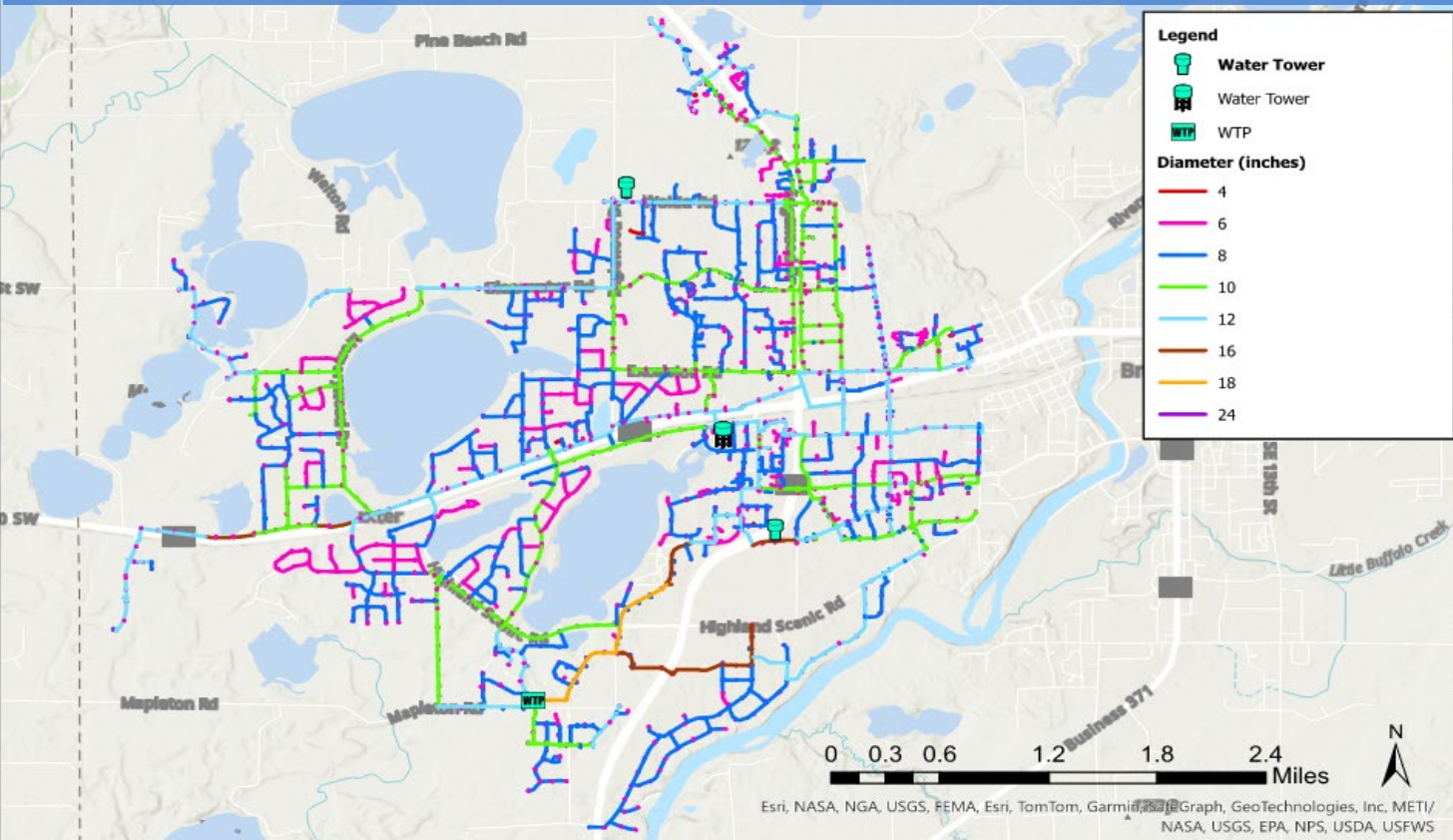


City of Baxter Water System Model, Demand Projections & Planning Update



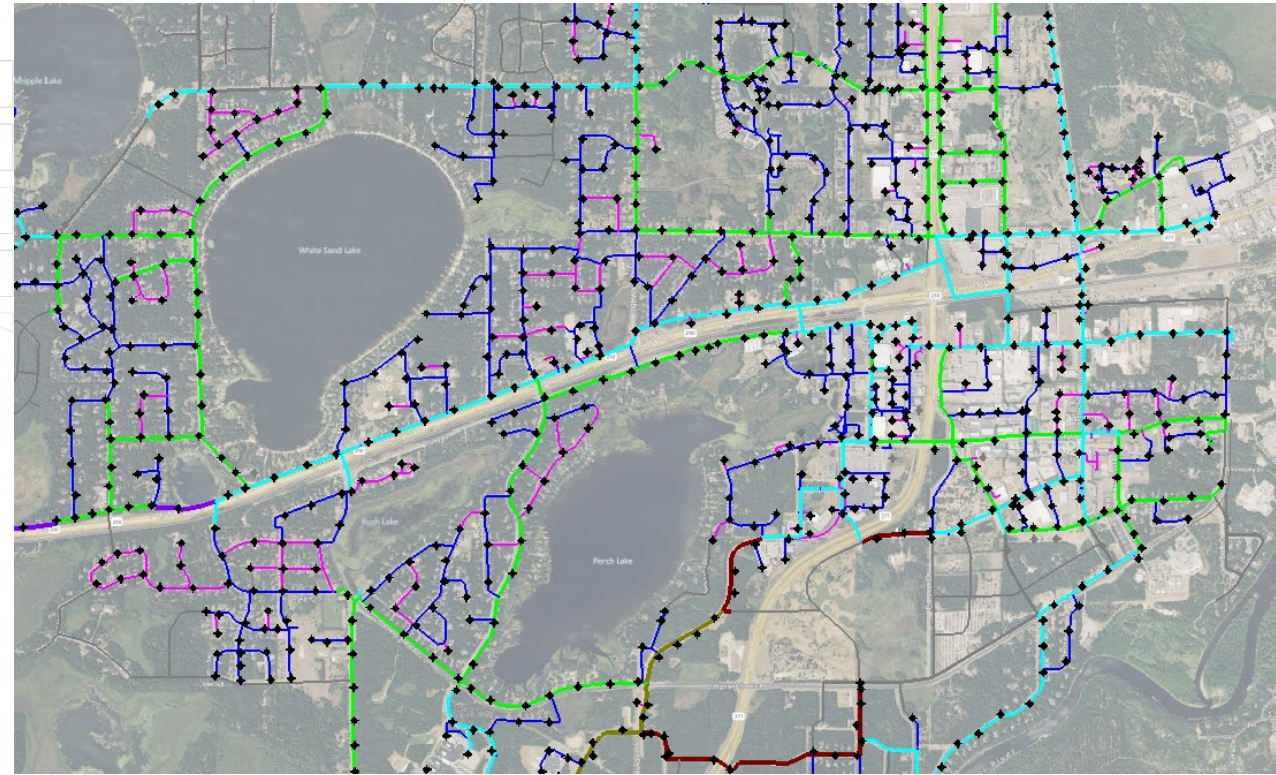
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BAXTER, MINNESOTA |



