

Technical Memorandum

To	Magdelene Wagner, Director of Public Works, Pewaukee Rich Wirtz, PE, CFM, Chief Engineer-Utilities, Pewaukee	Page	1
CC			
Subject	Foxwood – Kathryn Court Drainage Study AECOM Project #: 60339891		
From	Steve Parse, PE, CPMSM, Rick Eilertson, PE, Ashley Leisgang, PE		
Date	August 21, 2020, Revised September 11, 2020		

Introduction

A hydrologic and hydraulic analysis using XP-SWMM, a software program, was conducted by AECOM for the City of Pewaukee. This analysis specifically focused on an area north of Foxwood Lane and along Kathryn Court. The water flows west to east and discharges to the storm sewer system along Springdale Rd.

During storm events, storm water ponds southwest of the Kathryn Court cul-de-sac and north of Foxwood Lane in a localized low spot in an existing ditch (Foxwood ditch). The localized ponding has not impacted the street or neighboring houses, however, local residents have complained of smell and insects as result of standing water. In general, surface water runoff comes from a mix of urban and agricultural areas which drains from the west to the localized low spot southwest of Kathryn Court. The City contracted with AECOM to evaluate alternatives that would improve storm water drainage away from the low spot and ultimately to the Springdale Rd storm sewer system. The location of the ponding, the Foxwood Ditch, and Springdale Rd storm sewer system are found on Figure 1.

The specific goals for this analysis was:

- Document existing drainage issues found within the watershed.
- Evaluate three (3) alternatives that could alleviate the localized flooding and ponded water near Foxwood Lane and Kathryn Court.
- Provide the City with updated storm sewer GIS information based on the site survey.

Background

The objective of this study is to relieve standing water from the ditch located north of Foxwood Lane and southwest of Kathryn Court, in hopes of reducing odor and insects. Historically, the Foxwood ditch conveyed approximately 275 acres of storm water runoff from the upstream portions of the watershed to Springdale Road. The watershed of the Foxwood ditch is shown on Figure 1.

In the late 1980's, the Briarwood Homesites Plat was developed (which includes Kathryn Court and the residential properties around it). During this time, the ditch was relocated from its original location to a public drainage easement in Outlot 1 north of Kathryn Court and South of the Canadian Pacific (CP) Railway via a ditch along the eastern perimeter of the Zignego property. A copy of the Briarwood Homesites Plat showing the public drainage easement is included as Attachment A. The Briarwood Homesites Grading and Erosion Control Plan is included in Attachment B.

GIS contours from 2015, provided by the City, show the bottom of ditch elevation at the start of the Briarwood ditch (~846') is higher than the bottom of ditch elevation of the Foxwood ditch (~844'), creating a low spot at the ponding location. In general, the entire study area is clayey soils within the hydrologic soil groups B/D, C, and D, which allow very little to no infiltration. Visual evidence of standing water in the ponding area even during dry periods further suggests little to no infiltration is occurring in the ditch.

Drainage Conditions

Hydrology

Basins were delineated using 1-foot contour data from 2015 in ArcGIS for the entire study area. Once the basins were delineated, the longest flow paths were drawn, and a spreadsheet was used to determine the Time-of-Concentration (Tc) values for each basin, representing the time that it takes for water to flow from the most remote point in the basin to the outlet node. It was assumed that runoff in the area consists of primarily sheet flow and shallow concentrated flow. Slope flow, flow length, land type, and other factors were considered in the calculations.

In addition, an SCS curve number (CN) was calculated for all basins based on a weighted average using the formula below.

$$CN_{Basin} = [(Area_{Impervious} * CN_{Impervious}) + (Area_{Pervious} * CN_{Pervious})] / Area_{Basin}$$

A CN value of 98 was used for impervious surfaces, and values for pervious surfaces were selected based on the land characteristics of the area, considering that soils are primarily within soil groups C, D, and B/D. Areas were delineated using ArcGIS.

Model Setup

The existing and proposed conveyance system was modeled using Version 2018.2.2 of XP-SWMM software. XP-SWMM is a dynamic model using a link-node representation for ditches/conduits and junctions. The hydrologic calculations for the study area were completed using the SCS runoff method. The amount (volume) of runoff and peak flow (rate) of runoff, generated by each sub-basin area is dependent on the CN and Tc.

The model was run for multiple rainfall events using NOAA Atlas 14, MSE3, 24-hour rainfall distributions. The rainfall depths utilized were:

- 1-year, 24-hour - 2.38 in
- 2-year, 24-hour - 2.69 in
- 10-year, 24-hour - 3.81 in
- 100-year, 24-hour - 6.23 in

Existing Conditions

The existing model includes ditches, storm sewers, culverts, and storm water ponds located within the drainage basin. The drainage basin area upstream of the ponding area is approximately 275 acres. As-built drawings and GIS culvert, storm sewer, and topographic contour information were used to build the model. Following an analysis of the collected information, a supplemental site survey was conducted. This was done to verify the as-built and GIS information, and locate additional storm water structures that were not included in the provided information. The survey team also collected data on the ditch cross sections and elevations. The existing GIS shapefiles were then updated with the surveyed and field verified information. This data was then imported from GIS into XP-SWMM software. Ditches were incorporated in XP-SWMM based on the as-builts, GIS contours, and surveyed information. The existing drainage conditions are illustrated on Figure 1.

The Briarwood ditch north of Kathryn Court ends at a weir with a 15-inch culvert near Springdale Road. This weir was designed to control the 10-year peak rate flow from the Briarwood Homesites development (Kathryn Court) and allow overtopping of the weir during larger storm events.

Storm water from the Briarwood ditch is conveyed into a 42-inch storm sewer along the west side of Springdale Road. For the purposes of this study, the 42-inch storm sewer was only analyzed from its inlet north of Kathryn Court to its connection with a 15-inch sewer located south of Kathryn Court and north of Indianwood Court.

Flood Relief Alternative Evaluation

Following the completion of the existing conditions analysis, three potential flood reduction alternatives were evaluated by AECOM and City staff. The existing conditions model was used as a starting point. The following section describes the management alternatives that are modeled.

