# STORMWATER DRAINAGE PRIORITIZATION AND MANAGEMENT PRELIMINARY DESIGN

**For:**

## CITY OF FARMINGTON, MINNESOTA

**January 2023**

**Prepared by:**

# CERTIFICATION

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

Jacob Newhall, P.E. Reg. No. 49170

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# 1.0 Executive Summary

This subwatershed assessment analyzes the existing conditions of the City of Farmington portion of the drainage area to the main stem of the Vermillion River and outlines stormwater Best Management Practice (BMP) considerations and recommendations to reduce phosphorus loading to the river. Much of the core of Farmington was constructed prior to most stormwater regulations and drains to this reach of the Vermillion River with little to no treatment.

The Vermillion River flows through the southeast corner of the City of Farmington, near the city limit boundary with Empire Township in Dakota County. The Vermillion River Watershed encompasses approximately 364 square miles, with approximately 0.7 square miles (452 acres) draining to the river from the City of Farmington. Potential BMP options and specific locations were identified by the City and WSB as part of this study and were based on BMPs already in place, areas with large tributary areas to Vermillion River, and areas with green space available. Proposed BMP sizes and locations were evaluated using P8 to determine water quality improvement potential. The BMPs were then prioritized based on water quality benefit, construction and operation/maintenance costs, and constructability. The BMPs performing the best in those areas were ranked (**Table 2a and Table 2b**) and investigated further in this order.

In addition to potential BMPs, WSB evaluated previous studies to identify and evaluate previous work that had been done to improve stormwater management tributary to the Vermillion River.

# 2.0 Background

## 2.1 Purpose

The Vermillion River plays an important role supporting the life of aquatic creatures plus providing the City of Farmington with a broad range of recreational activities. The Minnesota Pollution Control Agency (MPCA) has identified portions of the Vermillion River as impaired water for aquatic life and recreation due primarily to turbidity, total suspended solids (TSS), low dissolved oxygen, and fecal coliform.

The Vermillion River Watershed Joint Powers Organization (VRWJPO) was awarded FY 2021-2022 Watershed Based Initiative Funding (WBIF) from the Minnesota Board of Water and Soil Resources (BWSR) to fund a study aimed at identifying potential stormwater treatment projects that would reduce pollutant loads, primarily Suspended Solids and Phosphorus, to the impaired portions of the Vermillion River.

The VRWJPO has designated this study as a top priority therefore, the City of Farmington has requested WSB's services to model Farmington's existing subwatersheds, identify feasible treatment options, and a conceptual and preliminary design of best management practices.

## 2.2 Study Area

The Vermillion River watershed covers about 364 square miles of land extending from eastern Scott County and through parts of Scott, Dakota and Goodhue Counties. Approximately 0.7 square miles (452 acres) of the drainage area is located within the boundaries of City of Farmington (**Figure 1**). The Vermillion River itself is a 59.6-mile waterway of which 13.5-miles have been designated as a "trout stream". The study area is highly developed, consisting mostly of industrial and residential land uses as well as park space. A section of Minnesota State Highway 3 bisects this city drainage area to Vermillion River from south to north. Across the study area there are also six stormwater ponds, as can be seen in **Figure 2**, which relative to the overall drainage area, appears insufficient to provide significant water quality treatment.

## 2.3 Modeling Methodology

The study area was divided into 24 subwatersheds using primarily LiDAR elevation data. The delineation also factored in existing BMPs, waterbodies, and storm sewer data provided by the City of Farmington and Dakota County. The portion of Farmington draining to Vermillion River was studied in detail to determine priority areas for water quality improvements and new BMPs implementation.

The primary tool used to assess the pollutant loadings was P8 (Program for Predicting Polluting Particle Passage through Pits, Puddles, and Ponds) Water Quality Modeling, a software that is commonly used for water quality analysis in Minnesota and is part of the modeling tools recommended by the Minnesota Pollution Control Agency (MPCA). The P8 model provides a simple runoff routing routine and, based on a set of assumptions with respect to pollutant concentration, particle settling, and infiltration, it provides a mass balance summary that includes the total and annual pollutant loadings and removal fraction. The input information consists of a) Precipitation and temperature data (over 25 years of hourly records for the Twin Cities Metro Area based on records from the MSP airport) b) Drainage area attributes such Curve Number determined based on as the Hydrologic Soil Type and Impervious Fraction, c) Geometry of the storm water treatment devices such as pond bathymetry, storage (bounce) volume, and outlet size, d) Particle sizes data (based on standard NURP particle data), and e) Soil infiltration rates.

Additionally to P8, HydroCAD and the direct estimate method was used to determine the drainage area pollutant loadings. Preliminary diversion structures were estimated using HydroCAD. Structures were selected based on Stormfilter capacity and by looking at the existing storm sewer structures. Following the Soil Conservation Service (SCS) methodology, precipitation excess was calculated as a function of cumulative precipitation, soil cover, and land use. This number was later used with the average pollutant influent concentration to estimate the Stormfilter filtration capacity and therefore, existing pollutant rates.

The model output targeted for this study consisted of Total Suspended Solids (TSS) and Total Phosphorous (TP), the main pollutants of concern for this study.

This subwatershed data was used to create an “existing conditions” model that serves as a benchmark for estimating the pollutant loadings absent any stormwater treatment. Subsequently, the proposed and improved BMPs were incorporated into the model to create a proposed conditions model. The existing conditions were compared to potential improvement options by summarizing the pollutant loadings for each scenario and assessing the pollutant reduction.

The main goal of the analysis was to identify potential locations for stormwater BMPs that would a) provide a relatively high level of water quality treatment by removing a significant fraction of the pollutant load, b) can be implemented at a reasonable cost, and c) involve a maintenance plan that is long term sustainable in terms of effort and cost.

Based on these considerations, a total of four locations were identified to merit further analysis. A total of four BMPs were then investigated in detail. To determine the most effective solutions, the potential options were prioritized based on removal efficiency and overall cost.

## 3.0 Existing Conditions

Stormwater runoff from portions of the 452-acre area is currently routed through the existing storm sewer network and short open water channels before entering the Vermillion River (**Figure 1**). A P8 model, reflecting the existing conditions, was developed using the hydrologic data discussed above. Seven different storm sewer outfalls draining to the Vermillion River were identified within the drainage area (**Figure 2).** Results per storm sewer outfall and total results of this model are shown below (**Table 1**).

**Table 1: Farmington Vermillion River Drainage Area – TSS & TP Loading per Storm Sewer Outfall**

| Outfall | Total TSS (lbs/year) | Total TP (lbs/year) |
|---|---|---|
| A | 10,712 | 41.4 |
| B | 2,170 | 7 |
| C | 58,527 | 186.5 |
| D | 12,791 | 40.9 |
| E | 694 | 3.2 |
| F | 19,771 | 65.9 |
| G | 1,774 | 5.7 |
| **Total Inflow (lbs/year)** | **106,439** | **350.6** |

The existing stormwater system draining to the Vermillion River generates 106,439 lbs/year of TSS and 350.6 lbs/year of TP.

### 3.1 Land Use and Soil Type

The Farmington portion of the Vermillion River drainage area is highly urbanized, including numerous residential neighborhoods, industrial and commercial areas, and major roadways. Calculated impervious percentage by drainage area ranges from 26-96%. High impervious fractions allow stormwater to runoff without infiltration, allowing for increased pollutant transport and deposition.

The hydrologic soil group classifications based on Natural Resources Conservation Service (NRCS) Web Soil Survey data for the area is predominantly groups B and C with an assumed curve number of 76 and an infiltration rate of 0.3 in/hr.

### 3.2 Subwatershed Summary

The subwatershed currently contains existing BMPs treating stormwater runoff which are identified on **Figure 2**. Some of these BMPs are small in size relative to the drainage area, providing little pollutant removal. Examining the existing conditions results, it appears that the subwatersheds with the highest annual pollutant loads are those that do not currently have BMPs in place and/or those with large amounts of impervious area. The amount of TP entering Vermillion River from Farmington is estimated at 350.6 lbs/year, most of which originates from untreated drainage areas nearest to the river (**Figure 2**). The absence of runoff treatment before discharging into Vermillion River is contributing to water quality decline. Thus, implementing stormwater treatment BMPs would reduce the pollutant load and improve the water quality of Vermillion River.

## 3.3 Existing Studies/Plans

A TMDL study was developed in 2015 and updated in 2017. The TMDL report addresses turbidity and bacteria impairments on several main stem and tributary reaches of the Vermillion River Watershed. This report can be found in the Minnesota Pollution Control Agency (MPCA) website (https://www.pca.state.mn.us/sites/default/files/wq-iw9-16e.pdf).

# 4.0 Stormwater Improvement Options

Stormwater improvement options were identified based on the existing conditions model described in Section 3. Results showed that subwatersheds with the highest annual loadings were those without BMPs in place and/or those with the largest amounts of impervious area. Consequently, new proposed BMP locations were identified as shown on **Figure 3**. Besides targeting the highest loading areas, WSB also focused on public-owned parcels and locations with enough open space for BMP construction. These four locations were modeled to determine water quality benefits. A total of seven BMPs (in four different locations) were further conceptualized and evaluated. Each option was then evaluated based on water quality benefit, construction and management costs, and constructability and compared to other options (**Table 2a and Table 2b**).

Though these locations were strategically chosen, it is important to note that further potential design challenges and additional cost considerations may occur and need to be fully evaluated prior to their implementation. Proposed BMP performance would vary depending on environmental factors and proper maintenance.

## 4.1 BMP Options

### 1. BMP Location: Willow and 4th Street

Proposed solution: This BMP option presents a treatment train (train) system located at the green space northwest of the intersection of 4th Street and Willow Street. The contributing subwatershed is approximately 161 acres of primarily developed area that currently drains directly to Outfall C (**Figure 4a and Figure 4b)**. The train system consists of a treatment structure (Environment 21) acting as pretreatment system that would allow for the capture and treatment of approximately 39,000 lbs of TSS annually. It would then be followed by an 8 ft x 14 ft STORMFILTER with 24 cartridges and approximate filtration rate of 1 cfs that removes 60-75% of the TP from the filtered flow. TP removal is estimated to range from 29 to 36 lbs per year. Though the use of Stormfilters would maximize TP removals, a less maintenance intensive structure is also analyzed in this report.

