LOWER MISSISSIPPI RIVER WMO—INTERSTATE VALLEY CREEK STABILIZATION AND VOLUME REDUCTION STUDY

FEASIBILITY REPORT

January 30, 2023

Prepared for:

Lower Mississippi River WMO

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WSB PROJECT NO. 020683-000

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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.

Jacob Newhall, PE

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Date: January 30, 2023 Lic. No. 49170

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Date: January 30, 2023 Lic. No. 58716

Executive Summary

This study is an analysis of the existing streambank erosion on Interstate Valley Creek and its two tributaries, Wentworth Creek and Marie Creek, and proposed stabilization projects to address known erosion. It includes identifying opportunities within the tributary drainage area to these waterbodies to reduce peak stormwater discharge rates, volume, and pollutant loads through a variety of projects. Stabilization projects were considered for the three streams and permanent stormwater Best Management Practices (BMPs) were considered throughout the tributary drainage area to provide improved stormwater management.

Interstate Valley Creek and its tributaries are located primarily within the City of Mendota Heights; however, Marie Creek originates in the City of West St. Paul and Interstate Valley Creek flows through the City of Lilydale before it outlets into the Mississippi. The contributing drainage area to these three waterbodies also includes portions of the Cities of Sunfish Lake and Inver Grove Heights. The entire contributing drainage area is within the Lower Mississippi River Watershed Management Organization.

The three projects with the highest overall ranking for both stabilization and stormwater BMP construction are shown below. Detailed discussion of the prioritization and ranking is included in Section J, along with prioritization tables that include all the concept designs covered in this study.

Table 1: Top 3 Stabilization Projects

Concept Design (Section No./Figure No.)	TSS Reduction (ton/yr)	TP Reduction (lbs/yr)	Total Project Cost	TP Pollutant Cost Benefit ($/lb/yr)
Valley Park RTR to Wentworth (B.4.1/B.1)	158.7	135.0	$ 83,250	$25
Valley Park Wetland (B.4.2/B.2)	74.9	85.2	$ 98,650	$46
Valley Park Playground (F.4.1/F.1)	48.3	41.1	$ 47,100	$46

Table 2: Top 3 BMP Projects

Concept Design (Section No./ Figure No.)	TSS Reduction (ton/yr)	TP Reduction (lbs/yr)	Rate Reduction (cfs)		Total Project Cost	TP Pollutant Cost Benefit ($/lb/yr)
			2-yr	10-yr		
Friendly Marsh Park Wetland Enhancement (D.4.1/D.1)	0.5	1.8	46.2	64.2	$ 180,225	$4,005
Valley Park Wetland Infiltration Basin (B.4.3/B.3)	1.2	4.7	10.9	12.6	$ 183,915	$1,565
Lower Marie Creek Wetland Enhancement (F.4.4/F.4)	8.1	24.9	0.1	0.5	$ 146,700	$236

Introduction

The Lower Mississippi River Watershed Management Organization (LMRWMO) selected WSB to complete an engineering study of Interstate Valley Creek (IVC) in May 2022. The LMRWMO and the City of Mendota Heights (City) wished to complete an engineering study which would complete the following tasks:

- Identify existing streambank erosion issues on IVC and two tributaries, Wentworth Creek and Marie Creek. The scope of investigation was generally limited to the channels of these waterways within the City of Mendota Heights.
- Propose potential stabilization projects which address existing erosion issues.
- Evaluate existing site conditions and identify opportunities within the watershed for projects which achieve stormwater volume and pollutant reductions.
- Propose potential Best Management Practice (BMP) projects which provide reductions in stormwater rate, volume, and pollutant loading.

Purpose and Background

The LMRWMO and the City of Mendota Heights had previously identified IVC and its tributaries as high priority areas for future projects due to the presence of existing bank erosion. However, the City and the LMRWMO wished to complete a more comprehensive assessment which would document the extent and severity of existing erosion issues and evaluate them based on their pollutant loading.

The LMRWMO and the City also suspected that stormwater volumes were contributing to existing erosion issues, therefore the study would also look for project opportunities that would reduce stormwater volumes which by extension would reduce erosion and improve water quality in IVC and its tributaries. The study area is shown in **Figure 1, Appendix A**.

Data Collected and Reviewed

Prior to completing the assessment, WSB met with the LMRWMO and City staff to discuss project goals and review existing data. WSB's review of existing data is summarized below in **Table 3**.

Table 3: Existing Data

Data Type	Source	Project Use
Stormwater infrastructure GIS layers	City of Mendota Heights	Reviewed prior to field work, used in mapping and preliminary design
LiDAR data		Reviewed prior to field work, used in mapping, 2D modeling, and preliminary design
City of Mendota Heights Boundaries (parks, parcel data, etc.)	City of Mendota Heights	Reviewed prior to field work, used in mapping and preliminary design
Homeowner requests regarding erosion issues	Parcel addresses provided by City of Mendota Heights Staff, used to create a shapefile used in erosion survey	Reviewed prior to field work, used to verify areas of identified erosion
Existing HydroCAD model	City of Mendota Heights	Output flows used in 2D modeling, used to site and analyze potential BMP locations
Existing culvert and crossing plan sets	City of Mendota Heights	2D model construction
Existing P8 model	City of Mendota Heights	Used to estimate pollutant reductions for proposed BMPs

Channel Erosion Survey Methodology

Field Survey Methodology

WSB conducted the channel erosion survey in July 2022. WSB staff walked the entire study area shown in **Figure 2, Appendix A**. WSB visually inspected creek banks for signs of erosion, including but not limited to sloughing, undercutting, steep (slope of approximately 2H:1V or steeper) or vertical banks, and perched culverts. WSB documented existing bank conditions with photos and field notes collected using a GPS-connected iPad. Where signs of erosion were present, WSB categorized the erosion issues as minor, moderate, or severe, based on the following criteria:

- Minor erosion issues are characterized as steep banks that are less than 3 feet high. Usually, these areas have some vegetation present which contributes to stability.

Photo 1: Minor Erosion

- Moderate erosion issues are characterized as steep banks approximately 3 to 6 feet high with generally minimal vegetation.

Photo 2: Moderate Erosion

- Severe erosion issues are banks greater than 6 feet high which are generally either vertical or undercut at the bottom. Banks which were 4 to 6 feet high and had a risk to existing infrastructure and/or public safety were also classified as having severe erosion issues.

Photo 3: Severe Erosion

Following completion of the field survey, WSB mapped all documented erosion issues and determined their approximate length. An overview of all documented erosion issues within the study area can be seen in **Figure 2, Appendix A**.

Estimating Erosion Rates

After mapping the areas of erosion, WSB needed to estimate the erosion rates for each area. WSB chose to use the Board of Water and Soil Resources Stream and Ditch Bank Stabilization Estimator Version 2.1 for all estimates of sediment and phosphorus loading via erosion.

The first step was to estimate lateral erosion, which is the movement of a channel across a landscape. This type of erosion is clearly visible by viewing aerial photos of the area over time, so WSB used historic aerial photo analysis to estimate this erosion rate.

Lateral movement of channels does not happen in a linear pattern; channels may appear quite stable for years or even decades, and then after a significant precipitation event they may move several feet in a short period of time. WSB's historic aerial photos used for the lateral erosion estimates given in this study are from 2006. WSB selected this year because it is old enough to give a reasonable estimate of lateral erosion over a large time frame, but recent enough that available images are of good quality for estimating distance.

WSB compared channel landscape position in current (2021) aerial photos of the project area with the position of the channel in 2006. Where there was noticeable movement, WSB measured the distance of movement of comparable banks (e.g. left bank position in 2006 to left bank position in

2021) at three points. These three points were averaged to provide an estimate of average lateral erosion across the site. Finally, the average lateral erosion was multiplied by the length of erosion (field estimated) and the bank height (field estimated) to create an eroded volume due to lateral erosion in cubic feet. **Figure 3, Appendix A** shows an example of lateral erosion within the project area.

The second source of erosion in the project area is vertical erosion. Vertical erosion is the tendency of channels to deepen, or down cut, as well as widen, particularly when input hydrologic flows increase in rate, duration, or both. WSB noticed indicators of vertical erosion during the field survey, most specifically in perched culverts along the Interstate Valley Creek corridor.

Vertical erosion is not visible on aerial photos, and unless it is severe it is generally not visible by comparing sets of LiDAR data. Vertical erosion can be measured using bank pins or repeat surveys of a channel reach over time. Because this project area does not have bank pins or historic survey data, WSB decided to use an assumed vertical erosion depth of four inches (0.33 ft) over all erosion areas. This is a conservative assumption for several reasons, including but not limited to:

- The calculation is only for documented erosion areas but it is likely that vertical erosion was nearly constant over the study area.
- The height of culvert perching observed on the IVC mainstem at Marie Avenue and TH 62 was larger than four inches.
- This calculation is based on a fixed width measured based on 2021 aerial photos and does not account for any channel widening during the study period.

WSB measured an average channel width from the current 2021 aerial photos and multiplied this width by the length of erosion (field estimated) and the assumed vertical erosion depth to calculate an eroded volume due to vertical erosion in cubic feet. The lateral and vertical erosion loads in tons/year are shown in the sediment loading tables for each stabilization design.

Concept Stabilization Designs

The priorities for concept stabilization designs were as follows:

1. Areas categorized as having severe erosion issues.
2. Areas which have volume reduction potential.
3. Areas categorized as moderate erosion issues that are long enough to have a significant sediment load from erosion OR where a stabilization project would have additional benefits (such as reducing risk to existing infrastructure or being adjacent to a severe erosion or volume reduction project).

This prioritization strategy means that not every area flagged as having moderate erosion issues received an initial stabilization design. For purposes of calculating sediment loading, the erosion areas contained within the limits of project activities such as bioengineering, grading, or native plant installations are counted for sediment load calculations; erosion areas outside these activities are not calculated within the project's loading estimates. However, many adjacent areas with moderate issues could be added onto the proposed concept stabilization designs to achieve additional benefits with minimal increases to project costs.

Additional Potential Impacts

The LMRWMO requested that concept stabilization designs be evaluated on the following criteria:

- Impact to trees
- Impact to parks
- Impact to infrastructure
- Impact to wetlands

WSB completed qualitative impact assessments to these items as follows:

- Impact to trees: WSB did not complete a tree survey as part of the erosion survey but assigned a likelihood of tree impact as low (less than 5 tree impacts), moderate (5 – 10 tree impacts), or high (greater than 10 tree impacts), in the impact tables in each section. These impacts are meant to be for the stabilization project itself and do not include impacts due to access routes, which are likely to cause additional impacts.
- Impact to parks: if the stabilization project is within a park parcel, it is deemed as having impact to parks. If it is on private land or public land not being used as a park, it has no impact to parks.
- Impact to infrastructure: WSB used aerial photos and GIS data sets from the City of Mendota Heights and Dakota County to look for above-ground visible infrastructure that might be impacted by earth-moving activities associated with the concept stabilization designs, including but not limited to fences, power lines, stormwater outfalls, and structures. WSB's infrastructure impact assessment is preliminary and may not include all existing infrastructure within the proposed stabilization area. The assessment does not include buried infrastructure such as drinking water lines, electric or fiber optic cables, and gas lines. All stabilization projects would require a utility locate before construction.
- Impacts to wetlands: WSB did not complete a wetland delineation anywhere within the project area. WSB ranked the likelihood of wetland impact as possible, likely, or very likely based on presence of existing vegetation, existing standing water, and consultation with the City's Natural Resource Management Plan (hereafter MH NRMP). As part of

progressing from concept to final design, all stabilization projects should have wetland delineations completed as part of the permitting process. The proposed improvements would likely qualify as an exemption from Wetland Conservation Act permitting under 8420.0420 Subpart 2. C.: Impacts Resulting from Soil and Water Conservation Projects.

Impact assessments for each site are summarized in a tabular view in Sections A.4 – F.4.

HEC-RAS 2D Model Methodology

Scope of Model

WSB developed an unsteady 2D model of the study area using HEC-RAS 6.0 as shown in **Figure 4, Appendix A**. The purpose of the model is to determine areas most vulnerable to erosion based on existing conditions.

Data Inputs

WSB used Dakota County LiDAR data to create an existing conditions terrain data file in HEC-RAS. Manning's n values came from the 2019 USGS National Land Cover Database. From this, a land cover layer was created in HEC-RAS to provide spatially varied Manning's n across the modeled area. A 2D perimeter was created and computation points were generated within the perimeter based on 20' by 20' cells. This size was maintained throughout the model, however exact cell size and shape varies due to break lines placed to ensure proper modeling of the terrain.

WSB used flow data from the existing sub watershed HydroCAD model that WSB developed in 2016. Three inflow boundary conditions were used – Interstate Valley Creek (north of TH 62 and west of Dodd Rd), Marie Creek (south of Marie Ave and west of Dodd Rd) and Wentworth Creek (north of Wentworth Ave and east of Watchler Ave). Hydrographs for the 2-year and 10-year events modeled in the Sub watershed HydroCAD model became the input flows at these three locations. The downstream boundary condition (south of Lilydale Rd's crossing of Interstate Valley Creek) was set to normal depth. This outflow computes the water surface elevation in each 2D cell along the boundary condition line. The computed water surface elevation is used as the downstream boundary for each modeled area. The computation settings for the unsteady state plan In HEC-RAS were refined to produce a stable unsteady state model with acceptable Courant number results.

Use of Results

Results from the 2D models were reviewed in HEC-RAS and exported as a raster to produce maps showing the maximum velocity in the 10-year event (see **Appendix E**). WSB used this information, paired with field observations, to inform erosion control decisions.

The model shows flooding on Marie Avenue for approximately 1.5 hours during the 10-year event. Conversations with City of Mendota Heights staff indicate that this has not been observed under real world conditions, however the 2D model does not account for catchbasins or the storm sewer system that serves Marie Avenue and neighboring streets. Revising the model to include additional surface drainage features would likely alter these peak flow results to remove water from the surface of Marie Avenue.

Rate, Volume, and Pollutant Reduction Study Methodology

Desk Survey Methodology

WSB completed a GIS analysis to identify potential areas for rate, volume and water quality improvements. Existing storm sewer mapping and subwatershed information, along with proximity to Interstate Valley Creek and its tributaries, were reviewed, as shown in **Figure 5, Appendix A**. Land use, parcel ownership information, utility information, topography, and tree cover were used to help identify possible locations for improvements.

Field Verification

Following identification of potential improvement areas via the desk survey, field verification was completed to determine overall feasibility and effectiveness of the locations identified. Constructability review and design considerations were evaluated to help determine which types and sizes of improvements could be implemented in each potential location depending on in-field existing conditions. These design considerations were then used in the hydrologic and hydraulic modeling and water quality modeling to help determine the benefits of each option.

Estimating Rate, Volume, and Pollutant Reductions

WSB used HydroCAD to estimate and evaluate the benefits of the proposed concept designs on peak discharge rates and total stormwater volume. The HydroCAD model for the City of Mendota Heights was used to establish existing conditions. A copy of this model was saved and modified to incorporate the proposed concept designs.

P8 water quality modeling was developed to estimate and evaluate the benefits of the proposed concept designs on Total Suspended Solids (TSS) and Total Phosphorus (TP) removals. The P8 model for the City of Mendota Heights was used to establish existing conditions. Like the HydroCAD model, a copy of this model was saved and modified to incorporate the proposed concept designs. Rate, volume and pollutant reduction benefits for the proposed concept designs are quantified in the description of each figure.

BMP Concept Designs

To identify the areas where BMPs could be sited most impactfully, the following were considered:

1. Rate and/or volume benefit.
2. Available open space (priority for publically owned open space, however private open space was not excluded).

3. Subwatersheds that outlet directly to IVC or its tributaries.
4. Size of storm sewer (prefer locations with 18-inch pipe or greater).
5. Water quality benefit (over and above erosion reduction as a result of reduced rates and volumes in IVC and its tributaries).

Additional Potential Impacts

For consistency in reviewing the qualitative impacts of proposed projects between the BMP and Stabilization Concept Designs, the same categories and qualitative assessment categories as used in the stabilization section will be used for the BMP Concept Designs.

- Impact to trees
- Impact to parks
- Impact to infrastructure
- Impact to wetlands

Cost Estimates

Each concept design is accompanied by a feasibility level cost estimate (see **Appendix B** for detailed cost estimates). These cost estimates include an assumed access route which could change as design progresses, as well as commonly used methods for site stabilization and erosion and sediment control. Prices and quantities in these cost estimates were based on best available information in December 2022 and will need to be revised during project design. Each construction cost estimate includes a 20% contingency, and engineering costs are estimated at 20% of construction costs (including contingency).

Report Organization

This feasibility study will present its findings starting with the downstream reaches of IVC and moving upstream towards the headwaters. The IVC drainage area was split up into 9 drainage basins, as shown in **Figure 1, Appendix A**. The following sections discuss each basin in detail, including the findings and recommendations from the channel erosion and volume reduction surveys. **Figure 6, Appendix A** gives an overview of the Concept Designs and any other recommendations that resulted from this study. **Figure 7, Appendix A** contains example details for the concept stabilization design elements.

A. Lower IVC Basin

1. Basin Description and History

The Lower IVC Basin as shown in **Figure 1, Appendix A** extends from where IVC crosses under Lilydale Road to the junction of Wentworth Creek and IVC. IVC has several culvert crossings in this basin, including a culvert crossing under the existing railroad, a culvert crossing under the Big Rivers Regional Trail, a bridge crossing beneath Highway 13, and a prefabricated bike/pedestrian bridge for the River to River Greenway Trail.

The Lower IVC Basin is located entirely in the City of Mendota Heights. Within the MH NRMP, the channel and its surrounding valley are mostly within the Valley Park North Natural Area. The MH NRMP describes the area as having vegetative quality ranging from good to poor and states that "currently the creek valley and its tributaries are experiencing channel downcutting, bank erosion, and slope failure."

2. Channel Erosion Survey Findings & Recommendations

As the lowest section of Interstate Valley Creek before it joins the Mississippi River, the channel is generally much smaller than its confining valley. Valley walls are quite steep and generally well forested, though mature forests do shade out banks and limit the presence of ground cover near the channel. Documented erosion issues are all characterized as mild to moderate and are mostly limited to areas where current channel alignment forces the flow up against existing valley walls.

3. Volume Reduction Study Findings & Recommendations

There are only three storm sewer outfalls to IVC in the Lower IVC Basin. Approximately 40 percent of the basin drains to two existing storm ponds. Approximately 15 percent of the basin drains to a 24-inch storm sewer pipe that outlets directly to IVC, while the remainder of the area overland flows directly to IVC. Considering the open space available in the basin, the 24-inch outfall, which is at the upstream end of the basin, provides the best opportunity to site a BMP that could intercept currently untreated water.

4. Concept Designs

4.1 Lilydale Trailhead Parking Lot

The field erosion study documented moderate erosion around the Lilydale Trailhead Parking Lot as shown in **Figure A.1**. Existing banks are steep and show evidence of prior stabilization efforts, including remnants of plastic-based geotextiles and riprap. The parking lot is built on top of a retaining wall protected by riprap, most of which has remained in place, though a significant amount of riprap has been lost from the north side below the retaining wall. WSB recommends that Dakota County replace this riprap.

Photo 4: Retaining Wall Below Lilydale Trailhead Parking Lot

Pollutant Reduction Estimates

The estimated pollutant reduction estimates for the Lilydale Trailhead Parking Lot are shown in **Table A.1** below. The load estimates for Lilydale Trailhead Parking Lot are based on the 50 feet of retaining wall that has lost its riprap.

Table A.1: Sediment Loading Table - Lilydale Trailhead Parking Lot

Total Length, ft	50
Average Bank Height, ft	6
Total Lateral TSS Load, Tons/yr	0.0
Total Vertical TSS Load, Tons/yr	0.7
Total P Load (Vertical + Lateral), lbs/yr	0.6

There has been no lateral erosion observed at the Lilydale Trailhead Parking Lot site, likely due to the presence of the existing retaining wall. Replacing the riprap which has been lost will not address the vertical erosion because it will not pause downcutting. Options for addressing vertical erosion in this area include using rock riffles as grade control or by constructing a plunge pool or other type of energy dissapating structure at the downstream end of the culvert below the Lilydale Road crossing.

Potential Impacts

A summary of potential impacts from the Lilydale Trailhead Parking Lot stabilization are shown in **Table A.2** below.

Table A.2: Design and Impacts Table - Lilydale Trailhead

Total Length, ft	50
Average Bank Height, ft	6
Ownership Type	Public
Impact to Parks	No
Impact to Existing Infrastructure	Closure of part of parking lot during construction
Impact to Trees	Low
Impact to Wetlands	Possible
Construction Access	From existing trailhead parking lot
Proposed Design Features	Replace lost riprap on existing retaining wall
Feasibility Level Cost Estimate	$30,900.00

Access to the riprap replacement area would be from the existing trailhead parking lot and part of the parking lot would likely need to be closed during the repair work. Placement of riprap on existing banks without grading would have minimal impacts to existing vegetation or existing infrastructure.

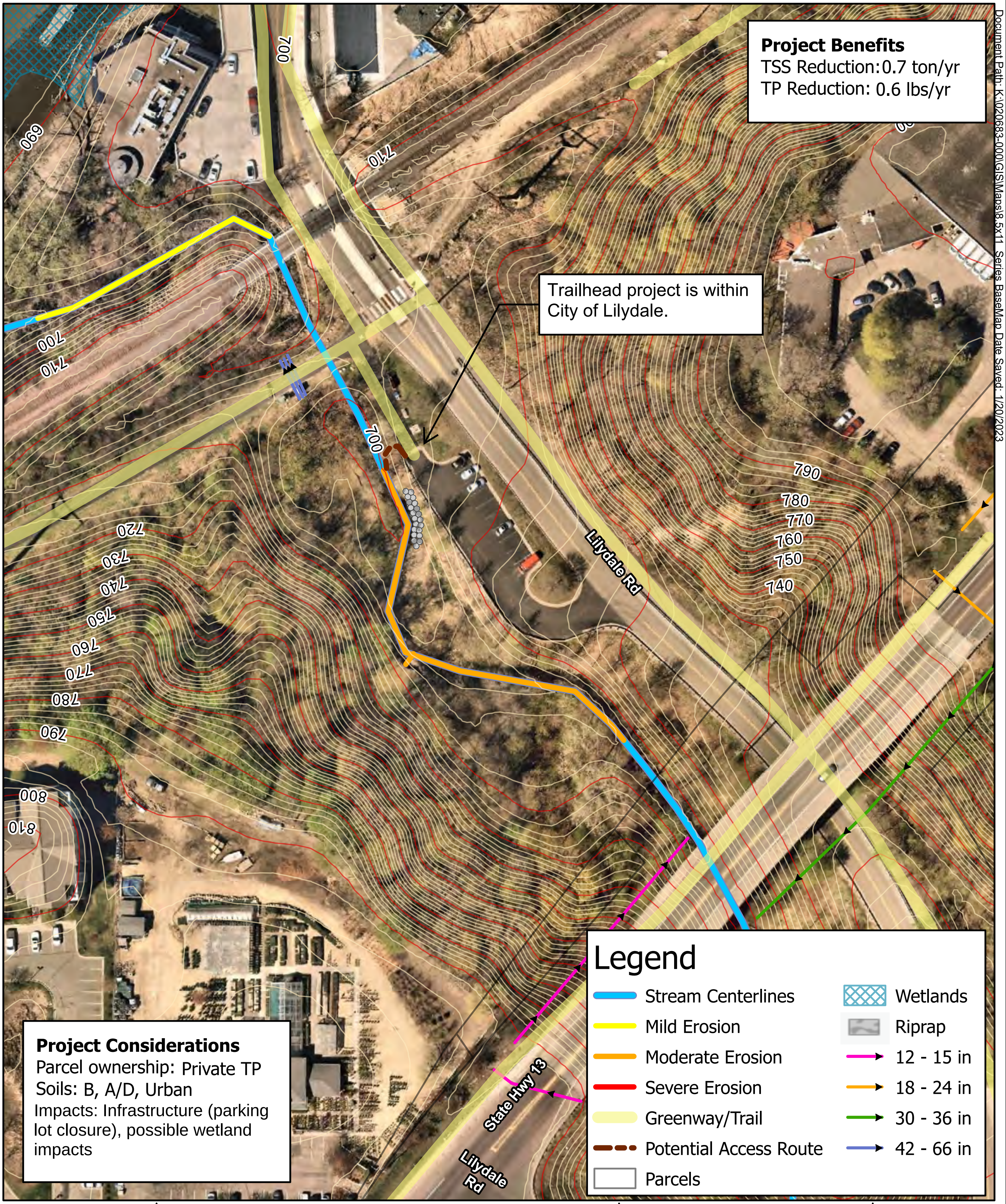

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Figure A.1 - Lilydale Trailhead Parking Lot

Interstate Valley Creek Study
Lower Mississippi River Watershed Management Organization

N

0 100 Feet

1 inch = 100 feet

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4.2 Park Place

The field assessment documented moderate erosion in the IVC channel within the Park Place neighborhood. The channel in this area is in a very confined valley with steep valley walls on either side, some have noticeable sloughing while others have nearly vertical banks. There are large rocks present in the existing channel bottom which suggest a past stabilization attempt. The 2D modeling results show an area of localized high velocity flow in the area of documented moderate erosion (**see Appendix E**).

Photo 5: Bank Erosion at Park Place Site

The proposed stabilization design for Park Place is shown in **Figure A.2**. WSB recommends addressing the vertical erosion with two rock riffles placed to deflect flow during major storm events away from the valley walls. Given the amount of large rock present in the channel already, these riffles may be able to be mostly constructed with material already on site.

Pollutant Reduction Estimates

Table A.3 shows the pollution load estimates from the Park Place site. Sediment load reductions at the Park Place site are based on the 150 feet of observed moderate erosion.

Table A.3: Sediment Loading Table - Park Place

Total Length, ft	150
Average Bank Height Range, ft	6
Total Lateral TSS Load, Tons/yr	1.6
Total Vertical TSS Load, Tons/yr	2.2
Total P Load (Vertical + Lateral), lbs/yr	3.3

The lateral loading from this site is not visible on aerial photos due to high tree cover, but the loading calculations shown above assume that the vertical banks and sloughing have moved the channel 0.5 feet in the 15-year time period studied. This is a conservative estimate and is less than the vertical erosion in the area. The proposed stabilization design uses rock riffles to address vertical erosion, reduce velocities, and minimize disturbance of the existing valley walls.

Potential Impacts

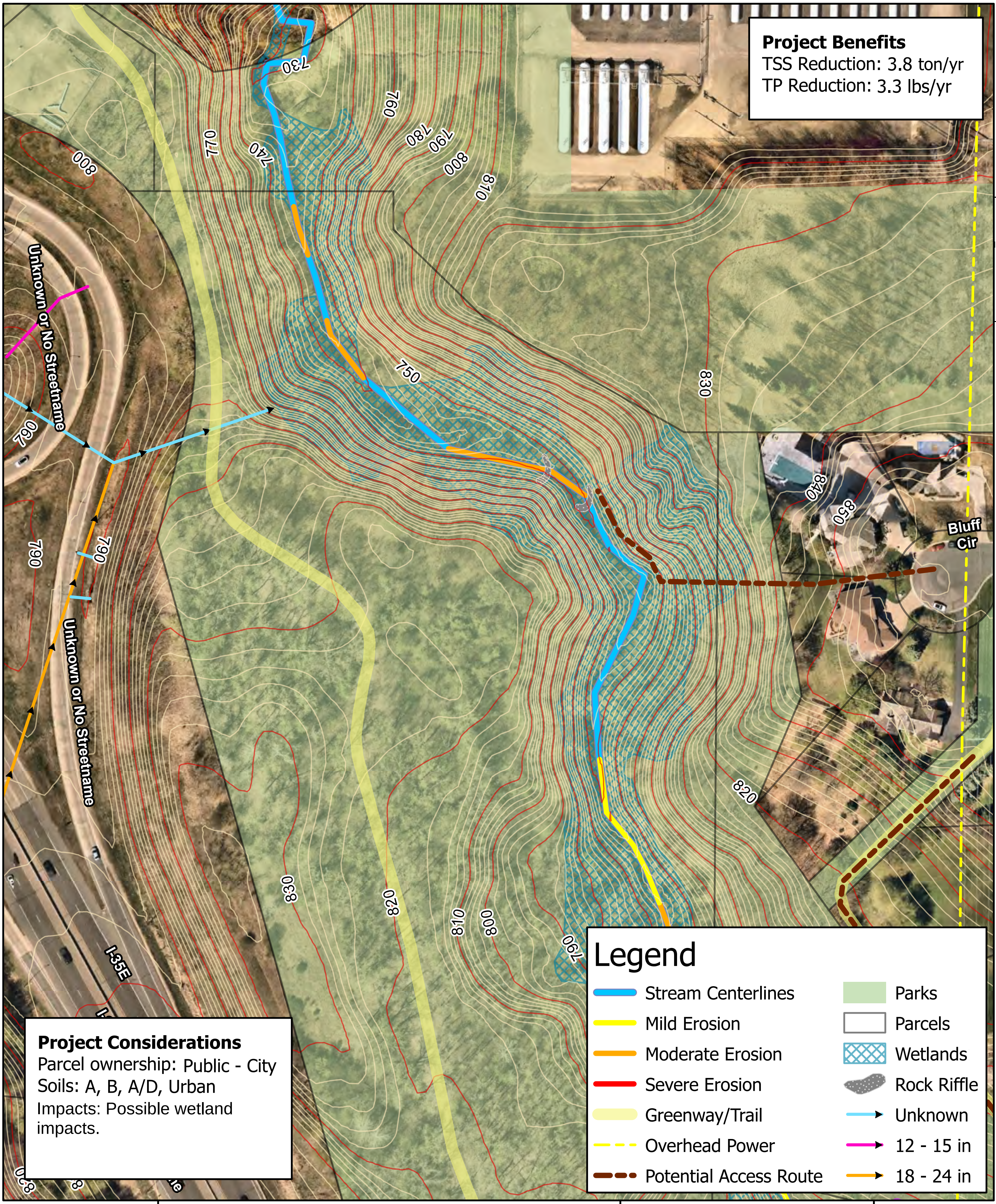
Table A.4 shows the potential impacts for the stabilization design for Park Place shown in **Figure A.2**.