Proposed - Alternative 1

Alternative 1 involves constructing a 12-inch storm pipe from the ponding area along the Zignego property and through the existing public drainage easement (Outlot 1 of Briarwood Homesites Plat) on the north side of Kathryn Court. The 12-inch storm pipe will outlet into the 42-inch storm sewer system along Springdale Rd. This would drain the area experiencing ponding while minimally affecting flows and/or potential issues downstream.

The 12-inch storm pipe will begin at a structure located at the low point of the ponding area where the Foxwood ditch and Briarwood ditch meet. It is modeled as a catch basin with an invert of 841.50, 2.5 feet below the existing low point in the ditch. The invert is set 2.5 feet below the existing low point of the ponding area so future underdrains can be constructed at the Foxwood ditch as part of a future storm water best management practice (BMP) device.

The 12" storm pipe will discharge into the 42-inch diameter sewer located on the west side of Springdale Road at the existing manhole northwest of the intersection with Kathryn Court. This will allow for a sufficient slope of 0.32% for the overall proposed pipe.

The layout for Alternative 1 is found in Figure 2.

Proposed - Alternative 2

Alternative 2 involves adding a 12-inch storm pipe from the ponding area, along a small portion of the Zignego property then through an existing 20-foot drainage easement located on the south side of parcels on Kathryn Court. This would drain the area experiencing ponding while minimally affecting flows and/or potential issues downstream.

The 12-inch storm pipe will outlet into a proposed storm sewer on Maplewood Lane. The existing 10- and 12-inch diameter storm sewer on Maplewood Lane, is currently undersized resulting in reported localized flooding. Thus, as part of Alternative 2, the Maplewood Lane storm sewers are recommended to be replaced with deeper 18-inch storm pipes to reduce localized flooding and provide the necessary slope to construct the 12-inch storm pipe.

As in Alternative 1, the inlet is modeled as a catch basin with an elevation of 841.50, 2.5 feet below the lowest ditch elevation for future storm water BMP installation while maintaining a slope of 0.39%.

The layout for Alternative 2 is found in Figure 3.

Proposed - Alternative 3

Alternative 3 involves re-grading the ditch along the Zignego property and then through the existing Briarwood ditch (Outlot 1) on the north side of Kathryn Court to obtain positive slope. This would drain the area experiencing ponding.

Alternative 3 will not involve any modifications to the weir structure in the public drainage easement. The layout for Alternative 3 is found in Figure 4.

Model Results

Ponding Area

The model results for the ponding area were analyzed to evaluate the impact of the ponding area in the proposed alternatives when compared to the existing conditions. The water surface elevation (WSE) and the time it takes to drain the ponding area were compared (duration). The ground/overbank elevations represent either the approximate elevation of surrounding structures (i.e. house, garages, sheds) or the surrounding edge of pavement (EOP) of a roadway.

Table 1 summarizes the water surface elevation for the existing conditions and three proposed alternatives. Table 2 summarizes the duration of ponding for each of the alternatives. The location of the XP-SWMM Nodes is found on Figure 1.

Table 1: Water Surface Elevations

XP-SWMM Node ⁽¹⁾	Ground/Overbank Elev.	10-year, 24-hour				100-year, 24-hour			
		Water Surface Elevation (WSE) (ft)				Water Surface Elevation (WSE) (ft)			
		Existing	Alt. 1	Alt. 2	Alt. 3	Existing	Alt. 1	Alt. 2	Alt. 3
Node 1364	855.00 (Structure)	848.86	848.83	848.83	847.29	850.31	850.29	850.29	848.49
Node 1412.1	847.00 (Structure)	845.87	845.86	845.85	846.02	846.86	846.85	846.84	846.83
Node 1413	847.00 (Road)	845.70	845.69	845.64	845.94	846.82	846.82	846.81	846.80
Node 1413.1	843.00 (Road)	843.41	843.45	843.36	843.58	844.36	844.43	844.36	844.34
Node 1414	841.00 (Road)	840.10	840.11	840.07	840.20	840.88	840.90	840.88	840.85
Node 1420	840.00 (Road)	836.05	836.05	836.04	836.06	836.14	836.14	836.14	836.14

(1) For node locations, see Figure 5.

Table 2: Duration of Ponding

Scenario	100-year, 24-hour Storm Event			
	Existing	Alternative 1	Alternative 2	Alternative 3
Duration of Ponding (hours)	>72	22.00	21.75	20.50

In Alternative 1 and 2, the change in peak WSE is negligible relative to the WSE in the existing conditions. However, the ponding area will drain within the recommended 24-hour time frame.

Alternative 2, will also provide improvements to Maplewood Lane. The proposed storm sewer pipes are sized to convey the 10-year 24-hour storm.

Alternative 3, provides the greatest reduction in the peak WSE at the ponding area. The regraded ditch allows the storm water runoff to efficiently drain and move downstream, thus causing an increase in peak WSE through the Briarwood ditch. According to WisDOT FDM 13-20-1, ditches are recommended to have a minimum slope of 0.5% with an absolute minimum slope of 0.3% to allow for proper drainage. The slope for Alternative 3 is limited to 0.09%. Due to the low slope and increased peak WSE downstream, this alternative is not recommended.

Drainage Basin Upstream of Ponding Area

This model can be utilized to analysis potential concerns upstream of the Foxwood ditch. The City typically designs new storm sewer systems to convey a minimum of the 10-year – 24-hour storm event. There are many locations throughout this basin where the existing storm sewer does not meet this criteria.

As the existing condition results were analyzed, there were three locations that appeared to have greater recurrence in surface ponding. The following locations experience flooding for storm events greater than the 1-year, 24-hour storm:

- A. Duplainville Road below the CP Railway
- B. Storm water easement south of Kathryn Court and north of Indianwood Court between Maplewood Lane and Springdale Road
- C. Foxwood Lane north of the intersection with Foxwood Court

Opinion of Probable Cost

Opinions of Probable Cost (OPCs) for the three alternatives are summarized in Table 3. Details spreadsheets for each alternative can be found in Attachment C.

Table 3: Opinion of Probable Cost Summary

Alternative	Cost
1	\$274,000
2	\$1,004,000
3	\$349,000

Recommendations

Considering cost, constructability, and achieving the goal of eliminating the standing water in the ponding area without adversely affecting the drainage conditions downstream, Alternative 1 is the recommended option. Further, Alternative 1 provides opportunity for potential conversion of the Foxwood ditch into a biofilter or similar best management practice that could help improve water quality of the downstream waters which may prove useful in meeting future Total Maximum Daily Load (TMDL) requirements for the watershed.

