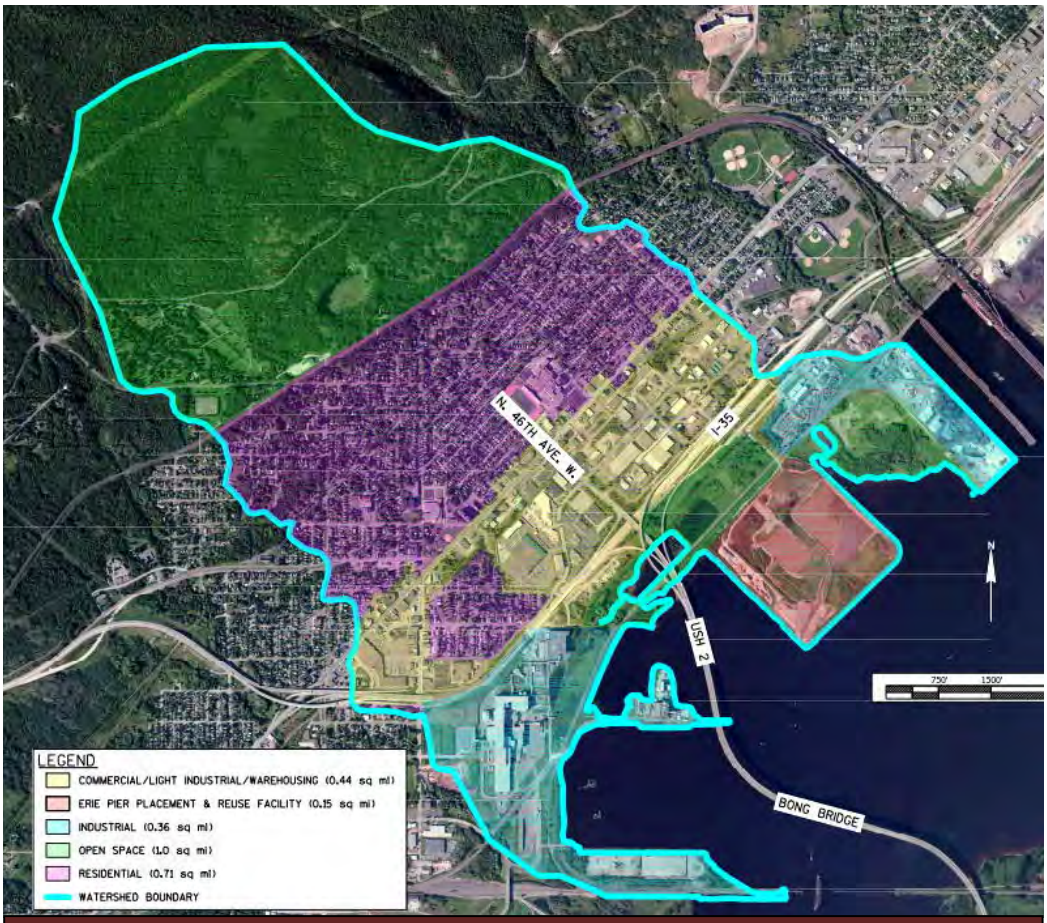
FOCUSED FEASIBILITY STUDY REPORT
FOR
40TH AVENUE PROJECT AREA
IN THE ST. LOUIS RIVER AREA OF CONCERN

August 28, 2015

APPENDIX C. WATERSHED EVALUATION for the 40TH AVENUE WEST PROJECT AREA IN THE ST. LOUIS RIVER AREA OF CONCERN



40th Avenue West Watershed Evaluation

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WATERSHED EVALUATION

for

40TH AVENUE WEST REMEDIATION TO RESTORATION PROJECT AREA IN THE ST. LOUIS RIVER AREA OF CONCERN

August 28, 2015

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LIST OF ACRONYMS AND ABBREVIATIONS

AC	Acres
AOC	Area of Concern
APE	Area of Potential Effects
ASTM	American Society for Testing and Materials
BMP	Best Management Practice
BUI	Beneficial Use Impairment
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
COC	Chain of Custody
COD	Chemical Oxygen Demand
CORPS	U.S Army Corps of Engineers
CWA	Clean Water Act
CY	Cubic Yards
DQO	Data Quality Objective
DTM	Digital Terrain Model
FFS	St. Louis River 40th Avenue West Focused Feasibility Study
FLV	Floating Leaf Vegetation
GIS	Geographical Information System
GIS	Geographic Information System
GPS	Geographic Positioning System
IGLD	International Great Lakes Datum of 1985
IGLD 85	International Great Lakes Datum of 1985
Jewell	Jewell Associates Engineers (USFWS Contractor)
LF	Linear Foot
LS	Lump Sum
LWD	Low Water Datum
MEP	Maximum Extent Practicable
MERLA	Minnesota Environmental Response and Liability Act
MDNR	Minnesota Department of Natural Resources
MPCA	Minnesota Pollution Control Agency

MS4	Municipal Separate Storm Sewer System
NAD	North American Datum
NAVD	North American Vertical Datum
NPDES	National Pollution Discharge Elimination System
NOAA	National Oceanic and Atmospheric Administration
OHWM	Ordinary High Water Mark
ROW	Right of Way
RSPT	Regional Stormwater Protection Team
SAV	Submerged Aquatic Vegetation
SLRA	St. Louis River Alliance
SLRAOC	Saint Louis River Area of Concern
Stantec	Stantec Consulting Services (USFWS Contractor)
SQT	Sediment Quality Target
SY	Square Yards
TES	Threatened, Endangered or Special Concern Species
TKN	Total Kjehldahl Nitrogen
TSS	Total Suspended Solids
USACE	United States Army Corps of Engineers
USEPA/EPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geographical Survey
USH	United States Highway
WDNR	Wisconsin Department of Natural Resources

GLOSSARY

Area of Potential Effects (APE) – The maximum area that may be affected by a project for the purpose of determining direct and indirect effects to historic resources.

Backwater - Backwater is the increase in the upstream water surface level resulting from an obstruction in flow, such as a roadway with a bridge or culvert opening.

Basin – see drainage basin

Bathymetry-is the study of underwater depth of lake or ocean floors. For this study it refers to the topography of the floor of the St. Louis River.

BMP – Best Management Practices – Term used to describe accepted activities, prohibitions of practices, maintenance procedures, and or other management practices to prevent or reduce pollution of stormwater runoff.

Cfs – cubic feet per second, a unit of measure of flow (448.8 gallons per minute).

Drainage Basin – an extent of land within which water flows down into a specified body, such as a river, or lake. (see watershed)

Forebay - an area at the inlet of a stormwater pond used to settle out larger sediments so that sediment removal will be easier

Hydraulic grade line – for open-channel flow (flow with a free surface), a line corresponding with the water surface; under pressure (such as pipes flowing full), the hydraulic grade line is what the level water would rise to in a small vertical tube connected to the pipe.

Lidar – which stands for Light Detection and Ranging, is a remote sensing method that uses a pulsed laser to measure ranges to the Earth. Lidar data is generally collected from equipment mounted on airplanes. The pulsed laser measurements, combined with other data recorded by the airborne system, generate precise, three-dimensional information about the shape of the Earth and its surface characteristics.

Maximum Extent Practicable (MEP) –A regulatory term, in the case of this Focused Feasibility Study referring to stormwater control and treatment, describing the point where the limitation of technology, project cost, and/or site constraints make full achievement of a regulatory requirement impracticable. Often the defining characteristics of MEP is left up to interpretation by the designer and the reviewer of each project. This can result in different definitions and standards for individual projects.

Non Point Source Pollution – In the context of this report non point source pollution (NPS) refers to surface water pollution washed off parking lots, roads and highways, and lawns (often containing fertilizers and pesticides).

Ordinary High Water Mark - The Ordinary High Water Mark is used to determine the extent of public water. Land disturbance activities below or near the OHWM often requires State or Federal permitting. Minnesota Statutes 103G.005 Subd. 14. states "Ordinary high water level. 'Ordinary high water level' means the boundary of waterbasins, watercourses, public waters, and public waters wetlands, and: 1.the ordinary high water level is an elevation delineating the highest water level that has been maintained for a sufficient period of time to leave evidence upon the landscape, commonly the point where the natural vegetation changes from predominantly aquatic to predominantly terrestrial; 2.for watercourses, the ordinary high water level is the elevation of the top of the bank of the channel; and 3.for reservoirs and flowages, the ordinary high water level is the operating elevation of the normal summer pool." For the purpose of interpreting Section 404 of the Clean Water Act, The Army Corps defines the term as follows: "The term ordinary high water mark means that line on the shore established by the fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas." The State of Minnesota and Federal OHWA can vary which has legal, regulatory and real estate/property rights implications.

Outfall – A point of discharge of stormwater or wastewater. Generally the end of a pipe or swale.

Point source – A single discernible source of pollution, such as a storm sewer outfall.

Storm Event – a rainfall event of a specific duration, intensity, and frequency. (see 100-year event).

Watershed - an extent of land within which water flows down into a specified body, such as a river, or lake. (also see drainage basin)

WinSLAMM– A Windows based Source Loading and Management Model used to evaluate stormwater control practices.

INTRODUCTION

On behalf of the US Fish and Wildlife Service (USFWS) and the St. Louis River Area of Concern, Jewell Associates Engineers (Jewell) conducted a watershed evaluation to determine possible contamination and hydrological influences on the 40th Avenue West Project Area in the St. Louis River Area of Concern (AOC) located in Duluth, Minnesota. Field surveys were performed to identify sources of potential surface water discharges and to map storm sewer and culvert outfalls, streams, and drainage channels within the shoreline area of the project location. Field data was compared to online sources as well as GIS mapping provided by the City of Duluth. As a result of the evaluation, it was determined that potential sources of pollution to the 40th Avenue West Project Area, although conveyed via storm sewers, are largely non-point source in nature and identifying and mitigating those sources will likely result in the most cost effective means of improving water quality entering the river from the watershed. This report also contains preliminary designs and opinions of probable cost for "end of pipe" stormwater treatment options. These include concepts for the modification of the existing ponds behind Erie Pier and construction of a sediment trap for a large city stormsewer near the northwest side of these ponds.

WATERSHED DESCRIPTION

The 40th Avenue West Project Area watershed is a developed urban area with a mix of commercial, industrial, and residential land use. The watershed boundary to the Project Area is shown in Figure 2 in Appendix A. The total land area of this watershed area is approximately 1702 acres (2.66 square miles). An approximate breakdown of the land uses in the watershed is shown in Table 1.

Table 1. Land Use Areas

Land Use	Area (Acres)	Area (square miles)	Percentage of Total Area
Open Space	640	1.00	37.6
Residential	454	0.71	26.7
Commercial/Light Industrial/Warehousing	282	0.44	16.5
Industrial	230	0.36	13.5
Erie Pier Placement & Reuse Facility	96	0.15	5.6
Total	**1702**	**2.66**	**100**

A majority of the stormwater from the 40th Avenue West watershed is collected in storm sewers and is conveyed to the St. Louis River. The storm sewer outfalls are shown in Figure 3 in Appendix B. Information received from the City of Duluth and data collected as part of a topographic survey performed by Jewell between June 2 and September 25, 2014, were used to

map the outfall locations. A substantial portion of the watershed discharges to a system of swales, ponds, and wetlands along the shore of the St. Louis River, prior to making its way to the river. The two streams that enter the ponds behind Erie Pier are primarily fed by city storm sewers and runoff from Interstate 35. One stream discharges in the southwest end of the ponds and the other in the northeast end. The streams and ponds are shown in Figure 4 in Appendix C.

Photo 1. Headwater of stream that flows to the ponds behind Erie Pier

Photo 2. Drainage channel conveying stormwater from Interstate 35 near stream headwaters.

A field survey of land use and activities within the 40th Avenue West watershed was conducted to determine potential sources of stormwater runoff. The survey consisted mainly of investigating the watershed area and noting different land uses that could generate significant volumes of stormwater runoff or potentially contaminated runoff. The businesses and activities of primary interest were those with large parking lots, heavy truck traffic, and that store, use, manufacture, or sell chemicals or other materials that could potentially lead to contaminated runoff, especially where stored materials were exposed to rainfall and snowmelt. A photo log from the field survey is included in Appendix D. Each photo includes a description of the business, a list of potential materials stored outside, and a list of potential materials that could contribute to stormwater contamination. It should be noted that the survey was not intended to serve as an ASTM Phase 1 Environmental Site Assessment (ESA). The investigation was cursory in nature and visual observations were made of from the public right-of-way. Public records of past or present contamination were not evaluated for this report.

Some examples of the types of businesses located within the watershed that have the potential to contribute to stormwater contaminants include filling stations, automotive repair shops, salvage yards, construction contractors, distribution centers, industrial supply centers, manufacturers, welding and machine shops, and power generation facilities. These businesses have the potential for past or future chemical spills, accidents, illegal disposals, leaking storage tanks, poor waste management, exposed material storage, or similar practices that may contaminate stormwater runoff from the watershed.

During the field investigation, one potential illicit discharge was discovered. A milky white discharge was observed flowing from a concrete storm sewer near the intersection of Ramsey Street and Recycle Way, as shown in Photo 3 (following page). The outfall is number 9 shown in Figure 3 in Appendix B. The discharge was later reported to the Minnesota Pollution Control Agency (MPCA) who did not observe the same conditions during their visit to the site.

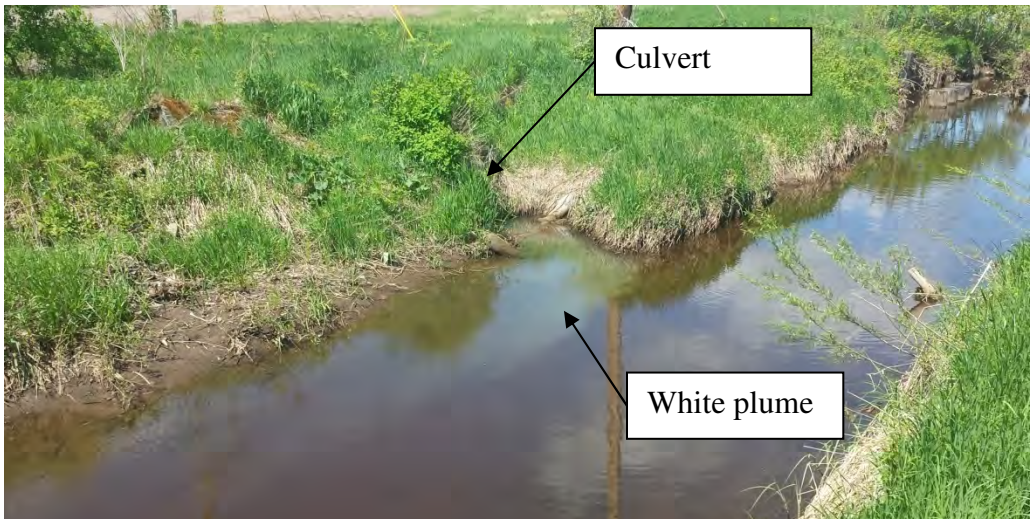


Photo 3. Culvert pipe with illicit discharge.

LAND USE STORMWATER IMPACTS

The following is a brief discussion of how various land uses identified in the watershed (Figure 2 – Appendix A) may contribute to contaminated runoff.

Residential Land Use

Residential areas contribute to non-point source stormwater discharges. Runoff from residential driveways, sidewalks, roads, roofs, and sloped lawns can contribute pollutants such as sediment, nutrients, oil and grease, metals, and bacteria. Some sources of these pollutants include; unstabilized bare ground, over application of fertilizers, pet and lawn wastes, vehicles, garbage, and metal roofs, gutters and downspouts.

Open Space Land Use

Open space is generally beneficial when working with stormwater and stormwater pollution control. Vegetated areas slow down surface water runoff, which not only allows pollutants to settle out, but also reduces peak runoff flows and allows surface water to infiltrate. Unfortunately, a majority of the open space within the 40th Avenue West watershed is located on the upstream side of the watershed so only a small portion of open space is available to buffer stormwater runoff from the other land use areas prior to discharging into the river. Protecting the remaining open space in the watershed from development, or utilizing low impact design for development, will be important for maintaining the current health of the watershed. The open space located in the upstream extents of the watershed is primarily steep hillside which may result in more sedimentation and runoff from the watershed if disturbed or developed.

Commercial/Light Industrial/Warehousing Land Use

The Commercial/Light Industrial/Warehousing area consists of businesses such as filling stations, automotive repair shops, construction contractors, distribution centers, industrial supply centers, manufacturers, and welding and machine shops. These businesses may be currently contributing, or have the potential to contribute to stormwater pollution due to the chemicals or materials used or sold as part of their operations. Many of the businesses located in this land use area also have large parking lots and considerable vehicle traffic which can contribute to oil, grease, and total suspended solids (TSS) in stormwater runoff.

Industrial Land Use

Industrial areas within the watershed are located along the river. There are primarily three significant industrial sites along the river within the watershed; a paper manufacturer, a salvage yard, and a power plant. There are also railroad properties along the water's edge throughout the project limits. The industrial facilities include large areas of impervious surfaces which increase runoff volume. Some of these sites have areas with large amounts of outdoor material stockpiles and storage that are unprotected from the elements.

In addition to these non-point sources, there is also the potential for point source pollution depending on how the industrial facilities operate and follow discharge requirements. At the paper facility, it appears runoff from some areas of the main plant drain to private stormwater treatment facilities. There is, however, a large pulpwood storage area at the southern extent of the 40th Avenue West Project Area located on what appears to be an old dock. Logs are stored under a blanket of snow and ice, some of which the facility creates with snowmaking equipment. There appears to be a channel that runs west to the river along the south side of this pile. This channel was not evaluated for contamination, but it potentially contains contaminated runoff from the wood storage area. According to a report titled "Review of environmental effects and treatment of runoff from storage and handling of wood" by Åsa Hedmarka, and Miklas Scholzb (Hedmarka & Scholzb, 2007), *"the principal environmental problem of (storage area) runoff is usually the high concentration of organic substances originating from the wood and bark, some of which are toxic to aquatic life. Phosphorus is also a problem according to some studies. The toxicity of the runoff varies greatly, and depends on the species of tree stored, the amount of water the wood has been in contact with and the degree of runoff treatment"*.