### 2. BMP Location: Elm Street & Division

Proposed solution: This BMP option presents a train system that captures and treats stormwater from about 82.7 acres that currently drain directly to Outfall F (**Figure 5a and Figure 5b**). The train system consists of a treatment structure (Environment 21) acting as pretreatment system that would allow for the capture of approximately 15,000 lbs of TSS. It would then be followed by an 8 ft x 14 ft STORMFILTER with 24 cartridges and approximate filtration rate of 1 cfs that removes 60-75% of the TP from the filtered flow. TP removal is estimated to range from 14 to 18 lbs per year. This BMP would be located at the open space adjacent to the Elm Street and Division Street intersection. Though the use of Stormfilters would maximize TP removals, a less maintenance intensive structure is also analyzed in this report.

### 3. BMP Location: Walnut & 4th Street

Proposed solution: an Underground Vault or Pipe Gallery at the southwest corner of existing parking lot at the intersection of 4th and Walnut Street. The contributing subwatershed is approximately 47.2 acres and drains to Outfall C (**Figure 6a and Figure 6b)**. This BMP option would remove approximately 11,198 lbs of TSS and 18.5 lbs of TP per year. Since this BMP involves underground construction, it has relatively higher potential construction costs but would allow this land to still be utilized in some capacity in the future.

### 4. BMP Location: Linden and 5th Street

Proposed solution: a Biofiltration Basin adjacent to the storm sewer Outfall B, upstream of the Vermillion River. The BMP would also treat a portion of the tributary draining to Outfall A (**Figure 7a and Figure 7b)**. This basin would treat and capture stormwater from 20.9 acres of mainly highly developed land. Results from P8 show the estimated annual removal is 7,367 lbs of TSS and 17 lbs of TP. An underground structure could be considered at this location too, but this report looked at the lower cost surface BMP because of the area available at the surface.

## Project Ranking

Seven potential BMP options (at four different locations) were given scores for their ability to treat stormwater, the capital and maintenance costs, and their constructability. **Table 2a** below shows a summary of all proposed BMP options, while **Table 2b** shows the weighted scores based on project needs. Higher scores indicate a better cost-benefit analysis. The first column reflects the initial pollutant reduction scores, the following three columns deduct points depending on the overall and maintenance costs, and potential constructability challenges. Last column shows the final obtained score, allowing comparisons between locations and BMP options.

**Table 2a: Stormwater Improvements Summary**

| Best Management Practice Decision Matrix for TSS/TP Reduction | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Best Management Practice** | **Total Area (ac)** | **Impervious Area (ac)** | **TSS Reduction at Outfall to Vermillion River (lbs/yr/acre)** | **TP Reduction at Outfall to Vermillion River (lbs/yr/acre)** | **TP Reduction at Outfall to Vermillion River (lbs/yr)** | **Maintenance** | **Cost** | **Notes:** |
| Elm and Division St. | | | | | | | | |
| Train system consisting of a stormwater diversion structure followed by 8' x 11' stormfilters | 82.2 | 39.7 (48%) | 178 | 0.16-0.2 | 13-17 | $25,000 | $250,000 | Intensive/expensive long term maintenance |
| Train system consisting of a stormwater diversion structure followed by 8' x 14' stormfilters | | | 178 | 0.18-0.22 | 14-18 | | $275,000 | |
| 4th and Willow St. | | | | | | | | |
| Train system consisting of a stormwater diversion structure followed by 8' x 11' stormfilters | 161 | 108.6 (67%) | 243 | 0.17-0.21 | 27-34 | $25,000 | $260,000 | Intensive/expensive long term maintenance |
| Train system consisting of a stormwater diversion structure followed by 8' x 14' stormfilters | | | 243 | 0.18-0.22 | 29-36 | | $285,000 | |
| 4th and Walnut St. | | | | | | | | |
| Underground Vault | 47.2 | 30 (64%) | 237.2 | 0.4 | 18.5 | $5,000 | $650,000 | Challenges with underground construction |
| Underground Pipe Gallery | | | 255.8 | 0.5 | 20.6 | | $570,000 | |
| 5th and Linden St. | | | | | | | | |
| Biofiltration Basin | 20.9 | 15.2 (73%) | 352.5 | 0.8 | 16.9 | $5,000 | $390,000 | Agreement with private party for biofiltration basin |

**Table 2b: Stormwater Improvements Decision Matrix**

| Best Management Practice | Removal Score | Construction Cost Score | Maintenance Score | Construction Challenges | Total Score |
|---|---|---|---|---|---|
| Elm and Division St. | | | | | |
| Train system consisting of a stormwater diversion structure followed by 8' x 11' stormfilters | 6 | 0 | -2 | -1 | 3 |
| Train system consisting of a stormwater diversion structure followed by 8' x 14' stormfilters | 7 | 0 | -2 | -1 | 4 |
| 4th and Willow St. | | | | | |
| Train system consisting of a stormwater diversion structure followed by 8' x 11' stormfilters | 9 | 0 | -2 | -1 | **6** |
| Train system consisting of a stormwater diversion structure followed by 8' x 14' stormfilters | 10 | 0 | -2 | -1 | **7** |
| 4th and Walnut St. | | | | | |
| Underground Storage Vault | 7 | -1 | 0 | -2 | 4 |
| Underground Pipe Gallery | 7 | -1 | 0 | -2 | **4** |
| 5th and Linden St. | | | | | |
| Biofiltration Basin | 8 | 0 | 0 | -1 | **7** |

## 4.2 Project Summaries

Based on the analysis, all BMPs were identified as potential feasible solutions to improve water quality and achieve better volume control. Descriptions, maps, pollutant removal tables, and costs for each option are shown in sections 4.2.1 through 4.2.7 below. For detailed cost breakdowns please refer to **Appendix A**.

### 4.2.1 BMP 1.1 – Install Pretreatment Structure (Environment 21) at 4th and Willow St.

This option consists of installing a Hydrodynamic Separator and a 96-inch diversion structure on the existing storm sewer with an 18-inch pipe routed to the BMP. The BMP would provide treatment to 161 acres of untreated tributary area upstream of Vermillion River (**Figure 4a and Figure 4b**). Green space is available for the proposed BMP and the area is owned by the City of Farmington. The results from SHSAM are outlined in **Table 3** below. Due to topography and site constraints, vegetated stormwater treatment is not feasible.

**Table 3: BMP 1.1 Improvements**

19.5 Tons/Yr

| Pollutant | Pollutants Removed by BMP (lbs/year) |
|---|---|
| TSS | 39,122 |

*TP removal for this option is estimated to remove be approximately 8-12 lbs/yr.

BMP 1.1 would remove 39,122 lbs of TSS from entering Vermillion River each year. The proposed improvements are estimated to cost approximately **$120,000** with an annual cost of **$5,000** to complete operations and maintenance.

Additional Considerations for this option:

- Diversion structure and pipe dimensions could change during final design.
- Consider potential issues with park trail and features/trees.
- Assumes some dewatering will be needed during construction.

### 4.2.2 BMP 1.2 – Install option 1.1 and Stormfilters at 4th and Willow St.

This option consists of installing Contech Stormfilters in addition to the pretreatment structure (BMP 1.1) at the intersection of 4th St. and Willow St. (**Figure 4b**). Like BMP 1.1, this would provide treatment to 161 acres of untreated area upstream of Vermillion River (**Figure 4a**). Two Stormfilter options were considered for this location. First structure would consist of an 8' x 14' Stormfilter with 24 cartridges. This proposed system has been designed to capture and treat first 0.12 inches of rainfall from the tributary area. The results from Annual Precipitation Runoff Data are outlined in **Table 4** below. Results are based on having a phosphorus removal efficiency ranging from 60 to 75%.

**Table 4: BMP 1.2 Improvements for 8' x 14' structure**

| Pollutant | Pollutants Removed by BMP (lbs/year) |
|---|---|
| TP | 29 to 36 |

Second structure would consist of an 8' x 11' Stormfilter with 18 cartridges. This proposed system has been designed to capture and treat first 0.11 inches of rainfall from the tributary area. The results from Annual Precipitation Runoff Data are outlined in **Table 5** below. Results are based on having a phosphorus removal efficiency ranging from 60 to 75%.

**Table 5: BMP 1.2 Improvements for 8' x 11' structure**

| Pollutant | Pollutants Removed by BMP (lbs/year) |
|---|---|
| TP | 27 to 34 |

Option one would remove approximately from 29 to 36 lbs of TP from entering Vermillion River each year. The proposed improvements are estimated to cost approximately **$285,000 (8' x 14' structure)** with an annual cost of **$20,000** to complete operations and maintenance cost. Option two would remove approximately from 27 to 34 lbs of TP from entering Vermillion River each year. The proposed improvements are estimated to cost approximately **$260,000 (8' x 11' structure)** with an annual cost of **$20,000** to complete operations and maintenance cost.

Additional Considerations for this option:

- Consider potential issues with park trail.
- Require yearly maintenance/replacement.

### 4.2.3 BMP 2.1 – Install Pretreatment Structure (Environment 21) at Elm St. and Division St.

This option consists of installing an underground storm structure west of the intersection of Elm and Division Street. SHSAM was used to evaluate various sizes of structures. The BMP would provide treatment to 82.2 acres of untreated tributary area upstream of Vermillion River (**Figure 5b)**. The 60-inch proposed diversion structure would have an 18-inch pipe (**Figure 5b**). Green space is available for the proposed BMP, however the majority is within Dakota County ROW. The water quality results from SHSAM are outlined in **Table 6** below. This proposed system has been designed to capture and treat first 0.5 inches of rainfall from the tributary area.

**Table 6: BMP 2.1 Improvements**

| Pollutant | Pollutants Removed by BMP (lbs/year) |
|---|---|
| TSS | 14,635 |

*TP removal for this option is estimated to remove be approximately 3-4 lbs/yr.

BMP 2.1 would remove 14,635 lbs of TSS from entering Vermillion River each year. The proposed improvements are estimated to cost approximately **$110**,**000** with an annual cost of **$5,000** to complete operations and maintenance.

Additional Considerations for this option:

- Diversion structure and pipe dimensions could change during final design.
- Trees are highly valued; impacts for structure would have to be balanced with tree benefits.
- Assumes some dewatering will be needed during construction.