Attachments

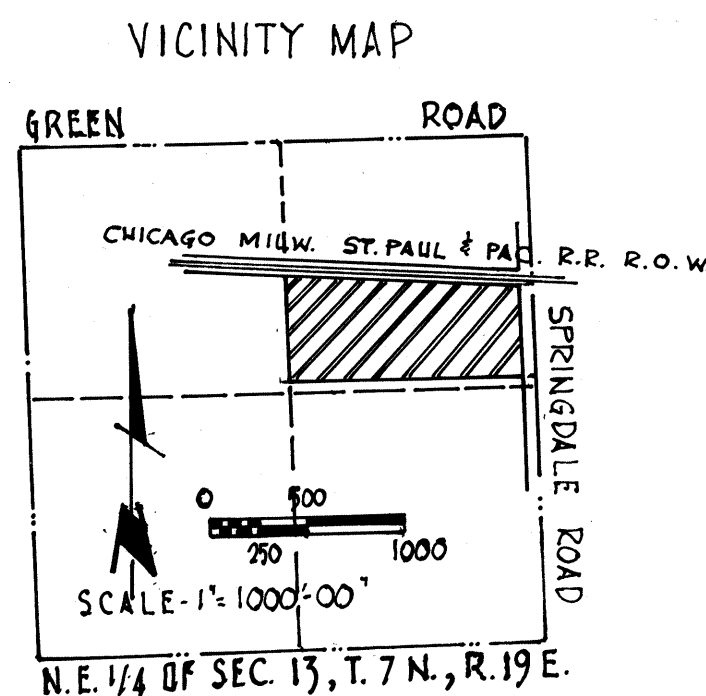
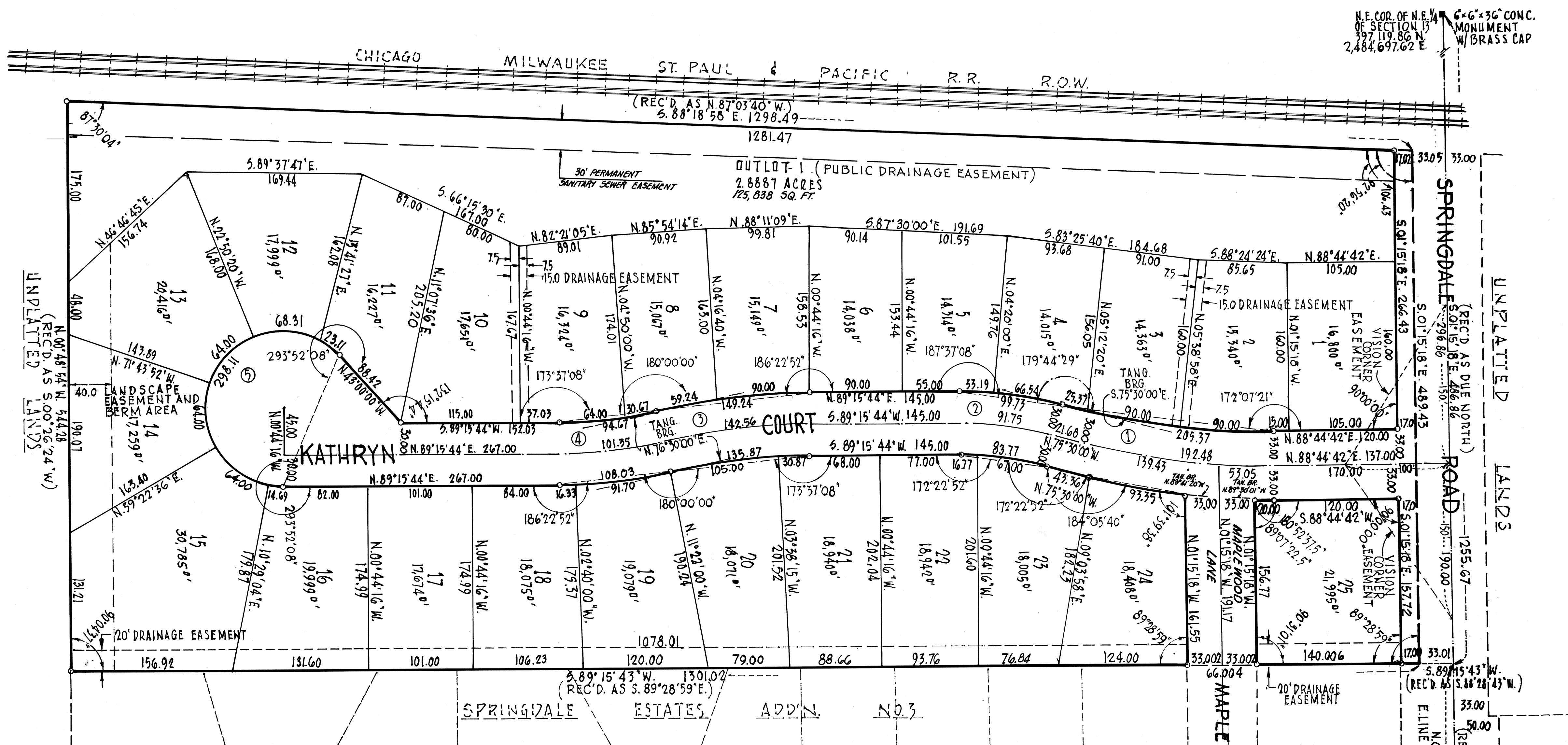
- A – Briarwood Homesites Plat
- B – Briarwood Homesites Grading & Erosion Control Plan
- C – Opinions of Probable Cost Spreadsheets

Figures

- 1 – Drainage Basin Study Area
- 2 – Alternative 1
- 3 – Alternative 2
- 4 – Alternative 3
- 5 – XP SWMM Model Node Locations

Attachments

Attachment A



NOTE:

- 1) ○ INDICATES 2" IRON PIPE 30" IN LENGTH WT. 3.65 LBS. PER LINEAL FT.
- 2) ALL OTHER LOT CORNERS HAVE 1" IRON PIPE 24" IN LENGTH WT. 1.13 LBS. PER LINEAL FT.
- 3) PLAT IS REFERENCED TO GRID NORTH WISCONSIN STATE PLANE CO-ORDINATE SYSTEM SOUTH ZONE
- 4) ALL DIMENSIONS ARE MEASURED AND SHOWN TO THE NEAREST HUNDREDTH OF A FOOT.
- 5) LOTS 1 AND 25 RESTRICTED TO NO DIRECT VEHICULAR ACCESS TO SPRINGDALE ROAD

BRIARWOOD HOMESITES

BEING A SUBDIVISION OF C.S.M. NO. 1778, BEING A PART OF THE NE. 1/4 OF THE NE. 1/4 OF SEC. 13, T. 7 N., R. 19 E., IN THE TOWN OF PEWAUKEE, WAUKESHA COUNTY, WISCONSIN

REVISED 7/14/87



SCALE: 1" = 60' 00"



25

Attachment B

Attachment C



1555 Rivercenter
Dr., Suite 214
Milwaukee,
Wisconsin 53212

CLIENT:	City of Pewaukee		
PROJECT:	Stormwater Management Plan Review Assistance		
CONTRACT NO.:	Foxwood-Kathryn Court Drainage Study Tasks		
AECOM PROJECT NO.:	60339891		
SUBMITTAL:	Opinion of Probable Construction Cost		
DATE CREATED/MODIFIED:	08/12/2020	BY:	SDP
DATE CHECKED:	08/12/2020	BY:	RE

Opinion of Probable Construction Cost

Line Item	Item Code	Item Description	Unit of Measure	Quantity	Unit Price	Total Cost
1	619.1000	Mobilization, Bonds, and Insurance (~7%)	LS	1	\$14,000	\$14,000
2	SP	Clearing & Grubbing	LS	1	\$15,000.00	\$15,000
3	628.1504	Silt Fence	LF	2,036	\$3.00	\$6,108
4	628.7504	Ditch Checks	LF	90	\$15.00	\$1,350
5	628.7560	Tracking Pad	EACH	1	\$3,500.00	\$3,500
6	SP	6" Topsoil Restoration, w/ Class 1, Urban, Type B Erosion Mat	SY	4,500	\$5.00	\$22,500
7	630.0140	Turfgrass Seed Mix	SY	4,500	\$2.00	\$9,000
7	SP	Storm Sewer Pipe HDPE 12-Inch	LF	1,990	\$60.00	\$119,400
8	SP	Drop Inlet Structure w/ Grate	EACH	1	\$2,000.00	\$2,000
9	611.2004	Manholes 4-FT Diameter w/ Casting	EA	6	\$2,000.00	\$12,000
10	SP	Construction Staking Storm Sewer	LS	1	\$1,500.00	\$1,500
11	416.1720	Concrete Flume Removal and Replacement	SY	50	\$80.00	\$4,000
12	SP	Core into Existing Storm Manhole	EA	1	\$750.00	\$750

Total Opinion of Probable Construction Cost \$198,000

Surveying & Design Engineering (~10%) \$20,000

Construction Administration/Observation (~10%) \$20,000

Contingency (~15%) \$36,000

Total Opinion of Probable Surveying, Engineering Design, Construction, and Administration/Inspection Cost Estimate \$274,000



1555 Rivercenter
Dr., Suite 214
Milwaukee,
Wisconsin 53212

CLIENT: City of Pewaukee

PROJECT: Stormwater Management Plan Review Assistance

CONTRACT NO.: Foxwood-Kathryn Court Drainage Study Tasks

AECOM PROJECT NO.: 60339891

SUBMITTAL:

DATE CREATED/MODIFIED: 08/06/2020 BY: SDP

DATE CHECKED: 08/13/2020 BY: RE

Line Item	Item Code	Item Description	Unit of Measure	Quantity	Unit Price	Total Cost
1	619.1000	Mobilization, Bonds, and Insurance (~7%)	LS	1	\$51,000	\$51,000
2	SP	Clearing & Grubbing	LS	1	\$5,000.00	\$5,000
3	628.1504	Silt Fence	LF	200	\$3.00	\$600
4	628.7504	Ditch Checks	LF	20	\$15.00	\$300
5	628.7560	Tracking Pad	EACH	2	\$3,500.00	\$7,000
6	SP	6" Topsoil Restoration, w/ Class 1, Urban, Type B Erosion Mat	SY	500	\$5.00	\$2,500
7	630.0140	Turfgrass Seed Mix	SY	500	\$2.00	\$1,000
8	SP	Storm Sewer Pipe HDPE 12-Inch via Trenchless Installation	LF	1,115	\$525.00	\$585,375
9	SP	Storm Sewer Pipe RCP 18-Inch	LF	40	\$80.00	\$3,200
10	SP	Storm Sewer Pipe HDPE 18-Inch via Trenchless Installation	LF	185	\$575.00	\$106,375
11	SP	Drop Inlet Structure w/ Grate	EACH	1	\$2,000.00	\$2,000
12	SP	Remove and Replace Inlets, 2' x 3', w/ Casting and Grate	EA	3	\$2,000.00	\$6,000
13	SP	Construction Staking Storm Sewer	LS	1	\$1,500.00	\$1,500
14	SP	Curb and Gutter Removal and Replacement	LF	40	\$25.00	\$1,000
15	SP	Asphalt Roadway and CABC Removal and Replacement	SY	75	\$50.00	\$3,750
16	SP	Core into Existing Field Inlet	EA	1	\$750.00	\$750

Total Opinion of Probable Construction Cost \$727,000

Surveying & Design Engineering (~10%) \$73,000

Construction Administration/Observation (~10%) \$73,000

Contingency (~15%) \$131,000

Total Opinion of Probable Surveying, Engineering Design, Construction, and Administration/Inspection Cost Estimate \$1,004,000



1555 Rivercenter
Dr., Suite 214
Milwaukee,
Wisconsin 53212

CLIENT: **City of Pewaukee**

PROJECT: **Stormwater Management Plan Review Assistance**

CONTRACT NO.: **Foxwood-Kathryn Court Drainage Study Tasks**

AECOM PROJECT NO.: **60339891**

SUBMITTAL:

DATE CREATED/MODIFIED: **08/06/2020** BY: **SDP**

DATE CHECKED: **08/13/2020** BY: **RE**

Line Item	Item Code	Item Description	Unit of Measure	Quantity	Unit Price	Total Cost
1	619.1000	Mobilization, Bonds, and Insurance (~7%)	LS	1	\$18,000	\$18,000
2	SP	Clearing & Grubbing	LS	1	\$30,000.00	\$30,000
3	628.1504	Silt Fence	LF	200	\$3.00	\$600
4	628.7504	Ditch Checks	LF	360	\$15.00	\$5,400
5	628.7560	Tracking Pad	EACH	1	\$3,500.00	\$3,500
6	205.0100	Excavation Common	CY	4,400	\$22.00	\$96,800
7	SP	6" Topsoil Restoration, w/ Class 1, Urban, Type B Erosion Mat	SY	7,800	\$5.00	\$39,000
8	630.0140	Turfgrass Seed Mix	SY	7,800	\$2.00	\$15,600
9	SP	Construction Staking	LS	1	\$3,500.00	\$3,500
10	416.1720	Concrete Flume Removal and Replacement	SY	700	\$80.00	\$56,000

Total Opinion of Probable Construction Cost \$251,000

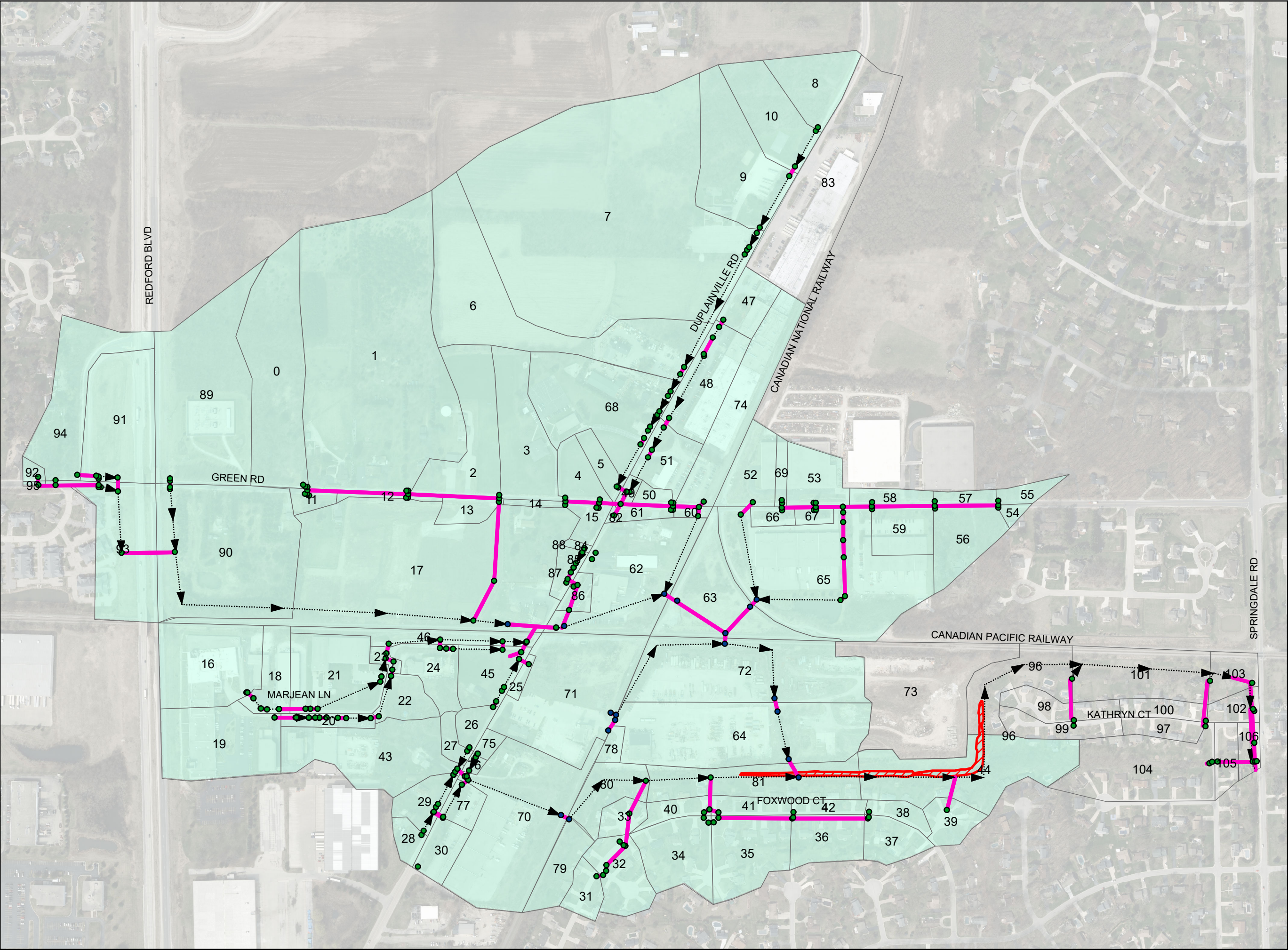
Surveying & Design Engineering (~10%) \$26,000

Construction Administration/Observation (~10%) \$26,000

Contingency (~15%) \$46,000

Total Opinion of Probable Surveying, Engineering Design, Construction, and Administration/Inspection Cost Estimate \$349,000

