Minnehaha Creek Watershed District *REQUEST FOR BOARD ACTION*

TITLE: Approval of the City of St. Louis Park Carpenter Park Regional Stormwater Management Plan.

RESOLUTION NUMBER: 17-027

MEETING DATE: March 23, 2016

PREPARED BY: Heidi Quinn

E-MAIL: hquinn@minnehahacreek.org **TELEPHONE:** 952-641-4504

REVIEWED BY: ☐ Administrator ☒ Counsel ☒ Program Mgr. – Katherine Sylvia
☒ Board Committee ☒ Engineer ☒ Other – Renae Clark

WORKSHOP ACTION:

☐ Advance to Board mtg. Consent Agenda. ☐ Advance to Board meeting for discussion prior to action.

☐ Refer to a future workshop (date):_____ ☐ Refer to taskforce or committee (date):_____

☐ Return to staff for additional work. ☐ No further action requested.

☒ Other (specify): **Approval at March 23rd, 2017 Board Meeting**

PURPOSE or ACTION REQUESTED:
Approval of the City of St. Louis Park Carpenter Park Regional Stormwater Management Plan pursuant to MCWD Stormwater Rule, paragraph 7.

PROJECT/PROGRAM LOCATION:
5005 Minnetonka Boulevard, St. Louis Park, MN

PROJECT TIMELINE:
Proposed construction start Spring of 2017 with completion Fall of 2017

PROJECT/PROGRAM COST:
Requested amount of funding: $0

PAST BOARD/COUNCIL ACTIONS:
N/A

SUMMARY:
On February 21st, 2017 the City of St. Louis Park submitted a Regional Stormwater Management Plan proposed at Carpenter Park located at 5005 Minnetonka Boulevard in the City of St. Louis Park. MCWD Staff provided a briefing of the proposed plan at the Planning and Policy Committee (PPC) meeting on March 9th, 2017 with the request that the PPC recommend to the Board of Managers to take action on this Plan at the March 23rd meeting. The proposed underground filtration best management practice (BMP) will provide volume, rate, and phosphorous controls for a 42 acre watershed that drains through existing City storm sewer to a City-owned 72" trunk-line that discharges to Bass Lake Preserve (Attachment 1, 2, & 3).

The Carpenter Park regional stormwater treatment system is proposed to provide stormwater management for a 42-acre catchment area, including the park itself, all of which is currently untreated. The downgradient area proposed to utilize compliance credit for the stormwater management provided by the regional facility consists of three parcels owned by the city: two parcels controlled by Economic Development Authority and the Beltline Park and Ride (Attachments 6 & 7). Because the regional facility is upgradient of the proposed redevelopment, approval of its use to meet regulatory requirements necessarily includes approval of an ad hoc crediting system, implicating MCWD's Variance and Exceptions Rule.

The proposed BMP will remove approximately 27 pounds of phosphorus annually from the contributing subwatershed, and reduce rates for the 1-, 10-, and 100-year storm event at 8.5 cubic feet per second (cfs), 2.2 cfs, and 1.5 cfs respectively, and provides a volume reduction of 18,982 cubic feet abstraction credit via filtration (Attachment 4). The City proposes to utilize this treatment to meet stormwater-management requirements for the skate park (which will be constructed in conjunction with construction of the BMP) and to off-set stormwater management regulatory requirements for the future redevelopment of the Economic Development Authority sites, located at 3130 Monterey Avenue S & 4601 Highway 7, and Beltline Park and Ride, located at 4725 Highway 7, (Attachment 6 & 7). Stormwater treatment capacity above and beyond what will be used by the downgradient redevelopment projects will serve to improve water quality of stormwater contributing to Bass Lake Preserve. In addition, the treatment capacity will be constructed and come online before any of the redevelopment work that will rely on the treatment it provides (a benefit of most regional stormwater management plans). A full accounting of stormwater credit has been provided in Attachment 5. As shown in Attachment 5, rate control is achieved for the catchment area contributing to the Carpenter Park regional BMP. Rate control is necessarily a site-specific function, though, so the City of St. Louis Park will be required to meet rate control on-site per MCWD regulation for the proposed EDA and Beltline redevelopments.

As required by subsection 7(b) of the MCWD Stormwater Management Rule, the regional filtration BMP will be lined with an impermeable liner and will not result in adverse impacts to local groundwater. Furthermore, the regional BMP will not adversely affect natural resources upstream, including no impacts to wetland hydrology, no changes to stream velocities or reduced water quality. There are no intermediate natural resources between the BMP, the EDA and Beltline properties, and Bass Lake Preserve. Per subsection 7(c) of the Stormwater Management Rule, individual project sites utilizing a regional facility to meet phosphorus, rate, or volume controls must incorporate BMPs on the project site in accordance with subsection 3(d). As required per subsection 7(d), the City of St. Louis Park will demonstrate that it holds the legal rights necessary to discharge to the stormwater facility prior to land altering activity. MCWD and the City of St. Louis Park have a programmatic maintenance agreement for stormwater facilities (Attachment 8) and the City has submitted an annual maintenance and inspection plan for the underground filtration BMP (pg 37-44 of Attachment 9), fulfilling the requirements of section 11 of the Stormwater Management Rule.

The proposed regional BMP is located upgradient of the EDA and Beltline sites proposed to utilize the stormwater treatment capacity to be created. Section 7 of the Stormwater Management rule applies, on its terms, to regional plans that provide treatment *downgradient* of proposed development or redevelopment activity prior to discharge to a receiving waterbody, and does not create a credit system but a regional treatment option. Because stormwater from the 42-acre drainage area to the proposed Carpenter Park BMP will be entirely delivered by the 72" trunk storm sewer line there is an overall net benefit to Bass Lake Preserve as a result of the regional BMP after applying the regulatory off-set for the proposed projects within the drainage area. Due to the enhanced water quality benefit, an expected phosphorous reduction of approximately 17.9 pounds per year, to Bass Lake Preserve, above the expected treatment required for the EDA and Beltline redevelopment and the provision of treatment in advance of when the credits will be utilized, staff recommends approval of this as an exception to Section 7 of the Stormwater Management rule.

The construction of the Skate Park and underground filtration BMP, Economic Development Authority site, and Beltline Park and Ride site will each require a separate permit through MCWD to ensure that the BMP and

redevelopments are in conformance of MCWD rules and, as applicable, the proposed Regional Stormwater Management Plan.

ATTACHMENTS:

1. Bass Lake Preserve Watershed
2. Carpenter Park Watershed
3. Carpenter Park Watershed Storm Sewer Drainage to Bass Lake Preserve
4. Wenck Technical Memo, March 20th, 2017: Carpenter Park Phosphorous and Abstraction Credits
5. City of St. Louis Park Stormwater Credit Accounting Plan
6. Proposed Skate Park Redevelopment
7. Proposed EDA & Beltline Park and Ride Redevelopment
8. Programmatic Maintenance Agreement
9. Carpenter Park Plan
10. EDA and Park and Ride Plan

RESOLUTION

RESOLUTION NUMBER: 17-027

TITLE: Approval of the City of St. Louis Park Regional Stormwater Plan for the stormwater facility at Carpenter Park.

WHEREAS, the Board of Managers adopted a policy "In Pursuit of a Balanced Urban Ecology in the Minnehaha Creek Watershed District" to guide the MCWD's planning and watershed management activities, integrating its water resource implementation efforts with urban planning, through innovation, partnership and a sustained geographic focus;

WHEREAS, the Board of Managers adopted the 2017 Strategic Alignment Plan to guide the MCWD Board and staff in aligning programs and their operations with the MCWD's mission and organizational strategy;

WHEREAS, the strategic direction of the MCWD Permitting Program is to improve the efficiency of its regulatory program through administrative, policy and rule changes and will work to increase partnerships with the land-use community that brings benefits to land and water resources that exceed regulatory requirements;

WHEREAS, the MCWD has a Stormwater Management Rule that specifies activity of development, redevelopment, and linear projects for which a stormwater management plan is required;

WHEREAS, MCWD Stormwater Management Rule paragraph 7 allows an applicant to meet its Stormwater Management Rule requirements by use of a regional best management practice, provided there is an approved regional plan that provides for annual accounting to the District of treatment capacity created and utilized by projects within the drainage area and that there is a maintenance plan in place in accordance with paragraph 11;

WHEREAS Carpenter Park is owned by the City of St. Louis Park;

WHEREAS, the Carpenter Park regional stormwater management plan submitted by the City of St. Louis Park proposes to route presently untreated stormwater runoff to a stormwater management facility in Carpenter Park that will provide 18,982 cubic feet of abstraction credit and 9.1 pounds of total phosphorous per year to meet the stormwater management requirements for the skate park to be built in the park and to provide stormwater management credit to meet MCWD regulatory requirements other than rate control for the redevelopment of the Economic Development Authority site, located at 3130 Monterey Avenue South & 4601 Highway 7, and the Beltline Park and Ride site, located at 4725 Highway 7, resulting in a reduction beyond compliance requirements under the MCWD Stormwater Management Rule of an expected 17.9 lbs of TP per year from Bass Lake Preserve;

WHEREAS, the Technical Memo from Wenck Associates dated March 20th, 2017 verifies the rate control, volume abstraction credit, and pollutant load reduction resulting from the proposed BMP;

WHEREAS, any future project requiring a MCWD Stormwater Management permit within the catchment area to the Carpenter Park BMP will not be eligible to use the Regional Stormwater Management facility and must meet MCWD Stormwater Management requirements by other means.

WHEREAS, approval of the Regional Stormwater Management Plan does not constitute as MCWD permit approval. The redevelopment of the Skate Park, located at 5005 Minnetonka Boulevard, the Economic Development Authority site, located at 3130 Monterey Avenue South & 4601 Highway 7, and the Beltline Park and Ride site, located at 4725 Highway 7, will be required to apply for individual MCWD permits, meet rate-control requirements onsite, provide onsite BMPs in accordance with paragraphs 3(d) and 7(c) of the MCWD Stormwater Management Rule, require an exception finding to use credits for stormwater-management compliance and demonstrate ownership of facility-use rights as required by paragraph 7(d);

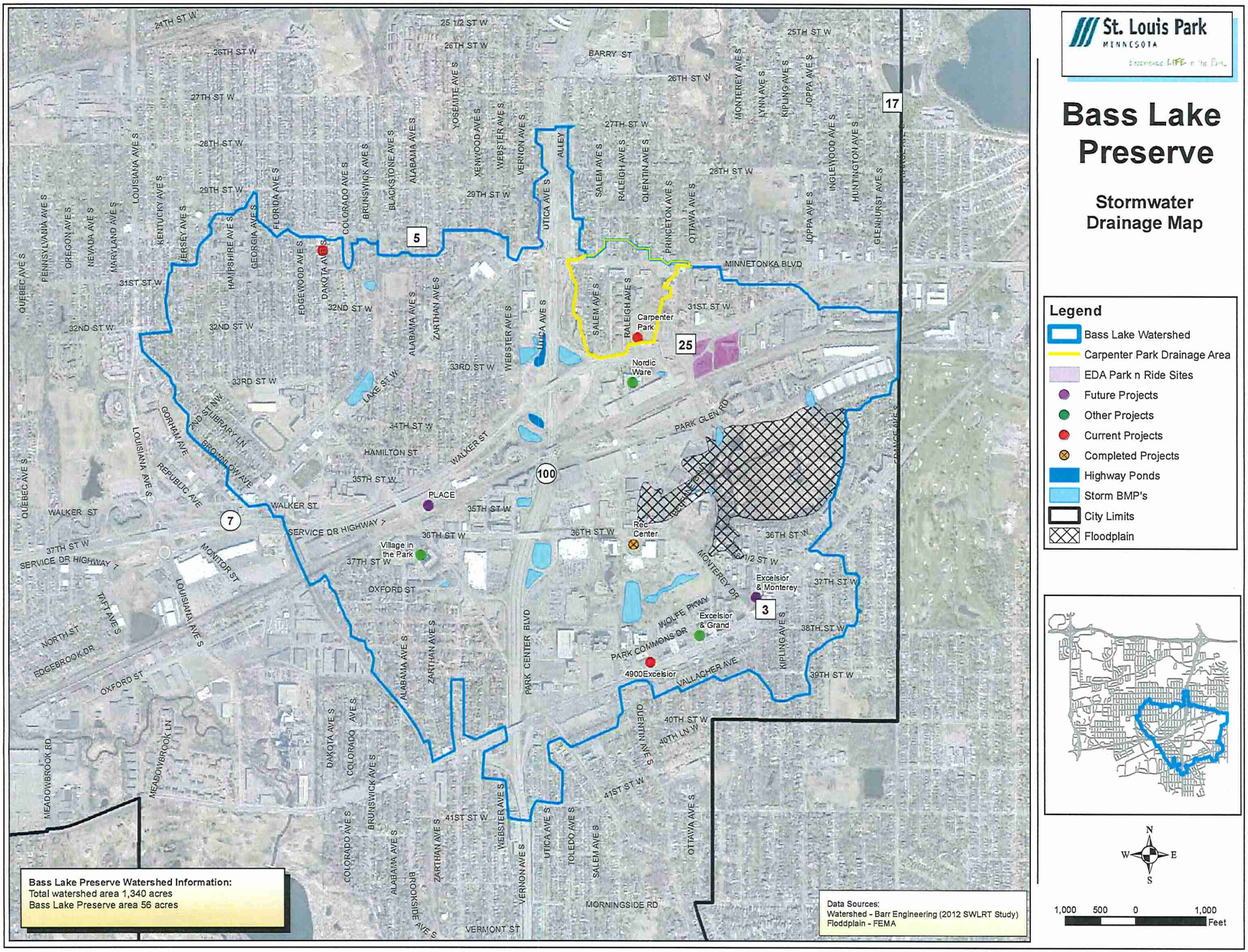
WHEREAS MCWD Stormwater Management Rule section 7 provides a regional stormwater management compliance option, but does not create a credit system allowing treatment at one site in lieu of treatment at another;

WHEREAS, MCWD Staff presented the concept of this Regional Stormwater Management Plan at the Policy and Planning Committee on March 9th, 2017, with the request that the PPC recommend to the Board of Managers to take action on this Plan at the March 23rd meeting;

NOW, THEREFORE, BE IT RESOLVED that the MCWD Board of Managers hereby approves the City of St. Louis Park Regional Stormwater Management Plan for the stormwater best management practice at Carpenter Park as an exception pursuant to MCWD Stormwater Rule, section 7 and MCWD Variances and Exceptions Rule section 5, conditional on the city entering a maintenance agreement for the facility after review and approval by MCWD and prior to commencement of any land-altering activities, and with the stipulation that the continuing validity of the regional plan is contingent on annual submission by the city of an accounting of the treatment capacity created and utilized.

Resolution Number 17-027 was moved by Manager _____, seconded by Manager _____.
Motion to adopt the resolution ____ ayes, ____ nays, _____abstentions. Date: _____

_____ Date:_____
Secretary


St. Louis Park
MINNESOTA
Bass Lake Preserve
Stormwater Drainage Map
Legend
Bass Lake Watershed
Carpenter Park Drainage Area
EDA Park n Ride Sites
Future Projects
Other Projects
Current Projects
Completed Projects
Highway Ponds
Storm BMP's
City Limits
Floodplain
Bass Lake Preserve Watershed Information:
Total watershed area 1,340 acres
Bass Lake Preserve area 56 acres
Data Sources:
Watershed - Barr Engineering (2012 SWLRT Study)
Floodplain - FEMA
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Carpenter Park
Nordic Ware
Rec Center
Village in the Park
PLACE
4900Excelsior
Excelsior & Monterey
Excelsior & Grand
MINNETONKA BLVD
WALKER ST
HAMILTON ST
OXFORD ST
MORNINGSIDE RD
VERMONT ST
PARK GLEN RD
WOLFE PKWY
PARK COMMONS DR
VALLACHER AVE
SERVICE DR HIGHWAY 7
PARK CENTER BLVD
MONTEREY DR
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BARRY ST
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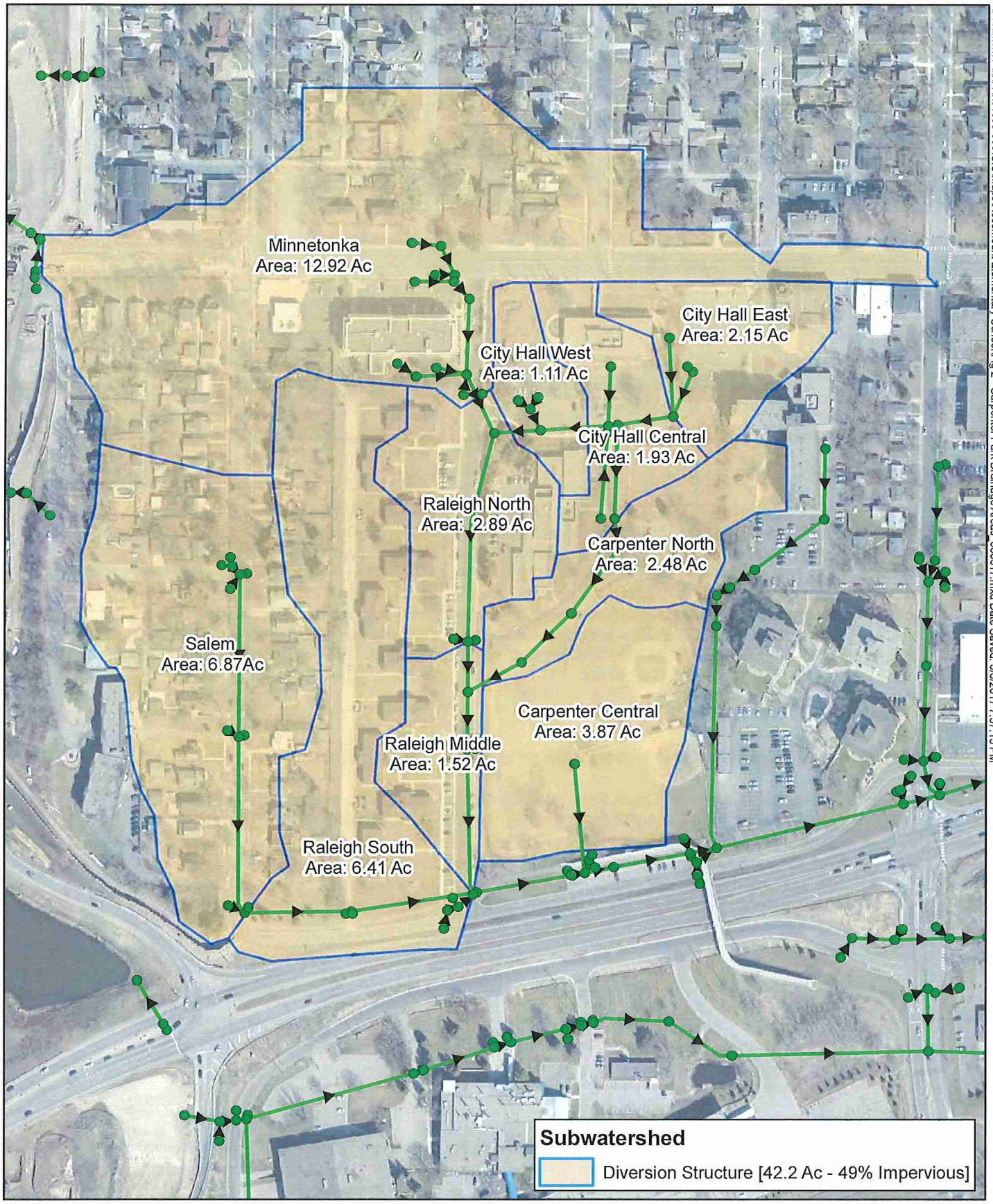

Document Path: K:\01005-000\GIS\Maps\Rosemount Elementary School\Fig 2 - Carpenter Park Drainage Areas_030617.mxd Date Saved: 3/6/2017 7:57:15 PM

Figure 2 - Carpenter Park Drainage Areas

St. Louis Park MINNESOTA

Carpenter Park Water Quality Improvement Project
City of St. Louis Park

N

0 250 Feet
1 inch = 250 feet

WSB

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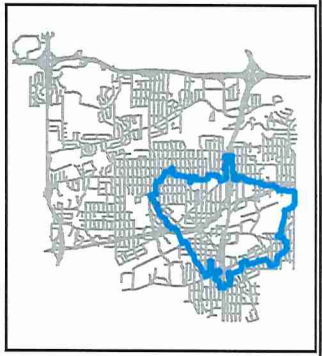
Bass Lake Preserve

Stormwater Drainage Map

Legend

- Bass Lake Watershed
- Carpenter Park Drainage Area
- EDA Park n Ride Sites
- Future Projects
- Other Projects
- Current Projects
- Completed Projects
- Storm Pipe
- Highway Ponds
- Storm BMP's
- City Limits
- Floodplain



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WENCK ASSOCIATES
Responsive partner. Exceptional outcomes.

To: Heidi Quinn, *Permitting Technician*, Minnehaha Creek Watershed District

From: Erik Megow, Wenck Associates, Inc.

Date: March 20, 2017

Subject: Carpenter Park Regional Stormwater Proposal

This memo summarizes the proposed stormwater facilities and their performance for the Carpenter Park regional facility. The City of St. Louis Park and WSB & Associates have provided preliminary plans and calculations showing how the proposed facility is designed to off-set redevelopment project downstream of the facility. Runoff from the future re-development and proposed regional facility discharge to the same 72" trunk line (storm sewer) that discharges to Bass Lake. Figure 1 below shows the proposed location of the BMP, the location of the EDA Park & Ride sites to be developed and the 72" trunk line that directs the pipeshed and its runoff to bass lake.

