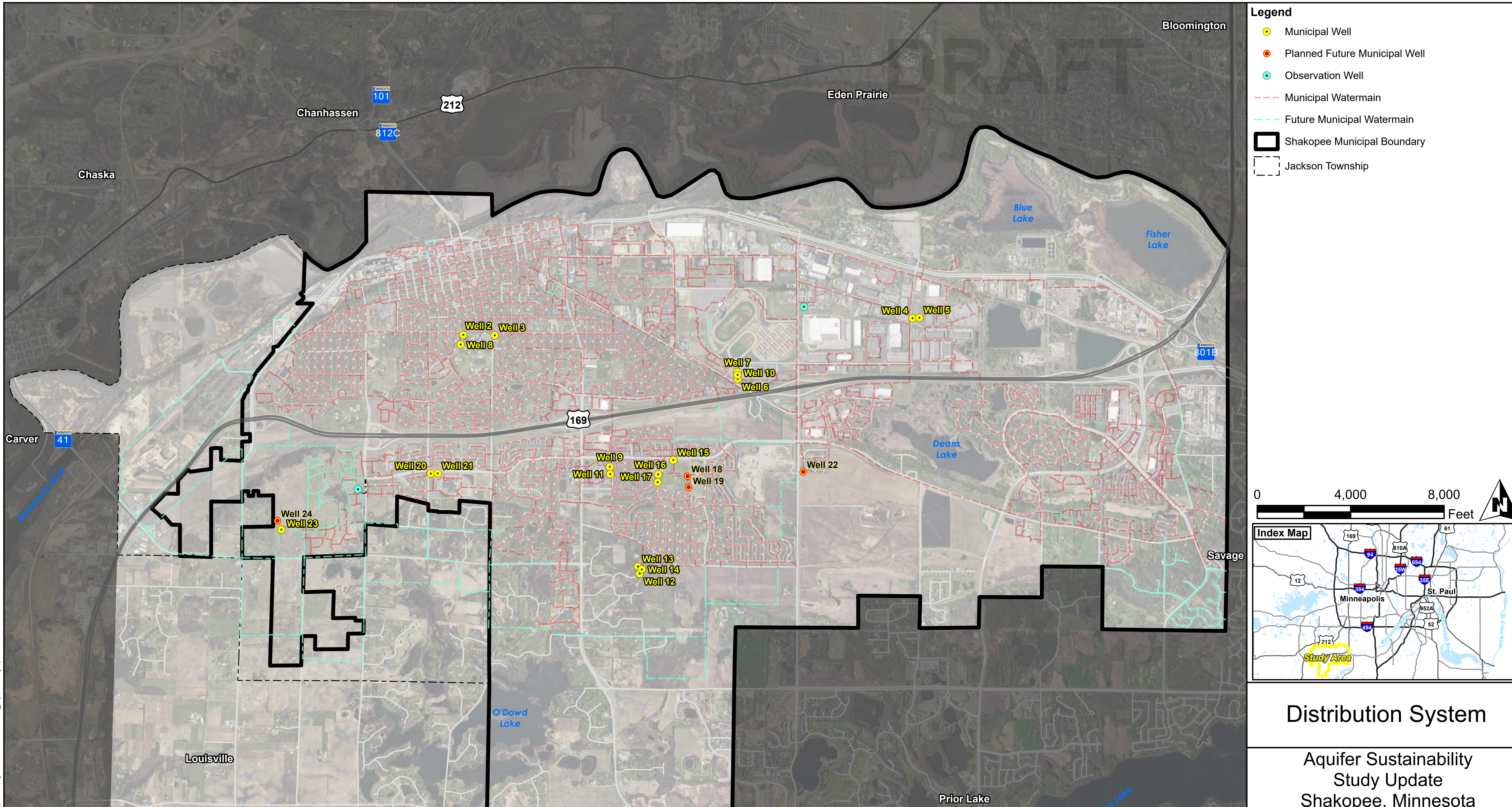
Figures



Distribution System

Aquifer Sustainability
Study Update
Shakopee, Minnesota

SEH

Print Date: 6/14/2024

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

Figure
1

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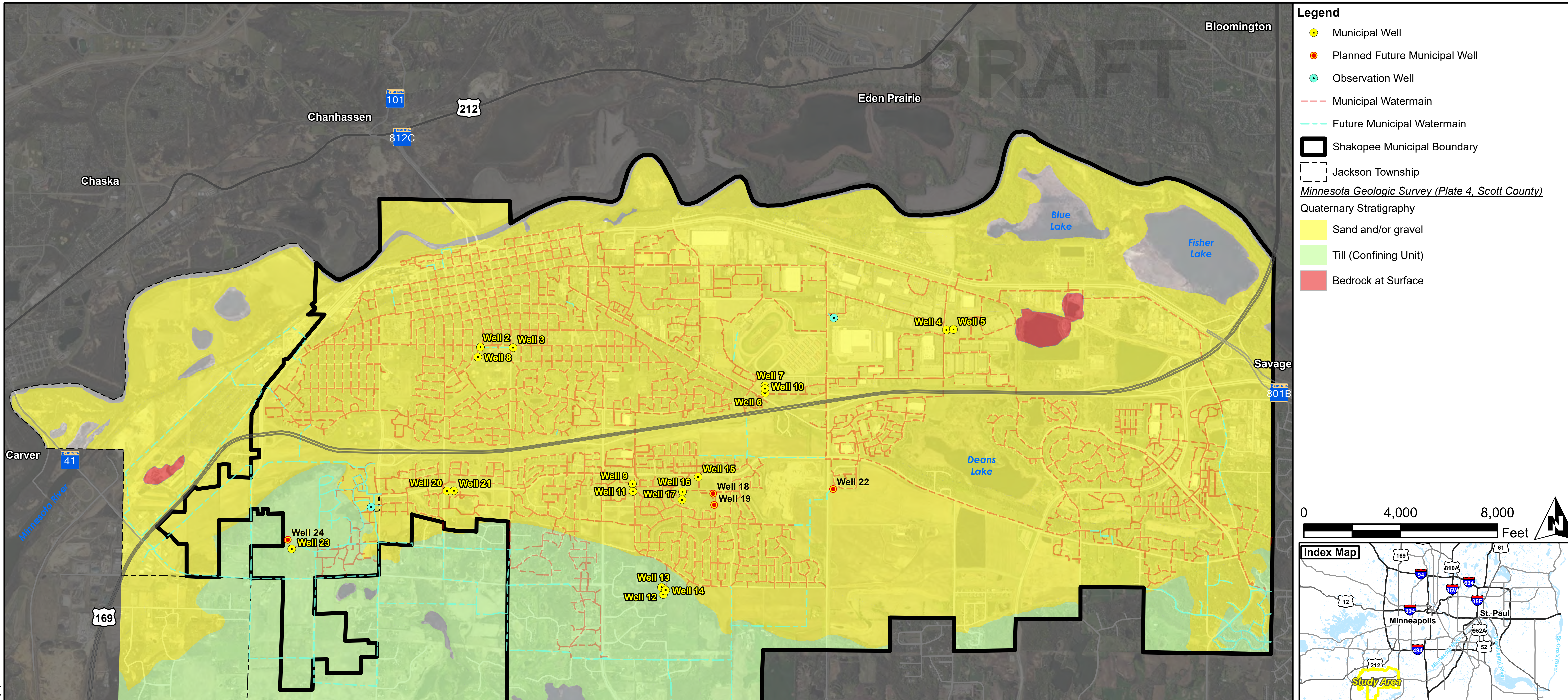


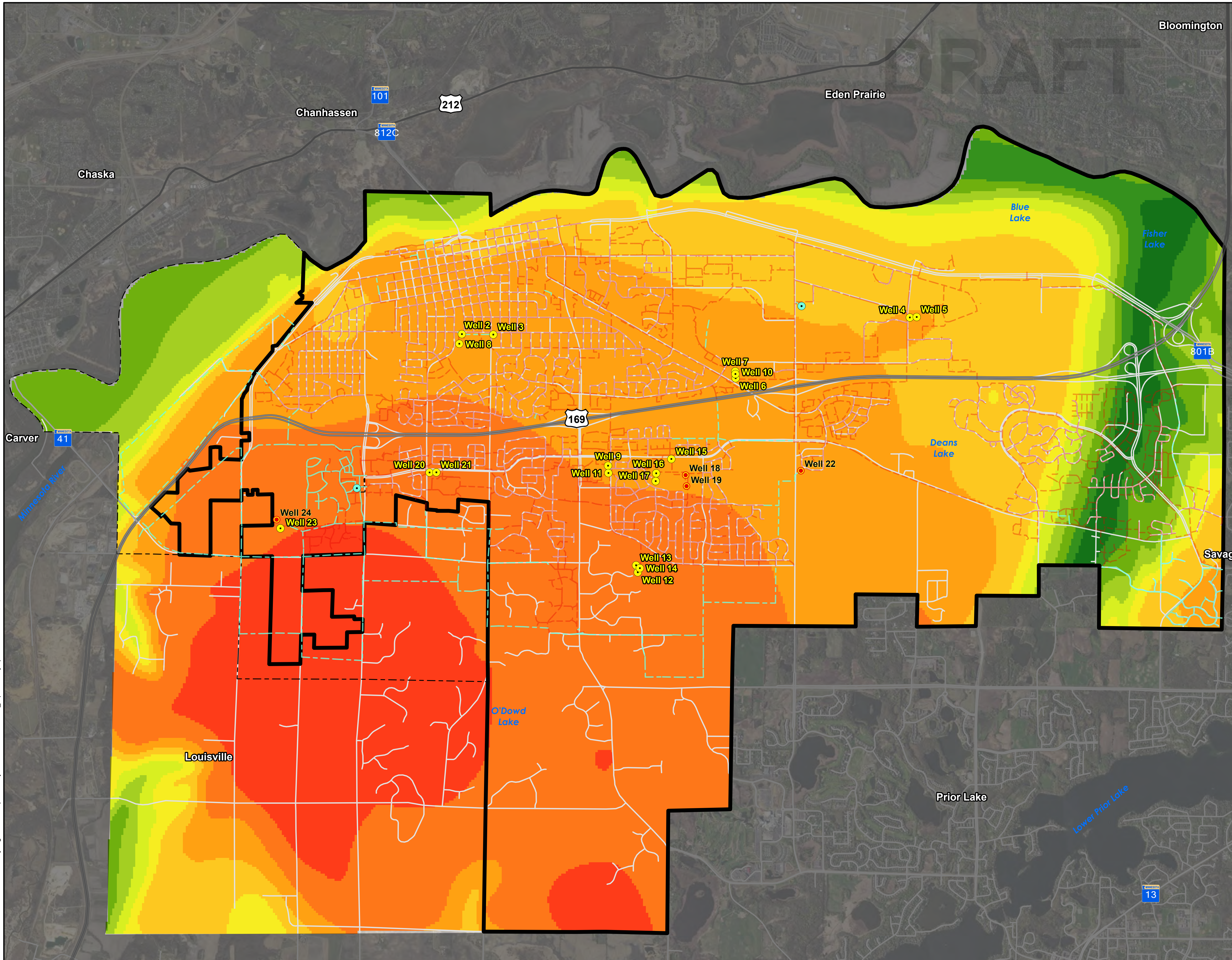
Surficial Geology

Aquifer Sustainability Study Update
Shakopee, Minnesota

Print Date: 6/14/2024

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

Figure 2



Legend

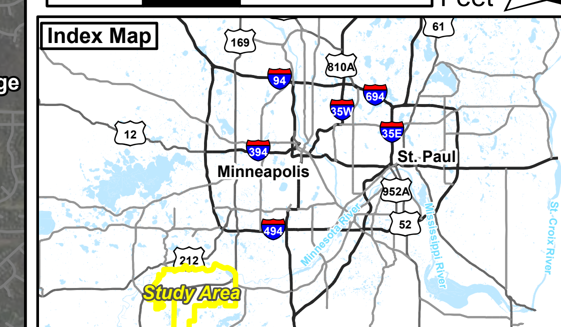
- Municipal Well
- Planned Future Municipal Well
- Observation Well
- Municipal Watermain
- Future Municipal Watermain
- Shakopee Municipal Boundary
- Jackson Township

Surficial Thickness / Depth to Bedrock (MGS, 2008)

Feet Below Ground Surface

- 392 - 433
- 434 - 485
- 486 - 532
- 533 - 579
- 580 - 633
- 634 - 682
- 683 - 725
- 726 - 774
- 775 - 818
- 819 - 852

0 4,000 8,000 Feet



Depth to Bedrock

Aquifer Sustainability Study Update
Shakopee, Minnesota

Print Date: 6/14/2024

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

Figure 3

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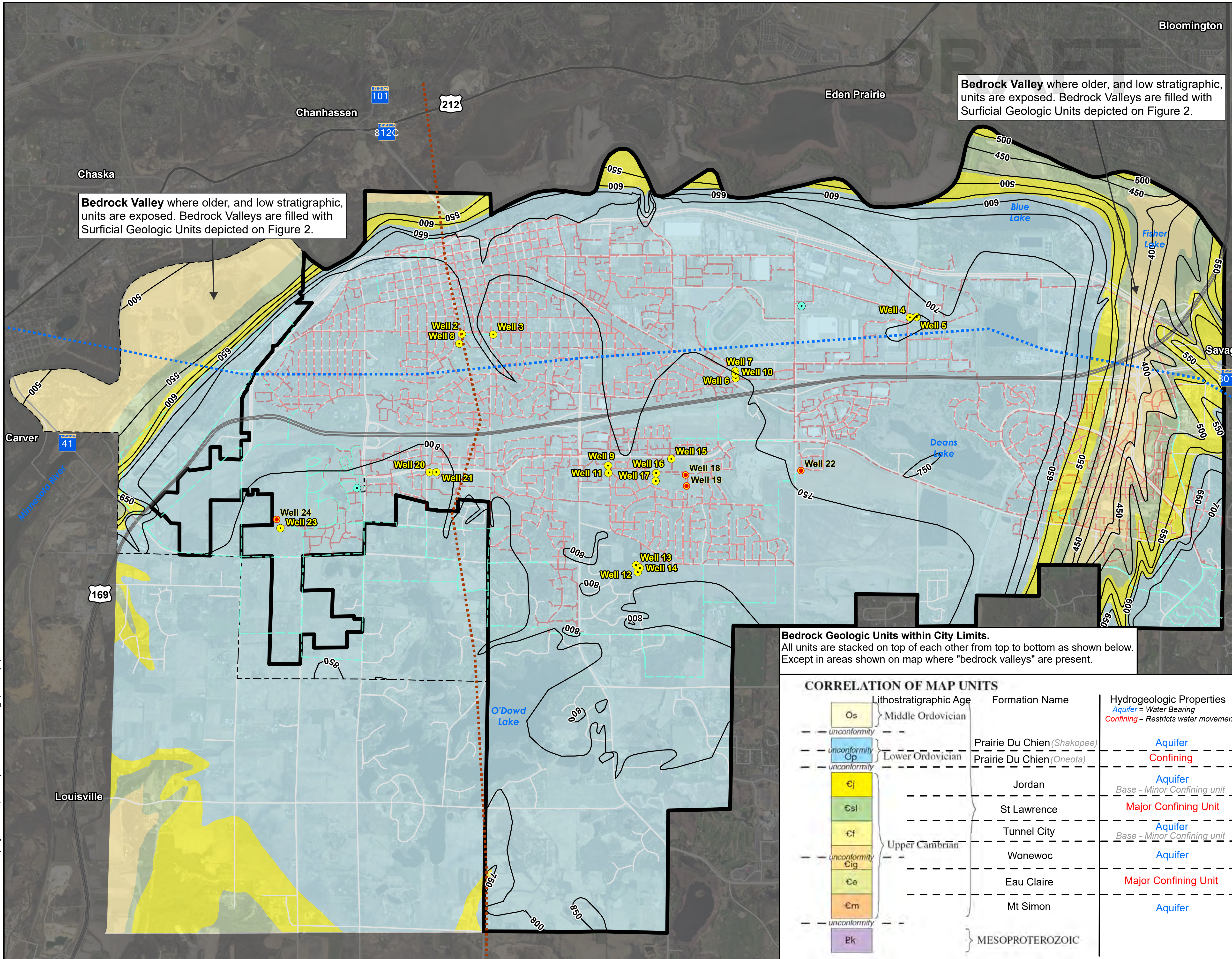


Legend

- Municipal Well
- Planned Future Municipal Well
- Observation Well
- Municipal Watermain
- Future Municipal Watermain
- Shakopee Municipal Boundary
- Jackson Township
- Cross Section A to A' (Figure 5)
- Cross Section B to B' (Figure 6)

Scott County Minnesota Geologic Survey (Plate 2)

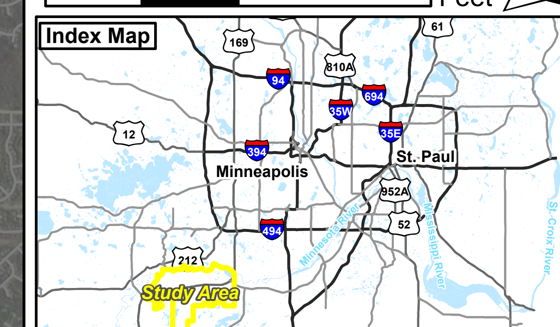
Bedrock Formation Name

- Prairie du Chien Group (Aquifer/confining)
- Jordan Sandstone (Aquifer)
- St Lawrence Formation (Confining Unit)
- Tunnel City Group (Aquifer)

Tunnel City Group was formerly referred to as the Franconia Formation

0 4,000 8,000 Feet

N



Bedrock Geology

Aquifer Sustainability Study Update Shakopee, Minnesota

SEH

Print Date: 6/14/2024

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

Figure 4

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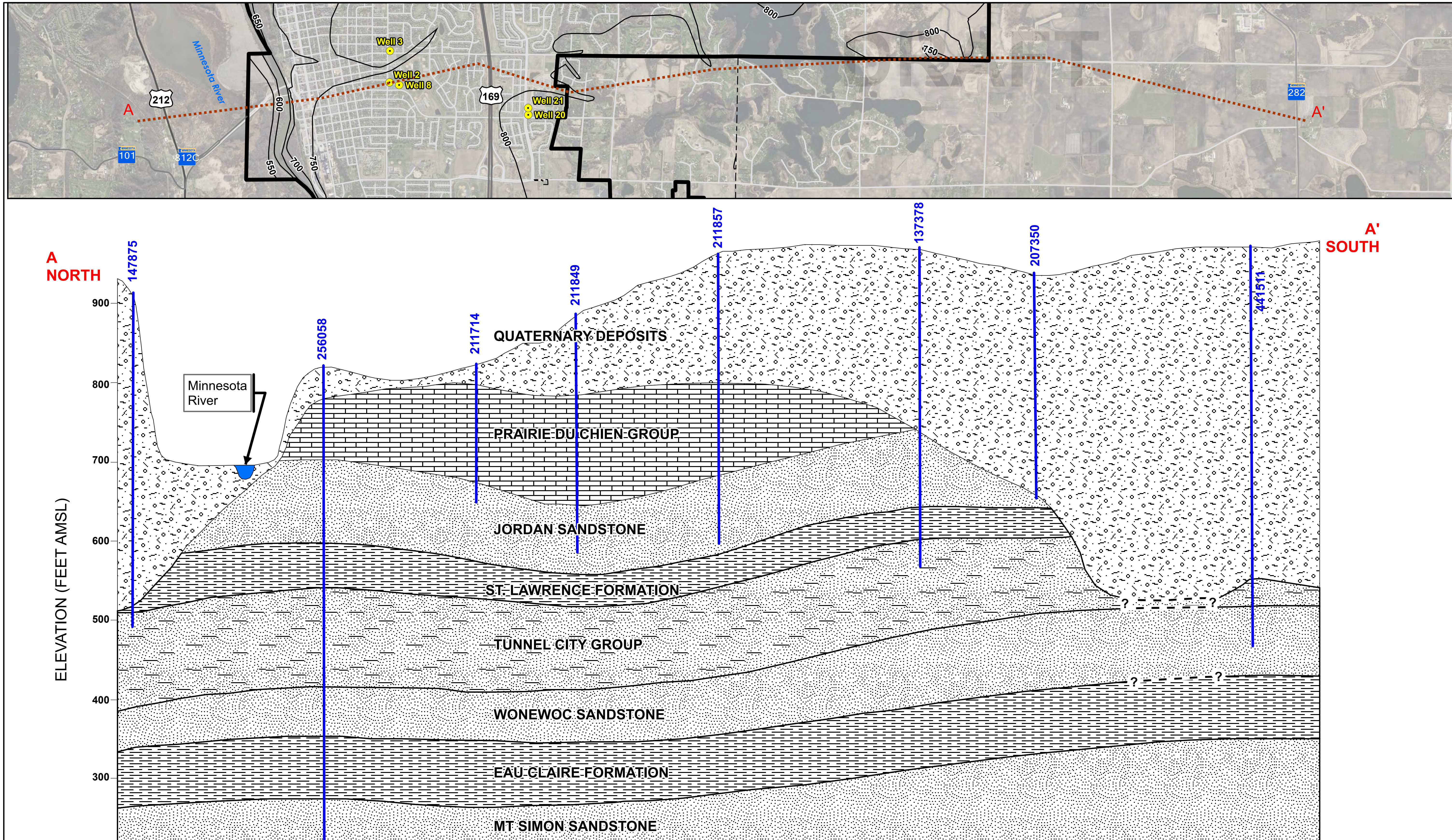

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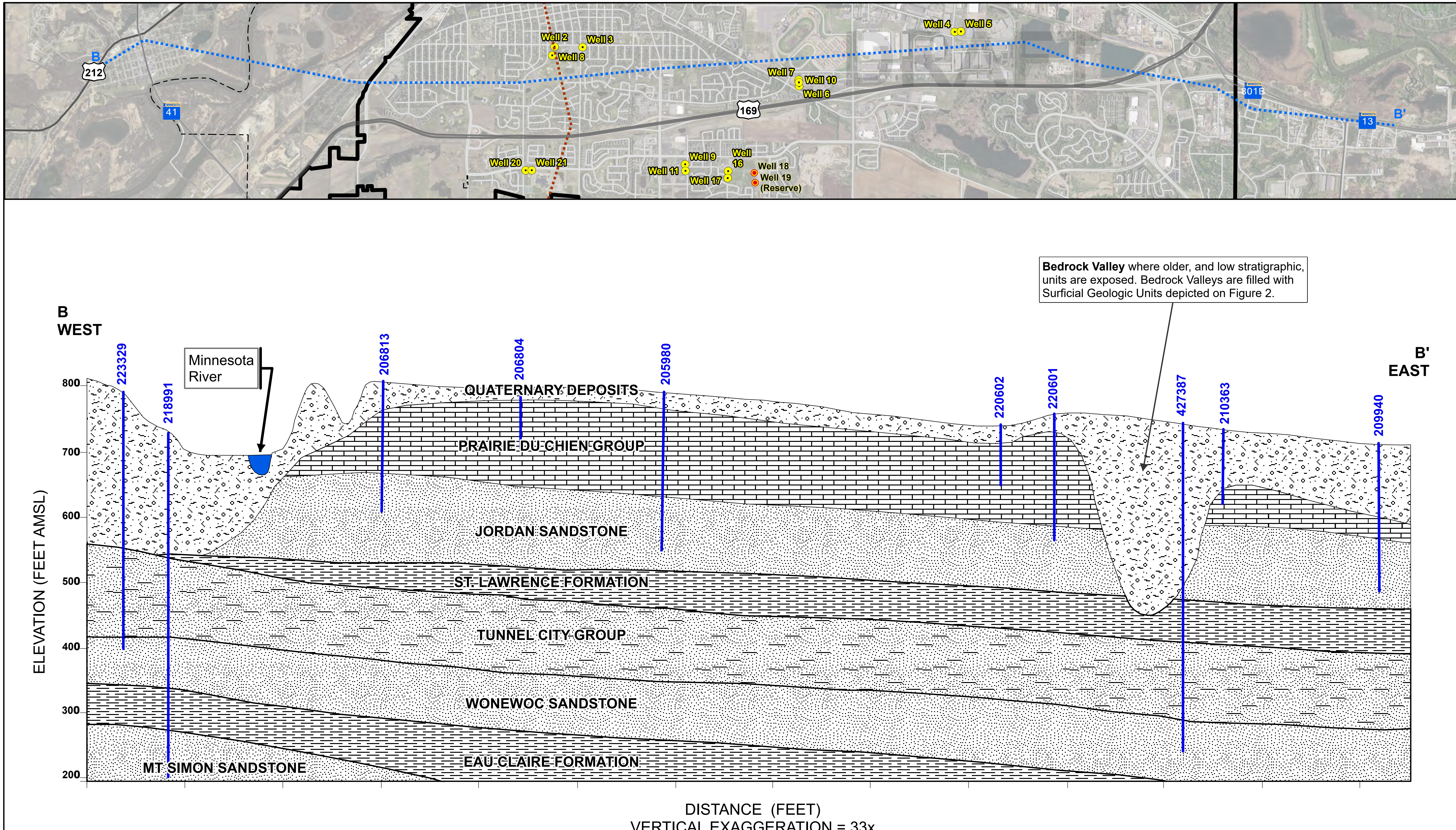
AQUIFER SUSTAINABILITY STUDY

Aquifer Sustainability Study Update
Shakopee, Minnesota

Typical Geologic Cross-section A - A'

Figure 5

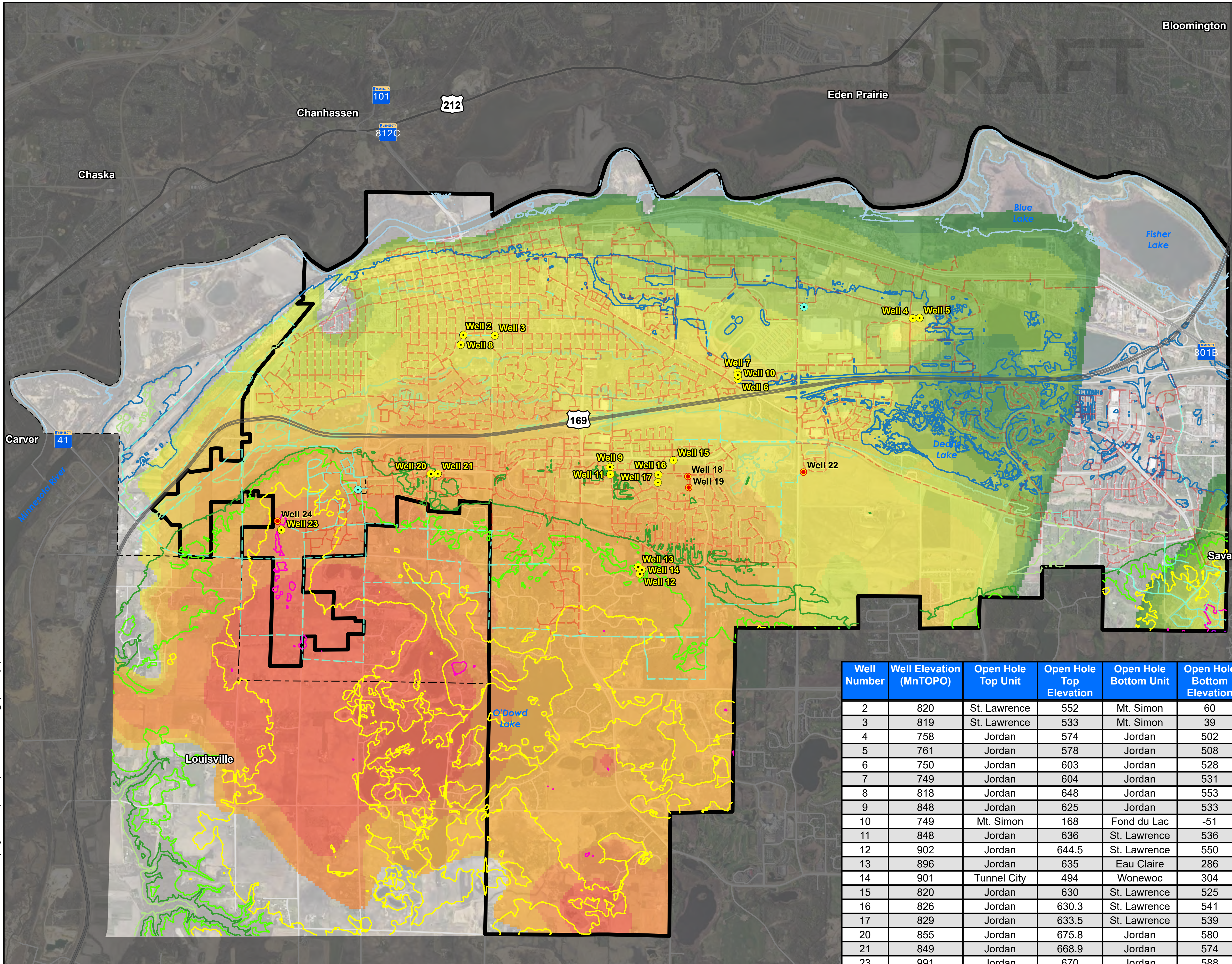


AQUIFER SUSTAINABILITY STUDY

Aquifer Sustainability Study Update
Shakopee, Minnesota

Typical Geologic Cross-section B - B'

