfen	It is an herbicide.
Perfluorooctanesulfonic acid (PFOS)	PFOS has been used to make carpets, leathers, textiles, fabrics for furniture, paper packaging, and other materials that are resistant to water, grease, or stains. It is also used in firefighting foams at airfields. Many of these uses have been phased out by its primary U.S. manufacturer; however, there are still some ongoing uses.

Perfluorooctanoic acid (PFOA)	PFOA has been used to make carpets, leathers, textiles, fabrics for furniture, paper packaging, and other materials that are resistant to water, grease, or stains. It is also used in firefighting foams at airfields. Many of these uses are being phased out by U.S. manufacturers; however, there are still some ongoing uses.
Permethrin	It is an insecticide.
Profenofos	It is an insecticide and an acaricide.
Quinoline	It is a component of coal tars and used in the production of other substances, and as a pharmaceutical (anti-malarial).
RDX (Hexahydro-1,3,5-trinitro-1,3,5-triazine)	It is an explosive.
sec-Butylbenzene	It is used as a solvent for coatings in organic synthesis, as a plasticizer and in surfactants.
Tebuconazole	It is a fungicide.
Tebufenozide	It is insecticide.
Tellurium	It is a naturally-occurring element and is commonly used as sodium tellurite in bacteriology and medicine.
Thiodicarb	It is an insecticide.
Thiophanate-methyl	It is a fungicide.
Toluene diisocyanate	It is used in the manufacturing of plastics.
Tribufos	It is an insecticide and used as a cotton defoliant.
Triethylamine	It is used in the production of other substances, as a stabilizer in herbicides and pesticides, in consumer products, in photographic chemicals and in carpet cleaners.
Triphenyltin hydroxide (TPTH)	It is a pesticide.
Urethane	It is a paint and coating ingredient (polyurethanes).
Vanadium	It is a naturally-occurring element. Vanadium pentoxide is a catalyst for the production of other substances catalyst. It is sometimes an ingredient in mineral supplements but is not classified as an essential nutrient
Vinclozolin	It is a fungicide.
Ziram	It is a fungicide.

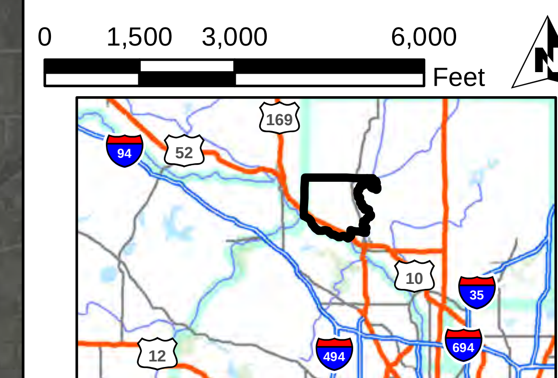
Appendix D

Groundwater Modeling Memo



Legend

- Municipal Well
- Municipal Watermain
- Municipality Boundary



Distribution System

Source Water Analysis
City of Ramsey
Minnesota

SEH

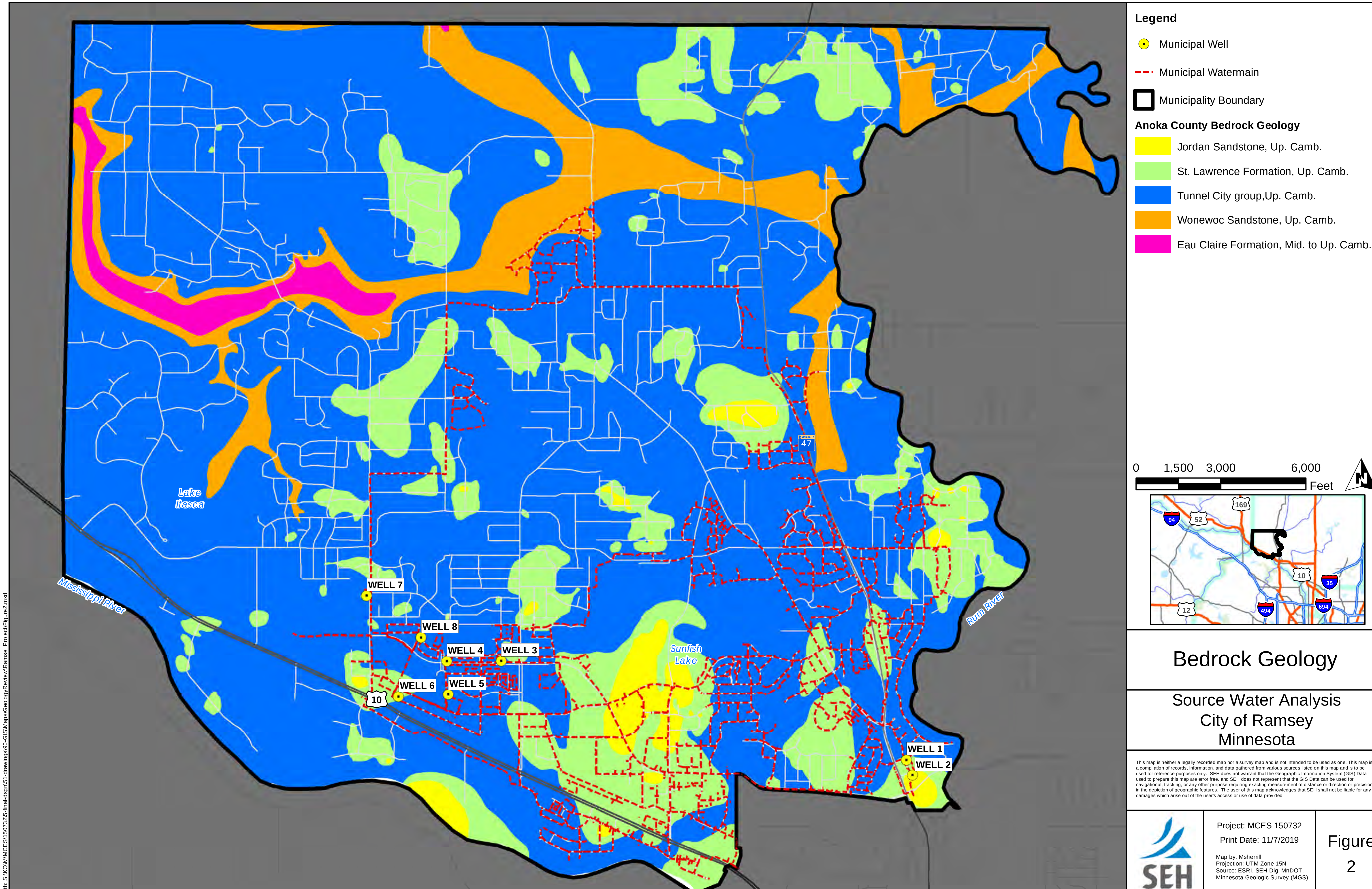
Project: MCES 150732

Print Date: 11/7/2019

Map by: Msherrill
Projection: UTM Zone 15N
Source: ESRI, SEH Digi MnDOT, Minnesota Geologic Survey (MGS)

Figure 1

Path: S:\KO\M\MCES\150732\5-final-dsgn\51-drawings\90-GIS\Maps\GeologyReview\Ramsey_Project\Figure1.mxd



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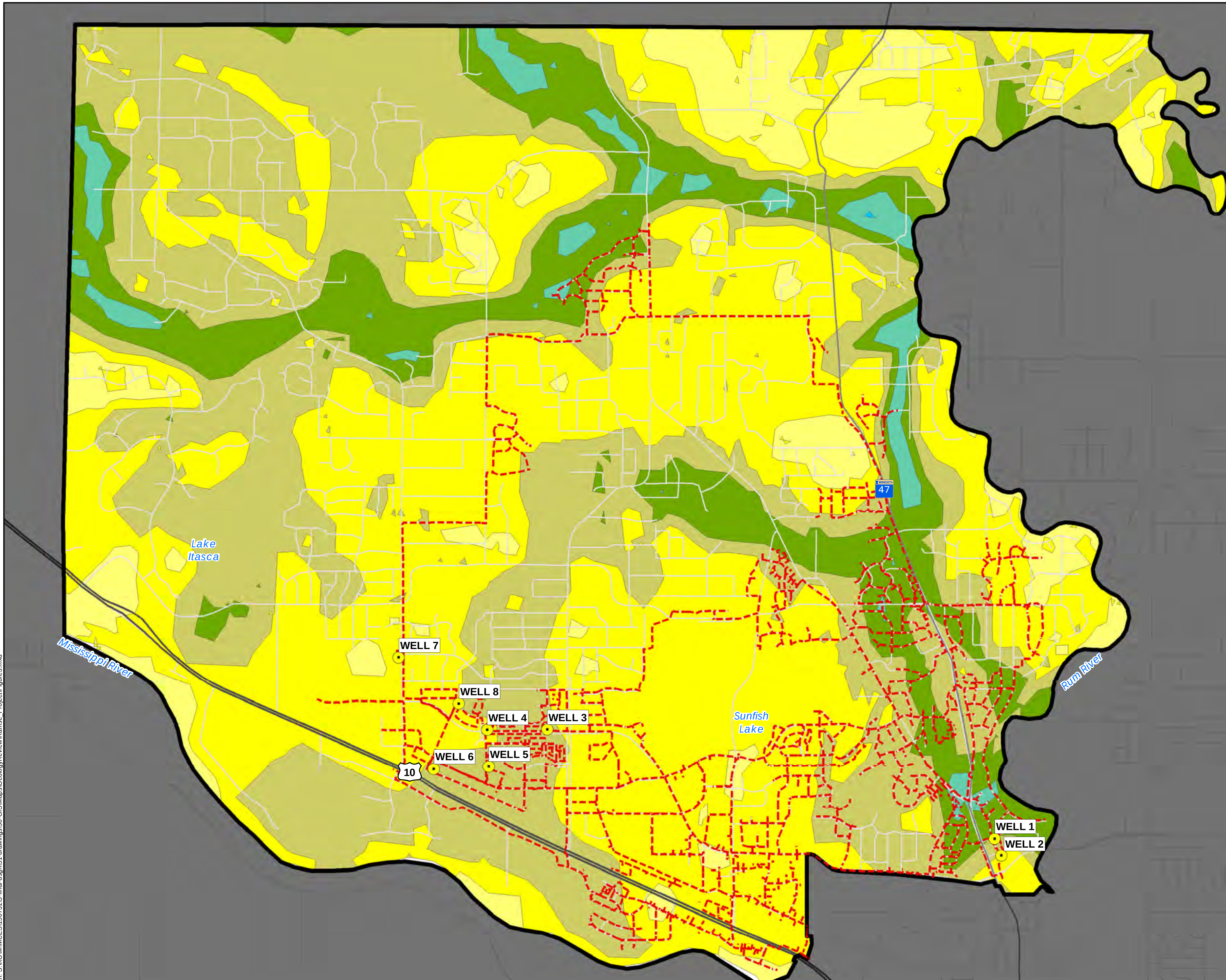


Legend

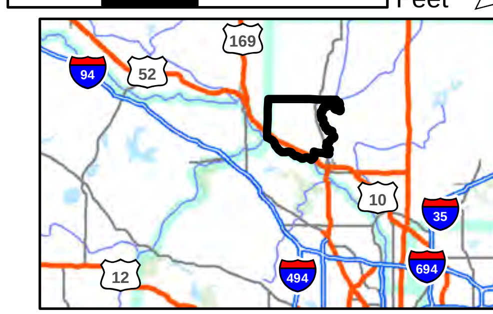
- Municipal Well
- Municipal Watermain
- Municipality Boundary

Anoka County Depth to Bedrock (ft)

Depth to bedrock (ft.)

- 1-50
- 51-100
- 101-150
- 151-200
- 201-250
- 251-300
- 301-350
- 351-400
- 401-450
- 451-500

0 1,500 3,000 6,000 Feet



Depth to Bedrock

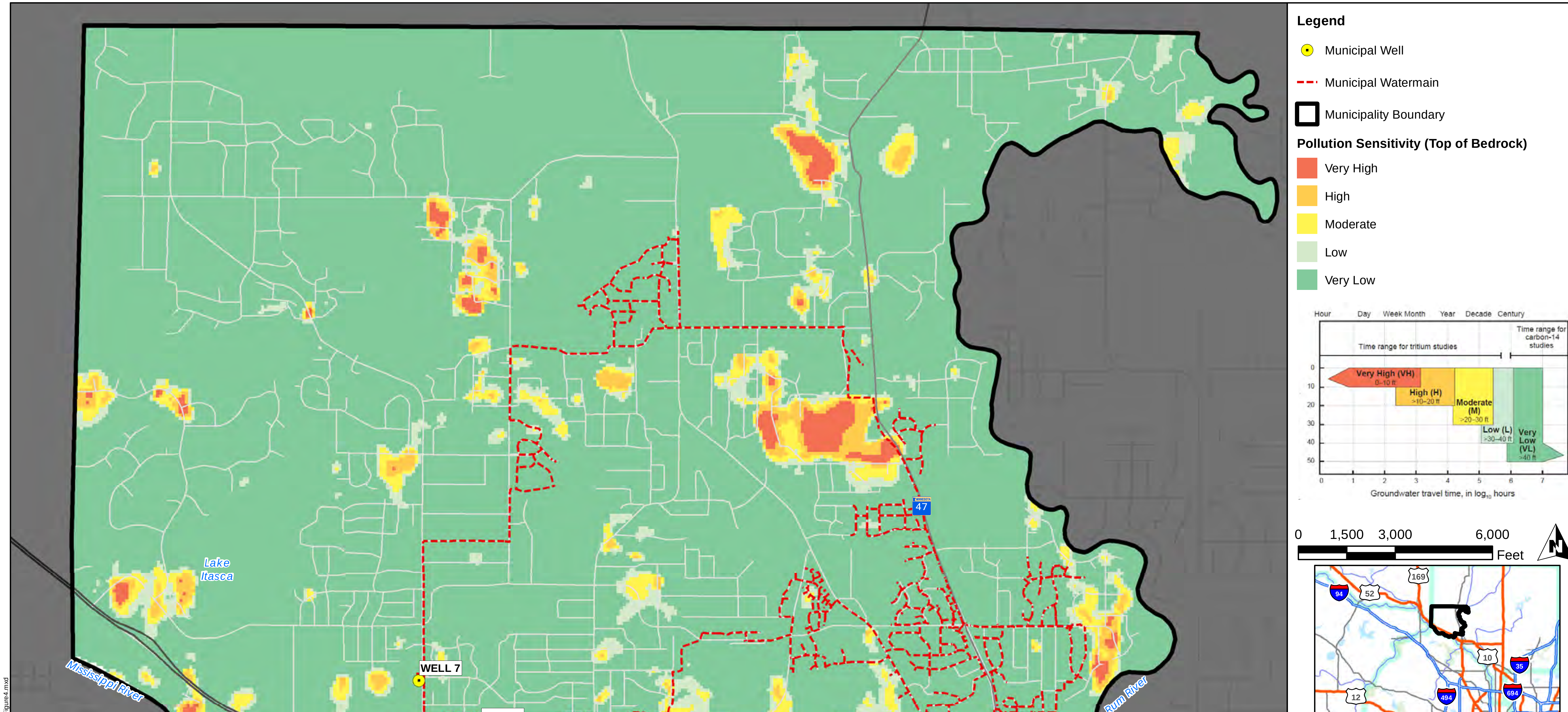
Source Water Analysis
City of Ramsey
Minnesota

Project: MCES 150732
Print Date: 11/7/2019

Map by: Msherrill
Projection: UTM Zone 15N
Source: ESRI, SEH Digi MnDOT, Minnesota Geologic Survey (MGS)

Figure 3

Path: S:\KO\M\MCES\150732\5-final-dsgn\51-drawings\90-GIS\Maps\GeologyReview\Ramse_ProjectFigure3.mxd



Pollution Sensitivity

Source Water Analysis
City of Ramsey
Minnesota

Project: MCES 150732
Print Date: 11/7/2019

Map by: Msherrill
Projection: UTM Zone 15N
Source: ESRI, SEH Digi MnDOT, Minnesota Geologic Survey (MGS)

Figure 4

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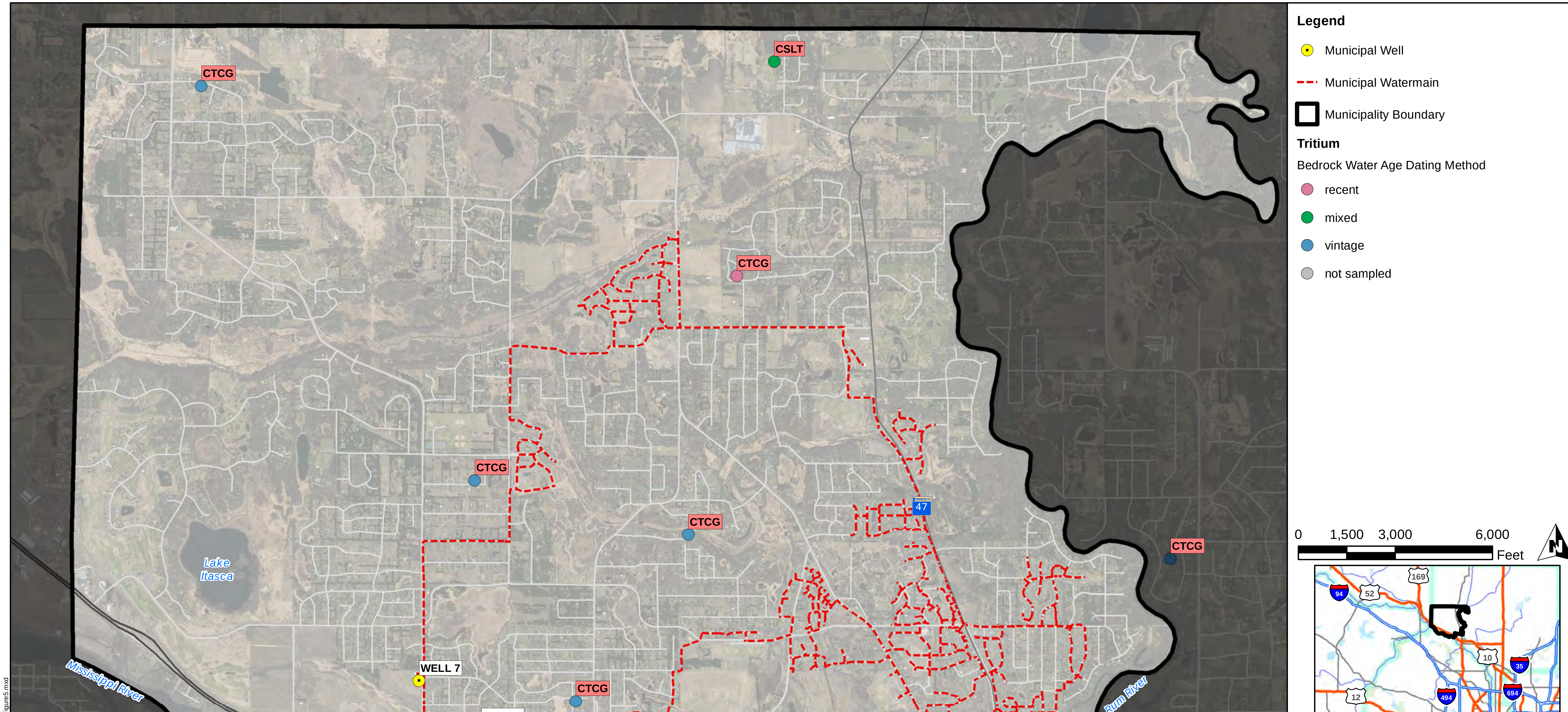

Tritium Data

Source Water Analysis
City of Ramsey
Minnesota

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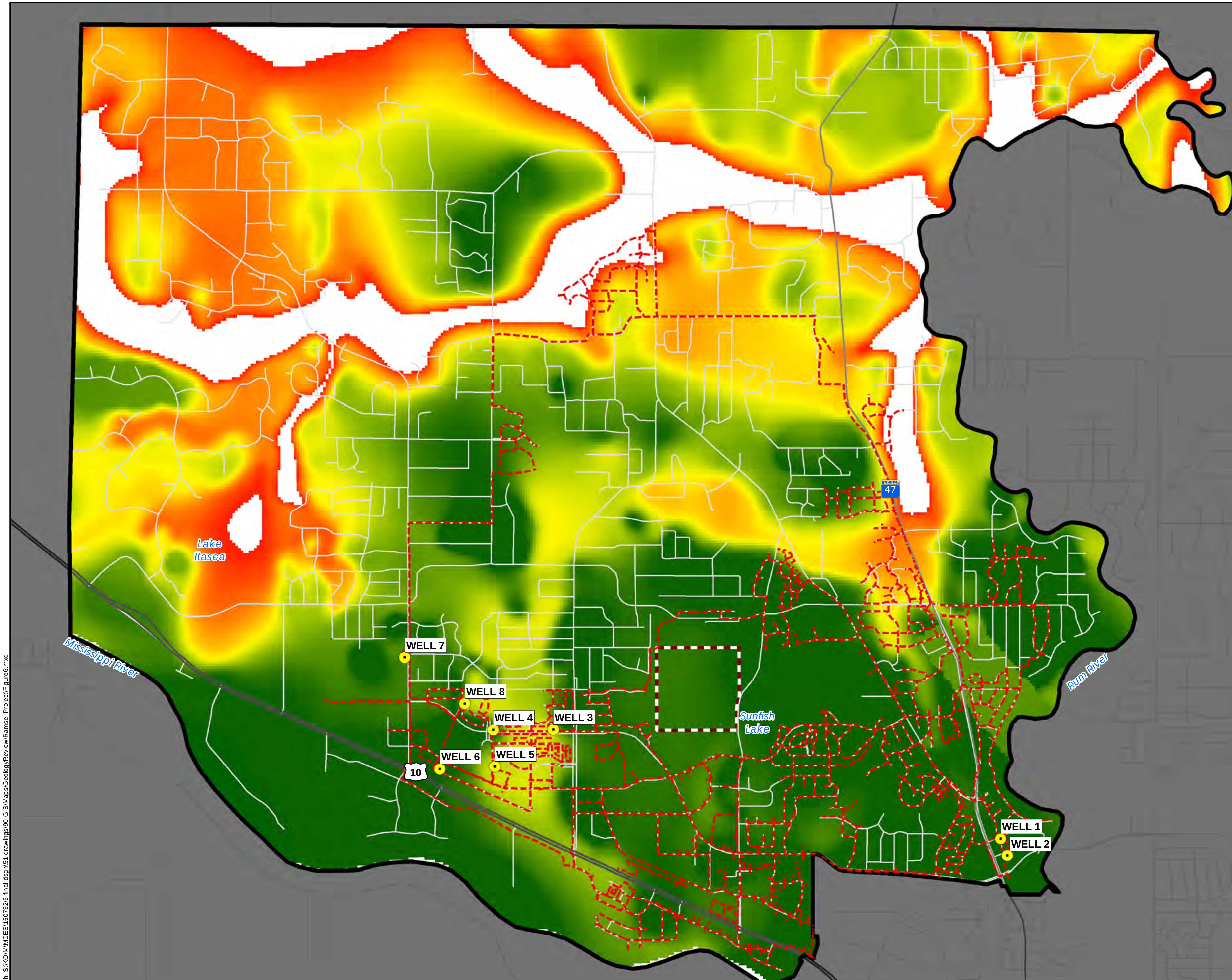
SEH

Project: MCES 150732
Print Date: 11/7/2019

Map by: Msherrill
Projection: UTM Zone 15N
Source: ESRI, SEH Digi MnDOT, Minnesota Geologic Survey (MGS)

Figure 5



Tunnel City Thickness

Source Water Analysis
City of Ramsey
Minnesota

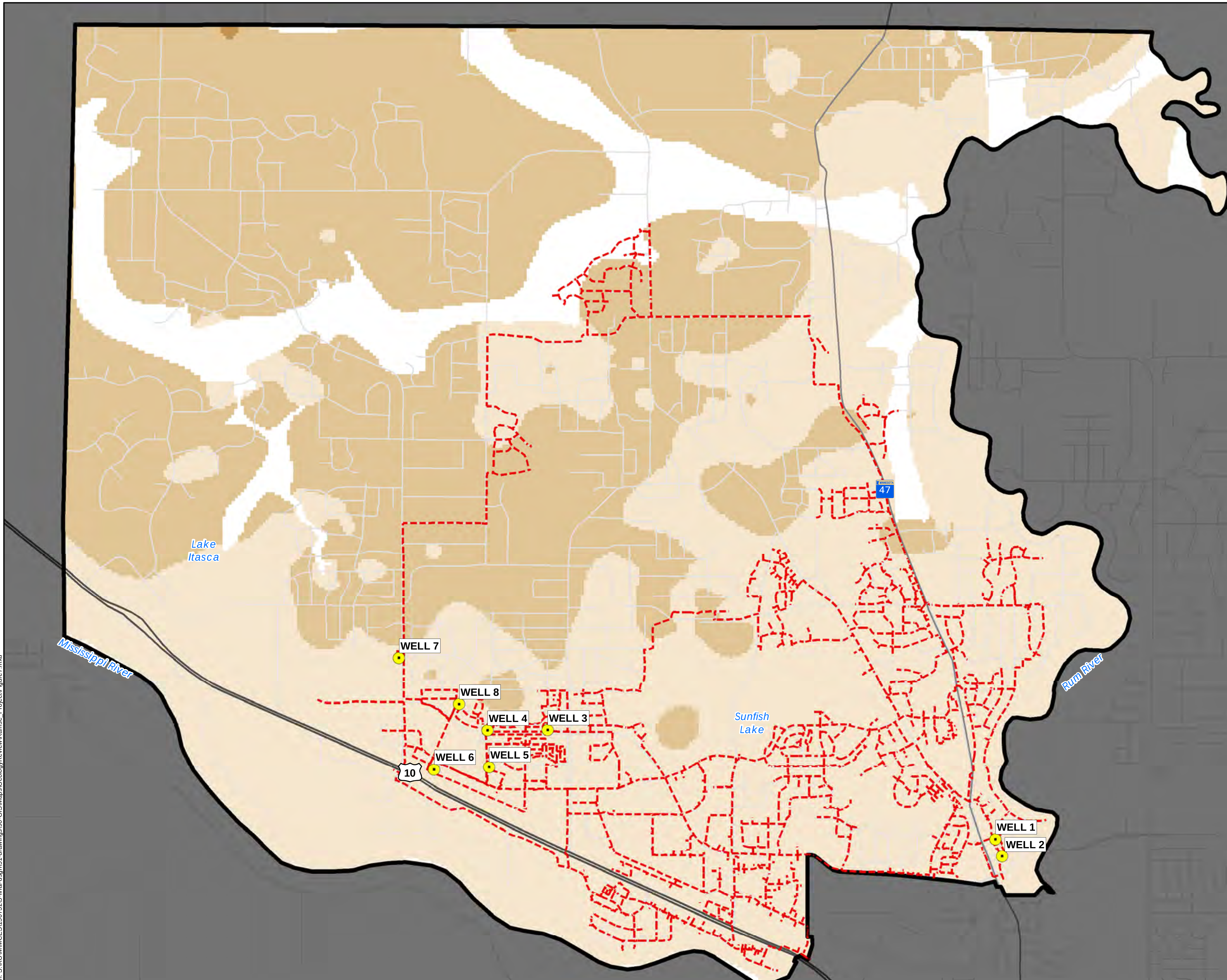
SEH

Project: MCES 150732
Print Date: 11/7/2019

Map by: Msherrill
Projection: UTM Zone 15N
Source: ESRI, SEH Digi MnDOT, Minnesota Geologic Survey (MGS)

Figure 6

Path: S:\KO\M\MCES\150732\5-final-dsgn\51-drawings\90-GIS\Maps\GeologyReview\Ramsey_Project\Figure6.mxd



Legend

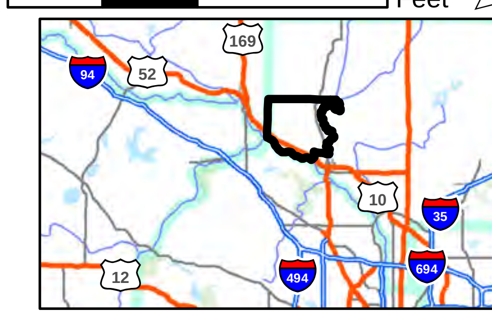
- Municipal Well
- Municipal Watermain
- Municipality Boundary

Potentiometric surface elevation

ELEVATION

- >820 to 860
- >860 to 900
- >900 to 940

0 1,500 3,000 6,000 Feet



Tunnel City Potentiometric Water Elevation

Source Water Analysis City of Ramsey Minnesota

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SEH

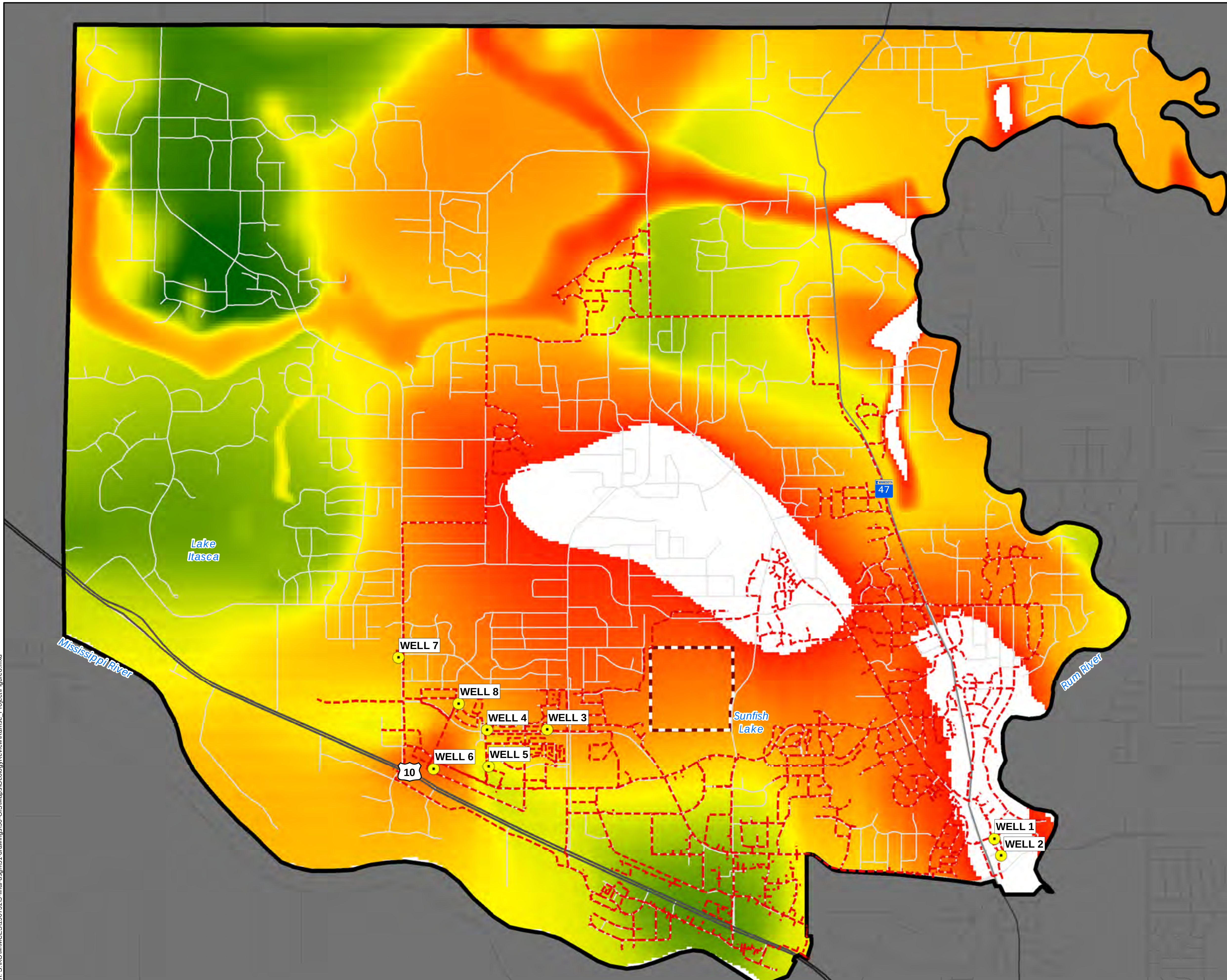
Project: MCES 150732

Print Date: 11/7/2019

Map by: Msherrill
Projection: UTM Zone 15N
Source: ESRI, SEH Digi MnDOT, Minnesota Geologic Survey (MGS)

Figure 7

Path: S:\KO\M\MCES\150732\5-final-dsgn\51-drawings\90-GIS\Maps\GeologyReview\Ramse Project\Figure7.mxd



Legend

- Municipal Well
- Municipal Watermain
- Municipality Boundary
- Landfill Boundary

Wonewoc Thickness (feet)

Value

133.674
120.307
106.939
93.5718
80.2044
66.837
53.4696
40.1022
26.7348
13.3675
6.10352e-05

0 1,500 3,000 6,000 Feet

Wonewoc Thickness

Source Water Analysis
City of Ramsey
Minnesota

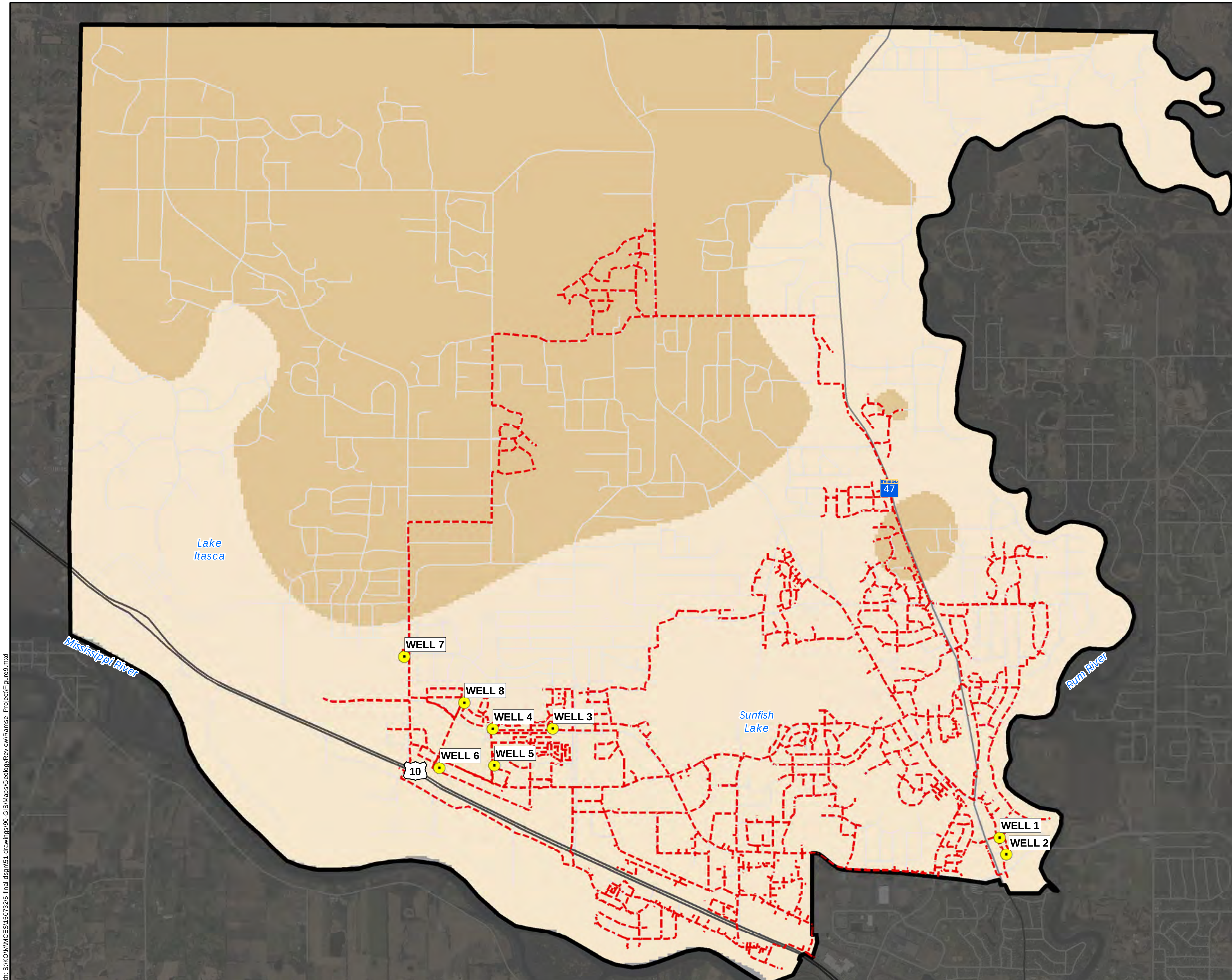
SEH

Project: MCES 150732
Print Date: 11/7/2019

Map by: Msherrill
Projection: UTM Zone 15N
Source: ESRI, SEH Digi MnDOT, Minnesota Geologic Survey (MGS)

Figure 8

Path: S:\KO\M\MCES\150732\5-final-dsgn\51-drawings\90-GIS\Maps\GeologyReview\Ramsey_Project\Figure8.mxd



Legend

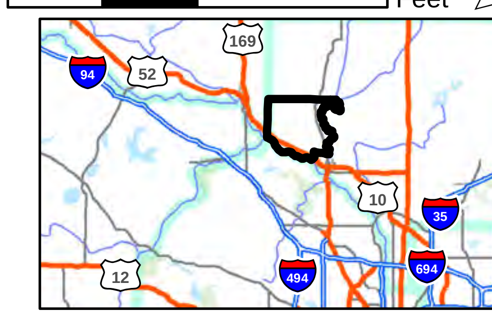
- Municipal Well
- Municipal Watermain
- Municipality Boundary

Potentiometric surface elevation

ELEVATION

- >820 to 860
- >860 to 900
- City of Ramsey Owned Parcel
- Anoka County Parcel Dataset

0 1,500 3,000 6,000 Feet



Wonewoc Potentiometric Surface Elevation

Source Water Analysis
City of Ramsey
Minnesota

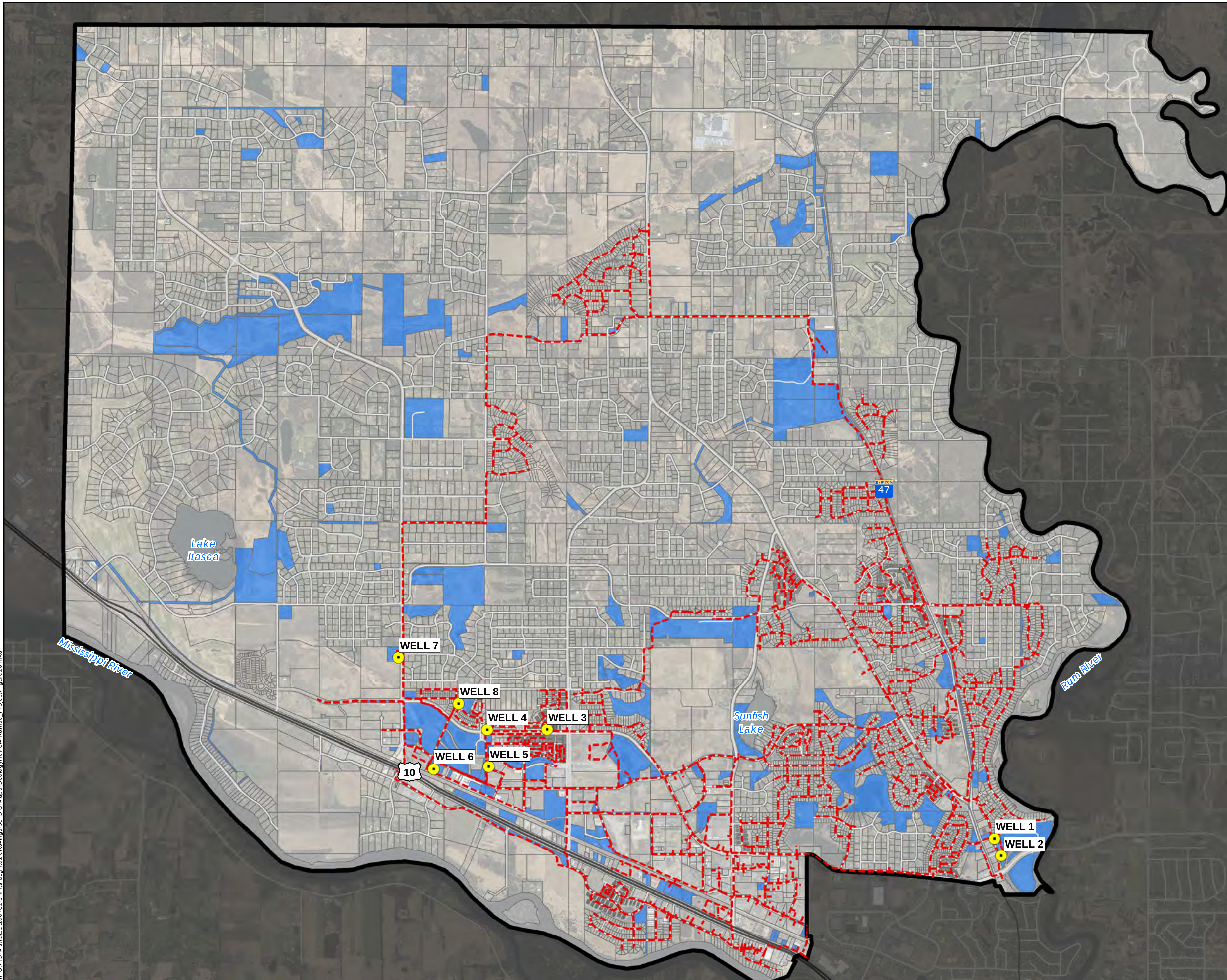
Project: MCES 150732

Print Date: 11/7/2019

Map by: Msherrill
Projection: UTM Zone 15N
Source: ESRI, SEH Digi MnDOT, Minnesota Geologic Survey (MGS)

Figure 9

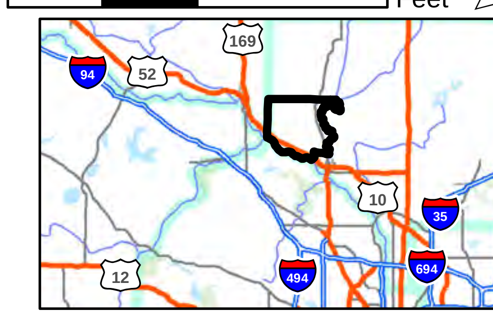
Path: S:\KO\M\MCES\150732\5-final-dsgn\51-drawings\90-GIS\Maps\GeologyReview\Ramsey Project\Figure9.mxd



Legend

- Municipal Well
- Municipal Watermain
- Municipality Boundary
- City of Ramsey Owned Parcel
- Anoka County Parcel Dataset

0 1,500 3,000 6,000 Feet



Parcel Data

Source Water Analysis
City of Ramsey
Minnesota

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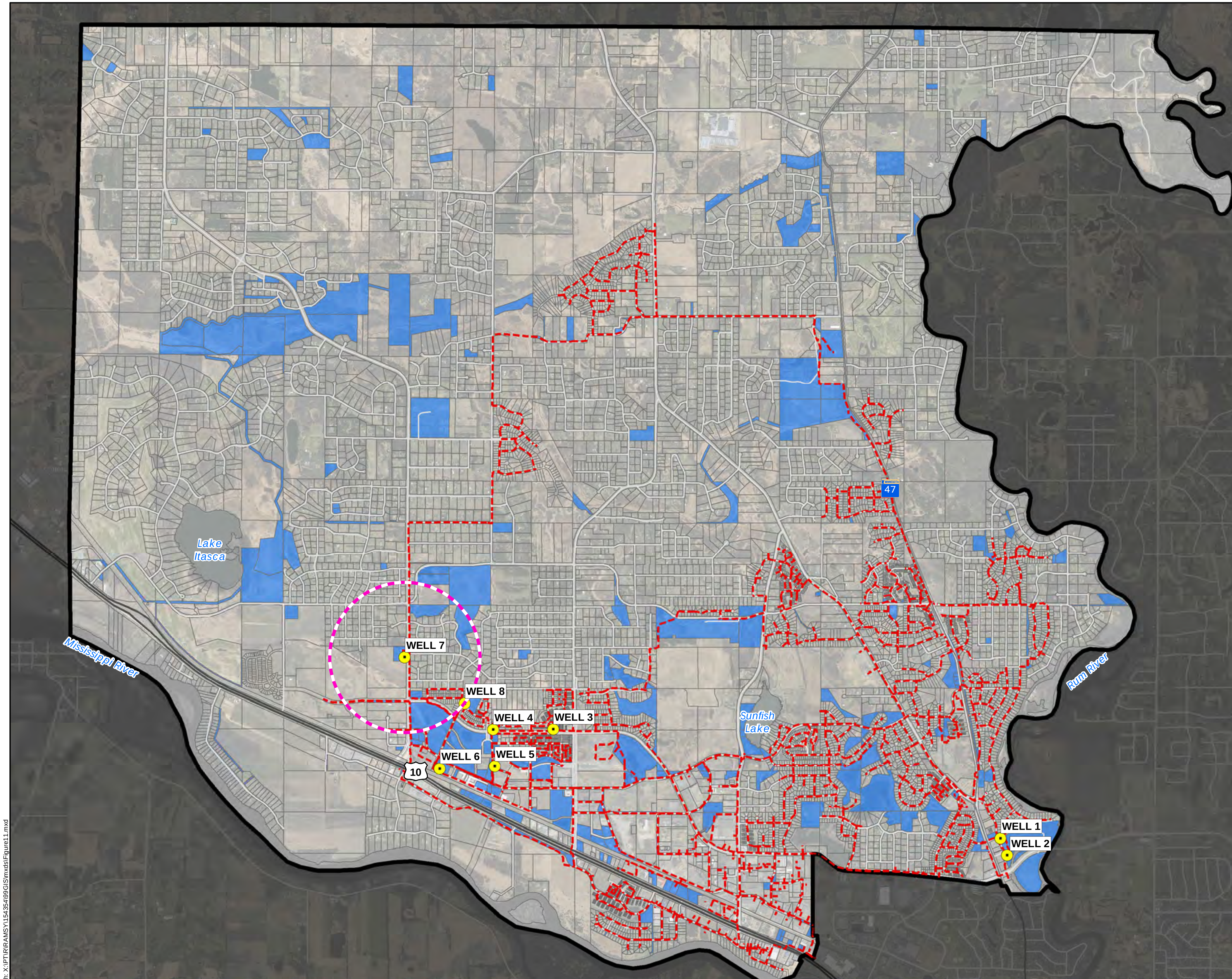
Project: MCES 150732

Print Date: 11/7/2019

Map by: Msherrill
Projection: UTM Zone 15N
Source: ESRI, SEH Digi MnDOT, Minnesota Geologic Survey (MGS)

Figure 10

Path: S:\KO\M\MCES\150732\5-final-dsgn\51-drawings\90-GIS\Maps\GeologyReview\Ramsey_Project\Figure10.mxd

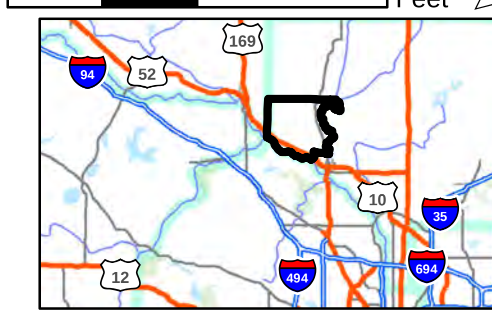


Legend

- Municipal Well
- Municipal Watermain
- Municipality Boundary
- City of Ramsey Owned Parcel
- Anoka County Parcel Dataset
- 2400 ft Radius of Influence for 3 feet of Drawdown.