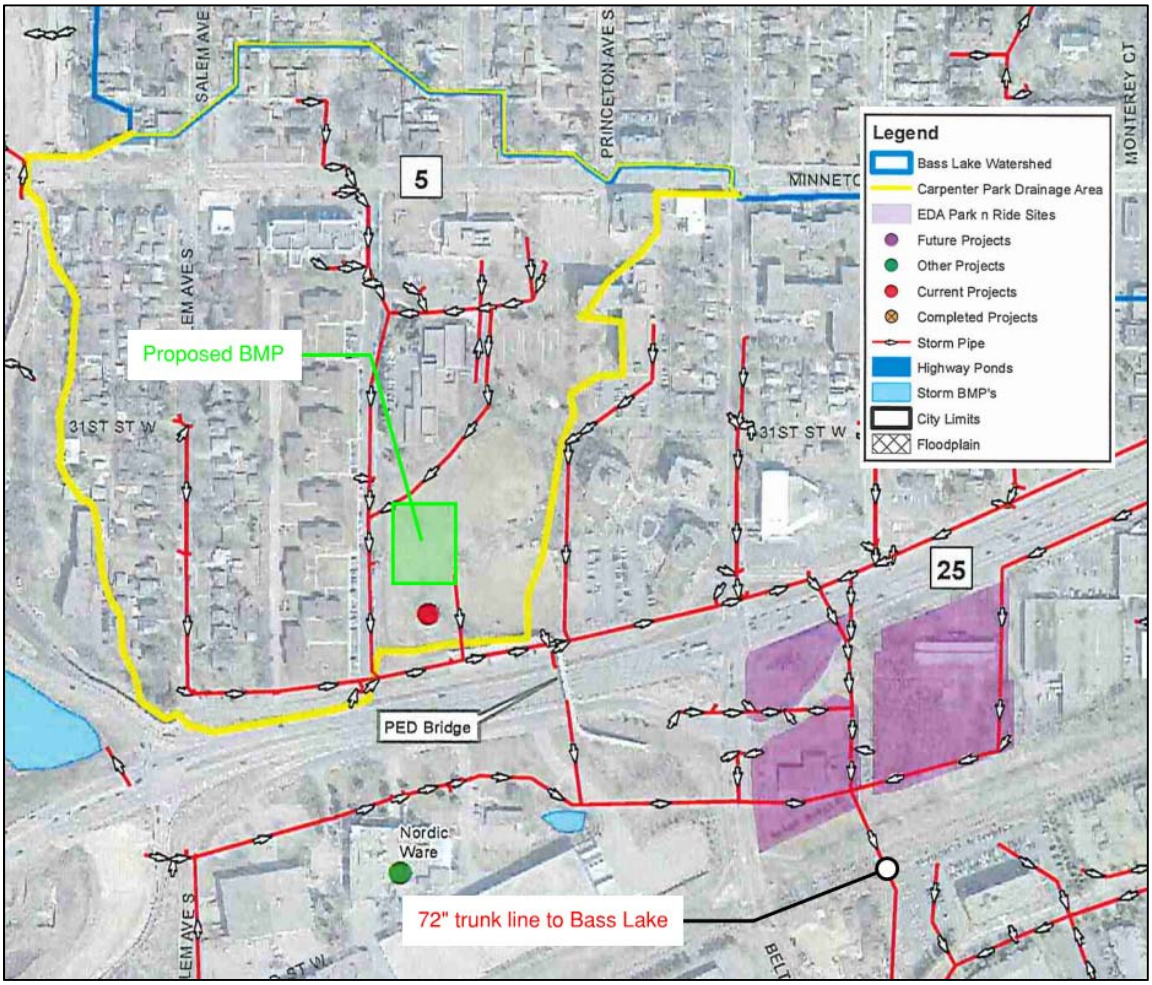


Figure 1. This figure shows the Carpenter Park BMP, its drainage area, and the pipeshed it shares with the future development (this Figure was developed from a St. Louis Park Stormwater Drainage Map)

The Carpenter Park regional facility will direct low flow rain events to an underground storage facility to be built beneath the park. The runoff will be directed to the facility with a diversion structure at the intersection of Raleigh Avenue and MN 7 Service Road. This diversion structure will direct low flow events to an underground storage/pond. The pond will be designed to capture at least 37,964 cubic-feet (cf) of runoff below its overflow outlet. The volume below the overflow outlet will be pumped through a primary outlet to the vault containing the filters at a rate of ~0.25 cubic-feet per second (cfs). The 0.25 cfs pumping rate will allow the filtration volume (37,964 cf) to be filtered through the vault in less than 48 hours. A preliminary design form WSB is shown in Figure 2. The BMP as described will provide rate control for the 1, 10, 100-year storm event at 8.5 cfs, 2.2 cfs, and 1.5 cfs, respectively.

Figure 2. This figure shows the preliminary design of the proposed Carpenter Park regional stormwater facility.

To off-set the future re-development at the EDA and Park & Ride sites, the project will need to provide the required abstraction and phosphorus control. Table 1 shows the abstraction and phosphorus requirements for the future EDA, Park & Ride (PNR) and Skateboard Park redevelopment. The Skateboard Park redevelopment will be located within Carpenter Park.

Table 1. Volume and Phosphorus Control Balance

Treatment	P-Load Increases/Abstraction Needed			P-Load Removal/ Abstraction Provided	Net Reduction
	EDA Site	PNR Site	Skateboard Park	Carpenter Park Facility	
Phosphorus Load (lbs/yr)	4.4	4.4	0.3	27.0	17.9
Abstraction Volume (cf)	9,220	9,220	542	18,982	0

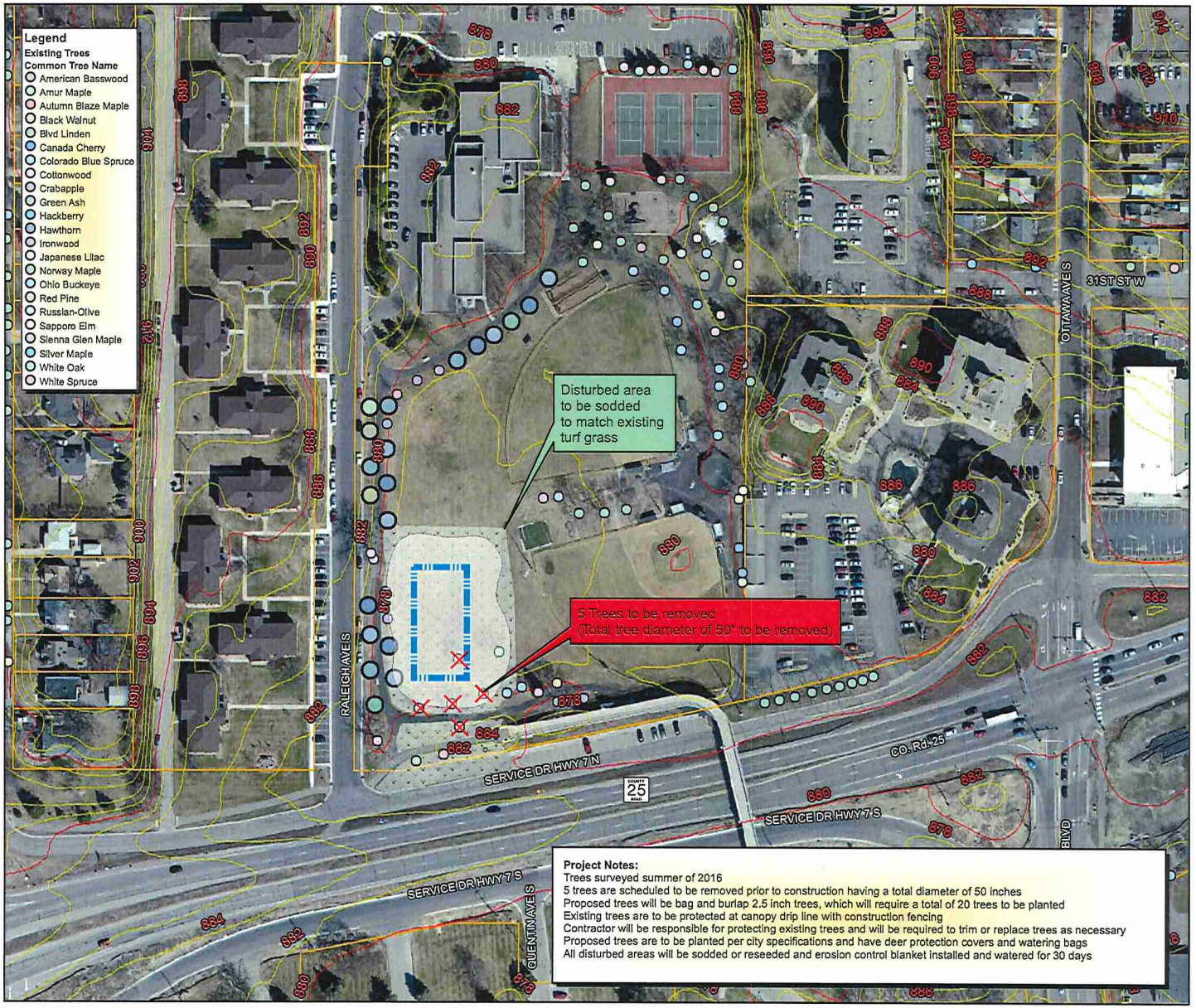
Table 1 shows that the proposed regional system will provide the necessary volume control to off-set the redevelopment, while providing a greater Phosphorus reduction than what would be required by providing specific BMPs for each of the EDA, PNR, and Skateboard Park redevelopments.

Table 6. Accounting Plan for use of credits through Carpenter Park Regional Plan

Treatment	Carpenter Park Provides	EDA Site Requires[1]	Beltline Park n Ride Requires[1]	Skateboard Park Requires[1]	Net Reduction
Abstraction Volume [cf]	18,982[2]	9,220	9,220	542	0
Rate Control (1-yr) [cfs]	8.5	4.4	2.7	0.4	1.0[3]
Rate Control (10-yr) [cfs]	2.2	5.2	2.9	0.5	-6.4[3]
Rate Control (100-yr) [cfs]	1.5	5.1	2.5	0.7	-6.8[3]
Phosphorus Reduction [lbs TP/yr]	27.0	4.4	4.4	0.3	17.9

Notes:

1. Requirements are based on conceptual site layout and may be subject to change during final site design.
2. Enhanced filtration technology proposed has a TP removal efficiency between 65-78%, which would provide an abstraction volume of 27,117 cubic-feet (at 70% credit). The city desires to continue to work with MCWD to obtain additional volume abstraction credit as required to meet permitting required for projects identified in this memo.
3. Rate control will be met onsite for the EDA and Beltline Park n Ride sites. Net reduction in rate to Bass Lake Preserve after the Skate Park redevelopment requirements for the 1, 10, & 100-year storm event are 8.1 cfs, 1.7 cfs, & 0.8 cfs, respectively.



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Carpenter Park Improvement Project

Landscaping Plan

Legend

Replacement Trees (20)

Common Tree Name

- American Linden
- Boulevard Linden
- Chokecherry
- Hackberry
- Honeylocust
- Ironwood
- Kentucky coffee tree
- Serviceberry
- Proposed Underground Stormwater Facility
- Proposed Skate Park Area
- Vegetation Restoration Area
- Index
- Intermediate
- Property Boundaries

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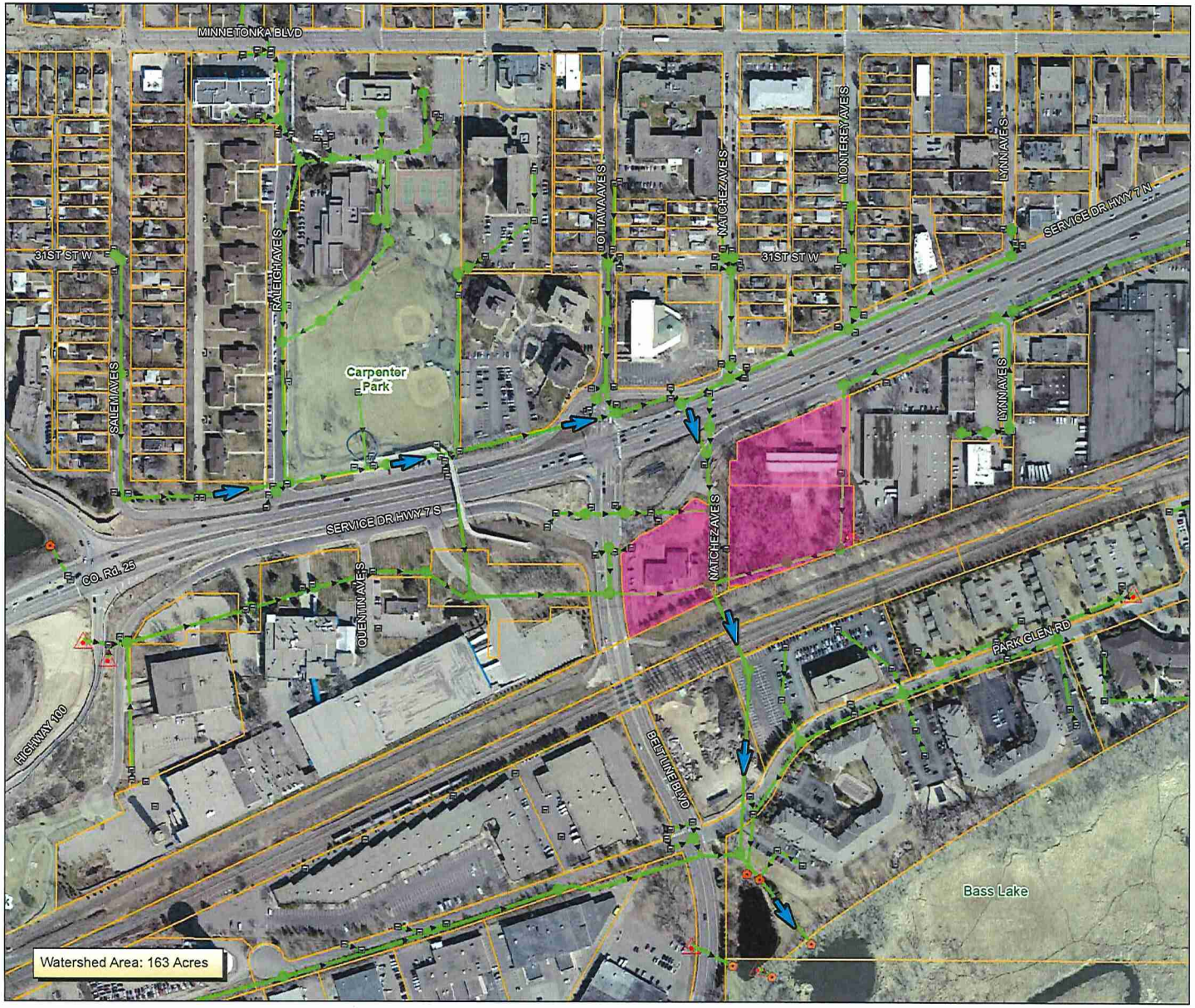

St. Louis Park
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Carpenter Park Site Locaiton & Storm Sewer Map

Legend

- EDA Properties
- City Limits
- CB
- CBMH
- INLET
- LIFT STA
- NODE
- OUTFALL
- OUTLET
- STMH
- STMVL
- Storm Mains
- Property Boundaries

N

0 75 150 300 Feet

FIRST AMENDMENT
TO THE STORMWATER MANAGEMENT FACILITY MAINTENANCE AGREEMENT
Between the Minnehaha Creek Watershed District and the City of St. Louis Park

This amends the 10-09-08 stormwater facility maintenance agreement (Agreement) between the Minnehaha Creek Watershed District, a watershed district with purposes and powers set forth in Minnesota Statutes Chapters 103B and 103D (MCWD), and the City of St. Louis Park, a home rule charter city and political subdivision of the State of Minnesota (St. Louis Park), for purposes of incorporating St. Louis Park's inspection and maintenance of wetland buffers into the Agreement. In consideration of the mutual terms and conditions set forth herein, including the obligations of mutual consideration, the sufficiency of which is hereby acknowledged, the MCWD and St. Louis Park amend the Agreement as follows:

1. The first recital is modified to read:

WHEREAS pursuant to Minnesota Statutes § 103D.345, the MCWD has adopted and implements Rule N, Stormwater Management, and Rule D, Wetland Protection;

2. The following recital is inserted after the second recital:

WHEREAS under Rule D, certain land development activity requires a landowner to record a declaration establishing the landowner's perpetual obligation to protect undisturbed buffer adjacent to wetlands;

3. The fourth recital is modified to read:

WHEREAS St. Louis Park from time to time is subject to stormwater facility and wetland buffer maintenance requirements pursuant to the terms of an MCWD permit; and

4. The fifth recital is modified to read:

WHEREAS the parties concur that it is clearer and procedurally more efficient for the MCWD and St. Louis Park to agree on standard requirements for stormwater facility and wetland buffer maintenance and to specify such requirements in this Agreement so that they may be incorporated into future permits as applicable.

5. The following is inserted as Paragraph 2:

St. Louis Park, at is cost, will comply with the following buffer protection and maintenance requirements under any future permit that explicitly applies the Agreement to a wetland buffer delineated or described in the permit:

a. The buffer will be maintained in perpetuity free from mowing or other vegetative disturbance, fertilizer application, yard or other waste disposal, the placement of structures or any other alteration that impedes the function of the buffer in protecting water quality, shading riparian edge, moderating flow into the wetland or providing habitat.

b. Selective removal of invasive plant species such as European buckthorn and periodic cutting or prescribed burning to promote the ecological health of the buffer are exempt from the provisions of paragraph 1.a, above, provided the work is conducted in accordance with a written proposal or plan approved by MCWD staff. Pesticides and herbicides may be used in the buffer in accordance with Minnesota Department of Agriculture rules and guidelines.

6. Paragraph 3 is modified to read:

MCWD permits for specific projects may contain additional conditions for stormwater management facility and wetland buffer maintenance in accordance with MCWD Rules as they may be amended from time to time.

7. All terms of the Agreement not explicitly modified by this amendment remain effective and binding on the parties.

IN WITNESS WHEREOF, intending to be legally bound, the parties hereto execute and deliver this First Amendment.

MINNEHAHA CREEK WATERSHED DISTRICT

By James B. Calkins
Date: 10-22-09
James Calkins, President

APPROVED AS TO FORM and EXECUTION

By _____
Date: November 20, 2009
Its Attorney

CITY OF ST. LOUIS PARK

By _____
Date:
Its City Manager

STORMWATER MANAGEMENT FACILITY MAINTENANCE AGREEMENT
Between Minnehaha Creek Watershed District and
the City of St. Louis Park

This Stormwater Management Facility Maintenance Agreement (Agreement) is made by and between the Minnehaha Creek Watershed District, a watershed district with purposes and powers set forth in Minnesota Statutes Chapters 103B and 103D (MCWD), and the City of St. Louis Park, a home rule charter city and political subdivision of the State of Minnesota (St. Louis Park), for purposes of St. Louis Park's inspection and maintenance of stormwater management facilities.

Recitals and Statement of Purpose

WHEREAS pursuant to Minnesota Statutes § 103D.345, the MCWD has adopted and implements Rule N, Stormwater Management;

WHEREAS under Rule N, certain land development activity requires a landowner to record a declaration establishing the landowner's perpetual obligation to inspect and maintain stormwater management facilities;

WHEREAS a public landowner, as an alternative to a recorded instrument, may memorialize its obligations in an unrecorded written agreement with the MCWD;

WHEREAS St. Louis Park from time to time is subject to stormwater facility maintenance requirements pursuant to the terms of an MCWD permit; and

WHEREAS the parties concur that it is clearer and procedurally more efficient for the MCWD and St. Louis Park to agree on standard requirements for stormwater facility maintenance and to specify such requirements in this Agreement so that they may be incorporated into future permits as applicable.

THEREFORE IT IS AGREED as follows:

1. The following stormwater management facility maintenance requirements will apply to St. Louis Park, at its own cost, under any future permit that explicitly applies this Agreement to stormwater management facilities identified in a permit:

a. St. Louis Park will inspect all stormwater retention and detention ponds at least annually. Pond function will be considered inadequate if sediment accumulation has decreased the wet storage volume by 50 percent, or dry detention volume by 25 percent. St. Louis Park will restore the pond to its original design elevations and dimensions, and restore vegetation in disturbed areas within one year of the inspection date.

b. St. Louis Park will inspect grit chambers, sump catch basins and sump manholes in the spring, summer and fall, and outlet structures, culverts and other stormwater facilities annually. Accumulated sediment and debris will be removed so that the facilities continue to operate as designed, and erosion or structural problems will be corrected.

c. St. Louis Park will inspect rain gardens and filtration basins annually, keep such facilities keep clean of excess sediment and debris, remove dead vegetation each spring, and remove and replace the top two to five inches of media every three to five years so as not to impede filtration of sediment and oils.

d. St. Louis Park will maintain naturally vegetated swales free from mowing or other vegetative disturbance, fertilizer application, yard or other waste disposal, the placement of structures, or any other alteration that impedes the function of the vegetated swale as a buffer to improve the quality of water flowing through the permitted project site.

e. St. Louis Park will inspect all pervious paver and porous concrete installations at least once each year after a major storm and otherwise annually; vacuum surface openings in dry weather to remove dry, encrusted sediment as necessary; and replace broken units that impair the structural integrity of the surface. If water stands for an extended period of time, St. Louis Park will remove and replace the base materials.

f. St. Louis Park will submit to the MCWD annually a brief written report that describes the maintenance activities performed under this Agreement, including dates, locations of inspection and maintenance activities performed.

3. MCWD permits for specific projects may contain additional conditions for stormwater management facility maintenance in accordance with MCWD Rules as they may be amended from time to time.

4. If St. Louis Park conveys into private ownership a fee interest in any property that has become subject to this Agreement, it shall require as a condition of sale, and enforce: (a) that the purchaser record a declaration on the property incorporating the stormwater management facility maintenance requirements of this Agreement; and (b) that recordation occur either before any encumbrance is recorded on the property or, if after, only as accompanied by a subordination and consent executed by the encumbrance holder ensuring that the declaration will run with the land in perpetuity. If St. Louis Park conveys into public ownership a fee interest in any property that has become subject to this Agreement, it shall require as a condition of the purchase and sale agreement that the purchaser accept an assignment of all obligations vested under this Agreement.

5. This Agreement may be amended only in a writing signed by the parties.

6. This Agreement is in force for five years from the date on which it has been fully executed and will renew automatically for five-year terms unless terminated. Either party may terminate the Agreement on 30 days' written notice to the other. Any obligations vested in St. Louis Park through incorporation into an issued permit before the effective date of termination of this Agreement will survive expiration.

7. The recitals above are incorporated as a part of this Agreement.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement.

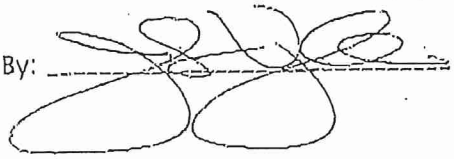
MINNEHAHA CREEK WATERSHED DISTRICT

By James B. Calkins Date: 10-9-08
President, Board of Managers

APPROVED AS TO FORM and EXECUTION

By _____ Date: 10-9-08
Its Attorney

CITY OF ST. LOUIS PARK

By:  Date: 10/1/08

701 Xenia Avenue South | Suite 300 | Minneapolis, MN 55416 | (763) 541-4800

Technical Memorandum

To: ***Phil Elkin, PE, City of St. Louis Park***
Erick Francis, City of St. Louis Park

From: ***Katy Thompson, PE, WSB & Associates***
Bill Alms, WSB & Associates

Date: ***September 16, 2016***

Re: ***Carpenter Park Water Quality Improvement Project Design Analysis***
WSB Project No. 3336-00

This technical memorandum summarizes the design analysis that has been completed for the Carpenter Park Water Quality Improvement Project. Three (3) routing options and four (4) treatment strategies are included along with design assumptions and the anticipated treatment results for the underground water quality treatment system options in Carpenter Park.

Purpose

The intent of the Carpenter Park Improvement Project is to provide an underground stormwater management facility in the southwest corner of Carpenter Park. The project will provide stormwater treatment and rate control to a 46 acre subwatershed which currently drains untreated to Bass Lake. This project also intendeds to:

- Provide improved flood management, in a historically flood prone area adjacent to the police station.
- Improve the usability and drainage of the existing play fields within Carpenter Park.
- Include design considerations and provide stormwater treatment for a 12,000 square-foot skateboard park and half size soccer field.

The additional water quality treatment credits obtained through project permitting with MCWD are intended to be used for future reconstruction projects located within the Triangle subwatershed.

Existing Conditions

Storm sewer extends from Minnetonka Boulevard at the northern boundary of Carpenter Park, to the frontage road south of Carpenter Park, covering a 42.2-acre drainage area. An additional 4.1-acre subwatershed is located northeast of Carpenter Park covering the Menorah Neighborhood. Stormwater from these two drainage areas flows into a central discharge point located just south of the pedestrian bridge. It then continues east to Ottawa Ave before crossing Highway 7. No phosphorus or sediment removal is provided prior to the water being discharged from either subwatershed.

During large storm events significant ponding occurs within the City Hall parking lot, in Carpenter Park, and along Raleigh Avenue.

A stormwater management analysis was competed by Barr Engineering in July 2012 for the Beltline LRT Station Project area. This study included a XPSWMM model and P8 analysis of the entire Bass Lake watershed. The XPSWMM model was utilized as a starting point for the analysis of different treatment options contained within this memo.

Carpenter Park is listed in two MPCA databases including State Assessment Site (SAS) SA7656 and Unpermitted Dump Site REM03727. A Limited Phase II Environmental Site Assessment (Phase II ESA) was completed by WSB in June 2016, which included excavation of five test pits to depths of 12 to 14 feet below grade in the area of the proposed stormwater improvements. Both soil and groundwater impacts were identified at the Site which would require a portion of the material excavated from Carpenter Park to be disposed of in landfill.