Figures



FOXWOOD-KATHRYN
COURT DRAINAGE STUDY
DRAINAGE BASIN
STUDY AREA
BASIN

City of Pewaukee, WI

Legend

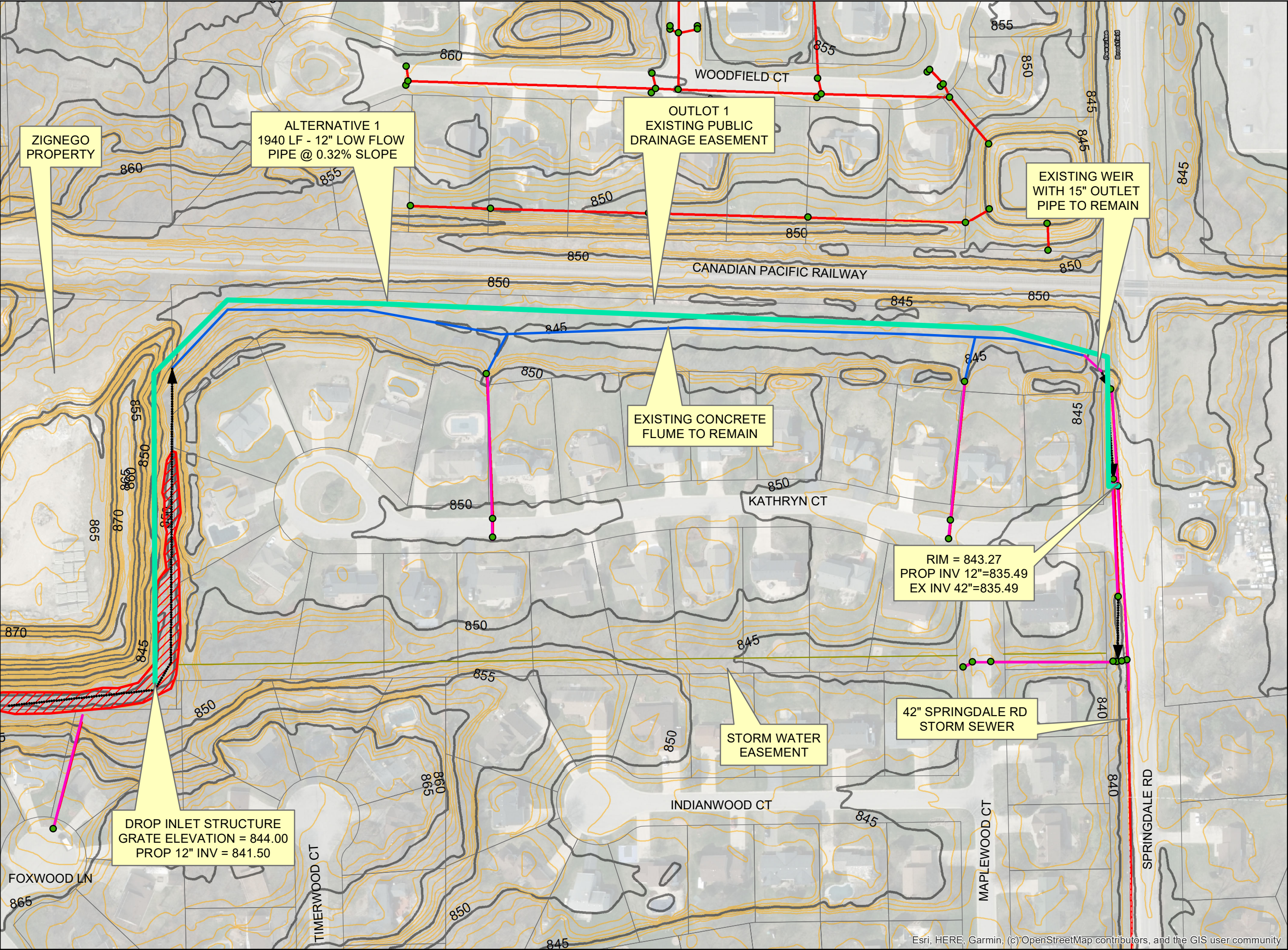
- EXISTING MODELED STORM PIPE
- EXISTING MODELED DITCH
- STORM STRUCTURES
- FOXWOOD CT DITCH PONDING AREA DRAINAGE BASIN
- SUB-BASINS (LABELED WITH SUB-BASIN ID)
- PONDING AREA

AECOM

Drawn By:	SDP
Checked By:	RE
Date:	8/20/2020
Project #:	60339891

Projection: NAD 1927 StatePlane Wisconsin South FIPS 4803	FIGURE 1
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FOXWOOD-KATHRYN
COURT DRAINAGE STUDY
ALTERNATIVE 1

City of Pewaukee, WI

Legend

- EXISTING MODELED STORM PIPE
- EXISTING MODELED DITCH
- EXISTING CONCRETE FLUME MODELED AS DITCH
- STORM STRUCTURES
- NON-MODELED EXISTING STORM PIPE
- PONDING AREA
- PROPOSED 12" STORM SEWER
- 5' CONTOUR
- 1' CONTOUR
- PROPERTY LINE