Figure 6



Well Number	Well Elevation (MnTOPO)	Open Hole Top Unit	Open Hole Top Elevation	Open Hole Bottom Unit	Open Hole Bottom Elevation
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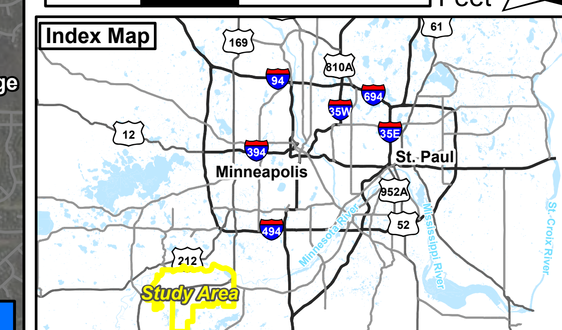
21	849	Jordan	668.9	Jordan	574
23	991	Jordan	670	Jordan	588



Prairie Du Chien (Shakopee) Top Elevation

Aquifer Sustainability Study Update
Shakopee, Minnesota

Print Date: 6/14/2024

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

Figure 7

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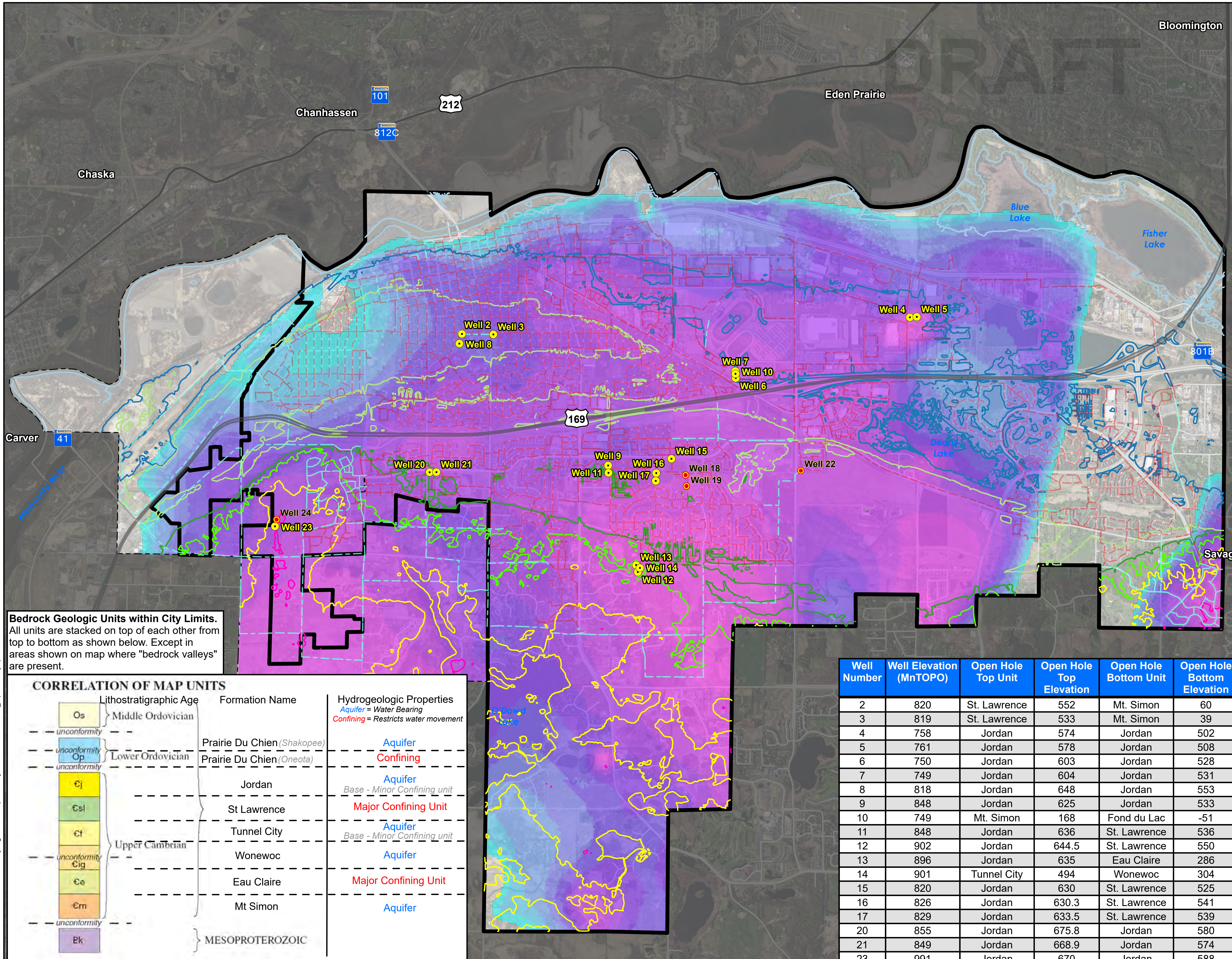

Legend

- Municipal Well
- Planned Future Municipal Well
- Municipal Watermain
- Future Municipal Watermain
- Shakopee Municipal Boundary
- Jackson Township

Surface Elevation (MnTOPO)

Feet Above Mean Sea Level

- 700
- 750
- 800
- 850
- 900
- 950
- 1000
- 1030

Prairie Du Chien (Shakopee) Aquifer Thickness

Aquifer Thickness in Feet

- 1 - 13
- 14 - 25
- 26 - 37
- 38 - 47
- 48 - 57
- 58 - 66
- 67 - 75
- 76 - 84
- 85 - 95
- 96 - 110

Bedrock Geologic Units within City Limits.
All units are stacked on top of each other from top to bottom as shown below. Except in areas shown on map where "bedrock valleys" are present.

CORRELATION OF MAP UNITS

Map Unit	Lithostratigraphic Age	Formation Name	Hydrogeologic Properties (*Aquifer* = Water Bearing; *Confining* = Restricts water movement)
Os	Middle Ordovician		
unconformity			
unconformity	Lower Ordovician	Prairie Du Chien *(Shakopee)*	Aquifer
Op	Lower Ordovician	Prairie Du Chien *(Oneota)*	Confining
unconformity			
Ꞓj	Upper Cambrian	Jordan	Aquifer *Base - Minor Confining unit*
Ꞓsl	Upper Cambrian	St Lawrence	Major Confining Unit
Ꞓf	Upper Cambrian	Tunnel City	Aquifer *Base - Minor Confining unit*
unconformity Ꞓig	Upper Cambrian	Wonewoc	Aquifer
Ꞓe	Upper Cambrian	Eau Claire	Major Confining Unit
Ꞓm	Upper Cambrian	Mt Simon	Aquifer
unconformity			
Ꞓk	MESOPROTEROZOIC		

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17	829	Jordan	633.5	St. Lawrence	539
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23	991	Jordan	670	Jordan	588

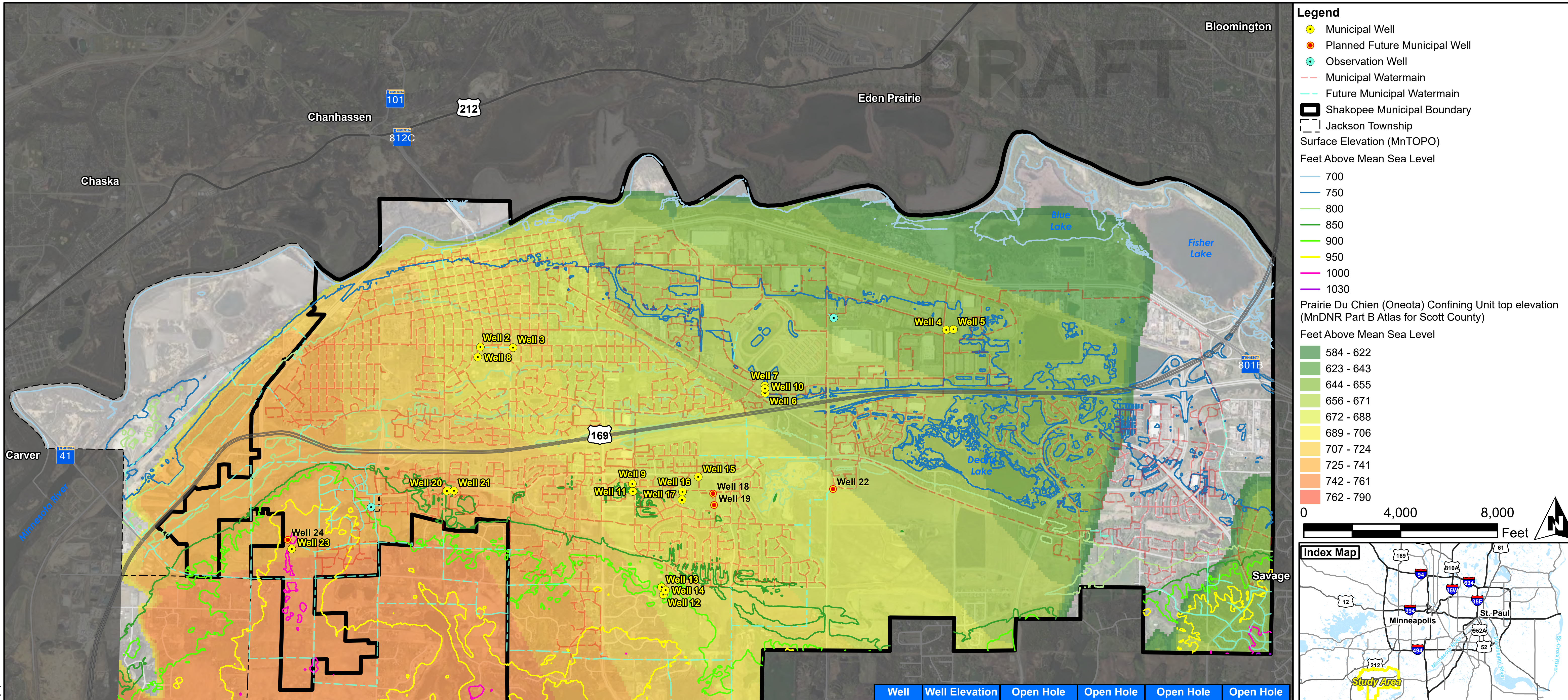
Prairie Du Chien (Shakopee) Thickness

Aquifer Sustainability Study Update
Shakopee, Minnesota

Print Date: 4/2/2024

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

Figure 8



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23	991	Jordan	670	Jordan	588

Prairie Du Chien (Oneota) Top Elevation

Aquifer Sustainability Study Update
Shakopee, Minnesota

Print Date: 6/14/2024
Map by: Mark Sherrill
Projection: UTM Zone 15N
Source: ESRI, SEH Digi, MnDOT, Minnesota Geologic Survey (MGS), Scott County

Figure 9

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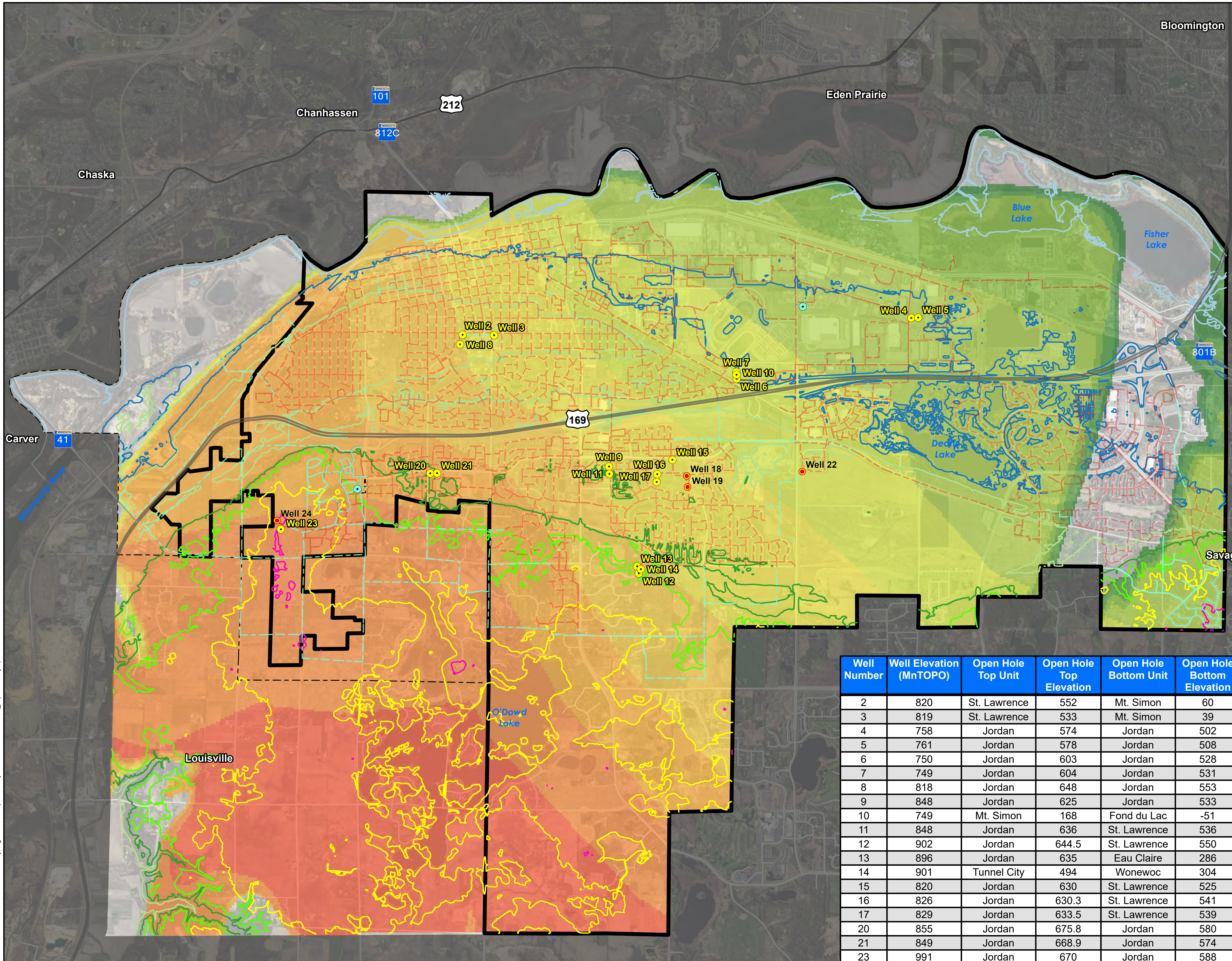

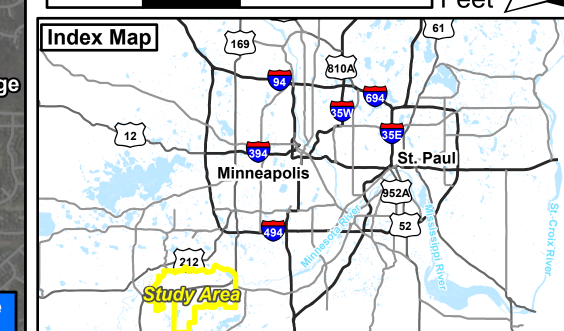

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Jordan Aquifer Top Elevation

Aquifer Sustainability Study Update
Shakopee, Minnesota

Print Date: 6/14/2024
Map by: Mark Sherrill
Projection: UTM Zone 15N
Source: ESRI, SEH Digi, MnDOT, Minnesota Geologic Survey (MGS), Scott County

Figure 10

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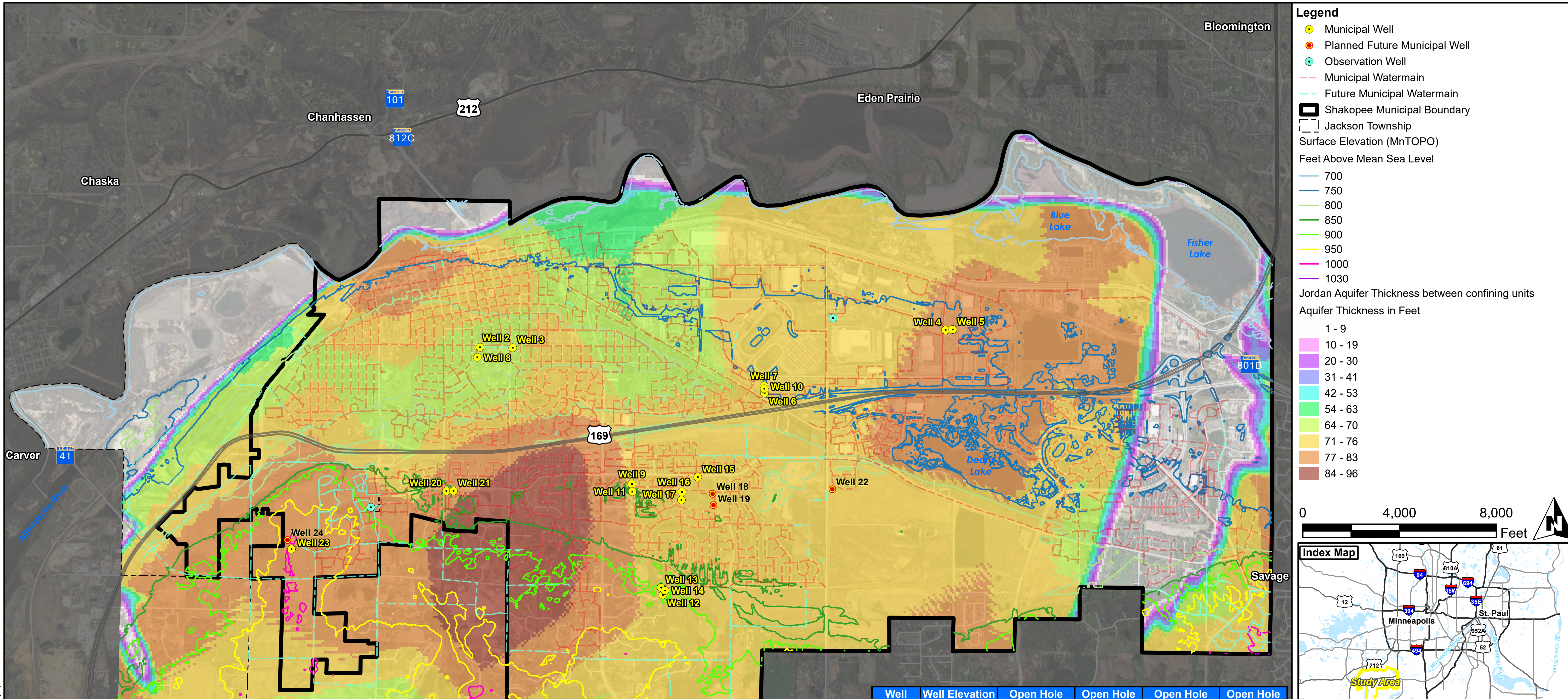
Jordan Aquifer Thickness

Aquifer Sustainability Study Update
Shakopee, Minnesota



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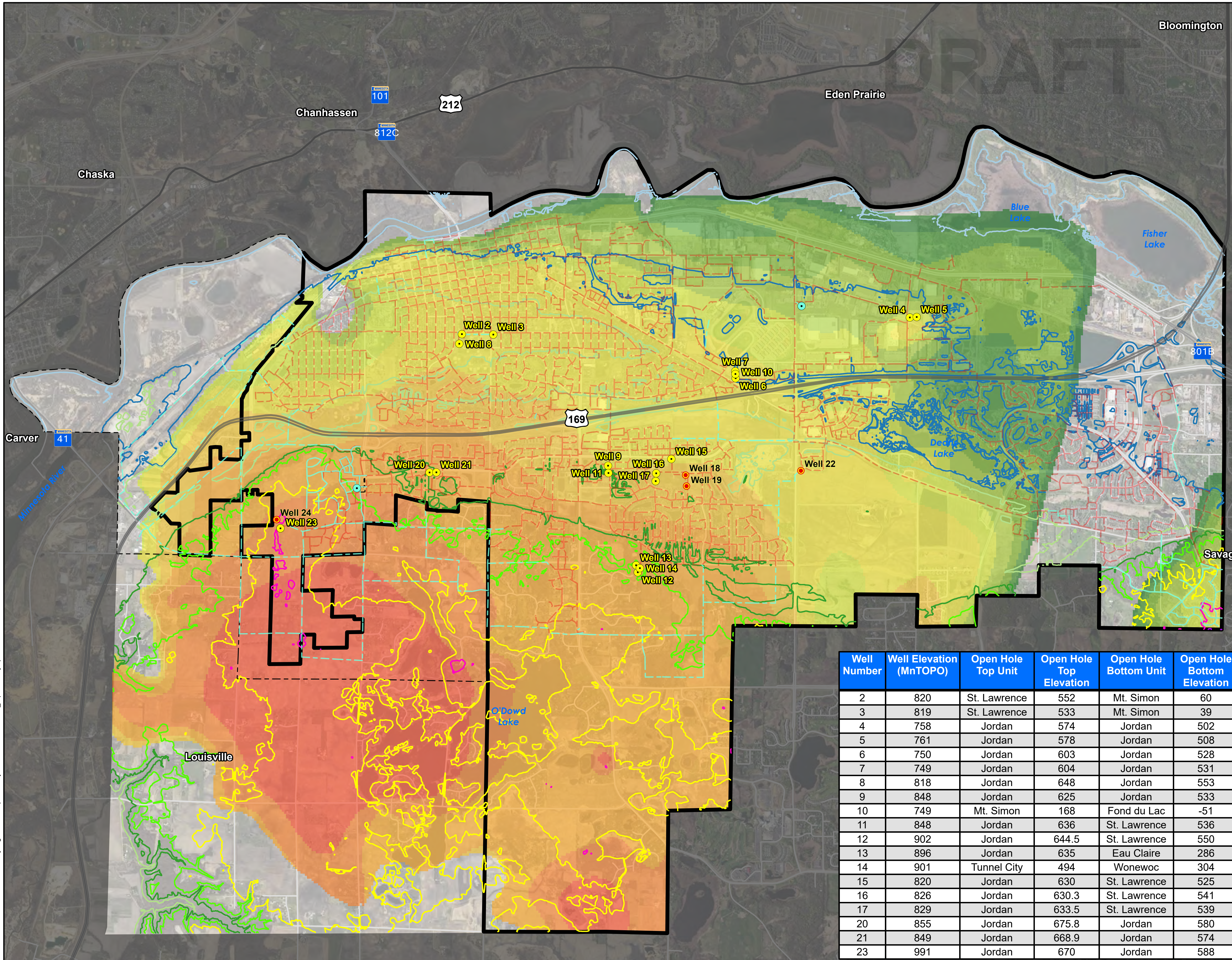
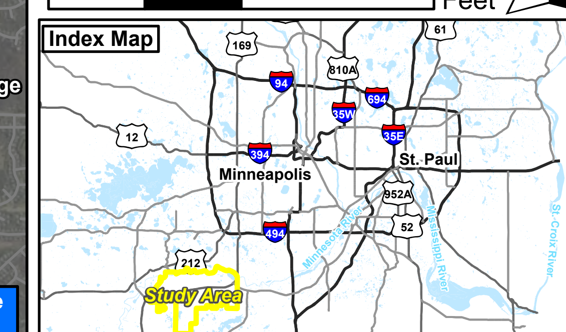
Print Date: 6/14/2024

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

Figure 11





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Jordan Confining Unit Top Elevation

Aquifer Sustainability Study Update
Shakopee, Minnesota

Print Date: 6/14/2024

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

Figure 12

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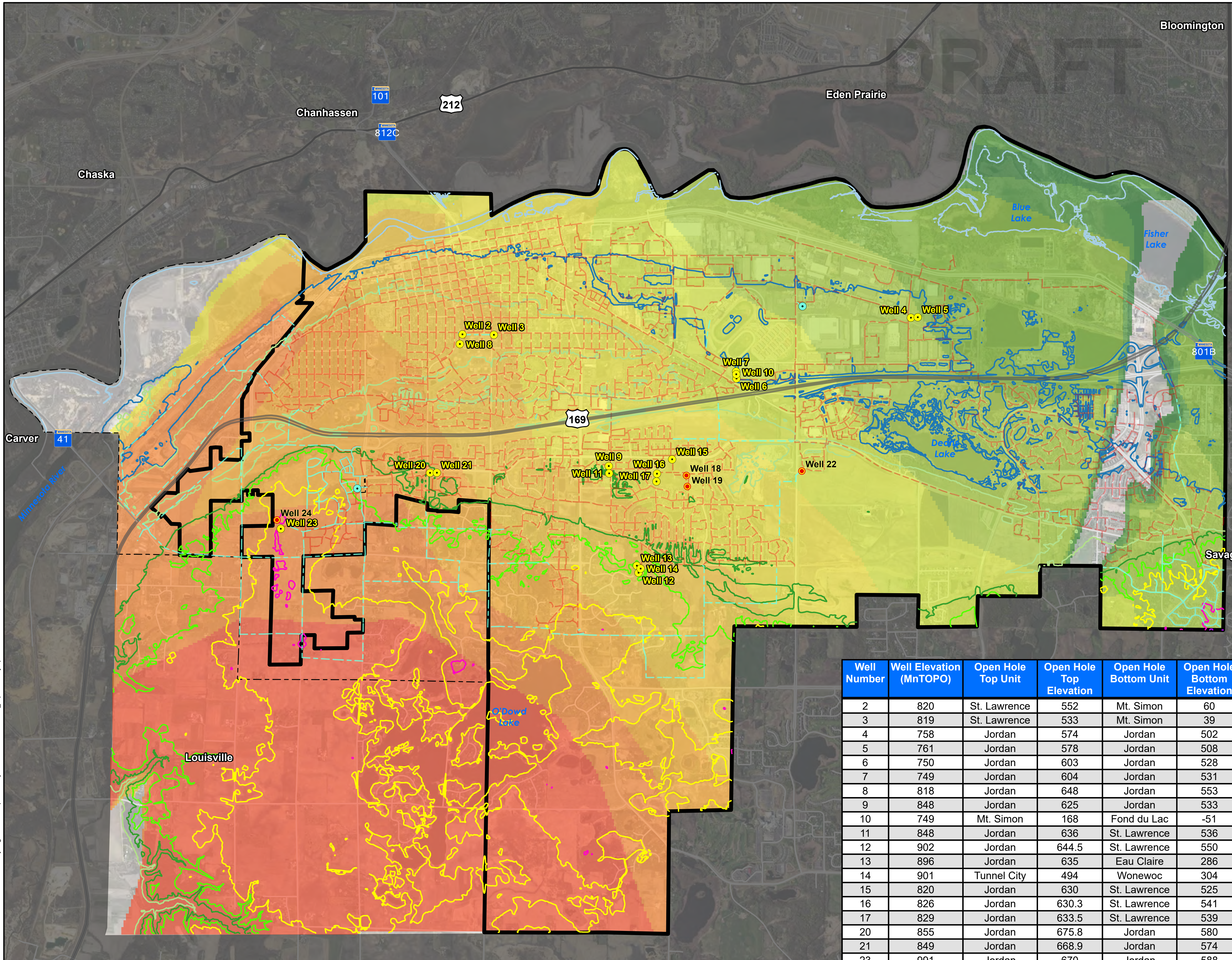

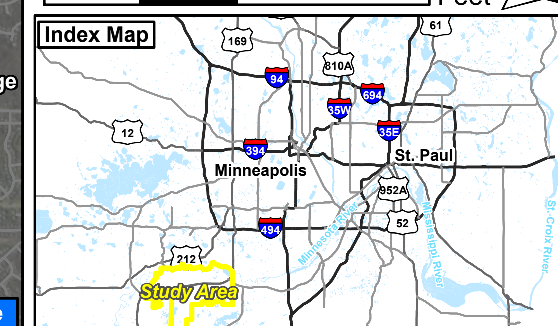

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St. Lawrence Confining Unit Top Elevation

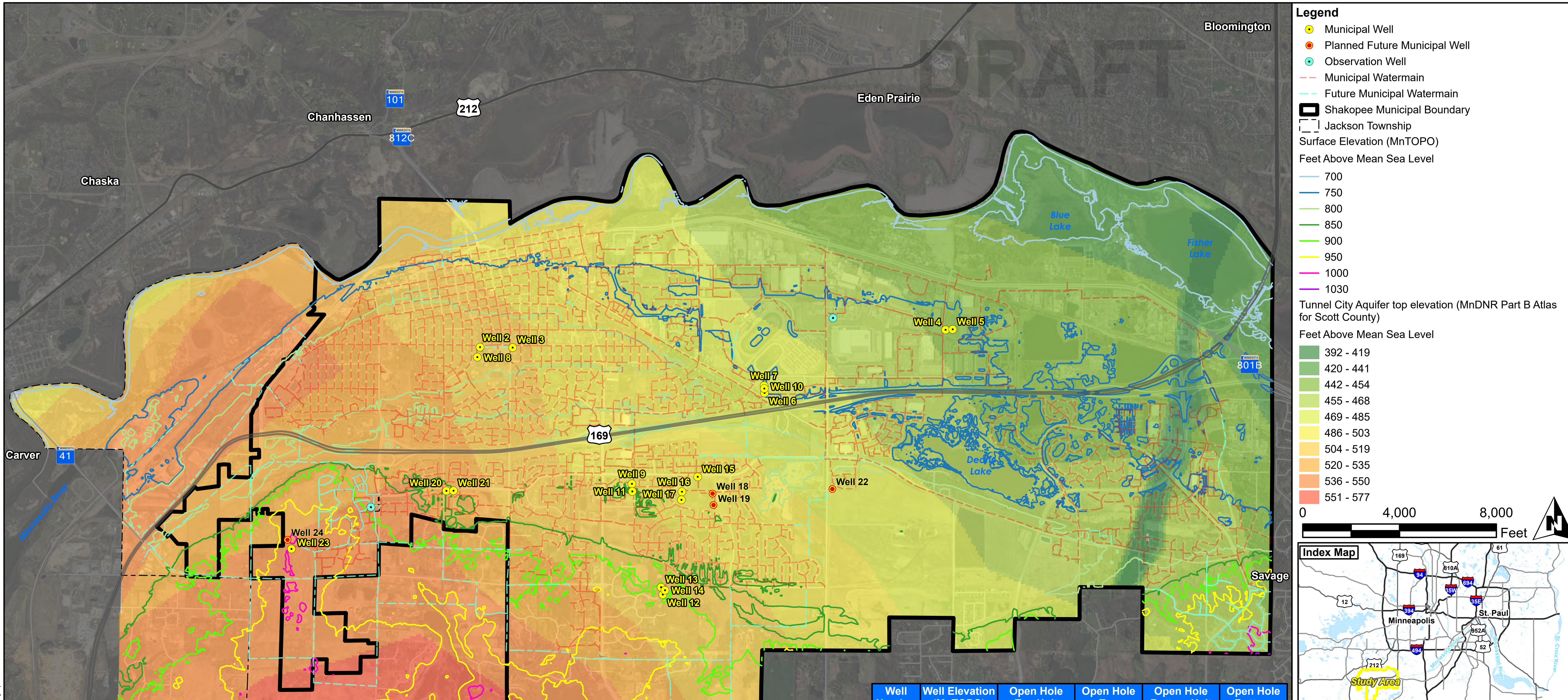
Aquifer Sustainability Study Update
Shakopee, Minnesota

