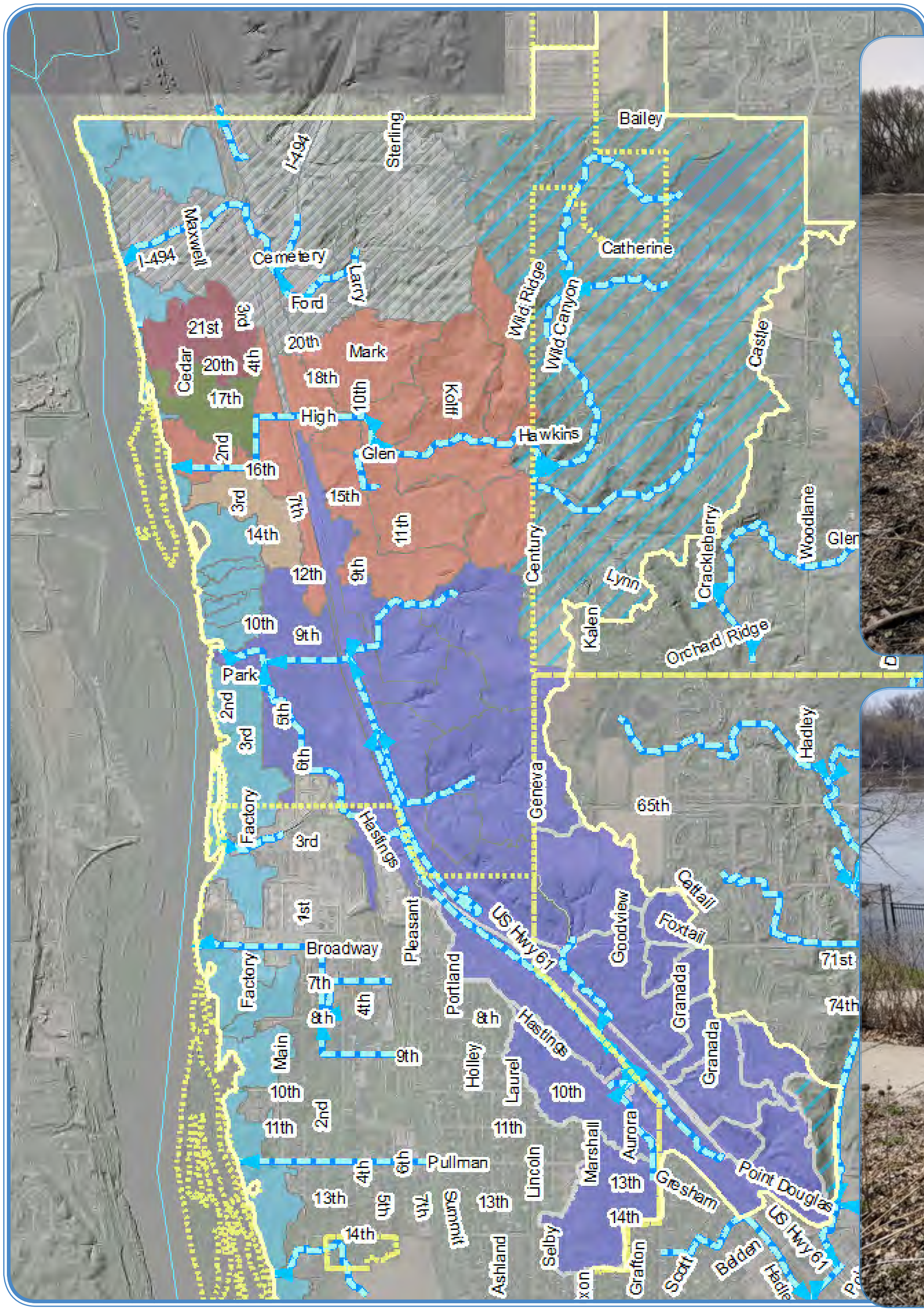
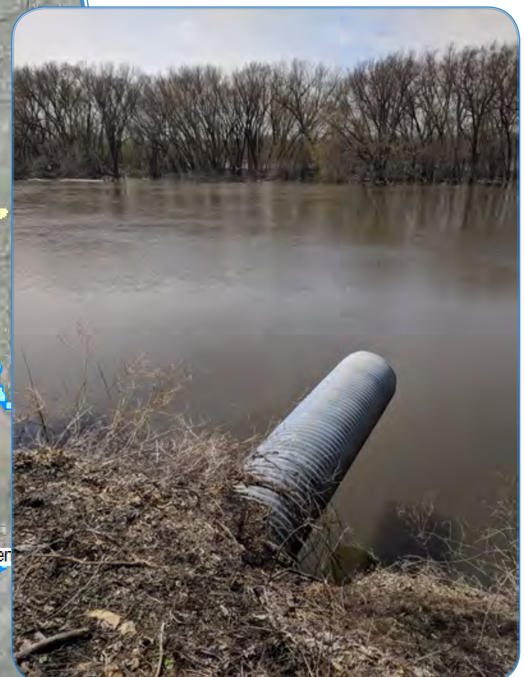
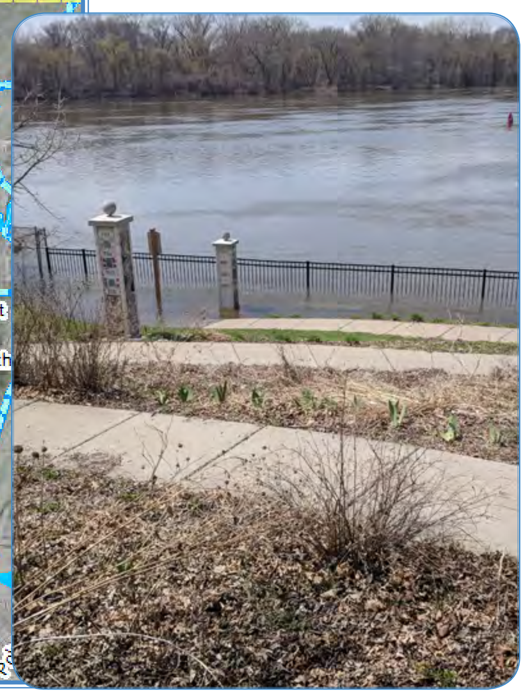
EAST MISSISSIPPI - NEWPORT
SUBWATERSHED RETROFIT ANALYSIS







MAY, 2018

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Summary

This analysis provides a prioritized list (ranked by cost effectiveness) of stormwater retrofit recommendations to primarily reduce Total Suspended Solids (TSS) loading to the Mississippi River from the East Mississippi Subwatershed – Newport, a 2,000 acre modeled area within the South Washington Watershed District (SWWD) boundary. TSS is the target pollutant as this section of the Mississippi river is listed as impaired for TSS by the South Metro Mississippi TMDL.

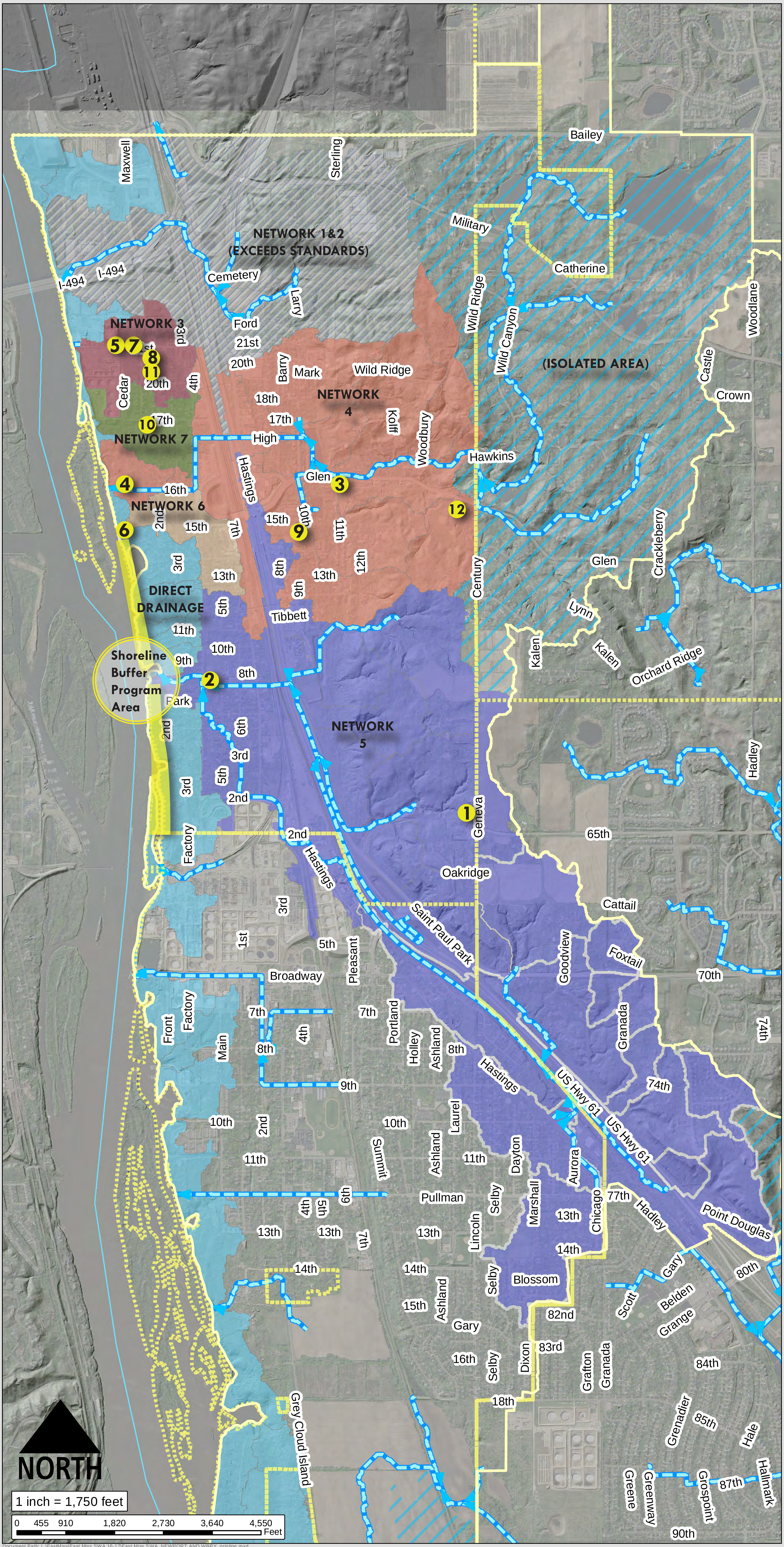
For this analysis, we used existing lidar, landuse, and stormsewer infrastructure data to develop a WinSLAMM model for the subwatershed. For areas that did not fit WinSLAMM modeling (e.g. rural ravine), the BWSR Pollution Reduction Estimator was used to model gully erosion and soil loss volumes. Catchment networks, consisting of multiple catchments sharing the same outfall to the Mississippi river were identified.

The proposed stormwater management practices within each catchment network were analyzed for annual pollutant loading - Total Phosphorus (TP), Total Suspended Solids (TSS) and Water Quality Volume (WQV) specifically. All known existing BMPs and their load reductions were accounted for in the modeling process. The existing loading was compared to a loading value of 154 lbs/acre, identified as the goal maximum loading value for the subwatershed by the South Metro Mississippi TMDL. Most identified and modeled catchment networks received field reconnaissance visits including all identified BMP opportunities. Proposed BMP options were then compared for each sub-catchment, given their specific site constraints and characteristics. Each final stormwater practice was selected and ranked by weighing cost, pollution reduction benefits, ease of installation and maintenance, and ability to serve multiple functions. A Ranking Table can be found on the following page and in the Appendix.

Much of the subwatershed sits on shallow bedrock. Areas with infiltration potential (based on soil survey data) are identified on the provided maps. The shallow bedrock favored BMPs with relatively small footprints to limit excavation costs.

The cost-benefit value for annual TSS reduction over 20 years ranges from $189 to $17,428 per ton.

IDENTIFIED AND RANKED STORMWATER BMP RETROFIT PROJECTS AND PROGRAM - *SUBWATERSHED SCALE*



LEGEND

- 3 IDENTIFIED PROJECT LOCATION AND RANKING
- DIRECT DRAINAGE
- NETWORK 1 AND 2 (NOT PRIORITIZED)
- NETWORK 3
- NETWORK 4
- NETWORK 5
- NETWORK 6
- NETWORK 7
- ISOLATED BASINS (NOT PRIORITIZED)

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Stormwater Retrofit Ranking by BMP Cost Effectiveness

The following table summarizes the assessment results, ascending in rank by $Cost per Lb of TSS removed over 20 years. Reported treatment levels are dependent upon optimal siting and sizing. The recommended treatment levels/amounts summarized here are based on a subjective assessment of what can realistically be expected to be installed considering expected public participation and site constraints. See Methods Section for how rankings were determined.

Project Rank	Drainage Network/Outfall	BMP Type	Projects Identified	BMP Location	TP Reduction (lb/yr)	TSS Reduction (lb/yr)	Volume Reduction (acft/yr)	Total Project cost	Estimated Annual O&M (2018 dollars)	Estimated cost/lb-TP/year (20 years)	Estimated cost/ton TSS/year (20 years)
1	**Network 5/ 65th Street**	Ravine Stabilization	1	NW corner of 65th Street and Geneva Ave	15*	18*	0.2*	$63,000	$250	$227	**$189**
2	**Network 5/ 8th Street**	Underground Stormfilter Vault	1	NE corner of 4th Avenue and 8th Street (Newport Elementary)	263	103,461	0.1	$1,010,000	$40,000	$344	**$1,749**
3	**Network 4/16th Street**	Underground Storage	1	SE corner of Glen Rd and 11th Ave	18.3	8,631	10.5	$155,000	$800	$468	**$1,981**
4	**Network 4/16th Street**	Underground Stormfilter Vault	1	Levee Park at 16th Street and Cedar Lane	60	24,450	0.5	$354,000	$30,000	$795	**$3,902**
5	**Network 3 / 21st Street**	Pond modification/Industrial Reuse	1	Aggregate Industries Concrete Plant	3.9	2,761	3.7	$123,500	$1,500	$1,978	**$5,560**
6	**Network 6/15th Street**	Upflo Filter	1	West side of 15th street and Cedar Lane	13.5	7,300	0.1	$163,000	$15,000	$1,715	**$6,342**
7	**Network 3 / 21st Street**	Underground Stormfilter Vault	1	21st Street Near Outfall	15.24	9,300	**0.5**	$335,000	$20,000	$2,411	**$7,903**
8	**Network 3 / 21st Street**	Underground storage/reuse	1	Fire Station/Future City Hall	3.4	1451	2.8	$106,500	$1,200	$1,902	**$8,994**
9	**Network 4/16th Street**	Bioretention	3	3 locations at Newport Lutheran Church and 10th Ave	3.4	1,430	3.3	$142,500	$1,500	$1,949	**$9,265**
10	**Network 7/ 17th Street**	Bioretention	3	3 locations along 17th and/or 4th Ave	10	900	6	$80,000	$1,500	$550	**$12,222**
11	**Network 3 / 21st Street**	Tree Pit Filters	3	Fire Station/Future City Hall	3.5	1400	0.6	$172,000	$1,500	$2,872	**$13,921**
12	**Network 4/16th Street**	Bioretention	2	Loveland Park Entrance	5.8	500	1.5	$127,000	$1,000	$1,051	**$17,428**
	Mississippi Shoreline Buffer/Direct Drainage	Vegetation Enhancements and Erosion Control	Multiple	Mississippi Shoreline to nearest N/S Ave, Including Dead End Streets	TBD						
Totals			**19 projects + 1 program**					**$2,831,500**			

About this Document

This Subwatershed Stormwater Retrofit Analysis is a watershed management tool to help prioritize stormwater retrofit projects by performance and cost effectiveness. This process helps maximize the value of each dollar spent.

