White Bear Lake Comprehensive Planning Study

Study 4 Stormwater Reuse for Irrigation

Prepared for
Metropolitan Council Environmental Services

Prepared by
Barr Engineering Co.

July 2026

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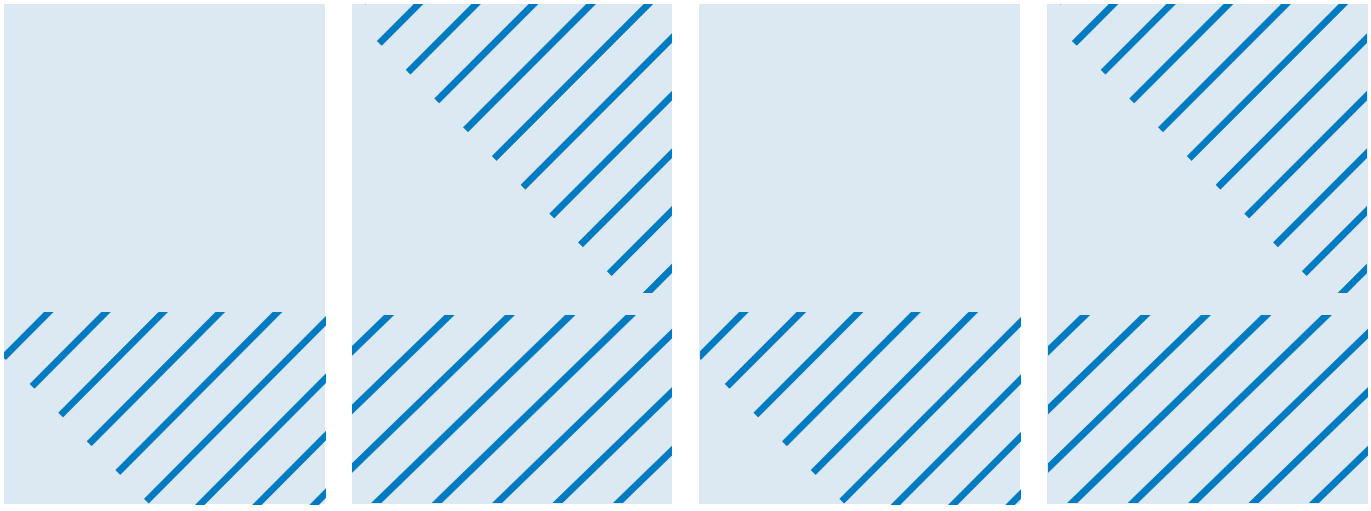


Certification
ENGINEER CERTIFICATION I hereby certify that this report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

Jennifer Koehler
PE #: 47500

07/09/2026
Date

Technical Memorandum

To: Greg Johnson, PE, and Jessica Collin-Pilarski, PE
From: Jennifer Koehler, PE, and Ruth Olson
Subject: White Bear Lake Comprehensive Planning Study 4 – Stormwater Reuse for Irrigation
Date: July 9, 2026
Project: 23621557.00
Cc: Brian LeMon (Barr); Judy Sventek (MCES)

Executive Summary

Barr performed an analysis to estimate the potential for stormwater reuse for irrigation purposes within the communities surrounding White Bear Lake.

Barr compiled a variety of public information and information from the study communities that was used to outline existing and future land uses, identify different land coverages including impervious areas and turf, and to identify and evaluate potential future development areas for stormwater reuse for irrigation purposes in subsequent tasks.

Once all of the datasets were compiled, Barr performed a land use analysis within the study area that was ultimately used to inform the stormwater reuse for irrigation analysis. For consistency in land use classifications, Barr leveraged the existing and future land use dataset from the Met Council for the Twin Cities metro area as currently available, aligning land use types into consistent categories from existing to future conditions. Additionally, we used land cover data from the University of Minnesota to define open water, wetland, and streams areas in both the existing and future land uses as these areas are typically protected by ordinance and rules. Barr developed figures for each community showing the existing and future land uses, along with the defined future development/redevelopment/infill areas based on either the information provided by the communities or developed by the land use analysis if the communities did not provide information and provided those maps to the communities for review and comment.

We used the existing conditions land use datasets generated above, along with the available land cover and impervious datasets, to quantify existing total imperviousness and turf area by land use type. The average total impervious and turf area assumptions were applied to the existing and future land use types to estimate anticipated runoff as well as the estimated irrigation area (turf) in these areas. Additionally, we flagged different land use categories based on whether they would typically be considered candidates for irrigation. This land use analysis was reviewed at a meeting with the communities and was finalized base for the entire study area based on any additional input recieved.

The stormwater reuse analysis was performed to estimate the amount of municipal water that could be offset by incorporating stormwater reuse for irrigation purposes within the future development/redevelopment areas, as well as by retrofitting stormwater reuse projects in existing developed areas. Barr used the following assumptions for this reuse analysis:

- existing land use with retrofits (5% irrigated land uses captured for reuse),
- future land use development/redevelopment (25% of irrigated land uses captured for reuse – in response to comments from communities that it is unlikely to be able to do stormwater reuse at all development sites/locations),
- future land use development/redevelopment (100% of irrigated land uses captured for reuse – maximum use scenario)

These assumptions we used to establish a range in the performance and were reviewed with MCES staff, who were in agreeance with these estimates.

Barr leveraged an existing stormwater reuse calculator from the Mississippi Watershed Management Organization (MWMO) to help inform this analysis of runoff, storage, and irrigation demand and estimate the optimal storage for reuse by the community. Using the existing and future land areas by community to inform watershed characteristics and irrigation areas, along with low (0.2" per week) and high (0.8" per week) irrigation rates based on actual data to reflect the variability in the range in reuse from year to year. Using the calculator results, we identified the optimized storage for each community and the volume of stormwater runoff that could be captured for reuse for irrigation purposes. Additionally, we summarized the available MPARS groundwater users for non-agricultural irrigation within the study area communities.

The total range in the potential stormwater reuse for irrigation purposes (in MGD) along with the MPARS usage is summarized in Table EX-1.

Table EX-1 Summary of Future Water Demands and Range in Estimated Stormwater Reuse for Irrigation (MGD)

	Range in Estimated Stormwater Reuse for Irrigation (MGD)
Total Stormwater Reuse Volume for Irrigation	2.9 - 35.4
Potential Additional Offset of Groundwater based on MPARS Permits	0.5 - 4.2

Using data provided by MCES for 2050 and Ultimate water demands for the communities along with average summer peaking factors, we estimated the low and high average peak summer daily demands to help understand how much of the anticipated demand could be offset by stormwater reuse.

Table EX-2 Future Peak Summer Water Demand Summary

	2050 Average Peak Summary Daily Usage – Low (MGD)	2050 Average Peak Summary Daily Usage – High (MGD)	Ultimate Average Peak Summary Daily Usage – Low (MGD)	Ultimate Average Peak Summary Daily Usage – High (MGD)
Total Usage	48.8	66.9	58.1	80.2

Based on this comparison, we estimated that:

- Retrofits in Existing Land Use and implementation in 25% of the future development/redevelopment areas with irrigatable land would be able to supply up to 10-15% of ultimate peak summer demand
- Retrofits in Existing Land Use and implementation in 100% of the future development/redevelopment areas with irrigatable land would be able to supply up to 45-60% of ultimate peak summer demand

Barr developed planning-level cost estimates based on recently bid stormwater reuse projects and extrapolated costs on a per unit basis to be applied to the anticipated number of reuse systems. The capital costs include engineering and design along with the construction costs of a reuse system. Cost ranges assumed with and without treatment and storage. The assumptions for future development and redevelopment areas are that irrigation system and storage costs are not part of the reuse system costs as they would be part of the development cost regardless of reuse. For retrofits, we assumed that some systems (50%) would not require storage, while the other half would require subsurface (25%) or surface (25%) storage. Annual operations and maintenance costs were also estimated for each scenario. The range in the total estimated costs for the reuse systems is summarized in Table EX-3.

Table EX-3 Estimated Reuse System Costs

Scenario	Number of Reuse Systems	Demand Met by Stormwater Reuse (MGD)	Estimated Capital Cost Range	Annual O&M Cost Range
Existing Land with Retrofits (5%)	36	0.1 - 0.4	$31.8 - $38.8 Million	$209,000 - $238,000
Future Development Area (25%)	650	2.8 - 8.7	$308.1 - $385.5 Million	$3.2 - $4.9 Million
Future Development Area (100%)	2182	11.2 – 35.0	$1,219.6 - $1,525.8 Million	$12.6 - $14.7 Million
Total Cost (25%)			$339.6 – $424.3 Million	$3.4 – $5.1 Million
Total Cost (100%)			$916.5 – $1,145.6 Million	$12.8 – $14.9 Million

1 Background

The Minnesota legislature provided funding for the Metropolitan Council (Met Council) to form a work group to develop a comprehensive plan to help ensure that communities in the White Bear Lake area have access to sufficient drinking water to allow for municipal growth while also ensuring the sustainability of surface and groundwater resources to supply the needs of future generations. The completed plan must be submitted to the Minnesota Legislature by June 30, 2027. Met Council has established a work group consisting of the following members:

- Commissioners or designees from the Minnesota Department of Natural Resources (DNR), Minnesota Department of Health (MDH), and Minnesota Pollution Control Agency (MPCA)
- Representatives from Metropolitan Area Water Supply Advisory Committee (MAWSAC) and Saint Paul Regional Water Services (SPRWS)
- The communities of Stillwater, Mahtomedi, Hugo, Lake Elmo, Lino Lakes, North St. Paul, Oakdale, Vadnais Heights, Shoreview, Woodbury, New Brighton, White Bear Lake, White Bear Township, and North Oaks

The consulting firms of Barr Engineering Co., Kimley-Horn, and Short Elliott Henderson (SEH) received master contracts for Water Supply Studies and Technical Analyses for White Bear Lake Area Comprehensive Plan (Contract Number 24P056). The consulting firm Hazen and Sawyer received a master contract for the Financial Analyses for White Bear Lake Area Comprehensive Plan (Contract Number 24P055).

The Comprehensive Plan shall evaluate the following water conservation methods as stated in the legislation:

1. Converting water supplies that are groundwater dependent to total or partial supplies from surface water
2. Reuse water, including water discharged from contaminated wells
3. Projects designed to increase groundwater recharge
4. Other methods for reducing groundwater use

For Category No. 2, reuse water, the work group identified the following three potential solutions to further evaluate for this area of legislation.

1. Reuse of treated wastewater from local Met Council interceptors for industrial and agricultural users
2. Stormwater reuse for irrigation
3. Reuse water discharged from contaminated wells – MPCA Project 1007

The scope of work for Study 4 includes the evaluation of Potential Solution No. 2 – Stormwater reuse for irrigation.

Barr performed an analysis to estimate the potential for stormwater reuse for irrigation purposes within the communities surrounding White Bear Lake. Figure 1 shows the study area. The focus of the evaluation was to leverage future land use information for remaining developable areas with the communities to estimate the potential water savings of using stormwater for irrigation to offset the use of potable water. Future development areas have the greatest potential for stormwater reuse, where stormwater management and reuse can be integrated from the outset, making implementation more cost-effective. Additionally, we used existing land use data to estimate the potential for retrofitting stormwater reuse within existing development areas within the White Bear Lake communities. Finally, we looked at the potential amount of groundwater that could be conserved if current water appropriations permits using groundwater for non-agricultural irrigation purposes were stormwater reuse in the communities.

Lino Lakes
Hugo
White Bear Lake Township
North Oaks
Shoreview
New Brighton
Vadnais Heights
White Bear Lake
Mahtomedi
Stillwater
North Saint Paul
Oakdale
Lake Elmo
Woodbury
St Paul
Forest Blvd
Highway 10
Maplewood Dr
Highway 36 W
State Highway 280
Lafayette Fwy
US Highway 10
US Highway 52
Highway 62
Highway 55
Courthouse Blvd
Point Douglas Dr S
Cedar Ave

Municipal Boundary

Future Land Use Category*

- Agricultural
- Undeveloped
- Farmstead/Rural Residential
- Single Family Detached
- Single Family Attached
- Manufactured Housing Park
- Multifamily
- Mixed Use Residential
- Retail and Other Commercial
- Mixed Use Commercial
- Industrial or Utility
- Mixed Use Industrial
- Institutional
- Office
- Open Water
- Park, Recreational, Preserve, or Golf Course
- Major Highway
- Major Railway
- Airport

*Future Land Use categories are recategorized from Met Council Regional Planned Land Use data and data provided by cities/townships.

0 6,000 12,000
Feet

Study Area
MCES Study 4

FIGURE 1

METROPOLITAN COUNCIL

BARR

2 Task 1: Data Collection

Barr compiled a variety of public information that was used to outline existing and future land use and to identify and evaluate potential future development areas for stormwater reuse for irrigation purposes in subsequent tasks. This included the following datasets:

- Current parcel data as available from the counties
- Municipal Boundary
- Metropolitan Urban Service Area (MUSA) boundary from Met Council and as provided by member communities
- Met Council existing and future land use data
- Existing and future/ultimate land use and developable area datasets (in GIS format) from White Bear Lake communities, as provided by the communities
- Guidelines or standards by White Bear Lake communities summarizing anticipated imperviousness by land use type – provided by the communities
- Other information the communities provided related to the identification and evaluation of future development areas/remaining developable land in the communities (GIS format)
- 2015 University of Minnesota (U of MN) Land Cover and Impervious Coverage Data
- 2021 Ramsey County Impervious Coverage Data
- Irrigation rates from previous stormwater reuse projects for irrigation to establish range of weekly irrigation rates (City of Hugo)
- Current MPARS water appropriations data related to existing high groundwater users for non-agricultural irrigation
- Actual and projected community water demands, using existing water demand and projected water demand for 2050 and ultimate conditions, as developed and provided by MCES
- Reuse system construction costs based on recently bid projects and annual O&M costs as available from previous projects, or if provided by communities in the study area.

Barr sent a data request to the study area communities. Community responses are provided in Table 1. The community data, in addition to the publicly available datasets, was utilized to develop a working GIS basemap that was used for Task 2.

Table 1 Community Responses to Data Request

Cities	Redevelopment Area Source	Other Studies/Information Provided
Hugo	GIS shapefile provided by community, MCES Study, additional community input	Stormwater reuse figure, stormwater reuse meter readings, updated MUSA boundary
Lake Elmo	2040 Comprehensive Plan	Maximum imperviousness by land use type data
Lino Lakes	2040 Comprehensive Plan, additional community input	Maximum imperviousness by land use type data
Mahtomedi	GIS shapefile provided by community, additional community input	Maximum imperviousness by land use type data
New Brighton	2040 Comprehensive Plan	
North Oaks	2040 Comprehensive Plan	
North St. Paul	2040 Comprehensive Plan	Maximum imperviousness by land use type data
Oakdale	GIS shapefile provided by community, additional community input	Maximum imperviousness by land use type data
Shoreview	GIS Shapefile	Maximum imperviousness by land use type data
Stillwater	2040 Comprehensive Plan	
Vadnais Heights	GIS shapefile provided by community, additional community input	
White Bear Lake	GIS shapefile provided by community, additional community input	Maximum imperviousness by land use type data
White Bear Township	Parcel IDs, additional community input	Maximum imperviousness by land use type data
Woodbury	2040 Comprehensive Plan	

3 Task 2: Land Use Analysis

Once all of the datasets were compiled, Barr performed a land use analysis within the study area that was used to inform the stormwater reuse for irrigation analysis.

For consistency in land use classifications, Barr leveraged the existing and future land use dataset from the Met Council for the Twin Cities metro area as currently available, aligning land use types into consistent categories from existing to future conditions. These land use datasets were overlayed with the open water, wetland, and stream classification data available from the 2015 U of MN land cover datasets to flag areas that are typically protected by ordinance/regulation and will not be expected to be developed in the future. Additionally, Barr performed a high-level review of future land use datasets and development guidelines as available and provided by the communities to generally confirm that the Met Council future land use reflects the future land use types still anticipated by the communities.

Barr requested that the communities provide GIS/spatial data identifying areas of remaining developable land within each community. If this data was not available or provided, differences between the modified Met Council existing and future land use data sets were used to flag where there are anticipated changes in land use. Land use changes were not reviewed on an individual parcel basis but rather targeting larger areas of expected development or redevelopment.

Barr developed figures for each community showing the existing and future land uses, along with the defined future development/redevelopment/infill areas based on either the information provided by the communities or developed by the land use analysis if the communities did not provide information. These figures were provided to communities for review and input to confirm the anticipated land use and development/redevelopment areas.

Barr had virtual calls with communities that had questions or wanted to further discuss the request for information. Additionally, we hosted a virtual review meeting that was open to all communities, which provided an overview of the study, reviewed the land use analysis, and discussed any questions or comments. Communities that provided additional input at this stage are identified in Table 1 (see column 2). We finalized the existing and future land use and future development and redevelopment areas based on the input from the communities. The slides from the meeting with the communities are included as Attachment 1. The final land use and development/redevelopment area figures for each community are included in Attachment 2. Also shown on these figures is the MUSA boundary as available from Met Council or as provided by the communities.

We used the existing conditions land use dataset generated above, along with the available land cover and impervious datasets (available from the U of MN and Ramsey County), to quantify existing total imperviousness and turf area by land use type as percentages of the land use area (see Table 2). These impervious percentages by land use generally aligned with development guidance or standards provided by the communities; thus, we took an average of these values to be applied across all study area communities for the corresponding land use types. The average total impervious and turf area assumptions were applied to the existing and future land use types to estimate anticipated runoff, as well as the estimated irrigation area (turf) in these future development areas. Additionally, we flagged different land use categories based on whether they would typically be considered candidates for stormwater reuse for irrigation. This information was also reviewed with the communities as part of the land use and future development review process. This is also included in Table 2.

This land use dataset was generated for the total project area, with a focus on the future development areas. The anticipated future development area land use, by municipality, and by area within the MUSA is summarized in Table 3 as inputs to the stormwater reuse analysis. This table only focuses on land uses that are assumed to have irrigation associated with them and does not include land area for those that typically do not include irrigation.

Table 2 Imperviousness and Turf Analysis Based on Existing Conditions/Land Use Category

MCES Existing Land Use Category	UMN (2015)	Ramsey County (2021)	Community Provided (Maximum Allowed)	Imperviousness for MCES Study 4	Turf – UMN (2015)	Stormwater Reuse Irrigation Status
Agricultural	5.1%	8.5%	25%	***6.8%***	34.4%	No
Airport or Airstrip	5.7%	4.8%		***5.2%***	66.8%	No
Extractive	33.5%	72.4%		***53.0%***	32.4%	No
Farmstead/Rural Residential	26.2%	6.2%	15%	***16.2%***	33.8%	No
Industrial or Utility	59.4%	60.0%	75%	***59.7%***	18.4%	Yes
Institutional	38.6%	38.2%	65%	***38.4%***	35.0%	Yes
Major Highway	47.5%	40.6%		***44.1%***	38.3%	No
Major Railway	38.6%	4.7%		***21.6%***	28.1%	No
Manufactured Housing Park	39.0%	28.5%		***33.8%***	22.5%	No
Mixed Use Commercial	77.0%	70.2%	80%	***73.6%***	12.2%	Yes
Mixed Use Industrial	68.7%	64.1%		***66.4%***	14.6%	Yes
Mixed Use Residential	67.1%	56.4%	75%	***61.7%***	11.0%	Yes
Multifamily	50.9%	36.4%	75%	***43.7%***	21.6%	Yes
Office	60.2%	59.8%	90%	***60.0%***	21.5%	Yes
Park, Recreational, Preserve, or Golf Course	6.9%	8.1%	30%	***7.5%***	28.0%	Yes
Retail and Other Commercial	71.7%	71.6%	80%	***71.6%***	14.9%	Yes
Seasonal/Vacation	45.7%	13.0%		***29.4%***	11.6%	Yes
Single Family Attached	45.7%	26.9%	65%	***36.3%***	25.4%	Yes
Single Family Detached	23.7%	19.4%	65%	***21.5%***	26.7%	Yes
Undeveloped	4.1%	8.2%		***6.1%***	24.8%	No

Table 3 Land Use Summarized by Community Potentially Available for Stormwater Reuse for Irrigation

Community	Summary Area	Total Area[1] (ac)	Total Area within MUSA Boundary (ac (%))[1]	Total Impervious Area[1] (ac)	Percent Impervious[1]	Irrigated Area[1] (ac)	Primary Soil Type[1]
Hugo	Existing Development	357	242 (68%)	68	19%	97	B/D
	Future Development	15253	5808 (38%)	4184	27%	3896	A/D
Lake Elmo	Existing Development	1320	264 (20%)	370	28%	353	A
	Future Development	5529	1388 (25%)	1188	21%	1449	C
Lino Lakes	Existing Development	2838	966 (34%)	357	13%	785	A/D
	Future Development	11788	10486 (89%)	3626	31%	2937	A/D
Mahtomedi	Existing Development	188	188 (100%)	56	30%	52	A
	Future Development	1879	1879 (100%)	499	27%	495	A
New Brighton	Existing Development	486	486 (100%)	148	30%	133	A/D
	Future Development	3243	3243 (100%)	923	28%	824	B/D
North Oaks	Existing Development	1004	220 (22%)	171	17%	278	B
	Future Development	3059	429 (14%)	562	18%	823	A/D
North St. Paul	Existing Development	417	417 (100%)	128	31%	114	B
	Future Development	1342	1342 (100%)	387	29%	333	B
Oakdale	Existing Development	1284	1284 (100%)	502	39%	292	C

[1] Total Area is limited to land use types that were assumed to be irrigated and does not include those land use types that are typically no expected to be irrigated.

Community	Summary Area	Total Area[1] (ac)	Total Area within MUSA Boundary (ac (%))[1]	Total Impervious Area[1] (ac)	Percent Impervious[1]	Irrigated Area[1] (ac)	Primary Soil Type[1]
	Future Development	4752	4752 (100%)	1308	28%	1215	C
Shoreview	Existing Development	829	829 (100%)	127	15%	226	A/D
	Future Development	5312	5312 (100%)	1354	25%	1383	A/D
Stillwater	Existing Development	1312	1312 (100%)	426	32%	341	A
	Future Development	3577	3577 (100%)	794	22%	948	B/D
Vadnais Heights	Existing Development	584	584 (100%)	157	27%	150	C
	Future Development	2968	2968 (100%)	807	27%	771	A/D
White Bear Lake	Existing Development	1152	1152 (100%)	386	33%	311	A/D
	Future Development	3580	3580 (100%)	995	28%	911	A/D
White Bear Lake Township	Existing Development	1037	980 (94%)	203	20%	287	A/D
	Future Development	3044	2868 (94%)	713	23%	785	B
Woodbury	Existing Development	5317	5031 (95%)	1886	35%	1343	C
	Future Development	11661	8189 (70%)	2348	20%	3121	A

4 Task 3: Stormwater Reuse Analysis

The stormwater reuse analysis was performed to estimate the amount of municipal water that could be offset by incorporating stormwater reuse for irrigation purposes within the future development/redevelopment areas, as well as by retrofitting stormwater reuse projects in existing developed areas.

Based on conversations during this process, communities within the study area raised concerns about the practicality of implementing stormwater reuse at every future development or redevelopment site as their experience suggests that not all sites have been able to implement stormwater reuse. As such, Barr used the assumption that 25% of future development or redevelopment sites implement stormwater reuse as a lower bound. The upper bound assumed 100% of future development or redevelopment sites implement stormwater reuse, which is a best case or maximum use scenario.

The ability to retrofit stormwater reuse in existing development is expected to be a much lower percentage than for the future development/redevelopment areas. A 2021 study looking at opportunities for stormwater reuse for irrigation purposes within Ramsey County found that 1% of parcels were identified to be technically feasible candidates for stormwater reuse. These parcels made up 18% of Ramsey County by land area. Considering these values, Barr assumed that 5% of existing development sites could be candidates for stormwater reuse for irrigation purposes, and MCES staff agreed with this estimate.

In addition to the potable water offset by reusing stormwater for irrigation in the existing and future development/redevelopment areas outlined above, we also wanted to understand the impact of the stormwater reuse on the future development/redevelopment areas within the MUSA boundary. Again, this boundary was based on the MUSA boundary available from the Metropolitan Council, and as modified based on additional information provided by a few communities in the study area. We assumed that the impact of stormwater reuse within the MUSA boundary would be proportional to the percentage of future development or redevelopment that falls within the MUSA boundary.

4.1 Stormwater Reuse Calculator

The estimated performance of a stormwater reuse system is typically based on three factors:

- The contributing watershed area and available runoff
- The irrigation demand
- The available storage for runoff for reuse

Barr leveraged an existing stormwater reuse calculator from the Mississippi Watershed Management Organization (MWMO) to help inform this analysis of runoff, storage, and irrigation demand and estimate the optimal storage for reuse by the community. We assumed that irrigation typically occurs from May through September for the reuse calculator estimates summarized in the remainder of this memorandum.

4.1.1 Watershed Area and Runoff

We recognize that there is the potential to capture and reuse water from a larger watershed area, but the ability to do so varies by individual locations. For this assessment, we assumed that the available watershed is equivalent to the total future development area or existing development area in each

community and that the stormwater management and reuse storage will be designed to fully capture these areas for reuse. Based on the land area of those land uses that were assumed to be irrigated, imperviousness of the land use types within the existing and future development areas, and the primary soil type in the development area, the reuse calculator was used to estimate runoff volume for the typical irrigation season (assumed to be May through September) using 50-years of precipitation data for Minneapolis-St. Paul area.

4.1.2 Irrigation Demand Estimation

The land use analysis from Task 2 was used to estimate the irrigation areas within the development areas based on the land use type by community.

Although the U of MN extension indicates that irrigation rates are typically up to 1.0 inches per week in Minnesota, data compiled from actual sites evaluated for stormwater reuse irrigation suggests that irrigation rates are typically less than that and can vary significantly from year to year, depending on rainfall.

Table 4 shows the estimated weekly irrigation demand data compiled from actual irrigation system operations from other recent stormwater reuse projects in the Twin Cities metro to estimate low, average, and high irrigation use rates. We used the average low (0.2” per week) and high (0.8” per week) irrigation rates to reflect the variability in the range in reuse from year to year and was used to in combination with the estimated irrigation areas to help inform the range in the water demand that could potentially be offset by stormwater reuse during the irrigation season.

4.1.3 Reuse Storage

Additionally, Barr used the reuse calculator to estimate and optimize the anticipated runoff storage needed to maximize benefits for both the existing and future development areas for each community. The optimized storage volume was selected based on the general breakpoint in the high irrigation rate (0.8 inch per week) curve. The breakpoint is the point where the slope changes and begins to level off as this is where investment in additional reuse storage would provide minimal additional benefits. The optimized storage curves developed using the reuse calculator are included in Attachment 3.

4.1.4 Reuse Calculator Results

The results of the reuse system evaluation using the optimized storage for each community for the various land use scenarios is summarized in Table 5, Table 6, and Table 7 for the following scenarios respectively:

- existing land use with retrofits (5% irrigated land uses captured for reuse),
- future land use development/redevelopment (25% of irrigated land uses captured for reuse),
- future land use development/redevelopment (100% of irrigated land uses captured for reuse)

Also, for the future land use scenarios, the estimated average daily stormwater reuse volume was scaled by the fraction of the future development/redevelopment areas that fall within the MUSA boundary for each community. The total estimated stormwater reuse volume for the land areas within the MUSA boundary are also included in this summary.

Table 4 Weekly Irrigation Demand Data from Stormwater Reuse Systems

Past Project	Location	Irrigation Area Type	Weekly Irrigation Rate (inch/week) May - September			Source
			Low	Average	High	
Chanhassen High School	Chanhassen	Athletic Fields/Landscaping	0.41	0.57	0.89	RPBCWD Feasibility Study/Final Design
Lake Susan Park Pond	Chanhassen	Athletic Fields	0.20	0.46	0.73	RPBCWD Feasibility Study/Final Design
Pioneer Park	Little Canada	Athletic Fields	0.15	0.34	0.69	Ramsey County Reuse Study/RWMWD Final Design
Polar Lakes Park	White Bear Township	Athletic Fields	0.24	0.34	0.48	VLAWMO Feasibility Study
Como Golf Course	St. Paul	Golf Course	0.12	0.4	1.41	Ramsey County Reuse Study
Phalen Golf Course	St. Paul	Golf Course	0.19	0.45	0.81	Ramsey County Reuse Study
Hill Murray School	Maplewood	Athletic Fields	0.09	0.32	0.7	Ramsey County Reuse Study
Midland Hills Country Club	St. Paul	Golf Course	0.05	0.43	0.75	Ramsey County Reuse Study
Oneka Ridge Golf Course	Hugo	Golf Course	0	0.13	0.3	MCES Study 4 based on City of Hugo Data
Clearwater Cove	Hugo	Housing Development	0.12	0.68	1.16	MCES Study 4 based on City of Hugo Data
Beaver Ponds Park	Hugo	Park	0.04	0.18	0.61	MCES Study 4 based on City of Hugo Data
Adelaide Landing	Hugo	Housing Development	0.05	0.69	1.14	MCES Study 4 based on City of Hugo Data
Waters Edge	Hugo	Housing Development	0.14	0.35	0.65	MCES Study 4 based on City of Hugo Data
Oneka Place	Hugo	Housing Development	0.1	0.22	0.43	MCES Study 4 based on City of Hugo Data
CSAH 8/Jack Pine	Hugo	Park	0.7	0.94	1.37	MCES Study 4 based on City of Hugo Data
Rice Lake Reserve	Hugo	Housing Development	0.36	0.71	0.95	MCES Study 4 based on City of Hugo Data
The Shores of Oneka Lake	Hugo	Housing Development	0.26	0.33	0.4	MCES Study 4 based on City of Hugo Data
Oneka Prairie	Hugo	Housing Development	0.4	0.53	0.67	MCES Study 4 based on City of Hugo Data
		Average	**0.20**	**0.45**	**0.79**	

Table 5 Optimized Stormwater Reuse by Community for Existing Land with Retrofits (5% Land Area Captured for Reuse)

Community	Total Area (ac)	Percent Impervious	Irrigated Area (ac)	Optimal Storage Volume (ac-ft/yr)	Annual Irrigation Demand (Low Rate) Met by Stormwater Reuse System (ac-ft/irrigation season)	Annual Irrigation Demand (High Rate) Met by Stormwater Reuse System (ac-ft/irrigation season)
Hugo	18	19%	5	2.5	1.2	3.8
Lake Elmo	66	28%	18	5.0	4.5	16.0
Lino Lakes	142	13%	39	5.0	9.6	20.7
Mahtomedi	9	30%	3	1.0	0.7	2.4
New Brighton	24	30%	7	2.5	1.7	6.1
North Oaks	50	17%	14	3.8	3.5	10.1
North St Paul	21	31%	6	2.0	1.4	5.3
Oakdale	64	39%	15	3.8	3.7	14.2
Shoreview	41	15%	11	2.5	2.8	7.4
Stillwater	66	32%	17	5.0	4.3	16.0
Vadnais Heights	29	27%	8	2.5	1.9	6.9
White Bear Lake	58	33%	16	5.0	4.8	14.6
White Bear Lake Township	52	20%	14	3.8	3.6	11.3
Woodbury	266	35%	67	12.5	17.0	62.3
Total Optimized Reuse Storage Volume (ac-ft)				56.8		
Total Stormwater Reuse Volume for Irrigation (ac-ft/irrigation season)					60.6	197.0
Total Stormwater Reuse Volume for Irrigation (MGD)					0.13	0.42

Table 6 Optimized Stormwater Reuse by Community for Future Development Area (25% Land Area Captured for Reuse)

Community	Total Area (ac)	Percent Impervious	Irrigated Area (ac)	Optimal Storage Volume (ac-ft/yr)	Annual Irrigation Demand (Low Rate) Met by Stormwater Reuse System (ac-ft/irrigation season)	Annual Irrigation Demand (High Rate) Met by Stormwater Reuse System (ac-ft/irrigation season)
Hugo	3813	27%	974	75.0	245.3	707.1
Lake Elmo	1382	21%	362	50.0	90.9	278.6
Lino Lakes	2947	31%	734	75.0	185.7	602.7
Mahtomedi	470	27%	124	25.0	31.2	109.0
New Brighton	810.7	28%	205.9	37.5	52.0	182.4
North Oaks	764.8	18%	205.8	37.5	52.0	150.4
North St Paul	335.5	29%	83.3	25.0	21.8	77.5
Oakdale	1188.0	28%	303.7	50.0	76.7	265.1
Shoreview	1328.1	25%	345.9	50.0	87.3	285.7
Stillwater	894.2	22%	237.1	37.5	60.0	188.9
Vadnais Heights	742.1	27%	192.7	37.5	49.1	169.7
White Bear Lake	894.9	28%	227.8	50.0	120.0	379.3
White Bear Lake Township	761.0	23%	196.2	37.5	49.8	164.4
Woodbury	2915.2	20%	780.2	75.0	195.5	542.1
Total Optimized Reuse Storage Volume (ac-ft)				662.5		
Total Stormwater Reuse Volume for Irrigation (ac-ft/irrigation season)					1317.2	4102.9
Total Stormwater Reuse Volume for Irrigation (MGD)					2.8	8.7
Total Stormwater Reuse Volume for Irrigation (MGD) within MUSA					2.1	6.6

Table 7 Optimized Stormwater Reuse by Community for Future Development Area (100% Land Area Captured for Reuse)

Community	Total Area (ac)	Percent Impervious	Irrigated Area (ac)	Optimal Storage Volume (ac-ft/yr)	Annual Irrigation Demand (Low Rate) Met by Stormwater Reuse System (ac-ft/irrigation season)	Annual Irrigation Demand (High Rate) Met by Stormwater Reuse System (ac-ft/irrigation season)
Hugo	15253	27%	3896	300.0	981.2	2828.4
Lake Elmo	5529	21%	1449	200.0	363.5	1114.4
Lino Lakes	11788	31%	2937	300.0	742.6	2410.9
Mahtomedi	1879	27%	495	100.0	124.8	436.0
New Brighton	3243	28%	824	150.0	208.1	729.7
North Oaks	3059	18%	823	150.0	208.0	601.5
North St Paul	1342	29%	333	100.0	87.2	309.9
Oakdale	4752	28%	1215	200.0	306.8	1060.4
Shoreview	5312	25%	1383	200.0	349.2	1142.8
Stillwater	3577	22%	948	150.0	239.8	755.6
Vadnais Heights	2968	27%	771	150.0	196.5	678.6
White Bear Lake	3580	28%	911	200.0	479.9	1517.3
White Bear Lake Township	3044	23%	785	150.0	199.4	657.8
Woodbury	11661	20%	3121	300.0	781.9	2168.4
Total Optimized Reuse Storage Volume (ac-ft)				2650.0		
Total Stormwater Reuse Volume for Irrigation (ac-ft/irrigation season)					5268.7	16411.6
Total Stormwater Reuse Volume for Irrigation (MGD)					11.2	35.0
Total Stormwater Reuse Volume for Irrigation (MGD) within MUSA					8.3	26.3

4.1.5 MPARS Groundwater Users

In addition to estimating at the anticipated irrigation volume that can be offset using stormwater reuse for irrigation in the existing and future development areas, Barr evaluated existing MPARS appropriations data as available from the MnDNR for current groundwater users for non-agricultural irrigation purposes (such golf courses, etc.) to identify what additional volume of groundwater use could potentially be offset by stormwater reuse assuming stormwater reuse could be retrofit at these sites. Average annual water usage by MPARS users within the study area, summarized by community, is included in Table 8. The total daily usage estimate was calculated assuming that irrigation typically occurs from May through September.

Table 8 MPARS Groundwater for Non-Agricultural Irrigation Users

City	Minimum Usage (MGY)	Average Usage (MGY)	Maximum Usage (MGY)
Hugo	2.30	20.72	47.23
Lake Elmo	0.00	5.68	42.72
Lino Lakes	2.34	14.58	37.54
North St. Paul	6.95	15.08	37.44
Oakdale	0.00	13.51	30.35
Shoreview	5.08	25.72	59.01
Stillwater	10.55	63.70	139.74
White Bear Lake	12.27	30.77	57.89
Woodbury	33.60	100.63	192.71
Total (MGY)	73.08	290.39	644.63
Total Usage (ac-ft/yr)	224.3	891.2	1978.3
Total Daily Usage (MGD)	0.48	1.90	4.21

4.1.6 Comparison to Projected Community Water Demands

As part of this study, MCES provided a range of estimates of community water demand for 2050 and Ultimate development conditions to reflect future water demand scenarios for the study communities. This included average daily demand over the year as well as a summary of summer peaking factors for many communities. The average of the available summer peaking factors was applied to the average daily rates to estimate the peak summer daily usage for each community. This data was summed up to estimate the total water demand for all the study area communities.

Table 9 summarizes the 2050 and ultimate community water demands, as well as the estimated water offsets from stormwater reuse for irrigation against actual and projected (2050) community water demands developed by MCES to provide a comparison of potential water savings by reusing stormwater for irrigation purposes within the study area.

Table 9 Summary of Community Water Demands Compared to Potential Offsets by Stormwater Reuse for Irrigation

Community	2050 Daily Demand				Ultimate Daily Demand			
	Annual Average Daily Usage (gallons/day) - Low	Annual Average Daily Usage (gallons/day) - High	Average Peak Summer Daily Usage (gallons/day) - Low	Average Peak Summer Daily Usage (gallons/day) - High	Annual Average Daily Usage (gallons/day) - Low	Annual Average Daily Usage (gallons/day) - High	Average Peak Summer Daily Usage (gallons/day) - Low	Average Peak Summer Daily Usage (gallons/day) - High
Hugo	1,509,413	2,042,147	2,319,770	3,138,513	2,659,442	3,598,068	4,087,214	5,529,761
Lake Elmo	1,701,437	3,316,517	2,614,886	5,097,053	1,939,749	3,781,046	2,981,141	5,810,973
Lino Lakes	1,886,964	2,868,940	2,900,017	4,409,186	4,177,254	6,351,097	6,419,893	9,760,806
Mahtomedi	747,720	1,011,622	1,149,148	1,554,730	859,387	1,162,700	1,320,766	1,786,918
New Brighton	2,905,732	3,931,285	4,465,731	6,041,871	2,905,732	3,931,285	4,465,731	6,041,871
North Oaks	1,409,770	1,723,052	2,166,632	2,648,106	1,409,770	1,723,052	2,166,632	2,648,106
North St. Paul	985,608	1,137,558	1,514,750	1,748,277	985,608	1,137,558	1,514,750	1,748,277
Oakdale	2,832,673	3,832,440	4,353,448	5,889,960	2,832,673	3,832,440	4,353,448	5,889,960
Shoreview	2,230,454	3,017,672	3,427,916	4,637,768	2,721,496	3,682,024	4,182,583	5,658,789
Stillwater	1,958,052	2,649,129	3,009,269	4,071,364	2,574,825	3,483,586	3,957,169	5,353,817
Vadnais Heights	1,198,504	1,547,983	1,841,945	2,379,047	1,620,106	2,092,521	2,489,891	3,215,932
White Bear Lake	2,082,613	2,534,571	3,200,704	3,895,305	2,797,136	3,404,157	4,298,832	5,231,744
White Bear Township (North & South System)	922,196	1,247,677	1,417,295	1,917,516	964,114	1,304,389	1,481,717	2,004,676
Woodbury	9,381,999	12,693,292	14,418,906	19,507,931	9,381,999	12,693,292	14,418,906	19,507,931
Total Usage (Gallons/Day)	***31,753,134***	***43,553,885***	***48,800,416***	***66,936,627***	***37,829,290***	***52,177,216***	***58,138,673***	***80,189,560***
Total Usage (MGD)	***31.8***	***43.6***	***48.8***	***66.9***	***37.8***	***52.2***	***58.1***	***80.2***
Total Stormwater Reuse Volume for Irrigation (MGD)	2.9 - 35.4							
Total Stormwater Reuse Volume for Irrigation (MGD) - Within MUSA Area	2.2 - 26.7							
Potential Additional Offset of Groundwater based on MPARS Non-Agricultural Irrigation Usage (MGD)	0.5 - 4.2							

4.1.7 Other Stormwater Reuse Considerations

Stormwater reuse for irrigation has been at the forefront of many state-level agency conversations for more than a decade, recognizing its use as a tool to help with stormwater management by helping protect water quality and mitigate flooding, and as part of a water supply strategy, especially for many developing communities. At the state level, there have been several facilitated workgroups around reuse including representatives from the Minnesota Department of Health (MDH), Board of Water and Soil Resources (BWSR), Minnesota Department of Labor and Industry (MnDLI), Minnesota Department of Natural Resources (MnDNR), Minnesota Pollution Control Agency (MPCA), Minnesota Department of Agriculture (MDA), the Metropolitan Council, and the University of Minnesota Water Resources Center as well as representatives from a variety of local/municipal, regional, and watershed organizations. These efforts have been focused on roles and jurisdiction related to the stormwater reuse projects as well as developing guidance related to the design and operations of stormwater reuse systems to protect the health of the public and minimize exposure to possible pathogens.