Table A.4: Design and Impacts Table - Park Place

Total Length, ft	150
Bank Height Range, ft	6 ft
Ownership Type	Public
Impact to Parks	Yes
Impact to Existing Infrastructure	None currently known
Impact to Trees	Low
Impact to Wetlands	Possible
Construction Access	From Bluff Circle, will cross private property
Proposed Design Features	Rock Riffles
Feasibility Level Cost Estimate	$37,500.00

Access to the Park Place site is from the west from Bluff Circle and will cross private property. This access route is recommended because it is the shortest path from Bluff Circle to the work area. There is a public park parcel containing a trail that heads south on Park Place which could serve as an alternate access route to the site, but it is not recommended because the access route would be nearly twice as long. There is no bank grading or other work requiring large construction vehicles, so smaller vehicles should be able to traverse the slopes of the shorter access route.

Assuming that the work remains primarily focused on the channel the impacts to existing trees would be minimal, and any wetlands delineated within the project area are likely to be of low quality. Completing construction during winter months under frozen ground conditions would help minimize any wetland impacts.



Project Benefits
TSS Reduction: 3.8 ton/yr
TP Reduction: 3.3 lbs/yr

Project Considerations
Parcel ownership: Public - City
Soils: A, B, A/D, Urban
Impacts: Possible wetland impacts.

Figure A.2 - Park Place

Interstate Valley Creek Study
Lower Mississippi River Watershed Management Organization

N
0 150 Feet
1 inch = 150 feet

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4.3 Park Place Filtration Basin

The proposed Park Place Filtration Basin, shown in **Figure A.3**, would provide rate and pollutant reductions for approximately 14.2 acres of single-family residential area that currently outlets directly to the IVC main stem from a 24-inch reinforced concrete (RC) pipe. The proposed filtration basin is in an area with soils that are primarily hydrologic soil group (HSG) B, which are conducive to infiltration. However, due to the presence of surface karsts in the area, infiltration is prohibited and filtration is proposed. The existing RC pipe outlets to a channel approximately 50 feet upstream of the IVC main stem. This channel exhibits minor erosion, with steep banks approximate 2-3 feet high, as shown in **Photos 6** and **7**.

Photo 6: Park Place Storm Sewer Outlet

Photo 7: Eroded Channel

Pollutant Reduction Estimates

The estimated pollutant reductions for the Park Place Filtration Basin are shown in **Table A.5** below.

Table A.5: Pollutant Reductions - Park Place Filtration Basin

TSS Reduction (tons/yr)	0.9
TP Reduction (lbs/yr)	3.5

Although not quantified here, the restoration of the eroded channel between the existing outfall and the IVC main stem and stabilization at the proposed outlet to IVC would result in additional pollutant reductions within IVC.

Rate and Volume Reduction Estimates

The proposed BMP provides live storage, reducing the rates to IVC, particularly in events smaller than the 50-year, as shown in **Table A.6**.

Table A.6: Rate Reductions - Park Place Filtration Basin

	Existing	Proposed	Reduction
2-year peak discharge (cfs)	4.2	0.8	3.4
10-year peak discharge (cfs)	14.9	9.1	5.8

Potential Impacts

The impacts of the construction of the Park Place Filtration Basin are shown in **Table A.7** below.

Table A.7: Design and Impacts Table - Park Place Filtration Basin

Ownership Type	Public
Impact to Parks	Yes
Impact to Existing Infrastructure	Closure of part of the trail during construction. Removal and rerouting of existing storm sewer.
Impact to Trees	Moderate
Impact to Wetlands	Unlikely
Construction Access	Via trail from Bluff Circle
Feasibility Level Cost Estimate	$184,775.00

The project may be partially located within an Xcel Energy Easement for the overhead power lines in this area. An encroachment application should be submitted and formal consent coordinated with Xcel Energy at the time of final design.

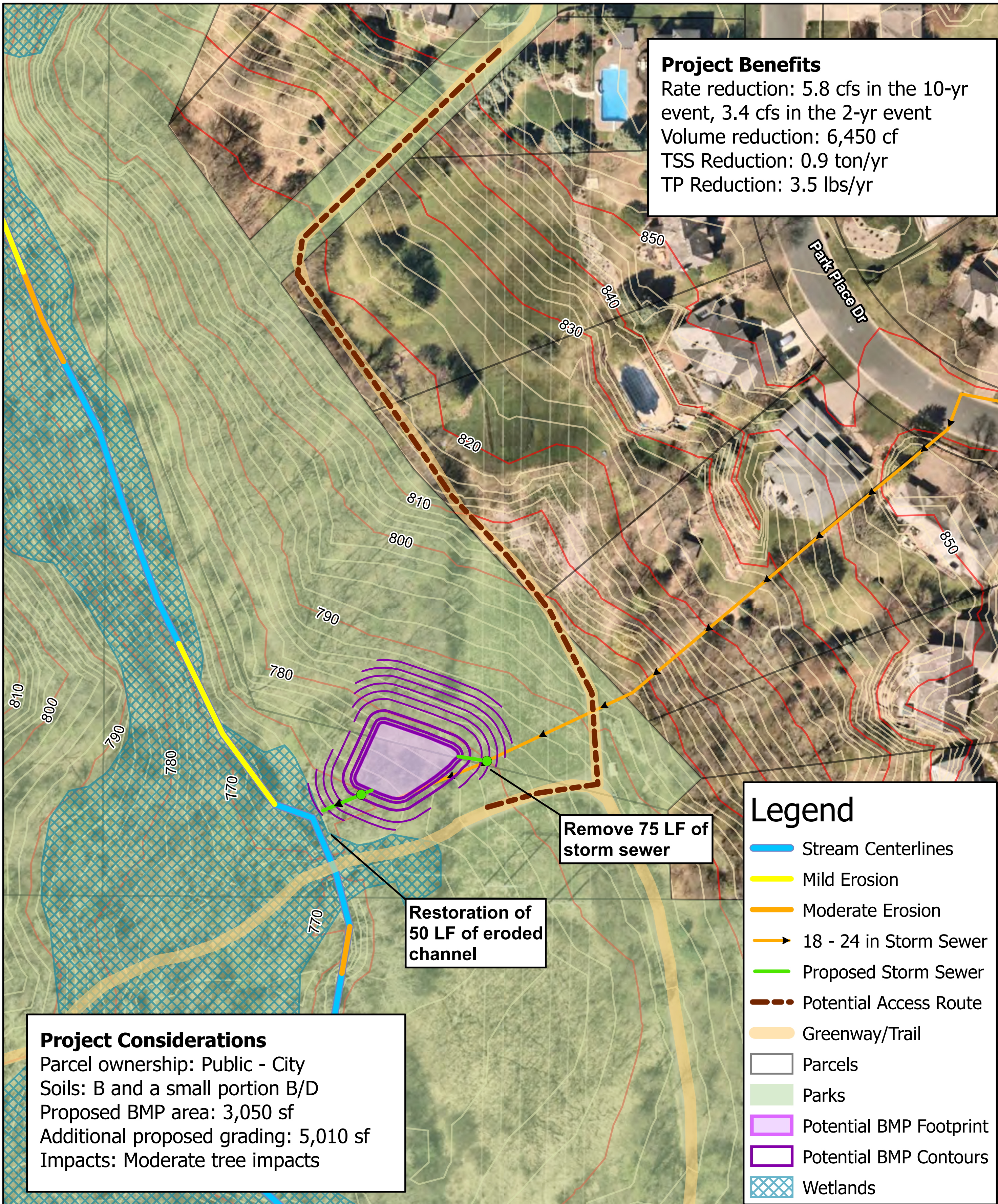

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Figure A.3 - Park Place Filtration Basin

Interstate Valley Creek Study
Lower Mississippi River Watershed Management Organization

N
0 100 Feet
1 inch = 100 feet

wsb

B. Middle IVC Basin

The Middle IVC Basin contains the direct drainage area to the middle section of IVC Creek between the confluences of Marie Creek to the south and Wentworth Creek to the north. The basin's eastern boundary is Delaware Avenue and its western boundary is the I-35E corridor. The basin contains approximately 2,200 feet of IVC main stem, but outside the direct drainage area of the creek there are no significant natural channels.

1. Basin Description and History

The majority of the basin land use is low-density residential, with the Mendota Heights Par 3 Golf Course and Valley Park as significant areas of non-residential land use. The MH NRMP notes that Valley Park in this area has some of the higher-quality natural communities remaining in the City. The MH NRMP also notes that Valley Park in particular has potential for improving forest management, protecting existing native trees within currently altered forest/lowland forest communities, and removing invasive species such as buckthorn, Siberian elm, and black locust.

2. Channel Erosion Survey Findings & Recommendations

Middle IVC Basin contains some of the most severe areas of bank erosion documented in the study. There are two primary areas of severe erosion; within the utility corridor between the River-to-River Greenway and IVC's junction with Wentworth Creek, and within the Valley Park wetland, before the channel crosses the River-to-River Greenway.

3. Volume Reduction Study Findings & Recommendations

There are few storm sewer outfalls to IVC in the Middle IVC Basin. An 18-inch RC outfall at the upstream end of the basin discharges water to IVC just upstream of a historic wood weir. There was no evidence of this weir observed on the site. Considering the open space available there and the limited number of direct discharge points in this area, the area around the historic weir provides the best opportunity to site a BMP that could intercept currently untreated water. However, the channel where the weir was historically sited has experienced downcutting, with banks that are now up to 8 feet high. The IVC channel is disconnected from the wetland floodplains around it due to this elevation difference.

4. Concept Designs

4.1 Valley Park RTR to Wentworth

Figure B.1 shows the area named Valley Park RTR to Wentworth (so named because it is between where IVC crosses the River-to-River Greenway and its junction with Wentworth Creek). The length of channel labeled as severe has vertical banks nearly 11 feet high for approximately 150 feet, and the surrounding sections with moderate erosion average 6-to-8-foot vertical banks for over 100 feet.

Results from the 2D modeling show low to moderate velocities in this area, likely because in storm events the water quickly floods the low bank opposite the most severe erosion and bypasses that existing tight bend entirely. This indicates that most erosion is likely occurring in smaller, high-frequency events, like the 2-year or the 5-year storm. However, high vertical banks with little to no vegetation present can be large sources of sediment to the river, and if the existing high banks remain unstabilized they may laterally migrate toward the existing power line corridor. Currently the IVC channel centerline is less than 75 feet from an existing power pole as shown in Figure B.1.

WSB recommends regrading the existing vertical banks and installing toe wood on the most severely eroded banks to create a stable bank that will not continue to laterally migrate toward the power line corridor. Regrading the vertical banks will reduce the likelihood of occasional large sediment inputs into IVC due to bank sloughing, and it will also create space for native plant installation in accordance with the vegetation management recommendations in the MH NRMP.

Photo 8: Severe Erosion at Valley Park RTR to Wentworth Site

Pollutant Reduction Estimates

Table B.1 below shows the estimated sediment loading rates for the Valley Park RTR to Wentworth site shown in **Figure B.1**. The sediment loading estimates are based on 150 feet of severe erosion and include 125 feet of moderate erosion on either side. This does not include all of the areas labeled as experiencing moderate erosion shown in **Figure B.1.**

Table B.1: Sediment Loading Table - Valley Park RTR to Wentworth

Total Length, ft	400
Bank Height Range, ft	6 to 11
Total Lateral TSS Load, Tons/yr	153.6
Total Vertical TSS Load, Tons/yr	5.1
Total P Load (Vertical + Lateral), lbs/yr	135.0

Potential Impacts

Table B.2 shows the potential impacts of the proposed stabilization design for the Valley Park RTR to Wentworth site.

Table B.2: Design and Impacts Table - Valley Park RTR to Wentworth

Total Length, ft	400
Bank Height Range, ft	6 to 11
Ownership Type	Public
Impact to Parks	Yes
Impact to Existing Infrastructure	Power lines, existing native vegetation plantings, RTR Greenway
Impact to Trees	High
Impact to Wetlands	Likely
Construction Access	From Deer Trail Point, will cross private property
Proposed Design Features	Toe wood, bank grading
Feasibility Level Cost Estimate	$83,250.00

There are several types of impacts to existing infrastructure at this stabilization site. The current creek alignment is encroaching on the existing power line corridor, so any stabilization project will need to cross that corridor as its access route, since access from I-35E to the west is not feasible due to both steep slopes and the safety concerns of staging large equipment in an interstate right-of-way. Access from the east will use a longer but less steep path and will allow for staging of equipment and materials outside the wetland area. Access from the east will also require crossing the River-to-River Greenway, which will impact public use unless project construction is in the winter.

Stabilization on this site will also likely disturb existing native vegetation plantings that have already been installed, but repair or replacement of these communities can be part of the design of the stabilization project.

Given the degree of vertical incision present in the current channel alignment, the presence of wetlands is more likely to be at the upstream and downstream project limits rather than the banks which are most severely eroded. Reconnecting the existing channel to a functional floodplain can be purposefully designed to create more wetland habitat by creating a “bankfull bench” at the elevation of approximately the 1.5-year storm. By creating more area which is allowed to flood frequently, the project will create more hydrologically diverse area and wider, more vegetated stream banks will help reduce channel velocities in small storm events, thereby reducing erosion.

Impact to trees in this area is likely to be high, though most trees which need to be removed can be used on site for the toe wood installation. Finally, the project will impact Valley Park, but it will not be an area which is highly visible to or accessible by the public. With careful planning and by scheduling construction for the winter season, disturbance to the public can be greatly minimized.

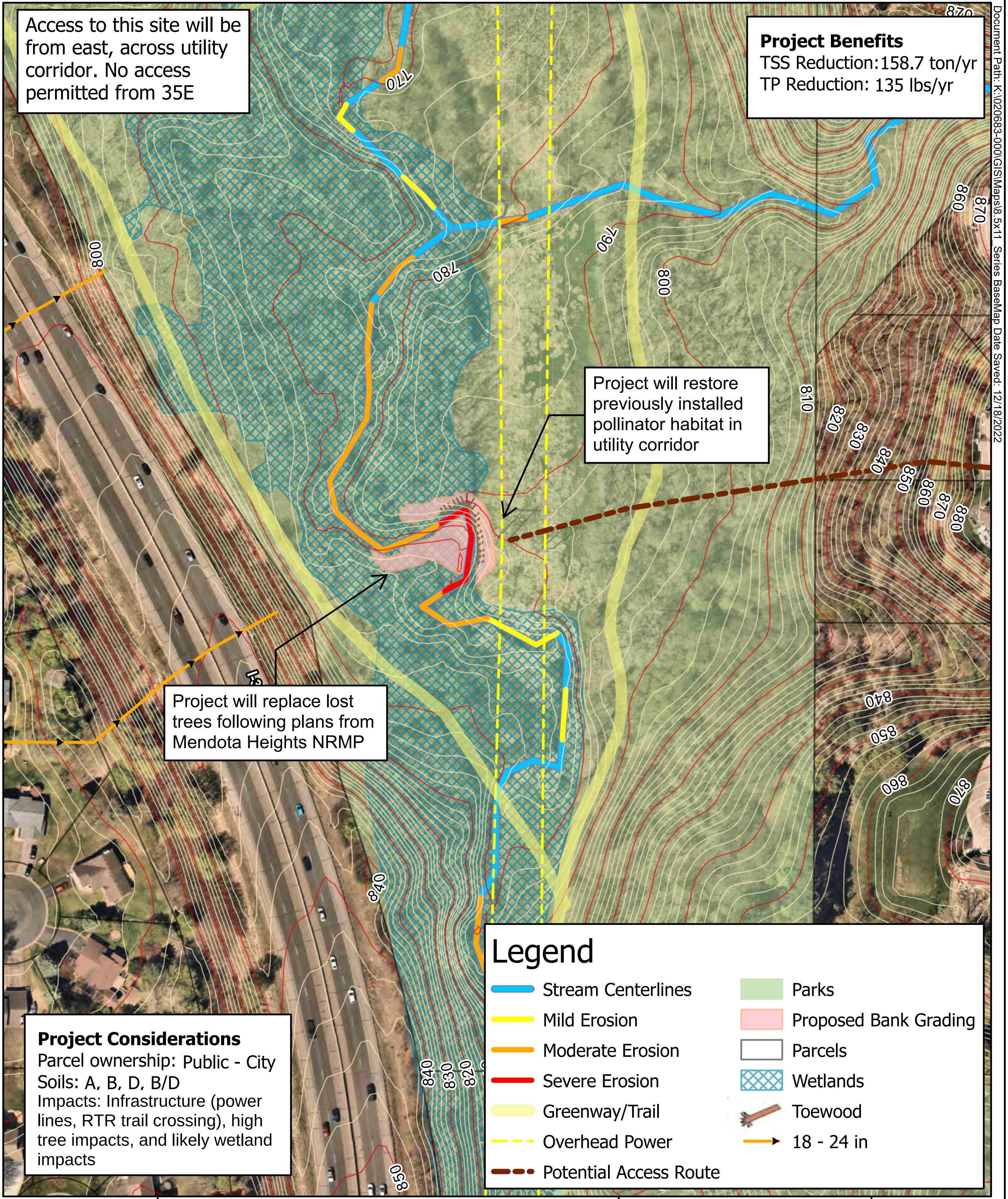

Figure B.1 - Valley Park RTR to Wentworth

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0 150 Feet

1 inch = 150 feet

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4.2 Valley Park Wetland

The Valley Park Wetland stabilization site is shown in **Figure B.2**. This site is upstream of where IVC crosses the River-to-River Greenway, but it is downstream of the ballfield and playground parts of Valley Park (erosion in these areas is discussed in Section F.4).

Photo 9: Severe Erosion at Valley Park Wetland Site

The field study documented nearly 300 feet of severely eroded channel banks within the Valley Park Wetland Stabilization site, and approximately 150 feet of moderate erosion. The maximum bank height in the severely eroded section was 8 feet, and the maximum in the moderate erosion section was 5 feet. This corresponds to the 2D model results which indicate channel velocities above 10 feet per second in the 10-year storm event in the reach labeled as having severe erosion.

The recommended stabilization measures for this site include toe wood and bank grading, as well as planting the regraded banks with native vegetation in accordance with the MH NRMP.

Pollutant Reduction Estimates

Table B.3 shows the sediment loading estimates from the Valley Park Wetland Stabilization Site shown in **Figure B.2**. Sediment loading estimates at this site include 350 feet of severe erosion and the first 75 feet of moderate erosion.

Table B.3: Sediment Loading Table - Valley Park Wetland

Total Length, ft	425
Bank Height Range, ft	5 to 10
Total Lateral TSS Load, Tons/yr	69.8
Total Vertical TSS Load, Tons/yr	5.1
Total P Load (Vertical + Lateral), lbs/yr	63.7

The proposed stabilization design for Valley Creek includes toe wood to prevent further lateral erosion into the existing Valley Creek wetland. Bank grading will reduce the slopes on the existing high banks and, by constructing a floodplain bench where there are currently vertical walls, reduce vertical incision by reducing velocities in storm flow events.

Potential Impacts

Table B.4 shows the potential impacts of the proposed stabilization design shown in **Figure B.2**.

Table B.4: Design and Impacts Table - Valley Park Wetland

Total Length, ft	425
Bank Height Range, ft	5 to 10
Ownership Type	Public
Impact to Parks	Yes
Impact to Existing Infrastructure	Removal of old weir and culvert structures
Impact to Trees	Moderate
Impact to Wetlands	Very Likely
Construction Access	From Trail Road following existing storm sewer route which may include an existing drainage easement
Proposed Design Features	Bank Grading, Toe Wood, Native Vegetation
Feasibility Level Cost Estimate	$98,650.00

The Valley Park Wetland Stabilization site will impact the use of Valley Park, but if the recommended access is selected or if the project construction is combined with the Valley Park Wetland Infiltration Basin (see Section 4.3) and/or the Valley Park Wetland Enhancement and Weir (See Section 4.4) the access route from Trail Road would limit impacts to the more popular sections of Valley Park like the ball fields and playground, and it would not impact public use of the River to River Greenway. The proposed access route follows the path of an existing storm sewer which outlets to Valley Park; if there is an existing drainage easement on this storm sewer line it may be possible to avoid obtaining additional easements for project access during construction.

Impact to wetlands is considered very likely because much of the area north of the proposed project is expected to be delineated as a wetland, though due to the prevalence of reed canary grass it may not be considered a high-quality wetland. Tree impacts are moderate because some trees will likely be removed during bank grading, but these trees can be used on site in the toe wood structure.

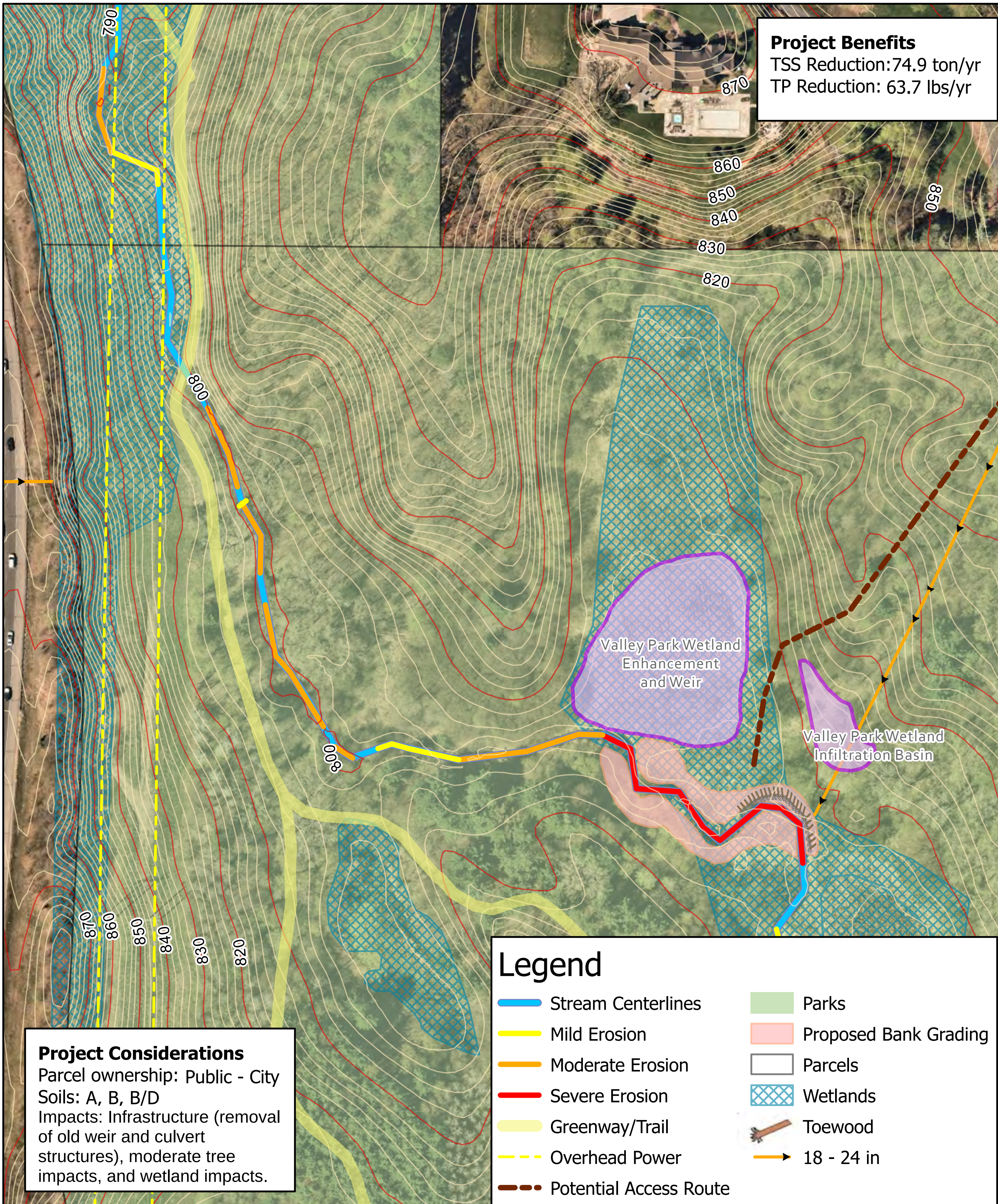

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Figure B.2 - Valley Park Wetland

Interstate Valley Creek Study
Lower Mississippi River Watershed Management Organization

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0 150 Feet
1 inch = 150 feet

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4.3 Valley Park Wetland Infiltration Basin

The proposed Valley Park Wetland Infiltration Basin, shown in **Figure B.3**, would provide rate volume and pollutant reductions for approximately 9.8 acres of single-family residential area that currently outlets directly to the IVC main stem from an 18-inch RC pipe. This area of IVC exhibits severe erosion as noted in the Valley Park Wetland discussion. The proposed infiltration basin is in an area with soils that are primarily HSG B/D. We are assuming that the soils in the upland area in which the infiltration basin is proposed would act like HSG B soils, which are conducive to infiltration. The outlet from the infiltration basin is proposed to drain to the wetland west of the basin and north of the IVC main stem. This gives additional opportunity for rate and pollutant reduction before the stormwater reaches the IVC main stem. Additionally, some grading and vegetation management in the wetland could be completed to create a higher quality wetland.

This work could be done in conjunction with the Valley Park Wetland Stabilization. The peak discharge rate and volume reductions to IVC, combined with stabilized banks, will reduce future erosion in the main stem.

Pollutant Reduction Estimates

The estimated pollutant reductions for the Valley Park Wetland Infiltration Basin are shown in **Table B.5** below.

Table B. 5: Pollutant Reductions - Valley Park Wetland Infiltration Basin

TSS Reduction (tons/yr)	1.2
TP Reduction (lbs/yr)	4.7

Rate and Volume Reduction Estimates

The infiltration basin provides live storage, reducing the peak discharge rates to IVC, as shown in **Table B.6**.

Table B.6: Rate and Volume Reductions - Valley Park Wetland Infiltration Basin

	Existing	Proposed	Reduction
2-year peak discharge (cfs)	11.1	0.2	10.9
10-year peak discharge (cfs)	22.8	10.3	12.6
Volume reduction (cf)	-	-	8,720

Potential Impacts

The impacts of the construction of the Valley Park Wetland Infiltration Basin are shown in **Table B.7**.

Table B.7: Design and Impacts Table - Valley Park Wetland Infiltration Basin

Ownership Type	Public
Impact to Parks	Yes
Impact to Existing Infrastructure	Removal of existing storm sewer
Impact to Trees	Moderate
Impact to Wetlands	Likely
Construction Access	From Trail Road, on public property. Likely to increase required tree removal.
Feasibility Level Cost Estimate	$183,915.00

Proposed construction access is from Trail Road, paralleling the existing storm sewer pipe, down the slope toward the wetland. The exact route should be determined in final design and with the contractor to minimize tree impacts.