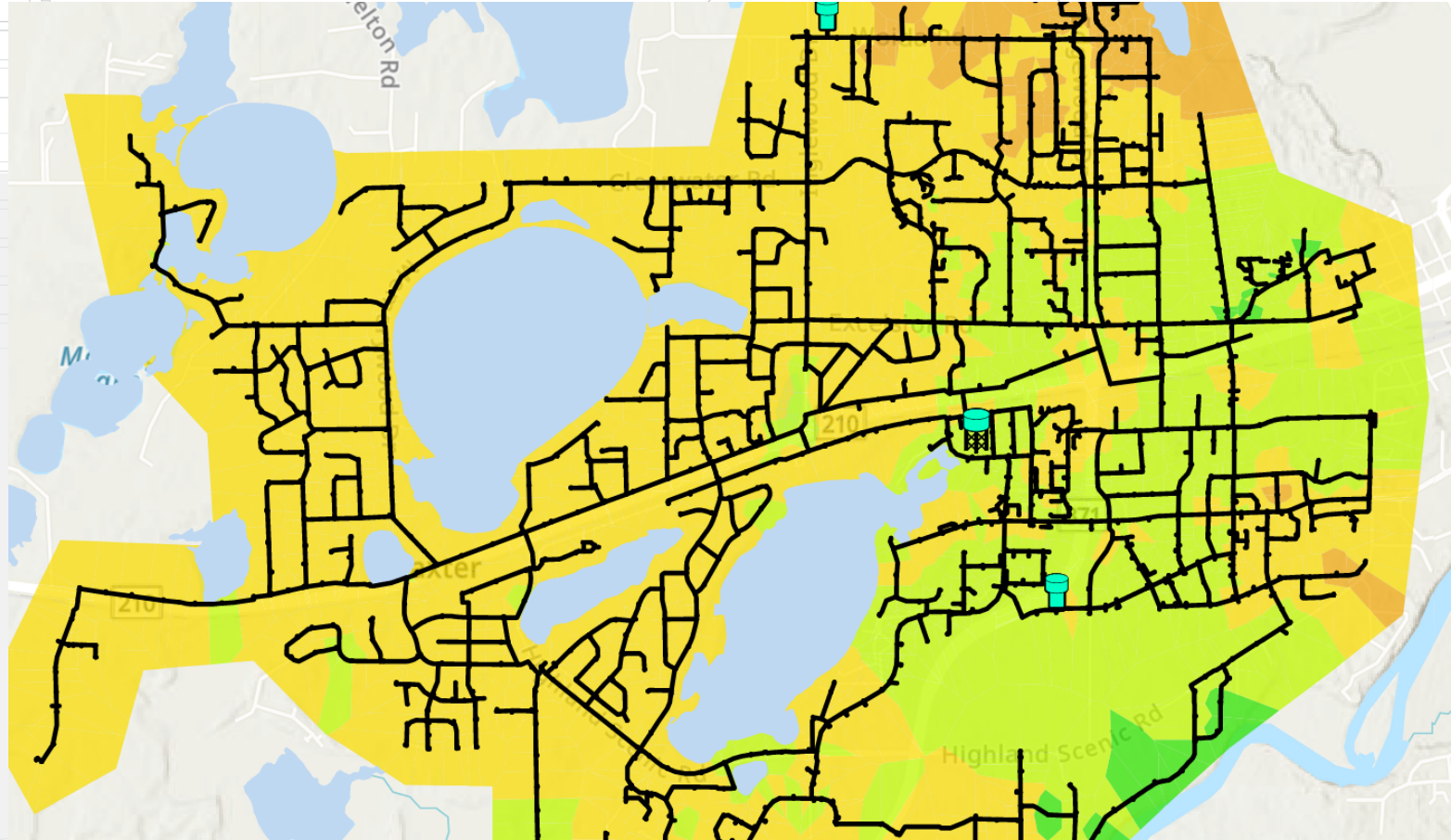
PRIMARY TASKS

- Phase 1: (Water Model Update & Operational Verification)
- Phase 2: Water Demand Analysis and Projections
- Phase 3: TH 210/371 Trunk Water Main Changes - Water System Model Evaluation(s)
- Phase 4: Ultimate Water System Planning Map



RECENT PLANNING EFFORTS

- Capital Asset Management Plan, CAMP (2024)
- Water Supply Planning Report & Model Update (2024)
- Aquifer Study and Well Exploration (2024)
- DNR Water Supply Plan (2017)



EVALUATE

PLAN

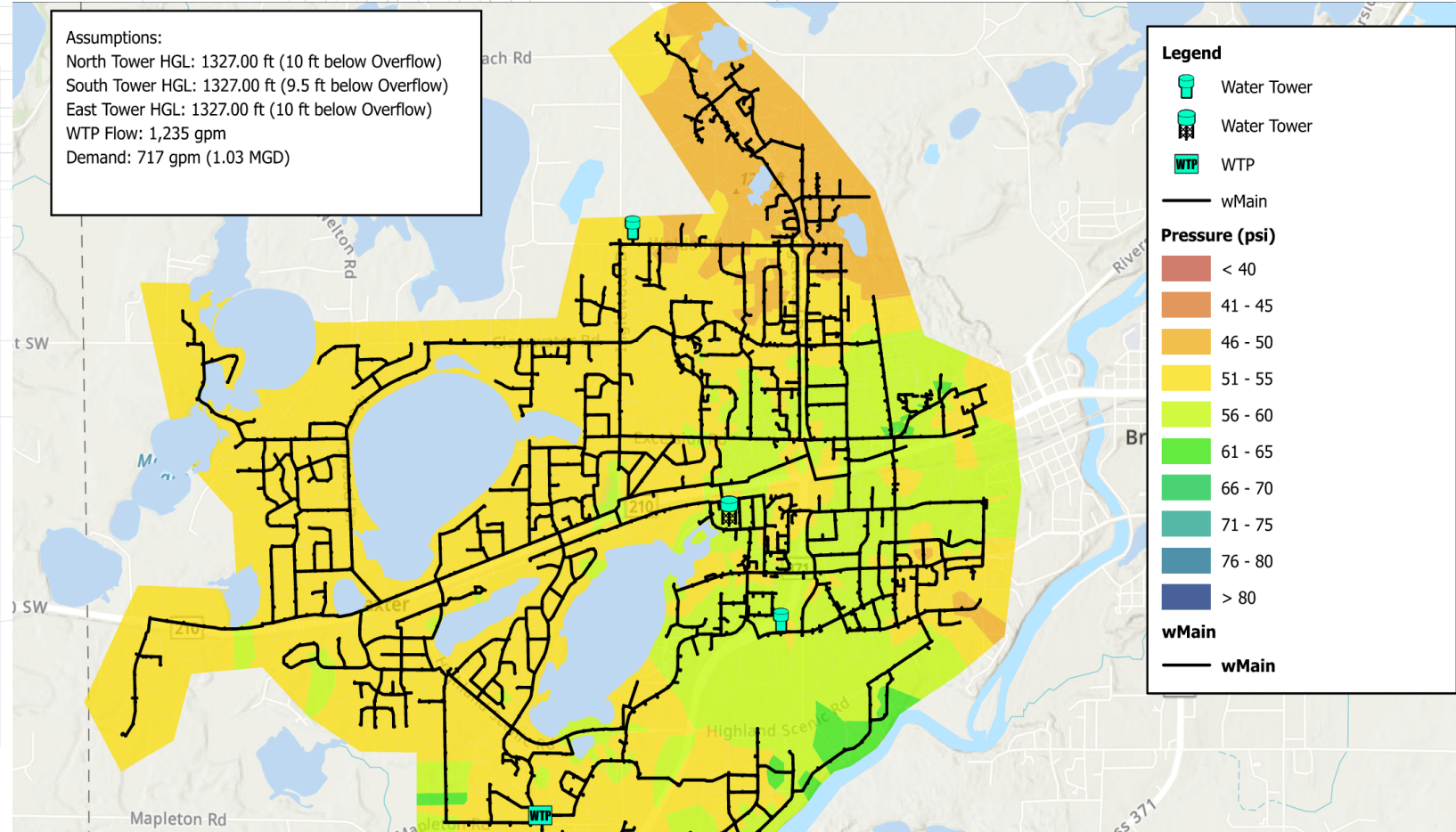
CONSTRUCT

EVALUATE

PLAN

WATER SYSTEM PLANNING

- **Provide Updated Water System Demand Projections:** In conjunction with new population forecasts and land use projections, anticipated water system demand projections can be updated with new supporting data.
- **Update Projected Water System Facility Needs:** As water use forecast changes, the required facilities to support the growth are reviewed and developed to meet the projected need.



HISTORICAL DEMAND

- Steady population growth
- Water use growth
- Excess water use demand in summer
- Annexation or addition of already present customers

Table 8 – Historical Water Use Summary

Year	City Population	Average Day (AD) Water Pumped/Sup. (MGD)	Maximum Day (MD) Water Pumped/Sup. (MGD)	MD:AD Ratio	Estimated Average Summer Day Water Use (MGD)
2005	7,219	0.77	1.13	1.47	1.46
2006	7,594	1.08	0.98	0.90	2.06
2007	7,758	1.09	1.02	0.93	2.07
2008	7,827	1.05	1.05	1.00	2.00
2009	7,921	1.03	2.01	1.96	1.95
2010	7,610	0.93	1.47	1.58	1.77
2011	7,620	0.92	0.93	1.01	1.75
2012	7,661	0.94	1.00	1.06	1.79
2013	7,747	0.97	1.90	1.96	1.84
2014	8,002	0.94	1.90	2.03	1.78
2015	8,065	0.99	1.90	1.92	1.88
2016	8,318	1.05	1.91	1.82	1.99
2017	8,360	1.02	2.11	2.06	1.95
2018	8,478	1.05	2.64	2.52	1.99
2019	8,555	0.97	2.20	2.26	1.85
2020	8,612	0.97	2.06	2.13	1.84
2021	8,911	0.98	2.03	2.06	1.87
2022	9,030	1.00	1.99	1.98	1.91
2023	9,092	1.27	2.87	2.26	2.41
Maximum		1.27	2.87	2.52	2.41