Summaries of these past efforts can be found at the following links:

- Advancing Safe and Sustainable Water Reuse in Minnesota (2018, MDH)
- Reuse of Stormwater and Rainwater in Minnesota, A Public Health Perspective (January 2022, MDH)
- Update on Developing a Clear Process for Implementing Stormwater Capture and Use in Minnesota (2025, EOR)

Many municipal and watershed management organizations allow for stormwater reuse as a way of helping achieve required volume reduction in their stormwater regulatory programs. The organizations have also been implementing their own stormwater reuse projects to achieve organizational goals related to stormwater management, improved water quality, and/or augmenting water supply and protecting groundwater resources. Additionally, the MPCA has developed design guidance and tools for the evaluation of stormwater reuse projects in the Minnesota Stormwater Manual.

The State of Minnesota Plumbing Code (2020) includes Chapter 16 which outlines requirements for Nonpotable Rainwater Catchment Systems which outlines requirements for reuse systems but does not currently apply to reuse systems for irrigation. In March 2026, the MnDLI accepted proposed changes to Chapter 15 related to alternate water sources for nonpotable applications from its ad hoc committee that would essentially not allow for stormwater reuse for irrigation purposes. A special meeting was held on 6/23/2026 to allow for public comment on the proposed code revisions and numerous state agencies, municipalities, watershed districts, professional and labor organizations provided public comments generally requesting that the MnDLI not adopt Chapter 15 of the proposed plumbing code as proposed, highlighting that it would prohibit stormwater reuse and have broad, negative implications on variety of fronts statewide. The board delayed any further action or discussion on Chapter 15 of the Plumbing Code until their July 2026 meeting, and it will be important to continue to track this effort and be involved in subsequent conversations.

Currently, there is limited regulation requiring any treatment of stormwater reuse required when used for irrigation, specifically as it relates to possible public exposure to bacteria and pathogens that can be present in stormwater runoff. The MDH completed a study in 2018 (linked above) that looked at possible

levels of treatment of stormwater reuse for different purposes. The general takeaway is from the study indicated there is possibly some health risk as stormwater contains some microbe and could lead to possible illness for people exposed to the water (especially if ingesting) and recommended a risk based framework for the treatment of stormwater should likely including water treatment options like chlorination, ultraviolet (UV) light, or filtration to minimize health risk. However, at this point, this study has not translated into any regulatory treatment requirements.

Ultimately, it is up to each system owner and project to determine the level of treatment included with the system. There are many existing reuse systems that have been implemented with minimal treatment (e.g. primarily pumps and possibly filtration) while other systems have incorporated pumps, filtration, and UV disinfection. There is evidence of some reuse/irrigation systems working without issue with limited treatment while there is also anecdotal information that some systems with minimal treatment have experienced fouling of the irrigation systems and plugging of irrigation nozzles that have ongoing operations and maintenance issues. Additionally, system operations, such as irrigation at night and signage, can help limit public exposure and health risk.

Additionally, when looking at stormwater reuse for irrigation from constructed ponds, wetlands, or even lakes, we see elevated chloride levels in many of these systems, especially in urban settings, that could preclude their use for irrigation. Chloride levels in water bodies are highly variable, often depending on the predominant land uses in the watersheds. For example, watersheds with uses dominated by commercial, industrial, office, mixed use, and multifamily uses often have water bodies with elevated chloride levels as commercial snow and ice management applicators are often hired in these areas and may overapply deicing salts. Some of these resources can even exceed the MPCA chronic chloride standards (<230 mg/L). General guidance for irrigation suggests that most plants, including turf grasses, can tolerate chloride concentrations up to 100 mg/L through some ornamental plants can be sensitive to lower levels (<30-70 mg/L). Removal of chlorides from water is expensive and requires sophisticated treatment, beyond what is typically used for stormwater reuse systems. Therefore, it is important to understand the water quality of any existing resources that may be used for stormwater reuse or to make sure there are chloride management plans in place for new or redevelopment areas to help control the application of deicing salts and protect downstream water bodies that are intended for stormwater reuse for irrigation.

5 Task 4: Cost Estimation

Barr estimated the cost to implement stormwater reuse systems in the existing and future development scenarios evaluated above. The first step was to estimate the number of reuse systems that may need to be implemented within each community. To determine the size of each potential stormwater reuse system, Barr considered parcel areas within the future development area across the entire study area, along with specific development data provided by the City of Hugo for reuse systems implemented within the community. The following is a summary of that analysis:

- The average parcel area of parcels within future development areas was 13.5 acres across the study area.
- Based on information provided by the City of Hugo, development areas with reuse incorporated ranged from 14 to 202 acres, with an average area of 98 acres. However, we recognize that Hugo is unique in that the development is happening in previously undeveloped areas while other communities are primarily redeveloping, likely resulting in smaller development footprints.

Further information about the Hugo developments was taken from a previous Rice Creek Watershed District Storm Water Re-Use Evaluation (WSB, 2025), that included a summary of the development and number of pumps included with each. For the sites included in this study, there was an average area of 52 acres per stormwater reuse pump. Ultimately, Barr selected 30 acres of development area per reuse system to apply across the study area, recognizing that for many of the study area communities, the development will not be as large as those in Hugo. This approach was reviewed by and agreed to by MCES staff. Based on the total irrigated land area within the existing retrofit and future development/redevelopment areas, we estimated the number of reuse systems for each community by dividing the land area by 30 acres, rounding up to the nearest integer to estimate the number of potential reuse systems in each community.

The next step was to estimate the planning level cost per stormwater reuse system. We recognize there can be significant variability in system costs based on complexity of the system related to potential lengths of pipe, incorporation of more advance treatment, or other site constraints. Barr developed planning-level cost estimates based on recently bid stormwater reuse projects and extrapolated costs on a per unit basis to be applied to the anticipated number of reuse systems. The capital costs include planning, engineer, and design (assumed to be 20% of the estimated construction cost), along with the construction costs of a reuse system, including the following components:

- Electrical/controls
- Intake
- Pumping
- Filtration and UV disinfection (Cost ranges include a reuse system with and without treatment)
- Piping and connection to an irrigation system

For this study, we assumed the cost of the irrigation system was not considered as this would be part of future development costs regardless of whether or not stormwater reuse would be implemented.

Additionally, for reuse systems within the future development/redevelopment area, the planning level costs do not include the estimated cost of the optimized reuse storage as we assumed the construction of stormwater storage volumes for reuse would be implemented as part of the required stormwater management for a given development site. This was reviewed with MCES staff who agreed with this assumption. For reuse systems to be retrofit within existing development areas, we estimated that retrofit costs are typically higher than new construction costs. For this assessment, we assumed half of the retrofitted reuse system implemented would be able to leverage water from existing water bodies or stormwater management infrastructure for water storage for reuse. The other half of the retrofit system would require the construction of the optimized storage volume, with half of those being able to construct lower cost surface storage while the other portion would require the use of more expensive subsurface storage systems. For those costs reflecting surface and subsurface storage, we divided the optimized storage volume for each community by the number of reuse systems to determine the storage per reuse system.

Additionally, we estimated the annual operating and maintenance (O&M) costs for an individual reuse system, based on the assumed components.

It is important to note the limited level of design (Class 5, 0 - 5% design completion per ASTM E 2516-11), with the cost estimate is based on a conceptual level of design, quantities and unit prices. Costs will change with further design. Time value-of-money escalation costs are not included, and a construction schedule is not available currently. The estimated accuracy range for the point opinions of probable costs presented in this study are defined is -50% to +100%. The accuracy range is based on professional judgement considering the level of design completed, the complexity of the project and the uncertainties in the project as scoped. All costs are in 2026 dollars.

The estimated costs per reuse system are summarized in Table 10, including the initial capital cost as well as the annual O&M cost. The difference in cost by community for the reuse system costs with storage are a result of the relationship between impervious area, irrigated area/demand, and the defined optimized storage volume. The range in the total estimated costs for the reuse systems is summarized in Table 11. Attachment 4 includes the cost estimates for the reuse systems, including the costs for systems with and without treatment (not including storage) as well as capital cost as used for the estimate of systems with and without treatment along with surface and subsurface treatment using the average optimized storage volume as an example. Additionally, this attachment includes the annual O&M cost estimates to establish the range in the annual O&M depending on system complexity and components.

Table 10 Estimated Reuse System Capital Costs and Annual O&M Costs Per System

Community	Cost per Reuse System (No Treatment or Storage)	Annual O&M Cost per System (No Treatment or Storage)	Cost per Reuse System (With Treatment but No Storage)	Annual O&M Cost per System (With Treatment but No Storage)	Cost per Reuse System (No Treatment; with Surface Storage)	Cost per Reuse System (No Treatment; with Subsurface Storage)	Annual O&M Cost per System (No Treatment; with Storage)	Cost per Reuse System (With Treatment and Surface Storage)	Cost per Reuse System (With Treatment and Subsurface Storage)	Annual O&M Cost per System (With Treatment and Storage)
Hugo	$474,000	$4,900	$593,000	$5,700	$547,000	$1,252,000	$6,700	$654,000	$1,496,000	$7,500
Lake Elmo	$474,000	$4,900	$593,000	$5,700	$602,000	$2,054,000	$6,700	$720,000	$2,455,000	$7,500
Lino Lakes	$474,000	$4,900	$593,000	$5,700	$609,000	$2,175,000	$6,700	$728,000	$2,600,000	$7,500
Mahtomedi	$474,000	$4,900	$593,000	$5,700	$638,000	$2,581,000	$6,700	$762,000	$3,085,000	$7,500
New Brighton	$474,000	$4,900	$593,000	$5,700	$628,000	$2,431,000	$6,700	$750,000	$2,906,000	$7,500
North Oaks	$474,000	$4,900	$593,000	$5,700	$669,000	$3,037,000	$6,700	$800,000	$3,630,000	$7,500
North St Paul	$474,000	$4,900	$593,000	$5,700	$653,000	$2,806,000	$6,700	$780,000	$3,354,000	$7,500
Oakdale	$474,000	$4,900	$593,000	$5,700	$611,000	$2,190,000	$6,700	$730,000	$2,617,000	$7,500
Shoreview	$474,000	$4,900	$593,000	$5,700	$577,000	$1,696,000	$6,700	$690,000	$2,027,000	$7,500
Stillwater	$474,000	$4,900	$593,000	$5,700	$681,000	$3,207,000	$6,700	$814,000	$3,833,000	$7,500
Vadnais Heights	$474,000	$4,900	$593,000	$5,700	$669,000	$3,037,000	$6,700	$800,000	$3,630,000	$7,500
White Bear Lake	$474,000	$4,900	$593,000	$5,700	$571,000	$1,586,000	$6,700	$682,000	$1,895,000	$7,500
White Bear Lake Township	$474,000	$4,900	$593,000	$5,700	$611,000	$2,190,000	$6,700	$730,000	$2,617,000	$7,500
Woodbury	$474,000	$4,900	$593,000	$5,700	$678,000	$3,171,000	$6,700	$810,000	$3,790,000	$7,500

Table 11 Stormwater Reuse System Summary of Costs

Community	Existing Land with Retrofits (5% Land Area Captured for Reuse)			Future Development Area (25% Land Area Captured for Reuse)			Future Development Area (25% Land Area Captured for Reuse) - Area within MUSA Only			Future Development Area (100% Land Area Captured for Reuse)			Future Development Area (100% Land Area Captured for Reuse) - Area within MUSA Only		
	Number of Reuse Systems	Estimated Capital Cost Range	Annual O&M Cost Range	Number of Reuse Systems	Estimated Capital Cost Range	Annual O&M Cost Range	Number of Reuse Systems	Estimated Capital Cost Range	Annual O&M Cost Range	Number of Reuse Systems	Estimated Capital Cost Range	Annual O&M Cost Range	Number of Reuse Systems	Estimated Capital Cost Range	Annual O&M Cost Range
Hugo	1	$694,000-$848,000	$6,000-$7,000	128	$60,672,000-$75,904,000	$627,000-$960,000	49	$23,102,000-$28,901,000	$239,000-$278,000	509	$241,266,000 - $301,837,000	$2,494,000-$2,901,000	194	$91,865,000-$114,928,000	$950,000-$1,105,000
Lake Elmo	3	$2,611,000-$3,182,000	$17,000-$20,000	47	$22,278,000-$27,871,000	$230,000-$353,000	12	$5,592,000-$6,996,000	$58,000-$67,000	46	$87,690,000-$109,705,000	$907,000-$1,055,000	46	$22,011,000-$27,537,000	$228,000-$265,000
Lino Lakes	5	$3,783,000-$4,616,000	$29,000-$33,000	99	$46,926,000-$58,707,000	$485,000-$743,000	88	$41,744,000-$52,224,000	$432,000-$502,000	350	$186,282,000 - $233,049,000	$1,926,000-$2,240,000	350	$165,710,000 - $207,312,000	$1,713,000-$1,993,000
Mahtomedi	1	$1,052,000-$1,280,000	$6,000-$7,000	16	$7,584,000-$9,488,000	$78,000-$120,000	16	$7,584,000-$9,488,000	$78,000-$91,000	63	$29,862,000-$37,359,000	$309,000-$359,000	63	$29,862,000-$37,359,000	$309,000-$359,000
New Brighton	1	$976,000-$1,188,000	$6,000-$7,000	28	$13,272,000-$16,604,000	$137,000-$210,000	28	$13,272,000-$16,604,000	$137,000-$160,000	109	$51,666,000-$64,637,000	$534,000-$621,000	109	$51,666,000-$64,637,000	$534,000-$621,000
North Oaks	2	$2,020,000-$2,458,000	$12,000-$13,000	26	$12,324,000-$15,418,000	$127,000-$195,000	4	$1,729,000-$2,163,000	$18,000-$21,000	14	$48,348,000-$60,486,000	$500,000-$581,000	14	$6,784,000-$8,487,000	$70,000-$82,000
North St Paul	1	$1,280,000-$1,555,000	$6,000-$7,000	12	$5,688,000-$7,116,000	$59,000-$90,000	12	$5,688,000-$7,116,000	$59,000-$68,000	45	$21,330,000-$26,685,000	$221,000-$257,000	45	$21,330,000-$26,685,000	$221,000-$257,000
Oakdale	3	$2,801,000-$3,410,000	$17,000-$20,000	40	$18,960,000-$23,720,000	$196,000-$300,000	40	$18,960,000-$23,720,000	$196,000-$228,000	159	$75,366,000-$94,287,000	$779,000-$906,000	159	$75,366,000-$94,287,000	$779,000-$906,000
Shoreview	2	$1,771,000-$2,158,000	$12,000-$13,000	45	$21,330,000-$26,685,000	$221,000-$338,000	45	$21,330,000-$26,685,000	$221,000-$257,000	178	$84,372,000-$105,554,000	$872,000-$1,015,000	178	$84,372,000-$105,554,000	$872,000-$1,015,000
Stillwater	3	$2,792,000-$3,400,000	$17,000-$20,000	30	$14,220,000-$17,790,000	$147,000-$225,000	30	$14,220,000-$17,790,000	$147,000-$171,000	120	$56,880,000-$71,160,000	$588,000-$684,000	120	$56,880,000-$71,160,000	$588,000-$684,000
Vadnais Heights	1	$1,026,000-$1,249,000	$6,000-$7,000	25	$11,850,000-$14,825,000	$123,000-$188,000	25	$11,850,000-$14,825,000	$123,000-$143,000	99	$46,926,000-$58,707,000	$485,000-$564,000	99	$46,926,000-$58,707,000	$485,000-$564,000
White Bear Lake	2	$2,161,000-$2,628,000	$12,000-$13,000	30	$14,220,000-$17,790,000	$147,000-$225,000	30	$14,220,000-$17,790,000	$147,000-$171,000	120	$56,880,000-$71,160,000	$588,000-$684,000	120	$56,880,000-$71,160,000	$588,000-$684,000
White Bear Lake Township	2	$2,020,000-$2,458,000	$12,000-$13,000	26	$12,324,000-$15,418,000	$127,000-$195,000	24	$11,612,000-$14,527,000	$120,000-$140,000	96	$48,348,000-$60,486,000	$500,000-$581,000	96	$45,555,000-$56,992,000	$471,000-$548,000
Woodbury	9	$6,831,000-$8,339,000	$52,000-$59,000	98	$46,452,000-$58,114,000	$480,000-$735,000	69	$32,623,000-$40,813,000	$337,000-$392,000	273	$184,386,000 - $230,677,000	$1,906,000-$2,217,000	273	$129,492,000 - $162,002,000	$1,339,000-$1,557,000
Total Cost[1]	***36***	***$31.8 - $38.8 Million***	***$209,000-$238,000***	***650***	***$308.1 - $385.5 Million***	***$3.2 - $4.9 Million***	***472***	***$223.5 - $279.6 Million***	***$2.3 - $2.7 Million***	***2182***	***$1,219.6 - $1,525.8 Million***	***$12.6 - $14.7 Million***	***1866***	***$884.7 - $1,106.8 Million***	***$9.1 - $10.6 Million***

1 - This planning level cost estimate (Class 5, 0 - 5% design completion per ASTM E 2516-11) is based on concept designs, alignments, quantities and unit prices. Costs will change with further design. Time value-of-money escalation costs are not included. A construction schedule is not available at this time. Contingency is an allowance for the net sum of costs that will be in the Final Total Project Cost at the time of the completion of design but are not included at this level of project definition. The estimated accuracy range for the Total Cost as the project is defined is -50% to +100%. The accuracy range is based on professional judgement considering the level of design completed, the complexity of the project and the uncertainties in the project as scoped. The contingency and the accuracy range are not intended to include costs for future scope changes that are not part of the project as currently scoped or costs for risk contingency.

6 Conclusion

Overall, stormwater reuse for irrigation can be an effective approach to offset groundwater or potable water usage for irrigation in many of the study area communities, especially for those communities that have significant land areas expected to develop or redevelop in the future. Some of these communities, such as Hugo, have already been actively working to integrate stormwater reuse for irrigation in new development areas for the past decade or so to augment water supply and meet stormwater management requirements.

The average irrigation rate and the amount of future development area stormwater reuse that is incorporated determines how much of the future water demand could be offset by reuse. If stormwater reuse could be broadly implemented in nearly all the future development and redevelopment areas that are expected to incorporate irrigation, stormwater reuse could possibly offset nearly 11.4-35.4 MGD. Based on the projected water demands for 2050 and ultimate conditions and the high and low estimates of water usage, this could be anywhere from 10-60% of the ultimate peak summer water demands. If stormwater reuse could be broadly implemented (e.g. existing retrofits and 100% of irrigatable land uses in future development and redevelopment areas), this could achieve ~45-60% of the peak summer demands. In a more likely scenario that retrofits stormwater reuse in 5% of the existing development area and possibly 25% of the future development areas that are expected to incorporate irrigation, stormwater reuse could offset 2.9-9.2 MGD. Based on the projected water demands, this could offset ~10-15% of the ultimate peak summer water demand in the study area. If only considering reuse within 25% of the anticipated future development within the MUSA boundary as available, this could offset peak summer demands by ~5-10% of the peak summer water demand.

An additional 0.48 – 4.21 MGD of groundwater pumping could be offset if MPARS users permitted to use groundwater for non-agricultural irrigation (ie. golf courses or large athletic fields) within the study area were able to leverage stormwater reuse systems to augment or replace their water usage.

The most cost-effective way of implementing stormwater reuse for irrigation is as part of new development or redevelopment projects, where reuse can be designed into the site as part of the stormwater management system and overall site design. The cost of retrofitting stormwater reuse for irrigation in existing development areas is significantly more expensive as it requires more disturbance of existing infrastructure and could require the construction of additional storage for stormwater runoff if existing water bodies are not available on site in the area. This is especially true if needing to implement subsurface storage systems for the capture and storage of stormwater for reuse.

The total estimated capital costs are expected to be significant if stormwater reuse is broadly implemented. Retrofitting 5% of the existing development area is estimated to cost between $31.8-$38.8 million. In the more realistic future development/redevelopment scenario (if 25% of future development area implements reuse), the estimated cost is $308.1 - $385.5 million, bringing the total cost to $339.9-$424.3 million. However, if all the future development areas capture stormwater runoff for reuse, the total cost would range from $1.25-$1.56 billion. It is important to remember that with private developments, the ultimate cost for reuse implementation would likely be part of the overarching development or redevelopment cost along with the long-term operations and maintenance of these systems.

Attachments

Attachment 1

Slides from Meeting with Communities

Stormwater Reuse for Irrigation

MCES White Bear Lake Study 4

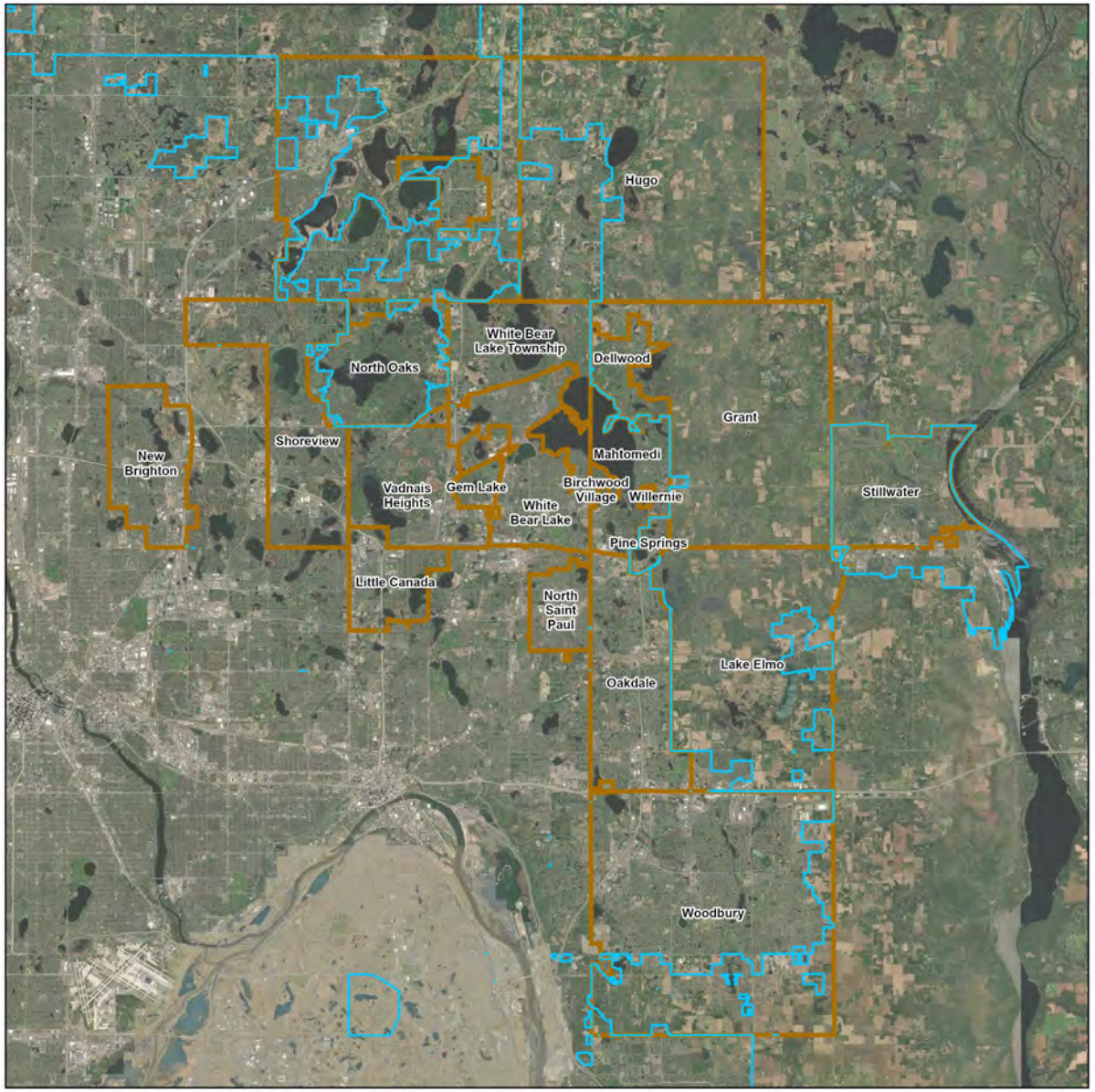
Jennifer Koehler, PE & Ruth Olson

April 14, 2026

BARR

Outline

- MCES White Bear Lake Study 4
- Data collection/compilation
- Land use analysis
- Imperviousness assumptions
- Turf and irrigation assumptions
- Next steps
- Community questions



MCES White Bear Lake Study 4: Stormwater Reuse for Irrigation

Data Collection
- Land use (existing, future)
- Assumptions (imperviousness, irrigation)

Land Use Analysis
- Consistent land use categories
- Development/redevelopment areas

Stormwater Reuse Analysis
- Stormwater reuse calculator
- MPARS permits summary

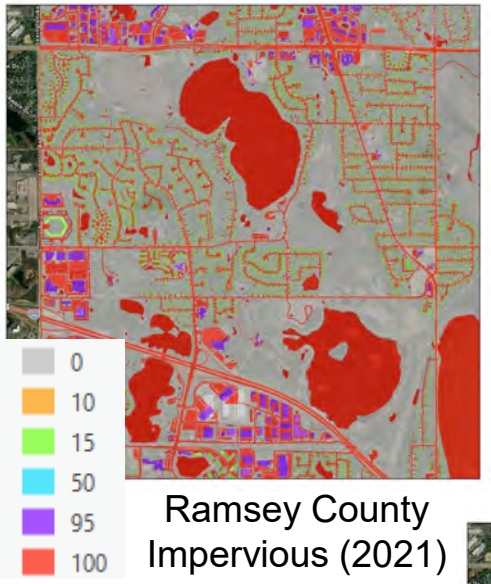
Cost Estimation
- Planning-level estimates

Reporting

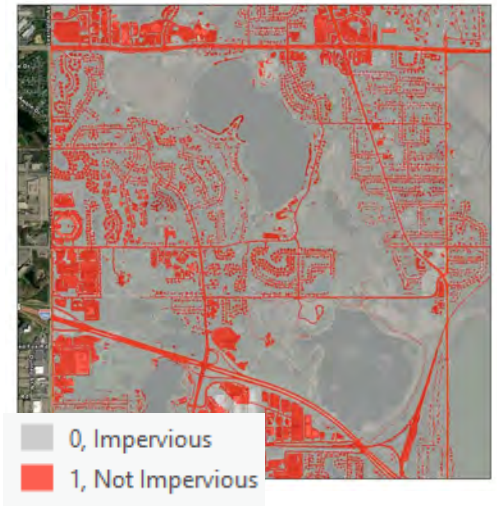
Key focus today:
Verifying proposed development/redevelopment areas with communities

Data Compilation

Publicly available spatial data sets:



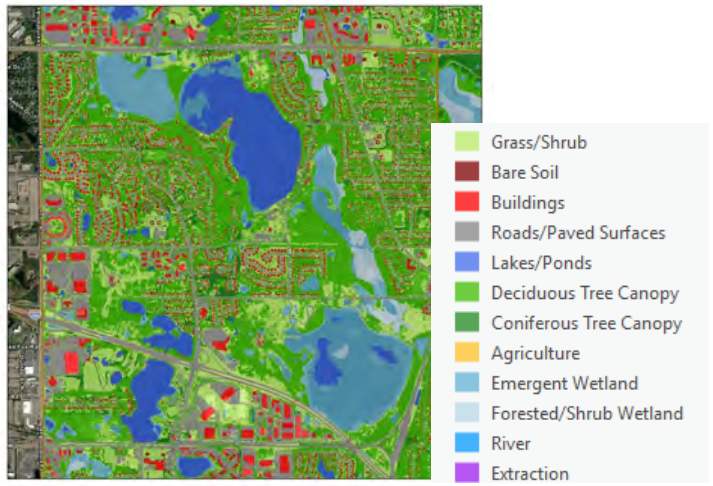
Ramsey County Impervious (2021)



U of M Impervious (2015)

+ MCES existing & future land use

+ MUSA boundary



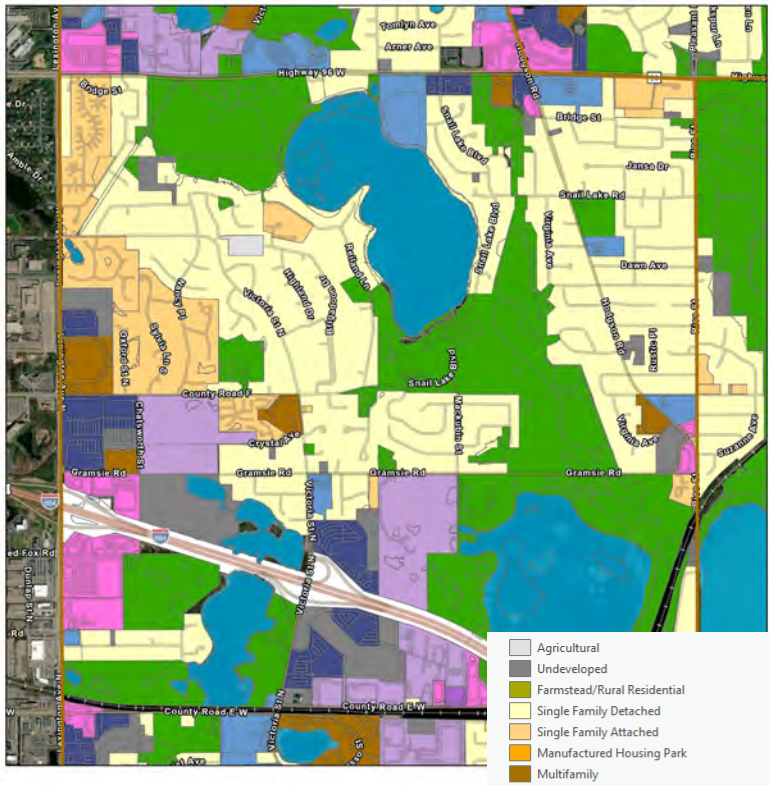
U of M Landcover (2015)

Community Data Requests:

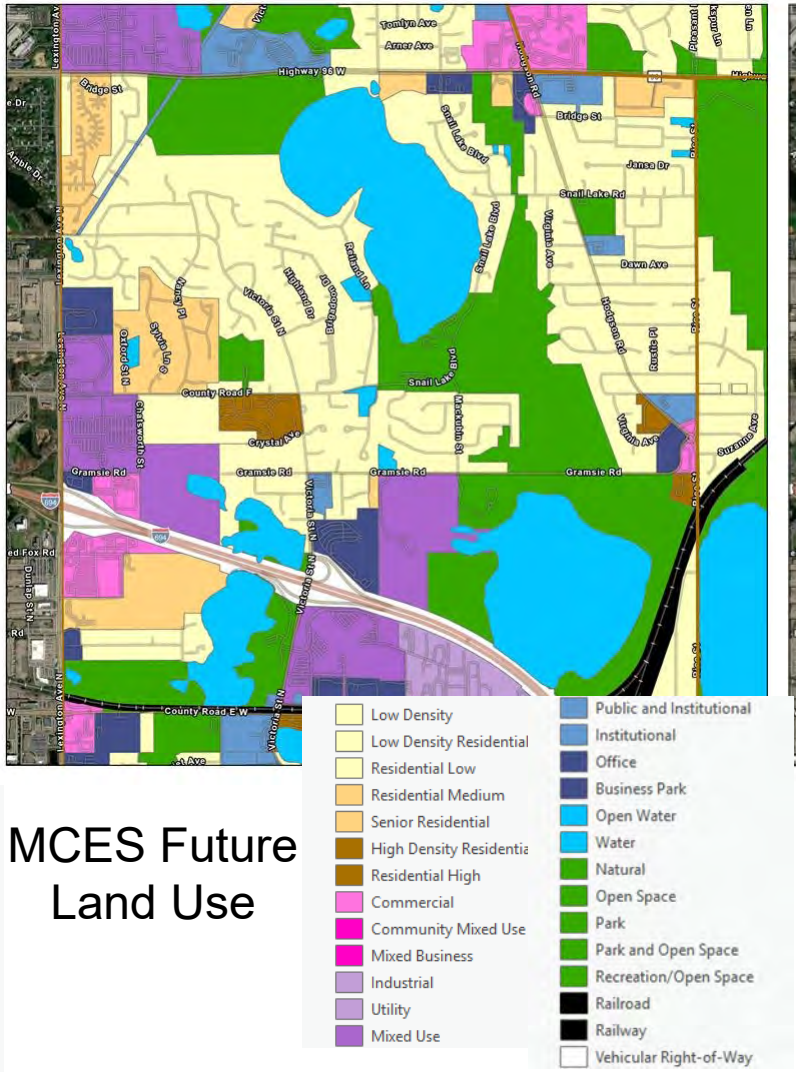
- 21 communities
  - 13 provided land use or redevelopment data
  - 5 filled in with publicly available Comprehensive Plans
  - 3 filled in with comparison between MCES existing and future land use

- 9 communities provided guidelines/standards of maximum imperviousness by land use type

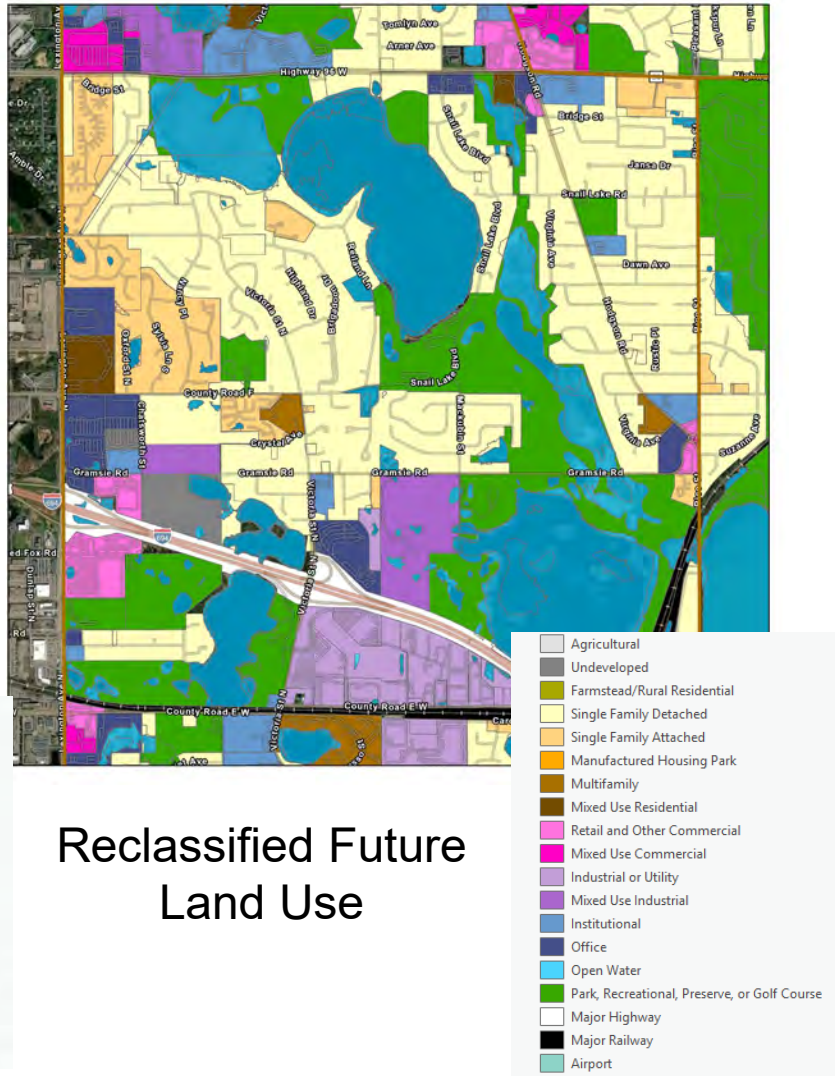
Land Use Reclassification for Consistency



MCES Existing Land Use



MCES Future Land Use



Reclassified Future Land Use

Land Use Analysis

1. Supplemented land use classifications based on data from the community
    - City future land use data priority over MCES future land use data
    - Aligned city land use categories with MCES land use categories
2. Prioritized future development/redevelopment areas provided by the community
    1. Provided by the community in response to data request
    2. Identified from community Comprehensive Plan
    3. Identified by land use change between Existing and Future