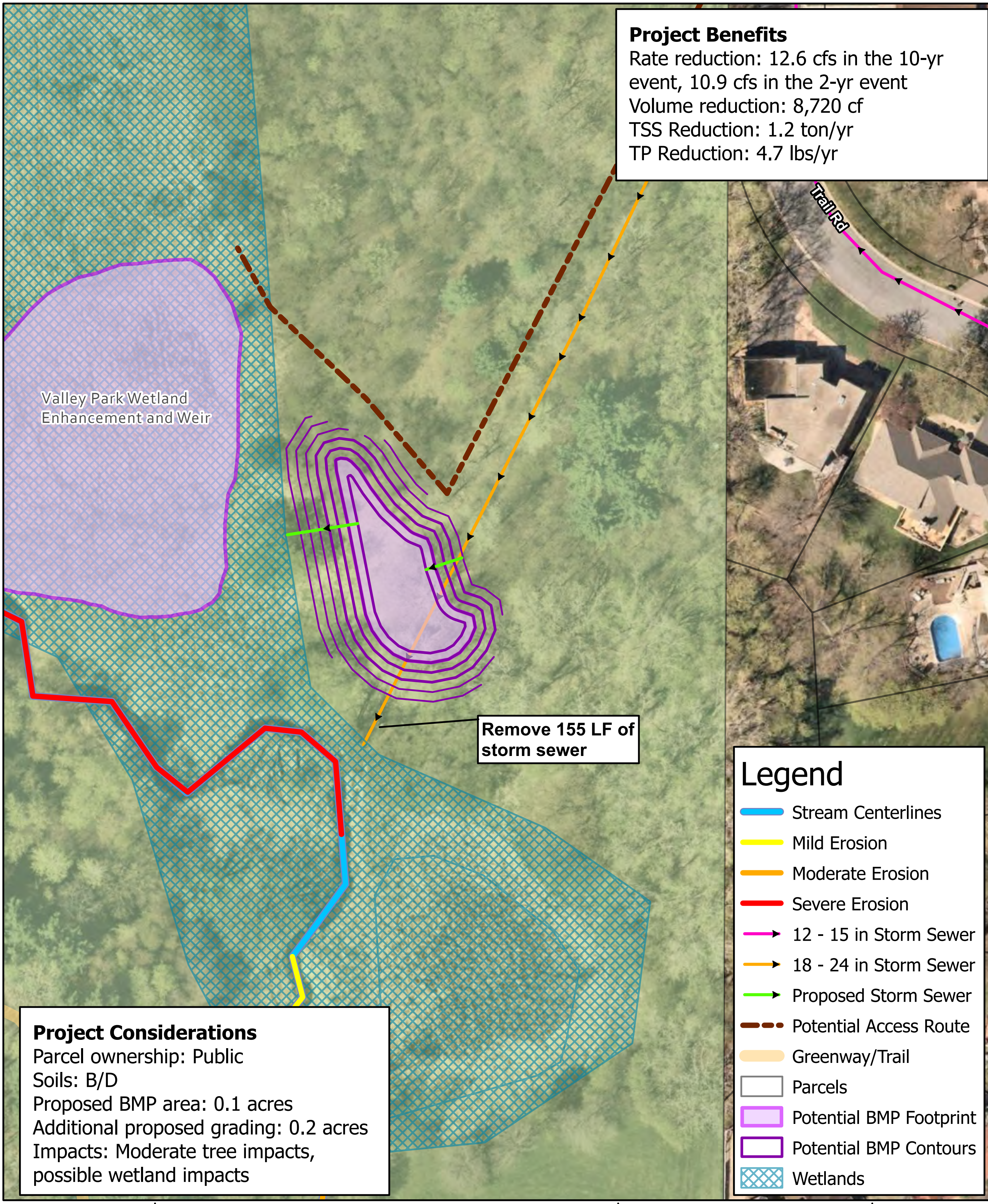

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Figure B.3 - Valley Park Wetland Infiltration Basin

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0 80 Feet
1 inch = 80 feet

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4.4 Valley Park Wetland Enhancement and Weir

The proposed Valley Park Wetland Enhancement and Weir, shown in **Figure B.4**, reestablishes a weir that historically existed in this area and would reconnect the IVC mainstem to the wetlands and floodplain areas around it. The weir is proposed slightly downstream of where it was sited historically, in an area where the banks are not as severely down cut and less excavation would be required to reconnect the wetland to the stream. A second weir could be considered at the location of the historic weir.

Ideally, this work could be done in conjunction with both the Valley Park Wetland Stabilization and Valley Park Wetland Infiltration Basin.

Pollutant Reduction Estimates

The estimated pollutant reductions for the Valley Park Wetland Enhancement and Weir are shown in **Table B.8** below.

Table B.8: Pollutant Reductions - Valley Park Wetland Enhancement and Weir

TSS Reduction (tons/yr)	0.2
TP Reduction (lbs/yr)	0.8

Rate and Volume Reduction Estimates

The wetland grading and improvements provide live storage, reducing the peak discharge rates to IVC, as shown in **Table B.9**.

Table B.9: Rate and Volume Reductions - Valley Park Wetland Enhancement and Weir

	Existing	Proposed	Reduction
2-year peak discharge (cfs)	12.1	1.7	10.4
10-year peak discharge (cfs)	28.5	16.1	12.4

Potential Impacts

The impacts of the construction of the Valley Park Enhancement and Weir are shown in **Table B.10**.

Table B.10: Design and Impacts Table - Valley Park Wetland Enhancement and Weir

Ownership Type	Public
Impact to Parks	Yes
Impact to Existing Infrastructure	None
Impact to Trees	Low
Impact to Wetlands	Very likely
Construction Access	From Trail Road, on public property. Likely to increase required tree removal.
Feasibility Level Cost Estimate	$230,825.00

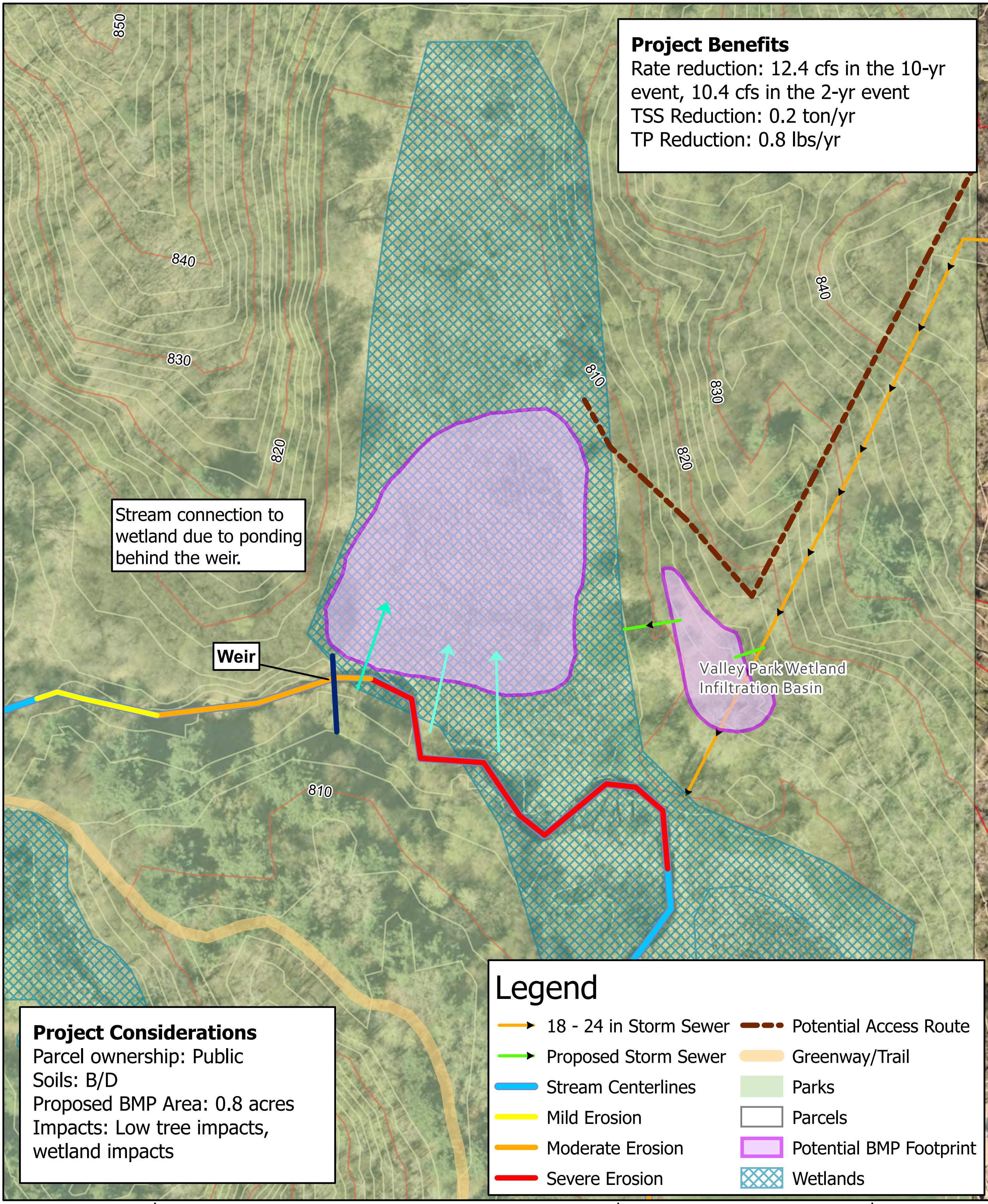

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Figure B.4 - Valley Park Wetland Enhancement and Weir

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C. Mendota Heights West Basin

The Mendota Heights West Basin includes IVC from its crossing under TH 62 to its crossing under Marie Avenue. The basin also includes the I-35E corridor from TH 62 almost to the Highway 13 interchange and some areas of high-density commercial development surrounding I-35E and TH 62. The basin is primarily low density residential, though it does include large sections of Valley Park. Portions of this basin, including the areas around Marie Park and Victoria Highland Park discharge at the northern end of the basin, under I-35E to the IVC main stem.

1. Basin Description and History

The Mendota Heights West Basin is generally flatter than the downstream basins such as Middle and Lower IVC basins, and a flatter valley slope generally means a lower channel slope. The primary remaining natural feature of the basin is the wetland that contains the IVC main stem in the center of the basin. The MH NRMP lists most of this wetland as a non-native community and the channel itself as of poor ecological quality.

2. Channel Erosion Survey Findings & Recommendations

Channel erosion documented in this section is generally mild to moderate. The IVC main stem in this basin is a mostly straightened section through a wetland west of Valley Curve Road. The channel is abnormally straight through this wetland, which is atypical of wetland streams, which are usually quite sinuous. The current wetland is generally low quality and is mostly a monoculture of reed canary grass.

Photo 10: Overview of Typical Channel in Valley Park South Area

Volume Reduction Study Findings & Recommendations

There is a concentration of open space in the Mendota Heights West Basin along the IVC main stem in Valley Park. Several locations in this area were explored as locations for BMPs. These did not rise to the level of full concept design, but will be described in section 4.2.

4. Concept Designs

4.1 Valley Park South

The concept design for Valley Park South is shown in **Figure C.1**. The proposed design consists of remeandering IVC through the existing wetland corridor. The 2D model results in **Appendix E** show that this is already an area where IVC floods during storm events, and both channel and floodplain velocities are generally moderate. A longer channel with better connection to the floodplain, along with planned vegetation management, could improve the vegetative quality of the wetland, encourage infiltration, and reduce erosion in the channel.

Pollutant Reduction Estimates

Table C.1 shows the sediment loading estimates for the existing Valley Park South alignment shown in **Figure C.1**. The sediment loading estimates for this site are based on stabilizing the three lengths of mild erosion shown in **Figure C.1**, which measured in the field as 100 feet each.

Table C.1: Sediment Loading Table - Valley Park South

Total Length, ft	300
Bank Height Range, ft	3 to 4
Total Lateral TSS Load, Tons/yr	0.0
Total Vertical TSS Load, Tons/yr	2.5
Total P Load (Vertical + Lateral), lbs/yr	2.2

The channel through the wetland is generally laterally stable, therefore all sediment loading is from vertical erosion. A longer channel traveling the same distance down the valley would have a lower slope, thereby reducing vertical erosion. By grading the bank slopes and managing the post-project wetland vegetation to minimize non-native species and encourage plant diversity, the existing wetland could move towards more of a wet meadow plant community.

Rate and Volume Reduction Estimates

The remeandered channel would slow down the water through this section of IVC, slightly reducing the peak discharge rates downstream as a result, as shown in **Table C.2**.

Table C.2: Rate and Volume Reductions - Valley Park South

	Existing	Proposed	Reduction
2-year peak discharge (cfs)	38.0	36.9	1.1
10-year peak discharge (cfs)	85.5	83.2	2.3

Potential Impacts

Table C.3 shows the potential impacts of the stabilization design proposed in **Figure C.1**.

Table C.3: Design and Impacts Table - Valley Park South

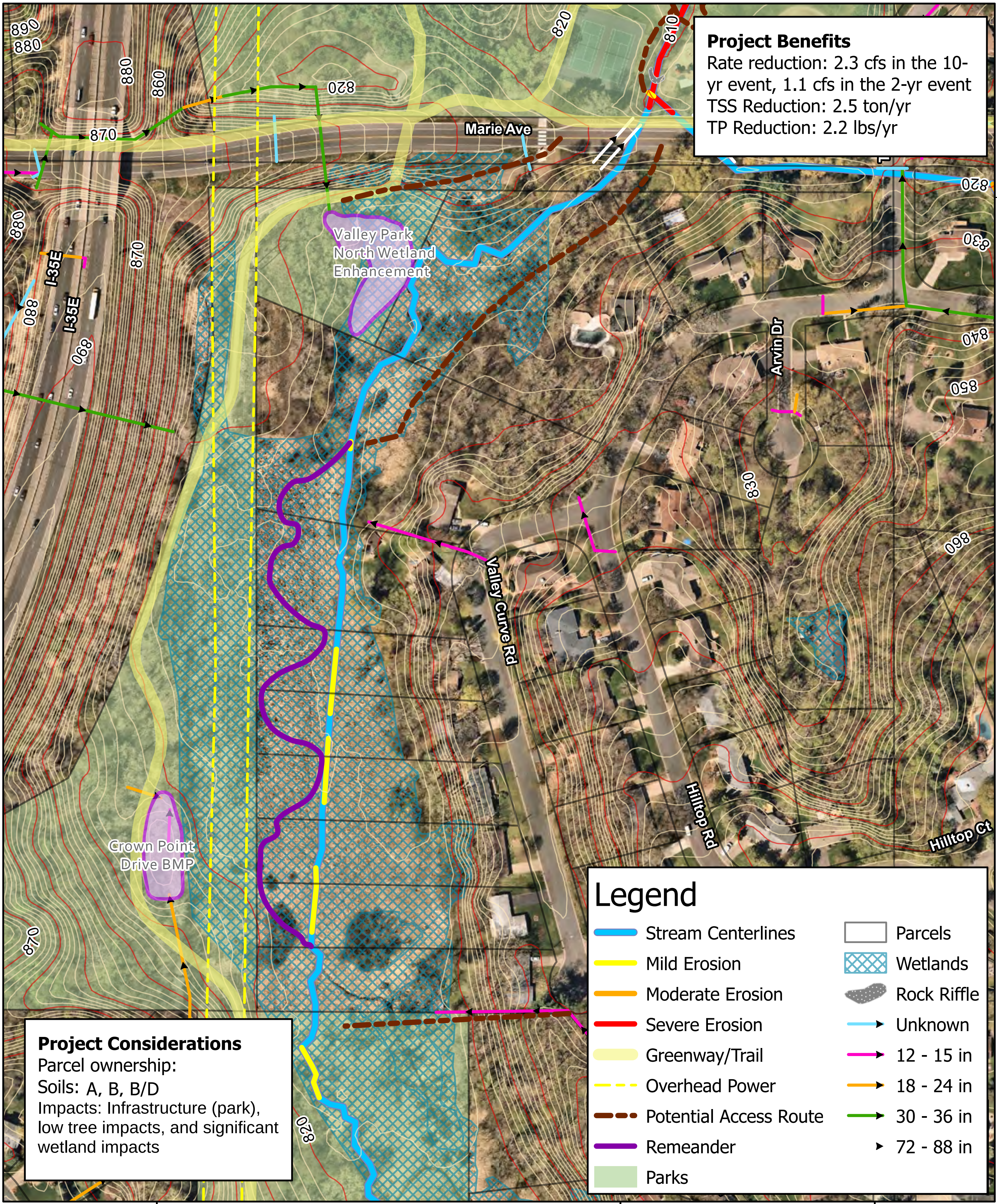
Total Length, ft	125
Bank Height Range, ft	3 to 4
Ownership Type	Public and Private
Impact to Parks	Yes
Impact to Existing Infrastructure	Possible
Impact to Trees	Low
Impact to Wetlands	Very Likely
Construction Access	From Valley Curve Road, will cross private property
Proposed Design Features	Remeander, native vegetation management
Feasibility Level Cost Estimate	$140,000.00

Access to the proposed project site would be from Valley Curve Road, and WSB recommends two access points, one on the north end of the site and one on the south. This is because digging a new and longer channel would require significant excavation and most of the excavated material would need to be removed from the site, though some would be used to fill the old channel. Dual access points would allow easier access to the site by heavy machinery and would allow the project to be completed more quickly and for a lower cost.

A remeander project on this site would have significant impacts to the existing wetland, though following a vegetation management plan could improve the wetland community enough that the City could potentially bank wetland credits that might be needed for future projects with wetland impacts. The impacts to trees would be low because there are few mature trees within the existing or proposed corridor. There are no known impacts to existing infrastructure. The project would impact

Valley Park but as this section is not currently in public use, the impact to the general public would be minimal.

Figure C.1 shows that the current IVC channel alignment is primarily on private parcels. The proposed new alignment for IVC would be on both public and private parcels. The early stages of project design should include landowner outreach to determine the likelihood of each landowner granting the required easements for the project to be completed. This would also be a good opportunity for landowner education and possible partnership in maintenance of the proposed native vegetation.



Project Benefits
Rate reduction: 2.3 cfs in the 10-yr event, 1.1 cfs in the 2-yr event
TSS Reduction: 2.5 ton/yr
TP Reduction: 2.2 lbs/yr

Project Considerations
Parcel ownership:
Soils: A, B, B/D
Impacts: Infrastructure (park), low tree impacts, and significant wetland impacts

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Figure C.1 - Valley Park South

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0 200 Feet
1 inch = 200 feet

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4.2 Additional BMP Locations

Two sites within the Mendota Heights West Basin were explored for potential BMP construction or improvement. The Valley Park North Wetland Enhancement, as shown in **Figure C.2**, could provide an opportunity to slow down the water coming from the 36-inch RC pipe under Marie Avenue. It is just north of the proposed Valley Park South remeander. Currently this outfall discharges into a channel that drains east into a wetland, before being conveyed back under Marie Avenue at the Valley Park Playground location. A sedimentation basin and wetland restoration/enhancement could allow for pollutant removals and peak discharge reductions as the water moves more slowly through this area than it does in existing conditions. This improvement would establish a hydraulic connection between the enhanced wetland and the IVC mainstem, particularly in larger storm events. Construction of the sedimentation basin would require tree removal, and this is in an area of native trees in lowland forest, as shown in the MH NRMP. Invasive reed canary grass is prevalent in the wetland restoration area, which could drive final design of the project to incorporate more stormwater management rather than wetland enhancements.

South of the Valley Park North Wetland Enhancement is a small existing BMP in need of maintenance, as shown in **Figure C.3**. The inlet into the Crown Point Drive BMP is largely submerged/buried as shown in **Photo 11**. A berm surrounds the BMP, through which the outlet pipe drains. A pipe under the adjacent RTR Greenway discharges at the same point as the discharge

Photo 11: Inlet to Crown Point BMP

Photo 12 - Outlet from Crown Point BMP

location from the Crown Point BMP, as shown in **Photo 12**. Maintenance of the BMPs inlet pipe is recommended, which would include clearing and excavating around the outfall. However, if a larger project were desired, the berm around the BMP could be expanded to include the water that drains under the trail. This expanded BMP could provide rate reductions and pollutant removals beyond that of the existing one. Some tree impacts are likely to maintain or expand the Crown Point Drive BMP, however based on the MH NRMP, this area does not appear to have dense oak or native trees.

If these improvements were pursued, they could be constructed at the same time as the Valley Park South remeander to minimize mobilization and restoration costs.

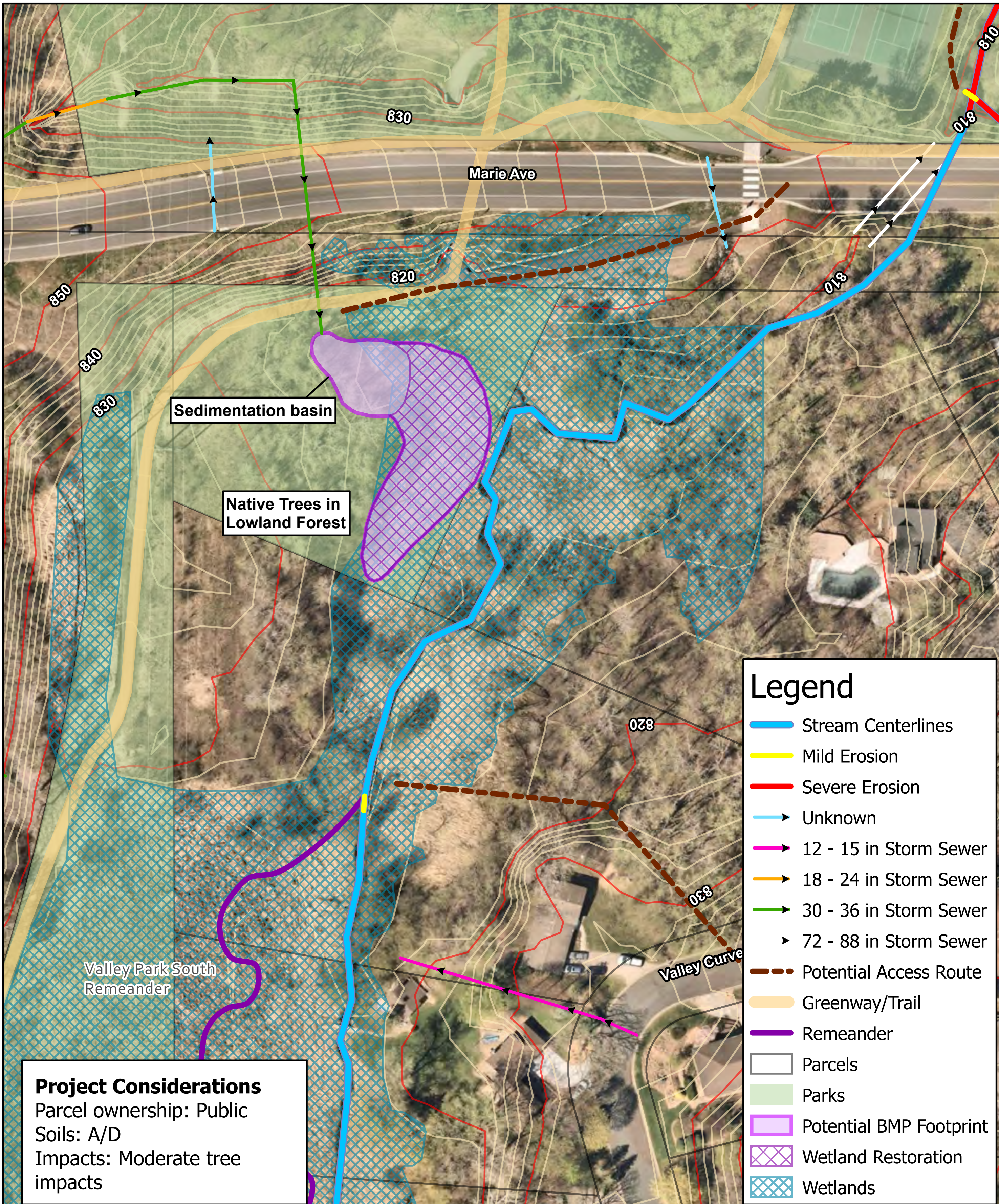

Figure C.2 - Valley Park North Wetland Enhancement

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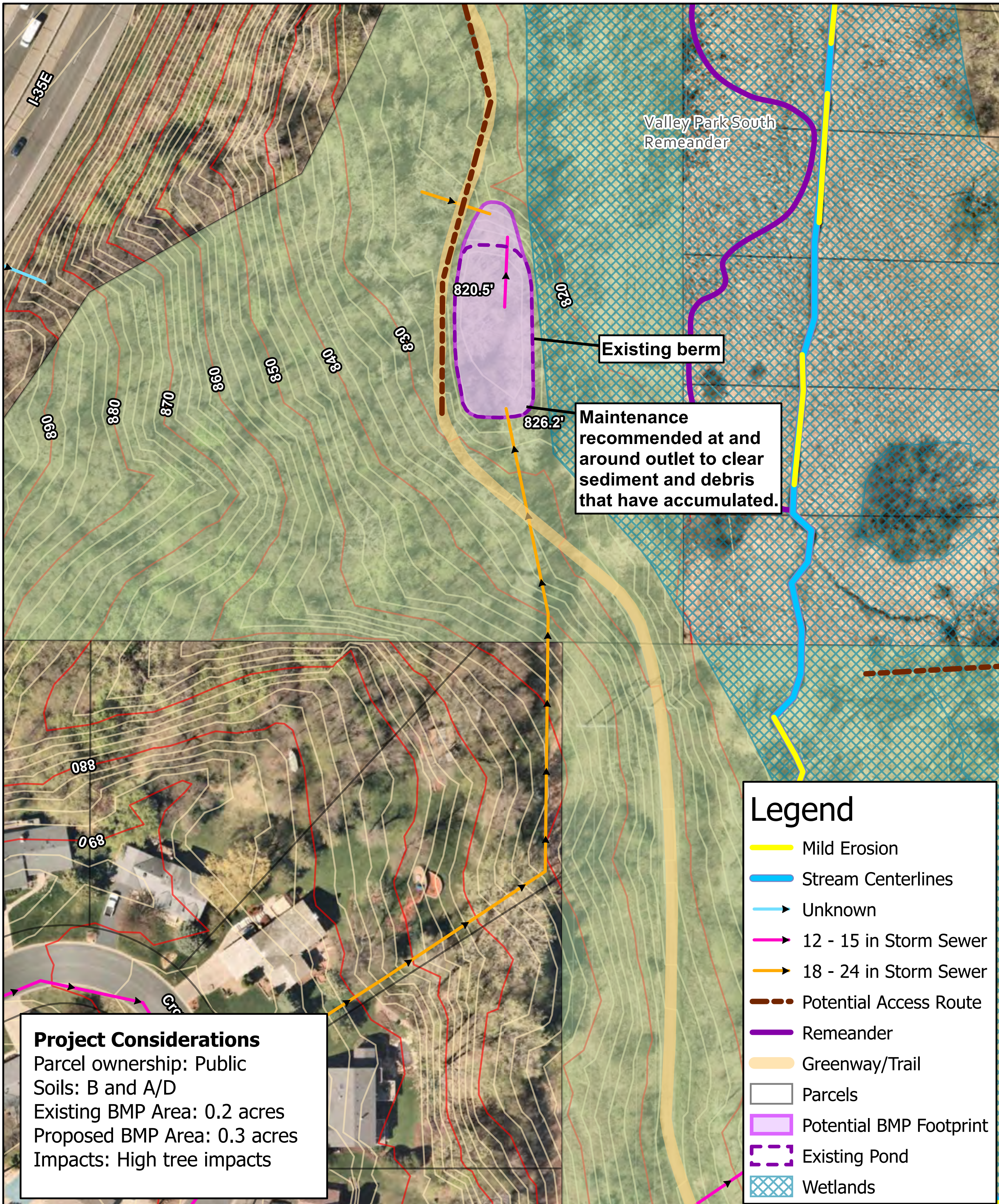

Figure C.3 - Crown Point Drive BMP

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0 100 Feet

1 inch = 100 feet

D. Upper IVC Basin

The Upper IVC Basin contains the headwaters of IVC as well as numerous ponds which drain residential neighborhoods and streets. It also contains all of Friendly Marsh Park and the Lily Property which is currently owned by Dodge Nature Center.

1. Basin Description and History

Upper IVC Basin contains the headwaters of IVC within Friendly Marsh Park and continues to the culvert crossing under TH 62. IVC has several other culvert crossings within this basin, including under South Plaza Way and North Plaza Drive.

The MH NRMP places the headwaters of IVC and most of Friendly Marsh Park within the Friendly Marsh Park Natural Area. The wetland containing IVC is almost entirely a non-natural community, dominated by reed canary grass and other invasive wetland species.

2. Channel Erosion Survey Findings & Recommendations

The channel erosion survey within Upper IVC Basin began at the headwaters of IVC within Friendly Marsh Park and extended to where IVC passes under TH 62. The field survey found a stable channel with no documented areas of erosion. The 2D model did not include the IVC main stem upstream of TH 62 so there are no 2D model results in this area.

Photo 13: Typical Section of IVC within Friendly Marsh Park

3. Volume Reduction Study Findings & Recommendations

Numerous existing storm ponds treat the stormwater that drains from the upstream portions of the Upper IVC Basin. Much of this water then flows through the wetland in Friendly Marsh Park before it is conveyed by a culvert under TH 62.

4. Concept Designs

Because there were no documented erosion sites within this basin, there are no stabilization designs proposed for the Upper IVC Basin.

4.1 Friendly Marsh Park Wetland Enhancement

The proposed Friendly Marsh Park Wetland Enhancement, shown in **Figure D.1**, includes the installation of a 2-foot high weir immediately upstream of a 72-inch RC culvert under a trail to hold water back in the northwestern portion of Friendly Marsh Park. By creating pools of various depths of water and improving the vegetation variety in this area, rate reductions could also be achieved in small events.