In addition to runoff from wood and bark, it appears the facility utilizes sawdust and/or wood chips as an insulator, which has the potential to runoff and contribute to stormwater contamination. Sediment samples taken from the bottom of the bay, offshore from where the drainage channel discharges, contain a "coffee ground" material that has been identified as

decomposing wood. This insulating material could contribute to the anthropogenic (wood) substrates found in the waters north of the storage area (see parcel 234 Figure 15) although much of this wood waste is likely the result of the past saw mills in this area.

Photo 4. Wood storage at south end of project area.

On the north side of the project area there is a large salvage yard that drains to the ponds behind Erie Pier. Runoff from salvage yards may contain automotive fluids, oils and grease, heavy metals, mercury, chlorinated solvents, and arsenic. Initial sediment sampling by others indicates these ponds may contain contaminated sediments. If remedial action is taken to treat or dispose of the pond sediment, and thereafter the ponds are modified for improved stormwater function, it is highly advised to further investigate potential sources of pollution to these ponds to reduce future contamination. Strategies for modifying the ponds behind Erie Pier to improve the stormwater treatment function will be discussed later in this report.

Photo 5. Salvage Yards at north end of project area.

Erie Pier Placement and Reuse Facility

The Erie Pier Placement and Reuse Facility has a separate designation due to its unique purpose of depositing and dewatering maintenance dredging material from the harbor. At this site there are a series of ponds and channels that are used to process dredge materials. Water is managed internally and no water discharges directly to the river. To aid in water management, a pipe was installed in 1993 connecting Erie Pier to the Duluth municipal wastewater collection system so that excess water could be treated and discharged via the WLSSD treatment facility. The pier's management plan identified evaluating other means of handling water should the need arise. The facility maintains compliance with all applicable permits. Sediments are tested for contamination prior to offloading and no evidence of discharges was observed. However, if a sediment runoff event did occur, it would be returning back to the harbor where it originated. By all appearances this facility does not contribute to the stormwater runoff within the watershed.

Thermal Impacts to Stormwater

One additional land use impact not always considered is thermal impacts from impervious surfaces. Hard surfaces, such as roofs and pavements, can increase the temperature of stormwater runoff and thermally impact receiving waterbodies. This is often referred to as the Urban Heat Island Effect. While coldwater fisheries tend to be particularly sensitive to thermal pollution, there can be effects to organisms in any waterbody due to rapidly changing water quality and temperature effecting normal activity which introduces stress.

CITY OF DULUTH STORMWATER MANAGEMENT PROGRAM

City Stormwater Efforts

The City of Duluth is authorized under the National Pollution Discharge Elimination System (NPDES) and a Clean Water Act (CWA) Municipal Separate Storm Sewer System (MS4) General Permit to discharge stormwater. As part of the MS4 requirements, the City must develop a Stormwater Pollution Prevention Program (SWPPP) which includes restrictions on discharging into designated waters, including the St. Louis River. This program requires all proposed development and redevelopment to include temporary and permanent erosion control, as well as sediment control Best Management Practices (BMPs).

The City has the required programs in place to achieve compliance with its NPDES Permit. The City maintains stormwater specific staff, including six water quality specialists that perform field investigations and outreach efforts. In addition, through a partnership with the Regional Stormwater Protection Team (RSPT), the stormwater staff performs "mutual support, education and outreach regarding protection of their shared Western Lake Superior watershed". The Duluth Stormwater Utility also hosts numerous small events and speaks at schools regarding the importance of stormwater protection. Additional information regarding the City's stormwater program can be found at http://www.duluthmn.gov/public-works-utilities/storm-sewers/. Minimizing nonpoint source pollution is the most effective way to control pollution in stormwater, and public education and outreach can be an effective tool in communicating this message.

The City's stormwater management efforts are of benefit to the estuary. Compliance monitoring and education and outreach efforts are likely resulting in an improvement to stormwater quality in the estuary. The following pollution mitigation efforts, although likely only serving as a reminder to the community, may provide additional gains in the quality of stormwater discharges. One area where the city can be assisted in its stormwater improvement efforts is if funding can be secured for the point source mitigation efforts described starting on page 10. Additional treatment capacity may help the city realize additional compliance goals in fulfillment of their NPDES Permit.

POTENTIAL NON-POINT SOURCE MITIGATION

The following are some concepts for reducing stormwater pollution from the 40th Avenue West watershed.

Non-point Source Control

1. Continue to raise public awareness of potential stormwater pollution issues with local businesses and residents through publicity events or mailings.
2. Continue to enforce current city ordinances regarding pre- and post-construction site erosion control and stormwater management practices.
3. Water quality sampling at storm sewer outfalls could determine the level of pollution contributed by different areas of the watershed and could possibly determine areas to focus stormwater pollution management efforts. This is especially important if the ponds behind Erie Pier are remediated and modified to improve stormwater treatment.
4. Consider more stringent enforcement of erosion control and stormwater post development standards for redevelopment sites. Requiring upgraded BMPs during redevelopment is likely the principle means of increasing the use of runoff control and treatment practices in the watershed.
5. Preserve undeveloped space where possible and/or look for means to require or encourage low impact design for new development.
6. Evaluate placement of City maintained BMPs within the watershed. As previously discussed, this watershed is nearly fully developed and opportunities for BMP placement may be limited. There are options available, however, to retrofit existing storm sewer systems. Inlet filter baskets, catch basins and other proprietary stormwater treatment devices are options to retrofit existing infrastructure. Inspection and maintenance of these options is often fairly involved in that they need to be cleaned and filter media replaced annually at a minimum. Visual inspection should occur even more frequently. Strategic placement of such practices such as near filling stations, exposed industrial areas, or parking lots near commercial areas may be the most cost effective approach. Further evaluation and sampling of the watershed may help define strategic placement of BMPs.
7. One observation made during the field survey was the lack of sediment control on a redevelopment site located in the commercial area of the watershed. There were no sediment tracking pads on any of the construction entrances/exits. Sediment was tracked onto the adjacent city streets and alley (Photo 6) creating the potential for runoff of sediments. While this may be an enforcement issue, an evaluation of erosion control requirements for redevelopment or infill development projects may be warranted.

Photo 6. Redevelopment site with sediment tracked onto adjacent alley.

POTENTIAL POINT SOURCE MITIGATION

Potential sources of polluted stormwater runoff to the 40th Avenue West Project Area, although conveyed via storm sewers, are largely non-point source in nature. Identifying and mitigating those sources will likely result in the most cost effective means of improving stormwater quality. Although more costly, point source controls may be the most reliable and fastest way to obtain measurable pollutant loading reductions within the AOC. Therefore, preliminary designs and cost estimates were prepared for several point source control concepts, including modification of the existing ponds behind Erie Pier and a sediment trap for a large city stormsewer. Modification of the ponds has been a concept discussed during the development of the 40th Avenue West design process. These treatment concepts were not designed for achievement of a particular water quality or quantity goal, but rather BMPs were integrated into the designs with the goal of achieving water quality improvements to the Maximum Extent Practicable (MEP) based on site constraints.

Based on observations during the field survey, it does not appear that there are any regional stormwater controls in the watershed. This is most likely due to the age of the existing development which most likely took place before regional stormwater plans were implemented. One exception to this may be the ponds located southeast of the I-35 and Highway 2 interchange under the Bong Bridge referred to in this report and other AOC documents as the ponds behind Erie Pier. It is not clear whether these ponds were constructed for stormwater management or for some other purpose. Most likely they served an original function other than stormwater treatment. While they may be currently serving as treatment ponds in a limited capacity, it appears based on modeling that they may not be highly effective at reducing pollution.

The following section of this report includes discussion on various options, including the construction of a sediment trap at the outfall of a large storm sewer, and modifying the ponds behind Erie Pier to potentially improve their effectiveness as stormwater treatment devices. These treatment concepts were not designed for achievement of a particular water quality or quantity goal, but rather BMPs were integrated into the designs with the goal of achiving water quality improvements to the MEP based on site constraints. Opinions of probable cost for the pond modifications ranged from $758,900 to $1,597,400.The estimate for the sediment trap at the stormsewer outfall is estimated at $167,700. These opinions of probable cost do not include the cost of land acquisition or enviromental remediation costs for contaminated sediments. Breakdowns of these costs are presented in Table 4 through Table 7 starting on page 15.

Point Source Control

The drainage entering the ponds is considered point source since the runoff carried by the streams discharges at a distinct location. Point source stormwater treatment typically involves some method to slow the stormwater down to promote settlement of suspended solids. When this involves a pond or sedimentation basin, the design typically includes a controlled outlet to reduce the outflow from the pond or basin during smaller rain events, and enough volume or void space within the pond or basin to store the solids that will settle out. It is also necessary to create a means to access the pond or basin to periodically clean out the captured sediment and for other maintenance purposes.

Point Source Control Alternatives

The following pages contain several alternatives for improving stormwater quality discharging to the 40th Avenue West Project Area.

1. Consider modifying the ponds behind Erie Pier shown in Figure 3 in Appendix C to improve stormwater treatment effectiveness. Two options are discussed below and are illustrated in Figures 4 through 11 in Appendix C.
    a. Option 1 (Figures 5-7, Appendix C). Excavate forebays where the streams enter the ponds at the northeast and the southwest to increase sedimentation. Construct a berm down the middle of the ponds to increase the residence time of the stormwater flows and to prevent short-circuiting to the estuary.
    b. Option 2 (Figures 8-11, Appendix C). Excavate forebays along the streams leading to the ponds. Construct a berm down the middle of the ponds to increase the residence time of the stormwater flows and to prevent short-circuiting to the estuary.

2. Consider constructing a sediment trap at Outfall 2 to improve sediment removal and maintainability of the culvert, as illustrated in Figures 12 and 13 in Appendix C. This request came from discussions with City stormwater staff. A significant amount of sand discharges from this outfall originating from I-35 and local streets in the winter months. They were looking for a better means of accessing this outfall for maintenance.

Comparison of Alternatives

Disturbance

Areas of disturbance were estimated for both proposed pond modification options and include disturbance above the design Low Water Datum (LWD) elevation of 601.1 (NAVD88), pond dredging limits, and pond dredging limits with a bridge buffer. Comparison of disturbance between both options is shown in Table 2 below.

Table 2. Estimated Disturbance of Existing Pond Area

Item	Option 1 (Acres)	Option 2 (Acres)
Disturbance Above Low Water Datum	2.64	7.36
Pond Dredging Limits	8.51	10.45
Pond Dredging Limits with Bridge Buffer	4.18	5.99

For Option 1, the disturbance area includes the large berm, two smaller berms, and access roads. For Option 2, this disturbance area includes the large and smaller berms as well as both sediment forebays. Note that the Option 2 sediment forebays are considered part of the disturbance above the LWD, whereas the sediment forebays in Option 1 are not considered part of the disturbance area. This is because the forebays in Option 1would be within the existing ponds while the forebays for Option 2 are proposed to be constructed outside of the existing ponds.

Pond dredging limits refers to any area of the existing ponds available for dredging minus any areas that contain proposed berms or sediment forebays. This calculation was completed in the event dredging of the bottom of the pond is required for removal of contaminated sediments or additional pond treatment efficiency is desired above what was evaluated (see "Modeling the Impact of Point Source Control"). Areas containing proposed structures were not included in the calculation because dredging or disturbance would already be required for any construction.

Pond dredging limits with a bridge buffer is the same as the pond dredging limits; however it includes a potential 200 foot buffer on either side of the I-35/U.S. Highway 2 interchange/Bong

Bridge in case the federal/state transportation departments would require such a buffer from dredging work being performed around the bridges.

Open Water Area

Table 3 below presents a comparison of the open water area at various elevations between the existing ponds and the modified ponds. The typical water elevation in the ponds is assumed at the design Low Water Datum elevation of approximately 601.1feet (NAVD88). Since the pond modifications of Option 1 are generally located within the existing limits of the ponds, and Option 1 includes the addition of several berms, the open water area of the proposed ponds will be slightly less than the open water area of the existing ponds. Option 2 also includes the addition of several berms; however the open water area of the proposed ponds will increase as sediment forebays are proposed outside the footprint of the existing ponds.

Table 3.Open Water Area of Ponds – Existing vs. Proposed Options.

Elevation	Surface Area (Acres)		
	Existing Ponds	Proposed Option 1	Proposed Option 2
601	12.8	11.6	15.3
602	14.1	12.9	17.0
603	18.8	17.7	19.9
604	26.2	25.3	25.6

Existing Landowners

In order to modify the lower portion of the watershed, including the shoreline along the river and the land in the vicinity of the existing ponds, land or easements may have to be purchased or agreements made with existing landowners. A map of landowners in the pond area is presented in Figure 15 in Appendix C. The map indicates the different shoreline parcels and their corresponding classifications. Landowners of the parcels in the area of concern were identified and classified into seven different categories:

- City of Duluth
- State of Minnesota
- Port Authority
- MN Power & Light
- Right of Way
- Railroad
- Unidentified

The listed categories are generally straightforward: The City of Duluth category includes land owned by the City of Duluth as well as the City of Duluth Municipal Corporation. The State of

Minnesota category includes land owned by the State of Minnesota, including state highway right of way. The Right of Way category includes land that is dedicated for the I-35 corridor and undeveloped land platted as right of way. The Railroad category includes the railroad companies in the area of concern. An enlargement of this map for the existing ponds behind Erie Pier is pictured below in Figure 1 along with a modified legend showing the landowners represented in this portion of the figure.

Figure 1. Shoreline Landowner Map of Existing Pond Area

As shown in the figure, the ponds are partially located on railroad property and lands owned by the State of Minnesota and City of Duluth. Land owned by the State of Minnesota includes highway right-of-way. For maintenance purposes, it may be necessary to acquire the land containing the ponds, and some of the land surrounding the ponds, by fee or easement to ensure accessibility to the ponds for future maintenance.

Photo 7. Existing ponds behind Erie Pier.

Opinion of Probable Costs

Preliminary estimates of probable costs for the pond modifications and sediment trap construction are shown in Tables 4 through 7 below. Units of measure are defined in the list of Acronyms and Abbreviations presented in this report.

Table 4. Preliminary Estimates of Probable Costs - Option 1

Item No.	Description	Quantity	Unit	Unit Price	Total Cost
1	Common Excavation	2,080	CY	$12	$24,960
2	Dredging[1.]	13,650	CY	$25	$341,250
3	Borrow (Fill)	12,790	CY	$15	$191,850
4	Riprap	130	CY	$50	$6,500
5	Geotextile Fabric	200	SY	$3	$600
6	Maintenance Road	1,475	SY	$5	$7,375
7	Erosion Control	1	LS	$5,000	$5,000
8	Restoration	3.10	AC	$2000	$6,200
	Subtotal				$583,735
	Engineering (15%)				$87,560
	Contingency (15%)				$87,560
	Total				**$758,900**

Note: 1. This volume and cost may be offset if dredging of contaminated sediments is required.

Table 5. Preliminary Estimates of Probable Costs - Option 2

Item No.	Description	Quantity	Unit	Unit Price	Total Cost
1	Common Excavation	9,300	CY	$12	$111,600
2	Marsh Excavation	37,050	CY	$20	$741,000
3	Borrow (Fill)	19,995	CY	$15	$299,925
4	Riprap	296	CY	$50	$14,800
5	Geotextile Fabric	200	SY	$3	$600
6	Culvert Pipe	180	LF	$200	$36,000
7	Culvert End Sections	6	EA	$2,000	$12,000
8	Erosion Control	1	LS	$5,000	$5,000
9	Restoration	3.9	AC	$2,000	$7,800
	Subtotal				$1,228,725
	Engineering (15%)				$184,309
	Contingency (15%)				$184,309
	Total				**$1,597,400**

Table 6. Preliminary Estimates of Probable Costs - Sediment Trap

Item No.	Description	Quantity	Unit	Unit Price	Total Cost
1	Common Excavation	750	CY	$12	$9,000
2	Marsh Excavation	750	CY	$20	$15,000
3	Riprap	210	CY	$50	$10,500
4	Geotextile Fabric	430	SY	$3	$1,290
5	Culvert Pipe	115	LF	$300	$34,500
6	Culvert End Sections	2	EA	$2,700	$5,400
7	Gabions	48	CY	$180	$8,640
8	Cellular Concrete Block Mat	3,445	SF	$12	$41,340
9	Erosion Control	1	LS	$2,000	$2,000
10	Restoration	0.65	AC	$2,000	$1,300
	Subtotal				$128,970
	Engineering (15%)				$19,346
	Contingency (15%)				$19,346
	Total				**$167,700**

Table 7. Preliminary Estimates of Probable Costs Comparison

Item	Units	Unit Cost	Option 1	Option 2	Sed. Trap
Common Excavation	CY	$12	$24,960	$111,600	$9,000
Dredging	CY	$25	$341,250	$0	$0
Marsh Excavation	CY	$20	$0	$741,000	$15,000
Borrow (Fill)	CY	$15	$191,850	$299,925	$0
Riprap	CY	$50	$6,500	$14,800	$10,500
Geotextile Fabric	SY	$3	$600	$600	$1,290
Maintenance Road	SY	$5	$7,375	$0	$0
Culvert Pipe	LF	$300	$0	$36,000	$34,500
Culvert End Sections	EA	$2,700	$0	$12,000	$5,400
Gabions	CY	$180	$0	$0	$8,640
Cellular Concrete Mat	SF	$12	$0	$0	$41,340
Erosion Control	LS		$5,000	$5,000	$2,000
Restoration	AC	$2,000	$6,200	$7,800	$1,300
Subtotal			$583,735	$1,228,725	$128,970
Engineering (15%)			$87,560	$184,309	$19,346
Contingency (15%)			$87,560	$184,309	$19,346
Total			**$758,900**	**$1,597,400**	**$167,700**

Further Considerations

Considerations that could affect the option selected for improving the ponds behind Erie Pier include: costs, logistics, natural community impacts, and permitting as described below:

Costs

As shown in Tables 4 through 7, Option 1 at $758,900 is less than half the costs of Option 2 at $1,597,400. During the design process it was theorized that increasing the size and subsequent costs explored in Option 2 would result in a significant increase in treatment efficiency when compared to Option 1. As discussed starting on page 19 this was not the case. Very significant stormwater treatment efficiencies can be gained by employing Option 1. For this reason, more cost effective reductions in stormwater contamination could be achieved by targeting projects upstream in the watershed. An additional consideration is project costs could be reduced by coordinating conversion of these ponds to BMPs during remediation of contaminated sediments from within them. Dredging, hauling and other heavy equipment will already be mobilized to the site performing the sediment removal necessary to increase the volume and reconfigure the ponds.