SEH

Print Date: 6/14/2024

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

Figure 13



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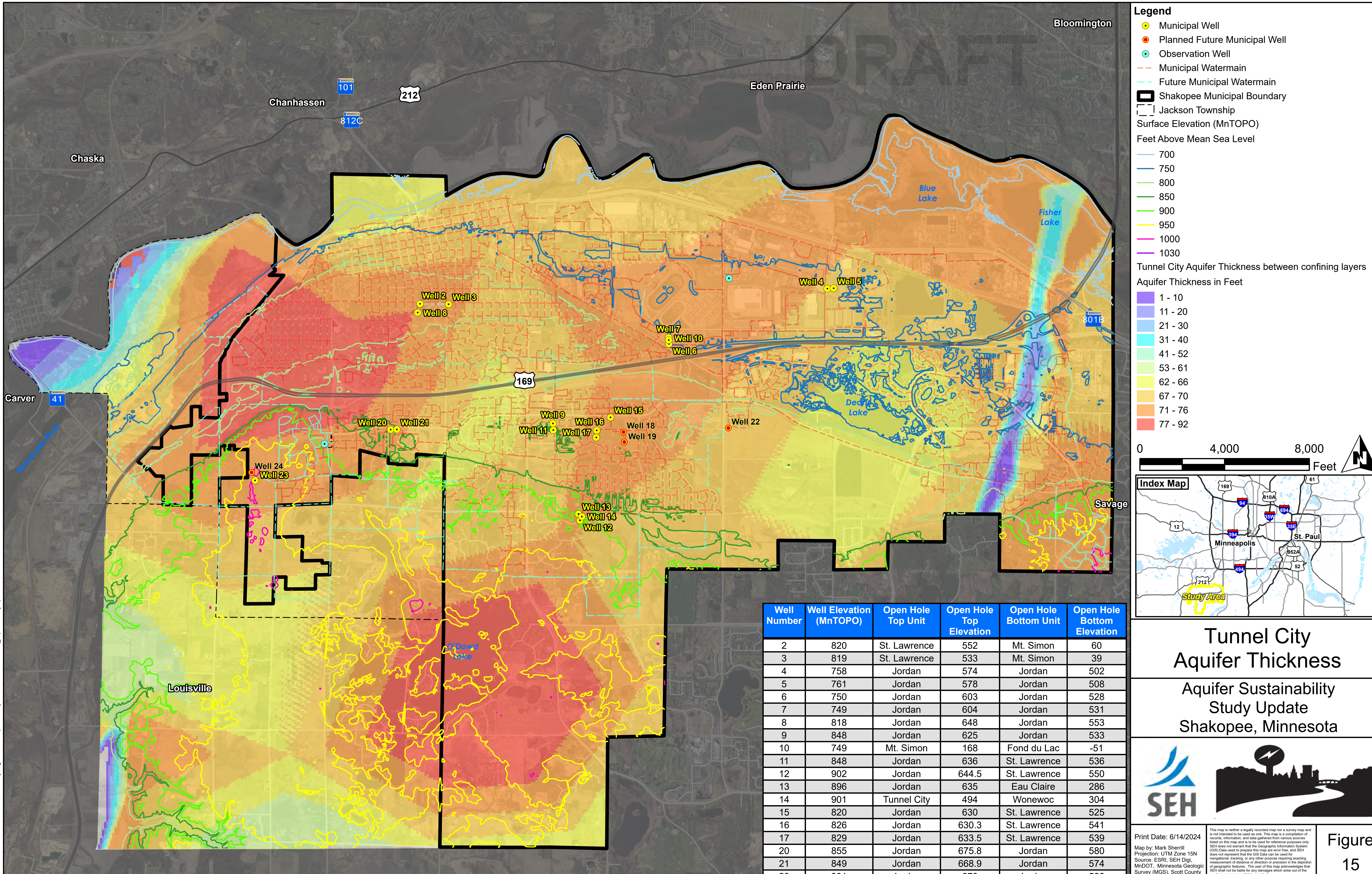
Tunnel City Aquifer Top Elevation

Aquifer Sustainability Study Update
Shakopee, Minnesota

Print Date: 6/14/2024

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

Figure 14



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Tunnel City Aquifer Thickness

Aquifer Sustainability Study Update
Shakopee, Minnesota

SEH

Print Date: 6/14/2024
Map by: Mark Sherrill
Projection: UTM Zone 15N
Source: ESRI, SEH Digi, MnDOT, Minnesota Geologic Survey (MGS), Scott County

Figure 15

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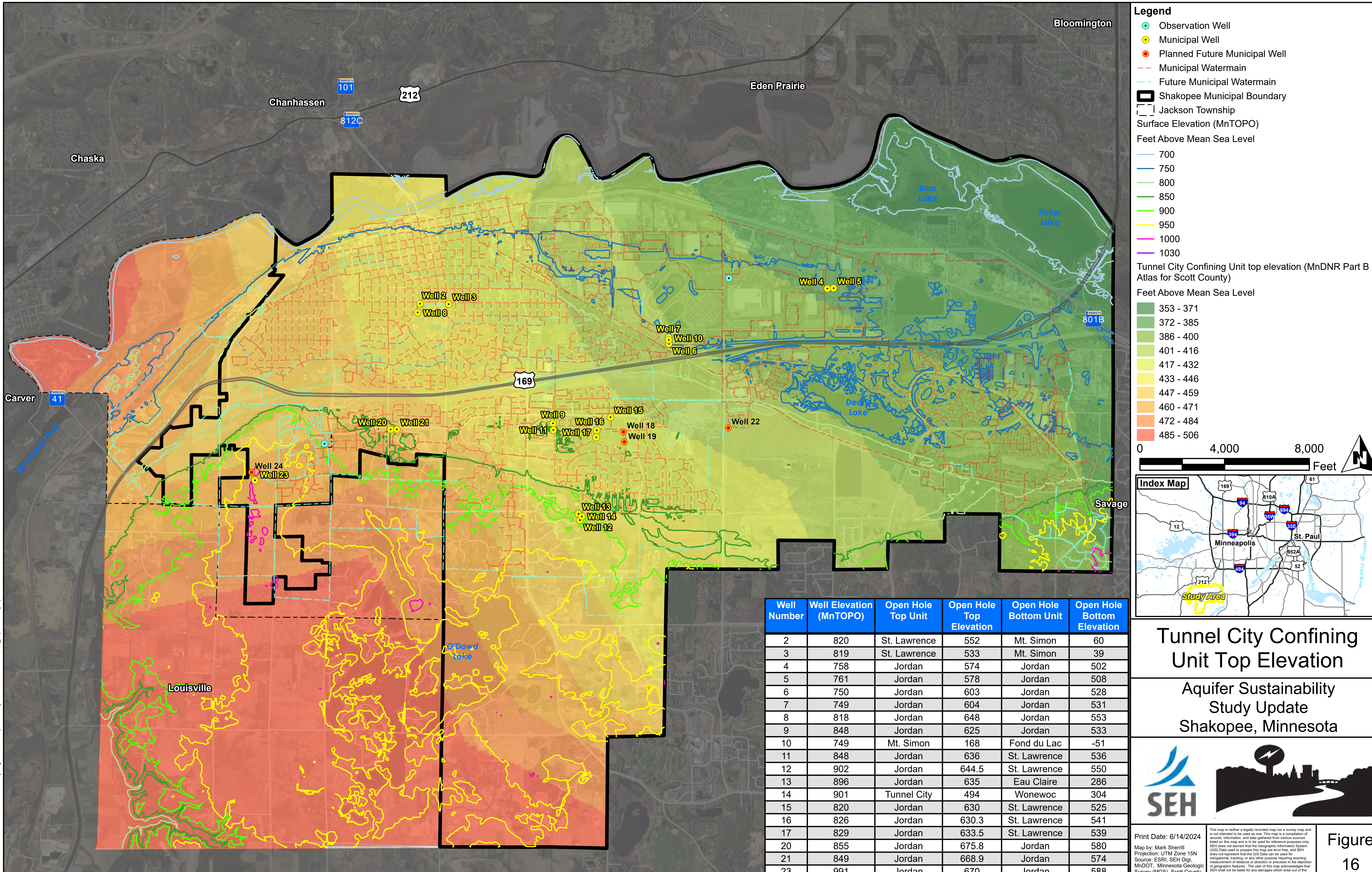

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20	855	Jordan	675.8	Jordan	580
21	849	Jordan	668.9	Jordan	574
23	991	Jordan	670	Jordan	588

Tunnel City Confining Unit Top Elevation

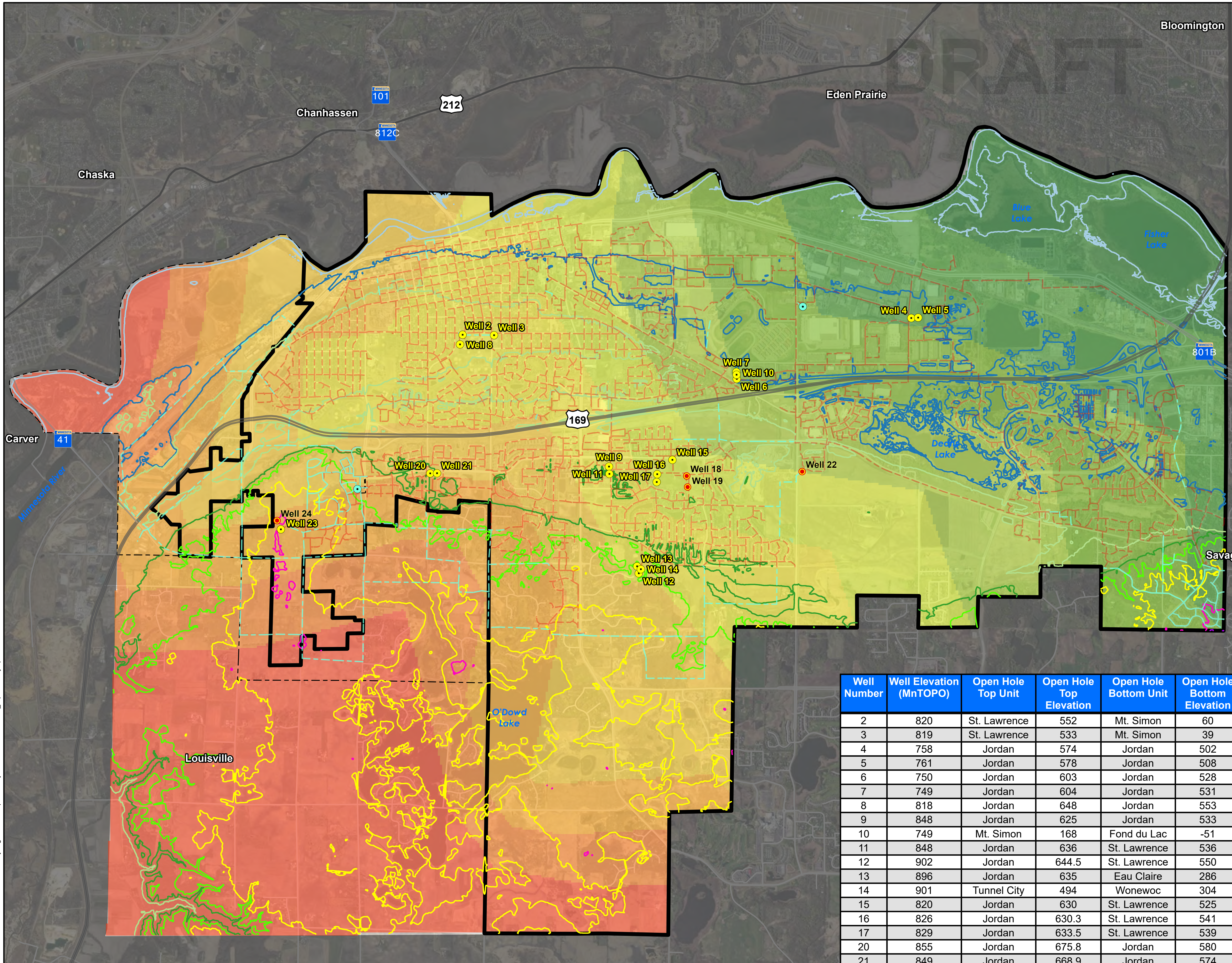
Aquifer Sustainability Study Update
Shakopee, Minnesota

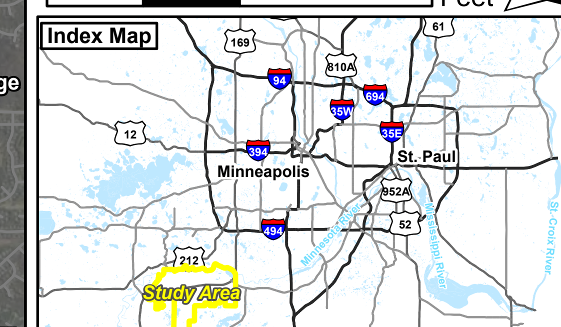
SEH

Print Date: 6/14/2024
Map by: Mark Sherrill
Projection: UTM Zone 15N
Source: ESRI, SEH Digi, MnDOT, Minnesota Geologic Survey (MGS), Scott County

Figure 16

Path: X:\PT\S\SHPUC\177653\3-env-stdy-regs\39-final\AquiferStudy\99GIS\SHPUC177653_AquiferStudy.aprx





Well Number	Well Elevation (MnTOPO)	Open Hole Top Unit	Open Hole Top Elevation	Open Hole Bottom Unit	Open Hole Bottom Elevation
2	820	St. Lawrence	552	Mt. Simon	60
3	819	St. Lawrence	533	Mt. Simon	39
4	758	Jordan	574	Jordan	502
5	761	Jordan	578	Jordan	508
6	750	Jordan	603	Jordan	528
7	749	Jordan	604	Jordan	531
8	818	Jordan	648	Jordan	553
9	848	Jordan	625	Jordan	533
10	749	Mt. Simon	168	Fond du Lac	-51
11	848	Jordan	636	St. Lawrence	536
12	902	Jordan	644.5	St. Lawrence	550
13	896	Jordan	635	Eau Claire	286
14	901	Tunnel City	494	Wonewoc	304
15	820	Jordan	630	St. Lawrence	525
16	826	Jordan	630.3	St. Lawrence	541
17	829	Jordan	633.5	St. Lawrence	539
20	855	Jordan	675.8	Jordan	580
21	849	Jordan	668.9	Jordan	574

Wonewoc Aquifer Top Elevation

Aquifer Sustainability Study Update
Shakopee, Minnesota

Print Date: 6/14/2024

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

Figure 17

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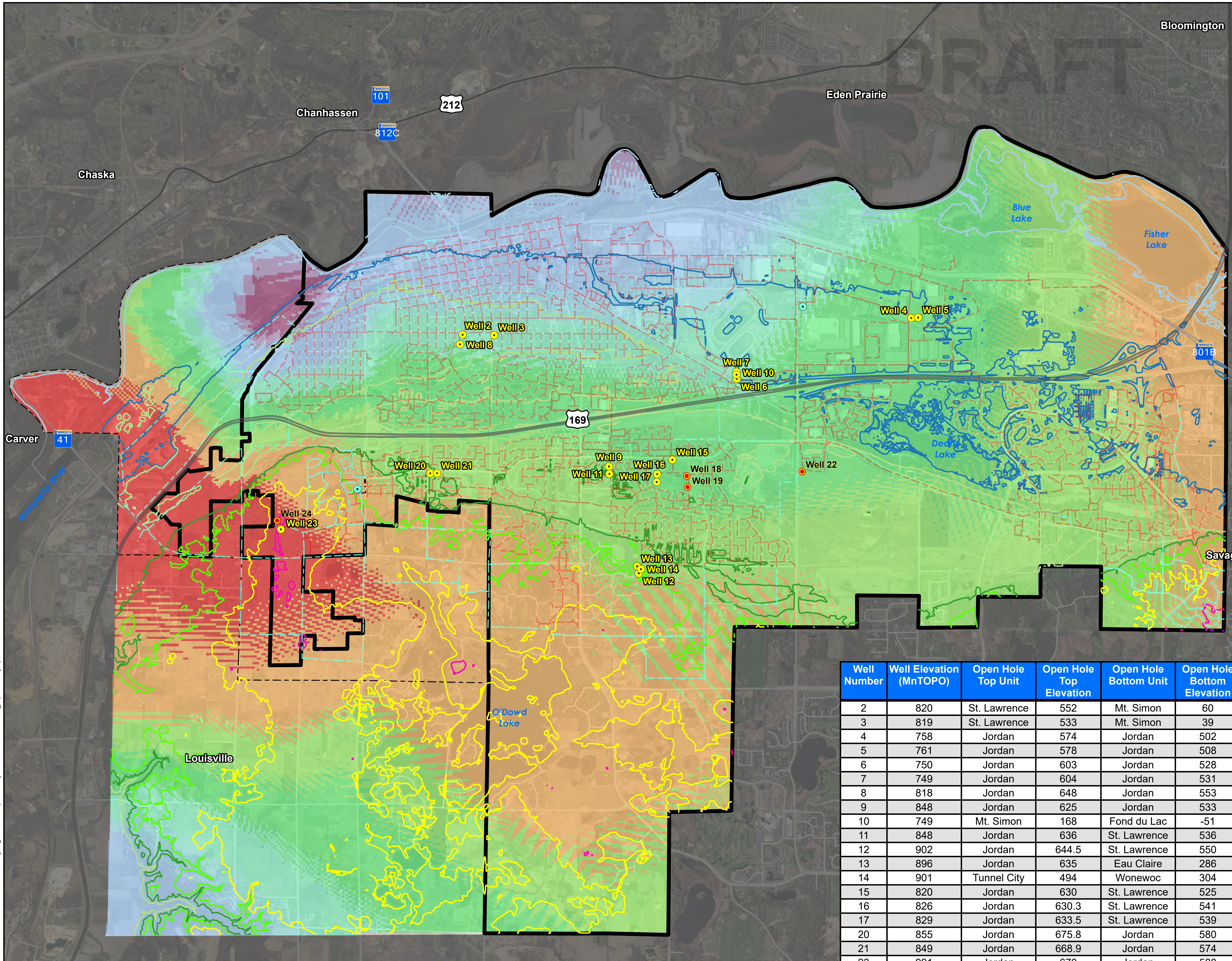
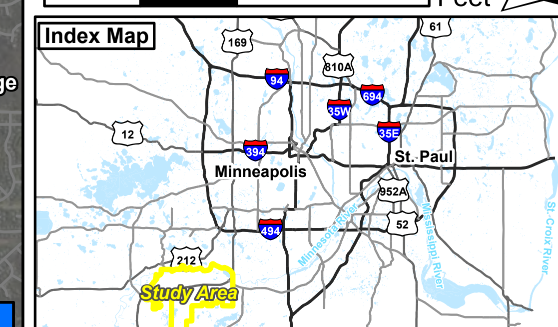


Well Number	Well Elevation (MnTOPO)	Open Hole Top Unit	Open Hole Top Elevation	Open Hole Bottom Unit	Open Hole Bottom Elevation
2	820	St. Lawrence	552	Mt. Simon	60
3	819	St. Lawrence	533	Mt. Simon	39
4	758	Jordan	574	Jordan	502
5	761	Jordan	578	Jordan	508
6	750	Jordan	603	Jordan	528
7	749	Jordan	604	Jordan	531
8	818	Jordan	648	Jordan	553
9	848	Jordan	625	Jordan	533
10	749	Mt. Simon	168	Fond du Lac	-51
11	848	Jordan	636	St. Lawrence	536
12	902	Jordan	644.5	St. Lawrence	550
13	896	Jordan	635	Eau Claire	286
14	901	Tunnel City	494	Wonewoc	304
15	820	Jordan	630	St. Lawrence	525
16	826	Jordan	630.3	St. Lawrence	541
17	829	Jordan	633.5	St. Lawrence	539
20	855	Jordan	675.8	Jordan	580
21	849	Jordan	668.9	Jordan	574
23	991	Jordan	670	Jordan	588

Index Map



Wonewoc Aquifer Thickness

Aquifer Sustainability Study Update
Shakopee, Minnesota

SEH

Print Date: 6/14/2024
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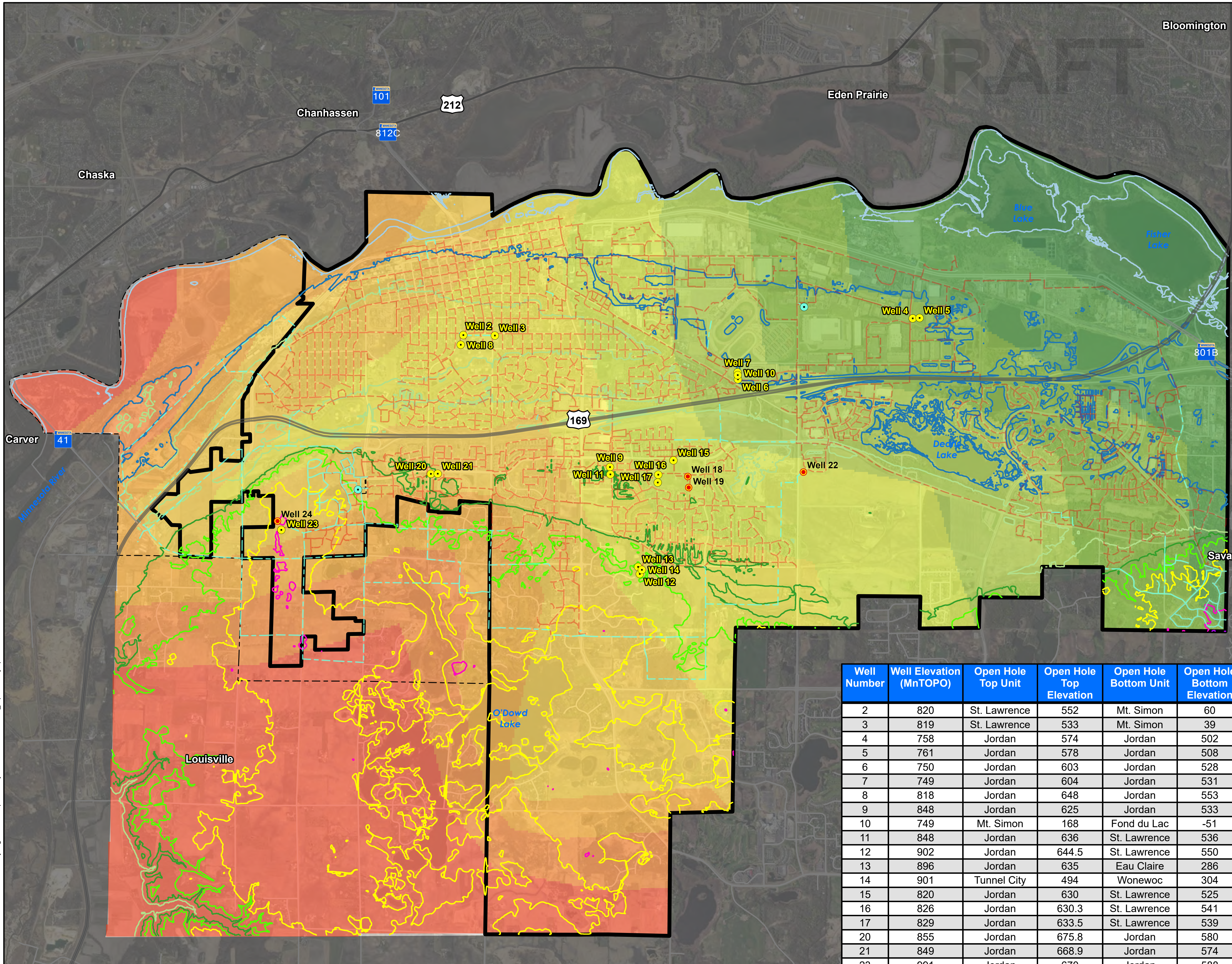
Projection: UTM Zone 15N
Source: ESRI, SEH Digi, MnDOT, Minnesota Geologic Survey (MGS), Scott County

Figure 18



Legend

- Municipal Well
- Planned Future Municipal Well
- Observation Well
- Municipal Watermain
- Future Municipal Watermain
- Shakopee Municipal Boundary
- Jackson Township

Surface Elevation (MnTOPO)

Feet Above Mean Sea Level

- 700
- 750
- 800
- 850
- 900
- 950
- 1000
- 1030

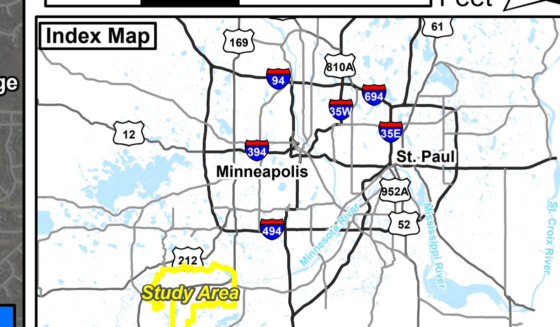
Eau Claire confining unit top elevation (MnDNR Part B Atlas for Scott County)

Feet Above Mean Sea Level

- 212 - 232
- 233 - 249
- 250 - 263
- 264 - 278
- 279 - 295
- 296 - 310
- 311 - 323
- 324 - 337
- 338 - 354
- 355 - 380

0 4,000 8,000 Feet

N



Well Number	Well Elevation (MnTOPO)	Open Hole Top Unit	Open Hole Top Elevation	Open Hole Bottom Unit	Open Hole Bottom Elevation
2	820	St. Lawrence	552	Mt. Simon	60
3	819	St. Lawrence	533	Mt. Simon	39
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7	749	Jordan	604	Jordan	531
8	818	Jordan	648	Jordan	553
9	848	Jordan	625	Jordan	533
10	749	Mt. Simon	168	Fond du Lac	-51
11	848	Jordan	636	St. Lawrence	536
12	902	Jordan	644.5	St. Lawrence	550
13	896	Jordan	635	Eau Claire	286
14	901	Tunnel City	494	Wonewoc	304
15	820	Jordan	630	St. Lawrence	525
16	826	Jordan	630.3	St. Lawrence	541
17	829	Jordan	633.5	St. Lawrence	539
20	855	Jordan	675.8	Jordan	580
21	849	Jordan	668.9	Jordan	574
23	991	Jordan	670	Jordan	588