Note:
Radius of Influence calculation was based upon "Methods for Determining the Proper Spacing of Wells" (USGS, 1961) for a single pumping well.

0 1,500 3,000 6,000 Feet



Radius of Influence and Parcel Data

Source Water Analysis City of Ramsey Minnesota

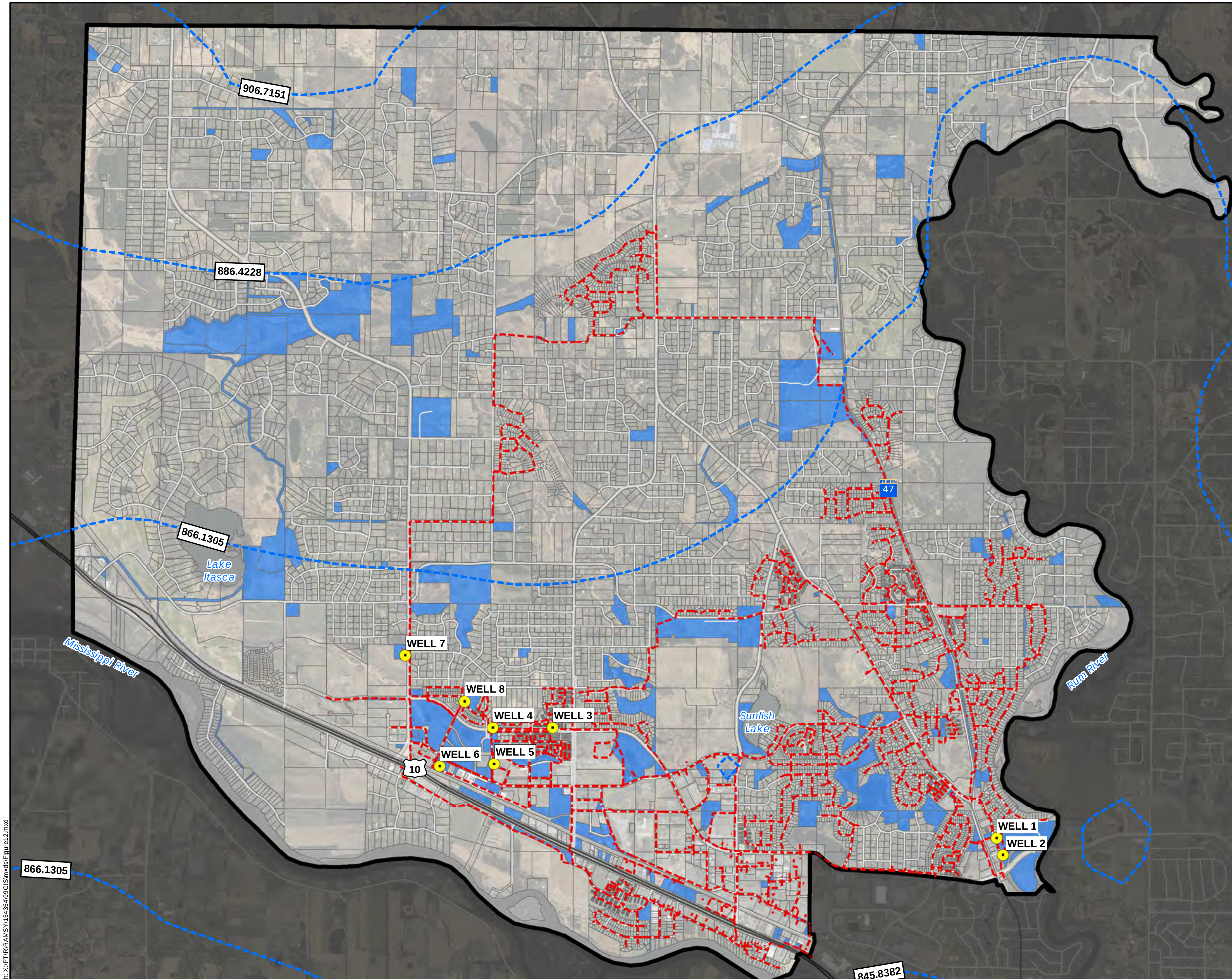
SEH

Project: MCES 150732
Print Date: 5/19/2020

Map by: Msherrill
Projection: UTM Zone 15N
Source: ESRI, SEH Digi MnDOT, Minnesota Geologic Survey (MGS)

Figure 11

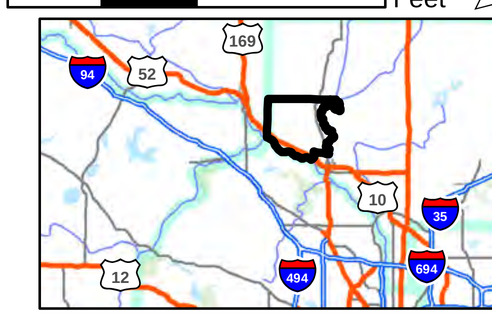
Path: X:\PT\R\RAMSY\154354\99GIS\mxds\Figure11.mxd



Legend

- Municipal Well
- Municipal Watermain
- Municipality Boundary
- City of Ramsey Owned Parcel
- Anoka County Parcel Dataset
- Modeled Steady State Source Water Aquifer Water Level with no City Wells Pumping

Note:
-Source Water Aquifer referes to the Tunnel City and Wonewoc Aquifers.
-Contours were modeled utilizing the Twin Cities Area Groundwater Flow Model (Metro Model 3, Metropolitan Council and Barr Engineering.)



Present Day - No Pumping Wells Aquifer Water Level Contours

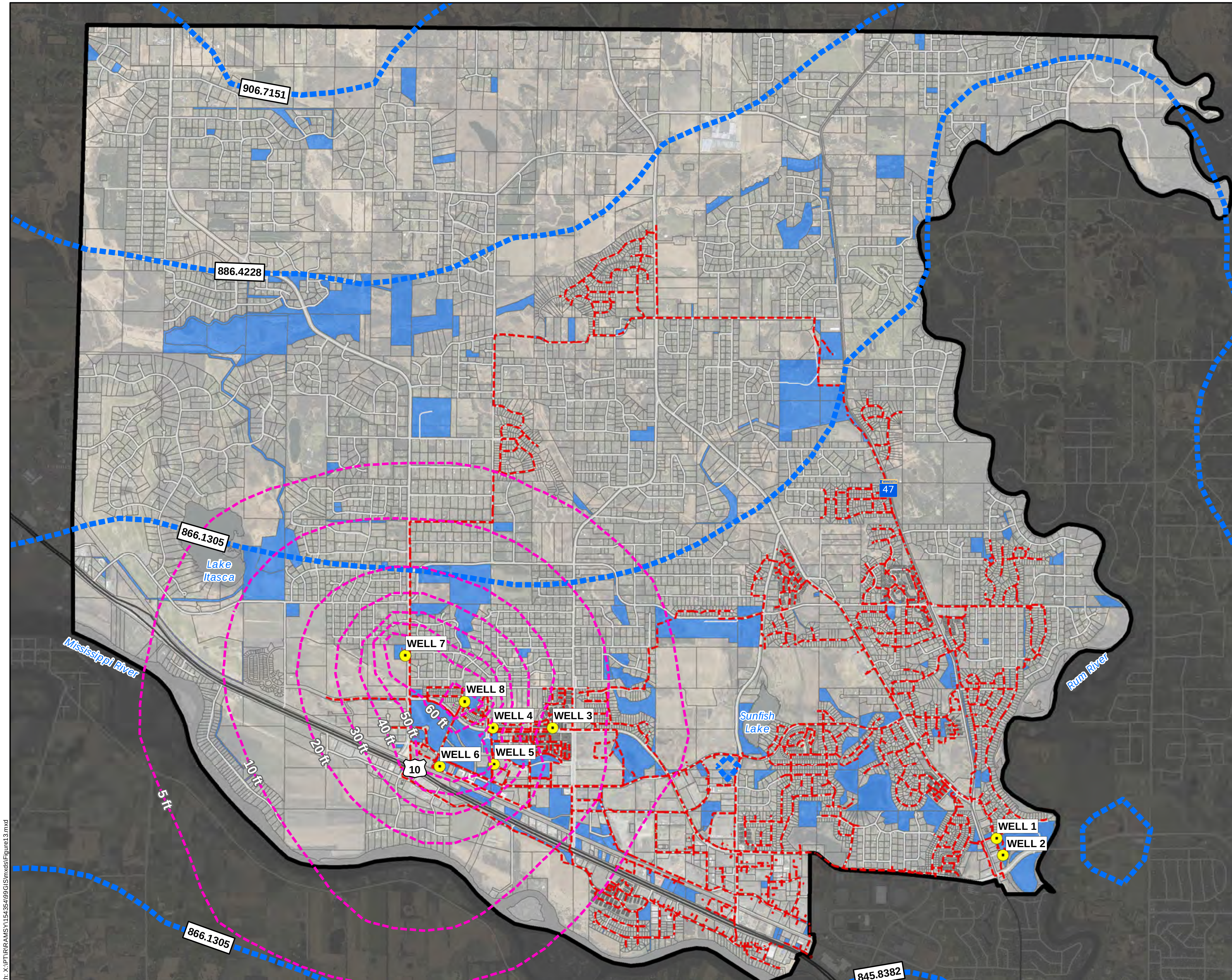
Source Water Analysis
City of Ramsey
Minnesota

Project: MCES 150732
Print Date: 5/19/2020

Map by: Msherrill
Projection: UTM Zone 15N
Source: ESRI, SEH Digi MnDOT, Minnesota Geologic Survey (MGS)

Figure 12

Path: X:\PT\R\RAMSY\154354\99GIS\mxds\Figure12.mxd



Legend

- Municipal Well
- Municipal Watermain
- Municipality Boundary
- City of Ramsey Owned Parcel
- Anoka County Parcel Dataset
- Modeled Steady State Source Water Aquifer Water Level with no City Wells Pumping
- Feet of Modeled Drawdown from June 13, 2019 Well Pumping

Note:
-Source Water Aquifer referes to the Tunnel City and Wonewoc Aquifers.
-Contours were modeled utilizing the Twin Cities Area Groundwater Flow Model (Metro Model 3, Metropolitan Council and Barr Engineering.)

Modeled Drawdown of June 13th Pumping on Aquifer Water Levels

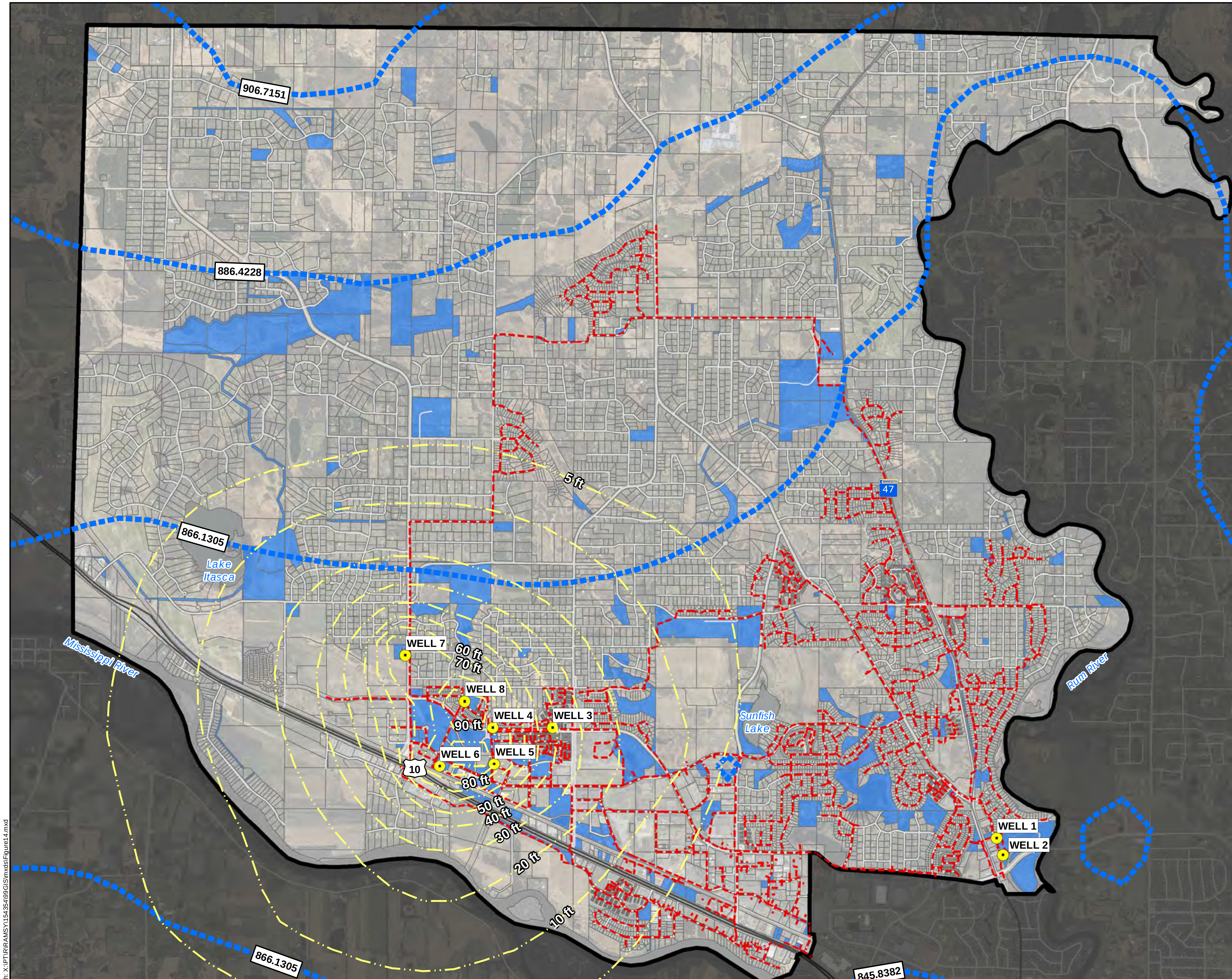
Source Water Analysis
City of Ramsey
Minnesota

Project: MCES 150732
Print Date: 5/19/2020

Map by: Msherrill
Projection: UTM Zone 15N
Source: ESRI, SEH Digi MnDOT, Minnesota Geologic Survey (MGS)

Figure 13

Path: X:\PT\R\RAMSY\154354\99GIS\mxds\Figure13.mxd



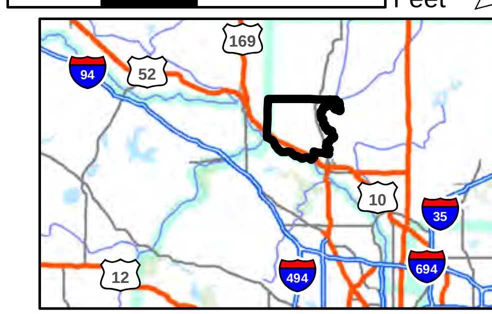
Path: X:\PT\R\RAMSY\154354\99GIS\mxds\Figure14.mxd

Legend

- Municipal Well
- Municipal Watermain
- Municipality Boundary
- City of Ramsey Owned Parcel
- Anoka County Parcel Dataset
- Modeled Steady State Source Water Aquifer Water Level with no City Wells Pumping
- Feet of Modeled Drawdown from Project 2040 Daily Demand Well Pumping of 10.25 Million Gallons

Note:
-Source Water Aquifer referes to the Tunnel City and Wonewoc Aquifers.
-Contours were modeled utilizing the Twin Cities Area Groundwater Flow Model (Metro Model 3, Metropolitan Council and Barr Engineering.)

0 1,500 3,000 6,000 Feet



Modeled Drawdown of 2040 Daily Demand on Aquifer Water Levels

Source Water Analysis City of Ramsey Minnesota

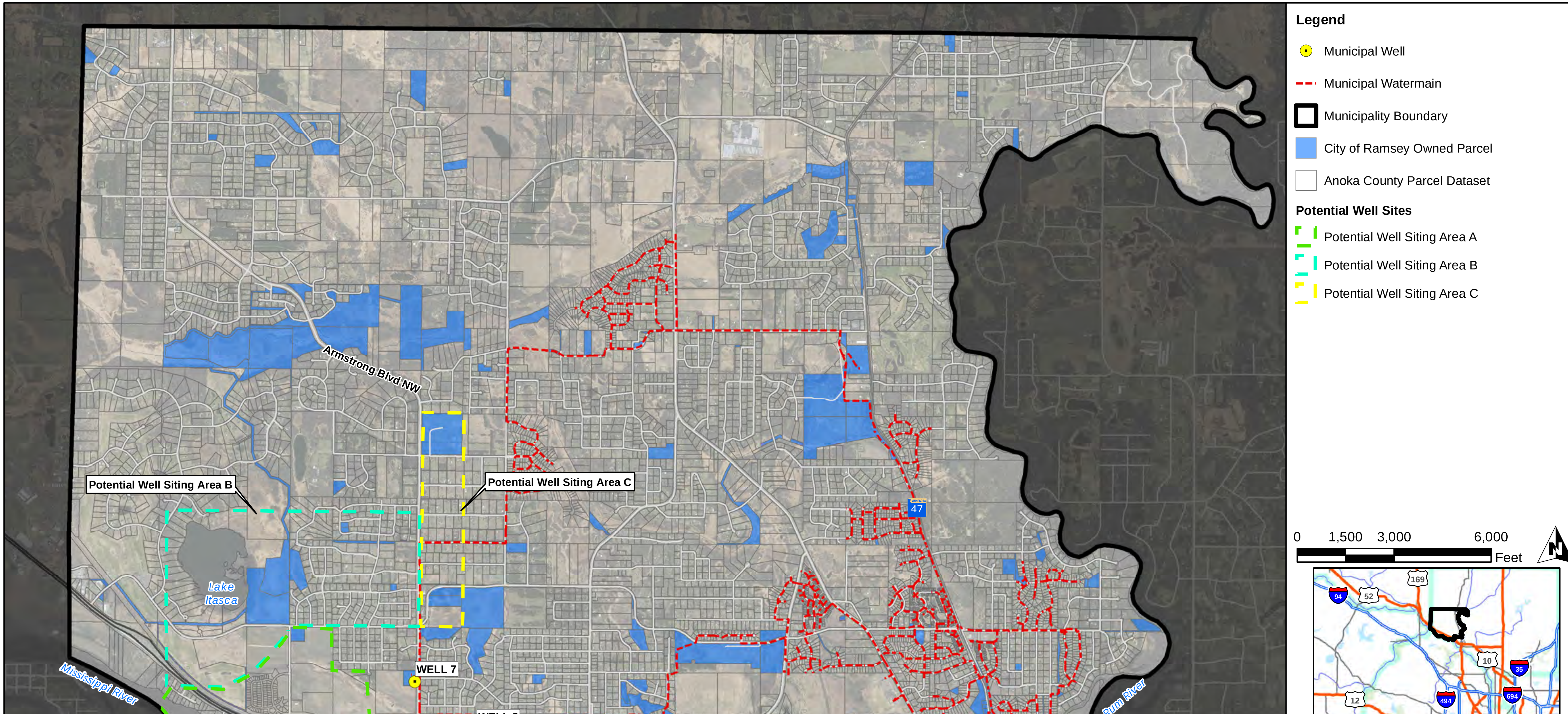
SEH

Project: MCES 150732

Print Date: 5/19/2020

Map by: Msherrill
Projection: UTM Zone 15N
Source: ESRI, SEH Digi MnDOT, Minnesota Geologic Survey (MGS)

Figure 14



Potential Well Sites

Source Water Analysis
City of Ramsey
Minnesota

Project: MCES 150732
Print Date: 6/5/2020

Map by: Msherrill
Projection: UTM Zone 15N
Source: ESRI, SEH Digi MnDOT, Minnesota Geologic Survey (MGS)

Figure 15

Path: X:\PT\R\RAMSY\154354\99GIS\mxds\Figure15.mxd

Appendix E

Pilot Study

Pilot Study Report

Water Treatment Plant

City of Ramsey, Minnesota

RAMSY 154354 | June 18, 2020

SEH

Building a Better World for All of Us®

Engineers | Architects | Planners | Scientists

Contents

List of Tables

Contents (continued)

List of Figures

Pilot Study Report

Water Treatment Plant

Prepared for the City of Ramsey, Minnesota

1 Introduction

1.1 Background

SEH was contracted by the City of Ramsey to conduct a centralized water treatment plant feasibility study. As part of the study, SEH conducted a pilot study to consider options for the removal of iron and manganese from their water supply. The water quality in Ramsey is high in both iron and manganese with levels exceeding the United States Environmental Protection Agency (US EPA) secondary standards of 0.3 mg/L and 0.05 mg/L respectively. Along with the manganese secondary standard, Ramsey's average manganese levels exceed Minnesota Department of Health's (MDH's) Health Based Value (HBV) of 0.1 mg/L for bottle-fed infants less than one year of age.

1.2 Objectives

The objectives of the study were to evaluate the effectiveness of various treatment methods for removing iron and manganese, and then to select treatment methods for the design of a Water Treatment Plant for the City of Ramsey.

The study included the following objectives:

- Evaluate the effectiveness of chlorine and permanganate for the removal of iron and manganese;
- Establish filter run lengths;
- Evaluate filter loading rates;
- Select the filter media type that provides the best removal of iron and manganese, and;
- Evaluate the use of aeration and detention as part of the treatment process.

2 Existing Facilities

2.1 Wells

The City of Ramsey has eight wells all located in the southern part of town north of U.S. Highway 10. The City's original two wells, Wells No. 1 and 2, are located in the southeast part of town, while the other wells are all located in the southwest part of town. The wells are capable of producing approximately 11 million gallons per day, although the treatment plant would be located within the southwest well field and thus would not be fed by Wells No. 1 or 2, making the potential treatment capacity 9.5 million gallons per day.

Current treatment at the wells consists of chemical treatment including polyphosphate for iron and manganese sequestration, gas chlorine for disinfection, and fluoride for dental health.

3 Pilot Study

The pilot study was conducted in the SEH pilot water plant trailer. Equipment used for the pilot study included chemical feed systems, an aerator, detention tank, and filter columns (filters). Train 1 of the study utilized direct filtration where the well water was treated with chemical injections of chlorine (sodium hypochlorite) and potassium permanganate, and then filtered through filters with two different media types. Train 2 of the study utilized the chemical injections and two different filter media types, but included aeration prior to the chemical injections, and detention prior to filtration. Sampling as part of the pilot study were conducted and analyzed by SEH's pilot plant operator.

3.1 Pilot Testing Processes

The pilot study was conducted for Ramsey's Wells No. 3 and 4 to establish the efficiency and reliability of the two treatment processes and filter media types to remove iron and manganese. Processes for the pilot study were selected based on the concentrations of iron and manganese, and on prior experience. The figures below show the processes for Train 1 and Train 2.

Figure 1 – Pilot Sudy Train 1

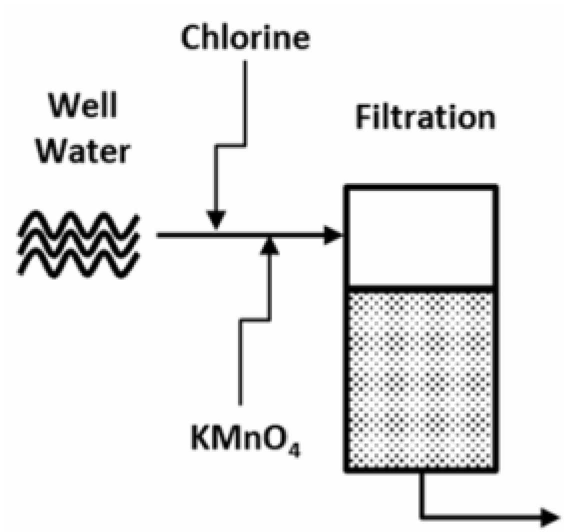
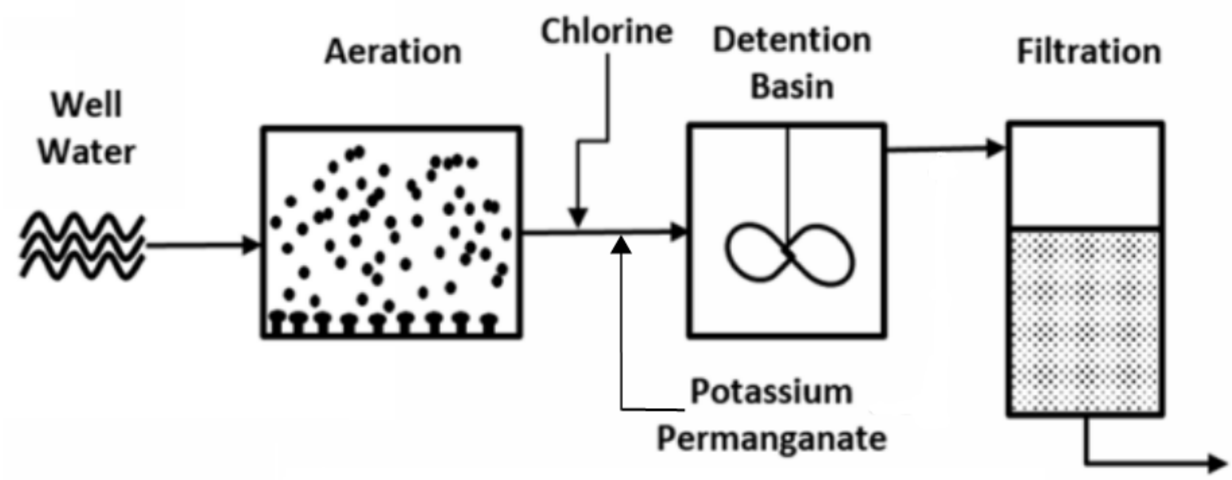


Figure 2 – Pilot Study Train 2



3.1.1 Forced Draft Aerator

The SEH pilot water plant utilized a forced draft aerator, which consists of an aerator column, packing material, and a blower. During treatment of the water for Train 2, water was pumped from the well into the pilot water plant aerator, and then percolated down through the packing material in the aerator column as air was blown up through the packing material. Aeration of water is done to oxidize the iron into solids so that they can be filtered out. Aeration of water can also remove dissolved gases in water such as hydrogen sulfide.

3.1.2 Detention Tank

After aeration during Train 2, a detention tank in the pilot water plant was used to provide additional reaction time for chlorine to oxidize iron and potassium permanganate to oxidize manganese in the water. For this study, the system was set up to provide 30 minutes of detention before filtration.

3.1.3 Chemical Feed System

The chemicals used for the pilot study included chlorine, in the form of sodium hypochlorite, and potassium permanganate ($KMnO_4$). While chlorine is used for oxidizing iron, potassium permanganate is used for the oxidation of manganese. Both chemicals are commonly used in treatment systems for the removal of iron and manganese. The sodium hypochlorite solution was fed at a strength of 15 grams per liter (gpl). Potassium permanganate was fed at a strength of 4 gpl.

The chemical feed systems used in the pilot study included Qdos peristaltic metering pumps capable of feeding a maximum of 31 gallons per hour (gph).

Chemical addition was measured using calibration columns for each chemical feed pump. The volume (in milliliters) of each chemical pumped was measured per unit of time and the dosage was calculated based on the flow to the individual treatment trains.

3.1.4 Filters

The SEH Pilot Water Plant contains four filter columns (filters) that each measure 8 inches in diameter and 72 inches tall. The resulting surface area for filtration of each filter is 0.35 ft^2. The filters each have a 0.75 inch inlet, 1.5 inch backwash waste outlets, underdrains, air release system, rate of flow meters, sample taps, and filter media. Pressure taps are located on the inlet and outlet of each filter to obtain filter head loss by comparing the two pressures. For the Ramsey pilot study, Filters 1 and 2 (Train 1) were operated without aeration and detention. Filters 3 and 4 (Train 2) were operated with aeration and detention. Each filter was supplied 1.05 gpm to achieve a target filtration rate of 3.0 gpm/ft^2 for this study. Each type of filter media used in the study was new and had not been used in other studies. The filters were backwashed with a combination of air and water between filter runs.

Table 1 – Pilot Study Filter Characteristics

Filter	Media	Filtration Rate (gpm/ft^2)	Effective Size (mm)	Media Depth (in)
1	Greensand	3	0.30-0.35	18
	Anthracite		0.9-1.0	12
2	Silica Sand	3	0.45-0.55	18
	Anthracite		0.9-1.0	12
3	Greensand	3	0.30-0.35	18
	Anthracite		0.9-1.0	12
4	Silica Sand	3	0.45-0.55	18
	Anthracite		0.9-1.0	12

3.2 Sampling and Analysis

Sampling and analysis was completed by the onsite SEH pilot plant operator. Field testing for iron and manganese was conducted using a Hach DR/890 Portable Colorimeter, and was done for the raw water and from the effluent of each filter. Testing for iron was conducted using the Hach Method 8147 (DR800 FerroZine Solution Pillow), which has a range of 0-1.3 mg/L iron (Fe), and an estimated detection limit of 0.011 mg/L Fe. Testing for manganese was conducted using the Hach Method 8149 (DR800 PAN), which has a range of 0-0.70 mg/L manganese (Mn), and an estimated detection limit of 0.020 mg/L Mn. Temperature and pH analyses were conducted using a Hach HQ 40 pH meter, and was done for the raw water. Samples for the analysis of chlorine were collected from the effluent of each filter and analyzed using the Hach DR/890 Portable Colorimeter. The chlorine demand was calculated by subtracting the residual chlorine after filtration from the dose of chlorine added to the raw water to oxidize iron. The results of the sampling and subsequent analysis are presented in the remainder of this report.

4 Pilot Study Results

As discussed, the pilot study was conducted for Ramsey's Wells No. 3 and 4 to establish the efficiency and reliability of the two treatment processes, as well as the two filter media types, to remove iron and manganese. Identical pilot studies were conducted at both wells. The purpose of this was to determine how well the treatment processes would do with more than one source water. The finished water quality met the EPA secondary standards for iron and manganese, as well as MDH's HBV for manganese, for both treatment processes and filter media types.

4.1 Well No. 3 Results

4.1.1 Raw Water Quality

The pilot study for Well No. 3 was completed between January 21, 2020 and January 22, 2020. Well No. 3 currently pumps approximately 1,450 gpm directly into the distribution system with polyphosphate, chlorine, and fluoride added in a shared pump house with Well No. 4. Table 2 below summarizes the raw water results collected from Well No. 3 during the pilot study.

Table 2 – Well No. 3 Raw Water Quality

Iron (mg/L)			**Manganese (mg/L)**			**pH**		
Min.	Avg.	Max	Min.	Avg.	Max.	Min.	Avg.	Max.
0.500	0.640	0.850	0.160	0.200	0.240	7.46	7.72	7.85

Results from the raw water sampling show that Well No. 3 exceeds EPA's secondary standards for iron and manganese, which can cause aesthetic water quality issues related to color, taste, sediment, and staining. Well No. 3 also exceeds MDH's HBV 0.1 mg/L for manganese for bottle-fed infants less than one year of age. Infants who drink water with manganese above 0.1 mg/L may develop learning and behavior problems.

4.1.2 Water Treatment

Water from Well No. 3 went through both treatment trains provided by the SEH pilot water treatment plant. Train 1 utilized direct filtration through Filters 1 and 2 after chlorine and potassium permanganate injection, while Train 2 utilized aeration and detention prior to filtration through Filters 3 and 4. With Train 2, aeration was provided prior to chemical injection to help oxidize iron, followed by chlorine and potassium permanganate injection, and then 30 minutes of detention time to allow for adequate chemical reaction time before filtration. The chemical doses to treat water from Well No. 3 are provided in Table 3. All four filters in the pilot water plant were operated at a rate of 3.0 gpm/ft^2.

Table 3 – Well No. 3 Chemical Dosages

Train 1 – Filters 1 and 2 (Direct Filtration)					
Chlorine (mg/L as Cl_2)			$KMnO_4$ (mg/L)		
Min.	Avg.	Max.	Min.	Avg.	Max.
2.15	2.92	3.58	0.49	0.49	0.49
Train 2 – Filters 3 and 4 (Aeration and Detention)					
Chlorine (mg/L as Cl_2)			$KMnO_4$ (mg/L)		
Min.	Avg.	Max.	Min.	Avg.	Max.
1.95	3.24	4.53	0.10	0.10	0.10

The chlorine dosages for the two treatment trains were similar, although the chlorine dosage with Train 2 may be able to be reduced as aeration provides significant iron oxidation, and 30 minutes of detention allows for additional chemical reaction time to increase iron oxidation. The potassium permanganate dosage in Train 2 was able to be lowered to about a fifth of that in Train 1, as the added chemical reaction time with 30 minutes of detention increases manganese oxidation.

4.1.3 Finished Water Quality

The SEH pilot water plant was able to treat water from Well No. 3 to levels that meet the EPA secondary standards, as well as MDH's HBV for manganese. In fact, no sample result exceeded the EPA secondary standards, and both treatment trains were able to remove both iron and manganese on average below the method detection limits of 0.011 mg/L and 0.020 mg/L respectively.

The finished water quality for Well No. 3 during the pilot study is summarized in Table 4 below.

Table 4 – Well No. 3 Finished Water Quality

Filter	Iron (mg/L)			Manganese (mg/L)		
	Min.	Avg.	Max.	Min.	Avg.	Max.
1	nd	nd	0.040	nd	nd	0.043
2	nd	nd	0.020	nd	nd	nd
3	nd	nd	0.020	nd	nd	0.048
4	nd	nd	nd	nd	nd	nd
Notes: nd = below method detection limit						

The use of detention in Train 2 did not provide a significant treatment advantage over Train 1 in removing iron and manganese, although the use of aeration in Train 2 provided slightly better results in the removal of iron. There also wasn't a significant difference in treatment effectiveness between the two filter media types, although Filters 1 and 3 each had at least one spiked result for manganese that approached the secondary standard.

4.2 Well No. 4 Results

4.2.1 Raw Water Quality

The pilot study for Well No. 4 was completed between January 20, 2020 and January 21, 2020. Well No. 4 currently pumps approximately 850 gpm directly into the distribution system with polyphosphate, chlorine, and fluoride added in a shared pump house with Well No. 3. Table 5 below summarizes the raw water results collected from Well No. 4 during the pilot study.

Table 5 – Well No. 4 Raw Water Quality

Iron (mg/L)			Manganese (mg/L)			pH		
Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.
0.180	0.240	0.360	0.035	0.392	0.360	7.51	7.61	7.71

Results from the raw water sampling show that Well No. 4 exceeds EPA's secondary standards for iron and manganese, which can cause aesthetic water quality issues related to color, taste, sediment, and staining. Well No. 4 also exceeds MDH's HBV 0.1 mg/L for manganese for bottle-fed infants less than one year of age. Infants who drink water with manganese above 0.1 mg/L may develop learning and behavior problems.

4.2.2 Water Treatment

Like Well No. 3, water from Well No. 4 went through both treatment trains provided by the SEH pilot water treatment plant. The chemical doses to treat water from Well No. 4 are provided in Table 3. All four filters in the pilot water plant were operated at a rate of 3.0 gpm/ft^2.

Table 6 – Well No. 4 Chemical Dosages

Train 1 – Filters 1 and 2 (Direct Filtration)					
Chlorine (mg/L as Cl_2)			$KMnO_4$ (mg/L)		
Min.	Avg.	Max.	Min.	Avg.	Max.
1.43	2.57	3.43	0.49	0.49	0.52
Train 2 – Filters 3 and 4 (Aeration and Detention)					
Chlorine (mg/L as Cl_2)			$KMnO_4$ (mg/L)		
Min.	Avg.	Max.	Min.	Avg.	Max.
1.95	2.66	2.72	0.21	0.21	0.21

The chlorine dosages for the two treatment trains were similar, although the chlorine dosage with Train 2 may be able to be reduced as aeration provides significant iron oxidation, and 30 minutes of detention allows for additional chemical reaction time to increase iron oxidation. The potassium permanganate dosage in Train 2 was able to be lowered to less than half of that in Train 1, as the added chemical reaction time with 30 minutes of detention increases manganese oxidation.

4.2.3 Finished Water Quality

The SEH pilot water plant was able to treat water from Well No. 4, on average, to levels that meet the EPA secondary standards, as well as MDH's HBV for manganese. Although the average iron and manganese levels were below those standards, the pilot water plant was not able to remove iron below the method detection limit on average like it did with Well No. 3. Filter 4 also saw a spike in manganese at the beginning of the filter run, which was above the MDH HBV, but quickly reduced manganese below the secondary standard and MDH HBV thereafter.

The finished water quality for Well No. 4 during the pilot study is summarized in Table 7 below.