Pollutant Reduction Estimates

The estimated pollutant reductions for the Friendly Marsh Park Wetland Enhancement are shown in **Table D.1** below.

Table D.1: Pollutant Reductions – Friendly Marsh Park Wetland Enhancement

TSS Reduction (tons/yr)	0.5
TP Reduction (lbs/yr)	1.8

Rate and Volume Reduction Estimates

The wetland grading and improvements provide live storage, reducing the peak discharge rates to IVC, as shown in **Table D.2**.

Table D.2: Rate and Volume Reductions – Friendly Marsh Park Wetland Enhancement

	Existing	Proposed	Reduction
2-year peak discharge (cfs)	74.3	28.1	46.2
10-year peak discharge (cfs)	170.2	106.0	64.2

Potential Impacts

The impacts of the construction of the Friendly Marsh Park Enhancement are shown in **Table D.3**.

Table D.3: Design and Impacts Table – Friendly Marsh Park Wetland Enhancement

Ownership Type	Public
Impact to Parks	Yes
Impact to Existing Infrastructure	Unlikely
Impact to Trees	Low
Impact to Wetlands	Very likely
Construction Access	Via paved trail from South Plaza Drive
Feasibility Level Cost Estimate	$180,225.00

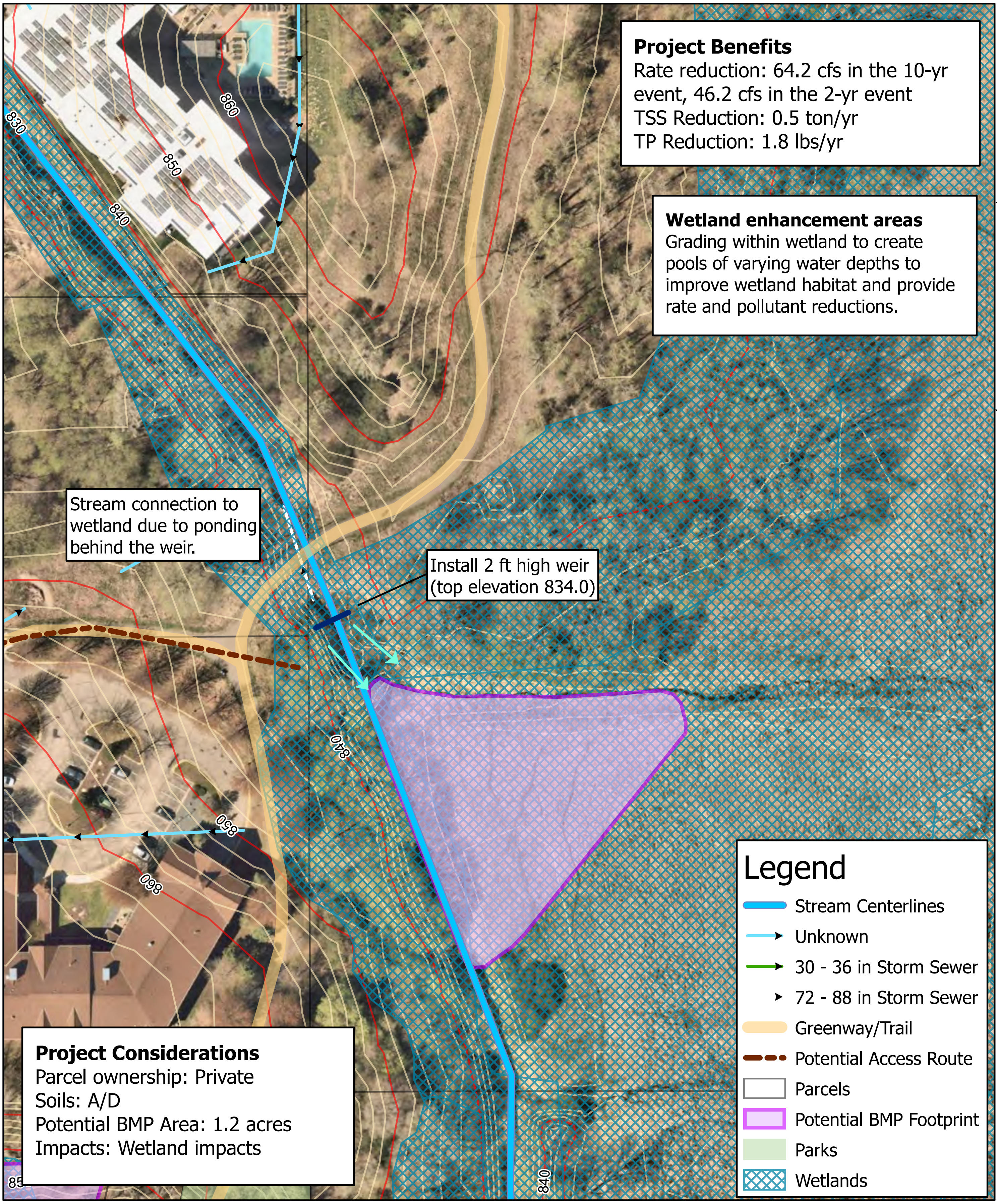

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Figure D.1 - Friendly Marsh Park Wetland Enhancement

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0 100 Feet
1 inch = 100 feet

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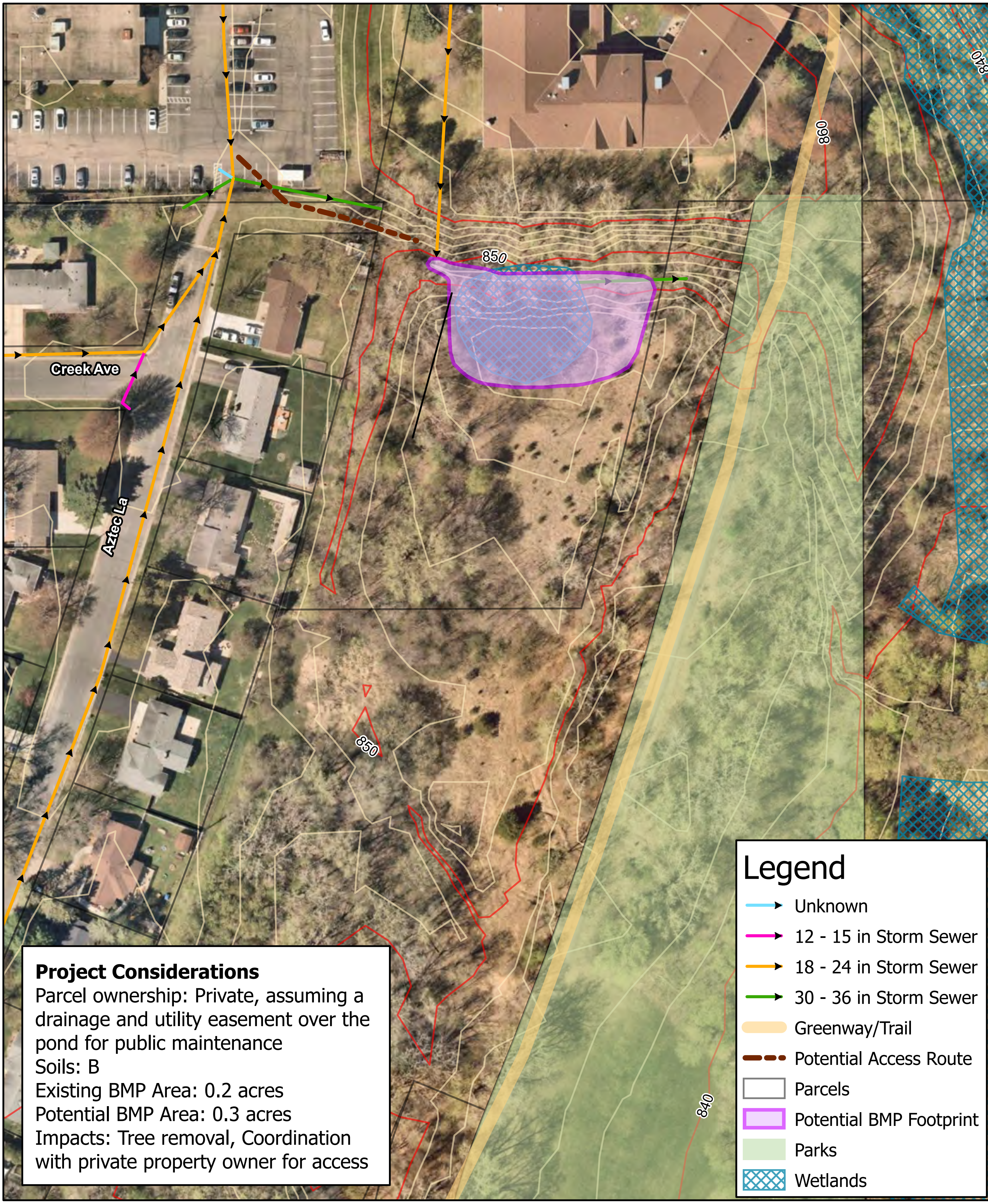
4.2 Additional Sites

Several sites for potential BMPs were explored but were not elevated to concept design level. These sites have potential for further exploration in the future, as shown in **Figures D.2, D.3, and D.4**.

Figure D.2 shows the Aztec Lane Pond. This existing pond needs maintenance. Sediment has accumulated at both inlets and at the time of WSB's field investigation, the outlet was completely clogged and covered by debris. We recommend that a bathymetric survey be completed to assess the depth of sediment accumulation and to determine if it is time for a pond cleanout project. At the time of potential pond cleanout, this basin could potentially be expanded to provide additional rate control upstream of the IVC main stem in Friendly Marsh Park.

Figure D.3 shows the Friendly Marsh Park Remeander. This ditch section of channel was constructed by the City of Mendota Heights in the 1960s. There is an opportunity to remeander this section, increasing the length from 1,145 feet to 1,480 feet, adding sinuosity of natural stream systems and connecting the main channel to more of the wetland area. While the concept shown includes an increase in length of 335 feet, if pursued, the final design for this remeander could likely increase that length further by introducing more sinuosity and extending further north into the area proposed for the Friendly Marsh Park Wetland Enhancement.

Figure D.4 shows the Cheyenne Lane Pond. This is an existing pond that received drainage from 611 acres, 475 of which first flow through Rogers Lake. Stormwater enters the pond via a 30-inch RC pipe; the pond discharges over a weir, into the headwaters of IVC. A sediment delta has formed at this inlet into the pond. There appears to be opportunity for expansion of this pond, increasing the footprint by approximately 35 percent. This would provide an opportunity to further reduce rates before water discharges into the IVC main stem and does not appear to be a concern for flooding of the adjacent homes.



Project Considerations
Parcel ownership: Private, assuming a drainage and utility easement over the pond for public maintenance
Soils: B
Existing BMP Area: 0.2 acres
Potential BMP Area: 0.3 acres
Impacts: Tree removal, Coordination with private property owner for access

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Figure D.2 - Aztec Lane Pond

Interstate Valley Creek Study
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1 inch = 100 feet

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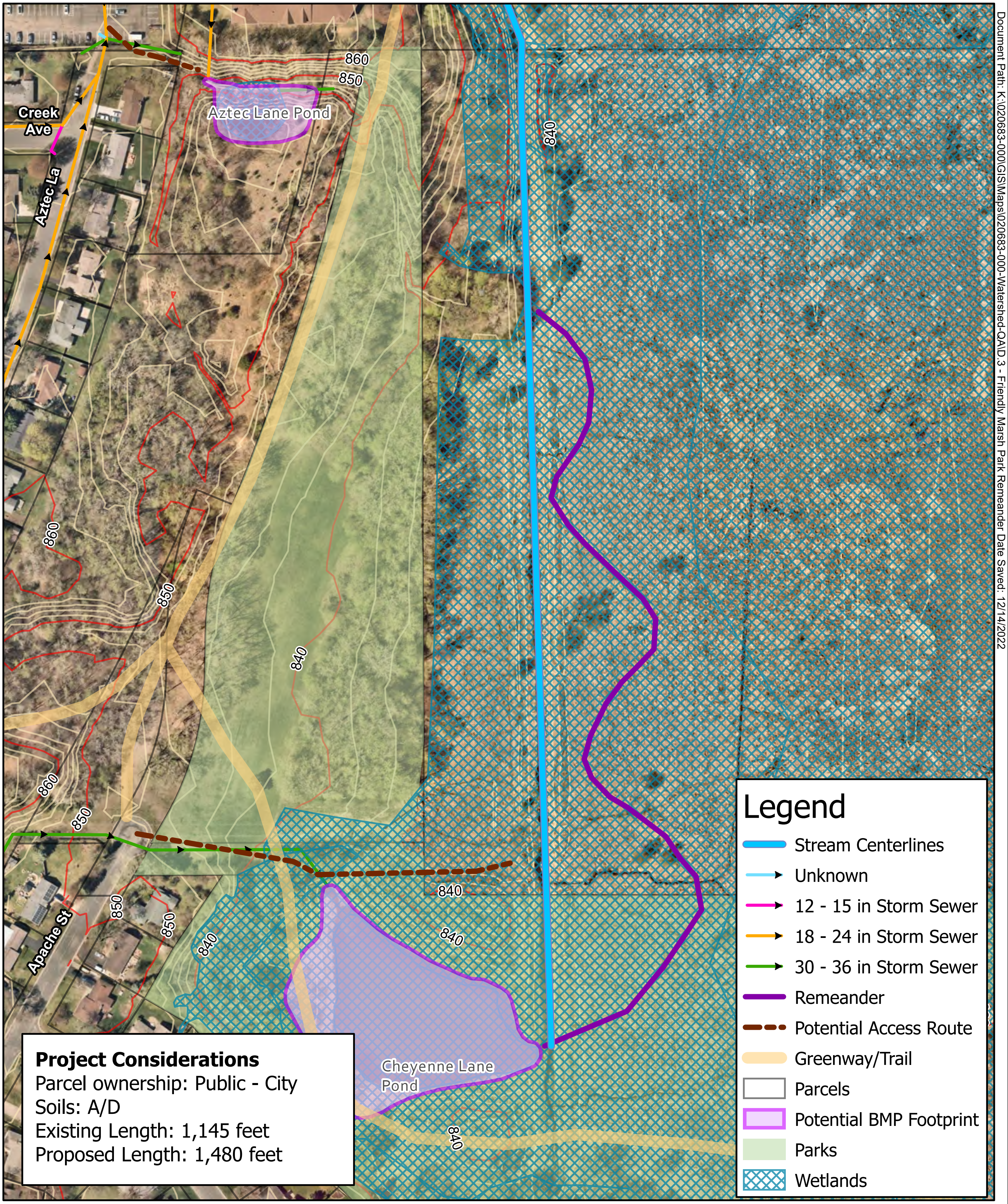

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Figure D.3 - Friendly Marsh Park Remeander

Interstate Valley Creek Study
Lower Mississippi River Watershed Management Organization

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1 inch = 200 feet

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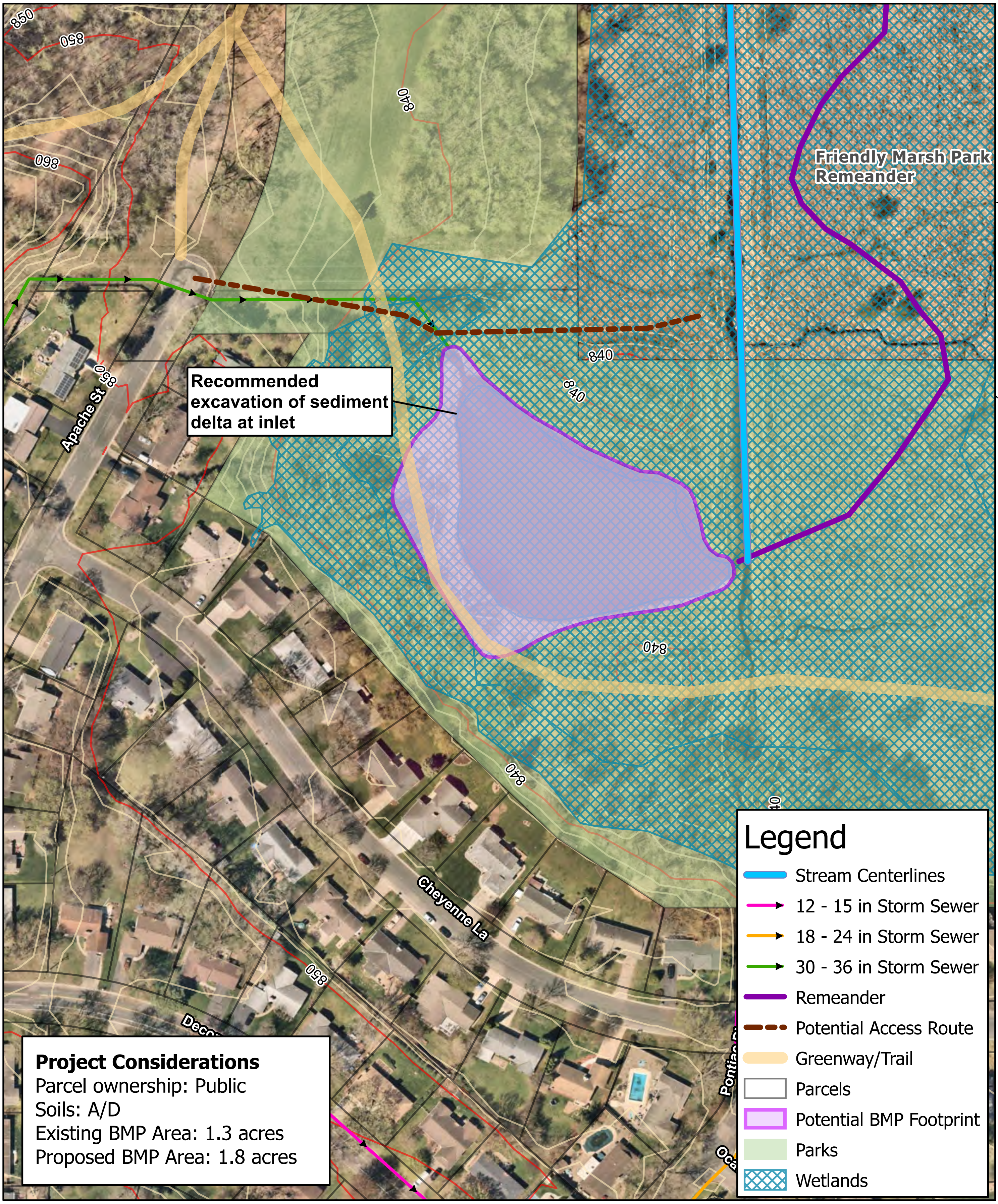

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Figure D.4 - Cheyenne Lane Pond

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0 150 Feet

1 inch = 150 feet

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E. Wentworth Basin

The Wentworth Basin is defined as the drainage area of Wentworth Creek within the City of Mendota Heights. Hydrologically the Wentworth Basin extends east of Delaware Avenue into the City of West St. Paul. In this study, the West St. Paul Basin is its own drainage basin.

1. Basin Description and History

The Wentworth Basin is generally low density residential with significant parks spaces in Wentworth Park and Somerset Country Club. Wentworth Creek within the basin is smaller (approximate average channel width of 5 feet) above Wentworth Park and larger (approximate average channel width of 7 feet) below Wentworth Park. The MH NRMP lists the vegetation communities within the creek corridor as moderate to poor quality.

2. Channel Erosion Survey Findings & Recommendations

The channel erosion survey within Wentworth Basin began where Wentworth Creek crosses under Dodd Road and ended at the junction of Wentworth Creek and IVC. Wentworth Creek has several road crossings, including Dodd Road, a private drive downstream of Wentworth Park and Wachtler Avenue.

Wentworth Creek changes significantly as it progresses through the basin. Upstream of Wentworth Park it is flowing through a residential neighborhood and has access to a floodplain. The most significant areas of erosion are found downstream of Wentworth Park where there are residences and gardens immediately adjacent to the channel. Downstream of Wachtler Avenue the channel starts to enter the IVC valley and the channel slope increases notably, but a steeper channel is not necessarily less stable or more prone to erosion.

3. Volume Reduction Study Findings & Recommendations

There are few storm sewer outfalls to Wentworth Creek and the majority of them are small pipes (12-15 inches). Wentworth Creek currently flows through an existing pond in Wentworth Park. Two creek reaches and one storm sewer pipe contribute to the pond. This area provides an opportunity for expanded rate control to Wentworth Creek.

4. Concept Designs

4.1 Lower Wentworth Creek

Lower Wentworth creek has approximately 150 feet of moderate erosion downstream from the crossing at Wachtler Avenue. Results from the 2D modeling in **Appendix E** indicate high velocities in this area after water crosses under Wachtler Avenue via a culvert; this is likely due to the steep slope of both the channel and the valley walls surrounding it. The proposed stabilization design for Lower Wentworth Creek is shown in **Figure E.1**. This reach of Wentworth Creek is within a mature forest with a high channel slope. There was no observed lateral erosion in this reach, so the design consists of a single rock riffle to address vertical erosion.

Photo 14: Vertical Incision in Lower Wentworth Creek Area

Pollutant Reduction Estimates

Table E.1 shows the sediment loading estimates for the Lower Wentworth Creek area shown in **Figure E.1**. The sediment loading estimates shown in **Table E.1** are calculated based on the 150 feet immediately upstream of the proposed rock riffle placement. Due to the steep slopes in the area, the riffle is unlikely to stabilize vertical erosion farther upstream than that.

Table E.1: Sediment Loading Table - Lower Wentwoth Creek

Total Length, ft	150
Bank Height Range, ft	6
Total Lateral TSS Load, Tons/yr	0
Total Vertical TSS Load, Tons/yr	1.3
Total P Load (Vertical + Lateral), lbs/yr	1.1

All of the sediment loading for this site comes from vertical incision in the valley. A rock riffle will address the existing vertical erosion and redirect high flows away from the valley walls.

Potential Impacts

Table E.2 shows the potential impacts of the proposed stabilization design shown in **Figure E.1**.

Table E.2: Design and Impacts Table - Lower Wentworth Creek

Total Length, ft	150
Bank Height Range, ft	6
Ownership Type	Public
Impact to Parks	No
Impact to Existing Infrastructure	None known
Impact to Trees	Low
Impact to Wetlands	Possible
Construction Access	From Wachtler Avenue
Proposed Design Features	Rock Riffle
Feasibility Level Cost Estimate	$15,175.00

Access to the site is from Wachtler Avenue and will not cross private property. Construction of a single rock riffle should have minimal impacts to trees and existing infrastructure. The presence of wetlands on site is possible but the size and quality of wetlands at this site are likely to be minimal. The riffle was placed to address the most severe areas of erosion in the area and to keep it on public property to avoid the need for permanent easements, however temporary easements for construction access will likely be needed.

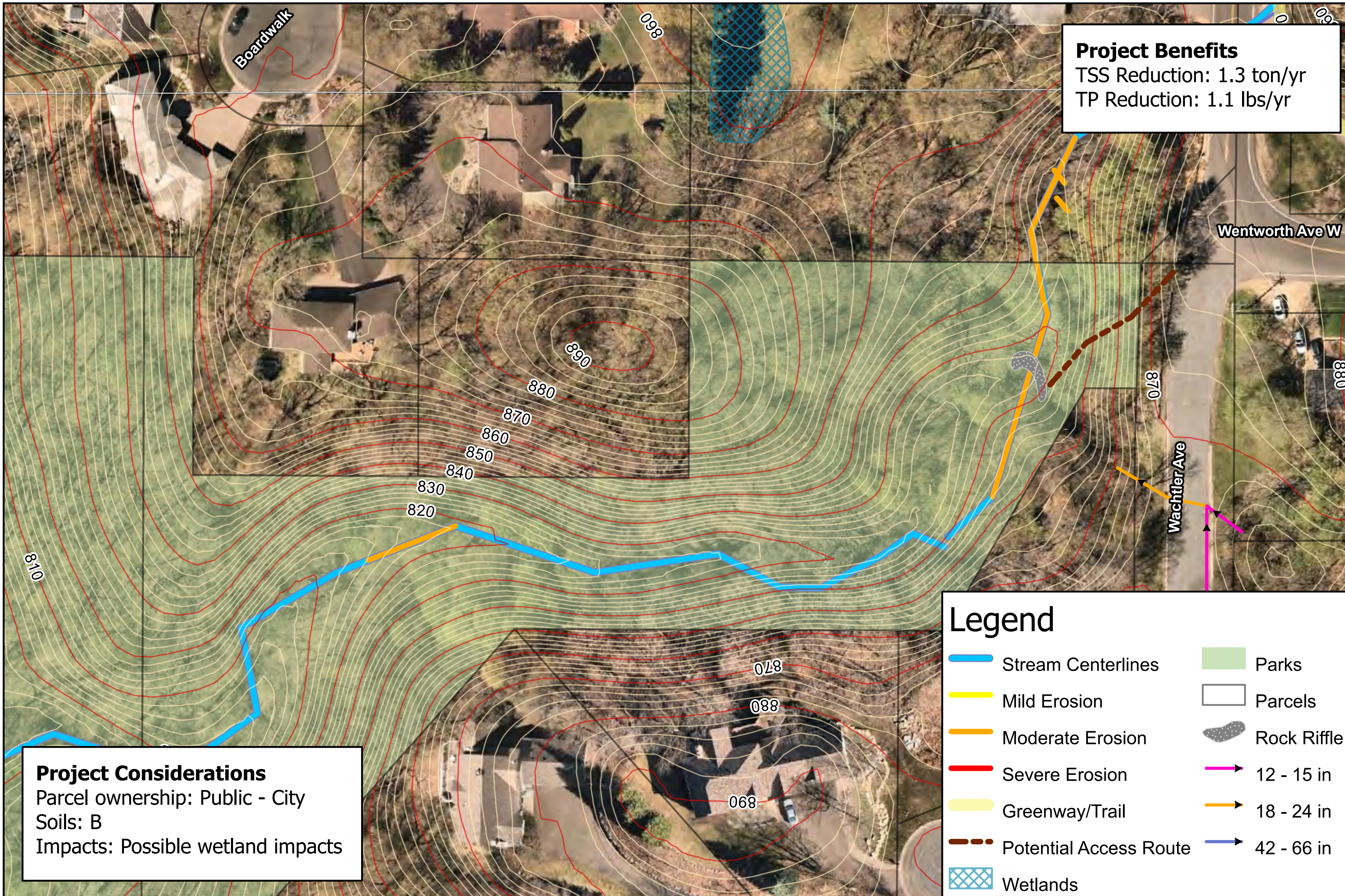

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Figure E.1 - Lower Wentworth Creek

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4.2 Middle Wentworth Creek

Middle Wentworth Creek has generally more severe erosion than Lower Wentworth Creek, despite having lower channel slopes. The channel before it crosses Wachtler Avenue has several areas of vertical or nearly vertical banks that are contributing sediment to the channel. The survey documented what appeared to be past stabilization projects consisting of geotextiles and riprap banks. Aerial photo analysis did not document any significant lateral erosion over the study period, therefore most of the sediment load is likely due to channel widening and vertical incision.

The 2D model results in **Appendix E** show relatively low velocities in the Middle Wentworth project area, but large amounts of water indicate that the culvert under Wachtler Avenue may be undersized. Stabilization in the Middle Wentworth project area must therefore be designed to handle brief periods of inundation during storm events.

Photo 15: Severe Erosion on Middle Wentworth Creek with Evidence of Past Stabilization Efforts (Riprap over Blanket)

The proposed stabilization design for Middle Wentworth Creek is shown in **Figure E.2**. The stabilization design consists of five rock riffles to address vertical incision and bank grading and bioengineering to address erosion occurring on private property.

Pollutant Reduction Estimates

Table E.3 shows the sediment loading estimates for the Middle Wentworth Creek area shown in **Figure E.2**. Sediment loading calculations for Middle Wentworth Creek include all the contiguous areas of mild, moderate and severe erosion from Wachtler Avenue up to the proposed riffle at the upstream end of the project. The segmented section of 30 feet of moderate erosion near the residence at 755 Wentworth Avenue is not included.

Table E.3: Sediment Loading Table - Middle Wentworth Creek

Total Length, ft	575
Bank Height Range, ft	4 to 6
Total Lateral TSS Load, Tons/yr	0.0
Total Vertical TSS Load, Tons/yr	4.9
Total P Load (Vertical + Lateral), lbs/yr	4.1

Potential Impacts

Table E.4 the potential impacts of the proposed stabilization design shown in **Figure E.2**.

Table E.4: Design and Impacts Table – Middle Wentworth Creek

Total Length, ft	340
Bank Height Range, ft	4 to 6
Ownership Type	Private
Impact to Parks	No
Impact to Existing Infrastructure	None known
Impact to Trees	Moderate
Impact to Wetlands	Possible
Construction Access	From Wachtler Avenue, will cross private property
Proposed Design Features	Rock Riffles, Bank Grading
Feasibility Level Cost Estimate	$57,850.00

The entire Middle Wentworth Creek Project is located on private property and the surrounding homeowners will experience impacts from project construction including access routes, noise, and land disturbance. There are no known pieces of public infrastructure within the project area, but private infrastructure (such as retaining walls and garden features) may need to be relocated or removed to complete the project. The grading proposed on the north bank of Wentworth Creek will be the source of most of the tree impacts, but they will be minimized whenever possible by consultation with homeowners. The proposed bioengineered bank stabilization that uses logs to construct a more stable and walkable bank will also make use of the trees that are removed.