Document Organization

This document is organized into three major sections, plus references and appendices. Each section is briefly described below.

Methods

The methods section outlines general procedures used when analyzing the subwatershed. It provides an overview of processes involved in retrofit scoping, desktop analysis, retrofit reconnaissance investigation, cost/treatment analysis and project ranking. See Appendix A for a detailed description of the methods for both the overall analysis as well as for how other practices were factored into the modelling and reporting.

Catchment Profiles

The East Mississippi – Newport Subwatershed was determined from existing SWWD catchment delineation data. Catchment drainage networks were delineated based existing catchment data, stormsewer data, and ground truthing. The numbering system for identifying the drainage networks is only for use in this report, whereas individual catchment identification numbers correlate with catchment datasets. For each catchment and drainage network, the following information is detailed:

Catchment Description

Within each catchment profile is a table that summarizes basic catchment information including acres, dominant land use, and estimated existing annual pollutant and volume loading. A brief description of the land use, stormwater infrastructure, exceedance of acceptable TSS loading in comparison to the Mississippi River TMDL, and any other important general information is also described. Existing stormwater practices are noted, and their estimated effectiveness presented. Appendix B outlines how to read a typical Catchment Profile.

BMP Retrofit Recommendations

The recommendation section describes the conceptual retrofit(s) that were identified. It includes tables outlining the estimated pollutant removals by all practices proposed, as well as costs and overall cost-benefit ranking. Following this Retrofit Recommendations summary page, each practice has its own page which includes a map, individual cost-benefit analysis, and site specific comments on the individual proposed retrofit.

Retrofit Rankings

This section ranks stormwater retrofit projects across all catchments to create a prioritized project list. The list is sorted by cost-per-pound of total suspended solids removed for each project over 20 years. The final cost-per-pound treatment value includes design, installation, and maintenance costs (in 2018 dollars). Cost estimates vary in precision due to exposure to real-world bids for specific practices, and will also vary when unknown site parameters are addressed during the design phase.

There are many possible ways to prioritize projects, and the list provided is merely a starting point. Other considerations for prioritizing installation may include:

- Non-target pollutant reductions
- Timing projects to occur with other CIPs
- Project visibility
- Availability of funding
- Total project costs
- Educational value
- Additional ecological and habitat connectivity value

References

This section identifies various sources of information synthesized to produce the assessment protocol used in this analysis.

Appendix

This section provides supplemental information and/or data used in various portions of the analysis protocol.

Stormwater BMP types identified in this report

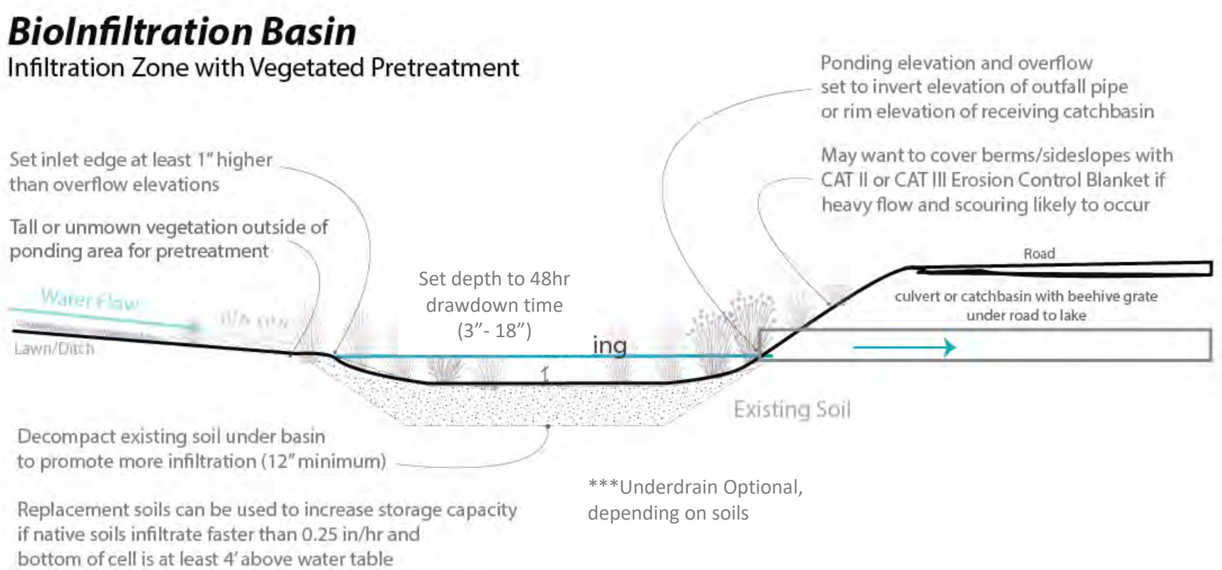
BioFiltration, BioInfiltration

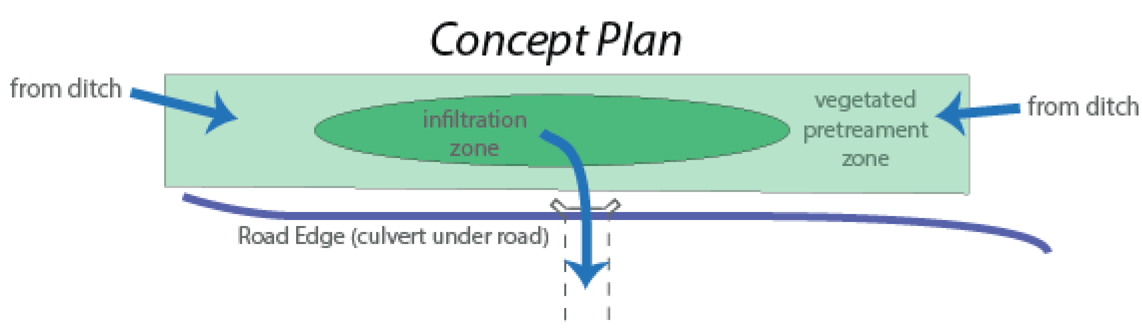
Summary

Biofiltration and BioInfiltration are the primary BMPs chosen for residential areas where rate control or pollution reduction is needed.

BioInfiltration

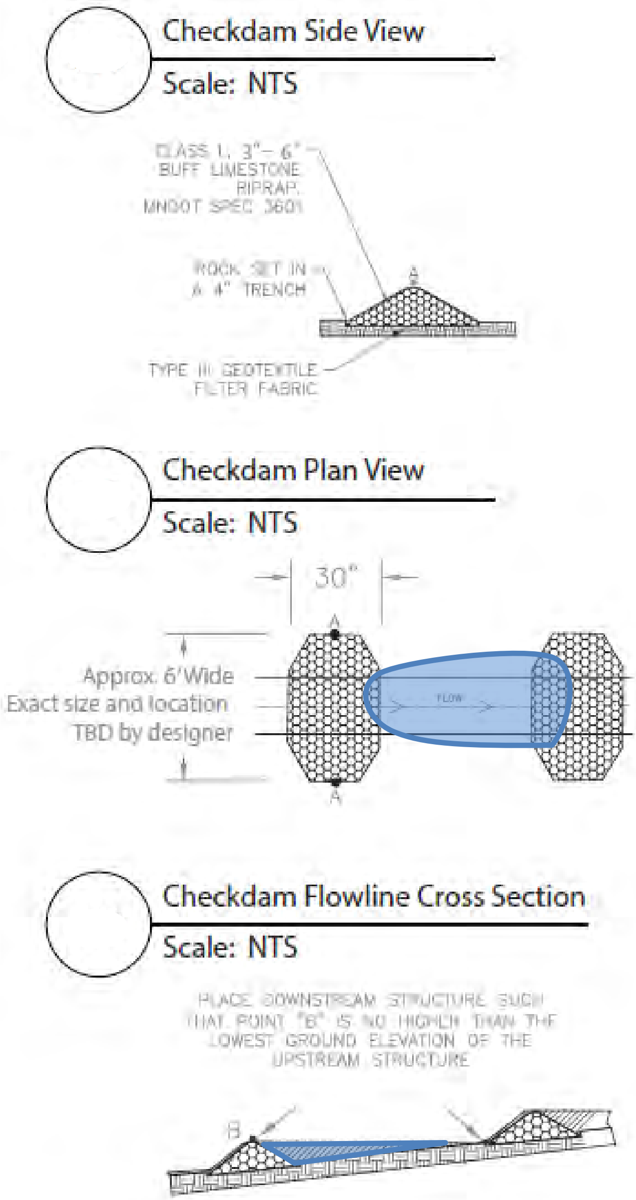
BioInfiltration is a basin that infiltrates into the native soil fast enough to allow for a fully drained basin within 48 hours. There are no underdrains in a BioInfiltration Basin. All basins of either type in the analysis do not have pretreatment devices to limit gross solid accumulation and rely on additional tall vegetation upstream to capture sediment prior to entering the basin.





Stormwater BMP types identified in this report

Checkdams



Check Dams

Used for grade stabilization, flow control, and rate control.

Can be used in a shallow sloped ditches to impound water temporarily, allowing sediment to drop out.

Only recommended for practices that are upstream of the ravines, where longer duration ponding can occur.

Most practices in this report will rely on hard armoring of headcuts rather than checkdams.

Modelling Pollutant Load Reductions for Checkdams:

Checkdams used for ponding and settling are modelled in WinSLAMM and are treated like an infiltration basin with minimal ponding. The underlying soils are classified as HSG C (unless replacement soils and underdrains are introduced). Pollution reductions are only significant if many are installed in succession and the slopes are shallow.

Erosion losses in the channel are typically only accounted for in modelling of Headcut Repairs, where direct losses of the eroded soil are accounted for.

Stormwater BMP types identified in this report

In-Channel Erosion Control and Sediment Capture Practices

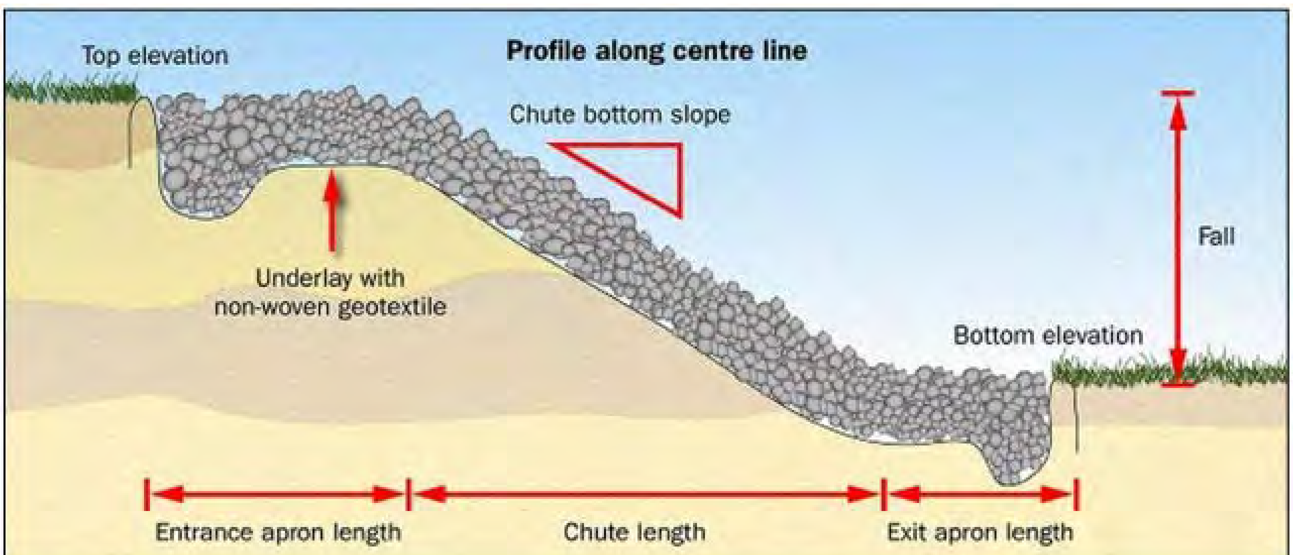
Hard Armoring and Headcut Repair

Hard armoring is the technical placement of various sized rocks along a flow path or channel slope, reducing the flow energy of the stream and stabilizing the headcut.

Used as a spillway or as a headcut stabilization method.

Modelling Pollutant Load Reductions for Headcut Repairs:

Only the direct losses from headcut being repaired are counted (the volume of the eroded zone lost over a field-identified duration of time). A conservative 50% credit for TSS and TP reductions is given to all headcut repairs. It is anticipated that side-bank losses may still occur in the largest of rain events.