Table 7 – Well No. 4 Finished Water Quality

Filter	Iron (mg/L)			Manganese (mg/L)		
	Min.	Avg.	Max.	Min.	Avg.	Max.
1	nd	0.018	0.080	nd	nd	0.044
2	nd	0.014	0.080	nd	nd	0.028
3	nd	0.014	0.080	nd	nd	0.031
4	nd	0.015	0.090	nd	nd	0.128
Notes: nd = below method detection limit						

The use of detention and aeration in Train 2 did not provide a significant treatment advantage over Train 1 in removing iron and manganese. There also wasn't a significant difference in treatment effectiveness between the two filter media types, although Filter 4 saw the spike in manganese that was above the secondary standard and MDH HBV.

5 Conclusions and Recommendations

The SEH pilot water plant was able to treat water from Well No. 3 and Well No. 4 to concentrations below the EPA secondary standards for iron and manganese, as well as the MDH HBV for manganese. Implementing either treatment trains at full-scale would allow the City of Ramsey to provide aesthetically pleasing as it relates to iron and manganese, as well as provide safe drinking water to the residents as it relates to manganese.

5.1 Aeration

Aeration of the water provided better results in terms of iron removal for Well No. 3, which had much higher raw water iron levels than Well No. 4, but provided similar results in terms of iron removal for Well No. 4. It is expected that the benefits of aeration will be more pronounced in water quality similar to that of Well No. 3. Based on the results and on previous experience, the use of an aerator may be preferred as it provides an additional layer in the removal or iron, and may also provide additional treatment benefits such as the removal of dissolved gases like hydrogen sulfide.

5.2 Detention

The addition of a detention tank did not provide a significant difference in treatment effectiveness for iron and manganese removal, but it did allow for the potassium permanganate dosage to be lowered. Although 30 minutes of detention was suitable for the removal of iron and manganese, and allowed for the reduction in the potassium permanganate dosage, it is not needed to provide quality water for the City of Ramsey. If a water treatment plant is pursued, the City should compare the cost savings of reducing the potassium permanganate dosage with the construction cost of a detention tank.

5.3 Chemical Feed

The pilot study evaluated the use of chlorine and potassium permanganate as oxidants. Feed rates are within normal ranges for the type of water treated. It is recommended to use these chemicals for a full-scale design, although chlorine may be fed as sodium hypochlorite solution or gas chlorine, and potassium permanganate may be fed as sodium permanganate instead.

5.4 Filtration

Both filter media types were effective in removing iron and manganese and successfully operated at a loading rate of 3.0 gpm/ft^2, but there wasn't a significant difference in effectiveness. Although there wasn't a significant difference between the two filter media types, SEH recommends the use of 12 inches of anthracite over 18 inches of Greensand Plus™, rather than 12 inches of anthracite over 18 inches of silica sand for full-scale filters. This is because Greensand Plus™ is a filter media that is coated with manganese dioxides that further aid in the removal of manganese.

Figure 3 – Well #3 Manganese Results

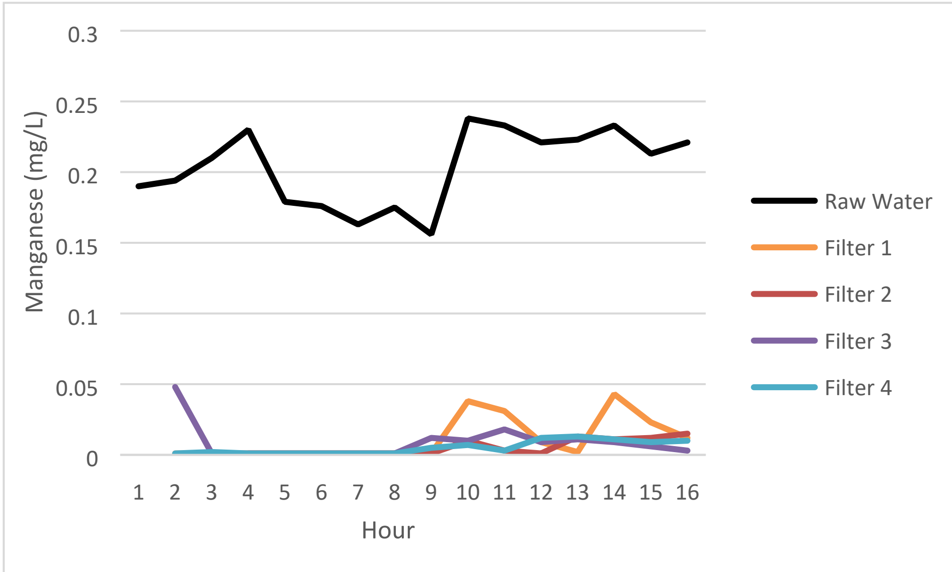


Figure 4 – Well #3 Iron Results

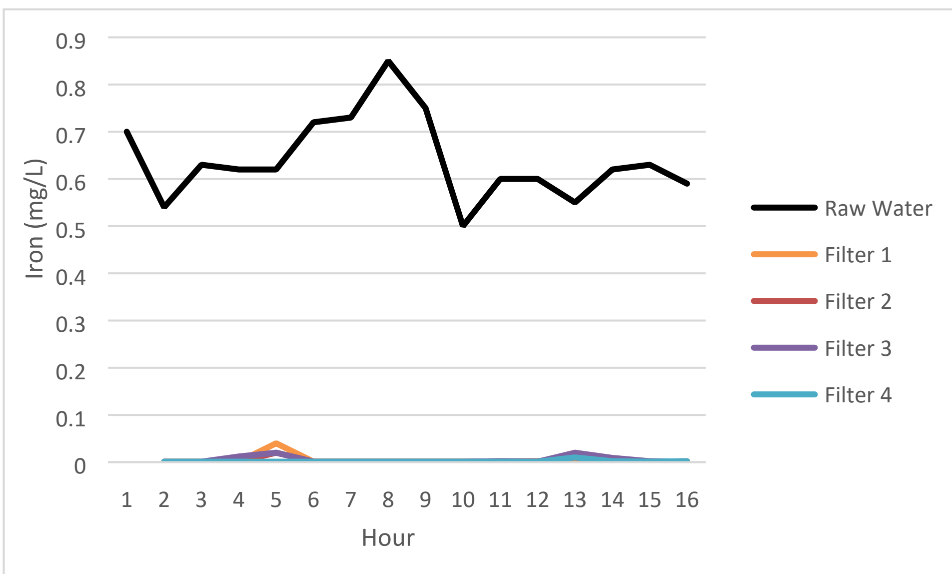


Figure 5 – Well #4 Manganese Results

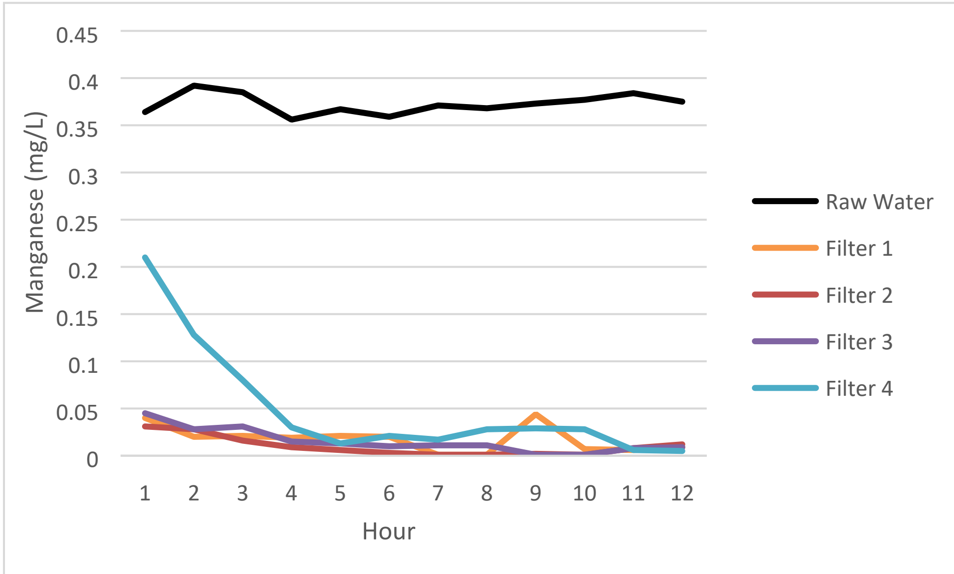
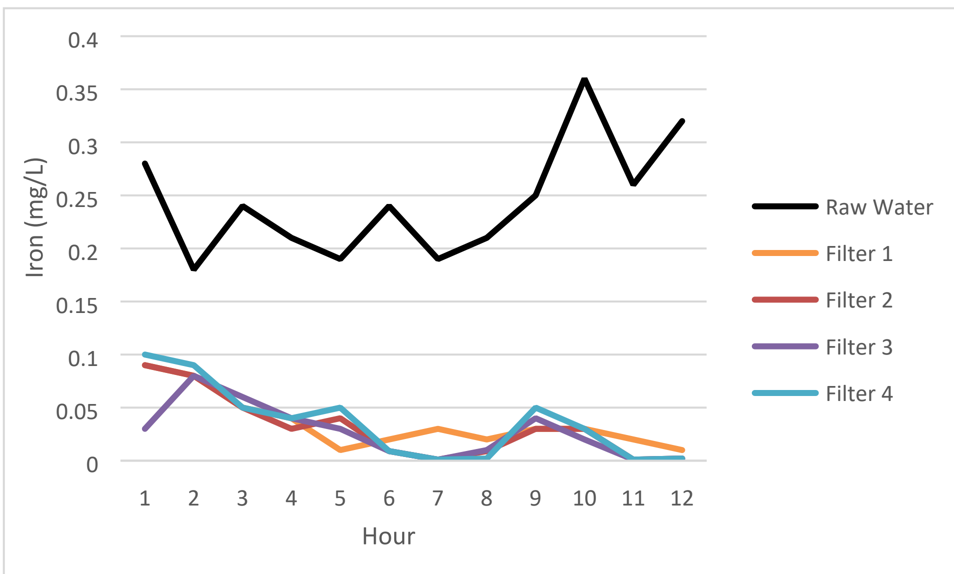


Figure 6 – Well #4 Iron Results



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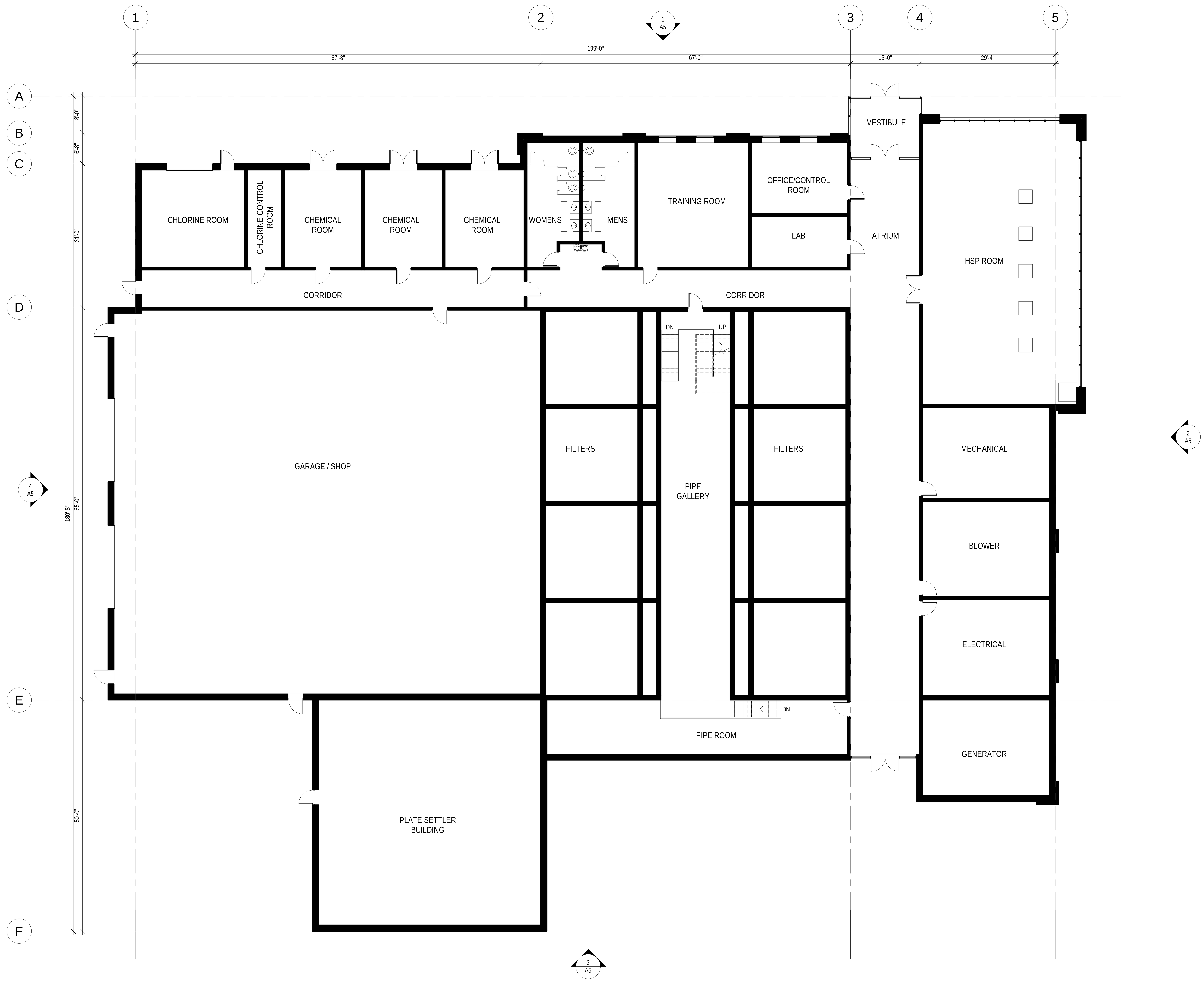
Appendix F

Gravity Filter Layouts



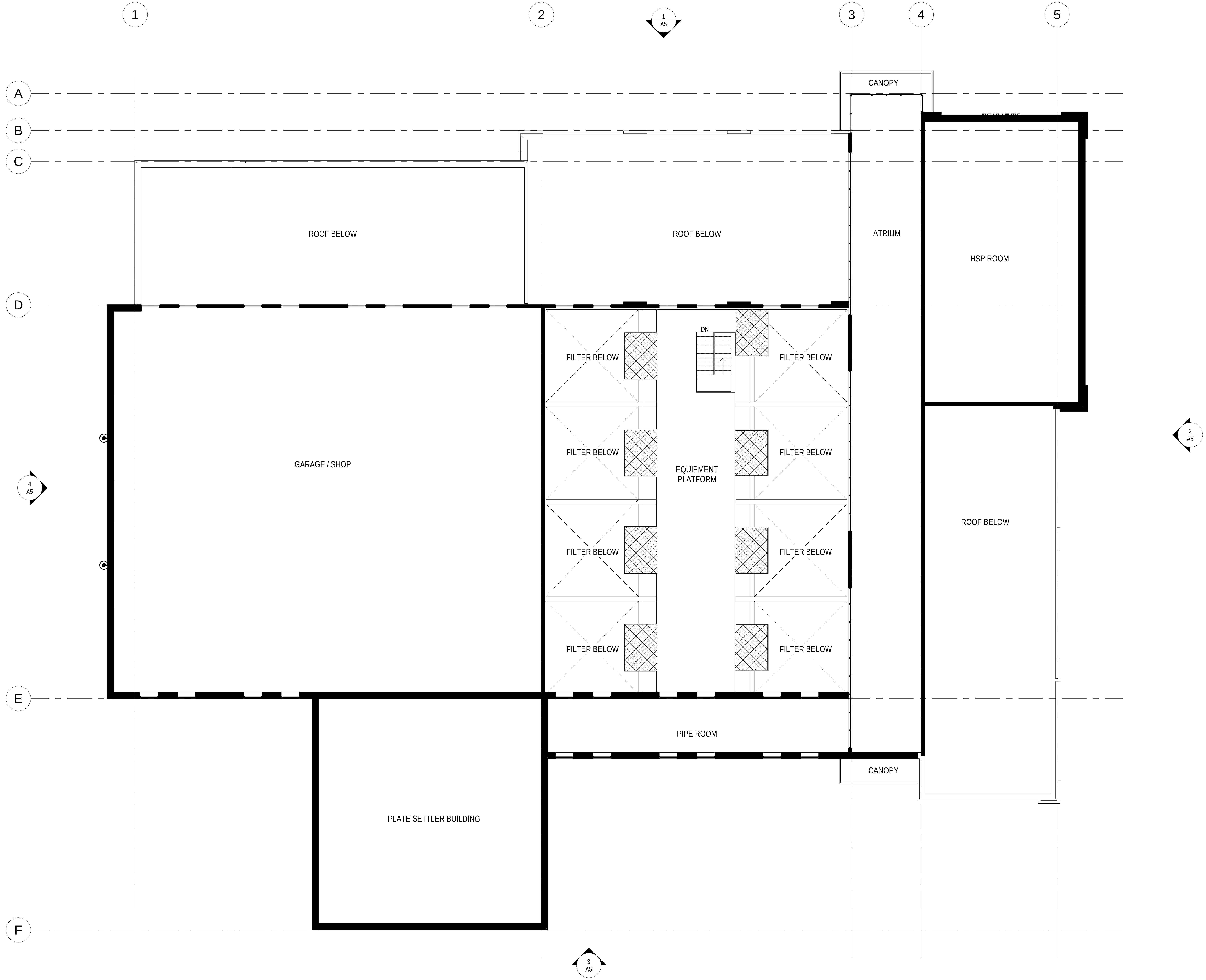
1
A3

MAIN LEVEL FLOOR PLAN - ALTERNATIVE 1 - WITH GARAGE

3/32" = 1'-0"

WTP FEASIBILITY REPORT FOR RAMSEY, MINNESOTA - ALTERNATIVE 1 - GRAVITY FILTER WATER TREATMENT PLANT

| MAIN LEVEL FLOOR PLAN | RAMSEY, MN | 06/2020 |



1
A4

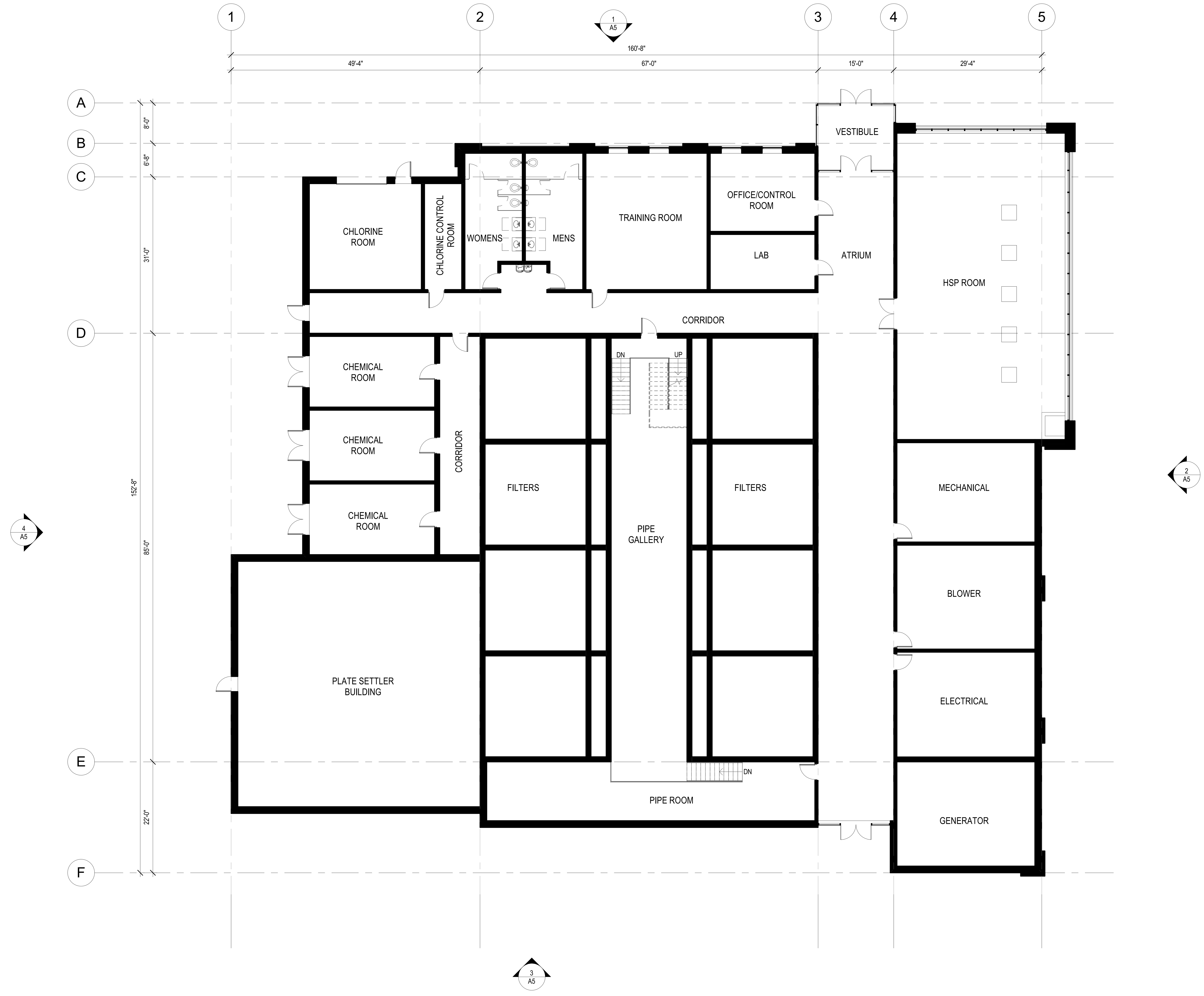
UPPER LEVEL FLOOR PLAN - ALTERNATIVE 1 - WITH GARAGE

3/32" = 1'-0"

SEH

WTP FEASIBILITY REPORT FOR RAMSEY, MINNESOTA - ALTERNATIVE 1 - GRAVITY FILTER WATER TREATMENT PLANT

| UPPER LEVEL FLOOR PLAN | RAMSEY, MN | 06/2020 |



1 A3 MAIN LEVEL FLOOR PLAN - ALTERNATIVE 1 - NO GARAGE

3/32" = 1'-0"

WTP FEASIBILITY REPORT FOR RAMSEY, MINNESOTA - ALTERNATIVE 1 - GRAVITY FILTER WATER TREATMENT PLANT

| MAIN LEVEL FLOOR PLAN | RAMSEY, MN | 11/2020 |

1 A4 UPPER LEVEL FLOOR PLAN - ALTERNATIVE 1 - NO GARAGE

3/32" = 1'-0"

SEH

WTP FEASIBILITY REPORT FOR RAMSEY, MINNESOTA - ALTERNATIVE 1 - GRAVITY FILTER WATER TREATMENT PLANT

| UPPER LEVEL FLOOR PLAN | RAMSEY, MN | 11/2020 |

Appendix G

Pressure Filter Layouts

1
A2
MAIN LEVEL FLOOR PLAN - ALTERNATIVE 2
3/32" = 1'-0"

WTP FEASIBILITY REPORT FOR RAMSEY, MINNESOTA - ALTERNATIVE 2 - PRESSURE FILTER WATER TREATMENT PLANT

| MAIN LEVEL FLOOR PLAN | RAMSEY, MN | 06/2020 |

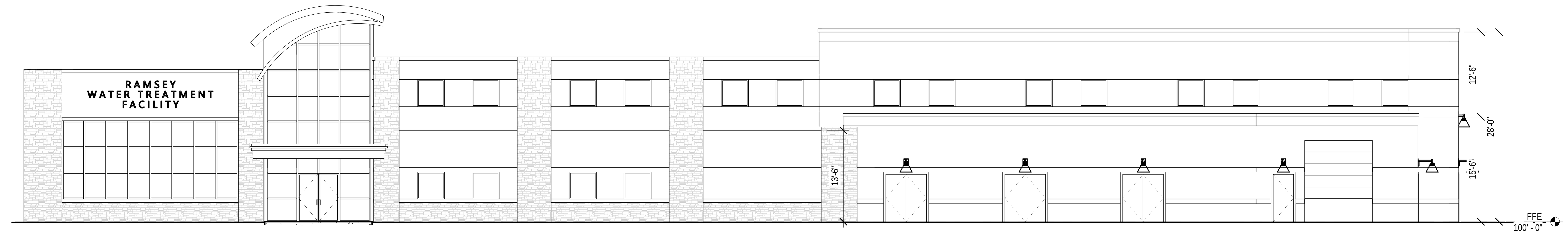
Appendix H

Architectural Renderings

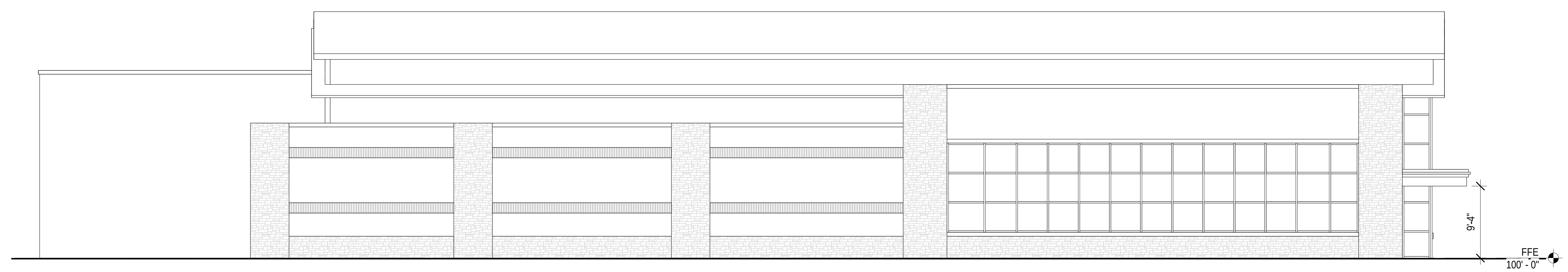
1 A1 EXTERIOR RENDERING - ALTERNATIVE 1

1
A2
EXTERIOR RENDERING - ALTERNATIVE 1

WTP FEASIBILITY REPORT FOR RAMSEY, MINNESOTA - ALTERNATIVE 1 - GRAVITY FILTER WATER TREATMENT PLANT

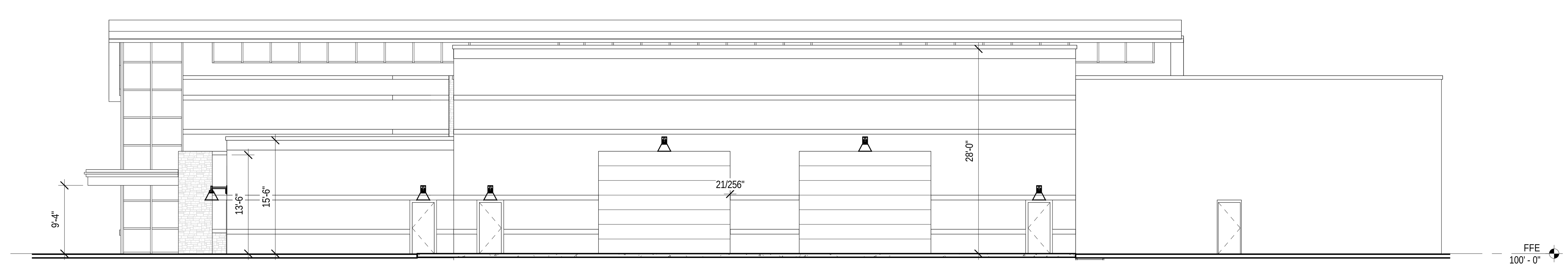


1
A5
EXTERIOR ELEVATION - FRONT - ALTERNATIVE 1
3/32" = 1'-0"



2
A5
EXTERIOR ELEVATION - LEFT - ALTERNATIVE 1
3/32" = 1'-0"

3
A5
EXTERIOR ELEVATION - BACK - ALTERNATIVE 1
3/32" = 1'-0"



4
A5
EXTERIOR ELEVATION - RIGHT - ALTERNATIVE 1
3/32" = 1'-0"

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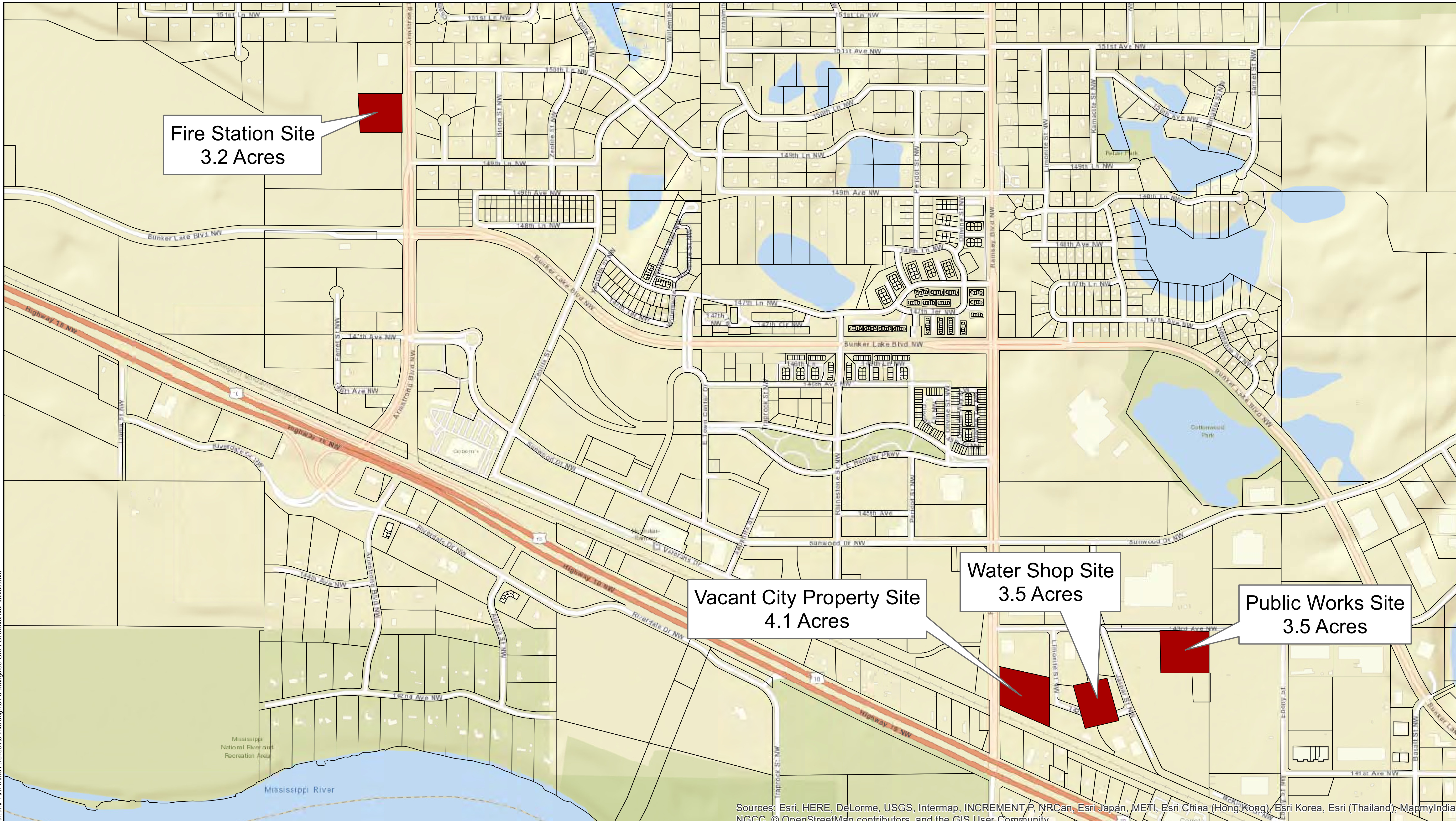
WTP FEASIBILITY REPORT FOR RAMSEY, MINNESOTA - ALTERNATIVE 1 - GRAVITY FILTER WATER TREATMENT PLANT

| EXTERIOR ELEVATIONS | RAMSEY, MN | 06/2020 |

Appendix I

Treatment Plant Sites and Raw Watermain



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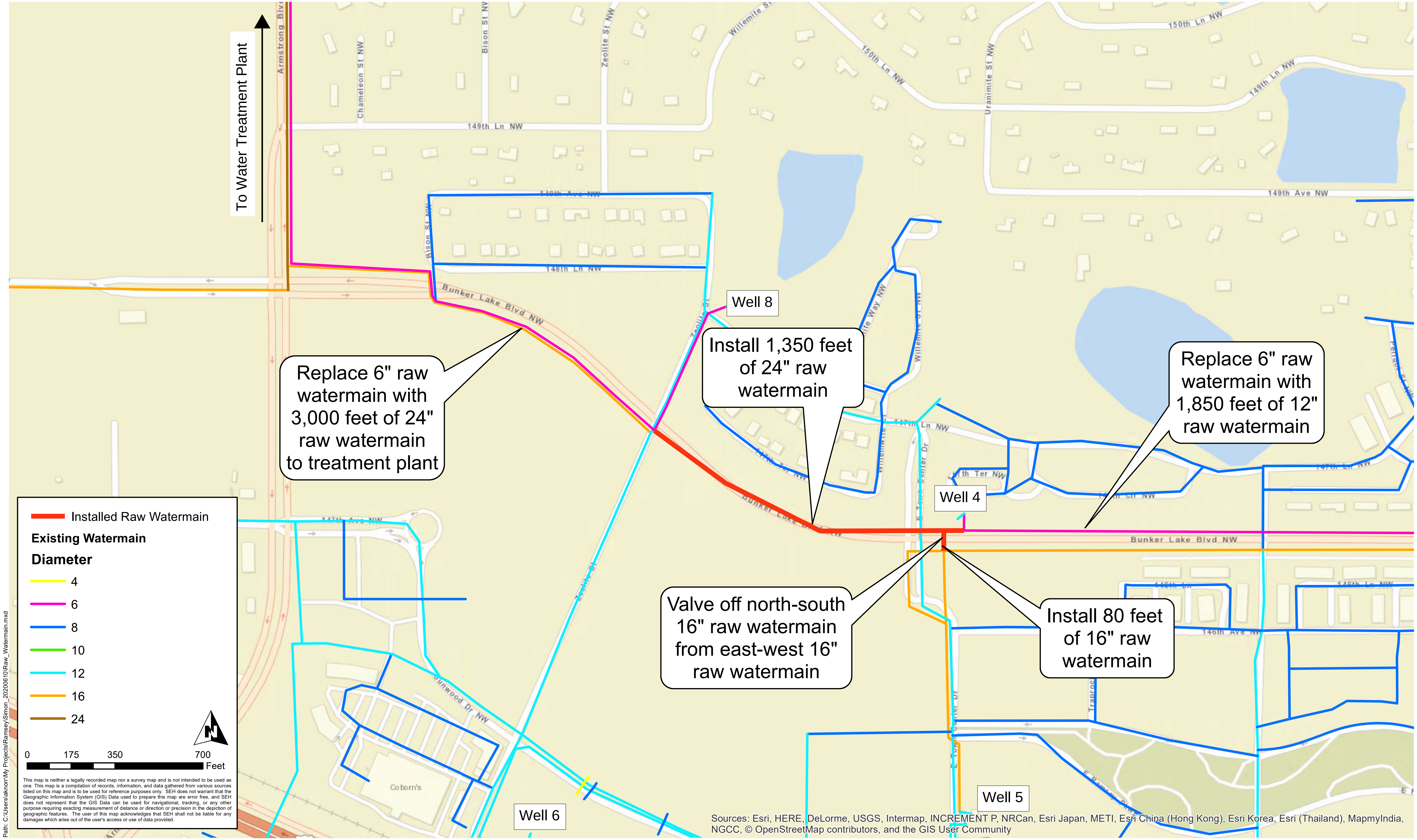
WTP SITE ALTERNATIVES

Ramey, Minnesota

Figure
1

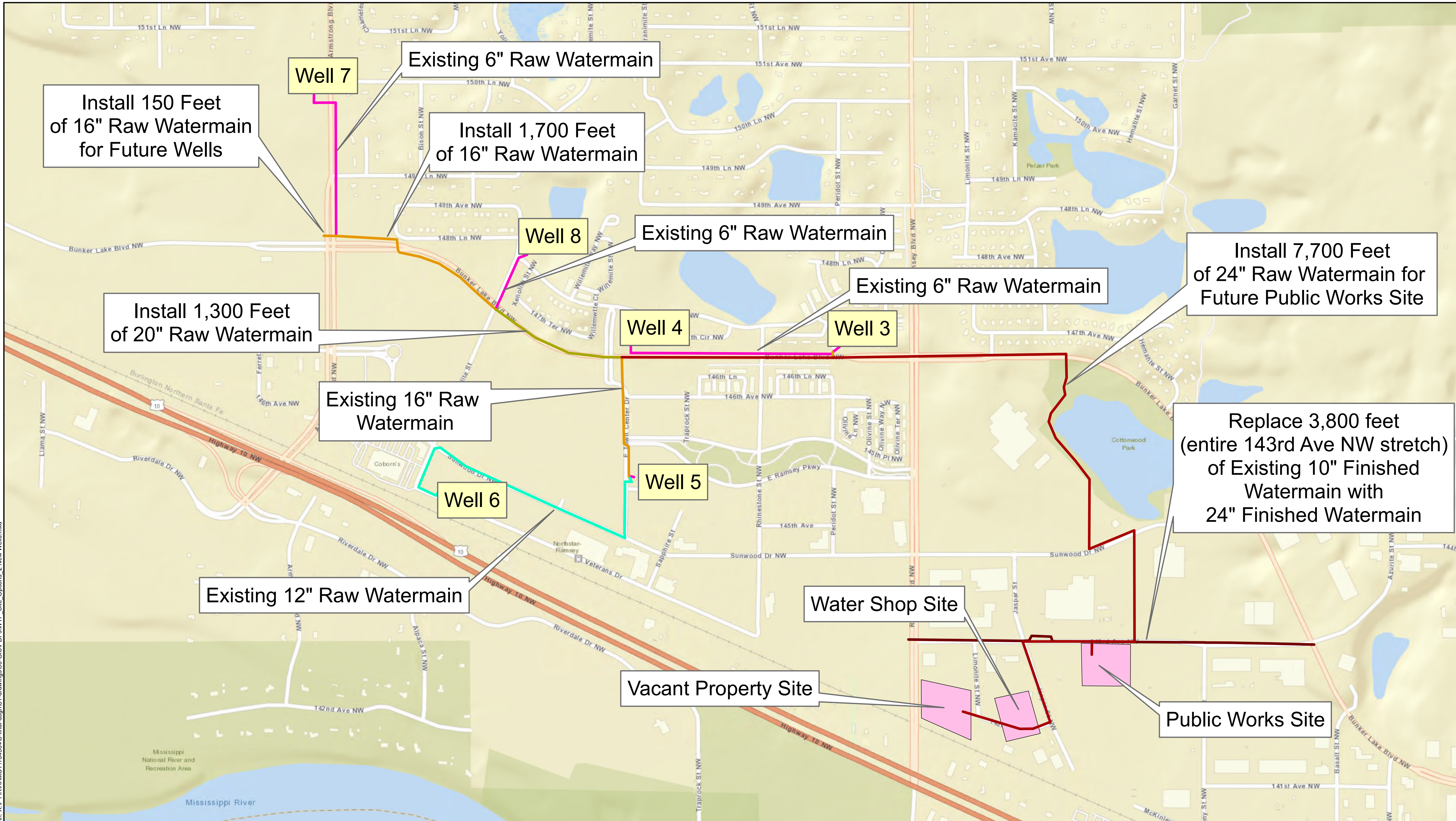


Project Number: RAMSY 154354
Print Date: Print Date: 6/16/2020

RAW WATERMAIN - FIRE STATION SITE

Ramsey, Minnesota

Figure 2
Raw Watermain



Path: X:\PT\R\RAMSY\154354\5-final-dsgn\51-drawings\90-GIS\PDFs\WTP_Site_Options_2 New Wells.mxd

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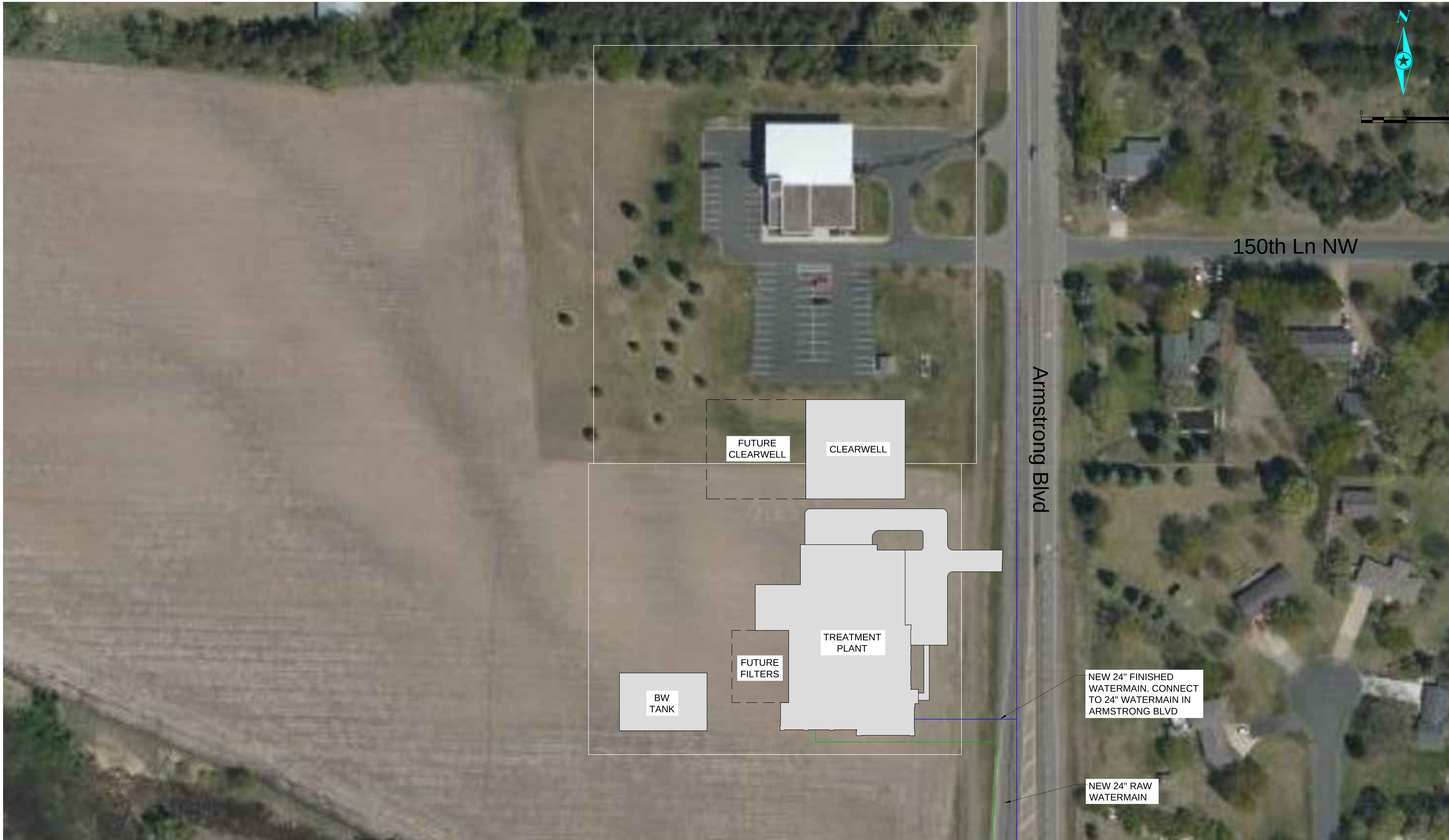
WATERMAIN - PUBLIC WORKS, WATER SHOP, OR VACANT PROPERTY SITES