If there are delineated wetlands within this site they will likely be small and low quality. Completing construction work within the winter will reduce wetland impacts.

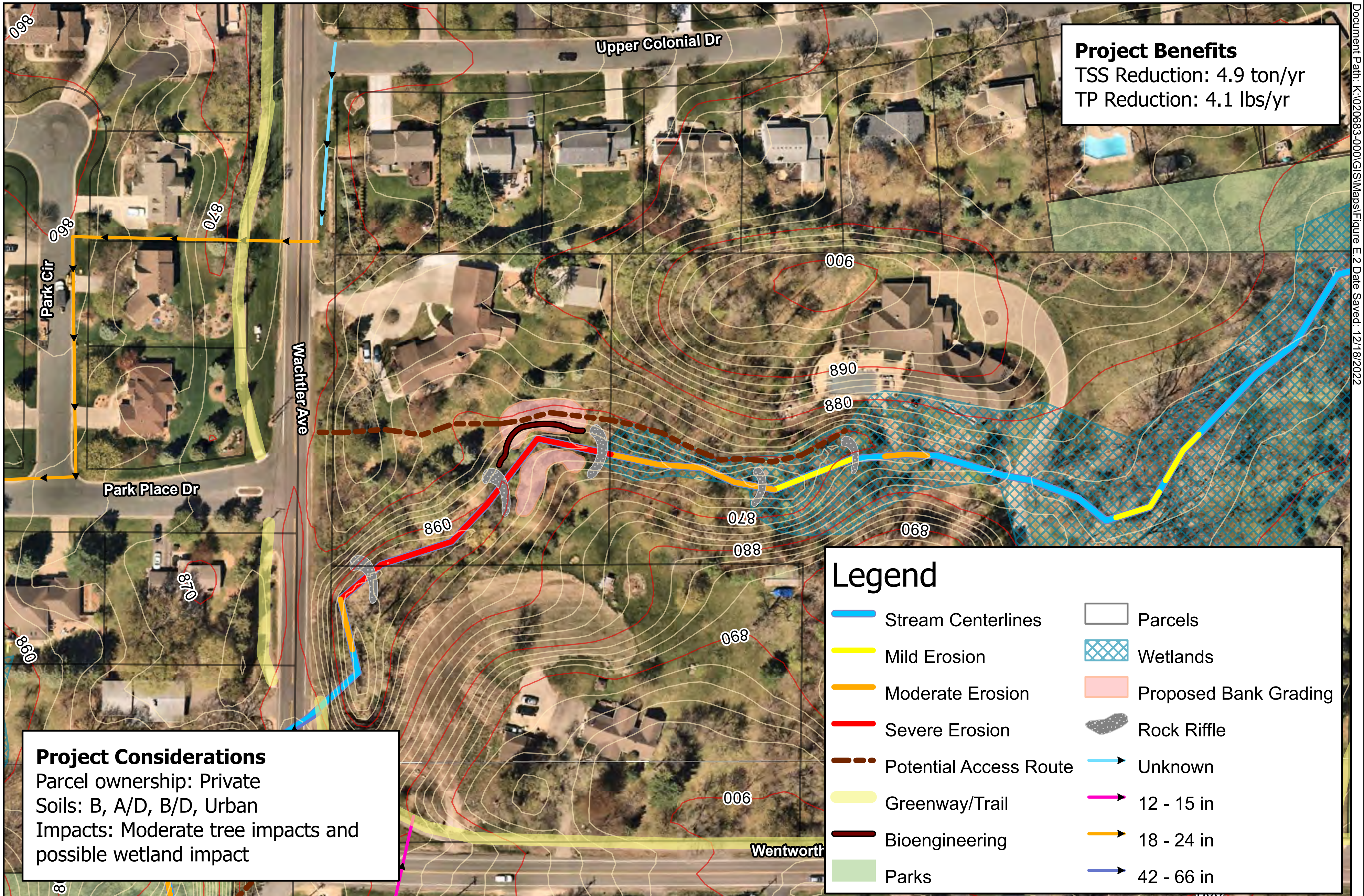

Figure E.2 - Middle Wentworth Creek

Interstate Valley Creek Study
Lower Mississippi River Watershed Management Organization

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0 125 Feet
1 inch = 125 feet

4.3 Wentworth Park Pond Expansion

There is opportunity to expand the existing pond in Wentworth Park, as shown in **Figure E.3**. The expansion would allow for rate reductions to the lower reaches of Wentworth Creek and the IVC main stem, with minimal impacts to the use and function of the park. The proposed expansion would increase the pond volume by approximately 40 percent and would be limited to the existing green spaces around the pond. Neither realignment of the trail nor removal of trees is expected for these improvements.

Pollutant Reduction Estimates

Although the expansion of the pond is primarily for rate reductions, minor improvements to pollutant removals would also result. The estimated pollutant reductions for the Wentworth Park Pond Expansion are shown in **Table E.5** below.

Table E.5: Pollutant Reductions - Wentworth Park Pond Expansion

TSS Reduction (tons/yr)	0.03
TP Reduction (lbs/yr)	0.2

Rate and Volume Reduction Estimates

The existing basin is a wet pond and therefore doesn't provide stormwater volume reductions downstream. However, the expansion of the pond's live storage would reduce peak discharge rates to Wentworth Creek, and downstream to the IVC main stem, as shown in **Table E.6**.

Table E.6: Rate and Volume Reductions - Wentworth Park Pond Expansion

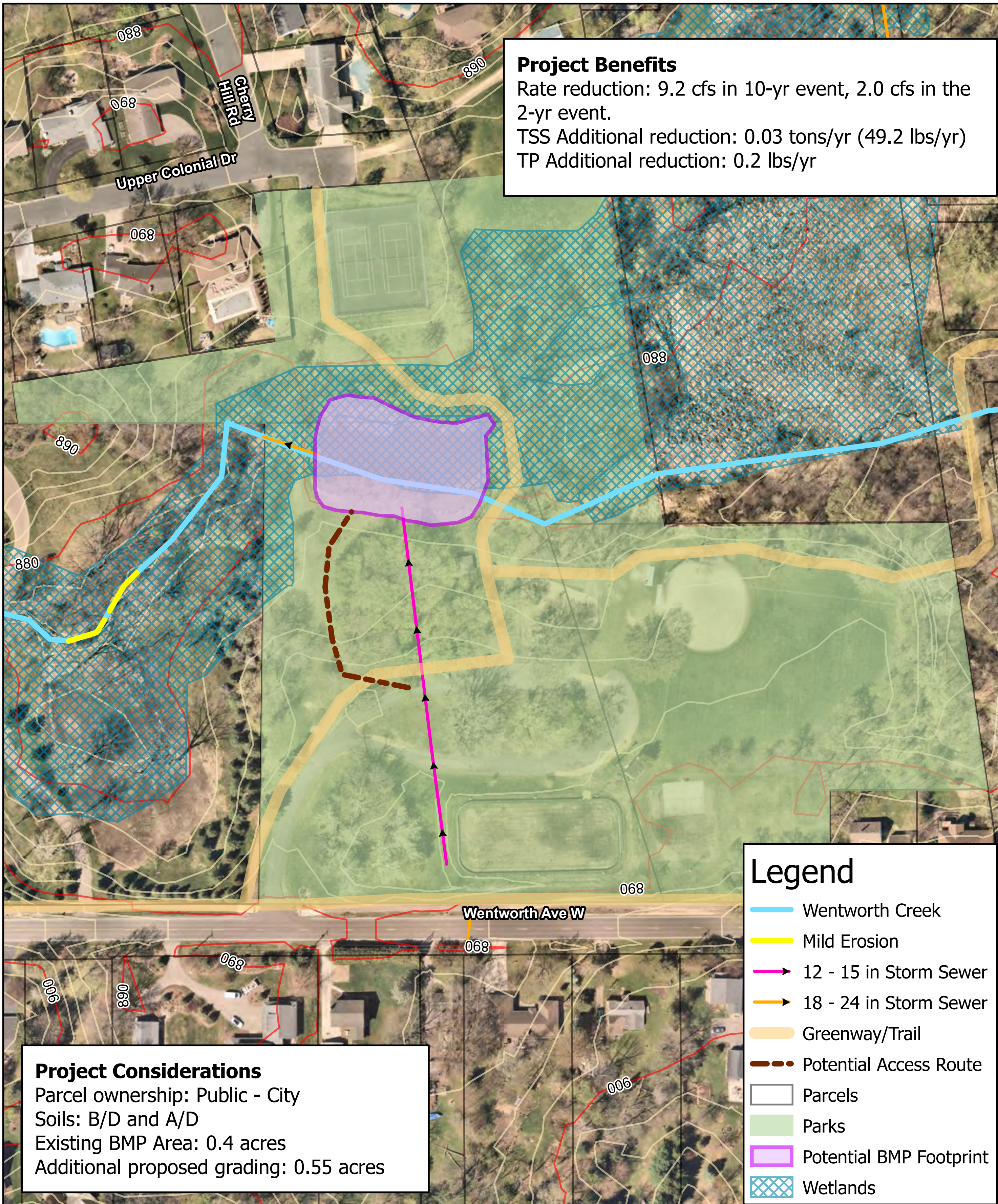
	Existing	Proposed	Reduction
2-year peak discharge (cfs)	7.3	5.3	2.0
10-year peak discharge (cfs)	36.4	27.2	9.2

Potential Impacts

The proposed Wentworth Pond Park Expansion was planned in such as way as to limit the construction impacts as shown in **Table E.7**.

Table E.7: Design and Impacts Table – Wentworth Park Pond Expansion

Ownership Type	Public
Impact to Parks	Yes
Impact to Existing Infrastructure	Access via the trail through the park would likely result in partial trail closure during construction.
Impact to Trees	Low
Impact to Wetlands	Unlikely
Construction Access	From park parking lot, on public land
Feasibility Level Cost Estimate	$164,125.00



Project Benefits
Rate reduction: 9.2 cfs in 10-yr event, 2.0 cfs in the 2-yr event.
TSS Additional reduction: 0.03 tons/yr (49.2 lbs/yr)
TP Additional reduction: 0.2 lbs/yr

Legend
- Wentworth Creek
- Mild Erosion
- 12 - 15 in Storm Sewer
- 18 - 24 in Storm Sewer
- Greenway/Trail
- Potential Access Route
- Parcels
- Parks
- Potential BMP Footprint
- Wetlands

Project Considerations
Parcel ownership: Public - City
Soils: B/D and A/D
Existing BMP Area: 0.4 acres
Additional proposed grading: 0.55 acres

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Figure E.3 - Wentworth Park Pond Expansion
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0 150 Feet
1 inch = 150 feet

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F. Marie Creek Basin

The Marie Creek Basin contains most of the main stem of Marie Creek and its contributing drainage areas. A short section of Marie Creek is within the West St. Paul Basin (**see Figure 1, Appendix A**) and this section was part of the channel erosion survey for Marie Creek.

1. Basin Description and History

The headwaters of Marie Creek are located within Dodge Nature Center, and the creek flows through several other existing ponds and wetlands on its way to join the main stem of IVC within Valley Park. The MH NRMP does not provide a ranking of ecological quality for any of the vegetative communities surrounding the ponds or wetlands along the Marie Creek channel. The part of the Marie Creek watershed that is within Dodge Nature Center is within West St. Paul and is therefore not covered by the MH NRMP.

2. Channel Erosion Survey Findings

The documented erosion within the Marie Creek channel is all classified as mild or moderate, there were no areas of severe erosion found. Most sections are short (100 feet or less) and some erosion issues appeared to be heavily influenced by landowner choices, such as installation of pedestrian bridges, retaining walls, and rip rap that narrow or harden the existing channel.

3. Volume Reduction Study Findings

Much of Marie Creek flows through heavily wooded private property. An existing pond and wetland area along a spur of Marie Creek, approximately 1,000 feet upstream of where Marie Creek meets the IVC mainstem provides an interesting opportunity for pollutant reductions and wetland enhancement. Further discussion is provided in Section F.4.4.

4. Concept Designs

4.1 Valley Park Playground

The Valley Park Playground site is shown in **Figure F.1**. The documented bank erosion consisted of vertical banks in the vicinity of the downstream end of the Marie Avenue culvert, as well as steep banks between the playground and the outer edge of the baseball field. The distance between the culvert invert and the channel bottom in this area indicates that there has been vertical erosion in this area as well. The average bank height in this area was 4 feet, which in this area would generally be considered moderate erosion, but WSB increased the qualitative rating for the 175 feet between the culvert outlet and the edge of the existing parking lot as severe because of its potential future encroachment into public facilities, specifically the playground, the pedestrian bridge, and the parking lot.

The 2D modeling results in **Appendix E** show very high velocities (exceeding 15 feet per second) from the outlet of the Marie Avenue culverts almost to the ball field outfield. The channel in this area is extremely confined and there is no floodplain for water to access during storms until it reaches the wetland downstream of the ball field. The result of this confinement is vertical downcutting and exposure of the new banks to high erosive pressures during storm events. Removal of trees near the playground may also cause further erosion towards the playground in the future as these tree roots decay and can no longer contribute to bank stability.

Photo 16: Severe Erosion near Valley Park Playground

Pollutant Reduction Estimates

Table F.1 shows the sediment loading estimates from the Valley Park Playground Site shown in **Figure F.1**. The 685 feet used for sediment loading calculations covers all the contiguous documented erosion areas (mild, moderate, and severe) from the culvert outlets at Marie Avenue past the baseball park outfield and into the existing wetland.

Table F.1: Sediment Loading Table - Valley Park Playground

Total Length, ft	685
Bank Height Range, ft	3.5 to 5
Total Lateral TSS Load, Tons/yr	40.3
Total Vertical TSS Load, Tons/yr	8.0
Total P Load (Vertical + Lateral), lbs/yr	41.1

The majority of the sediment loading in this area comes from lateral erosion and potentially widening of the channel. Vertical erosion contributes about 17 percent of the sediment load.

Potential Impacts

Table F.2 shows the potential impacts of the proposed stabilization design shown in **Figure F.1**.

Table F.2: Design and Impacts Table - Valley Park Playground

Total Length, ft	685
Bank Height Range, ft	3.5 to 5
Ownership Type	Public
Impact to Parks	Yes
Impact to Existing Infrastructure	Trail closures in Marie Park during construction
Impact to Trees	High
Impact to Wetlands	Likely
Construction Access	From parking lot within Marie Park
Proposed Design Features	Rock Riffle, Native Vegetation, Bank Grading
Feasibility Level Cost Estimate	$47,100.00

The proposed stabilization design for Valley Park Playground is focused on preserving the existing park features and minimizing impacts. A rock riffle will reduce vertical erosion and installing native plantings will help stabilize existing banks. Bank grading has been limited to the downstream area where the 2D model indicates high velocities (> 15 feet per second) in the channel. The goal of this bank grading is to create a new vegetated floodplain which the stream can access in high-frequency storm events. Bank grading has not been proposed for the area between the culvert outlet underneath Marie Avenue and the baseball fields because any significant attempt to regrade these banks would cause significant tree loss and disturbance to existing highly utilized parts of the park, specifically the playground and the tennis courts. WSB recommends planting new vegetation and managing existing vegetation in this area with the dual goal of improving bank stability while preserving existing park features that are highly valued by the community.

The Valley Park Playground project would be installed in some of the most highly utilized areas of Valley Park, therefore there will be park impacts during construction, likely including parking lot closures and limited access to some trails. Access will be from the existing parking lot and access routes have been kept out of public features and trails when possible. Wetland impacts are likely, though impacts to both wetlands and public enjoyment of the parks can be mitigated by planning for winter construction. Finally, construction of a new floodplain will include tree impacts. The current design marks high value white pines that must not be disturbed and grading can be done around these trees. If the Valley Park Playground and Valley Park Wetland (**see Figure B.2**) projects are completed either together as a single project or during consecutive winters, it will be possible to stockpile the trees removed during the Valley Park Playground project for use in the Valley Park Wetland toe wood structure.

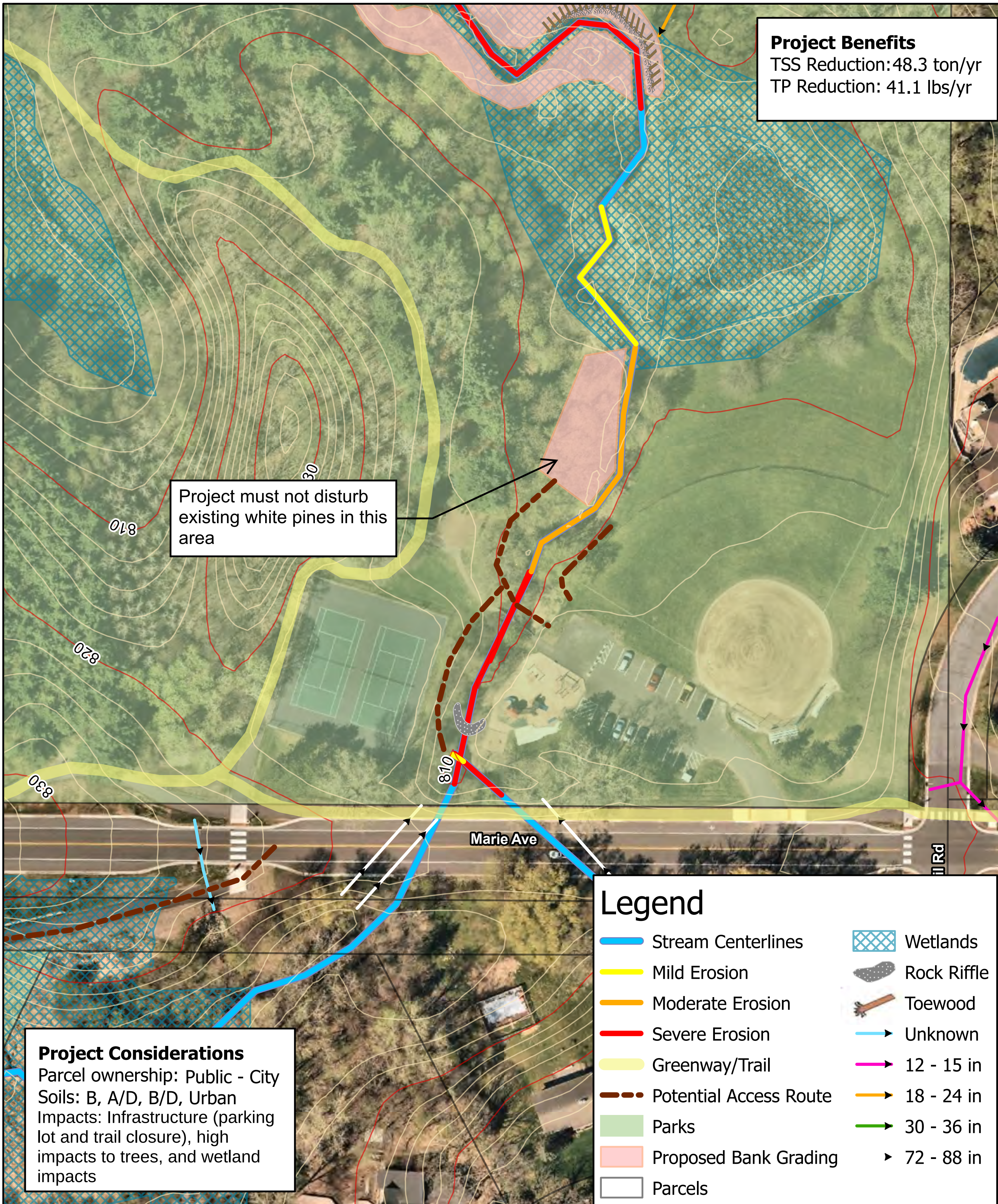

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Figure F.1 - Valley Park Playground

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0 100 Feet
1 inch = 100 feet

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4.2 Lower Marie Creek

The section designated as Lower Marie Creek extends from the culvert under Dodd Road to the culvert under Marie Avenue, just before the creek meets the IVC main stem within Valley Park.

2D model results in **Appendix E** show a strong correlation between areas of locally high velocities (>10 feet per second) and areas of documented moderate erosion. During the field survey Marie Creek had a more consistent presence of base flow than either the IVC main stem or Wentworth Creek, therefore the banks are subject to more consistent erosive pressure.

Photo 17: Moderate Erosion on Lower Marie Creek

The stabilization design for Lower Marie Creek is shown in **Figure F.2**. Because erosion severity in this area is mild to moderate the stabilization design consists of bank grading, bioengineering and installing native plantings for all sites.

The recommended bioengineering method consists of logs cabled to a bank which has been graded to a stable slope and native plantings are installed between the log structures (**see Figure 7, Appendix A** for a typical construction detail). The log structures differ slightly from revetments in that they do not have branches attached, but they do use the same cabling method. WSB has used this method in creek stabilization projects in the City of Maple Grove (2020) and the City of Plymouth (2022) and can provide additional detail on the design and installation of these structures upon request.

Photo 18: Bioengineered Slope Stabilization in use in Maple Grove One Year Post Installation

Pollutant Reduction Estimates

Table F.3 shows the sediment loading estimates for the area shown in **Figure F.2**. The 360 feet used for sediment loading calculations is the length of the three sections of moderate erosion where stabilization methods are being proposed. No areas of mild erosion were used in these calculations.

Table F.3: Sediment Loading Table - Lower Marie Creek

Total Length, ft	360
Bank Height Range, ft	3 to 7
Total Lateral TSS Load, Tons/yr	0.0
Total Vertical TSS Load, Tons/yr	2.6
Total P Load (Vertical + Lateral), lbs/yr	2.2

Aerial photo analysis did not show lateral erosion on this stretch and vertical erosion appears to be minor. Bank grading, native plantings, and bioengineering will help stabilize banks with mild to moderate erosion issues and can be customized to suit a homeowner's specific site and preferred aesthetics.

Potential Impacts

Table F.4 shows the potential impacts of the proposed stabilization design shown in **Figure F.2**.

Table F.4: Design and Impacts Table - Lower Marie Creek

Total Length, ft	335
Bank Height Range, ft	3 to 7
Ownership Type	Private
Impact to Parks	No
Impact to Existing Infrastructure	None known
Impact to Trees	Moderate
Impact to Wetlands	Possible
Construction Access	Multiple access points from Marie Avenue and Valley Curve, all will cross private property
Proposed Design Features	Bioengineering, native plantings, bank grading
Feasibility Level Cost Estimate	$38,400.00

All the stabilization sites on Lower Marie Creek are on private property. Access to each of these sites will be from the nearest residential street to the work area, and access routes were selected to be short in order to minimize disturbance to surrounding homeowners. The proposed bank grading and installation of bioengineering would be most quickly completed with small equipment such as Bobcats and skid steers. Projects like this can be done with hand installation to minimize disturbance but limiting contractors to hand installation will likely increase installation costs and the time required to complete the project.

Public engagement during the pre-design and design process should include outreach to willing landowners to discuss interest in completing a bank stabilization project as well as committing to ongoing maintenance of bioengineering and native vegetation. Landowners will experience impacts such as noise and ground cover disturbance during the project. There are no known impacts to public infrastructure on Lower Marie Creek and impacts to private infrastructure can be minimized with landowner input during the design process.

Tree impacts in this area are expected to be moderate, and trees which do need to be removed during bank grading can often be used in bioengineering techniques. Impacts to wetlands are possible but any wetlands present along the channel are likely to be small and low quality. Planning for winter construction will help minimize wetland impacts.

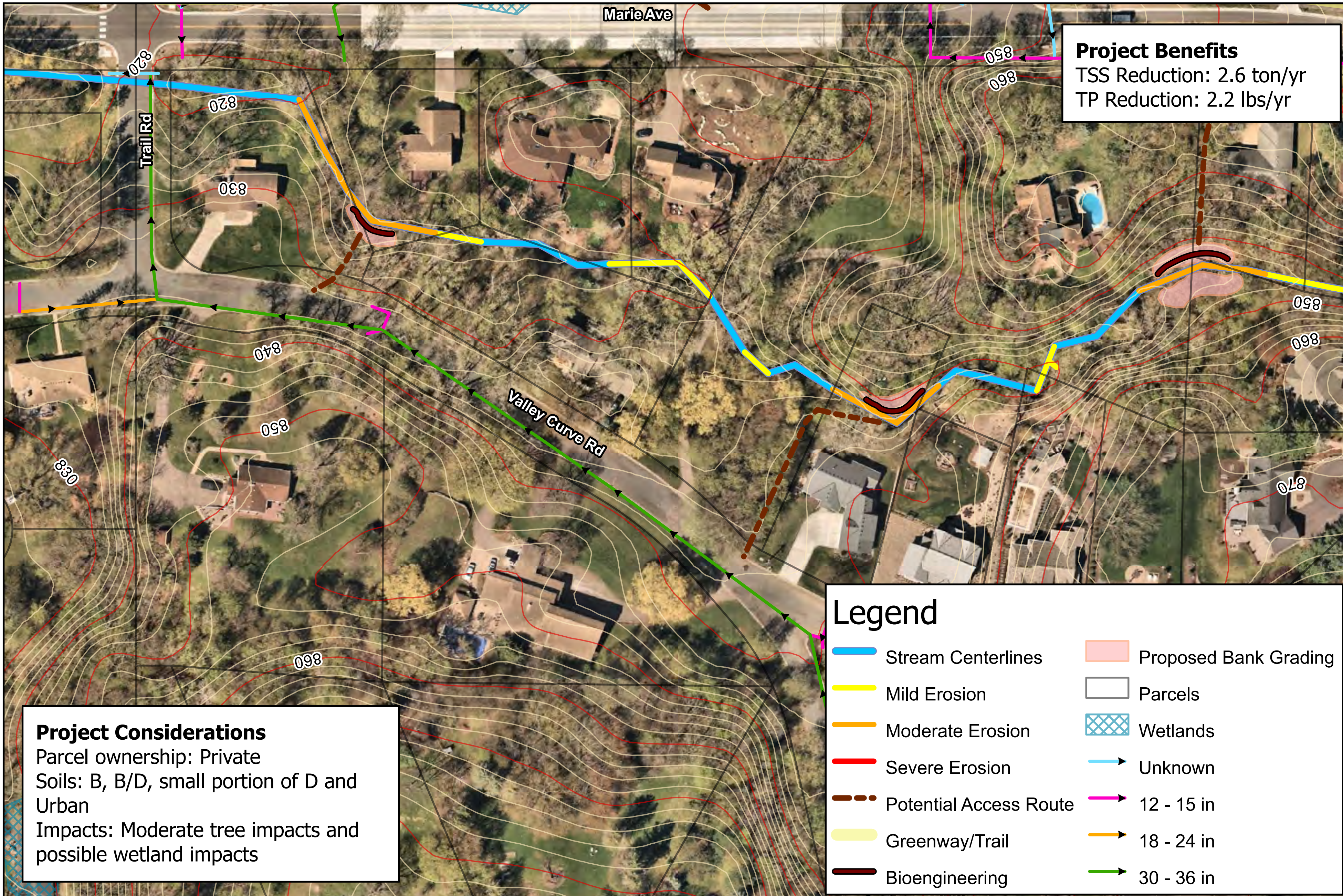

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Figure F.2 - Lower Marie Creek

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0 125 Feet
1 inch = 125 feet

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4.3 Middle Marie Creek

Middle Marie Creek is defined as the section of creek between Delaware Avenue and Dodd Road. Documented erosion issues on this section of the creek were all mild to moderate, therefore the most suitable sites for stabilization projects were two of the longer sections experiencing moderate erosion issues. Middle Marie Creek is upstream of the Marie Creek input to the 2D model so there are no 2D model results for these sites. These sections and the proposed stabilization plan are shown in **Figure F.3**.

Photo 19: Moderate Erosion on Middle Marie Creek

The stabilization plan for Middle Marie Creek consists of bank grading, native plantings, bioengineering, and a rock riffle.

Pollutant Reduction Estimates

Table F.5 shows the sediment loading estimates for the area shown in **Figure F.3**. The 235 feet used in calculations for the sediment loading estimates is from the length of the areas of moderate erosion being directly stabilized; adjoining areas of mild erosion are not included.

Table F.5: Sediment Loading Table - Middle Marie Creek

Total Length, ft	235
Bank Height Range, ft	4 to 5
Total Lateral TSS Load, Tons/yr	0.0
Total Vertical TSS Load, Tons/yr	1.7
Total P Load (Vertical + Lateral), lbs/yr	1.5

Aerial photo analysis showed that Middle Marie Creek did not have visible lateral erosion, so all sediment loading in this stretch is from vertical erosion.

Potential Impacts

Table F.6 shows the potential impacts of the proposed stabilization design shown in **Figure F.3**.