### 4.2.4 BMP 2.2 – Install option 2.1 and Peak Diversion Stormfilters at Elm St and Division St.

This option consisted of the installation of Contech's Stormfilters in addition to the pretreatment structure (BMP 2.1) at the intersection of Elm St and Division St. (**Figure 5b**) This BMP location will allow for the treatment of 82.2 acres of previously untreated area draining to Vermillion River (**Figure 5a**). Two Stormfilter options were evaluated. First option consists of an 8' x 14' Stormfilter with 24 cartridges. This proposed system has been designed to capture and treat first 0.18 inches of rainfall from the tributary area. The results from the Annual Precipitation Runoff Data are outlined in **Table 7** below. Results are based on having a phosphorus removal efficiency ranging from 60 to 75%.

**Table 7: BMP 2.2 Improvements for 8' x 14'**

| Pollutant | Pollutants Removed by BMP (lbs/year) |
|---|---|
| TP | 14 to 18 |

Second structure would consist of an 8' x 11' Stormfilter with 18 cartridges. This proposed system has been designed to capture and treat first 0.16 inches of rainfall from the tributary area. The results from Annual Precipitation Runoff Data are outlined in **Table 8** below. Results are based on having a phosphorus removal efficiency ranging from 60 to 75%.

**Table 8: BMP 2.3 Improvements for 8' x 11' structure**

| Pollutant | Pollutants Removed by BMP (lbs/year) |
|---|---|
| TP | 13 to 17 |

Option one would remove approximately from 14.4 to 18 lbs of TP from entering Vermillion River each year. The proposed improvements are estimated to cost approximately **$275,000 (8' x 14' structure)** with an annual cost of **$20,000** to complete operations and maintenance cost. Option two would remove approximately 13 to 16.6 lbs of TP from entering Vermillion River each year. The proposed improvements are estimated to cost approximately **$250,000 (8' x 11' structure)** with an annual cost of **$20,000** to complete

Additional Considerations for this option:

- Trees are highly valued; impacts for structure would have to be balanced with tree benefits.
- Require yearly maintenance/replacement.

### 4.2.5 BMP 3.1 – Construct Underground Storage Vault at 4th St. and Walnut St.

This option consists of the installation of an underground storage vault east of the parking lot located at 4th St. and Walnut St. The proposed BMP would allow for the treatment of 47.2 acres upstream of Vermillion River by acting as an underground pond. (**Figure 6a and Figure 6b**). The proposed option would have an area of approximately 5,800 $ft^2$, 5.67 ft deep (which is the standard size of a StormTrap piece), with a volume of 0.76 ac-ft. The parcel is owned by ISD 192 – Farmington School District which would require coordination. The results from P8 are outlined in **Table 10** below.

**Table 10: BMP 3.1 Improvements**

| Pollutant | Pollutants Removed by BMP (lbs/year) |
|---|---|
| TSS | 11,198 |
| TP | 18.5 |

The proposed vault would remove 11,198 lbs of TSS and 18.5 lbs of TP from entering Vermillion River each year. The proposed improvement is estimated to cost approximately **$650,000** with an annual cost of **$5,000** to complete operations and maintenance.

Additional Considerations for this option:

- Challenges may occur in underground construction and may limit future uses
- Further tests would need to be completed to determine if infiltration is possible.
- Additional TP can be achieved by using active filtration (estimated at 5-10 pounds annually, not included in numbers above).
- Assumes some dewatering will be needed during construction.
- Coordination with ISD 192 – Farmington School District

### 4.2.6 BMP 3.2 – Construct Underground Pipe Gallery at 4th St. and Walnut St.

This option consisted of the installation of an underground pipe structure east of the parking lot located at 4th St. and Walnut St. (**Figure 6b**) The proposed BMP would provide treatment for 47.2 acres of land upstream of Vermillion River (**Figure 6a**). This option would assume an underground gallery with filtration in 0.23 acres, 8 feet deep, having a volume of 0.76 ac-ft, 60-inch diameter pipes and crushed stones with 40% rock voids. The parcel is owned by ISD 192 – Farmington School District which would require coordination. The results from P8 are outlined in **Table 11** below.

**Table 11: BMP 3.2 Improvements**

| Pollutant | Pollutants Removed by BMP (lbs/year) |
|---|---|
| TSS | 12,076 |
| TP | 20.6 |

BMP 3.2 would remove 12,076 lbs of TSS and 20.6 lbs of TP from entering Vermillion River each year. Proposed improvements are estimated to cost approximately **$570,000** with an annual cost of **$5,000** to complete operations and maintenance.

Additional Considerations for this option:

- Challenges may occur in underground construction and may limit future uses
- Further tests would need to be completed to determine if infiltration is possible.
- Additional TP can be achieved by using active filtration (estimated at 5-10 pounds annually, not included in numbers above).
- Assumes some dewatering will be needed during construction.
- Coordination with ISD 192 – Farmington School District

### 4.2.7 BMP 4.1 – Construct Biofiltration Basin at 5th St. and Linden

The proposed option consists of constructing a biofiltration basin west of the intersection at 5th St. and Linden St. (**Figure 7a and Figure 7b**). This option considers the addition of two 60-inch diversion structures on the existing storm sewer with an 18-inch pipe (**Figure 5b**). First proposed structure would divert the flow coming south of 5th street. The second peak diversion structure would be located northeast of the study area on Linden Street. The proposed biofiltration basin would have a flood pool area of 17,000 $ft^2$ and a depth of 2 ft to better treat the existing 20.9 acres of tributary area. Green space is available for the proposed BMP. The results from P8 are outlined in the **Table 12** below.

**Table 12: BMP 4.1 Improvements**

| Pollutant | Pollutants Removed by BMP (lbs/year) |
|---|---|
| TSS | 7,367 |
| TP | 16.9 |

The proposed option would remove 7,367 lbs of TSS and 16.9 lbs of TP from entering Vermillion River each year. The proposed improvements are estimated to cost approximately **$390,000** with an annual cost of **$5,000** to complete operations and maintenance.

Additional Considerations for this option:

- Tree removals and floodplain vegetation impacts.
- Floodplain impacts should be reviewed. Area is subject to inundation during large rain events.
- Adjacent properties are privately owned and in Empire Township and will likely require individual coordination.

## 5.0 Conclusion/Recommendations

There are feasible and economic solutions to improve water quality throughout the Farmington-Vermillion River watershed area. WSB recommends investigating the implementation of multiple stormwater BMPs in multiple drainage areas identified in this subwatershed assessment.

In addition to BMP implementation, further studies should be performed on possible erosion areas tributary to the River or on the Vermillion River itself.