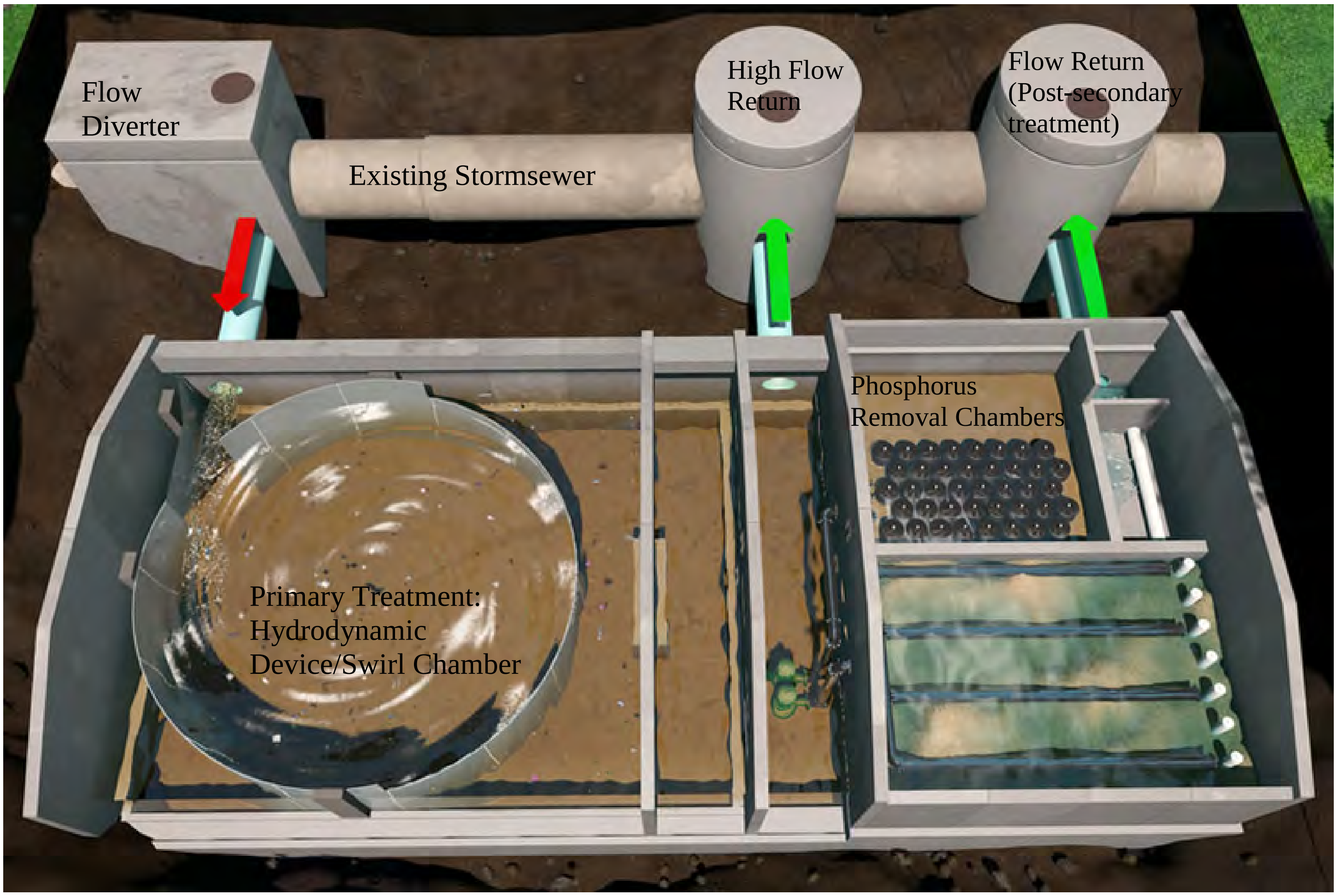


Rock Chute Spillway: Headcut Restoration and Diversion Spillways
(Ontario Ministry of Agriculture and Food)

Stormwater BMP types identified in this report

Underground Filtration Systems

Hydrodynamic Flow Devices, Stormfilters, underground storage, and Upflo systems



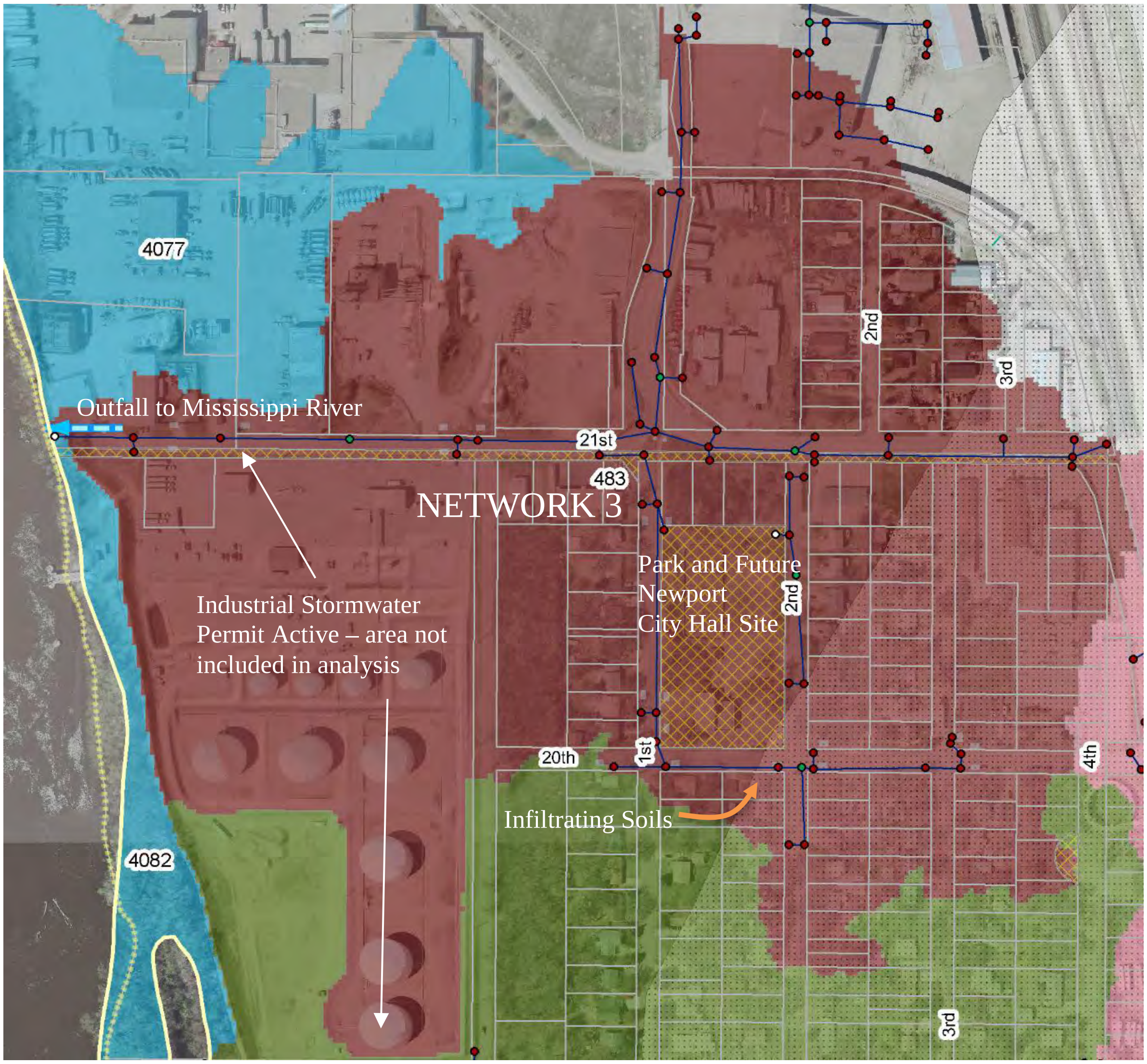
Stormfilter chamber BMP with hydrodynamic device as primary TSS treatment (image Mississippi Watershed Management Organization)

Filtration and storage chamber BMPs with an isolator row of chambers for TSS capture (image StormChamber)

Upflo filter floats as TSS accumulates on bottom of vault. High capacity filtration media adsorb phosphorus and fine particulates. The floating rack configuration allows for retrofitting of relatively shallow pipe configurations (image Upflo).

Catchment Drainage Network Profiles and BMP Rankings

Catchment Drainage Network 3



CATCHMENT DRAINAGE NETWORK DESCRIPTION

Catchment drainage network 3 (catchment 483) is over 65 acres; however only 50.8 acres was included in the analysis as the remaining 14.2 acre area is an industrial refinery and holds an industrial stormwater permit. The dominant land use is industrial. There is 1 private stormwater pond and 1 private filtration basin (Aggregate Industries concrete plant).

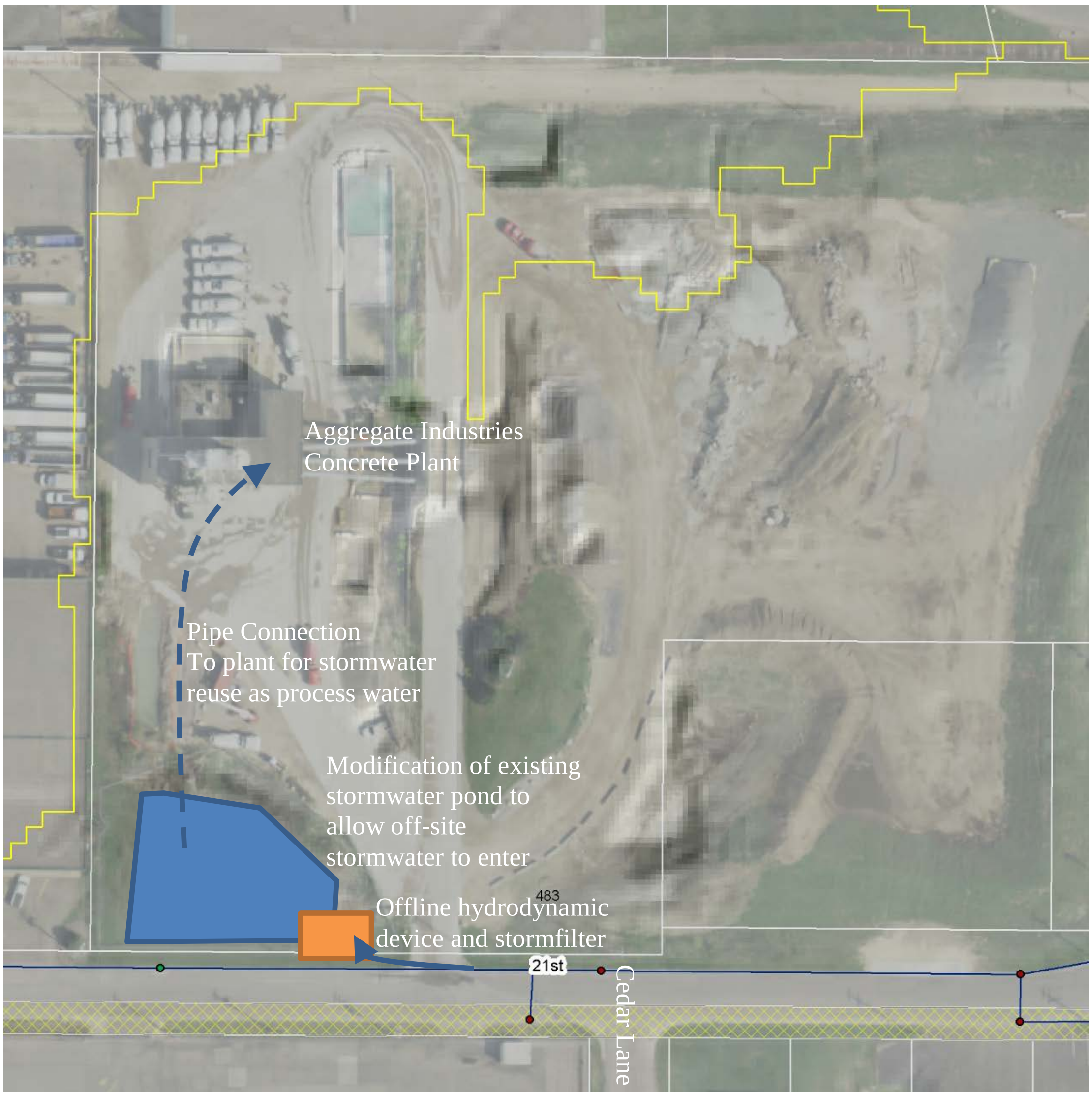
	Existing Conditions	Base Loading	Treatment	Net Treatment %	Existing Loading	Avg Loading per acre	Network Treatment needed to reach resource goal
Treatment	TP (lb/yr)	38.4	1.6	4.2%	**36.8**	**0.8**	**n/a**
	TSS (lb/yr)	24,918	1,424.0	5.7%	**23,494**	**503**	**16,292**
	Volume (acre-feet/yr)	35.7	0.5	1.4%	**35.2**	**0.8**	**n/a**
	Number of BMP's	2 constructed, 1 maintenance					
	BMP Size/Description	1 private stormwater pond, 1 private filtration bed, and street sweeping					

Network 3: Industrial Site Reuse System and Underground Filtration

Drainage Area – 49 acres
Location – Aggregate Industries Concrete Plant – Cedar Lane and 21st St
Property Ownership – Private

Rank 5 and
7 of 12

Description – There are 2 BMPs identified for at this location including (1) using ROW and potential easement to install an underground offline hydrodynamic device and stormfilter and (2) modifying the existing stormwater pond to take flows from the stormsewer network along 21st Street and use the stormwater in the industrial concrete plant process.



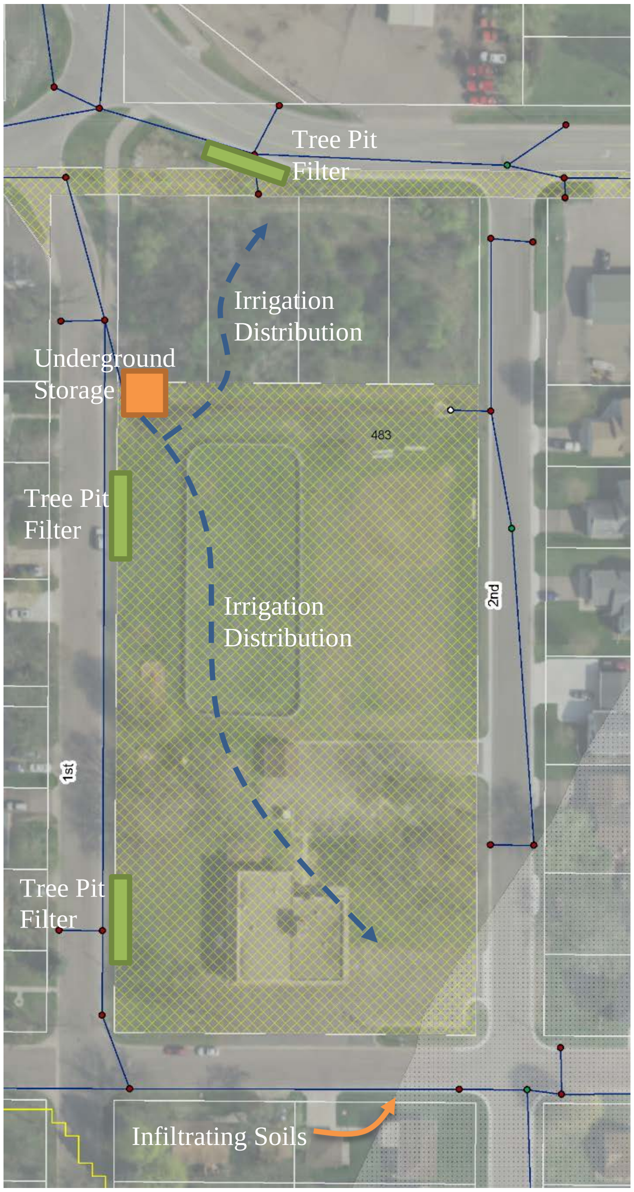
	Cost/Removal Analysis	*Project ID*	
		Underground Stormfilter with Hydrodynamic Device	
		New treatment	Net %
Treatment	TP (lb/yr)	15.2	41.4%
	TSS (lb/yr)	9,300	39.6%
	Volume (acre-feet/yr)	0.5	1.4%
	Number of BMP's	1	
	BMP Size/Description	212 (100 sf HD device, 112 sf stormfilter, does not include bypass structure	sqft
	BMP Type	Stormfilter with HD Device	
Cost	Materials/Labor/Design	$330,000	
	Promotion & Admin Costs	$5,000	
	Probable Project Cost	**$335,000**	
	Annual O&M	$20,000	
	20-yr Cost/lb-TP/yr	**$2,411**	
	20-yr Cost/2,000lb-TSS/yr	**$7,903**	

Network 3: Park Irrigation Reuse and Tree Pit Filtration

Rank 8 and 11 of 12

Drainage Area – 13.6 acres
Location – Current Newport Park and Fire Station / Future Newport City Hall and Park
Property Ownership – Public