Routing Stormwater to Carpenter Park

The intent of the underground stormwater facility is to treat as much of the existing drainage area as possible, while maximizing rate control and water quality benefits. The trunk storm sewer depth (8-12 feet) and flat profile (< 0.5%) limit the ability to provide storage in Carpenter Park without excavating deeper into the park to provide an underground storage system. Due to the effects of contaminated soil and high groundwater identified in the Carpenter park environmental site assessment, alternative options were reviewed for routing stormwater to the treatment system:

Routing Option 1: Extend Existing Storm Sewer – Minimize Excavation

To minimize the excavation depth necessary for the underground stormwater facility, and eliminate the need for a lift station, four alternative storm sewer connections were evaluated to provide a higher inlet elevation (**Figure 1 - Alternative Connections**). With Option 1, one or more alternative connection points would be identified upstream in the subwatershed and new storm sewer would be installed to reroute water to the underground storage facility by gravity. Each of these connections would allow for a higher base elevation of the underground treatment facility, thus less excavation would be required. However, each of these alternatives results in a large expense to extend storm sewer pipes, and would consequentially divert a smaller portion of the watershed to the facility.

Benefits

- Invert elevation of detention storage facility can be higher, therefore decreasing the amount of excavation necessary.

Drawbacks

- A smaller percentage of the drainage area is being treated.
    - Results in less overall pollutant removal
- Requires more linear feet of storm sewer than Option 2 and 3.
- Potential utility conflicts and additional easements may be required to reroute the storm sewer along side-yard property lines.

Routing Option 2: Lift Station

Including a high capacity lift station at the lower southwest corner of Carpenter Park's storm sewer network would also reduce the excavation depth of the stormwater facility. The lift station would continually pump water during a storm event. A majority of the contributing drainage area (42.2 of the 46.3 acres) would be directed to the stormwater facility. Although a lift station may decrease the initial cost of the storage facility in comparison to a deeper excavation, the operations and maintenance required would increase the life cycle cost of the system.

Benefits

- Invert elevation of detention storage facility can be higher, therefore decreasing the amount of excavation necessary.
- Majority of the drainage area can be directed to the stormwater facility.

Drawbacks

- Operations and maintenance required increases the life cycle cost of the system.
- Variable size and intensity of storm events would limit the ability to treat small and large storm events with the same pumps.

- Requires pumps to be operational to provide flood storage benefit.

Routing Option 3: Diversion from Existing Storm Sewer

Placing a new structure to divert stormwater would allow for runoff to be directed into the underground stormwater facility via gravity flow. Two potential diversion structure locations were evaluated: the southwest and northeast corner of Carpenter Park (**Figure 2 - Diversion Connection Options**). The northeast corner only diverts approximately four acres of runoff, and would require a similar structure to the southwest corner. It is more cost effective to only divert stormwater at the southwest corner. Option 3 requires less pipe material than Option 1, and stormwater runoff can be diverted via gravity flow rather than mechanical pump. However, excavation of the park to a depth of at least 10 feet is necessary.

Benefits:

- Majority of the drainage area can be directed to the stormwater facility.
- Treats stormwater runoff from all storm events.
- Requires fewer linear feet of storm sewer.
- Does not require any pumps to be operational to provide additional flood storage in the storm sewer network.

Drawbacks:

- An excavation depth of at least 10 feet is necessary resulting in requirement for additional contaminated material disposal.
- Requires large diversion (10' x 8' Box) structure direct stormwater into the underground system without causing upstream flood impacts.

We recommend that the City use Routing Option 3 to route stormwater to the underground treatment facility. Diverting storm to capture the majority of the tributary drainage area is the most cost effective method to maximize treatment while still maintaining a low life cycle cost. The Environmental Assessment that was completed at the proposed excavation site shows excavating down to a depth of 10 feet is feasible with some material requiring disposal at a landfill.

Water Quality Treatment Strategy Options

With the selection of Routing Option 3, four water quality treatment strategies were analyzed for total project cost, annual maintenance cost, and life cycle cost benefit for total phosphorus treatment. The four options are categorizes as one primary treatment option and three additional secondary treatment options in addition to the primary treatment.

Treatment Strategy 1: Detention Only

An underground stormwater treatment system would be constructed with a dead pool depth of four feet and live pool depth of one and a half feet. This underground pond would remove pollutants through sedimentation and would also provide additional storage capacity to the system. No pumps would be included as part of Treatment Strategy 1.

This option provides the lowest capital cost, lowest annual cost, and lowest life cycle cost of all of the treatment strategies. P8 modeling and the MIDS calculator show this treatment strategy providing 15.6 pounds of total phosphorus reduction per year. For each pound of total phosphorus removed per year, typical equivalency factors allow for 0.8 to 1.0 acres of fully reconstructed impervious surface can be credited for future projects.

A consideration could be to design the detention system with the potential for a retrofit for filtration or irrigation reuse (Treatment Strategies 1.A, B, or C) in the future, and the interim strategy would be primarily detention.

Benefits:

- Removes annual total phosphorous to credit approximately 12-15 acres of future reconstructed impervious surface.
- Lowest annual maintenance.
- Lowest capital cost.
- Lowest life cycle cost per pound of total phosphorus.
- Potential to be an interim primary solution and secondary treatment can be incorporated in future years as desired.

Drawbacks:

- Lowest annual total phosphorus removal.

Treatment Strategy 1.A: Media/Cartridge Filter

After the stormwater reaches the detention facility described in Strategy 1, stormwater would be pumped through a force main into a secondary treatment vault where cartridges would remove phosphorus by filtration fine sediments and absorption of dissolved phosphorous with aluminum oxide coated media. Treated water would be returned to the main line storm sewer system near the pedestrian bridge by gravity. Treatment Strategy 1.A removes between 65-78% of the total phosphorus that is pumped from the detention system. The system would include 30 cartridges that need to be replaced on an annual basis, at the cost of $400 per cartridge.

Benefits:

- Maintenance costs are predictable.
- Credit for approximately 22-28 acres of reconstructed impervious surface can be achieved.

Drawbacks

- Highest annual maintenance cost.

Treatment Strategy 1.B: Iron-Enhanced Sand Filter (IESF)

Similar to 1.A, stormwater would be pumped through a force main into a vault where the stormwater is then filtered through an iron-enhanced sand filter and exits into the main line storm sewer system. Minnesota Stormwater manual recommends a filter rate of three feet per day for iron-enhance sand filters. Therefor a 4,010 square foot sand filter would be required for the iron-enhanced sand filter system. The system could be constructed without a concrete detention vault, but would require the park to be excavated every 7 to 10 years to change out media. A concrete detention vault could be constructed to house the filter media; however, there would still be significant effort to remove 450 yard^3 of sand every 7 to 10 years from below grade. Note that the maintenance cycle for this system is highly variable and is still being researched.

Benefits:

- Highest annual total phosphorus removal of the secondary treatment options- credit for approximately 25 to 31 acres of reconstructed impervious surface can be achieved.
- Lowest life cycle cost per pound of total phosphorus of the secondary treatment options.

Drawbacks

- Large footprint required for either concrete vault or regular excavation for the replacement of materials.
- Less predictable maintenance costs.

Treatment Strategy 1.C: Reuse/Irrigation

Stormwater within the detention system can be reused for irrigation of Carpenter Field. This option utilizes volume reduction as a method of total phosphorus removal rather than filtration. The existing system needs to be assessed prior to finalizing irrigation system expansion estimate. The design cost estimates assume that an additional one and a half acres of irrigation would need to be added to the existing system.

Benefits:

- The only secondary treatment strategy that uses volume reduction as a method for phosphorus removal.
- Saves the City money in water costs for irrigating Carpenter Park (estimated $3,350/year).
- Public interest and engagement is strong for stormwater reuse and irrigation.
- Has the lowest annual operating cost of the secondary treatment options.

Drawbacks:

- Cost relies on existing irrigation system being in satisfactory condition.
- Has the lowest annual total phosphorus removal of the secondary treatment options - credit for approximately 15 acres of reconstructed impervious surface can be achieved.

Cost Estimate

Below in **Table 1** is a summary of each treatment strategy and its cost estimates. A detailed opinion of probable costs can be found in the attachments.

Table 1. Summary of Treatment Strategies and Costs

Water Quality Treatment Options	Annual Phosphorus Removal (lb/yr)	Construction Cost	Annual Maintenance Cost[1]	25-year Life Cycle Total Phosphorus Cost ($/lb TP)[3]
Option 1 - Detention	15.6	$805,300	$500	$2,097
Option 1A – Detention and Media/Cartridge Filter	27.6	$1,164,700	$12,500	$2,140
Option 1B – Detention and IESF	31.6	$1,362,200	$15,500	$2,215
Option 1C – Detention and Reuse/Irrigation	18.9	$1,133,600	$5,500 [2]	$2,513

[1] Annual Maintenance Cost Include:
- Option 1: $500 (Pretreatment Cleanout)
- Option 1A: $500 (Pretreatment Cleanout) + $12,000 (Cartridge Replacement 30*$400/cartridge)
- Option 1B: $500 (Pretreatment Cleanout) + $15,000 (Media Replacement $125,000*3 media replacements /25yr)
- Option 1C: $500 (Pretreatment Cleanout)+ $5,000 (Variable and some of the cost are included in the existing system operation)

[2] Annual Water Savings= $3,350 (1.7 MGY * $2/1000 Gal)

[3] 25-Yr Life Cycle TP Cost have been calculated as follows:
- Option 1: [$805,300+$500/yr*25yr]/[15.6lb TP/yr*25yr] = $2,097/ lb TP
- Option 1A: [$1,164,700+$12,500/yr*25yr]/[27.6lb TP/yr*25yr] = $2,140/ lb TP
- Option 1B: [$1,362,200+$15,500/yr*25yr]/[31.6lb TP/yr*25yr] = $2,215/ lb TP
- Option 1C: [$1,133,600+($5,500/yr-$3,350/yr)*25yr)]/[18.9lb TP/yr*25yr] = $2,513/ lb TP

Comparison to Alternative Water Quality Treatment Best Management Practices

The treatment strategies listed above have been compared with the alternative Best Management Practices (BMP) of ponding and raingardens. Ponding was estimated assuming National Urban Runoff Treatment (NURP) water quality treatment standards of a two and a half inch rainfall event. The dead pool volume for the Carpenter Park tributary area would need to be 4.9 ac-feet, which translates to a 100 foot by 250 foot surface area with a dead pool depth of 9 feet. The construction of this NURP pond assumes a cost of $9.9 per cubic feet of storage provided.

Rain gardens typically are sized to treat approximately one half acre of tributary area. Typical sizing for rain gardens are 10 by 20 feet in surface area, with a depth of one foot assuming the Soils are Type C. 230 rain gardens would be needed to remove 30 pounds per year of total phosphorus. Each rain garden would cost approximately $5,000 to construct (excavation, grading and materials). The assumptions and cost estimations for both BMP alternatives are listed in **Table 2**.

Table 2: Alternate Best Management Practice

BMP	Annual Phosphorus Removal (lb/year)	Construction Cost	Annual Maintenance Cost	25-year Life Cycle Total Phosphorus Cost ($/lb TP)
NURP Pond	29.0	$2,113,095.00	$1,500.00	$2,925.00
230 Rain Gardens	30.0	$1,150,000.00	$15,000.00	$2,200.00

Recommendations

The water quality treatment strategy chosen will greatly depend on the City's credit goals and annual maintenance expectations. If the City determines that the credit gained from a detention-only treatment strategy is sufficient to their current goals, then no secondary treatment is necessary. If the desire for additional credits is identified, the system can also be designed to facilitate a future retrofit for irrigation or reuse outlined in Strategies 1.A-1.C.

If a greater number of credits are desired, Treatment Strategy 1.A: Media/Cartridge Filter provides the greatest cost benefit over a 25 year life cycle.

The project is feasible, environmentally responsible, and cost-effective from an engineering perspective and WSB & Associates, Inc. recommends construction of the proposed improvements as detailed in this technical memorandum based upon option that best meets the needs of the City. The economic feasibility of this project should be determined by the City Council.

Attachments:

- Figure 1
- Figure 2
- Opinion Cost Spreadsheet
- MIDS Calculator Results
- Option 1 Detail: Storm Trap Concept
- Option 1A Details: Contech Storm Filter Info

Figure 1: Carpenter Park
Storm Sewer Rerouting Options

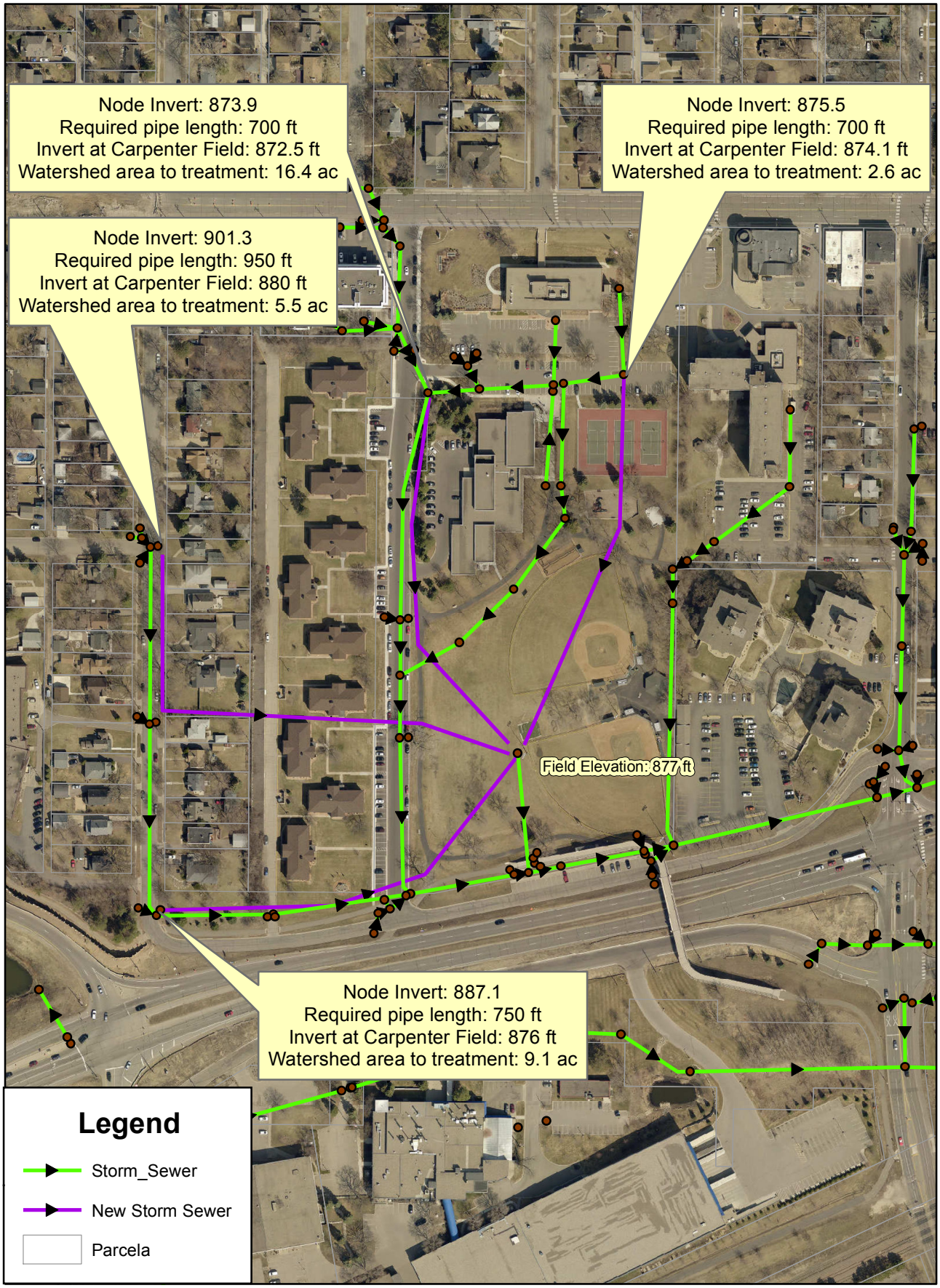
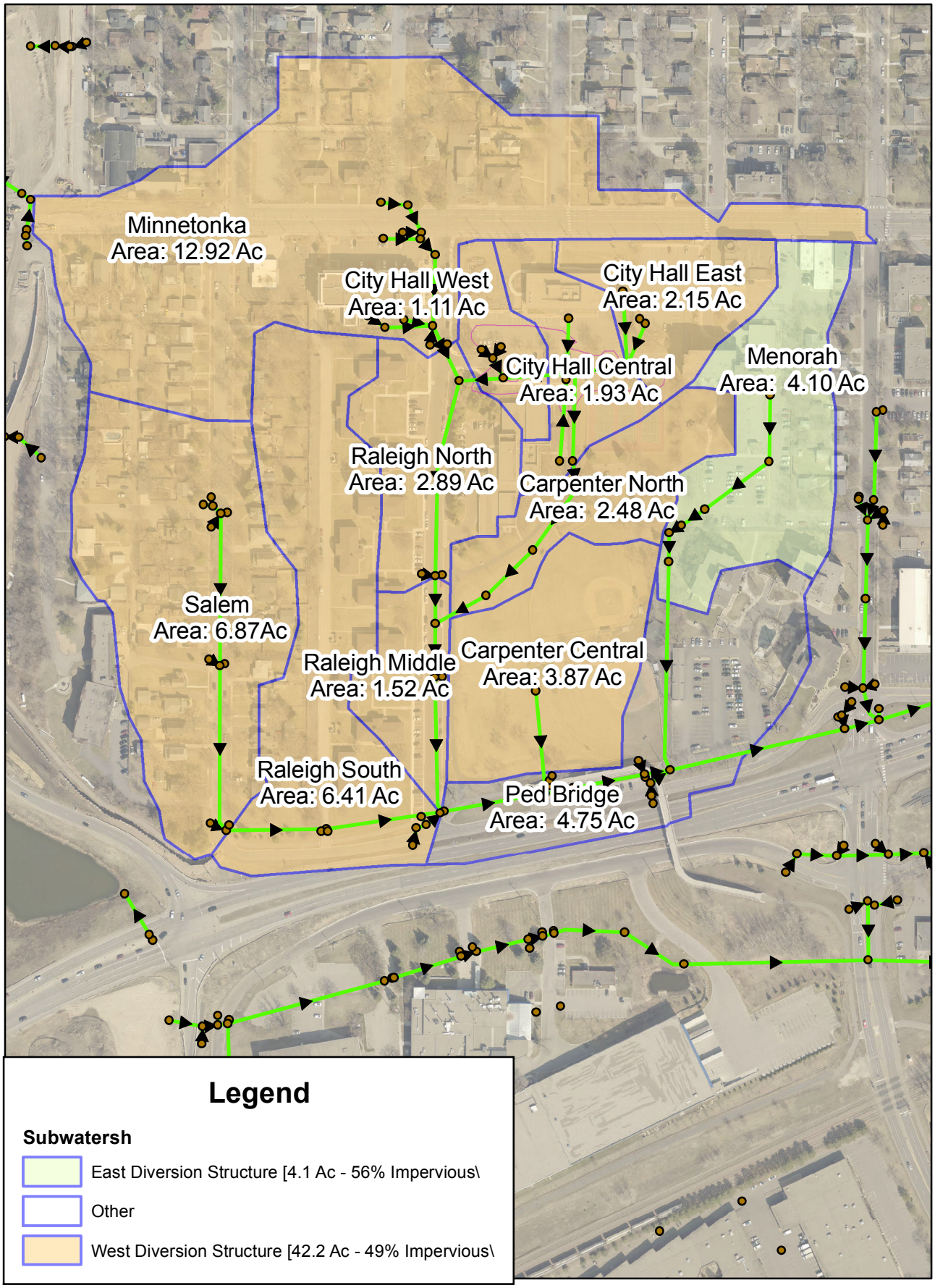


Figure 2: Carpenter Park Drainage Areas



Opinion of Probable Cost

WSB Project: Carpenter Park Water Quality Improvement Project — *Design By:* WCA
Project Location: City of St. Louis Park — *Checked By:*
WSB Project No: 03336-00 — *Date:* 9/7/2016

Item No.	MN/DOT Specification No.	Description	Unit	Estimated Total Quantity	Estimated Unit Price	Estimated Total Cost
Treatment Strategy 1 - Detention System (StormTrap)						
1	2021.501	MOBILIZATION	LUMP SUM	1	$30,300.00	$30,300.00
2	2101.511	CLEARING AND GRUBBING	LUMP SUM	1	$3,000.00	$3,000.00
3	2104.501	REMOVE PIPE SEWER (STORM)	LIN FT	20	$50.00	$1,000.00
4	2104.501	REMOVE DRAINAGE STRUCTURES (STORM)	EACH	1	$2,000.00	$2,000.00
5	2104.503	REMOVE BITUMINOUS SIDEWALK	SQ YD	100	$8.00	$800.00
6	2105.525	DEWATERING	LUMP SUM	1	$20,000.00	$20,000.00
7	2105.501	COMMON EXCAVATION MANAGEMENT LEVEL III	CU YD	4,200	$30.00	$126,000.00
8	2105.543	COMMON BARROW (BACKFILL)	CU YD	1,250	$10.00	$12,500.00
9	2501.511	36" PIPE SEWER	LIN FT	300	$100.00	$30,000.00
10	2506.501	DESIGN SPECIAL DIVERSION STRUCTURE	EACH	1	$50,000.00	$50,000.00
11	2506.502	DRAINAGE STRUCTURE DESIGN 96-4020	EACH	1	$15,000.00	$15,000.00
12	2506.601	UNDERGROUND STORAGE SYSTEM	LUMP SUM	1	$325,000.00	$325,000.00
13	2573.602	EROSION CONTROL	LUMP SUM	1	$8,500.00	$8,500.00
14	2575.502	SURFACE RESTORATION	LUMP SUM	1	$12,500.00	$12,500.00
					SUBTOTAL - TREATMENT STRATEGY 1 - DETENTION SYSTEM	**$636,600.00**
					+15% CONTINGENCY	**$95,500.00**
					CONSTRUCTION SUBTOTAL	**$732,100.00**
					+ 10% INDIRECT	**$73,200.00**
					TOTAL - TREATMENT STRATEGY 1 - DETENTION SYSTEM	**$805,300.00**

Treatment Strategy 1A - Media/Cartridge Filter						
15	2105.501	COMMON EXCAVATION MANAGEMENT LEVEL III	CU YD	150	$30.00	$4,500.00
16	5105.543	COMMON BARROW (BACKFILL)	CU YD	100	$10.00	$1,000.00
17	2501.511	15" RC PIPE CULVERT CLASS V	LF	20	$30.00	$600.00
18	2506.501	LIFT STATION	EACH	1	$125,000.00	$125,000.00
19	2503.603	6" PVC FORCE MAIN	LF	75	$40.00	$3,000.00
20	2506.602	MEDIA FILTER CARTRIDGES VAULT	LUMP SUM	1	$150,000.00	$150,000.00
					SUBTOTAL TREATMENT STRATEGY 1A	**$284,100.00**
					SUBTOTAL TREATMENT STRATEGY 1 + 1A	**$920,700.00**
					+ 15% CONTINGENCY	**$138,100.00**
					CONSTRUCTION SUBTOTAL	**$1,058,800.00**
					+ 10% INDIRECT	**$105,900.00**
					TOTAL TREATMENT STRATEGY 1A	**$1,164,700.00**

Opinion of Probable Cost

WSB Project: Carpenter Park Water Quality Improvement Project
Project Location: City of St. Louis Park
WSB Project No: 03336-00