Land Use Categories

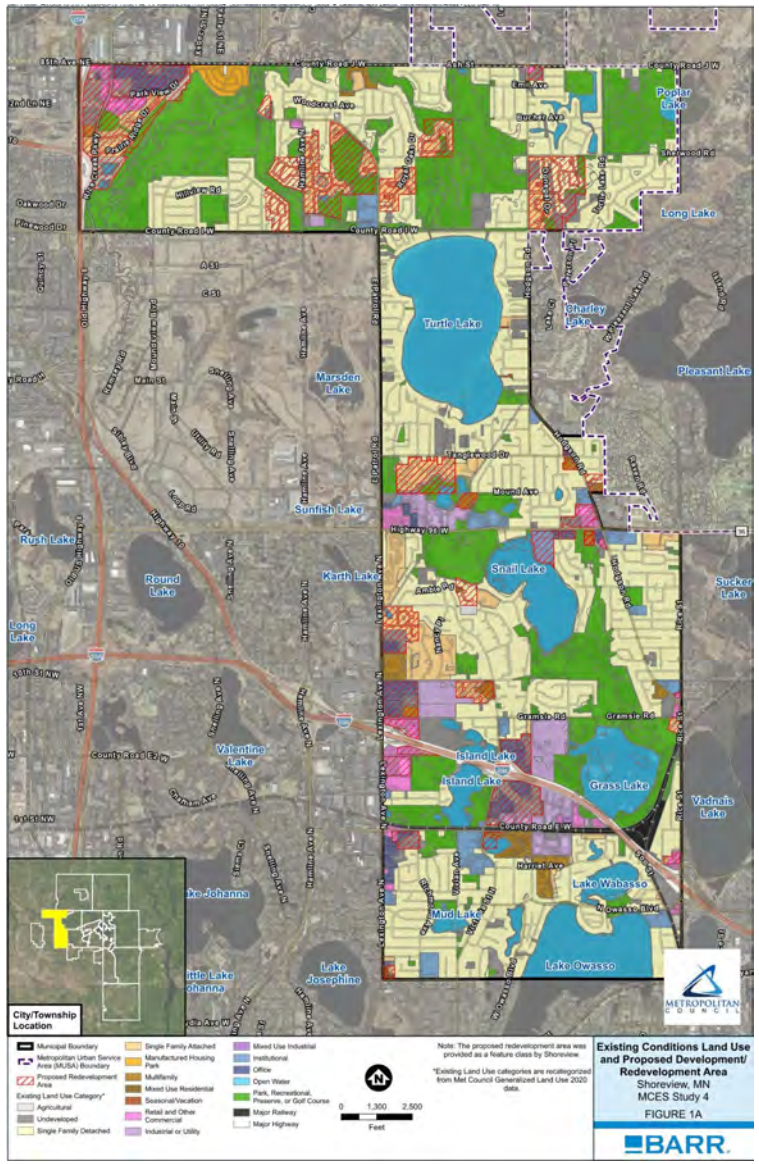
MCES Existing Land Use Category	MCES Future Land Use Categories
Agricultural	Agricultural, Agricultural Preserves
Airport or Airstrip	Airport
Extractive	
Farmstead/Rural Residential	Rural Estate, Rural Residential, Rural Residential Estate, Rural Residential/Ag, Very Low Density
Industrial or Utility	Industrial, General Industrial, Light Industrial, Heavy Industrial
Institutional	Institutional, Public Institutional, Public/Quasi-Public, Public-Institutional, School Facilities, Semi-Public
Major Highway	Highway Commercial, Vehicle Right-of-Way
Major Railway	Railroad, Railway, Railway Corridor
Manufactured Housing Park	Manufactured Home Park, Manufactured Housing, Manufactured Housing Park
Mixed Use Commercial	Community Commercial, Core Mixed Use, Corridor Mixed Use, Downtown, Downtown Mixed Use, Gateway, Neighborhood Commercial, Transitional Mixed-Use
Mixed Use Industrial	Industrial-Business Mix, TOD Mixed Use

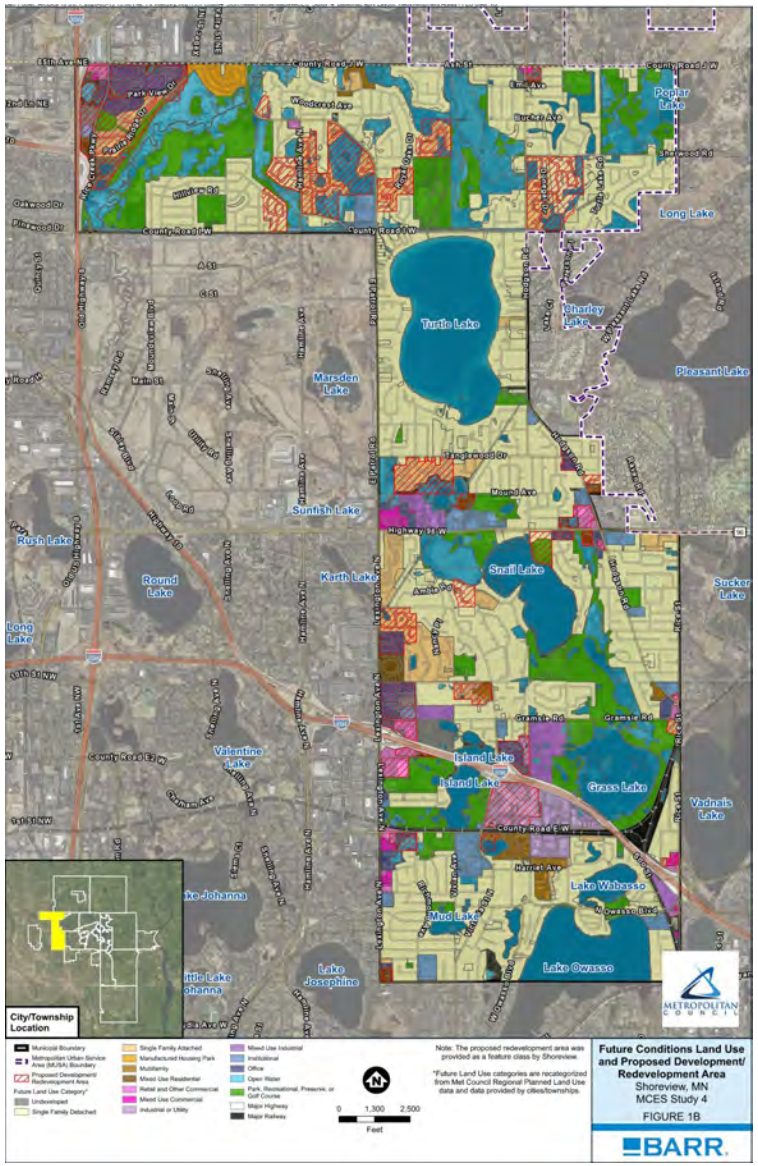
Land Use Categories

MCES Existing Land Use Category	MCES Future Land Use Categories
Mixed Use Residential	Mixed Residential Commercial, Mixed Use, Village – Mixed Use
Multifamily	High Density Residential, Medium Density Residential, Multi-Family Residential
Office	Business Campus, Business Park, Industrial/Office, Office, Office/Business, Research & Development Park
Open Water	
Park, Recreational, Preserve, or Golf Course	Golf Course Community, Park, Open Space, Park/Trail, Private Club
Retail and Other Commercial	Commercial, Community Commercial, Neighborhood Business, Neighborhood Commercial, Places to Shop
Seasonal/Vacation	
Single Family Attached	Low Density Residential, Low/Medium Density Residential, Medium Density Residential, Single Family Attached
Single Family Detached	Low Density Residential, Low/Medium Density Residential, Medium Density Residential, Single Family Detached, Single Family Detached (Unsewered), Village Low Density
Undeveloped	Undeveloped, Undevelopable, Vacant

Summary of Land Use Analysis – Provided to Communities for Review and Comment

Example of existing and future land use and proposed redevelopment areas in City of Shoreview





Imperviousness Analysis – by Existing Conditions/Land Use Category

MCES Existing Land Use Category	UMN (2015)	Ramsey County (2021)	Community Provided (Maximum Allowed)	Assumed Imperviousness for MCES Study 4 Average (UMN, Ramsey Co)
Agricultural	5.1%	8.5%	25%	***6.8%***
Airport or Airstrip	5.7%	4.8%		***5.2%***
Extractive	33.5%	72.4%		***53.0%***
Farmstead/Rural Residential	26.2%	6.2%	15%	***16.2%***
Industrial or Utility	59.4%	60.0%	75%	***59.7%***
Institutional	38.6%	38.2%	65%	***38.4%***
Major Highway	47.5%	40.6%		***44.1%***
Major Railway	38.6%	4.7%		***21.6%***
Manufactured Housing Park	39.0%	28.5%		***33.8%***
Mixed Use Commercial	77.0%	70.2%	80%	***73.6%***
Mixed Use Industrial	68.7%	64.1%		***66.4%***

Imperviousness Analysis – by Existing Conditions/Land Use Category

MCES Existing Land Use Category	UMN (2015)	Ramsey County (2021)	Community Provided (Maximum Allowed)	Assumed Imperviousness for MCES Study 4 Average (UMN, Ramsey Co)
Mixed Use Residential	67.1%	56.4%	75%	***61.7%***
Multifamily	50.9%	36.4%	75%	***43.7%***
Office	60.2%	59.8%	90%	***60.0%***
Park, Recreational, Preserve, or Golf Course	6.9%	8.1%	30%	***7.5%***
Retail and Other Commercial	71.7%	71.6%	80%	***71.6%***
Seasonal/Vacation	45.7%	13.0%		***29.4%***
Single Family Attached	45.7%	26.9%	65%	***36.3%***
Single Family Detached	23.7%	19.4%	65%	***21.5%***
Undeveloped	4.1%	8.2%		***6.1%***

Turf & Irrigation Assumptions – Based on Existing Conditions/Land Use Category

MCES Existing Land Use Category	Turf - UMN (2015)	Stormwater Reuse Irrigation Assumption
Agricultural	34.4%	No
Airport or Airstrip	66.8%	No
Extractive	32.4%	No
Farmstead/Rural Residential	33.8%	No
Industrial or Utility	18.4%	Yes
Institutional	35.0%	Yes
Major Highway	38.3%	No
Major Railway	28.1%	No
Manufactured Housing Park	22.5%	No
Mixed Use Commercial	12.2%	Yes
Mixed Use Industrial	14.6%	Yes
Mixed Use Residential	11.0%	Yes
Multifamily	21.6%	Yes
Office	21.5%	Yes
Park, Recreational, Preserve, or Golf Course	28.0%	Yes
Retail and Other Commercial	14.9%	Yes
Seasonal/Vacation	11.6%	Yes
Single Family Attached	25.4%	Yes
Single Family Detached	26.7%	Yes
Undeveloped	24.8%	No

Discussion Slide

- Do you generally agree with the future land use and potential redevelopment areas as shown for your community?
  - Or do you have edits for your specific community?

- Responses received from April 10 deadline:
  - Oakdale
  - White Bear Township
  - Lino Lakes
  - Vadnais Heights

- For the larger group, how widely could stormwater reuse realistically be incorporated in new developments or redevelopments?

- Questions for specific communities:
  - Vadnais Heights – Are redevelopment areas marked with an ‘X’ complete or no longer expected to redevelop?
  - Grant – A large portion of the community shows a change in land use due to the land use reclassification process from existing and future land use. Can you identify area of potential development or redevelopment? 2040 Comp Plan identifies 300-acre rural-residential plot – where will that be?
  - Hugo – the MUSA boundary provided is different than available from Met Council. Should we use the boundary provided by the City?

Next Steps

Data Collection
- Land use (existing, future)
- Assumptions (imperviousness, irrigation)

Land Use Analysis
- Consistent land use categories
- Development/redevelopment areas

Stormwater Reuse Analysis
- Stormwater reuse calculator (existing fraction and future development/redevelopment)
- MPARS permits summary

Cost Estimation
- Planning-level estimates

Reporting

Thank you!

Jen Koehler – JKoehler@barr.com
Ruth Olson – Ruth.Olson@barr.com

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Attachment 2

Final Land Use/Future Development Area Figures Based on Input from Communities

White Rock Lake
Forest Blvd N
Horseshoe Lake
Barker Lake
Oneka Lake
61
Frenchman Rd
Egg Lake
Rice Lake
Plaisted Lake
North School Section Lake
School Section Lake
Goggins Lake
Sunset Lake
Long Lake
Round Lake
Fish Lake
Mann Lake
Pine Tree Lake

City/Township Location

- Municipal Boundary
- Metropolitan Urban Service Area (MUSA) Boundary
- Proposed Redevelopment Area

Existing Land Use Category*

- Agricultural
- Undeveloped
- Farmstead/Rural Residential
- Single Family Detached
- Single Family Attached
- Manufactured Housing Park
- Multifamily
- Retail and Other Commercial
- Industrial or Utility
- Mixed Use Industrial
- Institutional
- Office
- Open Water
- Park, Recreational, Preserve, or Golf Course
- Major Highway

N

0 1,700 3,300
Feet

Note: The proposed redevelopment area was provided as shapefiles by Hugo. Data for outside the MUSA boundary is based on water supply planning effort by MCES.

*Existing Land Use categories are recategorized from Met Council Generalized Land Use 2020 data.

Existing Conditions Land Use and Proposed Development/ Redevelopment Area
Hugo, MN
MCES Study 4

FIGURE 1A

METROPOLITAN COUNCIL

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White Rock Lake
Forest Blvd N
Horseshoe Lake
Barker Lake
Oneka Lake
61
Frenchman Rd
Egg Lake
Rice Lake
Plaisted Lake
North School Section Lake
School Section Lake
Goggins Lake
Sunset Lake
Long Lake
Round Lake
Fish Lake
Mann Lake
Pine Tree Lake

City/Township Location

- Municipal Boundary
- Metropolitan Urban Service Area (MUSA) Boundary
- Proposed Development/ Redevelopment Area

Future Land Use Category*

- Agricultural
- Farmstead/Rural Residential
- Single Family Detached
- Single Family Attached
- Manufactured Housing Park
- Multifamily
- Mixed Use Residential
- Retail and Other Commercial
- Mixed Use Commercial
- Industrial or Utility
- Mixed Use Industrial
- Institutional
- Office
- Open Water
- Park, Recreational, Preserve, or Golf Course
- Major Highway
- Major Railway

N

0 1,700 3,300

Feet

Note: The proposed redevelopment area was provided as shapefiles by Hugo. Data for outside the MUSA boundary is based on water supply planning effort by MCES.

*Future Land Use categories are recategorized from Met Council Regional Planned Land Use data and data provided by cities/townships.

Future Conditions Land Use and Proposed Development/ Redevelopment Area
Hugo, MN
MCES Study 4

FIGURE 1B

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Long Lake
Clear Lake
Lake Olson
Lake Jane
Cloverdale Lake
Sunfish Lake
Lake Elmo
Downs Lake
Eagle Point Lake
Margaret Lake
Horseshoe Lake
Markgrafs Lake

State Highway 36
Stillwater Blvd N
Hudson Blvd N
Hudson Rd
Keats Ave N
Kimbro Ave N
Lake Elmo Ave N
Inwood Ave N
Hilo Ave N
Helmo Ave N
Helena Rd N
Jamaca Ave N
Jasmine Ave N
Hilltop Ave N
Hill Trl N
Jane Rd N
Island Trail Rd
Julep Ave N
Jade Trail N
Manning Ave N
Manning Trl N
Lake Elmo Ave S
Warner Ave N
Mannin
Ingate Blvd
Stillwater Blvd N
Boulder Bridge Trl N

66th St N
65th St N
62nd St N
55th St N
53rd St N
50th St N
47th St N
43rd St N
42nd St N
40th St N
39th St N
36th St N
34th St N
33rd St N
32nd St N
31st St N
30th St N
27th St N
26th St N
24th St N
22nd St N
20th St N
18th St N
15th St N
12th St N
10th St N

694
94

City/Township Location

Municipal Boundary
Metropolitan Urban Service Area (MUSA) Boundary
Proposed Redevelopment Area

Existing Land Use Category*
Agricultural
Undeveloped
Farmstead/Rural Residential
Single Family Detached
Single Family Attached
Manufactured Housing Park
Multifamily
Mixed Use Residential
Retail and Other Commercial
Mixed Use Commercial
Industrial or Utility
Institutional
Office
Open Water
Park, Recreational, Preserve, or Golf Course
Major Highway

N
0 1,400 2,800
Feet

Note: The proposed redevelopment area was determined using Lake Elmo's 2040 Comprehensive Plan.

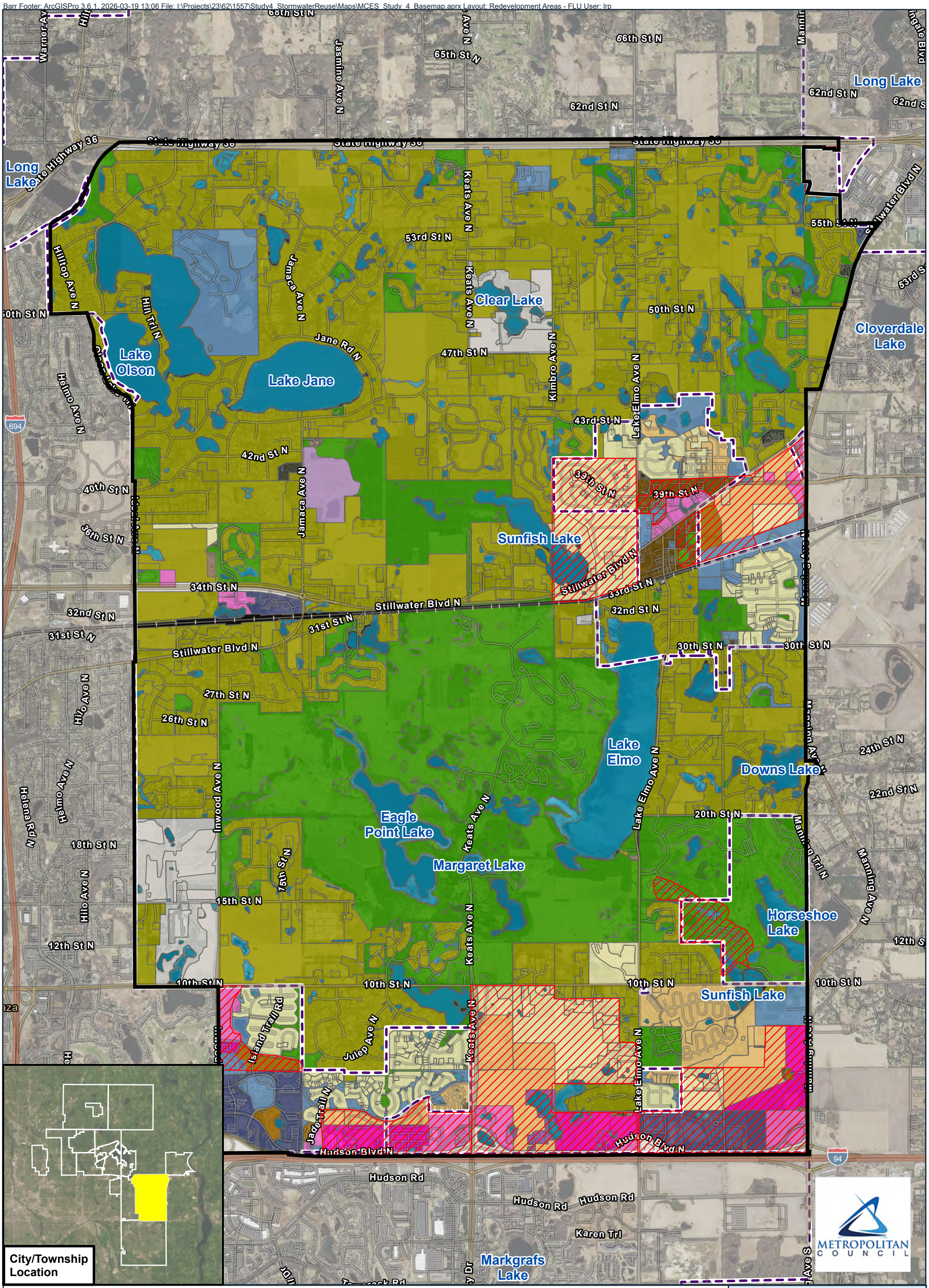
*Existing Land Use categories are recategorized from Met Council Generalized Land Use 2020 data.

Existing Conditions Land Use and Proposed Development/ Redevelopment Area
Lake Elmo, MN
MCES Study 4

FIGURE 1A

BARR

METROPOLITAN COUNCIL



Municipal Boundary
Metropolitan Urban Service Area (MUSA) Boundary
Proposed Development/ Redevelopment Area

Future Land Use Category*
- Agricultural
- Farmstead/Rural Residential
- Single Family Detached
- Single Family Attached
- Multifamily
- Mixed Use Residential
- Retail and Other Commercial
- Mixed Use Commercial
- Industrial or Utility
- Mixed Use Industrial
- Institutional
- Office
- Open Water
- Park, Recreational, Preserve, or Golf Course
- Major Highway
- Major Railway

0 1,400 2,800
Feet

Note: The proposed redevelopment area was determined using Lake Elmo's 2040 Comprehensive Plan.

*Future Land Use categories are recategorized from Met Council Regional Planned Land Use data and data provided by cities/townships.

Future Conditions Land Use and Proposed Development/ Redevelopment Area
Lake Elmo, MN
MCES Study 4

FIGURE 1B

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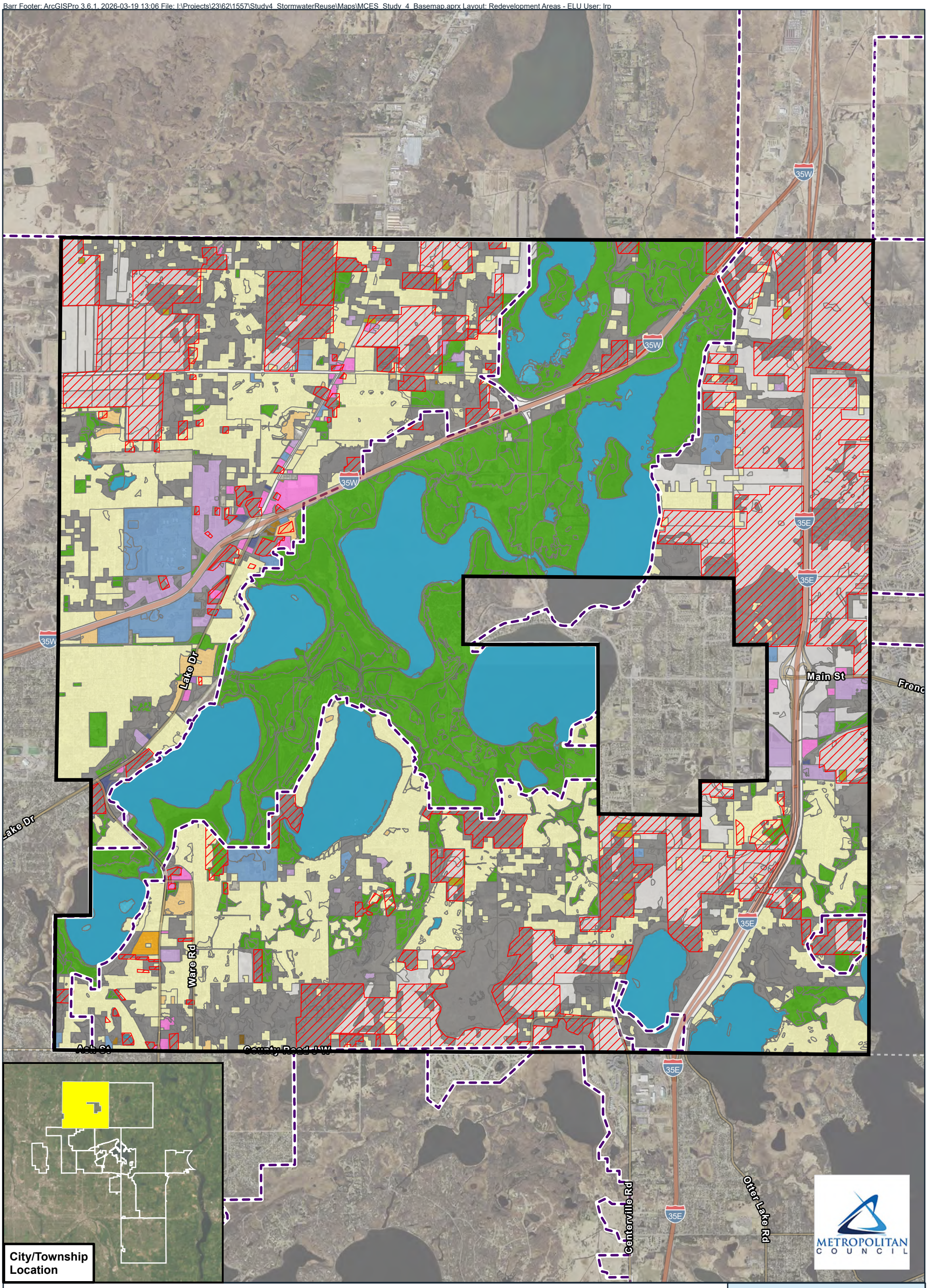


Municipal Boundary
Metropolitan Urban Service Area (MUSA) Boundary
Proposed Redevelopment Area

Existing Land Use Category*
- Agricultural
- Undeveloped
- Farmstead/Rural Residential
- Single Family Detached
- Single Family Attached
- Manufactured Housing Park
- Multifamily
- Mixed Use Residential
- Retail and Other Commercial
- Industrial or Utility
- Mixed Use Industrial
- Institutional
- Office
- Open Water
- Park, Recreational, Preserve, or Golf Course
- Major Highway

N

0 1,700 3,400
Feet

Note:

*Existing Land Use categories are recategorized from Met Council Generalized Land Use 2020 data.

Existing Conditions Land Use and Proposed Development/ Redevelopment Area
Lino Lakes, MN
MCES Study 4

FIGURE 1A

BARR

35W
35W
35E
35E
35E
35E
35E
35W
Lake Dr
Lake Dr
Main St
Ware Rd
Ash St
County Road E W
Centerville Rd
Otter Lake Rd

City/Township Location

- Municipal Boundary
- Metropolitan Urban Service Area (MUSA) Boundary
- Proposed Development/ Redevelopment Area

Future Land Use Category*

- Agricultural
- Undeveloped
- Farmstead/Rural Residential
- Single Family Detached
- Single Family Attached
- Multifamily
- Mixed Use Residential
- Retail and Other Commercial
- Mixed Use Commercial
- Industrial or Utility
- Institutional
- Office
- Open Water
- Park, Recreational, Preserve, or Golf Course
- Major Highway
- Airport

0 1,700 3,400
Feet

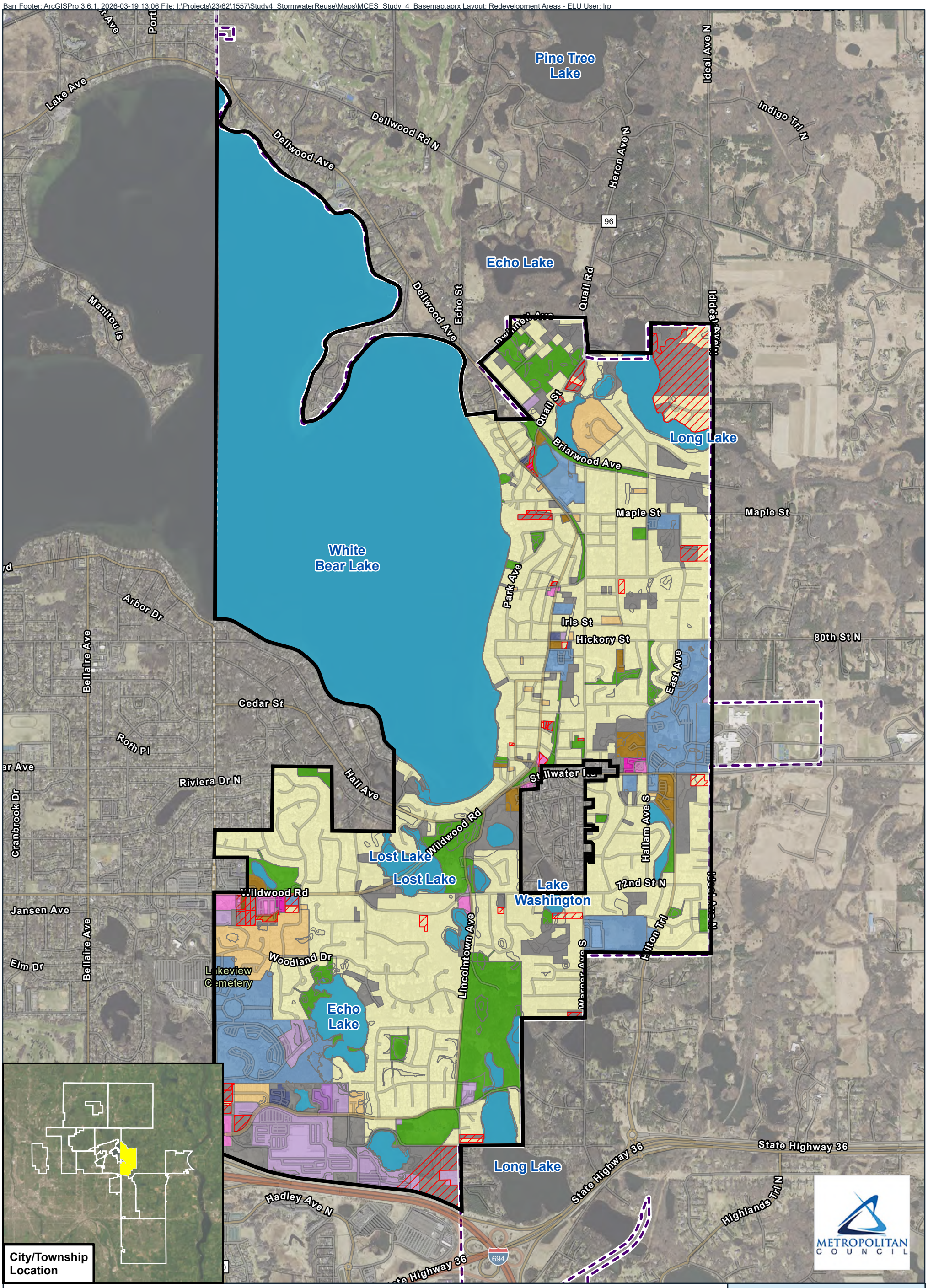
Note:

*Future Land Use categories are recategorized from Met Council Regional Planned Land Use data and data provided by cities/townships.

Future Conditions Land Use and Proposed Development/ Redevelopment Area
Lino Lakes, MN
MCES Study 4

FIGURE 1B

BARR



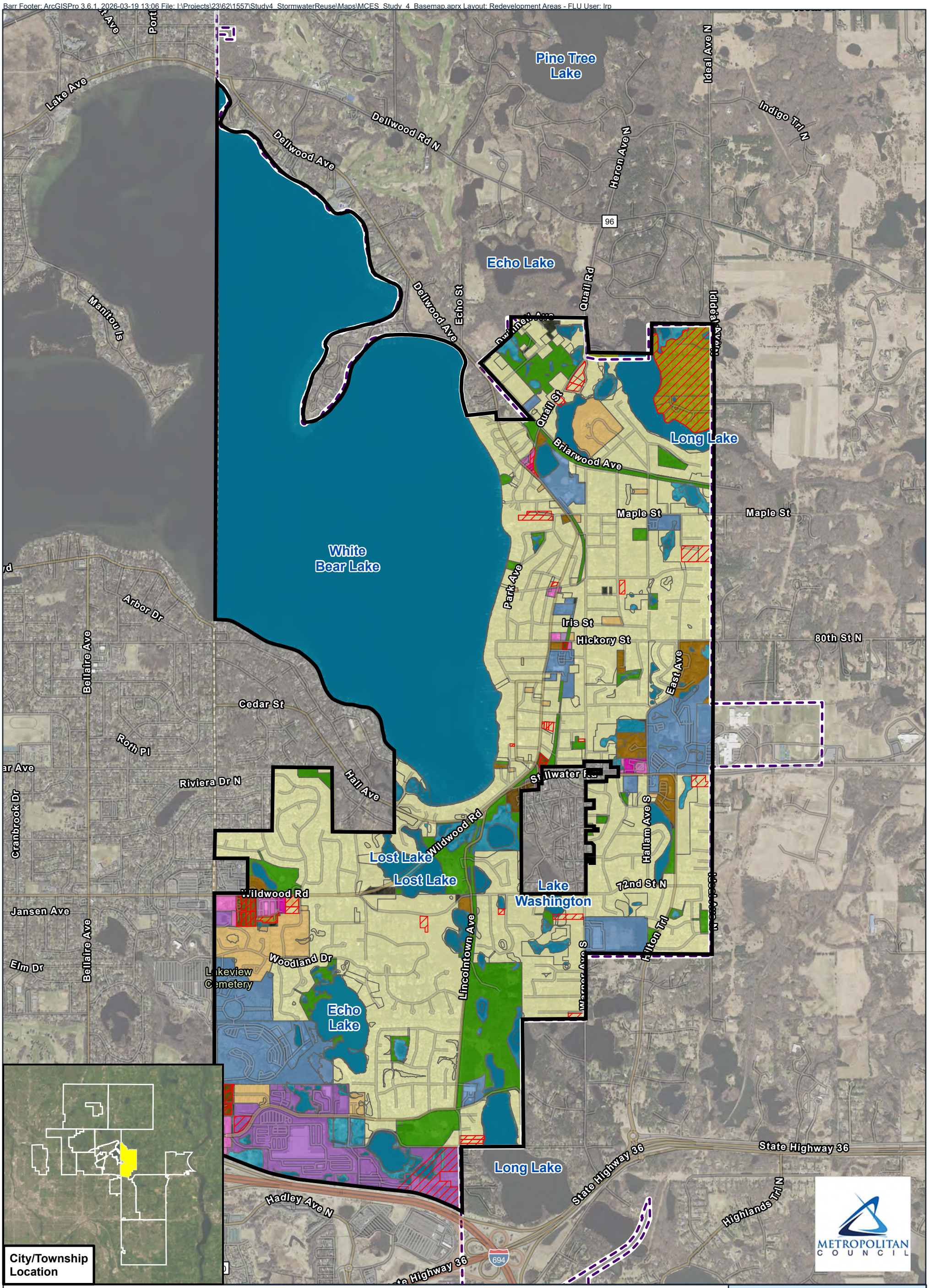
Note: The proposed redevelopment area was provided as shapefiles by Mahtomedi.

*Existing Land Use categories are recategorized from Met Council Generalized Land Use 2020 data.

Existing Conditions Land Use and Proposed Development/ Redevelopment Area
Mahtomedi, MN
MCES Study 4

FIGURE 1A

BARR



- Municipal Boundary
- Metropolitan Urban Service Area (MUSA) Boundary
- Proposed Development/ Redevelopment Area

Future Land Use Category*

- Farmstead/Rural Residential
- Single Family Detached
- Single Family Attached
- Multifamily
- Mixed Use Residential
- Retail and Other Commercial
- Mixed Use Commercial
- Industrial or Utility
- Mixed Use Industrial
- Institutional
- Office
- Open Water
- Park, Recreational, Preserve, or Golf Course
- Major Highway

0 920 1,800
Feet

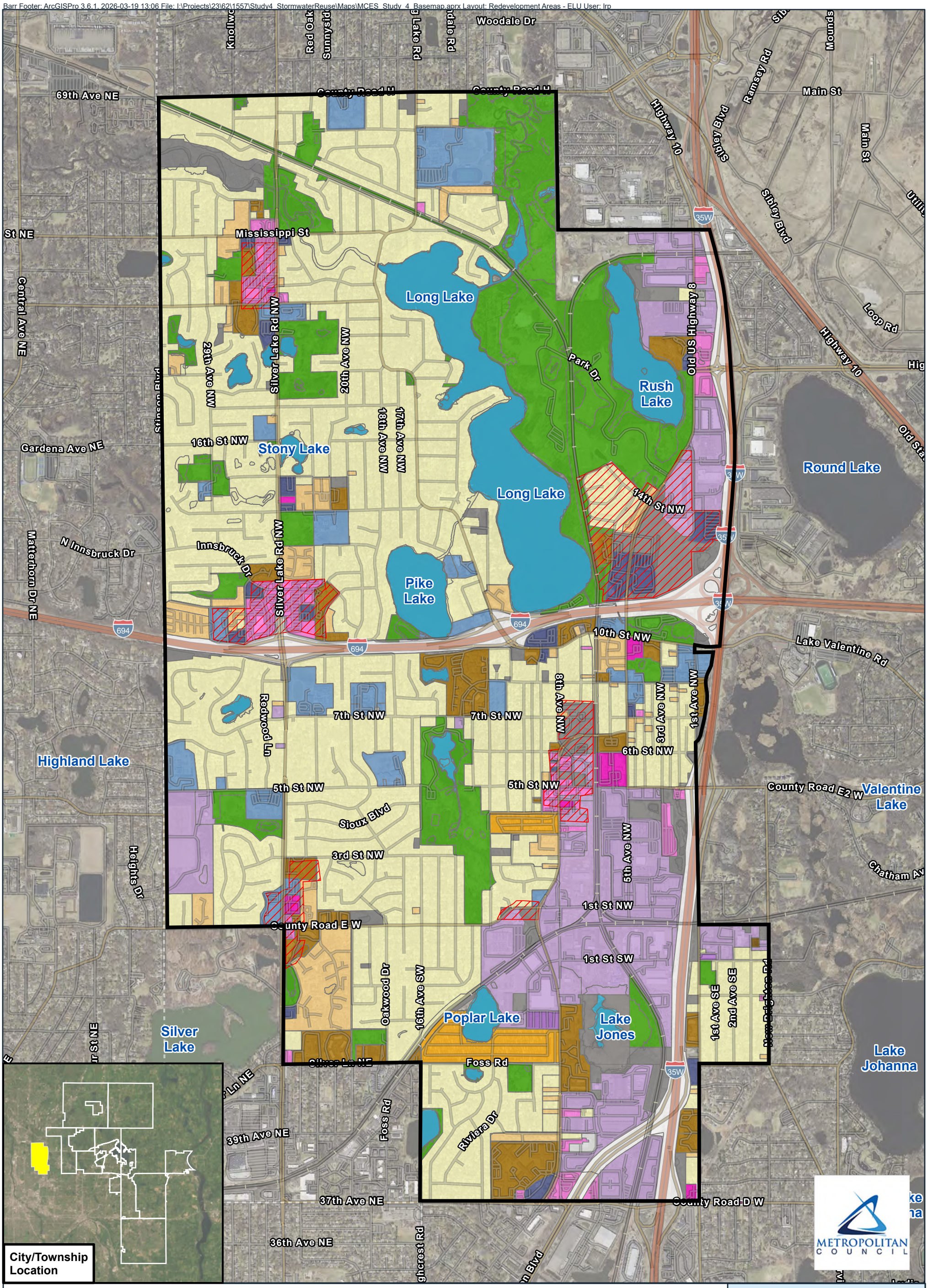
Note: The proposed redevelopment area was provided as shapefiles by Mahtomedi.

*Future Land Use categories are recategorized from Met Council Regional Planned Land Use data and data provided by cities/townships.