Eau Claire Confining Unit Top Elevation

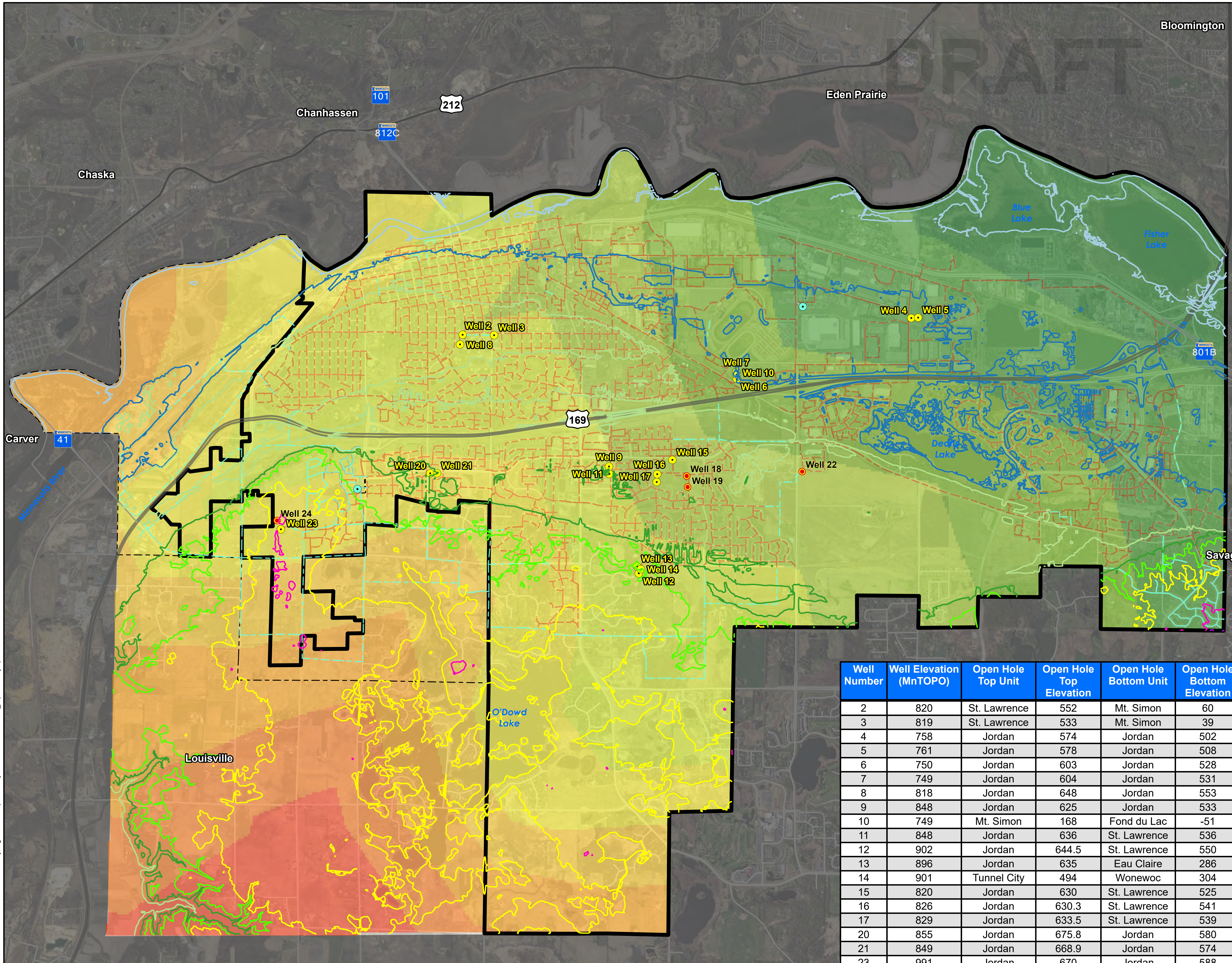
Aquifer Sustainability Study Update
Shakopee, Minnesota

Print Date: 6/14/2024

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

Figure 19

Path: X:\PT\S\SHPUC\177653\3-env-stdy-regs\39-final\AquiferStudy\99GIS\SHPUC177653_AquiferStudy.aprx



Well Number	Well Elevation (MnTOPO)	Open Hole Top Unit	Open Hole Top Elevation	Open Hole Bottom Unit	Open Hole Bottom Elevation
2	820	St. Lawrence	552	Mt. Simon	60
3	819	St. Lawrence	533	Mt. Simon	39
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9	848	Jordan	625	Jordan	533
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11	848	Jordan	636	St. Lawrence	536
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20	855	Jordan	675.8	Jordan	580
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23	991	Jordan	670	Jordan	588

Legend

- Municipal Well
- Planned Future Municipal Well
- Observation Well
- Municipal Watermain
- Future Municipal Watermain
- Shakopee Municipal Boundary
- Jackson Township

Surface Elevation (MnTOPO)

Feet Above Mean Sea Level

- 700
- 750
- 800
- 850
- 900
- 950
- 1000
- 1030

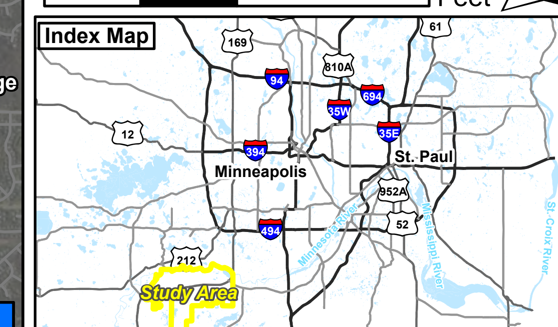
Mt Simon Aquifer top elevation (MnDNR Part B Atlas for Scott County)

Feet Above Mean Sea Level

- 134 - 159
- 160 - 181
- 182 - 201
- 202 - 224
- 225 - 243
- 244 - 261
- 262 - 280
- 281 - 302
- 303 - 327
- 328 - 364

0 4,000 8,000 Feet

N



Mt. Simon Aquifer Top Elevation

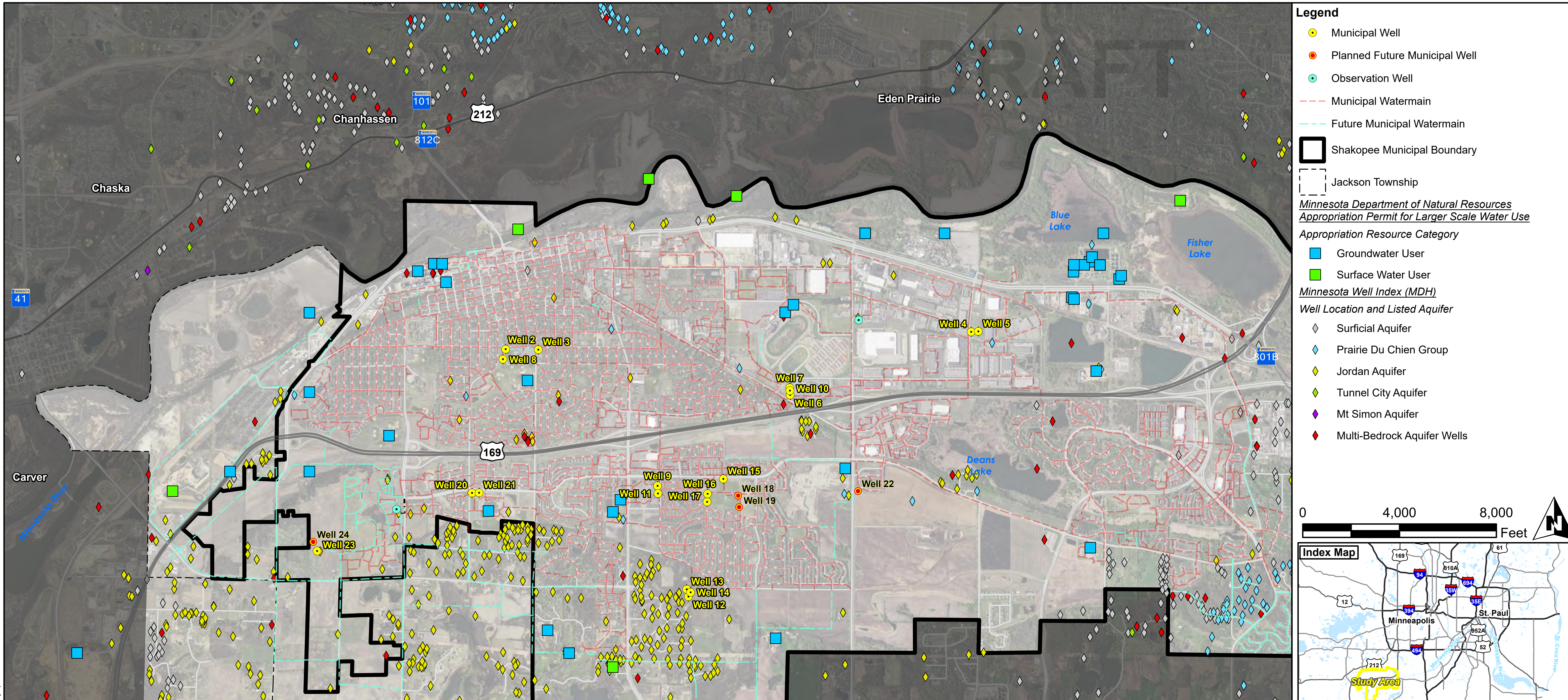
Aquifer Sustainability Study Update Shakopee, Minnesota

SEH

Print Date: 6/13/2024

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

Figure 20



Other Water Users

Aquifer Sustainability Study Update
Shakopee, Minnesota

Print Date: 6/13/2024

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

Figure 21

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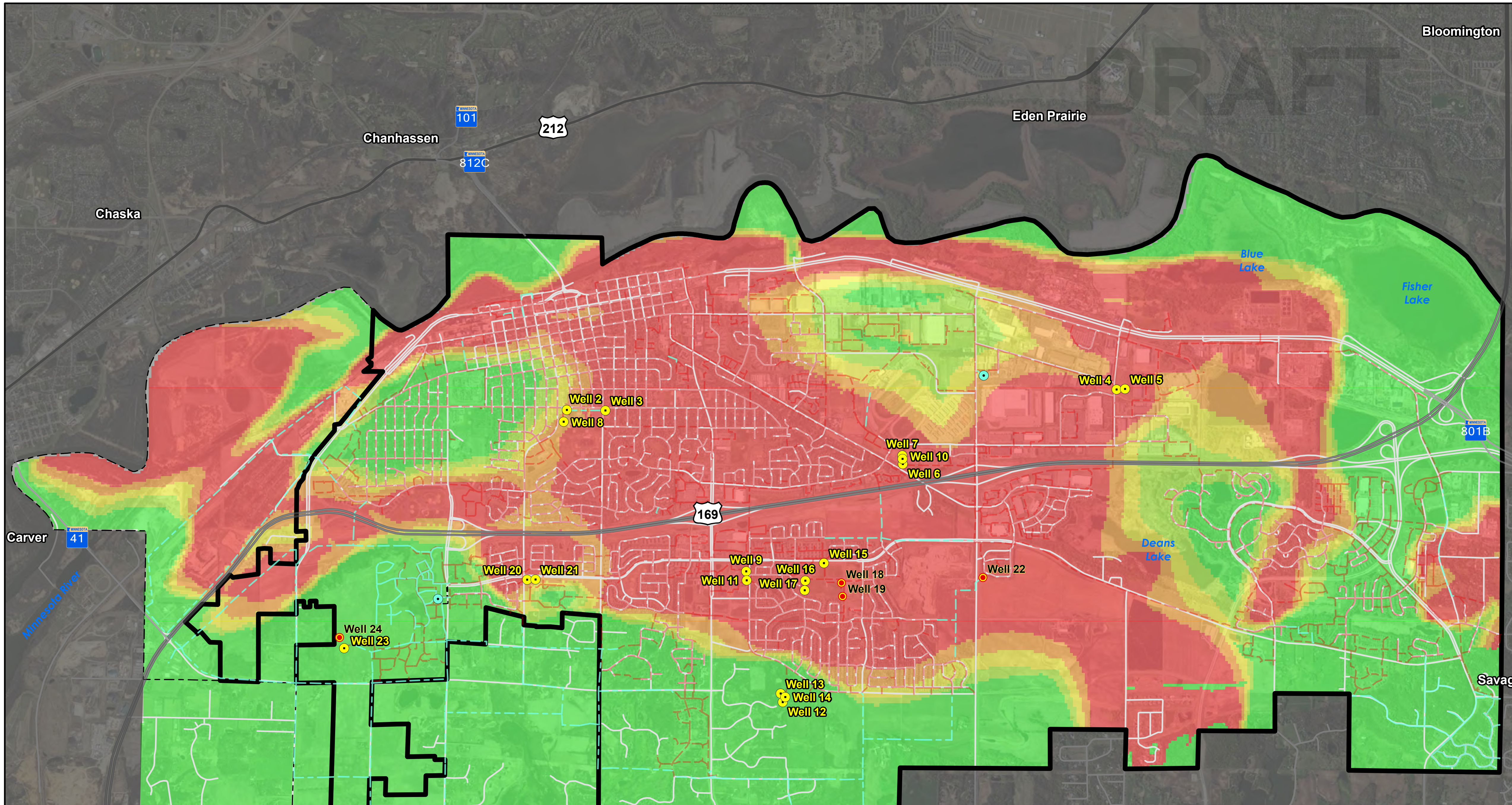


Legend

- Municipal Well
- Planned Future Municipal Well
- Observation Well
- Municipal Watermain
- Future Municipal Watermain
- Shakopee Municipal Boundary
- Jackson Township

Pollution Sensitivity (Plate 6, Scott County Geologic Atlas)

Speed of Surface Recahrge to Bedrock Aquifer

- Very Fast (Hours to Months)
- Fast (Weeks to Years)
- Moderate (Years to Decardes)
- Slow (Decades to a Century or more)
- Very Slow (Century or more)

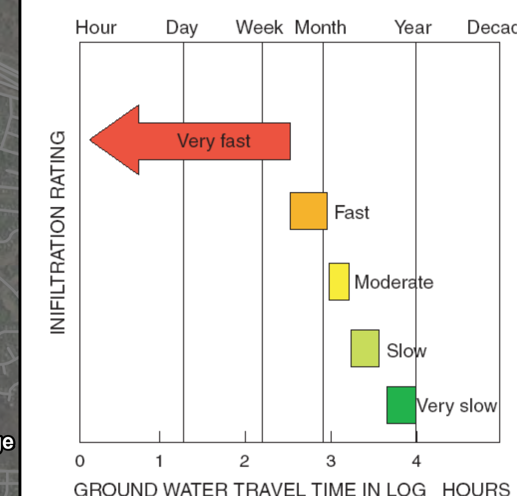
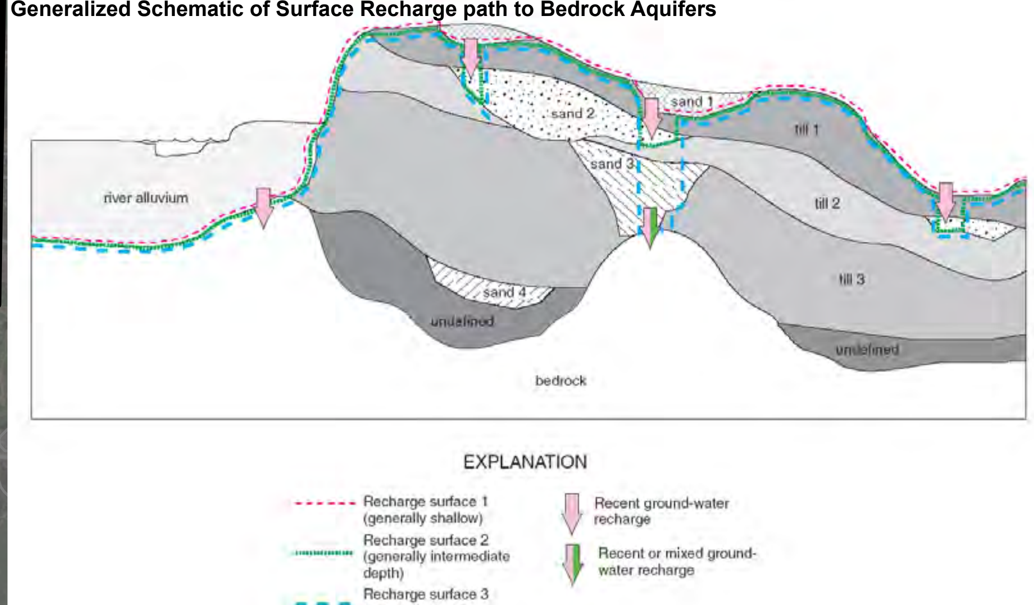


Figure 8. Infiltration ratings as defined by vertical travel time. Ratings are calculated from minimum estimated transmission rates for soil hydrologic groups (Natural Resources Conservation Service, 2006b) applied over a distance of 10 feet (3 meters).

Generalized Schematic of Surface Recharge path to Bedrock Aquifers



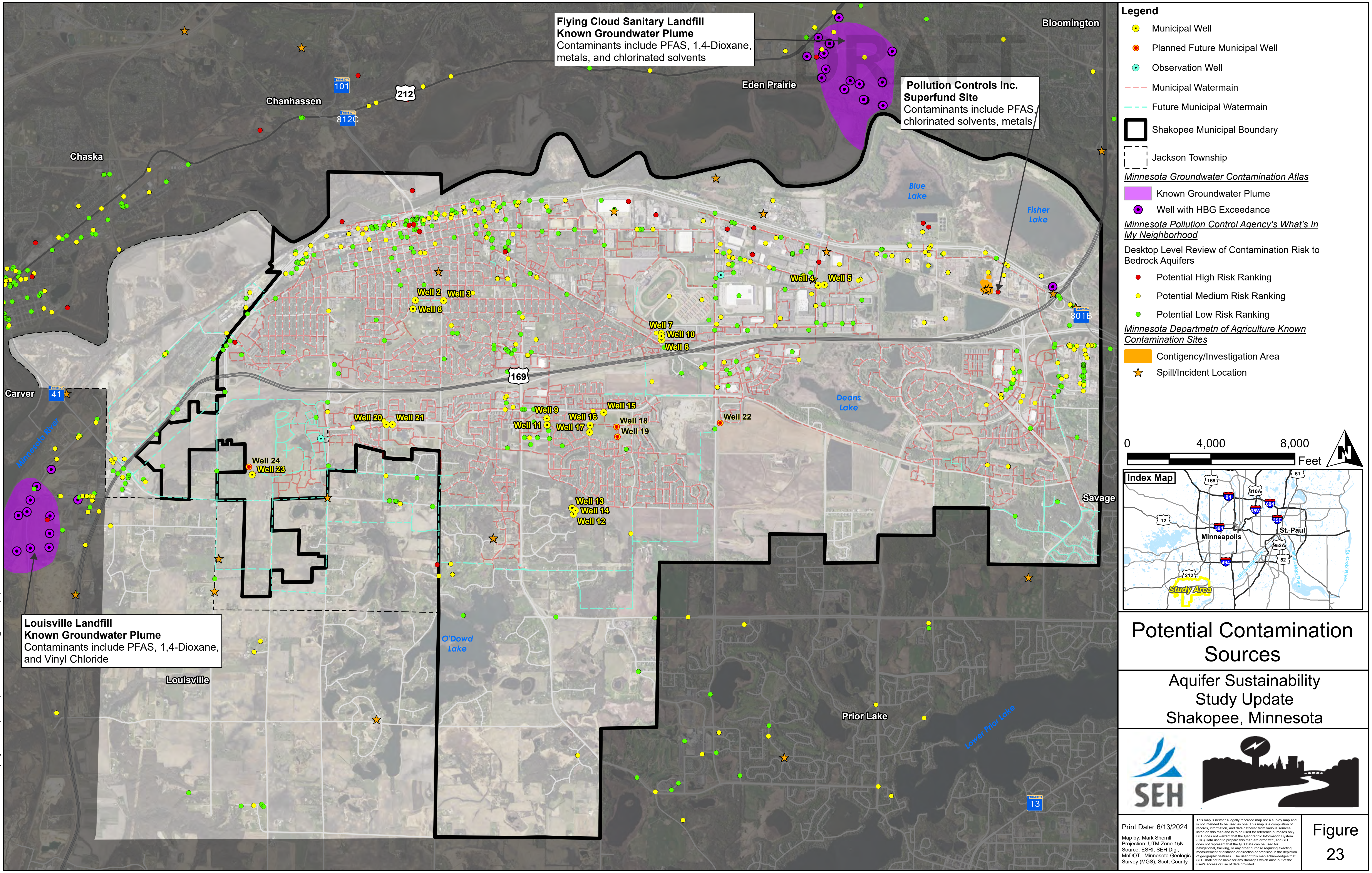
Pollution Sensitivity

Aquifer Sustainability Study Update
Shakopee, Minnesota

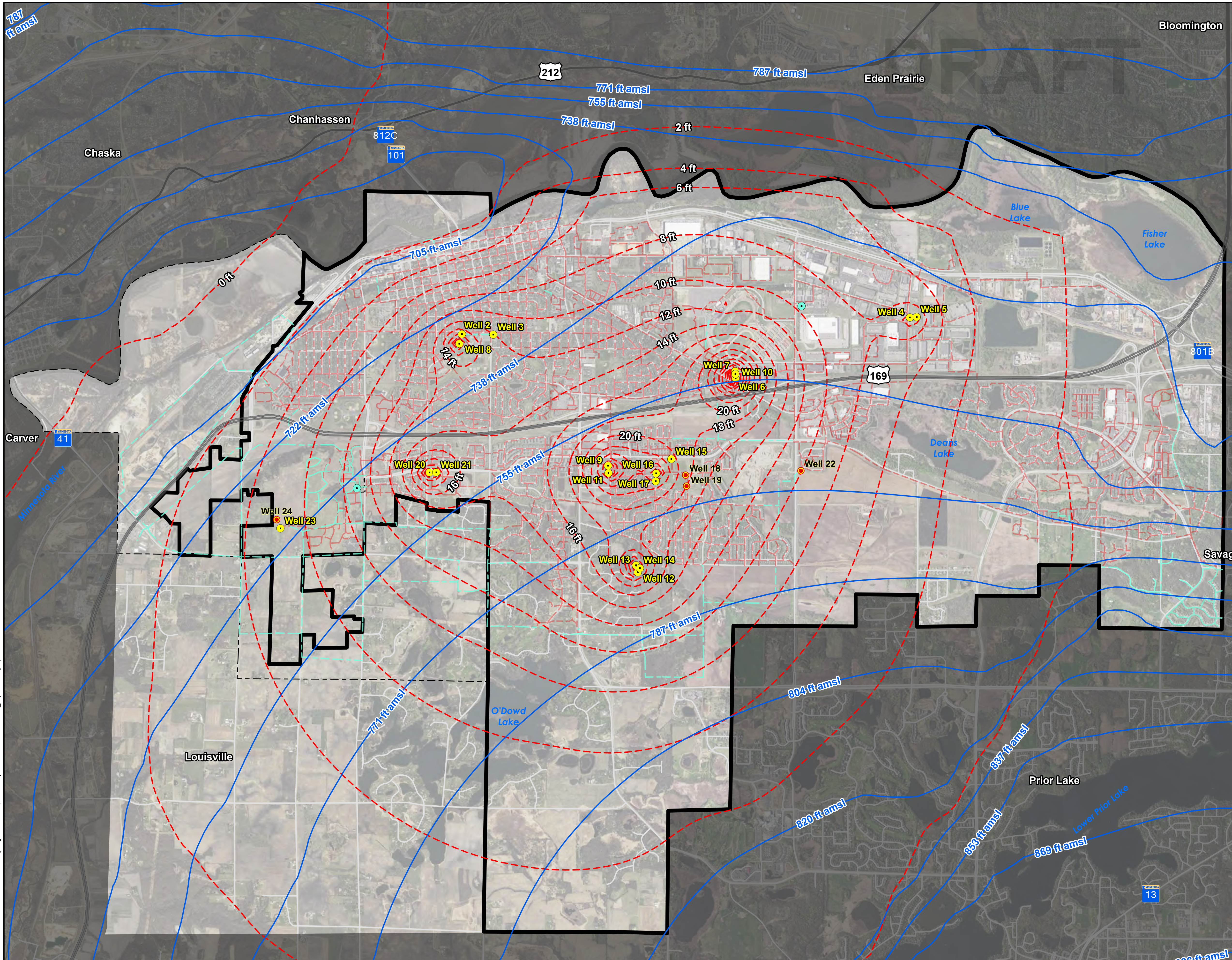
Print Date: 6/13/2024

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

Figure 22



Flying Cloud Sanitary Landfill Known Groundwater Plume
Contaminants include PFAS, 1,4-Dioxane, metals, and chlorinated solvents
Pollution Controls Inc. Superfund Site
Contaminants include PFAS, chlorinated solvents, metals
Louisville Landfill Known Groundwater Plume
Contaminants include PFAS, 1,4-Dioxane, and Vinyl Chloride
DRAFT
Bloomington
Eden Prairie
Chanhassen
Chaska
Carver
Louisville
Prior Lake
Savage
Blue Lake
Fisher Lake
Deans Lake
O'Dowd Lake
Lower Prior Lake
Minnesota River
101
212
812C
169
41
801B
13
Well 2
Well 3
Well 8
Well 4
Well 5
Well 7
Well 10
Well 6
Well 9
Well 11
Well 15
Well 16
Well 17
Well 18
Well 19
Well 20
Well 21
Well 22
Well 24
Well 23
Well 13
Well 14
Well 12
Legend
Municipal Well
Planned Future Municipal Well
Observation Well
Municipal Watermain
Future Municipal Watermain
Shakopee Municipal Boundary
Jackson Township
Minnesota Groundwater Contamination Atlas
Known Groundwater Plume
Well with HBG Exceedance
Minnesota Pollution Control Agency's What's In My Neighborhood
Desktop Level Review of Contamination Risk to Bedrock Aquifers
Potential High Risk Ranking
Potential Medium Risk Ranking
Potential Low Risk Ranking
Minnesota Departmetn of Agriculture Known Contamination Sites
Contigency/Investigation Area
Spill/Incident Location
0
4,000
8,000
Feet
N
Index Map
Minneapolis
St. Paul
Study Area
Potential Contamination Sources
Aquifer Sustainability Study Update
Shakopee, Minnesota
SEH
Print Date: 6/13/2024
Map by: Mark Sherrill
Projection: UTM Zone 15N
Source: ESRI, SEH Digi, MnDOT, Minnesota Geologic Survey (MGS), Scott County
Figure 23

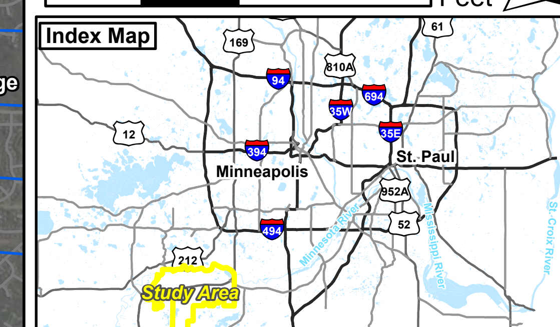


Legend

- Municipal Well
- Planned Future Municipal Well
- Observation Well
- Municipal Watermain
- Future Municipal Watermain
- Shakopee Municipal Boundary
- Jackson Township
- Modeled Steady State Jordan Aquifer Water Level with no City Wells Pumping
- Feet of Modeled Drawdown from average day demand in 2023 for a 3 day stress period with all wells pumping.

Note: Within the model well pumping for each well was set as a percentage of total yearly use of the well over the 3 day stress test. All City wells were set as active during this model test period

0 4,000 8,000 Feet



Modeled 2023 Drawdown within Jordan Aquifer

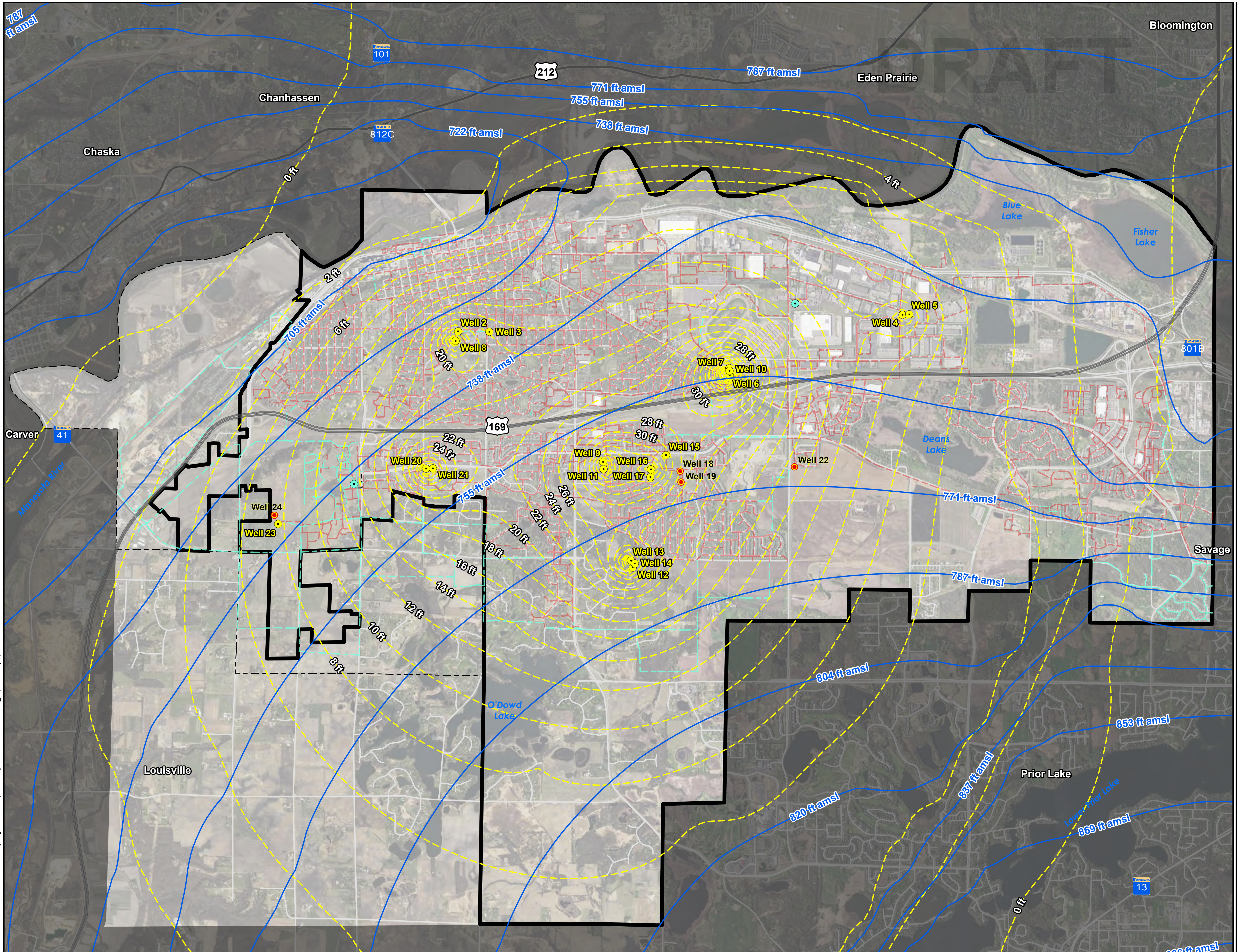
Aquifer Sustainability Study Update
Shakopee, Minnesota

Print Date: 6/13/2024

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

Figure 24

Path: X:\PT\S\SHPUC\177653\3-env-stdy-regs\39-final\AquiferStudy\99GIS\SHPUC177653_AquiferStudy.aprx



Legend

- Municipal Well
- Planned Future Municipal Well
- Observation Well
- Municipal Watermain
- Future Municipal Watermain
- Shakopee Municipal Boundary
- Jackson Township
- Modeled Steady State Jordan Aquifer Water Level with no City Wells Pumping
- Feet of Modeled Drawdown from 2040 projected demand for a 3 day stress test period with only existing wells pumped.