## APPENDIX A

## FIGURES

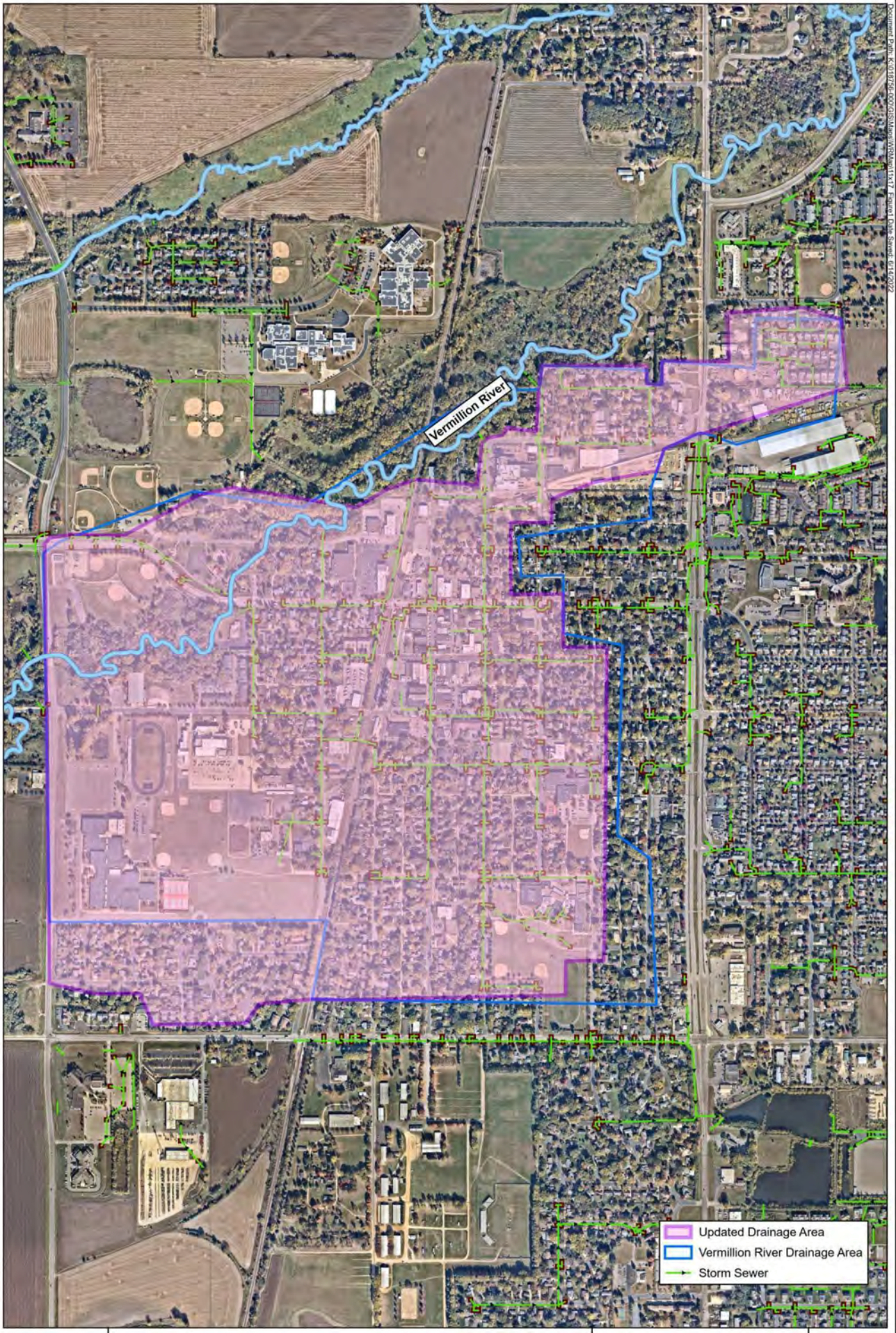


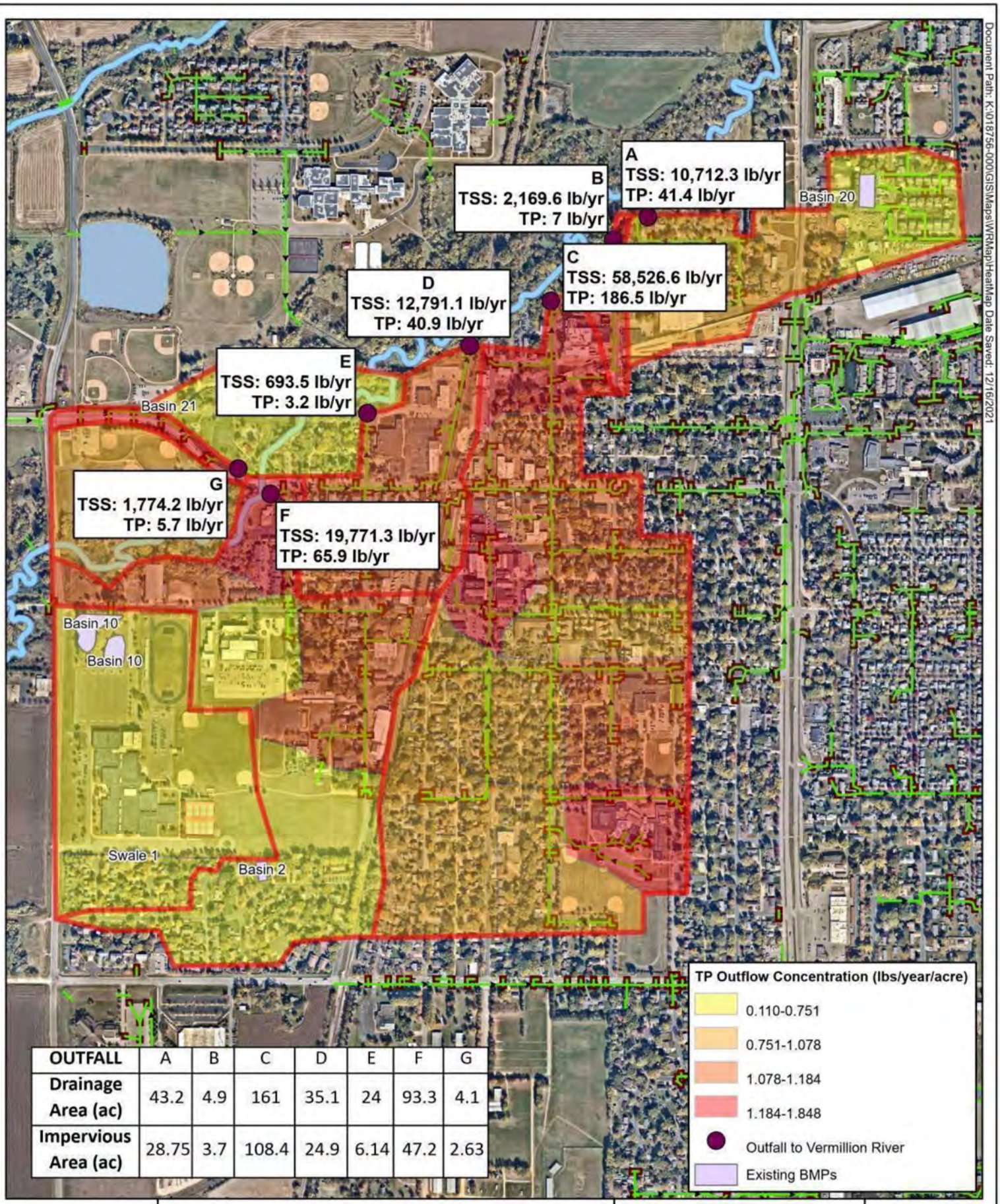

**Figure 1- Drainage Area**

Stormwater Direct Drainage Prioritization
The City of Farmington

N

0 700 Feet

1 inch = 700 feet




| OUTFALL | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| Drainage Area (ac) | 43.2 | 4.9 | 161 | 35.1 | 24 | 93.3 | 4.1 |
| Impervious Area (ac) | 28.75 | 3.7 | 108.4 | 24.9 | 6.14 | 47.2 | 2.63 |