Table F.6: Design and Impacts Table - Middle Marie Creek

Total Length, ft	235
Bank Height Range, ft	4 to 5
Ownership Type	Private
Impact to Parks	No
Impact to Existing Infrastructure	None known
Impact to Trees	Moderate
Impact to Wetlands	Likely
Construction Access	Multiple from Hidden Creek Trail, will cross private property
Proposed Design Features	Bioengineering, bank grading, native vegetation
Feasibility Level Cost Estimate	$51,600.00

All the stabilization sites on Middle Marie Creek are on private property. Access to these sites is from Hidden Creek trail. The public engagement process during the pre-design and design of these sites should include outreach to willing landowners to discuss interest in completing a bank stabilization project as well as committing to ongoing maintenance of bioengineering and native vegetation. Landowners will experience impacts such as noise and ground cover disturbance during the project. There are no known impacts to public infrastructure on Lower Marie Creek and impacts to private infrastructure can be minimized with landowner input during the design process.

Tree impacts in this area are expected to be moderate, and trees which do need to be removed during bank grading can often be used in bioengineering techniques. Impacts to wetlands are considered likely due to the presence of ponds along this reach, but any wetlands present along the channel itself are likely to be small and low quality. Planning for winter construction will help minimize wetland impacts.

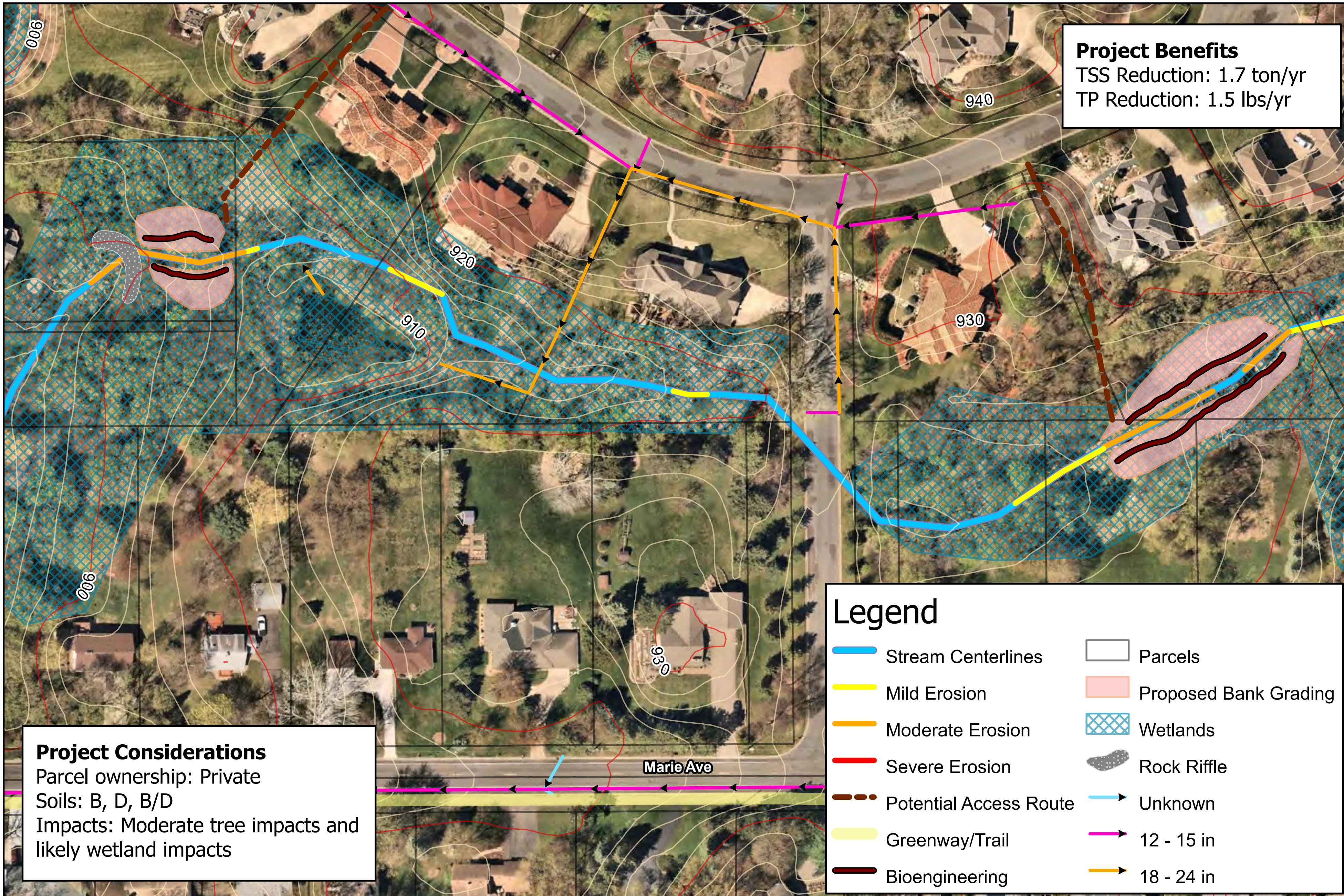

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Figure F.3 - Middle Marie Creek

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0 125 Feet
1 inch = 125 feet

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4.4 Lower Marie Creek Wetland Enhancement

There is an existing storm pond north of Marie Avenue, between Trail Road and Sutton Lane, that outlets to a wetland and channel, which ultimately discharge to Marie Creek. There is notable erosion at the southernmost outlet from the pond to the wetland and indications that stormwater is bypassing the wetland and the treatment that it could provide. Additionally, the channel along the north side of Marie Avenue exhibits mild erosion. The proposed enhancement of this area, as shown in **Figure F.4**, would include restoring the southern portion of the wetland and installing two rock riffles to allow water to pond in this area and back into the existing wetland. Additionally, the channel would be stabilized to prevent future erosion.

Pollutant Reduction Estimates

The estimated pollutant reductions for the Lower Marie Creek Wetland Enhancement are shown in **Table F.7**.

Table F.7: Pollutant Reductions - Lower Marie Creek Wetland Enhancement

TSS Reduction (tons/yr)	8.1
TP Reduction (lbs/yr)	12.7
TP Reduction – Channel Restoration (lbs/yr)	12.2

Rate and Volume Reduction Estimates

The proposed wetland enhancement would create pools within the wetland of at least an additional foot, slowing down water and reconnecting it to the wetland area to the north. The majority of the rate control for this drainage area is provided in the existing pond, adjacent to the proposed improvements, however, these improvements would result in slight peak discharge reductions as shown in **Table F.8**.

Table F.8: Rate and Volume Reductions - Lower Marie Creek Wetland Enhancements

	Existing	Proposed	Reduction
2-year peak discharge (cfs)	0.3	0.2	0.1
10-year peak discharge (cfs)	6.4	5.9	0.5

Potential Impacts

The impacts of the construction of the Lower Marie Creek Wetland Enhancement are shown in **Table F.9**. A large dead tree at the intersection of Sutton Lane and Marie Avenue could be removed as a part of the proposed project, along with invasive buckthorn that has grown in this area.

Table F.9: Design and Impacts Table - Lower Marie Creek Wetland Enhancement

Ownership Type	Public
Impact to Parks	Yes
Impact to Existing Infrastructure	Trail closure adjacent to Marie Avenue during construction
Impact to Trees	Moderate
Impact to Wetlands	Very likely
Construction Access	Via Marie Avenue on public parcels
Feasibility Level Cost Estimate	$146,700.00

Construction access could be via Marie Avenue, directly adjacent to the proposed wetland enhancement and channel stabilization areas. Access would likely require partial lane closure along Marie Avenue.

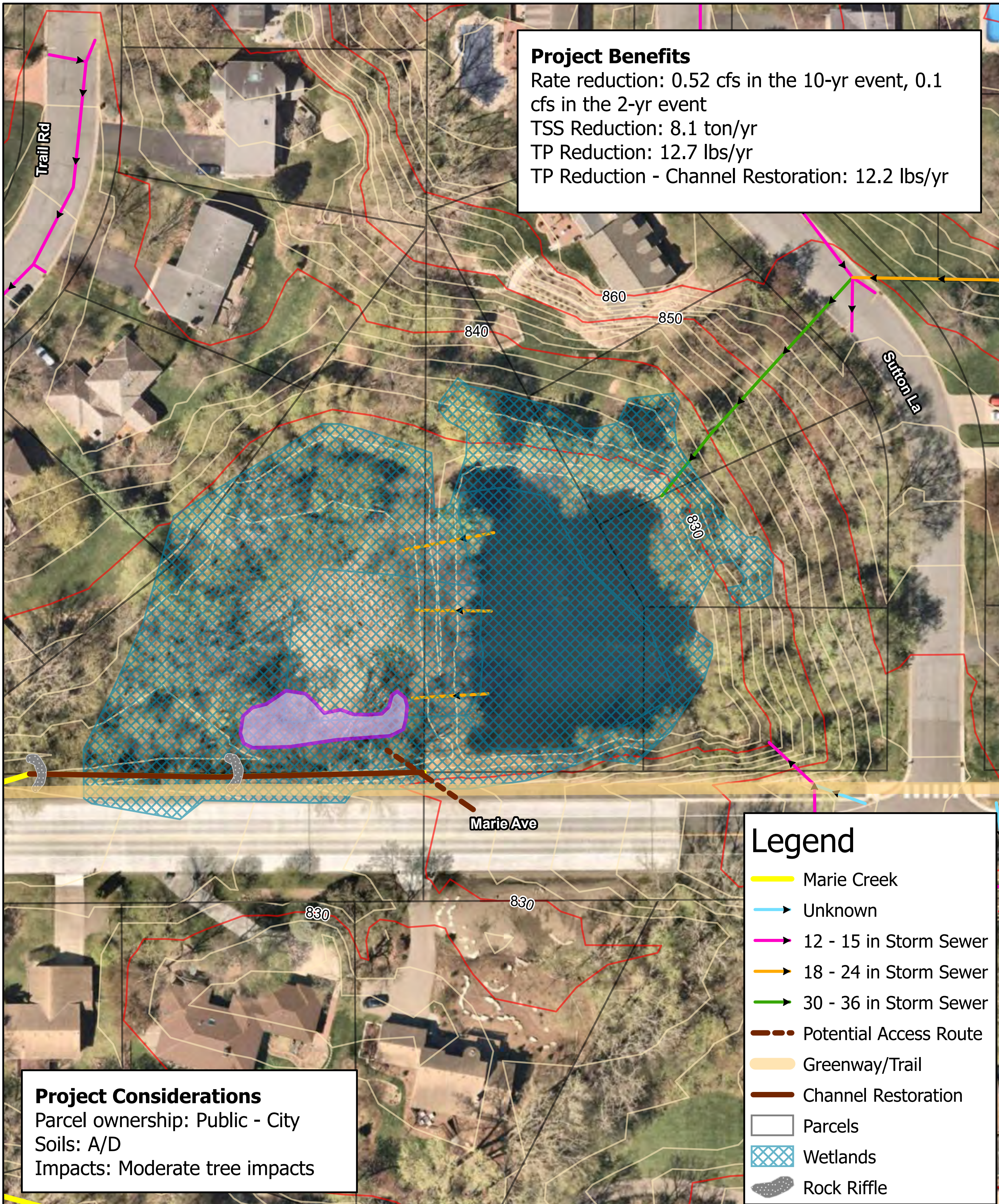

Figure F.4 - Lower Marie Creek Wetland Enhancement

Interstate Valley Creek Study
Lower Mississippi River Watershed Management Organization

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0 80 Feet
1 inch = 80 feet

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G. West St. Paul Basin

The West St. Paul Basin contains the portion of the IVC subwatershed in West St. Paul. Hydrologically, it includes areas that flow to Wentworth and Marie Creeks. The basin is approximately bounded by Thompson Avenue to the north and TH 62 to the south.

1. Basin Description and History

The land use in the West St. Paul Basin is primarily low density residential and open space, including the Dodge Nature Center.

2. Channel Erosion Survey Findings & Recommendations

The channel erosion survey within West St. Paul Basin began at the headwaters of Marie Creek within Dodge Nature Center and continued to where Marie Creek goes under Delaware Avenue at the basin's west boundary. The channel erosion survey did not document any areas of erosion on Marie Creek within the West St. Paul Basin.

3. Volume Reduction Study Findings & Recommendations

There are minimal storm sewer outfalls in this basin and none that provide a good opportunity to limit peak discharge rates or pollutants to downstream waterbodies. No BMPs are recommended in the West St. Paul Basin.

H. Rogers Lake Basin

The Rogers Lake Basin is in the southwestern corner of the IVC watershed. It does not contain any portion of the IVC main stem, Wentworth Creek, or Marie Creek.

1. Basin Description and History

The Rogers Lake Basin contains 475 acres that drain to a series of stormwater ponds and/or directly to Rogers Lake. The land use is mixed between low density residential, the Mendakota Country Club, and the open water of Rogers Lake. The basin also includes the I-35E corridor from Wagon Wheel Trail to TH 62. There is an outlet from Rogers Lake to the headwaters of IVC in Friendly Marsh Park.

2. Channel Erosion Survey Findings & Recommendations

The channel erosion field survey area did not include any areas within the Rogers Lake Basin. There are no documented erosion sites within the Rogers Lake Basin.

3. Volume Reduction Study Findings & Recommendations

No BMPs are proposed within the Rogers Lake Basin due to the existing stormwater BMPs, Rogers Lake itself, limited available open space, and no direct outfall to IVC or its tributaries.

I. Sunfish Lake Basin

The Sunfish Lake Basin is in the southeastern corner of the IVC watershed, in the City of Sunfish Lake. It does not contain any portion of the IVC main stem, Wentworth Creek, or Marie Creek.

1. Basin Description and History

Stormwater in the Sunfish Lake Basin is largely conveyed by a series of culverts. Much of the area drains to either Sunfish Lake or Hornbeam Lake, both contained within the basin. There are also existing stormwater BMPs throughout the basin. The land use is primarily rural residential; however, the basin also includes a portion of the I-494 corridor and the open water of Sunfish and Hornbeam Lakes.

2. Channel Erosion Survey Findings & Recommendations

The channel erosion field survey area did not include any areas within the Sunfish Lake Basin. There are no documented erosion sites within the Sunfish Lake Basin.

3. Volume Reduction Study Findings & Recommendations

No BMPs are proposed within the Sunfish Lake Basin due to the existing stormwater BMPs, Sunfish and Hornbeam Lakes themselves, and no direct outfall to IVC or its tributaries.

J. Conclusions

The concept designs presented throughout this report were ranked and prioritized based on TP removals, rate reduction (for BMP designs only), total project cost, and TP pollutant cost benefit, maintenance cost (for BMP designs only), and constructability. The projects were ranked on a scale of 1-3 or 1-5; the higher the number the better the project (higher pollutant reductions or easier constructability, for example). Everything was ranked 1-3 except for the TP cost benefit score and the rate reduction score (for BMP designs only), which were ranked 1-5. By ranking these two categories 1-5, they were given slightly more importance in the overall project ranking. Because of the different factors for the different project types, stabilization and BMP projects are ranked separately.

In general, stabilization projects have much better (lower cost) TP reduction cost benefit. However, stabilization projects repair and stabilize eroded areas and do not offer the rate and volume control benefits that permanent stormwater BMPs can provide. The concept designs outlined in this report will improve water quality, rate, and volumes in this area and ultimately provide benefit downstream. No single project can accomplish this on its own; multiple projects strategically implemented throughout the watershed can together achieve overall stormwater improvement.

When considering peak discharge rate reductions, rates are reported at the locations of each proposed BMP throughout this report and in **Table J.2** below. Due to varying timing of stormwater peak discharges throughout the tributary drainage area and to each proposed BMP, the cumulative peak discharge rate reduction to the downstream-most reach of IVC, and ultimately the Mississippi River, does not simply equal the sum of all peak discharge reductions. This cumulative downstream rate decrease is given in **Table J.3**.

Table J.1: Stabilization Project Decision Matrix and Prioritization

Concept Design (Section No./ Figure No.)	TSS Reduction (ton/yr)	TP Reduction (lbs/yr)	Total Project Cost[1]	TP Pollutant Cost Benefit ($/lb)[2]	TSS / TP Reduction Score	TP Cost Benefit Score	Constructability Score	Total Score
Valley Park RTR to Wentworth (B.4.1/B.1)	158.7	135.0	$83,250	$25	3	5	1	9
Valley Park Wetland (B.4.2/B.2)	74.9	85.2	$98,650	$46	3	5	1	9
Valley Park Playground (F.4.1/F.1)	48.3	41.1	$47,100	$46	2	5	2	9
Lower Wentworth Creek (E.4.1/E.1)	1.3	1.1	$15,175	$552	1	3	3	7
Middle Wentworth Creek (E.4.2/E.2)	4.9	4.1	$57,850	$564	1	3	3	7
Park Place (A.4.2/A.2)	3.8	3.3	$37,500	$455	1	3	2	6
Lower Marie Creek (F.4.2/F.2)	2.6	2.2	$38,400	$698	1	2	3	6
Lilydale Trailhead Parking Lot (A.4.1/A.1)	0.7	0.6	$30,900	$2,060	1	1	3	5
Middle Marie Creek (F.4.3/F.3)	1.7	1.5	$51,600	$1,376	1	1	3	5
Valley Park South (C.4.1/C.1)	2.5	2.2	$140,000	$2,545	1	1	2	4

[1]The project costs listed do not include potential land or easement acquisition costs.
[2]The cost benefit assumes a 25-year stabilization benefit lifecycle.

Table J.2: BMP Project Decision Matrix and Prioritization

Concept Design (Section No./ Figure No.)	TSS Reduction (ton/yr)	TP Reduction (lbs/yr)	Rate Reduction (cfs)		Annual Maintenance Cost	Total Project Cost[1]	TP Pollutant Cost Benefit ($/lb)[2]	TSS/ TP Reduction Score	Rate Reduction Score	TP Cost Benefit Score	Maintenance Score	Construct-ability Score	Total Score
			2-yr	10-yr									
Friendly Marsh Park Wetland Enhancement (D.4.1/D.1)	0.5	1.8	46.2	64.2	$1,000	$180,225	$4,561	2	5	3	3	2	15
Valley Park Wetland Infiltration Basin (B.4.3/B.3)	1.2	4.7	10.9	12.6	$1,500	$183,915	$1,884	2	4	4	2	2	14
Lower Marie Creek Wetland Enhancement (F.4.4/F.4)	8.1	24.9	0.1	0.5	$1,500	$146,700	$296	3	1	5	2	3	14
Park Place Filtration Basin (A.4.3/A.3)	0.9	3.5	3.4	5.7	$1,500	$184,775	$2,540	3	2	3	2	2	12
Valley Park Wetland Enhancement and Weir (B.4.4/B.4)	0.2	0.8	10.4	12.4	$1,000	$230,825	$12,791	1	4	2	3	2	12
Wentworth Park Pond Expansion (E.4.3/E.3)	0.03	0.2	2	9.2	$1,500	$164,125	$40,325	1	2	1	2	3	9

[1]The project costs listed do not include potential land or easement acquisition costs.
[2]The cost benefit assumes a 25-year life cycle for each BMP.

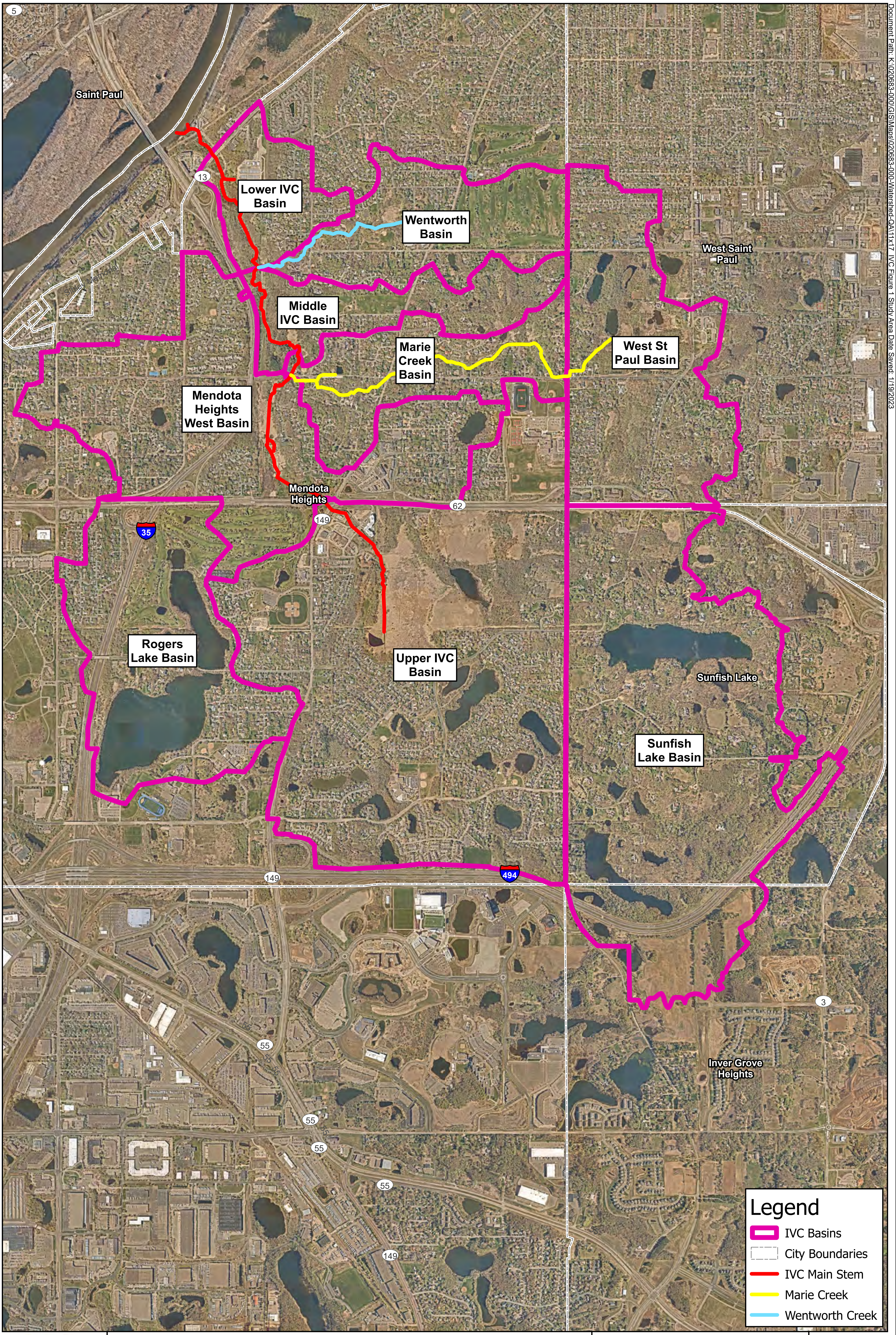
Table J.3: Downstream Peak Discharge Impacts[1]

	2-yr Peak Discharge (cfs)			10-yr Peak Discharge (cfs)		
	Existing	Proposed	Reduction	Existing	Proposed	Reduction
IVC at TH 62	142.3	142.2	0.1	183.8	182.9	0.9
Marie Creek	51.1	51.1	0	188.1	188.0	0.1
IVC downstream of confluence with Marie Creek	258.7	256.4	2.3	540.4	536	4.4
Wentworth Creek	8.5	7.0	1.5	43.0	32.0	11.0
IVC downstream of confluence with Wentworth Creek	284.9	275.3	9.6	651.5	617.2	34.3
IVC at confluence with Mississippi River	299.4	286.6	12.8	726.4	679.7	46.7

[1]Proposed discharge rates assume all proposed projects in this report have been implemented. The rates at each discharge point only consider those projects upstream.

Appendix A

Map Figures



LMRWMO
LOWER MISSISSIPPI RIVER WATERSHED MANAGEMENT ORGANIZATION

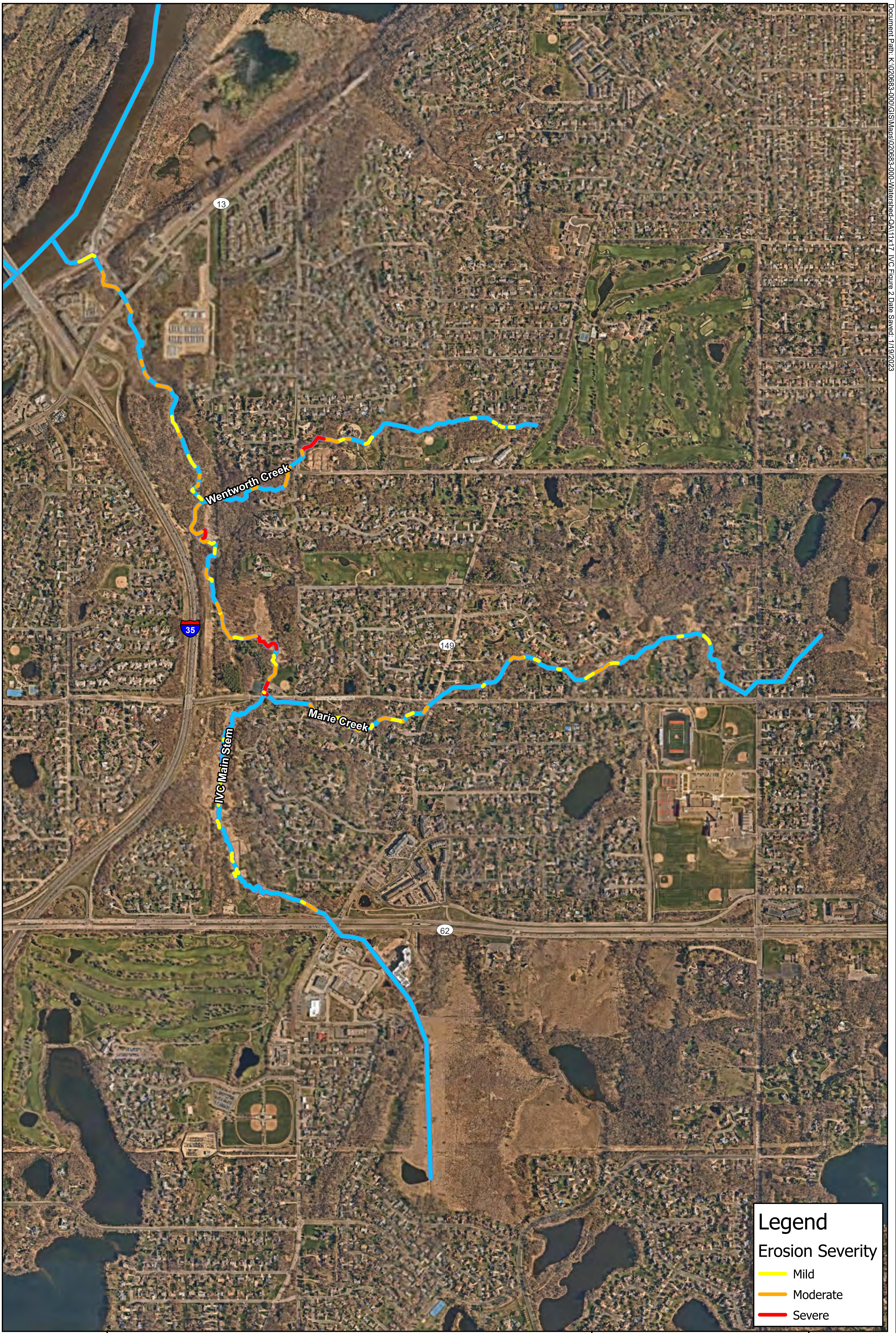
Figure 1 – Project Study Area

Interstate Valley Creek Study
Lower Mississippi River Watershed Management Organization

N

0 1,800 Feet
1 inch = 1,800 feet

wsb



Document Path: K:\020683-000\GIS\Maps\020683-000-Watershed-QA\11x17 IVC Figure 2 Date Saved: 1/19/2023

LMRWMO
LOWER MISSISSIPPI RIVER
WATERSHED MANAGEMENT ORGANIZATION

Figure 2 – Channel Erosion Survey Overview

Interstate Valley Creek Study

Lower Mississippi River Watershed Management Organization

N

0 1,000 Feet

1 inch = 1,000 feet

wsb

Document Path: K:\020683-000\GIS\Maps\020683-000-Watershed-OA\Figure 3 Lateral Erosion Date Saved: 1/19/2023