Ramsey, Minnesota

Figure 3



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WTP Alternatives - Fire Station Site

Ramsey, Minneota

Figure 4

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WTP Alternatives - Public Works Site

Ramsey, Minneota

Figure 5

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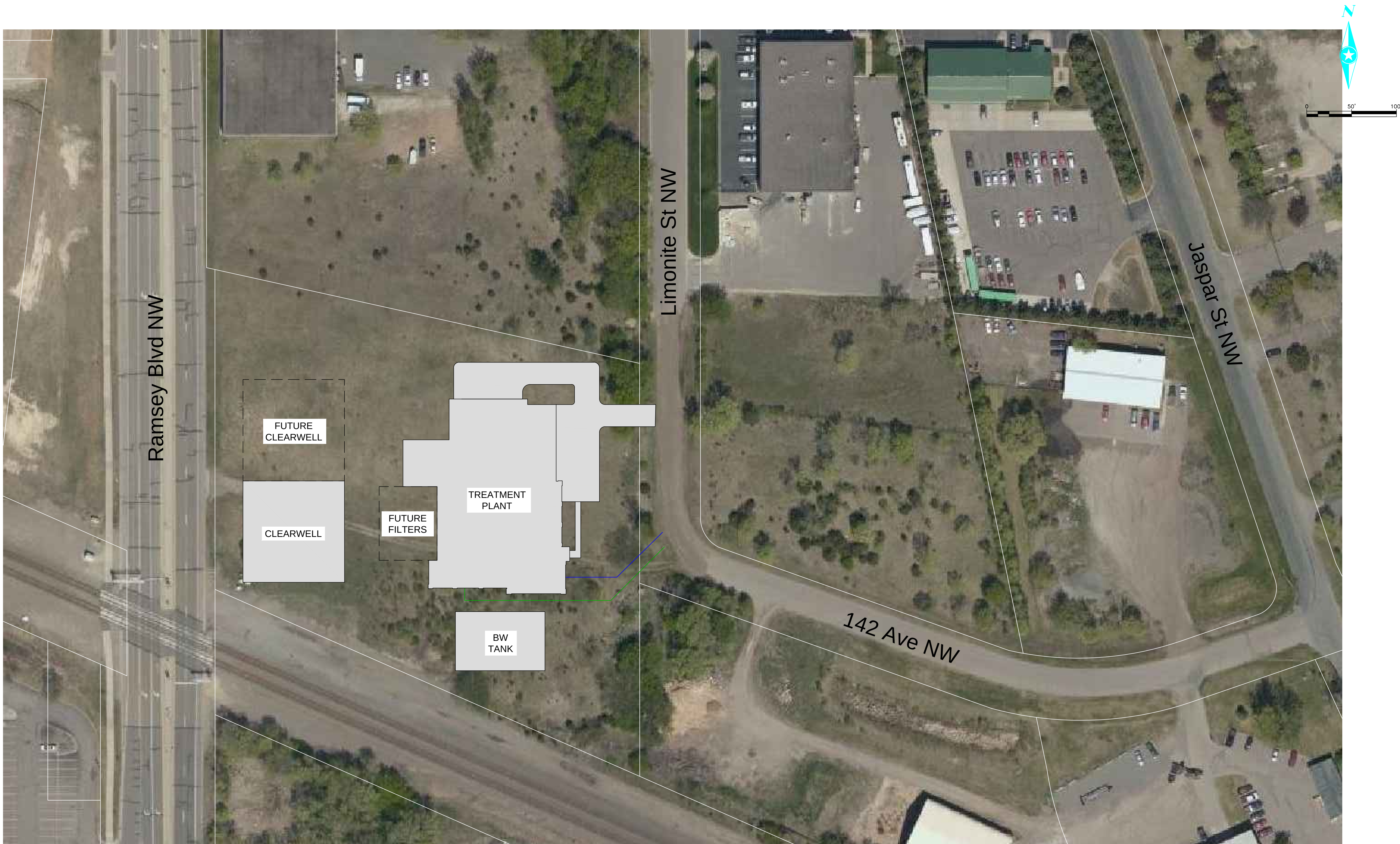
WTP Alternatives - Water Shop Site

Ramsey, Minneota

Figure 6



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WTP Alternatives - Vacant City Property Site

Ramsey, Minneota

Figure 7

Appendix J

Capital Cost Opinions

Project Name:	Ramsey WTP Feasibility Study
SEH Project No:	154354
Date:	March 3, 2021
Estimator:	MBJ
Description:	Alternative 1 - Concrete Gravity WTP

DIVISION 1 - GENERAL REQUIREMENTS	UNIT	EST. QUANTITY	UNIT PRICE	AMOUNT
GENERAL CONDITIONS	LUMP SUM	1	$ 2,368,955.00	$ 2,368,955.00
SUBTOTAL DIVISION 0 AND 01				*$ 2,368,955.00*
DIVISION 3 - CONCRETE	**UNIT**	**EST. QUANTITY**	**UNIT PRICE**	**AMOUNT**
CAST IN PLACE CONCRETE - BACKWASH TANKS	CU YD	950	$ 1,100.00	$ 1,045,000.00
CAST IN PLACE CONCRETE - CLEARWELL	CU YD	1500	$ 1,100.00	$ 1,650,000.00
CAST IN PLACE CONCRETE - FILTERS	CU YD	1050	$ 1,100.00	$ 1,155,000.00
CAST IN PLACE CONCRETE - SLAB ON GRADE/FOOTINGS	CU YD	600	$ 900.00	$ 540,000.00
PRECAST STRUCTURAL CONCRETE - 8" PLANK	SQ FT	9800	$ 25.00	$ 245,000.00
PRECAST STRUCTURAL CONCRETE - 12" PLANK	SQ FT	12700	$ 35.00	$ 444,500.00
SUBTOTAL DIVISION 3				*$ 5,079,500.00*
DIVISION 4 - MASONRY	**UNIT**	**EST. QUANTITY**	**UNIT PRICE**	**AMOUNT**
BRICK/STONE VENEER	SF	14600	$ 40.00	$ 584,000.00
CONCRETE UNIT MASONRY	SQ FT	34000	$ 35.00	$ 1,190,000.00
SUBTOTAL DIVISION 4				*$ 1,774,000.00*
DIVISION 5 - METALS	**UNIT**	**EST. QUANTITY**	**UNIT PRICE**	**AMOUNT**
RAILING, ALUMINUM - WTP	LIN FT	1000	$ 115.00	$ 115,000.00
MISCELLANEOUS METALS - WTP	LUMP SUM	1	$ 200,000.00	$ 200,000.00
SUBTOTAL DIVISION 5				*$ 315,000.00*
DIVISION 6 - WOOD, PLASTICS & COMPOSITES	**UNIT**	**EST. QUANTITY**	**UNIT PRICE**	**AMOUNT**
PLASTIC FABRICATIONS - FRP LADDERS	EACH	14	$ 3,000.00	$ 42,000.00
ROUGH CARPENTRY	LUMP SUM	1	$ 40,000.00	$ 40,000.00
GYPSUM DRYWALL	SF	8000	$ 4.00	$ 32,000.00
SUBTOTAL DIVISION 6				*$ 114,000.00*
DIVISION 7 - THERMAL & MOISTURE PROTECTION	**UNIT**	**EST. QUANTITY**	**UNIT PRICE**	**AMOUNT**
JOINT SEALANTS	LUMP SUM	1	$ 40,000.00	$ 40,000.00
WATERPROOFING/AIR BARRIER	LUMP SUM	1	$ 200,000.00	$ 200,000.00
MEMBRANE ROOFING AND INSULATION	SF	21600	$ 25.00	$ 540,000.00
SUBTOTAL DIVISION 7				*$ 780,000.00*
DIVISION 8 - OPENINGS	**UNIT**	**EST. QUANTITY**	**UNIT PRICE**	**AMOUNT**
FRP DOORS (SINGLE LEAF)	EACH	30	$ 3,300.00	$ 99,000.00
FRP DOORS (DOUBLE LEAF)	EACH	3	$ 6,600.00	$ 19,800.00
OVERHEAD DOOR - CHLORINE ROOM	EACH	1	$ 17,500.00	$ 17,500.00
ALUMINUM STOREFRONT	LUMP SUM	1	$ 260,000.00	$ 260,000.00
WINDOWS	EACH	28	$ 3,000.00	$ 84,000.00
FIRE RATED ALUM. FRAME AND GLASS	LUMP SUM	1	$ 5,000.00	$ 5,000.00
TANK HATCHES	UNIT	10	$ 3,000.00	$ 30,000.00
LOUVERS	LUMP SUM	1	$ 20,000.00	$ 20,000.00
SUBTOTAL DIVISION 8				*$ 535,300.00*
DIVISION 9 - FINISHES	**UNIT**	**EST. QUANTITY**	**UNIT PRICE**	**AMOUNT**
ACOUSTICAL CEILING	SF	2000	$ 6.00	$ 12,000.00
FLOORING - TILE AND CARPET	LUMP SUM	1	$ 170,000.00	$ 170,000.00
WALL & CEILING PAINTING	SF	69000	$ 3.00	$ 207,000.00
EQUIPMENT/PROCESS PIPING PAINTING	LUMP SUM	1	$ 150,000.00	$ 150,000.00
SUBTOTAL DIVISION 9				*$ 539,000.00*
DIVISION 10 - SPECIALTIES	**UNIT**	**EST. QUANTITY**	**UNIT PRICE**	**AMOUNT**
TOILET ACCESSORIES	LUMP SUM	2	$ 2,500.00	$ 5,000.00
FIRE EXTINGUISHERS	EACH	10	$ 250.00	$ 2,500.00
INTERIOR PANEL SIGNAGE	LUMP SUM	1	$ 3,000.00	$ 3,000.00
SUBTOTAL DIVISON 10				*$ 10,500.00*
DIVISION 12 - FURNISHINGS	**UNIT**	**EST. QUANTITY**	**UNIT PRICE**	**AMOUNT**
METAL CASEWORK - BASE AND UPPERS	LUMP SUM	1	$ 35,000.00	$ 35,000.00

FURNITURE	LUMP SUM	1	$ 30,000.00	$ 30,000.00
SUBTOTAL DIVISION 12				*$ 65,000.00*
DIVISION 21 - FIRE SUPPRESSION	**UNIT**	**EST. QUANTITY**	**UNIT PRICE**	**AMOUNT**
FIRE PROTECTION SYSTEM (WET)	LUMP SUM	1	$ 75,000.00	$ 75,000.00
SUBTOTAL DIVISION 21				*$ 75,000.00*
DIVISION 22 - PLUMBING	**UNIT**	**EST. QUANTITY**	**UNIT PRICE**	**AMOUNT**
PLUMBING	LUMP SUM	1	$ 430,000.00	$ 430,000.00
SUBTOTAL DIVISION 22				*$ 430,000.00*
DIVISION 23 - HVAC	**UNIT**	**EST. QUANTITY**	**UNIT PRICE**	**AMOUNT**
HVAC	LUMP SUM	1	$ 910,000.00	$ 910,000.00
SUBTOTAL DIVISION 23				*$ 910,000.00*
DIVISION 26 - ELECTRICAL	**UNIT**	**EST. QUANTITY**	**UNIT PRICE**	**AMOUNT**
ELECTRICAL	LUMP SUM	1	$ 2,900,000.00	$ 2,900,000.00
SUBTOTAL DIVISION 26				*$ 2,900,000.00*
DIVISION 31 - EARTHWORK	**UNIT**	**EST. QUANTITY**	**UNIT PRICE**	**AMOUNT**
CLEAR AND GRUB	ACRE	2.00	$ 10,000.00	$ 20,000.00
BUILDING EXCAVATION	CU YD	8500	$ 15.00	$ 127,500.00
CLEARWELL EXCAVATION	CU YD	8000	$ 15.00	$ 120,000.00
BACKWASH TANK	CU YD	7500	$ 15.00	$ 112,500.00
HAULING EARTH	CU YD	12000	$ 8.00	$ 96,000.00
BACKFILLING & COMPACTING	CU YD	15000	$ 25.00	$ 375,000.00
EROSION CONTROL	EACH	1	$ 30,000.00	$ 30,000.00
SUBTOTAL DIVISION 31				*$ 881,000.00*
DIVISION 32 - EXTERIOR IMPROVEMENTS	**UNIT**	**EST. QUANTITY**	**UNIT PRICE**	**AMOUNT**
AGGREGATE BASE (CL 5)	CU YD	1500	$ 40.00	$ 60,000.00
BITUMINOUS PAVEMENT	TON	1300	$ 100.00	$ 130,000.00
4" CONCRETE SIDEWALK	SQ FT	4000	$ 10.00	$ 40,000.00
TOPSOIL BORROW (3" DEPTH)	CU YD	500	$ 25.00	$ 12,500.00
LANDSCAPING	LUMP SUM	1.0	$ 40,000.00	$ 40,000.00
CHAIN LIKE FENCE	LIN FT	1200	$ 90.00	$ 108,000.00
SUBTOTAL DIVISION 32				*$ 390,500.00*
DIVISION 33 - UTILITIES	**UNIT**	**EST. QUANTITY**	**UNIT PRICE**	**AMOUNT**
24" RAW WATERMAIN	LIN FT	7300	$ 230	$ 1,679,000.00
24" ROAD CROSSING (RAMSEY BLVD and BUNKER LAKE BLVD) - JACKED CASING	LIN FT	400	$ 525	$ 210,000.00
24" FINISHED WATERMAIN	LIN FT	3800	$ 230	$ 874,000.00
20" RAW WATERMAIN	LIN FT	1300	$ 185	$ 240,500.00
16" RAW WATERMAIN	LIN FT	1750	$ 165	$ 288,750.00
16" RAW WATERMAIN (ARMSTRONG BLVD) - JACKED CASING	LIN FT	100	$ 425	$ 42,500.00
WELL 8 METER VAULT	LUMP SUM	1	$ 90,000	$ 90,000.00
HYDRANTS	EACH	4	$ 10,000	$ 40,000.00
SITE PROCESS PIPING	LUMP SUM	1	$ 450,000	$ 450,000.00
SANITARY SEWER	LUMP SUM	1	$ 50,000.00	$ 50,000.00
STORM SEWER	LUMP SUM	1	$ 40,000.00	$ 40,000.00
SUBTOTAL DIVISION 33				*$ 4,004,750.00*
DIVISION 40 - PROCESS INTERCONNECTIONS	**UNIT**	**EST. QUANTITY**	**UNIT PRICE**	**AMOUNT**
PROCESS PIPING AND VALVES	LUMP SUM	1	$ 2,700,000.00	$ 2,700,000.00
SUBTOTAL DIVISION 40				*$ 2,700,000.00*
DIVISION 43 - PROCESS GAS & LIQUID HANDLING, PURIFICATION & STORAGE EQUI	**UNIT**	**EST. QUANTITY**	**UNIT PRICE**	**AMOUNT**
HIGH SERVICE VERTICAL TURBINE PUMPS	EACH	5	$ 50,000.00	$ 250,000.00
BACKWASH VERTICAL TURBINE PUMP	EACH	1	$ 50,000.00	$ 50,000.00
MAGNETIC FLOW METERS	LUMP SUM	1	$ 80,000.00	$ 80,000.00
SUBTOTAL DIVISION 43				*$ 380,000.00*
DIVISION 44 - POLLUTION & CONTROL EQUIPMENT	**UNIT**	**EST. QUANTITY**	**UNIT PRICE**	**AMOUNT**
COMPRESSED AIR SYSTEM	LUMP SUM	1	$ 16,000.00	$ 16,000.00
AIR SCOUR BLOWER	EACH	1	$ 25,000.00	$ 25,000.00
GRAVITY FILTER EQUIPMENT	LUMP SUM	1	$ 900,000.00	$ 900,000.00
LAMELLA PLATE SETTLERS	EACH	2	$ 350,000.00	$ 700,000.00
GAS CHLORINATION SYSTEM	LUMP SUM	1	$ 50,000.00	$ 50,000.00
POLYPHOSPHATE FEED EQUIPMENT	LUMP SUM	1	$ 25,000.00	$ 25,000.00

SODIUM PERMANGANATE FEED EQUIPMENT	LUMP SUM	1	$ 40,000.00	$ 40,000.00
CHEMICAL FEED PIPING	LUMP SUM	1	$ 50,000.00	$ 50,000.00
				$ 1,806,000.00
SUBTOTAL CONSTRUCTION				**$ 26,060,000.00**
CONTINGENCY			10%	$ 2,606,000.00
TOTAL CONSTRUCTION				**$ 28,670,000.00**

Project Name:	Ramsey WTP Feasibility Study
SEH Project No:	154354
Date:	March 4, 2021
Estimator:	MBJ
Description:	Alternative 2 - Pressure Filter WTP

DIVISION 1 - GENERAL REQUIREMENTS	UNIT	EST. QUANTITY	UNIT PRICE	AMOUNT
GENERAL CONDITIONS	LUMP SUM	1	$ 2,251,435.00	$ 2,251,435.00
SUBTOTAL DIVISION 0 AND 01				*$ 2,251,435.00*
DIVISION 3 - CONCRETE	**UNIT**	**EST. QUANTITY**	**UNIT PRICE**	**AMOUNT**
CAST IN PLACE CONCRETE - BACKWASH TANKS	CU YD	950	$ 1,100.00	$ 1,045,000.00
CAST IN PLACE CONCRETE - SLAB ON GRADE/FOOTINGS	CU YD	1600	$ 1,100.00	$ 1,760,000.00
PRECAST STRUCTURAL CONCRETE - 8" PLANK	SQ FT	8500	$ 25.00	$ 212,500.00
PRECAST STRUCTURAL CONCRETE - 12" PLANK	SQ FT	10300	$ 35.00	$ 360,500.00
SUBTOTAL DIVISION 3				*$ 3,378,000.00*
DIVISION 4 - MASONRY	**UNIT**	**EST. QUANTITY**	**UNIT PRICE**	**AMOUNT**
BRICK/STONE VENEER	SF	12600	$ 40.00	$ 504,000.00
CONCRETE UNIT MASONRY	SQ FT	27000	$ 35.00	$ 945,000.00
SUBTOTAL DIVISION 4				*$ 1,449,000.00*
DIVISION 5 - METALS	**UNIT**	**EST. QUANTITY**	**UNIT PRICE**	**AMOUNT**
MISCELLANEOUS METALS - WTP	LUMP SUM	1	$ 150,000.00	$ 150,000.00
SUBTOTAL DIVISION 5				*$ 150,000.00*
DIVISION 6 - WOOD, PLASTICS & COMPOSITES	**UNIT**	**EST. QUANTITY**	**UNIT PRICE**	**AMOUNT**
PLASTIC FABRICATIONS - FRP LADDERS	EACH	6	$ 3,000.00	$ 18,000.00
ROUGH CARPENTRY	LUMP SUM	1	$ 30,000.00	$ 30,000.00
GYPSUM DRYWALL	SF	8000	$ 4.00	$ 32,000.00
SUBTOTAL DIVISION 6				*$ 80,000.00*
DIVISION 7 - THERMAL & MOISTURE PROTECTION	**UNIT**	**EST. QUANTITY**	**UNIT PRICE**	**AMOUNT**
JOINT SEALANTS	LUMP SUM	1	$ 40,000.00	$ 40,000.00
WATERPROOFING/AIR BARRIER	LUMP SUM	1	$ 200,000.00	$ 200,000.00
MEMBRANE ROOFING AND INSULATION	SF	22200	$ 25.00	$ 555,000.00
SUBTOTAL DIVISION 7				*$ 795,000.00*
DIVISION 8 - OPENINGS	**UNIT**	**EST. QUANTITY**	**UNIT PRICE**	**AMOUNT**
FRP DOORS (SINGLE LEAF)	EACH	26	$ 3,300.00	$ 85,800.00
FRP DOORS (DOUBLE LEAF)	EACH	3	$ 6,600.00	$ 19,800.00
OVERHEAD DOOR - CHLORINE ROOM	EACH	1	$ 17,500.00	$ 17,500.00
ALUMINUM STOREFRONT	LUMP SUM	1	$ 200,000.00	$ 200,000.00
WINDOWS	EACH	28	$ 3,000.00	$ 84,000.00
FIRE RATED ALUM. FRAME AND GLASS	LUMP SUM	1	$ 5,000.00	$ 5,000.00
TANK HATCHES	UNIT	6	$ 3,000.00	$ 18,000.00
LOUVERS	LUMP SUM	1	$ 20,000.00	$ 20,000.00
SUBTOTAL DIVISION 8				*$ 450,100.00*
DIVISION 9 - FINISHES	**UNIT**	**EST. QUANTITY**	**UNIT PRICE**	**AMOUNT**
ACOUSTICAL CEILING	SF	2000	$ 6.00	$ 12,000.00
FLOORING - TILE AND CARPET	LUMP SUM	1	$ 150,000.00	$ 150,000.00
WALL & CEILING PAINTING	SF	48000	$ 3.00	$ 144,000.00
EQUIPMENT/PROCESS PIPING PAINTING	LUMP SUM	1	$ 275,000.00	$ 275,000.00
SUBTOTAL DIVISION 9				*$ 581,000.00*
DIVISION 10 - SPECIALTIES	**UNIT**	**EST. QUANTITY**	**UNIT PRICE**	**AMOUNT**
TOILET ACCESSORIES	LUMP SUM	2	$ 2,500.00	$ 5,000.00
FIRE EXTINGUISHERS	EACH	10	$ 250.00	$ 2,500.00
INTERIOR PANEL SIGNAGE	LUMP SUM	1	$ 3,000.00	$ 3,000.00
SUBTOTAL DIVISON 10				*$ 10,500.00*
DIVISION 12 - FURNISHINGS	**UNIT**	**EST. QUANTITY**	**UNIT PRICE**	**AMOUNT**
METAL CASEWORK - BASE AND UPPERS	LUMP SUM	1	$ 35,000.00	$ 35,000.00
FURNITURE	LUMP SUM	1	$ 30,000.00	$ 30,000.00
SUBTOTAL DIVISION 12				*$ 65,000.00*
DIVISION 21 - FIRE SUPPRESSION	**UNIT**	**EST. QUANTITY**	**UNIT PRICE**	**AMOUNT**

FIRE PROTECTION SYSTEM (WET)	LUMP SUM	1	$ 75,000.00	$ 75,000.00
SUBTOTAL DIVISION 21				*$ 75,000.00*
DIVISION 22 - PLUMBING	**UNIT**	**EST. QUANTITY**	**UNIT PRICE**	**AMOUNT**
PLUMBING	LUMP SUM	1	$ 430,000.00	$ 430,000.00
SUBTOTAL DIVISION 22				*$ 430,000.00*
DIVISION 23 - HVAC	**UNIT**	**EST. QUANTITY**	**UNIT PRICE**	**AMOUNT**
HVAC	LUMP SUM	1	$ 835,000.00	$ 835,000.00
SUBTOTAL DIVISION 23				*$ 835,000.00*
DIVISION 26 - ELECTRICAL	**UNIT**	**EST. QUANTITY**	**UNIT PRICE**	**AMOUNT**
ELECTRICAL	LUMP SUM	1	$ 2,200,000.00	$ 2,200,000.00
SUBTOTAL DIVISION 26				*$ 2,200,000.00*
DIVISION 31 - EARTHWORK	**UNIT**	**EST. QUANTITY**	**UNIT PRICE**	**AMOUNT**
CLEAR AND GRUB	ACRE	2.00	$ 10,000.00	$ 20,000.00
BUILDING EXCAVATION	CU YD	4000	$ 15.00	$ 60,000.00
BACKWASH TANK	CU YD	7500	$ 15.00	$ 112,500.00
HAULING EARTH	CU YD	4000	$ 8.00	$ 32,000.00
BACKFILLING & COMPACTING	CU YD	4000	$ 25.00	$ 100,000.00
EROSION CONTROL	EACH	1	$ 30,000.00	$ 30,000.00
SUBTOTAL DIVISION 31				*$ 354,500.00*
DIVISION 32 - EXTERIOR IMPROVEMENTS	**UNIT**	**EST. QUANTITY**	**UNIT PRICE**	**AMOUNT**
AGGREGATE BASE (CL 5)	CU YD	1500	$ 40.00	$ 60,000.00
BITUMINOUS PAVEMENT	TON	1300	$ 100.00	$ 130,000.00
4" CONCRETE SIDEWALK	SQ FT	4000	$ 10.00	$ 40,000.00
TOPSOIL BORROW (3" DEPTH)	CU YD	500	$ 25.00	$ 12,500.00
LANDSCAPING	LUMP SUM	1.0	$ 40,000.00	$ 40,000.00
CHAIN LIKE FENCE	LIN FT	1200	$ 90.00	$ 108,000.00
SUBTOTAL DIVISION 32				*$ 390,500.00*
DIVISION 33 - UTILITIES	**UNIT**	**EST. QUANTITY**	**UNIT PRICE**	**AMOUNT**
24" RAW WATERMAIN	LIN FT	7300	$ 230	$ 1,679,000.00
24" ROAD CROSSING (RAMSEY BLVD and BUNKER LAKE BLVD) - JACKED CASING	LIN FT	400	$ 525	$ 210,000.00
24" FINISHED WATERMAIN	LIN FT	3800	$ 230	$ 874,000.00
20" RAW WATERMAIN	LIN FT	1300	$ 185	$ 240,500.00
16" RAW WATERMAIN	LIN FT	1750	$ 165	$ 288,750.00
16" RAW WATERMAIN (ARMSTRONG BLVD) - JACKED CASING	LIN FT	100	$ 425	$ 42,500.00
WELL 8 METER VAULT	LUMP SUM	1	$ 90,000	$ 90,000.00
HYDRANTS	EACH	4	$ 10,000.00	$ 40,000.00
SITE PROCESS PIPING	LUMP SUM	1	$ 250,000.00	$ 250,000.00
SANITARY SEWER	LUMP SUM	1	$ 50,000.00	$ 50,000.00
STORM SEWER	LUMP SUM	1	$ 40,000.00	$ 40,000.00
SUBTOTAL DIVISION 33				*$ 3,804,750.00*
DIVISION 40 - PROCESS INTERCONNECTIONS	**UNIT**	**EST. QUANTITY**	**UNIT PRICE**	**AMOUNT**
PROCESS PIPING AND VALVES	LUMP SUM	1	$ 2,950,000.00	$ 2,950,000.00
SUBTOTAL DIVISION 40				*$ 2,950,000.00*
DIVISION 43 - PROCESS GAS & LIQUID HANDLING, PURIFICATION & STORAGE EQUI	**UNIT**	**EST. QUANTITY**	**UNIT PRICE**	**AMOUNT**
MAGNETIC FLOW METERS	LUMP SUM	1	$ 110,000.00	$ 110,000.00
SUBTOTAL DIVISION 43				*$ 110,000.00*
DIVISION 44 - POLLUTION & CONTROL EQUIPMENT	**UNIT**	**EST. QUANTITY**	**UNIT PRICE**	**AMOUNT**
COMPRESSED AIR SYSTEM	LUMP SUM	1	$ 16,000.00	$ 16,000.00
AIR SCOUR BLOWER	EACH	1	$ 25,000.00	$ 25,000.00
PRESSURE FILTER EQUIPMENT	LUMP SUM	1	$ 3,500,000.00	$ 3,500,000.00
LAMELLA PLATE SETTLERS	EACH	2	$ 350,000.00	$ 700,000.00
GAS CHLORINATION SYSTEM	LUMP SUM	1	$ 50,000.00	$ 50,000.00
POLYPHOSPHATE FEED EQUIPMENT	LUMP SUM	1	$ 25,000.00	$ 25,000.00
SODIUM PERMANGANATE FEED EQUIPMENT	LUMP SUM	1	$ 40,000.00	$ 40,000.00
CHEMICAL FEED PIPING	LUMP SUM	1	$ 50,000.00	$ 50,000.00
				$ 4,406,000.00
TOTAL CONSTRUCTION				**$ 24,766,000.00**
CONTINGENCY			10%	$ 2,477,000.00
TOTAL PROJECT				**$ 27,240,000.00**

Appendix K

Life Cycle Cost Opinions

Updated: 3-Mar-21

50 Year Life Cycle Cost Estimate
Altenative 1
Concrete Gravity Filter Water Treatment Plant, Ramsey, Minnesota

Division	Item	Capital Cost		Annual Repair Costs	Capital Cost plus Admin, Eng, etc.	Useful Life	First Replacement PW	Second Replacement PW	Third Replacement PW	Salvage Value	Salvage Value PW	Total Materials & Equipment Replacement PW
1	General	$2,368,955	9.09%	$0	$2,944,962	50	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
3	Concrete	$5,079,500	19.49%	$0	$6,314,570	75	$0.00	$0.00	$0.00	$2,104,856.76	($2,104,856.76)	($2,104,856.76)
4	Masonry	$1,774,000	6.81%	$0	$2,205,345	50	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
5	Metals	$315,000	1.21%	$0	$391,592	50	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
6	Wood & Plastics	$114,000	0.44%	$0	$141,719	50	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
7	Thermal & Moisture	$780,000	2.99%	$5,000	$969,655	30	$969,655.44	$0.00	$0.00	$323,218.48	($323,218.48)	$646,436.96
8	Doors &Windows	$535,300	2.05%	$10,000	$665,457	25	$665,457.12	$0.00	$0.00	$0.00	$0.00	$665,457.12
9	Finishes	$539,000	2.07%	$5,000	$670,057	25	$670,056.77	$0.00	$0.00	$0.00	$0.00	$670,056.77
10	Specialties	$10,500	0.04%	$0	$13,053	30	$13,053.05	$0.00	$0.00	$4,351.02	($4,351.02)	$8,702.04
12	Furnishings	$65,000	0.25%	$0	$80,805	25	$80,804.62	$0.00	$0.00	$0.00	$0.00	$80,804.62
21	Fire Suppression	$75,000	0.29%	$0	$93,236	25	$93,236.10	$0.00	$0.00	$0.00	$0.00	$93,236.10
22	Plumbing	$430,000	1.65%	$0	$534,554	40	$534,553.64	$0.00	$0.00	$400,915.23	($400,915.23)	$133,638.41
23	HVAC	$910,000	3.49%	$20,000	$1,131,265	25	$1,131,264.68	$0.00	$0.00	$0.00	$0.00	$1,131,264.68
26	Electrical	$2,900,000	11.13%	$30,000	$3,605,129	25	$3,605,129.20	$0.00	$0.00	$0.00	$0.00	$3,605,129.20
31	Earthwork	$881,000	3.38%	$0	$1,095,213	50	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
32	Exterior Improvements	$390,500	1.50%	$0	$485,449	40	$485,449.29	$0.00	$0.00	$364,086.97	($364,086.97)	$121,362.32
33	Utilities	$4,004,750	15.37%	$0	$4,978,497	50	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
40	Process Piping	$2,700,000	10.36%	$10,000	$3,366,500	25	$3,366,499.60	$0.00	$0.00	$0.00	$0.00	$3,366,499.60
43	Process Pumps/Meters	$380,000	1.46%	$20,000	$472,396	30	$472,396.24	$0.00	$0.00	$157,465.41	($157,465.41)	$314,930.83
44	Process Equipment	$1,806,000	6.93%	$20,000	$2,245,125	35	$2,245,125.29	$0.00	$0.00	$1,282,928.74	($1,282,928.74)	$962,196.55
	TOTALS	$26,060,000	99.99%	$120,000	$32,400,000							$9,694,858

Inflation = 2.75%
Interest = 2.00%
Financing Years= 20

50 Year Life Cycle (Present Worth)		20 year Annual Costs		
Capital Project Costs	$32,400,000	Loan Payment	$1,981,478	
Equipment Replacement	$9,694,858	Annual Equipment Replacement	$308,522	
Labor	$6,488,398	Labor	$110,000	
Gas	$1,179,709	Gas	$20,000	
Chemicals	$6,488,398	Chemicals	$110,000	3 mgd, 2 mg/L Cl @ $1/lb, 1 mg/L NaMnO4 @ $10/gal, 2 mg/L phosphate @ $5/gal
Insurance	$1,769,563	Insurance	$30,000	
Electricity	$6,783,325	Electricity	$115,000	Assumes 120kW 24/7 at $0.10 per kWh
Equip. Repair	$7,078,253	Equip. Repair	$120,000	
TOTAL PW	$71,880,000	**TOTAL ANNUAL COST:**	$2,795,000	

Updated: 3-Mar-21

50 Year Life Cycle Cost Estimate
Altenative 2
Pressure Filter Water Treatment Plant, Ramsey, Minnesota

Division	Item	Capital Cost		Annual Repair Costs	Capital Cost plus Contingency, Admin, Eng, etc.	Useful Life	First Replacement PW	Second Replacement PW	Third Replacement PW	Salvage Value	Salvage Value PW	Total Materials & Equipment Replacement PW
1	General	$2,251,435	9.09%	$0	$2,798,534	50	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
3	Concrete	$3,378,000	13.64%	$0	$4,198,854	75	$0.00	$0.00	$0.00	$1,399,618.00	($1,399,618.00)	($1,399,618.00)
4	Masonry	$1,449,000	5.85%	$0	$1,801,107	50	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
5	Metals	$150,000	0.61%	$0	$186,450	50	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
6	Wood & Plastics	$80,000	0.32%	$0	$99,440	50	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
7	Thermal & Moisture	$795,000	3.21%	$5,000	$988,185	30	$988,185.00	$0.00	$0.00	$329,395.00	($329,395.00)	$658,790.00
8	Doors &Windows	$450,100	1.82%	$10,000	$559,474	25	$559,474.30	$0.00	$0.00	$0.00	$0.00	$559,474.30
9	Finishes	$581,000	2.35%	$10,000	$722,183	25	$722,183.00	$0.00	$0.00	$0.00	$0.00	$722,183.00
10	Specialties	$10,500	0.04%	$0	$13,052	30	$13,051.50	$0.00	$0.00	$4,350.50	($4,350.50)	$8,701.00
12	Furnishings	$65,000	0.26%	$0	$80,795	25	$80,795.00	$0.00	$0.00	$0.00	$0.00	$80,795.00
21	Fire Suppression	$75,000	0.30%	$0	$93,225	25	$93,225.00	$0.00	$0.00	$0.00	$0.00	$93,225.00
22	Plumbing	$430,000	1.74%	$0	$534,490	40	$534,490.00	$0.00	$0.00	$400,867.50	($400,867.50)	$133,622.50
23	HVAC	$835,000	3.37%	$20,000	$1,037,905	25	$1,037,905.00	$0.00	$0.00	$0.00	$0.00	$1,037,905.00
26	Electrical	$2,200,000	8.88%	$30,000	$2,734,600	25	$2,734,600.00	$0.00	$0.00	$0.00	$0.00	$2,734,600.00
31	Earthwork	$354,500	1.43%	$0	$440,644	50	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
32	Exterior Improvements	$390,500	1.58%	$0	$485,392	40	$485,391.50	$0.00	$0.00	$364,043.63	($364,043.63)	$121,347.88
33	Utilities	$3,804,750	15.36%	$0	$4,729,304	50	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
40	Process Piping	$2,950,000	11.91%	$10,000	$3,666,850	25	$3,666,850.00	$0.00	$0.00	$0.00	$0.00	$3,666,850.00
43	Process Pumps/Meters	$110,000	0.44%	$5,000	$136,730	30	$136,730.00	$0.00	$0.00	$45,576.67	($45,576.67)	$91,153.33
44	Process Equipment	$4,406,000	17.79%	$75,000	$5,476,658	25	$5,476,658.00	$0.00	$0.00	$0.00	$0.00	$5,476,658.00
	TOTALS	$24,766,000	100.00%	$165,000	$30,780,000							$13,985,687

Inflation = 2.75%
Interest = 2.00%
Financing Years= 20

50 Year Life Cycle (Present Worth)		20 year Annual Costs		
Capital Project Costs	$30,780,000	Loan Payment	$1,882,404	
Equipment Replacement	$13,985,687	Annual Equipment Replacement	$445,069	
Labor	$6,488,398	Labor	$110,000	
Gas	$1,179,709	Gas	$20,000	
Chemicals	$6,488,398	Chemicals	$110,000	3 mgd, 2 mg/L Cl @ $1/lb, 1 mg/L NaMnO4 @ $10/gal, 2 mg/L phosphate @ $5/gal
Insurance	$589,854	Insurance	$10,000	
Electricity	$6,193,471	Electricity	$105,000	Assumes 120kW 24/7 at $0.10 per kWh
Equip. Repair	$9,732,597	Equip. Repair	$165,000	
TOTAL PW	$75,440,000	**TOTAL ANNUAL COST:**	$2,847,000	

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UNIVERSITY OF MINNESOTA
MINNESOTA GEOLOGICAL SURVEY
Harvey Thorleifson, Director

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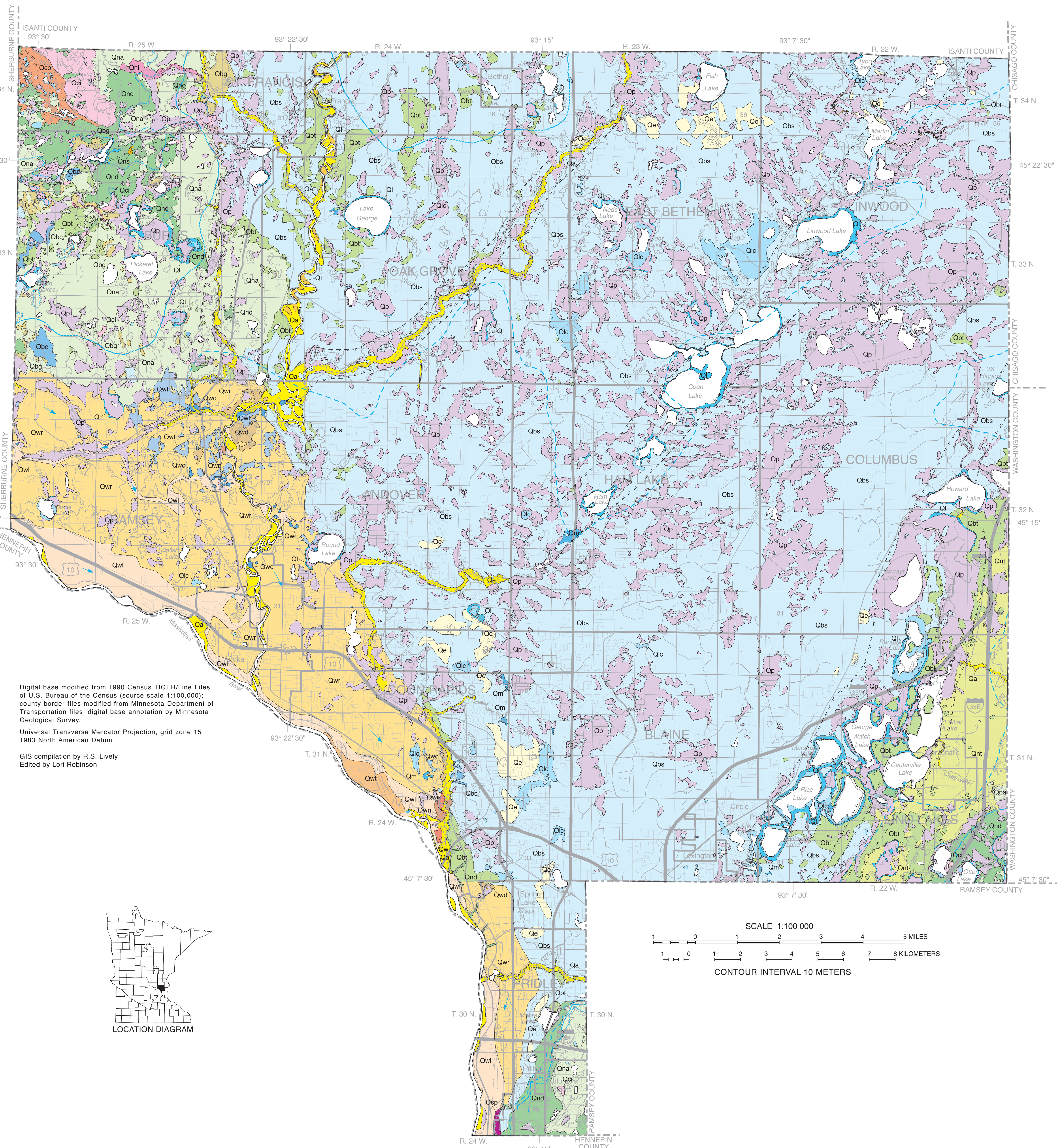
AND THE MINNESOTA ENVIRONMENT AND NATURAL RESOURCES TRUST FUND
AS RECOMMENDED BY THE LEGISLATIVE-CITIZEN COMMISSION ON MINNESOTA RESOURCES



Digital base modified from 1990 Census TIGER/Line Files of U.S. Bureau of the Census (source scale 1:100,000); county border files modified from Minnesota Department of Transportation files; digital base annotation by Minnesota Geological Survey.