Logistics

Option 1 and 2 offer similar challenges in construction. Permitting and native community impacts will be discussed in further detail below, but as stated previously, landowner coordination and access will provide a challenge. A majority of the pond site is held in private ownership by the adjacent railroads and access via purchase or permanent easement will need to be established for long term maintenance. With the fact these ponds are likely a liability to the railroad companies they may be willing to part with the property. The most sensible owner/manager of the future ponds BMPs is the City of Duluth. The ponds afford the City credit for pollutant removal under their existing NPDES stormwater permit and the ponds could be an asset for the trail planned for the adjacent abandoned rail corridor.

Natural Community Impacts

The field survey (Figure 16 Appendix C) conducted as part of the 40th Avenue West Focused Feasibility Study found that the vegetation located within the proposed north and south sediment forebay placements consist of cattail marsh, hardwood swamp, and shallow water communities. The cattail marsh community is characterized by tall emergent herbaceous vegetation located in both of the proposed north and south sediment forebays. The dominant species is hybrid cattail (*Typha x glauca*), an invasive species which forms dense mono-specific stands. Additional common species are reed canary grass (*Phalaris arundinacea*), bluejoint grass (*Calamagrostiscanadensis*), and common reed (*Phragmitesaustralis*), of which the native variety

was identified. The hardwood swamp is located in the northwest portion of the proposed north sediment forebay and is characterized by a tree canopy of willows (*Salix spp.*), balsam poplar (*Populusbalsamifera*) and green ash (*Fraxinuspennsylvanica*), with a shrubby understory composed of alder, willows, and red osier dogwood (*Cornussericea*). Non-native species are frequent in this hardwood swamp understory. The shallow water community is located in the east portion of the proposed south sediment forebay and is characterized by water less than 6 feet deep with a plant community of floating and submerged species. Water clarity varied from clear and brown stained to highly turbid. Common species identified included white water lily (*Nymphaea odorata*), duckweed (*Lemna minor*), Canada waterweed (*Elodea canadensis*) and naiad (*Najas flexilis*).The shallow water habitats appear to have been degraded by construction of railroads, roads and berms, and from polluted surface runoff with road salt and nutrient inputs. While these cattail marsh, hardwood swamp, and shallow water communities are not unique or endangered, they will certainly be impacted more by Option 2 than Option 1.

Permitting

In addition to the concerns at the Bong Bridge with MnDOT right of way permitting, there is a concern that these ponds are "in-line" with the streams. Often "in-line" stormwater treatment facilities are discouraged by regulatory agencies. It is advised that any options for the ponds be presented to the regulatory authorities as part of the AOC goals thus offering greater likelihood of permitting success. Discussion of the identified need for disturbance in the ponds for contaminant remediation and substantial gains in pollutant removal efficiency gained through redesigning the ponds as BMPs may provide a strong justification for regulatory support of the project.

MODELING THE IMPACT OF POINT SOURCE CONTROL

Jewell modeled the existing ponds and the Option 1 proposed pond modifications to determine the degree of stormwater treatment. Only Option 1 was modeled as it became evident removal efficiency would not increase significantly over Option 2 to justify roughly double the construction costs. Stormwater volumes or rate control were not directly evaluated in this study.

Modeling was conducted using WinSLAMM software v10.0. WinSLAMM is specifically identified as an approved stormwater model in Wisconsin, Minnesota, and a number of other US States, Government Agencies, and Canadian Provinces http://www.winslamm.com/model_use.html . The modeling predicted significant improvements to water quality resulting from modifications to the ponds behind Erie Pier. Modeling results are shown in the tables 8 and 9. If a refined quantification of pollutant reduction is required, further refinement of the watershed modeling as final designs for the ponds are developed is recommended.

The watershed was divided into two drainage areas for modeling purposes based on surface elevations and which direction stormwater runoff would flow (See Figure 2 in Appendix A). The dividing line within the developed area of the watershed roughly follows North 46th Avenue West. It is assumed that stormwater runoff to the south of the dividing line drains to the southwest pond, and the runoff north of the dividing line drains to the northeast pond. Model inputs include the acres of each land use type and the soil classification for each area as well as . Standard land use files from the model software were used to estimate the percentages of different surface types and impervious surface connectivity. The rainfall data used in the model is from historical data recorded in the Duluth area from rain events during a five year period from January 2, 1981 to December 31, 1985. The program uses data from the NOAA data as published on the EarthInfo CD ROMs. The model results are averages from this five year period.

The stream that discharges in the southwest end of the ponds is approximately 250 feet from the outlet to the St. Louis River. This short residence time in the existing pond will help to settle out some of the larger suspended solids (sand and grit), but it is assumed that it is not very effective in settling out the finer particles. For this reason the southwest drainage area was modeled in WinSLAMM assuming there is no stormwater treatment. The outlet of the stream that discharges in the northeast end of the ponds is approximately 1,700 feet from the river outlet. This allows a much longer residence time in the pond. The longer residence time within the ponds will allow more settling of finer particles. It is assumed that the ponds provide some treatment of the water entering the northeast ends of the ponds; therefore, the northeast drainage area was modeled as a conventional “wet” stormwater treatment pond.

The modeling results for the existing conditions are shown in Table 8. The model indicates a 22 percent reduction in (TSS) from the northeast stream under the existing conditions. Solving for the weighted average with the southwest stream removal of 0 percent TSS leaves a total reduction of approximately 10 percent of TSS. This may be artificially high since there is not a self-contained basin or outlet structure that the water must flow over or through to leave the ponds. The bottom of the ponds is approximately the same elevation as the bottom of the river. In addition, under the existing conditions, the pond level can rise and fall with the river levels, which could potentially re-suspend and wash settled material from the pond bottom out into the estuary.

Table 8.Pollutant Reduction of the Existing Ponds Behind Erie Pier (Existing Conditions)

Pollutant	Pollutant Yield No Controls (lbs.)	Pollutant Yield With Controls (lbs.)	Percent Reduction
Total Suspended Solids (TSS)	$2.043X10^6$	$1.846X10^6$	9.68%
Total Phosphorus	4,810	4,476	6.94%
Total Kjeldahl Nitrogen (TKN)	18,135	17,165	5.35%
Total Chemical Oxygen Demand (COD)	998,026	933,778	6.44%
Total Copper	492.4	463.4	5.89%
Total Lead	601.4	548.2	8.85%
Total Zinc	1,686.5	1,590.1	5.72%

The proposed pond configuration, Option 1, was also modeled using WinSLAMM. The modeling results for Option 1 are shown in Table 9. The model indicates a 72% reduction in TSS. As shown in Figure 5 in Attachment C, the proposed configuration increases the flow path of the water discharging from the southwest stream as well as restricts the flow with an overflow weir as the water leaves the pond and enters the river. These modifications will increase the holding time of the water within the pond and will reduce the amount of sediment that can be washed out of the ponds if the river level fluctuates. The sediment forebays will improve sediment capture and will improve the maintainability of the system by providing better access to the areas where most sediment will accumulate.

Table 9.Pollutant Reduction Resulting from Pond Modifications- Option 1

Pollutant	Pollutant Yield No Controls (lbs.)	Pollutant Yield With Controls (lbs.)	Percent Reduction
Total Suspended Solids (TSS)	1.987×10^6	542,132	72.72%
Total Phosphorus	4,706	2,361	49.83%
Total Kjeldahl Nitrogen (TKN)	17,915	10,883	39.25%
Total Chemical Oxygen Demand (COD)	985,229	525,913	46.62%
Total Copper	486.6	272.4	44.03%
Total Lead	590.5	194.9	67.00%
Total Zinc	1,667	950.8	42.96%

CONCLUSIONS

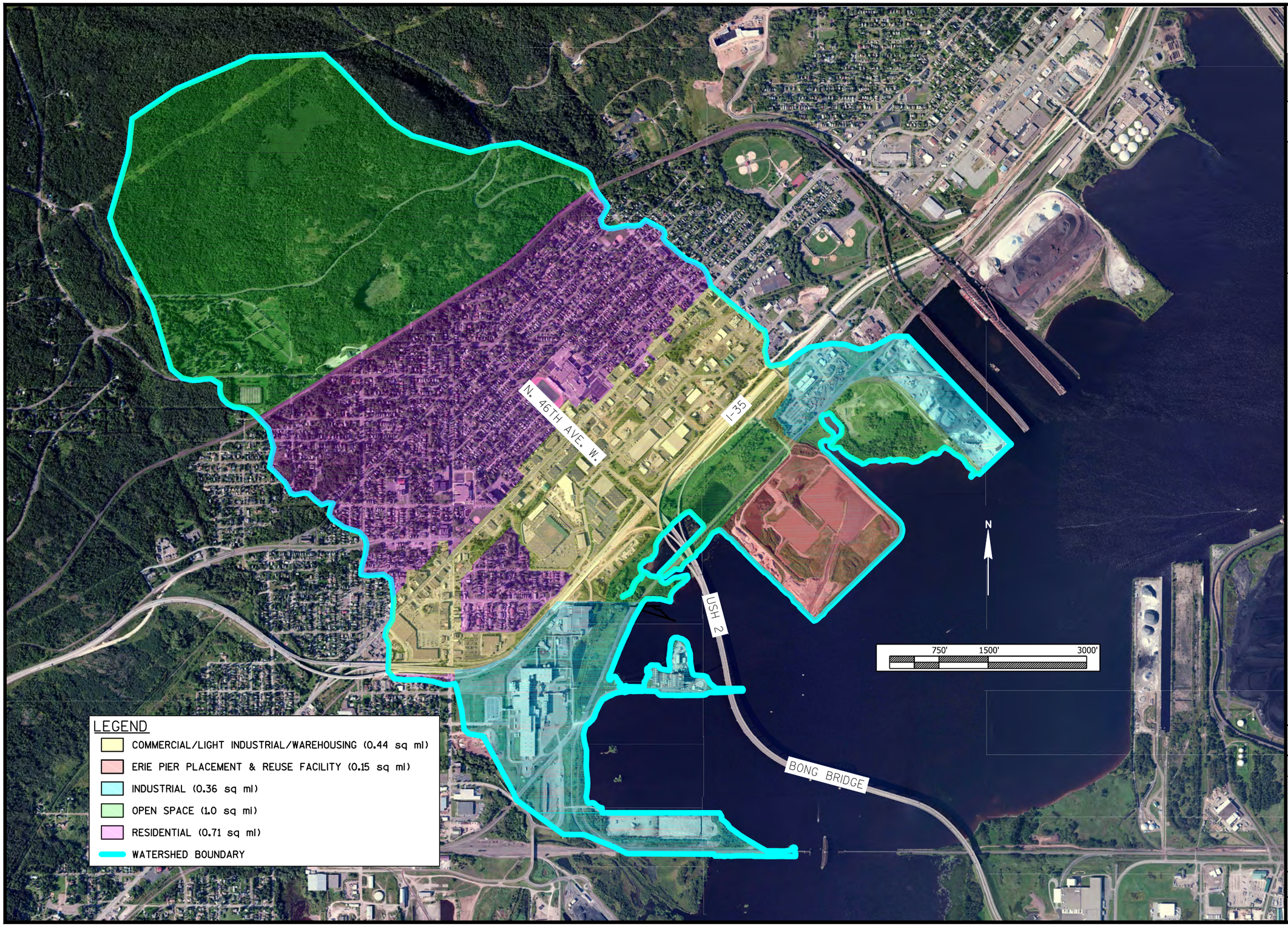
As a result of this evaluation, it was determined that potential sources of contaminated stormwater to the 40th Avenue West Project Area, although conveyed via storm sewers and discharging via point sources to the ponds behind Erie Pier, are largely non-point source in nature. Identifying and mitigating those sources will likely result in the most cost effective means of mitigating stormwater impacts. Although more costly due to construction and long-term maintenance requirements, point source controls may be the most reliable and fastest way to obtain measurable pollutant loading reductions within the area of concern. The preliminary designs and opinions of probable cost for "end of pipe" stormwater treatment options presented in this report can be effective in reducing pollutants released to the estuary.

Further evaluation of non point discharges to the watershed is recommended. Prior to investing in remediation of the sediments in ponds behind Erie Pier, potential sources of contamination should be identified and managed. For example, as previously discussed, the salvage yard north of the ponds is a potential source of contamination and while not directly connected to the ponds, the wood storage area along the south side of the project has the potential to generate contaminated runoff. Stormwater retention or treatment systems at both locations would likely result a reduction in contaminated runoff to estuary.

FOCUSED FEASIBILITY STUDY SUMMARY
FOR
40TH AVENUE WEST REMEDIATION TO RESTORATION PROJECT AREA
IN THE ST. LOUIS RIVER AREA OF CONCERN

August 28, 2015

APPENDIX A – FIGURE 2 – PRIMARY LAND USE



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Date
4/1/2015

Drawing Name
Figure 2 - Primary Land Use Map

Sheet No.
-

Jewell Project Number
U18010

FILE NAME : S:\PROJECTS\U18010 – USFW ST LOUIS RIVER FEASIBILITY STUDY\BASEDATA\WATERSHED MAP.DWG
LAYOUT : FIGURE 2 LAND USE

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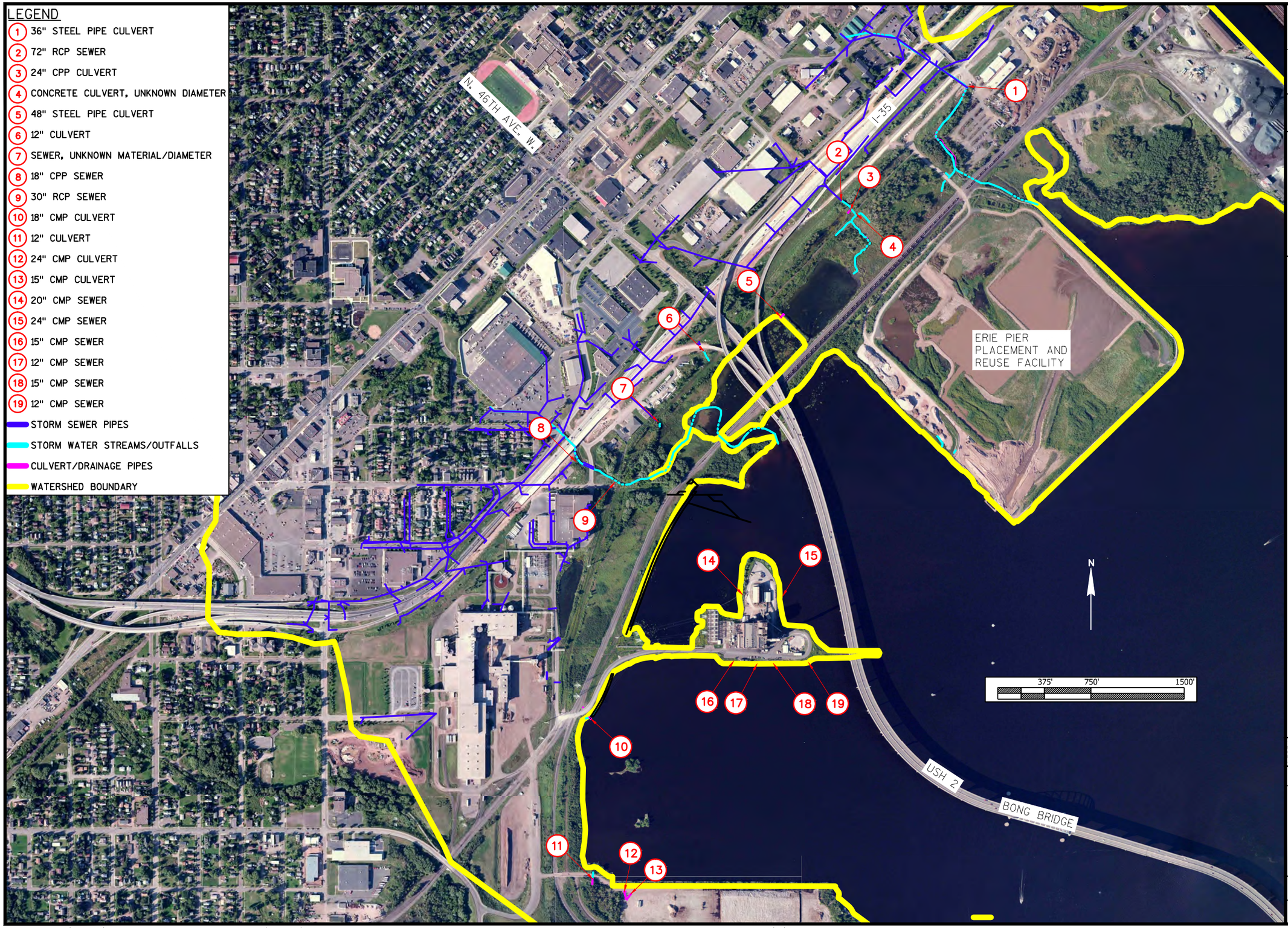
PLOT SCALE : 0.007143

FOCUSED FEASIBILITY STUDY SUMMARY
FOR
40TH AVENUE WEST REMEDIATION TO RESTORATION PROJECT AREA
IN THE ST. LOUIS RIVER AREA OF CONCERN

August 28, 2015

APPENDIX B – FIGURE 3 - STORM SEWER OUTFALL LOCATION MAP



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Date
4/1/2015

Drawing Name
Figure 3 - Storm Sewer Outfall Location Map

Sheet No.
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Jewell Project Number
U18010

S:\PROJECTS\U18010 – USFW ST LOUIS RIVER FEASIBILITY STUDY\BASEDATA\WATERSHED MAP.DWG
FIGURE 3 – STORM SEWER OUTFALL LOCATION MAP

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FOCUSED FEASIBILITY STUDY SUMMARY
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APPENDIX C –POND MODIFICATION CONCEPTUAL PLANS

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4/1/2015

Drawing Name
Figure 4 - Existing Ponds

Sheet No.
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Jewell Project Number
U18010

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LAYOUT : FIGURE 4 – EXISTING PONDS