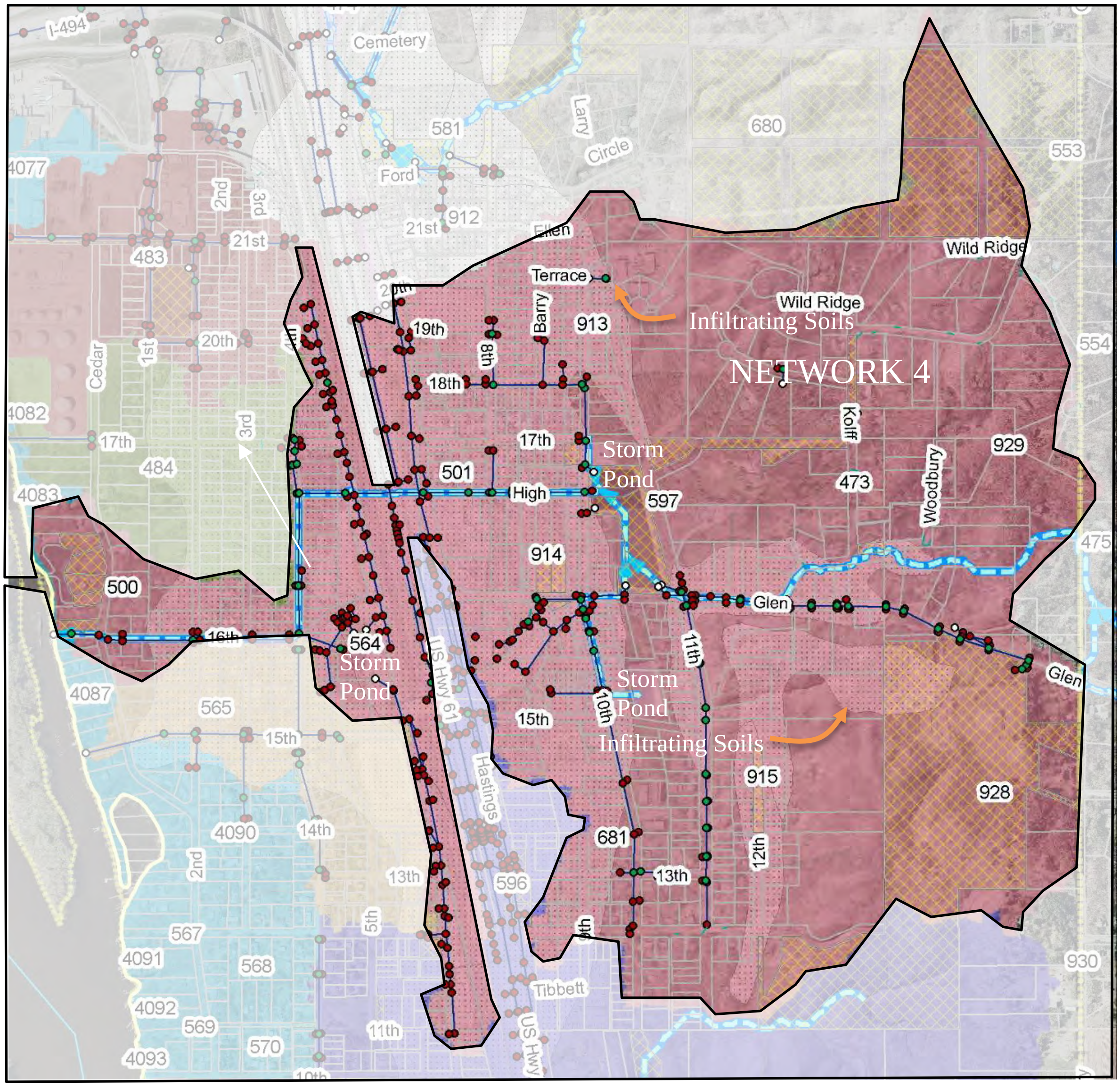
Description – There are 2 BMPs identified for at this location including (1) using parkland edge and future city hall property to install tree pit filters and (2) installing an underground storage vault to hold captured stormwater and use to irrigate the park and future city hall grounds and landscaping.



		Project ID	
	Cost/Removal Analysis	**Tree Pit Filter**	
		New trtmt	**Net %**
Treatment	**TP (lb/yr)**	3.5	10%
	TSS (lb/yr)	1,451	6%
	Volume (acre-feet/yr)	0.6	2%
	Number of BMP's	3	
	BMP Size/Description	2,000	sqft
	BMP Type	Tree pits with underdrain connection to Reuse System	
Cost	**Materials/Labor/Design**	$170,000	
	Promotion & Admin Costs	$2,000	
	Probable Project Cost	**$172,000**	
	Annual O&M	$1,500	
	20-yr Cost/lb-TP/yr	**$2,872**	
	20-yr Cost/2,000lb-TSS/yr	**$13,921**	

		Project ID	
	Cost/Removal Analysis	**Underground Storage/Reuse System**	
		New trtmt	**Net %**
Treatment	**TP (lb/yr)**	3.4	9%
	TSS (lb/yr)	1,451	6%
	Volume (acre-feet/yr)	2.8	8%
	Number of BMP's	1	
	BMP Size/Description	4,000	sqft
	BMP Type	Underground Vault with 3 acres irrigated (at 250k gal/ac/yr)	
Cost	**Materials/Labor/Design**	$105,000	
	Promotion & Admin Costs	$1,500	
	Probable Project Cost	**$106,500**	
	Annual O&M	$1,200	
	20-yr Cost/lb-TP/yr	**$1,902**	
	20-yr Cost/2,000lb-TSS/yr	**$8,994**	

Catchment Drainage Network 4



CATCHMENT DRAINAGE NETWORK DESCRIPTION

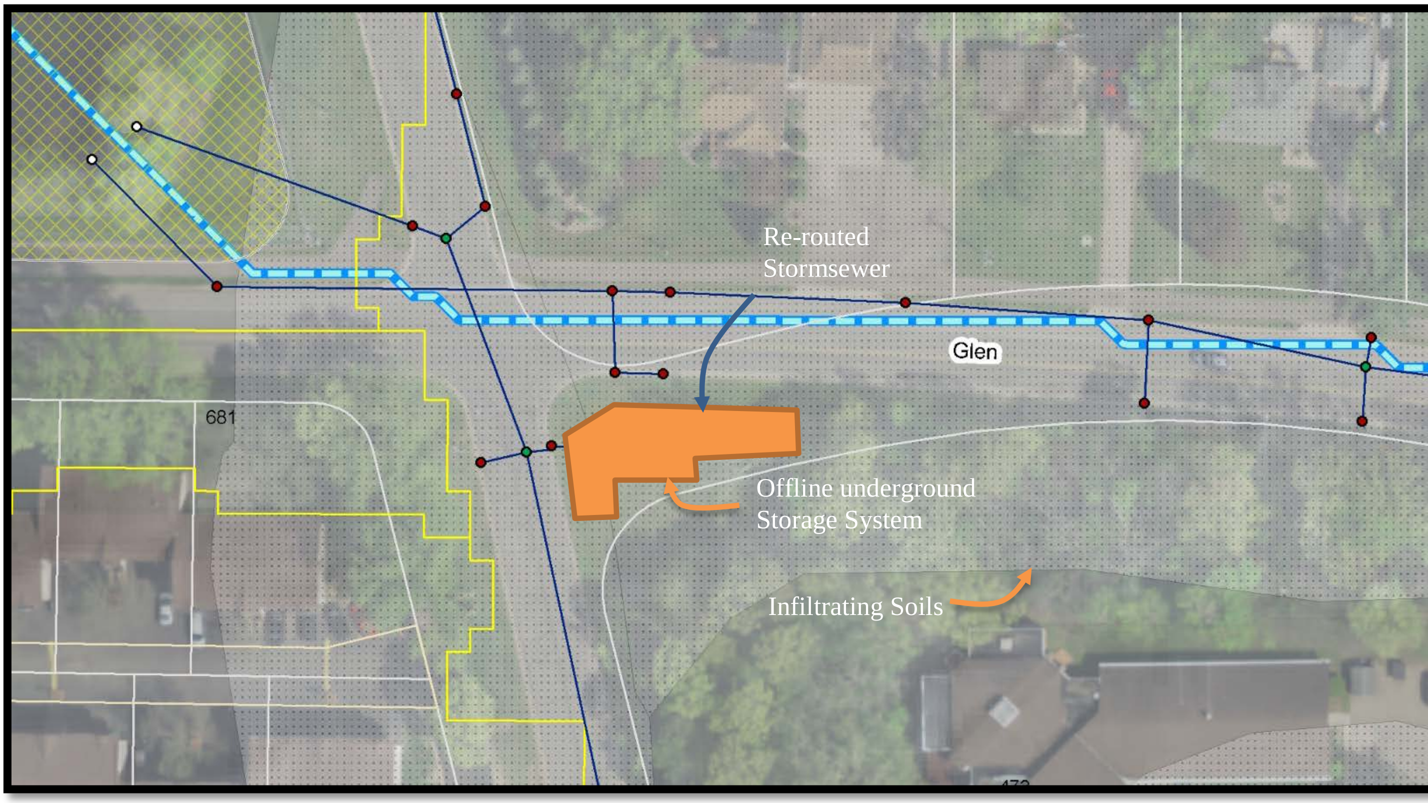
Catchment drainage network 4 is over 520 acres. The dominant land use is medium density residential. There are 3 stormwater ponds located within network. Like all areas, one street sweeping per year is assumed in the model existing conditions.

	Existing Conditions	Base Loading	Treatment	Net Treatment %	Existing Loading	Avg Loading per acre	Network Treatment needed to reach resource goal
Treatment	TP (lb/yr)	339.0	135.0	39.8%	**204.0**	**0.4**	**n/a**
	TSS (lb/yr)	153,930	57,891.0	37.6%	**96,039**	**185**	**15,959**
	Volume (acre-feet/yr)	247.0	3.2	1.3%	**243.8**	**0.5**	**n/a**
	Number of BMP's	3 constructed, 1 maintenance					
	BMP Size/Description	3 stormwater ponds and street sweeping					

Network 4: Underground Storage, Filtration and Infiltration

Rank 3 of 12

Drainage Area – 69 acres
Location – SE corner of Glen Road and 11th Avenue
Property Ownership – Public (ROW)
Description – The proposed BMP at this location helps to address not only TSS loading, but would also help reduce excess volume issues present in this part of Newport (according to SWWD's Newport 2018 XP SWMM model). The underground storage and filtration system captures sediment and stores a large volume of stormwater, slowly infiltrating and metering out flows back into the stormsewer system.



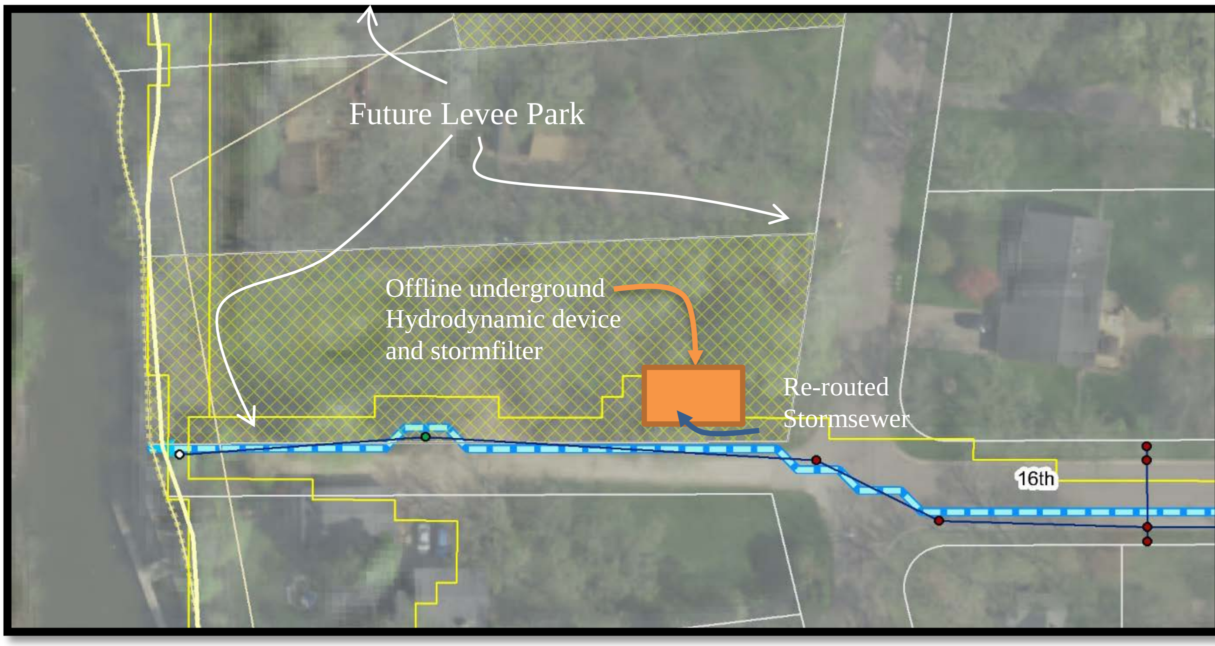
	Cost/Removal Analysis	Project ID	
		Underground Storage	
		New treatment	Net %
Treatment	TP (lb/yr)	18.3	9%
	TSS (lb/yr)	8,631	9%
	Volume (acre-feet/yr)	10.5	4%
	Number of BMP's	1	
	BMP Size each/Description	0.60	acft
	BMP Type	Underground Storage System	
Cost	Materials/Labor/Design	$150,000	
	Promotion & Admin Costs	$5,000	
	Probable Project Cost	**$155,000**	
	Annual O&M	$800	
	20-yr Cost/lb-TP/yr	**$468**	
	20-yr Cost/2,000lb-TSS/yr	**$1,981**	

Network 4: Underground Hydrodynamic Device and Stormfilter

Rank 4 of 12

Drainage Area – 519 acres
Location – Levee Park at NW corner of 16th and Cedar Lane
Property Ownership – Public

Description – The proposed BMP is located at the end of the drainage network, therefore an opportunity to filter runoff from nearly all of the 519 acres. The proposed offline underground hydrodynamic device and stormfilter provides a lot of TSS (and TP) treatment at a very small footprint. Keeping a small footprint is important as the bedrock is shallow (high cost for excavation) and is able to fit within future park development features.