CITY OF FARMINGTON

## Figure 2- Phosphorous Loading Map

Stormwater Direct Drainage Prioritization
The City of Farmington

N

0 900 Feet

1 inch = 900 feet

wsb

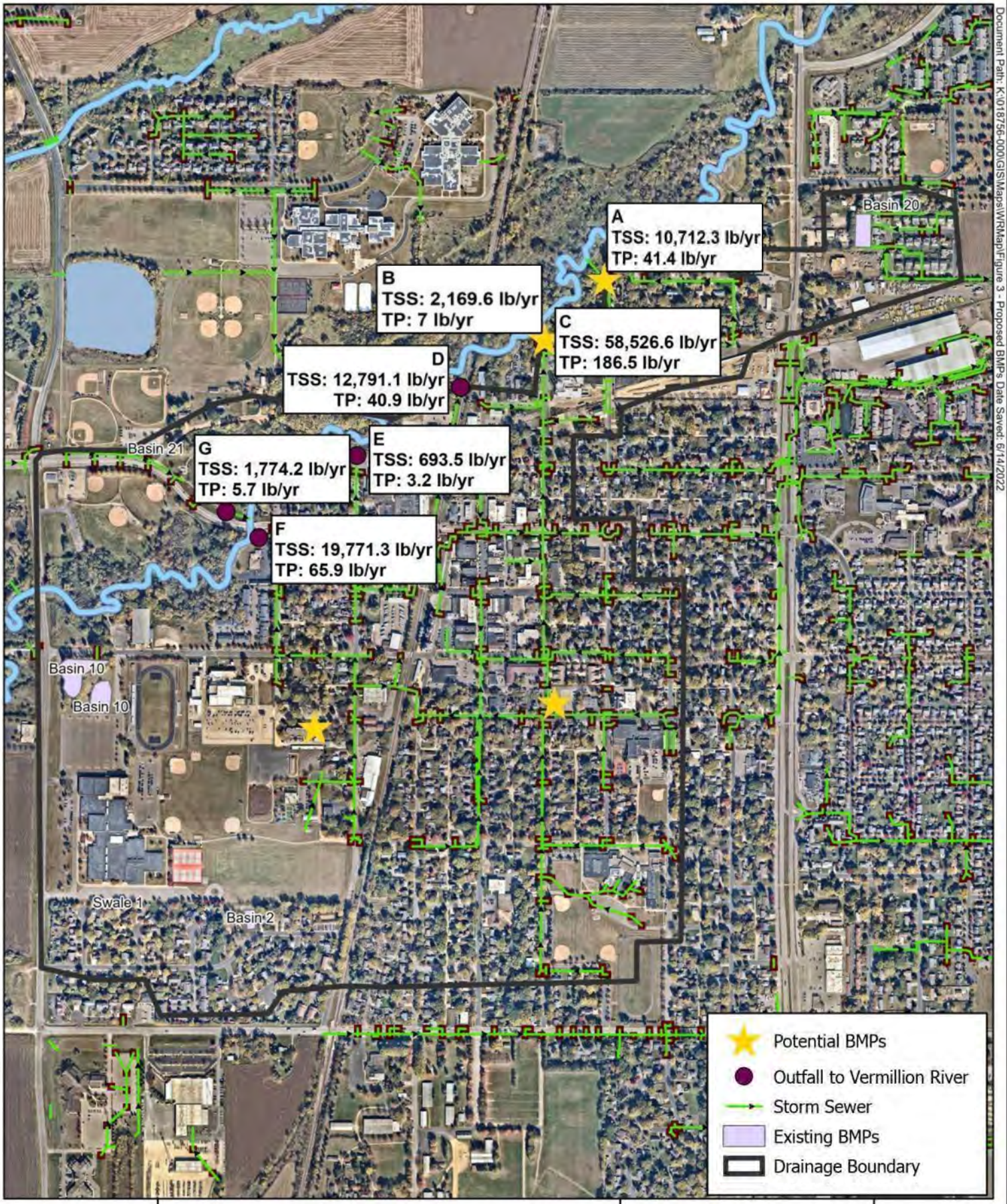



**Figure 3 - Proposed BMPs**

Stormwater Direct Drainage Prioritization
The City of Farmington

N

0 900 Feet

1 inch = 900 feet

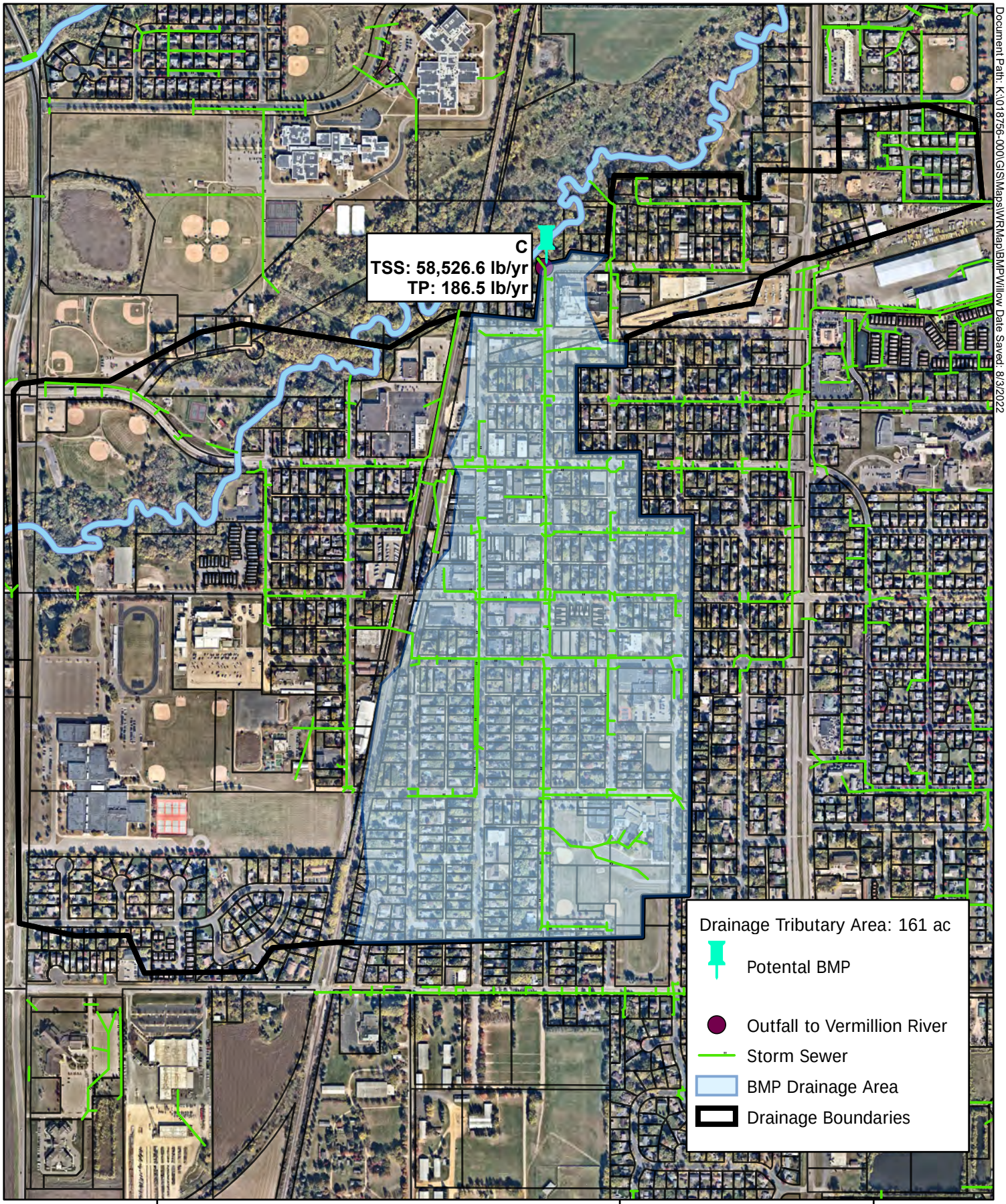



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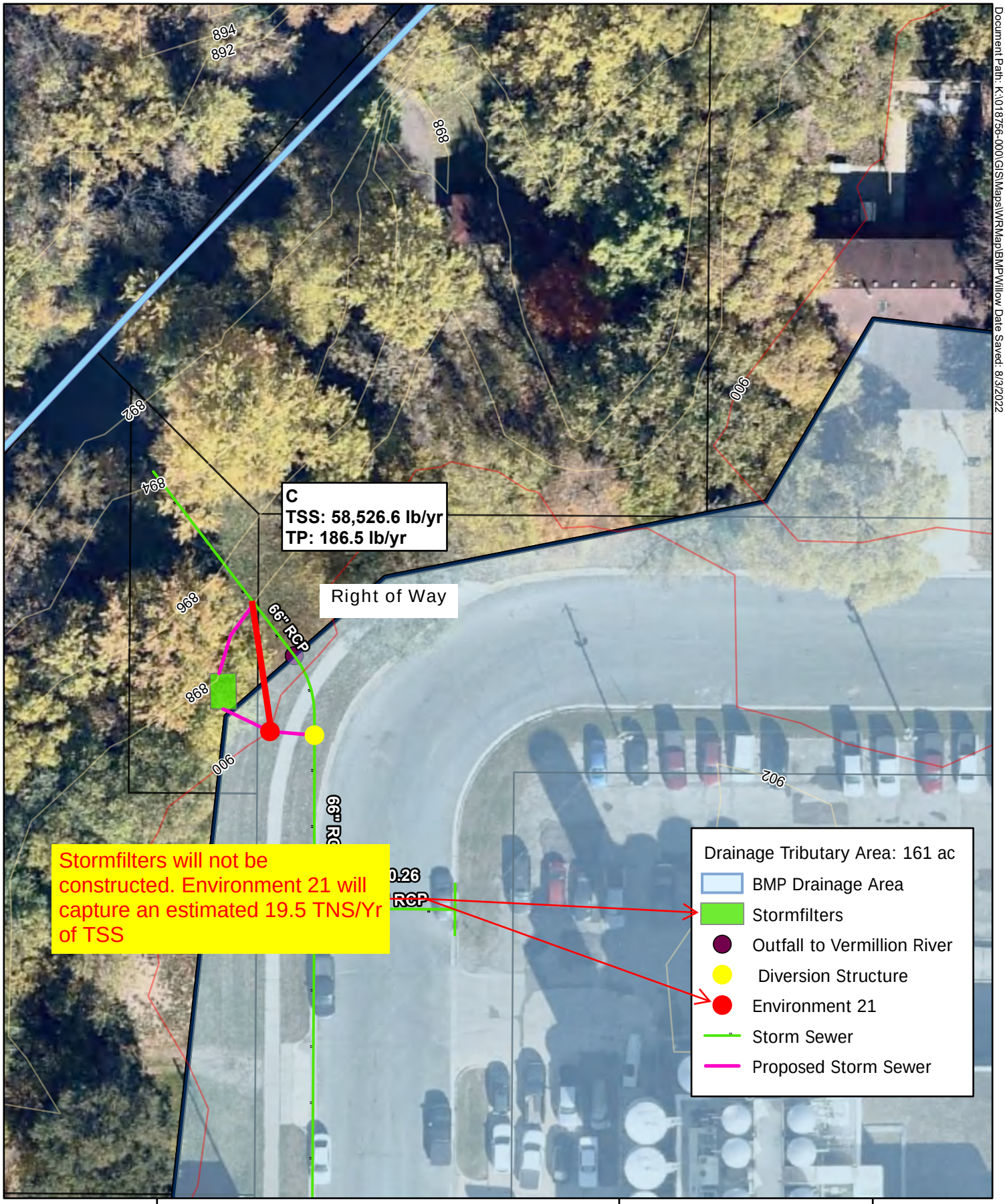
**Figure 4a - Willow and 4th Street Drainage Area**

Stormwater Direct Drainage Prioritization
The City of Farmington

0 860 Feet

1 inch = 860 feet




Document Path: K:\018756-000\GIS\Maps\WRMap\BMPWillow Date Saved: 8/3/2022

**Figure 4b - Willow and 4th Street BMP Improvements**

Stormwater Direct Drainage Prioritization
The City of Farmington

0 40 Feet

1 inch = 40 feet

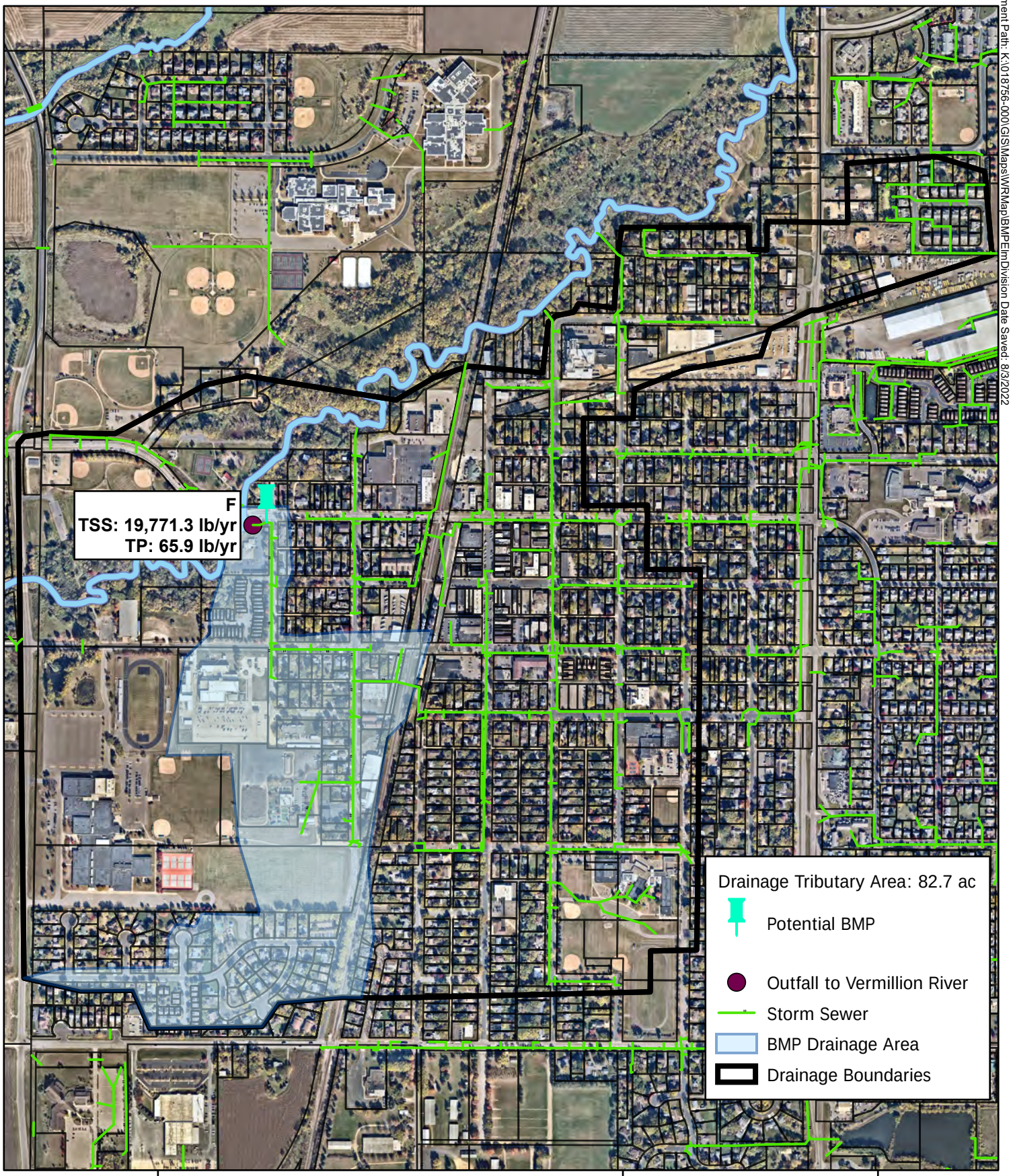
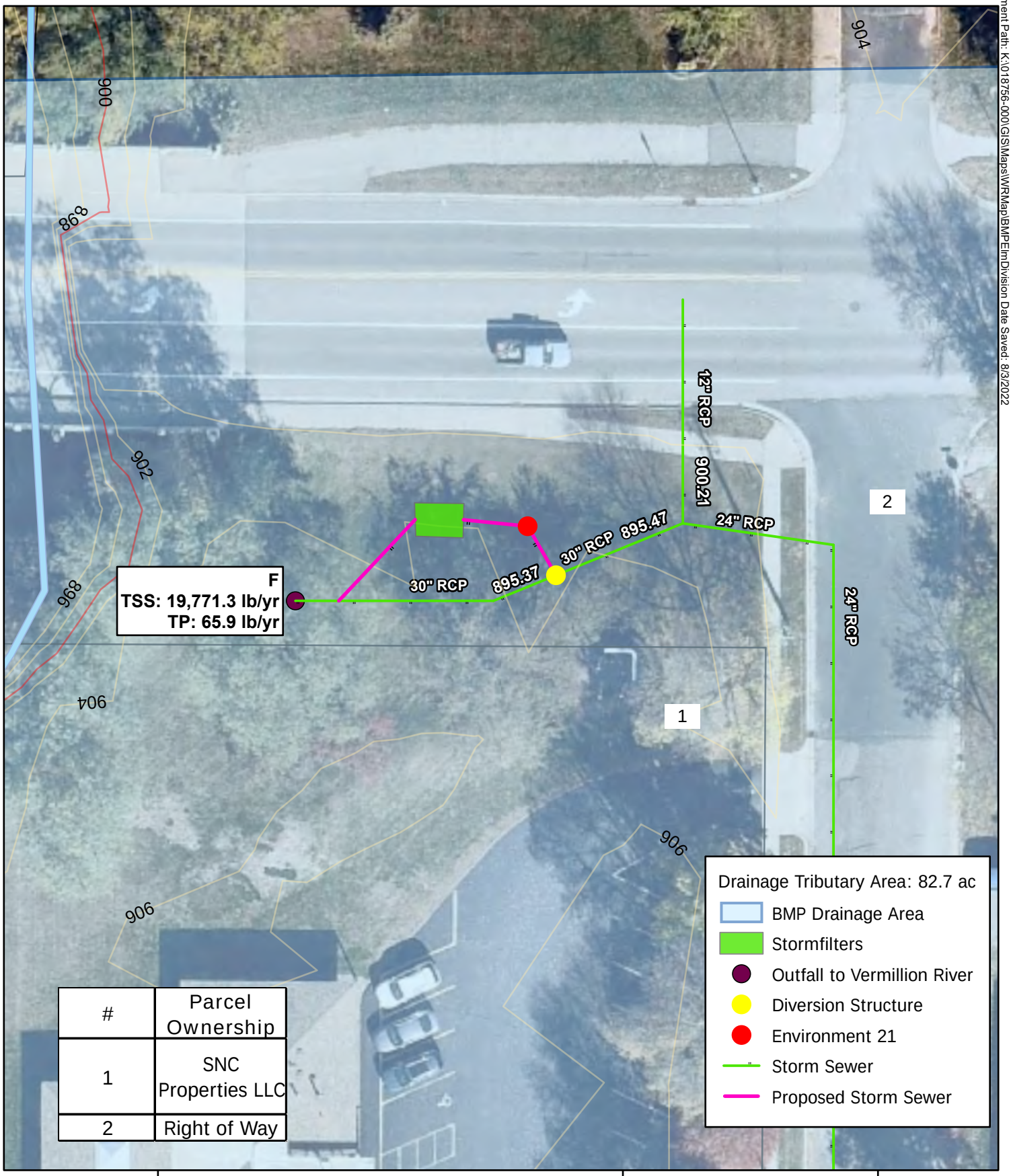