Note: Within the model well pumping for each well was set as a percentage of total yearly use of the well over the 3 day stress test. All City wells were set as active during this model test period

0 4,000 8,000 Feet

Index Map

Minneapolis
St. Paul
Study Area

Modeled 2040 Drawdown within Jordan Aquifer for Existing Wells

Aquifer Sustainability Study Update
Shakopee, Minnesota

SEH

Print Date: 6/13/2024
Map by: Mark Sherrill
Projection: UTM Zone 15N
Source: ESRI, SEH Digi, MnDOT, Minnesota Geologic Survey (MGS), Scott County

Figure 25

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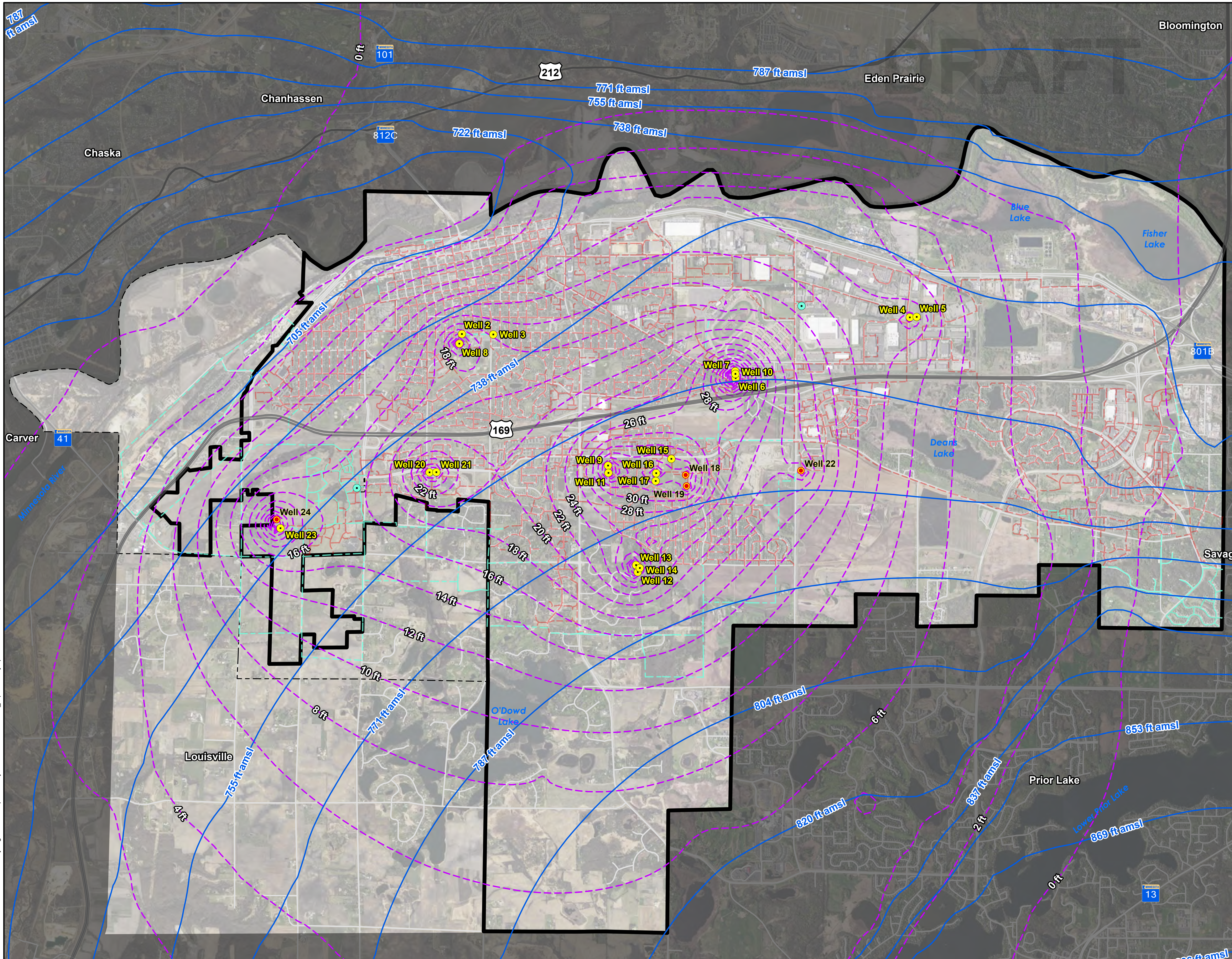

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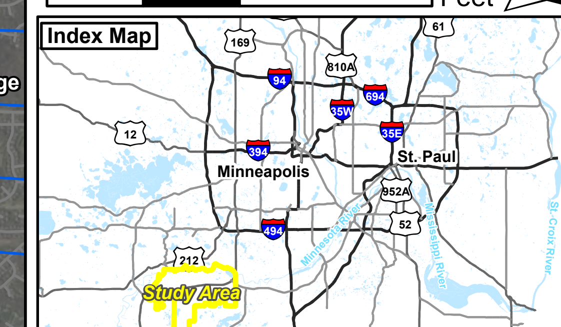
Legend

- Municipal Well
- Planned Future Municipal Well
- Observation Well
- Municipal Watermain
- Future Municipal Watermain
- Shakopee Municipal Boundary
- Jackson Township
- Modeled Steady State Jordan Aquifer Water Level with no City Wells Pumping
- Feet of Modeled Drawdown from 2040 projected demand for a 3 day stress test period with new and existing wells pumped.

Note: Within the model well pumping for each well was set as a percentage of total yearly use of the well over the 3 day stress test. All City wells were set as active during this model test period. New Wells were assigned average pumping rates of 250 - 500 gpm over the 3 day period.

0 4,000 8,000 Feet

N



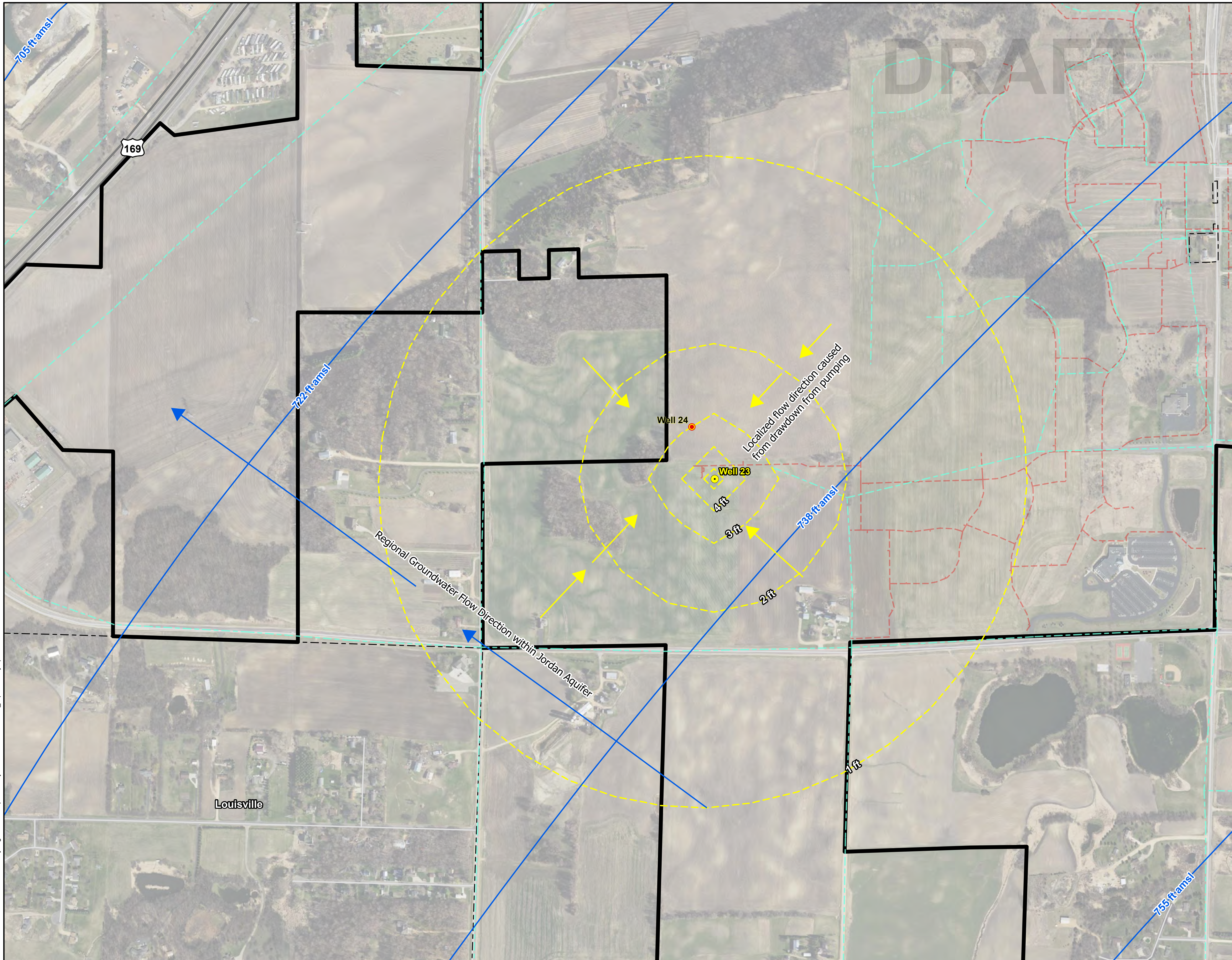
Modeled 2040 Drawdown within Jordan Aquifer w/ Proposed Wells

Aquifer Sustainability Study Update
Shakopee, Minnesota

Print Date: 6/13/2024

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

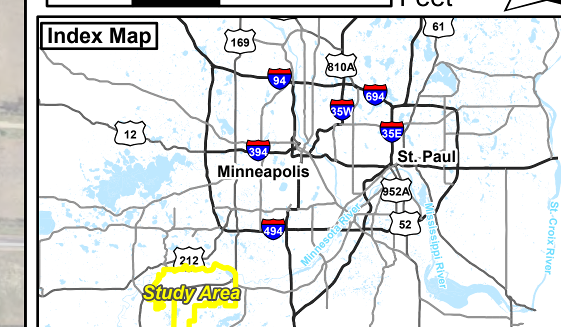
Figure 26



Legend

- Municipal Well
- Planned Future Municipal Well
- Municipal Watermain
- Future Municipal Watermain
- Shakopee Municipal Boundary
- Jackson Township
- Modeled Steady State Jordan Aquifer Water Level with no City Wells Pumping
- Feet of Modeled Drawdown with Well 23 pumping at 800 gpm for 3 days.

0 600 1,200 Feet



Drawdown in Well 23 Pumping at 800 gpm

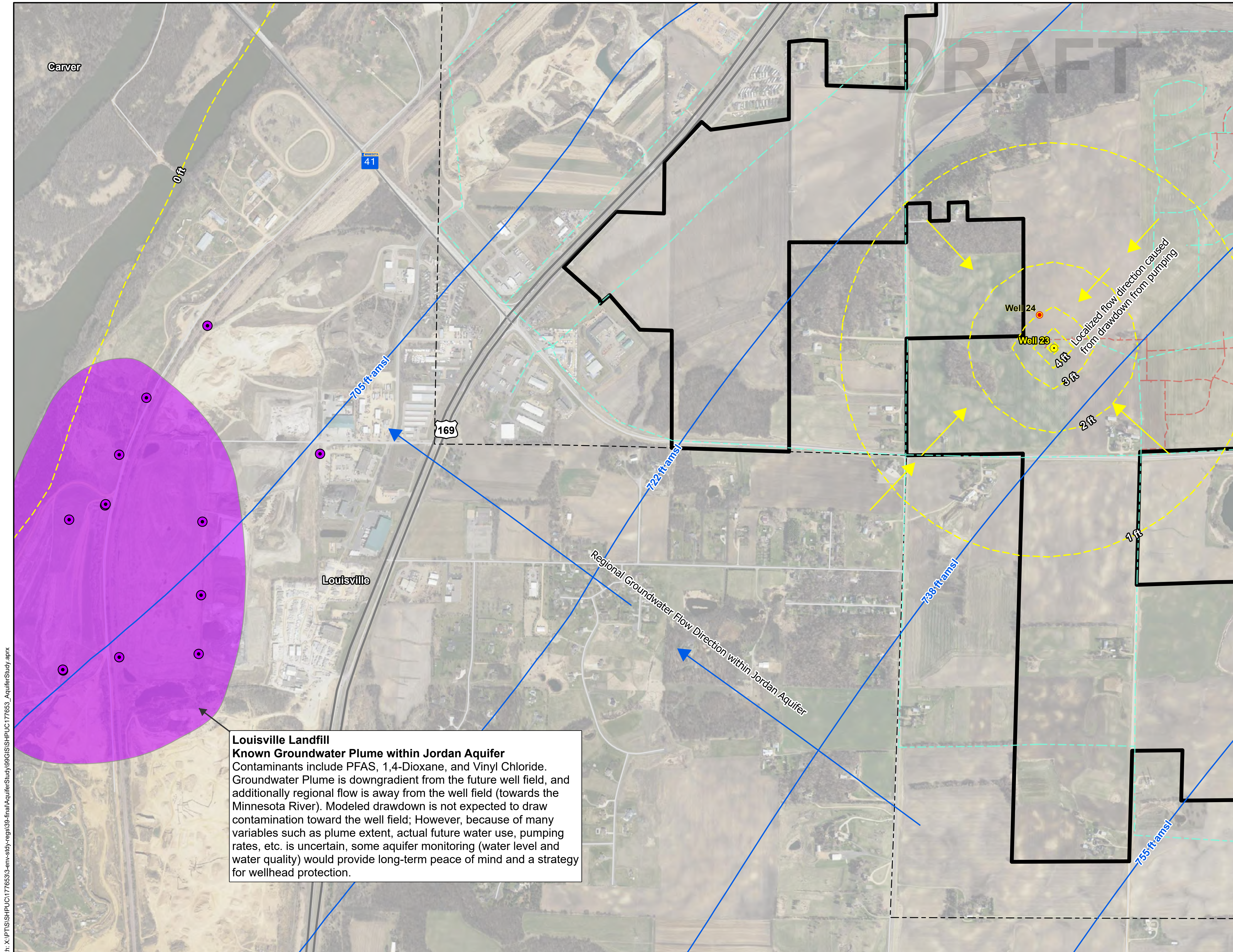
Aquifer Sustainability Study Update
Shakopee, Minnesota

Print Date: 6/13/2024

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

Figure 27

Path: X:\PT\S\SHPUC\177653\3-env-stdy-regs\39-final\AquiferStudy\99GIS\SHPUC177653_AquiferStudy.aprx

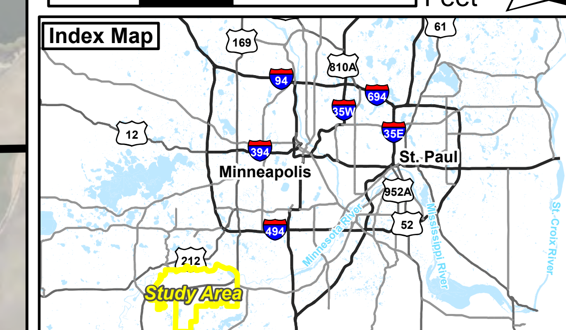


Legend

- Municipal Well
- Planned Future Municipal Well
- Municipal Watermain
- Future Municipal Watermain
- Shakopee Municipal Boundary
- Jackson Township
- Modeled Steady State Jordan Aquifer Water Level with no City Wells Pumping
- Feet of Modeled Drawdown with Well 23 pumping at 800 gpm for 3 days.

Minnesota Groundwater Contamination Atlas

- Known Groundwater Plume
- Well with HBG Exceedance



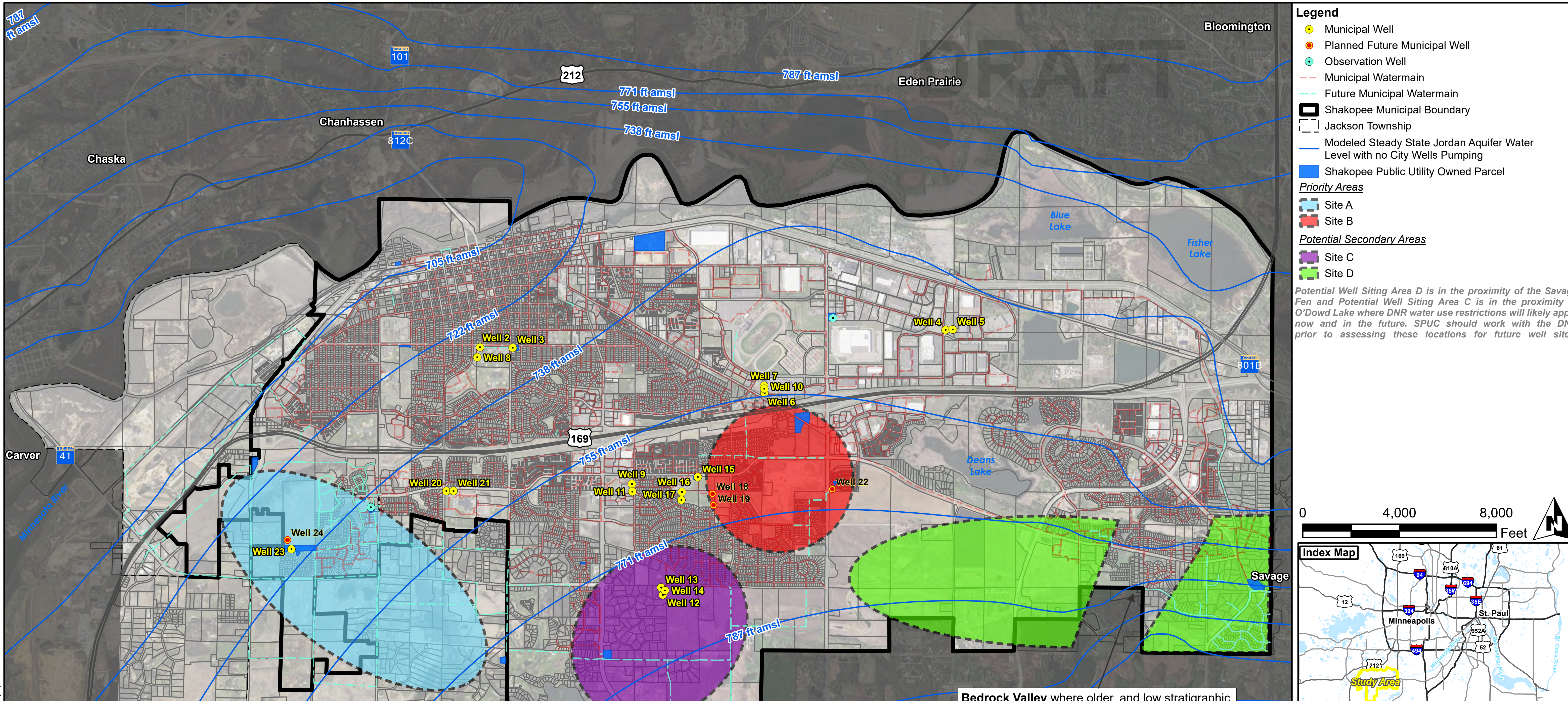
Well 23 Wellfield and Louisville Landfill

Aquifer Sustainability Study Update
Shakopee, Minnesota

Print Date: 6/13/2024

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

Figure 28



Potential Well Feasibility Areas

Aquifer Sustainability Study Update
Shakopee, Minnesota

Print Date: 6/14/2024

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

Figure 29

Path: X:\PT\S\SHPUC\177653\3-env-stdy-regs\39-final\AquiferStudy\99GIS\SHPUC177653_AquiferStudy.aprx

DRAFT

Appendix A

United States Geologic Survey Age Dating

Program USGS-CFC2008xls -- **Major revision --Change from the SIO 1998 to the SIO 2005 Scale**
Please send comments or suggestions to: USGS Chlorofluorocarbon Laboratory --cfc@usgs.gov

Air data SIO 2005 Scale

NOAA 2002 air-SIO 2005 scale (F-12=548.39; F-11=260.84; F-113=79.98
Enrichment factor of 1.00 = Niwot Ridge, CO air (CMDL, NOAA).
Factors other than 1.00 can be used to model local variations of CFCs in air
CAUTION: Use a factors of 1.00 if no enrichment data is available
Factors other than 1.00 will change the air curves and results obtained with this worksheet!
Yellow background cells are INPUT locations through out this worksheet

	INPUT	
CFC-11 enrichment	1.00	Local CFC-11 enrichment factor
CFC-12 enrichment	1.00	Local CFC-11 enrichment factor
CFC-113 enrichment	1.00	Local CFC-113 enrichment factor
Meters =0; feet =1	1	Select units of elevation
pMol/kg =0; pg/kg =1	0	Select units of concentration

You can calculate the sensitivity of
of recharge ages to temperature and
to temperature and elevation uncertainties.

Temperature add or subtract uncertainty in tempt. (C) =
Elevation add or subtract uncertainty in elevation =
MAKE ABSOLUTELY SURE TO SET THE CELL BACK TO 0.0
+++++++++++++ **CAUTION !** ++++++++++++++++
"0.0" is required in cells "X15 & X16" for the correct
calculation of the correct recharge ages.
Use below feature to evaluate the sensitivity of all well together.
Use "Sensitivity sheet" to evaluate individual wells.
MAKE ABSOLUTELY SURE TO SET THE CELL BACK TO 0.0

INPUT	
0.0	**degrees C**
0.0	**feet**

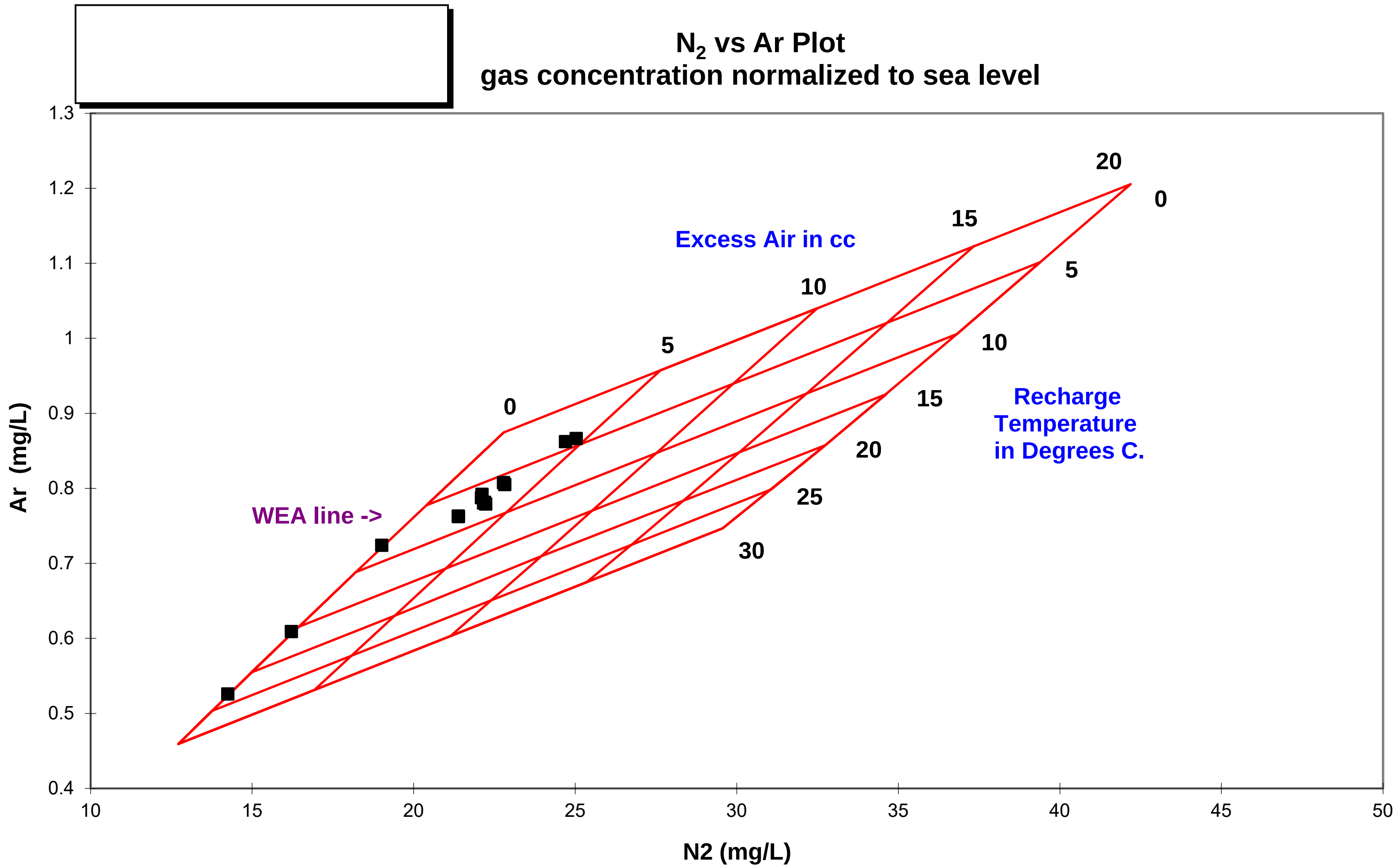
Sample Number (Do not alter cells A22 through A252)	Sample Name (INPUT)	No. (INPUT)	(Format Column) Sampling Date (m/d/y) (INPUT)	Time (INPUT)	Corrected concentrations IN SOLUTION CFC-12 pmol/kg	CFC-11 pmol/kg	CFC-113 pmol/kg	Percent error in concentrations IN SOLUTION CFC-12 % (INPUT)	CFC-11 % (INPUT)	CFC-113 % (INPUT)	Excess Air cc/kg (INPUT)	Recharge Temp C (INPUT)	Recharge Elevation feet (INPUT)	Salinity o\oo (INPUT)	Recommended Age Based on	Comments
1	Well #11	2	07/26/22	1245	2.677	3.012	13.127	0.667	0.697	0.514	3.0	6.1	750	0.000	SF6	Early 2000s
2	Well #11	4	07/26/22	1245	2.676	3.019	12.921	0.702	0.724	0.534	3.0	6.1	750	0.000	CFCs	
3	Well #9	2	07/26/22	1335	3.243	4.216	19.007	0.629	0.624	0.467	2.5	6.6	750	0.000	SF6	Early 2000s
4	Well #9	4	07/26/22	1335	3.240	4.379	17.738	0.677	0.647	0.487	2.5	6.6	750	0.000	CFCs	
5	Well #2	3	07/27/22	815	5.249	10.835	0.173	0.547	0.471	1.307	4.1	4.1	750	0.000	SF6	Around 1990
6	Well #2	4	07/27/22	815	5.230	10.524	0.168	0.585	0.496	1.334	4.1	4.1	750	0.000		
7	Well #8	2	07/27/22	855	7.629	11.331	0.357	0.649	0.526	0.879	2.4	8.0	750	0.000	SF6	Around 2010
8	Well #8	4	07/27/22	855	7.713	11.463	0.366	0.687	0.553	0.887	2.4	8.0	750	0.000		
9	Well #16	1	07/27/22	1010	2.308	3.729	66.367	0.724	0.736	0.535	3.1	7.6	750	0.000	SF6	Early 2000s
10	Well #16	4	07/27/22	1010	2.336	3.558	61.486	0.750	0.766	0.556	3.1	7.6	750	0.000	CFCs	
11	Well #17	3	07/27/22	1040	2.240	4.422	7.290	0.776	0.781	0.607	3.0	7.5	750	0.000	SF6	Early 2000s
12	Well #17	4	07/27/22	1040	2.267	4.302	6.881	0.817	0.809	0.629	3.0	7.5	750	0.000	CFCs	
13	Berkeley Spr.	18	12/16/21	1200	0.351	0.283	0.020	1.993	0.864	11.211	2.0	12.0	800	0.000	Berkeley Spr.	
14	Lewis Spr	16	11/18/21	1400	2.555	3.915	0.378	0.215	0.104	0.651	0.0	9.0	3000	0.000	Lewis Spr	

Changing the recharge temperatures, elevations or excess air will change the model ages. You can alter temperature and elevation in cells AN15 and AN16 and the spreadsheet will calculate new ages.
The recharge temperatures, elevations and excess air values in the above report were derived from dissolved gas data when available or from the estimated mean annual temperatures.
Since small changes in the above variables can significantly change the model ages, it is important to input the best available data. In the comments column, the indicated ages were determined assuming piston flow, unless noted, and do not account for mixing scenarios that can occur in wells with large open intervals or multiple producing fractures. For this reason the reported ages are referred to as "apparent ages" or "model ages".
The mixing information provided may or may not be valid for a particular sample.
In anoxic environments, CFC-11 degrades first, followed by CFC-113 and CFC-12. Under these conditions some or all of the model ages will appear older than they actually are.
In the interpretation of CFC ages, the ages are considered reliable when all CFC tracers give similar model ages. If the model ages differ, CFC-12 has proved to be the most reliable tracer followed by CFC-113 and CFC-11.