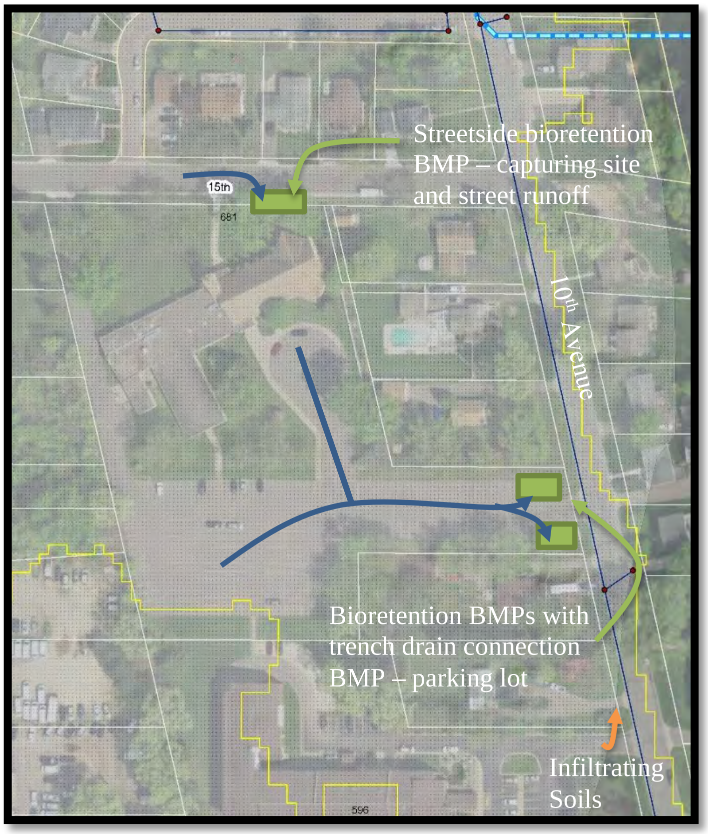
	Cost/Removal Analysis	Project ID	
		Underground Stormfilter with HD	
		New treatment	Net %
Treatment	TP (lb/yr)	60.0	29%
	TSS (lb/yr)	24,450	25%
	Volume (acre-feet/yr)	31.0	13%
	Number of BMP's	1	
	BMP Size each/Description	430 (150 sf sediment storage, 217 sf - 60 cartridge chamber, does not include bypass flow chamber)	sqft
	BMP Type	Offline Stormfilter Vault System with Hydrodynamic Device	
Cost	Materials/Labor/Design	$350,000	
	Promotion & Admin Costs	$4,000	
	Probable Project Cost	**$354,000**	
	Annual O&M	$30,000	
	20-yr Cost/lb-TP/yr	**$795**	
	20-yr Cost/2,000lb-TSS/yr	**$3,902**	

Network 4: Bioretention Basins

Rank 9 of 12

Drainage Area – 4 acres
Location – Newport Lutheran Church at 10th Avenue
Property Ownership – Religious Non-profit

Description – The proposed BMP is located on the Newport Lutheran Church property, one of the larger parcels in an area of Newport where excess volume is an issue and infiltration potential is high. The parking lot, building runoff on and flows along 15th street could be captured by a few bioretention systems (conventional or tree pit-type).



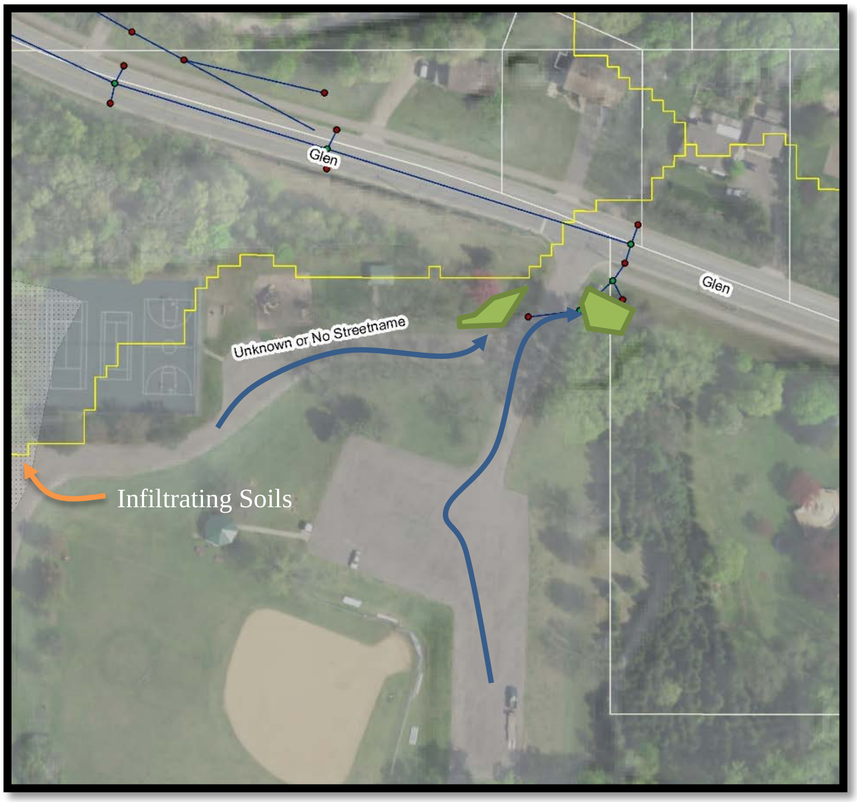
	Cost/Removal Analysis	Project ID: Bioretention Basins at Newport Lutheran Church	
		New treatment	Net %
Treatment	TP (lb/yr)	3.4	2%
	TSS (lb/yr)	1,430	1%
	Volume (acre-feet/yr)	3.3	1%
	Number of BMP's	3	
	BMP Size each/Description	2,500	sqft
	BMP Type	Bioretentions Basins	
Cost	Materials/Labor/Design	$100,000	
	Promotion & Admin Costs	$2,500	
	Probable Project Cost	**$102,500**	
	Annual O&M	$1,500	
	20-yr Cost/lb-TP/yr	**$1,949**	
	20-yr Cost/2,000lb-TSS/yr	**$9,265**	

Network 4: Bioretention Basins

Rank 12 of 12

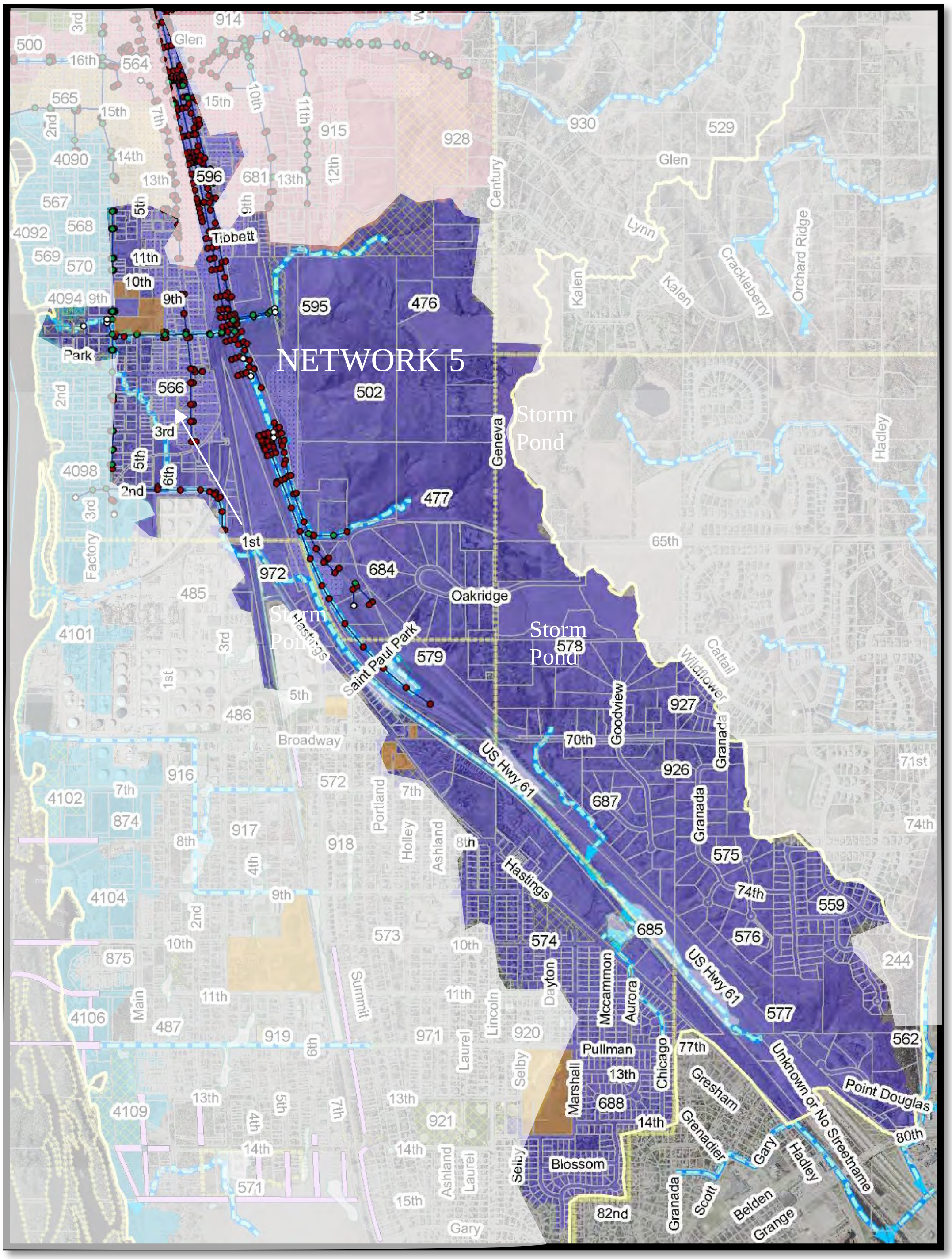
Drainage Area – 36 acres
Location – Loveland City Park
Property Ownership – Public

Description – The proposed BMP is located at the entrance to Loveland City Park, off of Glen Road. This BMP location is near the top of network 4's drainage; however it is located in an area were excess volume is a concern. Nearly all of the parking lot, adjacent greenspace, and drive lanes in the park flow to the entrance. A couple bioretention basins at the entrance could capture a significant amount of runoff. The basins may need to be tiered due to the relatively steep grades.



	Cost/Removal Analysis	Project ID: Bioretention Basins at Loveland Park	
		New treatment	Net %
Treatment	TP (lb/yr)	5.8	3%
	TSS (lb/yr)	700	1%
	Volume (acre-feet/yr)	1.5	1%
	Number of BMP's	2	
	BMP Size each/Description	2,500	sqft
	BMP Type	Bioinfiltration Basins	
Cost	Materials/Labor/Design	$100,000	
	Promotion & Admin Costs	$2,000	
	Probable Project Cost	**$102,000**	
	Annual O&M	$1,000	
	20-yr Cost/lb-TP/yr	**$1,051**	
	20-yr Cost/2,000lb-TSS/yr	**$17,428**	

Catchment Drainage Network 5



CATCHMENT DRAINAGE NETWORK DESCRIPTION

Catchment drainage network 5 is over 1,330 acres. The dominant land cover is open space and residential. There are 8 stormwater ponds and 1 grass swale (ditch) located within the network. As modeled, the TSS loading in the network is below the Mississippi TMDL TSS goal. However, there are opportunities worth noting and each model used provides different pollutant loading and removal amounts. Like all areas, one street sweeping per year is assumed in the model existing conditions.

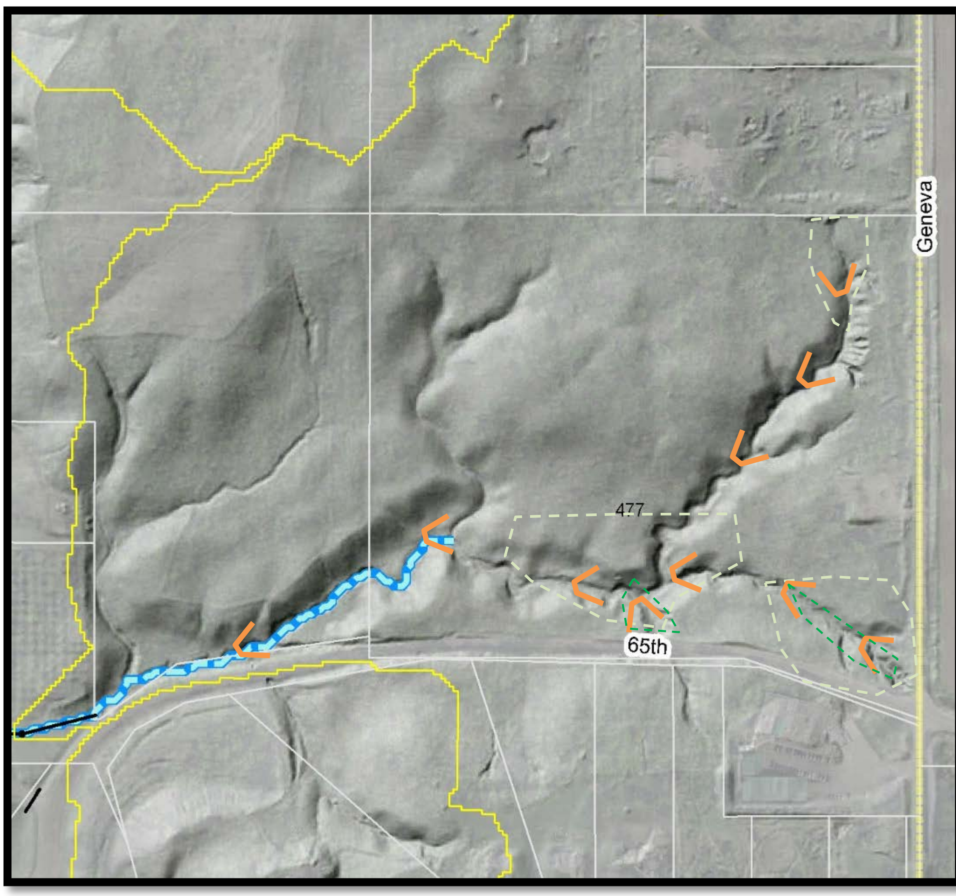
	Existing Conditions	Base Loading	Treatment	Net Treatment %	Existing Loading	Avg Loading per acre	Network Treatment needed to reach resource goal
Treatment	TP (lb/yr)	1271.0	786.0	61.8%	**485.0**	**0.4**	**n/a**
	TSS (lb/yr)	474,787	276,884.0	58.3%	**197,903**	**148**	**-8,251**
	Volume (acre-feet/yr)	695.0	306.4	44.1%	**388.7**	**0.3**	**n/a**
	Number of BMP's	9 constructed, 1 maintenance					
	BMP Size/Description	8 stormwater ponds, 1 grass swale, and street sweeping					

Network 5: Ravine Stabilization

Rank 1 of 12

Drainage Area – 116 acres
Location – North side of 65th Street and Geneva Avenue
Property Ownership – Private (Refinery)

Description – The proposed BMP is located adjacent/parallel to 65th Street. The ravine is heavily wooded with road, residential, and agricultural contributing drainage area - although most of the erosion seems to be due to a legacy ravine that is eroding because groundcover has not been able to establish due to dense shade. A combination of soft and hard stabilization methods are recommended. **This BMP was modeled using the BWSR spreadsheet tool as WinSLAMM does not support rural BMP scenarios – a delivery ratio of 0.5 to the Mississippi was assumed.**