Future Conditions Land Use and Proposed Development/ Redevelopment Area
Mahtomedi, MN
MCES Study 4

FIGURE 1B

BARR



Municipal Boundary
Metropolitan Urban Service Area (MUSA) Boundary
Proposed Redevelopment Area

Existing Land Use Category*
- Agricultural
- Undeveloped
- Single Family Detached
- Single Family Attached
- Manufactured Housing Park
- Multifamily
- Mixed Use Residential
- Retail and Other Commercial
- Mixed Use Commercial
- Industrial or Utility
- Mixed Use Industrial
- Institutional
- Office
- Open Water
- Park, Recreational, Preserve, or Golf Course
- Major Railway
- Major Highway

N

0 830 1,700
Feet

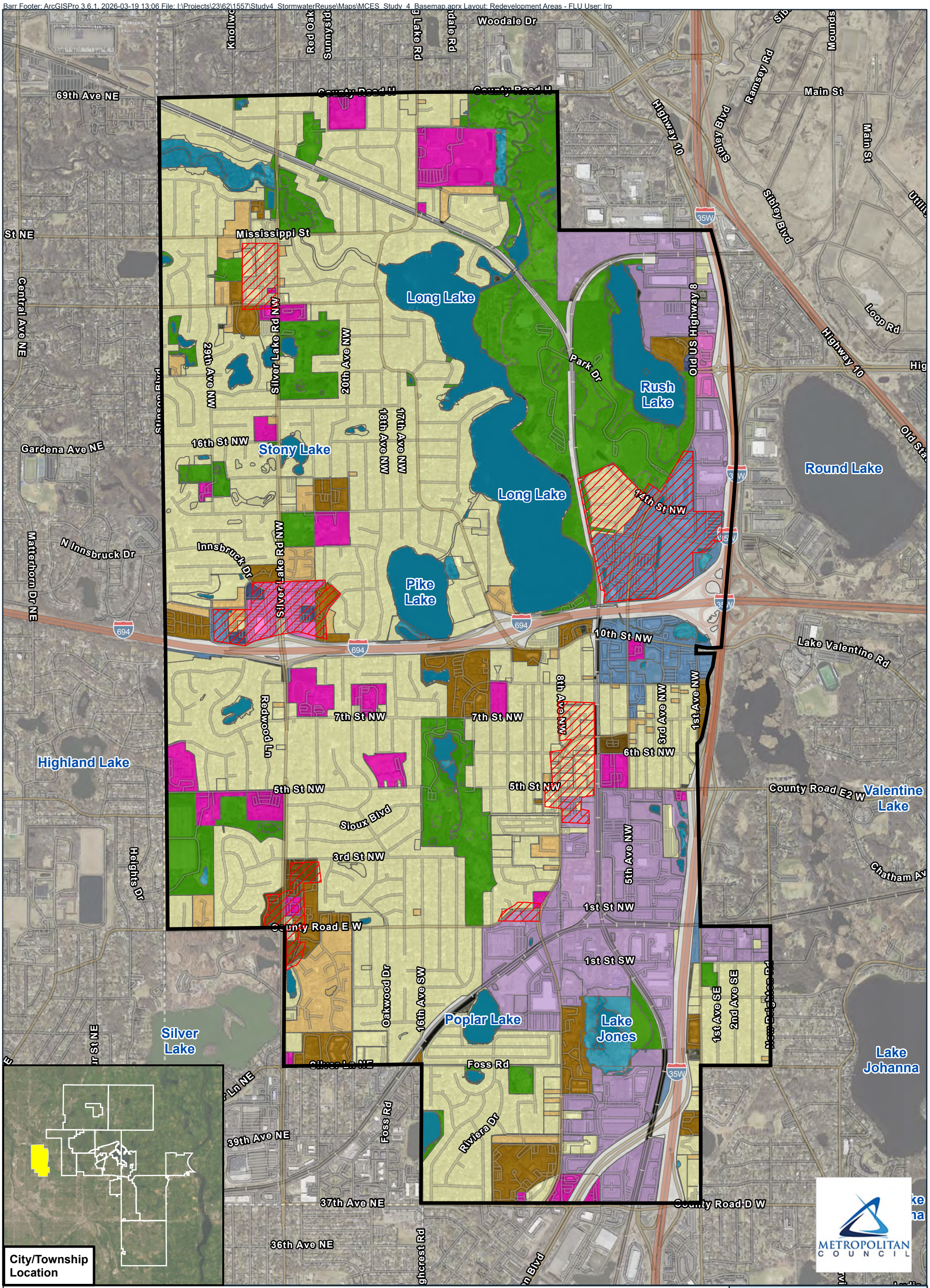
Note: The proposed redevelopment area was determined using New Brighton's 2040 Comprehensive Plan.

*Existing Land Use categories are recategorized from Met Council Generalized Land Use 2020 data.

Existing Conditions Land Use and Proposed Development/ Redevelopment Area
New Brighton, MN
MCES Study 4

FIGURE 1A

BARR


Woodale Dr
County Road H
69th Ave NE
Main St
Highway 10
Sibley Blvd
Ramsey Rd
Mounds
Mississippi St
Long Lake
Rush Lake
Round Lake
Stony Lake
Pike Lake
Poplar Lake
Lake Jones
Silver Lake
Highland Lake
Valentine Lake
Lake Johanna
Park Dr
Old US Highway 8
Loop Rd
Central Ave NE
Silver Lake Rd NW
20th Ave NW
18th Ave NW
17th Ave
16th St NW
Gardena Ave NE
Matterhorn Dr NE
N Innsbruck Dr
Innsbruck Dr
14th St NW
10th St NW
Lake Valentine Rd
Redwood Ln
7th St NW
8th Ave NW
3rd Ave NW
1st Ave NW
6th St NW
5th St NW
County Road E2 W
Sioux Blvd
3rd St NW
5th Ave NW
1st St NW
County Road E W
Heights Dr
Oakwood Dr
16th Ave SW
1st St SW
1st Ave SE
2nd Ave SE
Foss Rd
Riviera Dr
39th Ave NE
37th Ave NE
36th Ave NE
County Road D W
Chatham Av
694
35W
City/Township Location
Municipal Boundary
Metropolitan Urban Service Area (MUSA) Boundary
Proposed Development/ Redevelopment Area
Future Land Use Category*
Single Family Detached
Single Family Attached
Manufactured Housing Park
Multifamily
Mixed Use Residential
Retail and Other Commercial
Mixed Use Commercial
Industrial or Utility
Institutional
Office
Open Water
Park, Recreational, Preserve, or Golf Course
Major Highway
Major Railway
N
0
830
1,700
Feet
Note: The proposed redevelopment area was determined using New Brighton's 2040 Comprehensive Plan.
*Future Land Use categories are recategorized from Met Council Regional Planned Land Use data and data provided by cities/townships.
Future Conditions Land Use and Proposed Development/ Redevelopment Area
New Brighton, MN
MCES Study 4
FIGURE 1B
METROPOLITAN COUNCIL
BARR

Baldwin Lake
Hawthorn Rd
W Shadow Lake Dr
Deerwood Ln
Holly Dr W
Karth Rd
Holly Dr
Centerville Rd
Laurene Ave
Hodgson Rd
Ware Rd
62nd St
Holly Dr N
Cedar Lake
Amelia Lake
County Road J W
Emil Ave
Poplar Lake
Bucher Ave
Sherwood Rd
Wilkinson Lake
Deep Lake
Donegal Dr
Turtle Lake Rd
Long Lake
Peterson Pl
Island Rd
Catbird Ln
Charley Lake
Lake Ct
W Pleasant Lake Rd
Oriole Ln
N Oaks Rd
Pleasant Lake
Dogwood Ln
Black Lake
Spring Farm Ln
E Oaks Rd
Raven Rd
Ridge Rd
Gilfillan Lake
Robb Farm Rd
Allendale Dr
Mound Ave
Highway 96 W
Highway 96 E
Sucker Lake
McMenemy St
Oakcrest Dr
Rice St
County Road F E
Vadnais Lake
35E

City/Township Location

- Municipal Boundary
- Metropolitan Urban Service Area (MUSA) Boundary
- Proposed Redevelopment Area

Existing Land Use Category*

- Agricultural
- Undeveloped
- Farmstead/Rural Residential
- Single Family Detached
- Single Family Attached
- Multifamily
- Seasonal/Vacation
- Retail and Other Commercial
- Industrial or Utility
- Institutional
- Office
- Open Water
- Park, Recreational, Preserve, or Golf Course

0 1,000 2,000
Feet

Note: The proposed redevelopment area was determined using North Oaks' 2040 Comprehensive Plan.

*Existing Land Use categories are recategorized from Met Council Generalized Land Use 2020 data.

Existing Conditions Land Use and Proposed Development/ Redevelopment Area
North Oaks, MN
MCES Study 4

FIGURE 1A

BARR

Baldwin Lake
Hawthorn Rd
W Shadow Lake Dr
Deerwood Ln
Holly Dr W
Karth Rd
Holly Dr
Centerville Rd
Laurene Ave
Hodgson Rd
Ware Rd
62nd St
Holly Dr N
Cedar Lake
Amelia Lake
County Road J W
Emil Ave
Poplar Lake
Bucher Ave
Wilkinson Lake
Sherwood Rd
Deep Lake
Donegal Dr
Turtle Lake Rd
Long Lake
Peterson Pl
Island Rd
Catbird Ln
Oriole Ln
Charley Lake
Lake Ct
W Pleasant Lake Rd
Pleasant Lake
Dogwood Ln
N Oaks Rd
Black Lake
Spring Farm Ln
E Oaks Rd
Raven Rd
Ridge Rd
Gilfillan Lake
Robb Farm Rd
Allendale Dr
Mound Ave
Highway 96 W
Highway 96 E
Sucker Lake
McMenemy St
Rice St
Oakcrest Dr
35E
County Road F E
Vadnais Lake

City/Township Location

- Municipal Boundary
- Metropolitan Urban Service Area (MUSA) Boundary
- Proposed Development/ Redevelopment Area

Future Land Use Category*

- Undeveloped
- Single Family Detached
- Single Family Attached
- Mixed Use Residential
- Retail and Other Commercial
- Mixed Use Commercial
- Industrial or Utility
- Institutional
- Open Water
- Park, Recreational, Preserve, or Golf Course
- Major Railway

N

0 1,000 2,000
Feet

Note: The proposed redevelopment area was determined using North Oaks' 2040 Comprehensive Plan.

*Future Land Use categories are recategorized from Met Council Regional Planned Land Use data and data provided by cities/townships.

Future Conditions Land Use and Proposed Development/ Redevelopment Area
North Oaks, MN
MCES Study 4

FIGURE 1B

METROPOLITAN COUNCIL

BARR

Gall Ave
Bear Ave N
Woodlynn Ave E
Maplewood Mall Dr
Lydia Ave E
Furness St
Howard St N
Maple Ln E
Beam Ave
Mapleview Ave
Radatz Ave
Mesabi Ave
Shoshone Rd
Navajo Rd
Indian Way
Chippewa Ave
2nd St N
Hilltop Ct
Bartelmy Ln
Mary St
Bellaire Ave
Lake Blvd
Joy Rd
Division St N
Golfview Ave N
54th St N
Silver Lake
Casey Lake
White Bear Ave N
McKnight Rd N
Apache Rd N
Mohawk Rd E
19th Ave E
18th Ave E
17th Ave E
16th Ave E
15th Ave E
14th Ave E
13th Ave E
12th Ave E
11th Ave E
3rd St N
Helen St N
Charles St N
Margaret St N
Highway 36 E
7th Ave E
8th Ave E
6th Ave E
5th Ave E
4th Ave E
3rd Ave E
2nd Ave E
1st Ave E
Castle Ave E
Cope Ave E
6th St N
Hazel St N
German St
South Ave E
Burke Ave E
Eldridge Ave E
Belmont Ln E
1st St N
N Ivy St
Northwood Dr
Shryer Ave E
Park Row
Henry St N
Cowern Pl E
Holloway Ave E
Myrtle St
Ripley Ave
Beebe Rd N
Benet Rd
Geneva Ave N
Gershwin Ave N
49th
48th St
47th St N
Upper 46th St N
46th St N
43rd St N
Upper 44th St N
Upper 35th St
36th St
State H

City/Township Location

Municipal Boundary
Metropolitan Urban Service Area (MUSA) Boundary
Proposed Redevelopment Area

Existing Land Use Category*
Agricultural
Undeveloped
Single Family Detached
Single Family Attached
Multifamily
Mixed Use Residential
Retail and Other Commercial
Mixed Use Commercial
Industrial or Utility
Mixed Use Industrial
Institutional
Office
Open Water
Park, Recreational, Preserve, or Golf Course
Major Highway

0 540 1,100
Feet

Note: The proposed redevelopment area was determined using North St. Paul's 2040 Comprehensive Plan.

*Existing Land Use categories are recategorized from Met Council Generalized Land Use 2020 data.

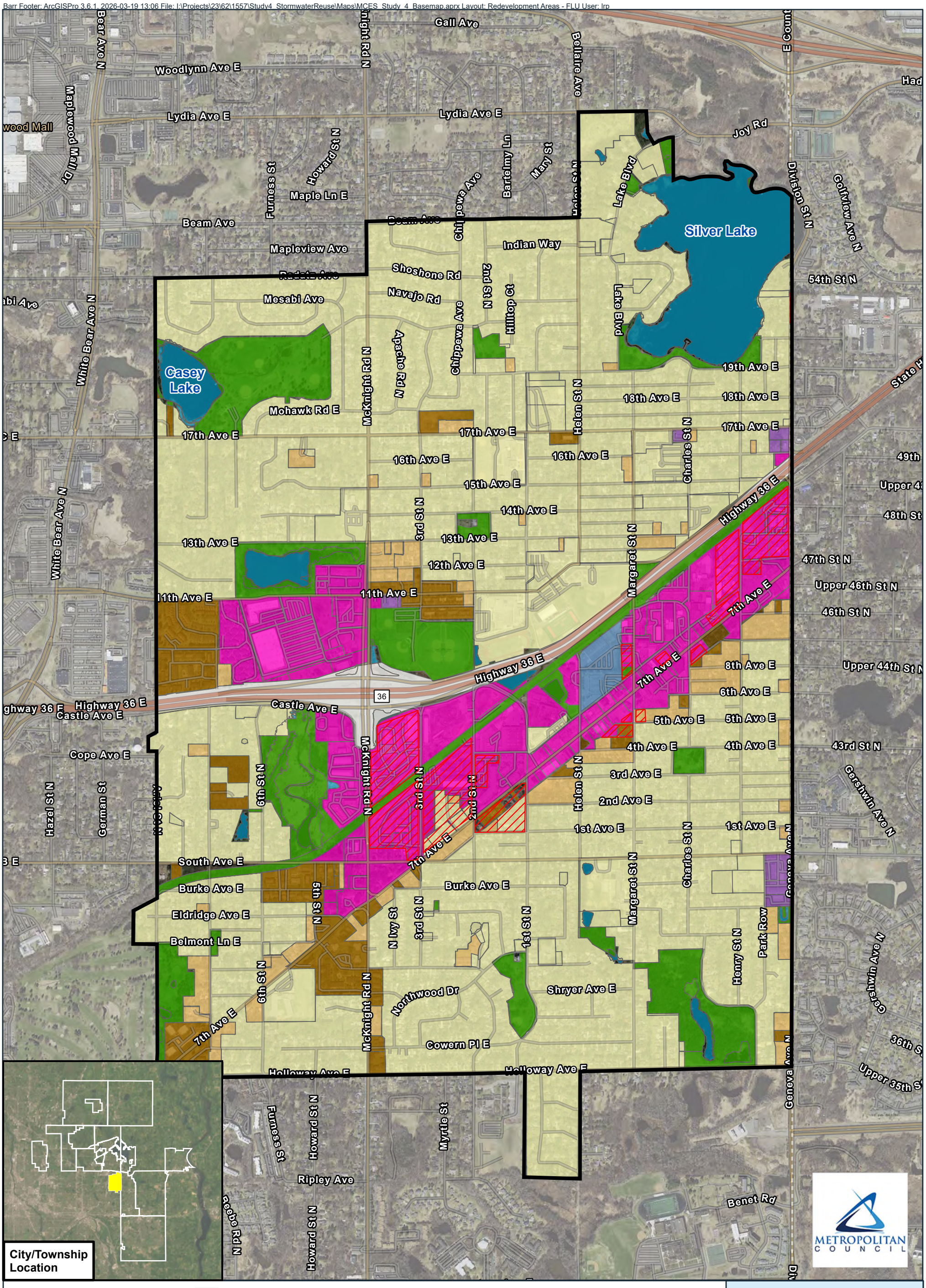
Existing Conditions Land Use and Proposed Development/ Redevelopment Area

North Saint Paul, MN
MCES Study 4

FIGURE 1A

METROPOLITAN COUNCIL

BARR



Municipal Boundary

Metropolitan Urban Service Area (MUSA) Boundary

Proposed Development/ Redevelopment Area

Future Land Use Category*

- Single Family Detached
- Single Family Attached
- Multifamily
- Mixed Use Residential
- Retail and Other Commercial
- Mixed Use Commercial
- Mixed Use Industrial
- Institutional
- Open Water
- Park, Recreational, Preserve, or Golf Course
- Major Highway

0 540 1,100

Feet

Note: The proposed redevelopment area was determined using North St. Paul's 2040 Comprehensive Plan.

*Future Land Use categories are recategorized from Met Council Regional Planned Land Use data and data provided by cities/townships.

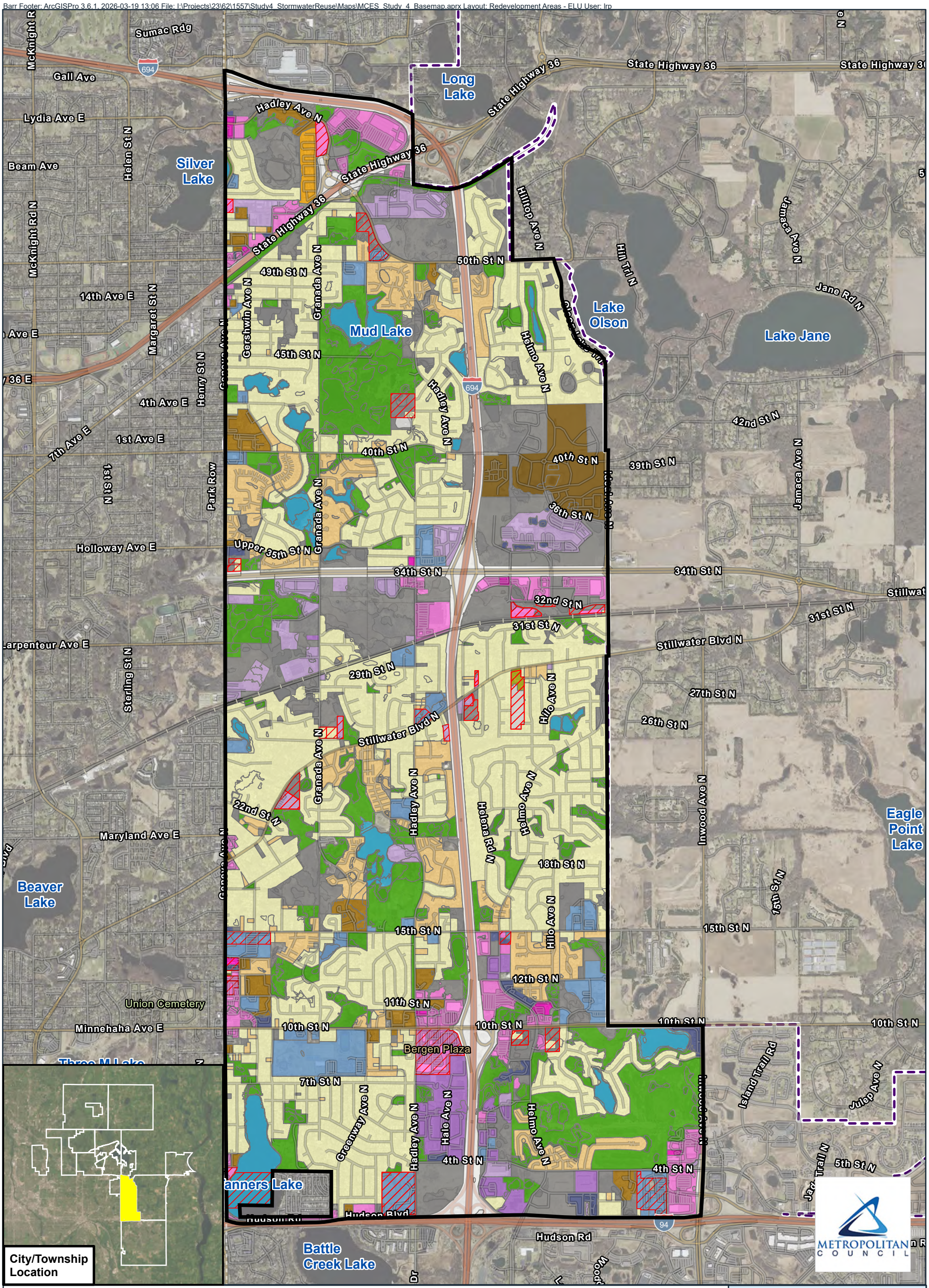
Future Conditions Land Use and Proposed Development/ Redevelopment Area

North Saint Paul, MN

MCES Study 4

FIGURE 1B

BARR



Municipal Boundary
Metropolitan Urban Service Area (MUSA) Boundary
Proposed Redevelopment Area

Existing Land Use Category*
- Agricultural
- Undeveloped
- Farmstead/Rural Residential
- Single Family Detached
- Single Family Attached
- Manufactured Housing Park
- Multifamily
- Mixed Use Residential
- Retail and Other Commercial
- Mixed Use Commercial
- Industrial or Utility
- Mixed Use Industrial
- Institutional
- Office
- Open Water
- Park, Recreational, Preserve, or Golf Course
- Major Railway
- Major Highway

N

0 1,200 2,400
Feet

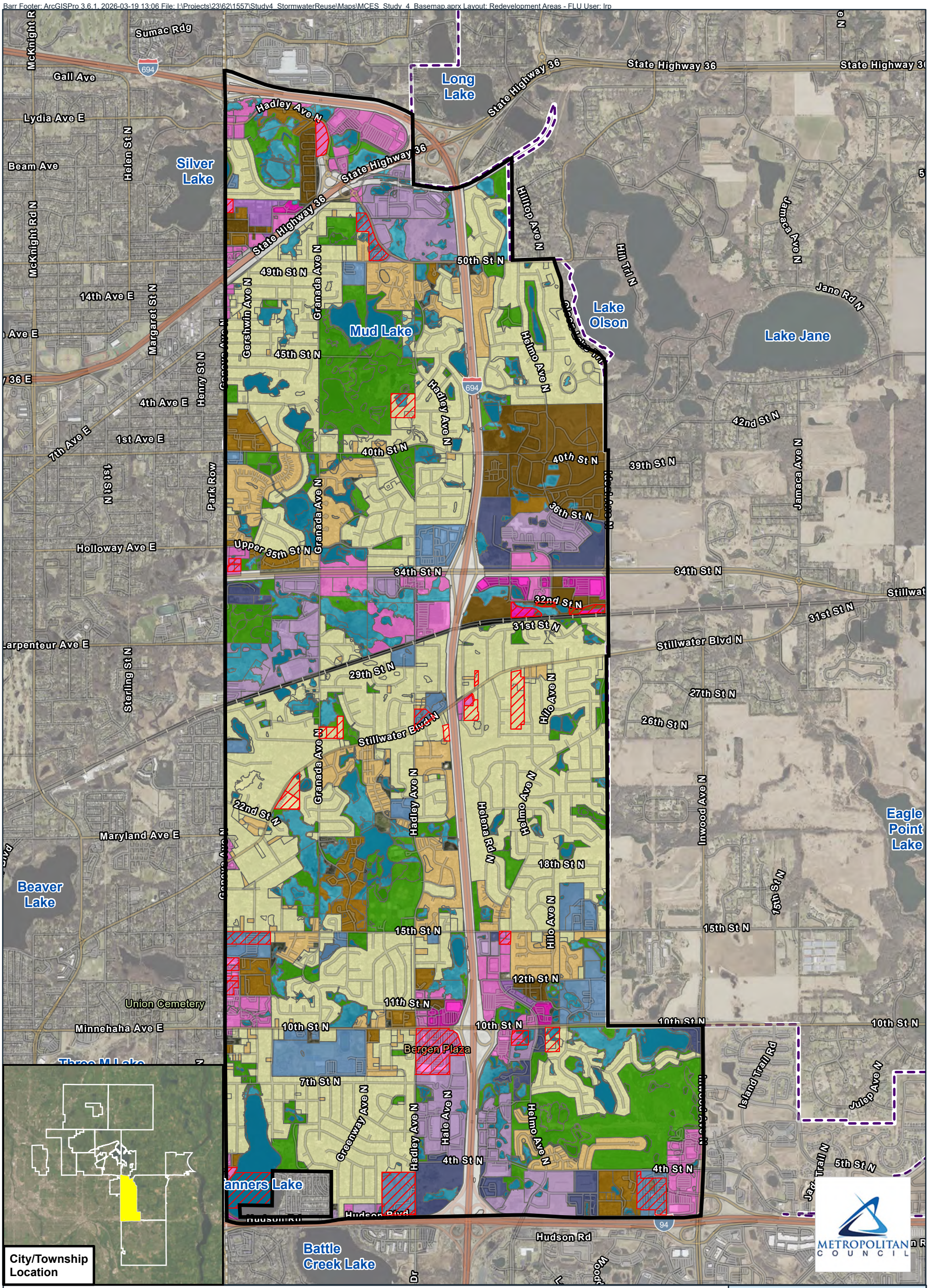
Note: The proposed redevelopment area was provided as layer files by Oakdale.

*Existing Land Use categories are recategorized from Met Council Generalized Land Use 2020 data.

Existing Conditions Land Use and Proposed Development/ Redevelopment Area
Oakdale, MN
MCES Study 4

FIGURE 1A

BARR



Municipal Boundary
Metropolitan Urban Service Area (MUSA) Boundary
Proposed Development/ Redevelopment Area

Future Land Use Category*
- Agricultural
- Undeveloped
- Farmstead/Rural Residential
- Single Family Detached
- Single Family Attached
- Multifamily
- Mixed Use Residential
- Retail and Other Commercial
- Mixed Use Commercial
- Industrial or Utility
- Mixed Use Industrial
- Institutional
- Office
- Open Water
- Park, Recreational, Preserve, or Golf Course
- Major Highway
- Major Railway

0 1,200 2,400
Feet

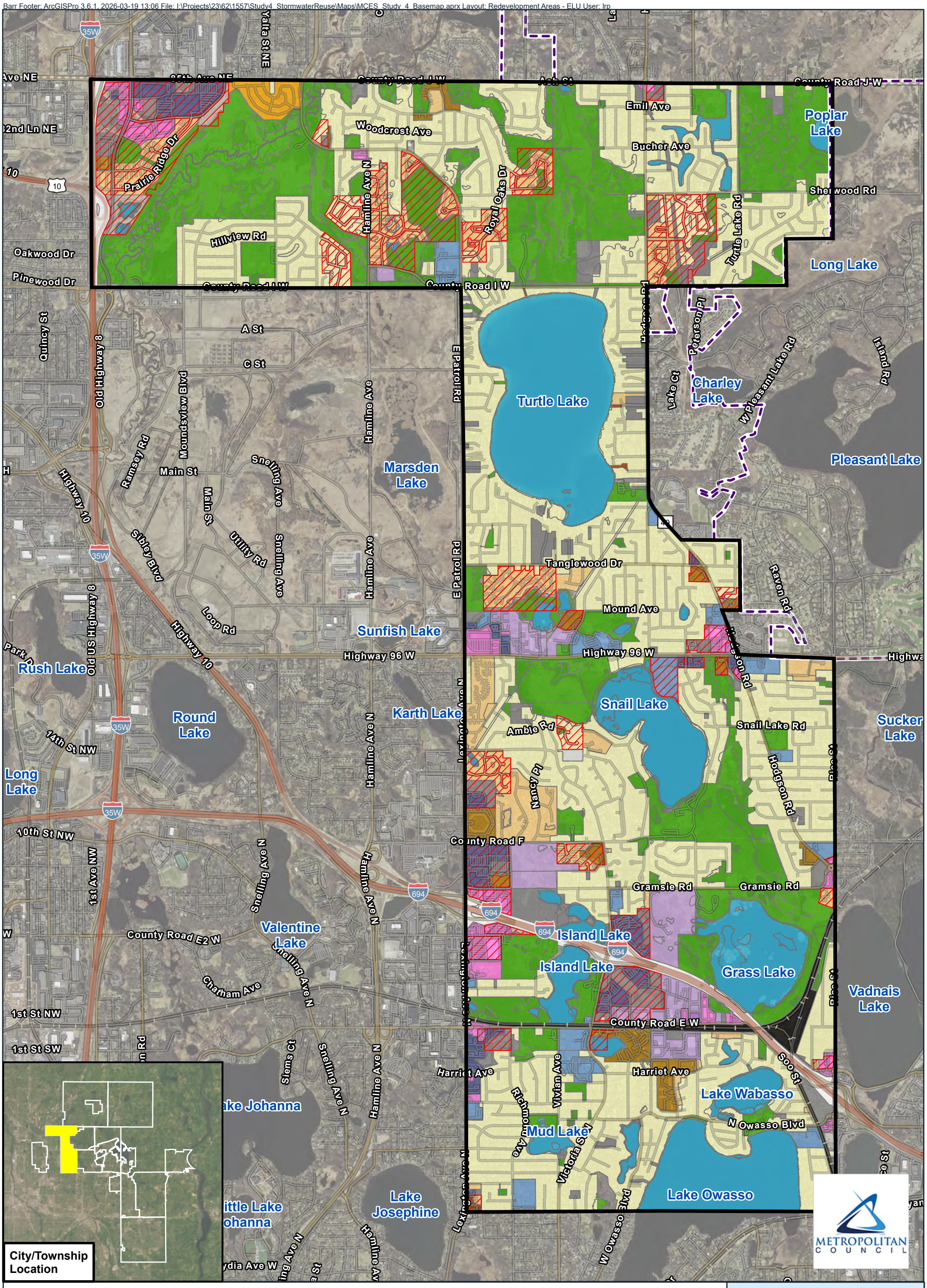
Note: The proposed redevelopment area was provided as layer files by Oakdale.

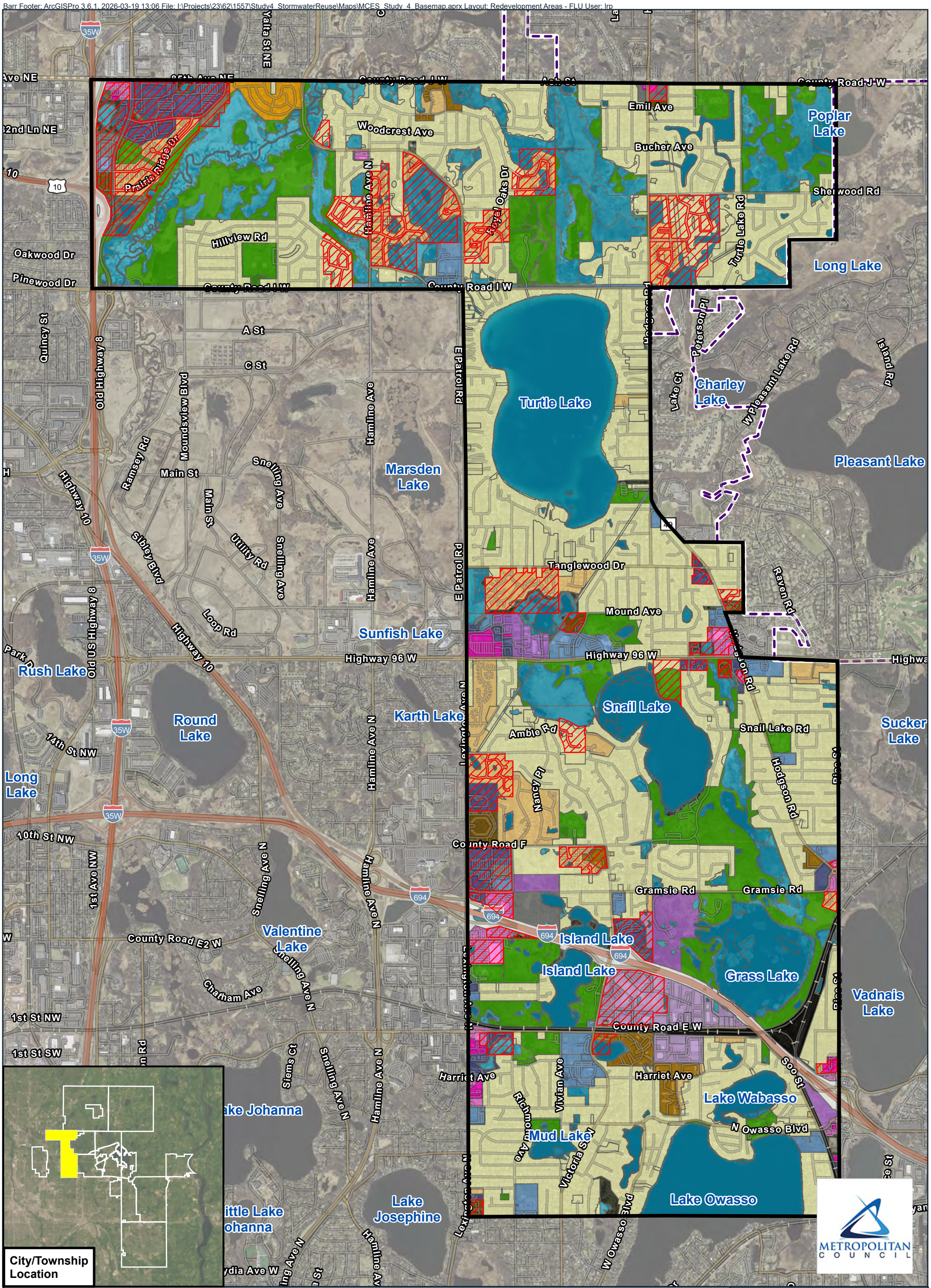
*Future Land Use categories are recategorized from Met Council Regional Planned Land Use data and data provided by cities/townships.

Future Conditions Land Use and Proposed Development/ Redevelopment Area
Oakdale, MN
MCES Study 4

FIGURE 1B

BARR


35W
Yalta St NE
County Road J W
Ash St
Emil Ave
Poplar Lake
Woodcrest Ave
Bucher Ave
Prairie Ridge Dr
Hamline Ave N
Royal Oaks Dr
Turtle Lake Rd
Sherwood Rd
Hillview Rd
Oakwood Dr
Pinewood Dr
County Road I W
Long Lake
Quincy St
A St
C St
Old Highway 8
E Patrol Rd
Peterson Pl
Lake Ct
Charley Lake
W Pleasant Lake Rd
Island Rd
Turtle Lake
Ramsey Rd
Moundsview Blvd
Main St
Snelling Ave
Marsden Lake
Pleasant Lake
Highway 10
Sibley Blvd
Utility Rd
Tanglewood Dr
Raven Rd
Mound Ave
Loop Rd
Sunfish Lake
Old US Highway 8
Highway 96 W
Rush Lake
Round Lake
Karth Lake
Snail Lake
Amble Rd
Snail Lake Rd
Sucker Lake
14th St NW
Nancy Pl
Hodgson Rd
10th St NW
County Road F
Gramsie Rd
1st Ave NW
Valentine Lake
County Road E2 W
Island Lake
Grass Lake
Vadnais Lake
Chatham Ave
1st St NW
1st St SW
County Road E W
Siems Ct
Harriet Ave
Vivian Ave
Richmond Ave
Soo St
Lake Wabasso
N Owasso Blvd
Mud Lake
Victoria St
Lake Owasso
W Owasso Blvd
Lake Josephine
694
City/Township Location
Municipal Boundary
Metropolitan Urban Service Area (MUSA) Boundary
Proposed Redevelopment Area
Existing Land Use Category*
Agricultural
Undeveloped
Single Family Detached
Single Family Attached
Manufactured Housing Park
Multifamily
Mixed Use Residential
Seasonal/Vacation
Retail and Other Commercial
Industrial or Utility
Mixed Use Industrial
Institutional
Office
Open Water
Park, Recreational, Preserve, or Golf Course
Major Railway
Major Highway
N
0
1,300
2,500
Feet
Note: The proposed redevelopment area was provided as a feature class by Shoreview.
*Existing Land Use categories are recategorized from Met Council Generalized Land Use 2020 data.
Existing Conditions Land Use and Proposed Development/ Redevelopment Area
Shoreview, MN
MCES Study 4
FIGURE 1A
METROPOLITAN COUNCIL
BARR



- Municipal Boundary
- Metropolitan Urban Service Area (MUSA) Boundary
- Proposed Development/ Redevelopment Area

Future Land Use Category*

- Undeveloped
- Single Family Detached
- Single Family Attached
- Manufactured Housing Park
- Multifamily
- Mixed Use Residential
- Retail and Other Commercial
- Mixed Use Commercial
- Industrial or Utility
- Mixed Use Industrial
- Institutional
- Office
- Open Water
- Park, Recreational, Preserve, or Golf Course
- Major Highway
- Major Railway

0 1,300 2,500
Feet

Note: The proposed redevelopment area was provided as a feature class by Shoreview.

*Future Land Use categories are recategorized from Met Council Regional Planned Land Use data and data provided by cities/townships.

Future Conditions Land Use and Proposed Development/ Redevelopment Area
Shoreview, MN
MCES Study 4

FIGURE 1B

BARR

Manning Ave N
103rd St N
Mendel Rd N
Stonebridge Trl N
100th St N
Perkins Ave N
Saint Croix Trl N
97th St N
Twin Lakes
Neal Ave N
Newgate Ave N
Norell Ave N
Fairy Falls Rd N
Dellwood Rd N
White Pine Way
Broadway St N
80th St N
Boutwell Rd N
Lake McKusick
Meadowlark Dr
Maple St W
William St N
4th St N
2nd St N
Hilltop Dr
Main St
State Highway 36
75th St N
Linden St W
Mulberry St W
Myrtle St W
Maryknoll Dr
Olive St W
Pine St W
Croixwood Blvd
Northland Ave
Long Lake
Lily Lake
Holcombe St S
Greeley St S
Everett St S
5th St S
3rd St S
1st St S
4th Ave S
Main St S
Lookout Trl N
Orleans St W
Curve Crest Blvd W
Tower Dr W
Shelton Dr
62nd St N
60th St N
State Highway 36
Stillwater Blvd N
Sunrise Ave
Lexington Blvd
58th St N
57th St N
55th St N
51st St N
49th St N
47th St N
Osgood Ave N
Stagecoach Trl N
5th Ave N
McDonald Lake
King Plant Rd

City/Township Location

- Municipal Boundary
- Metropolitan Urban Service Area (MUSA) Boundary
- Proposed Redevelopment Area

Existing Land Use Category*

- Agricultural
- Undeveloped
- Single Family Detached
- Single Family Attached
- Multifamily
- Mixed Use Residential
- Retail and Other Commercial
- Mixed Use Commercial
- Industrial or Utility
- Mixed Use Industrial
- Institutional
- Office
- Open Water
- Park, Recreational, Preserve, or Golf Course
- Major Highway

N

0 1,100 2,200

Feet

Note: The proposed redevelopment area was determined using Stillwater's 2040 Comprehensive Plan.

*Existing Land Use categories are recategorized from Met Council Generalized Land Use 2020 data.

Existing Conditions Land Use and Proposed Development/ Redevelopment Area
Stillwater, MN
MCES Study 4

FIGURE 1A

METROPOLITAN COUNCIL

BARR

Twin Lakes
Lake McKusick
Long Lake
Lily Lake
McDonald Lake

Manning Ave N
Mendel Rd N
103rd St N
Stonebridge Trl N
100th St N
Perkins Ave N
Saint Croix Trl N
97th St N
Neal Ave N
Newgate Ave N
Norell Ave N
Fairy Falls Rd N
Dellwood Rd N
White Pine Way
Broadway St N
80th St N
Boutwell Rd N
Meadowlark Dr
75th St N
Linden St W
Mulberry St W
Myrtle St W
Olive St W
Pine St W
Maryknoll Dr
Northland Ave
Croixwood Blvd
Sunrise Ave
Partridge Blvd
Orleans St W
Curve Crest Blvd W
Tower Dr W
Shelton Dr
62nd St N
60th St N
State Highway 36
Stillwater Blvd N
58th St N
57th St N
55th St N
51st St N
49th St N
47th St N
Osgood Ave N
Stagecoach Trl N
5th Ave N
King Plant Rd
William St N
4th St N
2nd St N
3rd St N
Main St N
Maple St W
Hilltop Dr
Main St
Holcombe St S
Greeley St S
Everett St S
5th St S
3rd St S
1st St S
4th Ave S
Main St S
Lookout Trl N
State Highway 36

City/Township Location

Municipal Boundary
Metropolitan Urban Service Area (MUSA) Boundary
Proposed Development/ Redevelopment Area

Future Land Use Category*
- Agricultural
- Farmstead/Rural Residential
- Single Family Detached
- Single Family Attached
- Multifamily
- Retail and Other Commercial
- Mixed Use Commercial
- Industrial or Utility
- Mixed Use Industrial
- Institutional
- Office
- Open Water
- Park, Recreational, Preserve, or Golf Course
- Major Highway

0 1,100 2,200
Feet

Note: The proposed redevelopment area was determined using Stillwater's 2040 Comprehensive Plan.