The analytical equipment calibration is not reliable past these concentrations 1200pg/kg for CFC-11, 2500pg/kg for CFC-12 and 900pg/kg for CFC-113.
Any concentrations above these values are estimates.
If you have any questions please call

Samples submitted by:	T. Meyers	Revised 2/1/2011	Program written by E. Busenberg, USGS, (8-30-1994), Revised (4/19/2006), Revised (6/16/2009), Revised (01/19/2011), Revised (2/1/2012)	
Project:		Version: 7.0	This program calculates the dissolved gas composition of waters, and the volume percent composition in a gas sample (revised 2/2/2012).	
Geographic location:	MN		{N2, Ar} R. F. Weiss, 1970, Deep-Sea Res., vol. 17, 721-735. R.F. {CO2} Weiss, 1974, Marine Chem. 2, 203-215.[Bunsen Coef.]	
Date received:	8/3/2022		{O2} B. B Beson and D. Krause,1980, Limnol. Oceanogr. 25(4) 662-671; 1984, Limnol. Oceanogr. 29(3), 620-632.	
Dated analyzed:	9/7/2022		{CH4} D.A. Wiesenburg and N.L. Guinasso, 1979, J. Chem. Eng. Data Vol. 24, 356-360.	
Analyzed by:	JC			
Comments:		Land surface elevation used for estimated recharge elevation		0.7808 0.2094 0.00934

***** SAMPLES *****	Site	Date	Time	Field		Recharge			Concentration in mg/L					Concentration in mmol/L					Partial pressures at Field Temperatures in atm.					Measured	Tot Press	Elevation	Barometric
Well Name	Number	Collected	Collected	Temp	Salinity	Elevation	Lab ID #	Bottle #	CH4	CO2	N2	O2	Ar	CH4	CO2	N2	O2	Ar	CH4	CO2	N2	O2	Ar	Pressure	Corrected		pressure
Well #11		7/26/2022	1311	10.56		750		22Y4008	0.0000	41.6339	22.1959	4.3223	0.7832	0.0000	0.9460	0.7923	0.1351	0.0196	0.000000	0.017968	0.9552	0.0803	0.01063	1.06407	1.09378	750	0.972834
Well #11		7/26/2022	1311	10.56		750		22Y4022	0.0000	40.7370	22.1572	4.4506	0.7858	0.0000	0.9256	0.7910	0.1391	0.0197	0.000000	0.017581	0.9536	0.0826	0.01067	1.06443	1.09416	750	0.972834
Well #9		7/26/2022	1343	10.56		750		22Y4003	0.0000	39.3302	21.4951	4.2796	0.7663	0.0000	0.8937	0.7673	0.1337	0.0192	0.000000	0.016974	0.9251	0.0795	0.01041	1.03190	1.06071	750	0.972834
Well #9		7/26/2022	1343	10.56		750		22Y4010	0.0000	39.6315	21.5122	4.6415	0.7707	0.0000	0.9005	0.7679	0.1451	0.0193	0.000000	0.017104	0.9258	0.0862	0.01046	1.03954	1.06857	750	0.972834
Well #2		7/27/2022	846	11.66		750		22Y4013	0.0047	26.3770	24.3487	0.9080	0.8430	0.0003	0.5993	0.8692	0.0284	0.0211	0.000157	0.011812	1.0717	0.0173	0.01173	1.11263	1.14370	750	0.972834
Well #2		7/27/2022	846	11.66		750		22Y4018	0.0047	28.2090	24.0270	1.1447	0.8389	0.0003	0.6410	0.8577	0.0358	0.0210	0.000156	0.012632	1.0575	0.0218	0.01167	1.10374	1.13456	750	0.972834
Well #8		7/27/2022	915	12.22		750		22Y4017	0.0000	24.1379	20.8009	4.9620	0.7417	0.0000	0.5485	0.7425	0.1551	0.0186	0.000000	0.011012	0.9258	0.0956	0.01044	1.04287	1.07199	750	0.972834
Well #8		7/27/2022	915	12.22		750		22Y4023	0.0000	22.9069	20.7996	5.5123	0.7425	0.0000	0.5205	0.7425	0.1723	0.0186	0.000000	0.010450	0.9258	0.1062	0.01046	1.05286	1.08226	750	0.972834
Well 16		7/27/2022	1035	11.11		750		22Y4002	0.0000	31.0983	21.5910	3.6639	0.7603	0.0000	0.7066	0.7707	0.1145	0.0190	0.000000	0.013673	0.9397	0.0689	0.01045	1.03273	1.06157	750	0.972834
Well 16		7/27/2022	1035	11.11		750		22Y4011	0.0000	31.8860	21.6231	3.7254	0.7580	0.0000	0.7245	0.7719	0.1164	0.0190	0.000000	0.014019	0.9411	0.0700	0.01042	1.03560	1.06452	750	0.972834
Well #17		7/27/2022	1100	10.56		750		22Y4009	0.0005	28.9808	21.5588	3.5432	0.7594	0.0000	0.6585	0.7696	0.1107	0.0190	0.000018	0.012507	0.9278	0.0658	0.01031	1.01642	1.04480	750	0.972834
Well #17		7/27/2022	1100	10.56		750		22Y4019	0.0000	28.8443	21.5766	3.7980	0.7599	0.0000	0.6554	0.7702	0.1187	0.0190	0.000000	0.012449	0.9286	0.0705	0.01032	1.02185	1.05038	750	0.972834
21Q1118		8/17/2022		23.06				21Q1118	0.0000	0.0852	14.0771	8.3336	0.5198	0.0000	0.0019	0.5025	0.2604	0.0130	0.000000	0.000054	0.7587	0.1981	0.00903	0.96582	0.96582		1
21Q1101		7/26/2022		8.52				21Q1101	0.0000	0.4667	18.7709	10.7692	0.7151	0.0000	0.0106	0.6701	0.3365	0.0179	0.000000	0.000188	0.7738	0.1908	0.00927	0.97400	0.97400		1
21Q1088		7/6/2022		16.10				21Q1088	0.0000	0.1005	15.9524	9.5202	0.5993	0.0000	0.0023	0.5695	0.2975	0.0150	0.000000	0.000052	0.7646	0.1988	0.00915	0.97262	0.97262		1


N2 vs Ar Plot
gas concentration normalized to sea level
Excess Air in cc
Recharge Temperature in Degrees C.
WEA line ->
0
5
10
15
20
25
30
Ar (mg/L)
N2 (mg/L)
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
10
15
20
25
30
35
40
45
50

K(Henry) from Bullister et al., 2002, Deep-Sea Reseach, v. 49, 175-187.
In older version K(Henry) was from Wilhelm et al., 1977, Chemical Reviews, v. 77, 219-262.
Bullister et al., 2002, salting out effect was added.
Units of concentration fMol/L fMol = 10E-15 Moles.
Revised 02/26/14

Worksheet Name: MN Meyers

Standard used for calibration. **Lab Temperature in °C** **21.0**

Scott tank SF6 in N2 104 pptv **K_{Henry}** **0.0002649 Headspace Correction**

CMDL/NOAA tank Air 5.12 ppt **Lab Pressure in mm mercury** **750.0**

INPUT **Salinity** **0.0**

Enrichment	1.00	**Local SF6 enrichment factor (1.00= Northern Hemisphere)**
Meters =0; feet =1	1	**Select units of elevation**
fMol/L=0; pg/kg =1	0	**Select units of concentration**

You can change:
1) Excess air in cc at STP
2) Temperature in C
3) Elevation
4) Salinity in o/oo

Corrected Age Date Results

Samples should be collected without headspace (HS). If a HS forms, the HS volume (column "H") is measured and a correction is applied. Since the total pressure of the HS bubble cannot be measured, the HS SF_6 concentration cannot be exactly calculated. The MAXIMUM PERCENT UNCERTAINTY in the water concentration that may be introduced by the HS bubble is given in column "AO". The uncertainty is significantly smaller in most cases.

USGS ID No.	INPUT Sample No.	INPUT Sample Name	INPUT Sampling Date (Mo/day/year)	INPUT Time	INPUT Bottle Headspace in cc	INPUT Excess Air (mL)	INPUT Recharge Temperature (C)	INPUT Recharge Elevation feet	INPUT Salinity in (o/oo) parts per thousand	*SF6 Concentration in water* *SF6 FemtoMol/kg With HS corr.*	*Excess air cc/kg at STP*	*SF6 in pptv corrected for Excess air* *Calculated SF6 (pptv) partial pressure*	*SF6 Corrected for Excess air* *Piston flow model SF6 recharge year*	*SF6 Corrected for Excess air* *Piston flow model SF6 recharge age, years*	Sample Name	(see abovecomment) Maximum % headspace uncertainty	Comments
	1	Well #11	07/26/22	1300	2.80	**3.0**	**6.1**	**750**		3.25	3	**5.55**	**2004.0**	**18.6**	Well #11	3.06	
	2	Well #11	07/26/22	1300	1.10	**3.0**	**6.1**	**750**		3.30	3	**5.64**	**2004.5**	**18.1**	Well #11	1.20	
	1	Well #9	07/26/22	1325	2.00	**2.5**	**6.6**	**750**		2.90	2.5	**5.24**	**2002.5**	**20.1**	Well #9	2.19	
	2	Well #9	07/26/22	1325	0.30	**2.5**	**6.6**	**750**		3.29	2.5	**5.95**	**2006.0**	**16.6**	Well #9	0.33	
	1	Well #2	07/27/22	830	2.00	**4.1**	**4.1**	**750**		1.82	4.1	**2.69**	**1991.5**	**31.1**	Well #2	2.19	
	2	Well #2	07/27/22	830	0.90	**4.1**	**4.1**	**750**		1.84	4.1	**2.72**	**1991.5**	**31.1**	Well #2	0.98	
	1	Well #8	07/27/22	900	1.60	**2.4**	**8.0**	**750**		3.85	2.4	**7.36**	**2010.5**	**12.1**	Well #8	1.75	
	2	Well #8	07/27/22	900	1.10	**2.4**	**8.0**	**750**		3.95	2.4	**7.56**	**2011.5**	**11.1**	Well #8	1.20	
	1	Well #16	07/27/22	1025	2.00	**3.1**	**7.6**	**750**		2.55	3.1	**4.55**	**1999.5**	**23.1**	Well #16	2.19	
	2	Well #16	07/27/22	1025	1.30	**3.1**	**7.6**	**750**		2.70	3.1	**4.81**	**2001.0**	**21.6**	Well #16	1.42	
	1	Well #17	07/27/22	1050	2.00	**3.0**	**7.5**	**750**		2.61	3	**4.68**	**2000.5**	**22.1**	Well #17	2.19	
	2	Well #17	07/27/22	1050	1.60	**3.0**	**7.5**	**750**		2.73	3	**4.89**	**2001.0**	**21.6**	Well #17	1.75	
		Aerated Water 21.9 degrees C	09/14/22	1040	0.00	**0.0**	**21.9**	**450**		2.47	0	**10.03**	**2019.0**	**3.7**	Aerated Water 21.9 degrees C	0.00	Lab Air 11.38 ppt

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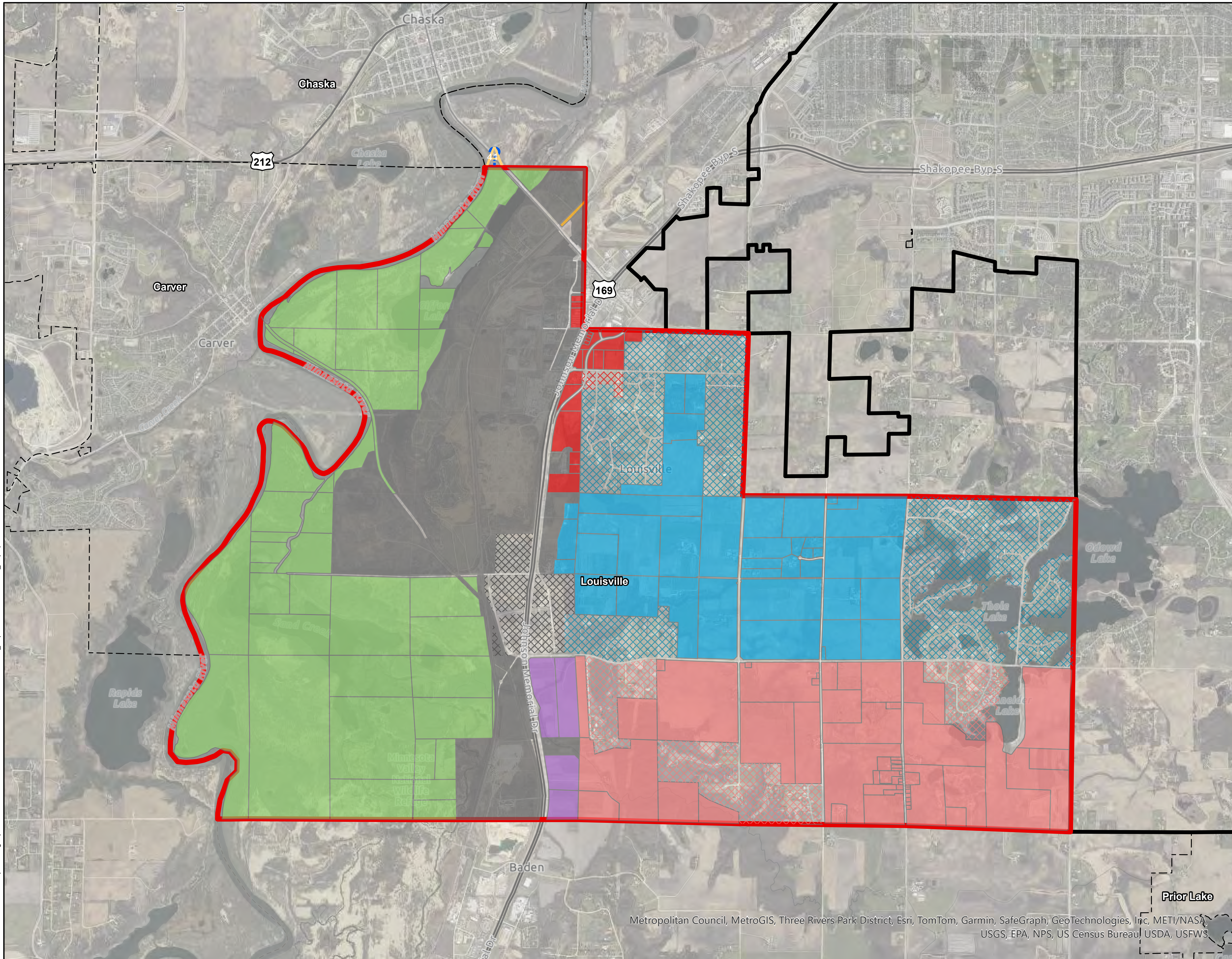
DRAFT

Appendix B

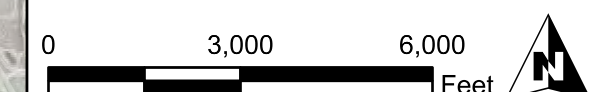
Louisville Township Water Service

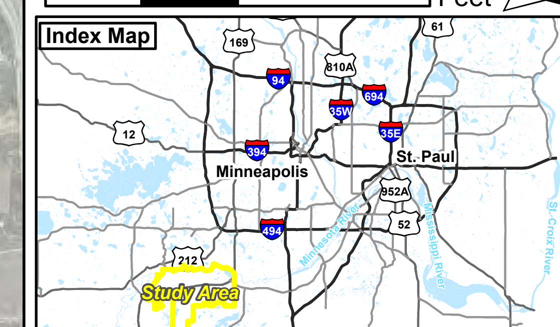


Legend

Comprehensive Landuse 2040 (Scott County)

- Commercial
- Commercial (Existing Development)
- Industrial
- Industrial (Existing Development)
- Transition Area
- Transition Area (Existing Development)
- Urban Expansion
- Urban Expansion (Existing Development)
- Commercial Reserve
- Public Lands
- Rural Business Reserve





Future Land Use Planning - Louisville

2024 Comprehensive Water Plan Update
Shakopee, Minnesota

Print Date: 7/25/2024

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

Appendix B-1

Path: X:\PT\S\SHPUC\177653\4-prelim-dsgn-rpts\Data from Client\SPUWaterDistribution\SPUWaterDistribution_Map\SPUWaterDistribution_Map.aprx

Table B1
Projected Water Consumption By Land Use - Louisville Township

Land Use[1]	Full Buildout Units/Parc	Full Buildout Units or Acres[1]	Estimated AD Water Use (gpd/acre or Unit)	Projected Full Buildout AD Water Use (MGD)	MD/AD Ratio	Projected Full Buildout MD Water Use (gpd)
Future Service to Existing Development						
Commercial	441	1,405	675	0.76	2.0	1.52
Industrial	6	152	500	0.06	1.3	0.08
Residential	441	1,405	245	0.11	2.5	0.27
Subtotal	**447**	**1,557**	**--**	**0.9**		**1.9**
Future Service to Developing Areas						
Commercial	25	116	675	0.06	2.0	0.13
Industrial	73	1,648	675	0.89	1.3	1.11
Public Lands	51	2,425	0	0.00	0.0	0.00
Rural Business Reserve	4	129	675	0.07	2.0	0.14
Transition Area (Low Density Res.)	55	1,437	245	0.28	2.5	0.70
Urban Expansion (Res.)	373	1,013	490	0.40	2.5	0.99
Subtotal	**581**	**6,769**	**--**	**1.7**		**3.1**
All Land Use	**1,028**	**8,326**		**2.63**		**4.9**

*Estimates based on typical historical usage

1. 20 percent of future areas assumed to be streets and open areas. Calculated by [(Future - Existing) x 0.8] + Existing.

2. 20 percent of Township areas assumed to be streets and open areas and 80 percent as 1/2 acre single-family lots; water not included; (2.9 persons per household x 2 households per acre x 84 gpcd = 490 gpd/acre).

Table B - C-9
Supply & Storage Analysis for 2nd High West Zone + Louisville

Pumping Capacity Analysis	Design Demand Year 2025	2035	2045
Combined Maximum Day Demand (mgd)[1]	1.14	4.10	8.9
Combined Average Day Demand (mgd)	0.41	1.64	3.7
Existing Firm Supply Capacity (mgd)[2]	2.59	3.74	4.32
Firm Supply and/or Interzone Transfer Capacity Mass Balance (mgd)[3]	**1.45**	**-0.35**	**-4.59**
Recommended Storage Volume			
Maximum Day Equalization Volume (gallons)[4]	170,000	610,000	1,340,000
Reserve Storage (1/2 AD)	205,000	818,000	1,844,000
Fire Protection Volume (gallons)[5]	300,000	300,000	300,000
Recommended Total Volume (gallons)	*495,000*	*1,526,000*	*3,321,000*
Existing Storage & Pumping Volume			
Surplus Firm Pump Volume (gallons)[6]	180,000	202,000	163,000
No Storage			
Total Existing Volume Available (gallons)	*750,000*	*750,000*	*750,000*
Storage or Pumping Volume Mass Balance (gallons)[3]	**255,000**	**-776,000**	**-2,571,000**

1. See Table 4-6
2. Assumes addition of booster stations and supply wells
3. A positive value represents a surplus. A negative valve represents a deficiency.
4. Maximum Day Equalization Volume is the projected maximum volume depletion during the peak hours of the maximum day assuming the pumping rate into the service zone is equal to the maximum day demand rate. Typical residential diurnal curves were assumed with a peaking factor of 1.65.
5. Fire Protection storage was calculated based on one fire of 2,500 gpm for 2 hours.
6. Surplus Firm Pump Volume is the difference between maximum day demand and Firm Pumping Capacity which is available to supplement fire protection for 3 hours.

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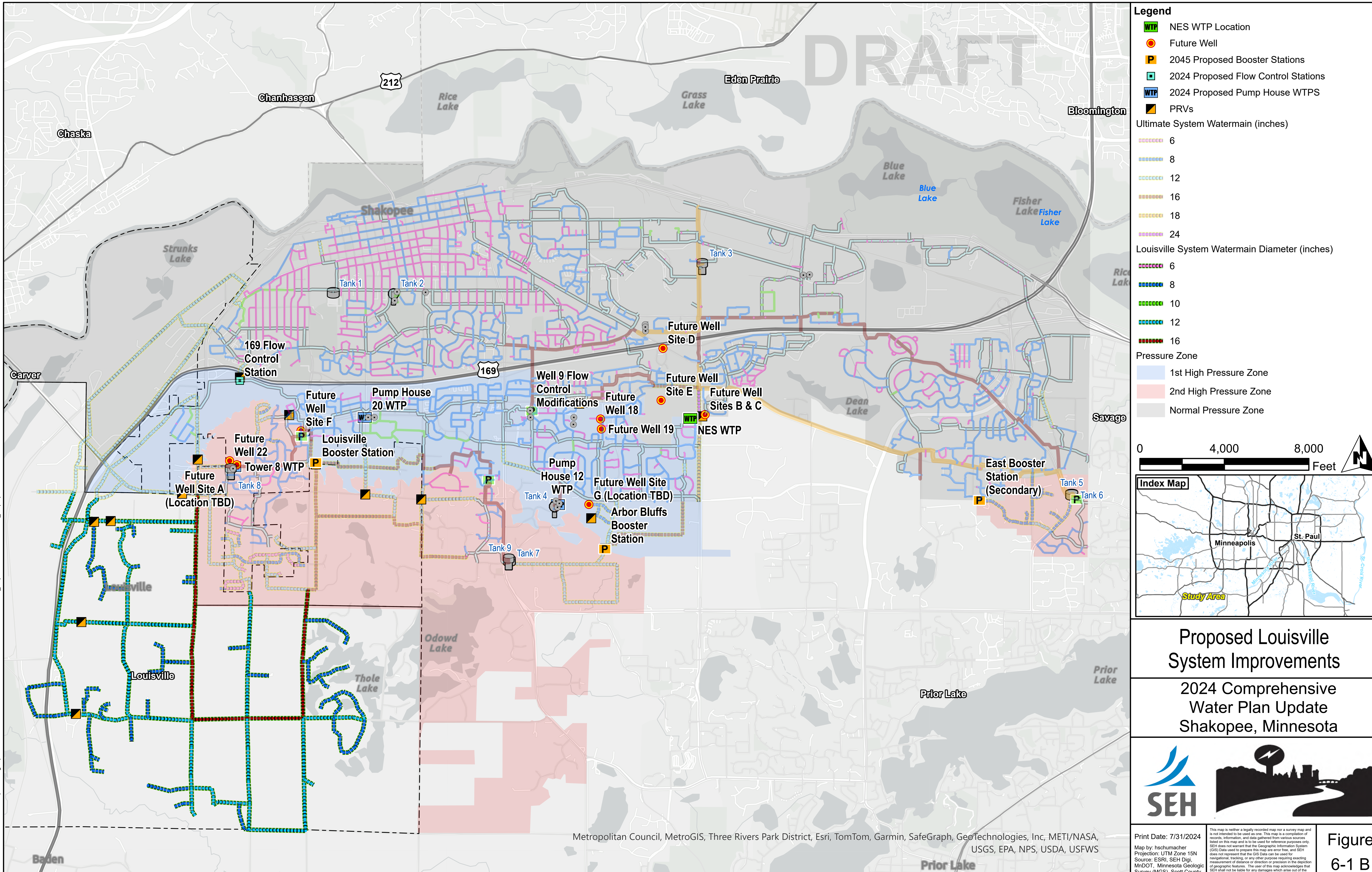
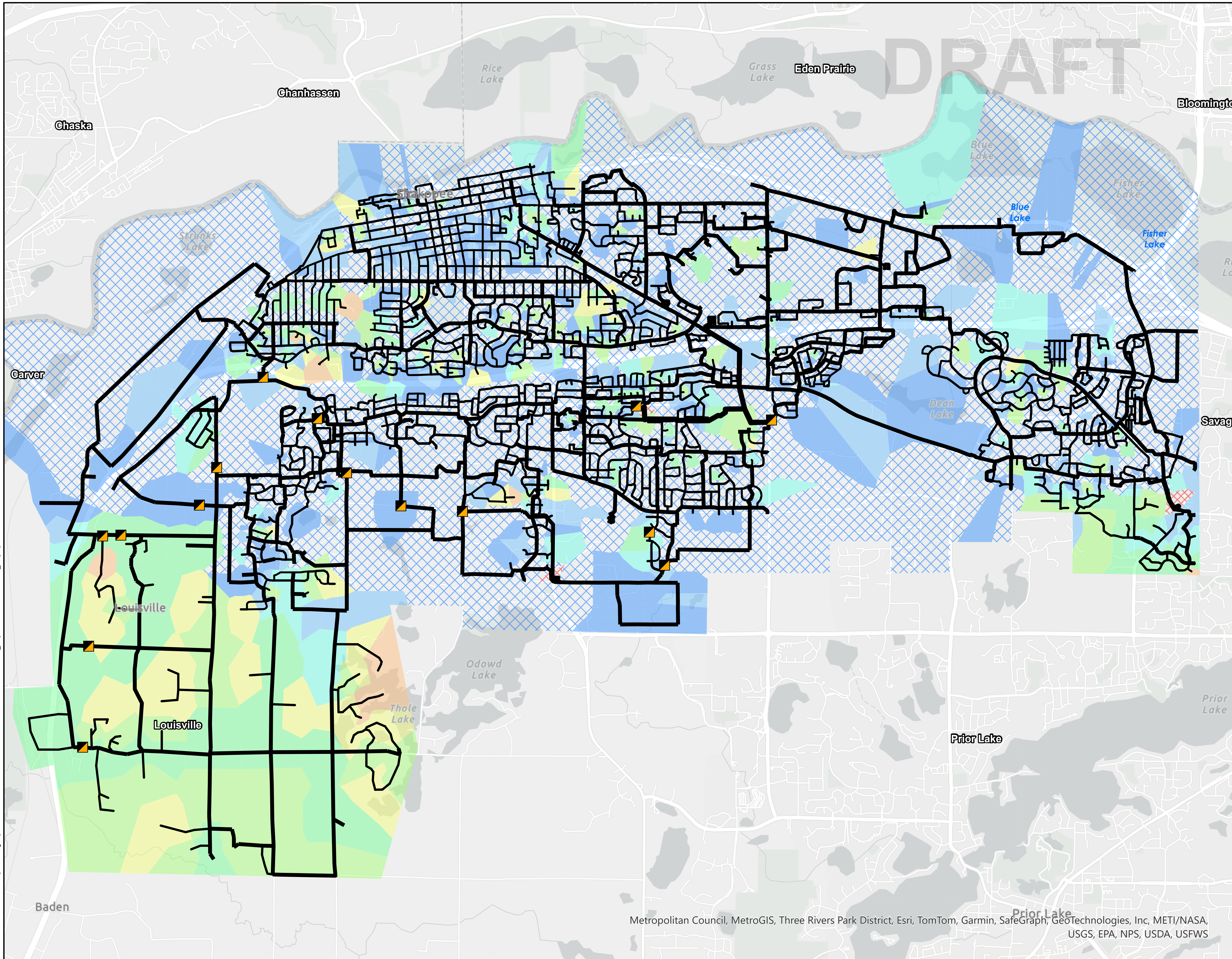
Table B-10.2
Supply & Storage Analysis for 2nd High West + Central Zones +Louisville

	Design Demand Year		
Pumping Capacity Analysis	**2025**	**2035**	**2045**
Combined Maximum Day Demand (mgd)[1]	1.41	4.50	9.42
Combined Average Day Demand (mgd)	0.51	1.78	3.87
Existing Firm Supply Capacity (mgd)[2]	5.47	5.47	5.47
Firm Supply and/or Interzone Transfer Capacity Mass Balance (mgd)[3]	**4.06**	**0.98**	**-3.95**
Recommended Storage Volume			
Maximum Day Equalization Volume (gallons)[4]	210,000	670,000	1,410,000
Reserve Storage (1/2 AD)	255,000	890,000	1,935,000
Fire Protection Volume (gallons)[5]	300,000	240,000	240,000
Recommended Total Volume (gallons)	*255,000*	*1,678,000*	*3,585,000*
Existing Storage & Pumping Volume			
Surplus Firm Pump Volume (gallons)[6]	510,000	122,000	(493,000)
No Storage			
Total Existing Volume Available (gallons)	*1,250,000*	*1,250,000*	*1,250,000*
Storage or Pumping Volume Mass Balance (gallons)[3]	**995,000**	**-428,000**	**-2,335,000**

1. See Table 4-6
2. Assumes addition of booster stations and supply wells
3. A positive value represents a surplus. A negative valve represents a deficiency.
4. Maximum Day Equalization Volume is the projected maximum volume depletion during the peak hours of the maximum day assuming the pumping rate into the service zone is equal to the maximum day demand rate. Typical residential diurnal curves were assumed with a peaking factor of 1.65.
5. Fire Protection storage was calculated based on one fire of 2,500 gpm for 2 hours.
6. Surplus Firm Pump Volume is the difference between maximum day demand and Firm Pumping Capacity which is available to supplement fire protection for 3 hours.