=Thin Trees, add groundcover

= Stabilize Base of Slopes

= Check Dams or Cross Vanes

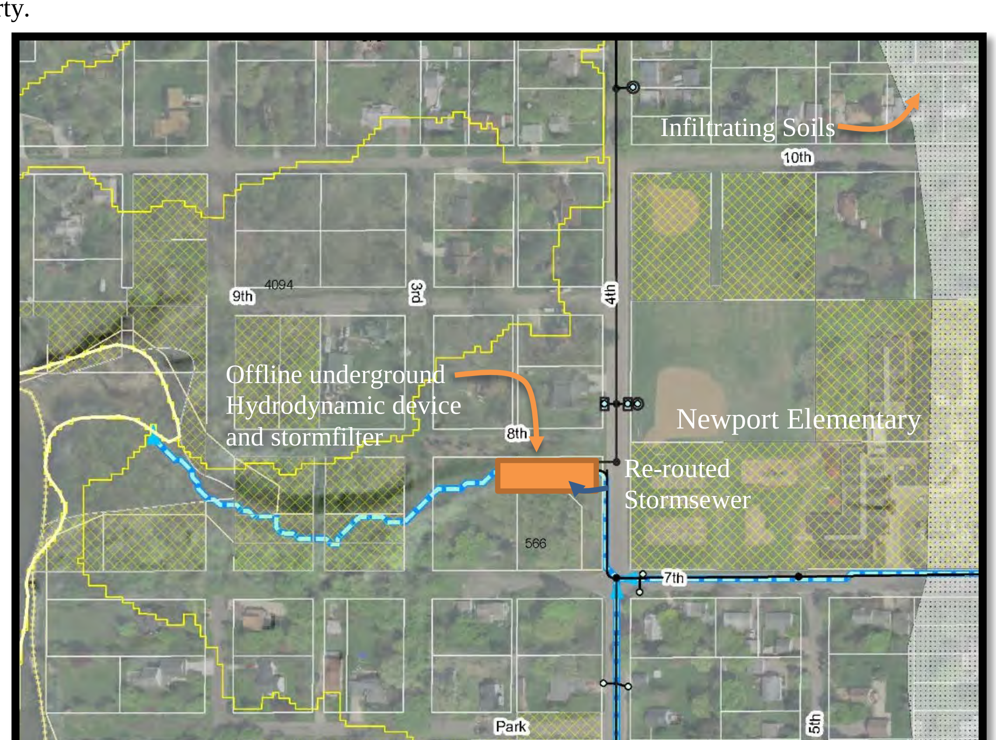
	Cost/Removal Analysis	***Project ID***	
		Ravine Stabilization	
		New trtmt	**Net %**
Treatment	**TP (lb/yr)**	15.0	3%
	TSS (lb/yr)	36,000	18%
	Volume (acre-feet/yr)	0.2	0%
	Number of BMP's	1	
	BMP Size/Description	750	lnft
	BMP Type	Ravine Stabilization	
Cost	**Materials/Labor/Design**	$60,000	
	Promotion & Admin Costs	$3,000	
	Probable Project Cost	**$63,000**	
	Annual O&M	$250	
	20-yr Cost/lb-TP/yr	**$227**	
	20-yr Cost/2,000lb-TSS/yr	**$189**	

Network 5: Underground Hydrodynamic Device and Stormfilter

Drainage Area – 1330 acres
Location – 8th street ROW
Property Ownership – Public

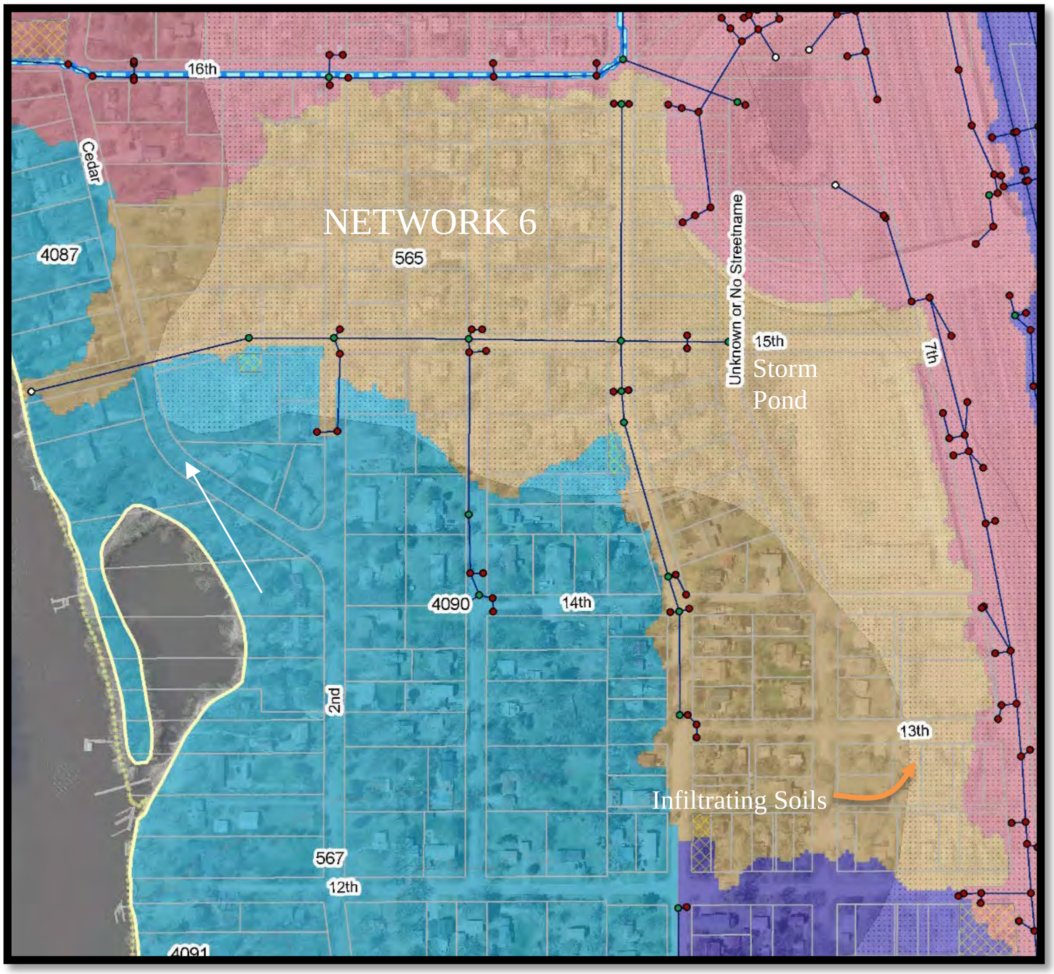
Rank 2 of 12

Description – The proposed BMP is located at the end of the drainage network, therefore an opportunity to filter runoff from nearly all of the 1330 acres. The proposed offline underground hydrodynamic device and stormfilter provides a lot of TSS (and TP) treatment at a very small footprint. Keeping a small footprint is important as the bedrock is shallow (high cost for excavation) and is able to fit within public property.



	Cost/Removal Analysis	*Project ID*	
		Stormfilter at Newport Elementary	
		New trtmt	**Net %**
Treatment	**TP (lb/yr)**	263.0	54%
	TSS (lb/yr)	103,461	52%
	Volume (acre-feet/yr)	0.1	0%
	Number of BMP's	1	
	BMP Size/Description	470 (250 sf HD device, 220 sf - 60 cartridge chamber area, does not include weir/bypass structure)	sqft
	BMP Type	HD pretreatment with Stormfilter Vault	
Cost	**Materials/Labor/Design**	$1,000,000	
	Promotion & Admin Costs	$10,000	
	Probable Project Cost	**$1,010,000**	
	Annual O&M	$40,000	
	20-yr Cost/lb-TP/yr	**$344**	
	20-yr Cost/2,000lb-TSS/yr	**$1,749**	

Catchment Drainage Network 6



CATCHMENT DRAINAGE NETWORK DESCRIPTION

Catchment drainage network 6 is 46 acres. The dominant land cover is residential. There is 1 stormwater pond located within network. Like all areas, one street sweeping per year is assumed in the model existing conditions.

	Existing Conditions	Base Loading	Treatment	Net Treatment %	Existing Loading	Avg Loading per acre	Network Treatment needed to reach resource goal
Treatment	TP (lb/yr)	37.3	1.7	4.5%	**35.6**	**0.8**	**n/a**
	TSS (lb/yr)	17,402	1,362.0	7.8%	**16,040**	**350**	**8,988**
	Volume (acre-feet/yr)	26.3	0.0	0.0%	**26.3**	**0.6**	**n/a**
	Number of BMP's	1 constructed, 1 maintenance					
	BMP Size/Description	1 stormwater ponds, and street sweeping					

Network 6: Underground Upflo Filtration

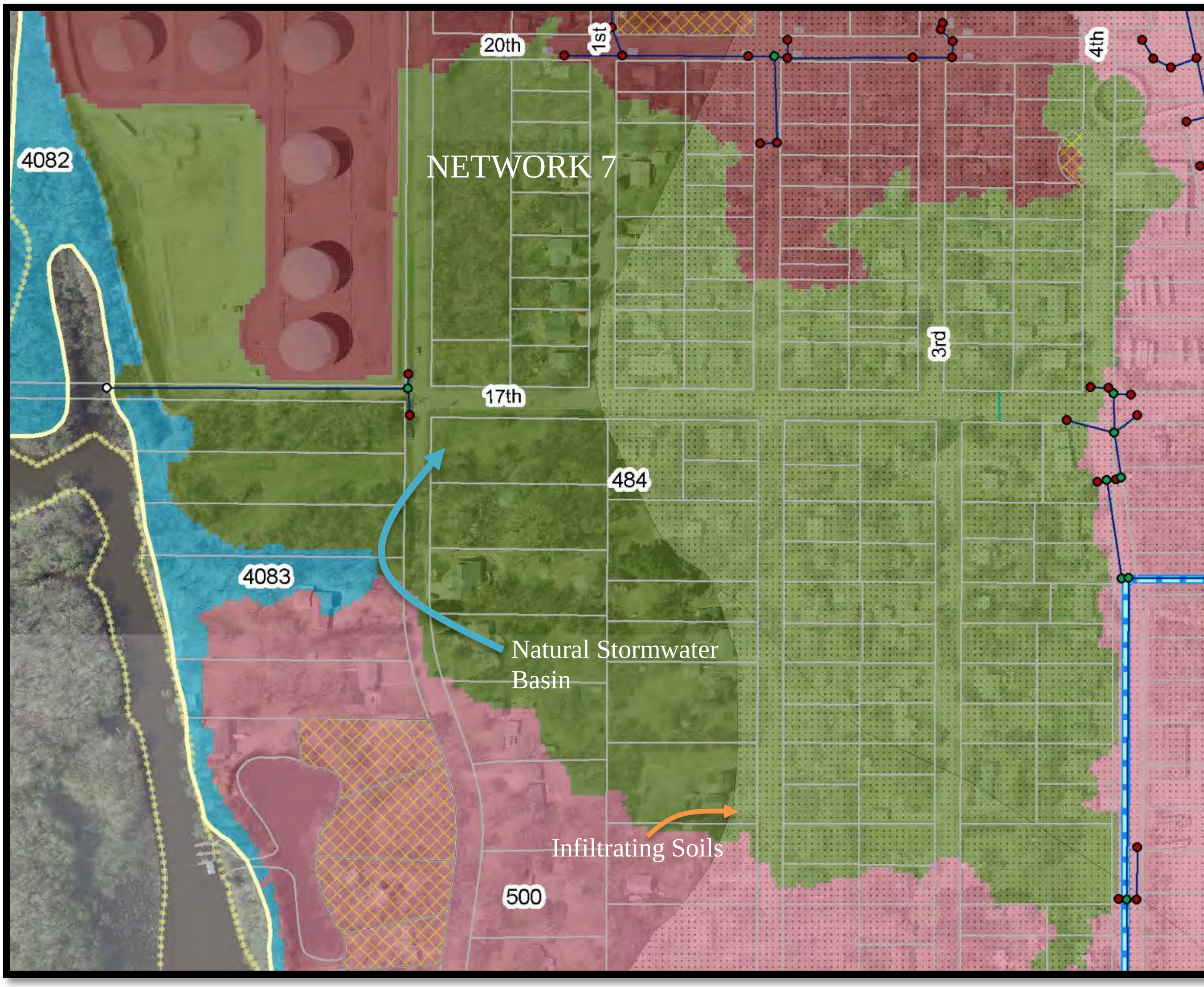
Rank 6 of 12

Drainage Area – 45 acres
Location – Cedar Lane and 15th Street
Property Ownership – Public

Description – The proposed BMP is located at the end of the drainage network, therefore an opportunity to filter runoff from nearly all of the 45 acres. The proposed offline underground hydrodynamic device and stormfilter provides a lot of TSS (and TP) treatment at a very small footprint. Keeping a small footprint is important as the bedrock is shallow (high cost for excavation) and is able to fit within public property.

	Cost/Removal Analysis	***Project ID***	
		Upflo Filter	
		New treatment	**Net %**
Treatment	**TP (lb/yr)**	13.5	38%
	TSS (lb/yr)	7,300	46%
	Volume (acre-feet/yr)	0.1	0%
	Number of BMP's	1	
	BMP Size/Description	100	sqft
	BMP Type	Upflo Filter with 8 foot deep sump	
Cost	**Materials/Labor/Design**	$160,000	
	Promotion & Admin Costs	$3,000	
	Probable Project Cost	**$163,000**	
	Annual O&M	$15,000	
	20-yr Cost/lb-TP/yr	**$1,715**	
	20-yr Cost/2,000lb-TSS/yr	**$6,342**	

Catchment Drainage Network 7



CATCHMENT DRAINAGE NETWORK DESCRIPTION

Catchment drainage network 7 is 44 acres. The dominant land cover is residential. There is 1 natural stormwater basin located within network. As modeled, the existing conditions already meet Mississippi TSS loading goal; however, there are opportunities worth noting and each model used provides different pollutant loading and removal amounts. Like all areas, one street sweeping per year is assumed in the model existing conditions.