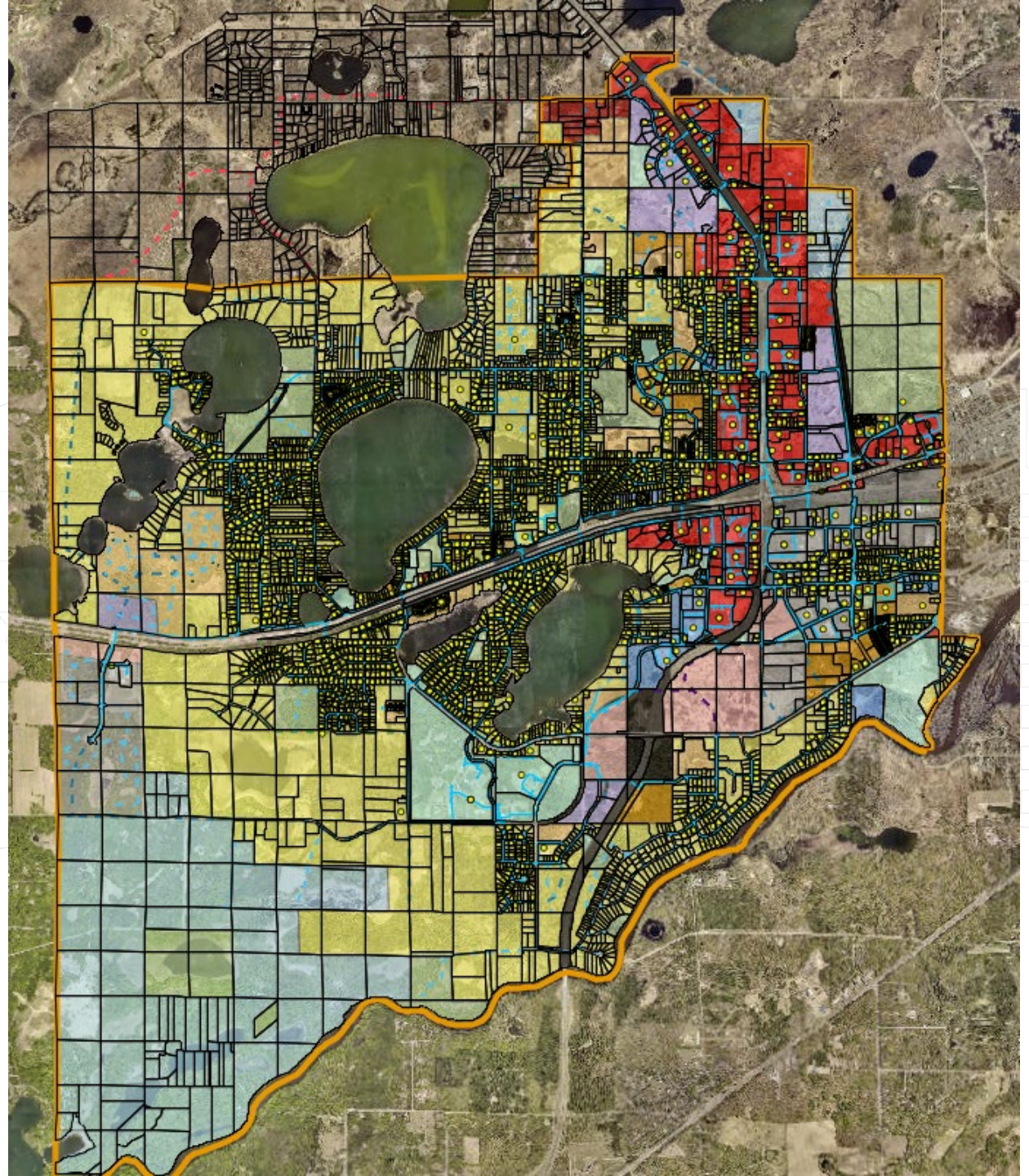
Source: City of Baxter Records

**DEMAND GROWTH LOCATIONS
& LAND USE**

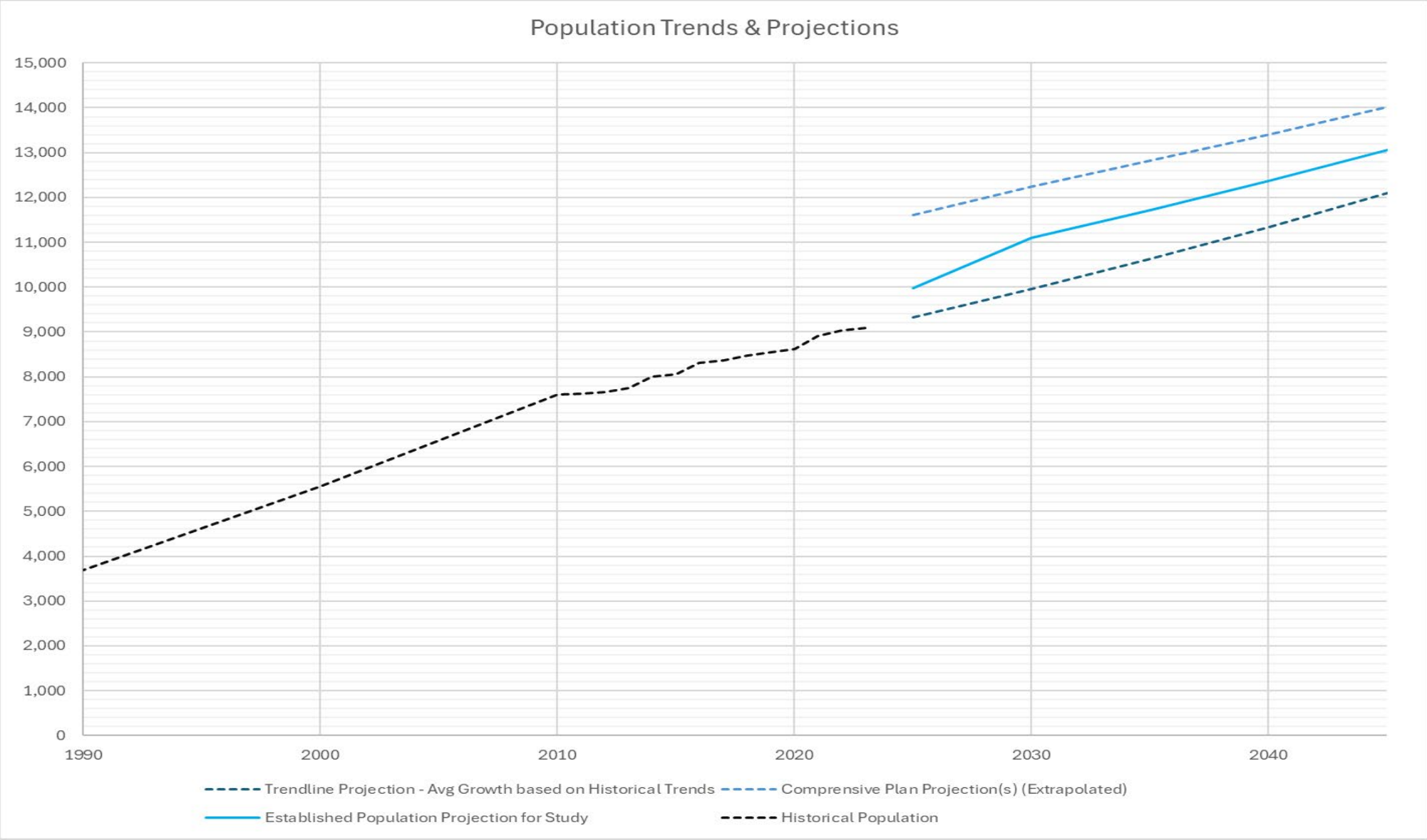
Existing City land Use Planning
Mapping

Historical Water Billing Records

Other Growth Areas

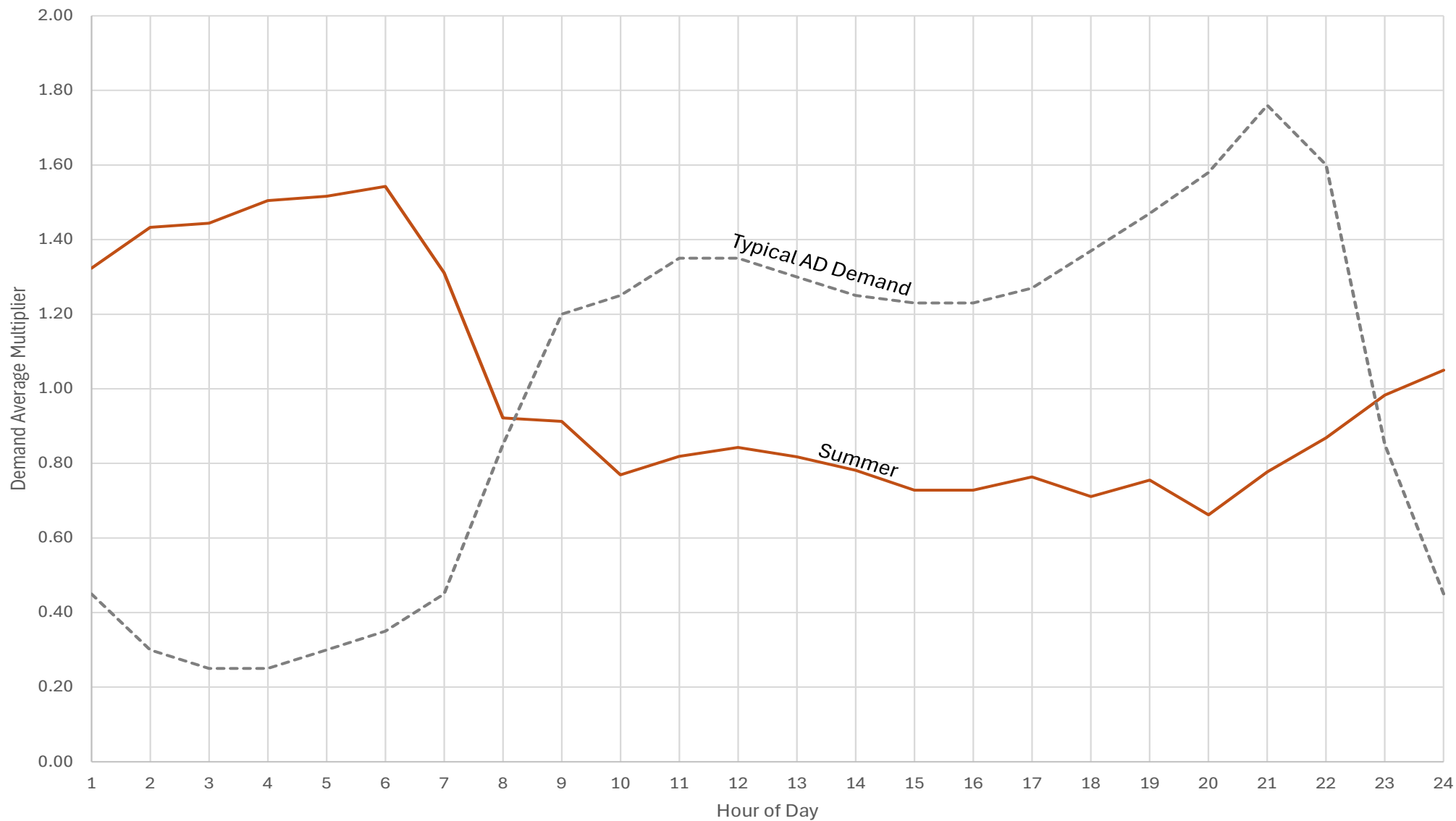


HISTORICAL & PROJECTED POPULATION





Baxter Hourly Diurnal Demand Patterns



— Baxter Summer Demand Pattern

- - - Example AD Demand Pattern (AWWA)