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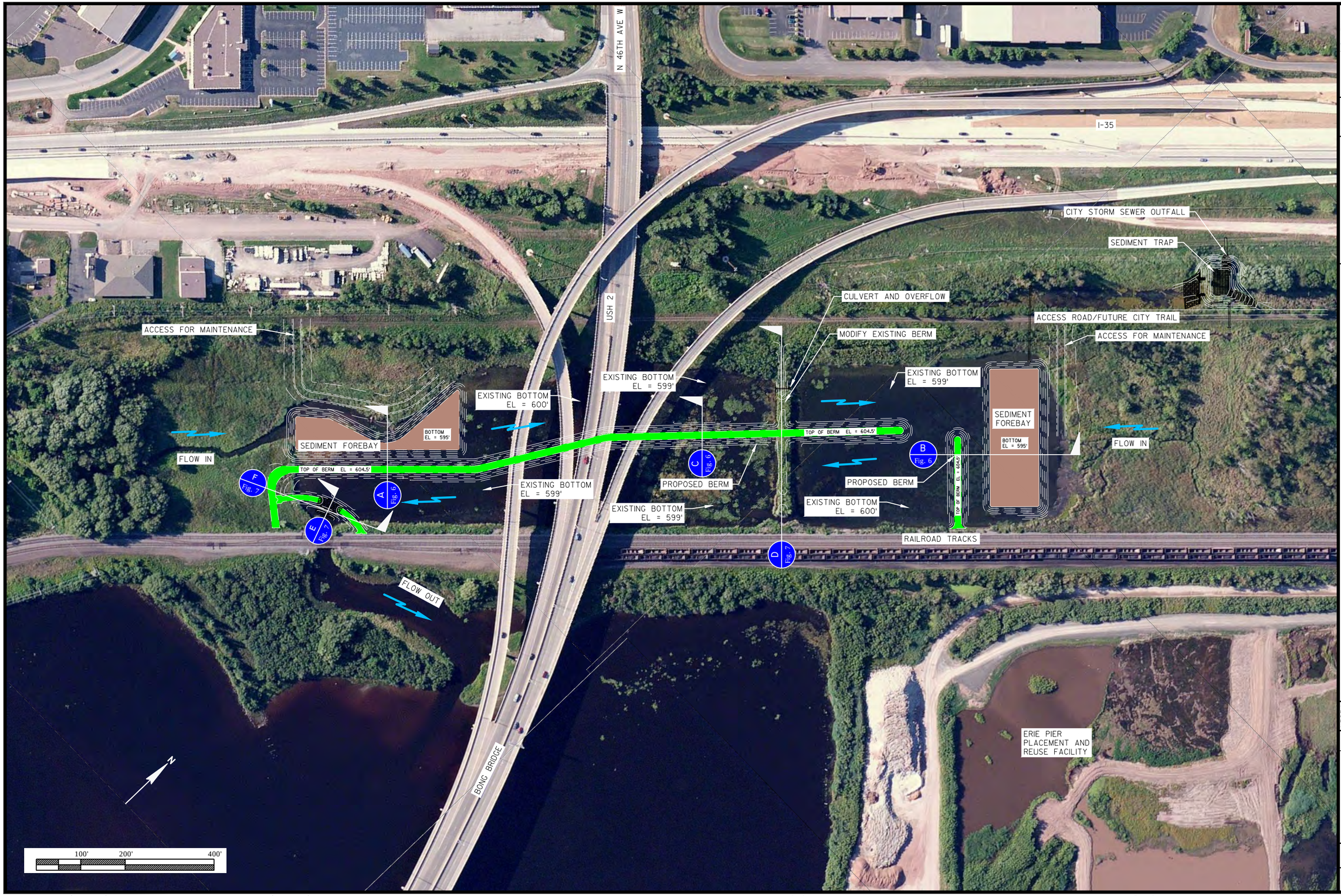

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4/1/2015

Drawing Name
Figure 5 - Option 1 Overview

Sheet No.
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Jewell Project Number
U18010

FILE NAME : S:\PROJECTS\U18010 – USFW ST LOUIS RIVER FEASIBILITY STUDY\BASEDATA\U18010_STORM POND EXHIBITS.DWG
LAYOUT : FIGURE 5 – OPTION 1 OVERVIEW

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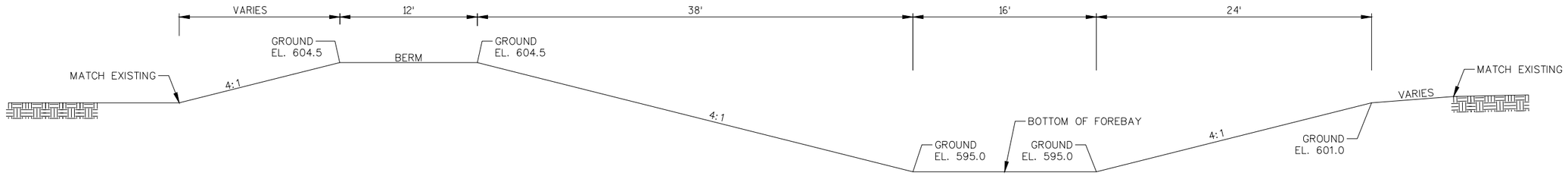

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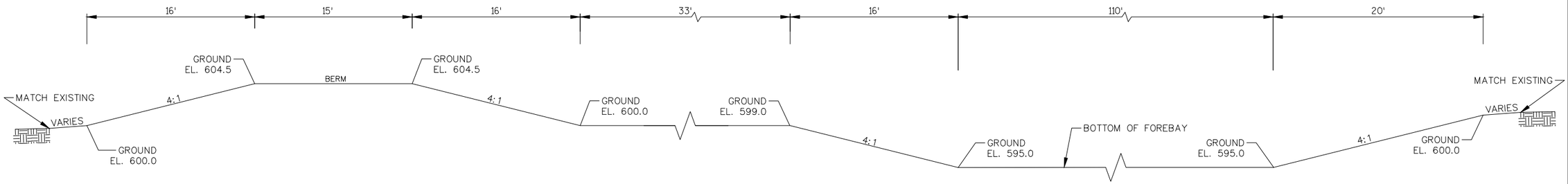

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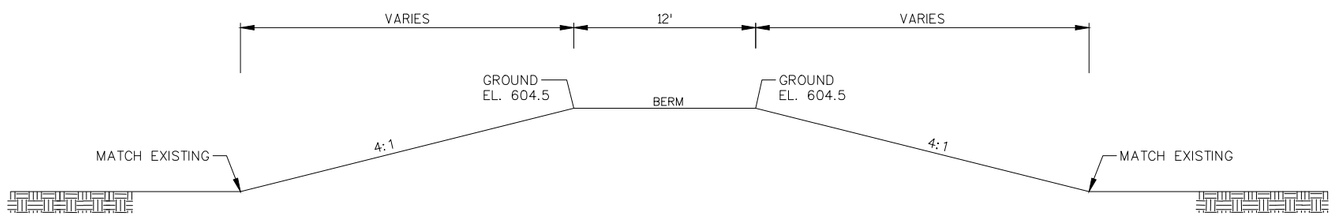

C TYPICAL BERM SECTION
N.T.S.

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Date
4/1/2015

Drawing Name
Figure 6 - Option 1 Sections

Sheet No.
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Jewell Project Number
U18010

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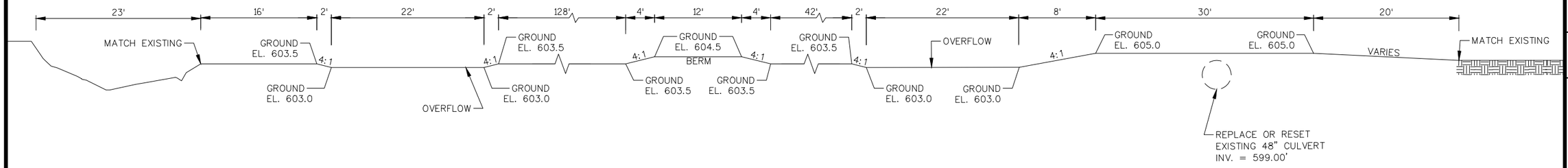

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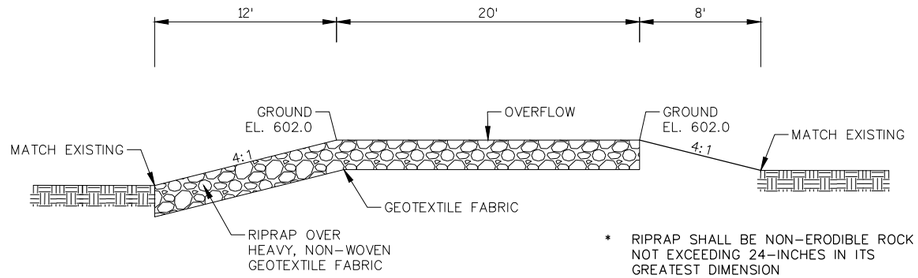
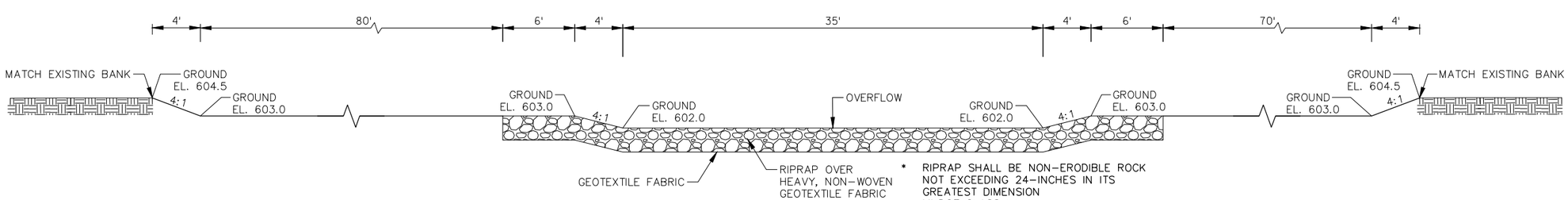


* RIPRAP SHALL BE NON-ERODIBLE ROCK
NOT EXCEEDING 24-INCHES IN ITS
GREATEST DIMENSION
MNDOT CLASS IV
WISDOT CLASS RIPRAP, HEAVY

E OUTLET BERM SECTION
N.T.S.



* RIPRAP SHALL BE NON-ERODIBLE ROCK
NOT EXCEEDING 24-INCHES IN ITS
GREATEST DIMENSION
MNDOT CLASS IV
WISDOT CLASS RIPRAP, HEAVY

F OUTLET BERM SECTION
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Drawing Name
Figure 7 - Option 1 Sections

Sheet No.
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Jewell Project Number
U18010

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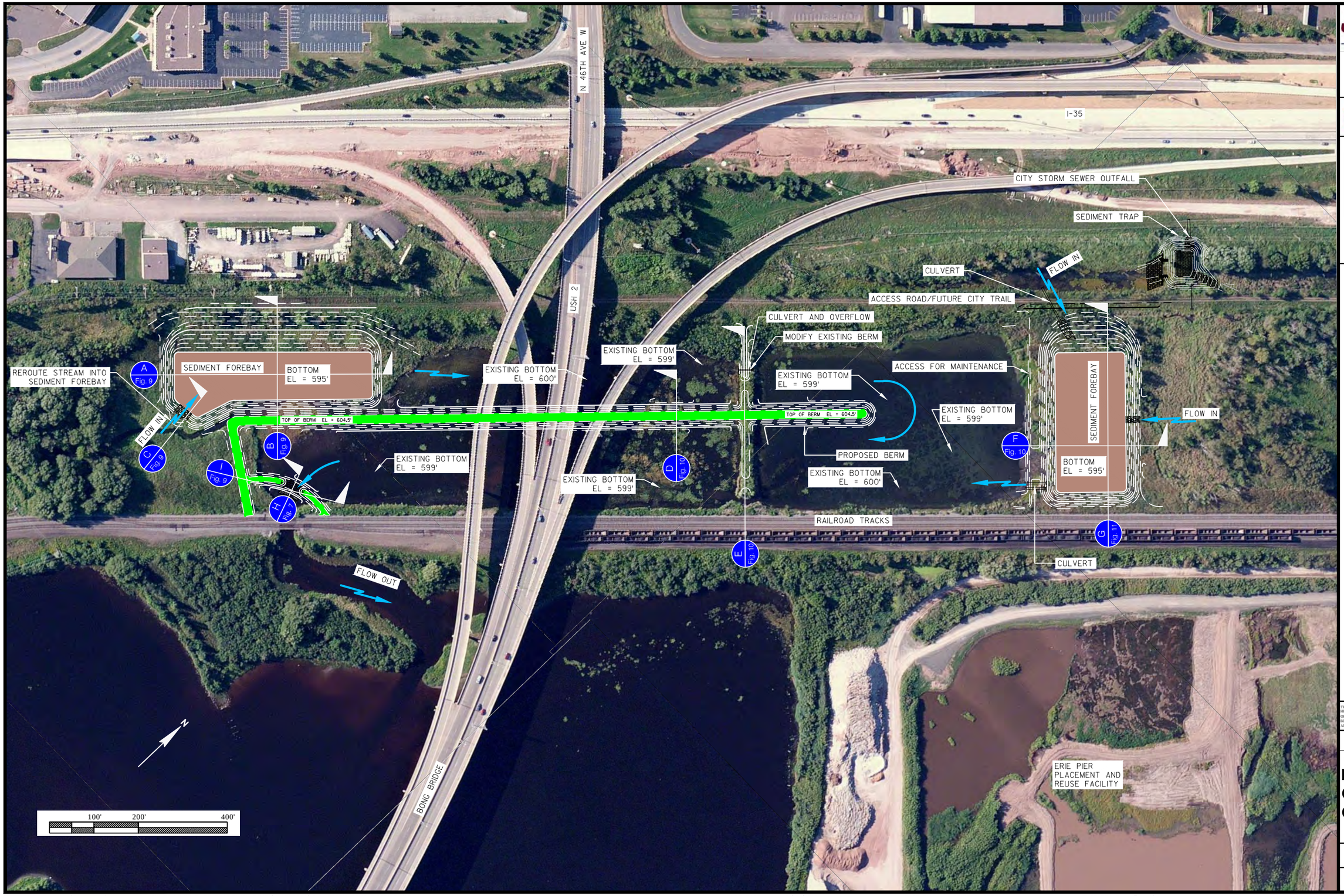

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Drawing Name
Figure 8 - Option 2 Overview

Sheet No.
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Jewell Project Number
U18010

FILE NAME : S:\PROJECTS\U18010 – USFW ST LOUIS RIVER FEASIBILITY STUDY\BASEDATA\TLD_STORM POND EXHIBITS.DWG
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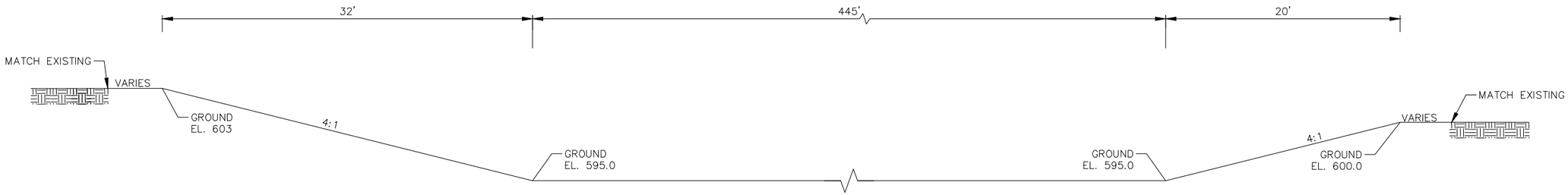

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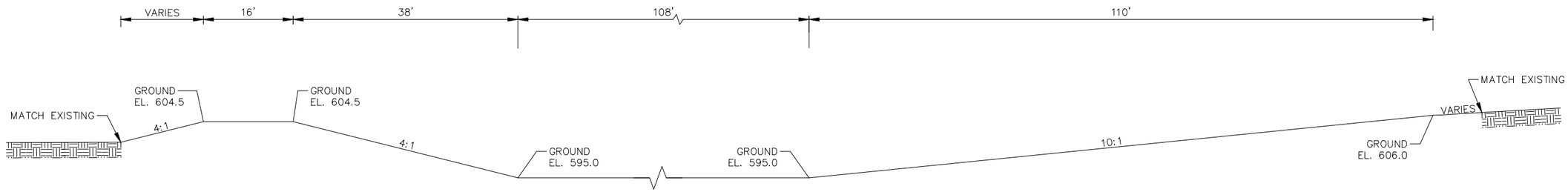

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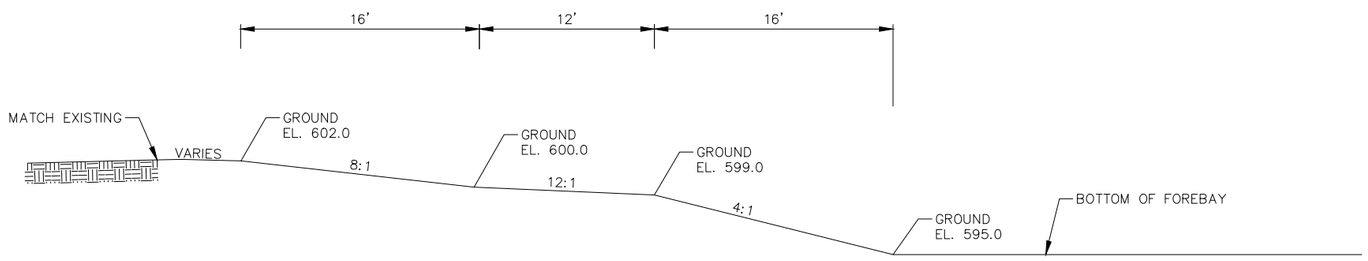

C OUTLET SECTION
N.T.S.