Design By: WCA
Checked By:
Date: 9/7/2016

Item No.	MN/DOT Specification No.	Description	Unit	Estimated Total Quantity	Estimated Unit Price	Estimated Total Cost
Treatment Strategy 1B - IESF						
21	2105.501	COMMON EXCAVATION MANAGEMENT LEVEL III	CU YD	1,500	$30.00	$45,000.00
22	2105.522	COARSE FILTER AGGREGATE	CU YD	150	$20.00	$3,000.00
23	2105.522	SELECT GRANULAR (BACKFILL)	CU YD	1,000	$10.00	$10,000.00
24	2105.522	IRON ENHANCED FILTRATION MEDIUM	CY	450	$200.00	$90,000.00
25	2501.511	15" RC PIPE CULVERT CLASS V	LF	50	$30.00	$1,500.00
26	2503.603	6" PVC FORCE MAIN	LF	20	$40.00	$800.00
27	2506.501	LIFT STATION	EACH	1	$125,000.00	$125,000.00
28	2506.602	DESIGN SPECIAL - FILTER VAULT CONC.	LUMP SUM	1	$165,000.00	$165,000.00
					SUBTOTAL TREATMENT STRATEGY 1B	**$440,300.00**
					SUBTOTAL TREATMENT STRATEGY 1 + 1B	**$1,076,900.00**
					+ 15% CONTINGENCY	**$161,500.00**
					CONSTRUCTION SUBTOTAL	**$1,238,400.00**
					+ 10% INDIRECT	**$123,800.00**
					TOTAL TREATMENT STRATEGY 1B	**$1,362,200.00**

Treatment Strategy 1C - IRRIGATION/WATER REUSE						
29	2503.603	6" PVC FORCE MAIN	LF	250	$40.00	$10,000.00
30	2504.601	IRRIGATION SYSTEM (EXPANSION)	LUMP SUM	1	$35,000.00	$35,000.00
31	2504.602	6" IRRIGATION GATE VALVE	EACH	2	$1,500.00	$3,000.00
32	2504.602	CONNECT TO EXISTING IRRIGATION SYSTEM	EACH	1	$15,000.00	$15,000.00
33	2504.602	RPZ & ENCLOSURE	EACH	1	$1,500.00	$1,500.00
34	2504.602	IRRIGATION METER AND CONTROLS	EACH	1	$5,000.00	$5,000.00
35	2506.602	LIFT STATION (PUMP+FILTER + ENCLOSURE)	LUMP SUM	1	$150,000.00	$150,000.00
36	2506.602	UV TREATMENT ADD-ON	LUMP SUM	1	$30,000.00	$30,000.00
37	2575.502	SURFACE RESTORATION	LUMP SUM	1	$10,000.00	$10,000.00
					SUBTOTAL TREATMENT STRATEGY 1C	**$259,500.00**
					SUBTOTAL TREATMENT STRATEGY 1 + 1C	**$896,100.00**
					+ 15% CONTINGENCY	**$134,400.00**
					CONSTRUCTION SUBTOTAL	**$1,030,500.00**
					+ 10% INDIRECT	**$103,100.00**
					TOTAL TREATMENT STRATEGY 1C	**$1,133,600.00**

Project Information

Calculator Version:	Version 2: June 2014
Project Name:	Carpenter Park Improvements
User Name / Company Name:	Bill Alms - WSB & Associates
Date:	September 6, 2016
Project Description:	Assessment of Filtration

Site Information

Retention Requirement (inches):	1.1
Site's Zip Code:	55416
Annual Rainfall (inches):	31
Phosphorus EMC (mg/l):	0.3
TSS EMC (mg/l):	54.5

Total Site Area

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land					0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed			21.9		21.9
				Impervious Area (acres)	20.3
				Total Area (acres)	42.2

Site Areas Routed to BMPs

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land					0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed			21.9		21.9
				Impervious Area (acres)	20.3
				Total Area (acres)	42.2

Summary Information

Performance Goal Requirement

Performance goal volume retention requirement:	81058	ft3
Volume removed by BMPs towards performance goal:		ft3
Percent volume removed towards performance goal		**%**

Annual Volume and Pollutant Load Reductions

Post development annual runoff volume	56.0395	acre-ft
Annual runoff volume removed by BMPs:	0	acre-ft
Percent annual runoff volume removed:	**0**	**%**
Post development annual particulate P load:	25.15	lbs
Annual particulate P removed by BMPs:	15.59	lbs
Post development annual dissolved P load:	20.58	lbs
Annual dissolved P removed by BMPs:	0	lbs
Percent annual total phosphorus removed:	**34**	**%**
Post development annual TSS load:	8307	lbs
Annual TSS removed by BMPs:	4984	lbs
Percent annual TSS removed:	**60**	**%**

15.6 (Part. P) + 0 (Diss. P)
= 15.6 lb TP / Yr

BMP Summary

Performance Goal Summary

BMP Name	BMP Volume Capacity (ft3)	Volume Recieved (ft3)	Volume Retained (ft3)	Volume Outflow (ft3)	Percent Retained (%)
Underground Stormwater pond	0	81058	0	81058	0

Annual Volume Summary

BMP Name	Volume From Direct Watershed (acre-ft)	Volume From Upstream BMPs (acre-ft)	Volume Retained (acre-ft)	Volume outflow (acre-ft)	Percent Retained (%)
Underground Stormwater pond	56.0395	0	0	56.0395	0

Particulate Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
Underground Stormwater pond	25.15	0	15.59	9.56	62

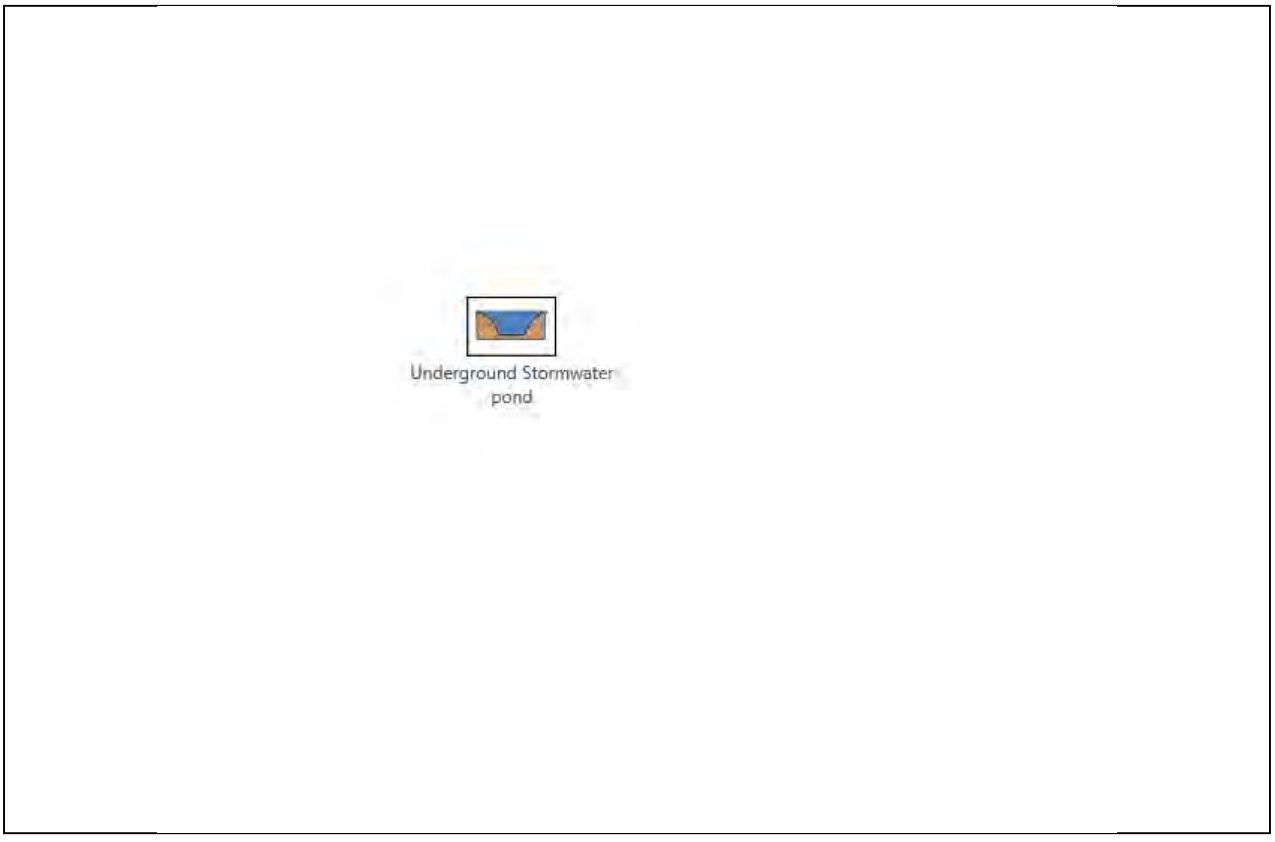
Dissolved Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
Underground Stormwater pond	20.58	0	0	20.58	0

TSS Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
Underground Stormwater pond	8307	0	4984	3323	60

BMP Schematic



Project Information

Calculator Version:	Version 2: June 2014
Project Name:	Carpenter Park Improvements
User Name / Company Name:	Bill Alms - WSB & Associates
Date:	September 6, 2016
Project Description:	Assessment of Filtration - Enhanced

Site Information

Retention Requirement (inches):	1.1
Site's Zip Code:	55416
Annual Rainfall (inches):	31
Phosphorus EMC (mg/l):	0.3
TSS EMC (mg/l):	54.5

Total Site Area

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land					0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed			21.9		21.9
				Impervious Area (acres)	20.3
				Total Area (acres)	42.2

Site Areas Routed to BMPs

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land					0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed			21.9		21.9
				Impervious Area (acres)	20.3
				Total Area (acres)	42.2

Summary Information

Performance Goal Requirement

Performance goal volume retention requirement:	81058	ft3
Volume removed by BMPs towards performance goal:		ft3
Percent volume removed towards performance goal		**%**

Annual Volume and Pollutant Load Reductions

Post development annual runoff volume	56.0395	acre-ft
Annual runoff volume removed by BMPs:	0	acre-ft
Percent annual runoff volume removed:	**0**	**%**
Post development annual particulate P load:	25.15	lbs
Annual particulate P removed by BMPs:	21.33	lbs
Post development annual dissolved P load:	20.58	lbs
Annual dissolved P removed by BMPs:	10.29	lbs
Percent annual total phosphorus removed:	**69**	**%**
Post development annual TSS load:	8307	lbs
Annual TSS removed by BMPs:	7975	lbs
Percent annual TSS removed:	**96**	**%**

21.3 (Part. P) + 10.3 (Diss. P) = 31.6 lb TP / Yr

BMP Summary

Performance Goal Summary

BMP Name	BMP Volume Capacity (ft3)	Volume Recieved (ft3)	Volume Retained (ft3)	Volume Outflow (ft3)	Percent Retained (%)
Underground Stormwater pond	0	81058	0	81058	0
Enhanced Media Filter	0	81058	0	81058	0

Annual Volume Summary

BMP Name	Volume From Direct Watershed (acre-ft)	Volume From Upstream BMPs (acre-ft)	Volume Retained (acre-ft)	Volume outflow (acre-ft)	Percent Retained (%)
Underground Stormwater pond	56.0395	0	0	56.0395	0
Enhanced Media Filter	0	0	0	0	0

Particulate Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
Underground Stormwater pond	25.15	0	15.59	9.56	62
Enhanced Media Filter	0	9.56	5.74	3.82	60

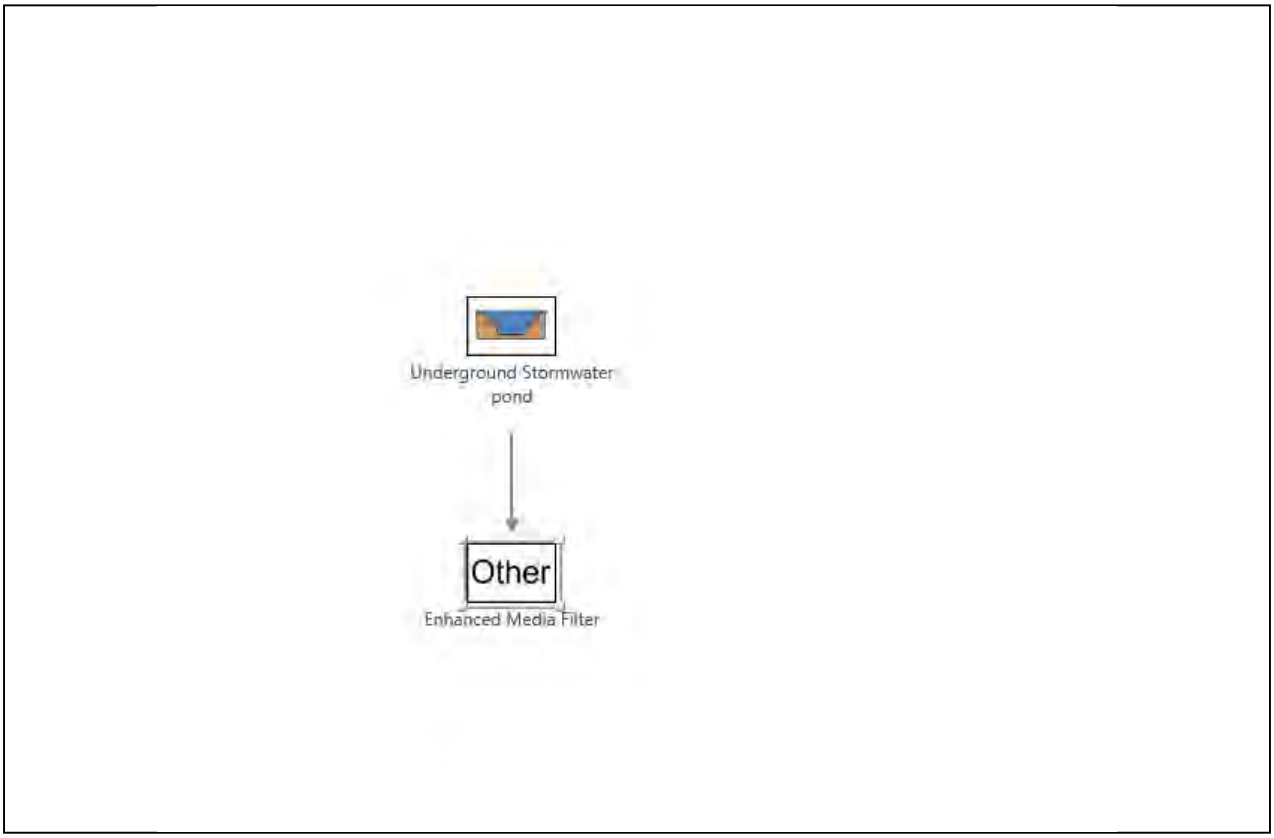
Dissolved Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
Underground Stormwater pond	20.58	0	0	20.58	0
Enhanced Media Filter	0	20.58	10.29	10.29	50

TSS Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
Underground Stormwater pond	8307	0	4984	3323	60
Enhanced Media Filter	0	3323	2991	332	90

BMP Schematic



Project Information

Calculator Version:	Version 2: June 2014
Project Name:	Carpenter Park Improvements
User Name / Company Name:	Bill Alms - WSB & Associates
Date:	September 6, 2016
Project Description:	Assessment of reuse

Site Information

Retention Requirement (inches):	1.1
Site's Zip Code:	55416
Annual Rainfall (inches):	31
Phosphorus EMC (mg/l):	0.3
TSS EMC (mg/l):	54.5

Total Site Area

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land					0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed			21.9		21.9
				Impervious Area (acres)	20.3
				Total Area (acres)	42.2

Site Areas Routed to BMPs

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land					0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed			21.9		21.9
				Impervious Area (acres)	20.3
				Total Area (acres)	42.2

Summary Information

Performance Goal Requirement

Performance goal volume retention requirement:	81058	ft3
Volume removed by BMPs towards performance goal:	5834	ft3
Percent volume removed towards performance goal	**7**	**%**

Annual Volume and Pollutant Load Reductions

Post development annual runoff volume	56.0395	acre-ft
Annual runoff volume removed by BMPs:	6.107	acre-ft
Percent annual runoff volume removed:	**11**	**%**
Post development annual particulate P load:	25.15	lbs
Annual particulate P removed by BMPs:	16.63	lbs
Post development annual dissolved P load:	20.58	lbs
Annual dissolved P removed by BMPs:	2.24	lbs
Percent annual total phosphorus removed:	**41**	**%**
Post development annual TSS load:	8307	lbs
Annual TSS removed by BMPs:	5346	lbs
Percent annual TSS removed:	**64**	**%**

16.6 (Part. P) + 2.24 (Diss. P) = 18.9 lb TP / Yr

BMP Summary

Performance Goal Summary

BMP Name	BMP Volume Capacity (ft3)	Volume Recieved (ft3)	Volume Retained (ft3)	Volume Outflow (ft3)	Percent Retained (%)
Reuse Irrigation System	5834	81058	5834	75224	7
Underground Stormwater pond	0	75224	0	75224	0

Annual Volume Summary

BMP Name	Volume From Direct Watershed (acre-ft)	Volume From Upstream BMPs (acre-ft)	Volume Retained (acre-ft)	Volume outflow (acre-ft)	Percent Retained (%)
Reuse Irrigation System	56.0395	0	6.107	49.9325	11
Underground Stormwater pond	0	49.9325	0	49.9325	0

Particulate Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
Reuse Irrigation System	25.15	0	2.74	22.41	11
Underground Stormwater pond	0	22.41	13.89	8.52	62

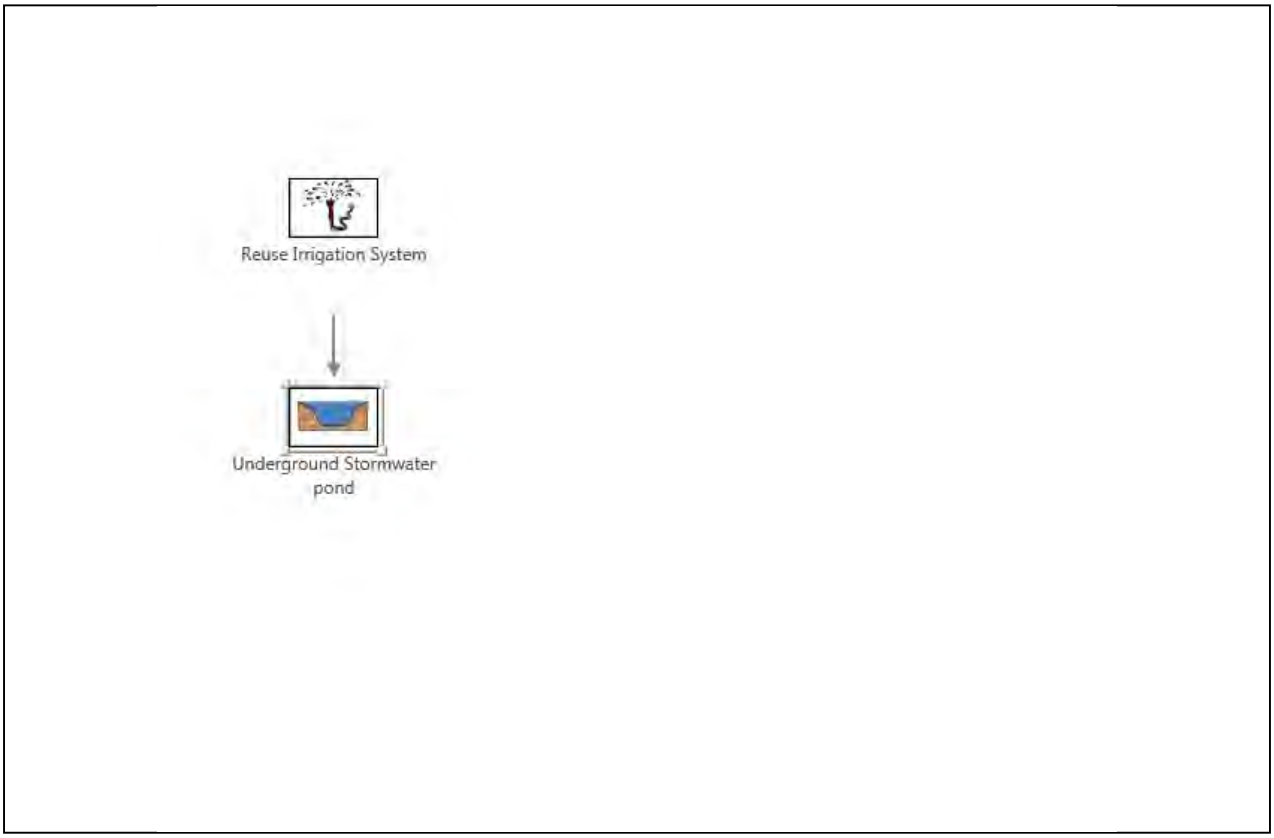
Dissolved Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
Reuse Irrigation System	20.58	0	2.24	18.34	11
Underground Stormwater pond	0	18.34	0	18.34	0

TSS Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
Reuse Irrigation System	8307	0	905	7402	11
Underground Stormwater pond	0	7402	4441	2961	60

BMP Schematic



May 24, 2016

William Alms
WSB & Associates, Inc.
701 Xenia Ave South, Suite 300
Minneapolis, MN 55416

LEED Contribution and Water Quality Available Upon Request

RE: Carpenter Park RWH Vault - St. Louis Park , MN

Dear William:

** Excludes waterproofing liner, risers/grates/frames **

StormTrap, LLC is pleased to offer the following opinion of cost for the installation of the StormTrap system for the above stated project. Please note that the opinion of cost assumes that all spoil will be left on site and is exclusive of any applicable taxes. *Assumptions used for this project are as follows (see page 2 of the design for complete design criteria): Cover: 6ft (min) to 8ft (max); Groundwater: @ Elevation 876.00'; Loading ASTM C857 HS-20*

5'-8" Headroom Units SINGLETRAP BUDGET ESTIMATE

Total Water Storage Provided 1.04 Acre-Feet or 45,495 C.F.
Footprint (Outside Area) (137' x 65') 4'-0" Dead Volume = 32,800 CF
Interior Square Footage 7536 SqFt. = 0.753 Ac-Ft

72	StormTrap Units (see attached layout)						
(StormTrap Units + Delivery + JointTape + JointWrap)							
SUB TOTAL FOR MATERIAL AND FREIGHT							**$161,951.00**
Excavation	4,191	C.Y.	@	$9.00	Per	C.Y.	$37,720.91
(StormTrap Area + Minimum Cover + 8 Inch Pad)							
Overdig Excavation	1,585	C.Y.	@	$9.00	Per	C.Y.	$14,262.19
(Overdig is 1:1 Slope per OSHA Standard)							
Install Units	72	Pieces	@	$125.00	Per	Piece	$9,000.00
(Crane + Labor Costs for Setting Units)							
CONCRETE PAD (S.F.)	9,164	S.F.	@	$8.50	Per	S.F.	$77,894.05
(Forming + Labor + Rebar + Finishing)							
Backfill	956	C.Y.	@	$30.00	Per	C.Y.	$28,671.36
(Filling Overdig w/ 3/4" Stone, to Top of Roof Slab)							
SUB-TOTAL FOR INSTALLATION							**$167,548.51**
TOTAL OPINION OF COST FOR MATERIAL AND INSTALLATION							**$329,499.51**

Please feel free to call me if you have any questions.