City of Baxter - Estimated Yearly Water Use Projections

Year	Selected Average Population Projection	City Population - Low	Estimated Population Served (Inc. Multi Fam)	% of Population Served	*Estimated Population Served from Res. Conn.	Total Connections	Residential Connections	Average Day (AD) Water Pumped/Sup. (MGD)	Average Summer Day (ASD) Water Pumped/Sup. (MGD)	Maximum Day (MD) Water Pumped/Sup. (MGD)
2024	10,300	9,211	8,300	90%	6,083	3,579	2,433	1.27	2.42	2.88
2025	9,559	9,332	8,642	90%	6,180	3,645	2,472	1.33	2.52	3.00
2026	9,910	9,454	8,990	91%	6,278	3,711	2,511	1.38	2.62	3.12
2027	10,264	9,578	9,341	91%	6,375	3,777	2,550	1.43	2.72	3.24
2028	10,459	9,703	9,550	91%	6,473	3,843	2,589	1.46	2.78	3.31
2029	10,610	9,830	9,719	92%	6,570	3,909	2,628	1.49	2.83	3.37
2030	11,105	9,959	10,207	92%	6,668	3,975	2,667	1.57	2.97	3.54
2031	11,227	10,090	10,346	92%	6,765	4,041	2,706	1.59	3.02	3.59
2032	11,349	10,222	10,487	92%	6,863	4,107	2,745	1.61	3.06	3.64
2033	11,472	10,356	10,630	93%	6,960	4,173	2,784	1.63	3.10	3.69
2034	11,596	10,491	10,774	93%	7,058	4,239	2,823	1.65	3.14	3.73
2035	11,721	10,629	10,920	93%	7,155	4,305	2,862	1.67	3.18	3.79
2036	11,850	10,768	11,063	93%	7,253	4,371	2,901	1.70	3.22	3.84
2037	11,979	10,909	11,208	94%	7,350	4,437	2,940	1.72	3.27	3.89
2038	12,110	11,052	11,354	94%	7,448	4,503	2,979	1.74	3.31	3.94
2039	12,241	11,197	11,502	94%	7,545	4,569	3,018	1.76	3.35	3.99
2040	12,373	11,344	11,651	94%	7,643	4,635	3,057	1.79	3.40	4.04
2041	12,509	11,492	11,797	94%	7,740	4,701	3,096	1.81	3.44	4.09
2042	12,646	11,643	11,946	94%	7,838	4,767	3,135	1.83	3.48	4.14
2043	12,784	11,795	12,095	95%	7,935	4,833	3,174	1.86	3.53	4.19
2044	12,923	11,950	12,246	95%	8,033	4,899	3,213	1.88	3.57	4.25
2045	13,063	12,106	12,398	95%	8,130	4,965	3,252	1.90	3.61	4.30

WATER USE TRENDS & PROJECTIONS – LAND USE BASED

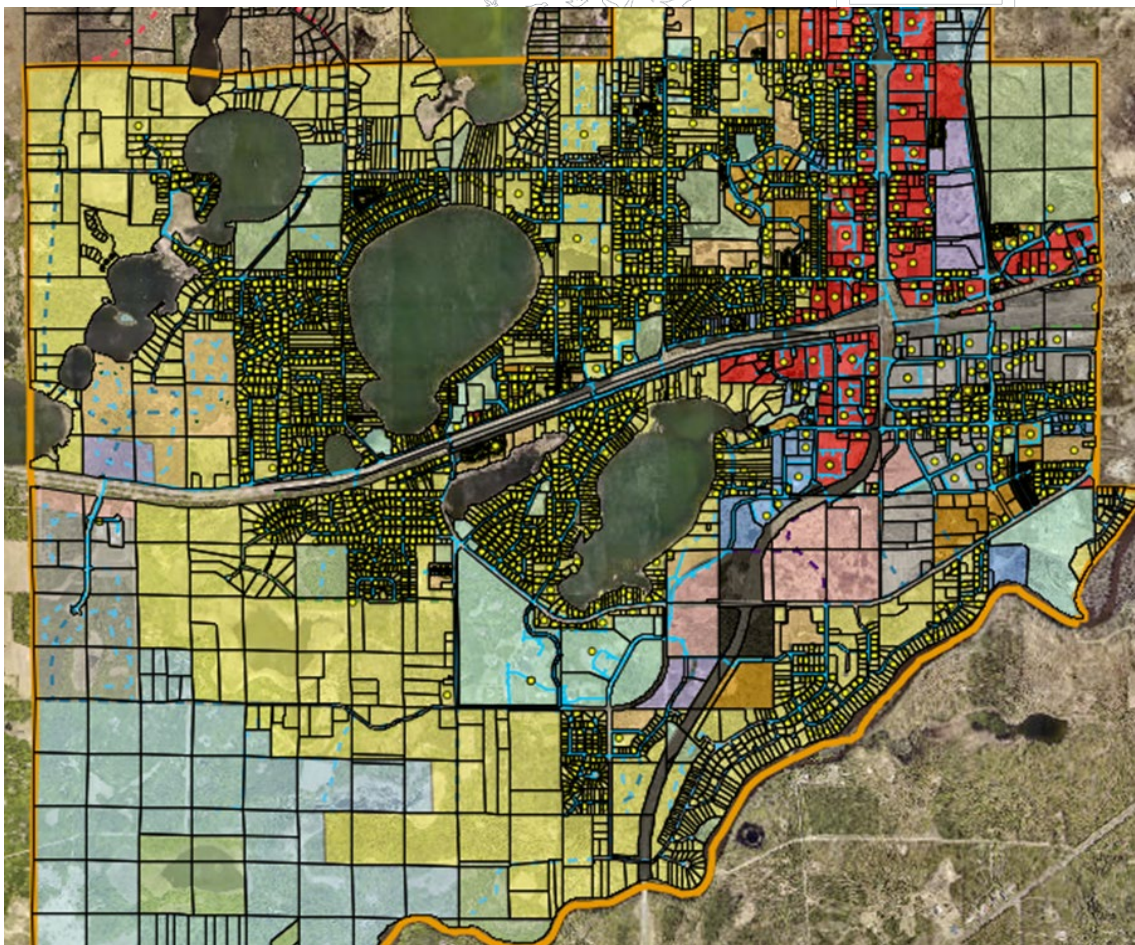


Table 12 – Projected Full Development Ultimate Water Use

Total Ultimate Water Use Potential	Average Day (MGD)	Max Day (MGD)	Avg. Summer Day - ASD (MGD)	Avg. Winter Day - AWD (MGD)
	3.07	6.93	6.05	1.43