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40TH AVENUE WEST
REMEDIATION TO RESTORATION PROJECT
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Date
4/1/2015

Drawing Name
Figure 9 - Option 2 Sections

Sheet No.
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Jewell Project Number
U18010

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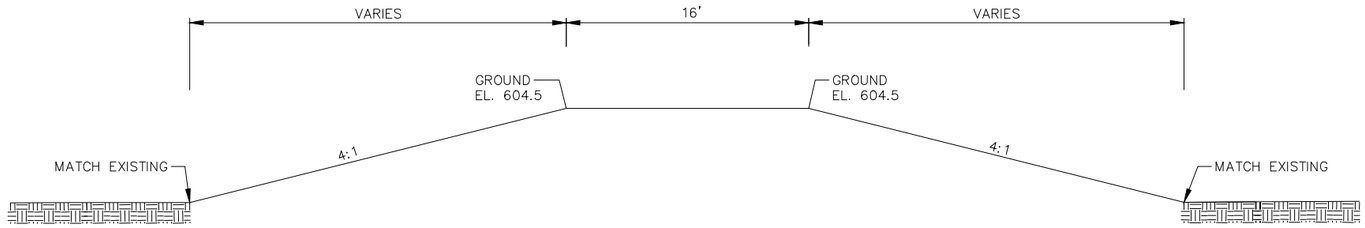

D TYPICAL BERM SECTION
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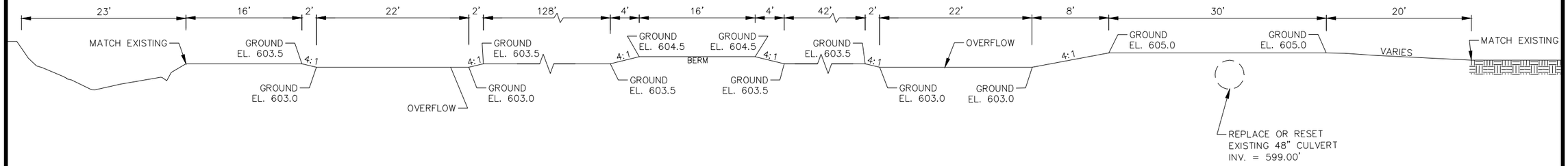

E BERM SECTION
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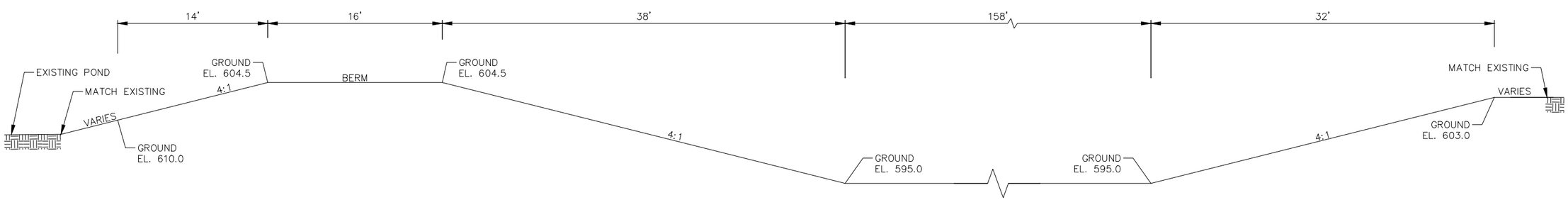

F SEDIMENT FOREBAY SECTION
N.T.S.

JEWELL
associates engineers, inc.
Engineers - Surveyors - Architects
560 Sunrise Drive
Spring Green, WI 53588
phone: 608-588-7484
fax: 608-588-9322

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DEPARTMENT OF THE INTERIOR

US FISH AND WILDLIFE SERVICE
FOCUSED FEASIBILITY STUDY FOR
40TH AVENUE WEST
REMEDIATION TO RESTORATION PROJECT
ST. LOUIS RIVER ESTUARY

Date
4/1/2015

Drawing Name
Figure 10 - Option 2 Sections

Sheet No.
-

Jewell Project Number
U18010

FILE NAME : S:\PROJECTS\U18010 – USFW ST LOUIS RIVER FEASIBILITY STUDY\BASEDATA\TLD_STORM POND EXHIBITS.DWG
LAYOUT : FIGURE 10 – OPTION 2 SECTIONS
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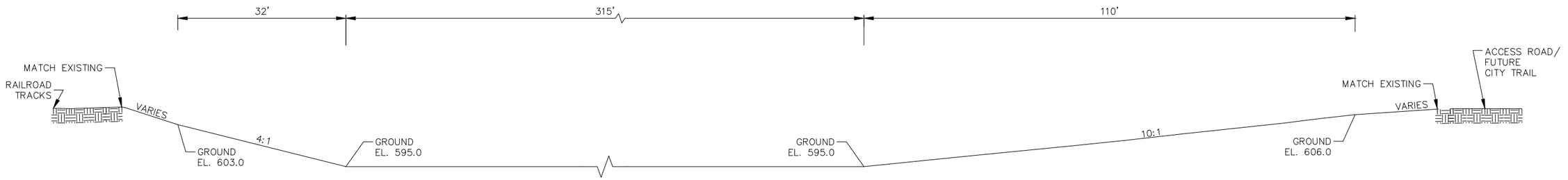
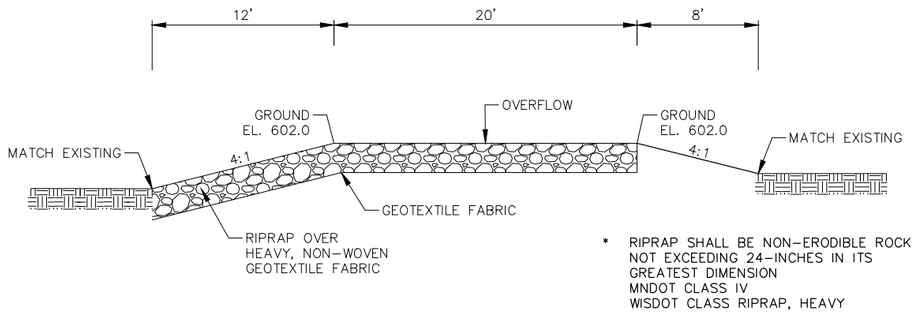
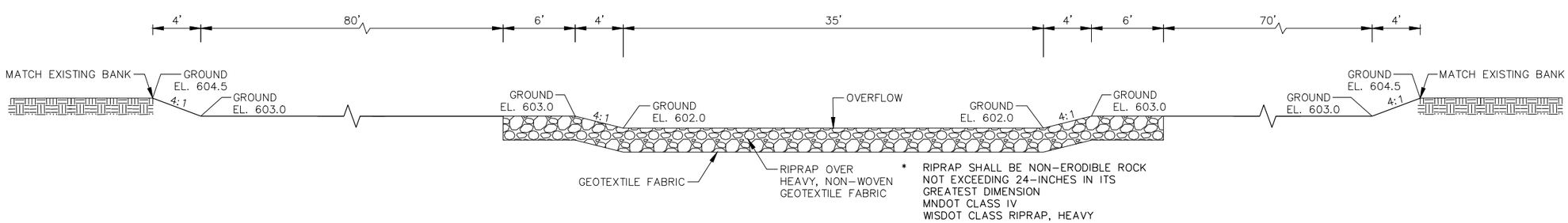
PLOT TIME : 2:39:39 PM
PLOT BY : DEIBERT, TODD
PLOT SCALE : 1" = 1'



G SEDIMENT FOREBAY SECTION
N.T.S.



H OUTLET BERM SECTION
N.T.S.



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REMEDIATION TO RESTORATION PROJECT
ST. LOUIS RIVER ESTUARY

Date
4/1/2015

Drawing Name
Figure 11 - Option 2 Sections

Sheet No.
-

Jewell Project Number
U18010

FILE NAME : S:\PROJECTS\U18010 – USFW ST LOUIS RIVER FEASIBILITY STUDY\BASEDATA\TLD_STORM POND EXHIBITS.DWG
LAYOUT : FIGURE 11 – OPTION 2 SECTIONS
PLOT DATE : 3/19/2015
PLOT TIME : 2:40:03 PM
PLOT BY : DEIBERT, TODD
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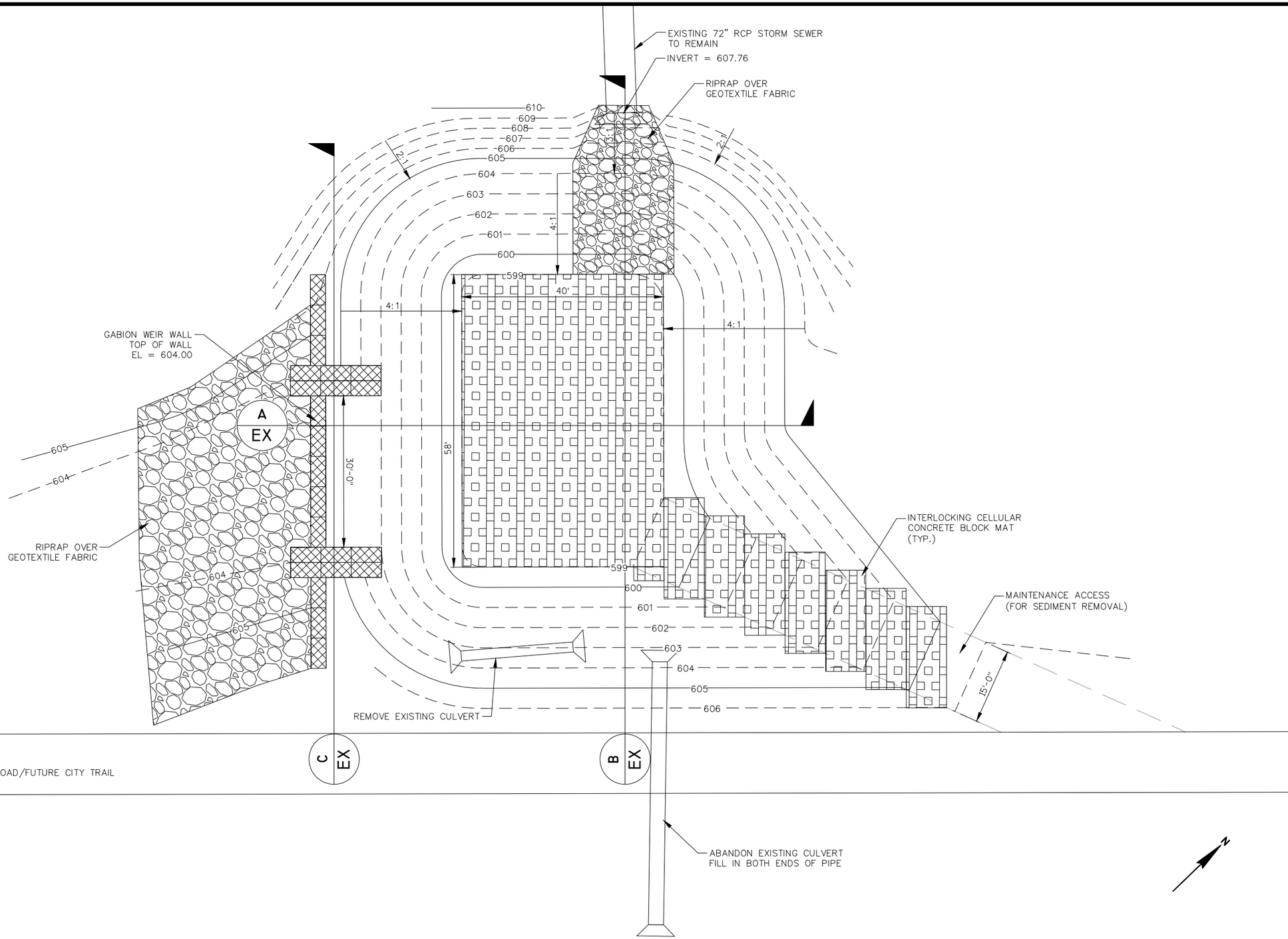

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ST. LOUIS RIVER ESTUARY

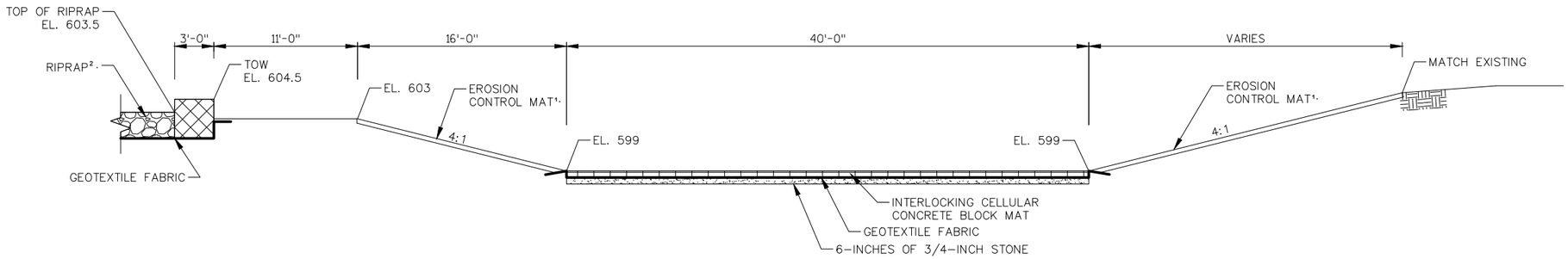
Date
4/1/2015

Drawing Name
Figure 12 - Sediment Trap at Outfall 2

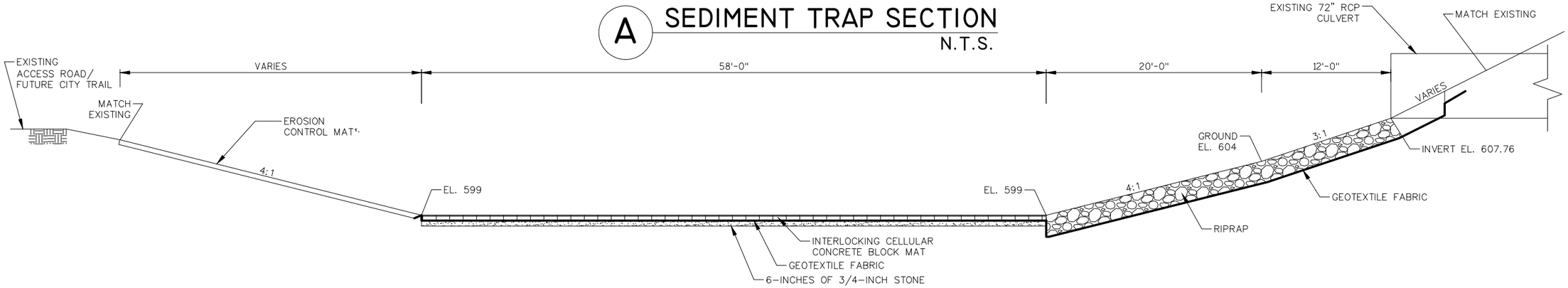
Sheet No.
-

Jewell Project Number
U18010

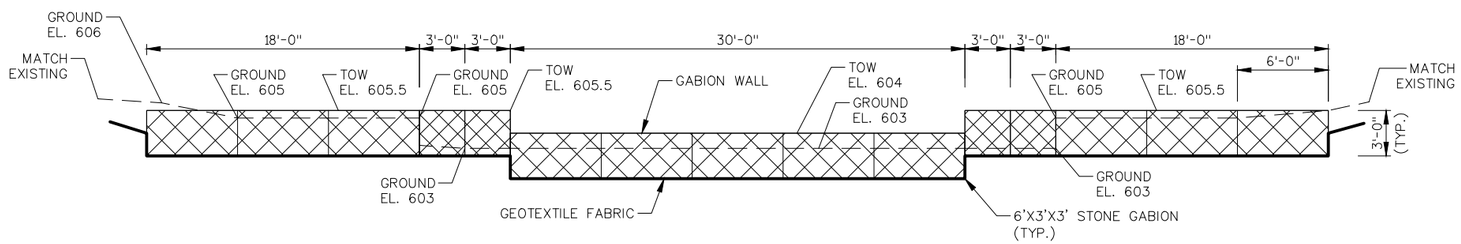
FILE NAME : S:\PROJECTS\U18010 – USFW ST LOUIS RIVER FEASIBILITY STUDY\BASEDATA\U18010_STORM POND EXHIBITS.DWG
LAYOUT : FIGURE 12 – SED TRAP AT OUTFALL 2 OVERVIEW
PLOT DATE : 3/19/2015
PLOT TIME : 2:11:49 PM
PLOT BY : DEIBERT, TODD
PLOT SCALE : 1" = 1'



A SEDIMENT TRAP SECTION
N.T.S.



B SEDIMENT TRAP SECTION
N.T.S.



C SEDIMENT TRAP OUTLET SECTION
N.T.S.

NOTES

1. EROSION CONTROL MAT SHALL BE FULLY BIODEGRADABLE WITH "NOW TRAPPING" NETTING MNDOT EROSION CONTROL BLANKET CATEGORY 0 WISDOT CLASS I, URBAN TYPE B.
2. SIZE RIPRAP FOR ANTICIPATED FLOWS OR MINIMUM 24 INCH DEPTH OF 12 INCH – 15 INCH RIPRAP MNDOT CLASS IV WISDOT CLASS RIPRAP, HEAVY.

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ST. LOUIS RIVER ESTUARY

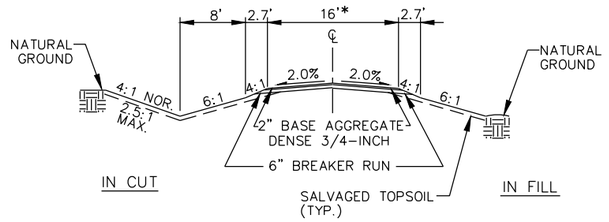
Date
4/1/2015

Drawing Name
Figure 13 - Sediment Trap Sections

Sheet No.
-

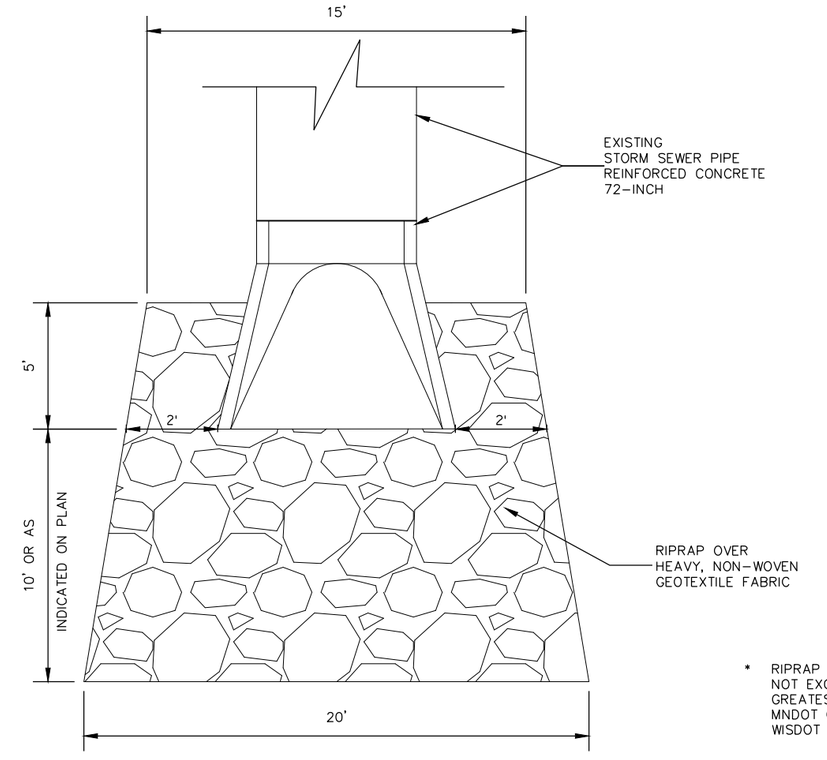
Jewell Project Number
U18010

FILE NAME : S:\PROJECTS\U18010 – USFW ST LOUIS RIVER FEASIBILITY STUDY\BASEDATA\U18010_STORM POND EXHIBITS.DWG
LAYOUT : FIGURE 13 – SED TRAP SECTIONS
PLOT DATE : 3/19/2015
PLOT TIME : 2:12:35 PM
PLOT BY : DEIBERT, TODD
PLOT SCALE : 1" = 1'

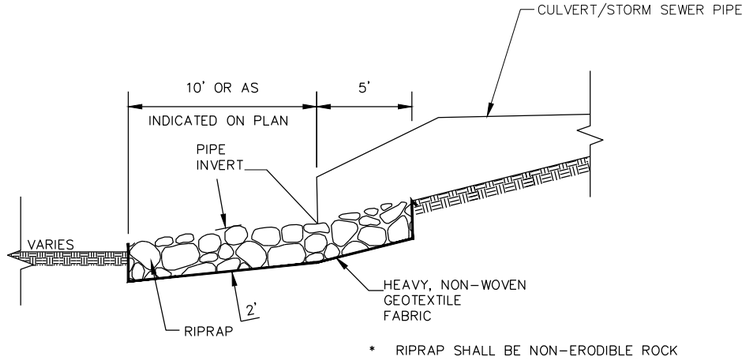


1 -- GRAVEL ACCESS ROAD

N.T.S.