LMRWMO LOWER MISSISSIPPI RIVER WATERSHED MANAGEMENT ORGANIZATION

Figure 3 – Lateral Channel Erosion

Interstate Valley Creek Study

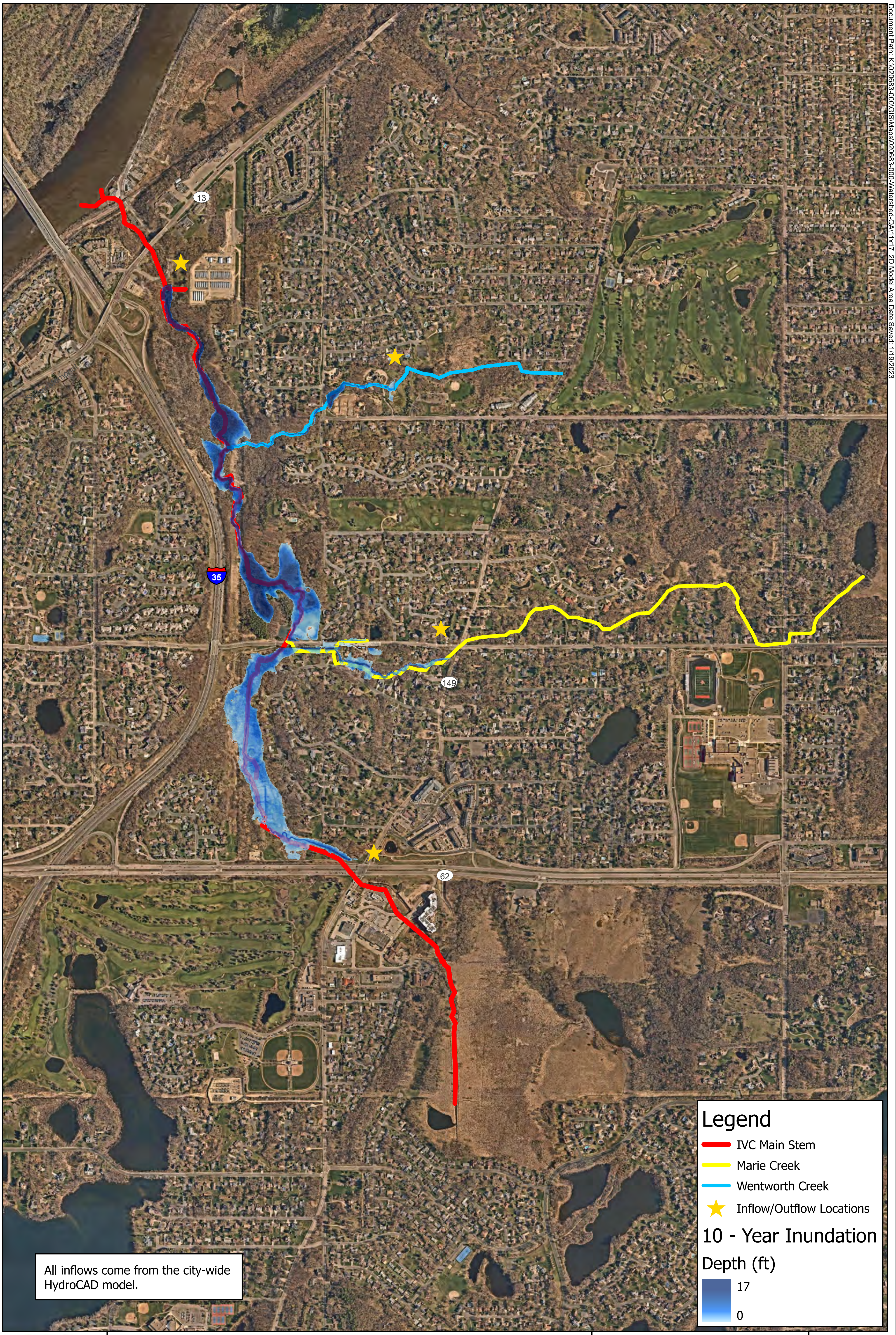
Lower Mississippi River Watershed Management Organization

N

0 50 Feet

1 inch = 50 feet

wsb



Document Path: K:\020683-000\GIS\Maps\020683-000-Watershed-QA\11x17 2D Model Area Date Saved: 1/19/2023

Figure 4 – 2D Model Area and Input Locations

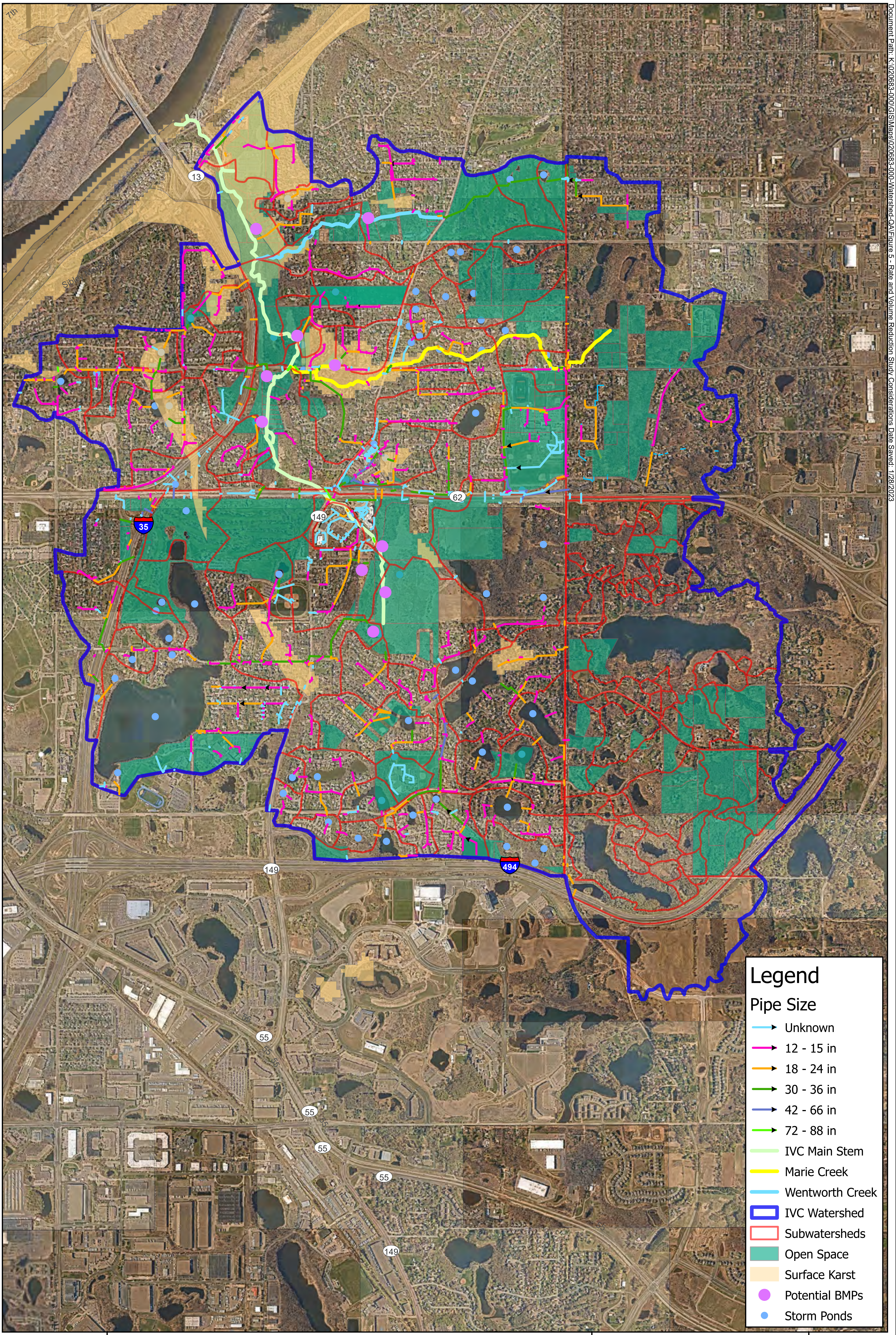
Interstate Valley Creek Study

Lower Mississippi River Watershed Management Organization

N

0 1,000 Feet

1 inch = 1,000 feet



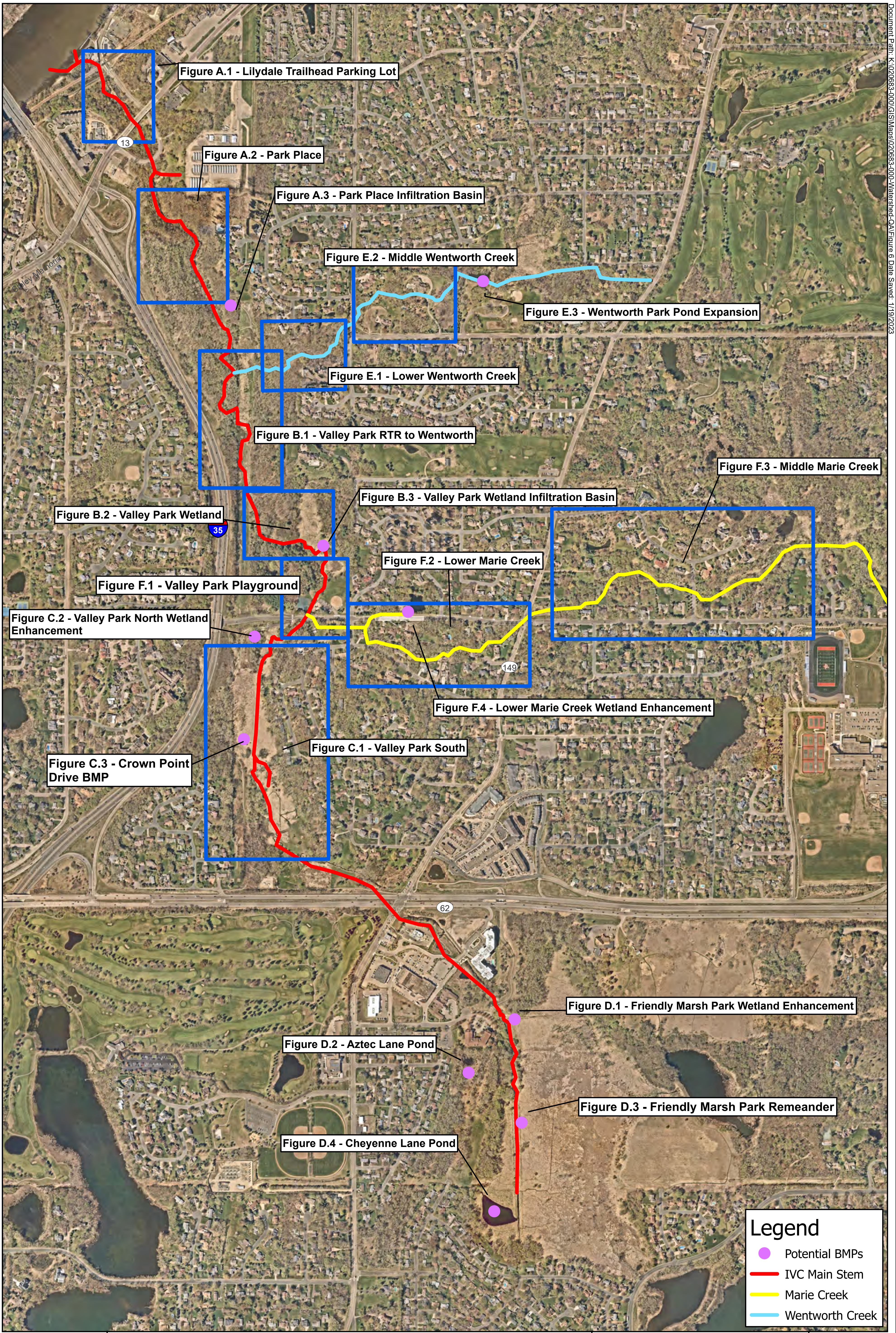
Document Path: K:\020683-000\GIS\Maps\020683-000-Watershed-QA\Figure 5 - Rate and Volume Reduction Study Considerations Date Saved: 1/28/2023

LMRWMO
LOWER MISSISSIPPI RIVER
WATERSHED MANAGEMENT ORGANIZATION

Figure 5 - Rate and Volume Reduction Study Considerations
Interstate Valley Creek Study
Lower Mississippi River Watershed Management Organization

N
0 1,800
Feet
1 inch = 1,800 feet

wsb



Document Path: K:\020683-000\GIS\Maps\020683-000-Watershed-QA\Figure 6 Date Saved: 1/19/2023

LMRWMO
LOWER MISSISSIPPI RIVER
WATERSHED MANAGEMENT ORGANIZATION

Figure 6 - Concept Design and Recommended Improvements Overview

Interstate Valley Creek Study

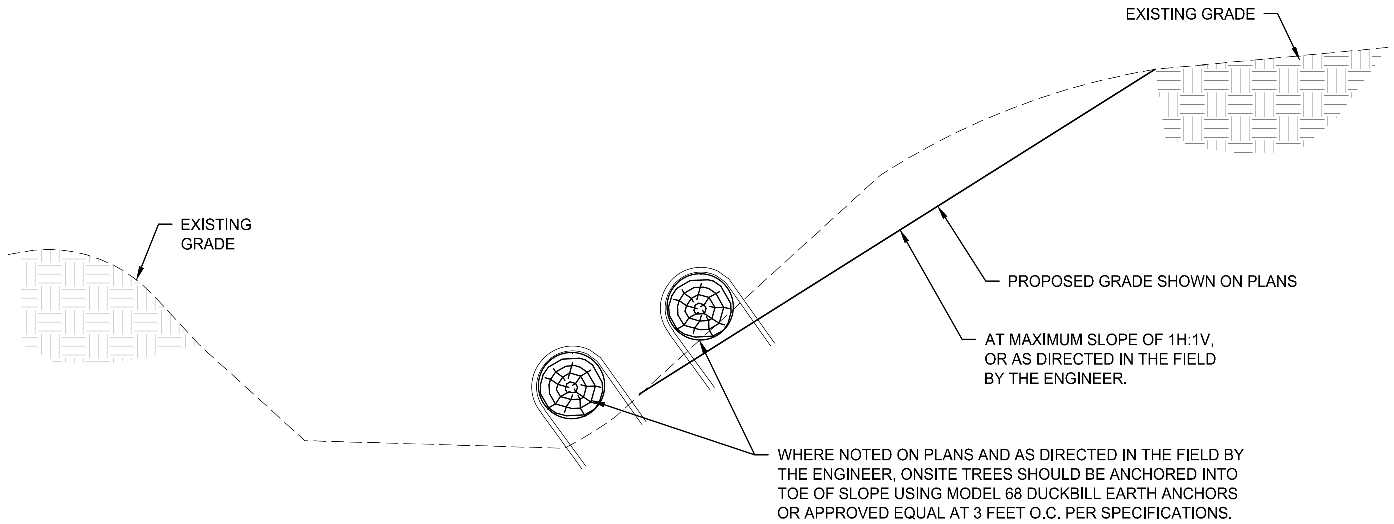
Lower Mississippi River Watershed Management Organization

N

0 800 Feet

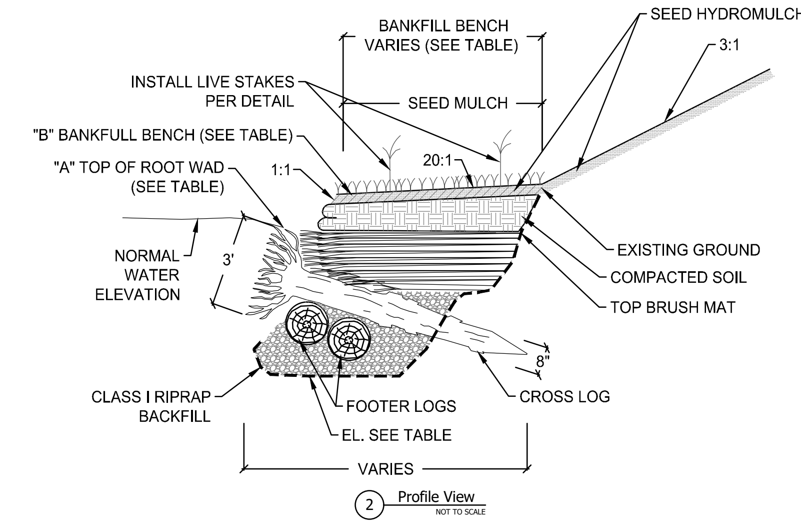
1 inch = 800 feet

wsb

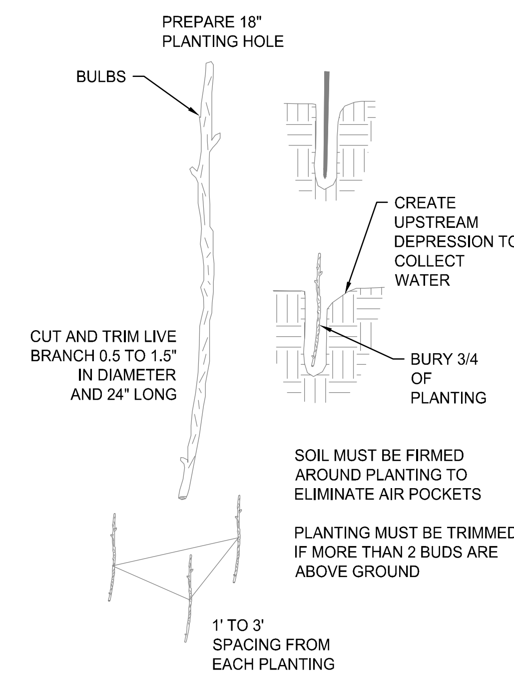


BIOENGINEERED SLOPE STABILIZATION
SCALE: NOT TO SCALE

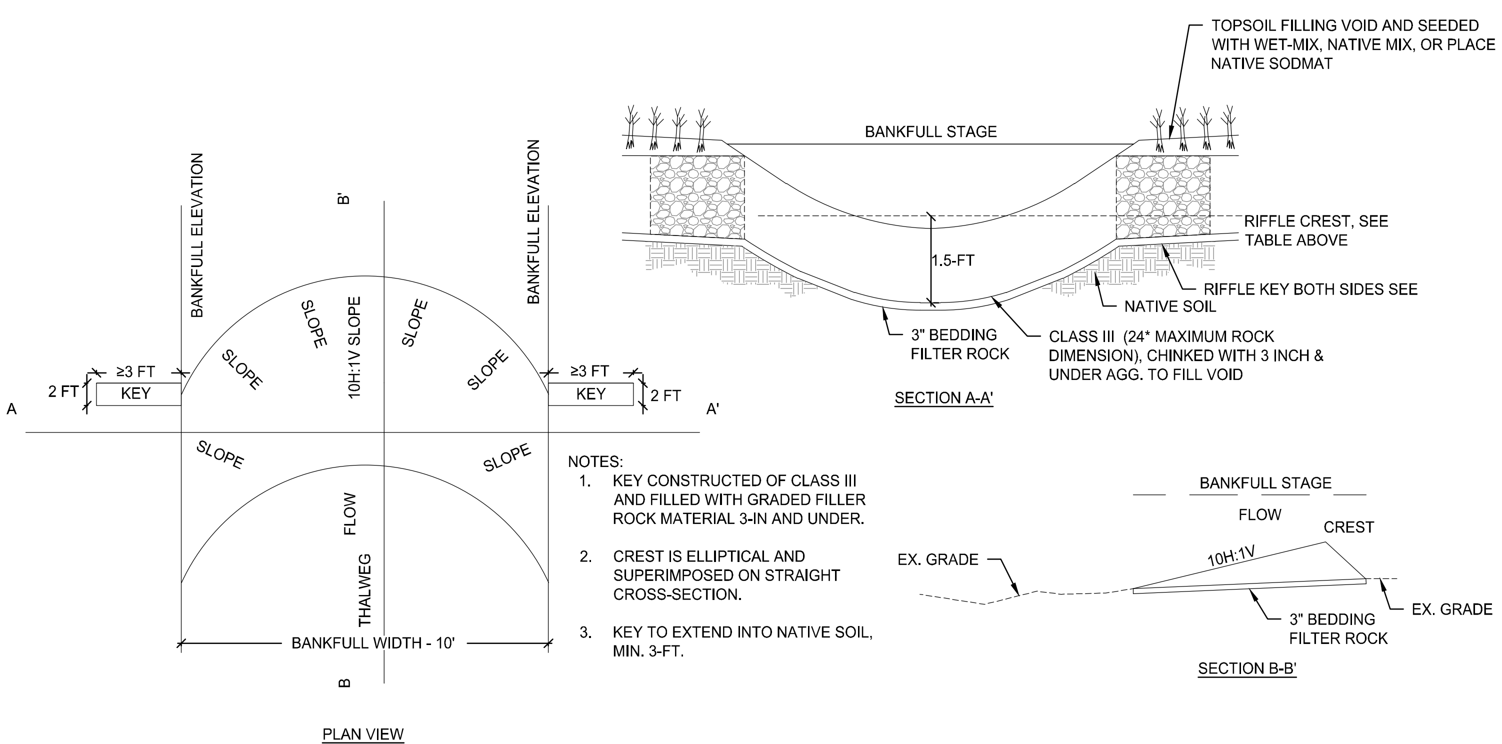
NOTES:
1. TREES USED TO ANCHOR SLOPE MAY NOT BE ROTTEN.
2. TREES USED TO ANCHOR SLOPE MUST A MINIMUM 12" IN DIAMETER.
3. ANCHORS USED MUST BE MODEL 68 DUCKBILL EARTH ANCHORS OR APPROVED EQUAL AND MUST BE INSTALLED PER MANUFACTURER'S SPECIFICATIONS.



TOEWOOD DETAIL
SCALE: NOT TO SCALE

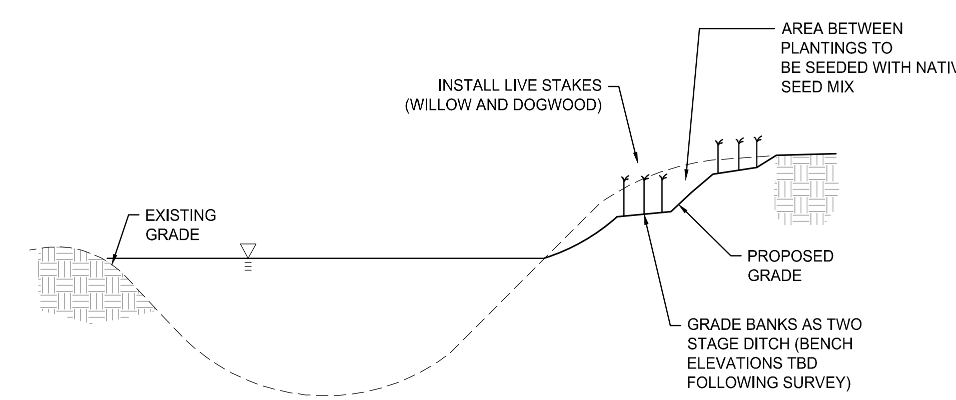


LIVE STAKING DETAIL
SCALE: NOT TO SCALE



NOTES:
1. KEY CONSTRUCTED OF CLASS III AND FILLED WITH GRADED FILLER ROCK MATERIAL 3-IN AND UNDER.
2. CREST IS ELLIPTICAL AND SUPERIMPOSED ON STRAIGHT CROSS-SECTION.
3. KEY TO EXTEND INTO NATIVE SOIL, MIN. 3-FT.

ROCK RIFFLE DETAIL
SCALE: NOT TO SCALE



BANK GRADING
SCALE: NOT TO SCALE

LMR WMO
LOWER MISSISSIPPI RIVER WATERSHED MANAGEMENT ORGANIZATION

wsb

WSB PROJECT NO.: 020683-000

SCALE: AS NOTED	DESIGN BY:
PLAN BY:	CHECK BY:

INTERSTATE VALLEY CREEK STUDY
LOWER MISSISSIPPI RIVER WMO & CITY OF MENDOTA HEIGHTS

Figure 7 - Stabilization Details

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Appendix B

Detailed Cost Estimates

Table AB.1: Lilydale Trailhead Cost Estimate

Item	Unit	Quantity	Unit Cost	Total Cost
Mobilization	LS	1	$ 2,000.00	$ 2,000.00
Clearing and Grubbing	ACRE	0.1	$ 4,000.00	$ 400.00
Common Excavation	CY	20	$ 25.00	$ 500.00
Class III Riprap	CY	20	$ 125.00	$ 2,500.00
Erosion Control	LS	1	$ 8,000.00	$ 8,000.00
Restoration	LS	1	$ 8,000.00	$ 8,000.00
Construction Subtotal				$ 21,400.00
20% Contingency				$ 4,300.00
Engineering Costs (20%)				$ 5,200.00
Estimated Project Total				**$ 30,900.00**

Table AB.2: Park Place Stabilization Cost Estimate

Item	Unit	Quantity	Unit Cost	Total Cost
Mobilization	LS	1	$ 2,400.00	$ 2,400.00
Clearing and Grubbing	ACRE	0.5	$ 4,000.00	$ 2,000.00
Common Excavation	CY	8	$ 25.00	$ 200.00
Class III Riprap	CY	8	$ 125.00	$ 1,000.00
Granular Filter	CY	4	$ 100.00	$ 400.00
Erosion Control	LS	1	$ 8,000.00	$ 8,000.00
Vegetation Management Year 1	LS	1	$ 6,000.00	$ 6,000.00
Vegetation Management Year 2	LS	1	$ 6,000.00	$ 6,000.00
Construction Subtotal				$ 26,000.00
20% Contingency				$ 5,200.00
Engineering Costs (20%)				$ 6,300.00
Estimated Project Total				**$ 37,500.00**

Table AB.3: Park Place Filtration Basin Cost Estimate

Item	Unit	Quantity	Unit Cost	Total Cost
Mobilization	LS	1	$ 11,700.00	$ 11,700.00
Clearing and Grubbing	ACRE	0.8	$ 4,000.00	$ 3,200.00
Site Grading	LS	1	$ 15,000.00	$ 15,000.00
Common Excavation	CY	980	$ 25.00	$ 24,500.00
Class III Riprap	CY	9	$ 125.00	$ 1,125.00
Erosion Control	LS	1	$ 8,000.00	$ 8,000.00
Dewatering	LS	1	$ 5,000.00	$ 5,000.00
Restoration	LS	1	$ 8,000.00	$ 8,000.00
Storm Pipe Removal	LF	75	$ 10.00	$ 750.00
Diversion Structure	EACH	2	$ 6,000.00	$ 12,000.00
Filtration Media	CY	250	$ 100.00	$ 25,000.00
6” Draintile	LF	120	$ 50.00	$ 6,000.00
24" Storm Pipe	LF	64	$ 125.00	$ 8,000.00
Construction Subtotal				$ 128,275.00
20% Contingency				$ 25,700.00
Engineering Costs (20%)				$ 30,800.00
Estimated Project Total				**$ 184,775.00**

Table AB.4: Valley Park RTR to Wentworth Stabilization Cost Estimate

Item	Unit	Quantity	Unit Cost	Total Cost
Mobilization	LS	1	$ 5,300.00	$ 5,300.00
Clearing and Grubbing	ACRE	0.7	$ 4,000.00	$ 2,800.00
Common Excavation	CY	250	$ 25.00	$ 6,250.00
Erosion Control	LS	1	$ 8,000.00	$ 8,000.00
Vegetation Management Year 1	LS	1	$ 6,000.00	$ 6,000.00
Vegetation Management Year 2	LS	1	$ 6,000.00	$ 6,000.00
Toe Wood	LF	100	$ 110.00	$ 11,000.00
Live Stakes	EA	300	$ 8.00	$ 2,400.00
Restoration	LS	1	$ 10,000.00	$ 10,000.00
Construction Subtotal				$ 57,750.00
20% Contingency				$ 11,600.00
Engineering Costs (20%)				$ 13,900.00
Estimated Project Total				**$ 83,250.00**

Table AB.5: Valley Park Wetland Stabilization Cost Estimate

Item	Unit	Quantity	Unit Cost	Total Cost
Mobilization	LS	1	$ 6,300.00	$ 6,300.00
Clearing and Grubbing	ACRE	0.4	$ 4,000.00	$ 1,600.00
Common Excavation	CY	450	$ 25.00	$ 11,250.00
Erosion Control	LS	1	$ 8,000.00	$ 8,000.00
Vegetation Management Year 1	LS	1	$ 6,000.00	$ 6,000.00
Vegetation Management Year 2	LS	1	$ 6,000.00	$ 6,000.00
Toe Wood	LF	150	$ 110.00	$ 16,500.00
Live Stakes	EA	600	$ 8.00	$ 4,800.00
Restoration	LS	1	$ 8,000.00	$ 8,000.00
Construction Subtotal				$ 68,450.00
20% Contingency				$ 13,700.00
Engineering Costs (20%)				$ 16,500.00
Estimated Project Total				**$ 98,650.00**

Table AB.6: Valley Park Wetland Filtration Basin Cost Estimate

Item	Unit	Quantity	Unit Cost	Total Cost
Mobilization	LS	1	$ 11,300.00	$ 11,300.00
Clearing and Grubbing	ACRE	0.21	$ 4,000.00	$ 840.00
Clearing and Grubbing	EACH	25	$ 500.00	$ 12,500.00
Site Grading	LS	1	$ 8,000.00	$ 8,000.00
Common Excavation	CY	2000	$ 25.00	$ 50,000.00
Class III Riprap	CY	9	$ 125.00	$ 1,125.00
Erosion Control	LS	1	$ 8,000.00	$ 8,000.00
Dewatering	LS	1	$ 5,000.00	$ 5,000.00
Restoration	LS	1	$ 8,000.00	$ 8,000.00
Storm Pipe Removal	LF	155	$ 10.00	$ 1,550.00
Diversion Structure	EACH	2	$ 6,000.00	$ 12,000.00
18" Storm Pipe	LF	68	$ 75.00	$ 5,100.00
Construction Subtotal				$ 123,415.00
20% Contingency				$ 24,700.00
Engineering Costs (20%)				$ 30,700.00
Estimated Project Total				**$183,915.00**