Table 10 – Existing Water Use by Land Use Type

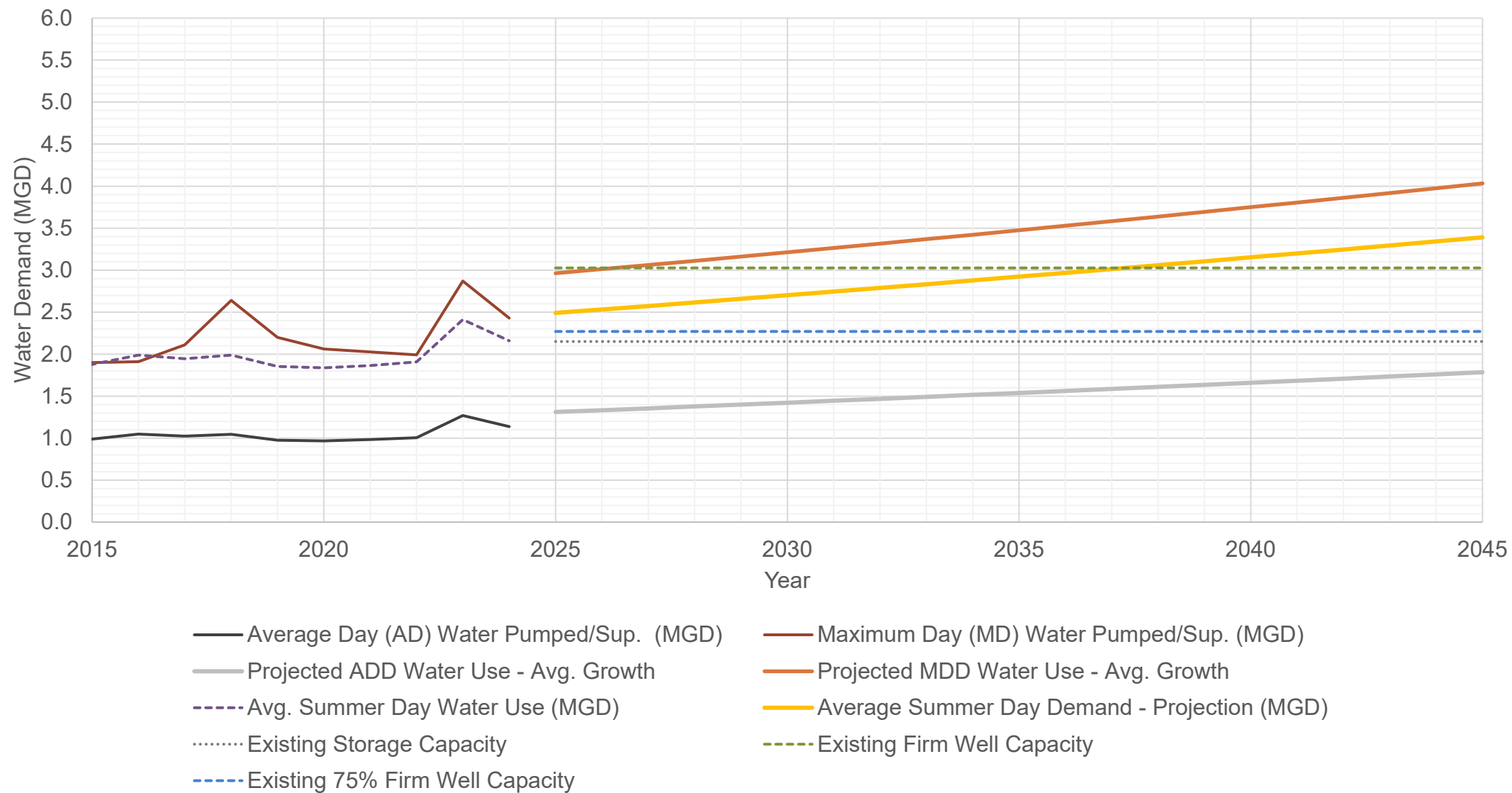
Land Use Type	Existing Acres	ADD/Acre (gpd/acre)	Total ADD (gpd)	ASD/ADD	ASD (gpd)
Business Gateway	2	680	1,561	2.73	4,261
Commercial	487	731	355,679	1.78	633,212
General Industrial	173	337	58,142	2.21	128,366
High Density Residential	112	1226	137,793	1.93	265,684
Medium Density Residential	86	580	49,905	1.94	96,779
Mixed Use	25	1284	32,390	1.98	64,287
Office Service	54	761	40,954	2.30	94,282
Parks	52	73	3,803	2.93	11,160
Public/Semi-Public/Institutional	204	100	20,401	2.72	55,439
Single Family Residential	1612	205	330,257	1.78	588,825
Total	2,808		1,031,000	-	1,942,000

Table 11 – Project Water Use by Land Use Type – Growth Areas

Potential Future Water Use – Future Growth Areas								
Land Use Type	Future Acres	Future Units	ADD/Acre (gpd/acre)	Total ADD (mgd)	ASD/ADD	ASD (gpd)	AWD/ADD	AWD (gpd)
Business Gateway	274	5	836	148,850	2.75	409,000	0.13	20,000
Commercial	437	18	750	213,200	1.80	384,000	0.58	124,000
Commercial Industrial	46	126	1300	39,000	1.95	76,000	0.31	12,000
General Industrial	397	12	1000	258,050	2.20	568,000	0.31	80,000
Single Family Residential - TBD	2106	-	250	341,900	1.78	609,000	0.65	222,000
Single Family Residential - DEV	1090	415	170	120,250	2.00	241,000	0.65	78,000
High Density Residential	138	47	1300	116,350	1.95	227,000	0.52	61,000
Medium Density Residential	434	23	600	169,650	1.96	333,000	0.53	90,000
Mixed Use	257	95	1300	217,100	2.00	434,000	0.53	115,000
Office Service	93	29	800	48,750	2.30	112,000	0.30	15,000
Parks	754	43	75	37,050	3.00	111,000	0.20	7,000
Public/Semi-Public/Institutional	274	82	100	17,550	2.72	48,000	0.23	4,000
UUT - Residential - EC		230	170	-	1.78	-	0.65	-
UUT - Residential - FD	120	-	250	19,500	1.78	35,000	0.65	13,000
UUT - Commercial - Light Industrial	80	-	1000	52,000	1.21	63,000	0.31	16,000
Total				1,799,000	-	3,650,000	-	857,000

WATER USE TRENDS & PROJECTIONS – POPULATION BASED

Historical & Projected Water Use - City of Baxter, MN



WATER SUPPLY & STORAGE NEEDS

- Water Supply & Storage Needs are closely related
- Lack of supply will result in an operational reliance on storage

Table 14 – Water Supply Needs

Pumping Capacity Analysis	Design Demand Period			
	2025	2035	2045	Ultimate
Maximum Day Demand (mgd) ¹	3.00	3.79	4.30	6.93
Average Day Demand (mgd)	1.33	1.67	1.90	3.07
Average Summer Day Demand (mgd)	2.52	3.18	3.61	6.05
Existing Operational Firm Supply Capacity (mgd) ²	2.59	2.59	2.59	2.59
Firm Supply Mass Balance (mgd)³	-0.41	-1.20	-1.71	-4.34

1. Calculation assumes proposed MDD
 2. Based on recommended firm well operational capacity
 3. A positive value represents a surplus. A negative value represents a deficiency.

WATER STORAGE ALLOCATION

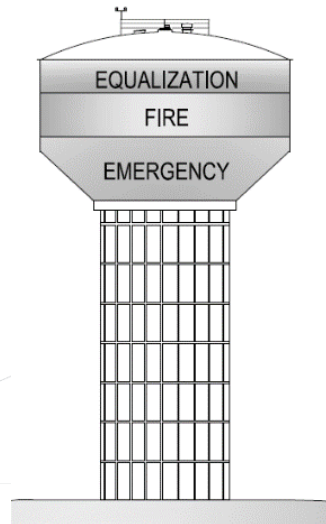


Table 15 – Water Storage Needs Analysis

Pumping Capacity Analysis	Design Demand Period			
	2025	2035	2045	Ultimate
Maximum Day Demand (mgd) ¹	3.00	3.79	4.30	6.93
Average Day Demand (mgd)	1.33	1.67	1.90	3.07
Assumed Firm Supply Capacity (mgd) ²	2.59	4.32	5.18	6.98
Firm Supply Mass Balance (mgd)³	-0.41	0.53	0.88	0.05
Recommended Storage Volume				
Maximum Day Equalization Volume (gallons) ⁴	449,402	567,810	644,692	1,039,713
Reserve Storage (1/2 AD)	663,000	837,000	951,000	1,534,000
Fire Protection Volume (gallons) ⁵	630,000	630,000	630,000	630,000
<i>Requirement 1 Recommended Total Volume (gallons)</i>	<i>1,325,669</i>	<i>1,674,956</i>	<i>1,901,747</i>	<i>3,067,000</i>
<i>Requirement 2 Recommended Total Volume (gallons)</i>	<i>1,742,402</i>	<i>2,034,810</i>	<i>2,225,692</i>	<i>3,203,713</i>
Existing Storage & Pumping Volume				
Surplus Firm Pump Volume (gallons) ⁷	(50,000)	70,000	110,000	10,000
North Water Tower	750,000	750,000	750,000	750,000
South Water Tower	400,000	400,000	400,000	400,000
East Water Tower	1,250,000	1,250,000	1,250,000	1,250,000
<i>Total Existing Volume Available (gallons)</i>	<i>2,350,000</i>	<i>2,470,000</i>	<i>2,510,000</i>	<i>2,410,000</i>
Storage Requirement 1 Mass Balance (gallons)	1,024,331	795,044	608,253	-657,000
Storage Requirement 2 Mass Balance (gallons)	607,598	435,190	284,308	-793,713
Additional Storage Recommended	-	-	*R	*700,000