**Figure 5a - Elm and Division Street Drainage Area**

Stormwater Direct Drainage Prioritization
The City of Farmington

0 860 Feet

1 inch = 860 feet




| # | Parcel Ownership |
|---|---|
| 1 | SNC Properties LLC |
| 2 | Right of Way |

**Figure 5b - Elm and Division BMP Improvements**

Stormwater Direct Drainage Prioritization
The City of Farmington

0 30 Feet

1 inch = 30 feet

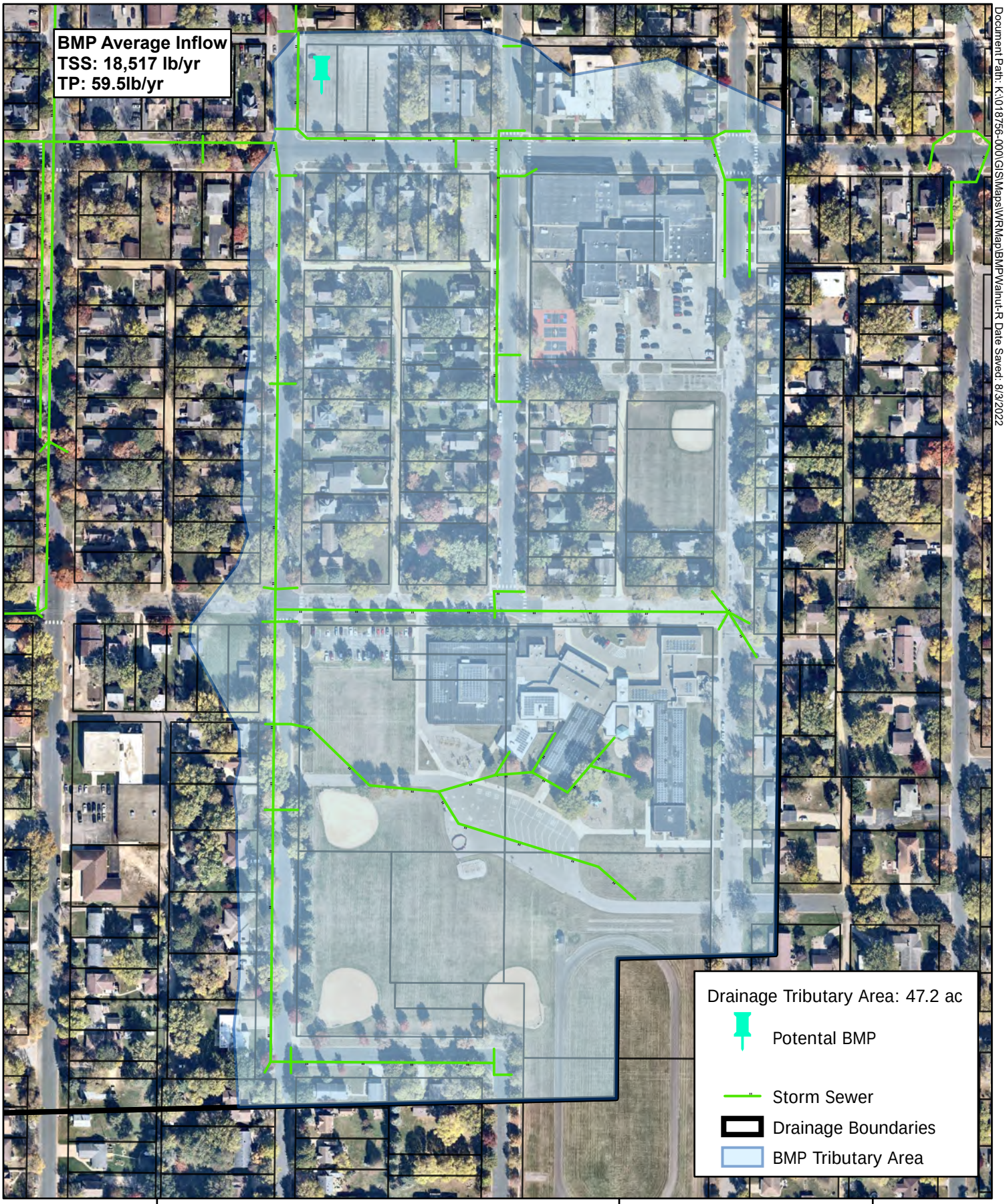



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**Figure 6a - Walnut and 4th Drainage Area**

Stormwater Direct Drainage Prioritization
The City of Farmington

0 250 Feet

1 inch = 250 feet


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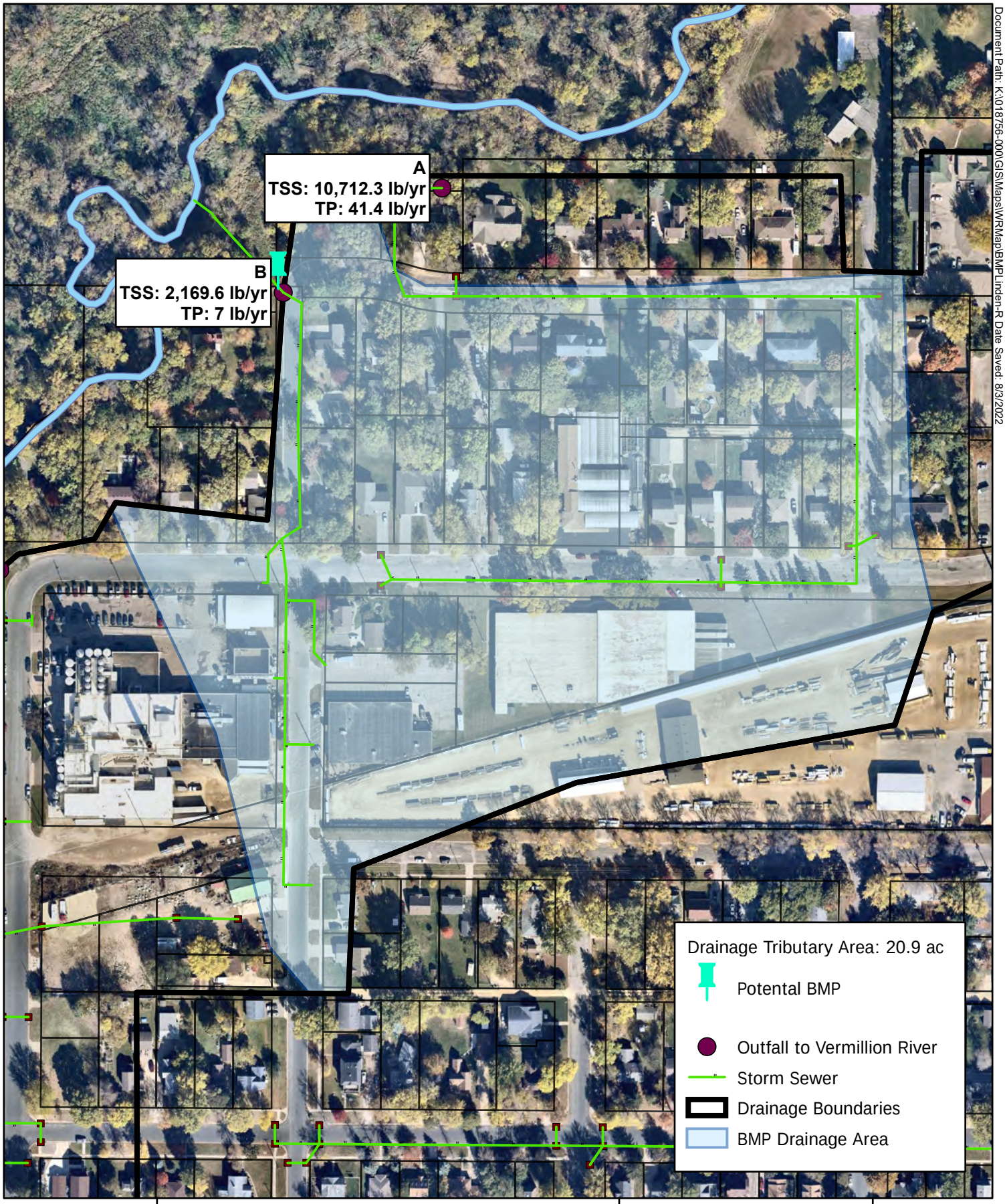
**Figure 6b - Walnut and 4th Street BMP Improvements**