Universal Transverse Mercator Projection, grid zone 15
1983 North American Datum

GIS compilation by R.S. Lively
Edited by Lori Robinson

LOCATION DIAGRAM

SCALE 1:100 000

1 0 1 2 3 4 5 MILES

1 0 1 2 3 4 5 6 7 8 KILOMETERS

CONTOUR INTERVAL 10 METERS

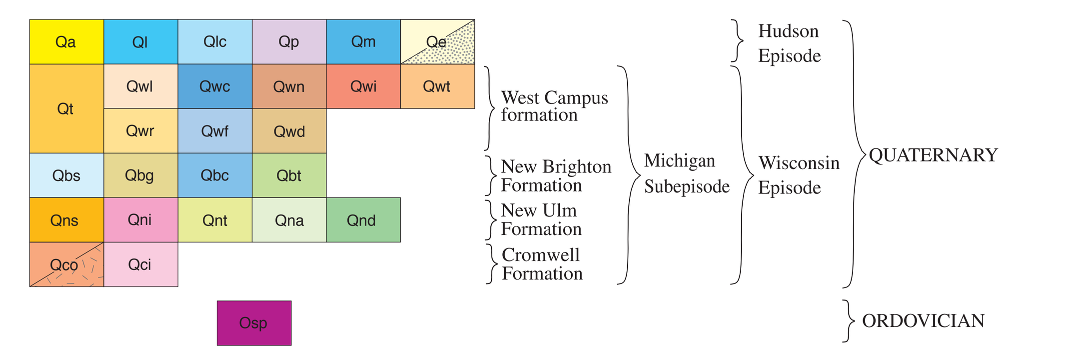
SURFICIAL GEOLOGY

By

Gary N. Meyer

2011

CORRELATION OF MAP UNITS



MAP SYMBOLS

Geologic contact—Approximately located.

General flow direction of former streams—Arrow points downstream in the direction glacial meltwater last flowed.

Approximate shoreline of glacial Lake Anoka—The maximum extent of the lake is obscure because it was supported by buried stagnant ice. The landscape was lowered as the ice melted. Sediment of the New Ulm and Cromwell Formations mapped within the bounds of glacial Lake Anoka have been wave-washed and covered in places with thin beds of silt, sand, or gravel. The sediment in some of these areas subsequently collapsed due to melt-out of underlying stagnant ice. However, some of the collapsed areas now lower in elevation than adjacent areas of the New Brighton Formation likely were once islands or peninsulas in glacial Lake Anoka. The Hugo and Fridley levels of the lake are recognized still-stands during the gradual drainage of glacial Lake Anoka (Meyer, 1998).

Fridley level—About 915 feet (279 meters) above mean sea level.

Hugo level—About 940 feet (287 meters) above mean sea level.

Maximum extent—About 960 feet (293 meters) above mean sea level.

Esker—A sinuous ridge of predominantly sand and gravel, interpreted to have been deposited in an ice-walled stream or subglacial tunnel. Arrows show inferred flow direction. Where burying the fluvial sediment of Superior-lobe eskers, younger sediments may be more than 30 feet (9 meters) thick.

Broad, irregular trough—Hachures point downslope; identified by alignment of depressions and lakes. Likely mark partially filled, pre-existing channels. These troughs are interpreted to reflect valleys cut by meltwater flowing beneath Superior lobe ice that were buried by subsequent glacial events. Drainage channels beneath Superior lobe ice locally eroded deeply into the substrate, and in places may have exploited pre-existing bedrock valleys.

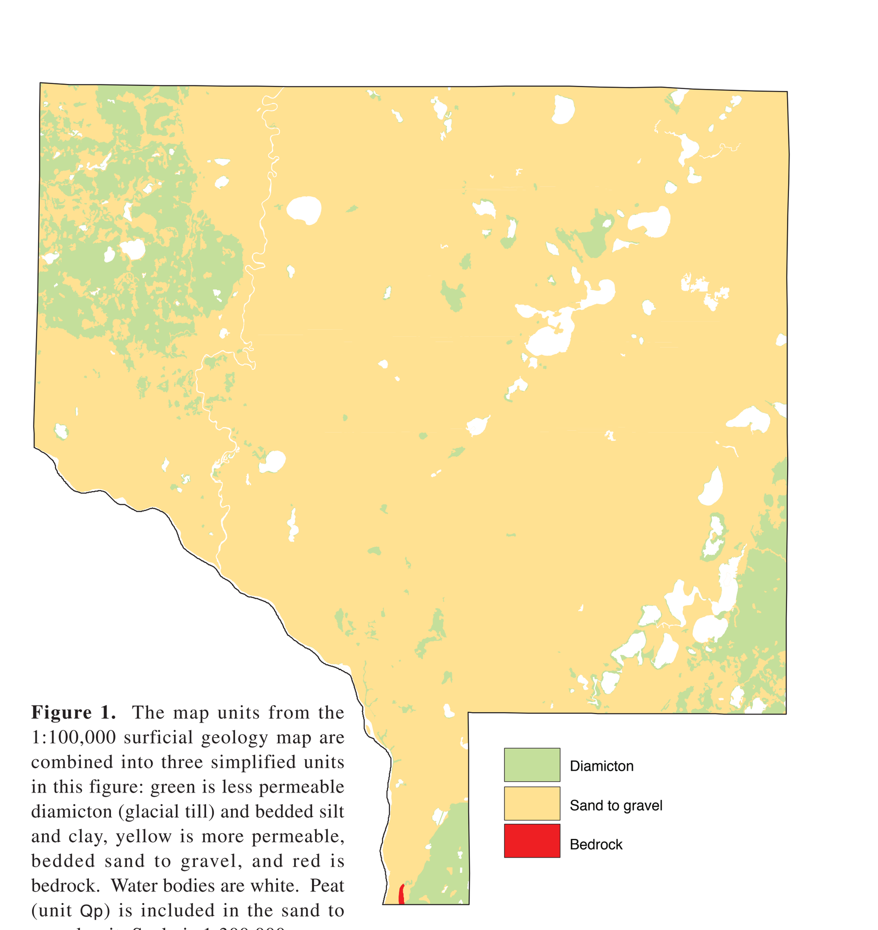


Figure 1. The map units from the 1:100,000 surficial geology map are combined into three simplified units in this figure: green is less permeable diamicton (glacial till) and bedded silt and clay, yellow is more permeable, bedded sand to gravel, and red is bedrock. Water bodies are white. Peat (unit Qp) is included in the sand to gravel unit. Scale is 1:300,000.

INTRODUCTION

The surficial geology map of Anoka County shows the earth material expected to be encountered below the topsoil, generally about 3 feet (1 meter) below the land surface. The map is a revision of Meyer and Patterson (1999) and Meyer (2007), based largely on a 40 percent increase in water-well log data collected for this project. Anoka County soil surveys of various ages (Smith and others, 1918; Chamberlain, 1977; Natural Resources Conservation Service, 2009) were relied on extensively, particularly in mapping the postglacial swamp and lake deposits. Field work included drilling 18 shallow auger holes and collecting 4 deep rotary-sonic cores. In Figure 1, the surficial sediments are grouped for simplicity into more permeable (bedded sand to gravel) and less permeable (bedded silt to clay and diamicton) units. The topographic expression created mainly by glacial sculpturing and subsequent meltwater erosion and deposition is displayed on the Digital Elevation Model (Fig. 2). The surficial geology of Anoka County, like most of Minnesota, is dominated by unconsolidated sediments laid down by glacial ice and meltwater during the Wisconsin Episode (Johnson and others, 1997). Glacial ice from the continental ice sheet to the north (the Laurentide ice sheet) entered the county from different directions, reflected in the diverse deposits they left behind. The provenance of an ice advance (Fig. 3; Table 1) is the unique area of bedrock that the ice passed over and incorporated, and then deposited as it moved away from its source area. During the final recession of glacial ice from the region, sand deposited in glacial Lake Anoka covered much of the county (Meyer, 1998). Post-glacial processes during the Hudson Episode (Johnson and others, 1997) continue to alter the landscape of the county, albeit in a less dramatic fashion.

DESCRIPTION OF MAP UNITS

QUATERNARY

Hudson Episode

Qa **Alluvium**—Typically coarser-grained (sand and gravel) in the channels, and finer-grained (fine-grained sand and silt) on floodplains. Generally coarsens with depth. Wider areas are typically topped by and interbedded with thin, organic-rich layers, and some depressions within the floodplains have been filled with thick silty to clayey sediment. Unit comprises sediment of modern streams. Along the Mississippi River, unit consists of generally less than 6 feet (2 meters) of silt loam to loamy sand overlying sand, gravelly sand, or cobbly gravel, with scattered wood and shell fragments. Sand is chiefly present along the Rum River, commonly overlain by about 5 feet (1.5 meters) of sandy loam to loamy sand, with interbeds of organic-rich layers or gravelly sand in some places. Sediment along smaller streams is generally more loamy and organic-rich.

Qlc **Lake silt and clay**—Organic-rich, deposited in ponded water (limnic sediment); interbedded with sand at the margins in places; mollusk shells are locally common. Generally greater than 3 feet (1 meter) thick, and more than 30 feet (9 meters) thick in the center of some deposits (Wilson and Potzger, 1943); covered by up to 4 feet (1.2 meters) of peat and muck. Marl may be present at depth. In developed areas, some of these deposits have been drained and buried under artificial fill; the organic sediment is commonly removed prior to filling in areas where structures are built.

Ql **Lake sand**—Sand to gravelly sand, with local organic-rich layers, loamy in places where bordering glacial sediment (till); deposited in a beach or nearshore environment; includes human-made beaches. In places underlies or overlies muck, peat, or limnic sediment. Width of exposure varies depending on the water level in the lake. Includes ice ramparts (sediment pushed into ridges by the expansion of lake ice; Zumberge, 1952), such as along the north shore of Neds Lake in East Bethel (T. 33 N., R. 23 W., sec. 9).

Qp **Peat and muck**—Partially decomposed plant matter deposited in swamps, commonly formed in ice-block melt-out depressions and in former meltwater channels. Generally mapped only where greater than 4 feet (1.2 meters) thick. Includes fine-grained organic matter laid down in ponded water, marl at depth in places, and small bodies of open water. In developed areas, many of these deposits have been drained and buried under artificial fill; the organic sediment is commonly removed prior to filling in areas where structures are built (such as in Blaine).

Qm **Marl**—Calcareous clay deposited in ponded water; mollusk shells are common. Generally greater than 3 feet (1 meter) thick; covered by 1 to 4 feet (0.3 to 1.2 meters) of peat and muck. In developed areas, some of these deposits have been drained and buried under artificial fill; the soft sediment is commonly removed prior to filling in areas where structures are built.

Qe **Eolian sand**—Well-sorted, very fine- to medium-grained sand; blown by predominantly northwest winds (Keen, 1985) into generally low-lying dunes, except in stippled areas where dune relief exceeds 30 feet (9 meters). The upper part of the fine-grained sand deposited in glacial Lake Anoka (unit Qbs) has likely been altered by wind activity across much of the county, but eolian deposits are only mapped where dune relief generally exceeds 5 feet (1.5 meters). Dunes were likely more extensive than mapped in the more urbanized areas, where landforms have been obliterated by human activity.

Wisconsin Episode

Qt **Terrace sand and gravelly sand**—Fluvial sediment laid down by the nascent Rum River, and preserved in a terrace above the modern floodplain. Initial entrenchment of the Rum River valley was likely begun during the drainage of glacial Lake Anoka, and continued as the master stream, the Mississippi River, formed its valley.

West Campus formation (Meyer and Patterson, 1999)—Mostly sand and gravelly sand of mixed Riding Mountain and Superior provenance (Fig. 3; Table 1); scattered cobbles occur in places. Sediments were laid down during early, higher stages of the Mississippi River, and preserved in terraces above the modern floodplain. The West Campus formation is mapped at two major terrace levels above St. Anthony Falls in Minneapolis.

Qwl ***Langdon terrace***—Sand and gravelly sand about 10 to 40 feet (3 to 12 meters) above the modern floodplain, ranging in elevation from about 840 feet (256 meters) in southern Fridley to about 880 feet (268 meters) in western Ramsey.

Qwc **Silt and clay facies**—Generally thinly bedded, clay to sandy silt; silt predominates over clay in most places. Deposited in slack water connected to the Mississippi River when it flowed at the Langdon terrace level. In places may include sediment of unit Qwf lowered by erosion to the Langdon terrace level, or possibly exhumed silt and clay of the New Brighton Formation (unit Qbc).

Qwn **Sand overlying yellowish to gray, sandy to loamy till**—Sand and gravelly sand generally less than 10 feet (3 meters) thick over till of the New Ulm Formation. Boulder lags are common at the contact.

Qwi **Sand overlying reddish silt and clay**—Sand and gravelly sand generally less than 10 feet (3 meters) thick over lacustrine silt and clay of the Sunrise Member (glacial Lake Lind deposits; Johnson, in press), and silty clayey till of the Coon Creek member (Meyer, 1998) of the Cromwell Formation.

Qwt **Sand overlying reddish sandy till**—Sand and gravelly sand generally less than 10 feet (3 meters) thick over sandy till of the Cromwell Formation. Boulder lags are common at the contact. Thin patches of silt and clay of the Sunrise Member are present in between the sand and till in places.

Qwr ***Richfield terrace***—Sand and gravelly sand about 50 to 70 feet (15 to 21 meters) above the modern floodplain, ranging in elevation from about 870 feet (265 meters) in southern Fridley to about 915 feet (279 meters) in western Ramsey.

Qwf **Silt and clay facies**—Generally thinly bedded, clay to sandy silt; silt predominates over clay in most places. Deposited in ice-block melt-out depressions by slack water of the Mississippi River at the Richfield terrace level. In places may include exhumed silt and clay of the New Brighton Formation (unit Qbc).

Qwd **Sand overlying yellowish to gray, sandy to loamy till**—Sand and gravelly sand generally less than 10 feet (3 meters) thick over till of the New Ulm Formation. Boulder lags are common at the contact. In places the sand overlies silt and clay of the New Brighton Formation (unit Qbc).

New Brighton Formation (Meyer, in press)—Mostly yellowish-brown to gray, fine-grained sand, laid down in glacial Lake Anoka. Clasts are of Riding Mountain provenance mixed with varying amounts of Superior provenance (Table 1). Included in these map units are some low-lying areas where New Brighton Formation sediment may be overlain by 3 feet (1 meter) or more of sandy to clayey, organic-bearing colluvium, or by thin peat.

Qbs ***Sand facies***—Very fine- to medium-grained sand; silty in places; contains scattered lenses of silt to silty clay at depth, mainly at the base. Gravelly sand occurs locally near the surface, especially where adjacent to glacial or fluvial sediment, and at depth in places. Following drainage of glacial Lake Anoka, the surface became pitted primarily due to melting of buried stagnant ice, but also in places by wind activity. The upper few feet (1 meter) of sand has commonly been reworked by wind.

Qbc ***Silt and clay facies***—Silt and clay; interbedded with fine-grained sand in places; locally rhythmically bedded. Unit is capped by generally less than 5 feet (1.5 meters) of fine-grained sand, and is generally less than 20 feet (6 meters) thick over till of the New Ulm Formation. Deposited in deeper, quiet water of glacial Lake Anoka, in depressions on the lake bottom. Unit occurs at the surface likely where the overlying sand facies was stripped away by wave action as the lake level was lowered, and finally drained. Where present at the surface above the Hugo level, the unit was likely deposited in calm bays isolated from the main body of the lake, where the prograding sand facies was laid down.

Qbg ***Sand and gravel facies***—Medium- to coarse-grained sand to fine-grained gravel; scattered cobbles in places. Deposited in deltaic or shallow-water environments in glacial Lake Anoka. Generally less than 20 feet (6 meters) thick over till, but in places may overlie coarser-grained fluvial sediment of the New Ulm or Cromwell Formations.

Qbt ***Fine-grained sand overlying yellowish to gray, loamy to sandy till***—Till of the New Ulm Formation beneath as much as 20 feet (6 meters) of lake sand. In places beneath the sand, gravel is present on the surface of the till. The sand also may overlie unit Qbc or till or lake sediment of the Cromwell Formation.

New Ulm Formation (Lusardi, in press)—Glacial, fluvial, and lacustrine sediment of Riding Mountain provenance (Table 1) deposited by ice and meltwater of the last glacial advance into the area, that of the Grantsburg sublobe (Fig. 3). Included in these map units are some low-lying areas where New Ulm Formation sediment may be overlain by 3 feet (1 meter) or more of sandy to clayey, organic-bearing colluvium, or by thin peat.

Qns ***Lake sand***—Very fine- to fine-grained sand and silty sand, with minor interbeds of silt and medium-grained sand. Capped and underlain in places by sandy silt. Coarse-grained, gravelly sand occurs locally along margins and at or near the base. The one deposit mapped, in T. 33 N., R. 25 W., sec. 4, was laid down in a small, ice-walled lake during retreat and stagnation of the Grantsburg sublobe.

Qni ***Ice-contact stratified deposit***—Sand, gravelly sand, and cobbly gravel. Deposited by meltwater flowing at or behind (beneath) the ice margin, during retreat and stagnation of the Grantsburg sublobe. Sediment can be quite variable and is typically faulted and folded. Commonly includes interbeds of, and in places is capped by, sandy to loamy diamicton (mudflow sediment) and silt (lake sediment). Typically forms hills and ridges.

Qnt ***Loamy till (wave-washed)***—Chiefly loam-textured, unsorted sediment (diamicton); pebbly, with scattered cobbles and rare boulders. Texture ranges to sandy clay loam and fine-grained sandy loam. Lenses of stratified sediment are uncommon in most areas. Generally more than 20 feet (6 meters) thick over the Cromwell Formation. Wave-washed and overlain in places by a few feet (1 meter) of sand to gravelly sand. The till surface is relatively flat, except for depressions created by ice-block melt-out.

Qna ***Sandy till***—Chiefly sandy loam-textured, unsorted sediment (diamicton), pebbly, with cobbles and boulders; commonly capped by, or interbedded with, thin deposits of silty to gravelly stratified sediment. Includes complex deposits of thick sand and gravel too small to distinguish on the map from adjacent till bodies. Large bodies of sand and gravel are present at depth in places. In the vicinity of the Twin Cities member, unit is commonly less than 20 feet (6 meters) thick over Cromwell Formation deposits. Within the bounds of glacial Lake Anoka the unit may include beach or nearshore sediment of the New Brighton Formation. Near present-day lakes the unit may include modern beach deposits.

Qnd ***Twin Cities member*** (Meyer and Patterson, 1999)—Complexly intermixed yellowish-brown to gray and reddish-brown to reddish-gray, loam- to sandy loam-textured, unsorted sediment (diamicton), pebbly, with cobbles and boulders. This mixture of both Riding Mountain and Superior provenance sediment formed by the erosion and incorporation of Cromwell Formation material by the overriding ice of the Grantsburg sublobe. Small lenses of stratified sediment are common in many areas. Covered in places by as much as 20 feet (6 meters) of the sandy till facies of the New Ulm Formation. Cromwell Formation deposits are commonly within 10 feet (3 meters) of the surface, and locally are at or very near the surface. Wave-washed and overlain in places by a few feet (1 meter) of lacustrine or eolian sand within areas covered by glacial Lake Anoka.

Cromwell Formation (Hobbs, in press)—Primarily fluvial sediment of Superior provenance (Table 1), deposited by Superior lobe (Fig. 3) meltwater. The upper part of Cromwell Formation deposits in Anoka County is commonly reworked (by the overriding Grantsburg sublobe or subsequent hydraulic action) and mantled in places too patchy to show by generally less than 10 feet (3 meters) of younger deposits.

Qco ***Outwash***—Sand, gravelly sand, and gravel; cobbly in places. Laid down by meltwater issuing from the ice margin. Bedding is highly disturbed in the patterned area due to the melting of underlying buried ice blocks following deposition of the sand and gravel.

Qci ***Ice-contact stratified deposit***—Sand, gravelly sand, and cobbly gravel; deposited by meltwater flowing at or behind (beneath) the retreating ice margin. Sediment can be quite variable and is typically faulted and folded owing to collapse upon melting of supporting ice. Commonly includes interbeds of, and in places is capped by sandy to silty diamicton (mudflow sediment) and silt (lake sediment). Some deposits contain boulders. Deposits generally stand as positive features on the landscape.

ORDOVICIAN

Osp **St. Peter Sandstone**—Massive, very fine- to medium-grained quartzose sandstone. At or near the surface following excavation to expand a railroad yard in southern Fridley.

ACKNOWLEDGEMENTS

Angela S. Gowan and Roberta S. Adams of the Minnesota Geological Survey carried out field work, including auger drilling and lithologic analysis, that contributed to this map.

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Table 1. Physical characteristics of mapped glacial deposits.

SOURCE AREA	NORTHWEST	NORTHEAST
PROVENANCE	RIDING MOUNTAIN	SUPERIOR
COLOR		
Oxidized	Yellow-brown to olive-brown	Red-brown
Unoxidized	Gray	Gray and red-gray
PEBBLE TYPE		
Carbonate	Common	Rare to uncommon
Mafic	Uncommon to common	Common to abundant
Red felsite	Rare to uncommon	Common
Gray shale	Uncommon to abundant	Absent

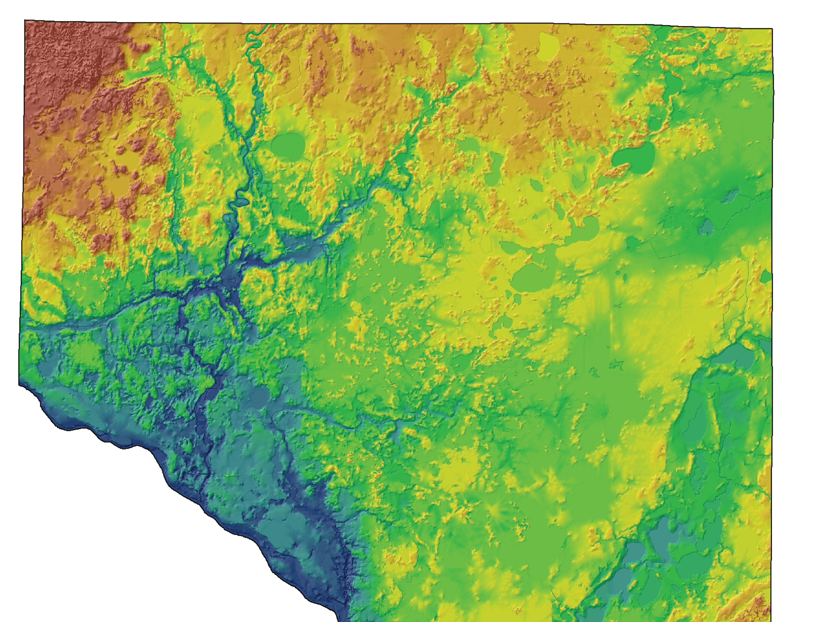

Figure 2. Physical relief of the land surface in Anoka County. Elevation is shown by color: red (higher surface elevation) grading to blue (lower surface elevation). A false sun illumination at an elevation of 30° from the northwest (315°) provides contrast (gray shadowing) to accent the details of the landforms. The map was created using the U.S. Geological Survey's Digital Elevation Model with a 10-meter grid; scale is 1:300,000.

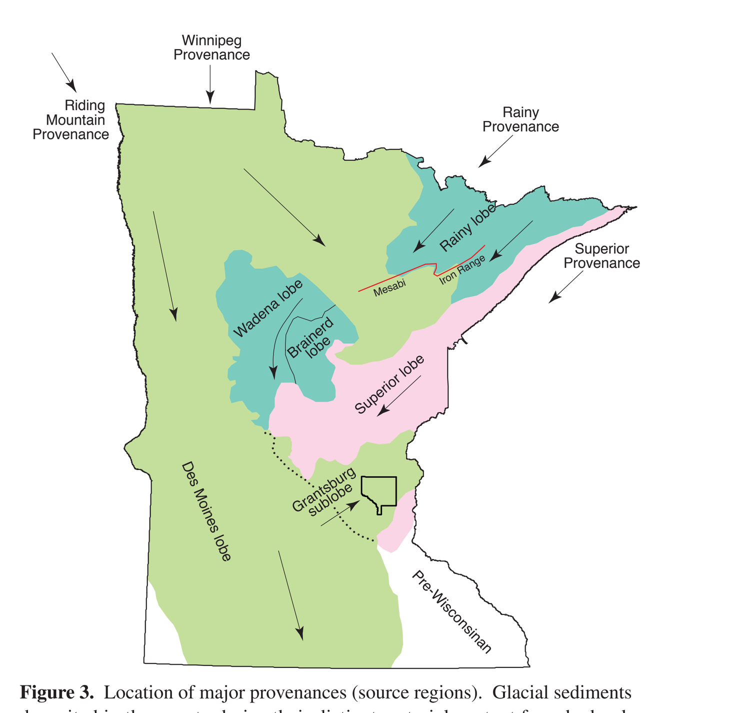

Figure 3. Location of major provenances (source regions). Glacial sediments deposited in the county derive their distinct material content from bedrock and sediment found in the region of these provenances. During the last glaciation, the Michigan Subepisode, Anoka County was repeatedly covered by ice carrying debris of Superior provenance, the Superior lobe (the line of maximum extent is dotted where covered by the Des Moines lobe). After the final retreat of the Superior lobe, the Grantsburg sublobe of the Des Moines lobe, carrying debris of Riding Mountain provenance, moved into the county from the southwest, covering it with ice one last time.

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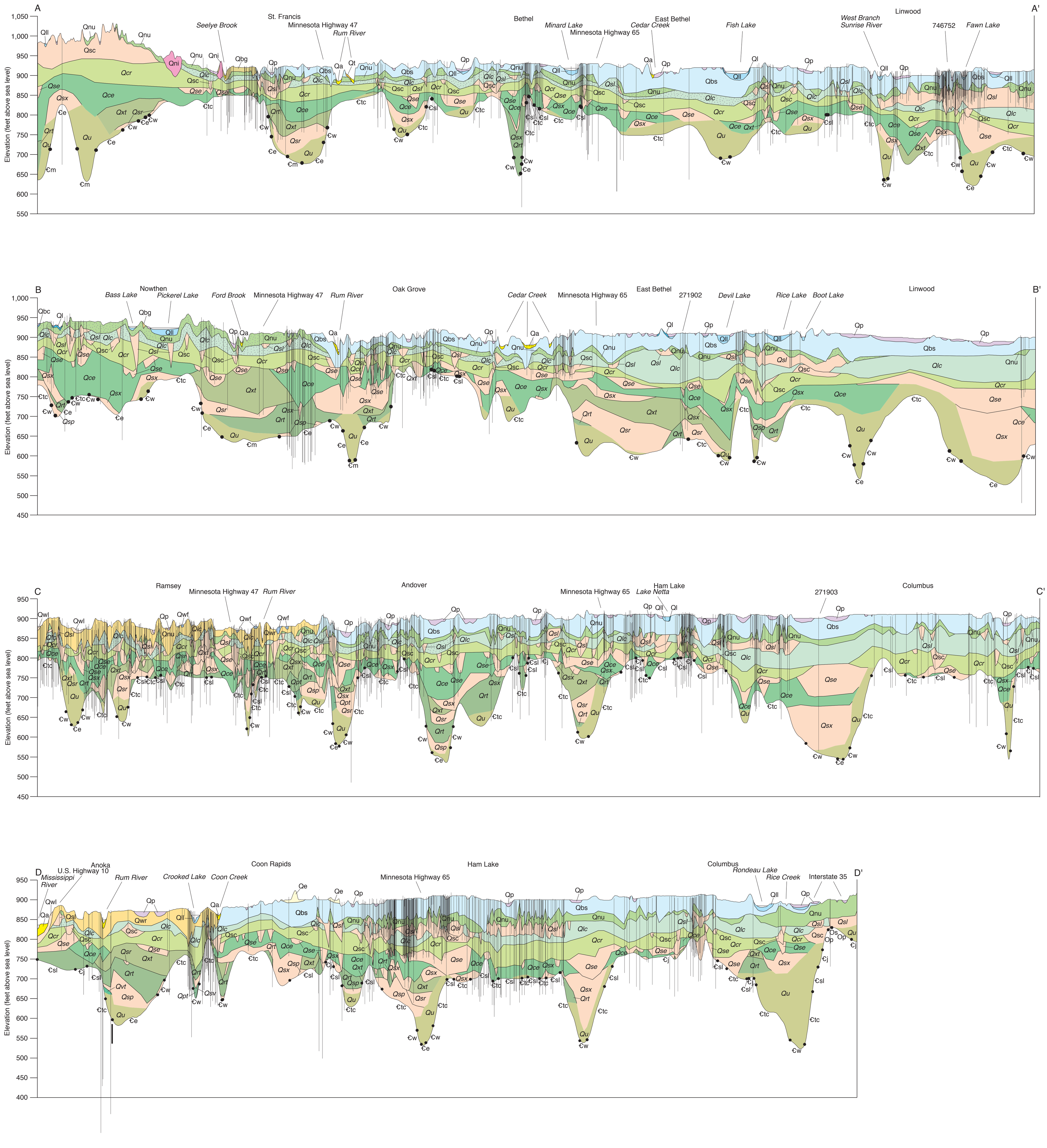
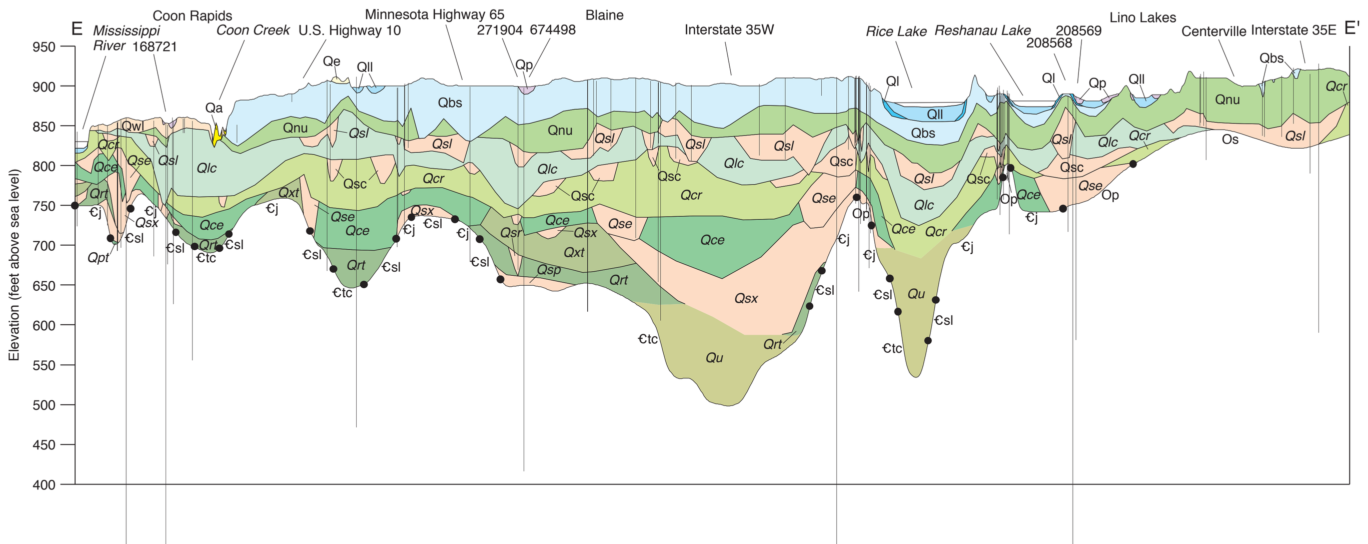
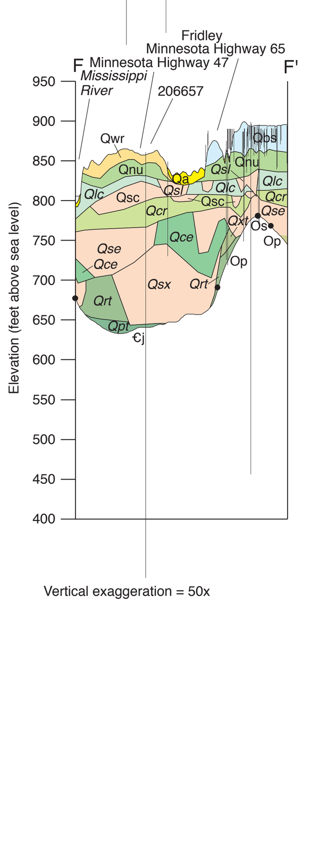
QUATERNARY STRATIGRAPHY

By
Gary N. Meyer

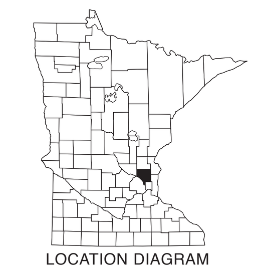
2013







Vertical exaggeration = 50x



LOCATION DIAGRAM

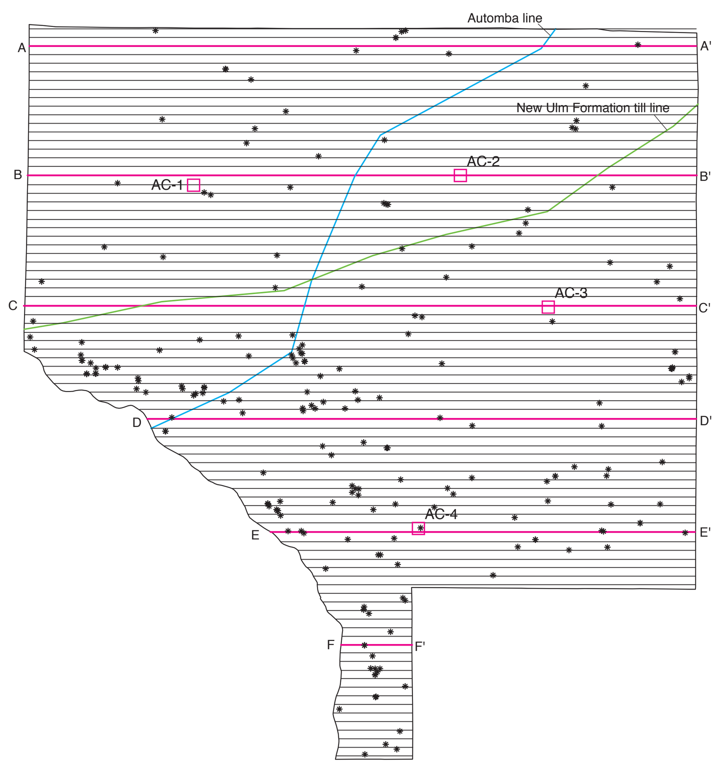


Figure 1. Location of the 87 cross sections, constructed at regular 0.3 mile (0.5 kilometer) intervals, used to create a three-dimensional model of the Quaternary deposits of Anoka County. The locations of cross sections A–A' through F–F' are shown here, and are also shown on Plate 3, *Surficial Geology*. Magenta squares depict the locations of the four Minnesota Geological Survey rotary-sonic core sites, and black asterisks depict the location of drill cutting sites. North of the green line, till of the New Ulm Formation (unit Qnu) is generally sandy textured, whereas south of the green line its texture ranges from loam to fine-grained sandy loam. Northwest of the blue line, till of the Automba phase of the Superior lobe (unit *Qlc*) is generally sandy, whereas to the southeast the till is clayey-textured. Scale is 1:300,000.

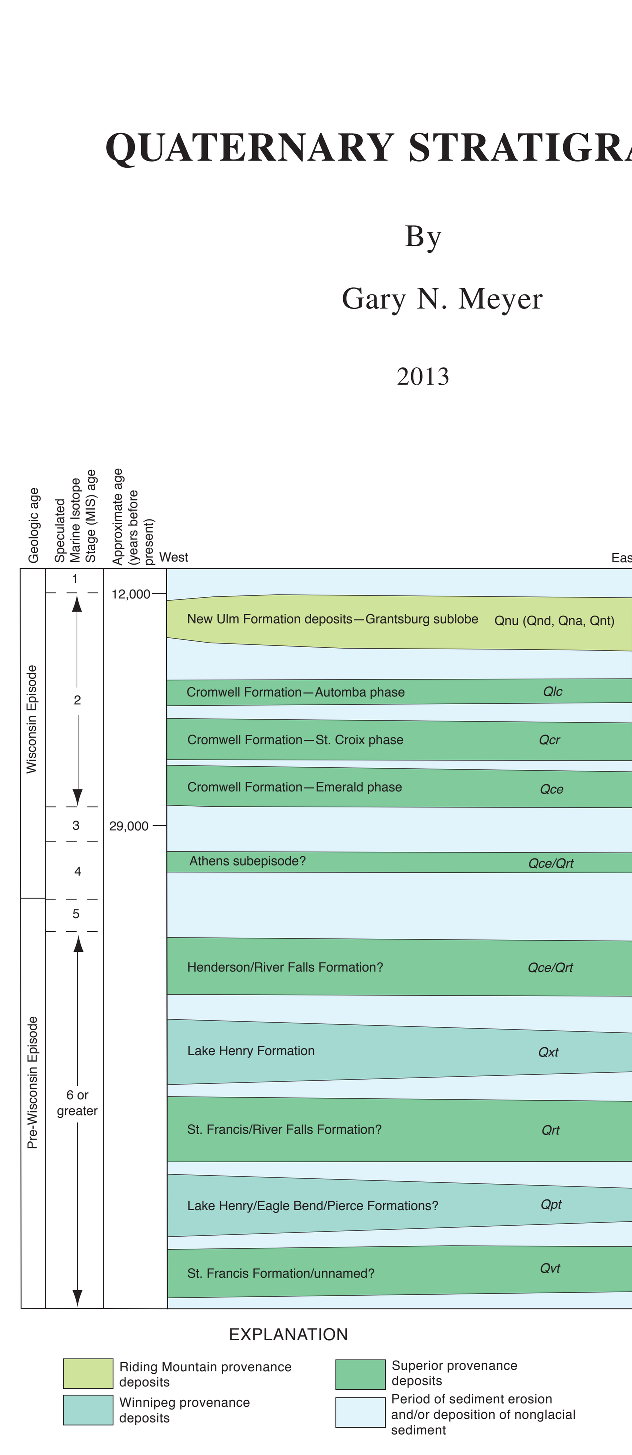


Figure 2. Diagram showing relative age, locations (across Anoka County from west to east), provenance (on Plate 3 see Fig. 3 and Table 1), and related unit labels from the cross sections for Wisconsin Episode and pre-Wisconsin Episode glacial deposits (Table 1); corresponding units from Plate 3, *Surficial Geology*, are shown in parentheses. The age column and deposit drawings are not to scale. Marine Isotope Stage correlations were estimated using figures in Jennings and others (2006). Approximate age shown for deglaciation of the Grantsburg sublobe (12,000 years before present) was based on radiocarbon dates from a half dozen sites in the Anoka County area (Meyer, 1998). Deposits of the Emerald phase bury an organic horizon in core from nearby Chisago County that yielded a radiocarbon date of about 29,000 years before present (Meyer, 2010). Marl deposits stratigraphically above the Lake Henry Formation in central Minnesota had a uranium series minimum age of 200,000 years before present (Knaeble and Meyer, 2007). Core samples from the older units in AC-2, AC-3, and AC-4 (Figs. 4 through 6) all were found to have normal polarity, indicating they were likely deposited after the Bruhnes normal–Matuyama reversed polarity boundary, dated at 780,000 years B.P. (Lisiecki and Raymo, 2005). These inferred dates place the cored pre-Wisconsin Episode units in the Middle Pleistocene, between Marine Isotope Stages 8 and 18.

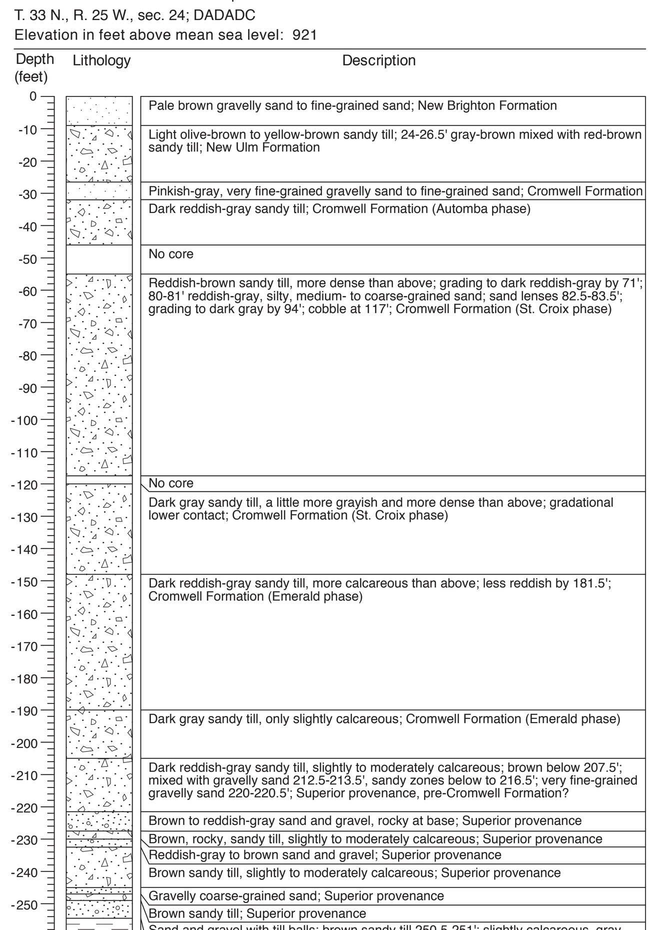


Figure 3. Descriptive log of rotary-sonic core AC-1, drilled by Mark J. Traut Wells for this study. Location of drilling is shown on Figure 1 and Plate 1, *Data-Base Map*.