* RIPRAP SHALL BE NON-ERODIBLE ROCK
NOT EXCEEDING 24-INCHES IN ITS
GREATEST DIMENSION
MNDOT CLASS IV
WISDOT CLASS RIPRAP, HEAVY



* RIPRAP SHALL BE NON-ERODIBLE ROCK
NOT EXCEEDING 24-INCHES IN ITS
GREATEST DIMENSION
MNDOT CLASS IV
WISDOT CLASS RIPRAP, HEAVY

CULVERT/STORM SEWER OUTFALL SECTION

2 -- CULVERT/STORM SEWER OUTFALL PLAN

N.T.S.

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40TH AVENUE WEST
REMEDIATION TO RESTORATION PROJECT
ST. LOUIS RIVER ESTUARY

Date
4/1/2015

Drawing Name
Figure 14 - Construction Details

Sheet No.
-

Jewell Project Number
U18010

FILE NAME : S:\PROJECTS\U18010 – USFW ST LOUIS RIVER FEASIBILITY STUDY\BASEDATA\U18010_STORM POND EXHIBITS.DWG
LAYOUT : FIGURE 14 – CONSTRUCTION DETAILS
PLOT DATE : 3/19/2015
PLOT TIME : 2:54:21 PM
PLOT BY : DEIBERT, TODD
PLOT SCALE : 1" = 1'

Figure No.

15

Title

Shoreline Landowners Map

Client/Project

U.S. Fish and Wildlife Service
40th Avenue West
Remediation to Restoration Project
St. Louis River Estuary

Project Location

T49N, R14W, S07; 08; 17; 18
C of Duluth, St. Louis Co., MN

Prepared by XXX on 2015-3-17
Technical Review by EGL on 2015-XX-XX

0 300 600 Feet
1:600 (At original document size of 11X17)

N

Legend

SHORELINE LANDOWNERS

- CITY OF DULUTH
- STATE OF MINNESOTA
- PORT AUTHORITY
- MN POWER & LIGHT
- RIGHT OF WAY
- RAILROAD
- WEST DULUTH LAND COMPANY
- UNIDENTIFIED

Notes

1. Coordinate System: NAD 1983 UTM Zone 15N

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U.S. FISH & WILDLIFE SERVICE

FILE NAME : S:\PROJECTS\U18010 – USFW ST LOUIS RIVER FEASIBILITY STUDY\BASEDATA\WATERSHED MAP.DWG
LAYOUT : FIGURE 16 SHORELINE LANDOWNERS MAP 11X17

PLOT DATE : 8/24/2015
PLOT TIME : 2:04:13 PM

PLOT BY : LILLA, ED

PLOT SCALE : 0.950006

Figure No.
16

Title
Botanical Communities and Shoreline Composition

Client/Project
U.S. Fish and Wildlife Service
40th Avenue Restoration
St. Louis River Estuary

Project Location
T49N, R14W, S07; 08; 17; 18
C. of Duluth, St. Louis Co., MN

193702726
Prepared by MCP on 2015-01-26
Technical Review by XXX on 2014-XX-XX
Independent Review by XXX on 2014-XX-XX

0 125 250 Feet

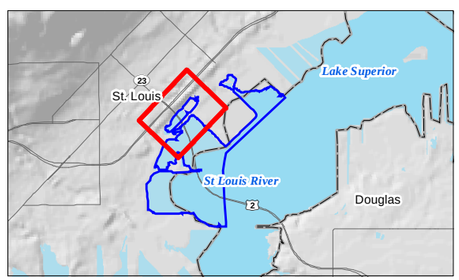
1:3,000 (At original document size of 11x17)

Legend

1861 Historical Shoreline

Shoreline Habitat
- Alder Thicket, Sparse Trees (4619.47ft)
- Common Reed (*Phragmites*) (183.85ft)
- Concrete Wall or Dock (2203.64ft)
- Power Plant Intake (51.28ft)
- Rock, Riprap, and Rubble (12165.02ft)
- Sand (632.06ft)
- Sand with Heavy Driftwood (97.38ft)
- Shallow Marsh: *Typha X glauca* (4085.75ft)
- Wet Meadow/Rocky (718.75ft)
- Wet Meadow/Sand-Gravel (867.07ft)
- Wood Trestle (52.97ft)

Botanical Community (Total Acres)
- AT - Alder Thicket (15.05ac)
- CM - Cattail Marsh (21.51ac)
- DW - Deep Water (194.90ac)
- DS - Disturbed Shoreline (0.87ac)
- HS - Hardwood Swamp (34.60ac)
- IT - Industrial/Transportation (122.56ac)
- SM - Sedge Meadow (1.15ac)
- SW - Shallow Water (125.89ac)
- UDF - Upland Degraded Forest (5.88ac)
- UDM - Upland Degraded Meadow (25.18ac)
- UM - Upland Meadow (1.87ac)
- UUA - Upland Unvegetated Area (25.46ac)
- WM - Wet Meadow (9.75ac)



Notes
1. Coordinate System: NAD 1983 UTM Zone 15N
2. Data Sources Include: Stantec, Esri, Community GIS Services, Jewell
3. Orthophotography: Esri

Stantec

FOCUSED FEASIBILITY STUDY SUMMARY
FOR
40TH AVENUE WEST REMEDIATION TO RESTORATION PROJECT AREA
IN THE ST. LOUIS RIVER AREA OF CONCERN

August 28, 2015

APPENDIX D – 40TH AVENUE WEST WATERSHED FIELD SURVEY PHOTO LOG

40th Avenue West Watershed Evaluation Field Survey Photo Log

Photo 1 – Daugherty Appliance Sales, 3931 W 1st Street
Business description: Appliance sales and service.
Materials stored outside: None
Potential stormwater contaminants: Legacy contaminants (building has appearance of prior commercial/industrial use), parking lot oil and grease, TSS

Photo 2 – City of Duluth Street Department, 105 N 40th Avenue W
Business description: City Street Department operations and maintenance yard
Materials stored outside: Stockpiles of sand, stone, vehicles, salt in covered storage
Potential stormwater contaminants: Salt, material stockpiles, parking lot oil and grease, TSS

Photo 3 – City of Duluth Street Department, 105 N 40th Avenue W
Business description: City Street Department operations and maintenance yard
Materials stored outside: Stockpiles of sand, stone, vehicles, salt in covered storage
Potential stormwater contaminants: Salt, material stockpiles, parking lot oil and grease, TSS

Photo 4 – Accurate Auto Repair, 3402 Grand Avenue
Business description: Auto mechanic
Materials stored outside: Vehicles in need of repair
Potential stormwater contaminants: Parking lot oil and grease, TSS, various automotive fluids

Photo 5 – Miners Inc. Food Distributor, 3800 W 2nd Street
Business description: Food warehouse and distribution
Materials stored outside: Truck trailers
Potential stormwater contaminants: Parking lot oil and grease, TSS

Photo 6 – Arrowhead Paint Products, Inc., 24 N 39th Avenue W
Business description: Paint sales
Materials stored outside: Various drums
Potential stormwater contaminants: Paints and solvents, parking lot oil and grease, TSS

Photo 7 – Praxair, Welding Gas and Supply Center, 4105 W Superior Street
Business description: Welding gas supply center
Materials stored outside: Various gas canisters/containers
Potential stormwater contaminants: Various chemicals, parking lot oil and grease, TSS

Photo 8 – Holiday Stationstore, 100 N 4th Avenue W
Business description: Gas station
Materials stored outside: Underground storage tanks
Potential stormwater contaminants: Gasoline and diesel fuel, parking lot oil and grease, TSS

Photo 9 – Industrial Welders & Machinists (IWM), 3902 Oneota Street
Business description: Welding and machine shop
Materials stored outside: Metal scraps, heavy equipment, various machine parts
Potential stormwater contaminants: Heavy metals, machining oils, parking lot oil and grease, TSS

Photo 10 – Bayside Recycling Corporation, 220 S 39th Avenue W
Business description: Recycling center
Materials stored outside: Recycle material stockpiles
Potential stormwater contaminants: Heavy metals, oil and grease, automotive fluids, mercury, chlorinated solvents, arsenic

Photo 11 – Kraus-Anderson Construction, 3716 Oneota Street
Business description: Construction contractor
Materials stored outside: Job trailers, construction materials
Potential stormwater contaminants: Parking lot oil and grease, TSS

Photo 12 – Hallett Dock Company, 303 S 37th Avenue W
Business description: Bulk commodity transporter
Materials stored outside: Unknown material stockpiles, heavy equipment
Potential stormwater contaminants: Runoff from stockpiles, parking lot oil and grease, TSS

Photo 13 – Lifespan Closets, 215 S 37th Avenue W
Business description: Shelving and organizational system manufacturer and designer
Materials stored outside: None
Potential stormwater contaminants: Parking lot oil and grease, TSS, paints, stains, solvents

Photo 14 – Kramer & Moen Machine Co., 4110 W Superior Street
Business description: Machine shop
Materials stored outside: None
Potential stormwater contaminants: Parking lot oil and grease, TSS, machining oils, solvents

Photo 15 – Elite Tinting & Graphics, 4114 W Superior Street
Business description: Graphics designers
Materials stored outside: None
Potential stormwater contaminants: Paint, printing chemicals, solvents

Photo 16 – Associated Milk Producers, 4107 W Michigan Street
Business description: Milk wholesaler
Materials stored outside: Underground fuel tank, milk storage tank
Potential stormwater contaminants: Diesel fuel, milk, parking lot oil and grease, TSS

Photo 17 – Superior Construction Co., 4120 W Superior Street
Business description: Construction contractor
Materials stored outside: Construction materials and heavy equipment
Potential stormwater contaminants: Oil and grease, fuel spills

Photo 18 – Mac Arthur Co., 30 N 43rd Street
Business description: Construction material warehouse
Materials stored outside: Covered storage
Potential stormwater contaminants: Parking lot oil and grease, TSS

Photo 19 – Vitran Express, 4319 W 1st Street
Business description: Freight company
Materials stored outside: Landscaping rock
Potential stormwater contaminants: Parking lot oil and grease, TSS, leaks or spills

Photo 20 – Johnson Wilson Constructors, 4431 W Michigan Street
Business description: Building Contractor
Materials stored outside: Heavy equipment
Potential stormwater contaminants: Parking lot oil and grease, TSS, fuel spills

Photo 21 – Bernick's, 4301 W Michigan Street
Business description: Beverage distributor
Materials stored outside: None
Potential stormwater contaminants: Parking lot oil and grease, TSS

Photo 22 – Viking Electric Supply, 4531 W 1st Street
Business description: Electric equipment supplier
Materials stored outside: Unknown materials in small enclosure
Potential stormwater contaminants: Parking lot oil and grease, TSS

Photo 23 – Como Oil and Propane, 4330 W 1st Street, Suite A
Business description: Fuel distributor
Materials stored outside: None
Potential stormwater contaminants: Parking lot oil and grease, TSS

Photo 24 – WP & RS Mars Co., 4319 W 1st Street
Business description: Industrial supply
Materials stored outside: None
Potential stormwater contaminants: Parking lot oil and grease, TSS, industrial chemical leaks or spills

Photo 25 – YRC Freight, 4425 W 1st Street
Business description: Shipping company
Materials stored outside: Truck trailers
Potential stormwater contaminants: Parking lot oil and grease, TSS, leaks or spills

Photo 26 – SMDC Health Systems, 4505 W 1st Street
Business description: Healthcare supply distribution
Materials stored outside: None
Potential stormwater contaminants: Parking lot oil and grease, TSS

Photo 27 – Aspen Aerials, Inc., 4303 W 1st Street
Business description: Bridge inspection equipment manufacturer/supplier
Materials stored outside: Steel parts, trucks
Potential stormwater contaminants: Parking lot oil and grease, TSS

Photo 28 – Wesco Distribution/Communications Supply Corp., 4304 W 1st Street
Business description: Data communications supply
Materials stored outside: None
Potential stormwater contaminants: Parking lot oil and grease, TSS

Photo 29 – Brock White, 4231 W 1st Street
Business description: Construction material supplier
Materials stored outside: Brick and construction supplies
Potential stormwater contaminants: Parking lot oil and grease, TSS, runoff from materials

Photo 30 – Servpro, 4201 W 1st Street
Business description: Fire and water damage restoration service
Materials stored outside: Service vehicles
Potential stormwater contaminants: Parking lot oil and grease, TSS

Photo 31 – North Star Marine, 4119 W Superior Street
Business description: Marine parts and accessories supplier
Materials stored outside: None
Potential stormwater contaminants: Parking lot oil and grease, TSS

Photo 32 – Praxair, 4105 W Superior Street
Business description: Industrial, specialty, medical and welding gases, equipment and supplies
Materials stored outside: None
Potential stormwater contaminants: Parking lot oil and grease, TSS, chemical spills

Photo 33 – Gustave A. Larson Company (AC and refrigeration supply), 4001 W Superior Street
Business description: Air conditioner and refrigeration equipment supplier
Materials stored outside: None
Potential stormwater contaminants: Parking lot oil and grease, TSS, refrigerant leaks or spills

Photo 34 – Abandoned Collision Repair Garage, 4032 Grand Avenue
Business description: Auto body/ auto mechanic shop
Materials stored outside: None
Potential stormwater contaminants: Legacy contamination (oil, grease, solvents, automotive fluids)

Photo 35 – Future Kwik Trip (under construction), 4233 Grand Avenue
Business description: Gas station
Materials stored outside: None
Potential stormwater contaminants: Parking lot oil and grease, TSS, fuel spills

Photo 36 – Arrowhead Machinists, 4218 Grand Avenue
Business description: Welding and machine shop
Materials stored outside: None
Potential stormwater contaminants: Heavy metals, machining oils, parking lot oil and grease, TSS

Photo 37 – Finish Master, 4418 Grand Avenue
Business description: Automotive and industrial paint and supplies
Materials stored outside: None
Potential stormwater contaminants: Paint and solvent leaks or spills

Photo 38 – Grainger Industrial Supply, 101 N 46th Avenue W
Business description: Industrial equipment/tools/material supplier
Materials stored outside: None
Potential stormwater contaminants: Parking lot oil and grease, TSS, chemical spills or leaks

Photo 39 – Asdco Construction Material Supply, 4631 Mike Colalillo Drive
Business description: Construction materials supplier
Materials stored outside: None
Potential stormwater contaminants: Parking lot oil and grease, TSS

Photo 40 – Essentia Health Services, 4614 Mike Colalillo Drive
Business description: Health care provider
Materials stored outside: None
Potential stormwater contaminants: Parking lot oil and grease, TSS

Photo 41 – Enbridge, 4628 Mike Colalillo Drive
Business description: Energy company
Materials stored outside: None
Potential stormwater contaminants: Parking lot oil and grease, TSS

Photo 42 - Jamar Co., 4701 Mike Colalillo Drive
Business description: Construction contractor
Materials stored outside: Construction materials and equipment
Potential stormwater contaminants: Parking lot oil and grease, TSS, runoff from materials

Photo 43 – City of Duluth Maintenance Operations Fleet Services, 4825 Mike Colalillo Drive
Business description: Equipment and vehicle repair
Materials stored outside: None
Potential stormwater contaminants: Parking lot oil and grease, TSS, automotive fluid spills

Photo 44 – Menards, 503 N 50th Avenue W
Business description: Home improvement store
Materials stored outside: Covered storage of building materials
Potential stormwater contaminants: Parking lot oil and grease, TSS

Photo 45 – Duluth Business University, 4724 Mike Colalillo Drive
Business description: University
Materials stored outside: None
Potential stormwater contaminants: Parking lot oil and grease, TSS

Photo 46 – Fresenius Medical Care - Spirit Valley Dialysis, 4700 Mike Colalillo Drive
Business description: Dialysis center
Materials stored outside: None
Potential stormwater contaminants: Parking lot oil and grease, TSS

Photo 47 – Viking Industrial North, 4730 Grand Avenue
Business description: Safety and fastening equipment supplier
Materials stored outside: Shipping containers
Potential stormwater contaminants: Parking lot oil and grease, TSS