X:\PT\S\SHPUC\177653\4-prelim-dsgn-rpts\[2024 Supply & Storage_Add Louisville.xlsx]C-10 2ndH W+C Stg


DRAFT
Legend
NES WTP Location
Future Well
2045 Proposed Booster Stations
2024 Proposed Flow Control Stations
2024 Proposed Pump House WTPS
PRVs
Ultimate System Watermain (inches)
6
8
12
16
18
24
Louisville System Watermain Diameter (inches)
6
8
10
12
16
Pressure Zone
1st High Pressure Zone
2nd High Pressure Zone
Normal Pressure Zone
0 4,000 8,000 Feet
Index Map
Minneapolis
St. Paul
Study Area
Chanhassen
Chaska
Eden Prairie
Bloomington
Carver
Shakopee
Savage
Louisville
Prior Lake
Baden
Rice Lake
Grass Lake
Blue Lake
Fisher Lake
Strunks Lake
Dean Lake
Odowd Lake
Thole Lake
212
169
Tank 1
Tank 2
Tank 3
Tank 4
Tank 5
Tank 6
Tank 7
Tank 8
Tank 9
169 Flow Control Station
Future Well Site F
Pump House 20 WTP
Well 9 Flow Control Modifications
Future Well 18
Future Well 19
Future Well Site D
Future Well Site E
Future Well Sites B & C
NES WTP
Future Well 22
Tower 8 WTP
Louisville Booster Station
Future Well Site A (Location TBD)
Pump House 12 WTP
Future Well Site G (Location TBD)
Arbor Bluffs Booster Station
East Booster Station (Secondary)
Metropolitan Council, MetroGIS, Three Rivers Park District, Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, USDA, USFWS
Proposed Louisville System Improvements
2024 Comprehensive Water Plan Update
Shakopee, Minnesota
SEH
Print Date: 7/31/2024
Map by: hschumacher
Projection: UTM Zone 15N
Source: ESRI, SEH Digi, MnDOT, Minnesota Geologic Survey (MGS), Scott County
Figure 6-1 B



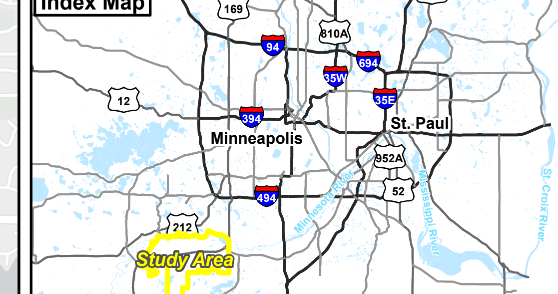
Legend

- PRVs

Fire Flow (gpm)

- 0 - 500
- 501 - 1000
- 1001 - 1500
- 1501 - 2000
- 2001 - 2500
- 2501 - 3000
- 3001 - 4000
- 4001 - 5000
- 5001+

Index Map



2045 System Fire Flows Ultimate System & Louisville Fire Flow

2024 Comprehensive Water Plan Update
Shakopee, Minnesota

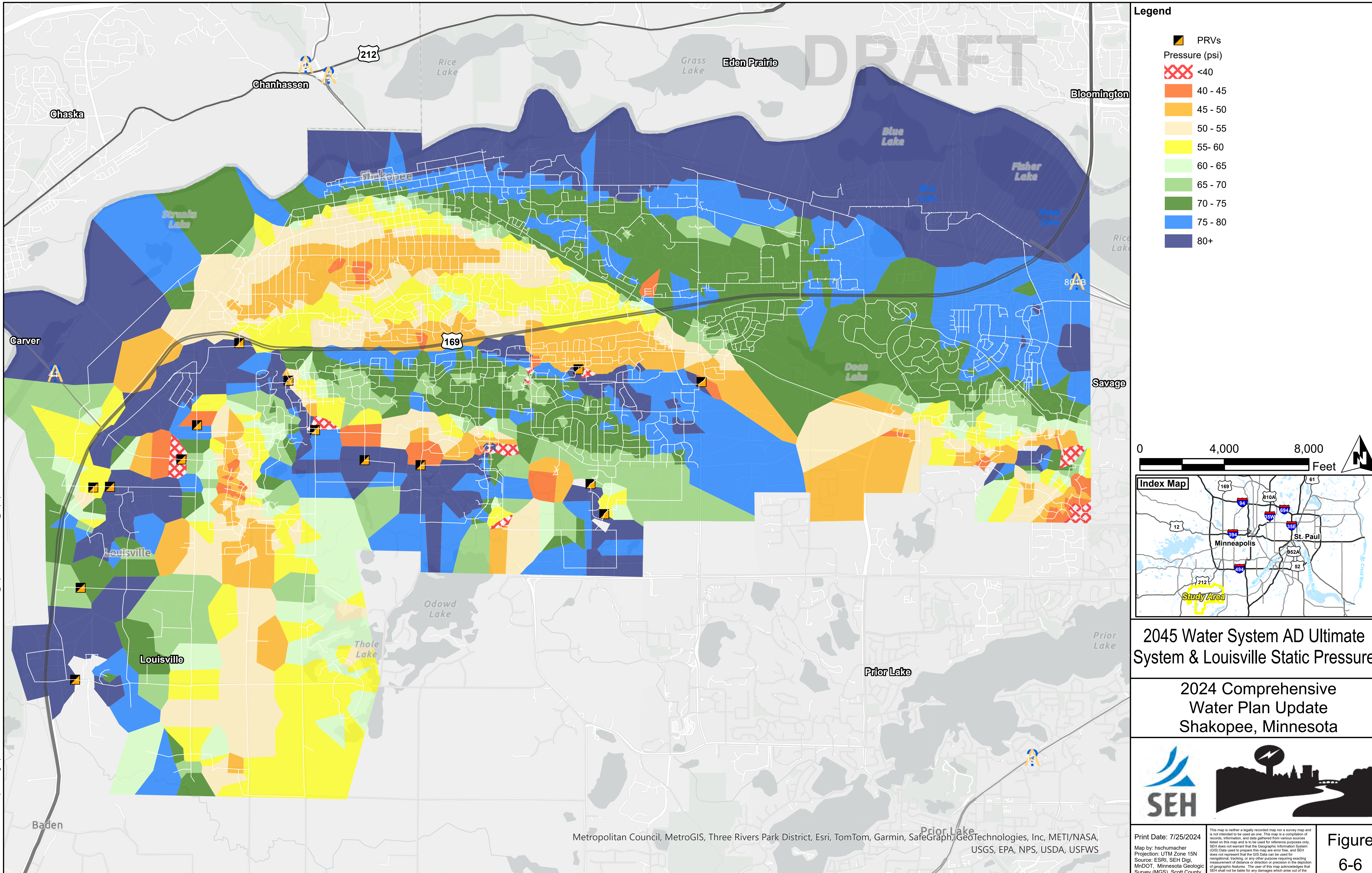
SEH

Print Date: 7/25/2024

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

Figure 6-4

Path: X:\PT\S\SHPUC\177653\4-prelim-dsgn-rpts\Data from Client\SPUWaterDistribution\SPUWaterDistribution_Map\SPUWaterDistribution_Map.aprx



2045 Water System AD Ultimate System & Louisville Static Pressure

2024 Comprehensive Water Plan Update
Shakopee, Minnesota

SEH

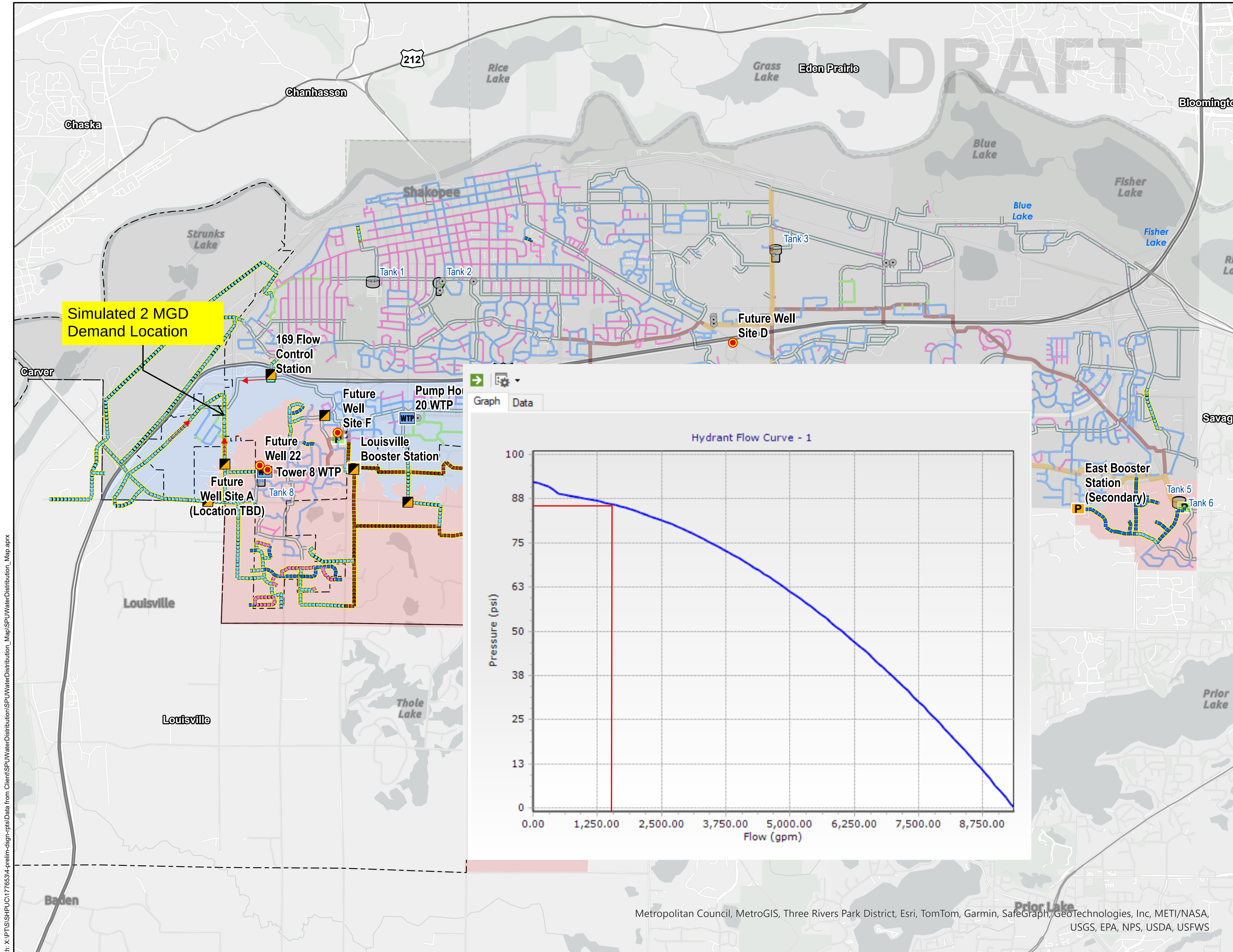
Print Date: 7/25/2024
Map by: hschumacher
Projection: UTM Zone 15N
Source: ESRI, SEH Digi, MnDOT, Minnesota Geologic Survey (MGS), Scott County

Figure 6-6

DRAFT

Appendix C

Large Water User Modeling and Planning



Legend

- PRVs
- NES WTP Location
- Future Well
- 2045 Proposed Booster Stations
- 2024 Proposed Flow Control Stations
- 2024 Proposed Pump House WTPS

Existing Watermain

- 4-inch
- 6-inch
- 8-inch
- 10-inch
- 12-inch
- 16-inch
- 18-inch

Diameter (inches)

- 6
- 8
- 10
- 12
- 16

Pressure Zone

- 1st High Pressure Zone
- 2nd High Pressure Zone
- Normal Pressure Zone

0 4,000 8,000 Feet

Index Map: Minneapolis, St. Paul, Study Area

Large Format Water User Impacts

2024 Comprehensive Water Plan Update
Shakopee, Minnesota

SEH

Print Date: 7/31/2024

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

C1

Appendix D

Capital Improvement Planning

Cost Per Foot Water Main
Diameter

Item	6	8	10	12	16	20	24	30	36
Water Main		0.9	0.95	1.05	1.07	1.1	1.15	1.2	1.25
Water Main - Cement-Lined Class 52 DIP w/ Push-On Locking Gasket Joints + Bonding Straps	$ 32	$ 38	$ 46	$ 57	$ 82	$ 113	$ 156	$ 233	$ 350
Fittings - Full Body Gray Cast Iron w/ MegaLug Gasket Joints + Thrust Blocks - Every 150 feet	$ 5	$ 6	$ 8	$ 10	$ 14	$ 19	$ 26	$ 39	$ 58
Polyethythene Encasement - 8 mil thickness	$ 1	$ 1	$ 1	$ 2	$ 3	$ 4	$ 5	$ 7	$ 11
Gate Valves w/ Megalug Gasket Joints + Thrust Block - Every 300 feet	$ 4	$ 5	$ 6	$ 7	$ 10	$ 14	$ 19	$ 29	$ 44
Hydrant w/ Megalug Gasket Joints + 30' 6" Lead + Thrust Block - Every 300 feet	$ 20	$ 21	$ 22	$ 23	$ 25	$ 26	$ 28	$ 31	$ 34
Curb Stop, Box, copper service - Every 50 feet	$ 31	$ 31	$ 31	$ 31	$ 31	$ 31	$ 31	$ 31	$ 31
Pipe Trench									
Pipe Bedding - 6" thick	$ 4	$ 4	$ 4	$ 4	$ 4	$ 5	$ 5	$ 5	$ 6
Trench Excavation - 8 foot bury depth	$ 32	$ 33	$ 34	$ 35	$ 38	$ 40	$ 43	$ 47	$ 52
Pavement									
Saw Cut Asphalt Pavement - Full Depth	$ 4	$ 4	$ 4	$ 4	$ 4	$ 4	$ 4	$ 4	$ 4
Lower Layer Asphalt Pavement - 2-3/4" 58-28S	$ 33	$ 33	$ 33	$ 33	$ 33	$ 33	$ 33	$ 33	$ 33
Tack Coat	$ 9	$ 9	$ 9	$ 9	$ 9	$ 9	$ 9	$ 9	$ 9
Upper Layer Asphalt Pavement - 2-3/4" 58-28S	$ 33	$ 33	$ 33	$ 33	$ 33	$ 33	$ 33	$ 33	$ 33
12" 1-1/4" CABC	$ 30	$ 30	$ 30	$ 30	$ 30	$ 30	$ 30	$ 30	$ 30
Traffic Control	$ 10	$ 10	$ 10	$ 10	$ 10	$ 10	$ 10	$ 10	$ 10
Base Total Price Per Foot	$ 336	$ 349	$ 365	$ 389	$ 439	$ 500	$ 583	$ 732	$ 950

AI Provided $24 per inch-foot for 12-inch

Price with Contingency + Engineering based on project size

Contingency Scale Factor Based on Project Size		6	8	10	12	16	20	24	30	36
100	1.75	$ 587	$ 611	$ 639	$ 681	$ 768	$ 875	$ 1,020	$ 1,281	$ 1,663
120	1.73	$ 581	$ 605	$ 633	$ 674	$ 761	$ 867	$ 1,010	$ 1,268	$ 1,647
144	1.72	$ 576	$ 599	$ 626	$ 668	$ 753	$ 858	$ 1,000	$ 1,255	$ 1,630
173	1.70	$ 570	$ 593	$ 620	$ 661	$ 746	$ 850	$ 990	$ 1,243	$ 1,614
207	1.68	$ 564	$ 587	$ 614	$ 655	$ 738	$ 841	$ 980	$ 1,231	$ 1,598
249	1.67	$ 559	$ 582	$ 608	$ 648	$ 731	$ 833	$ 971	$ 1,218	$ 1,582
299	1.65	$ 553	$ 576	$ 602	$ 642	$ 724	$ 825	$ 961	$ 1,206	$ 1,567
358	1.63	$ 548	$ 570	$ 596	$ 635	$ 717	$ 816	$ 952	$ 1,194	$ 1,551
430	1.62	$ 542	$ 565	$ 590	$ 629	$ 710	$ 808	$ 942	$ 1,183	$ 1,536
516	1.60	$ 537	$ 559	$ 584	$ 623	$ 703	$ 800	$ 933	$ 1,171	$ 1,521
619	1.58	$ 532	$ 553	$ 578	$ 617	$ 696	$ 792	$ 924	$ 1,159	$ 1,506
743	1.57	$ 526	$ 548	$ 573	$ 611	$ 689	$ 785	$ 915	$ 1,148	$ 1,491
892	1.55	$ 521	$ 542	$ 567	$ 604	$ 682	$ 777	$ 905	$ 1,136	$ 1,476
1,070	1.54	$ 516	$ 537	$ 561	$ 598	$ 675	$ 769	$ 896	$ 1,125	$ 1,461
1,284	1.52	$ 511	$ 532	$ 556	$ 593	$ 668	$ 761	$ 888	$ 1,114	$ 1,447
1,541	1.51	$ 506	$ 527	$ 550	$ 587	$ 662	$ 754	$ 879	$ 1,103	$ 1,433
1,849	1.49	$ 501	$ 521	$ 545	$ 581	$ 655	$ 746	$ 870	$ 1,092	$ 1,418
2,219	1.48	$ 496	$ 516	$ 539	$ 575	$ 649	$ 739	$ 862	$ 1,081	$ 1,404
2,662	1.46	$ 491	$ 511	$ 534	$ 569	$ 642	$ 732	$ 853	$ 1,071	$ 1,390
3,195	1.45	$ 486	$ 506	$ 529	$ 564	$ 636	$ 724	$ 845	$ 1,060	$ 1,377
3,834	1.43	$ 481	$ 501	$ 524	$ 558	$ 630	$ 717	$ 836	$ 1,050	$ 1,363
4,601	1.42	$ 476	$ 496	$ 518	$ 553	$ 623	$ 710	$ 828	$ 1,039	$ 1,350
5,521	1.41	$ 472	$ 491	$ 513	$ 547	$ 617	$ 703	$ 820	$ 1,029	$ 1,336
6,625	1.39	$ 467	$ 486	$ 508	$ 542	$ 611	$ 696	$ 812	$ 1,019	$ 1,323
7,950	1.38	$ 462	$ 481	$ 503	$ 536	$ 605	$ 689	$ 804	$ 1,009	$ 1,310
9,540	1.36	$ 458	$ 477	$ 498	$ 531	$ 599	$ 683	$ 796	$ 999	$ 1,297
11,448	1.20	$ 403	$ 419	$ 438	$ 467	$ 527	$ 600	$ 700	$ 878	$ 1,140
13,737	1.19	$ 399	$ 415	$ 434	$ 462	$ 522	$ 594	$ 693	$ 869	$ 1,129
16,484	1.18	$ 395	$ 411	$ 429	$ 458	$ 516	$ 588	$ 686	$ 861	$ 1,118
19,781	1.16	$ 391	$ 407	$ 425	$ 453	$ 511	$ 583	$ 679	$ 852	$ 1,107
23,738	1.15	$ 387	$ 403	$ 421	$ 449	$ 506	$ 577	$ 672	$ 844	$ 1,096
28,485	1.14	$ 383	$ 399	$ 417	$ 444	$ 501	$ 571	$ 666	$ 836	$ 1,085
34,182	1.13	$ 379	$ 395	$ 413	$ 440	$ 496	$ 565	$ 659	$ 827	$ 1,074
41,019	1.12	$ 376	$ 391	$ 409	$ 436	$ 491	$ 560	$ 653	$ 819	$ 1,064
49,222	1.11	$ 372	$ 387	$ 405	$ 431	$ 487	$ 554	$ 646	$ 811	$ 1,053

DRAFT

Appendix E

Water Quality Data

DEPARTMENT OF HEALTH

Shakopee PFAS Summary

Jessie Kolar | District Engineer

Todd Johnson | District Engineer Supervisor

January 18, 2022

Per- and Polyfluoroalkyl Substances (PFAS)





- Family of many synthetic chemicals
- Developed and used since the 1940s
  - resist heat, stains, water, oil, grease
  - “non-stick”
- Production increased rapidly in the 1970s
- Persist in the environment, found everywhere
- Not regulated under the SDWA





Source: open access images – bing.com

SAMPLING OF SHAKOPEE FOR PFAS

- Shakopee initially sampled for PFAS in 2014 & 2015
  - UCMR3
  - Not every well sampled
  - No PFAS compounds detected.
- Current sampling conducted as part of MDH's Statewide PFAS Sampling
  - MDH goal of sampling all PWSs for PFAS (started in 2021)
  - 'Voluntary', or not required.

Minnesota PFAS Guidance- How low can we go?

- MDH develops health-based guidance values (HBVs) at concentrations likely to pose little or no risk to human health
- Not enforceable
- Do not consider cost and treatability
- Health Risk Index (HRI): additive risk assessment of co-contaminants with similar health effects
  - HRI > 1 considered an exceedance

	PFOA	PFOS	PFBA	PFBS	PFHxS
2002	7	1			
2006	1	0.6	1		
2007	0.5	0.3	7		
2009	0.3	0.3	7	7	
2013	0.3	0.3	7	7	0.3
2016	0.07	0.07	7	7	0.07
2017	0.035	0.027	7	3/2	0.027
2019	0.035	0.015	7	3/2	0.047

Blue = HRL; Red = HBV; Green = Surrogate units = µg/L

$$HRI = \frac{PFOA_{[conc]}}{0.035} + \frac{PFOS_{[conc]}}{0.015} + \frac{PFBA_{[conc]}}{7} + \frac{PFBS_{[conc]}}{2} + \frac{PFHxS_{[conc]}}{0.047}$$

Well	PFOA	PFOS	PFBA	PFBS	PFHxS	PFHxA	HRI
Well #2	0.0008	0.0016	0.011	0.0015	0	0.0019	0.14
Well #4	0.002	0.0012	0.03	0.0026	0.0009	0.02	0.26
Well #5	0.0027	0.0018	0.036	0.0031	0.001	0.021	0.33
(Wells 6, 7 & 10)	0.0017	0.0028	0.017	0.0017	0	0.0024	0.25
Well #8	0.0012	0.0027	0.017	0.0015	0.002	0.0029	0.27
Well #9	0	0	0.01	0.0009	0	0	0.00
Well #11	0	0	0.005	0	0	0	0.00
Well #12	0	0	0.002	0	0	0	0.00
Well #15	0	0	0.009	0.0012	0	0.0011	0.01
Well #16	0	0	0.011	0.0015	0	0	0.00
Well #17	0	0	0.011	0.0016	0	0	0.00
Well #20	0.0011	0	0.011	0.001	0	0.0014	0.04
Well #21	0.0017	0	0.014	0.0015	0	0.0043	0.07

WHAT'S NEXT?

- MDH has no plans for immediate follow up sampling at Shakopee.
- EPA preliminary draft MCLs for PFOS & PFOA scheduled for release in fall of this year. (Final MCLs in fall 2023).
- Shakopee will be sampled by MDH for PFAS in December 2024 and June 2025 (UCMR5).

COMMUNICATIONS

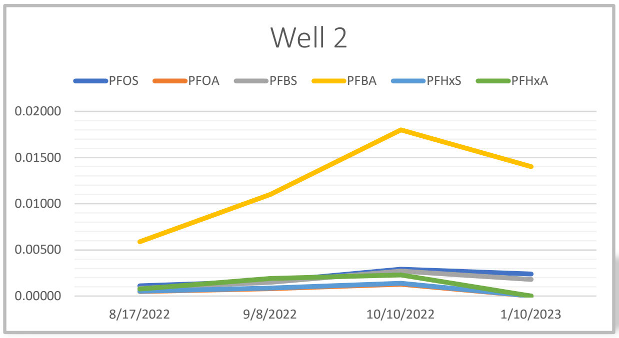
- PFAS results not required to be included in CCR.
- MDH recommends that you include them in your next CCR and can provide resources to help you give context about what these results mean.
- Results will be included in MDH's PFAS Dashboard.
- Perfluoroalkyl Substances (PFAS) - EH: Minnesota Department of Health (state.mn.us)

Thank you

jessie.kolar@state.mn.us

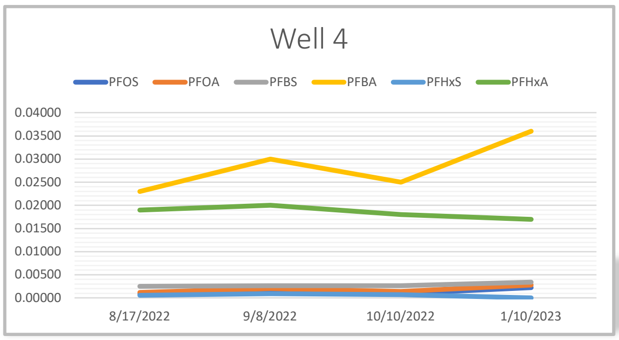
MDH - (651) 201-4562

Minnesota Department of Health
PFAS HRI Testing Results



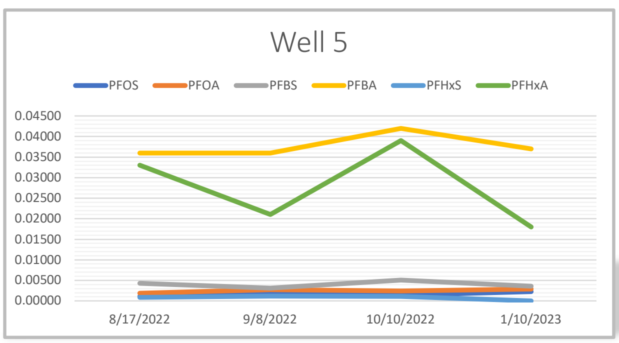
HRI Average
0.19

	PFOS	PFOA	PFBS	PFBA	PFHxS	PFHxA	HRI
8/17/2022	0.00110	0.00049	0.00083	0.00590	0.00054	0.00075	0.11
9/8/2022	0.00160	0.00079	0.00150	0.01100	0.00088	0.00190	0.17
10/10/2022	0.00290	0.00130	0.00270	0.01800	0.00140	0.00230	0.30
1/10/2023	0.00240	0.00000	0.00180	0.01400	0.00000	0.00000	0.18



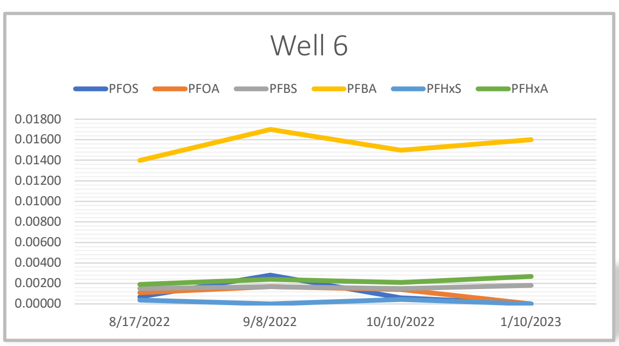
HRI Average
0.27

	PFOS	PFOA	PFBS	PFBA	PFHxS	PFHxA	HRI
8/17/2022	0.00077	0.00120	0.00250	0.02300	0.00058	0.01900	0.22
9/8/2022	0.00120	0.00200	0.00260	0.03000	0.00090	0.02000	0.29
10/10/2022	0.00095	0.00140	0.00260	0.02500	0.00074	0.01800	0.24
1/10/2023	0.00220	0.00280	0.00340	0.03600	0.00000	0.01700	0.35



HRI Average
0.38

	PFOS	PFOA	PFBS	PFBA	PFHxS	PFHxA	HRI
8/17/2022	0.00110	0.00190	0.00430	0.03600	0.00085	0.03300	0.36
9/8/2022	0.00180	0.00270	0.00310	0.03600	0.00120	0.02100	0.36
10/10/2022	0.00140	0.00240	0.00510	0.04200	0.00110	0.03900	0.44
1/10/2023	0.00230	0.00290	0.00360	0.03700	0.00000	0.01800	0.37



HRI Average
0.13

	PFOS	PFOA	PFBS	PFBA	PFHxS	PFHxA	HRI
8/17/2022	0.00068	0.00110	0.00150	0.01400	0.00040	0.00190	0.11
9/8/2022	0.00280	0.00170	0.00170	0.01700	0.00000	0.00240	0.27
10/10/2022	0.00061	0.00140	0.00150	0.01500	0.00045	0.00210	0.12
1/10/2023	0.00000	0.00000	0.00180	0.01600	0.00000	0.00270	0.03

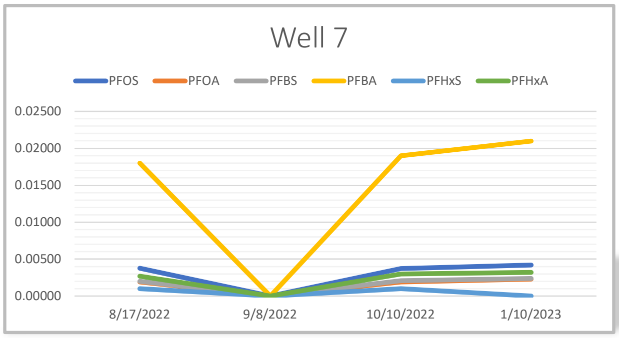
All values are in µg/L
A value of 0.00000 indicates that a compound is below detection.