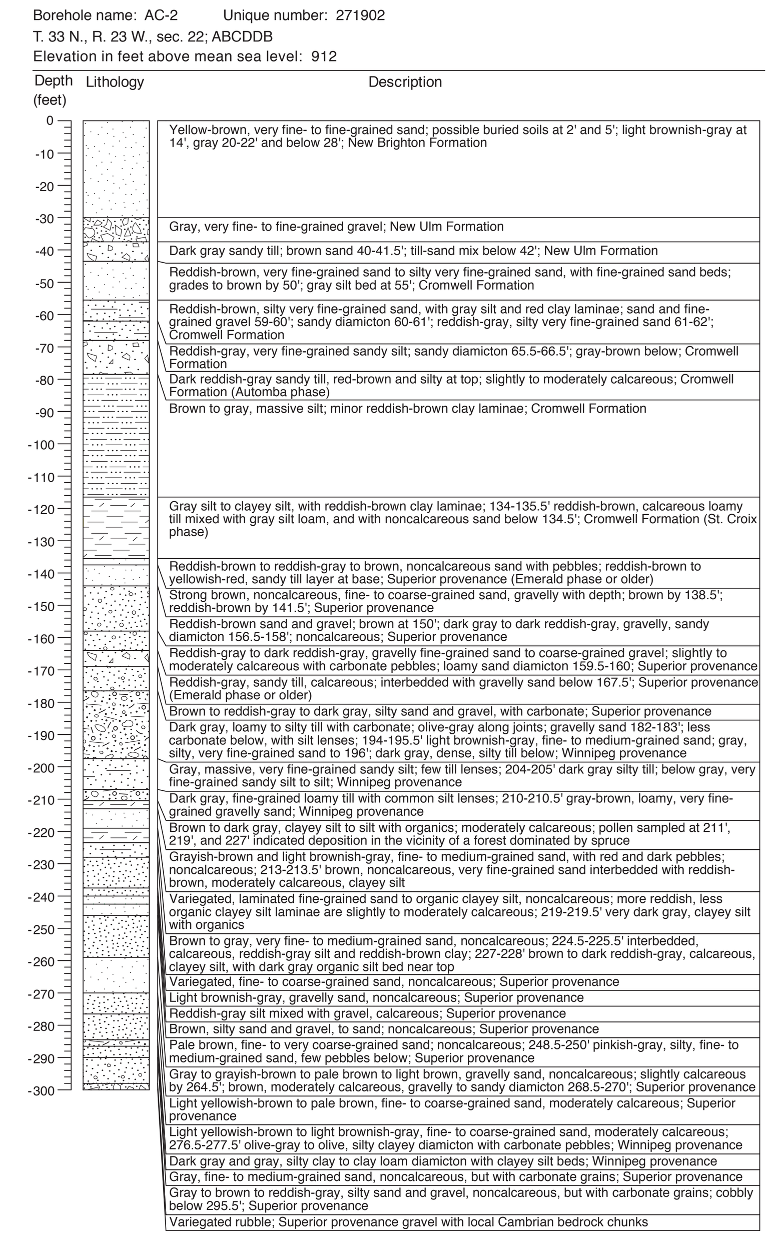


Figure 4. Descriptive log of rotary-sonic core AC-2, drilled by Mark J. Traut Wells for this study. Location of drilling is shown on Figure 1 and Plate 1, *Data-Base Map*.

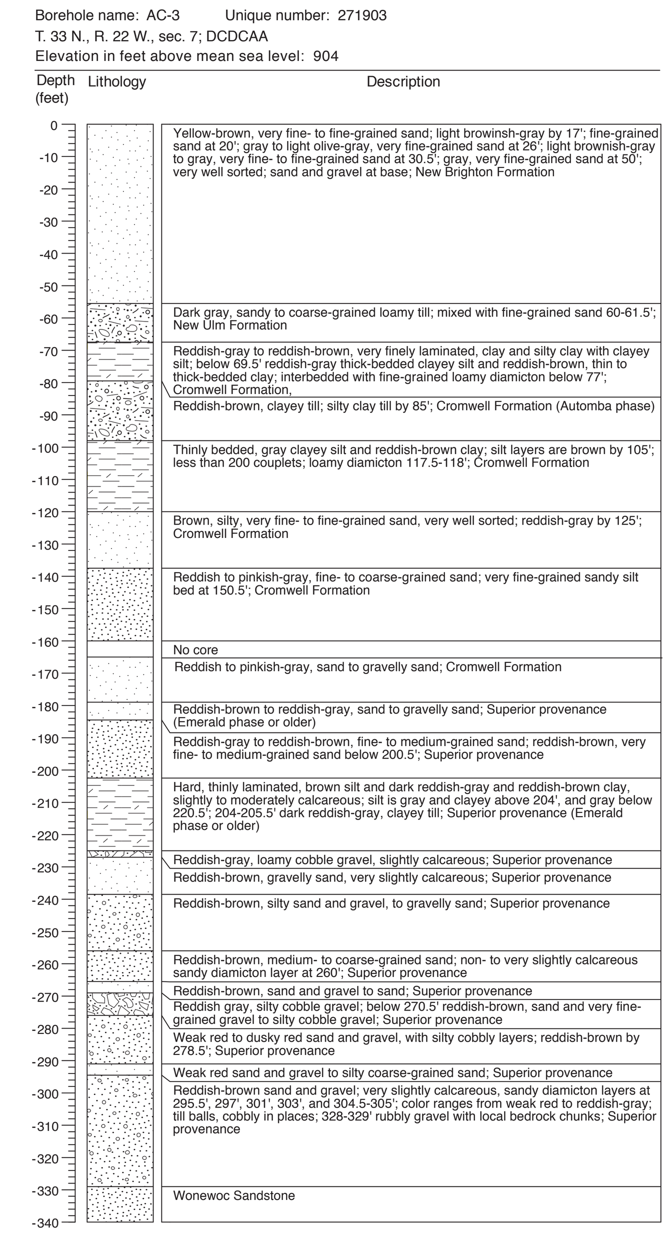


Figure 5. Descriptive log of rotary-sonic core AC-3, drilled by Mark J. Traut Wells for this study. Location of drilling is shown on Figure 1 and Plate 1, *Data-Base Map*.

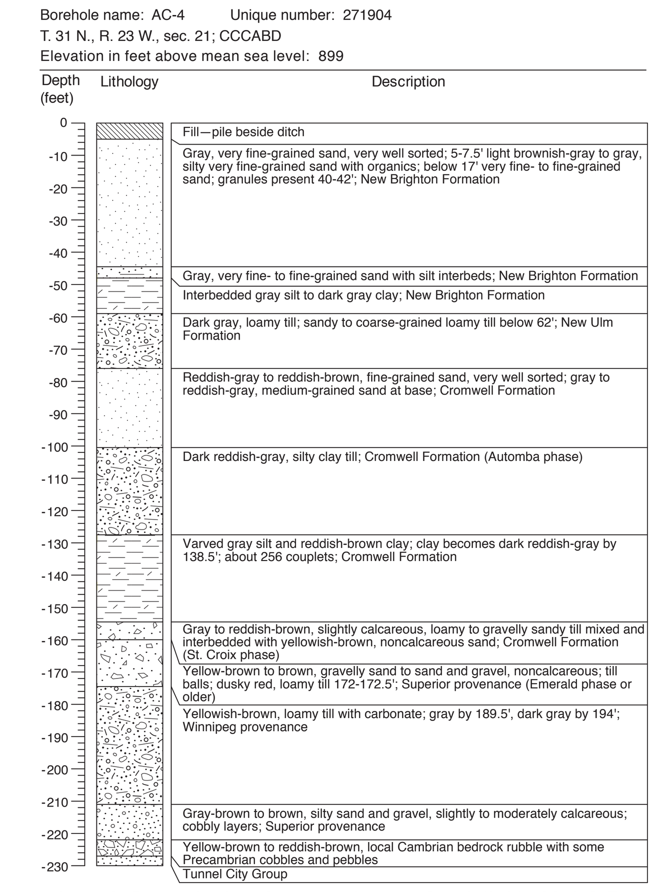


Figure 6. Descriptive log of rotary-sonic core AC-4, drilled by Mark J. Traut Wells for this study. Location of drilling is shown on Figure 1 and Plate 1, *Data-Base Map*.

CROSS SECTION SYMBOLS

Geologic contact—No-line boundaries occur where data were insufficient to reliably extend units. Dots at the base of the cross section denote bedrock contacts (as depicted on Plate 2, *Bedrock Geology*).

Drill hole—Well records from the County Well Index within 0.16 mile (0.25 kilometer) of the cross section line. Core holes and holes with cuttings from the Quaternary section are labeled by unique number. The top of the drill hole may not coincide with the cross section surface elevation line because the point is located near but not on the cross section line and therefore may have a different surface elevation. In areas of less data, well records (not shown) from 0.3 mile (0.5 kilometer) or more were used to depict the units. Data from auger holes and outcrops were also used in constructing the cross sections—see Plate 1, *Data Base Map*.

Fault in bedrock

Table 1. Average values for the matrix texture and composition of tills recognized in Anoka County. Matrix texture (the less than 2 millimeter grain-size fraction of the sample) is expressed as relative proportions of sand, silt, and clay in percent. The lithologic composition of the very coarse-grained sand fraction (1-2 millimeters) is expressed in percent as relative proportions of Precambrian rocks, Paleozoic (mostly carbonate) rocks, and Cretaceous rocks (mostly shale and limestone) using the classification system of Hobbs (1998). The Precambrian 1-2 millimeter fraction is further differentiated by rock type—light (granite and gneiss), monomineralic quartz, dark (mafic-rich igneous and metamorphic rocks), red (rhyolite, agate), sandstone, and other; T = trace amount.

	MATRIX TEXTURE					CLAST TYPE									
			percentage of the less than 2 millimeter fraction				percentage of total grains counted of the 1-2 millimeter fraction			percentage of total crystalline grains counted					
Deposit description and geologic unit shown on cross sections	Total number of samples	Gravel (percentage of total sample weight)	Sand	Silt	Clay	Total number of samples	Precambrian	Paleozoic	Cretaceous	Light	Monomineralic quartz	Dark	Red	Sandstone	Other
New Ulm Formation till (unit Qnu)	85	5	53	30	17	63 (all)				62	15	16	5	2	T
						(unleached) 58	68	18	14						
(Loam-textured portion of unit Qnu)	32	5	46	34	20	24	59	21	20	65	16	15	3	1	T
(Sandy-textured portion of unit Qnu)	53	6	59	27	14	39 (all)				60	15	17	5	3	T
						(unleached) 34	75	16	9						
Cromwell Formation till (clayey till portion of unit *Qlc*)	22	2	20	41	39	11	97	3	T	26	13	35	19	6	1
Cromwell Formation till (sandy till portion of unit *Qlc*, and units *Qcr* and *Qce*)	63	9	64	25	11	46 (all)				33	13	31	16	6	1
						(unleached) 42	98	2	T						
Pre-Wisconsin Episode, Winnipeg provenance till (units *Qxt* and *Qpt*)	20	3	33	45	22	18	69	30	1	61	20	15	3	1	T
Pre-Emerald phase, Superior provenance till (unit *Qrt*)	31	16	66	23	11	26 (all)				28	26	27	14	4	1
						(unleached) 21	98	2	T						

INTRODUCTION

The Quaternary Stratigraphy plate shows the unconsolidated sediment expected to be encountered between the land surface and bedrock in Anoka County. Cross sections A–A' through F–F' are representative of 87 cross sections (Fig. 1) that were constructed to create a three-dimensional model of the Quaternary deposits of Anoka County. The major sand bodies from this model are depicted on Plate 5, *Sand Distribution Model*; the full model and all the cross sections used to develop it can be accessed through the digital files of the Minnesota Geological Survey. The geologic units shown on the cross sections were defined using data from previous studies completed in the area (see Plate 3, Introduction) and through the interpretation of new data collected for this study. Some units match those on Plate 3, *Surficial Geology,* some new units appear only on the cross sections, others are a combination of multiple units from Plate 3, and still others are the result of dividing a unit from Plate 3. Outcrops, auger samples, drill core, drill cuttings, and water-well and soil boring drillers' logs (Plate 1, *Data Base Map*) were used to interpret the stratigraphy. Drill cuttings from the Quaternary section of about 150 wells were examined for this study (Fig. 1). Cuttings and split spoon cores had been described and sampled from four holes drilled for an earlier study (Meyer and Falteisek, 1993), and four continuous rotary-sonic core holes were drilled and the cores described and sampled for this project. Vertical exaggeration is 50x for all cross sections.

Figure 2 is a schematic illustration showing the relationships between age, provenance, stratigraphic position, and location of the sediments deposited by major glacial episodes (on Plate 3 see Fig. 3, Table 1, and the Summary of Glacial History section for additional information). Analyses of the texture and rock types of the Quaternary sediments were done for selected geologic units, as listed in Table 1. Logs of the four rotary-sonic cores drilled for the Minnesota Geological Survey for this study are shown in Figures 3 through 6.

DESCRIPTION OF CROSS SECTION UNITS

Each unit description on the cross sections is placed in one of three categories, as indicated in parentheses after the description: 1. *Surficial Geology* unit—unit having an identical description, label, and color as on Plate 3, *Surficial Geology*. See Plate 3 for detailed descriptions; 2. New unit—unit that appears only on the cross sections that has a unique label and color (the new sand and gravel units have the same color to emphasize their status as potential aquifers); or 3. Modified unit—multiple units from Plate 3 combined into one unit on the cross sections. The till units of the New Ulm Formation are combined into one unit, which is divided by pattern into a coarser- and finer-grained facies (Fig. 1). Deposits of the three phases of the Superior lobe that compose the Cromwell Formation (see Plate 3, Summary of Glacial History) are divided into finer- and coarser-grained sediment, with the till and fine-grained lake sediment combined as aquitards, and the fluvial and coarser lake sediment combined as potential aquifers. Sand bodies were assumed to divide the deposits of the different phases of the Superior lobe. Except for the finer-grained texture of some Automba phase deposits in Anoka County (Fig. 1), the characteristics of the various tills of Superior provenance are similar (Table 1). Without the intervening yellow to gray, fine-grained till of unit *Qxt*, it was difficult using primarily water-well records to distinguish the Cromwell Formation from older deposits of Superior provenance. It is likely that deposits from three (or more) pre-Emerald phase advances of the Superior lobe are included in units *Qce* and *Qrt*.

Underlying bedrock units are indicated by unit boundaries and labels corresponding to those described on Plate 2, *Bedrock Geology*. A fault in the bedrock is also indicated.

QUATERNARY

Hudson Episode

Qa — **Alluvium** (*Surficial Geology* unit)

Qll — **Lake silt and clay** (*Surficial Geology* unit)

Ql — **Lake sand** (*Surficial Geology* unit)

Qp — **Peat and muck** (*Surficial Geology* unit)

Qe — **Eolian sand** (*Surficial Geology* unit)

Wisconsin Episode

Qt — **Terrace sand and gravelly sand** (*Surficial Geology* unit)

West Campus formation

Qwl — ***Langdon terrace sand and gravelly sand*** (modified unit)—Map units Qwl, Qwn, Qwi, and Qwt from Plate 3.

Qwr — ***Richfield terrace sand and gravelly sand*** (modified unit)—Map units Qwr and Qwd from Plate 3.

Qwf — **Silt and clay facies** (*Surficial Geology* unit)

New Brighton Formation

Qbs — ***Sand facies*** (modified unit)—Map units Qbs and Qbt from Plate 3. In the lower portion includes sand and gravel of unit Qbg and fluvial sediment of the New Ulm Formation in places. Also includes silt to silty clay lenses of unit Qbc in places.

Qbc — ***Silt and clay facies*** (*Surficial Geology* unit)

Qbg — ***Sand and gravel facies*** (*Surficial Geology* unit)

New Ulm Formation

Qni — ***Ice-contact stratified deposit*** (*Surficial Geology* unit)

Qnu — ***Till to sandy till*** (modified unit)—Map units Qnt, Qna, and Qnd from Plate 3. Includes lacustrine silt and clay of unit Qbc in the upper part in a number of places where underlying unit Qbs. The patterned portion of the unit consists primarily of sandy till, with a texture commonly as coarse-grained as that of sandy till of the Cromwell Formation (Fig. 1; Table 1). The remainder of the unit is generally finer-grained, ranging from loam to fine-grained sandy loam.

New Ulm and Cromwell Formations

Qsl — ***Sand and gravel*** (new unit)—Consists at lower elevations of mostly reddish, fine- to medium-grained sand of the Cromwell Formation, overlain in places by sand and gravel of the New Ulm Formation, but at higher elevations in the northwest and southeast portions of the county includes gravel of both the Cromwell (included in map unit Qci on Plate 3) and New Ulm Formations.

Cromwell Formation

Qlc — ***Lacustrine clay and silt and/or clayey till, to sandy till*** (new unit)—At lower elevations, unit is mostly reddish, laminated clay and silt (glacial Lake Lind sediment, Sunrise Member; Johnson and others, in press) overlain or interbedded with fine-grained till; at higher elevations, unit is mostly reddish, fine-grained till (sandy-textured in the upper portion in places) deposited during the Automba phase of the Superior lobe (Fig. 2; Table 1; Coon Creek till of Meyer, 1998). Includes reddish clayey sediment reworked by the Grantsburg sublobe in places. The unit generally coarsens to the northwest (Fig. 1), with the patterned portion consisting primarily of sandy till similar to that of units *Qcr* and *Qce*.

Qsc — ***Sand and gravel*** (new unit)—Included in map units Qci and Qco on Plate 3.

Qcr — ***Sandy till*** (new unit)—Reddish, sandy loam-textured till (Table 1) primarily deposited during the St. Croix phase of the Superior lobe (Fig. 2). The upper part may include lacustrine clay and silt where unit Qsc occurs between Automba phase till and glacial Lake Lind sediment. May be finer-grained towards the base in places, particularly where filling deep valleys. Includes thick deposits of silty lacustrine sediment in places.

Qse — ***Sand and gravel*** (new unit).

Qce — ***Sandy till*** (new unit)—Reddish, sandy loam-textured till (Table 1) primarily deposited during the Emerald phase of the Superior lobe (Fig. 2), but likely includes in places till of the St. Croix phase in the upper portions, and older Superior provenance till in the lower portions. May be finer-grained towards the base in places, particularly where filling deep valleys. Includes thick deposits of silty lacustrine sediment in places.

Qsx — ***Sand and gravel*** (new unit)—Includes older sediment of both Winnipeg and Superior provenances (see Plate 3, Fig. 3).

Pre-Wisconsin Episode

Qxt — **Loam till** (new unit)—Yellow-brown to gray, generally silt-rich, loam-textured till of Winnipeg provenance, with common clasts of Paleozoic carbonate (Table 1; see Plate 3, Fig. 3). Equivalent to the K2 till of Ramsey County (Meyer, 1992), and correlated with the Lake Henry Formation (Fig. 2) of central Minnesota (Johnson and others, in press), and the upper two tills of the Good Thunder formation of south-central Minnesota (Lusardi and others, 2012). Includes deposits of silty to clayey lacustrine sediment, particularly in the thicker sections. In the western portion of the town of Ramsey and likely elsewhere, includes or consists of fine-grained basal sediment of the Cromwell Formation. This sediment is apparently mostly reworked interglacial sediment.

Qsr — **Sand and gravel** (new unit)—Sediment of both Winnipeg and Superior provenances.

Qrt — **Sandy till** (new unit)—Red-brown to gray, generally sandy loam-textured till of Superior provenance (Table 1); may be finer-grained towards the base in places, particularly where filling deep valleys. Includes thick deposits of silty lacustrine sediment in places. Correlated, at least in part, with the River Falls Formation (Baker and others, 1983; Mickelson and others, 1984; Attig and others, 1988; Meyer, 1992; Johnson, 2000), which has an uncertain relationship to unit *Qxt* (Fig. 2). Where not overlain by unit *Qxt*, may include Superior provenance sediment equivalent to the Henderson Formation (Johnson and others, in press), and/or sediment deposited during the Athens Subepisode of the Wisconsin Episode (Johnson and others, 1997; Meyer and Stefanova, 2009). Where overlain by unit *Qxt*, correlates with the St. Francis Formation of central Minnesota (Johnson and others, in press) or with older, unnamed units of Superior provenance.

Qsp — **Sand and gravel** (new unit)—Sediment of Superior provenance, and also of Winnipeg provenance in places.

Qpt — **Loam till** (new unit)—Yellow-brown to gray, generally loam to clay loam-textured till of Winnipeg provenance, with common clasts of Paleozoic carbonate (Table 1). Correlated with till of the lower (Meyer Lake) member of the Lake Henry Formation or in places till of the Eagle Bend Formation of central Minnesota (Fig. 2; Johnson and others, in press), and tills 2 and 3 of the Good Thunder formation of south-central Minnesota (Lusardi and others, 2012). Although not identified in the county, sediment of the older, Winnipeg provenance Pierce Formation (Baker and others, 1983; Mickelson and others, 1984; Attig and others, 1988; Johnson, 2000) is likely included in this unit in places. Includes deposits of silty to clayey lacustrine sediment, particularly in the thicker sections.

Qsv — **Sand and gravel** (new unit)—Sediment of Superior provenance, and probably also of Winnipeg provenance in places.

Qvt — **Sandy till** (new unit)—Red-brown to gray, generally sandy loam-textured till of Superior provenance. Correlates with the lower member of the St. Francis Formation of central Minnesota (Johnson and others, in press) or with older, unnamed units of Superior provenance.

Undifferentiated

Qu — **Undifferentiated sediment** (new unit)—Includes till and bedded clay, silt, sand, and gravel. Shown in areas where control data were absent.

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WATER SUPPLY PLANNING IN THE TWIN CITIES METROPOLITAN AREA (2005-2020)

Metropolitan Council report on findings, recommendations and continuing planning activities completed under Minnesota Statutes 473.1565

METROPOLITAN
COUNCIL

September 2020

The Council's mission is to foster efficient and economic growth for a prosperous metropolitan region

The Metropolitan Council is the regional planning organization for the seven-county Twin Cities area. The Council operates the regional bus and rail system, collects and treats wastewater, coordinates regional water resources, plans and helps fund regional parks, and administers federal funds that provide housing opportunities for low- and moderate-income individuals and families. The 17-member Council board is appointed by and serves at the pleasure of the governor.

Table of contents

About this report

The Twin Cities seven-county metropolitan area is home to three million people, over half of Minnesota's population. Securing residents' safe and plentiful water – while protecting the region's diverse water resources – requires coordinated, interdisciplinary and ongoing effort.

Although the seven-county region is relatively water-rich, the region's steady population growth, increased groundwater pumping, changing land use, and variable weather and climate is challenging some communities' ability to meet current and future water demand.

This report summarizes findings, recommendations, and continuing planning activities that address the water supply needs of the metropolitan area. It also documents work done since 2005 by Metropolitan Council (Council), with the Metropolitan Area Water Supply Policy (MAWSAC) and Technical Advisory Committees (TAC), and other partners, to fulfill the requirement of Minnesota Statute 473.1565.

Activities include:

1) Support for **collaboration**

2) Development and maintenance of a **base of technical information** including:
   a) Surface and groundwater availability analyses
   b) Water demand projections
   c) Water withdrawal and use impact analyses
   d) Modeling
   e) Similar studies

3) Development and periodic update of a **Metropolitan Area Master Water Supply Plan (Master Plan)** that:
   a) Provides guidance for local water supply systems and future regional investments
   b) Emphasizes conservation, interjurisdictional cooperation, and long-term sustainability
   c) Addresses the reliability, security, and cost-effectiveness of the metropolitan area water supply and its local and subregional components

4) **Recommendations**:
   a) Clarify the appropriate roles and responsibilities of local, regional, and state government in metropolitan area water supply
   b) Streamline and consolidate metropolitan area water supply decision-making and approval processes
   c) Fund ongoing and long-term metropolitan area water supply planning activities and capital investments

The Council considers the work and recommendations of the policy and technical advisory committees as the Council prepares regional development framework updates.

Minnesota's Clean Water Fund supports two Metropolitan Council programs that increase communities' implementation of projects to help achieve sustainable water supplies.

Twin Cities metropolitan area water supply at a glance

Water supply sources, demand, and infrastructure

Twin Cities metropolitan area water supply sources include four extensive underground layers of rock, gravel and sand (aquifers) which hold and transport billions of gallons of water for over two million people; the Mississippi River which supplies huge volumes of water for commercial, industrial and residential uses; and treated stormwater and wastewater which could potentially provide water for non-drinkable uses such as cooling or irrigation. A variety of factors must be considered when using any of these sources.

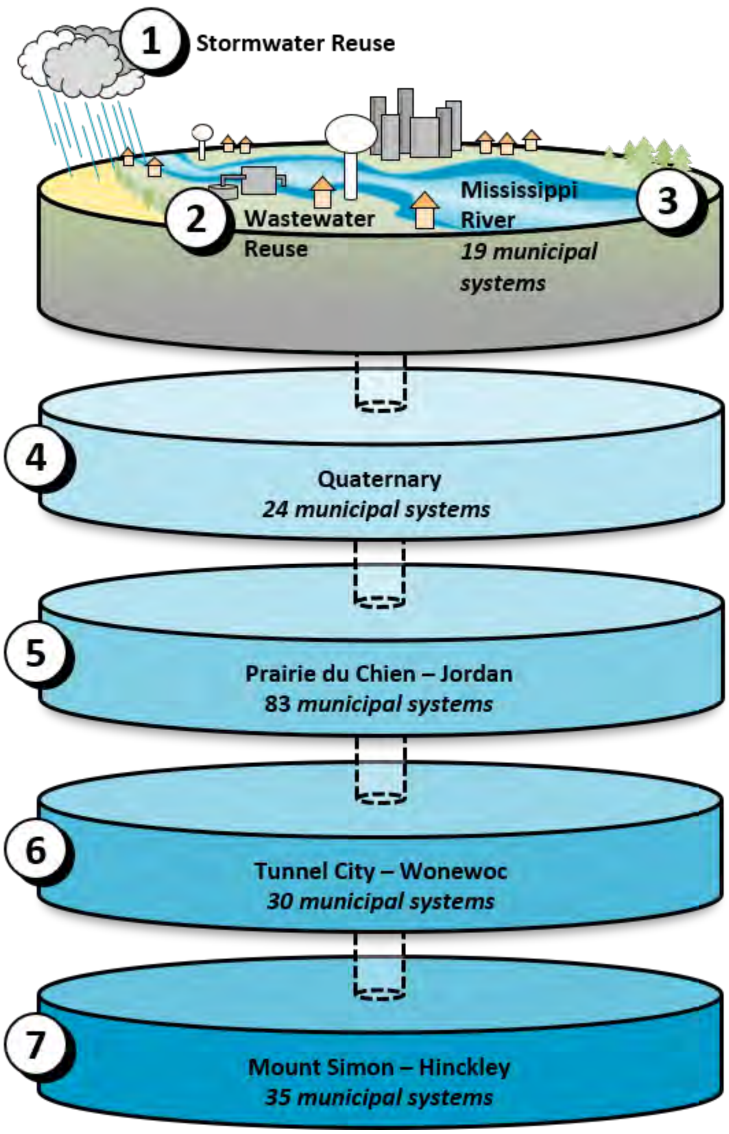


Figure 1. Water supply sources of the Twin Cities metropolitan area.

Water supply source considerations include:

- Access to the source – not all sources are equally available or productive across the region
- Seasonal variability of the supply – stormwater is not available in the winter
- Recharge rates – some aquifers replenish more quickly than others
- Nearby competing demands
- Vulnerability to contamination and/or existing natural or manmade contamination (examples: nitrate, PFAS, TCE, arsenic, radium, chloride)
- Regulated withdrawal limits and treatment requirements to protect public and environmental health
- Funding challenges

The Twin Cities metropolitan area water supply environment is large and complex. Figure 2 highlights some of the key factors shaping the Council's and partners' approach to water supply planning.

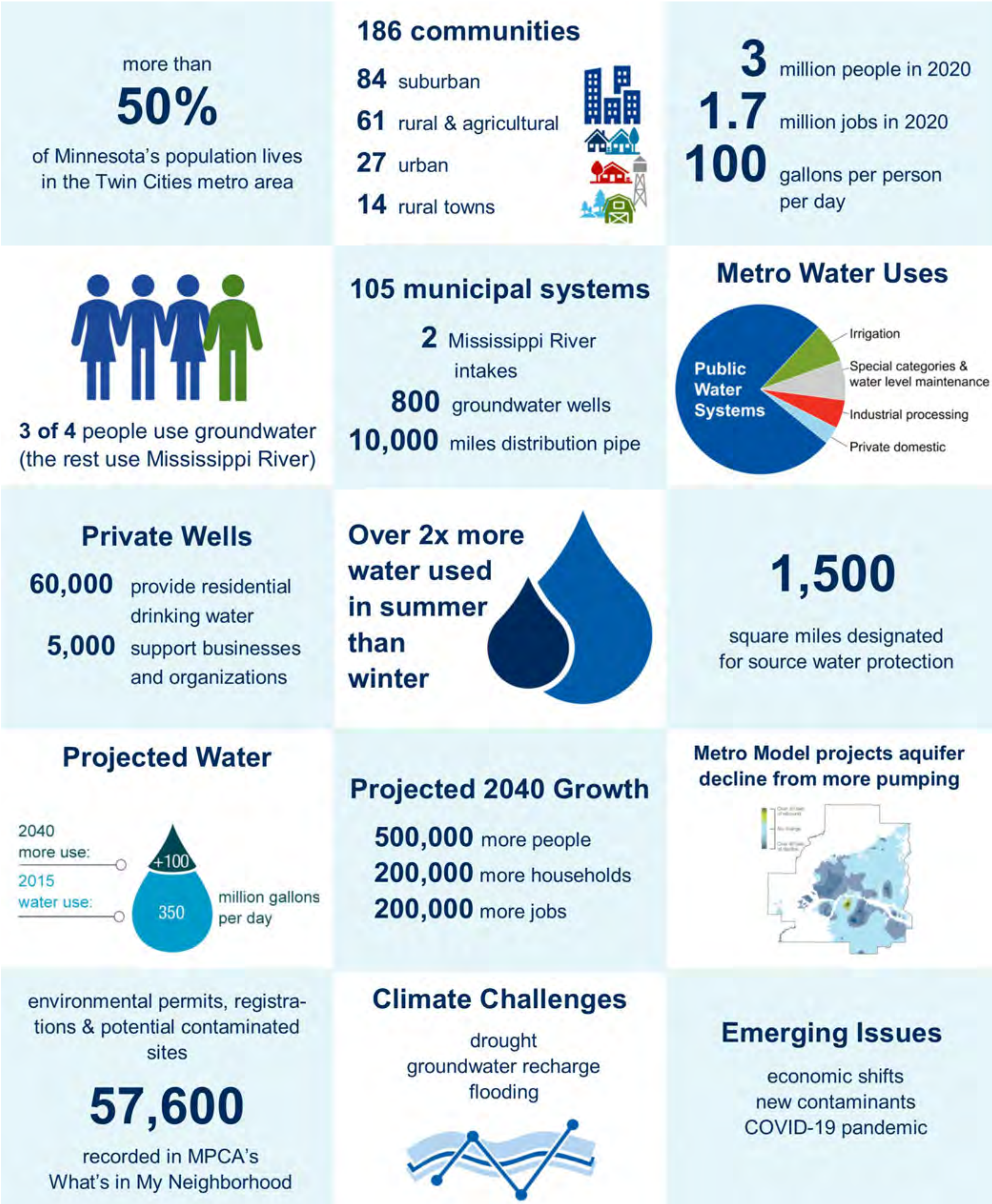


Figure 2. Selected information about water supply conditions in the Twin Cities metropolitan area.

Metropolitan Council has a unique role as a planning agency, not a regulator or utility

Bringing together the many different and changing facets of water supply into a regional picture is outside the scope of any one community, yet it is necessary to adequately plan for the region's growth and economic development. The Metropolitan Council, as the regional planning agency for the seven-county Twin Cities metropolitan area, provides this role in collaboration with communities and state agencies under the advisement of several committees.

The Council has a unique role regarding water supply planning; it is not a regulator nor a water supplier. The Council's regional water supply work has been designed and applied to ensure local water suppliers have control of and responsibility for their water supply systems, while at the same time assuring state agency oversight is effective and efficient. This program supports municipality and industry efforts to address threats to drinking water supplies, provides cost-effective regional solutions, boosts inter-jurisdictional coordination, supports local implementation of water supply reliability and water quality protection projects, and protects groundwater for current and future use. Through its work, the Council helps to bolster the livability of the region, foster economic growth and prosperity, and alleviate competition and conflict over water supply. No other agency or unit of government provides this.

The Council's role is authorized in Minnesota Statutes (Minn. Stat. 473.1565) and supported by Council policies. Specifically, the Council:

1) Maintains a database of technical information, based on analysis of regional and local issues
2) Identifies approaches for addressing emerging issues
3) Develops and updates a metropolitan area Master Water Supply Plan (Master Plan) with partners
4) Assists communities with developing their local water supply plans and other local plans
5) Facilitates cooperation between communities and supports local and subregional efforts

Figure 3. In collaboration with partners, the Council investigates, plans, and implements water supply projects and programs.

LOCAL PERSPECTIVES SHAPE REGIONAL PLANNING

"Water Supply Planning since 2005 reflects a partnered approach between the Council, local governments as well as other water-specific agencies/ entities. To me, the greatest value in this partnered approach is that documents like the Master Water Supply Plan (2015) are informed by the real experiences and expertise of the local water suppliers that the public has come to trust for safe and sustainable delivery of drinking water. The incorporation of those local government assets in MAWSAC, TAC, and water supply workgroups have added value and credibility to the necessary water supply planning efforts of the Metropolitan Council."

Mark Maloney, Public Utilities Director, City of Shoreview

Metro Area Water Supply Advisory Committee and Technical Advisory Committees shape the work

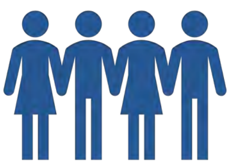
The Metropolitan Area Water Supply Advisory Committee (MAWSAC) and the Technical Advisory Committee (TAC), policy and technical committees established by Minn. Stat. 473.1565, are responsible for assisting the Metropolitan Council with its water supply planning activities.

MAWSAC responsibilities and membership

MAWSAC is responsible for:

1) Assisting the Council in its planning activities identified in Minn. Stat. 473.1565
2) Approving the Master Plan developed in cooperation with the Council
3) Appointing and consulting with the Technical Advisory Committee (see below), established to inform MAWSAC's work
4) Reporting to the Council, the Legislative Water Commission, and the chairs and ranking minority members of the Minnesota House of Representatives and Senate committees' divisions with jurisdiction over environment and natural resources, and providing the information required under this statutory section; MAWSAC's report and recommendations must include information provided by the TAC

The membership of MAWSAC is specified by Minn. Stat. 473.1565. The committee includes representatives of the Metropolitan Council, state water agencies, water utilities, and local and/or county governments from each county in the 11-county metropolitan area. Members are appointed in consultation with the Association of Minnesota Counties, Association of Metropolitan Municipalities (Metro Cities), and the League of Minnesota Cities, as appropriate.



Since 2005, more than 50 people have served on MAWSAC, bringing perspectives from more than a dozen different communities in all 11 metro counties.

TAC responsibilities and membership

TAC is responsible for informing MAWSAC's work by providing scientific and engineering expertise.

Most of the 15 committee members represent single-city and multicity public water supply systems in the metropolitan area and include experts in water resources analysis and modeling; hydrology; and the engineering, planning, design, and construction of water systems or water systems finance. Members are appointed by MAWSAC with input from the Association of Metropolitan Municipalities (Metro Cities), as appropriate.

Since its creation in 2015, 17 people have served on TAC, bringing perspectives from communities and utilities in the seven-county metro area.

See Tables 1 and 2 in the appendix for MAWSAC and TAC membership history.

Regional water supply work is based on shared principles

Although attention often focuses on “what” water supply planning activities the Metropolitan Council has done under Minn. Stat. 473.1565, equally important is “how” that work is done. Guided by stakeholders during the development of *Thrive MSP 2040* – the Council’s long-range vision and plan for the region over the next 30 years – the Council identified three principles to carry out all its work, including water supply planning:

Collaboration recognizes that shared efforts advance our region most effectively toward shared outcomes. Addressing the region’s issues—particularly the emerging challenges of climate change, economic competitiveness, racial disparities, and water sustainability—requires collaboration because no single entity has the capacity or the authority to do the work alone.

Integration is the intentional combining of related activities to achieve more effective results, leveraging multiple policy tools to address complex regional challenges and opportunities.

Accountability includes a commitment to monitor and evaluate the effectiveness of our policies and practices toward achieving shared outcomes and a willingness to adjust course to improve performance.

Collaboration sets direction and drives results

Metropolitan Council’s water supply planning activities support both local stakeholder goals and progress toward the regional outcomes put forth in *Thrive MSP 2040,* shown in Figure 4.

Figure 4. Regional outcomes put forth in Thrive MSP 2040 include stewardship, prosperity, equity, livability, and sustainability.

Since 2005, the Council has connected with hundreds of water supply leaders in the State government’s water agencies, local governments, public water utilities, academic institutions, environmental advocacy groups, businesses, and neighborhoods (Table 3 of the appendix). Working together to tackle challenges has better equipped communities to meet current and future needs:

- Scoping and contributing to technical projects at subregional water supply work groups, MAWSAC and TAC meetings, inter-agency coordination team meetings and focus groups
- Shaping regional plans and related local plan requirements through input to and approval of Master Plan and development of local water supply and comprehensive plans
- Demonstrating new approaches through projects such as rainwater harvesting and stormwater reuse at CHS field in Saint Paul and turfgrass demonstration site at the Minnesota Landscape Arboretum
- Building capacity through new programs such as industrial water efficiency audits through Minnesota Technical Assistance Program (MnTAP) intern program, community grants for water efficiency rebates, and the water conservation efforts of the Freshwater Society Water Stewards program

Collaboration milestones

2005 and 2015 Convened metropolitan area water supply policy and technical advisory committees (MAWSAC and TAC), which guide the Council's water supply work and approve the Master Plan.

2006-2015 Engaged stakeholders in water supply-related plan and policy updates including scoping workshops, technical forums, and formal public review processes.

2009-2017 Convened subregional water supply work groups, which serve as a cornerstone for collaboration. More than 70 communities have received technical and financial support from the Council through their work in these groups.

2013-2020 With partners, hosted several engagement events such as: the 2013 Our Water, Our Future workshops, 2014 forums and technical workshops to guide policy and plan updates, 2017 and 2018 tours of the University of Minnesota turfgrass research site, Water Bar on opening day of the 2019 Minnesota State Fair, and a 2020 webinar series for water efficient landscapes.

LOCAL SUPPORT FOR WORKING TOGETHER

"Groundwater doesn't know community boundaries. We can have a greater impact if we work together on water supply sustainability."

Russ Matthys, Public Work Director, Eagan

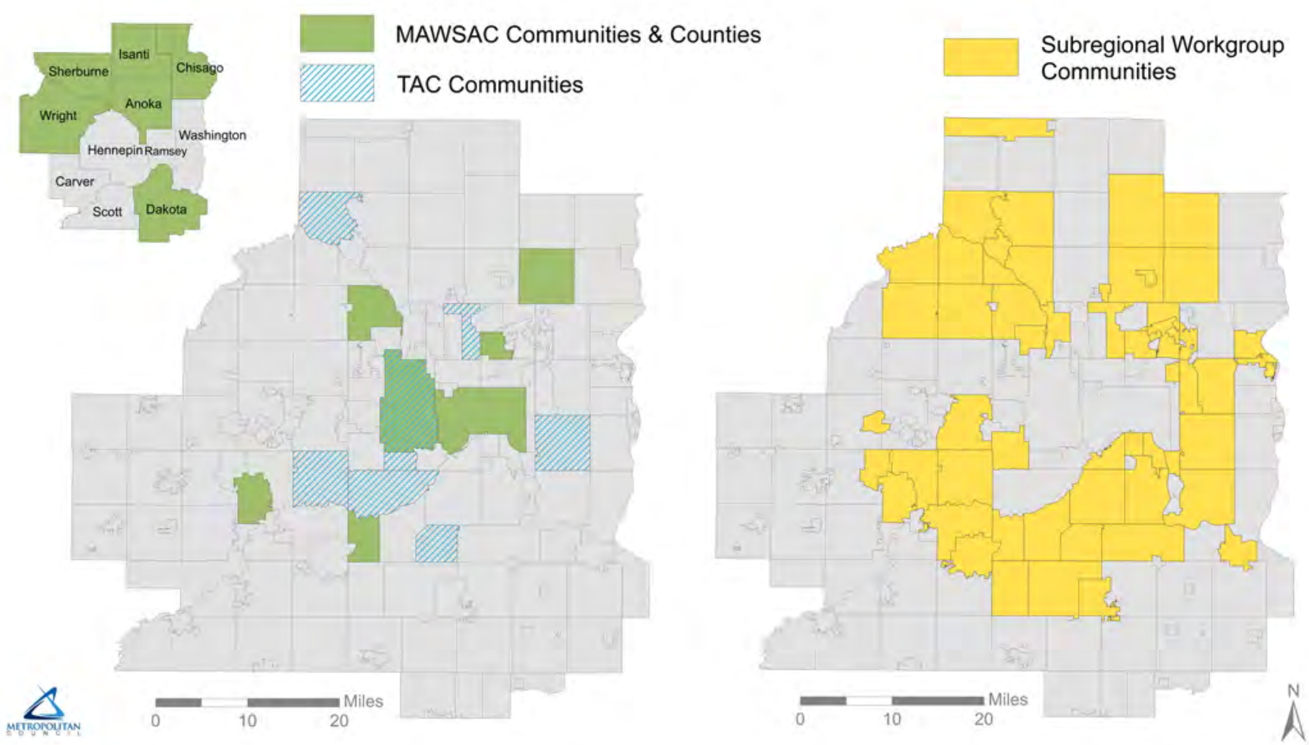


Figure 5. Communities represented in MAWSAC, TAC and subregional water supply work groups.

Technical investigations provide a foundation for planning and implementation

Since 2005, the Council has worked with its partners to develop and maintain a base of technical information including analyses of surface and groundwater availability, water demand projections, water withdrawal and use impact analyses, modeling, and similar studies.

In its technical work, the Council taps into extensive scientific and engineering expertise available in the region through contracts with engineering consultants, partnerships with academic institutions and the research branches of water agencies, and engineering and research support from across all divisions of the Council itself. The work – guided by MAWSAC, TAC, subregional water supply work groups, and others as appropriate – shapes regional policy plans, the Master Plan, and local programs and projects.

Technical investigation milestones

2005-2020 Projects to collect and analyze new geologic, water level, and water chemistry information improve the conceptual understanding of groundwater and surface water sources. Examples: 2007 mapping of metro surficial geology and geochemistry; 2009 synoptic groundwater measurement of the metro area; 2015 analysis of enhanced recharge potential.