Sincerely,

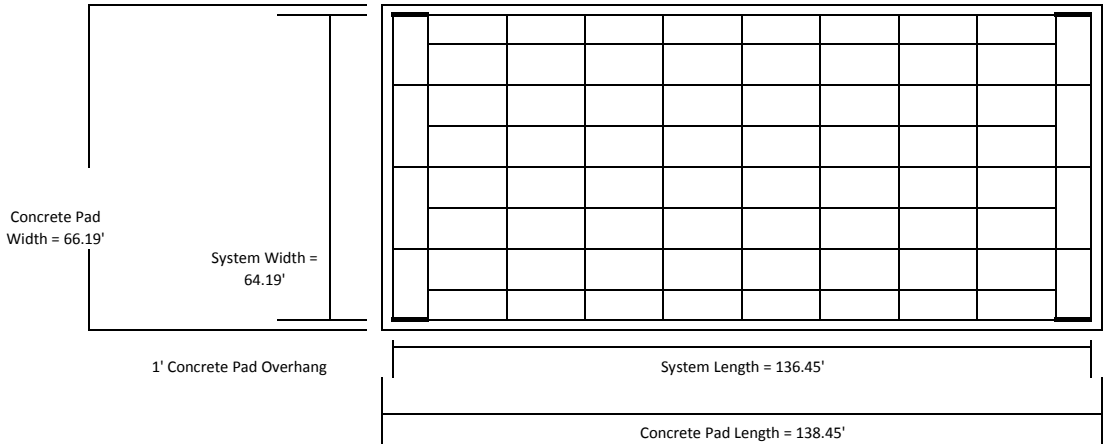
Matt Kamenick

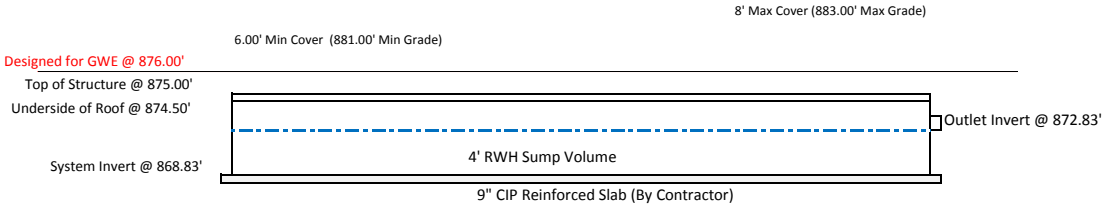
Territory Manager - WI & MN
StormTrap, LLC.
310-210-0029
mkamenick@stormtrap.com

Carpenter Park StormTrap Management Facility

StormTrap Preliminary Footprint
5/24/2016

5'-8" SingleTrap set on 8" CIP Slab



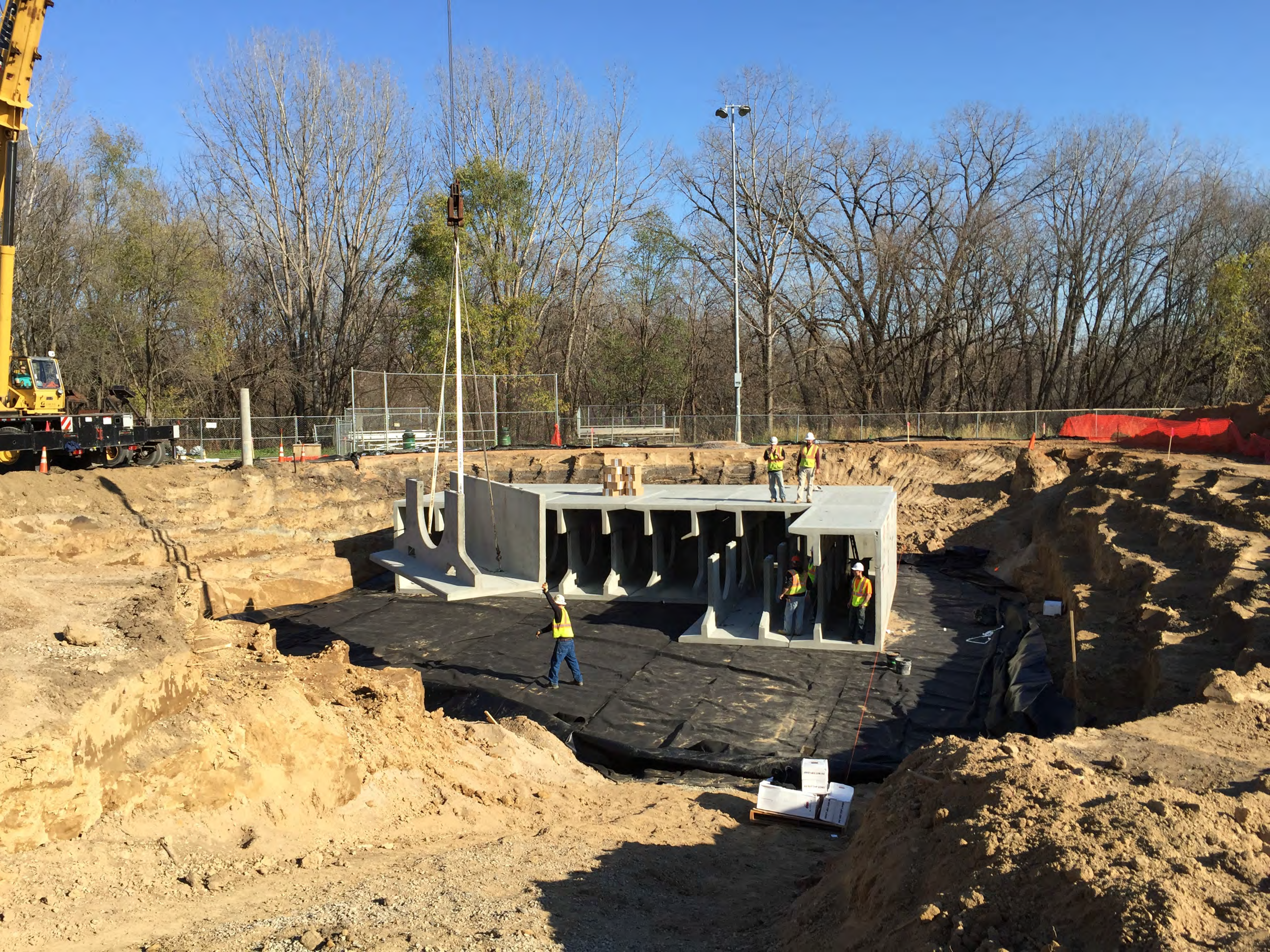


DATA: **TOTAL STORAGE VOLUME = 45,495 C.F.**

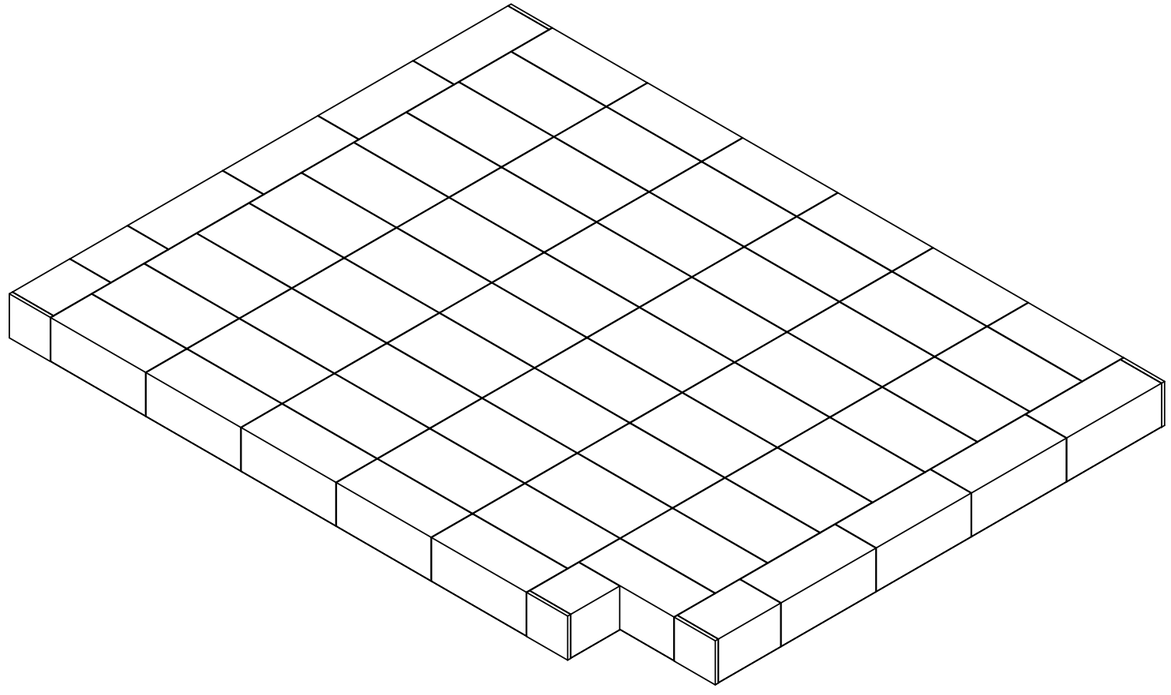
5'-8" SingleTrap = 72 Pieces Total + 8 End Panels

HS-20 Design Loading

4'-0" RWH Volume = 32,800 CF



PRECAST CONCRETE MODULAR STORMWATER MANAGEMENT SYSTEM



STORMTRAP USA - SINGLETRAP

ANYWHERE,USA

PRECAST CONCRETE MODULAR STORMWATER MANAGEMENT SYSTEMS
THIS STORMTRAP DESIGN MAY BE COVERED BY 1 OR MORE OF THE FOLLOWING U.S. PATENTS: NO. 6,991,402 B2, 7,160,058 B2, 7,344,335 B2 C.A. PATENT NO. 2,45,609

2495 WEST BUNGALOW ROAD
MORRIS, IL 60450
P: 815-941-4663
F: 815-416-1100

ENGINEER INFORMATION:

ENGINEERS USA

ANYWHERE, USA
PHONE:
FAX:

PROJECT INFORMATION:

STORMTRAP USA - SINGLETRAP

ANYWHERE, USA.

DESIGN ASSUMPTIONS

COVER:	MIN: 1.08' - MAX: 6.00'
GROUND WATER TABLE:	BELOW THE SYSTEMS INVERT
SOIL PRESSURE:	3000 PSF
LOADING:	AASHTO HS-20 HIGHWAY LOADING

SHEET INDEX

JOB SITE INFORMATION

DESCRIPTION

JOB NAME:	STORMTRAP USA - SINGLETRAP
ENGINEERING COMPANY:	ENGINEERS USA
CONTACT NAME:	
CONTACT PHONE:	
CONTACT FAX:	
STORM TRAP SUPPLIER:	STORMTRAP
CONTACT NAME:	~
CELL PHONE:	~
SALES EMAIL:	~
WATER STORAGE REQ'D:	43,560.00 CUBIC FEET
WATER STORAGE PROV:	43,962.61 CUBIC FEET
UNIT HEADROOM:	5'-8" SINGLETRAP
UNIT QUANTITY:	71 TOTAL PIECES

CURRENT ISSUED DATE:

01-MAY-2014

APPROVED BY:

PRELIMINARY

REV.:	DATE:	DESC.	DWG.
1	01-MAY-2014	ISSUED FOR PRELIMINARY	~

SCALE:

NTS

SHEET TITLE:

COVER SHEET

SHEET NUMBER:

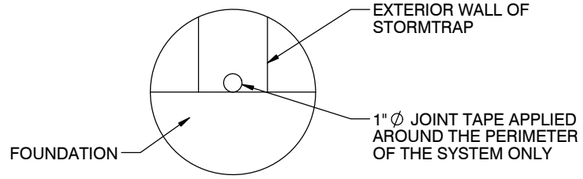
0.0

STORMTRAP INSTALLATION SPECIFICATION

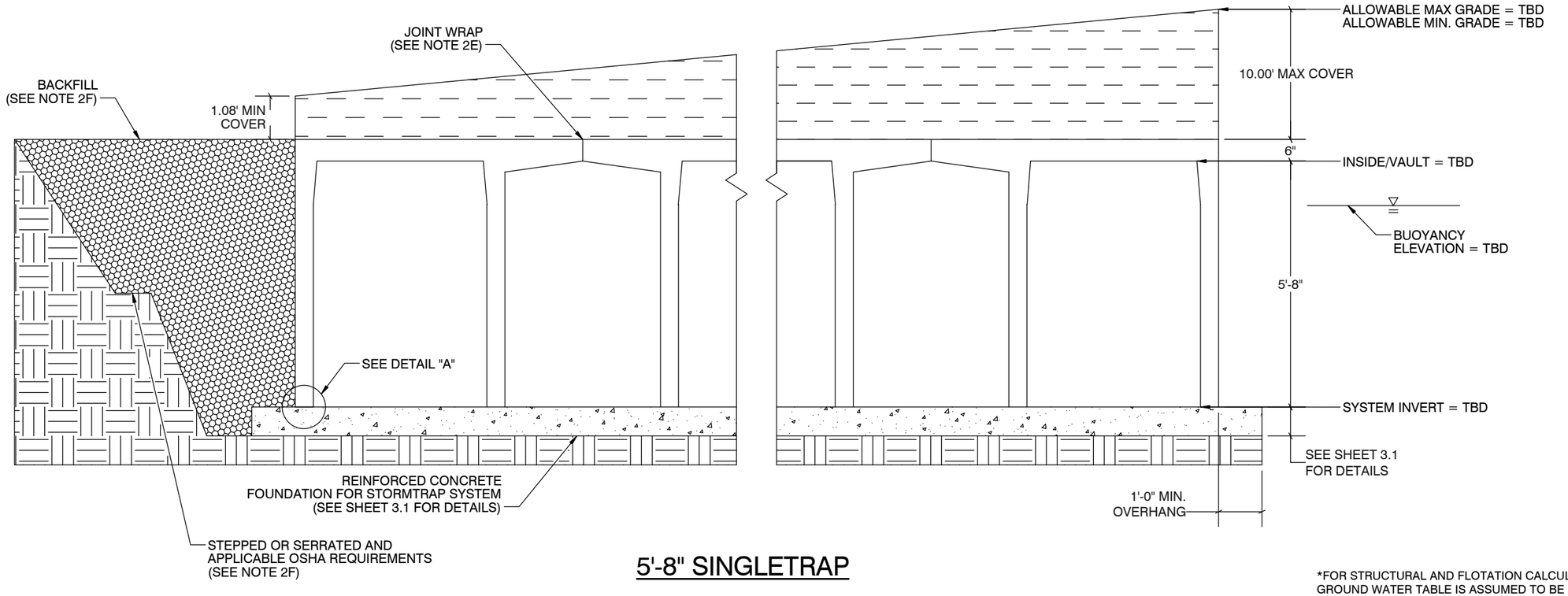
1. STORMTRAP MODULES SHALL BE MANUFACTURED ACCORDING TO SHOP DRAWINGS APPROVED BY THE INSTALLING CONTRACTOR AND ENGINEER. THE SHOP DRAWINGS SHALL INDICATE SIZE AND LOCATION OF ROOF OPENINGS AND INLET/ OUTLET PIPE OPENINGS.
2. STORMTRAP SHALL BE INSTALLED IN ACCORDANCE WITH ASTM C891-09, STANDARD PRACTICE FOR INSTALLATION OF UNDERGROUND PRECAST CONCRETE UTILITY STRUCTURES. THE FOLLOWING ADDITIONS AND/OR EXCEPTIONS SHALL APPLY:
   - A. SPECIFICATIONS ON THE ENGINEER'S DRAWINGS SHALL TAKE PRECEDENCE.
   - B. STORMTRAP MODULES SHALL BE PLACED ON LEVEL FOUNDATION (SEE SHEET 3.1) WITH A 1'-0" OVERHANG ON ALL SIDES THAT SHALL BE POURED IN PLACE BY INSTALLING CONTRACTOR.
   - C. THE STORMTRAP MODULES SHALL BE PLACED SUCH THAT THE MAXIMUM SPACE BETWEEN ADJACENT MODULES DOES NOT EXCEED 3/4". IF THE SPACE EXCEEDS 3/4", THE MODULES SHALL BE RESET WITH APPROPRIATE ADJUSTMENT MADE TO LINE AND GRADE TO BRING THE SPACE INTO SPECIFICATION.
   - D. THE PERIMETER HORIZONTAL JOINT OF THE STORMTRAP MODULES SHALL BE SEALED TO THE FOUNDATION WITH PREFORMED MASTIC JOINT SEALER ACCORDING TO ASTM C891-09, 8.8 AND 8.12. SEE DETAIL "A".
   - E. ALL EXTERIOR JOINTS BETWEEN ADJACENT STORMTRAP MODULES SHALL BE SEALED WITH PRE-FORMED, COLD-APPLIED, SELF-ADHERING ELASTOMERIC RESIN BONDED TO A WOVEN HIGHLY PUNCTURE RESISTANT POLYMER WRAP CONFORMING TO ASTM C891-09 AND SHALL BE 0'-8" INTEGRATED PRIMER SEALANT AS APPROVED BY STORMTRAP. THE ADHESIVE EXTERIOR JOINT WRAP SHALL BE INSTALLED ACCORDING TO THE FOLLOWING INSTALLATION INSTRUCTIONS:
     1. USE A BRUSH OR WET CLOTH TO THOROUGHLY CLEAN THE OUTSIDE SURFACE AT THE POINT WHERE THE JOINT WRAP IS TO BE APPLIED.
     2. A RELEASE PAPER PROTECTS THE ADHESIVE SIDE OF THE JOINT WRAP. PLACE THE ADHESIVE TAPE (BUTYL SIDE DOWN) AROUND THE STRUCTURE, REMOVING THE RELEASE PAPER AS YOU GO. PRESS THE JOINT WRAP FIRMLY AGAINST THE STORMTRAP MODULE SURFACE WHEN APPLYING.
   - F. THE FILL PLACED AROUND THE STORMTRAP UNITS MUST BE DEPOSITED ON BOTH SIDES AT THE SAME TIME AND TO APPROXIMATELY THE SAME ELEVATION. AT NO TIME SHALL THE FILL BEHIND ONE SIDE WALL BE MORE THAN 2'-0" HIGHER THAN THE FILL ON THE OPPOSITE SIDE. BACKFILL SHALL BE COMPACTED TO 95% STANDARD PROCTOR DENSITY OR OTHERWISE SPECIFIED BY ENGINEER. CARE SHALL BE TAKEN TO PREVENT ANY WEDGING ACTION AGAINST THE STRUCTURE, AND ALL SLOPES BOUNDING OR WITHIN THE AREA TO BE BACKFILLED MUST BE STEPPED OR SERRATED TO PREVENT WEDGE ACTION. (REFERENCE ARTICLE 502.10 I.D.O.T. S.S.R.B.C.) CARE SHALL ALSO BE TAKEN AS NOT TO DISRUPT THE JOINT WRAP FROM THE JOINT DURING THE BACKFILL PROCESS. BACKFILL MATERIAL SHALL BE CLEAN, CRUSHED, ANGULAR No.5 (AASHTO M43) AGGREGATE.

STORMTRAP SPECIFICATION

1. TOTAL COVER: MIN. 1.08' MAX. 10.00' CONSULT STORMTRAP FOR ADDITIONAL COVER OPTIONS.
2. CONCRETE CHAMBER DESIGNED FOR AASHTO HS-20 HIGHWAY LOADING. MIN. SOIL PRESSURE 3000 PSF.
3. ALL DIMENSIONS AND SOIL CONDITIONS, INCLUDING BUT NOT LIMITED TO GROUNDWATER AND SOIL BEARING CAPACITY ARE TO BE VERIFIED IN THE FIELD BY OTHERS PRIOR TO STORMTRAP INSTALLATION.
4. FOR STRUCTURAL CALCULATIONS THE GROUND WATER TABLE IS ASSUMED TO BE BELOW THE SYSTEMS INVERT. IF WATER TABLE IS DIFFERENT THAN ASSUMED, CONTACT STORMTRAP.
5. FOR STRUCTURAL CALCULATIONS THE SOIL DENSITY IS ASSUMED TO BE 120 PCF.
6. FOR FLOTATION CALCULATIONS THE GROUND WATER TABLE IS ASSUMED TO BE BELOW THE SYSTEMS INVERT. IF WATER TABLE IS DIFFERENT THAN ASSUMED, CONTACT STORMTRAP.
7. STORMTRAP IS NOT WATERTIGHT. CONTACT STORMTRAP FOR WATERTIGHT OPTIONS. WATERTIGHT APPLICATION TO BE PROVIDED BY OTHERS.



DETAIL "A"
JOINT TAPE INSTALLATION



5'-8" SINGLETRAP

*FOR STRUCTURAL AND FLOTATION CALCULATIONS THE GROUND WATER TABLE IS ASSUMED TO BE BELOW THE SYSTEMS INVERT. IF WATER TABLE IS DIFFERENT THAN ASSUMED, CONTACT STORMTRAP.

STORMTRAP
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2495 WEST BUNGALOW ROAD
MORRIS, IL 60450
P: 815-941-4663
F: 815-416-1100

ENGINEER INFORMATION:

ENGINEERS USA

ANYWHERE, USA
PHONE:
FAX:

PROJECT INFORMATION:

STORMTRAP USA - SINGLETRAP

ANYWHERE, USA.

CURRENT ISSUED DATE:

01-MAY-2014

APPROVED BY:

PRELIMINARY

REV.:	DATE:	DESC.	DWG.
1	01-MAY-2014	ISSUED FOR PRELIMINARY	~

SCALE:

NTS

SHEET TITLE:

SINGLETRAP INSTALLATION SPECIFICATIONS

SHEET NUMBER:

1.0

RECOMMENDED
ACCESS OPENING SPECIFICATION

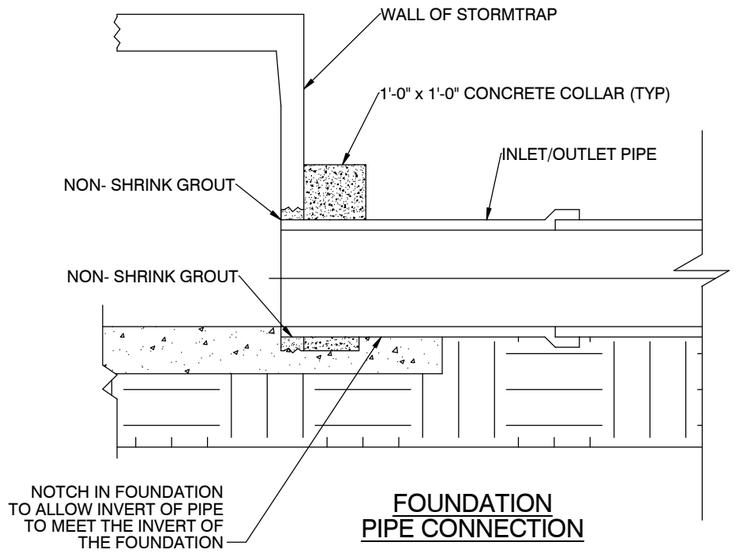
1. TYPICAL ACCESS OPENINGS FOR THE STORMTRAP SYSTEM ARE 2'-0" IN DIAMETER. ACCESS OPENINGS LARGER THAN 2'-0" IN DIAMETER NEED TO BE APPROVED BY STORMTRAP. ALL OPENINGS MUST RETAIN AT LEAST 1'-0" OF CLEARANCE IN ALL DIRECTIONS FROM THE EDGE OF THE STORMTRAP UNITS.
2. PLASTIC COATED STEEL STEPS PRODUCED BY M.A. INDUSTRIES PART #PS3-PFC (SEE DETAIL TO THE RIGHT) ARE PROVIDED INSIDE ANY UNIT WHERE DEEMED NECESSARY. THE HIGHEST STEP IN THE UNIT IS TO BE PLACED A DISTANCE OF 1'-0" FROM THE INSIDE EDGE OF THE STORMTRAP UNITS. ALL ENSUING STEPS SHALL BE PLACED WITH A MAXIMUM DISTANCE OF 1'-4" BETWEEN THEM. STEPS MAY BE MOVED OR ALTERED TO AVOID OPENINGS OR OTHER IRREGULARITIES IN THE UNIT.
3. STORMTRAP LIFTING INSERTS MAY BE RELOCATED TO COINCIDE WITH THE ACCESS OPENING OR THE CENTER OF GRAVITY OF THE UNIT AS NEEDED.
4. STORMTRAP ACCESS OPENINGS MAY BE RELOCATED TO AVOID INTERFERENCE WITH INLET AND/OR OUTLET PIPE OPENINGS SO PLACEMENT OF STEPS IS ATTAINABLE.
5. ACCESS OPENINGS SHOULD BE LOCATED IN ORDER MEET THE APPROPRIATE MUNICIPAL REQUIREMENTS. STORMTRAP RECOMMENDS AT LEAST ONE ACCESS OPENING PER SYSTEM FOR ACCESS AND INSPECTION.
6. USE PRECAST ADJUSTING RINGS AS NEEDED TO MEET GRADE. STORMTRAP RECOMMENDS FOR COVER OVER 2' TO USE PRECAST BARREL OR CONE SECTIONS. (BY OTHERS)

RECOMMENDED
PIPE OPENING SPECIFICATION

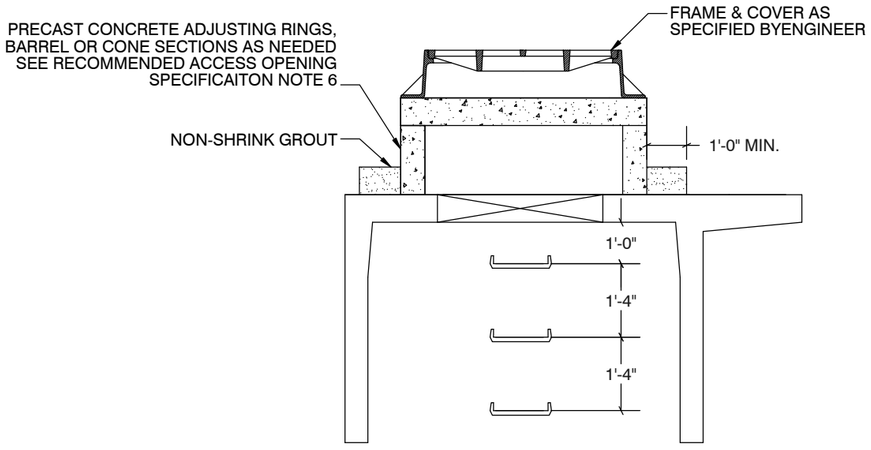
1. PIPE OPENINGS SHALL MAINTAIN A MINIMUM 1'-0" OF CLEARANCE FROM A VERTICAL EDGE OF THE STORMTRAP UNIT.
2. MAXIMUM OPENING SIZE TO BE DETERMINED BY UNIT HEIGHT. PREFERRED OPENING SIZE ∅36" OR LESS. ANY OPENING NEEDED THAT DOES NOT FIT THIS CRITERIA SHALL BE BROUGHT TO THE ATTENTION OF STORMTRAP FOR REVIEW.
3. CONNECTING PIPES SHALL BE INSTALLED WITH A 1'-0" CONCRETE COLLAR, AND A AGGREGATE CRADLE FOR AT LEAST ONE PIPE LENGTH, AS SHOWN. A STRUCTURAL GRADE CONCRETE OR GROUT WITH A MINIMUM 28 DAY COMPRESSIVE STRENGTH OF 3000 PSI SHALL BE USED.
4. THE ANNULAR SPACE BETWEEN THE PIPE AND THE HOLE SHALL BE FILLED WITH NON-SHRINK GROUT.