*Future Land Use categories are recategorized from Met Council Regional Planned Land Use data and data provided by cities/townships.

Future Conditions Land Use and Proposed Development/ Redevelopment Area
Stillwater, MN
MCES Study 4

FIGURE 1B

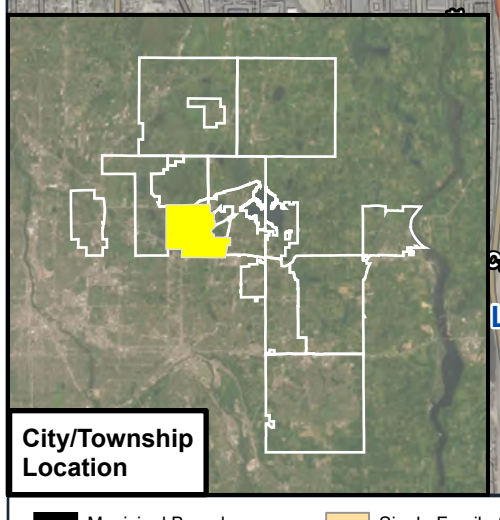
METROPOLITAN COUNCIL

BARR

Pleasant Lake
Black Lake
Tamarack Lake
Gilfillan Lake
Birch Lake
Sucker Lake
Vadnais Lake
Vadnais Lake
Twin Lake
Gem Lake
Willow Lake
Kohlman Lake
Gervais Lake
Lake

Dogwood Ln
Spring Farm Ln
E Oaks Rd
Ridge Rd
Robb Farm Rd
Allendale Dr
Centerville Rd
Hammond Rd
Sandra Ln
Carolyn Ln
Otter Lake Rd
S Birch Lake Blvd
Oakmede Ln
McMenemy St
Oakcrest Dr
County Road F E
Clover Ave
Labore Rd
Goose Lake Rd
Scheuneman Rd
Hoffman Rd
Koehler Rd
Vadnais Blvd
Edgerton St N
Greenbrier St
Service Rd
Highway 61 N
County Road E E
Rice St
Spruce St
Ryan Dr
County Dr
Centerville Rd
Allen Ave
Desoto St
Payne Ave
Ontario St
Walter St
Frank St
Duluth St
Maplewood Dr
County Road D E
Kennard St
Beam Ave
Keller Pkwy
Noel Dr
Forest St
Kohlman Ave
County Road C E
Canada Rd E

Highway 96 E
35E
49
694



Municipal Boundary
Metropolitan Urban Service Area (MUSA) Boundary
Proposed Redevelopment Area

Existing Land Use Category*
Agricultural
Undeveloped
Single Family Detached
Single Family Attached
Manufactured Housing Park
Multifamily
Mixed Use Residential
Retail and Other Commercial
Mixed Use Commercial
Industrial or Utility
Mixed Use Industrial
Institutional
Office
Open Water
Park, Recreational, Preserve, or Golf Course
Major Railway
Major Highway

N

0 1,000 2,100
Feet

Note: The proposed redevelopment area was determined by future land use data defined as "redevelopable" by Vadnais Heights.

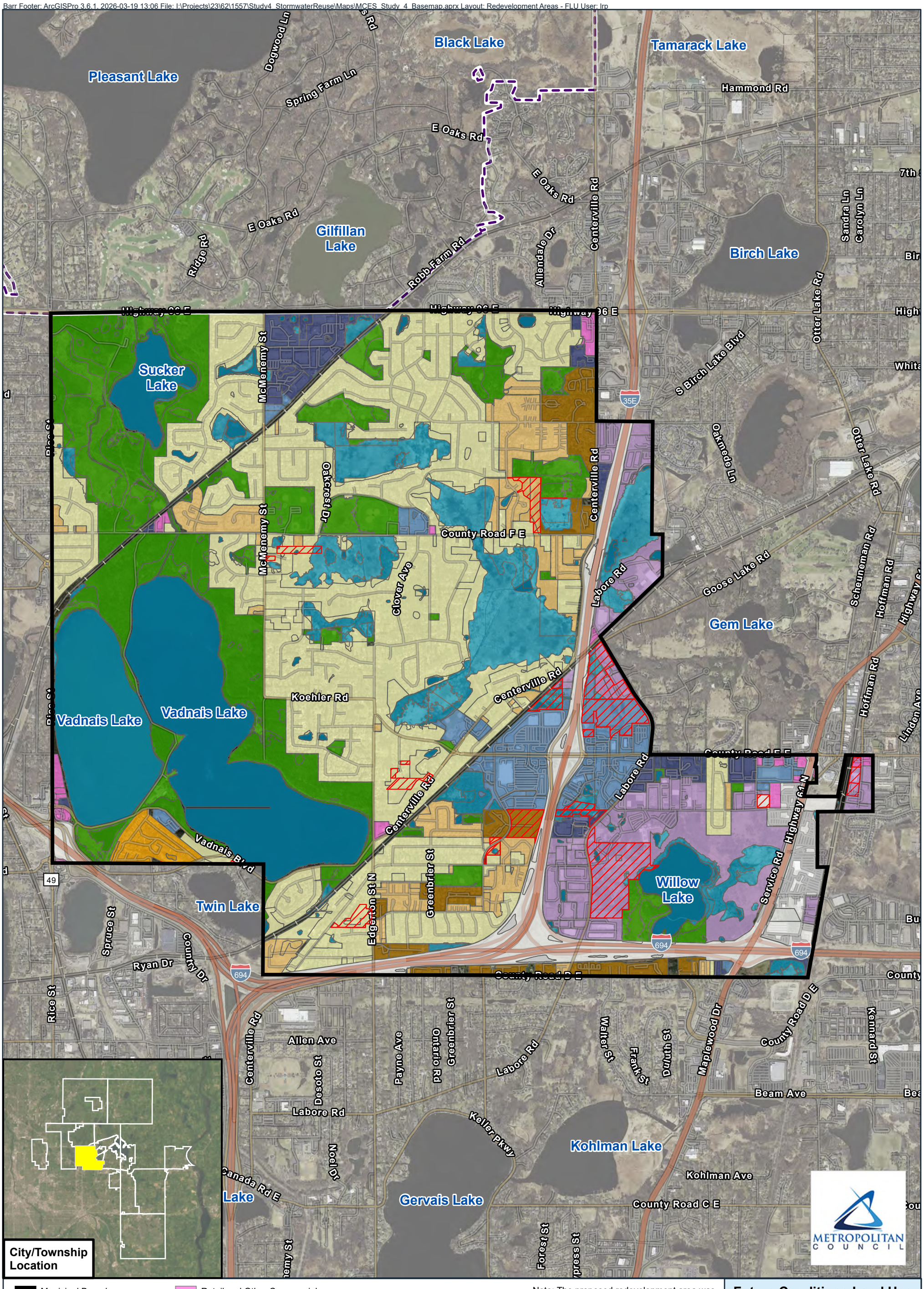
*Existing Land Use categories are recategorized from Met Council Generalized Land Use 2020 data.

Existing Conditions Land Use and Proposed Development/ Redevelopment Area
Vadnais Heights, MN
MCES Study 4

FIGURE 1A

METROPOLITAN COUNCIL

BARR



City/Township Location

- Municipal Boundary
- Metropolitan Urban Service Area (MUSA) Boundary
- Proposed Development/ Redevelopment Area

Future Land Use Category*

- Single Family Detached
- Single Family Attached
- Manufactured Housing Park
- Multifamily
- Retail and Other Commercial
- Mixed Use Commercial
- Industrial or Utility
- Institutional
- Office
- Open Water
- Park, Recreational, Preserve, or Golf Course
- Major Highway
- Major Railway

0 1,000 2,100
Feet

Note: The proposed redevelopment area was determined by future land use data defined as "redevelopable" by Vadnais Heights.

*Future Land Use categories are recategorized from Met Council Regional Planned Land Use data and data provided by cities/townships.

Future Conditions Land Use and Proposed Development/ Redevelopment Area
Vadnais Heights, MN
MCES Study 4

FIGURE 1B

METROPOLITAN COUNCIL

BARR

George Watch Lake
Wards Lake
Sherman Lake
Reshanau Lake
Rice Lake
Egg Lake
Forest Blvd
Cedar Lake
Amelia Lake
Otter Lake
Fish Lake
Poplar Lake
Wilkinson Lake
Deep Lake
Long Lake
Centerville Rd
Otter Lake Rd
Bald Eagle Lake
Black Lake
Pleasant Lake
Tamarack Lake
Highway 61 N
Lake Ave
White Bear Lake
Gilfillan Lake
Birch Lake
Sucker Lake
McMenemy St
Goose Lake Rd
Gem Lake
Grass Lake
Rice St
Vadnais Lake
County Road E E
Bellaire Ave
Edgerton St N
Labore Rd
Willow Lake
McKnight Rd N
Arcade St
Beam Ave
Gervais Lake
Kohlman Lake
35E
61
96
244
694

City/Township Location

Municipal Boundary
Metropolitan Urban Service Area (MUSA) Boundary
Proposed Redevelopment Area

Existing Land Use Category*
Agricultural
Undeveloped
Single Family Detached
Single Family Attached
Multifamily
Mixed Use Residential
Seasonal/Vacation
Retail and Other Commercial
Industrial or Utility
Mixed Use Industrial
Institutional
Office
Open Water
Park, Recreational, Preserve, or Golf Course
Major Highway

0 1,700 3,300
Feet

Note: The proposed redevelopment area was provided as parcel numbers by White Bear Lake Township.

*Existing Land Use categories are recategorized from Met Council Generalized Land Use 2020 data.

Existing Conditions Land Use and Proposed Development/ Redevelopment Area
White Bear Lake Township, MN
MCES Study 4

FIGURE 1A

METROPOLITAN COUNCIL

BARR

George Watch Lake
Wards Lake
Sherman Lake
Reshanau Lake
Rice Lake
Egg Lake
Forest Blvd
Cedar Lake
Amelia Lake
Otter Lake
Fish Lake
Poplar Lake
Wilkinson Lake
Deep Lake
Long Lake
Centerville Rd
Otter Lake Rd
Bald Eagle Lake
Black Lake
Pleasant Lake
Tamarack Lake
Highway 61 N
Lake Ave
White Bear Lake
Gilfillan Lake
Birch Lake
Sucker Lake
McMenemy St
Goose Lake Rd
Gem Lake
Grass Lake
Rice St
Vadnais Lake
County Road E E
Bellaire Ave
Edgerton St N
Labore Rd
Willow Lake
McKnight Rd N
Arcade St
Beam Ave
Gervais Lake
Kohlman Lake
35E
61
96
244
694

City/Township Location

Municipal Boundary
Metropolitan Urban Service Area (MUSA) Boundary
Proposed Development/ Redevelopment Area

Future Land Use Category*
- Undeveloped
- Farmstead/Rural Residential
- Single Family Detached
- Single Family Attached
- Multifamily
- Retail and Other Commercial
- Mixed Use Commercial
- Industrial or Utility
- Mixed Use Industrial
- Institutional
- Open Water
- Park, Recreational, Preserve, or Golf Course
- Major Highway
- Major Railway
- Airport

0 1,700 3,300
Feet

Note: The proposed redevelopment area was provided as parcel numbers by White Bear Lake Township.

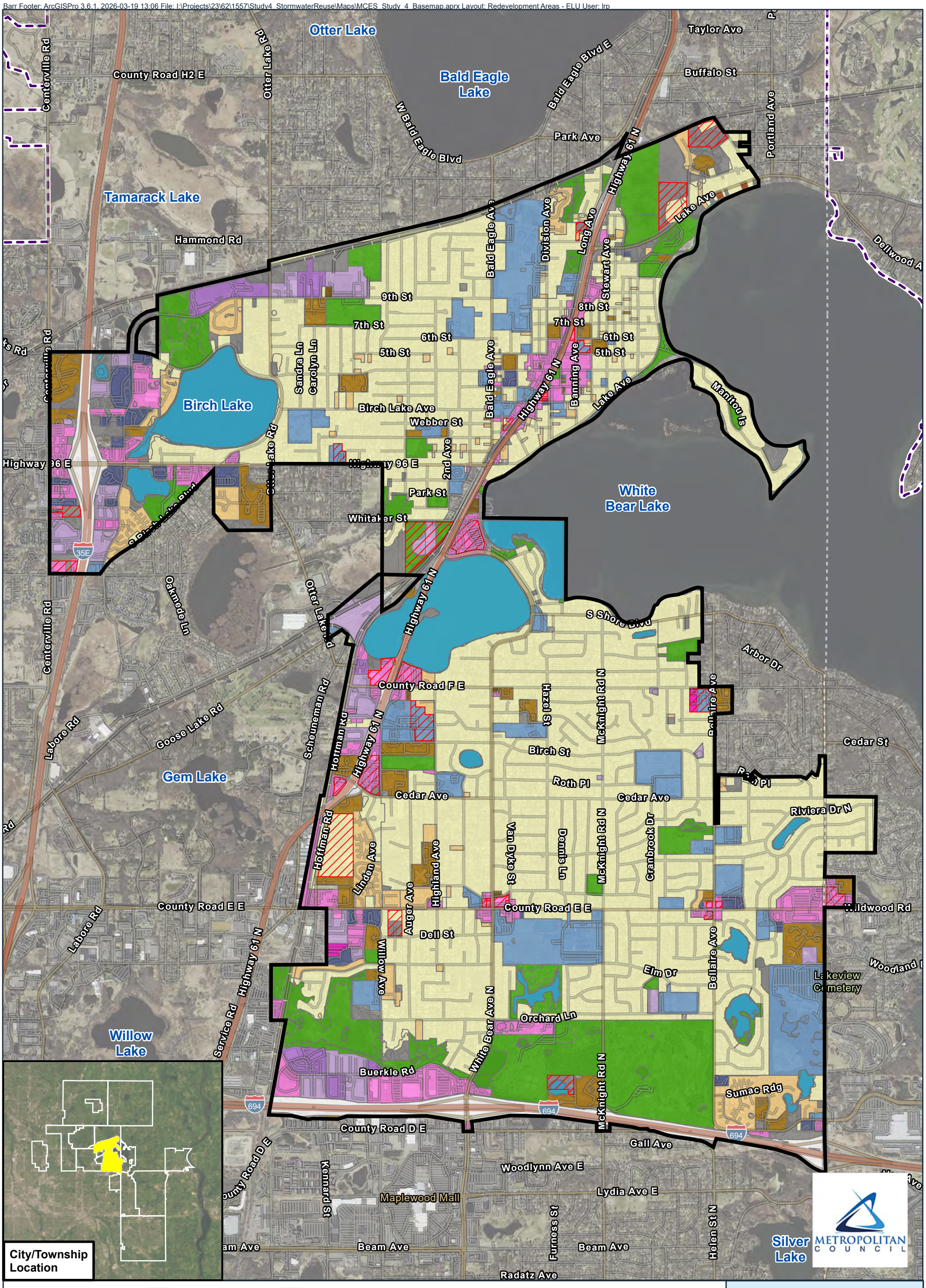
*Future Land Use categories are recategorized from Met Council Regional Planned Land Use data and data provided by cities/townships.

Future Conditions Land Use and Proposed Development/ Redevelopment Area
White Bear Lake Township, MN
MCES Study 4

FIGURE 1B

METROPOLITAN COUNCIL

BARR



Note: The proposed redevelopment area was provided as a feature class by White Bear Lake.

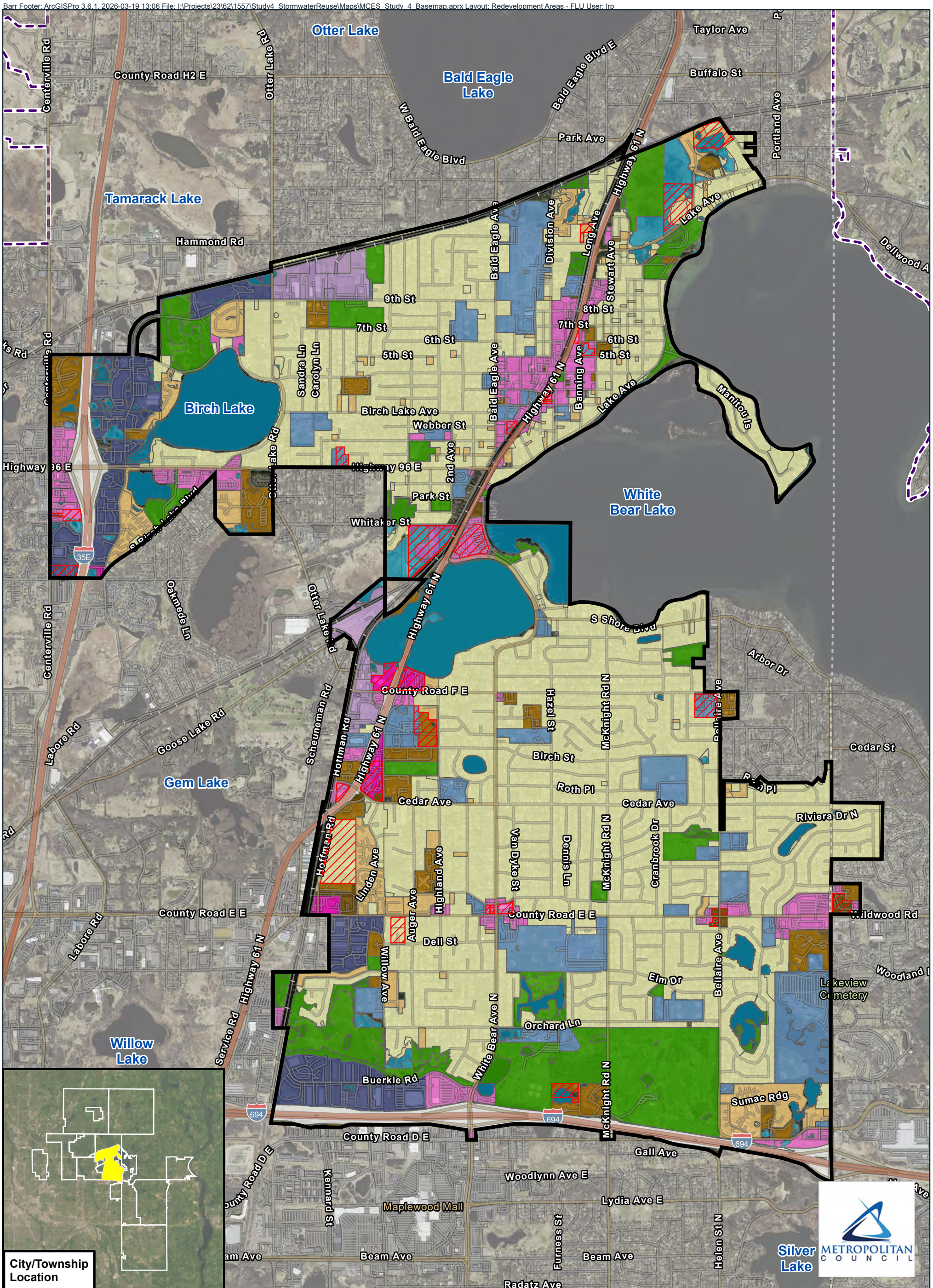
*Existing Land Use categories are recategorized from Met Council Generalized Land Use 2020 data.

Existing Conditions Land Use and Proposed Development/ Redevelopment Area
White Bear Lake, MN
MCES Study 4

FIGURE 1A

METROPOLITAN COUNCIL

BARR



Municipal Boundary
Metropolitan Urban Service Area (MUSA) Boundary
Proposed Development/ Redevelopment Area

Future Land Use Category*
- Undeveloped
- Single Family Detached
- Single Family Attached
- Multifamily
- Mixed Use Residential
- Retail and Other Commercial
- Mixed Use Commercial
- Industrial or Utility
- Mixed Use Industrial
- Institutional
- Office
- Open Water
- Park, Recreational, Preserve, or Golf Course
- Major Highway
- Major Railway

N

0 1,000 2,100
Feet

Note: The proposed redevelopment area was provided as a feature class by White Bear Lake.

*Future Land Use categories are recategorized from Met Council Regional Planned Land Use data and data provided by cities/townships.

Future Conditions Land Use and Proposed Development/ Redevelopment Area
White Bear Lake, MN
MCES Study 4

FIGURE 1B

BARR

Eagle Point Lake
Horseshoe Lake
Sunfish Lake
Tanners Lake
Battle Creek Lake
Markgrafs Lake
Wilmes Lake
Wilmes Lake
Powers Lake
Carver Lake
Colby Lake
Ria Lake
La Lake
Bailey Lake
Gables Lake
10th St N
Valley Creek Rd
Bailey Rd
70th St S
Inwood Ave N
Manning Ave N
Century Ave S
Radio Dr
Woodbury Dr
Keats Ave S
694
494
94

City/Township Location

Municipal Boundary
Metropolitan Urban Service Area (MUSA) Boundary
Proposed Redevelopment Area

Existing Land Use Category*
Agricultural
Undeveloped
Farmstead/Rural Residential
Single Family Detached
Single Family Attached
Multifamily
Mixed Use Residential
Retail and Other Commercial
Mixed Use Commercial
Industrial or Utility
Mixed Use Industrial
Institutional
Office
Open Water
Park, Recreational, Preserve, or Golf Course
Major Highway

N
0 1,700 3,300
Feet

Note: The proposed redevelopment area was determined using Woodbury's 2040 Comprehensive Plan.

*Existing Land Use categories are recategorized from Met Council Generalized Land Use 2020 data.

Existing Conditions Land Use and Proposed Development/ Redevelopment Area
Woodbury, MN
MCES Study 4

FIGURE 1A

METROPOLITAN COUNCIL

BARR

Eagle Point Lake
Horseshoe Lake
Sunfish Lake
Tanners Lake
Battle Creek Lake
Markgrafs Lake
Wilmes Lake
Powers Lake
Carver Lake
Colby Lake
Ria Lake
La Lake
Bailey Lake
Gables Lake

10th St N
Valley Creek Rd
Bailey Rd
70th St S

Inwood Ave N
Manning Ave N
Century Ave S
Radio Dr
Woodbury Dr
Keats Ave S

694
494
94
96

City/Township Location

Municipal Boundary
Metropolitan Urban Service Area (MUSA) Boundary
Proposed Development/ Redevelopment Area

Future Land Use Category*
- Agricultural
- Farmstead/Rural Residential
- Single Family Detached
- Single Family Attached
- Multifamily
- Mixed Use Residential
- Retail and Other Commercial
- Mixed Use Commercial
- Industrial or Utility
- Institutional
- Office
- Open Water
- Park, Recreational, Preserve, or Golf Course
- Major Highway

N

0 1,700 3,300
Feet

Note: The proposed redevelopment area was determined using Woodbury's 2040 Comprehensive Plan.

*Future Land Use categories are recategorized from Met Council Regional Planned Land Use data and data provided by cities/townships.

Future Conditions Land Use and Proposed Development/ Redevelopment Area
Woodbury, MN
MCES Study 4

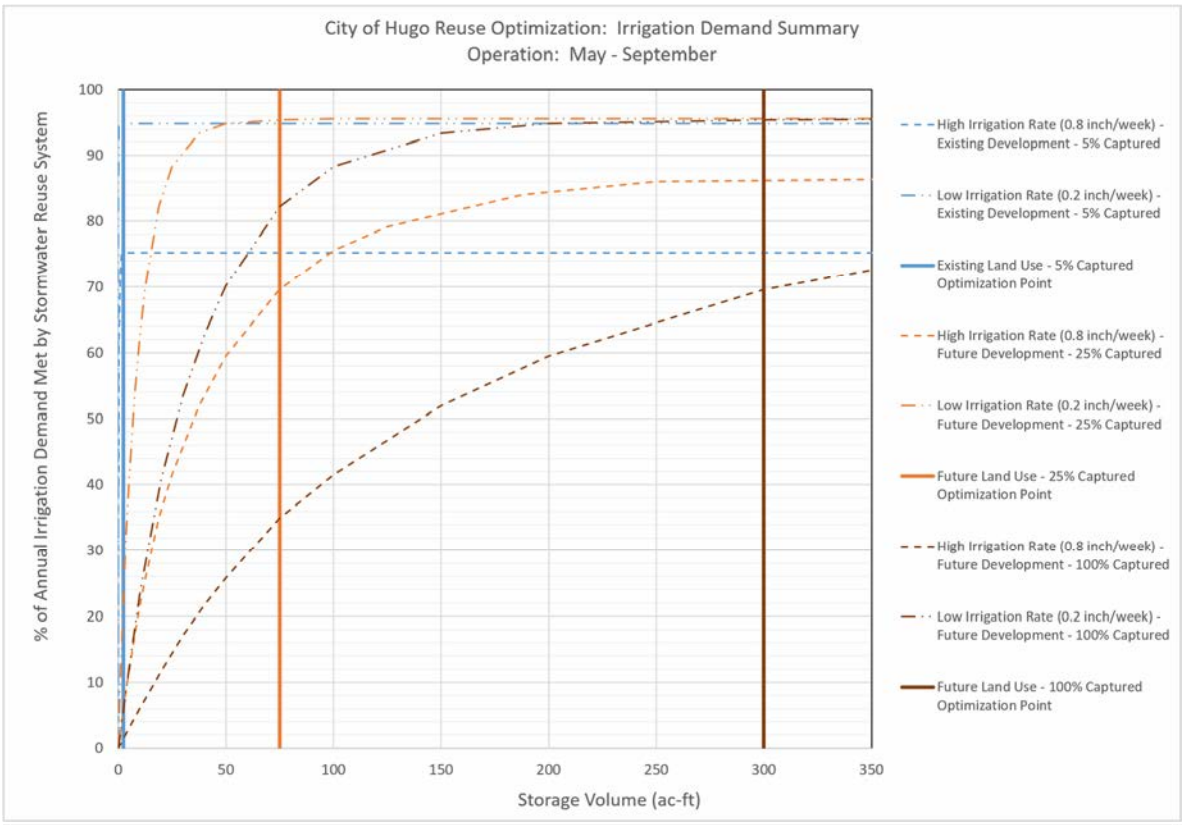
FIGURE 1B

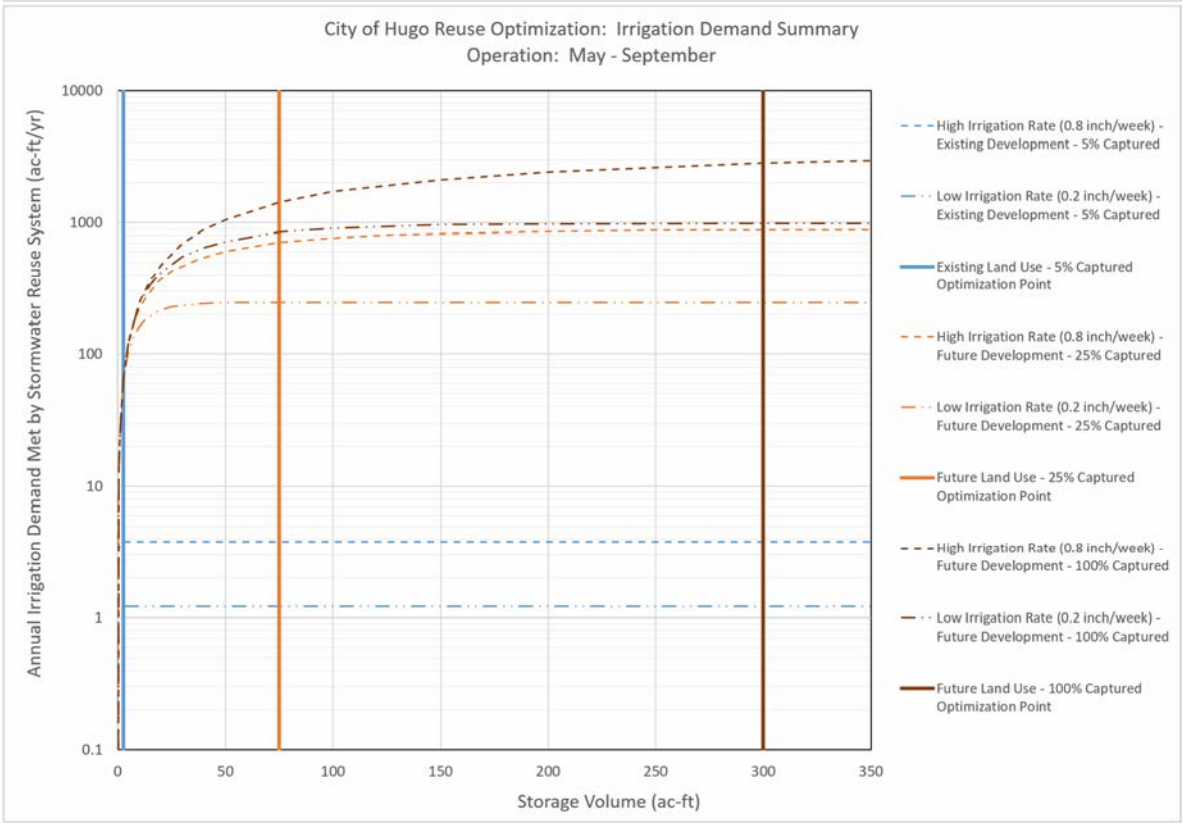
METROPOLITAN COUNCIL

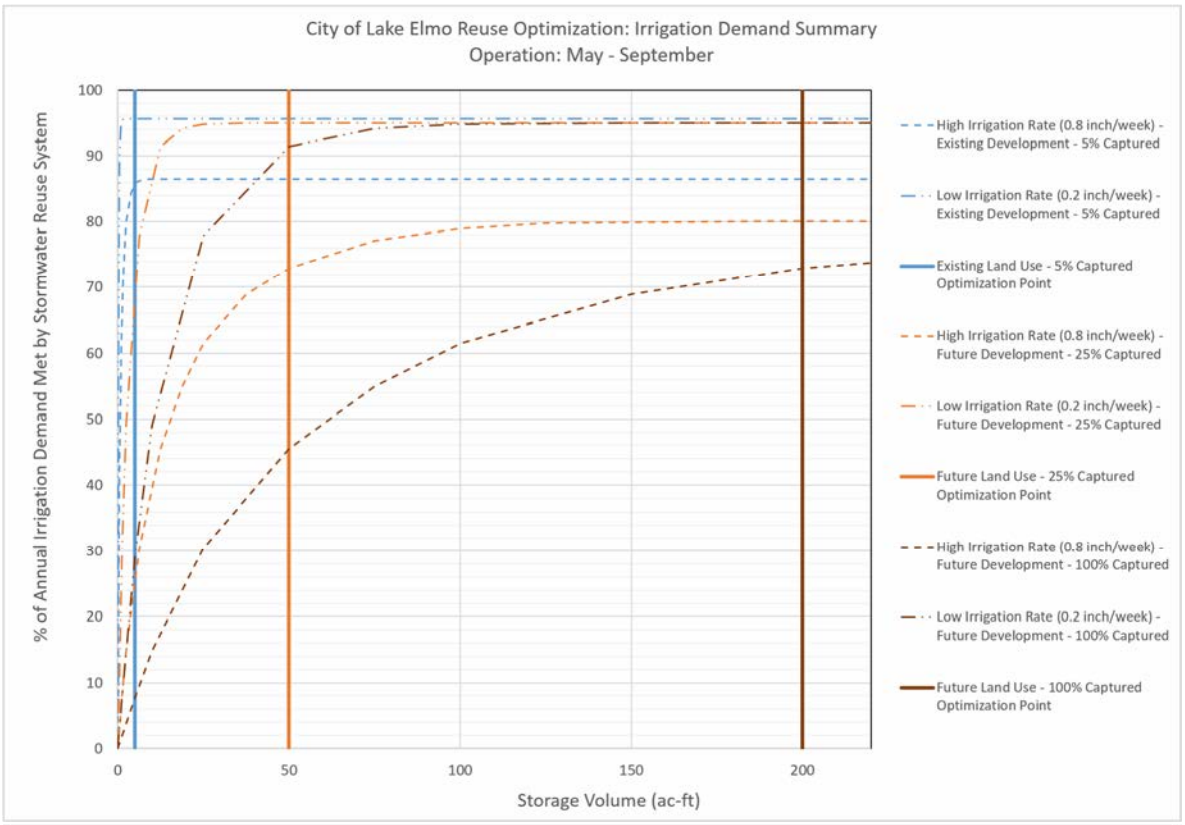
BARR

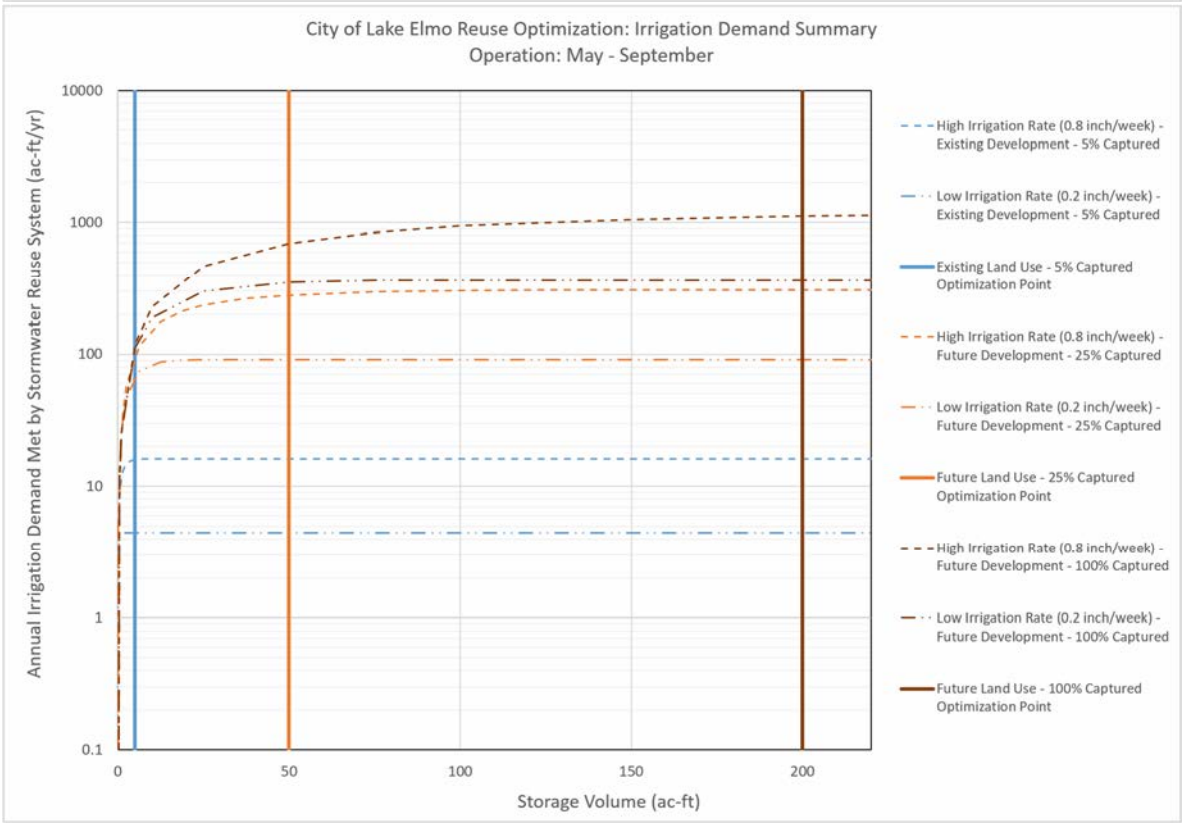
Attachment 3

Reuse Storage Optimization Curves by Community


City of Hugo Reuse Optimization: Irrigation Demand Summary
Operation: May - September
% of Annual Irrigation Demand Met by Stormwater Reuse System
Storage Volume (ac-ft)
0
10
20
30
40
50
60
70
80
90
100
0
50
100
150
200
250
300
350
High Irrigation Rate (0.8 inch/week) - Existing Development - 5% Captured
Low Irrigation Rate (0.2 inch/week) - Existing Development - 5% Captured
Existing Land Use - 5% Captured Optimization Point
High Irrigation Rate (0.8 inch/week) - Future Development - 25% Captured
Low Irrigation Rate (0.2 inch/week) - Future Development - 25% Captured
Future Land Use - 25% Captured Optimization Point
High Irrigation Rate (0.8 inch/week) - Future Development - 100% Captured
Low Irrigation Rate (0.2 inch/week) - Future Development - 100% Captured
Future Land Use - 100% Captured Optimization Point


City of Hugo Reuse Optimization: Irrigation Demand Summary
Operation: May - September
Annual Irrigation Demand Met by Stormwater Reuse System (ac-ft/yr)
Storage Volume (ac-ft)
0.1
1
10
100
1000
10000
0
50
100
150
200
250
300
350
High Irrigation Rate (0.8 inch/week) - Existing Development - 5% Captured
Low Irrigation Rate (0.2 inch/week) - Existing Development - 5% Captured
Existing Land Use - 5% Captured Optimization Point
High Irrigation Rate (0.8 inch/week) - Future Development - 25% Captured
Low Irrigation Rate (0.2 inch/week) - Future Development - 25% Captured
Future Land Use - 25% Captured Optimization Point
High Irrigation Rate (0.8 inch/week) - Future Development - 100% Captured
Low Irrigation Rate (0.2 inch/week) - Future Development - 100% Captured
Future Land Use - 100% Captured Optimization Point


City of Lake Elmo Reuse Optimization: Irrigation Demand Summary
Operation: May - September
% of Annual Irrigation Demand Met by Stormwater Reuse System
Storage Volume (ac-ft)
0
10
20
30
40
50
60
70
80
90
100
0
50
100
150
200
High Irrigation Rate (0.8 inch/week) - Existing Development - 5% Captured
Low Irrigation Rate (0.2 inch/week) - Existing Development - 5% Captured
Existing Land Use - 5% Captured Optimization Point
High Irrigation Rate (0.8 inch/week) - Future Development - 25% Captured
Low Irrigation Rate (0.2 inch/week) - Future Development - 25% Captured
Future Land Use - 25% Captured Optimization Point
High Irrigation Rate (0.8 inch/week) - Future Development - 100% Captured
Low Irrigation Rate (0.2 inch/week) - Future Development - 100% Captured
Future Land Use - 100% Captured Optimization Point