AECOM

Drawn By: SDP

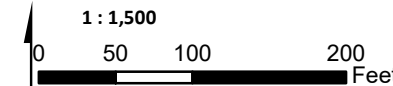
Checked By: RE

Date: 8/20/2020

Project #: 60339891

Projection:
NAD 1927 StatePlane Wisconsin
South FIPS 4803

FIGURE
2



FOXWOOD-KATHRYN
COURT DRAINAGE STUDY
ALTERNATIVE 2

City of Pewaukee, WI

Legend

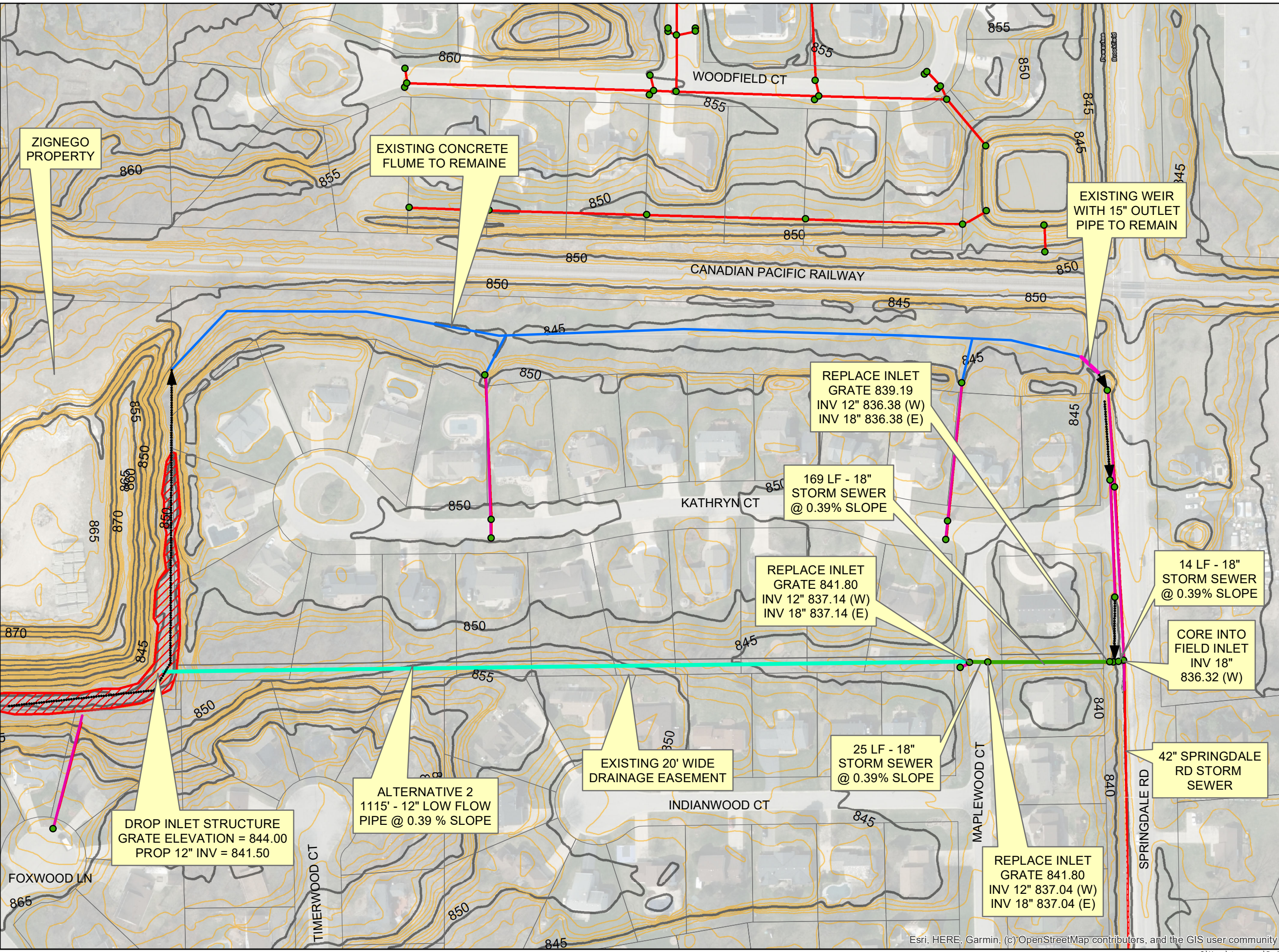
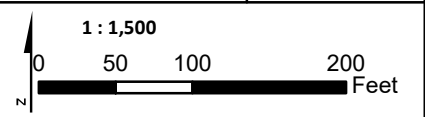
- EXISTING MODELED STORM PIPE
- EXISTING MODELED DITCH
- EXISTING CONCRETE FLUME MODELED AS DITCH
- STORM STRUCTURES
- NON-MODELED EXISTING STORM PIPE
- PONDING AREA
- PROPOSED 12" STORM SEWER
- PROPOSED 18" STORM SEWER
- 5' CONTOUR
- 1' CONTOUR
- PROPERTY LINE