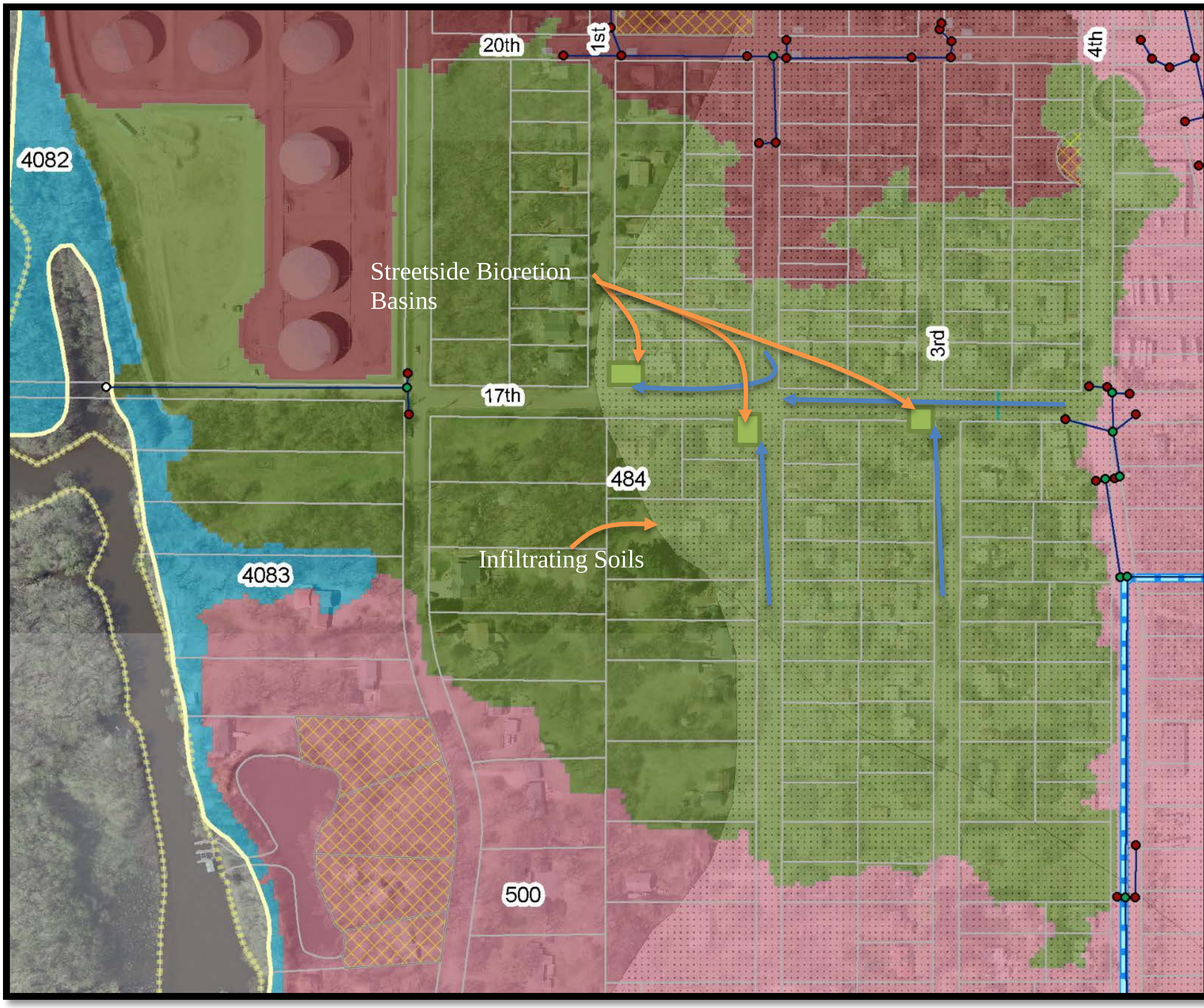
	Existing Conditions	Base Loading	Treatment	Net Treatment %	Existing Loading	Avg Loading per acre	Network Treatment needed to reach goal
Treatment	TP (lb/yr)	32.5	16.3	50.0%	**16.2**	**0.4**	**n/a**
	TSS (lb/yr)	12,710	6,375.0	50.2%	**6,335**	**143.7**	**-457**
	Volume (acre-feet/yr)	19.3	2.1	10.9%	**17.2**	**0.4**	**n/a**
	Number of BMP's	1 natural, 1 maintenance					
	BMP Size/Description	natural stormwater basin, street sweeping					

Network 7: Bioretention Basins

Rank 10 of 12

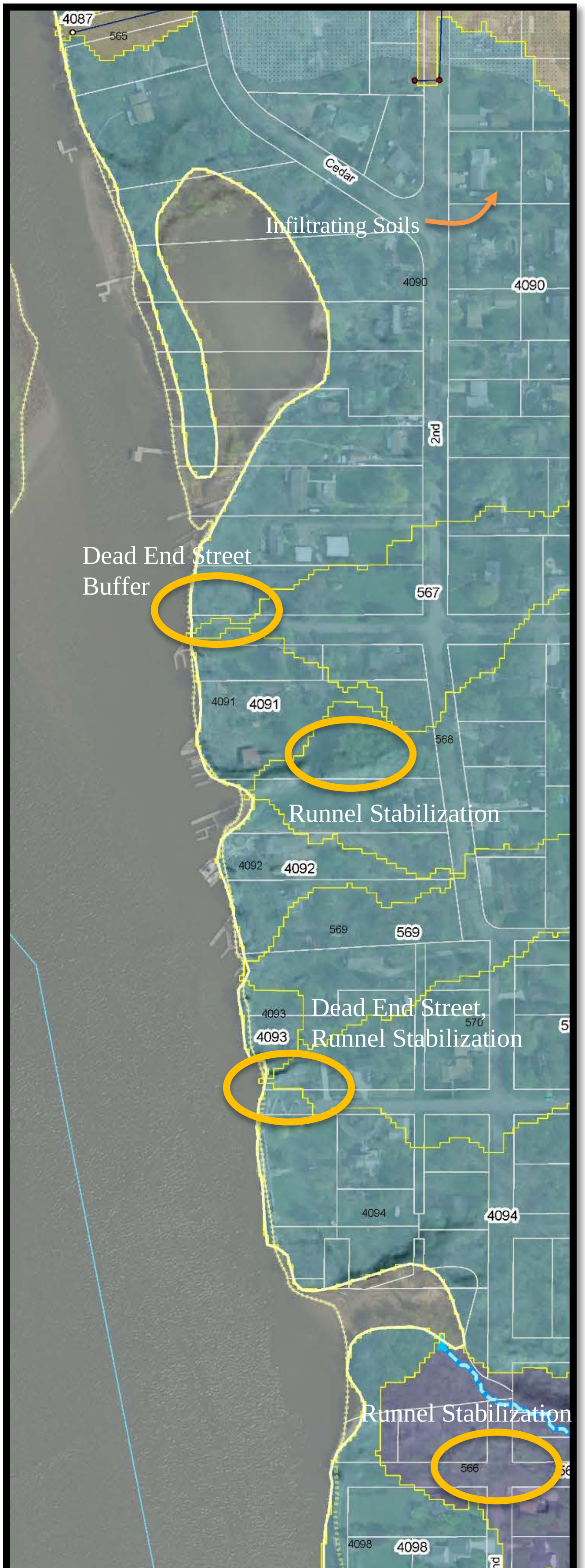
Drainage Area – 15 acres
Location – Multiple locations, near 17th Street and 2nd Avenue
Property Ownership – Public (ROW) and Private

Description – The proposed BMPs (3 total) are streetside bioretention basins (or tree pit filter-type) placed within the infiltrating soils area were their drainage areas can be maximized. The locations shown below are examples, other multiple other locations exist within the infiltrating portion of network 7.



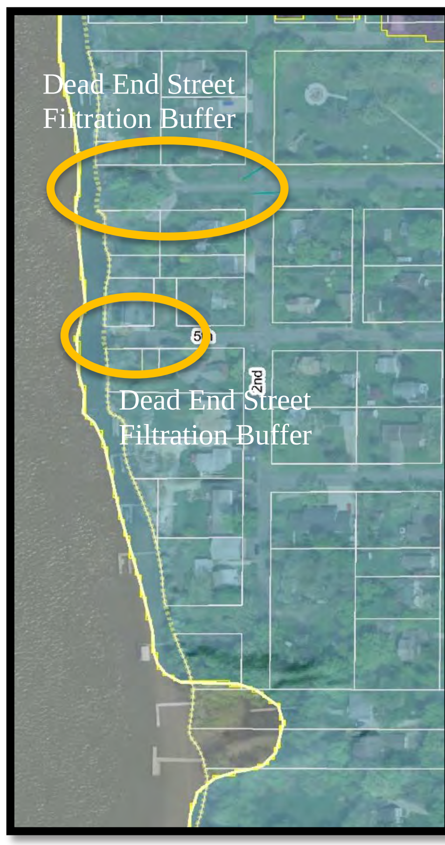
	Cost/Removal Analysis	*Project ID*	
		Streetside Bioretention Basins	
		New trtmt	**Net %**
Treatment	**TP (lb/yr)**	10.0	62%
	TSS (lb/yr)	900	14%
	Volume (acre-feet/yr)	6.0	35%
	Number of BMP's	3	
	BMP Size/Description	1,500	sqft
	BMP Type	Streetside Raingardens within infiltrating soils area	
Cost	**Materials/Labor/Design**	$76,000	
	Promotion & Admin Costs	$4,000	
	Probable Project Cost	**$80,000**	
	Annual O&M	$1,500	
	20-yr Cost/lb-TP/yr	**$550**	
	20-yr Cost/2,000lb-TSS/yr	**$12,222**	

Catchment Drainage – Direct Drainage Areas



CATCHMENT DRAINAGE NETWORK DESCRIPTION

Direct drainage areas are small catchments that directly drain to the Mississippi River with little to no pipe infrastructure – i.e. all overland flow. The proposed BMP for this area is a program to enroll landowners and the city (dead-end streets) to promote native vegetation along the Mississippi River corridor. Native vegetation would take care of most of the small erosion issues observed in the field. Native vegetation will also help provide much needed habitat for pollinators in this area.



Appendix A: Methods

Methods

Selection of Subwatershed

Many factors are considered when choosing which subwatershed to analyze for stormwater retrofits. Water quality monitoring data, non-degradation report modeling, and TMDL studies are just a few of the resources available to help determine which water bodies are a priority. Stormwater retrofit analyses supported by a Local Government Unit with sufficient capacity (staff, funding, available GIS data, etc.) to greater facilitate the process also rank highly. For some communities a stormwater retrofit analysis complements their MS4 stormwater permit. The focus is always on a priority waterbody.

For this analysis, the City of Newport was chosen for the study as it entirely drains to the Mississippi River with little or no treatment of runoff. The Mississippi River is listed on the EPA's 303(d) list of impaired water bodies, including the South

Metro Mississippi TMDL - Turbidity. Identifying areas that receive little to no pretreatment become a priority as these areas typically have a large impact on water quality.

Stormwater runoff from impervious surfaces like pavement and roofs can carry a variety of pollutants. While stormwater treatment to remove these pollutants is adequate in some areas, other areas were built before modern-day stormwater treatment technologies and requirements or have undersized treatment devices.

Stormwater Retrofit Analysis Methods

The process used for this analysis is outlined in the following pages and was modified from the Center for Watershed Protection's Urban Stormwater Retrofit Practices, Manuals 2 and 3 (Schueler, 2005, 2007). Locally relevant design considerations were also incorporated into the process (Minnesota Stormwater Manual).

Step 1: Retrofit Scoping

Retrofit scoping includes determining the objectives of the retrofits (volume reduction, target pollutant, etc.) and the level of treatment desired. It involves meeting with local stormwater managers, city staff and watershed management organization members to determine the issues in the subwatershed. This step also helps to define preferred retrofit treatment options and retrofit performance criteria. In order to create a manageable area to analyze in large subwatersheds, a focus area may be determined.

In this analysis, the focus area was all catchments either partially or wholly within the City of Newport. This selection was primarily due to a recent completion of a hydraulic and hydrologic model. Included are areas of residential, commercial, industrial, institutional, and agricultural land uses, as well as undeveloped areas of mature woodlands. The subwatershed was divided into subcatchments using a combination of existing subwatershed catchment data, stormwater infrastructure maps, and observed topography.

The targeted pollutant for this study was Total Suspended Solids (TSS), though Total Phosphorus (TP) and Water Quality Volume (WQV) were also modeled and reported allow for multiple approaches to prioritize projects for implementation.

Step 2: Desktop Retrofit Analysis

The desktop analysis involves computer-based scanning of the subwatershed for potential retrofit catchments and/or specific sites. This step also identifies areas that don't need to be analyzed because of existing stormwater infrastructure or disconnection from the target water body. Several catchments and associated drainage networks that were identified as isolated basins on a 10-year event (existing dataset) or had multiple stormwater BMPs in place (northern part of the City – hwy 61 and 494 interchange) were removed.

Desktop retrofit analysis features to look for and potential stormwater retrofit projects.

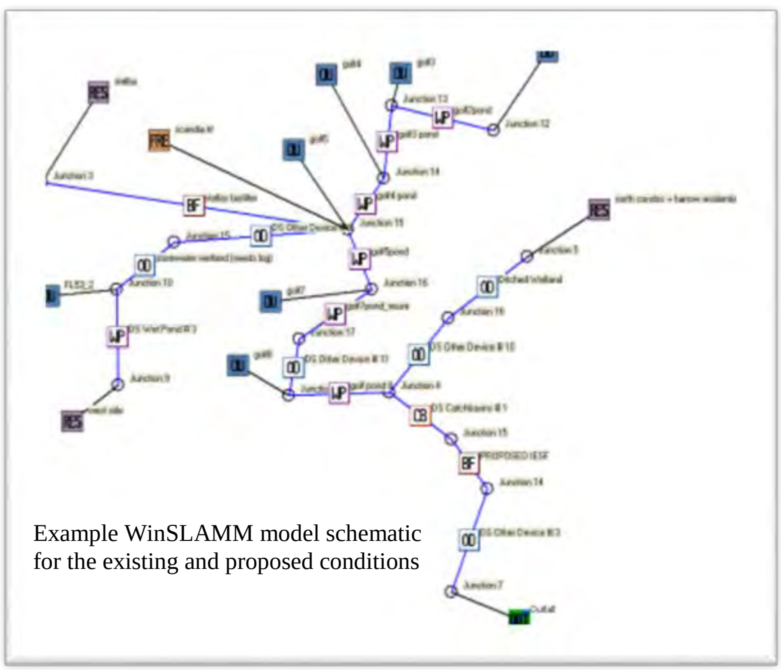
Feature	*Potential Retrofit Project*
Existing Ponds	**Add storage and/or improve water Add storage and/or improve water quality by excavating pond bottom, modifying riser, raising embankment, and/or modifying flow routing.**
Open Space	**New regional treatment (pond, bioretention).**
Roadway Culverts	**Add wetland or extended detention water quality treatment upstream.**
Outfalls	**Split flows or add storage below outfalls if open space is available.**
Conveyance system	**Add or improve performance of existing swales, ditches and non-perennial streams.**
Large Impervious Areas (campuses, commercial, parking)	**Stormwater treatment on site or in nearby open spaces.**
Neighborhoods	**Utilize right of way, roadside ditches, curb-cut rain gardens, or filter systems before water enters storm drain network.**

Step 3: Reconnaissance Investigation

After identifying potential retrofit sites through this desktop search, a field investigation was conducted to evaluate each site and identify additional opportunities. During the investigation, the drainage area and stormwater infrastructure mapping data were verified. Site constraints were assessed to determine the most feasible retrofit options as well as eliminate sites from consideration. The field investigation may have also revealed additional retrofit opportunities that could have gone unnoticed during the desktop search.

Step 4: Treatment Analysis/Cost Estimates

Sites most likely to be conducive to addressing the cities' and watershed district's goals and appear to have simple-to-moderate design, installation, and maintenance were chosen for a cost/benefit analysis. Estimated costs included design, installation, and maintenance annualized across a 30-year period. Estimated benefits included are pounds of phosphorus and total suspended solids removed, though projects were ranked only by cost per pound of phosphorus removed annually.



Example WinSLAMM model schematic for the existing and proposed conditions

Treatment analysis

For nearly the entire analysis WinSLAMM was used to analyze existing conditions and proposed BMP scenarios and iterations. The only area were another runoff and loading model was used is for the ravine stabilization along 65th Street. This load was calculated using the BWSR Spreadsheets (GULLY tab). Through historic aerial inspection, it appears the majority of erosion occurred by the 1940's. The general shape of the gully has not changed much since however the amount of tree cover has increased significantly. It is assumed that the lack of ground cover is keeping the soil in the ravine exposed and unstable even with a relatively small contributing drainage area.