RECOMMENDED PIPE
INSTALLATION INSTRUCTIONS

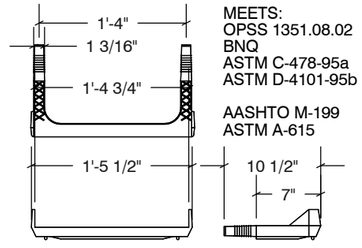
1. CLEAN AND LIGHTLY LUBRICATE ALL OF PIPE TO BE INSERTED INTO STORMTRAP.
2. IF PIPE IS CUT, CARE SHOULD BE TAKEN TO ALLOW NO SHARP EDGES. BEVEL AND LUBRICATE LEAD END OF PIPE.
3. ALIGN CENTER OF PIPE TO CORRECT ELEVATION AND INSERT INTO OPENING.



FOUNDATION
PIPE CONNECTION



RISER / STAIR DETAIL



STAIR DETAIL

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CA. PATENT NO. 2,45,609
2495 WEST BUNGALOW ROAD
MORRIS, IL 60450
P: 815-941-4663
F: 815-416-1100

ENGINEER INFORMATION:

ENGINEERS USA

ANYWHERE, USA
PHONE:
FAX:

PROJECT INFORMATION:

STORMTRAP USA - SINGLETRAP

ANYWHERE, USA.

CURRENT ISSUED DATE:

01-MAY-2014

APPROVED BY:

PRELIMINARY

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SCALE:

NTS

SHEET TITLE:

RECOMMENDED SINGLETRAP INSTALLATION SPECIFICATIONS

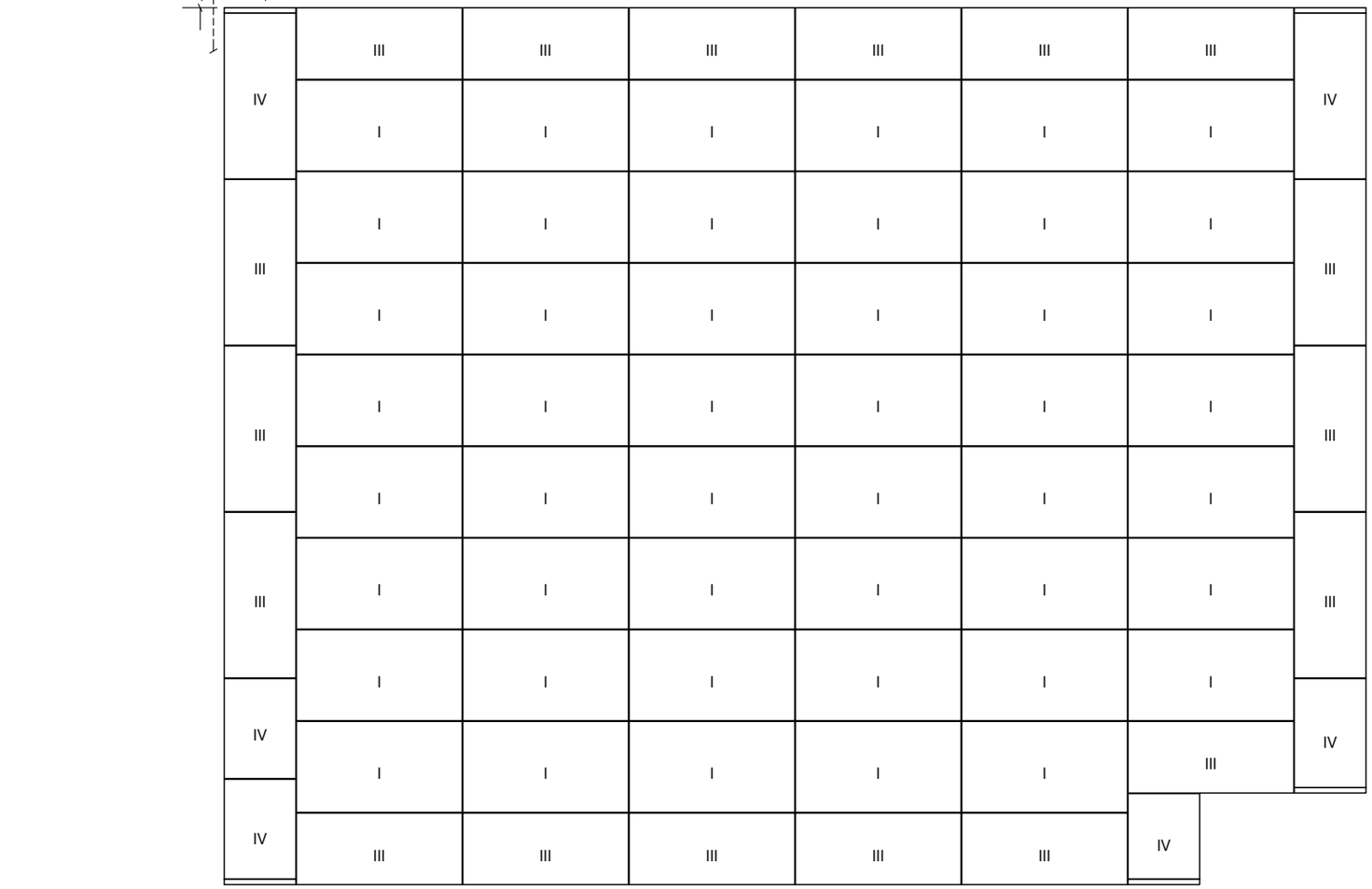
SHEET NUMBER:

2.0

BILL OF MATERIALS

QTY.	UNIT TYPE	DESCRIPTION	WEIGHT
47	I	5'-8" SINGLETRAP	15900
0	II	5'-8" SINGLETRAP	18762
18	III	5'-8" SINGLETRAP	16254
2	IV	5'-8" SINGLETRAP	17685
0	VII	5'-8" SINGLETRAP	16601
4	SPIV	5'-8" SINGLETRAP	VARIES
5	PANEL	6" THICK WALL PANELS	3066#
13	JOINTWRAP	150' PER ROLL	
29	JOINTTAPE	14.5' PER ROLL	

FOUNDATION DETAILS
SEE SHEET 1.0



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SCALE:

NTS

SHEET TITLE:

DETAIL LAYOUT

SHEET NUMBER:

3.0

DESIGN CRITERIA

ALLOWABLE MAX GRADE = TBD
ALLOWABLE MIN GRADE = TBD
INSIDE HEIGHT ELEVATION = TBD
SYSTEM INVERT = TBD
STORMTRAP VOLUME = 43,962.61 C.F. / A.F.

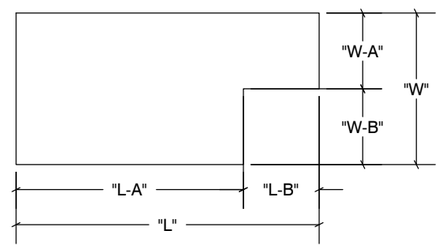
NOTES:

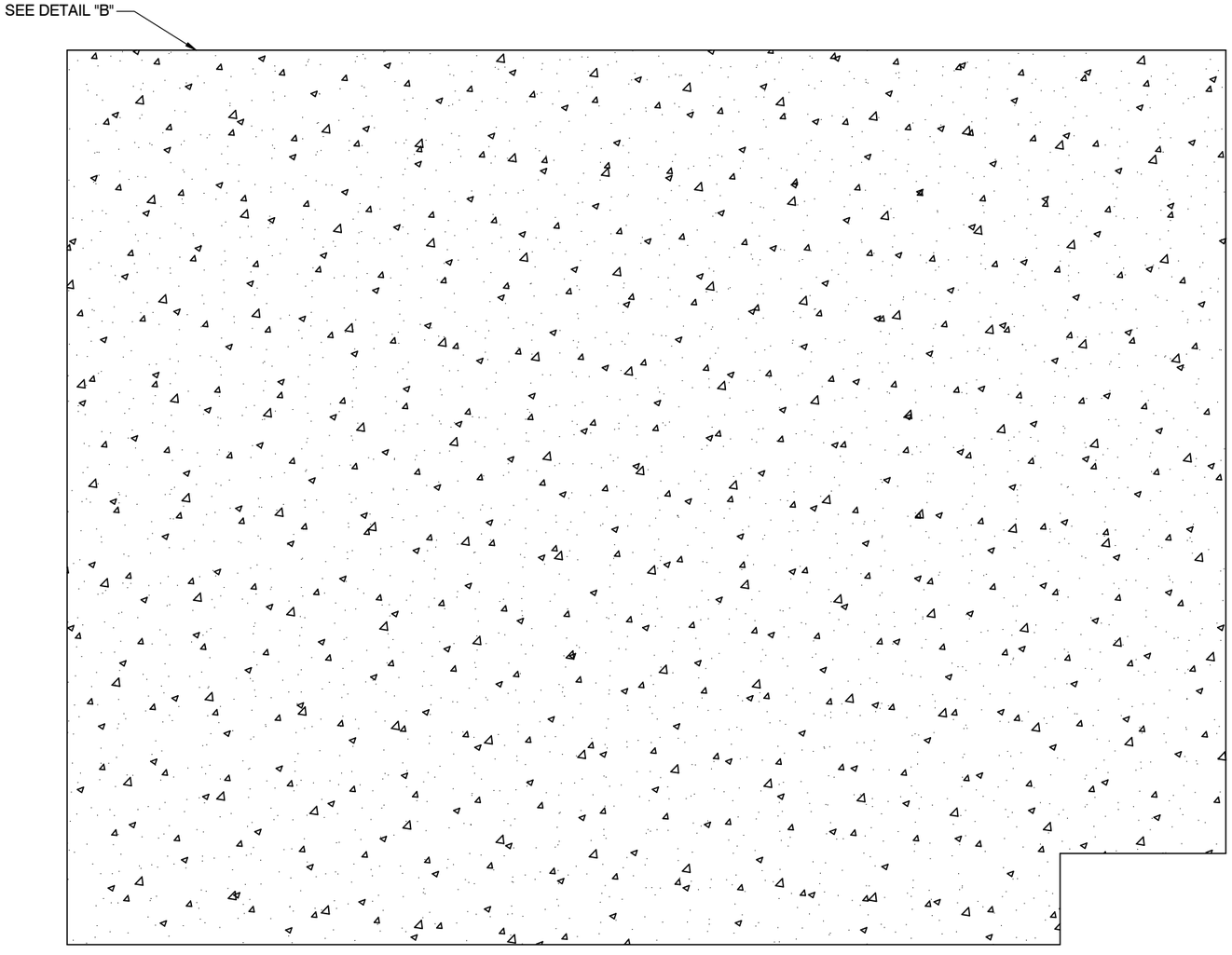
1. DIMENSION OF STORMTRAP SYSTEM ALLOW FOR A 3/4" GAP BETWEEN EACH UNIT.
2. ALL DIMENSIONS TO BE VERIFIED IN THE FIELD BY OTHERS.
3. SEE SHEET 2 FOR INSTALLATION SPECIFICATIONS.
4. SP - INDICATES A UNIT WITH MODIFICATIONS.
5. P - INDICATES A UNIT WITH A PANEL ATTACHMENT

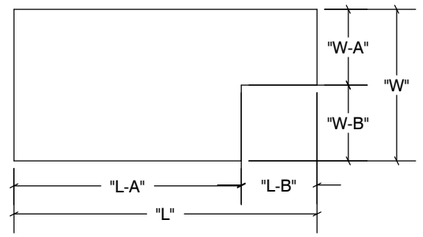
DETAIL LAYOUT

SYSTEM DIMENSIONS

L= 105 FT - 8.25 IN
W = 81 FT - 1.75 IN
L-A = 90 FT - 3.5 IN
L-B = 15 FT - 4.75 IN
W-A = 72 FT - 8 IN
W-B = 8 FT - 5.75 IN







FOUNDATION DIMENSIONS

L= 107 FT - 8.25 IN

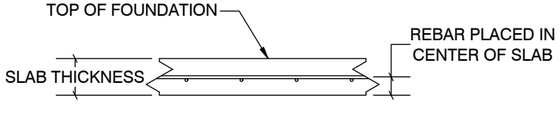
W = 83 FT - 1.75 IN

L-A = 92 FT - 3.5 IN

L-B = 15 FT - 4.75 IN

W-A = 74 FT - 8 IN

W-B = 8 FT - 5.75 IN



DETAIL "B"

STORM TRAP FOUNDATION

NOTES:

1. CONCRETE STRENGTH @ 28 DAYS, 5%-8% ENTRAINED AIR, 4" MAX. SLUMP.
2. NET ALLOWABLE SOIL PRESSURE GREATER THAN OR EQUAL TO 3000 PSF.
3. SOIL CONDITIONS TO BE VERIFIED ON SITE BY OTHERS.
4. 1'-0" OVERHANG AROUND OUTSIDE OF SYSTEM.
5. REBAR: ASTM A-615 GRADE 60. BLACK BAR.
6. DIMENSION OF FOUNDATION MUST HAVE 1'-0" OVERHANG BEYOND EXTERNAL FACE OF UNITS.
7. DIMENSION OF STORMTRAP SYSTEM ALLOW FOR A 3/4" GAP BETWEEN EACH UNIT.
8. ALL DIMENSIONS TO BE VERIFIED IN THE FIELD BY OTHERS.
9. SEE SHEET 2 FOR INSTALLATION SPECIFICATIONS.
10. THE CONTROL JOINTS CAN BE 16'-0" TO 24'-0" MAX APART.

CONCRETE FOUNDATION PLAN

MAXIMUM SYSTEM COVER	SLAB THICKNESS	CONCRETE STRENGTH	REINFORCEMENT (BOTH DIRECTIONS)
6" - 1'-0"	8"	4000 psi	#4 @ 18" o.c.
1'-1" - 2'-0"	8"	4000 psi	#4 @ 16" o.c.
2'-1" - 3'-0"	8"	4000 psi	#4 @ 12" o.c.
3'-1" - 4'-0"	8"	4000 psi	#4 @ 12" o.c.
4'-1" - 5'-0"	8"	4000 psi	#5 @ 18" o.c.
5'-1" - 6'-0"	8"	4000 psi	#5 @ 16" o.c.
6'-1" - 7'-0"	8"	4000 psi	#5 @ 16" o.c.
7'-1" - 8'-0"	9"	4000 psi	#5 @ 12" o.c.
8'-1" - 9'-0"	10"	4000 psi	#5 @ 12" o.c.
9'-1" - 10'-0"	10"	4500 psi	#5 @ 12" o.c.

STORMTRAP
PRECAST CONCRETE MODULAR STORMWATER MANAGEMENT SYSTEMS
THIS STORMTRAP DESIGN MAY BE COVERED BY 1 OR MORE OF THE FOLLOWING U.S. PATENTS: NO. 6,991,402 B2, 7,160,058 B2, 7,344,335 B2
C.A. PATENT NO. 2,45,609
2495 WEST BUNGALOW ROAD
MORRIS, IL 60450
P: 815-941-4663
F: 815-416-1100

ENGINEER INFORMATION:

ENGINEERS USA

ANYWHERE, USA
PHONE:
FAX:

PROJECT INFORMATION:

STORMTRAP USA - SINGLETRAP

ANYWHERE, USA.

CURRENT ISSUED DATE:

01-MAY-2014

APPROVED BY:

PRELIMINARY

REV.:	DATE:	DESC.	DWG.
1	01-MAY-2014	ISSUED FOR PRELIMINARY	~

SCALE:

NTS

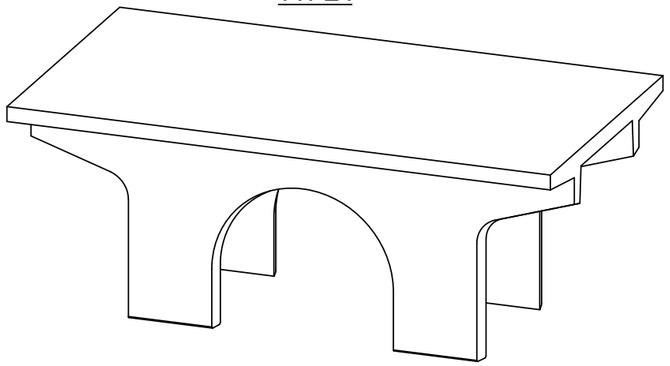
SHEET TITLE:

CONCRETE FOUNDATION DETAIL

SHEET NUMBER:

3.1

TYPE I



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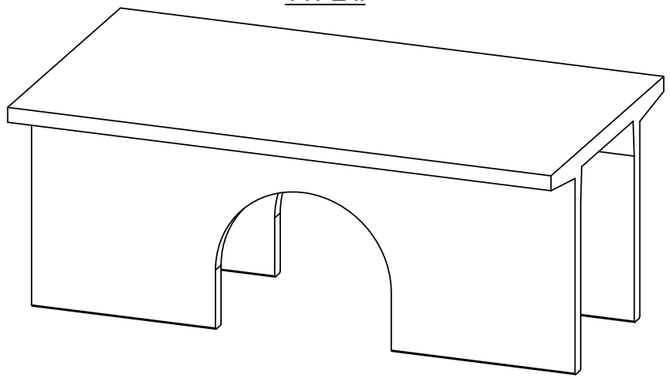

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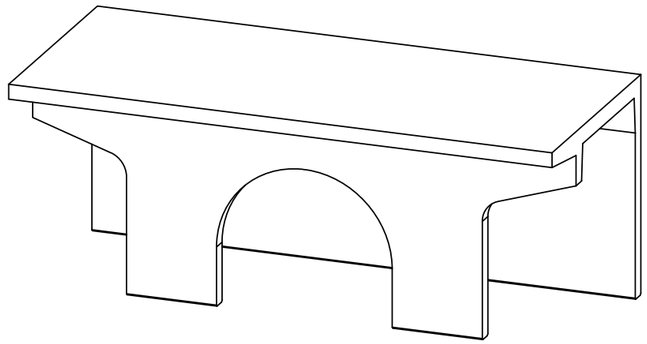

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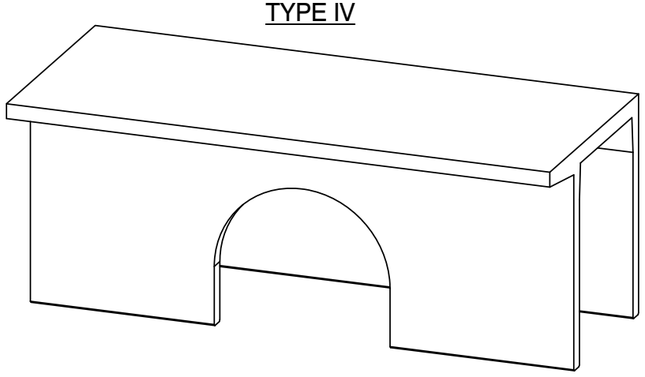

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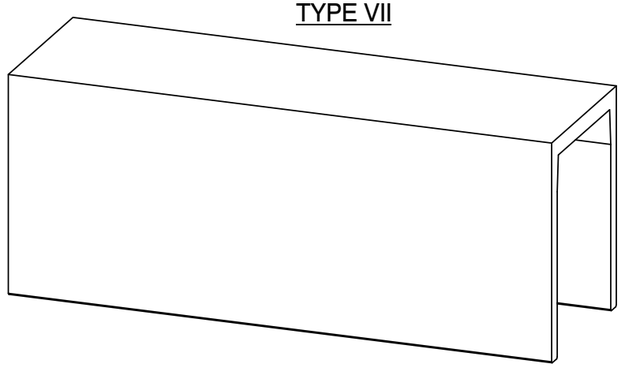

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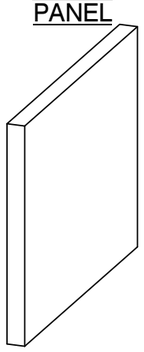

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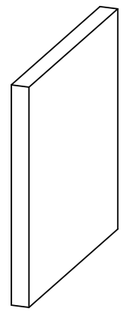
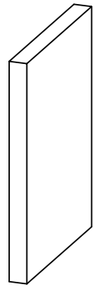


TYPE VII PANEL



NOTES:

1. OPENING LOCATIONS VARY ON UNIT HEIGHT AND LENGTHS.
2. SP - INDICATES A UNIT WITH MODIFICATIONS.
3. P - INDICATES A UNIT WITH A PANEL ATTACHMENT
4. POCKET WINDOW OPENINGS ARE OPTIONAL

STORMTRAP

PRECAST CONCRETE MODULAR STORMWATER MANAGEMENT SYSTEMS
THIS STORMTRAP DESIGN MAY BE COVERED BY 1 OR MORE OF THE FOLLOWING U.S. PATENTS: NO. 6,991,402 B2, 7,160,058 B2, 7,344,335 B2 CA. PATENT NO. 2,45,609

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REV.:	DATE:	DESC.	DWG.
1	01-MAY-2014	ISSUED FOR PRELIMINARY	~

SCALE:

NTS

SHEET TITLE:

5'-8" SINGLETRAP UNIT TYPES

SHEET NUMBER:

4.0

Size and Cost Estimate

Prepared by Craig Fairbaugh on September 12, 2016

Carpenter Park – St. Louis Park – Stormwater Treatment System

Minneapolis, MN

Information provided:

- Stormfilter Inflow = 0.25 cfs
- Influent TSS = 1989.2 lb/yr
- Influent TP = 15.3 lb/yr
- TP removal required = 10-12 lb/yr (65-78% removal)

Assumptions:

- Media = PhosphoSorb
- Cartridge Size = 27 in.
- Per Cartridge flow rate = 11.3 gpm
- Specific flow rate = 1.0 gpm/ft^2
- Drop required from inlet to outlet = 3.05' minimum
- Estimated TSS removal = 54.0 lbs/cartridge/yr
- Estimated phosphorus removal efficiency = 67%[1]

[1] Total phosphorus removal for 16 events with influent TP concentrations in the range of 0.1 to 0.5 mg/L averaged 75 percent. A bootstrap estimate of the lower 95 percent confidence limit (LCL95) of the mean total phosphorus reduction was 67 percent (see attached GULD approval).