Table AB.7: Valley Park Wetland Enhancement and Weir Cost Estimate

Item	Unit	Quantity	Unit Cost	Total Cost
Mobilization	LS	1	$ 14,600.00	$ 14,600.00
Clearing and Grubbing	ACRE	1	$ 4,000.00	$ 4,000.00
Clearing and Grubbing	EACH	20	$ 500.00	$ 10,000.00
Common Excavation	CY	3150	$ 25.00	$ 78,750.00
Class III Riprap	CY	15	$ 125.00	$ 1,875.00
Erosion Control	LS	1	$ 8,000.00	$ 8,000.00
Dewatering	LS	1	$ 5,000.00	$ 5,000.00
Restoration	LS	1	$ 8,000.00	$ 8,000.00
Weir	EACH	1	$ 30,000.00	$ 30,000.00
Construction Subtotal				$ 160,225.00
20% Contingency				$ 32,100.00
Engineering Costs (20%)				$ 38,500.00
Estimated Project Total				**$ 230,825.00**

Table AB.8: Valley Park South Stabilization Basin Cost Estimate

Item	Unit	Quantity	Unit Cost	Total Cost
Mobilization	LS	1	$ 8,900.00	$ 8,900.00
Clearing and Grubbing	ACRE	0.5	$ 4,000.00	$ 2,000.00
Common Excavation	CY	720	$ 25.00	$ 18,000.00
Erosion Control	LS	1	$ 8,000.00	$ 8,000.00
Vegetation Management Year 1	LS	1	$ 6,000.00	$ 6,000.00
Vegetation Management Year 2	LS	1	$ 6,000.00	$ 6,000.00
Live Stakes	EA	3000	$ 8.00	$ 24,000.00
Grading (Fill old channel)	CY	460	$ 20.00	$ 9,200.00
Restoration	LS	1	$ 15,000.00	$ 15,000.00
Construction Subtotal				$ 97,100.00
20% Contingency				$ 19,500.00
Engineering Costs (20%)				$ 23,400.00
Estimated Project Total				**$ 140,000.00**

Table AB.9 Friendly Marsh Park Wetland Enhancement Cost Estimate

Item	Unit	Quantity	Unit Cost	Total Cost
Mobilization	LS	1	$ 11,400.00	$ 11,400.00
Clearing and Grubbing	ACRE	1.1	$ 4,000.00	$ 4,400.00
Common Excavation	CY	2254	$ 25.00	$ 56,350.00
Class III Riprap	CY	15	$ 125.00	$ 1,875.00
Erosion Control	LS	1	$ 8,000.00	$ 8,000.00
Dewatering	LS	1	$ 5,000.00	$ 5,000.00
Restoration	LS	1	$ 8,000.00	$ 8,000.00
Weir	EACH	1	$ 30,000.00	$ 30,000.00
Construction Subtotal				$ 125,025.00
20% Contingency				$ 25,100.00
Engineering Costs (20%)				$ 30,100.00
Estimated Project Total				**$ 180,225.00**

Table AB.10 Lower Wentworth Creek Stabilization Cost Estimate

Item	Unit	Quantity	Unit Cost	Total Cost
Mobilization	LS	1	$ 1,000.00	$ 1,000.00
Clearing and Grubbing	ACRE	0.1	$ 4,000.00	$ 400.00
Common Excavation	CY	5	$ 25.00	$ 125.00
Class III Riprap	CY	6	$ 125.00	$ 750.00
Granular Filter	CY	2	$ 100.00	$ 200.00
Erosion Control	LS	1	$ 8,000.00	$ 8,000.00
Construction Subtotal				$ 10,475.00
20% Contingency				$ 2,100.00
Engineering Costs (20%)				$ 2,600.00
Estimated Project Total				$ **15,175.00**

Table AB.11 Middle Wentworth Creek Stabilization Cost Estimate

Item	Unit	Quantity	Unit Cost	Total Cost
Mobilization	LS	1	$ 3,700.00	$ 3,700.00
Clearing and Grubbing	ACRE	0.3	$ 4,000.00	$ 1,200.00
Common Excavation	CY	20	$ 25.00	$ 500.00
Class III Riprap	CY	30	$ 125.00	$ 3,750.00
Granular Filter	CY	10	$ 100.00	$ 1,000.00
Erosion Control	LS	1	$ 8,000.00	$ 8,000.00
Vegetation Management Year 1	LS	1	$ 6,000.00	$ 6,000.00
Vegetation Management Year 2	LS	1	$ 6,000.00	$ 6,000.00
Bioengineered Slope Protection	LF	150	$ 50.00	$ 7,500.00
Live Stakes	EACH	300	$ 8.00	$ 2,400.00
Construction Subtotal				$ 40,050.00
20% Contingency				$ 8,100.00
Engineering Costs (20%)				$ 9,700.00
Estimated Project Total				**$ 57,850.00**

Table AB.12 Wentworth Park Pond Expansion Cost Estimate

Item	Unit	Quantity	Unit Cost	Total Cost
Mobilization	LS	1	$ 10,400.00	$ 10,400.00
Clearing and Grubbing	ACRE	0.6	$ 4,000.00	$ 2,400.00
Common Excavation	CY	3160	$ 25.00	$ 79,000.00
Class III Riprap	CY	9	$ 125.00	$ 1,125.00
Erosion Control	LS	1	$ 8,000.00	$ 8,000.00
Dewatering	LS	1	$ 5,000.00	$ 5,000.00
Restoration	LS	1	$ 8,000.00	$ 8,000.00
Construction Subtotal				$ 113,925.00
20% Contingency				$ 22,800.00
Engineering Costs (20%)				$ 27,400.00
Estimated Project Total				**$ 164,125.00**

Table AB.13 Valley Park Playground Stabilization Cost Estimate

Item	Unit	Quantity	Unit Cost	Total Cost
Mobilization	LS	1	$ 3,000.00	$ 3,000.00
Clearing and Grubbing	ACRE	0.9	$ 4,000.00	$ 3,600.00
Common Excavation	CY	10	$ 25.00	$ 250.00
Class III Riprap	CY	6	$ 125.00	$ 750.00
Granular Filter	CY	2	$ 100.00	$ 200.00
Erosion Control	LS	1	$ 8,000.00	$ 8,000.00
Vegetation Management Year 1	LS	1	$ 6,000.00	$ 6,000.00
Vegetation Management Year 2	LS	1	$ 6,000.00	$ 6,000.00
Live Stakes	EACH	600	$ 8.00	$ 4,800.00
Construction Subtotal				$ 32,600.00
20% Contingency				$ 6,600.00
Engineering Costs (20%)				$ 7,900.00
Estimated Project Total				**$ 47,100.00**

Table AB.14 Lower Marie Creek Stabilization Cost Estimate

Item	Unit	Quantity	Unit Cost	Total Cost
Mobilization	LS	1	$ 2,500.00	$ 2,500.00
Clearing and Grubbing	ACRE	0.3	$ 4,000.00	$ 1,200.00
Common Excavation	CY	20	$ 25.00	$ 500.00
Erosion Control	LS	1	$ 8,000.00	$ 8,000.00
Vegetation Management Year 1	LS	1	$ 6,000.00	$ 6,000.00
Vegetation Management Year 2	LS	1	$ 6,000.00	$ 6,000.00
Live Stakes	EACH	300	$ 8.00	$ 2,400.00
Construction Subtotal				$ 26,600.00
20% Contingency				$ 5,400.00
Engineering Costs (20%)				$ 6,400.00
Estimated Project Total				**$ 38,400.00**

Table AB.15 Middle Marie Creek Stabilization Cost Estimate

Item	Unit	Quantity	Unit Cost	Total Cost
Mobilization	LS	1	$ 3,300.00	$ 3,300.00
Clearing and Grubbing	ACRE	0.7	$ 4,000.00	$ 2,800.00
Common Excavation	CY	30	$ 25.00	$ 750.00
Class III Riprap	CY	6	$ 125.00	$ 750.00
Granular Filter	CY	2	$ 100.00	$ 200.00
Erosion Control	LS	1	$ 8,000.00	$ 8,000.00
Vegetation Management Year 1	LS	1	$ 6,000.00	$ 6,000.00
Vegetation Management Year 2	LS	1	$ 6,000.00	$ 6,000.00
Live Stakes	EACH	1000	$ 8.00	$ 8,000.00
Construction Subtotal				$ 35,800.00
20% Contingency				$ 7,200.00
Engineering Costs (20%)				$ 8,600.00
Estimated Project Total				**$ 51,600.00**

Table AB.16 Lower Marie Creek Wetland Enhancement Cost Estimate

Item	Unit	Quantity	Unit Cost	Total Cost
Mobilization	LS	1	$ 9,300.00	$ 9,300.00
Clearing and Grubbing	ACRE	0.25	$ 4,000.00	$ 1,000.00
Clearing and Grubbing	EACH	8	$ 500.00	$ 4,000.00
Common Excavation	CY	1960	$ 25.00	$ 49,000.00
Class III Riprap	CY	60	$ 125.00	$ 7,500.00
Erosion Control	LS	1	$ 8,000.00	$ 8,000.00
Dewatering	LS	1	$ 5,000.00	$ 5,000.00
Grading	LS	1	$ 10,000.00	$ 10,000.00
Restoration	LS	1	$ 8,000.00	$ 8,000.00
Construction Subtotal				$ 101,800.00
20% Contingency				$ 20,400.00
Engineering Costs (20%)				$ 24,500.00
Estimated Project Total				**$ 146,700.00**

Appendix C

Pollutant Load Reduction Estimates

Table AC.1: Stabilization - Total Loading Rates

Name	Field Estimated Length (FT)	Bank Height Range (FT)	Total Lateral Erosion Load (tons/yr)	Total Vertical Erosion Load (tons/yr)	Total Erosion Load (tons/yr)	Total P Load, lbs/yr
Lilydale Trailhead Parking Lot	50	6	0	0.6	0.6	0.6
Park Place	150	6	1.7	2.2	3.8	3.3
Valley Park RTR to Wentworth	400	6 to 11	153.6	5.1	158.8	135
Valley Park Wetland	425	5 to 10	69.8	5.1	74.9	63.7
Valley Park South	300	3 to 4	0	2.5	2.5	2.2
Lower Wentworth Creek	150	6	0	1.3	1.3	1.1
Middle Wentworth Creek	575	4 to 6	0	4.9	4.9	4.1
Valley Park Playground	685	3.5 to 5	40.3	8	48.3	41.1
Lower Marie Creek	360	3 to 7	0	2.6	2.6	2.2
Middle Marie Creek	235	4 to 5	0	1.7	1.7	1.5

Appendix D

HydroCAD Model

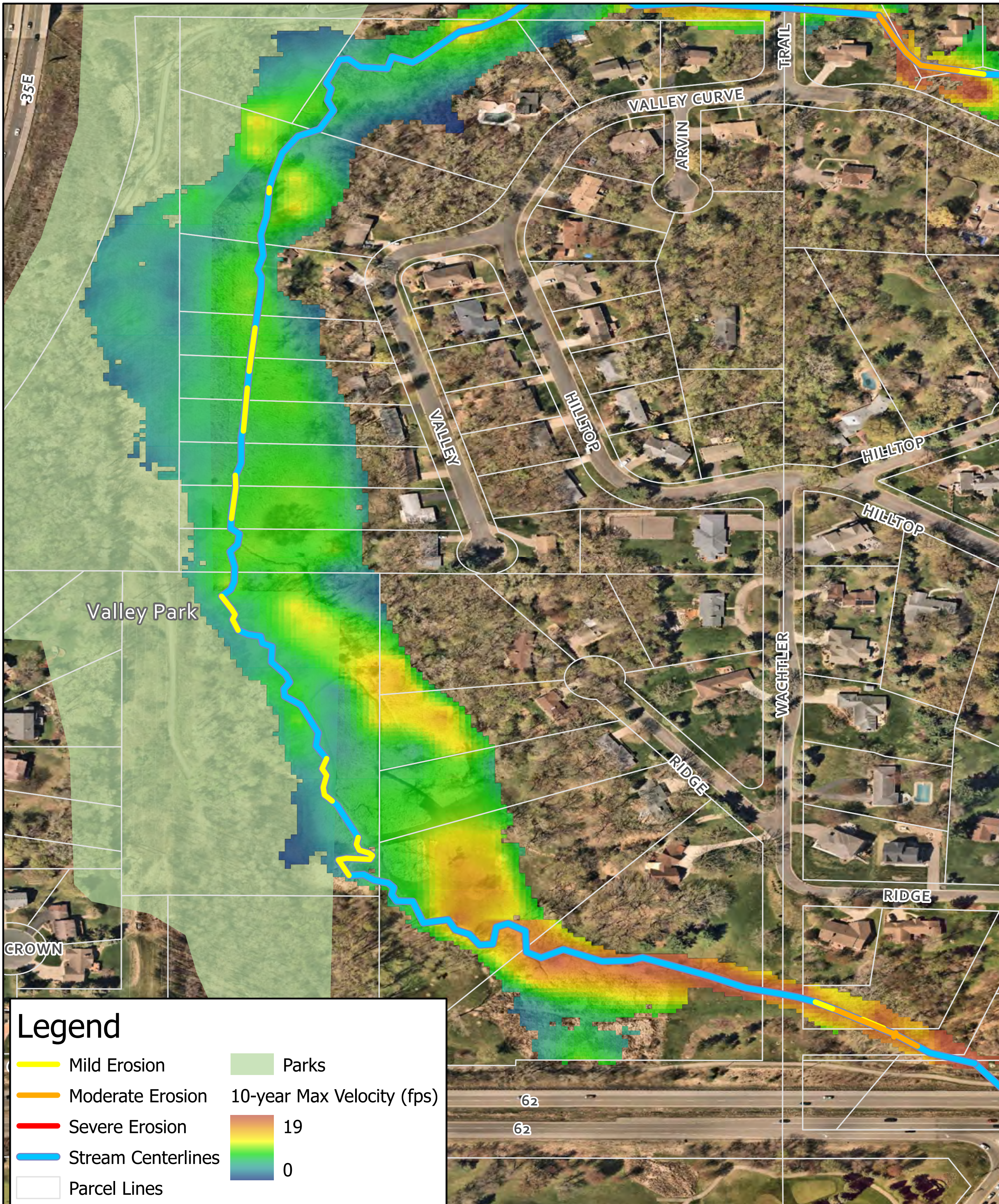
The existing and proposed conditions HydroCAD models used in the analysis in this report are available for use in preliminary and final design of the recommended BMPs. The relevant nodes are listed in **Table AD.1** below.

Table AD.1: HydroCAD Model Nodes

Concept Design or Discharge Point (Section No./ Figure No.)	Existing Conditions	Proposed Conditions
Park Place Filtration Basin (A.4.3/A.3)	Subcatchment 167S: IV-124	Pond 126P: Pond IV-124
Valley Park Wetland Infiltration Basin (B.4.3/B.3)	Subcatchment 163S: IV-127.2	Pond 164P: Pond IV-127.2
Valley Park Wetland Enhancement and Weir (B.4.4/B.4)	Link 170L: Creek IV-127.1	Pond 141P: Creek & Wetland IV-127.1
Valley Park South (C.4.1/C.1)	Subcatchment 138S: IV79, 110	Subcatchment 138S: IV79, 110
Friendly Marsh Park Wetland Enhancement (D.4.1/D.1)	Subcatchment 171S: IV-67.0a	Pond 172P: Pond IV-67.0a
Wentworth Park Pond Expansion (E.4.3/E.3)	Pond 161P: Pond IV-118	Pond 161P: Pond IV-118
Lower Marie Creek Wetland Enhancement (F.4.4/F.4)	Pond 143P: Pond IV104	Pond 134P: IV105
IVC at TH 62	Pond 131P: Pond IV68	Pond 131P: Pond IV68
Marie Creek	Pond 148P: Pond IV109	Pond 148P: Pond IV109
IVC downstream of confluence with Marie Creek	Link 174L	Link 174L
Wentworth Creek	Link 175L	Link 175L
IVC downstream of confluence with Wentworth Creek	Link 176L	Link 176L
IVC at confluence with Mississippi River	Reach 165R: IV Creek 139	Reach 165R: IV Creek 139

Appendix E

2D Modeling



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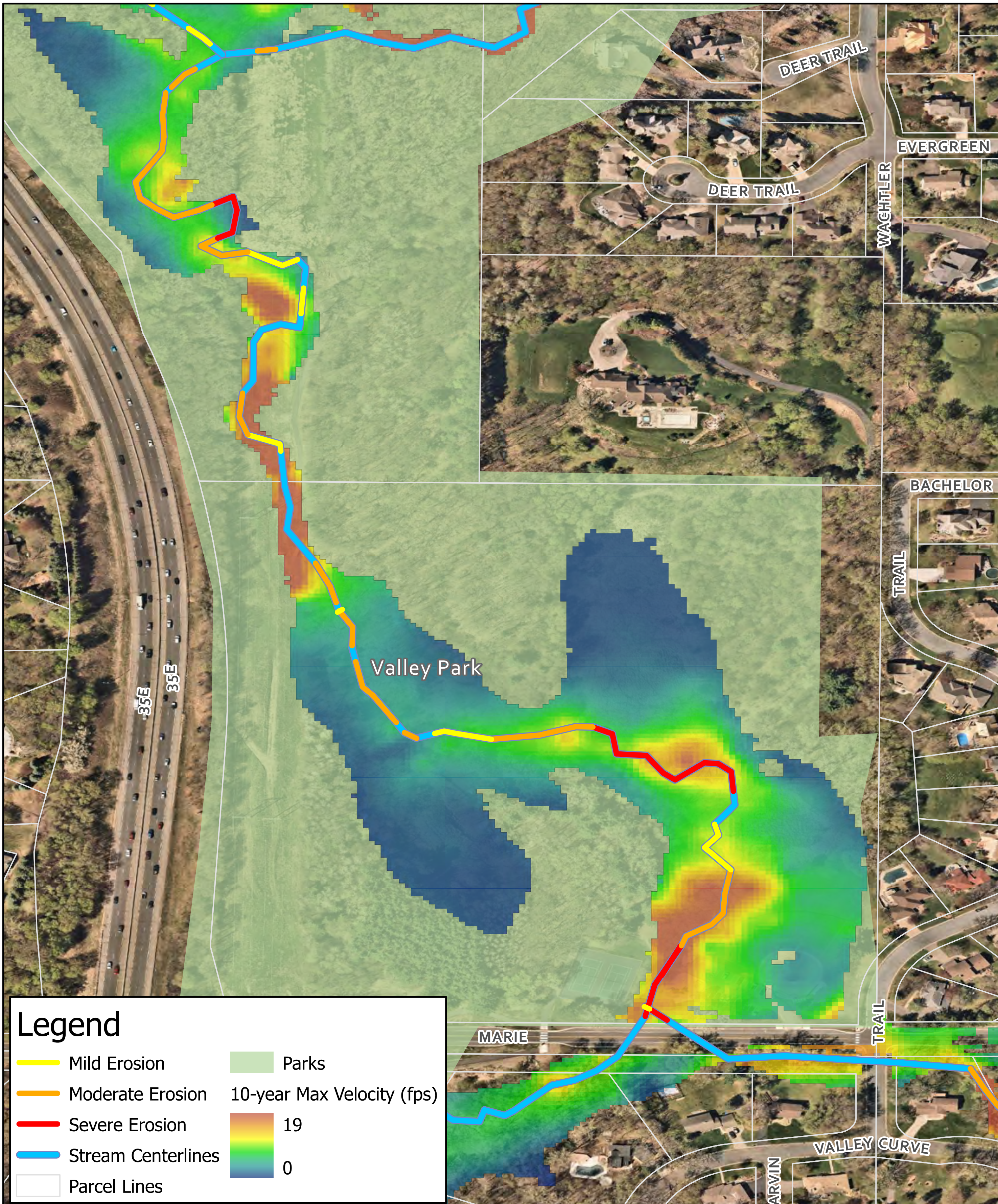
LMRWMO LOWER MISSISSIPPI RIVER WATERSHED MANAGEMENT ORGANIZATION

Figure AE.1, 10 Year Max Velocities, IVC South

Interstate Valley Creek Study
Lower Mississippi River Watershed Management Organization

N
0 300 Feet
1 inch = 300 feet

wsb



LMRWMO
LOWER MISSISSIPPI RIVER WATERSHED MANAGEMENT ORGANIZATION

Figure AE.2, 10 Year Max Velocities, IVC Central

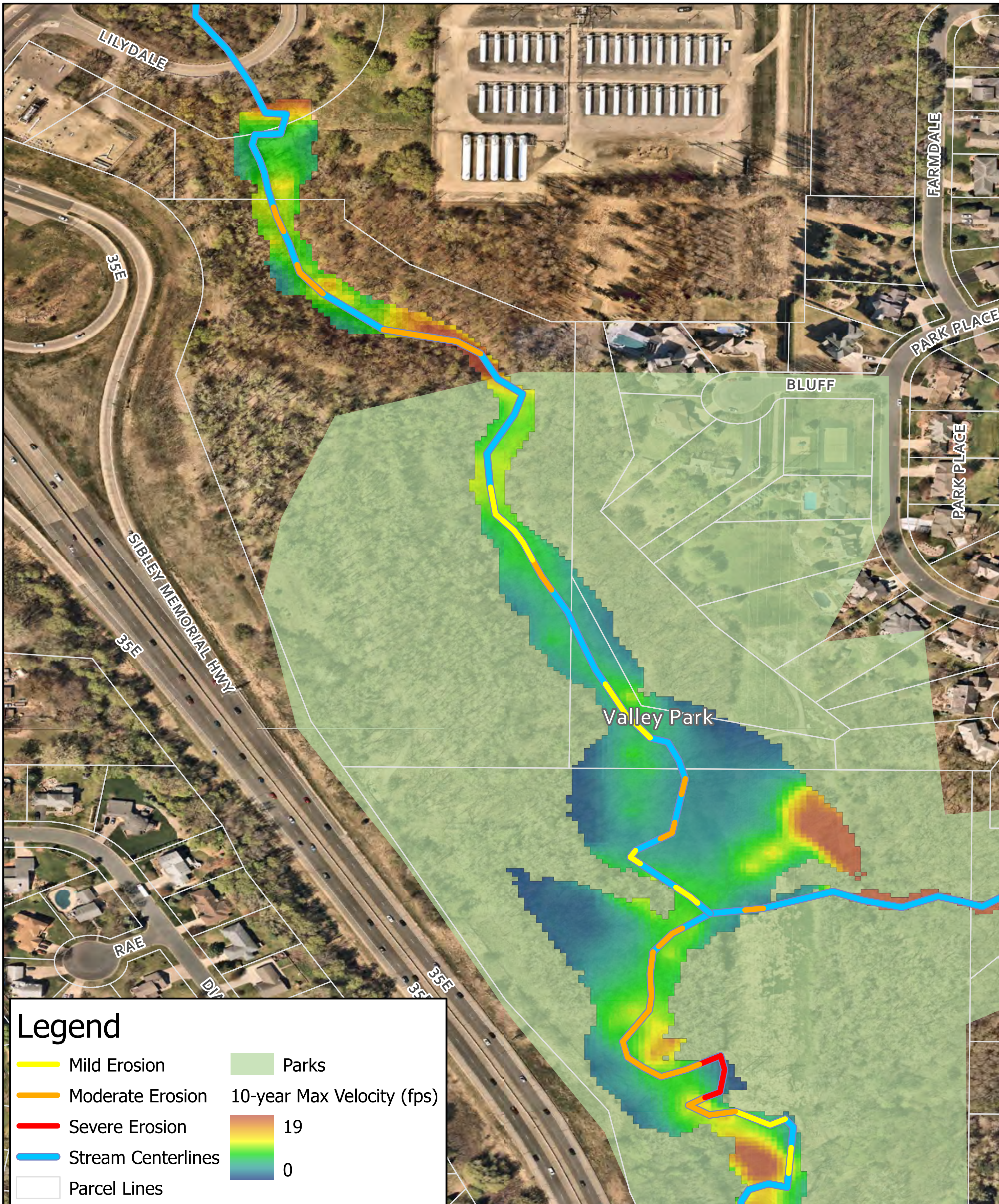
Interstate Valley Creek Study
Lower Mississippi River Watershed Management Organization

N

0 300 Feet

1 inch = 300 feet

wsb



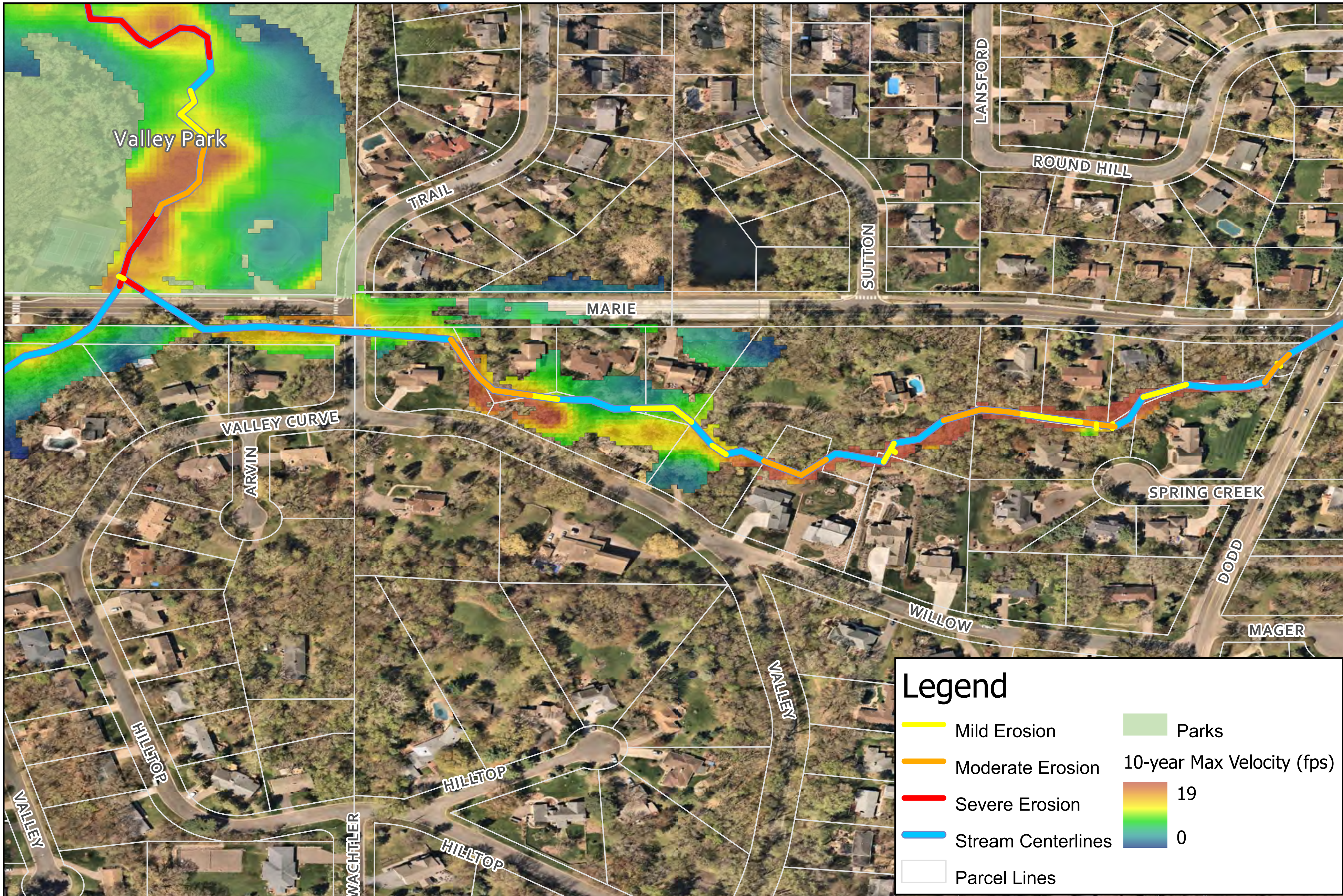
LMRWMO
LOWER MISSISSIPPI RIVER

Figure AE.3, 10 Year Max Velocities, IVC North

Interstate Valley Creek Study
Lower Mississippi River Watershed Management Organization

N
0 300 Feet
1 inch = 300 feet

wsb



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LMRWMO LOWER MISSISSIPPI RIVER WATERSHED MANAGEMENT ORGANIZATION

Figure AE.4, 10 Year Max Velocities, Lower Marie Creek

Interstate Valley Creek Study

Lower Mississippi River Watershed Management Organization

wsb

Figure AE.5, 10 Year Max Velocities, Lower and Middle Wentworth Creek

Interstate Valley Creek Study

Lower Mississippi River Watershed Management Organization

N

0 300 Feet

1 inch = 300 feet