PFAS Testing of Minnesota Community Water Systems

https://tinyurl.com/PFAS-MDH

MDH - (651) 201-4562

Minnesota Department of Health
PFAS HRI Testing Results

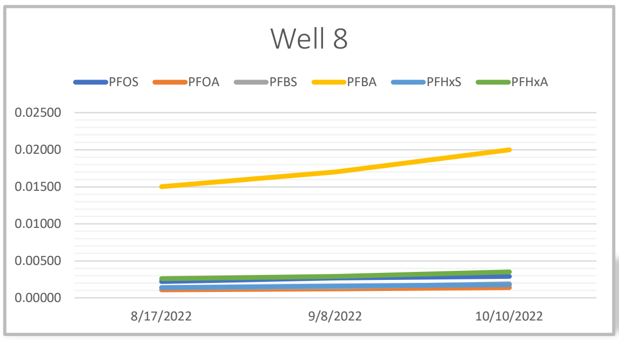


Sampled w/Well 6

HRI Average

0.37

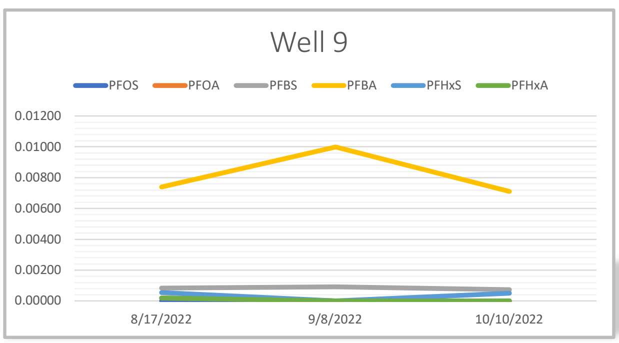
	PFOS	PFOA	PFBS	PFBA	PFHxS	PFHxA	HRI
8/17/2022	0.00380	0.00190	0.00200	0.01800	0.00100	0.00270	0.36
9/8/2022	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00
10/10/2022	0.00370	0.00190	0.00210	0.01900	0.00100	0.00300	0.36
1/10/2023	0.00420	0.00230	0.00240	0.02100	0.00000	0.00320	0.39



HRI Average

0.28

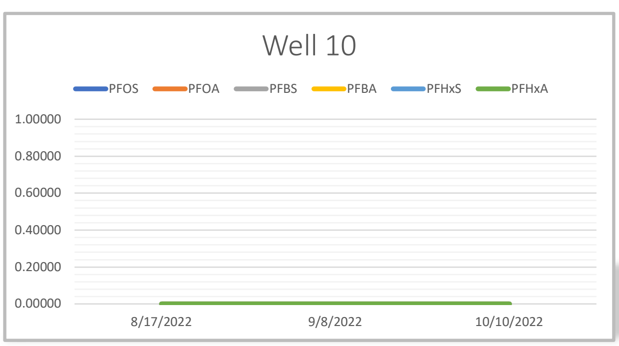
	PFOS	PFOA	PFBS	PFBA	PFHxS	PFHxA	HRI
8/17/2022	0.00220	0.00110	0.00140	0.01500	0.00140	0.00260	0.24
9/8/2022	0.00270	0.00120	0.00150	0.01700	0.00160	0.00290	0.28
10/10/2022	0.00290	0.00140	0.00190	0.02000	0.00180	0.00350	0.31



HRI Average

0.02

	PFOS	PFOA	PFBS	PFBA	PFHxS	PFHxA	HRI
8/17/2022	0.00000	0.00020	0.00083	0.00740	0.00054	0.00019	0.03
9/8/2022	0.00000	0.00000	0.00092	0.01000	0.00000	0.00000	0.01
10/10/2022	0.00000	0.00000	0.00073	0.00710	0.00051	0.00000	0.02



HRI Average

0.00

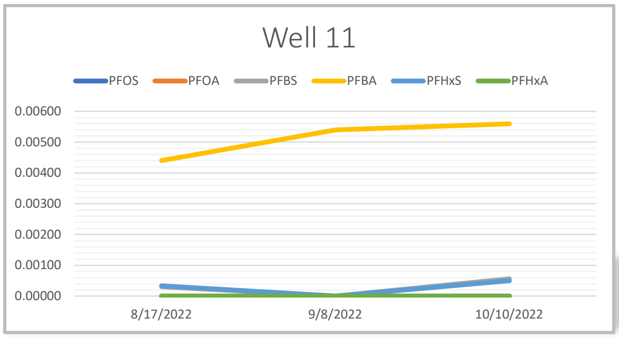
	PFOS	PFOA	PFBS	PFBA	PFHxS	PFHxA	HRI
8/17/2022	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00
9/8/2022	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00
10/10/2022	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00

All values are in µg/L
A value of 0.00000 indicates that a compound is below detection.

MDH - (651) 201-4562

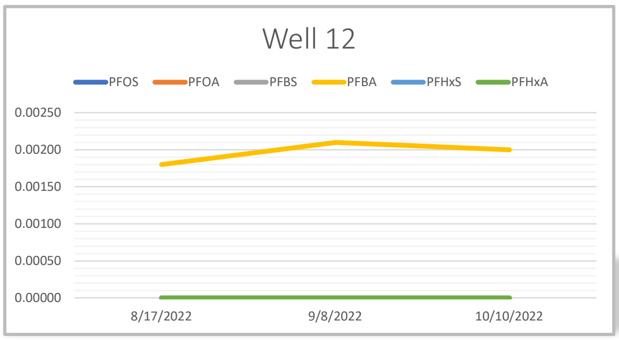
Minnesota Department of Health
PFAS HRI Testing Results

DRAFT



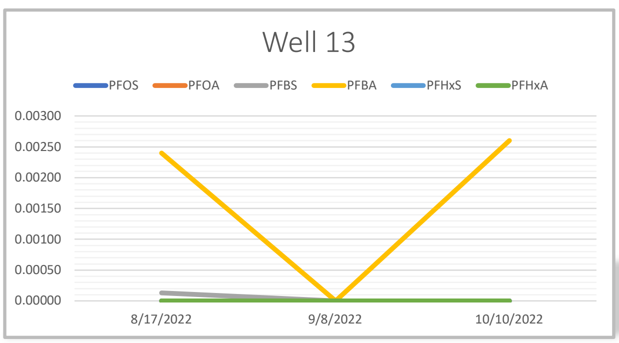
HRI Average
0.01

	PFOS	PFOA	PFBS	PFBA	PFHxS	PFHxA	HRI
8/17/2022	0.00000	0.00000	0.00030	0.00440	0.00033	0.00000	0.01
9/8/2022	0.00000	0.00000	0.00000	0.00540	0.00000	0.00000	0.00
10/10/2022	0.00000	0.00000	0.00056	0.00560	0.00050	0.00000	0.02



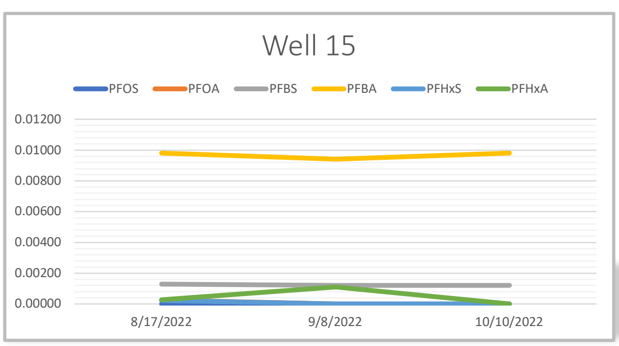
HRI Average
0.00

	PFOS	PFOA	PFBS	PFBA	PFHxS	PFHxA	HRI
8/17/2022	0.00000	0.00000	0.00000	0.00180	0.00000	0.00000	0.00
9/8/2022	0.00000	0.00000	0.00000	0.00210	0.00000	0.00000	0.00
10/10/2022	0.00000	0.00000	0.00000	0.00200	0.00000	0.00000	0.00



HRI Average
0.00

	PFOS	PFOA	PFBS	PFBA	PFHxS	PFHxA	HRI
8/17/2022	0.00000	0.00000	0.00013	0.00240	0.00000	0.00000	0.00
9/8/2022	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00
10/10/2022	0.00000	0.00000	0.00000	0.00260	0.00000	0.00000	0.00



HRI Average
0.02

	PFOS	PFOA	PFBS	PFBA	PFHxS	PFHxA	HRI
8/17/2022	0.00000	0.00026	0.00130	0.00980	0.00023	0.00027	0.03
9/8/2022	0.00000	0.00000	0.00120	0.00940	0.00000	0.00110	0.02
10/10/2022	0.00000	0.00000	0.00120	0.00980	0.00000	0.00000	0.01

All values are in µg/L
A value of 0.00000 indicates that a compound is below detection.

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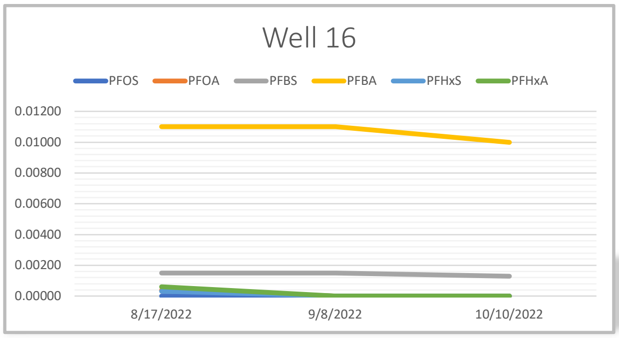
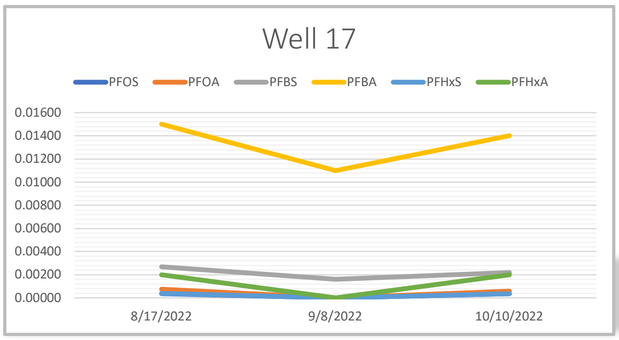
Minnesota Department of Health
PFAS HRI Testing Results



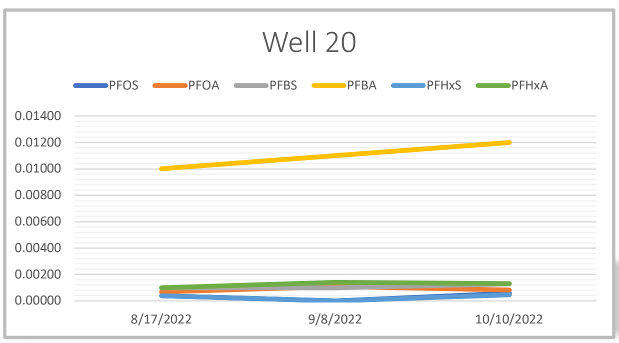
HRI Average
0.02

	PFOS	PFOA	PFBS	PFBA	PFHxS	PFHxA	HRI
8/17/2022	0.00000	0.00037	0.00150	0.01100	0.00031	0.00061	0.04
9/8/2022	0.00000	0.00000	0.00150	0.01100	0.00000	0.00000	0.02
10/10/2022	0.00000	0.00000	0.00130	0.01000	0.00000	0.00000	0.01



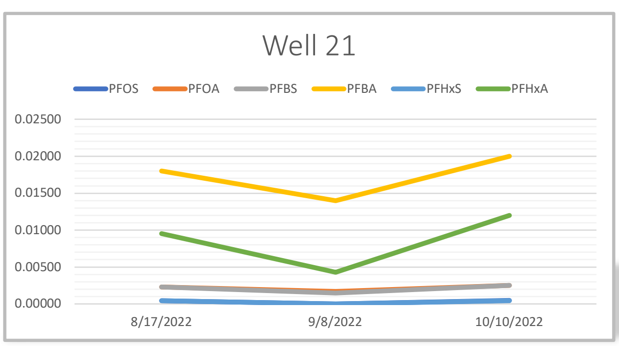
HRI Average
0.06

	PFOS	PFOA	PFBS	PFBA	PFHxS	PFHxA	HRI
8/17/2022	0.00038	0.00076	0.00270	0.01500	0.00039	0.00200	0.09
9/8/2022	0.00000	0.00000	0.00160	0.01100	0.00000	0.00000	0.02
10/10/2022	0.00036	0.00059	0.00220	0.01400	0.00037	0.00200	0.08



HRI Average
0.07

	PFOS	PFOA	PFBS	PFBA	PFHxS	PFHxA	HRI
8/17/2022	0.00039	0.00069	0.00100	0.01000	0.00039	0.00100	0.07
9/8/2022	0.00000	0.00110	0.00100	0.01100	0.00000	0.00140	0.05
10/10/2022	0.00058	0.00084	0.00130	0.01200	0.00046	0.00130	0.09



HRI Average
0.16

	PFOS	PFOA	PFBS	PFBA	PFHxS	PFHxA	HRI
8/17/2022	0.00043	0.00230	0.00230	0.01800	0.00041	0.00950	0.18
9/8/2022	0.00000	0.00170	0.00150	0.01400	0.00000	0.00430	0.09
10/10/2022	0.00050	0.00250	0.00250	0.02000	0.00043	0.01200	0.20

All values are in µg/L
A value of 0.00000 indicates that a compound is below detection.

PFAS Testing of Minnesota Community Water Systems

https://tinyurl.com/PFAS-MDH

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Appendix F

Supply + Storage Needs Calculations

Table F-1
Pumping Capacity & Storage Analysis for Entire System

	Design Demand Year		
Pumping Capacity Analysis	**2025**	**2035**	**2045**
Maximum Day Demand (mgd)[1]	18.4	21.3	24.0
Average Day Demand	6.6	7.7	8.7
Recommended Storage Volume			
Maximum Day Equalization Volume (gallons)[4]	2,750,000	3,200,000	3,600,000
Fire Protection Volume (gallons)[5]	630,000	630,000	630,000
Reserve Volume (1/2 of Average Day)	3,316,000	3,854,000	4,333,000
Recommended Total Volume (gallons)	*6,696,000*	*7,684,000*	*8,563,000*
Existing Storage & Pumping Volume			
Surplus Firm Pump Volume (gallons)[7]	550,000	180,000	(150,000)
Tank 1	1,000,000	1,000,000	1,000,000
Tank 2	250,000	250,000	250,000
Tank 3	1,500,000	1,500,000	1,500,000
Tank 4	500,000	500,000	500,000
Tank 5	2,000,000	2,000,000	2,000,000
Tank 6	2,000,000	2,000,000	2,000,000
Tank 7	2,000,000	2,000,000	2,000,000
Total Existing Volume Available (gallons)	*9,250,000*	*9,250,000*	*9,250,000*
Water Storage Mass Balance	2,554,000	1,566,000	687,000
Additional Storage Recommended (gallons)	**None**	**None**	**None**

1. Additional firm pumping capacity may be recommended if the maximum day demand exceeds the existing firm pumping capacity.
2. Maximum Day Equalization Volume is the projected maximum volume depletion during the peak hours of the maximum day assuming the pumping rate into the service zone is equal to the maximum day demand rate. Typical residential dirunal curves were assumed with a peaking factor of 1.65.
3. Fire Protection storage was calcuated based on one fire of 3,500 gpm for 3 hours.
4. Reserve Volume is recommended to provide supply in event of a power outage
5. Surplus Firm Pump Volume is the difference between maximum day demand and Firm Pumping Capacity which is available to supplement fire protection for 3 hours.

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Table F-2
Supply Capacity into Normal Zone

Well Name	Pressure Zone	Unique Well Number	Depth (ft)	Rated Capacity (gpm)	Normal Operational Capacity (gpm)	Daily Capacity (MGD)
Well 2	Normal	206803	0.43228	300	300	0.43
Well 3	Normal	205978	1.29683	900	900	1.30
Well 4	Normal	206854	1.0317	716	716	1.03
Well 5	Normal	206855	1.22478	850	850	1.22
Well 6	Normal	180922	1.69308	1175	1175	1.69
Well 7	Normal	415975	1.58501	1100	1100	1.59
Well 8	Normal	500657	1.58501	1100	1100	1.59
Well 10	Normal	578948	1.62104	1125	1125	1.62
Well 15	Normal	694921	1.65706	1150	1150	1.66
Well 16	Normal	731139	2.08934	1450	1450	2.09
Well 17	Normal	731140	2.01729	1400	1400	2.02
				Total	**11,266**	**16.2**
					Highest Yielding Well (Well No. 16)	**2.1**
					Firm Capacity (Minus Well No. 16)	**14.1**

Table Notes:

Source: City Records

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Table F-3
Supply & Storage Analysis for Main Zone Dependencies

	Design Demand Year		
Pumping Capacity Analysis	**2025**	**2035**	**2045**
Maximum Day Demand (mgd)[1]	12.77	13.93	14.97
Average Day Demand (mgd)	4.62	5.04	5.41
Existing Firm Supply Capacity (mgd)[2]	14.14	14.14	14.14
Firm Supply and/or Interzone Transfer Capacity Mass Balance (mgd)[3]	**1.37**	**0.21**	**-0.82**
Recommended Storage Volume			
Maximum Day Equalization Volume (gallons)[4]	1,920,000	2,090,000	2,250,000
Reserve Storage (1/2 AD)	2,308,000	2,518,000	2,704,000
Fire Protection Volume (gallons)[5]	630,000	630,000	630,000
Preliminary Recommended Total Volume (gallons)	*4,858,000*	*5,238,000*	*5,584,000*
Existing Storage & Pumping Volume			
Surplus Firm Pump Volume (gallons)[7]	170,000	30,000	(100,000)
Tank 1	1,000,000	1,000,000	1,000,000
Tank 2	250,000	250,000	250,000
Tank 3	1,500,000	1,500,000	1,500,000
Tank 5	2,000,000	2,000,000	2,000,000
Tank 6	2,000,000	2,000,000	2,000,000
Total Existing Volume Available (gallons)	*6,750,000*	*6,750,000*	*6,750,000*
Storage or Pumping Volume Mass Balance (gallons)[3]	**1,892,000**	**1,512,000**	**1,166,000**
Additional Storage Recommended (gallons)	**None**	**None**	**None**

1. Includes Normal Zone and East Zone
2. See Table 5-1
3. A positive value represents a surplus. A negative valve represents a deficiency.
4. Maximum Day Equalization Volume is the projected maximum volume depletion during the peak hours of the maximum day assuming the pumping rate into the service zone is equal to the maximum day demand rate. Typical residential diurnal curves were assumed with a peaking factor of 1.65.
5. Fire Protection storage was calculated based on one fire of 3,500 gpm for 3 hours.
6. Surplus Firm Pump Volume is the difference between maximum day demand and Firm Pumping Capacity which is available to supplement fire protection for 3 hours.

Table F-4
Supply Capacity into First High Zone

Well/Supply Name	Unique Well Number	Normal Operational Capacity (gpm)	Allowed Pumping Time per Day (Hours)	Daily Capacity (MGD)
Well No.12	626775	810	24	1.17
Well No.13	674456	1,036	24	1.49
Well No.14	694904	381	24	0.55
Well No.20	722624	1,142	24	1.64
Well No.21	722625	1,175	24	1.69
VC Booster		1,000	24	1.69
W9 Booster		1,000	24	1.69
	Total	**6,544**	**--**	**9.93**
			Highest Yielding Well (Well No. 21)	**1.69**
			Firm Capacity (Minus Well No. 21)	**8.24**

Table Notes:
Source: City Records

Table F-5
Supply & Storage Analysis for 1st High Zone Dependencies

	Design Demand Year		
Pumping Capacity Analysis	**2025**	**2035**	**2045**
Maximum Day Demand (mgd)[1]	4.36	4.99	5.54
Average Day Demand (mgd)	1.58	1.80	2.00
Existing Firm Supply Capacity (mgd)[2]	8.24	8.24	8.24
Firm Supply and/or Interzone Transfer Capacity Mass Balance (mgd)[3]	**3.87**	**3.25**	**2.69**
Recommended Storage Volume			
Maximum Day Equalization Volume (gallons)[4]	650,000	750,000	830,000
Reserve Storage (1/2 AD)	788,000	901,000	1,002,000
Fire Protection Volume (gallons)[5]	630,000	630,000	630,000
Recommended Total Volume (gallons)	*1,588,000*	*1,871,000*	*2,122,000*
Existing Storage & Pumping Volume			
Surplus Firm Pump Volume (gallons)[6]	480,000	410,000	340,000
Tank 4	500,000	500,000	500,000
Tank 7	2,000,000	2,000,000	2,000,000
Total Existing Volume Available (gallons)	*2,500,000*	*2,500,000*	*2,500,000*
Storage or Pumping Volume Mass Balance (gallons)[3]	**912,000**	**629,000**	**378,000**

1. Includes First High and both Second High Zones.
2. See Table 5-1.
3. A positive value represents a surplus. A negative valve represents a deficiency.
4. Maximum Day Equalization Volume is the projected maximum volume depletion during the peak hours of the maximum day assuming the pumping rate into the service zone is equal to the maximum day demand rate. Typical residential diurnal curves were assumed with a peaking factor of 1.65.
5. Fire Protection storage was calculated based on one fire of 3,500 gpm for 3 hours.
6. Surplus Firm Pump Volume is the difference between maximum day demand and Firm Pumping Capacity which is available to supplement fire protection for 3 hours.

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Table F-6
Pumping Capacity into 2nd High Central Zone

Pump Name	Normal Operational Capacity (gpm)	Daily Capacity (MGD)
Valley Creek 1	1,000	1.44
Valley Creek 2	1,000	1.44
Total	**2,000**	**2.88**
Largest Pump		**1.44**
Firm Capacity (Largest Pump)		**1.44**
Table Notes: Shakopee does not have any water treatment.		

Source: City Records

Table F-7
Supply & Storage Analysis for 2nd High Central Zone

	Design Demand Year		
Pumping Capacity Analysis	**2025**	**2035**	**2045**
Maximum Day Demand (mgd)[1]	0.27	0.40	0.50
Average Day Demand (mgd)	0.10	0.14	0.18
Existing Firm Supply Capacity (mgd)[2]	1.44	1.44	1.44
Firm Supply and/or Interzone Transfer Capacity Mass Balance (mgd)[3]	**1.17**	**1.04**	**0.94**
Recommended Storage Volume			
Maximum Day Equalization Volume (gallons)[4]	40,000	60,000	80,000
Reserve Storage (1/2 AD)	50,000	72,000	91,000
Fire Protection Volume (gallons)[5]	300,000	300,000	300,000
Recommended Total Volume (gallons)	*240,000*	*302,000*	*351,000*
Existing Storage & Pumping Volume			
Surplus Firm Pump Volume (gallons)[6]	150,000	130,000	120,000
No Storage			
Total Existing Volume Available (gallons)	*500,000*	*500,000*	*500,000*
Storage or Pumping Volume Mass Balance (gallons)[3]	**260,000**	**198,000**	**149,000**

1. See Table 4-6
2. See Table 5-1.
3. A positive value represents a surplus. A negative valve represents a deficiency.
4. Maximum Day Equalization Volume is the projected maximum volume depletion during the peak hours of the maximum day assuming the pumping rate into the service zone is equal to the maximum day demand rate. Typical residential diurnal curves were assumed with a peaking factor of 1.65.
5. Fire Protection storage was calculated based on one fire of 2,500 gpm for 2 hours.
6. Surplus Firm Pump Volume is the difference between maximum day demand and Firm Pumping Capacity which is available to supplement fire protection for 3 hours.

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Table F-8
Pumping Capacity into 2nd High West Zone

Pump Name	Normal Operational Capacity (gpm)	Daily Capacity (MGD)
Windermere 1	1,000	1.44
Windermere 2	1,000	1.44
Well No. 23	800	1.15
Total	**2,800**	**4.03**
	Largest Pump	**1.44**
	Firm Capacity (Largest Pump)	**2.59**

Table Notes:

Source: City Records

Table F-9
Supply & Storage Analysis for 2nd High West Zone

	Design Demand Year		
Pumping Capacity Analysis	**2025**	**2035**	**2045**
Maximum Day Demand (mgd)[1]	1.14	2.13	3.02
Average Day Demand (mgd)	0.41	0.77	1.09
Existing Firm Supply Capacity (mgd)[2]	2.59	3.74	4.32
Firm Supply and/or Interzone Transfer Capacity Mass Balance (mgd)[3]	**1.45**	**1.61**	**1.31**
Recommended Storage Volume			
Maximum Day Equalization Volume (gallons)[4]	170,000	320,000	450,000
Reserve Storage (1/2 AD)	205,000	385,000	544,000
Fire Protection Volume (gallons)[5]	300,000	300,000	300,000
Recommended Total Volume (gallons)	*495,000*	*803,000*	*1,131,000*
Existing Storage & Pumping Volume			
Surplus Firm Pump Volume (gallons)[6]	180,000	202,000	163,000
No Storage			
Total Existing Volume Available (gallons)	*750,000*	*750,000*	*750,000*
Storage or Pumping Volume Mass Balance (gallons)[3]	**255,000**	**-53,000**	**-381,000**

1. See Table 4-6
2. Assumes addition of booster stations and supply wells
3. A positive value represents a surplus. A negative valve represents a deficiency.
4. Maximum Day Equalization Volume is the projected maximum volume depletion during the peak hours of the maximum day assuming the pumping rate into the service zone is equal to the maximum day demand rate. Typical residential diurnal curves were assumed with a peaking factor of 1.65.
5. Fire Protection storage was calculated based on one fire of 2,500 gpm for 2 hours.
6. Surplus Firm Pump Volume is the difference between maximum day demand and Firm Pumping Capacity which is available to supplement fire protection for 3 hours.

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Table F-10
Pumping Capacity into 2nd High West + Central Zone

Pump Name	Normal Operational Capacity (gpm)	Daily Capacity (MGD)
Windermere 1	1,000	1.44
Windermere 2	1,000	1.44
Well No. 23	800	1.15
Valley Creek 1	1000	1.44
Valley Creek 2	1000	1.44
Total	**4,800**	**6.91**
	Largest Pump	**1.44**
	Firm Capacity (Largest Pump)	**5.47**
Table Notes:		

Source: City Records

Table F11
Supply & Storage Analysis for 2nd High West + Central Zones

	Design Demand Year		
Pumping Capacity Analysis	2025	2035	2045
Maximum Day Demand (mgd)[1]	1.41	2.53	3.52
Average Day Demand (mgd)	0.51	0.91	1.27
Existing Firm Supply Capacity (mgd)[2]	5.47	5.47	5.47
Firm Supply and/or Interzone Transfer Capacity Mass Balance (mgd)[3]	**4.06**	**2.94**	**1.95**
Recommended Storage Volume			
Maximum Day Equalization Volume (gallons)[4]	210,000	380,000	530,000
Reserve Storage (1/2 AD)	255,000	456,000	635,000
Fire Protection Volume (gallons)[5]	300,000	240,000	240,000
Recommended Total Volume (gallons)	*255,000*	*708,000*	*1,161,000*
Existing Storage & Pumping Volume			
Surplus Firm Pump Volume (gallons)[6]	510,000	368,000	244,000
No Storage			
Total Existing Volume Available (gallons)	*1,250,000*	*1,250,000*	*1,250,000*
Storage or Pumping Volume Mass Balance (gallons)[3]	**995,000**	**542,000**	**89,000**

1. See Table 4-6
2. Assumes addition of booster stations and supply wells
3. A positive value represents a surplus. A negative valve represents a deficiency.
4. Maximum Day Equalization Volume is the projected maximum volume depletion during the peak hours of the maximum day assuming the pumping rate into the service zone is equal to the maximum day demand rate. Typical residential diurnal curves were assumed with a peaking factor of 1.65.
5. Fire Protection storage was calculated based on one fire of 2,500 gpm for 2 hours.
6. Surplus Firm Pump Volume is the difference between maximum day demand and Firm Pumping Capacity which is available to supplement fire protection for 3 hours.

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Table F-12
Pumping Capacity into East Zone

Pump Name	Normal Operational Capacity (gpm)	Daily Capacity (MGD)
River View 1	1,000	1.44
River View 2	1,000	1.44
Total	**2,000**	**2.88**
Largest Pump		**1.44**
Firm Capacity (Largest Pump)		**1.44**
Table Notes:		

Source: City Records

Table F-13
Supply & Storage Analysis for East Zone

	Design Demand Year		
Pumping Capacity Analysis	**2025**	**2035**	**2045**
Maximum Day Demand (mgd)[1]	0.23	0.30	0.37
Existing Firm Supply Capacity (mgd)[2]	1.44	1.44	1.44
Firm Supply and/or Interzone Transfer Capacity Mass Balance (mgd)[3]	**1.21**	**1.14**	**1.07**
Recommended Storage Volume			
Maximum Day Equalization Volume (gallons)[4]	30,000	50,000	60,000
Fire Protection Volume (gallons)[5]	180,000	180,000	180,000
Recommended Total Volume (gallons)	*60,000*	*90,000*	*110,000*
Existing Storage & Pumping Volume			
Surplus Firm Pump Volume (gallons)[7]	150,000	140,000	130,000
No Storage			
Total Existing Volume Available (gallons)	*150,000*	*140,000*	*130,000*
Storage or Pumping Volume Mass Balance (gallons)[3]	**90,000**	**50,000**	**20,000**

1. See Table 4-6
2. One pump offline
3. A positive value represents a surplus. A negative valve represents a deficiency.
4. Maximum Day Equalization Volume is the projected maximum volume depletion during the peak hours of the maximum day assuming the pumping rate into the service zone is equal to the maximum day demand rate. Typical residential diurnal curves were assumed with a peaking factor of 1.65.
5. Fire Protection storage was calculated based on one fire of 1,500 gpm for 2 hours.
6. Surplus Firm Pump Volume is the difference between maximum day demand and Firm Pumping Capacity which is available to supplement fire protection for 3 hours.

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We're confident in our ability to balance these requirements.