Size and cost estimates:

The StormFilter is a flow-based system, and therefore, is sized by calculating the peak water quality flow rate associated with the design storm. However, when the StormFilter is placed downstream of detention the flow rate generated at the water quality storm is not always representative of the total volume of water that will go through the system or type of pollutant-loading the system may experience in one year.

Based on the information provided, Contech Engineered Solutions LLC recommends using an 8' x 16' StormFilter Vault with (30) 27" PhosphoSorb cartridges (see attached standard detail). The estimated cost of this system is **$103,200**, complete and delivered to the job site. This estimate assumes the rim to outlet elevation is approximately 8.75'. The final system cost will depend on the actual depth of the unit and whether additional costs are required (access hatch, grated inlets, etc.).

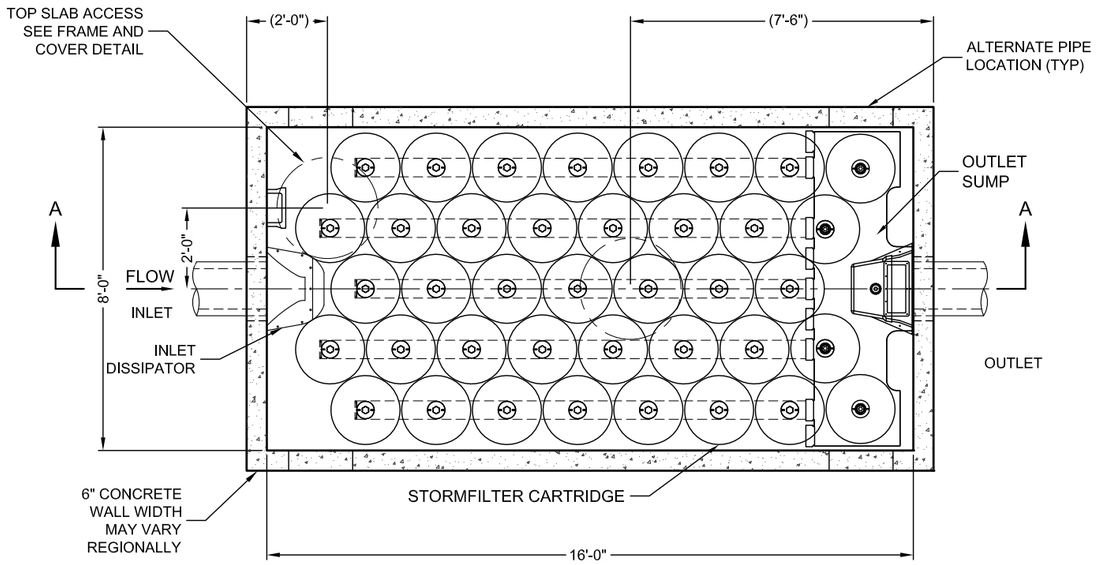
The contractor is responsible for setting the StormFilter system and all external plumbing.

Please contact your local Contech representative for any further questions.

Regards,

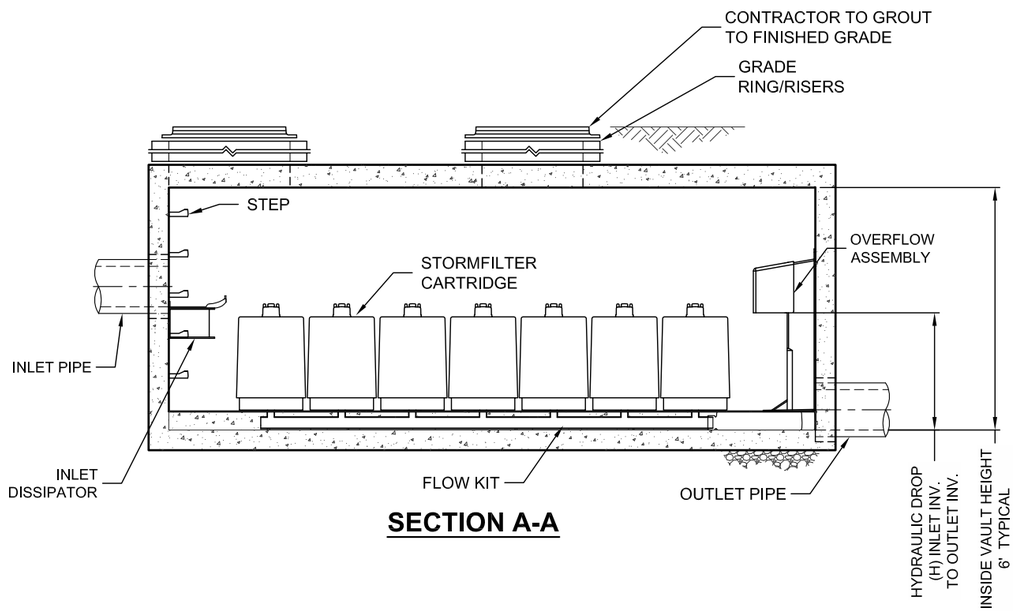
Craig Fairbaugh
Stormwater Design Engineer

Contech Engineered Solutions LLC
Off: 503-258-3140 Fax: 800-561-1271
CFairbaugh@conteches.com
www.ContechES.com



PLAN VIEW

VAULT STYLE: OUTLET SUMP (NIB)



SECTION A-A

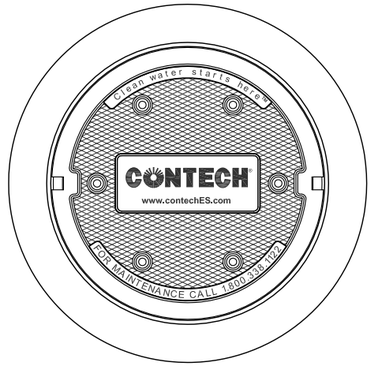
STORMFILTER DESIGN NOTES

STORMFILTER TREATMENT CAPACITY IS A FUNCTION OF THE CARTRIDGE SELECTION AND THE NUMBER OF CARTRIDGES. THE STANDARD VAULT STYLE IS SHOWN WITH THE MAXIMUM NUMBER OF CARTRIDGES (39). VAULT STYLE OPTIONS INCLUDE INLET BAY (32), INLET BAY/OUTLET BAY (27), OUTLET BAY (34), INLET BAY/FULL HEIGHT BAFFLE (23), FULL HEIGHT BAFFLE WALL (30). STORMFILTER 8X16 PEAK HYDRAULIC CAPACITY IS 1.8 CFS. IF THE SITE CONDITIONS EXCEED 1.8 CFS AN UPSTREAM BYPASS STRUCTURE IS REQUIRED.

CARTRIDGE SELECTION

CARTRIDGE HEIGHT	27"			18"			LOW DROP		
RECOMMENDED HYDRAULIC DROP (H)	3.05'			2.3'			1.8'		
SPECIFIC FLOW RATE (gpm/sf)	2 gpm/sf	1.67* gpm/sf	1 gpm/sf	2 gpm/sf	1.67* gpm/sf	1 gpm/sf	2 gpm/sf	1.67* gpm/sf	1 gpm/sf
CARTRIDGE FLOW RATE (gpm)	22.5	18.79	11.25	15	12.53	7.5	10	8.35	5

* 1.67 gpm/sf SPECIFIC FLOW RATE IS APPROVED WITH PHOSPHOSORB ® (PSORB) MEDIA ONLY



FRAME AND COVER

(DIAMETER VARIES)
N.T.S.

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID	*
WATER QUALITY FLOW RATE (cfs)	*
PEAK FLOW RATE (cfs)	*
RETURN PERIOD OF PEAK FLOW (yrs)	*
CARTRIDGE HEIGHT (27", 18", LOW DROP(LD))	*
NUMBER OF CARTRIDGES REQUIRED	*
CARTRIDGE FLOW RATE	*
MEDIA TYPE (PERLITE, ZPG, PSORB)	*

PIPE DATA:	I.E.	MATERIAL	DIAMETER
INLET PIPE #1	*	*	*
INLET PIPE #2	*	*	*
OUTLET PIPE	*	*	*

UPSTREAM RIM ELEVATION	*
DOWNSTREAM RIM ELEVATION	*

ANTI-FLOTATION BALLAST	WIDTH	HEIGHT
	*	*

NOTES/SPECIAL REQUIREMENTS:

* PER ENGINEER OF RECORD

GENERAL NOTES

1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. DIMENSIONS MARKED WITH ( ) ARE REFERENCE DIMENSIONS. ACTUAL DIMENSIONS MAY VARY.
3. FOR SITE SPECIFIC DRAWINGS WITH DETAILED VAULT DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.ContechES.com
4. STORMFILTER WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
5. STRUCTURE SHALL MEET AASHTO HS20 LOAD RATING, ASSUMING EARTH COVER OF 0' - 5' AND GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION. CASTINGS SHALL MEET AASHTO M306 AND BE CAST WITH THE CONTECH LOGO.
6. FILTER CARTRIDGES SHALL BE MEDIA-FILLED, PASSIVE, SIPHON ACTUATED, RADIAL FLOW, AND SELF CLEANING. RADIAL MEDIA DEPTH SHALL BE 7-INCHES. FILTER MEDIA CONTACT TIME SHALL BE AT LEAST 38 SECONDS.
7. SPECIFIC FLOW RATE IS EQUAL TO THE FILTER TREATMENT CAPACITY (gpm) DIVIDED BY THE FILTER CONTACT SURFACE AREA (sq ft).
8. STORMFILTER STRUCTURE SHALL BE PRECAST CONFORMING TO ASTM C-857 AND AASHTO LOAD FACTOR DESIGN METHOD.

INSTALLATION NOTES

A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE STORMFILTER VAULT (LIFTING CLUTCHES PROVIDED).
C. CONTRACTOR TO INSTALL JOINT SEALANT BETWEEN ALL VAULT SECTIONS AND ASSEMBLE VAULT.
D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT PIPES. MATCH OUTLET PIPE INVERT WITH OUTLET BAY FLOOR.
E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT CARTRIDGES FROM CONSTRUCTION-RELATED EROSION RUNOFF.

CONTECH® ENGINEERED SOLUTIONS LLC
www.contechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

SF0816 STORMFILTER STANDARD DETAIL

WASHINGTON STATE DEPARTMENT OF ECOLOGY

November 2015

GENERAL USE LEVEL DESIGNATION FOR BASIC (TSS) AND PHOSPHORUS TREATMENT
For
CONTECH Engineered Solutions
Stormwater Management StormFilter®
with PhosphoSorb® media

Ecology's Decision:

1. **Based on Contech Engineered Solutions application, Ecology hereby issues the following use level designation for the Stormwater Management StormFilter® using PhosphoSorb® media cartridges:**

   - **General Use Level Designation (GULD) for Basic Treatment (total suspended solids) and for Phosphorus (total phosphorus) treatment.**
     - **Sized at a hydraulic loading rate of no greater than 1.67 gallon per minute (gpm) per square foot (sq ft.) of media surface, per Table 1.**
     - **Using Contech's PhosphoSorb media. Specifications for the media shall match the specifications provided by the manufacturer and approved by Ecology.**

   Table 1. StormFilter cartridge design flow rates for 18-inch diameter cartridges with PhosphoSorb media operating at 1.67 gpm/sq ft.

Effective cartridge height (in)	Cartridge flow rate (gpm/cartridge)
12	8.35
18	12.53
27	18.79

2. **Ecology approves StormFilter systems containing PhosphoSorb media for treatment at the cartridge flow rate shown in Table 1, to achieve the maximum water quality design flow rate. Calculate the water quality design flow rates using the following procedures:**
    - **Western Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using the latest version of the Western Washington Hydrology Model or other Ecology-approved continuous runoff model.**
    - **Eastern Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using one of the three methods described in Chapter 2.2.5 of the Stormwater Management Manual for Eastern Washington (SWMMEW) or local manual.**
    - **Entire State: For treatment installed downstream of detention, the water quality design flow rate is the full 2-year release rate of the detention facility.**
3. **The GULD designation has no expiration date but it may be amended or revoked by Ecology and is subject to the conditions specified below.**

Ecology's Conditions of Use:

StormFilter systems containing PhosphoSorb media shall comply with these conditions:

1. **Design, assemble, install, operate, and maintain StormFilter systems containing PhosphoSorb media in accordance with applicable Contech Engineered Solutions manuals, documents, and the Ecology Decision.**
2. **Use sediment loading capacity, in conjunction with the water quality design flow rate, to determine the target maintenance interval.**
3. **Owners shall install StormFilter systems in such a manner that bypass flows exceeding the water quality treatment rate or flows through the system will not re-suspend captured sediments.**
4. **Pretreatment of TSS and oil and grease may be necessary, and designers shall provide pre-treatment in accordance with the most current versions of the CONTECH *Product Design Manual* or the applicable Ecology Stormwater Manual. Design pre-treatment using the performance criteria and pretreatment practices provided in the Stormwater Management Manual for Western Washington (SWMMWW), the Stormwater Management Manual for Eastern Washington (SWMMEW), or on Ecology's "Evaluation of Emerging Stormwater Treatment Technologies" website.**
5. **Maintenance: The required maintenance interval for stormwater treatment devices is often dependent upon the degree of pollutant loading from a particular drainage basin. Therefore, Ecology does not endorse or recommend a "one size fits all" maintenance cycle for a particular model/size of manufactured filter treatment device.**
    - **Typically, CONTECH designs StormFilter systems for a target filter media replacement interval of 12 months. Maintenance includes removing accumulated sediment from the vault, and replacing spent cartridges with recharged cartridges.**

- **Indications of the need for maintenance include the effluent flow decreasing to below the design flow rate, as indicated by the scumline above the shoulder of the cartridge.**
- **Owners/operators must inspect StormFilter with PhosphoSorb media for a minimum of twelve months from the start of post-construction operation to determine site-specific maintenance schedules and requirements. You must conduct inspections monthly during the wet season, and every other month during the dry season. (According to the *SWMMWW,* the wet season in western Washington is October 1 to April 30. According to *SWMMEW,* the wet season in eastern Washington is October 1 to June 30). After the first year of operation, owners/operators must conduct inspections based on the findings during the first year of inspections.**
- **Conduct inspections by qualified personnel, follow manufacturer's guidelines, and use methods capable of determining either a decrease in treated effluent flowrate and/or a decrease in pollutant removal ability.**
- **When inspections are performed, the following findings typically serve as maintenance triggers:**
    - **Accumulated vault sediment depths exceed an average of 2 inches, or**
    - **Accumulated sediment depths on the tops of the cartridges exceed an average of 0.5 inches, or**
    - **Standing water remains in the vault between rain events, or**
    - **Bypass during storms smaller than the design storm.**
- **Note: If excessive floatables (trash and debris) are present, perform a minor maintenance consisting of gross solids removal, not cartridge replacement.**

6. **Discharges from the StormFilter systems containing PhosphoSorb media shall not cause or contribute to water quality standards violations in receiving waters.**

Applicant:	CONTECH Engineered Solutions
Applicant's Address:	11835 NE Glenn Widing Dr. Portland, OR 97220

Application Documents:

- The Stormwater Management StormFilter, PhosphoSorb at a Specific Flow Rate of 1.67 gpm/ft^2, Conditional Use Level Designation Application. August 2012.
- Quality Assurance Project Plan The Stormwater Management StormFilter® PhosphoSorb® at a Specific Flow Rate of 1.67 gpm/ft^2 Performance Evaluation. August 2012.
- The Stormwater Management StormFilter® PhosphoSorb® at a Specific Flow Rate of 1.67 gpm/ft^2, General Use Level Designation, Technical Evaluation Report. October 2015.

Applicant's Use Level Request:

- General use level designation as a basic (TSS) and phosphorus (total phosphorus) treatment device in accordance with Table 2 of Ecology's 2011 *Technical Guidance Manual for Evaluating Emerging Stormwater Treatment Technologies Technology Assessment Protocol – Ecology (TAPE)*.

Applicant's Performance Claims:

Based on results from laboratory and field-testing, the applicant claims:

- The Stormwater Management StormFilter® with PhosphoSorb® media operating at 1.67 gpm/ft^2 is able to remove 80% of Total Suspended Solids (TSS) for influent concentrations greater than 100 mg/L, is able to remove greater than 80% TSS for influent concentrations greater than 200 mg/L, and achieve a 20 mg/L effluent for influent concentrations less than 100 mg/L.
- The StormFilter with PhosphoSorb media is able to remove 50% or greater total phosphorus for influent concentrations between 0.1 to 0.5 mg/L.

Recommendations:

Ecology finds that:

- CONTECH Engineered Solutions has shown Ecology, through laboratory and field testing, that the Stormwater Management StormFilter® with PhosphoSorb® media is capable of attaining Ecology's Basic and Total Phosphorus treatment goals.

Findings of Fact:

Laboratory testing

- A Phosphosorb StormFilter cartridge test unit, operating at 28 L/min (equivalent to 1.0 gpm/ sq. ft.), and subject to SSC with a silt loam texture (25% sand, 65% silt, and 10% clay by mass) originating from SCS 106 provides a mean SSC removal efficiency of 88%;
- A Phosphosorb StormFilter cartridge test unit, operating at 56 L/min (equivalent to 2.0 gpm/sq. ft.), and subject to SSC with a silt loam texture (25% sand, 65% silt, and 10% clay by mass) originating from SCS 106 provides a mean turbidity reduction of 82%;

- Laboratory testing of PhosphoSorb media in a Horizontal Flow Column (HFC; a 1/24th scale of a full cartridge) resulted in 50 percent dissolved phosphorus removal for the first 1,000 bed volumes. Granular activated carbon (GAC) tested under the same conditions resulted in 30 percent removal of dissolved phosphorus.

Field testing

- Contech conducted monitoring of a StormFilter® with PhosphoSorb® media at a site along Lolo Pass Road in Zigzag, Oregon between February 2012 and February 2015. The manufacturer collected flow-weighted influent and effluent composite samples during 17 separate storm events. The system treated approximately 96 percent of the flows recorded during the monitoring period. The applicant sized the system at 1.67 gpm/sq. ft.
    - Influent TSS concentrations for qualifying sampled storm events ranged from 40 to 780 mg/L. For influent concentrations less than 100 mg/L (n=2) the effluent concentration was less than 10 mg/L. For influent concentrations greater than 100 mg/L the bootstrap estimate of the lower 95 percent confidence limit (LCL95) of the mean TSS reduction was 85%.

      Total phosphorus removal for 16 events with influent TP concentrations in the range of 0.1 to 0.5 mg/L averaged 75 percent. A bootstrap estimate of the lower 95 percent confidence limit (LCL95) of the mean total phosphorus reduction was 67 percent.

Other StormFilter system with PhosphoSorb media items the Company should address:

1. Conduct testing to obtain information about maintenance requirements in order to come up with a maintenance cycle.
2. Conduct loading tests on the filter to determine maximum treatment life of the system.

Technology Description: Download at: http://www.conteches.com/Products/Stormwater-Management/Treatment/Stormwater-Management-StormFilter®.aspx

Contact Information:

Applicant: Sean Darcy
Contech Engineered Solutions
11815 NE Glenn Widing Drive
Portland, OR, 97220
503-258-3105
sdarcy@conteches.com

Applicant website: www.conteches.com

Ecology web link: http://www.ecy.wa.gov/programs/wq/stormwater/newtech/index.html

Ecology: Douglas C. Howie, P.E.
Department of Ecology
Water Quality Program
(360) 407-6444
douglas.howie@ecy.wa.gov

Revision History

Date	Revision
December 2012	Original use-level-designation document: CULD for basic and phosphorus treatment.
January 2013	Revised document to match standard formatting
August 2014	Revised TER and expiration dates
November 2015	Approved GULD designation for Basic and Phosphorus treatment

CONTECH®
ENGINEERED SOLUTIONS

StormFilter Inspection and Maintenance Procedures

The Stormwater Management StormFilter®

Maintenance Guidelines

The primary purpose of the Stormwater Management StormFilter® is to filter and prevent pollutants from entering our waterways. Like any effective filtration system, periodically these pollutants must be removed to restore the StormFilter to its full efficiency and effectiveness.

Maintenance requirements and frequency are dependent on the pollutant load characteristics of each site. Maintenance activities may be required in the event of a chemical spill or due to excessive sediment loading from site erosion or extreme storms. It is a good practice to inspect the system after major storm events.

Maintenance Procedures

Although there are many effective maintenance options, we believe the following procedure to be efficient, using common equipment and existing maintenance protocols. The following two-step procedure is recommended::

1. **Inspection**
   - Inspection of the vault interior to determine the need for maintenance.
2. **Maintenance**
   - Cartridge replacement
   - Sediment removal

Inspection and Maintenance Timing

At least one scheduled inspection should take place per year with maintenance following as warranted.

First, an inspection should be done before the winter season. During the inspection the need for maintenance should be determined and, if disposal during maintenance will be required, samples of the accumulated sediments and media should be obtained.

Second, if warranted, a maintenance (replacement of the filter cartridges and removal of accumulated sediments) should be performed during periods of dry weather.

In addition to these two activities, it is important to check the condition of the StormFilter unit after major storms for potential damage caused by high flows and for high sediment accumulation that may be caused by localized erosion in the drainage area. It may be necessary to adjust the inspection/ maintenance schedule depending on the actual operating conditions encountered by the system. In general, inspection activities can be conducted at any time, and maintenance should occur, if warranted, during dryer months in late summer to early fall.

Maintenance Frequency

The primary factor for determining frequency of maintenance for the StormFilter is sediment loading.

A properly functioning system will remove solids from water by trapping particulates in the porous structure of the filter media inside the cartridges. The flow through the system will naturally decrease as more and more particulates are trapped. Eventually the flow through the cartridges will be low enough to require replacement. It may be possible to extend the usable span of the cartridges by removing sediment from upstream trapping devices on a routine as-needed basis, in order to prevent material from being re-suspended and discharged to the StormFilter treatment system.

The average maintenance lifecycle is approximately 1-5 years. Site conditions greatly influence maintenance requirements. StormFilter units located in areas with erosion or active construction may need to be inspected and maintained more often than those with fully stabilized surface conditions.

Regulatory requirements or a chemical spill can shift maintenance timing as well. The maintenance frequency may be adjusted as additional monitoring information becomes available during the inspection program. Areas that develop known problems should be inspected more frequently than areas that demonstrate no problems, particularly after major storms. Ultimately, inspection and maintenance activities should be scheduled based on the historic records and characteristics of an individual StormFilter system or site. It is recommended that the site owner develop a database to properly manage StormFilter inspection and maintenance programs..

Inspection Procedures

The primary goal of an inspection is to assess the condition of the cartridges relative to the level of visual sediment loading as it relates to decreased treatment capacity. It may be desirable to conduct this inspection during a storm to observe the relative flow through the filter cartridges. If the submerged cartridges are severely plugged, then typically large amounts of sediments will be present and very little flow will be discharged from the drainage pipes. If this is the case, then maintenance is warranted and the cartridges need to be replaced.