2009-2017 Developed and updated a regional groundwater flow model (Metro Model 2 and 3) to understand the cumulative and long-term implications of planned growth and related water demand.

2010 and 2020 Evaluations of groundwater and surface water interaction to better understand potential water supply impacts of regional growth, land use changes, and climate change.

2015-2020 Guided by water supply work groups and partners, completed subregional analyses of alternative water supply approaches, to inform future planning and project scoping. For example, in 2016 the Council and partners completed evaluations of recharge and stormwater reuse in the northeast, northwest, and southeast metro areas.

2013-2020 Water demand management analyses, including 2014 assessment of industrial water conservation barriers and opportunities, 2016 water billing analysis, 2018 study of efficient water use on Twin Cities metro area lawns). This work supports new programs such as Freshwater Society's Master Water Stewards Water Conservation Advisors, University of Minnesota Extension Turfgrass research and education.

For a more detailed list of technical investigation activities, see Table 4 in the appendix.

WORKING TOGETHER FOR SHARED RESOURCES

"Council funding of studies and projects was important because it isn't always easy to get local city councils to commit funds to something that reaches beyond their borders."

Steve Albrecht, Former Burnsville Public Works Director

Key findings: challenges, opportunities and changing conditions

With partners, the Council's water supply collaboration and technical investigations have highlighted challenges in several areas, summarized below. For more information, refer to the Master Plan and technical studies included in the bibliography.

Socio-economic conditions

By 2040, the region is projected to grow by 500,000 people; 200,000 households; and 200,000 jobs compared to 2010. Understanding changing water supply needs and securing a sustainable supply of plentiful, clean water for these growing communities is the primary goal of the Council's water supply planning work.

Funding and finance

High-quality drinking water, wastewater treatment, and stormwater systems are a critical, and costly, component of community planning. Costs include planning and design, capital costs, operation and maintenance costs, and costs to monitor and report compliance with regulatory requirements. Public water suppliers, wastewater utilities, community planners, and elected officials stress the need for financial support for infrastructure changes to achieve sustainable solutions. Examples of challenges:

- Balancing short- versus long-term needs and costs when planning to rebuild or build new infrastructure
- Equitably balancing utility revenue versus affordability, particularly if decreased water demand impacts revenue while water supply system maintenance costs go up
- Addressing the need for more intense monitoring and treatment in water supply systems with mixed water sources
- Lacking reliable and adequate funding sources for implementing many stormwater reuse opportunities

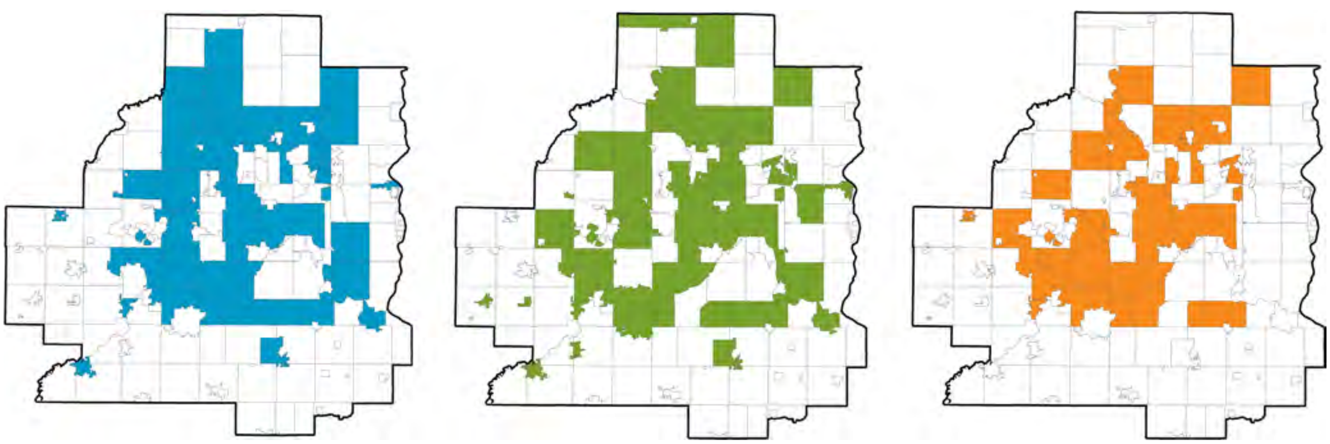


Figure 6. Based on information submitted to the Council in local comprehensive plan updates, by 2040 more than 50 communities plan to drill new municipal wells (left), more than 60 communities plan to improve and/or expand their distribution systems (middle), and more than 35 communities plan to enhance their water supply treatment processes (right). Note: Not all local plan updates have been submitted to the Council as of August 31, 2020 and this information will be revised as plans are received.

Water quality

Contamination issues vary throughout the region, primarily driven by differences in hydrogeologic setting and in level of development. The most cost-effective way to address contamination is usually to prevent it through protection of source waters. However, such protection in the metro area is complicated when drinking water management areas extend outside communities' jurisdictions or overlap with one another. Opportunities exist for more coordinated plans and implementation.

Aquifer water levels and groundwater-surface water relationships

Aquifer levels are useful for providing information about groundwater flow directions, relationships between groundwater and surface water systems, and water levels near wells. Aquifer water level issues are closely related to issues like water quality, relationships between surface water and groundwater, and well interference. A regional evaluation of hydrogeologic conditions suggests that about half of the surface water features in the metropolitan area are likely to be directly connected to the regional groundwater flow system, highlighting opportunities for more integrated surface water and groundwater planning.

Land use

Land use is expected to change to reflect the changing population, economy, and community needs. Changes on the landscape, particularly in Drinking Water Supply Management Areas, can affect downstream drinking water sources and lead to increased treatment needs and public health risks.

Regulatory considerations

The regulatory complexity of water management in Minnesota has been identified as a key challenge by public water suppliers, communities and watersheds for decades. Examples include:

- Missed opportunities to coordinate water-related plans to more efficiently use resources and achieve multiple benefits
- Supplying, treating and distributing water to consumers in compliance with Safe Drinking Water Act standards, water appropriation permits and the well code
- Agency codes and permit requirements that may contradict one another such as source water protection guidance limiting stormwater infiltration or plumbing code that confuses reuse options
- Minnesota rules preventing use of wells for injection to enhance recharge

Reliability

Approximately 50 communities in the metropolitan area use only one source (either groundwater or surface water) to supply all their water demands. Communities already use federal and state regulations and programs to identify and establish protocols for protecting the safety, security and reliability of their water supplies. However, there are still opportunities in some areas to improve the protection of water supplies as a priority for ensuring the reliability of water supply in the region.

Managing water demand

Water demand is the driving factor for water resource planning. Water demand is shaped by various socioeconomic and climate factors but planning and maintaining efficient systems are common goals. Analysis of historical and projected data on water use and population shows that decreasing the regional average total municipal water use to 90 gallons per person per day would accommodate 2040 population growth, with no regional increase in water use by municipal public water supply systems.

Uncertainty

Uncertainty is a constant factor. Several current questions remain unanswered, and other questions will inevitably emerge. Water supply planning must be done so that plans can adapt to factors such as climate changes, technology and emerging contaminants, and changing cultural priorities and attitudes.

Climate change

Mounting evidence shows that Minnesota’s climate is changing, including in the metro area, and stakeholders have raised the following question: How might changes in precipitation patterns, longer growing seasons and increased risk of drought change the region’s water demand, sustainable limits and quality of surface and groundwater supply sources, and the priorities set by decision-makers?

Regional planning and local planning assistance provide a framework for coordinated work

Developed and updated in collaboration with hundreds of stakeholders across the region, the Twin Cities Metropolitan Area Master Water Supply Plan (Master Plan) provides the framework for the Council's water supply activities and guides local plan updates.

First adopted in 2010, the plan and supporting technical information shaped the 2040 metropolitan development guide (Thrive MSP 2040) and regional policy and system plans. The Master Plan was then updated in 2015 to support implementation of the new regional policies – providing guidance so that communities can take the most proactive, cost-effective approach to long-term planning and permitting to ensure plentiful, safe, and affordable water that supports the prosperity and livability of the region for future generations.

Both local water supply plans and local comprehensive plans are informed by the Master Plan.

Planning milestones

2010 Adopted first Master Plan, shaped by information gathered and reviewed by staff and in partnership with stakeholders.

2014 & 2015 Adopted *Thrive MSP 2040* and Water Resources Policy Plan; their content reflects information developed in the 2010 Master Plan.

2015 Updated Master Plan to reflect new information and stakeholder priorities and to support implementation of *Thrive* and the Water Resources Policy Plan.

2015-2020 Provided local planning assistance to help communities update local plans. Examples: "PlanIt" conference, tutorials and webinars.

2016-2018 Communities updated local comprehensive plans, including local water supply plans, to align with regional policy and system plans.

For a more detailed list of planning activities, see Table 5 in the appendix.

LOCAL SUPPORT FOR REGIONAL WATER SUPPLY PLANNING

"The County is supportive of the Met Council's role in coordination and the provision of technical assistance, financial assistance, and regional facilitation. The Board and County Staff look forward to continuing discussions as we continue to define our regional vision and implement Thrive MSP 2040."

Randy Maluchnik, Chair, Board of Commissioners, Carver County

Implementation is guided by a shared vision of sustainability

The Master Plan has a single goal: a sustainable water supply now and in the future. Together, the Council and stakeholders who contributed to the Master Plan said that the region's water supplies will be considered sustainable when:

1. The use of existing water supply infrastructure and investments is maximized (within sustainable limits of available sources)
2. Use of surface water is planned and implemented in a way that maintains protected flows (Minnesota Rule 6115.0630)
3. Use of groundwater is planned and implemented in a way that:
    a. Maintains aquifer levels consistent with safe-yield conditions (Minnesota Rule 6115.0630) and protected surface water flows and water levels
    b. Minimizes impacts to groundwater-flow directions in areas where groundwater contamination has, or may, result in risks to the public health
4. Water demand that exceeds sustainable groundwater withdrawal rates is supplied by the most feasible combination of efficiency and conservation, surface water, and/or wastewater and stormwater reuse
5. Legislative changes are made that align agency directions on all aspects of water supply
6. Water users and suppliers recognize uncertainty and seek to minimize risk

Implementation milestones

2007 Changes made to Minn. Stat. 473.859, Subd. 3 and to Minn. Stat. 103G.291 to clarify and consolidate water supply planning requirements.

2009-2020 Leveraged outside funding for implementation of projects and programs identified in the Master Plan with guidance from MAWSAC, TAC, and subregional water supply work groups. Examples: Clean Water Fund; interagency cost-sharing agreements; and local matching funds for Council water efficiency grants.

2014 Initiated industrial water efficiency intern program with MnTAP to promote water efficiency in metro area industries and organizations.

COUNCIL PROGRAMS ARE SUPPORTING LOCAL RESULTS

"The City of Hugo has allocated all [water efficiency grant] funds. We are still having residents call and ask if our program is still available and we are looking forward to the time that we have more funds to allocate. We believe it has really made a significant impact on the amount of groundwater being used in Hugo."

City of Hugo Community Development

"Metro Cities' policies recognize the importance of an adequate and sustainable water supply for the metropolitan region. Many communities have benefited from these programs as they strive to use water more efficiently, and stand to further benefit in important ways from continued support of these programs."

Patricia Nauman, Director, Metro Cities

2015 Created water efficiency grants to support municipal rebate programs, funded with Clean Water Fund appropriation; began awarding grants to promote innovative stormwater reuse, funded by the Council general fund (also grants in 2016, 2017, and 2019).

2018 Developed water conservation advisory training with Freshwater Society to empower residents to be leaders in their own neighborhoods.

2020 Added water supply content to the Council's Climate Vulnerability Assessment, a tool that assists the Council and communities to prepare and adapt to climate change.

For a more detailed list of implementation activities, see Table 6 in the appendix.

Outcomes: the water supply picture in 2005 versus 2020

Through the Council's work in partnership with stakeholders across the region, we have achieved:

1. Better understanding of shared water resource conditions and challenges
2. Subregional collaborative platform to advance water sustainability goals
3. Better management and long-term resiliency of shared resources
4. More technical and financial resources focused on regional water supply challenges
5. Better equipped to pursue next steps

The following pages highlight examples of the work that has generated the achievements above.

Future work

In addition to the ongoing implementation of the Master Plan, the Council and its partners have identified some topics for further study and policy exploration. These topics arose out of the shared experience accrued through the regional and local water supply work done so far (summarized in part on pages 12-13).

At recent meetings of the Council's Environment Committee, MAWSAC and TAC, and the Land Use Advisory Committee (LUAC), these questions were raised:

- How could equity be implemented in water supply activities?
- What is the impact of climate change on our resources and operations in the water supply sector?
- How can we strengthen land use and water supply planning connections?
- What can we do to prevent contamination of our water supply sources and respond more effectively to emerging contamination (recent examples: PFAS, chloride)?

By supporting local leadership and collaboration, our shared water supplies will sustain us through the challenges ahead.

Highlights: What success looks like

The Twin Cities metropolitan area Master Water Supply Plan lays out the following strategies to achieve sustainable water supplies:

Figure 7. Master Plan strategies: funding; collaboration; technical investigations; planning; and water efficiency and reuse.

The Council was given new water supply planning responsibility in 2005 (Minn. Stat. 473.1565) but was not given dedicated funding to support that work. Instead the Council uses several sources to fund its various water supply activities.

The primary source of funding for the past 10 years has been the Clean Water Fund (CWF), which supports two Metropolitan Council programs that increase communities' implementation of projects to help achieve sustainable water supplies:

1. **Water demand reduction grant program:** Providing grants for communities to implement water demand reduction measures to ensure the reliability and protecting of drinking water supplies (Figure 9).

2. **Metropolitan area water supply sustainability support:** Implementing projects that address emerging drinking water supply threats, provide cost-effective regional solutions, leverage inter-jurisdictional coordination, support local implementation of water supply reliability projects, and prevent degradation of groundwater.

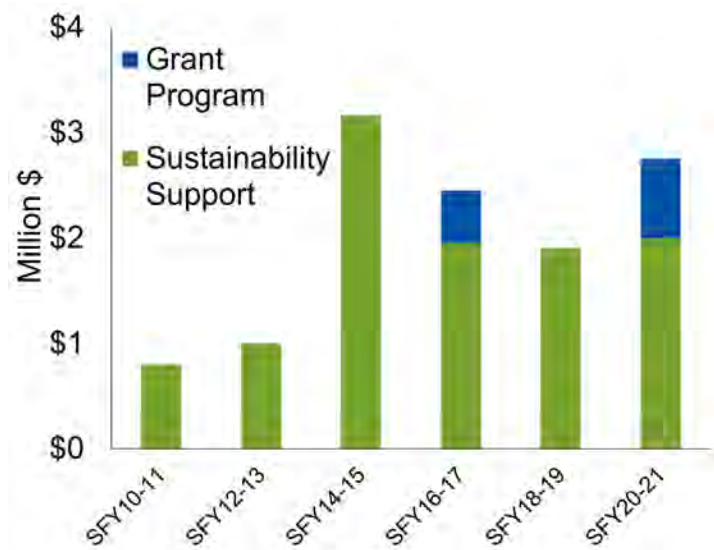


Figure 8. Council Clean Water Fund appropriation history.

CWF, however, cannot be used for the following water supply-related planning activities:

- Review of local water supply plans, comprehensive plan updates and amendments, or wellhead protection plans
- Technical support for communities in developing local plans
- Coordination and support for MAWSAC, TAC, or subregional water supply work groups
- Coordination and development of the Master Plan

Therefore, planning work has been funded through limited Council funds. For a brief time (2015-2016), the state general fund supported plan development and stakeholder engagement for the 2015 Master Plan and related Water Resources Policy Plan updates.

While wastewater rates revenue is not used for water supply *planning* activities – this source is restricted for use on activities directly tied to wastewater utility operation – this source does support work such as reuse investigations, which indirectly support the water supply sustainability of the region.

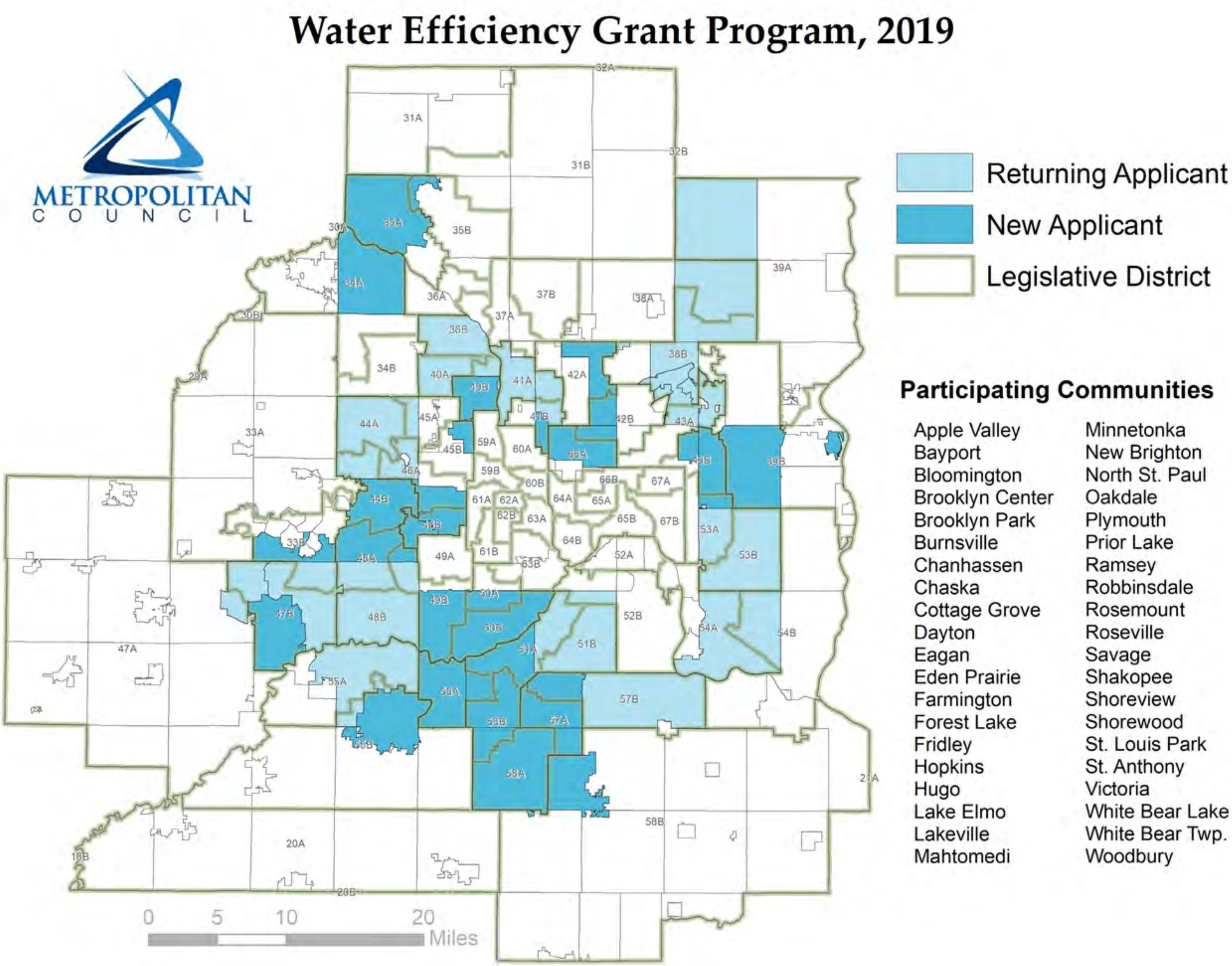


Figure 9. Communities participating in the Council's Clean Water Fund-supported water efficiency grant program, by Minnesota Legislative district.

Funding Highlight: Metropolitan Council Water Efficiency Grant Program

Through the Council's water supply planning activities since 2005, the Council and its stakeholders have worked to promote water conservation and efficiency so that communities, businesses, and residents are more equipped to support better management for long-term resiliency of shared water supply resources.

One program that highlights this work is the Council's Water Efficiency Grant Program. Begun as a pilot in 2015, this Clean Water Fund-supported program has been very successful and was reestablished with Clean Water Fund support for 2019-2022.

The Council covers 75% of the program cost; the municipality must provide the remaining 25%. Municipalities use the combined Council and municipality funds to run their own grant or rebate programs.

Objective

Support technical and behavioral changes that improve municipal water use efficiency through local water efficiency rebate programs for WaterSense-labeled fixtures:

- Irrigation controllers, spray sprinkler bodies, and system audits
- Toilets
- Clothes washers

Participants

Apple Valley, Bayport, Bloomington, Brooklyn Park, Brooklyn Center, Burnsville, Chanhassen, Chaska, Circle Pines, Cottage Grove, Dayton, Eagan, Eden Prairie, Farmington, Forest Lake, Fridley, Hopkins, Hugo, Lake Elmo, Lakeville, Mahtomedi, Minnetonka, New Brighton, Newport, North St. Paul, Oakdale, Plymouth, Prior Lake, Ramsey, Robbinsdale, Rosemount, Roseville, Savage, Shakopee, Shoreview, Shorewood, St. Anthony, St. Louis Park, Victoria, White Bear Lake, White Bear Township, Woodbury

2015-2017:
- 19 communities established local water efficiency programs
- **Estimated water saved:** 52 million gallons/year

2019-2022:
- 17 returning communities enhanced local water efficiency programs
- 23 new communities established local water efficiency programs

LOCAL SUPPORT FOR THE COUNCIL'S WATER EFFICIENCY GRANT PROGRAM

"Many communities, including Hugo, have benefited from these programs and will continue to benefit from the expansion of these programs."

Tom Weidt, Mayor of Hugo

"The Program is valuable for several reasons beyond the obvious water conservation benefits. The public awareness the Program creates is important … As more residents become aware of the Program, we believe it will be important to continue it into the future."

Mark Burch, Former White Bear Lake Public Works Director

Funding Highlight: Twin Cities Regional Water Billing Analysis

Through the Council's water supply planning activities since 2005, the Council and its stakeholders have worked to support better understanding of shared challenges and better management for long-term resiliency of shared water supply resources. Public water suppliers, wastewater utilities, community planners, and elected officials stress the need to consider the local financial aspects of this work.

One project that highlights this is the 2015 Twin Cities Regional Water Billing Analysis.

Partners

126 metro municipal utilities, Minnesota Department of Natural Resources, Metropolitan Council

Objective

Determine if the rates and rate structures used by water utilities in the Twin Cities metropolitan area to bill their customers have any affect on water consumption. Socioeconomic and land use factors also were considered in this analysis.

Findings and next steps

- Water is relatively inexpensive
- Wealthier households use more water
- Lower prices are associated with greater summer water use
- Inclined block rate structures are not necessarily water conservation rate structures
- Significant room for improvement in rate structures across the metro area
- Water savings realized could be substantial
- Continue to track and share *metro area water rate information* and work with communities to create resources to understand the relationships between rates, water conservation, and long-term utility budgets

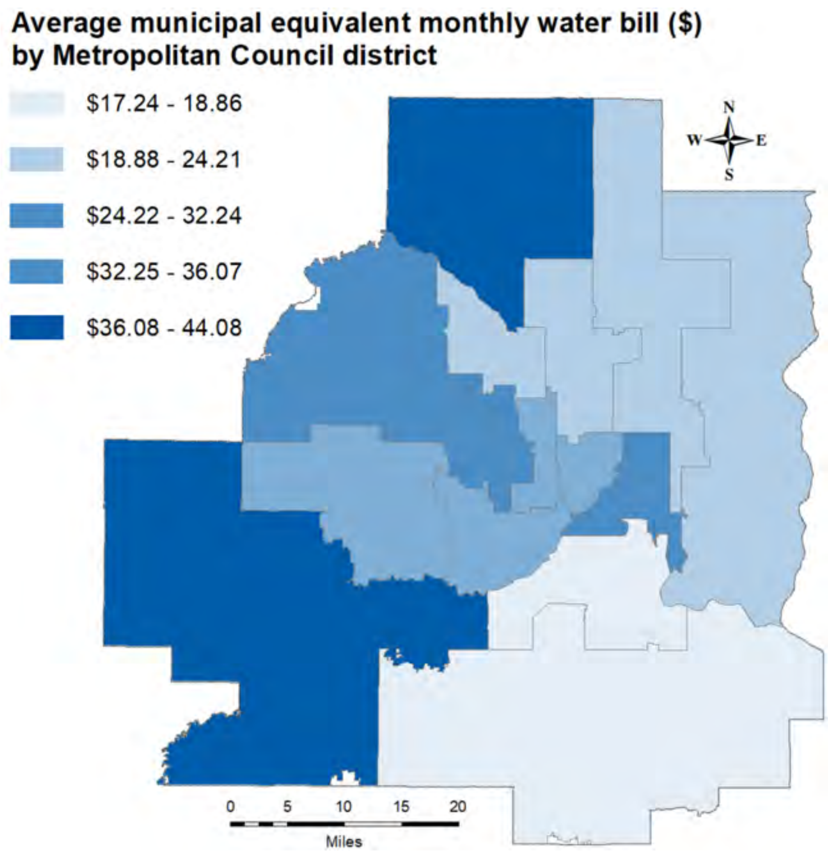


Figure 10. The 2015 Twin Cities Regional Water Billing Analysis includes a range of information about municipal water rates and other factors for 126 communities in the metro area. This information improved understanding of the impacts of rates on water consumption and supported subsequent projects. This figure is an example of the report content.

Collaboration Highlight: Northwest Metro Area Water Supply System Study

Through the Council's water supply planning activities since 2005, a successful subregional collaborative platform has been established to advance regional and local water sustainability goals. For example, participation in subregional water supply work groups has increased from 20 communities in 2005 to more than 70 communities in 2020.

One project that highlights the collaborative and long-range work being done by these groups is the 2020 Northwest Metro Area Water Supply System Study.

Partners

Corcoran, Dayton, Ramsey, Rogers, Metropolitan Council

Objective

Understand the relative costs and implementation considerations of different approaches to a multi-community water supply in the northwest metro area.

The study evaluates four approaches to water supply:

1. Multi-community surface water treatment plant
2. Multi-community groundwater treatment plant
3. Multi-community conjunctive use system (surface water augmented with groundwater)
4. Status quo

The study does not provide "shovel-ready" projects for implementation. Rather, the project defined by each approach are at a concept-level with the intent to compare relative differences in costs between approaches and, more importantly, to explore the implementation issues associated with each approach.

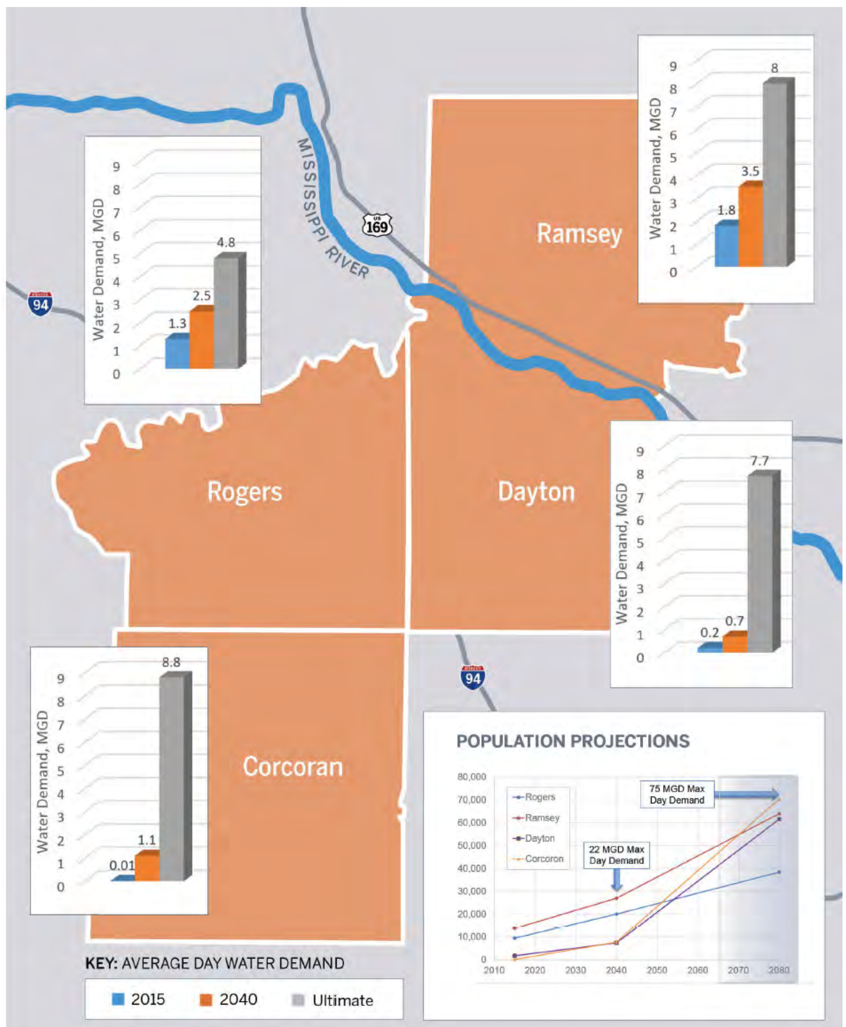


Figure 11. The 2020 Northwest Metro Area Water Supply System Study includes a range of information about projected population water demand and other water supply system components for the cities of Corcoran, Dayton, Ramsey and Rogers. This information is used to explore the costs and implementation considerations for four different water supply approaches. This figure provides an example of the report content.

Technical Investigations Highlight: Metro Model

Through the Council's water supply planning activities since 2005, the Council and its stakeholders have a better understanding of shared resources and challenges.

One project that highlights cumulative and long-term changes to aquifers (the water supply source for 75% of the metro area population) is the regional groundwater flow model – Metro Model (versions 2 and 3).

Partners

The technical advisory group providing guidance during this project included representatives of the University of Minnesota, University of Wisconsin, MN Department of Health, MN Department of Natural Resources, MN Department of Agriculture, MN Pollution Control Agency, MN Geological Survey, U.S. Geological Survey, City of Woodbury, Dakota County, Shakopee Mdewakanton Sioux Community, and the consulting firms Antea Group, Braun Intertec, HDR, and LGB.

Objective

Help address a broad range of regional planning questions and to be as flexible as practical to accommodate new questions or scenarios, while still incorporating the best available data. Some examples of questions the model is intended to help address include:

LOCAL SUPPORT FOR COUNCIL GROUNDWATER MODELING

"Encourage the continued development of a metropolitan groundwater model, as a tool to define aquifers and aquifer recharge areas and as a basis for aquifer protection and management."

Bloomington 2040 Comprehensive Plan Update

- Given projected water demands, what impacts may be expected on groundwater levels and groundwater-dependent surface-water features?
- What combinations of source aquifers, well locations, and withdrawal rates can be used to achieve sustainable water consumption?

Metro Model is a fundamental part of the Council's water supply planning efforts. It has also served as a starting point for other local and subregional modeling efforts such as local wellhead protection planning and groundwater modeling in the northeast metro groundwater management area.

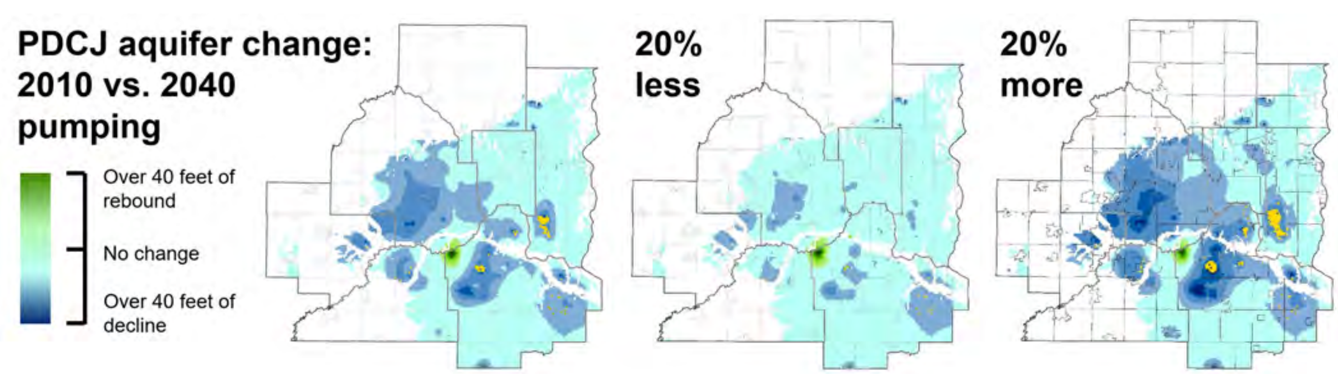


Figure 12. Model-projected water level change in the Prairie du Chien-Jordan (PDCJ) aquifer – which is used by most communities in the Twin Cities metro area – based on estimated 2040 groundwater pumping rates (left), 20% less than the 2040 estimate (middle), and 20% more than the 2040 estimate (right).

Planning Highlight: Climate Vulnerability Assessment – Water Supply

Through the Council's water supply planning activities since 2005, the Council and its stakeholders have worked to improve the water supply process and planning tools for better management for long-term resiliency of shared water supply resources.

One project that highlights this work, led and funded by the Council's Local Planning Assistance group is the addition of water supply content to the Council's *Climate Vulnerability Assessment* (CVA).

Evidence is mounting that Minnesota's climate is changing, including in the Twin Cities metro area and Minnesota Governor Tim Walz is urging bold action across the state to address climate change. The CVA is a tool that can assist in Council and community planning efforts in preparing and adapting to climate change because the CVA can reveal system vulnerabilities to currently occurring and, to some extent, expected climatic changes. The CVA project consists of Council-related analysis and recommendations as well as tools for communities and other stakeholders.

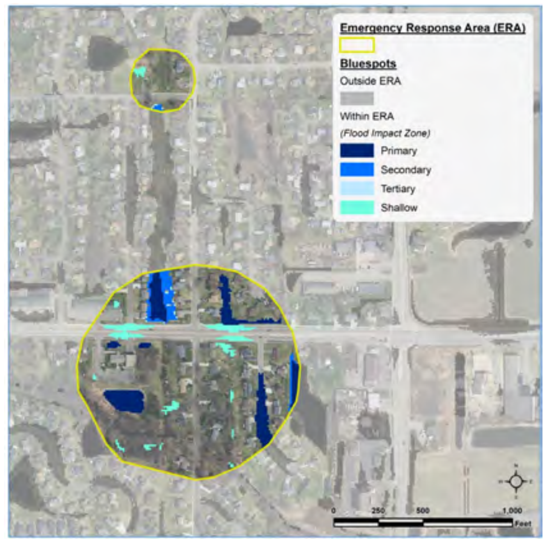
Objective

Include water supply content in the Climate Vulnerability Assessment, specifically the identification of areas around wells that are most at risk of flooding and potential strategies to improve management in these areas.

Findings

Private and public wells across the region are at risk of being overtopped by flooding during extreme events. This analysis provides information about where that risk may be most likely.

Local communities and other stakeholders may conduct similar analyses to assess conditions and vulnerabilities that may inform adaptive strategies for local system assets.



Analysis Layer	Total (Acres)	Total Analysis Layer in FIZ*	Flood Impact Zone % for Analysis Layers in a FIZ			
			Primary	Secondary	Tertiary	Shallow
Domestic Wells (50ft Buffer)	12,054	7.6%	37.2%	19.2%	29.4%	14.2%
Inner Wellhead Management Zone (200ft Buffer Around Public Well)	2,539	13.1%	40.8%	19.5%	25.4%	14.3%
Emergency Response Areas (1-year Time-of-Travel to Public Well)	39,562	16.3%	46.2%	18.5%	22.6%	12.7%

Figure 13. Results of the Climate Vulnerability Assessment analysis of potential localized flood impacts to private domestic and public (municipal and nonmunicipal) water supply wells, based on a calculation of the acres around wells that overlap a Flood Impact Zone (FIZ).

Implementation Highlight: MnTAP Water Efficiency Intern Program

Through the Council's water supply planning activities since 2005, the Council and its stakeholders have worked to promote water conservation and efficiency so that communities, businesses, and residents are more equipped to support better management for long-term resiliency of shared water supply resources.

One program that highlights this work is the Council's partnership with the University of Minnesota's Minnesota Technical Assistance Program (MnTAP) to support an industry-focused intern program focused on water efficiency.

Objective

This program, launched in 2012, places student interns in metro area industries and other organizations. The students get hands-on experience and the organizations benefit as opportunities to operate more efficiently are identified.

Participants

Aqseptence, Anoka-Hennepin ISD11, Aveda Inc., Bailey Nurseries, Ball Corporation, Boston Scientific, Cemstone, CertainTeed Roofing, City of Plymouth, City of Woodbury, Electric Machinery, Federal Cartridge Company, Fulton Beer, Gedney Foods Company, GE Water & Process Technologies, HCMC, Health Systems Cooperative Laundries, Kapstone Containers, Lloyd's BBQ, Minnesota Zoo, Northern Star Co., North Memorial Health, R&D Systems, Sanimax, Science Museum of Minnesota, TEL FSI Inc., Thomson Reuters, TreeHouse Foods, Xcel Energy

2013-2017:

- 20 projects making 159 recommendations
- **Total intern recommendations implemented as of 2018:** 87 million gallons/year
- **Realized cost savings:** $486,000/year

Learn more! Information about *intern projects* and *industrial water conservation research in the metro area* is on the MnTAP website.

Figure 14. MnTAP water efficiency interns working in local businesses.

Implementation Highlight: Rainwater Harvesting and Reuse Demonstration Project at CHS Field

Through the Council's water supply planning activities since 2005, the Council and its stakeholders have built strong partnerships that allow for new approaches to water supply and shared learning.

One project that highlights this work is a rainwater harvesting and reuse demonstration project in downtown Saint Paul. The construction of CHS Field, home of the Saint Paul Saints, immediately next to Metro Transit's Green Line Operations and Maintenance Facility (OMF) in downtown Saint Paul created a unique opportunity to capture rainwater from a portion of OMF roof and convey it to CHS Field for ball field irrigation and toilet flushing.

Partners

Capital Region Watershed District, City of Saint Paul, Saint Paul Saints, Metropolitan Council/Metro Transit

Objective

Reduce potable water use as well as pollution runoff flowing to the river from CHS Field, home of the Saint Paul Saints

Results

- Approximately 450,000 gallons/year of municipal water saved
- Value of water conservation and reuse is promoted
- Freshwater Society 2015 Clean Water Champion

Figure 15. Stormwater reuse is showcased on tours of the cistern that holds rainwater captured from the roof of Metro Transit's Green Line Operations and Maintenance Facility, for use at CHS Field.

STRONG PARTNERSHIPS LEAD TO SUCCESS

"There were so many challenges to incorporating stormwater management into CHS Field, it couldn't have happened without the strong partnerships between CRWD, the City, Met Council, and the Saints. The ballpark demonstrates how water conservation can be achieved when people make it a priority, and are willing to think creatively."

Nate Zwonitzer, Project Manager

Implementation Highlight: Exploring Impacts of Infiltrating Reclaimed Water on Groundwater and Surface Water in the Southeast Metro

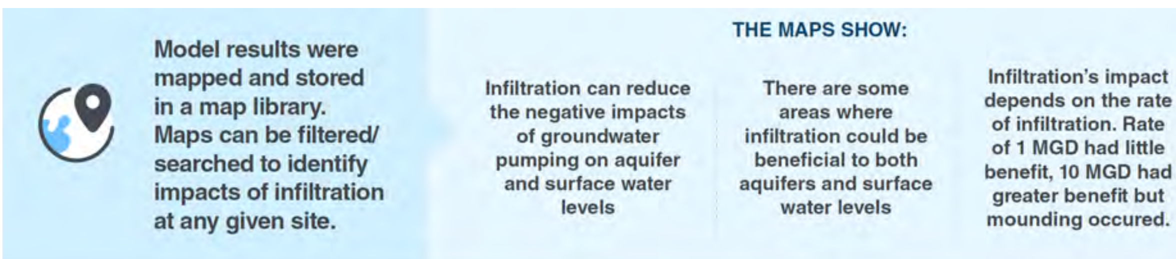
The Twin Cities metropolitan area Master Water Supply Plan identifies investigating the reuse of wastewater as a strategy for achieving sustainable water supplies and supporting the Water Resources Policy Plan policy on conservation and reuse**.**

One project that highlights this work, led and funded by the Metropolitan Council Environmental Services Technical Services group, was an analysis exploring the impacts of infiltrating reclaimed water on groundwater and surface water in the Southeast Metro.

Objective

Answer Metropolitan Council Environmental Services' Southeast Metro customers' question: can infiltrating water lessen projected future groundwater level drawdown and surface water level impacts?

Southeast Metro communities depend on groundwater for drinking water. They have sought ways to avoid or lessen potential future issues such as groundwater level drawdown. Infiltrating highly treated wastewater (reclaimed water) may be one method that helps avoid or lessens potential future groundwater level drawdown and surface water impacts due to pumping.



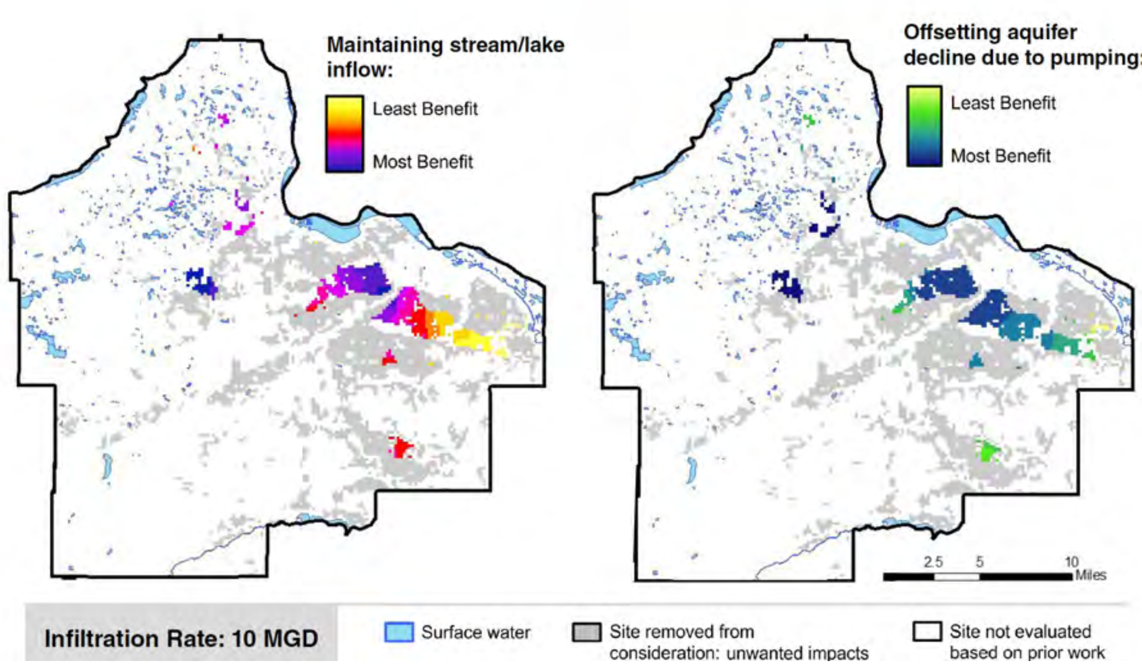


Figure 16. Process steps (above) and examples of maps generated by this project (left).