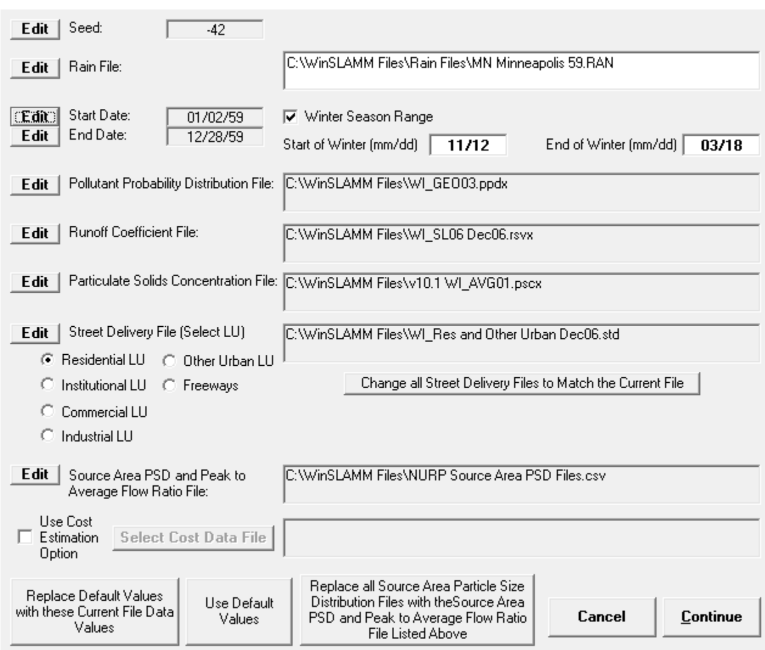
WinSLAMM uses an abundance of stormwater data from the upper Midwest and elsewhere to quantify runoff volumes and pollutant loads from urban areas. It is useful for determining the effectiveness of proposed stormwater control practices. It has detailed accounting of pollutant loading from various land uses, and allows the user to build a model "landscape" that reflects the actual landscape being considered. The user is allowed to place a variety of stormwater treatment practices that treat water from various parts of this landscape. It uses rainfall and temperature data from a typical year, routing stormwater through the user's model for each storm.

The initial step was to create a "base" model which estimated pollutant loading from each catchment in its present-day state without taking into consideration any existing stormwater treatment. To accurately model the land uses in each catchment, we delineated each land use in each catchment using geographic information systems (specifically, ArcMap), and assigned each a WinSLAMM standard land use file. A site specific land use file was created by adjusting total acreage and accounting for local soil types (all soils were modeled as silt in this analysis). This process resulted in a model that included estimates of the acreage of each type of source area (roof, road, lawn, etc.) in each catchment. For certain source areas critical to our models we verified that model estimates were accurate by calculating actual acreages in ArcMap, and adjusting the model acreages if needed.

Once the "base" model was established, an "existing conditions" model was created by incorporating any existing stormwater treatment practices in the catchment. For example, street cleaning with mechanical or vacuum street sweepers, rain gardens, stormwater treatment ponds, and others were included in the "existing conditions" model if they were present in the catchment.

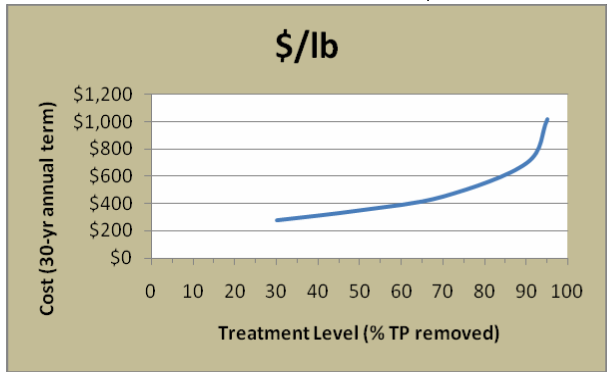
Finally, each proposed stormwater treatment practice was added to the "existing conditions" model and pollutant reductions were generated. Because neither a detailed design of each practice nor in-depth site investigation was completed, a generalized design for each practice was used. Whenever possible, site-specific parameters were included. Design parameters were modified to obtain various levels of treatment. It is worth noting that we modeled each practice individually, and the benefits of projects may not be additive, especially if serving the same area. Reported treatment levels are dependent upon optimal site selection and sizing.

WinSLAMM stormwater model inputs



Cost Estimates

All estimates were developed using 2018 dollars. Cost estimates were annualized costs that incorporated design, installation, installation oversight, and maintenance over a 20-year period. In cases where promotion to landowners is important, such as rain gardens, those costs were included as well. In cases where multiple, similar projects are proposed in the same locality, promotion and administration costs were estimated using a non-linear relationship that accounted for savings with scale. Design assistance from an engineer is assumed for practices in-line with the stormwater conveyance system, involving complex stormwater treatment interactions, or posing a risk for upstream flooding. It should be understood that no site-specific construction investigations were done as part of this stormwater retrofit analysis, and therefore cost estimates account for only general site considerations.



The costs associated with several different pollution reduction levels were calculated. Generally, more or larger practices result in greater pollution removal. However the costs of obtaining the highest levels of treatment are often prohibitively expensive (see figure). By comparing costs of different treatment levels, the cities and watershed district can best choose the project sizing that meets their goals.

Step 5: Evaluation and Ranking

The cost per ton of TSS treated was calculated for each potential retrofit project. Only projects that seemed realistic and feasible were considered. The recommended level was the level of treatment that would yield the greatest benefit per dollar spent while being considered feasible and not falling below a minimal amount needed to justify crew mobilization and outreach efforts. Local officials may wish to revise the recommended level based on water quality goals, finances, or public opinion.

Appendix B:
How to Read Catchment Profiles

Catchment Profiles and How to Read Them

The analysis contains pages referred to as “Catchment Profiles.” These profiles provide the most important details of this report, including:

- Summary of existing conditions, including existing stormwater infrastructure, and estimated pollutant export to target water body.
- Map of the catchment
- Recommended stormwater retrofits, pollutant reductions, and costs.

Following all of the catchment profiles (also in the executive summary) is a summary table that ranks all projects in all catchments by cost effectiveness.

To save space and avoid being repetitive, explanations of the catchment profiles are provided below. We strongly recommend reviewing this section before moving forward in the report.

The analyses of each catchment are broken into “base, existing, and proposed” conditions. They are defined as follows:

Existing conditions - Volume and pollutant loadings after already-existing stormwater practices are taken into account.

Proposed conditions - Volume and pollutant loadings after proposed stormwater retrofits.

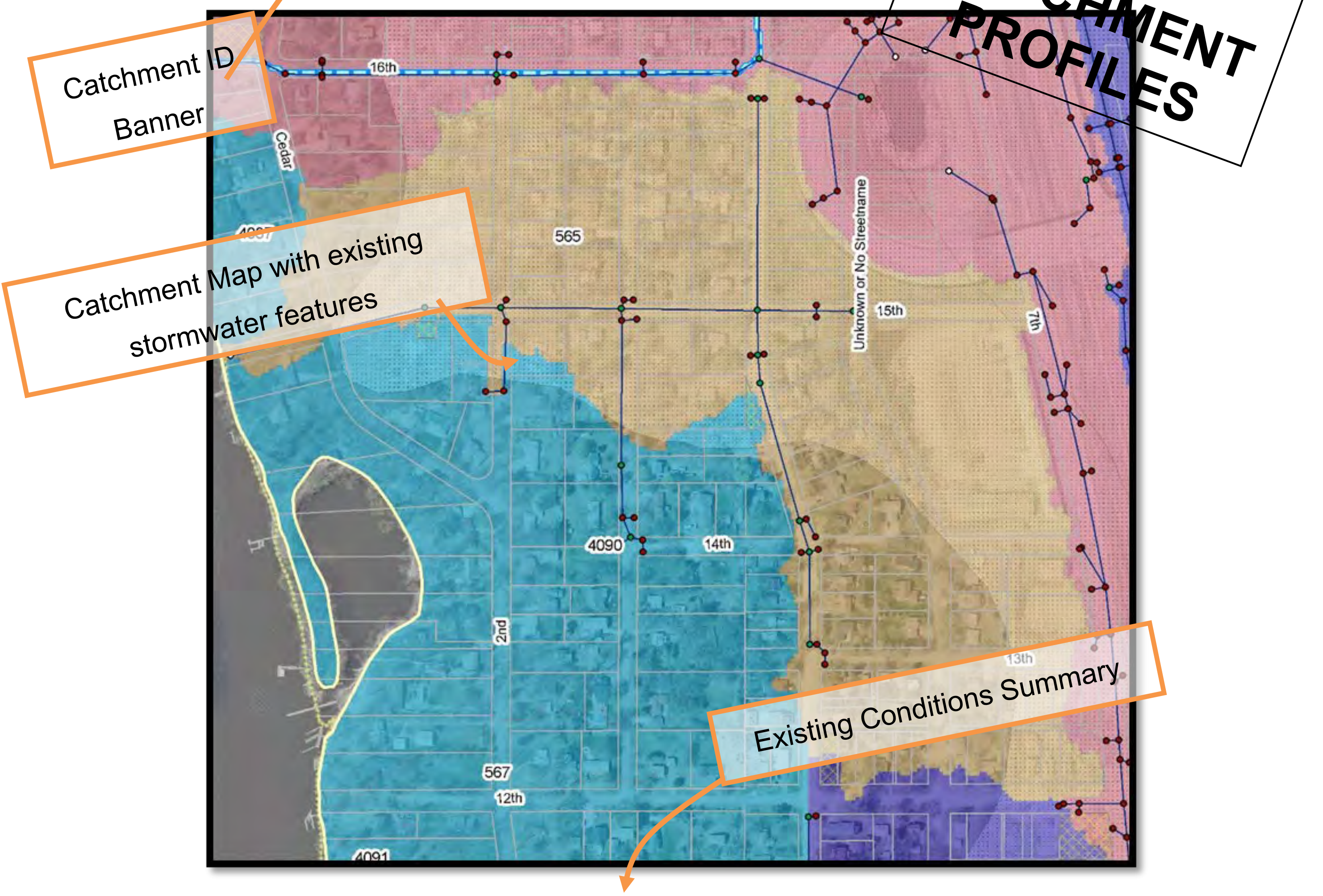
Analyses were performed at one of two geographic scales, “catchment or network.” They are defined as follows:

BMP Sub-catchment level analyses - V o l u m e and pollutant loads exiting the sub-catchment of the proposed BMP or the proposed Priority Shoreline Catchment. BMP Sub-catchments are then ranked on a cost/Lb Tp/10years and compared to all other proposed practices. This method highlights best BMPs overall, irrespective of sub-catchment location.

The example catchment profile on the following pages explains important features of each profile.

1

EXAMPLE Catchment Network 6



CATCHMENT DRAINAGE NETWORK DESCRIPTION

Catchment drainage network 6 is 46 acres. The dominant land cover is residential. There is 1 stormwater pond located within network. Like all areas, one street sweeping per year is assumed in the model existing conditions.

	Existing Conditions	Base Loading	Treatment	Net Treatment %	Existing Loading	Avg Loading per acre	Network Treatment needed to reach resource goal
Treatment	TP (lb/yr)	37.3	1.7	4.5%	**35.6**	**0.8**	**n/a**
	TSS (lb/yr)	17,402	1,362.0	7.8%	**16,040**	**350**	**8,988**
	Volume (acre-feet/yr)	26.3	0.0	0.0%	**26.3**	**0.6**	**n/a**
	Number of BMP's	1 constructed, 1 maintenance					
	BMP Size/Description	1 stormwater ponds, and street sweeping					

Network 6: Underground Upflo Filtration

BMP Name and Site Description

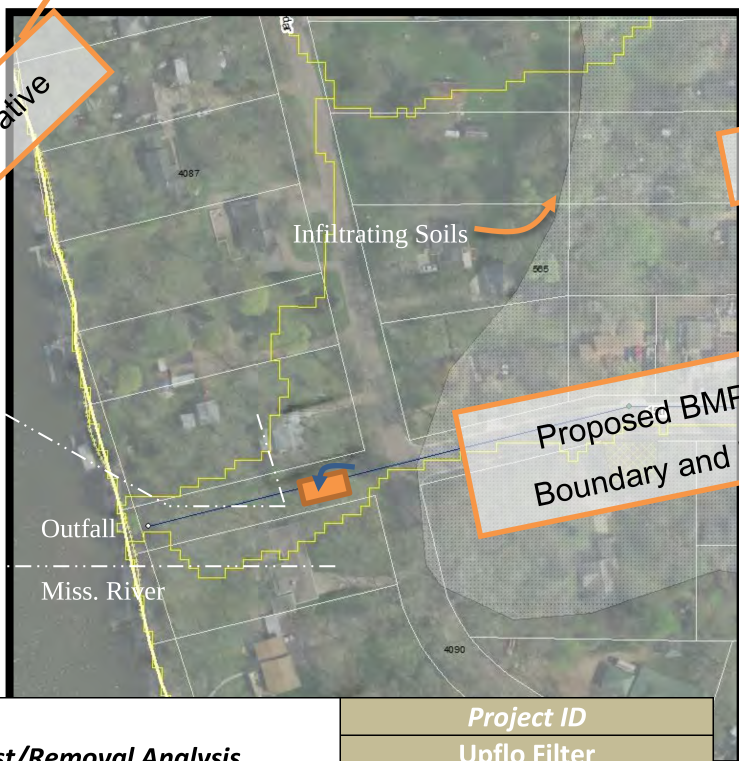
Rank 6 of 12

Drainage Area – 45 acres
Location – Cedar Lane and 15th Street
Property Ownership – Public

Description – The proposed BMP is located at the end of the drainage network, therefore an opportunity to filter runoff from nearly all of the 45 acres. The proposed offline underground hydrodynamic device and stormfilter provides a lot of TSS (and TP) treatment at a very small footprint. Keeping a small footprint is important as the bedrock is shallow (high cost for excavation) and is able to fit within public property.

Practice Design Narrative

Practice Ranking



Proposed BMP Catchment Boundary and BMP Location

Cost/Removal Analysis		Project ID	
		Upflo Filter	
		New treatment	Net %
Treatment	TP (lb/yr)	13.5	38%
	TSS (lb/yr)	7,300	46%
	Volume (acre-feet/yr)	0.1	0%
	Number of BMP's	1	
	BMP Size/Description	100	sqft
	BMP Type	Upflo Filter with 8 foot deep sump	
Cost	Materials/Labor/Design	$160,000	
	Promotion & Admin Costs	$3,000	
	Probable Project Cost	**$163,000**	
	Annual O&M	$15,000	
	20-yr Cost/lb-TP/yr	**$1,715**	
	20-yr Cost/2,000lb-TSS/yr	**$6,342**	

Practice Sizing and Treatment Summary

Design, Install, Maintenance, and Promotion Costs

Proposed Cost per Lb of TP and TSS