City of Lake Elmo Reuse Optimization: Irrigation Demand Summary
Operation: May - September
Annual Irrigation Demand Met by Stormwater Reuse System (ac-ft/yr)
Storage Volume (ac-ft)
0.1
1
10
100
1000
10000
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50
100
150
200
High Irrigation Rate (0.8 inch/week) - Existing Development - 5% Captured
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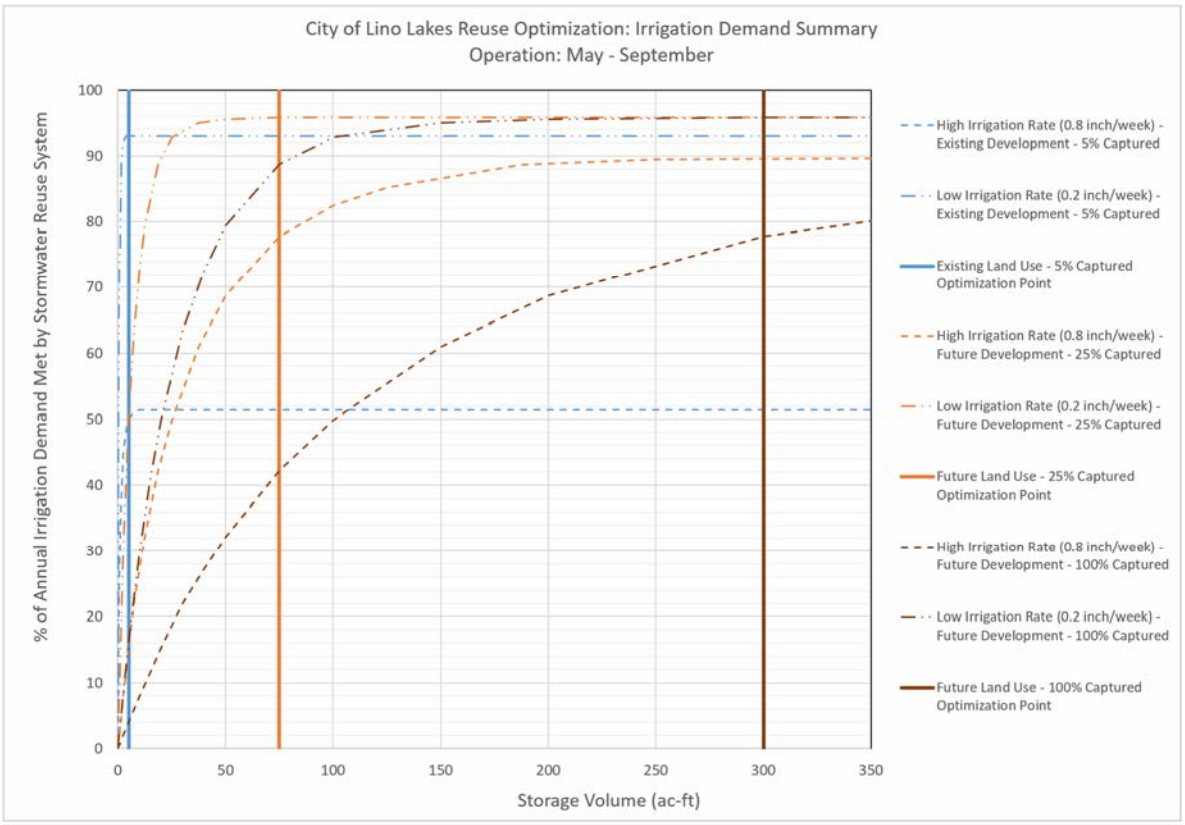
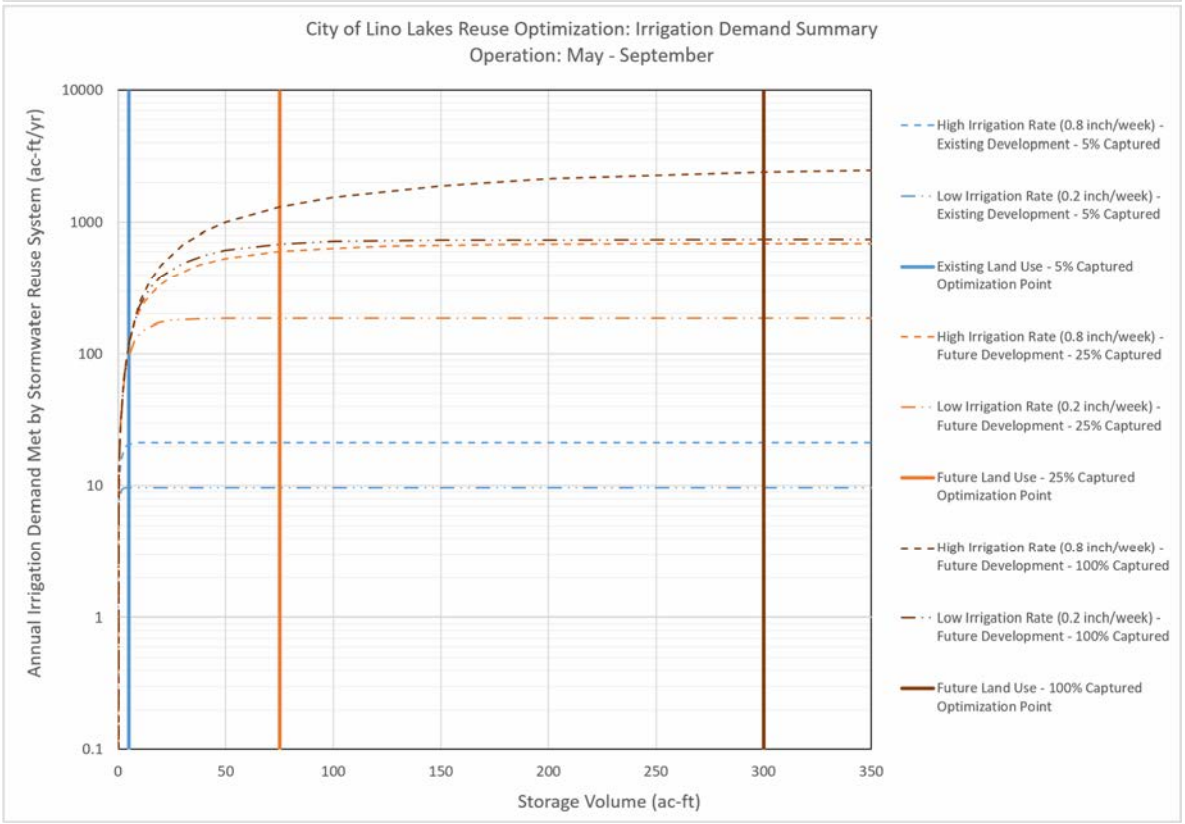
Low Irrigation Rate (0.2 inch/week) - Future Development - 100% Captured
Future Land Use - 100% Captured Optimization Point


City of Lino Lakes Reuse Optimization: Irrigation Demand Summary
Operation: May - September
% of Annual Irrigation Demand Met by Stormwater Reuse System
Storage Volume (ac-ft)
0
10
20
30
40
50
60
70
80
90
100
0
50
100
150
200
250
300
350
High Irrigation Rate (0.8 inch/week) - Existing Development - 5% Captured
Low Irrigation Rate (0.2 inch/week) - Existing Development - 5% Captured
Existing Land Use - 5% Captured Optimization Point
High Irrigation Rate (0.8 inch/week) - Future Development - 25% Captured
Low Irrigation Rate (0.2 inch/week) - Future Development - 25% Captured
Future Land Use - 25% Captured Optimization Point
High Irrigation Rate (0.8 inch/week) - Future Development - 100% Captured
Low Irrigation Rate (0.2 inch/week) - Future Development - 100% Captured
Future Land Use - 100% Captured Optimization Point


City of Lino Lakes Reuse Optimization: Irrigation Demand Summary
Operation: May - September
Annual Irrigation Demand Met by Stormwater Reuse System (ac-ft/yr)
Storage Volume (ac-ft)
0.1
1
10
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Low Irrigation Rate (0.2 inch/week) - Existing Development - 5% Captured
Existing Land Use - 5% Captured Optimization Point
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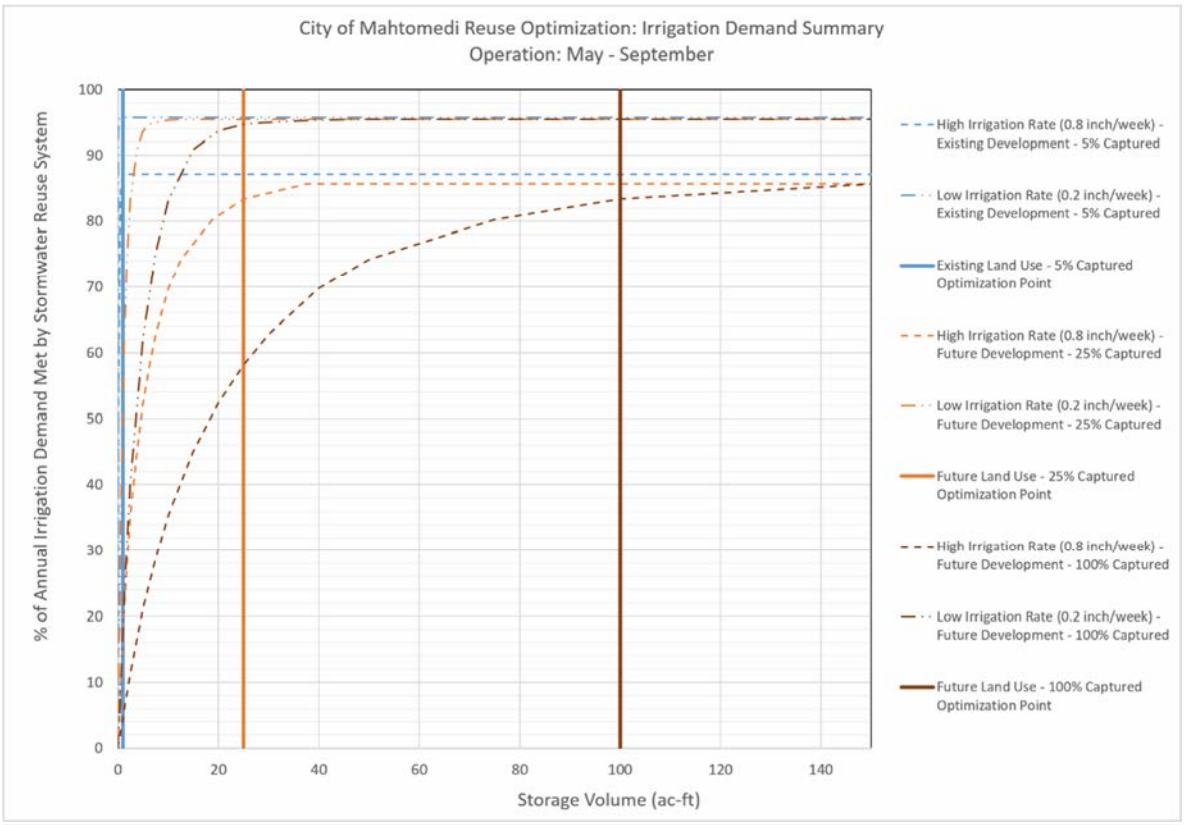
Low Irrigation Rate (0.2 inch/week) - Future Development - 100% Captured
Future Land Use - 100% Captured Optimization Point


City of Mahtomedi Reuse Optimization: Irrigation Demand Summary
Operation: May - September
% of Annual Irrigation Demand Met by Stormwater Reuse System
Storage Volume (ac-ft)
0
10
20
30
40
50
60
70
80
90
100
0
20
40
60
80
100
120
140
High Irrigation Rate (0.8 inch/week) - Existing Development - 5% Captured
Low Irrigation Rate (0.2 inch/week) - Existing Development - 5% Captured
Existing Land Use - 5% Captured Optimization Point
High Irrigation Rate (0.8 inch/week) - Future Development - 25% Captured
Low Irrigation Rate (0.2 inch/week) - Future Development - 25% Captured
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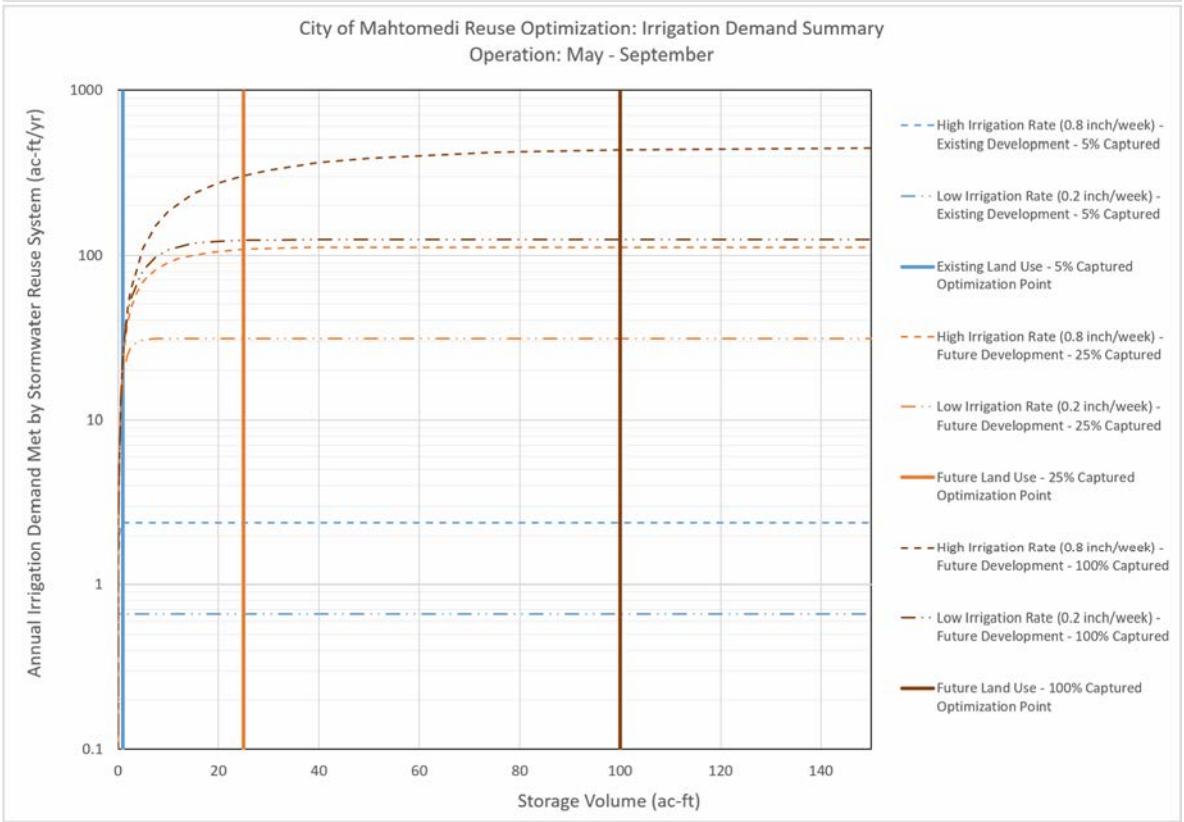
Low Irrigation Rate (0.2 inch/week) - Future Development - 100% Captured
Future Land Use - 100% Captured Optimization Point


City of Mahtomedi Reuse Optimization: Irrigation Demand Summary
Operation: May - September
Annual Irrigation Demand Met by Stormwater Reuse System (ac-ft/yr)
Storage Volume (ac-ft)
0.1
1
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0
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140
High Irrigation Rate (0.8 inch/week) - Existing Development - 5% Captured
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Low Irrigation Rate (0.2 inch/week) - Future Development - 100% Captured
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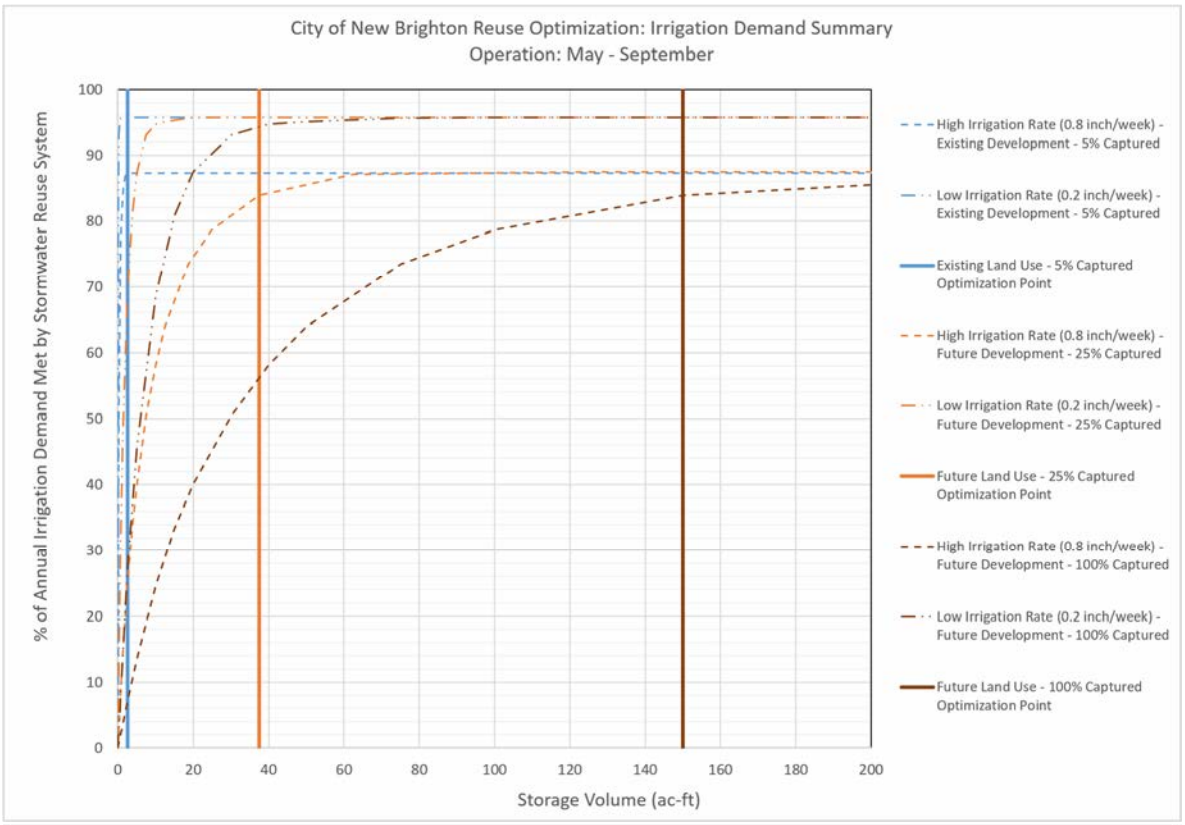
City of New Brighton Reuse Optimization: Irrigation Demand Summary
Operation: May - September
% of Annual Irrigation Demand Met by Stormwater Reuse System
Storage Volume (ac-ft)
0
10
20
30
40
50
60
70
80
90
100
0
20
40
60
80
100
120
140
160
180
200
High Irrigation Rate (0.8 inch/week) - Existing Development - 5% Captured
Low Irrigation Rate (0.2 inch/week) - Existing Development - 5% Captured
Existing Land Use - 5% Captured Optimization Point
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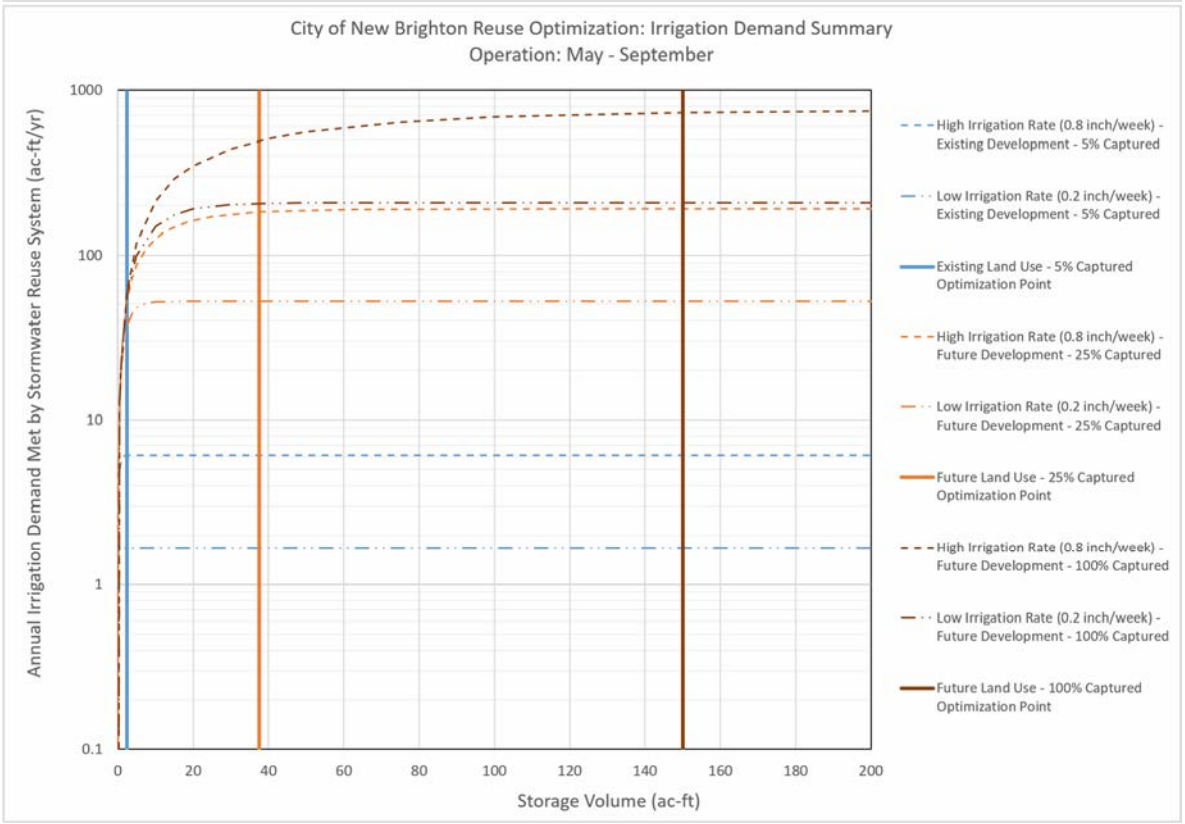
Low Irrigation Rate (0.2 inch/week) - Future Development - 25% Captured
Future Land Use - 25% Captured Optimization Point
High Irrigation Rate (0.8 inch/week) - Future Development - 100% Captured
Low Irrigation Rate (0.2 inch/week) - Future Development - 100% Captured
Future Land Use - 100% Captured Optimization Point


City of New Brighton Reuse Optimization: Irrigation Demand Summary
Operation: May - September
Annual Irrigation Demand Met by Stormwater Reuse System (ac-ft/yr)
Storage Volume (ac-ft)
0.1
1
10
100
1000
0
20
40
60
80
100
120
140
160
180
200
High Irrigation Rate (0.8 inch/week) - Existing Development - 5% Captured
Low Irrigation Rate (0.2 inch/week) - Existing Development - 5% Captured
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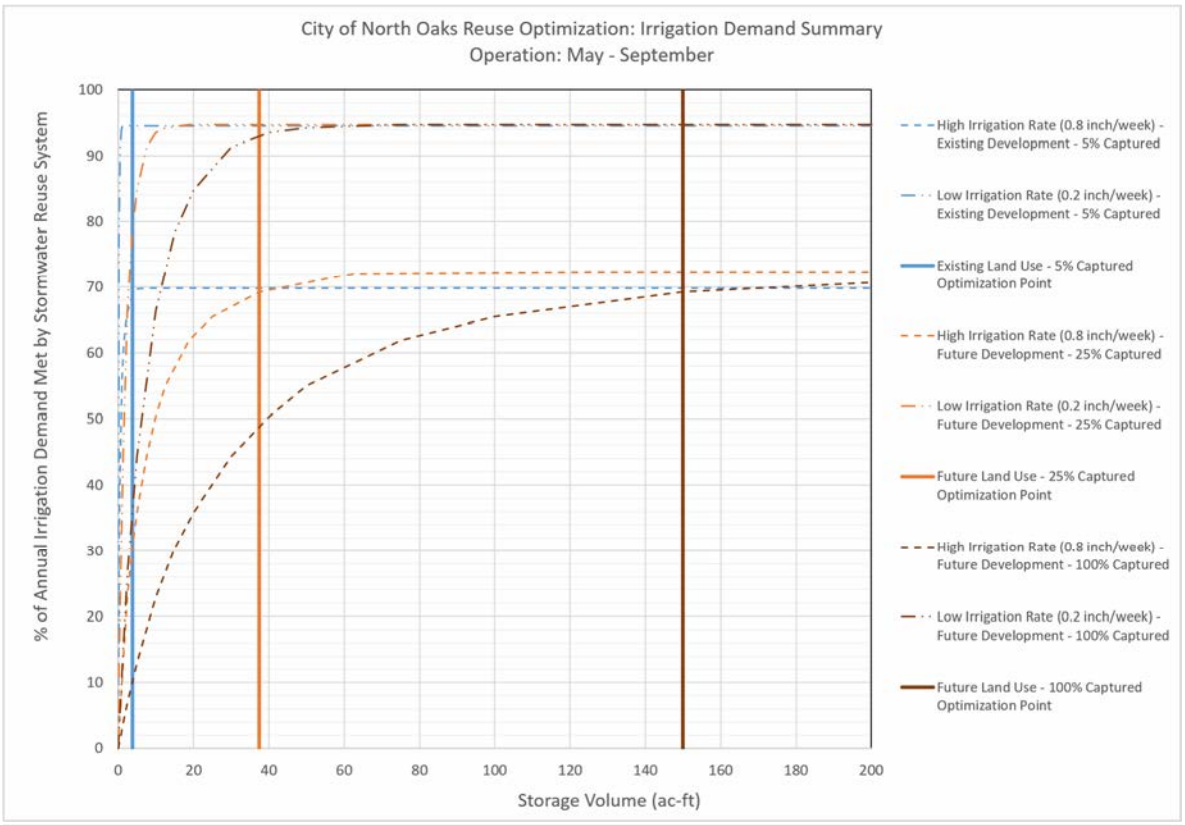
Low Irrigation Rate (0.2 inch/week) - Future Development - 100% Captured
Future Land Use - 100% Captured Optimization Point


City of North Oaks Reuse Optimization: Irrigation Demand Summary
Operation: May - September
% of Annual Irrigation Demand Met by Stormwater Reuse System
Storage Volume (ac-ft)
0
10
20
30
40
50
60
70
80
90
100
0
20
40
60
80
100
120
140
160
180
200
High Irrigation Rate (0.8 inch/week) - Existing Development - 5% Captured
Low Irrigation Rate (0.2 inch/week) - Existing Development - 5% Captured
Existing Land Use - 5% Captured Optimization Point
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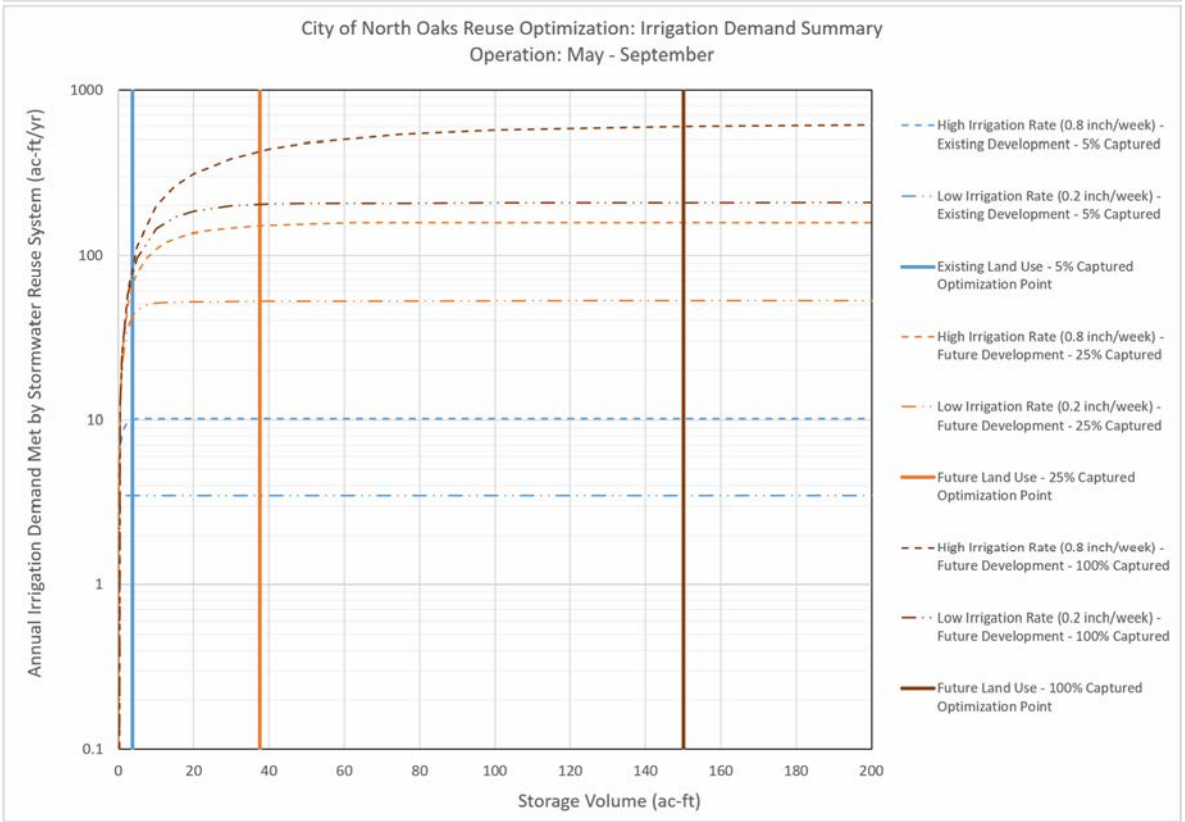
Low Irrigation Rate (0.2 inch/week) - Future Development - 25% Captured
Future Land Use - 25% Captured Optimization Point
High Irrigation Rate (0.8 inch/week) - Future Development - 100% Captured
Low Irrigation Rate (0.2 inch/week) - Future Development - 100% Captured
Future Land Use - 100% Captured Optimization Point


City of North Oaks Reuse Optimization: Irrigation Demand Summary
Operation: May - September
Annual Irrigation Demand Met by Stormwater Reuse System (ac-ft/yr)
Storage Volume (ac-ft)
0.1
1
10
100
1000
0
20
40
60
80
100
120
140
160
180
200
High Irrigation Rate (0.8 inch/week) - Existing Development - 5% Captured
Low Irrigation Rate (0.2 inch/week) - Existing Development - 5% Captured
Existing Land Use - 5% Captured Optimization Point
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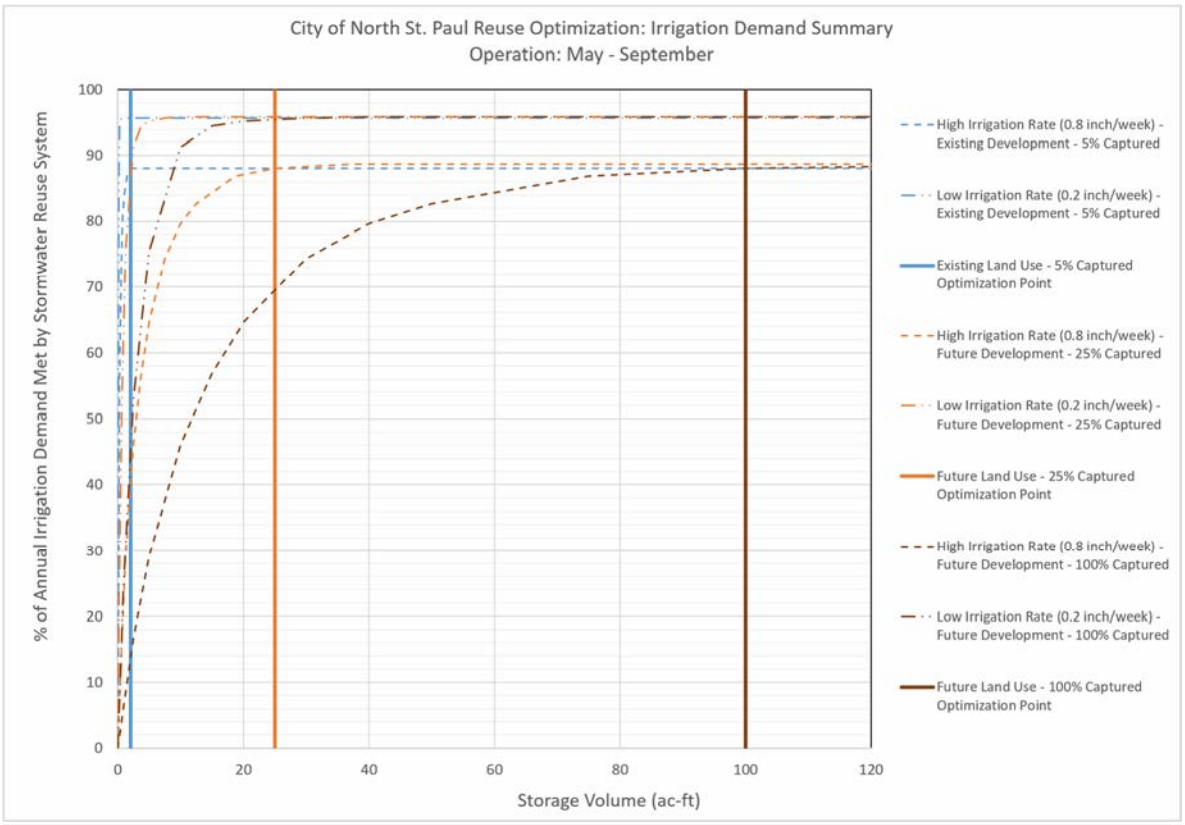
Low Irrigation Rate (0.2 inch/week) - Future Development - 100% Captured
Future Land Use - 100% Captured Optimization Point