Stormwater Direct Drainage Prioritization
The City of Farmington

0 50 Feet

1 inch = 50 feet



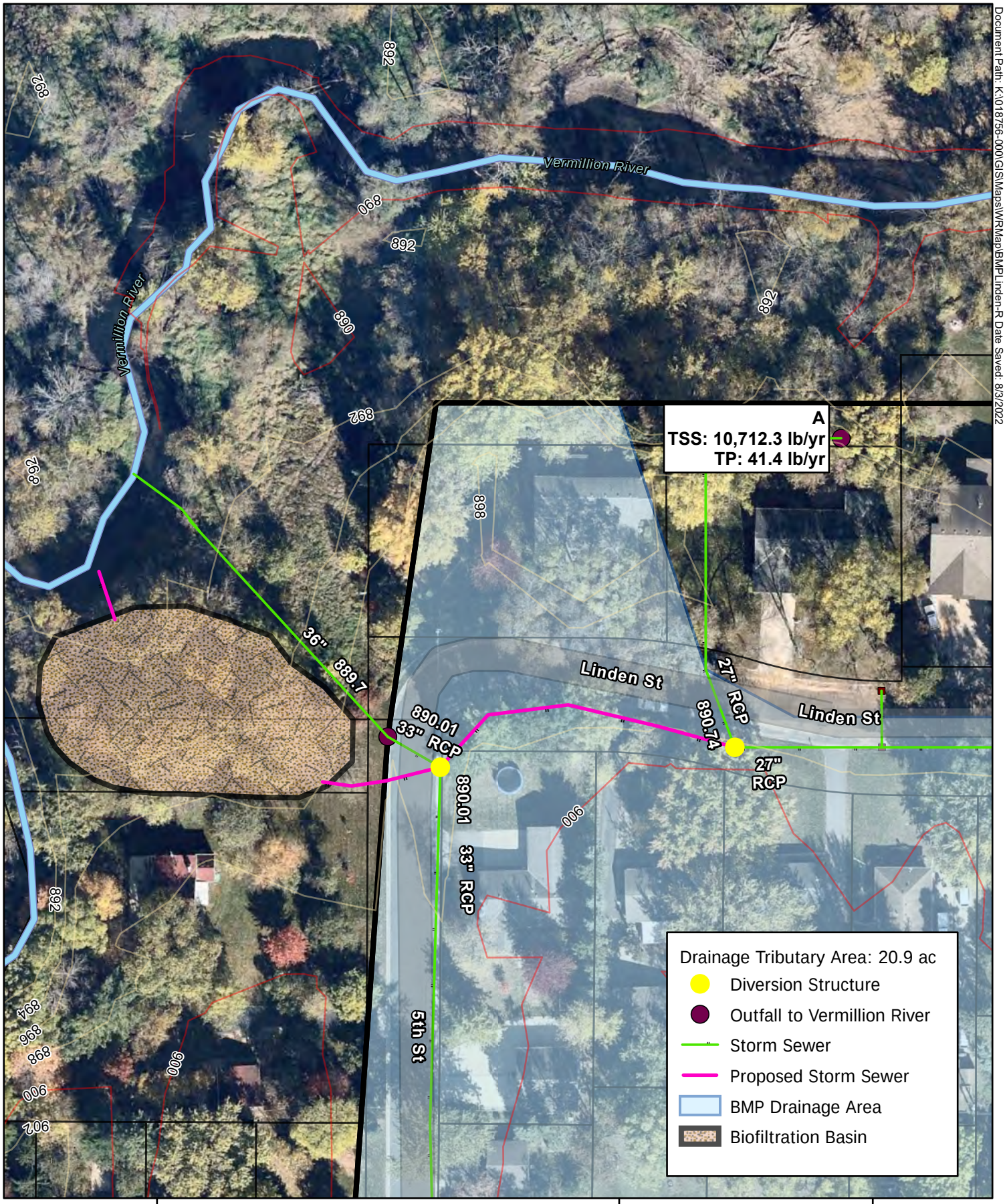

Document Path: K:\018756-000\GIS\Maps\WRMap\BMPLinden-R Date Saved: 8/3/2022

**Figure 7a - Linden and 5th Street Drainage Area**

Stormwater Direct Drainage Prioritization
The City of Farmington

0 200 Feet

1 inch = 200 feet




Document Path: K:\018756-000\GIS\Maps\WRMap\BMPLinden-R Date Saved: 8/3/2022

**Figure 7b - Linden and 5th Street BMP Improvements**

Stormwater Direct Drainage Prioritization
The City of Farmington

0 70 Feet

1 inch = 70 feet

## APPENDIX B

## COST BREAKDOWN

# Treatment Structure at 4th & Willow St. (Environment 21)

*WSB Project:* Farmington Subwatershed Assessment
*Project Location:* City of Farmington
*WSB Project No:* 018756-000

*Completed By:* KL
*Checked By:* JN
*Date:* 8/26/2022

| Item No. | MN/DOT Specification No. | Description | Unit | Estimated Total Quantity | Estimated Unit Price | Estimated Total Cost |
|---|---|---|---|---|---|---|
| 1 | 2021.501 | MOBILIZATION | LS | 1 | $10,000.00 | $10,000.00 |
| 2 | 2503.602 | ENVIRONMENT 21 | EACH | 1 | $50,000.00 | $50,000.00 |
| 3 | 2573.602 | DIVERSION STRUCTURE | EACH | 1 | $15,000.00 | $15,000.00 |
| 4 | 2501.603 | 18" RCP | LF | 20 | $75.00 | $1,500.00 |
| 5 | 2100.601 | DEWATERING | LS | 1 | $5,000.00 | $5,000.00 |
| 6 | 2100.601 | RESTORATION | LS | 1 | $5,000.00 | $5,000.00 |
| 7 | 2573.501 | EROSION CONTROL | LS | 1 | $5,000.00 | $5,000.00 |
| | | | | | **CONSTRUCTION TOTAL** | **$91,500.00** |
| | | | | | **CONTINGENCY (10%)** | **$9,150.00** |
| | | | | | **INDIRECT (18%)** | **$16,470.00** |
| | | | | | **PROJECT TOTAL** | **$117,120.00** |

# Train System at 4th & Willow St. (Environment 21 + 8' x 11' stormfilters)

*WSB Project:* Farmington Subwatershed Assessment
*Project Location:* City of Farmington
*WSB Project No:* 018756-000

*Completed By:* KL
*Checked By:* JN
*Date:* 8/26/2022

| Item No. | MN/DOT Specification No. | Description | Unit | Estimated Total Quantity | Estimated Unit Price | Estimated Total Cost |
|---|---|---|---|---|---|---|
| | | | | | | |
| 1 | 2021.501 | MOBILIZATION | LS | 1 | $10,000.00 | $10,000.00 |
| 2 | 2503.602 | ENVIRONMENT 21 | EACH | 1 | $50,000.00 | $50,000.00 |
| 3 | 2573.502 | 8' x 11' STORMFILTERS | EACH | 1 | $100,000.00 | $100,000.00 |
| 4 | 2573.602 | DIVERSION STRUCTURE | EACH | 1 | $15,000.00 | $15,000.00 |
| 5 | 2501.603 | 18" RCP | LF | 55 | $75.00 | $4,125.00 |
| 6 | 2100.601 | DEWATERING | LS | 1 | $10,000.00 | $10,000.00 |
| 7 | 2100.601 | RESTORATION | LS | 1 | $5,000.00 | $5,000.00 |
| 8 | 2573.501 | EROSION CONTROL | LS | 1 | $5,000.00 | $5,000.00 |
| | | | | | | |
| | | | | | **CONSTRUCTION TOTAL** | **$199,125.00** |
| | | | | | **CONTINGENCY (10%)** | **$19,912.50** |
| | | | | | **INDIRECT (18%)** | **$35,842.50** |
| | | | | | **PROJECT TOTAL** | **$254,880.00** |

# Train System at 4th & Willow St. (Environment 21 + 8' x 14' stormfilters)

*WSB Project:* Farmington Subwatershed Assessment
*Project Location:* City of Farmington
*WSB Project No:* 018756-000

*Completed By:* KL
*Checked By:* JN
*Date:* 8/26/2022

| Item No. | MN/DOT Specification No. | Description | Unit | Estimated Total Quantity | Estimated Unit Price | Estimated Total Cost |
|---|---|---|---|---|---|---|
| | | | | | | |
| 1 | 2021.501 | MOBILIZATION | LS | 1 | $10,000.00 | $10,000.00 |
| 2 | 2503.602 | ENVIRONMENT 21 | EACH | 1 | $50,000.00 | $50,000.00 |
| 3 | 2573.502 | 8' x 14' STORMFILTERS | EACH | 1 | $120,000.00 | $120,000.00 |
| 4 | 2573.602 | DIVERSION STRUCTURE | EACH | 1 | $15,000.00 | $15,000.00 |
| 5 | 2501.603 | 18" RCP | LF | 55 | $75.00 | $4,125.00 |
| 6 | 2100.601 | DEWATERING | LS | 1 | $10,000.00 | $10,000.00 |
| 7 | 2100.601 | RESTORATION | LS | 1 | $5,000.00 | $5,000.00 |
| 8 | 2573.501 | EROSION CONTROL | LS | 1 | $5,000.00 | $5,000.00 |
| | | | | | | |
| | | | | | **CONSTRUCTION TOTAL** | **$219,125.00** |
| | | | | | **CONTINGENCY (10%)** | **$21,912.50** |
| | | | | | **INDIRECT (18%)** | **$39,442.50** |
| | | | | | **PROJECT TOTAL** | **$280,480.00** |