1. Calculation assumes single zone water system operation

2. Assumed Firm Supply = MDD

3. A positive value represents a surplus. A negative value represents a deficiency.

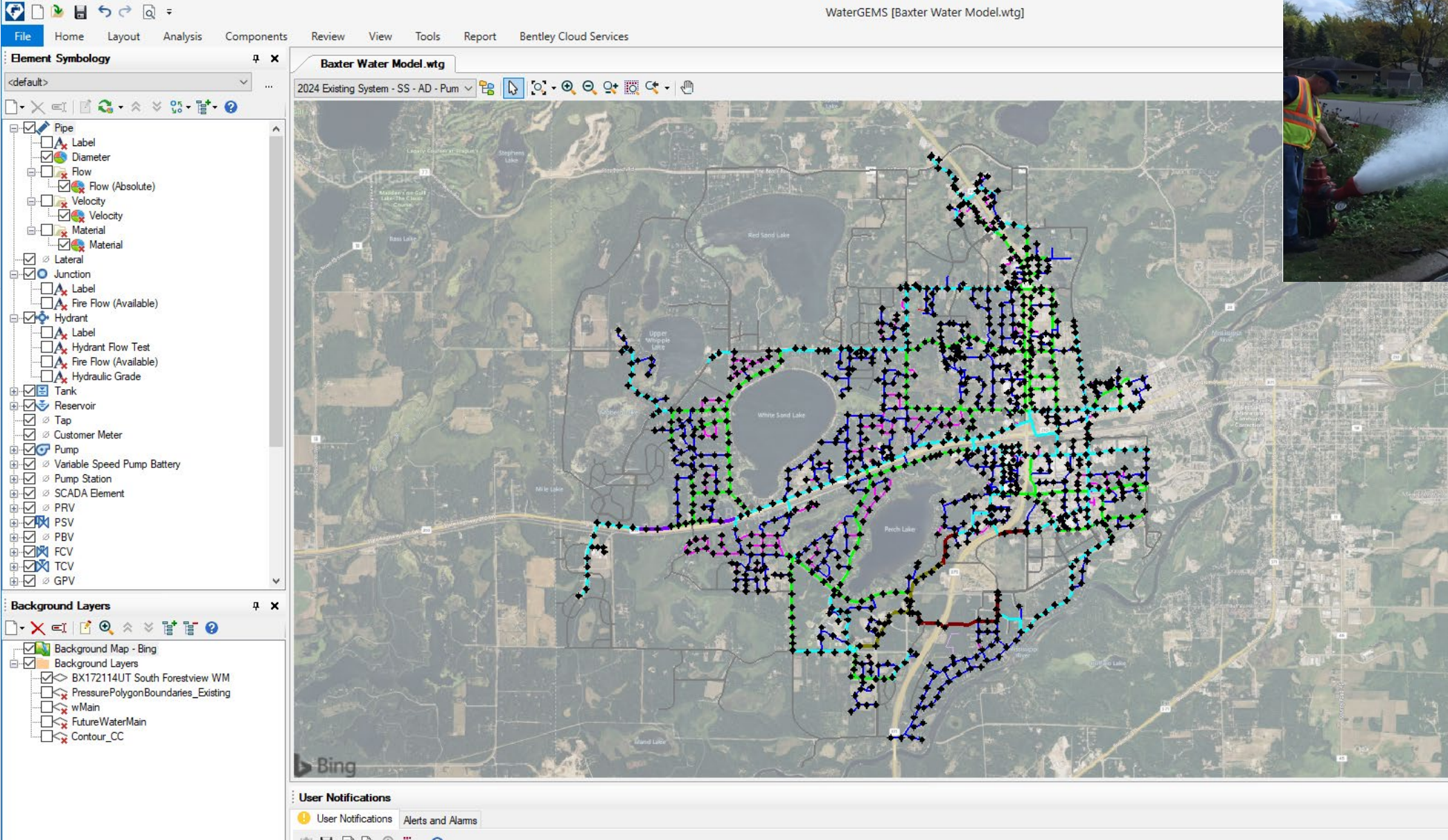
4. Maximum Day Equalization Volume is the projected maximum volume depletion during the peak hours of the maximum day assuming the pumping rate into the service zone is equal to the maximum day demand rate using the Baxter summer diurnal curve

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.

*R. Added storage can occur sooner if capacity of South Tank Replaced

WATER MODEL UPDATE



DEMAND ALLOCATION

Assumptions:

Demand: 1,354 gpm (1.95 MGD)

Legend

 Water Tower

 Water Tower

 WTP

 wMain

ASDD Distribution (gpm)