City of North St. Paul Reuse Optimization: Irrigation Demand Summary
Operation: May - September
% of Annual Irrigation Demand Met by Stormwater Reuse System
Storage Volume (ac-ft)
0
10
20
30
40
50
60
70
80
90
100
0
20
40
60
80
100
120
High Irrigation Rate (0.8 inch/week) - Existing Development - 5% Captured
Low Irrigation Rate (0.2 inch/week) - Existing Development - 5% Captured
Existing Land Use - 5% Captured Optimization Point
High Irrigation Rate (0.8 inch/week) - Future Development - 25% Captured
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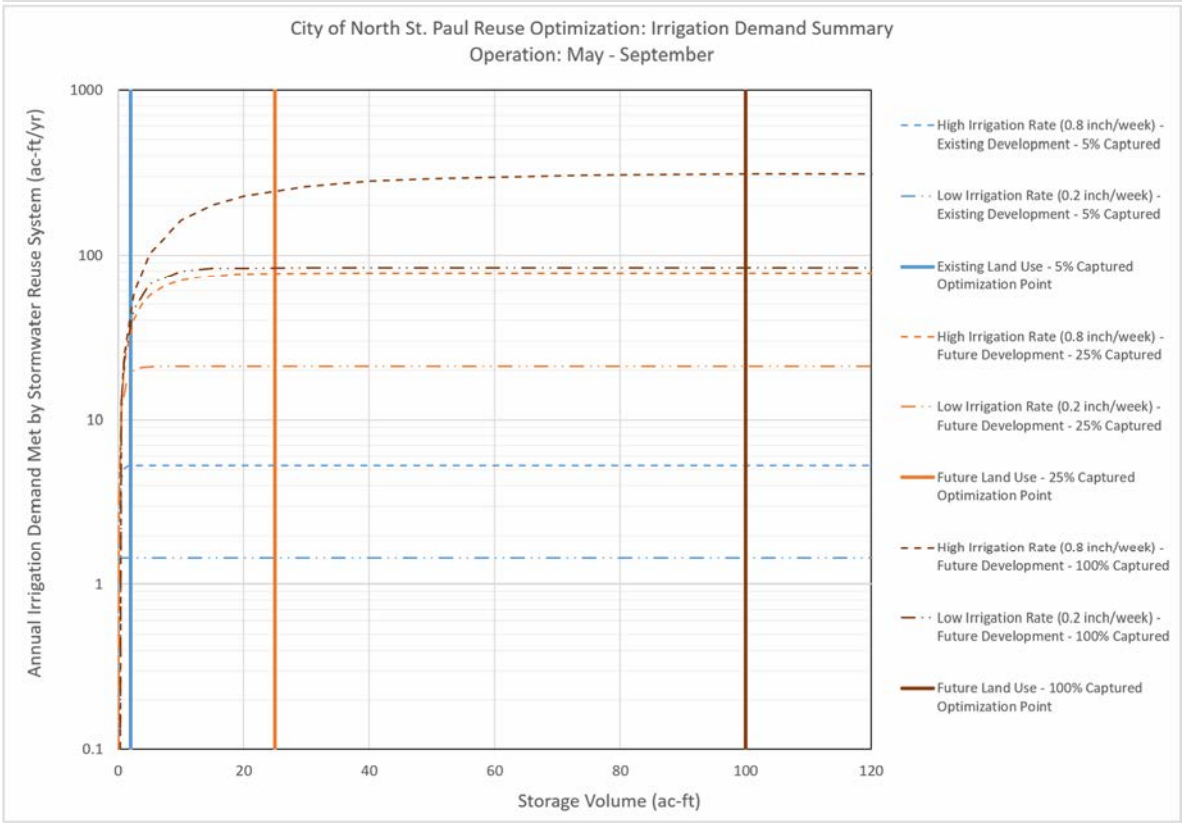
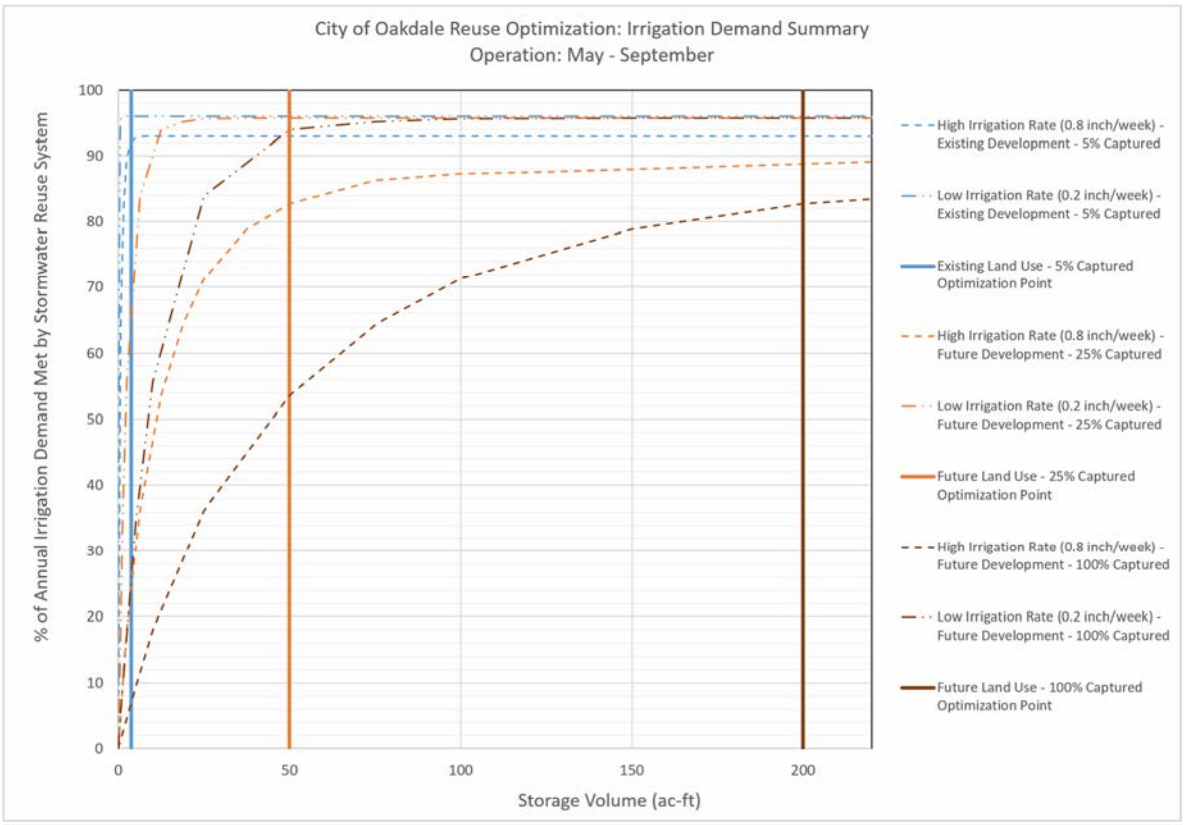
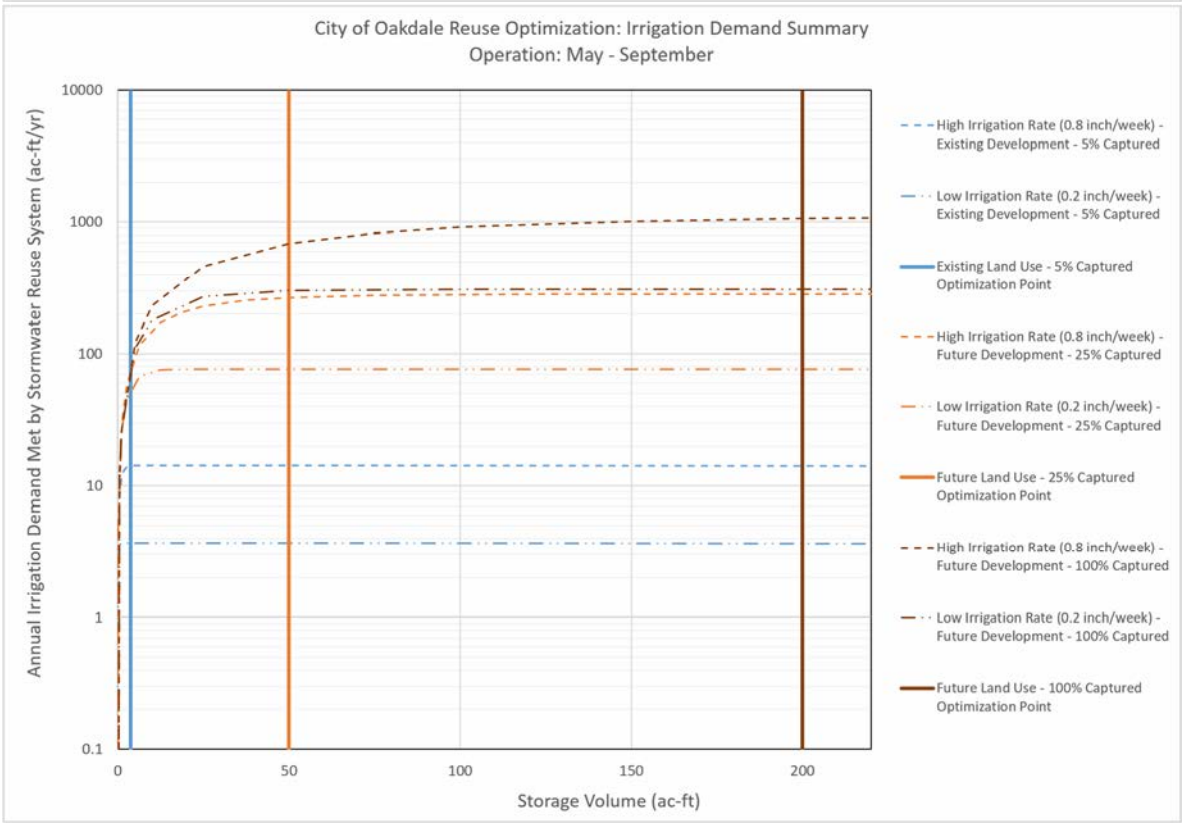
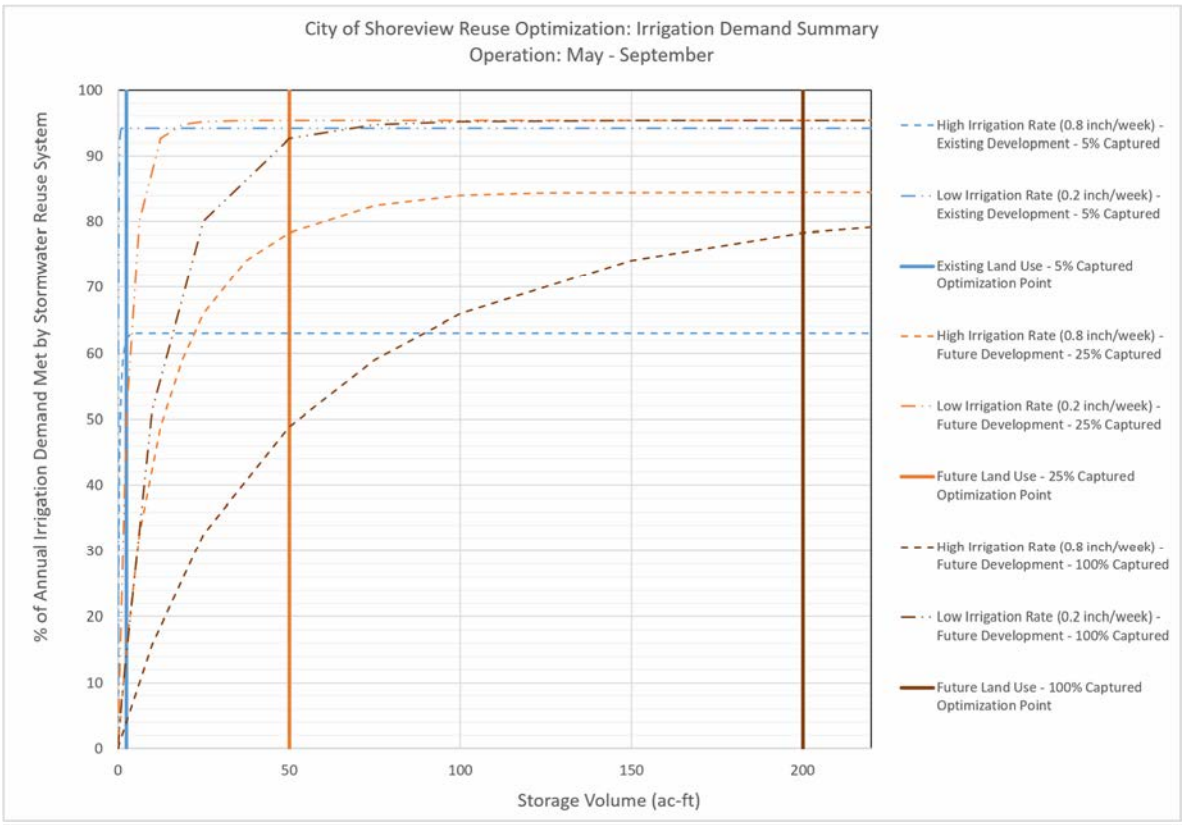
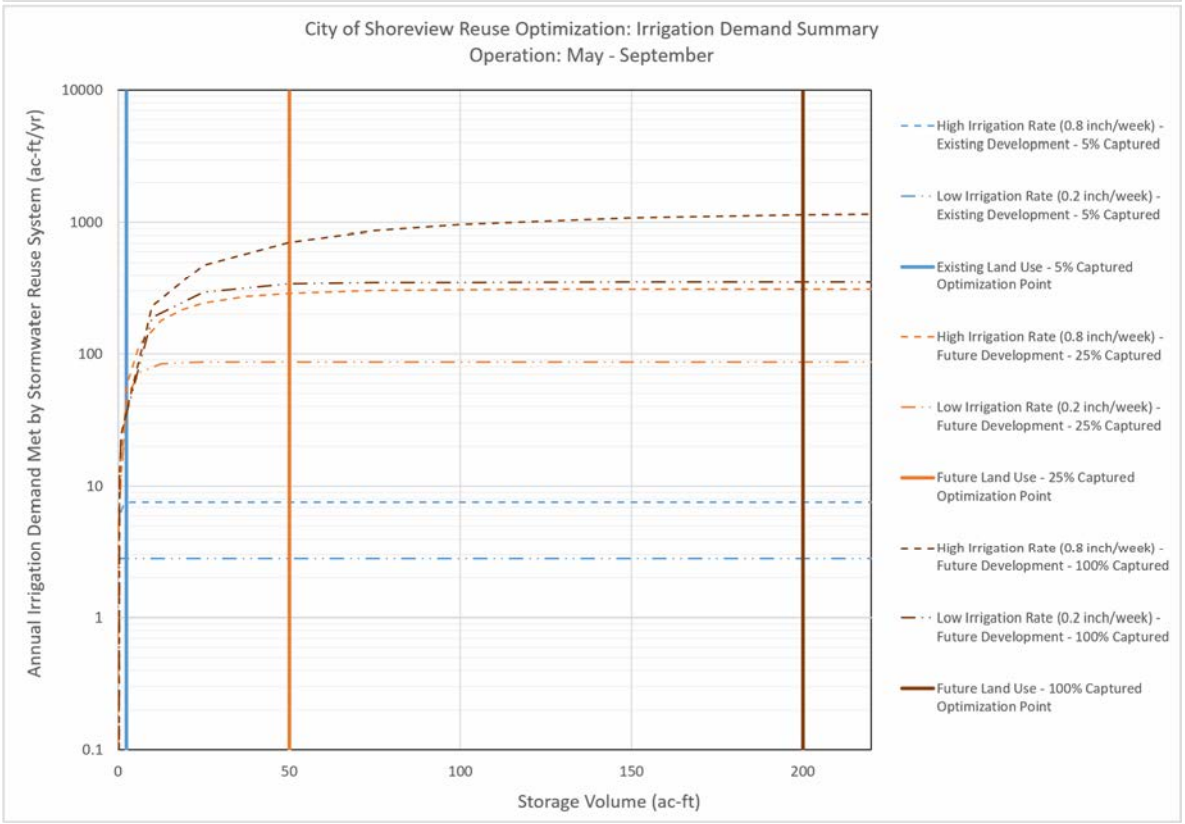
Future Land Use - 25% Captured Optimization Point
High Irrigation Rate (0.8 inch/week) - Future Development - 100% Captured
Low Irrigation Rate (0.2 inch/week) - Future Development - 100% Captured
Future Land Use - 100% Captured Optimization Point


City of North St. Paul Reuse Optimization: Irrigation Demand Summary
Operation: May - September
Annual Irrigation Demand Met by Stormwater Reuse System (ac-ft/yr)
Storage Volume (ac-ft)
0.1
1
10
100
1000
0
20
40
60
80
100
120
High Irrigation Rate (0.8 inch/week) - Existing Development - 5% Captured
Low Irrigation Rate (0.2 inch/week) - Existing Development - 5% Captured
Existing Land Use - 5% Captured Optimization Point
High Irrigation Rate (0.8 inch/week) - Future Development - 25% Captured
Low Irrigation Rate (0.2 inch/week) - Future Development - 25% Captured
Future Land Use - 25% Captured Optimization Point
High Irrigation Rate (0.8 inch/week) - Future Development - 100% Captured
Low Irrigation Rate (0.2 inch/week) - Future Development - 100% Captured
Future Land Use - 100% Captured Optimization Point


City of Oakdale Reuse Optimization: Irrigation Demand Summary
Operation: May - September
% of Annual Irrigation Demand Met by Stormwater Reuse System
Storage Volume (ac-ft)
0
10
20
30
40
50
60
70
80
90
100
0
50
100
150
200
High Irrigation Rate (0.8 inch/week) - Existing Development - 5% Captured
Low Irrigation Rate (0.2 inch/week) - Existing Development - 5% Captured
Existing Land Use - 5% Captured Optimization Point
High Irrigation Rate (0.8 inch/week) - Future Development - 25% Captured
Low Irrigation Rate (0.2 inch/week) - Future Development - 25% Captured
Future Land Use - 25% Captured Optimization Point
High Irrigation Rate (0.8 inch/week) - Future Development - 100% Captured
Low Irrigation Rate (0.2 inch/week) - Future Development - 100% Captured
Future Land Use - 100% Captured Optimization Point


City of Oakdale Reuse Optimization: Irrigation Demand Summary
Operation: May - September
Annual Irrigation Demand Met by Stormwater Reuse System (ac-ft/yr)
Storage Volume (ac-ft)
0.1
1
10
100
1000
10000
0
50
100
150
200
High Irrigation Rate (0.8 inch/week) - Existing Development - 5% Captured
Low Irrigation Rate (0.2 inch/week) - Existing Development - 5% Captured
Existing Land Use - 5% Captured Optimization Point
High Irrigation Rate (0.8 inch/week) - Future Development - 25% Captured
Low Irrigation Rate (0.2 inch/week) - Future Development - 25% Captured
Future Land Use - 25% Captured Optimization Point
High Irrigation Rate (0.8 inch/week) - Future Development - 100% Captured
Low Irrigation Rate (0.2 inch/week) - Future Development - 100% Captured
Future Land Use - 100% Captured Optimization Point


City of Shoreview Reuse Optimization: Irrigation Demand Summary
Operation: May - September
% of Annual Irrigation Demand Met by Stormwater Reuse System
Storage Volume (ac-ft)
0
10
20
30
40
50
60
70
80
90
100
0
50
100
150
200
High Irrigation Rate (0.8 inch/week) - Existing Development - 5% Captured
Low Irrigation Rate (0.2 inch/week) - Existing Development - 5% Captured
Existing Land Use - 5% Captured Optimization Point
High Irrigation Rate (0.8 inch/week) - Future Development - 25% Captured
Low Irrigation Rate (0.2 inch/week) - Future Development - 25% Captured
Future Land Use - 25% Captured Optimization Point
High Irrigation Rate (0.8 inch/week) - Future Development - 100% Captured
Low Irrigation Rate (0.2 inch/week) - Future Development - 100% Captured
Future Land Use - 100% Captured Optimization Point


City of Shoreview Reuse Optimization: Irrigation Demand Summary
Operation: May - September
Annual Irrigation Demand Met by Stormwater Reuse System (ac-ft/yr)
Storage Volume (ac-ft)
0.1
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1000
10000
0
50
100
150
200
High Irrigation Rate (0.8 inch/week) - Existing Development - 5% Captured
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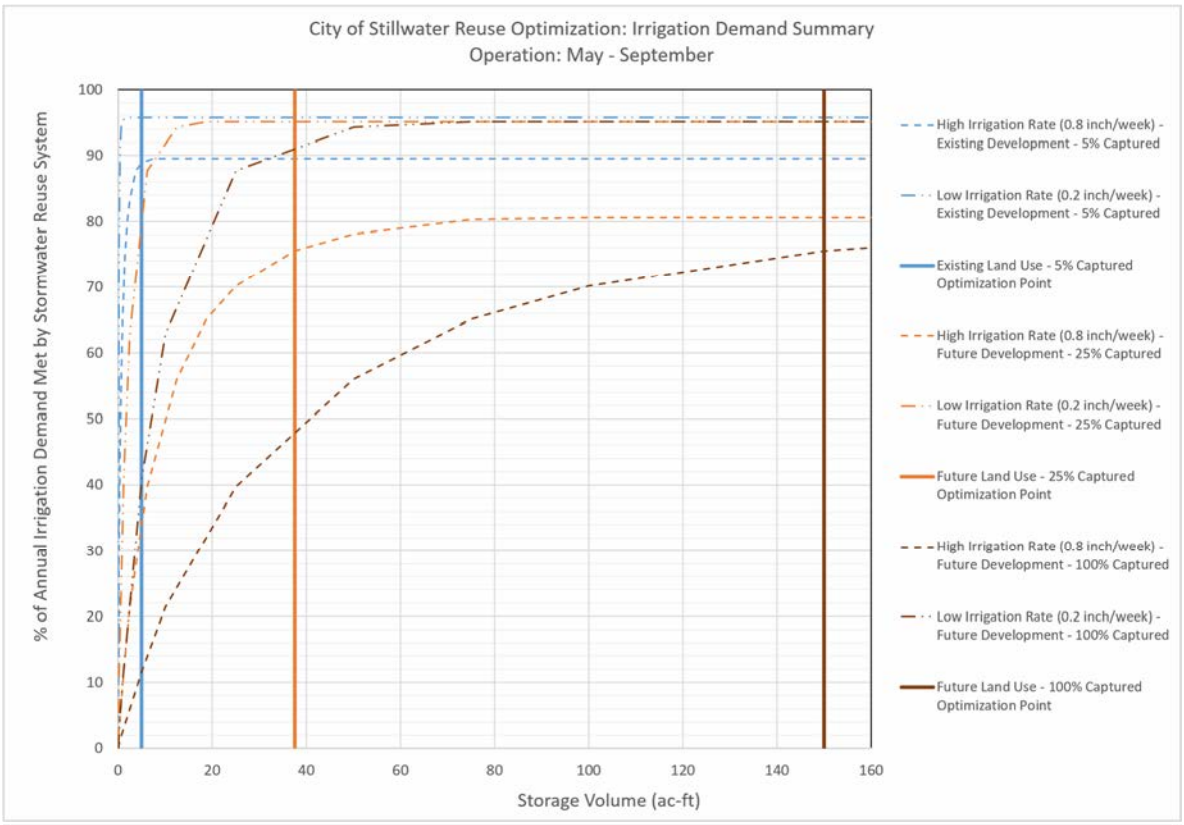
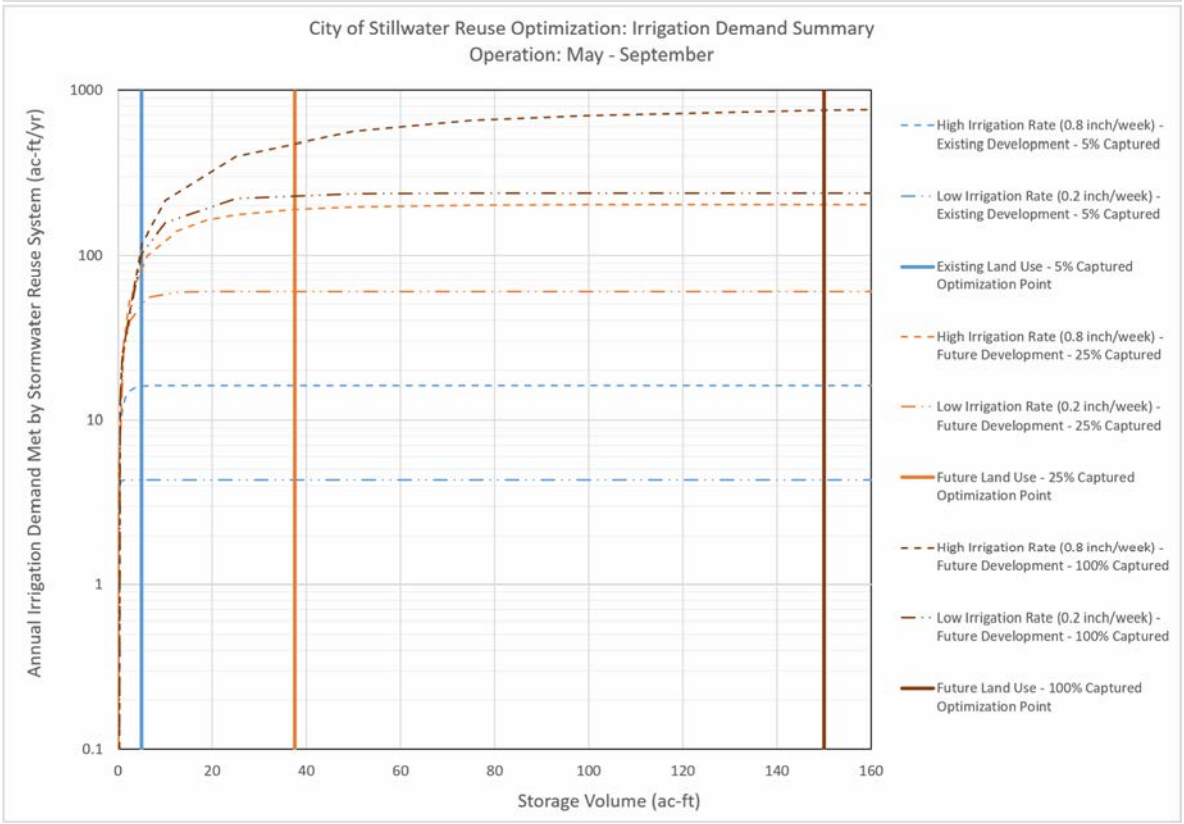
Future Land Use - 100% Captured Optimization Point


City of Stillwater Reuse Optimization: Irrigation Demand Summary
Operation: May - September
% of Annual Irrigation Demand Met by Stormwater Reuse System
Storage Volume (ac-ft)
0
10
20
30
40
50
60
70
80
90
100
0
20
40
60
80
100
120
140
160
High Irrigation Rate (0.8 inch/week) - Existing Development - 5% Captured
Low Irrigation Rate (0.2 inch/week) - Existing Development - 5% Captured
Existing Land Use - 5% Captured Optimization Point
High Irrigation Rate (0.8 inch/week) - Future Development - 25% Captured
Low Irrigation Rate (0.2 inch/week) - Future Development - 25% Captured
Future Land Use - 25% Captured Optimization Point
High Irrigation Rate (0.8 inch/week) - Future Development - 100% Captured
Low Irrigation Rate (0.2 inch/week) - Future Development - 100% Captured
Future Land Use - 100% Captured Optimization Point


City of Stillwater Reuse Optimization: Irrigation Demand Summary
Operation: May - September
Annual Irrigation Demand Met by Stormwater Reuse System (ac-ft/yr)
Storage Volume (ac-ft)
0.1
1
10
100
1000
0
20
40
60
80
100
120
140
160
High Irrigation Rate (0.8 inch/week) - Existing Development - 5% Captured
Low Irrigation Rate (0.2 inch/week) - Existing Development - 5% Captured
Existing Land Use - 5% Captured Optimization Point
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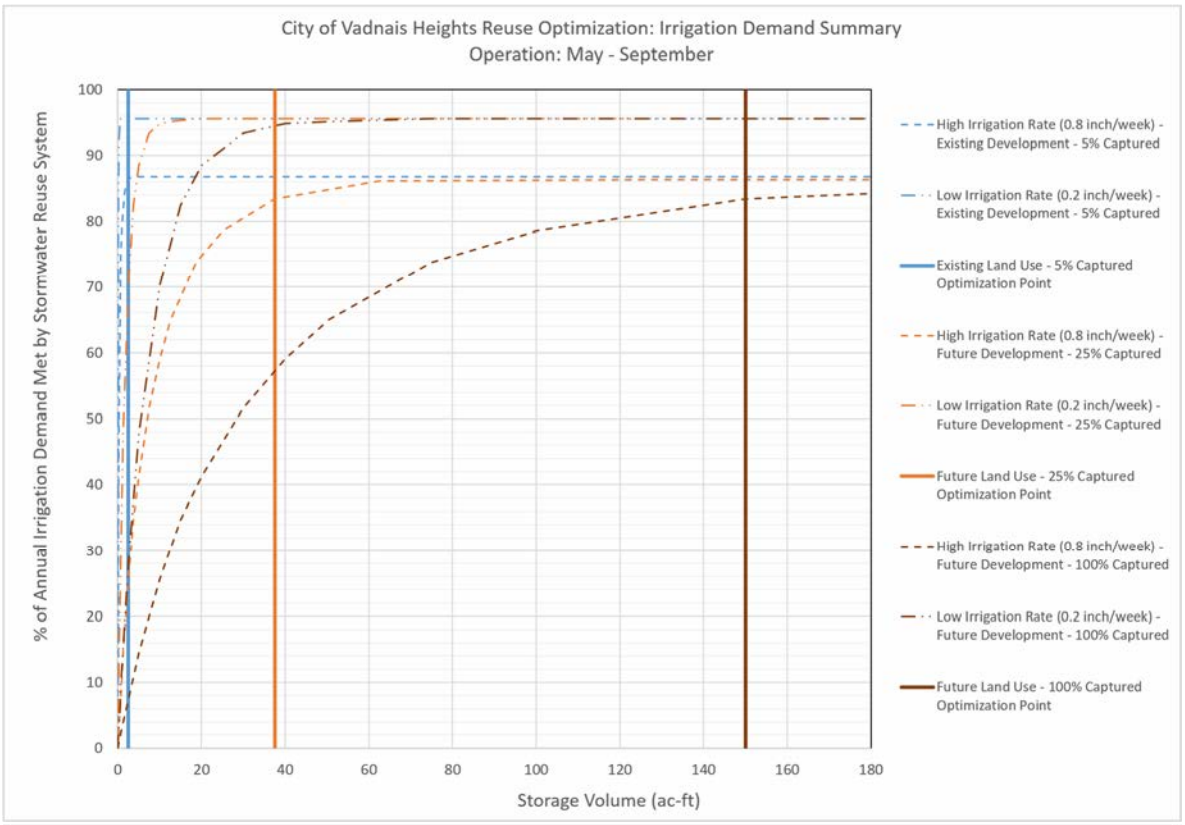
Future Land Use - 100% Captured Optimization Point


City of Vadnais Heights Reuse Optimization: Irrigation Demand Summary
Operation: May - September
% of Annual Irrigation Demand Met by Stormwater Reuse System
Storage Volume (ac-ft)
0
10
20
30
40
50
60
70
80
90
100
0
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80
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120
140
160
180
High Irrigation Rate (0.8 inch/week) - Existing Development - 5% Captured
Low Irrigation Rate (0.2 inch/week) - Existing Development - 5% Captured
Existing Land Use - 5% Captured Optimization Point
High Irrigation Rate (0.8 inch/week) - Future Development - 25% Captured
Low Irrigation Rate (0.2 inch/week) - Future Development - 25% Captured
Future Land Use - 25% Captured Optimization Point
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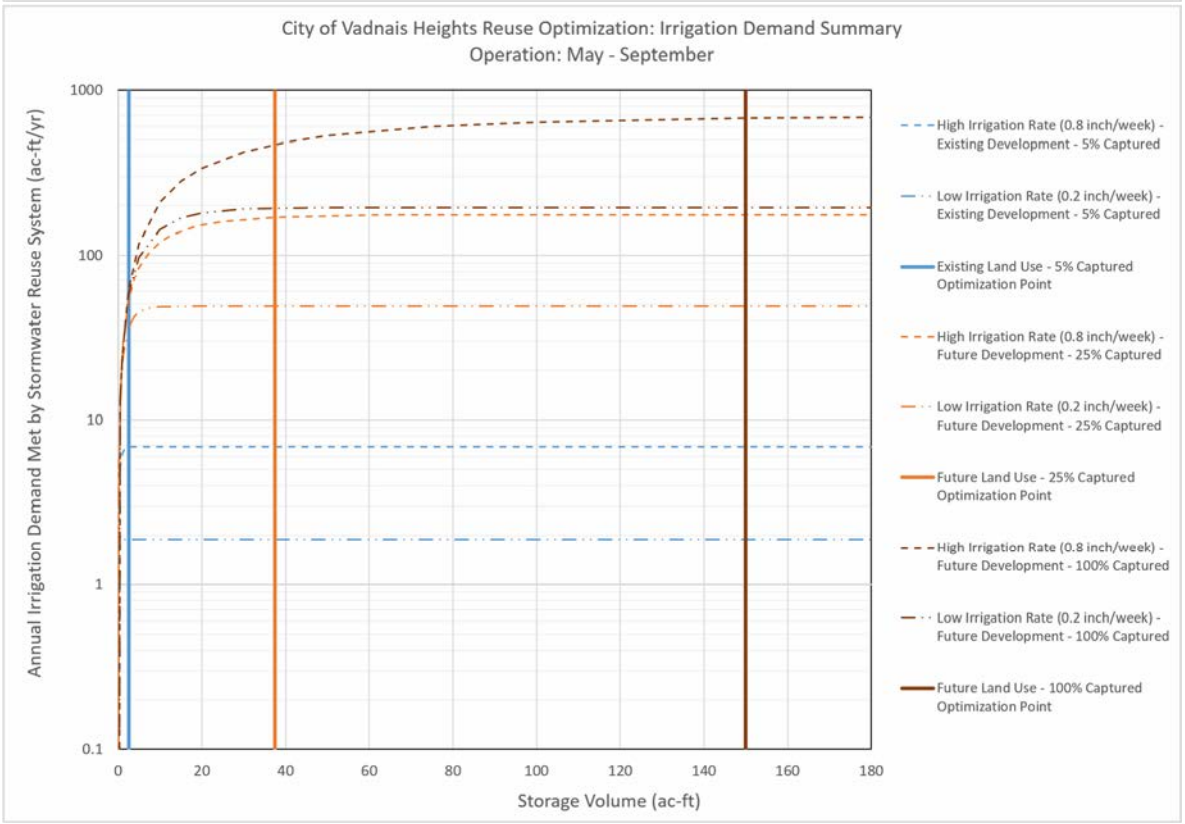
Low Irrigation Rate (0.2 inch/week) - Future Development - 100% Captured
Future Land Use - 100% Captured Optimization Point


City of Vadnais Heights Reuse Optimization: Irrigation Demand Summary
Operation: May - September
Annual Irrigation Demand Met by Stormwater Reuse System (ac-ft/yr)
Storage Volume (ac-ft)
0.1
1
10
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140
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180
High Irrigation Rate (0.8 inch/week) - Existing Development - 5% Captured
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Existing Land Use - 5% Captured Optimization Point
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Future Land Use - 25% Captured Optimization Point
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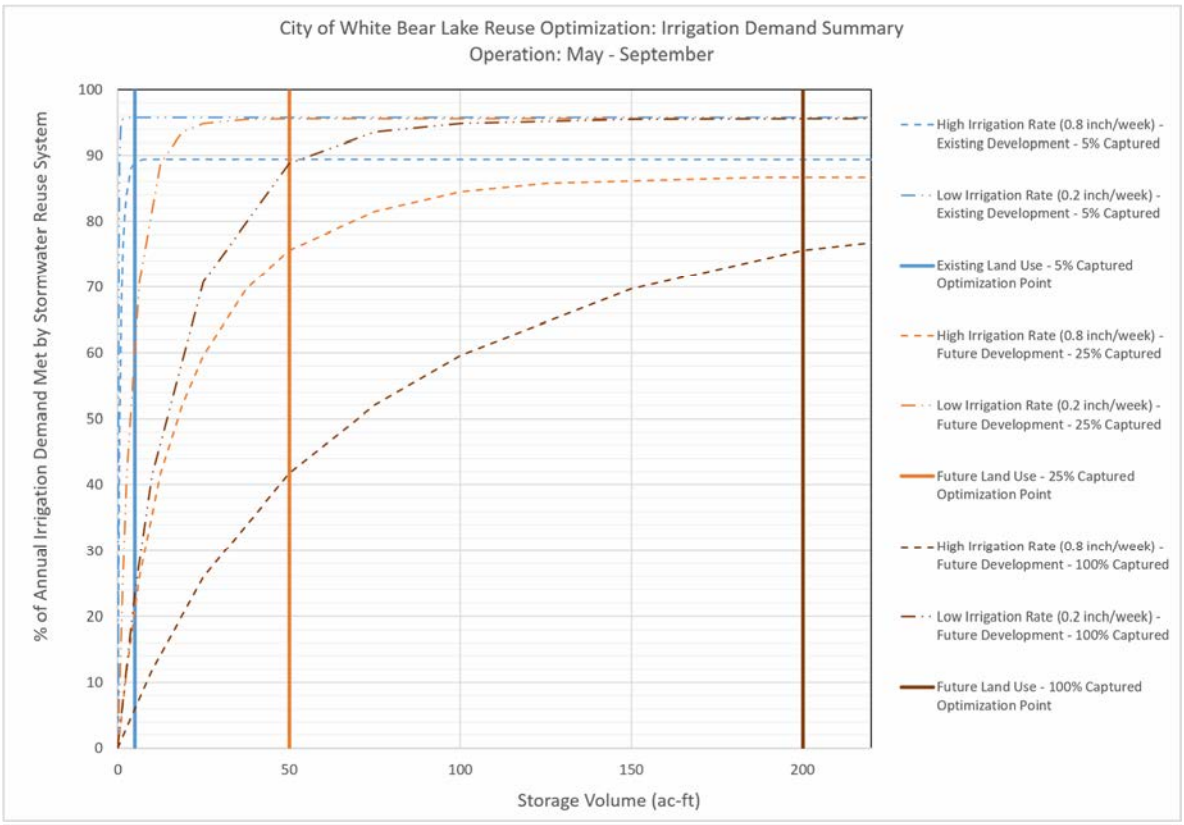
Future Land Use - 100% Captured Optimization Point


City of White Bear Lake Reuse Optimization: Irrigation Demand Summary
Operation: May - September
% of Annual Irrigation Demand Met by Stormwater Reuse System
Storage Volume (ac-ft)
0
10
20
30
40
50
60
70
80
90
100
0
50
100
150
200
High Irrigation Rate (0.8 inch/week) - Existing Development - 5% Captured
Low Irrigation Rate (0.2 inch/week) - Existing Development - 5% Captured
Existing Land Use - 5% Captured Optimization Point
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Future Land Use - 25% Captured Optimization Point
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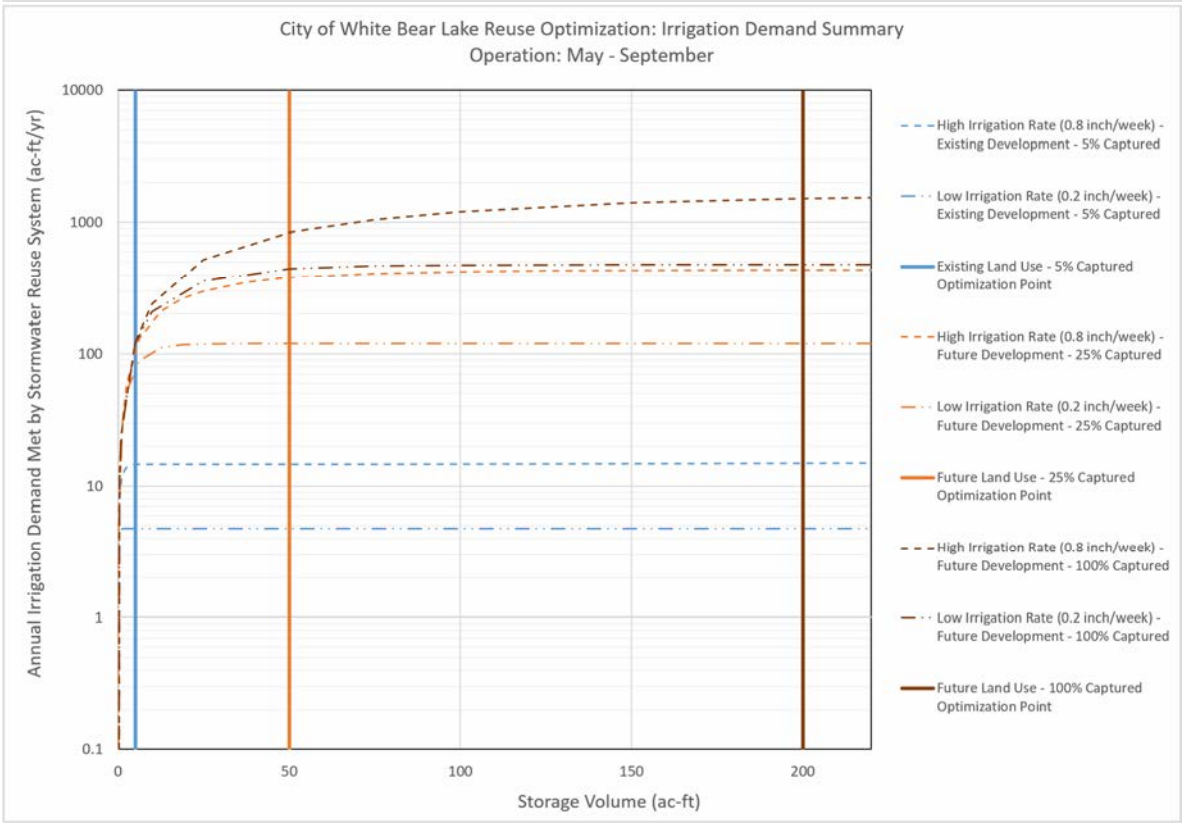
Low Irrigation Rate (0.2 inch/week) - Future Development - 100% Captured
Future Land Use - 100% Captured Optimization Point