# Treatment Structure at Elm & Division St. (Environment 21)

*WSB Project:* Farmington Subwatershed Assessment
*Project Location:* City of Farmington
*WSB Project No:* 018756-000

*Completed By:* KL
*Checked By:* JN
*Date:* 8/26/2022

| Item No. | MN/DOT Specification No. | Description | Unit | Estimated Total Quantity | Estimated Unit Price | Estimated Total Cost |
|---|---|---|---|---|---|---|
| | | | | | | |
| 1 | 2021.501 | MOBILIZATION | LS | 1 | $10,000.00 | $10,000.00 |
| 2 | 2503.602 | ENVIRONMENT 21 | EACH | 1 | $50,000.00 | $50,000.00 |
| 3 | 2573.602 | DIVERSION STRUCTURE | EACH | 1 | $8,000.00 | $8,000.00 |
| 4 | 2501.603 | 18" RCP | LF | 20 | $75.00 | $1,500.00 |
| 5 | 2100.601 | DEWATERING | LS | 1 | $5,000.00 | $5,000.00 |
| 6 | 2100.601 | RESTORATION | LS | 1 | $5,000.00 | $5,000.00 |
| 7 | 2573.501 | EROSION CONTROL | LS | 1 | $5,000.00 | $5,000.00 |
| | | | | | | |
| | | | | | **CONSTRUCTION TOTAL** | **$84,500.00** |
| | | | | | **CONTINGENCY (10%)** | **$8,450.00** |
| | | | | | **INDIRECT (18%)** | **$15,210.00** |
| | | | | | **PROJECT TOTAL** | **$108,160.00** |

# Train System at Elm & Division St. (Environment 21 + 8' x 11' stormfilters)

*WSB Project:* Farmington Subwatershed Assessment
*Project Location:* City of Farmington
*WSB Project No:* 018756-000

*Completed By:* KL
*Checked By:* JN
*Date:* 8/26/2022

| Item No. | MN/DOT Specification No. | Description | Unit | Estimated Total Quantity | Estimated Unit Price | Estimated Total Cost |
|---|---|---|---|---|---|---|
| | | | | | | |
| 1 | 2021.501 | MOBILIZATION | LS | 1 | $10,000.00 | $10,000.00 |
| 2 | 2503.602 | ENVIRONMENT 21 | EACH | 1 | $50,000.00 | $50,000.00 |
| 3 | 2573.502 | 8' x 11' STORMFILTERS | EACH | 1 | $100,000.00 | $100,000.00 |
| 4 | 2573.602 | DIVERSION STRUCTURE | EACH | 1 | $8,000.00 | $8,000.00 |
| 5 | 2501.603 | 18" RCP | LF | 54 | $75.00 | $4,050.00 |
| 6 | 2100.601 | DEWATERING | LS | 1 | $10,000.00 | $10,000.00 |
| 7 | 2100.601 | RESTORATION | LS | 1 | $5,000.00 | $5,000.00 |
| 8 | 2573.501 | EROSION CONTROL | LS | 1 | $5,000.00 | $5,000.00 |
| | | | | | | |
| | | | | | **CONSTRUCTION TOTAL** | **$192,050.00** |
| | | | | | **CONTINGENCY (10%)** | **$19,205.00** |
| | | | | | **INDIRECT (18%)** | **$34,569.00** |
| | | | | | **PROJECT TOTAL** | **$245,824.00** |

# Train System at Elm & Division St. (Environment 21 + 8' x 14' stormfilters)

*WSB Project:* Farmington Subwatershed Assessment
*Project Location:* City of Farmington
*WSB Project No:* 018756-000

*Completed By:* KL
*Checked By:* JN
*Date:* 8/26/2022

| Item No. | MN/DOT Specification No. | Description | Unit | Estimated Total Quantity | Estimated Unit Price | Estimated Total Cost |
|---|---|---|---|---|---|---|
| | | | | | | |
| 1 | 2021.501 | MOBILIZATION | LS | 1 | $10,000.00 | $10,000.00 |
| 2 | 2503.602 | ENVIRONMENT 21 | EACH | 1 | $50,000.00 | $50,000.00 |
| 3 | 2573.502 | 8' x 11' STORMFILTERS | EACH | 1 | $120,000.00 | $120,000.00 |
| 4 | 2573.602 | DIVERSION STRUCTURE | EACH | 1 | $8,000.00 | $8,000.00 |
| 5 | 2501.603 | 18" RCP | LF | 54 | $75.00 | $4,050.00 |
| 6 | 2100.601 | DEWATERING | LS | 1 | $10,000.00 | $10,000.00 |
| 7 | 2100.601 | RESTORATION | LS | 1 | $5,000.00 | $5,000.00 |
| 8 | 2573.501 | EROSION CONTROL | LS | 1 | $5,000.00 | $5,000.00 |
| | | | | | | |
| | | | | | **CONSTRUCTION TOTAL** | **$212,050.00** |
| | | | | | **CONTINGENCY (10%)** | **$21,205.00** |
| | | | | | **INDIRECT (18%)** | **$38,169.00** |
| | | | | | **PROJECT TOTAL** | **$271,424.00** |

# Underground Vault at 4th and Walnut St

*WSB Project:* Farmington Subwatershed Assessment
*Project Location:* City of Farmington
*WSB Project No:* 018756-000

*Completed By:* KL
*Checked By:* JN
*Date:* 8/26/2022

| Item No. | MN/DOT Specification No. | Description | Unit | Estimated Total Quantity | Estimated Unit Price | Estimated Total Cost |
|---|---|---|---|---|---|---|
| | | | | | | |
| 1 | 2021.501 | MOBILIZATION | LS | 1 | $25,000.00 | $25,000.00 |
| 2 | 2502.601 | UNDERGROUND STORAGE VAULT | CF | 33000 | $12.00 | $396,000.00 |
| 3 | 2573.602 | DIVERSION STRUCTURE | EACH | 1 | $15,000.00 | $15,000.00 |
| 4 | 2501.603 | 18" RCP | LF | 190 | $75.00 | $14,250.00 |
| 5 | 2100.601 | DEWATERING | LS | 1 | $20,000.00 | $20,000.00 |
| 6 | 2100.601 | RESTORATION | LS | 1 | $25,000.00 | $25,000.00 |
| 7 | 2573.501 | EROSION CONTROL | LS | 1 | $10,000.00 | $10,000.00 |
| | | | | | | |
| | | | | | **CONSTRUCTION TOTAL** | **$505,250.00** |
| | | | | | **CONTINGENCY (10%)** | **$50,525.00** |
| | | | | | **INDIRECT (18%)** | **$90,945.00** |
| | | | | | **PROJECT TOTAL** | **$646,720.00** |

# Underground Pipe Gallery at 4th and Walnut St

*WSB Project:* Farmington Subwatershed Assessment
*Project Location:* City of Farmington
*WSB Project No:* 018756-000

*Completed By:* KL
*Checked By:* JN
*Date:* 8/26/2022

| Item No. | MN/DOT Specification No. | Description | Unit | Estimated Total Quantity | Estimated Unit Price | Estimated Total Cost |
|---|---|---|---|---|---|---|
| | | | | | | |
| 1 | 2021.501 | MOBILIZATION | LS | 1 | $25,000.00 | $25,000.00 |
| 2 | 2502.601 | UNDERGROUND PIPE GALLERY | CF | 33000 | $10.00 | $330,000.00 |
| 3 | 2573.602 | DIVERSION STRUCTURE | EACH | 1 | $15,000.00 | $15,000.00 |
| 4 | 2501.603 | 18" RCP | LF | 190 | $75.00 | $14,250.00 |
| 5 | 2106.601 | DEWATERING | LS | 1 | $20,000.00 | $20,000.00 |
| 6 | 2100.601 | RESTORATION | LS | 1 | $25,000.00 | $25,000.00 |
| 7 | 2573.501 | EROSION CONTROL | LS | 1 | $10,000.00 | $10,000.00 |
| | | | | | | |
| | | | | | **CONSTRUCTION TOTAL** | **$439,250.00** |
| | | | | | **CONTINGENCY (10%)** | **$43,925.00** |
| | | | | | **INDIRECT (18%)** | **$79,065.00** |
| | | | | | **PROJECT TOTAL** | **$562,240.00** |

# Biofiltration Basin at 5th and Linden St

*WSB Project:* Farmington Subwatershed Assessment
*Project Location:* City of Farmington
*WSB Project No:* 018756-000

*Completed By:* KL
*Checked By:* JN
*Date:* 8/26/2022

| Item No. | MN/DOT Specification No. | Description | Unit | Estimated Total Quantity | Estimated Unit Price | Estimated Total Cost |
|---|---|---|---|---|---|---|
| | | | | | | |
| 1 | 2021.501 | MOBILIZATION | LS | 1 | $25,000.00 | $25,000.00 |
| 2 | 2021.501 | CLEARING AND GRUBBING | LS | 1 | $15,000.00 | $15,000.00 |
| 3 | 2105.607 | COMMON EXCAVATION | CY | 5000 | $25.00 | $125,000.00 |
| 4 | 2106.601 | GRADING | LS | 1 | $20,000.00 | $20,000.00 |
| 5 | 2573.602 | DIVERSION STRUCTURE | EACH | 2 | $12,000.00 | $24,000.00 |
| 6 | 2501.603 | 18" RCP | LF | 260 | $75.00 | $19,500.00 |
| 7 | 2106.601 | DEWATERING | LS | 1 | $10,000.00 | $10,000.00 |
| 8 | 2232.601 | ROAD PATCHING | LS | 1 | $20,000.00 | $20,000.00 |
| 9 | 2100.601 | RESTORATION | LS | 1 | $30,000.00 | $30,000.00 |
| 10 | 2573.501 | EROSION CONTROL | LS | 1 | $15,000.00 | $15,000.00 |
| | | | | | | |
| | | | | | **CONSTRUCTION TOTAL** | **$303,500.00** |
| | | | | | **CONTINGENCY (10%)** | **$30,350.00** |
| | | | | | **INDIRECT (18%)** | **$54,630.00** |
| | | | | | **PROJECT TOTAL** | **$388,480.00** |