Appendix

Commonly used acronyms & abbreviations

CVA – Metropolitan Council Climate Vulnerability Assessment

CWF – Clean Water Fund

DNR – Minnesota Department of Natural Resources

DWSMA – Drinking Water Supply Management Area

GWMA – Groundwater Management Area, as designated by the DNR

LUAC – Land Use Advisory Committee

Master Plan – Twin Cities metropolitan area Master Water Supply Plan

MAWSAC – Metropolitan Area Water Supply Policy Advisory Committee

MDA – Minnesota Department of Agriculture

MDH – Minnesota Department of health

MM3 – Metro Model 3, the regional groundwater flow model

MnTAP – Minnesota Technical Assistance Program at University of Minnesota

MPCA – Minnesota Pollution Control Agency

MWSP – Twin Cities metropolitan area Master Water Supply Plan

PFAS – Broad group of perfluoroalkyl and polyfluoroalkyl substances

TCE – Trichloroethylene, a volatile organic compound

TAC – Metropolitan Area Water Supply Policy Advisory Committee

WRPP – Water Resources Policy Plan

U of M – University of Minnesota

History of Metro Area Water Supply Policy and Technical Advisory Committee membership

Table 1. History of Metro Area Water Supply Policy Advisory Committee membership (MAWSAC).

Statutorily required MAWSAC representative	Current and past MAWSAC representatives
Commissioner of Agriculture or Designee	**Jeff Berg (current)** Dan Stoddard Bob Patton Quinn Cheney Greg Buzicky Gene Hugoson
Commissioner of Health or Designee	**Sandeep Burman (current)** Karla Peterson Randy Ellingboe Chris Elvrum Diane Mandernach John Stine Doug Mandy
Commissioner of Natural Resources or Designee	**Jack Gleason (current)** Jeanne Daniels Julie Eckman Terrie Yearwood Dale Holmuth James Japs Gene Merriam
Commissioner of Pollution Control Agency or Designee	**Catherine Neuschler (current)** Katrina Kessler Sheryl Corrigan Faye Sleeper Galen Reetz Brad Moore Sherri Kroening
Metro area county official #1	**Valerie Grover, Dakota County (current)** **Georg Fischer, Dakota County (2013-2020)** Joseph Harris, Dakota County (2005-2013)
Metro area county official #2	**Jamie Schurbon, Anoka County (current)** Beverly Aplikowsky, Ramsey County (2005-2007) Dennis Berg Anoka Co/Ramsey (2005-2012)

Statutorily required MAWSAC representative	Current and past MAWSAC representatives
Metro area noncounty LGU #1	**Phillip Klein, Hugo (current)**
	Chuck Haas, Hugo (2005-2016)
Metro area noncounty LGU #2	**Tonja West-Hafner, Brooklyn Park (current)**
	Dean Lotter, New Brighton (2015-2019)
	Sandy Colvin Roy, Minneapolis (2012-2014)
	Linda Loomis, Golden Valley (2005-2012)
Metro area noncounty LGU #3	**Mike Huang, Chaska (current)**
	Todd Gerhardt, Chanhassen (2015-2019)
	Tom Furlong, Chanhassen (2005-2015)
Metro area noncounty LGU #4	**Brad Larson, Savage (2020-Present)**
	Barry Stock, Savage (2005-2018)
Metro area noncounty LGU #5	**Kevin Watson, Vadnais Heights (2020-Present)**
	Patty Acomb, Minnetonka (2015-2018)
Chair of the Metropolitan Council or Designee	**Wendy Wulff (2019-Present)**
	Sandy Rummel (2012-2019)
	Peggy Leppick (2010-2011)
	Peter Bell (2005-2010)
Chisago County official	**Michael Robinson (current)**
Isanti County official	**Susan Morris (current)**
	Greg Anderson (2014-2015)
Sherburne County official	**Lisa Volbrecht (current)**
Wright County official	**Mark Daleiden (current)**
	Elmer Eichelberg (2012-2013)
Representative of St. Paul Regional Water Services	**Steve Schneider (current)**
Representative of Minneapolis Water Department	**Glen Gerads (current)**

Table 2. History of Metro Area Water Supply Technical Advisory Committee membership (TAC).

TAC member organization	Representative (tenure)
Single-city public water supply system	Jim Westerman, Woodbury (2017-Present)
	Klayton Eckles, Woodbury (2016-2017)
	Jessica Levitt, Cottage Grove (2016-2018)
	Matt Saam, Apple Valley (2017-Present)
	Scott Anderson, Bloomington (2017-Present)
	Robert Ellis, Eden Prairie (2017-Present)
	Bruce Westby, Ramsey (2016-Present)
	Kristin Asher, Richfield (2016-Present)
	Mark Maloney, Shoreview (2016-Present)
	Lon Schemel, Shakopee (2016-2017)
Multicity public water supply system	Dale Folen, Minneapolis Water Works (2016-Present)
Not public water supply system	Ray Wuolo, Barr Engineering (2016-Present)
	John Dustman, Summit Envirosolutions (2016-Present)
	Crystal Ng, U of M (2016-Present)
	Jamie Wallerstedt MPCA (2016-Present)
	Lih-in Rezania, MDH (2016-Present)
	Jim Stark, Legislative Water Commission/USGS (2016-Present)

History of collaboration

Table 3. History of collaboration in Metropolitan Council's water supply work.

YEAR	Metropolitan Council Water Supply Collaboration Activity
2006	Convened Metropolitan Area Water Supply Advisory Committee (MAWSAC)
2008	Convened stakeholders to shape/draft scope of master water supply plan
2009	Convened East Metro water supply work group Coordinated with DNR to streamline water use data sharing Joined Clean Water Fund Interagency Coordination Team, to ensure funding requests to support water supply planning are aligned with other water agencies' work
2010	Convened Seminary Fen work group
2011	Convened South Washington Co. water supply work group
2012	Received Governor's Continuous Improvement Award as part of Clean Water Fund Performance and Outcomes team
2013	Collaboration between Council and DNR water supply leadership on shared projects, water supply plan requirements Hosted Our Water Our Future workshop series in the northeast metro Hosted stormwater reuse guide tour and workshops
2014	Hosted forums and technical workshops for water supply stakeholders to provide guidance and share information shaping the update of regional water supply policies and the MWSP Convened Southeast Metro water supply work group
2015	Convened Metropolitan Council Water Supply Technical Advisory Committee (TAC)
2016	Reconvened West Metro water supply work group after a hiatus of several years Convened West Metro water supply work group
2017	Completed workshop series with southeast metro stakeholders to draft a water conservation and efficiency assessment tool Convened a forum of all the subregional water supply work groups to share experiences and water supply planning priorities Hosted tours of U of M Turfgrass research site Published online tutorials to guide local water supply plan updates as part of the Council's PlanIt program Convened Council's land use and water supply advsiory committees to begin collaboration on overlapping land use-water supply issues

YEAR	**Metropolitan Council Water Supply Collaboration Activity**
2018	Hosted tours of U of M Turfgrass research site Council Co-hosted the 2018 One Water Summit with local and national partners and supported MAWSAC and TAC member participation
2019	Completed education and outreach to reduce lawn water use Hosted a Water Bar on the first day of the MN State Fair, with city and agency partners
2020	Hosted webinar series for water efficient landscapes

History of technical investigations

Table 4. History of technical investigations in Metropolitan Council's water supply work.

YEAR	Metropolitan Council Water Supply Planning Activity
2007	Completed mapping of metro area surficial geology and geochemistry
2008	Piloted project with Dakota County to map groundwater contamination
2009	Completed synoptic groundwater measurement of the metro area Completed Metro Model 2, the regional groundwater flow model
2010	Completed analysis of Mississippi River low-flow characteristics Filled gaps in metro area hydrostratigraphic and hydrogeochemical data Completed evaluation of groundwater-surface water interaction Completed East Bethel groundwater analysis
2011	Completed mapping bedrock recharge and Platteville Formation hydrostratigraphy
2013	Updated Soil Water Balance (SWB) model to estimate recharge Surveyed private industrial water users regarding conservation barriers and opportunities
2014	Completed assessment of stormwater infiltration impacts on groundwater Updated the regional groundwater flow model to Metro Model 3 Completed assessment of industrial water conservation barriers and opportunities
2015	Drafted study of Turtle Lake augmentation (Shoreview, MN) Completed groundwater modeling to explore sustainable groundwater limits Completed joint water utility feasibility study for six northwest metro communities Completed regional enhanced recharge study
2016	Completed water billing analysis Oversaw completion of USGS Scientific Investigations Report Completed recharge and stormwater reuse study in the northeast, northwest, & southeast metro areas Completed water supply feasibility assessment for Washington County Water Coalition Completed research on industrial water conservation in the north and east GWMA
2017	Contributed technical assistance to screening level evaluation of the impacts of infiltrating reclaimed water on groundwater and surface water in the southeast metro

YEAR	**Metropolitan Council Water Supply Planning Activity**
	Updated transient regional groundwater flow model
2018	Completed study of efficient water use on Twin Cities lawns Completed water efficiency study for Washington County Municipal Water Coalition
2019	Completed assessment of economic benefits of residential-focused water efficiency programs Installed turfgrass irrigation research and demonstration plots at MN Landscape Arboretum
2020	Updated evaluation of groundwater and surface water interactions Completed preliminary assessment of metro area municipal water supplier data reporting

History of planning

Table 5. History of Metropolitan Council water supply-related planning activities.

YEAR	Metropolitan Council Water Supply Planning Activity
2005	Minnesota Statutes 473.1565 enacted
2007	Council supported changes to MS 473.859, Subd. 3 and 103G.291 to clarify and consolidate water supply planning requirements
2010	Council adopted Master Water Supply Plan (Master Plan), shaped by information gathered and reviewed by staff and in partnership with stakeholders
2014	Council adopted Thrive MSP 2040, the updated metropolitan development guide
2015	Adopted Water Resources Policy Plan Supported guidance, webinars, and workshops for planners working on water supply information for local comprehensive plans, included in the Local Planning Handbook and PlanIt program Updated Master Water Supply Plan based on Metro Model 3, conservation and reuse projects, and feasibility assessments
2016	Technical assistance to communities updating local water supply plans
2018	Council amended the 2040 Water Resources Policy Plan to clarify wastewater reuse policy
2020	Council launched development of Met Council Climate Action and Resilience Plan

History of implementation

Table 6. History of Metropolitan Council water supply-related implementation activities.

YEAR	**Metropolitan Council Water Supply Planning Activity**
2007	Reported to MN Legislature on progress: water supply planning in the Twin Cities metro area, including technical findings
2009	One-time funding for Master Water Supply Plan implementation from Clean Water Fund ($400K)
2010	Awarded Clean Water Fund appropriation for specific water supply projects ($400K)
2011	Awarded Clean Water Fund appropriation for Master Water Supply Plan implementation ($1M)
2012	Award from American Society of Landscape Architects for Stormwater Reuse Guide
2013	Awarded Clean Water Fund appropriation for regional groundwater planning ($2M) + agreement with USGS to investigate White Bear Lake ($537K)
2014	Awarded appropriation for grant to Shoreview to study Turtle Lake ($75K) + Plan for the North and East Metro GWMA ($400K) + Investigation to treat stormwater in NE metro ($100K)+ Partnership with MnTAP ($50K)
2014 *2014*	Initiated industrial water efficiency intern program with MnTAP Reported to Minnesota Legislature: Metropolitan Council water supply activities supported by CWF
2015	Created water efficiency grant program to support community programs Awarded Clean Water Fund appropriation to implement projects ($1.95M) + water demand reduction grant program ($500K) Council awarded grants for innovative stormwater reuse Fresh Water Society's Clean Water Champion Award for Council and partners' work to help communities reduce demands on groundwater by harvesting and reusing rainwater at CHS Field, home of the St. Paul Saints baseball team in St. Paul
2016	Updated Water Conservation Toolbox
2017	Awarded Clean Water Fund appropriation to implement projects ($1.9M)
2017	Supported MAWSAC report to Legislature: summary of water sources, challenges, goal, and planned activities
2018	Developed water conservation advisory training with Freshwater Society Released Climate Vulnerability Assessment, a planning tool to help Twin Cities prepare for climate change
2019	Awarded Clean Water Fund appropriation to implement projects ($2M) + water demand reduction grant program ($750K) Council awarded grants to communities for stormwater management, including reuse

History of legislative recommendations

Table 7. History and status of Metropolitan Council-supported water supply recommendations to the Minnesota Legislature.

Recommendation to the Legislature		Status
2007:	Approve statutory changes clarifying agency roles in water supply plan review and consolidate into one statute the requirements of community water supply plans in the metropolitan area.	Completed MS 473.859, Subd. 3 and 103G.291, subdivision 3 were revised so that DNR local water supply plan now fulfills MC comp plan requirements for water supply content and WHP no longer required part of comp plan
2007:	Support an appropriate level of state funding, upon the request of local governmental units, for interconnections and other physical water system improvements to ensure water supply reliability, natural resource protection, and/or safety and security, including economic security, of the region and state. Consistent with this recommendation, support an appropriate level of state funding for the proposed Minneapolis and St. Paul water supply systems interconnection.	Partially completed Burnsville-Savage interconnection funded
2008:	Provide funding for implementation of the metropolitan area Master Water Supply Plan	Completed Received $400K for one year from CWF
2009:	Provide funding for implementation of the metropolitan area master water supply plan	Partial – received $400K for one year, with additional stipulations to include protection of Seminary Fen and Valley Branch Trout Stream and other work from CWF
2010:	Provide funding for implementation of the metropolitan area Master Water Supply Plan	Completed Received $1M over two years from CWF
2010:	Eliminate the sunset date for the Metropolitan Area Water Supply Advisory Committee, because it provides valuable guidance to the Council in its water supply planning efforts	Partially completed (extended)
2012:	Recommended, with CWF Interagency Coordination Team, the legislature provide funding for groundwater planning to achieve water supply reliability and sustainability	Completed – received $2M over two years
2013:	Extend the sunset date for the Metropolitan Area Water Supply Advisory Committee from 12/31/12 to 12/31/16	Completed

Recommendation to the Legislature	Status
2014: Provide funding to implement projects that address emerging drinking water supply threats, provide cost-effective regional solutions, leverage interjurisdictional coordination, support local implementation of water supply reliability projects, and prevent degradation of groundwater resources in the metro area. (Co-recommended by CWF Interagency Coordination Team)	Completed Received $1.95M over two years
2016: Provide funding to continue implementing projects that address emerging drinking water supply threats, provide cost-effective regional solutions, leverage interjurisdictional coordination, support local implementation of water supply reliability projects, and prevent degradation of groundwater resources in the metro area. (Co-recommended by CWF Interagency Coordination Team)	Completed Received $1.9M over two years
2017: Provide necessary funds to plan and collaborate, for conserving, protecting our water supply (stakeholder-identified projects that provide regional benefit, increased collaboration, improved local assistance, source water protection). (Co-recommended by MAWSAC)	Ongoing
2017: Support boosting efficiency and wise use of water so the region can grow (region-wide messaging, grants and tools to reduce regional per capita water use). (Co-recommended by MAWSAC)	Ongoing
2017: Support work that leads to solutions (multi-community water supply analyses, feasibility assessments of innovative approaches) (Co-recommended by MAWSAC)	Ongoing
2018: Provide funding to continue implementing projects that address emerging drinking water supply threats, provide cost-effective regional solutions, leverage interjurisdictional coordination, support local implementation of water supply reliability projects, and prevent degradation of groundwater resources in the metro area.	Completed Received $1.9M over two years

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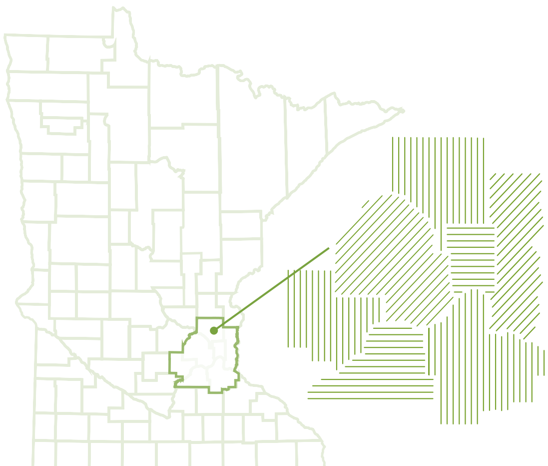
Water Supply Planning in the Twin Cities Metro

(2005-2020)

Highlights of a report to the Minnesota Legislature

September 2020

MORE THAN HALF OF MINNESOTA'S POPULATION LIVES, WORKS AND PLAYS IN THE TWIN CITIES METROPOLITAN AREA.



3.2 million people live here

1.8 million jobs (2019), 15 Fortune 500 headquarters

64 million visits to regional parks and trails

The region's people, businesses, and natural environment are all dependent on clean and plentiful water supplies.

OUR SOURCES OF DRINKING WATER

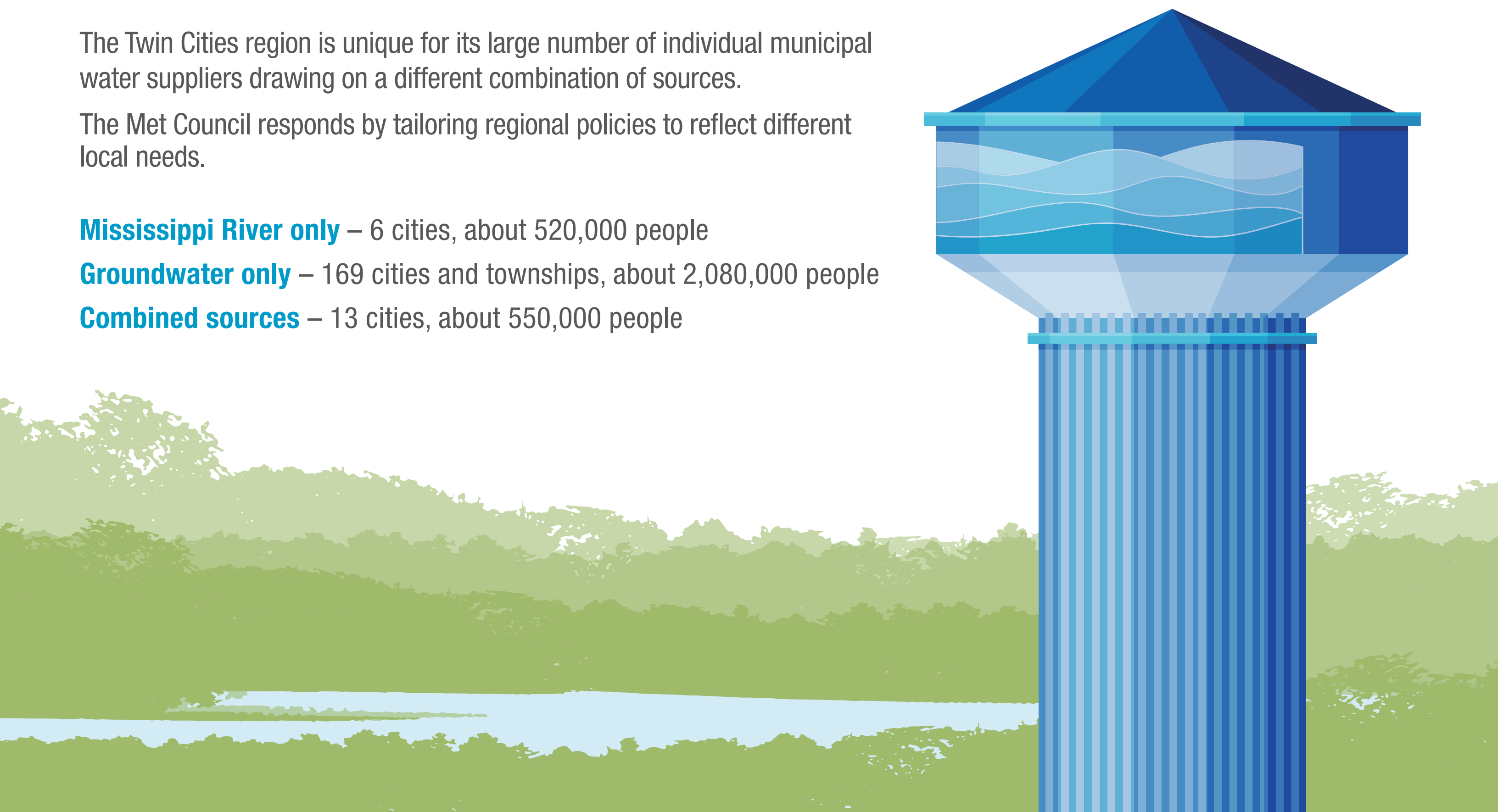
The Twin Cities region is unique for its large number of individual municipal water suppliers drawing on a different combination of sources.

The Met Council responds by tailoring regional policies to reflect different local needs.

Mississippi River only – 6 cities, about 520,000 people

Groundwater only – 169 cities and townships, about 2,080,000 people

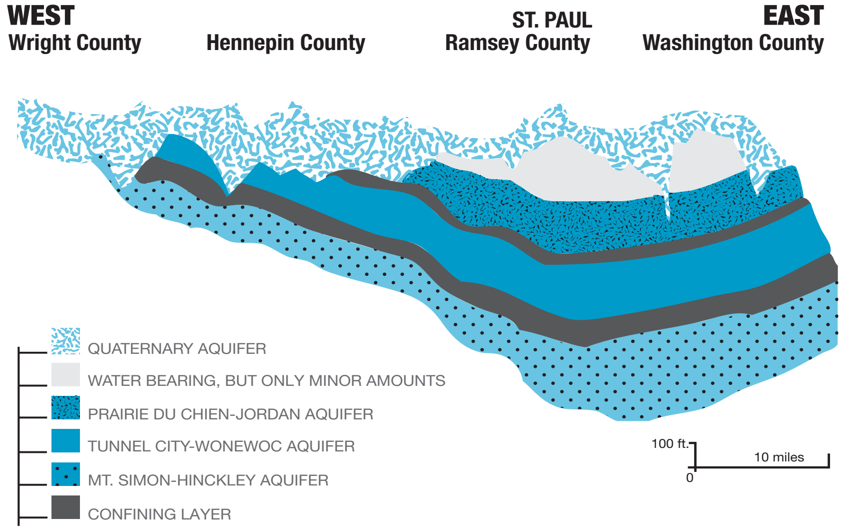
Combined sources – 13 cities, about 550,000 people



GROUNDWATER IS DRAWN FROM FOUR AQUIFERS —

QUATERNARY - supplies 24 city systems
PRAIRIE DU CHIEN-JORDAN - supplies 83 city systems
TUNNEL CITY-WONEWOC - supplies 30 city systems
MT. SIMON-HINCKLEY - supplies 35 city systems

THE MISSISSIPPI RIVER - supplies 19 municipal systems



WASTEWATER REUSE

Increasingly, stormwater and wastewater are reused for activities like irrigation and industrial processes.

STORMWATER REUSE

While water supplies in the seven-county metro area are relatively abundant, the region does face challenges that need attention and – in some cases – action.

WATER SUPPLY PLANNING CHALLENGES TO CONSIDER:

- Funding and finance to maintain and enhance infrastructure
- Variation in water source availability across the region
- Changing socioeconomic conditions and related land use and water demand
- Changes in climate and impacts on quantity and quality of water supplies
- Water quality and implications for public health and treatment costs
- Opportunities for water conservation and efficiency

> *"The greatest value in a partnered approach is that plans like the Master Water Supply Plan are informed by the real experiences and expertise of the local water suppliers that the public has come to trust."*
>
> **— Mark Maloney, Public Works Director, Shoreview**

2005 Minnesota Legislature gives Met Council charge for regional water supply planning

2006 Metropolitan Area Water Supply Advisory Committee, with state agency heads and local government representatives, begins to meet

2007-09 Data collection and analysis produce maps of shallow aquifers, groundwater contamination, and a new regional groundwater model

2010 Council adopts first Master Water Supply Plan

2012 Council collaborates with University of Minnesota MnTAP to support industrial water efficiency

OUTCOMES

THE MET COUNCIL ROLE

The Met Council collaborates with many partners to achieve outcomes as a planner – not a regulator; not a supplier

The Council's regional water supply work ensures local water suppliers retain control of and responsibility for their water supply systems. Through our work with partners, we help to bolster the livability of the region, foster economic growth and prosperity, and alleviate competition and conflict over water supply.

Since 2005, the Council has worked with our partners on many water supply projects and programs, focused in four key areas.

COLLABORATION

- Ideas and recommendations are shared in Metropolitan Area Water Supply Advisory Committees and subregional water supply work groups
- Policy and plan updates are shaped by hundreds of people
- Learning events build local capacity and expertise
- Since 2005, more than 70 communities in the region have participated in subregional work groups, supported by the Council, to address localized water supply issues.

Example: Northwest Metro Area Water Supply System Study

Met Council partnered with Corcoran, Dayton, Ramsey, and Rogers on a study of the relative costs and implementation of four different approaches to a multi-community water supply system.

PLANNING AND POLICYMAKING

- Metro area master water supply plan guides regional policies and implementation to meet diverse community needs
- Local planning assistance programs and tools available to 188 municipalities in the region

Example: Met Council's Climate Vulnerability Assessment

The Climate Vulnerability Assessment is a tool that can assist regional and local planning efforts in preparing and adapting to climate change. The tool reveals system vulnerabilities to currently occurring and expected climate changes.

Met Council added water supply content to the assessment to identify areas around wells that are most at risk of flooding and potential strategies to improve management in these areas.

TECHNICAL INVESTIGATIONS

- New data and analyses improve understanding of regional water resource conditions
- Subregional water supply groups identify and evaluate alternative water supply approaches
- Local and regional partners cooperate to investigate factors impacting water demand management such as efficiency, rates/budget

Example: Metro Model

Guided by a multi-organizational technical advisory group, Met Council developed a regional groundwater flow model. The model helps address a broad range of regional and local planning questions and scenarios. We regularly update it with the best available data. The model has served, for example, as a starting point for local wellhead protection planning and groundwater modeling in the northeast metro groundwater management area.

IMPLEMENTATION

- $12 million of Clean Water Fund leveraged to support work
- Technical assistance provided for local water efficiency and climate resiliency
- Track and report progress

Example: Water Efficiency Grant Program

With Clean Water Fund support, the Met Council makes grants to local governments to promote water conservation and efficiency. Residents are offered rebates on WaterSense-labeled fixtures and appliances.

2015-2017: 19 communities, 52 million gallons water saved per year.

2019-2022: 40 communities, savings to be determined.

2013 Water partners come together to envision a future of sustainable water supply at Our Water, Our Future workshops

2015 Council convenes new Technical Advisory Committee to tap into local expertise and deepen partnerships for water supply planning; Master Water Supply Plan updated

2017 Forum of all seven subregional water supply work groups

2016-19 Lawn irrigation research and demonstrations; water efficiency grants to communities

FUTURE WORK

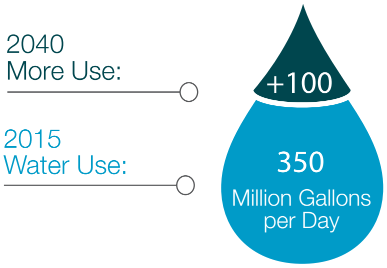
Regional partnerships lead to positive outcomes

The result of all this work greatly benefits the region:

- Shared water resources are better managed and more resilient for the long-term.
- Local governments and others better understand regional water resources and challenges.
- More resources are focused on water supply challenges.
- Our region's successful subregional platform advances water sustainability.

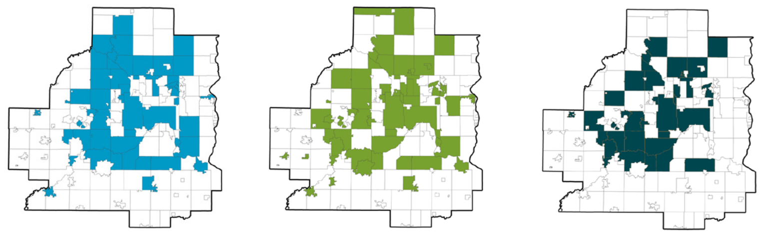
Looking into 2040

The region is expected to continue growing with impacts to land use and water demand and the systems that supply it.



Cities plan to invest in their water supply infrastructure to continue to provide residents with clean, plentiful, and affordable water.

Wells | **Distribution** | **Treatment**



By 2040

more than 50 communities plan to drill new municipal wells

more than 60 communities plan to improve and/or expand their distribution systems

more than 35 communities plan to enhance their water supply treatment processes

Support efficiency incentives | Promote sustainability efforts

Although the Council and its partners have accomplished much through the water supply planning work, new questions continue to emerge.

- How could equity be implemented in water supply activities?
- What is the impact of climate change on our resources and operation in the water supply sector?
- How can we strengthen land use and water supply planning connections?
- What can we do to prevent contamination of our water supply sources and respond more effectively to emerging contamination (recent examples: PFAS, chloride)?

> *"Council funding of studies and projects was important because it isn't always easy to get local city councils to commit funds to something that reaches beyond their borders."*
>
> **— Steve Albrecht, Former Burnsville Public Works Director**

> *"Groundwater doesn't know community boundaries. We can have a greater impact if we work together on water supply sustainability."*
>
> **— Russ Matthys, Public Works Director, Eagan**

CLEAN WATER LAND & LEGACY AMENDMENT

METROPOLITAN COUNCIL

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Complete report at metrocouncil.org/Wastewater-Water/Publications-And-Resources/WATER-SUPPLY-PLANNING/Water-Supply-Planning-in-the-Twin-Cities-Metropoli.aspx

Project #	16-WTR-002
Project Name	Construct Well #9 and Pumphouse #5

Total Project Cost	$1,150,000	Department	Water Utility
Type	Improvement	Category	Water Utility Improvement
Priority	2-New Addition (High)	Status	Active
Useful Life	50 years		

Description

Construct new municipal groundwater supply well with supporting pumphouse. A study will be conducted in 2026 to determine a desirable site - $50,000 est.

Justification

This project will provide a ninth municipal groundwater well with pumphouse. As the City of Ramsey continues to grow, two additional wells will be needed by 2040.

Expenditures	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	Total
Improvements Other than Building Cost	50,000	1,100,000	0	0	0	0	0	0	0	0	**1,150,000**
Total	**50,000**	**1,100,000**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1,150,000**

Funding Sources	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	Total
Water Utility Fund	50,000	1,100,000	0	0	0	0	0	0	0	0	**1,150,000**
Total	**50,000**	**1,100,000**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1,150,000**

Project #	24-WTR-001
Project Name	Well #10 and Pump House #6

Total Project Cost	$1,750,000	Department	Water Utility
Type	Improvement	Category	Water Utility Improvement
Priority	4-New Addition (Med)	Status	Active
Useful Life	50 years		

Description

Construct municipal well #10 and pump house #6. Location to be determined for a well-siting study in 2026.

Justification

As Ramsey's population continues to grow, there will be a need to increase the water supply pumping capacity to meet daily water consumption needs. The 2017 comprehensive water system study update identified the need to construct additional wells for daily demand needs in 2023 and 2028. A well was not added in 2023, but based on current population projections, new wells are proposed to be constructed in 2027 and 2030 and they will be connected to the new water treatment plant.

Expenditures	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**Total**
Improvements Other than Building Cost	0	0	0	0	1,750,000	0	0	0	0	0	**1,750,000**
Total	**0**	**0**	**0**	**0**	**1,750,000**	**0**	**0**	**0**	**0**	**0**	**1,750,000**

Funding Sources	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**Total**
Water Utility Fund	0	0	0	0	1,750,000	0	0	0	0	0	**1,750,000**
Total	**0**	**0**	**0**	**0**	**1,750,000**	**0**	**0**	**0**	**0**	**0**	**1,750,000**

Public Works Committee

Meeting Date: 05/19/2026

Primary Strategic Plan Initiative: Not Applicable

Title:

Receive Updates on Improvement Projects, Studies and Items of Interest

Purpose/Background:

The purpose of this case is to update the Public Works Committee on current and proposed City, County and MnDOT improvement projects and studies, and on other items of interest to the Committee.

City Improvement Projects

2027 Pavement Management Program Project Updates

- ***See separate case***
- City Council accepted Geotechnical Proposals by Haugo Geotechnical Services for IP #'s 27-01, 03, 04, 05 and 06 in the total amount of $62,020.

#26-01 MSA Bunker Lake Boulevard Reconstruction

- Bunker Lake Blvd. is closed to traffic during construction
- Coordinating schedule with Kwik Trip development
- Substantial completion proposed by July 31st

#26-02 2026 MSA Pavement Overlay Improvements

- Preparing plans and specifications in-house
- 2026 construction proposed

#26-03 Carol-Rose Acres & Sports Haven Street Reconstructions

- May 15th bids advertised
- 2026 construction proposed

#26-04 Countryside Estates & Wildwood Acres Street Reconstructions

- Pavement reclamation proposed for week of May 18th
- Substantial completion proposed by August 28th

#26-05 Flintwood Hills 2nd & 3rd Street Reconstructions

- Construction in progress
- Substantial completion proposed by August 28th

#26-06 Riverside West Street Reconstructions

- ***See separate case***
- Substantial completion proposed by October 2nd

#26-07 Section 01 Unplatted (S. CR 27) Street Reconstructions

- 2026 construction
- Substantial completion proposed by August 28th

#26-08 2026 Neighborhood Pavement Overlay Improvements

- May 26th City Council considers awarding construction contract to lowest responsible bidder
- 2026 Summer construction proposed

#26-09 2026 Crack Seal Improvements

- Prepared plans and specifications in-house
- Scheduling preconstruction meeting with MP Asphalt Maintenance

#26-10 2026 Pavement Rejuvenation Improvements
- Prepared plans and specifications in-house
- Scheduling preconstruction meeting with Corrective Asphalt Materials

#26-11 2026 Pavement Marking Improvements
- Requests for Proposals ordered
- 2026 construction proposed

#26-53 2026 Pavement Skim Patching Contracted Services
- May 15th bids advertised
- June 15th bids publicly opened
- June 23rd City Council considers award of contract to lowest responsible bidder
- Substantial completion by July 31st

#25-03 MSA Alpine Drive Reconstruction – CSAH 57 to TH 47
- Regional trail recently received a 1" overlay due to surface scarring
- Closing project out

#25-04 Dickenson's Mississippi Estate Street Reconstruction
- Closing project out

#25-06 Sortebergs Street Reconstruction
- Closing project out

#25-08 Sunwood Drive Crosswalk Repairs
- **See separate case**

#25-12 COR Street Lighting Improvements
- Street lights proposed along Ramsey Parkway and all intersections
- Connexus Energy preparing final plans and specifications plus required agreements
- 2026 construction proposed

#25-58 Waterfront Water Play Area Improvements
- Construction of restroom and waterplay improvements in progress
- Construction substantially complete by July 1st

#24-13 Fox Ridge Estates 1st and 2nd Additions Street Reconstruction
- Closing project out

#24-51 TH 47 Trail Gap Connection – 142nd Avenue to Xkimo Street
- Bolton & Menk revised construction plans for 10' pedestrian trail per MnDOT comments
- Minimized right-of-way impacts and need to obtain temporary/permanent easements
- MnDOT proposes to construct 10' trail with their 2028 TH 47 mill and overlay project

#20-11 Ramsey Gateway Highway 10 Improvements
- Project complete
- Punch list items are being finalized

<u>City of Anoka Improvement Projects & Studies</u>
Ferry Street (Trunk Highway 47) Grade Separation of BNSF Rail Crossing
- City-led project
- $45M in bonds authorized October 2020
- Tied to Highway 47 Corridor Improvements Project

Highway 47 Corridor Improvements Project – Pleasant St (CSAH 30) to Bunker Lk Blvd
- Improvements proposed to address intersection operations and safety, providing safe pedestrian and bicyclist routes, providing safe driveway access, and accommodating future growth
- Proposing 3-lane design with center two-way turn lane (CTWTL)

- Received regional solicitation funds
- Permanent signal system at McKinley Street
- Under design
- Construction proposed for ***2029 - 2031***
- Website; https://www.anokaminnesota.com/836/Trunk-Hwy-47-Corridor-BNSF-Railroad-Grad

City of Elk River Improvement Projects & Studies

Highway 10 Corridor Improvements - Highway 169 to city boundary with Ramsey

- Corridor planning project
- Received $1.6M from MnDOT Corridors of Commerce Readiness Advancement program for preliminary design and environmental analysis

Anoka County Improvement Projects

- 2027 Sunfish Lake Blvd. pavement overlay/reclamation proposed north of Bunker Lake Blvd.
- 2027 Bunker Lake Blvd. / Ramsey Blvd. intersection improvements including pavement overlay of Bunker Lake Blvd. from Ramsey Blvd. to Limonite St., and a pavement reclamation from Ramsey Blvd. to Rhinestone St.

MnDOT Improvement Projects

#SP 0202-126 TH 10 Traffic Management System Improvements

- Construct TH 10 traffic management system improvements from Thurston Ave in City of Anoka to TH 101 in Elk River, and TH 101 from CSAH 38 (70th St) to N of CSAH 39 in Otsego
- No impacts to existing utilities anticipated
- 2026 construction proposed

#SP 0202-119 Highway 10 Mill & Overlay and RCI Improvements

- Proposed improvements include;
  - Mill & overlay pavement from approx. ½-mile west of Cleveland/Jarvis Avenue in Elk River to ½-mile west of Ramsey Boulevard in Ramsey, including Dayton Rest Area
  - Reduced Conflict Intersection (RCI) improvements (J-Turns w/out signal systems) at Edison and Jarvis Streets in Elk River, and Alpine and Beatty Drives in Ramsey
  - Remove median crossovers
  - Extend pedestrian trail south of US 10/169 from 500-feet East of Adams Street to Edison Street
  - Construct pedestrian crossover/refuge in median of US 10/169 at Jarvis Street
  - Remove, repair and replace drainage culverts
  - Construct, repair and replace misc. guardrail/end treatments
- 2027 construction proposed
- 60-percent plans complete
- No public open houses scheduled yet for Elk River or Ramsey

Studies & Items of Interest

Wetland 114P Outlet Control Structure

- Staff continue to monitor water levels. No updates at this time.

Commercial/Industrial/Residential Developments

- Staff can respond to questions as needed.

Miscellaneous Staff Updates

- On July 21st, staff plans to present updates on the redundancy/safety features built into the new Water Treatment Plant to ensure treated water will remain safe to drink at all times, and will discuss when the water tower at Dysprosium Street and Nowthen Boulevard is proposed to be painted as requested during the February 17th PWC meeting.

PWC Future Topics Calendar Discussion Items
See calendar in following case.

Time Frame/Observations/Alternatives:
Staff estimates up to 15 minutes will be needed for updates and discussion.

Recommendation:
Staff can offer recommendations on specific items upon request.

Outcome/Action:
No formal action required. For Committee review and discussion purposes only.

Attachments

No file(s) attached.

Form Review

Inbox	Reviewed By	Date
Brian Hagen	Brian Hagen	05/13/2026 03:56 PM
Form Started By: Bruce Westby		Started On: 05/12/2026 07:42 PM
Final Approval Date: 05/13/2026		

Public Works Committee

Meeting Date: 05/19/2026

Primary Strategic Plan Initiative: Not Applicable

Title:

Review Future Topics Calendar

Purpose/Background:

Attached is a calendar of future topics for review and discussion by the Public Works Committee. The calendar includes topics drawn from Committee requests received during meetings and/or unresolved topics previously discussed by the Committee. Calendar dates are subject to change based on the availability of information and required attendees, staff workload, and competing interests and objectives.

Time Frame/Observations/Alternatives:

Less than 5 minutes is anticipated to be necessary to review the future topics calendar and address questions.

Recommendation:

Staff recommend reviewing the attached calendar and to either approve the calendar by consensus or to direct Staff to revise the calendar as follows; _______.

Outcome/Action:

No formal action required. For Committee review and discussion purposes only.

Attachments

PWC Calendar May2026

Form Review

Inbox	Reviewed By	Date
Brian Hagen	Brian Hagen	05/13/2026 03:56 PM
Form Started By: Bruce Westby		Started On: 05/12/2026 07:43 PM
Final Approval Date: 05/13/2026		

Public Works Committee Future Topics Calendar *

Date	Topics for Discussion – Committee Action
Q4 2026	Sunwood Drive roundabout landscaping *(Riverblood)*
Q3 2026	Veterans Drive Dog Park Fence *(Riverblood)*
June 2026	COR Street Lighting Improvements *(Westby)*
Date	**Topics for Discussion – Regulatory**
Date	**Topics for Discussion – Policy**
Q3 2026	Landscaped median maintenance policy *(Riverblood)*
Date	**Topics for Discussion – Planning and Budget**
Q4 2026	Asset management program update *(Westby)*
Ongoing	Trail gap connection opportunities *(Riverblood)*
Date	**Topics for Discussion – Staff Updates**
Monthly	Waterfront waterplay improvements *(Riverblood/Westby)*
Ongoing	Flashing Yellow Arrow opportunities *(Westby-**continue lobbying for**)*
Monthly	TH 47 Anoka improvements, Bunker Lk Blvd to Hwy 10 *(Westby)*
Monthly	TH 47 trail connection 142nd to Xkimo St *(Riverblood)*

* Dates subject to change based on availability of information, required attendees, staff workload, and competing interests and objectives.