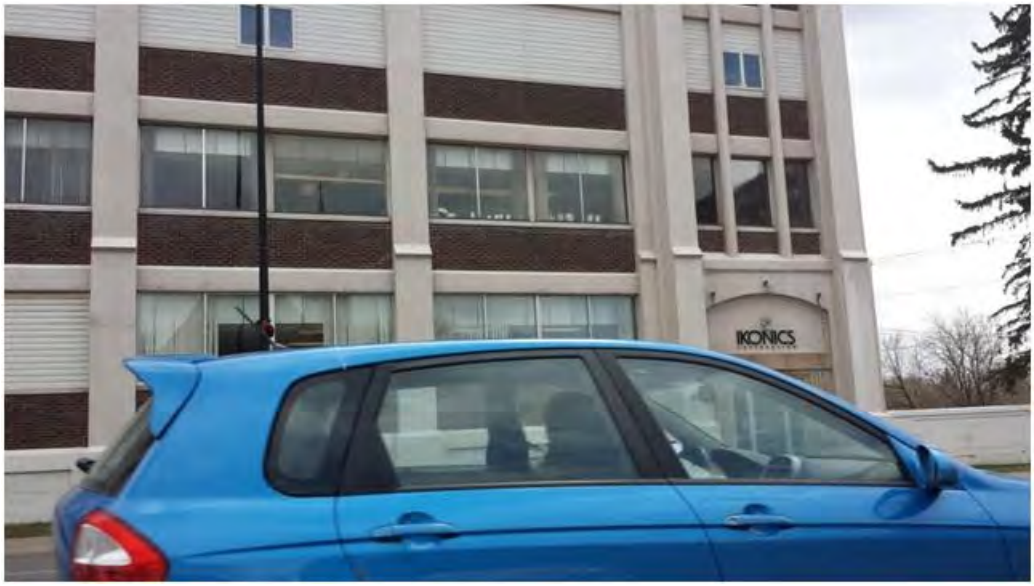


Photo 48 – Ikonics Imaging, 4832 Grand Avenue
Business description: Sand carving equipment and product supplier
Materials stored outside: None
Potential stormwater contaminants: Parking lot oil and grease, TSS

Photo 49 – Amerigas, 4702 Oneota Street
Business description: Propane supplier
Materials stored outside: Propane tanks, delivery trucks
Potential stormwater contaminants: Oil and grease from trucks, TSS

Photo 50 – Era Laboratories, 4730 Oneota Street
Business description: Analytical laboratory
Materials stored outside: None
Potential stormwater contaminants: Chemical spills, parking lot oil and grease, TSS

Photo 51 – EcoLab, 4802 Oneota Street
Business description: Water, hygiene and energy technology and service provider
Materials stored outside: None
Potential stormwater contaminants: Parking lot runoff (oil and grease, TSS and past chemical spills)

Photo 52 – New Page, 4920 Recycle Way
Business description: Paper manufacturer
Materials stored outside: Wood, pulp, equipment
Potential stormwater contaminants: Parking lot oil and grease, TSS, chemical spills

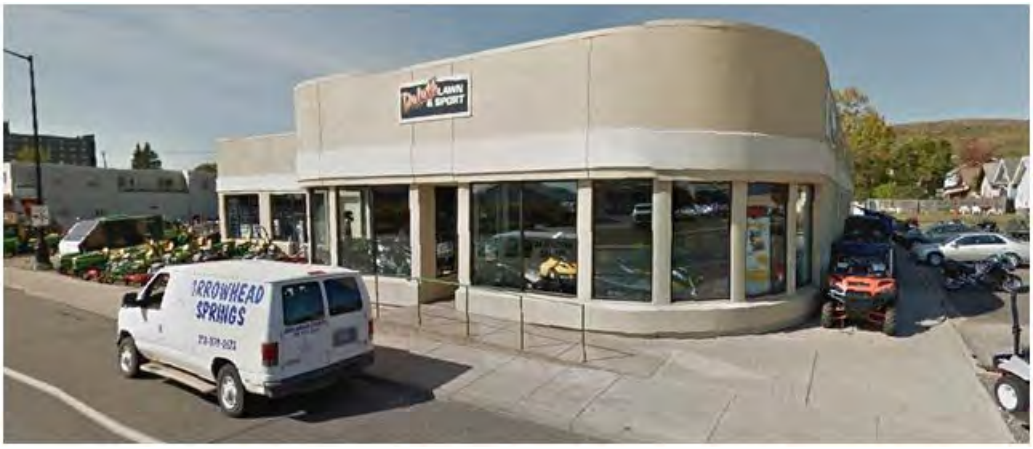


Photo 53 – Duluth Lawn & Sport, 4715 Grand Avenue
Business description: Lawn equipment and ATV sales
Materials stored outside: Lawn tractors, ATVs, tractors, skid steers, snowmobiles, etc.
Potential stormwater contaminants: Oil and grease

Photo 54 – Little Store, 7002 Grand Avenue
Business description: Gas station
Materials stored outside: Underground storage tanks
Potential stormwater contaminants: Parking lot oil and grease, TSS, fuel, automotive fluid spills

Photo 55 – Dieryck's Service, 5608 Cody Street
Business description: Automotive service, gas station, and U-haul rental
Materials stored outside: U-haul trucks and trailers
Potential stormwater contaminants: Parking lot oil and grease, TSS, gasoline, automotive fluid spills

Photo 56 – Lot with construction materials, 306 Spirit Drive (approx.)
Business description: Construction materials
Materials stored outside: Concrete block and other building materials
Potential stormwater contaminants: Runoff from construction materials

Photo 57 – Jimmy's Nuts and Bolts, 5116 Ramsey Street
Business description: Automotive service
Materials stored outside: Cars to be fixed
Potential stormwater contaminants: Parking lot oil and grease, TSS, automotive fluid spills

Photo 58 – Holiday Stationstore, 5430 Grand Avenue
Business description: Gas station
Materials stored outside: Underground storage tanks
Potential stormwater contaminants: Gasoline and diesel fuel, parking lot oil and grease, TSS

Photo 59 – Minnesota Power and Light (Hibbard Renewable Energy Center)
Business description: Power plant, biomass plant, secondary fuel coal
Materials stored outside: Trucks, equipment.
Potential stormwater contaminants: Parking lot oil and grease, TSS, process waste spills or PCBs, runoff from ash handling and transport spillage

Photo 60 – New Page Duluth Paper Mill, 100 N. Central Avenue
Business description: Paper production,
Materials stored outside: Trucks, equipment, pulp log storage under snow and sawdust.
Potential stormwater contaminants: Parking lot oil and grease, TSS, organic substances originating from the wood and bark, phosphorus.

FOCUSED FEASIBILITY STUDY SUMMARY
FOR
40TH AVENUE WEST REMEDIATION TO RESTORATION PROJECT AREA
IN THE ST. LOUIS RIVER AREA OF CONCERN

August 28, 2015

APPENDIX E – MODELING INPUTS

Duluth Existing NE - InputData
Data file name: S:\Projects\U18010 - USFW St Louis River Feasibility Study\Winslamm\Duluth Existing NE.mdb
WinSLAMM Version 10.0.2
Rain file name: C:\WinSLAMM Files\Rain Files\WisReg - Madison WI 1981.RAN
Particulate Solids Concentration file name: C:\WinSLAMM Files\WI_AVG01.pscx
Runoff Coefficient file name: C:\WinSLAMM Files\v10 WI_SL06 Dec06.rsv
Residential Street Delivery file name: C:\WinSLAMM Files\WI_Res and Other Urban Dec06.std
Institutional Street Delivery file name: C:\WinSLAMM Files\WI_Com Inst Indust Dec06.std
Commercial Street Delivery file name: C:\WinSLAMM Files\WI_Com Inst Indust Dec06.std
Industrial Street Delivery file name: C:\WinSLAMM Files\WI_Com Inst Indust Dec06.std
Other Urban Street Delivery file name: C:\WinSLAMM Files\WI_Res and Other Urban Dec06.std
Freeway Street Delivery file name: C:\WinSLAMM Files\Freeway Dec06.std
Apply Street Delivery Files to Adjust the After Event Load Street Dirt Mass Balance: False
Pollutant Relative Concentration file name: C:\WinSLAMM Files\WI_GEO02.ppdx
Cost Data file name:
Seed for random number generator: -42
Study period starting date: 01/01/81 Study period ending date: 12/31/81
Date: 02-23-2015 Time: 11:17:02
Site information:

LU# 1 - Other Urban: Open Space 1 Total area (ac): 205.730
  1 - Roofs 1: 1.132 ac. Flat Connected
  25 - Driveways 1: 1.193 ac. Connected
  37 - Streets 1: 3.539 ac. Smooth Street Length = 2.116 curb-mi
Default St. Dirt Accum. Default Initial St. Dirt Loading
  38 - Streets 2: 4.156 ac. Intermediate Street Length = 2.494 curb-mi
Default St. Dirt Accum. Default Initial St. Dirt Loading
  45 - Large Landscaped Areas 1: 1.213 ac. Clayey Low Density
  57 - Undeveloped Areas 1: 194.497 ac. Clayey Low Density

LU# 2 - Residential: High Density Residential Total area (ac): 171.520
  1 - Roofs 1: 17.667 ac. Pitched Connected
  2 - Roofs 2: 19.039 ac. Pitched Disconnected Sandy
  25 - Driveways 1: 24.184 ac. Connected
  31 - Sidewalks 1: 3.430 ac. Connected
  32 - Sidewalks 2: 3.430 ac. Disconnected Sandy
  37 - Streets 1: 7.718 ac. Smooth Street Length = 4.245 curb-mi
Default St. Dirt Accum. Default Initial St. Dirt Loading
  38 - Streets 2: 15.437 ac. Intermediate Street Length = 8.49 curb-mi
Default St. Dirt Accum. Default Initial St. Dirt Loading
  51 - Small Landscaped Areas 1: 70.323 ac. Sandy
  69 - Isolated Areas: 0.172 ac.
  71 - Other Pervious Areas 1: 10.120 ac. Sandy

LU# 3 - Industrial: Light Industrial Total area (ac): 136.620
  1 - Roofs 1: 28.021 ac. Flat Connected
  2 - Roofs 2: 3.101 ac. Flat Disconnected Sandy
  3 - Roofs 3: 3.511 ac. Pitched Connected
  13 - Paved Parking 1: 45.003 ac. Connected
  19 - Unpaved Parking 1: 8.662 ac. Disconnected Sandy
  25 - Driveways 1: 3.497 ac. Connected
  31 - Sidewalks 1: 1.749 ac. Connected
  37 - Streets 1: 2.514 ac. Smooth Street Length = 1.185 curb-mi
Default St. Dirt Accum. Default Initial St. Dirt Loading
  38 - Streets 2: 11.859 ac. Intermediate Street Length = 5.591 curb-mi

Default St. Dirt Accum. Default Initial St. Dirt Loading
     39 - Streets 3: 0.437 ac. Rough Street Length = 0.206 curb-mi Default St. Dirt Accum. Default Initial St. Dirt Loading
     45 - Large Landscaped Areas 1: 4.795 ac. Sandy
     51 - Small Landscaped Areas 1: 13.471 ac. Sandy
     57 - Undeveloped Areas 1: 5.929 ac. Sandy
     71 - Other Pervious Areas 1: 3.784 ac. Sandy
     78 - Other Part Con Imp Areas 1: 0.287 ac. Disconnected Sandy

LU# 4 - Industrial: Industrial Total area (ac): 21.321
     1 - Roofs 1: 3.582 ac. Flat Connected
     2 - Roofs 2: 0.951 ac. Flat Disconnected Sandy
     3 - Roofs 3: 0.394 ac. Pitched Connected
     13 - Paved Parking 1: 7.268 ac. Connected
     14 - Paved Parking 2: 3.115 ac. Disconnected Sandy
     25 - Driveways 1: 0.384 ac. Connected
     26 - Driveways 2: 0.213 ac. Disconnected Sandy
     31 - Sidewalks 1: 0.096 ac. Connected
     32 - Sidewalks 2: 0.096 ac. Disconnected Sandy
     37 - Streets 1: 0.241 ac. Smooth Street Length = 0.11 curb-mi Default St. Dirt Accum. Default Initial St. Dirt Loading
     38 - Streets 2: 1.322 ac. Intermediate Street Length = 0.606 curb-mi Default St. Dirt Accum. Default Initial St. Dirt Loading
     39 - Streets 3: 0.047 ac. Rough Street Length = 0.022 curb-mi Default St. Dirt Accum. Default Initial St. Dirt Loading
     45 - Large Landscaped Areas 1: 0.599 ac. Sandy
     51 - Small Landscaped Areas 1: 0.853 ac. Sandy
     57 - Undeveloped Areas 1: 1.145 ac. Sandy
     71 - Other Pervious Areas 1: 0.966 ac. Sandy
     78 - Other Part Con Imp Areas 1: 0.049 ac. Disconnected Sandy

LU# 5 - Other Urban: Open Space 2 Total area (ac): 36.499
     1 - Roofs 1: 0.200 ac. Flat Connected
     25 - Driveways 1: 0.212 ac. Connected
     37 - Streets 1: 0.628 ac. Smooth Street Length = 0.377 curb-mi
Default St. Dirt Accum. Default Initial St. Dirt Loading
     38 - Streets 2: 0.737 ac. Intermediate Street Length = 0.442 curb-mi
Default St. Dirt Accum. Default Initial St. Dirt Loading
     45 - Large Landscaped Areas 1: 0.215 ac. Sandy
     57 - Undeveloped Areas 1: 34.507 ac. Sandy

Control Practice 1: Wet Detention Pond CP# 1 (DS) - DS Wet Pond # 1
   Particle Size Distribution file name: C:\WinSLAMM Files\NURP.CPZ
   Initial stage elevation (ft): 3
   Peak to Average Flow Ratio: 3.8
   Maximum flow allowed into pond (cfs): No maximum value entered
   Outlet Characteristics:
        Outlet type: Broad Crested Weir
              1. Weir crest length (ft): 42
              2. Weir crest width (ft): 50
              3. Height of weir opening (cfs): 2
              4. Height from datum to bottom of weir opening: 3
   Pond stage and surface area

Entry Number	Stage (ft)	Pond Area (acres)	Natural Seepage (in/hr)	Other Outflow (cfs)
0	0.00	0.0000	0.00	0.00

1	0.01	0.0020	0.00
0.00			
2	1.00	9.2000	0.00
0.00			
3	2.00	13.0000	0.00
0.00			
4	3.00	13.7200	0.00
0.00			
5	4.00	19.0500	0.00
0.00			
6	5.00	25.7500	0.00
0.00			

Data file name: S:\Projects\U18010 - USFW St Louis River Feasibility Study\Winslamm\Duluth Existing SW.mdb
WinSLAMM Version 10.0.2
Rain file name: C:\WinSLAMM Files\Rain Files\WisReg - Madison WI 1981.RAN
Particulate Solids Concentration file name: C:\WinSLAMM Files\WI_AVG01.pscx
Runoff Coefficient file name: C:\WinSLAMM Files\v10 WI_SL06 Dec06.rsv
Residential Street Delivery file name: C:\WinSLAMM Files\WI_Res and Other Urban Dec06.std
Institutional Street Delivery file name: C:\WinSLAMM Files\WI_Com Inst Indust Dec06.std
Commercial Street Delivery file name: C:\WinSLAMM Files\WI_Com Inst Indust Dec06.std
Industrial Street Delivery file name: C:\WinSLAMM Files\WI_Com Inst Indust Dec06.std
Other Urban Street Delivery file name: C:\WinSLAMM Files\WI_Res and Other Urban Dec06.std
Freeway Street Delivery file name: C:\WinSLAMM Files\Freeway Dec06.std
Apply Street Delivery Files to Adjust the After Event Load Street Dirt Mass Balance: False
Pollutant Relative Concentration file name: C:\WinSLAMM Files\WI_GEO02.ppdx
Cost Data file name:
Seed for random number generator: -42
Study period starting date: 01/01/81 Study period ending date: 12/31/81
Date: 02-24-2015 Time: 13:24:28
Site information:

LU# 1 - Other Urban: Open Space 1 Total area (ac): 334.250
  1 - Roofs 1: 1.838 ac. Flat Connected
  31 - Sidewalks 1: 1.939 ac. Connected
  37 - Streets 1: 5.749 ac. Smooth Street Length = 3.449 curb-mi Default St. Dirt Accum. Default Initial St. Dirt Loading
  38 - Streets 2: 6.752 ac. Intermediate Street Length = 4.051 curb-mi Default St. Dirt Accum. Default Initial St. Dirt Loading
  45 - Large Landscaped Areas 1: 1.972 ac. Clayey Low Density
  57 - Undeveloped Areas 1: 316.000 ac. Clayey Low Density

LU# 2 - Other Urban: Open Space 2 Total area (ac): 9.610
  1 - Roofs 1: 0.053 ac. Flat Connected
  31 - Sidewalks 1: 0.056 ac. Connected
  37 - Streets 1: 0.165 ac. Smooth Street Length = 0.101 curb-mi Default St. Dirt Accum. Default Initial St. Dirt Loading
  38 - Streets 2: 0.194 ac. Intermediate Street Length = 0.119 curb-mi Default St. Dirt Accum. Default Initial St. Dirt Loading
  45 - Large Landscaped Areas 1: 0.057 ac. Clayey Low Density
  57 - Undeveloped Areas 1: 9.085 ac. Clayey Low Density

LU# 3 - Residential: High Density Residential 1 Total area (ac): 241.710
  1 - Roofs 1: 24.896 ac. Pitched Connected
  2 - Roofs 2: 26.830 ac. Pitched Disconnected Sandy
  25 - Driveways 1: 34.081 ac. Connected
  31 - Sidewalks 1: 4.834 ac. Connected
  32 - Sidewalks 2: 4.834 ac. Disconnected Sandy
  37 - Streets 1: 10.877 ac. Smooth Street Length = 5.982 curb-mi Default St. Dirt Accum. Default Initial St. Dirt Loading
  38 - Streets 2: 21.754 ac. Intermediate Street Length = 11.965 curb-mi Default St. Dirt Accum. Default Initial St. Dirt Loading
  51 - Small Landscaped Areas 1: 99.101 ac. Sandy
  69 - Isolated Areas: 0.242 ac.
  71 - Other Pervious Areas 1: 14.261 ac. Sandy

LU# 4 - Residential: High Density Residential 2 Total area (ac): 36.373
  1 - Roofs 1: 3.746 ac. Pitched Connected

2 - Roofs 2: 4.037 ac. Pitched Disconnected Sandy
25 - Driveways 1: 5.128 ac. Connected
31 - Sidewalks 1: 0.727 ac. Connected
32 - Sidewalks 2: 0.727 ac. Disconnected Sandy
37 - Streets 1: 1.637 ac. Smooth Street Length = 0.9 curb-mi Default St. Dirt Accum. Default Initial St. Dirt Loading
38 - Streets 2: 3.273 ac. Intermediate Street Length = 1.8 curb-mi Default St. Dirt Accum. Default Initial St. Dirt Loading
51 - Small Landscaped Areas 1: 14.912 ac. Sandy
69 - Isolated Areas: 0.040 ac.
71 - Other Pervious Areas 1: 2.146 ac. Sandy