City of White Bear Lake Reuse Optimization: Irrigation Demand Summary
Operation: May - September
Annual Irrigation Demand Met by Stormwater Reuse System (ac-ft/yr)
Storage Volume (ac-ft)
0.1
1
10
100
1000
10000
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100
150
200
High Irrigation Rate (0.8 inch/week) - Existing Development - 5% Captured
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Future Land Use - 25% Captured Optimization Point
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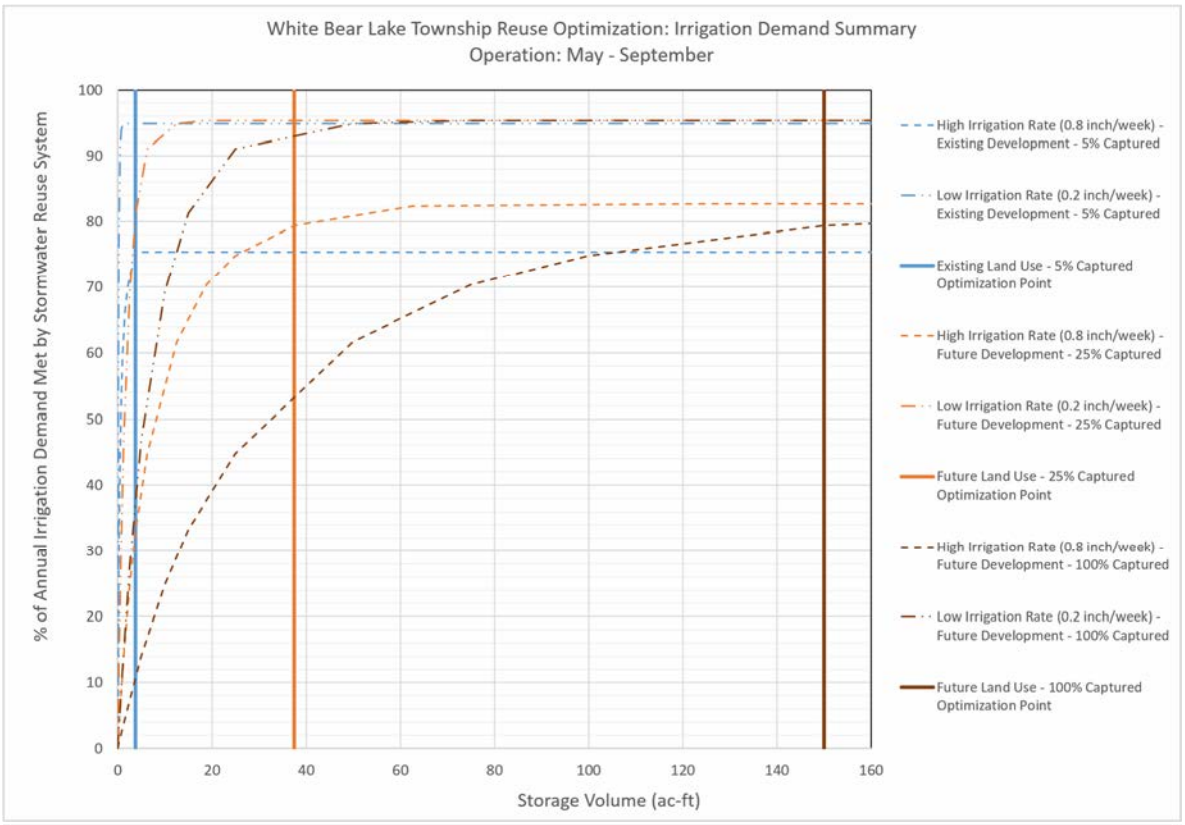
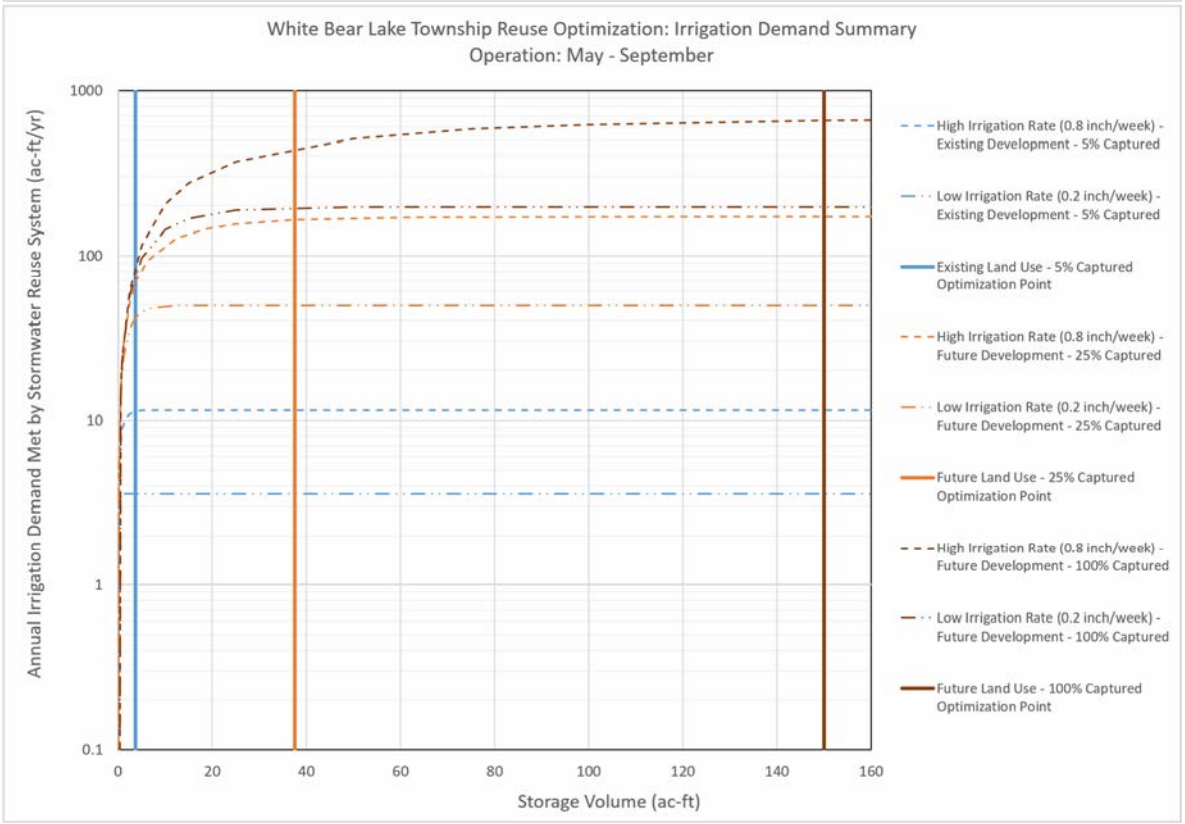
Low Irrigation Rate (0.2 inch/week) - Future Development - 100% Captured
Future Land Use - 100% Captured Optimization Point


White Bear Lake Township Reuse Optimization: Irrigation Demand Summary
Operation: May - September
% of Annual Irrigation Demand Met by Stormwater Reuse System
Storage Volume (ac-ft)
0
10
20
30
40
50
60
70
80
90
100
0
20
40
60
80
100
120
140
160
High Irrigation Rate (0.8 inch/week) - Existing Development - 5% Captured
Low Irrigation Rate (0.2 inch/week) - Existing Development - 5% Captured
Existing Land Use - 5% Captured Optimization Point
High Irrigation Rate (0.8 inch/week) - Future Development - 25% Captured
Low Irrigation Rate (0.2 inch/week) - Future Development - 25% Captured
Future Land Use - 25% Captured Optimization Point
High Irrigation Rate (0.8 inch/week) - Future Development - 100% Captured
Low Irrigation Rate (0.2 inch/week) - Future Development - 100% Captured
Future Land Use - 100% Captured Optimization Point


White Bear Lake Township Reuse Optimization: Irrigation Demand Summary
Operation: May - September
Annual Irrigation Demand Met by Stormwater Reuse System (ac-ft/yr)
Storage Volume (ac-ft)
0.1
1
10
100
1000
0
20
40
60
80
100
120
140
160
High Irrigation Rate (0.8 inch/week) - Existing Development - 5% Captured
Low Irrigation Rate (0.2 inch/week) - Existing Development - 5% Captured
Existing Land Use - 5% Captured Optimization Point
High Irrigation Rate (0.8 inch/week) - Future Development - 25% Captured
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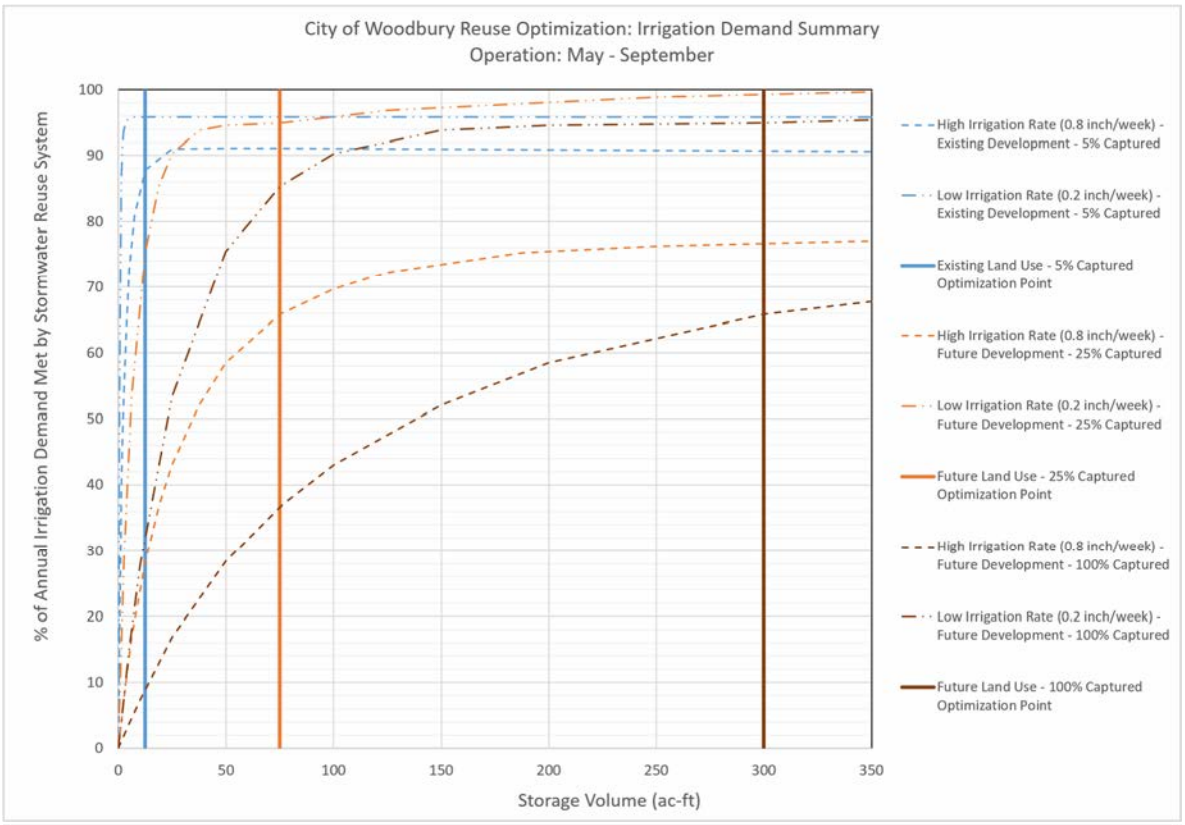
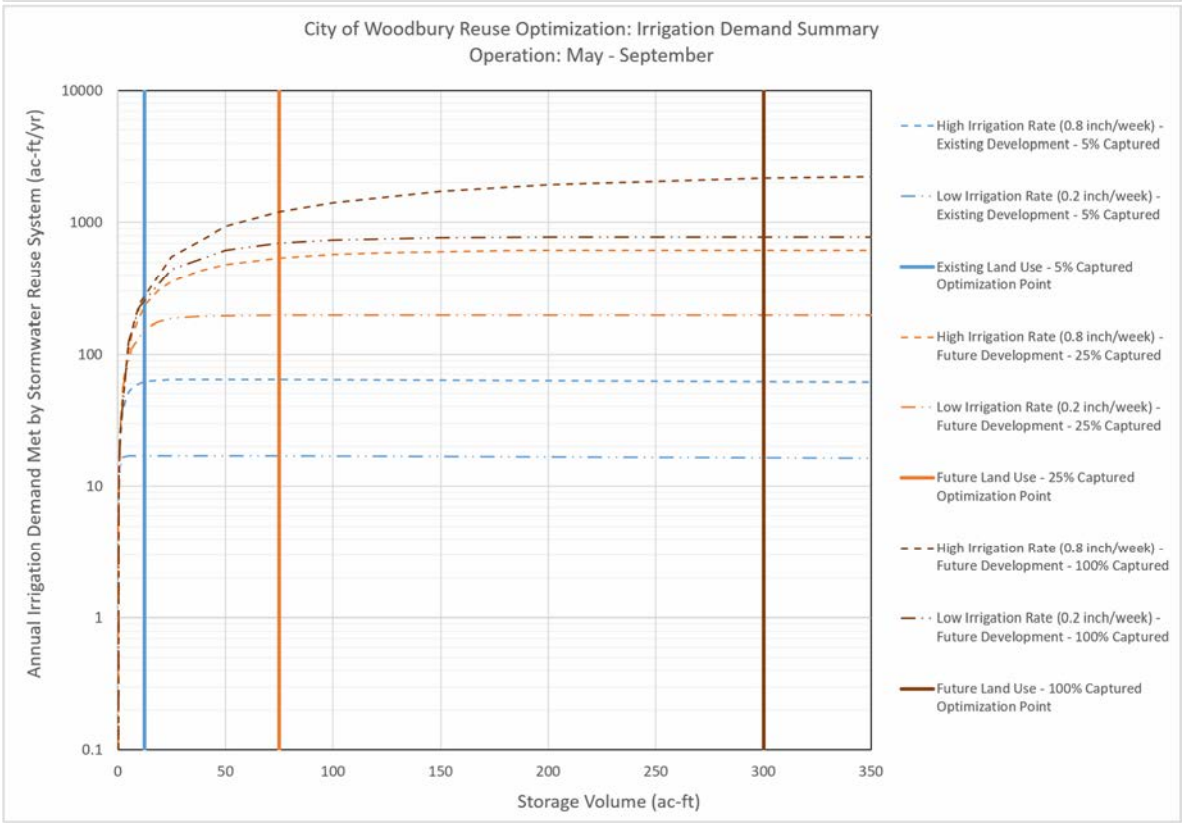
Low Irrigation Rate (0.2 inch/week) - Future Development - 100% Captured
Future Land Use - 100% Captured Optimization Point


City of Woodbury Reuse Optimization: Irrigation Demand Summary
Operation: May - September
% of Annual Irrigation Demand Met by Stormwater Reuse System
Storage Volume (ac-ft)
0
10
20
30
40
50
60
70
80
90
100
0
50
100
150
200
250
300
350
High Irrigation Rate (0.8 inch/week) - Existing Development - 5% Captured
Low Irrigation Rate (0.2 inch/week) - Existing Development - 5% Captured
Existing Land Use - 5% Captured Optimization Point
High Irrigation Rate (0.8 inch/week) - Future Development - 25% Captured
Low Irrigation Rate (0.2 inch/week) - Future Development - 25% Captured
Future Land Use - 25% Captured Optimization Point
High Irrigation Rate (0.8 inch/week) - Future Development - 100% Captured
Low Irrigation Rate (0.2 inch/week) - Future Development - 100% Captured
Future Land Use - 100% Captured Optimization Point


City of Woodbury Reuse Optimization: Irrigation Demand Summary
Operation: May - September
Annual Irrigation Demand Met by Stormwater Reuse System (ac-ft/yr)
Storage Volume (ac-ft)
0.1
1
10
100
1000
10000
0
50
100
150
200
250
300
350
High Irrigation Rate (0.8 inch/week) - Existing Development - 5% Captured
Low Irrigation Rate (0.2 inch/week) - Existing Development - 5% Captured
Existing Land Use - 5% Captured Optimization Point
High Irrigation Rate (0.8 inch/week) - Future Development - 25% Captured
Low Irrigation Rate (0.2 inch/week) - Future Development - 25% Captured
Future Land Use - 25% Captured Optimization Point
High Irrigation Rate (0.8 inch/week) - Future Development - 100% Captured
Low Irrigation Rate (0.2 inch/week) - Future Development - 100% Captured
Future Land Use - 100% Captured Optimization Point

Attachment 4

Cost Estimates

Stormwater Reuse System Cost Estimates

BARR	**PREPARED BY: BARR ENGINEERING COMPANY**		SHEET:	1	OF	1
			BY:	JMH6	DATE:	6/19/2026
White Bear Lake Comprehensive Planning Study - Study 4			CHECKED BY:	RLO	DATE:	6/22/2026
ENGINEER'S OPINION OF PROBABLE PROJECT COST			APPROVED BY:	JAK2	DATE:	6/25/2026
PROJECT:	MCES White Bear Lake Comprehensive Planning Study - Study 4	ISSUED:			DATE:	
LOCATION:	MCES	ISSUED:			DATE:	
PROJECT #:	23621557	ISSUED:			DATE:	
OPINION OF COST - SUMMARY		ISSUED:			DATE:	

Engineer's Opinion of Probable Project Cost - Stormwater Reuse Project Typical Cost Per System (30 acre site; 150 gpm; No Treatment; No Storage)

Cat. No.	ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT COST	ITEM COST	NOTES
A	Mobilization/Demobilization	L.S.	1	$32,600	$32,600	1,2,3,4
B	Sediment and Erosion Control	L.S.	1	$6,400	$6,400	1,2,3,4
C	Reuse Surface Storage: Excavation and Disposal (Clean)	C.Y.	0.00	$40	$0	1,2,3,4
D	Reuse Intake Structure	Each	1	$40,000	$40,000	1,2,3,4
E	4" Piping (connections to/from reuse skid and connection to irrigation system)	Each	1	$20,000	$20,000	1,2,3,4
F	Package Pump System, Enclosure, Concrete Foundation (No Treatments)	Each	1	$220,000	$220,000	1,2,3,4
G	Electrical and Controls	Each	1	$40,000	$40,000	1,2,3,4
H	Restoration (Seeding, Planting, Erosion Control Blanket)	Acre	0.00	$25,000	$0	1,2,3,4
					$0	1,2,3,4
	CONSTRUCTION SUBTOTAL				$359,000	1,2,3,4,6
	CONSTRUCTION CONTINGENCY		10%		$36,000	1,4,6
	ESTIMATED CONSTRUCTION COST				$395,000	1,2,3,4,6
	ENGINEERING & DESIGN		20%		$79,000	
	ESTIMATED TOTAL PROJECT COST				**$474,000**	1,2,3,4,5,6
	ESTIMATED ACCURACY RANGE	-50%			$237,000	4,5,6
		100%			$948,000	4,5,6

Notes

[1] Level of design work limited (0-5%).

[2] Quantities based on limited design work completed.

[3] Unit prices based on information available at this time including recently bid projects. Assumes any excavated material is clean (no contaminated or requiring special disposal). Assumes site work and installation of irriation system part of site development/redevelopment and not included in reuse system irrigation costs.

[4] This design level (Class 5, 0 - 5% design completion per ASTM E 2516-11) cost estimate is based on concept designs, alignments, quantities and unit prices. Costs will change with further design. Time value-of-money escalation costs are not included. A construction schedule is not available at this time. Contingency is an allowance for the net sum of costs that will be in the Final Total Project Cost at the time of the completion of design, but are not included at this level of project definition. The estimated accuracy range for the Total Project Cost as the project is defined is -50% to +100%. The accuracy range is based on professional judgement considering the level of design completed, the complexity of the project and the uncertainties in the project as scoped. The contingency and the accuracy range are not intended to include costs for future scope changes that are not part of the project as currently scoped or costs for risk contingency. Operation and Maintenance costs are not included.

[5] Estimate costs are for construction. The estimated costs do not include maintenance, monitoring or additional tasks following construction.

[6] Estimate costs are reported to nearest thousand dollars.

BARR	**PREPARED BY: BARR ENGINEERING COMPANY**		SHEET:	1	OF	1
			BY:	JMH6	DATE:	6/19/2026
White Bear Lake Comprehensive Planning Study - Study 4			CHECKED BY:	RLO	DATE:	6/22/2026
ENGINEER'S OPINION OF PROBABLE PROJECT COST			APPROVED BY:	JAK2	DATE:	6/25/2026
PROJECT:	MCES White Bear Lake Comprehensive Planning Study - Study 4		ISSUED:		DATE:	
LOCATION:	MCES		ISSUED:		DATE:	
PROJECT #:	23621557		ISSUED:		DATE:	
OPINION OF COST - SUMMARY			ISSUED:		DATE:	

Engineer's Opinion of Probable Project Cost - Stormwater Reuse Project Typical Cost Per System (30 acre site; 150 gpm; No Treatment; Surface Storage)

Cat. No.	ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT COST	ITEM COST	NOTES
A	Mobilization/Demobilization	L.S.	1	$42,500	$42,500	1,2,3,4
B	Sediment and Erosion Control	L.S.	1	$8,300	$8,300	1,2,3,4
C	Reuse Surface Storage: Excavation and Disposal (Clean)	C.Y.	2091	$40	$83,641	1,2,3,4
D	Reuse Intake Structure	Each	1	$40,000	$40,000	1,2,3,4
E	4" Piping (connections to/from reuse skid and connection to irrigation system)	Each	1	$20,000	$20,000	1,2,3,4
F	Package Pump System, Enclosure, Concrete Foundation (No Treatments)	Each	1	$220,000	$220,000	1,2,3,4
G	Electrical and Controls	Each	1	$40,000	$40,000	1,2,3,4
H	Restoration (Seeding, Planting, Erosion Control Blanket)	Acre	0.52	$25,000	$12,961	1,2,3,4
					$0	1,2,3,4
	CONSTRUCTION SUBTOTAL				$467,000	1,2,3,4,6
	CONSTRUCTION CONTINGENCY		10%		$47,000	1,4,6
	ESTIMATED CONSTRUCTION COST				$514,000	1,2,3,4,6
	ENGINEERING & DESIGN		20%		$103,000	
	ESTIMATED TOTAL PROJECT COST				**$617,000**	1,2,3,4,5,6
	ESTIMATED ACCURACY RANGE	-50%			$309,000	4,5,6
		100%			$1,234,000	4,5,6

Notes

[1] Level of design work limited (0-5%).

[2] Quantities based on limited design work completed.

[3] Unit prices based on information available at this time including recently bid projects. Assumes any excavated material is clean (no contaminated or requiring special disposal). Assumes site work and installation of irriation system part of site development/redevelopment and not included in reuse system irrigation costs.

[4] This design level (Class 5, 0 - 5% design completion per ASTM E 2516-11) cost estimate is based on concept designs, alignments, quantities and unit prices. Costs will change with further design. Time value-of-money escalation costs are not included. A construction schedule is not available at this time. Contingency is an allowance for the net sum of costs that will be in the Final Total Project Cost at the time of the completion of design, but are not included at this level of project definition. The estimated accuracy range for the Total Project Cost as the project is defined is -50% to +100%. The accuracy range is based on professional judgement considering the level of design completed, the complexity of the project and the uncertainties in the project as scoped. The contingency and the accuracy range are not intended to include costs for future scope changes that are not part of the project as currently scoped or costs for risk contingency. Operation and Maintenance costs are not included.

[5] Estimate costs are for construction. The estimated costs do not include maintenance, monitoring or additional tasks following construction.

[6] Estimate costs are reported to nearest thousand dollars.

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ENGINEER'S OPINION OF PROBABLE PROJECT COST			APPROVED BY:	JAK2	DATE:	6/25/2026
PROJECT:	MCES White Bear Lake Comprehensive Planning Study - Study 4		ISSUED:		DATE:	
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Engineer's Opinion of Probable Project Cost - Stormwater Reuse Project Typical Cost Per System (30 acre site; 150 gpm; No Treatment; Subsurface Storage)

Cat. No.	ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT COST	ITEM COST	NOTES
A	Mobilization/Demobilization	L.S.	1	$177,300	$177,300	1,2,3,4
B	Sediment and Erosion Control	L.S.	1	$34,800	$34,800	1,2,3,4
C	Reuse Subsurface Storage: Excavation and Disposal (Clean) & System	C.F.	56457	$25	$1,411,434	1,2,3,4
D	Reuse Intake Structure	Each	1	$40,000	$40,000	1,2,3,4
E	4" Piping (connections to/from reuse skid and connection to irrigation system)	Each	1	$20,000	$20,000	1,2,3,4
F	Package Pump and Treatment System, Shelter, Concrete Foundation	Each	1	$220,000	$220,000	1,2,3,4
G	Electrical and Controls	Each	1	$40,000	$40,000	1,2,3,4
H	Restoration (Seeding, Planting, Erosion Control Blanket)	Acre	0.26	$25,000	$6,480	1,2,3,4
					$0	1,2,3,4
	CONSTRUCTION SUBTOTAL				$1,950,000	1,2,3,4,6
	CONSTRUCTION CONTINGENCY		10%		$195,000	1,4,6
	ESTIMATED CONSTRUCTION COST				$2,145,000	1,2,3,4,6
	ENGINEERING & DESIGN		20%		$429,000	
	ESTIMATED TOTAL PROJECT COST				**$2,574,000**	1,2,3,4,5,6
	ESTIMATED ACCURACY RANGE	-50%			$1,287,000	4,5,6
		100%			$5,148,000	4,5,6

Notes

[1] Level of design work limited (0-5%).

[2] Quantities based on limited design work completed.

[3] Unit prices based on information available at this time including recently bid projects. Assumes any excavated material is clean (no contaminated or requiring special disposal). Assumes site work and installation of irriation system part of site development/redevelopment and not included in reuse system irrigation costs.

[4] This design level (Class 5, 0 - 5% design completion per ASTM E 2516-11) cost estimate is based on concept designs, alignments, quantities and unit prices. Costs will change with further design. Time value-of-money escalation costs are not included. A construction schedule is not available at this time. Contingency is an allowance for the net sum of costs that will be in the Final Total Project Cost at the time of the completion of design, but are not included at this level of project definition. The estimated accuracy range for the Total Project Cost as the project is defined is -50% to +100%. The accuracy range is based on professional judgement considering the level of design completed, the complexity of the project and the uncertainties in the project as scoped. The contingency and the accuracy range are not intended to include costs for future scope changes that are not part of the project as currently scoped or costs for risk contingency. Operation and Maintenance costs are not included.

[5] Estimate costs are for construction. The estimated costs do not include maintenance, monitoring or additional tasks following construction.

[6] Estimate costs are reported to nearest thousand dollars.

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OPINION OF COST - SUMMARY			ISSUED:		DATE:	

Engineer's Opinion of Probable Project Cost - Stormwater Reuse Project Typical Cost Per System (30 acre site; 150 gpm; Treatment; No Storage)

Cat. No.	ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT COST	ITEM COST	NOTES
A	Mobilization/Demobilization	L.S.	1	$40,800	$40,800	1,2,3,4
B	Sediment and Erosion Control	L.S.	1	$8,000	$8,000	1,2,3,4
C	Reuse Surface Storage: Excavation and Disposal (Clean)	C.Y.	0	$40	$0	1,2,3,4
D	Reuse Intake Structure	Each	1	$40,000	$40,000	1,2,3,4
E	4" Piping (connections to/from reuse skid and connection to irrigation system)	Each	1	$20,000	$20,000	1,2,3,4
F	Package Pump and Treatment System, Shelter, Concrete Foundation	Each	1	$300,000	$300,000	1,2,3,4
G	Electrical and Controls	Each	1	$40,000	$40,000	1,2,3,4
H	Restoration (Seeding, Planting, Erosion Control Blanket)	Acre	0.00	$25,000	$0	1,2,3,4
					$0	1,2,3,4
	CONSTRUCTION SUBTOTAL				$449,000	1,2,3,4,6
	CONSTRUCTION CONTINGENCY		10%		$45,000	1,4,6
	ESTIMATED CONSTRUCTION COST				$494,000	1,2,3,4,6
	ENGINEERING & DESIGN		20%		$99,000	
	ESTIMATED TOTAL PROJECT COST				**$593,000**	1,2,3,4,5,6
	ESTIMATED ACCURACY RANGE	-50%			$297,000	4,5,6
		100%			$1,186,000	4,5,6

Notes

[1] Level of design work limited (0-5%).

[2] Quantities based on limited design work completed.

[3] Unit prices based on information available at this time including recently bid projects. Assumes any excavated material is clean (no contaminated or requiring special disposal). Assumes site work and installation of irriation system part of site development/redevelopment and not included in reuse system irrigation costs.

[4] This design level (Class 5, 0 - 5% design completion per ASTM E 2516-11) cost estimate is based on concept designs, alignments, quantities and unit prices. Costs will change with further design. Time value-of-money escalation costs are not included. A construction schedule is not available at this time. Contingency is an allowance for the net sum of costs that will be in the Final Total Project Cost at the time of the completion of design, but are not included at this level of project definition. The estimated accuracy range for the Total Project Cost as the project is defined is -50% to +100%. The accuracy range is based on professional judgement considering the level of design completed, the complexity of the project and the uncertainties in the project as scoped. The contingency and the accuracy range are not intended to include costs for future scope changes that are not part of the project as currently scoped or costs for risk contingency. Operation and Maintenance costs are not included.

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[6] Estimate costs are reported to nearest thousand dollars.

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Engineer's Opinion of Probable Project Cost - Stormwater Reuse Project Typical Cost Per System (30 acre site; 150 gpm; Treatment; Surface Storage)

Cat. No.	ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT COST	ITEM COST	NOTES
A	Mobilization/Demobilization	L.S.	1	$50,700	$50,700	1,2,3,4
B	Sediment and Erosion Control	L.S.	1	$9,900	$9,900	1,2,3,4
C	Reuse Surface Storage: Excavation and Disposal (Clean)	C.Y.	2091	$40	$83,641	1,2,3,4
D	Reuse Intake Structure	Each	1	$40,000	$40,000	1,2,3,4
E	4" Piping (connections to/from reuse skid and connection to irrigation system)	Each	1	$20,000	$20,000	1,2,3,4
F	Package Pump and Treatment System, Shelter, Concrete Foundation	Each	1	$300,000	$300,000	1,2,3,4
G	Electrical and Controls	Each	1	$40,000	$40,000	1,2,3,4
H	Restoration (Seeding, Planting, Erosion Control Blanket)	Acre	0.52	$25,000	$12,961	1,2,3,4
					$0	1,2,3,4
	CONSTRUCTION SUBTOTAL				$557,000	1,2,3,4,6
	CONSTRUCTION CONTINGENCY		10%		$56,000	1,4,6
	ESTIMATED CONSTRUCTION COST				$613,000	1,2,3,4,6
	ENGINEERING & DESIGN		20%		$123,000	
	ESTIMATED TOTAL PROJECT COST				**$736,000**	1,2,3,4,5,6
	ESTIMATED ACCURACY RANGE	-50%			$368,000	4,5,6
		100%			$1,472,000	4,5,6

Notes

[1] Level of design work limited (0-5%).

[2] Quantities based on limited design work completed.

[3] Unit prices based on information available at this time including recently bid projects. Assumes any excavated material is clean (no contaminated or requiring special disposal). Assumes site work and installation of irriation system part of site development/redevelopment and not included in reuse system irrigation costs.

[4] This design level (Class 5, 0 - 5% design completion per ASTM E 2516-11) cost estimate is based on concept designs, alignments, quantities and unit prices. Costs will change with further design. Time value-of-money escalation costs are not included. A construction schedule is not available at this time. Contingency is an allowance for the net sum of costs that will be in the Final Total Project Cost at the time of the completion of design, but are not included at this level of project definition. The estimated accuracy range for the Total Project Cost as the project is defined is -50% to +100%. The accuracy range is based on professional judgement considering the level of design completed, the complexity of the project and the uncertainties in the project as scoped. The contingency and the accuracy range are not intended to include costs for future scope changes that are not part of the project as currently scoped or costs for risk contingency. Operation and Maintenance costs are not included.

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Engineer's Opinion of Probable Project Cost - Stormwater Reuse Project Typical Cost Per System (30 acre site; 150 gpm; Treatment; Subsurface Storage)

Cat. No.	ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT COST	ITEM COST	NOTES
A	Mobilization/Demobilization	L.S.	1	$185,400	$185,400	1,2,3,4
B	Sediment and Erosion Control	L.S.	1	$36,400	$36,400	1,2,3,4
C	Reuse Subsurface Storage: Excavation and Disposal (Clean) & System	C.F.	56457	$25	$1,411,434	1,2,3,4
D	Reuse Intake Structure	Each	1	$40,000	$40,000	1,2,3,4
E	4" Piping (connections to/from reuse skid and connection to irrigation system)	Each	1	$20,000	$20,000	1,2,3,4
F	Package Pump and Treatment System, Shelter, Concrete Foundation	Each	1	$300,000	$300,000	1,2,3,4
G	Electrical and Controls	Each	1	$40,000	$40,000	1,2,3,4
H	Restoration (Seeding, Planting, Erosion Control Blanket)	Acre	0.26	$25,000	$6,480	1,2,3,4
					$0	1,2,3,4
	CONSTRUCTION SUBTOTAL				$2,040,000	1,2,3,4,6
	CONSTRUCTION CONTINGENCY		10%		$204,000	1,4,6
	ESTIMATED CONSTRUCTION COST				$2,244,000	1,2,3,4,6
	ENGINEERING & DESIGN		20%		$449,000	
	ESTIMATED TOTAL PROJECT COST				**$2,693,000**	1,2,3,4,5,6
	ESTIMATED ACCURACY RANGE	-50%			$1,347,000	4,5,6
		100%			$5,386,000	4,5,6

Notes

[1] Level of design work limited (0-5%).

[2] Quantities based on limited design work completed.

[3] Unit prices based on information available at this time including recently bid projects. Assumes any excavated material is clean (no contaminated or requiring special disposal). Assumes site work and installation of irriation system part of site development/redevelopment and not included in reuse system irrigation costs.

[4] This design level (Class 5, 0 - 5% design completion per ASTM E 2516-11) cost estimate is based on concept designs, alignments, quantities and unit prices. Costs will change with further design. Time value-of-money escalation costs are not included. A construction schedule is not available at this time. Contingency is an allowance for the net sum of costs that will be in the Final Total Project Cost at the time of the completion of design, but are not included at this level of project definition. The estimated accuracy range for the Total Project Cost as the project is defined is -50% to +100%. The accuracy range is based on professional judgement considering the level of design completed, the complexity of the project and the uncertainties in the project as scoped. The contingency and the accuracy range are not intended to include costs for future scope changes that are not part of the project as currently scoped or costs for risk contingency. Operation and Maintenance costs are not included.

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Stormwater Reuse System Annual Operations and Maintenance Costs

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Engineer's Opinion of Probable Project Cost - Annual Operations and Matainenance
Stormwater Reuse - 150 gpm Pump (No Treatment System; No Storage)

Cat. No.	ITEM DESCRIPTION	UNIT	ANNUAL QUANTITY	UNIT COST	ANNUAL TOTAL	NOTES
1	**UTILITIES**					
1.1	Electricity - pump & treatment	LS	1	$900	$900	1,2,3,4
2	**CONSUMABLES**					
2.1	Pump Maintenance	LS	1	$1,500	$1,500	1,2,3,4
2.1	UV light bulbs	EA	0	$400	$0	1,2,3,5
2.2	Quartz sleeves (UV bulb sleeves)	EA	0	$200	$0	1,2,3
3	**MAINTENANCE**					
3.1	Spring Start-Up	LS	1	$1,000	$1,000	1,2,3,6
3.2	Inspection and Maintenance of Storage	LS	0	$1,000	$0	1,2,3,6
3.3	Pretreatment Maintenance	LS	0	$800	$0	1,2,3,6
3.4	Pump Intake/Structure Maintenance	LS	1	$500	$500	1,2,3,6
3.5	Winterization	LS	1	$1,000	$1,000	1,2,3,6
	ESTIMATED ANNUAL O&M COST				**$4,900.00**	1,2,3,7

Notes

[1] Limited design work completed (0-2%).

[2] Quantities based on design work completed.

[3] Unit prices based on information available at this time.

[4] See column N assumptions.

[5] Changeout is anticipated less than once per year. Annual replacement shown to be conservative.

[6] Assumes maintenance is completed by an irrigation contractor or similar. Cost would be eliminated if WD/WMO winterized/completed start-up themselves.

[7] Estimate costs are reported to nearest thousand dollars.

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Engineer's Opinion of Probable Project Cost - Annual Operations and Matainenance
Stormwater Reuse - 150 gpm Pump (No Treatment System; Storage)

Cat. No.	ITEM DESCRIPTION	UNIT	ANNUAL QUANTITY	UNIT COST	ANNUAL TOTAL	NOTES
1	**UTILITIES**					
1.1	Electricity - pump & treatment	LS	1	$900	$900	1,2,3,4
2	**CONSUMABLES**					
2.1	Pump Maintenance	LS	1	$1,500	$1,500	1,2,3,4
2.1	UV light bulbs	EA	0	$400	$0	1,2,3,5
2.2	Quartz sleeves (UV bulb sleeves)	EA	0	$200	$0	1,2,3
3	**MAINTENANCE**					
3.1	Spring Start-Up	LS	1	$1,000	$1,000	1,2,3,6
3.2	Inspection and Maintenance of Storage	LS	1	$1,000	$1,000	1,2,3,6
3.3	Pretreatment Maintenance	LS	1	$800	$800	1,2,3,6
3.4	Pump Intake/Structure Maintenance	LS	1	$500	$500	1,2,3,6
3.5	Winterization	LS	1	$1,000	$1,000	1,2,3,6
	ESTIMATED ANNUAL O&M COST				**$6,700.00**	1,2,3,7

Notes

[1] Limited design work completed (0-2%).

[2] Quantities based on design work completed.

[3] Unit prices based on information available at this time.

[4] See column N assumptions.

[5] Changeout is anticipated less than once per year. Annual replacement shown to be conservative.

[6] Assumes maintenance is completed by an irrigation contractor or similar. Cost would be eliminated if WD/WMO winterized/completed start-up themselves.

[7] Estimate costs are reported to nearest thousand dollars.

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Engineer's Opinion of Probable Project Cost - Annual Operations and Matainenance
Stormwater Reuse - 150 gpm Pump (Treatment System; No Storage)

Cat. No.	ITEM DESCRIPTION	UNIT	ANNUAL QUANTITY	UNIT COST	ANNUAL TOTAL	NOTES
1	**UTILITIES**					
1.1	Electricity - pump & treatment	LS	1	$1,100	$1,100	1,2,3,4
2	**CONSUMABLES**					
2.1	Pump Maintenance	LS	1	$1,500	$1,500	1,2,3,4
2.1	UV light bulbs	EA	1	$400	$400	1,2,3,5
2.2	Quartz sleeves (UV bulb sleeves)	EA	1	$200	$200	1,2,3
3	**MAINTENANCE**					
3.1	Spring Start-Up	LS	1	$1,000	$1,000	1,2,3,6
3.2	Inspection and Maintenance of Storage	LS	0	$1,000	$0	1,2,3,6
3.3	Pretreatment Maintenance	LS	0	$800	$0	1,2,3,6
3.4	Pump Intake/Structure Maintenance	LS	1	$500	$500	1,2,3,6
3.5	Winterization	LS	1	$1,000	$1,000	1,2,3,6
	ESTIMATED ANNUAL O&M COST				**$5,700.00**	1,2,3,7

Notes

[1] Limited design work completed (0-2%).

[2] Quantities based on design work completed.

[3] Unit prices based on information available at this time.

[4] See column N assumptions.

[5] Changeout is anticipated less than once per year. Annual replacement shown to be conservative.

[6] Assumes maintenance is completed by an irrigation contractor or similar. Cost would be eliminated if WD/WMO winterized/completed start-up themselves.

[7] Estimate costs are reported to nearest thousand dollars.

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Engineer's Opinion of Probable Project Cost - Annual Operations and Matainenance
Stormwater Reuse - 150 gpm Pump (Treatment System; Storage)

Cat. No.	ITEM DESCRIPTION	UNIT	ANNUAL QUANTITY	UNIT COST	ANNUAL TOTAL	NOTES
1	**UTILITIES**					
1.1	Electricity - pump & treatment	LS	1	$1,100	$1,100	1,2,3,4
2	**CONSUMABLES**					
2.1	Pump Maintenance	LS	1	$1,500	$1,500	1,2,3,4
2.1	UV light bulbs	EA	1	$400	$400	1,2,3,5
2.2	Quartz sleeves (UV bulb sleeves)	EA	1	$200	$200	1,2,3
3	**MAINTENANCE**					
3.1	Spring Start-Up	LS	1	$1,000	$1,000	1,2,3,6
3.2	Inspection and Maintenance of Storage	LS	1	$1,000	$1,000	1,2,3,6
3.3	Pretreatment Maintenance	LS	1	$800	$800	1,2,3,6
3.4	Pump Intake/Structure Maintenance	LS	1	$500	$500	1,2,3,6
3.5	Winterization	LS	1	$1,000	$1,000	1,2,3,6
	ESTIMATED ANNUAL O&M COST				**$7,500.00**	1,2,3,7

Notes

[1] Limited design work completed (0-2%).

[2] Quantities based on design work completed.

[3] Unit prices based on information available at this time.

[4] See column N assumptions.

[5] Changeout is anticipated less than once per year. Annual replacement shown to be conservative.

[6] Assumes maintenance is completed by an irrigation contractor or similar. Cost would be eliminated if WD/WMO winterized/completed start-up themselves.

[7] Estimate costs are reported to nearest thousand dollars.