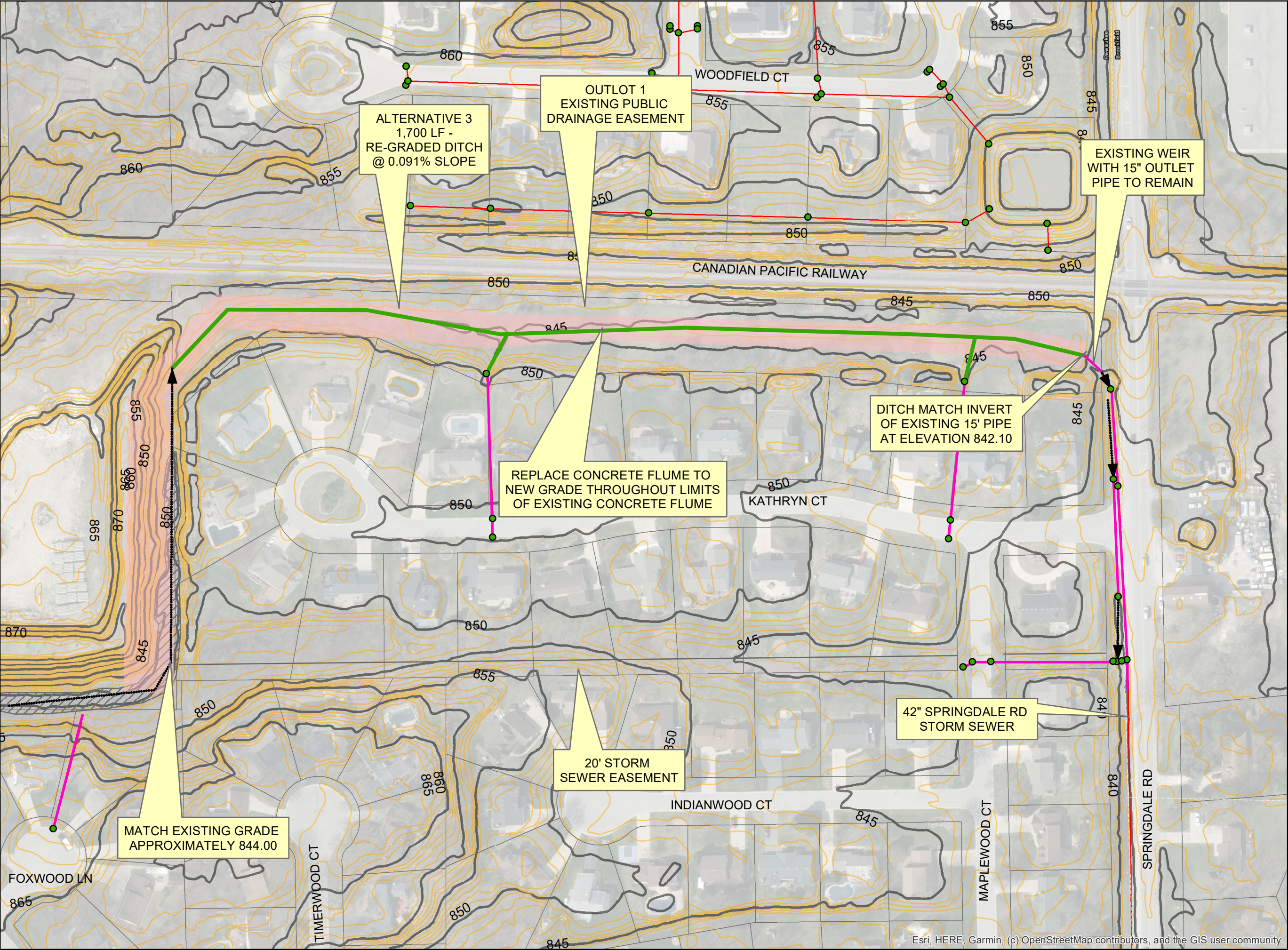


Drawn By:	SDP
Checked By:	RE
Date:	8/20/2020
Project #:	60339891

Projection:
NAD 1927 StatePlane Wisconsin
South FIPS 4803

FIGURE
3





FOXWOOD-KATHRYN
COURT DRAINAGE STUDY
ALTERNATIVE 3

City of Pewaukee, WI

Legend

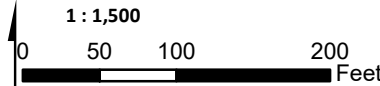
- EXISTING MODELED STORM PIPE
- EXISTING MODELED DITCH
- PROPOSED CONCRETE FLUME MODELED AS DITCH
- STORM STRUCTURES
- NON-MODELED EXISTING STORM PIPE
- PONDING AREA
- 5' CONTOUR
- 1' CONTOUR
- PROPERTY LINE
- RE-GRADED DITCH

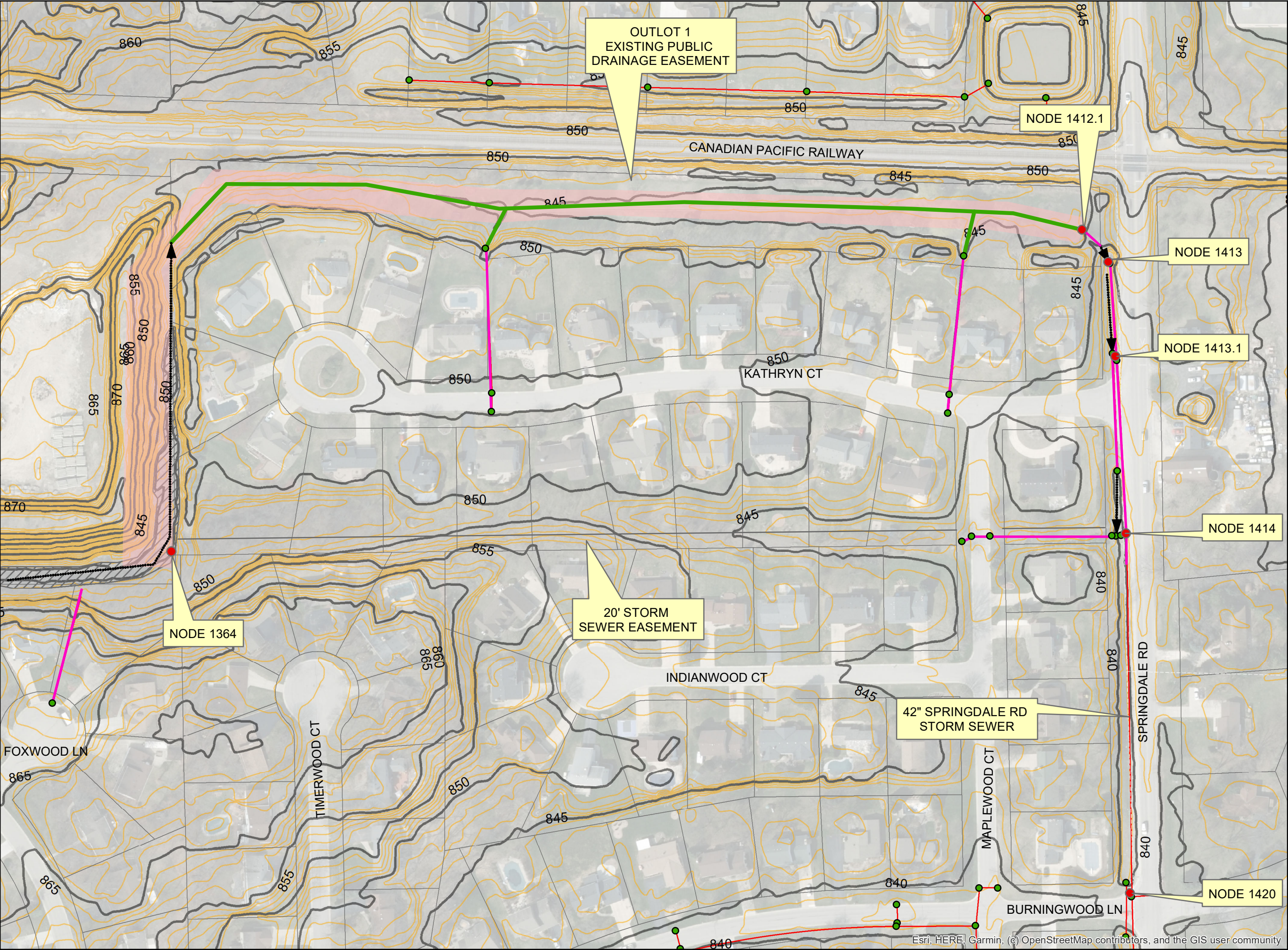
AECOM

Drawn By:	SDP
Checked By:	RE
Date:	8/20/2020
Project #:	60339891

Projection:
NAD 1927 StatePlane Wisconsin
South FIPS 4803

FIGURE
4





FOXWOOD-KATHRYN
COURT DRAINAGE STUDY
XP SWMM MODEL
NODE LOCATIONS

City of Pewaukee, WI

Legend

- EXISTING MODELED STORM PIPE
- EXISTING MODELED DITCH
- PROPOSED CONCRETE FLUME MODELED AS DITCH
- STORM STRUCTURES
- NON-MODELED EXISTING STORM PIPE
- PONDING AREA
- 5' CONTOUR
- 1' CONTOUR
- PROPERTY LINE
- RE-GRADED DITCH
- XP SWMM MODEL NODE LOCATION



Drawn By:	SDP
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Projection:
NAD 1927 StatePlane Wisconsin
South FIPS 4803

FIGURE
5