 0.00 - 0.10

 0.11 - 0.25

 0.26 - 0.50

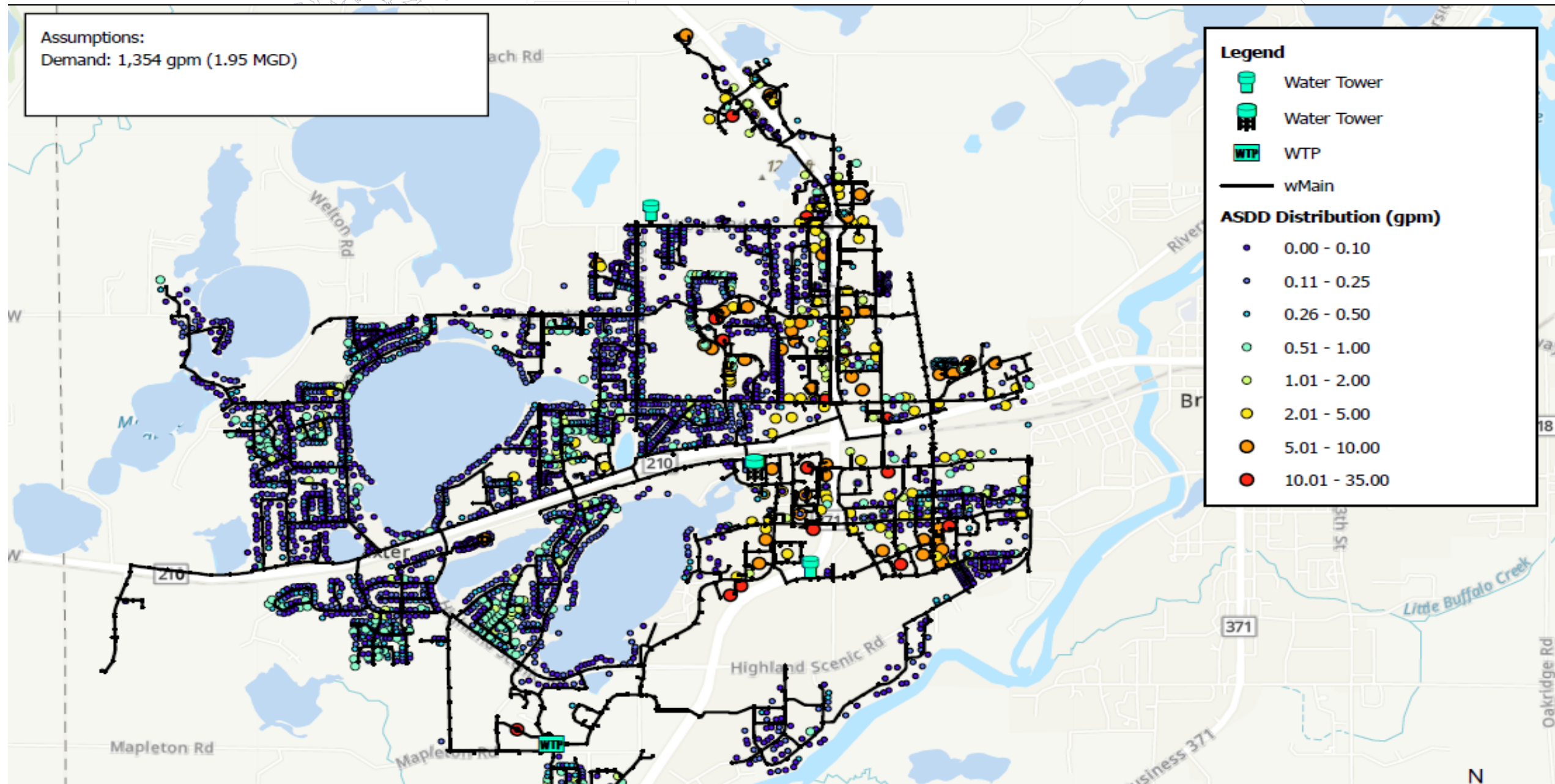
 0.51 - 1.00

 1.01 - 2.00

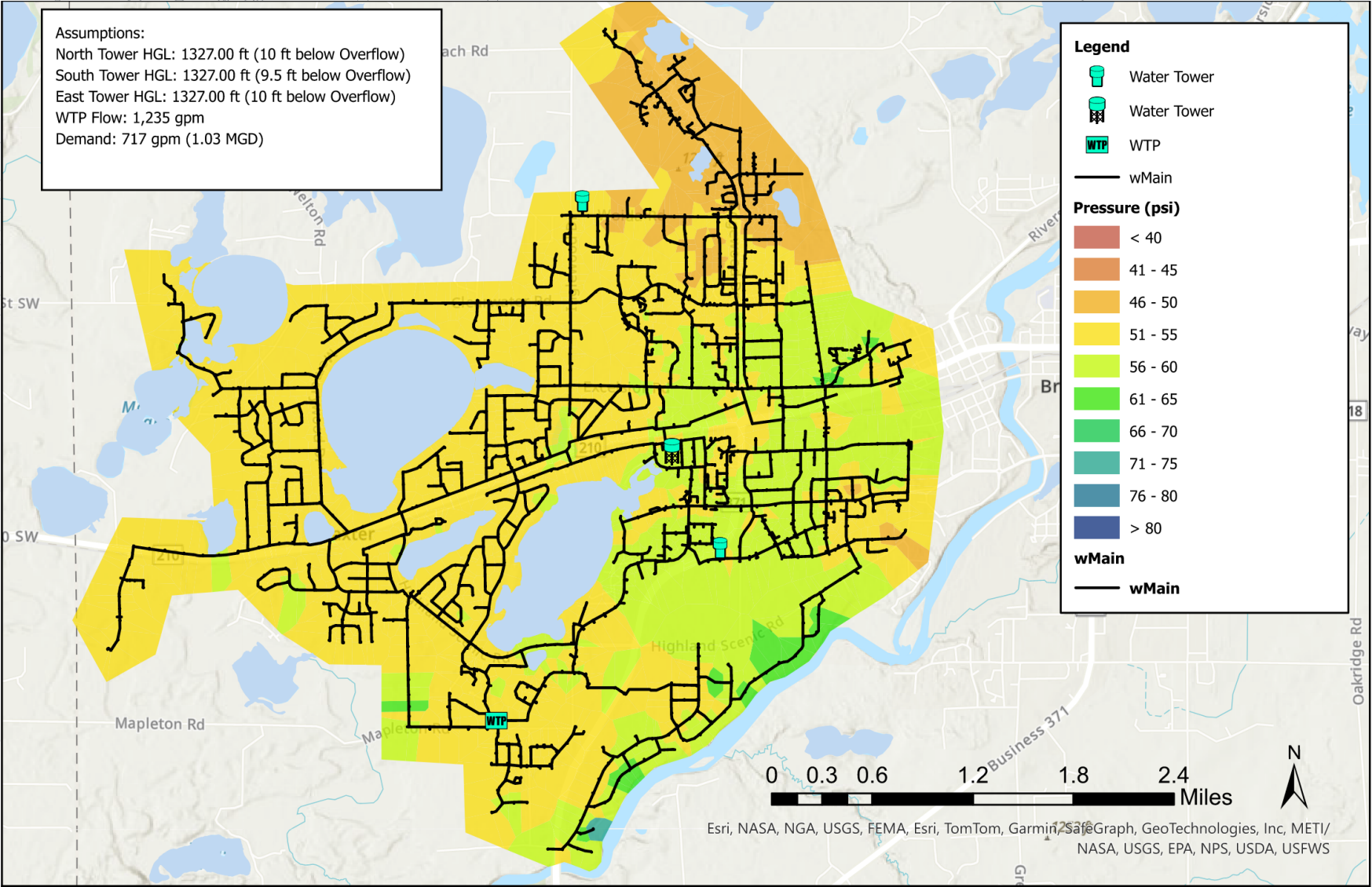
 2.01 - 5.00

 5.01 - 10.00

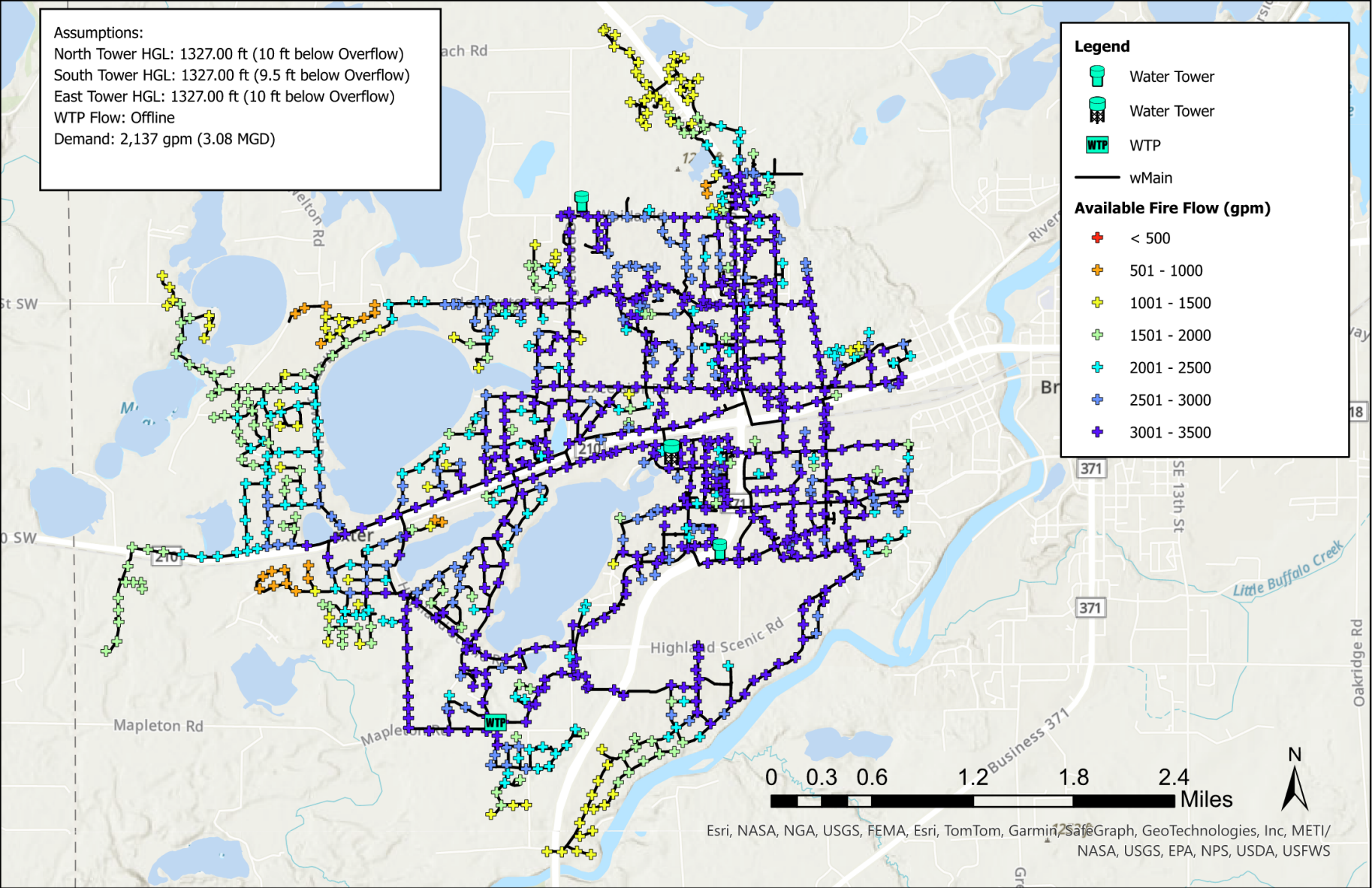
 10.01 - 35.00



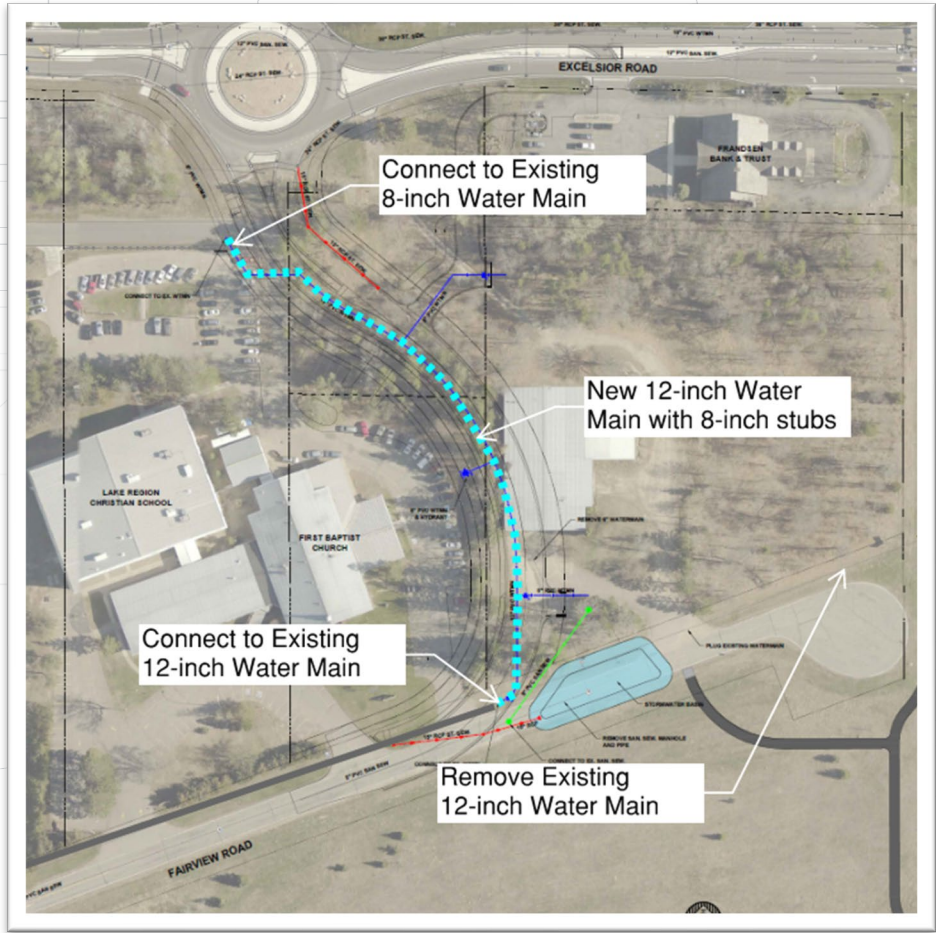
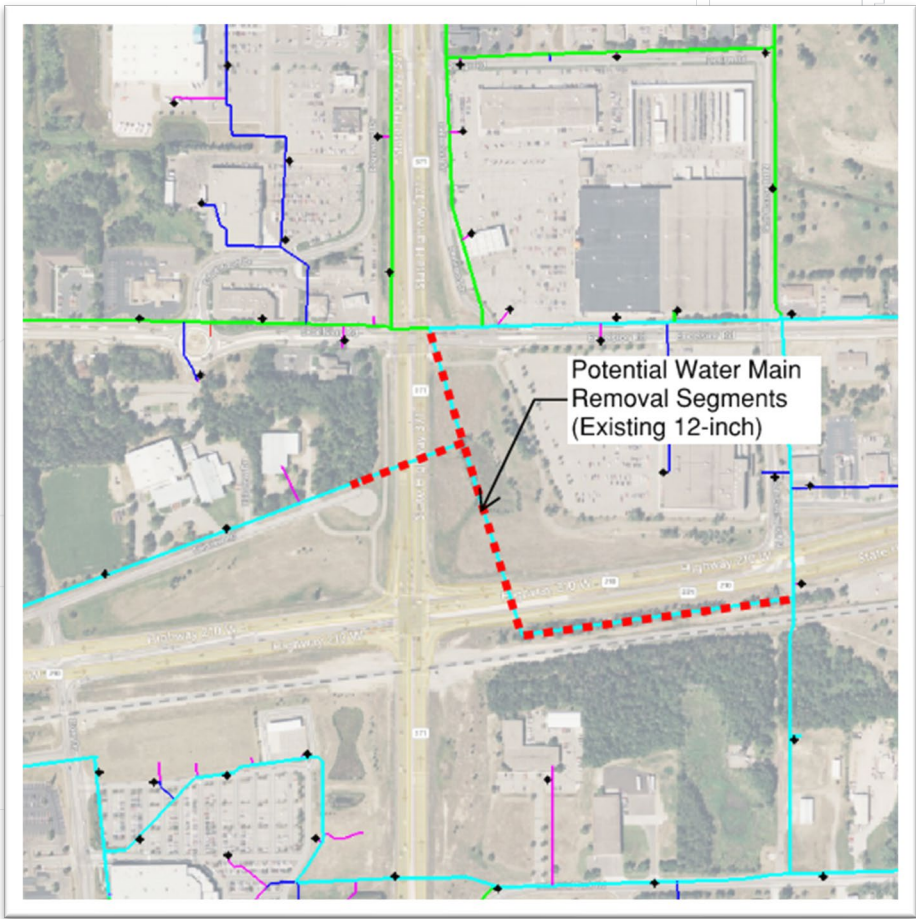
EXAMPLE MODEL ANALYSIS
WATER DISTRIBUTION - PRESSURE