LU# 5 - Industrial: Light Industrial Total area (ac): 115.841
1 - Roofs 1: 23.759 ac. Flat Connected
2 - Roofs 2: 2.630 ac. Flat Disconnected Sandy
3 - Roofs 3: 2.977 ac. Pitched Connected
13 - Paved Parking 1: 38.158 ac. Connected
19 - Unpaved Parking 1: 7.344 ac. Disconnected Sandy
25 - Driveways 1: 2.966 ac. Connected
31 - Sidewalks 1: 1.483 ac. Connected
37 - Streets 1: 2.131 ac. Smooth Street Length = 1.005 curb-mi Default St. Dirt Accum. Default Initial St. Dirt Loading
38 - Streets 2: 10.055 ac. Intermediate Street Length = 4.74 curb-mi Default St. Dirt Accum. Default Initial St. Dirt Loading
39 - Streets 3: 0.371 ac. Rough Street Length = 0.175 curb-mi Default St. Dirt Accum. Default Initial St. Dirt Loading
45 - Large Landscaped Areas 1: 4.066 ac. Sandy
51 - Small Landscaped Areas 1: 11.422 ac. Sandy
57 - Undeveloped Areas 1: 5.027 ac. Sandy
71 - Other Pervious Areas 1: 3.209 ac. Sandy
78 - Other Part Con Imp Areas 1: 0.243 ac. Disconnected Sandy

LU# 6 - Industrial: Industrial Total area (ac): 29.265
1 - Roofs 1: 4.917 ac. Flat Connected
2 - Roofs 2: 1.305 ac. Flat Disconnected Sandy
3 - Roofs 3: 0.541 ac. Pitched Connected
13 - Paved Parking 1: 9.978 ac. Connected
19 - Unpaved Parking 1: 4.276 ac. Disconnected Sandy
25 - Driveways 1: 0.527 ac. Connected
26 - Driveways 2: 0.293 ac. Disconnected Sandy
31 - Sidewalks 1: 0.132 ac. Connected
32 - Sidewalks 2: 0.132 ac. Disconnected Sandy
37 - Streets 1: 0.331 ac. Smooth Street Length = 0.152 curb-mi Default St. Dirt Accum. Default Initial St. Dirt Loading
38 - Streets 2: 1.815 ac. Intermediate Street Length = 0.832 curb-mi Default St. Dirt Accum. Default Initial St. Dirt Loading
39 - Streets 3: 0.064 ac. Rough Street Length = 0.029 curb-mi Default St. Dirt Accum. Default Initial St. Dirt Loading
45 - Large Landscaped Areas 1: 0.822 ac. Sandy
51 - Small Landscaped Areas 1: 1.171 ac. Sandy
57 - Undeveloped Areas 1: 1.572 ac. Sandy
71 - Other Pervious Areas 1: 1.326 ac. Sandy
78 - Other Part Con Imp Areas 1: 0.063 ac. Disconnected Sandy

LU# 7 - Commercial: Shopping Center Total area (ac): 29.299
1 - Roofs 1: 6.332 ac. Flat Connected
13 - Paved Parking 1: 17.779 ac. Connected
19 - Unpaved Parking 1: 0.100 ac. Connected
25 - Driveways 1: 0.530 ac. Connected
31 - Sidewalks 1: 0.158 ac. Connected
37 - Streets 1: 1.236 ac. Smooth Street Length = 0.68 curb-mi Default St. Dirt Accum. Default Initial St. Dirt Loading
38 - Streets 2: 0.636 ac. Intermediate Street Length = 0.35

curb-mi	Default St. Dirt Accum.	Default Initial St. Dirt Loading
51 - Small Landscaped Areas 1:	1.327 ac.	Sandy
57 - Undeveloped Areas 1:	0.858 ac.	Sandy
71 - Other Pervious Areas 1:	0.240 ac.	Sandy
77 - Other Direct Con Imp Areas:	0.103 ac.	Connected

Data file name: S:\Projects\U18010 - USFW St Louis River Feasibility Study\Winslamm\Duluth Proposed (Option 1).mdb
WinSLAMM Version 10.0.2
Rain file name: C:\WinSLAMM Files\Rain Files\WisReg - Madison WI 1981.RAN
Particulate Solids Concentration file name: C:\WinSLAMM Files\WI_AVG01.pscx
Runoff Coefficient file name: C:\WinSLAMM Files\v10 WI_SL06 Dec06.rsv
Residential Street Delivery file name: C:\WinSLAMM Files\WI_Res and Other Urban Dec06.std
Institutional Street Delivery file name: C:\WinSLAMM Files\WI_Com Inst Indust Dec06.std
Commercial Street Delivery file name: C:\WinSLAMM Files\WI_Com Inst Indust Dec06.std
Industrial Street Delivery file name: C:\WinSLAMM Files\WI_Com Inst Indust Dec06.std
Other Urban Street Delivery file name: C:\WinSLAMM Files\WI_Res and Other Urban Dec06.std
Freeway Street Delivery file name: C:\WinSLAMM Files\Freeway Dec06.std
Apply Street Delivery Files to Adjust the After Event Load Street Dirt Mass Balance: False
Pollutant Relative Concentration file name: C:\WinSLAMM Files\WI_GEO02.ppdx
Cost Data file name:
Seed for random number generator: -42
Study period starting date: 01/01/81 Study period ending date: 12/31/81
Date: 02-24-2015 Time: 13:24:51
Site information:

LU# 1 - Other Urban: Open Space 1 Total area (ac): 334.250
  1 - Roofs 1: 1.838 ac. Flat Connected
  31 - Sidewalks 1: 1.939 ac. Connected
  37 - Streets 1: 5.749 ac. Smooth Street Length = 3.449 curb-mi Default St. Dirt Accum. Default Initial St. Dirt Loading
  38 - Streets 2: 6.752 ac. Intermediate Street Length = 4.051 curb-mi Default St. Dirt Accum. Default Initial St. Dirt Loading
  45 - Large Landscaped Areas 1: 1.972 ac. Clayey Low Density
  57 - Undeveloped Areas 1: 316.000 ac. Clayey Low Density

LU# 2 - Other Urban: Open Space 2 Total area (ac): 9.610
  1 - Roofs 1: 0.053 ac. Flat Connected
  31 - Sidewalks 1: 0.056 ac. Connected
  37 - Streets 1: 0.165 ac. Smooth Street Length = 0.101 curb-mi Default St. Dirt Accum. Default Initial St. Dirt Loading
  38 - Streets 2: 0.194 ac. Intermediate Street Length = 0.119 curb-mi Default St. Dirt Accum. Default Initial St. Dirt Loading
  45 - Large Landscaped Areas 1: 0.057 ac. Clayey Low Density
  57 - Undeveloped Areas 1: 9.085 ac. Clayey Low Density

LU# 3 - Residential: High Density Residential 1 Total area (ac): 241.710
  1 - Roofs 1: 24.896 ac. Pitched Connected
  2 - Roofs 2: 26.830 ac. Pitched Disconnected Sandy
  25 - Driveways 1: 34.081 ac. Connected
  31 - Sidewalks 1: 4.834 ac. Connected
  32 - Sidewalks 2: 4.834 ac. Disconnected Sandy
  37 - Streets 1: 10.877 ac. Smooth Street Length = 5.982 curb-mi Default St. Dirt Accum. Default Initial St. Dirt Loading
  38 - Streets 2: 21.754 ac. Intermediate Street Length = 11.965 curb-mi Default St. Dirt Accum. Default Initial St. Dirt Loading
  51 - Small Landscaped Areas 1: 99.101 ac. Sandy
  69 - Isolated Areas: 0.242 ac.
  71 - Other Pervious Areas 1: 14.261 ac. Sandy

LU# 4 - Residential: High Density Residential 2 Total area (ac): 36.373
  1 - Roofs 1: 3.746 ac. Pitched Connected

2 - Roofs 2: 4.037 ac. Pitched Disconnected Sandy
25 - Driveways 1: 5.128 ac. Connected
31 - Sidewalks 1: 0.727 ac. Connected
32 - Sidewalks 2: 0.727 ac. Disconnected Sandy
37 - Streets 1: 1.637 ac. Smooth Street Length = 0.9 curb-mi Default St. Dirt Accum. Default Initial St. Dirt Loading
38 - Streets 2: 3.273 ac. Intermediate Street Length = 1.8 curb-mi Default St. Dirt Accum. Default Initial St. Dirt Loading
51 - Small Landscaped Areas 1: 14.912 ac. Sandy
69 - Isolated Areas: 0.040 ac.
71 - Other Pervious Areas 1: 2.146 ac. Sandy

LU# 5 - Industrial: Light Industrial Total area (ac): 115.841
1 - Roofs 1: 23.759 ac. Flat Connected
2 - Roofs 2: 2.630 ac. Flat Disconnected Sandy
3 - Roofs 3: 2.977 ac. Pitched Connected
13 - Paved Parking 1: 38.158 ac. Connected
19 - Unpaved Parking 1: 7.344 ac. Disconnected Sandy
25 - Driveways 1: 2.966 ac. Connected
31 - Sidewalks 1: 1.483 ac. Connected
37 - Streets 1: 2.131 ac. Smooth Street Length = 1.005 curb-mi Default St. Dirt Accum. Default Initial St. Dirt Loading
38 - Streets 2: 10.055 ac. Intermediate Street Length = 4.74 curb-mi Default St. Dirt Accum. Default Initial St. Dirt Loading
39 - Streets 3: 0.371 ac. Rough Street Length = 0.175 curb-mi Default St. Dirt Accum. Default Initial St. Dirt Loading
45 - Large Landscaped Areas 1: 4.066 ac. Sandy
51 - Small Landscaped Areas 1: 11.422 ac. Sandy
57 - Undeveloped Areas 1: 5.027 ac. Sandy
71 - Other Pervious Areas 1: 3.209 ac. Sandy
78 - Other Part Con Imp Areas 1: 0.243 ac. Disconnected Sandy

LU# 6 - Industrial: Industrial Total area (ac): 29.265
1 - Roofs 1: 4.917 ac. Flat Connected
2 - Roofs 2: 1.305 ac. Flat Disconnected Sandy
3 - Roofs 3: 0.541 ac. Pitched Connected
13 - Paved Parking 1: 9.978 ac. Connected
19 - Unpaved Parking 1: 4.276 ac. Disconnected Sandy
25 - Driveways 1: 0.527 ac. Connected
26 - Driveways 2: 0.293 ac. Disconnected Sandy
31 - Sidewalks 1: 0.132 ac. Connected
32 - Sidewalks 2: 0.132 ac. Disconnected Sandy
37 - Streets 1: 0.331 ac. Smooth Street Length = 0.152 curb-mi Default St. Dirt Accum. Default Initial St. Dirt Loading
38 - Streets 2: 1.815 ac. Intermediate Street Length = 0.832 curb-mi Default St. Dirt Accum. Default Initial St. Dirt Loading
39 - Streets 3: 0.064 ac. Rough Street Length = 0.029 curb-mi Default St. Dirt Accum. Default Initial St. Dirt Loading
45 - Large Landscaped Areas 1: 0.822 ac. Sandy
51 - Small Landscaped Areas 1: 1.171 ac. Sandy
57 - Undeveloped Areas 1: 1.572 ac. Sandy
71 - Other Pervious Areas 1: 1.326 ac. Sandy
78 - Other Part Con Imp Areas 1: 0.063 ac. Disconnected Sandy

LU# 7 - Commercial: Shopping Center Total area (ac): 29.299
1 - Roofs 1: 6.332 ac. Flat Connected
13 - Paved Parking 1: 17.779 ac. Connected
19 - Unpaved Parking 1: 0.100 ac. Connected
25 - Driveways 1: 0.530 ac. Connected
31 - Sidewalks 1: 0.158 ac. Connected
37 - Streets 1: 1.236 ac. Smooth Street Length = 0.68 curb-mi Default St. Dirt Accum. Default Initial St. Dirt Loading
38 - Streets 2: 0.636 ac. Intermediate Street Length = 0.35

curb-mi Default St. Dirt Accum. Default Initial St. Dirt Loading
51 - Small Landscaped Areas 1: 1.327 ac. Sandy
57 - Undeveloped Areas 1: 0.858 ac. Sandy
71 - Other Pervious Areas 1: 0.240 ac. Sandy
77 - Other Direct Con Imp Areas: 0.103 ac. Connected

LU# 8 - Other Urban: Open Space 3 Total area (ac): 205.730
1 - Roofs 1: 1.132 ac. Flat Connected
25 - Driveways 1: 1.193 ac. Connected
37 - Streets 1: 3.539 ac. Smooth Street Length = 2.116 curb-mi
Default St. Dirt Accum. Default Initial St. Dirt Loading
38 - Streets 2: 4.156 ac. Intermediate Street Length = 2.494
curb-mi Default St. Dirt Accum. Default Initial St. Dirt Loading
45 - Large Landscaped Areas 1: 1.213 ac. Clayey Low Density
57 - Undeveloped Areas 1: 194.497 ac. Clayey Low Density

LU# 9 - Other Urban: Open Space 4 Total area (ac): 36.499
1 - Roofs 1: 0.200 ac. Flat Connected
25 - Driveways 1: 0.212 ac. Connected
37 - Streets 1: 0.628 ac. Smooth Street Length = 0.377 curb-mi
Default St. Dirt Accum. Default Initial St. Dirt Loading
38 - Streets 2: 0.737 ac. Intermediate Street Length = 0.442
curb-mi Default St. Dirt Accum. Default Initial St. Dirt Loading
45 - Large Landscaped Areas 1: 0.215 ac. Sandy
57 - Undeveloped Areas 1: 34.507 ac. Sandy

LU# 10 - Industrial: Light Industrial 2 Total area (ac): 136.620
1 - Roofs 1: 28.021 ac. Flat Connected
2 - Roofs 2: 3.101 ac. Flat Disconnected Sandy
3 - Roofs 3: 3.511 ac. Pitched Connected
13 - Paved Parking 1: 45.003 ac. Connected
19 - Unpaved Parking 1: 8.662 ac. Disconnected Sandy
25 - Driveways 1: 3.497 ac. Connected
31 - Sidewalks 1: 1.749 ac. Connected
37 - Streets 1: 2.514 ac. Smooth Street Length = 1.185 curb-mi
Default St. Dirt Accum. Default Initial St. Dirt Loading
38 - Streets 2: 11.859 ac. Intermediate Street Length = 5.591
curb-mi Default St. Dirt Accum. Default Initial St. Dirt Loading
39 - Streets 3: 0.437 ac. Rough Street Length = 0.206 curb-mi
Default St. Dirt Accum. Default Initial St. Dirt Loading
45 - Large Landscaped Areas 1: 4.795 ac. Sandy
51 - Small Landscaped Areas 1: 13.471 ac. Sandy
57 - Undeveloped Areas 1: 5.929 ac. Sandy
71 - Other Pervious Areas 1: 3.784 ac. Sandy
78 - Other Part Con Imp Areas 1: 0.287 ac. Disconnected Sandy

LU# 11 - Residential: High Density Residential 3 Total area (ac):
171.520
1 - Roofs 1: 17.667 ac. Pitched Connected
2 - Roofs 2: 19.039 ac. Pitched Disconnected Sandy
25 - Driveways 1: 24.184 ac. Connected
31 - Sidewalks 1: 3.430 ac. Connected
32 - Sidewalks 2: 3.430 ac. Disconnected Sandy
37 - Streets 1: 7.718 ac. Smooth Street Length = 4.245 curb-mi
Default St. Dirt Accum. Default Initial St. Dirt Loading
38 - Streets 2: 15.437 ac. Intermediate Street Length = 8.49
curb-mi Default St. Dirt Accum. Default Initial St. Dirt Loading
51 - Small Landscaped Areas 1: 70.323 ac. Sandy
69 - Isolated Areas: 0.172 ac.
71 - Other Pervious Areas 1: 10.120 ac. Sandy

LU# 12 - Industrial: Industrial 2 Total area (ac): 21.321
1 - Roofs 1: 3.582 ac. Flat Connected
2 - Roofs 2: 0.951 ac. Flat Disconnected Sandy
3 - Roofs 3: 0.394 ac. Pitched Connected
13 - Paved Parking 1: 7.268 ac. Connected
14 - Paved Parking 2: 3.115 ac. Disconnected Sandy
25 - Driveways 1: 0.384 ac. Connected
26 - Driveways 2: 0.213 ac. Disconnected Sandy
31 - Sidewalks 1: 0.096 ac. Connected
32 - Sidewalks 2: 0.096 ac. Disconnected Sandy
37 - Streets 1: 0.241 ac. Smooth Street Length = 0.11 curb-mi Default St. Dirt Accum. Default Initial St. Dirt Loading
38 - Streets 2: 1.322 ac. Intermediate Street Length = 0.606 curb-mi Default St. Dirt Accum. Default Initial St. Dirt Loading
39 - Streets 3: 0.047 ac. Rough Street Length = 0.022 curb-mi Default St. Dirt Accum. Default Initial St. Dirt Loading
45 - Large Landscaped Areas 1: 0.599 ac. Sandy
51 - Small Landscaped Areas 1: 0.853 ac. Sandy
57 - Undeveloped Areas 1: 1.145 ac. Sandy
71 - Other Pervious Areas 1: 0.966 ac. Sandy
78 - Other Part Con Imp Areas 1: 0.049 ac. Disconnected Sandy

Control Practice 1: Wet Detention Pond CP# 1 (DS) - DS Wet Pond # 1
Particle Size Distribution file name: C:\WinSLAMM Files\NURP.CPZ
Initial stage elevation (ft): 7
Peak to Average Flow Ratio: 3.8
Maximum flow allowed into pond (cfs): No maximum value entered
Outlet Characteristics:
Outlet type: Broad Crested Weir
1. Weir crest length (ft): 35
2. Weir crest width (ft): 45
3. Height of weir opening (cfs): 3
4. Height from datum to bottom of weir opening: 7
Pond stage and surface area

Entry Number	Stage (ft)	Pond Area (acres)	Natural Seepage (in/hr)	Other Outflow (cfs)
0	0.00	0.0000	0.00	0.00
1	0.01	1.2830	0.00	0.00
2	1.00	1.4700	0.00	0.00
3	2.00	1.6000	0.00	0.00
4	3.00	1.8400	0.00	0.00
5	4.00	3.3500	0.00	0.00
6	5.00	8.5200	0.00	0.00
7	6.00	11.7700	0.00	0.00
8	7.00	12.6500	0.00	0.00
9	8.00	17.7400	0.00	0.00
10	9.00	25.2700	0.00	0.00