WATER DISTRIBUTION – FIRE FLOW

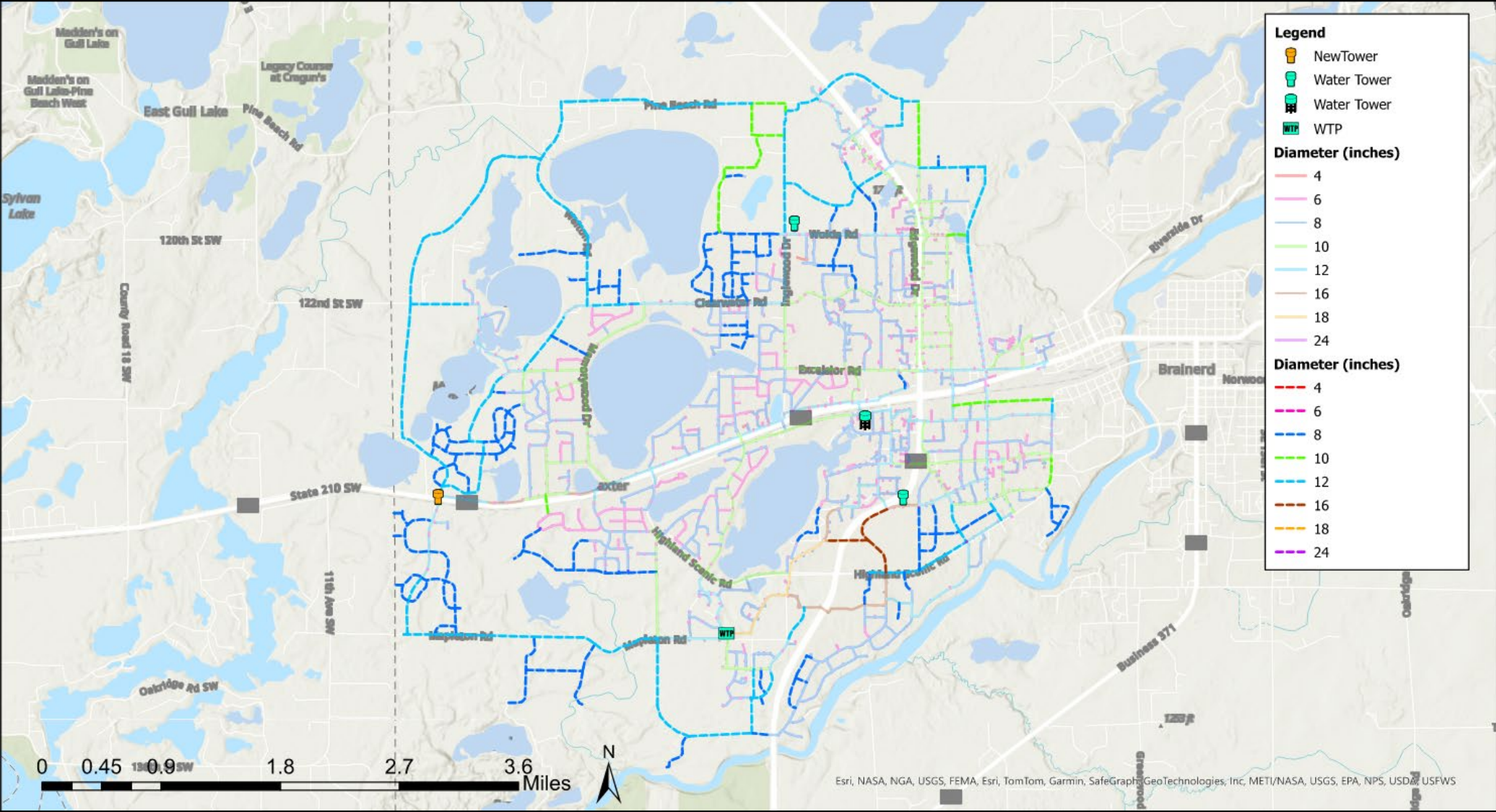


TRUNK HIGHWAY 310/271 WATER MAIN ANALYSIS

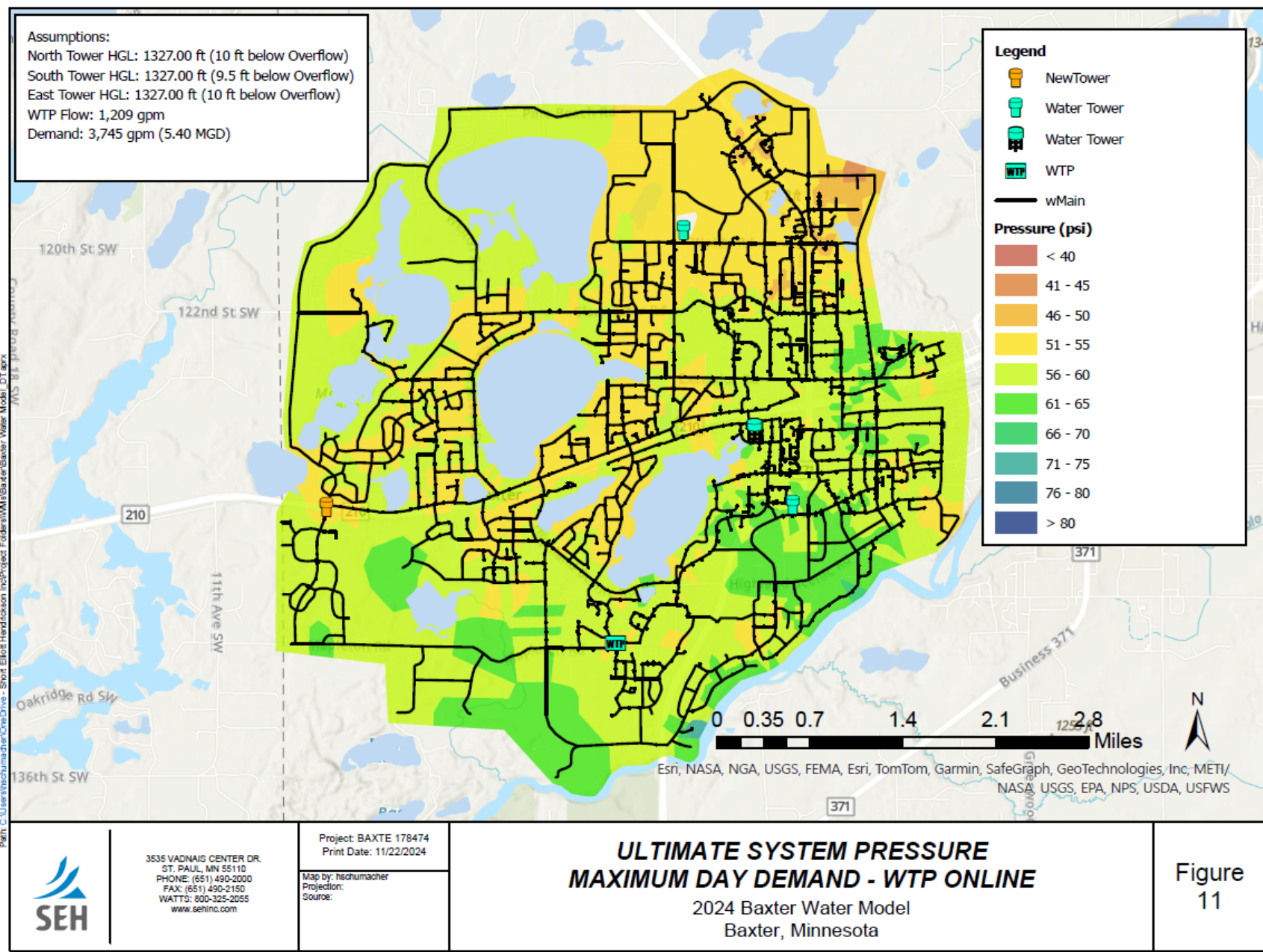




ULTIMATE SYSTEM PLANNING MAP



ULTIMATE WATER SYSTEM - MODEL RESULTS



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PROJECT SUMMARY



- Updated Water System Demand Projections
- Water Model Update
- Water Model System Evaluation
- Ultimate Water System Planning Map
- Water model and other planning tools available for active water system planning