Warning: In the case of a spill, the worker should abort inspection activities until the proper guidance is obtained. Notify the local hazard control agency and Contech Engineered Solutions immediately.

To conduct an inspection:

Important: Inspection should be performed by a person who is familiar with the operation and configuration of the StormFilter treatment unit.

1. If applicable, set up safety equipment to protect and notify surrounding vehicle and pedestrian traffic.
2. Visually inspect the external condition of the unit and take notes concerning defects/problems.
3. Open the access portals to the vault and allow the system vent.
4. Without entering the vault, visually inspect the inside of the unit, and note accumulations of liquids and solids.
5. Be sure to record the level of sediment build-up on the floor of the vault, in the forebay, and on top of the cartridges. If flow is occurring, note the flow of water per drainage pipe. Record all observations. Digital pictures are valuable for historical documentation.
6. Close and fasten the access portals.
7. Remove safety equipment.
8. If appropriate, make notes about the local drainage area relative to ongoing construction, erosion problems, or high loading of other materials to the system.
9. Discuss conditions that suggest maintenance and make decision as to weather or not maintenance is needed.

Maintenance Decision Tree

The need for maintenance is typically based on results of the inspection. The following Maintenance Decision Tree should be used as a general guide. (Other factors, such as Regulatory Requirements, may need to be considered)

1. Sediment loading on the vault floor.
   a. If >4" of accumulated sediment, maintenance is required.
2. Sediment loading on top of the cartridge.
   a. If >1/4" of accumulation, maintenance is required.
3. Submerged cartridges.
   a. If >4" of static water above cartridge bottom for more than 24 hours after end of rain event, maintenance is required. (Catch basins have standing water in the cartridge bay.)
4. Plugged media.
   a. If pore space between media granules is absent, maintenance is required.
5. Bypass condition.
   a. If inspection is conducted during an average rain fall event and StormFilter remains in bypass condition (water over the internal outlet baffle wall or submerged cartridges), maintenance is required.
6. Hazardous material release.
   a. If hazardous material release (automotive fluids or other) is reported, maintenance is required.
7. Pronounced scum line.
   a. If pronounced scum line (say ≥ 1/4" thick) is present above top cap, maintenance is required.

Maintenance

Depending on the configuration of the particular system, maintenance personnel will be required to enter the vault to perform the maintenance.

Important: If vault entry is required, OSHA rules for confined space entry must be followed.

Filter cartridge replacement should occur during dry weather. It may be necessary to plug the filter inlet pipe if base flows is occurring.

Replacement cartridges can be delivered to the site or customers facility. Information concerning how to obtain the replacement cartridges is available from Contech Engineered Solutions.

Warning: In the case of a spill, the maintenance personnel should abort maintenance activities until the proper guidance is obtained. Notify the local hazard control agency and Contech Engineered Solutions immediately.

To conduct cartridge replacement and sediment removal maintenance:

1. If applicable, set up safety equipment to protect maintenance personnel and pedestrians from site hazards.
2. Visually inspect the external condition of the unit and take notes concerning defects/problems.
3. Open the doors (access portals) to the vault and allow the system to vent.
4. Without entering the vault, give the inside of the unit, including components, a general condition inspection.
5. Make notes about the external and internal condition of the vault. Give particular attention to recording the level of sediment build-up on the floor of the vault, in the forebay, and on top of the internal components.
6. Using appropriate equipment offload the replacement cartridges (up to 150 lbs. each) and set aside.
7. Remove used cartridges from the vault using one of the following methods:

Method 1:

A. This activity will require that maintenance personnel enter the vault to remove the cartridges from the under drain manifold and place them under the vault opening for lifting (removal). Disconnect each filter cartridge from the underdrain connector by rotating counterclockwise 1/4 of a turn. Roll the loose cartridge, on edge, to a convenient spot beneath the vault access.

   Using appropriate hoisting equipment, attach a cable from the boom, crane, or tripod to the loose cartridge. Contact Contech Engineered Solutions for suggested attachment devices.

B. Remove the used cartridges (up to 250 lbs. each) from the vault.

Important: Care must be used to avoid damaging the cartridges during removal and installation. The cost of repairing components damaged during maintenance will be the responsibility of the owner.

C. Set the used cartridge aside or load onto the hauling truck.

D. Continue steps a through c until all cartridges have been removed.

Method 2:

A. This activity will require that maintenance personnel enter the vault to remove the cartridges from the under drain manifold and place them under the vault opening for lifting (removal). Disconnect each filter cartridge from the underdrain connector by rotating counterclockwise 1/4 of a turn. Roll the loose cartridge, on edge, to a convenient spot beneath the vault access.

B. Unscrew the cartridge cap.

C. Remove the cartridge hood and float.

D. At location under structure access, tip the cartridge on its side.

E. Empty the cartridge onto the vault floor. Reassemble the empty cartridge.

F. Set the empty, used cartridge aside or load onto the hauling truck.

G. Continue steps a through e until all cartridges have been removed.

8. Remove accumulated sediment from the floor of the vault and from the forebay. This can most effectively be accomplished by use of a vacuum truck.
9. Once the sediments are removed, assess the condition of the vault and the condition of the connectors.
10. Using the vacuum truck boom, crane, or tripod, lower and install the new cartridges. Once again, take care not to damage connections.
11. Close and fasten the door.
12. Remove safety equipment.
13. Finally, dispose of the accumulated materials in accordance with applicable regulations. Make arrangements to return the used **empty** cartridges to Contech Engineered Solutions.

Material Disposal

The accumulated sediment found in stormwater treatment and conveyance systems must be handled and disposed of in accordance with regulatory protocols. It is possible for sediments to contain measurable concentrations of heavy metals and organic chemicals (such as pesticides and petroleum products). Areas with the greatest potential for high pollutant loading include industrial areas and heavily traveled roads.

Sediments and water must be disposed of in accordance with all applicable waste disposal regulations. When scheduling maintenance, consideration must be made for the disposal of solid and liquid wastes. This typically requires coordination with a local landfill for solid waste disposal. For liquid waste disposal a number of options are available including a municipal vacuum truck decant facility, local waste water treatment plant or on-site treatment and discharge.

Related Maintenance Activities - Performed on an as-needed basis

StormFilter units are often just one of many structures in a more comprehensive stormwater drainage and treatment system.

In order for maintenance of the StormFilter to be successful, it is imperative that all other components be properly maintained. The maintenance/repair of upstream facilities should be carried out prior to StormFilter maintenance activities.

In addition to considering upstream facilities, it is also important to correct any problems identified in the drainage area. Drainage area concerns may include: erosion problems, heavy oil loading, and discharges of inappropriate materials.

Inspection Report

Date: Personnel:

Location: System Size:

System Type: Vault ☐ Cast-In-Place ☐ Linear Catch Basin ☐ Manhole ☐ Other ☐

Sediment Thickness in Forebay: Date:

Sediment Depth on Vault Floor:

Structural Damage:

Estimated Flow from Drainage Pipes (if available):

Cartridges Submerged: Yes ☐ No ☐ Depth of Standing Water:

StormFilter Maintenance Activities (check off if done and give description)

☐ Trash and Debris Removal:

☐ Minor Structural Repairs:

☐ Drainage Area Report

Excessive Oil Loading: Yes ☐ No ☐ Source:

Sediment Accumulation on Pavement: Yes ☐ No ☐ Source:

Erosion of Landscaped Areas: Yes ☐ No ☐ Source:

Items Needing Further Work:

Owners should contact the local public works department and inquire about how the department disposes of their street waste residuals.

Other Comments:

Review the condition reports from the previous inspection visits.

StormFilter Maintenance Report

Date: _____ Personnel: _____

Location: _____ System Size: _____

System Type: Vault ☐ Cast-In-Place ☐ Linear Catch Basin ☐ Manhole ☐ Other ☐

List Safety Procedures and Equipment Used: _____

_____

_____

System Observations

Months in Service:

Oil in Forebay (if present): Yes ☐ No ☐

Sediment Depth in Forebay (if present): _____

Sediment Depth on Vault Floor: _____

Structural Damage: _____

Drainage Area Report

Excessive Oil Loading: Yes ☐ No ☐ Source: _____

Sediment Accumulation on Pavement: Yes ☐ No ☐ Source: _____

Erosion of Landscaped Areas: Yes ☐ No ☐ Source: _____

StormFilter Cartridge Replacement Maintenance Activities

Remove Trash and Debris: Yes ☐ No ☐ Details: _____

Replace Cartridges: Yes ☐ No ☐ Details: _____

Sediment Removed: Yes ☐ No ☐ Details: _____

Quantity of Sediment Removed (estimate?):

Minor Structural Repairs: Yes ☐ No ☐ Details: _____

Residuals (debris, sediment) Disposal Methods: _____

Notes:

_____

_____

_____

_____

_____

_____

_____

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Memorandum

To: ***Phillip Elkin, PE, City of St. Louis Park***
Erick Francis, City of St. Louis Park

From: ***Katy Thompson, PE***
Bill Alms, PE

Date: ***March 13, 2017***

Re: ***Carpenter Park Water Quality Improvement - Preliminary Hydraulic Investigation for Proposed EDA and Park and Ride Developments***
WSB Project No. 03336-000

Introduction

The City of St. Louis Park has requested that WSB & Associates, Inc. (WSB) quantify the impacts of stormwater treatment for the proposed development on the Economic Development Authority (EDA) and neighboring parcels located on Highway 7 and Beltline Boulevard (**Figure 1**). The parcels will be developed in conjunction with the Southwest Light Rail Train (SWLRT). The proposed development includes a Park and Ride (PNR) parking ramp, two office buildings, and an apartment building. The two sites together are a combined 6.35 acres, based on the proposed outlined parcels, shown in **Figure 1**. Under existing conditions, the PNR site contains a building and parking lot, with a service road on the northern half. The EDA site contains an industrial building, parking lot, and sidewalks. The EDA site is 3.17 acres and the PNR site is 3.18 acres.

Deliverables

The City of St. Louis Park has requested WSB perform the following analyses:

- Review the Minnehaha Creek Watershed District (MCWD) rules and determine the proposed stormwater treatment requirements for the proposed development
- Assess the Total Suspended Solids (TSS) and Total Phosphorus (TP) annual loading generated from the parcels under existing and proposed conditions; and
- Evaluate the mitigation potential derived from the proposed Carpenter Park Water Quality Improvement Project that may be directly applied to the EDA and PNR developments.

MCWD Rules

The conditions of MCWD Stormwater Management Rule 5.(c) apply to the EDA and PNR sites and can be broken up into three categories:

1. Rate Control
2. Volume Control
3. Phosphorus Control

Rate Control
All development shall limit post-development runoff rates to the existing peak runoff rates for the 1-, 10-, and 100-year design storms, to ensure no net increase in peak runoff. At this time, it is assumed that rate control requirements will be met by utilizing underground detention on the PNR site. Rate control obtained through the Carpenter Park Water Quality Improvement Project may not be sufficient to meet the needs of the proposed development. See **Table 5** for additional available rate reduction credits.

Volume Control
Stormwater management must provide for the abstraction of the first one-inch of rainfall from the site's impervious surfaces. Neither site can accommodate infiltration practices due to high groundwater and low hydraulic capacity soils with potentially contamination. Per MCWD, when the applicant demonstrates that it is infeasible to meet the one-inch volume abstraction requirement, the stormwater management plan must provide for abstraction of runoff to the greatest extent feasible, and at least one-half-inches, and phosphorus control in an amount equivalent to that which would be achieved through abstraction of one inch of rainfall from the site's impervious surfaces. Additionally, Appendix A states that filtration volume will be credited for abstraction volume at a rate of 50%. A summary of the required volume abstraction is provided in **Table 1**.

Table 1. Proposed Volume Abstraction Requirements

	EDA Site	**PNR Site**
Total Site Area [ac]	3.17	3.18
Proposed Impervious Area [ac]	2.54	2.54
1.0-inch Volume Abstraction [ft^3]	9220	9220
Filtration Volume Abstraction Credit Requirement [ft^3]	**18,440**	**18,440**

Phosphorus Control
Redevelopment must provide equivalent phosphorus treatment to the abstraction of one-inch of rainfall falling on the impervious surfaces, summarized below in **Table 2**.

Table 2. Proposed Phosphorus Control Requirements

	EDA Site	**PNR Site**
Total Site Area [ac]	3.17	3.18
Proposed Impervious Area [ac]	2.54	2.54
1-inch Rainfall Abstraction Volume [ft^3]	9220	9220
TP Load Reduction from 1-inch Volume Abstraction [lbs]	**4.4**	**4.4**

Methodology

Peak Discharge Rates
The parcel boundaries were provided by the City and used to determine total areas for the EDA and PNR sites. At the City's direction, WSB assumed that the new proposed sites would be redeveloped with 80 percent impervious surface area, and that there would be Best Management Practices (BMPs) located on the PNR site to maintain existing discharge rates and meet the MCWD Rule requirements. The remaining 20 percent of the sites were assumed to be hydrologic soil group C soils with a curve number of 74, based on USDA NRCS soil survey data.

NOAA Atlas 14 precipitation data and the MSE 3 rainfall distribution were used to develop a HydroCAD model of the existing and proposed conditions. Given the conceptual nature of the proposed PNR and EDA developments, each site was modeled as a single catchment. For existing conditions, the impervious area was determined on recent aerial photographs; the proposed condition assumed 80 percent impervious coverage. These sites currently outlet to a 72-inch pipe that carries stormwater south, underneath the railroad tracks, and ultimately into Bass Lake.

Volume Control
MCWDs abstraction volume credit outlined in Appendix A of the stormwater management rule provides for a 50% volume abstractions credit through filtration based on the Minnesota Stormwater Manual's standard sand filter. The Carpenter Park design proposes enhanced filtration technology utilizing aluminum oxide coated media filters, which have a TP removal efficiency between 65-78%. The proposed filtration practices at Carpenter Park far exceed the MCWD volume abstraction credit assumptions. The city desires to continue to work with MCWD to obtain additional volume abstraction credits as required to meet permitting requirements for projects identified in this memo.

Total Phosphorus Loading
Due to the conceptual nature of the two developments, the MPCA Simple Method for estimating pollutant loading was used to estimate the existing and proposed total phosphorus and total suspended sediment loading from the sites, assuming the same design parameters as for rate control above.

Modeling Results

Rate Control
The HydroCAD model results are provided in **Appendix B**. Additional off-site runoff or current ponding conditions will need to be considered during the preliminary design of these sites. As required by the MCWD for redevelopment per Rule N.3.b.1, there should be no net increase in peak runoff rate for the 1-, 10-, and 100-year storms. **Table 3** demonstrates the increase in discharge rates that will need mitigated on-site.

Table 3. Existing and Proposed Peak Discharge Rates

	Total Site Area [ac]	1-Yr Peak Discharge [cfs]	10-Yr Peak Discharge [cfs]	100-Yr Peak Discharge [cfs]
EXISTING CONDITIONS				
EDA Site	3.17	3.9	10.5	23.1
PNR Site	3.18	5.6	12.8	25.7
TOTAL	6.35	9.5	23.3	48.8
PROPOSED CONDITIONS				
EDA Site	3.17	8.3	15.7	28.2
PNR Site	3.18	8.3	15.7	28.2
TOTAL	6.35	16.5	31.4	56.5

Phosphorus Control
MIDS Calculator Results are provided in **Appendix C**. The results are also summarized in **Table 4** below for total phosphorus (TP) and total suspended solid (TSS) loading.

Table 4. Estimated TP & TSS Loading [lb/yr]

	EDA SITE	PNR SITE
EXISTING CONDITIONS		
Total Site Area [ac]	3.17	3.18
Existing Impervious Percentage [%]	21.5	46.2
Existing TSS Loading [lbs/yr]	**412**	**610**
Existing TP Loading [lbs/yr]	**2.27**	**3.36**
PROPOSED CONDITIONS		
Total Site Area [ac]	3.17	3.18
Proposed Impervious Percentage [%]	80	80
Proposed TSS Loading [lbs/yr]	**878**	**881**
Proposed TP Loading [lbs/yr]	**4.8**	**4.9**

These initial estimates show increases in both total phosphorus and suspended solids of 4.1 and 1,022 pounds per year, respectively, without considering the treatment effects from any rate controls devices.

Carpenter Park Mitigation Potential

The City is proposing to develop a regional stormwater treatment facility upstream of the EDA and PNR sites in Carpenter Park. This proposed facility will provide water quality treatment for a watershed of roughly 42.2 acres that currently is untreated, via underground detention and media filtration. The project, as currently designed, has a * cubic-feet below the overflow elevation that will be pumped through media filters. Through sedimentation and filtration processes, the proposed water quality improvement project will remove up to 27.6 pounds of total phosphorus annually from the upstream watershed tributary to Bass Lake.

The proposed project provides some minimal rate control. The XPSWMM model developed by MCWD and used for evaluation of flooding at Carpenter Park was used to assess the peak discharge rates at the EDA and PNR sites. The model was only updated upstream of the Carpenter Park site. The results of the analysis, both with and without the Carpenter Park treatment facility are shown in **Table 5**.

Table 5. Impact on Discharge Rates at EDA and PNR sites from Carpenter Park Project

	1-year (cfs)	10-year (cfs)	100-year (cfs)
Existing Conditions	147.4	149.5	171.1
Proposed Carpenter Park Project	138.9	147.3	169.6
Peak Reduction	**8.5**	**2.2**	**1.5**

During final design of the EDA and PNR sites, the City should further define model up and downstream of the project to more accurately assess the rate control requirements

Conclusion

This was a preliminary investigation of the proposed redevelopment sites; therefore, assumptions and calculations will need to be confirmed during final design. It is estimated that the two sites will require a phosphorus reduction of 8.8 pounds annually. The proposed Carpenter Park Project is planned to remove up to 27.6 pounds of TP annually; leaving the City of St. Louis Park with a net phosphorus reduction of 18.8 pounds per year from the upstream watershed tributary to Bass Lake.

Rate control for the EDA and PNR sites is assumed to be met on-site. This preliminary investigation indicates some minor rate control benefits propagate downstream from the Carpenter Park stormwater facility to the EDA and PNR sites. It is suggested that further evaluation of the rate control be conducted, including refining the XPSWMM modeling at the EDA and PNR sites, to facilitate future permitting discussions with MCWD.

Table 6 below provides an accounting plan for the credits generated by the Carpenter Park Stormwater treatment facility. The proposed redevelopment of the Stake Park, EDA, and Park n Ride sites will be the only projects to utilize credits created by the regional treatment to meet MCWD regulatory requirements. All remaining treatment provided by the regional plan will provide water quality benefit to the downstream water resource, Bass Lake Preserve.

Table 6. Accounting Plan for use of credits through Carpenter Park Regional Plan

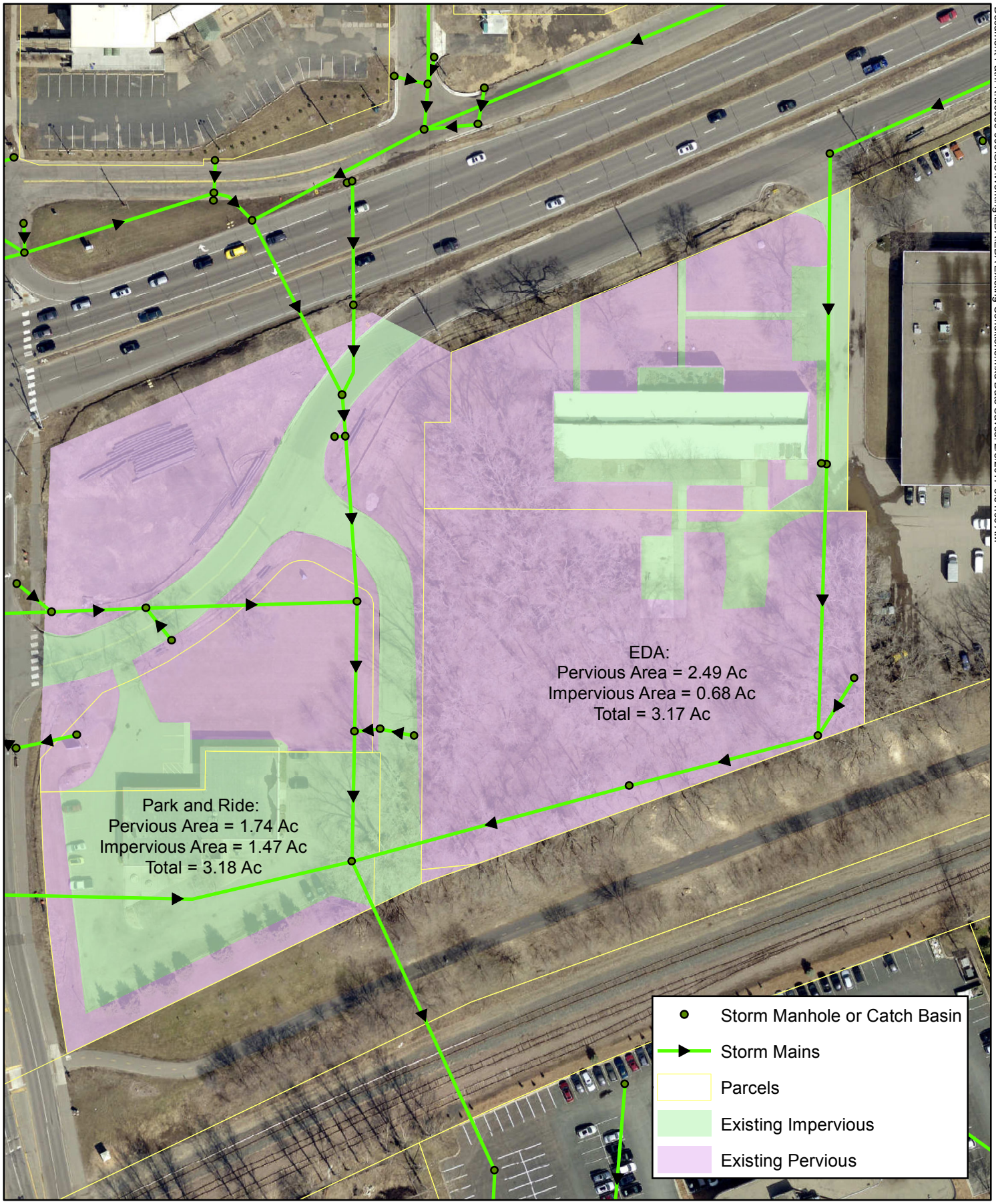
Treatment	Carpenter Park Provides	EDA Site Requires[1]	Beltline Park n Ride Requires[1]	Skateboard Park Requires[1]	Net Reduction
Abstraction Volume [cf]	18,982[2]	9,220	9,220	542	0
Rate Control (1-yr) [cfs]	8.5	4.4	2.7	0.4	1.0
Rate Control (10-yr) [cfs]	2.2	5.2	2.9	0.5	-6.4
Rate Control (100-yr) [cfs]	1.5	5.1	2.5	0.7	-6.8
Phosphorus Reduction [lbs TP/yr]	27.6	4.4	4.4	0.3	18.5

Notes:

1. Requirements are based on conceptual site layout and may be subject to change during final site design.
2. Enhanced filtration technology proposed has a TP removal efficiency between 65-78%, which would provide an abstraction volume of 27,117 cubic-feet (at 70% credit). The city desires to continue to work with MCWD to obtain additional volume abstraction credit as required to meet permitting required for projects identified in this memo.

Appendix A:

Figures



Document Path: K:\03336-000\GIS\Working\EDA\EDA Existing Conditions.mxd Date Saved: 2/8/2017 8:54:06 AM

Figure 1 - Existing Conditions

Preliminary Hydraulic Investigation for
Proposed EDA and Park and Ride Developments
City of St. Louis Park

St. Louis Park MINNESOTA

WSB

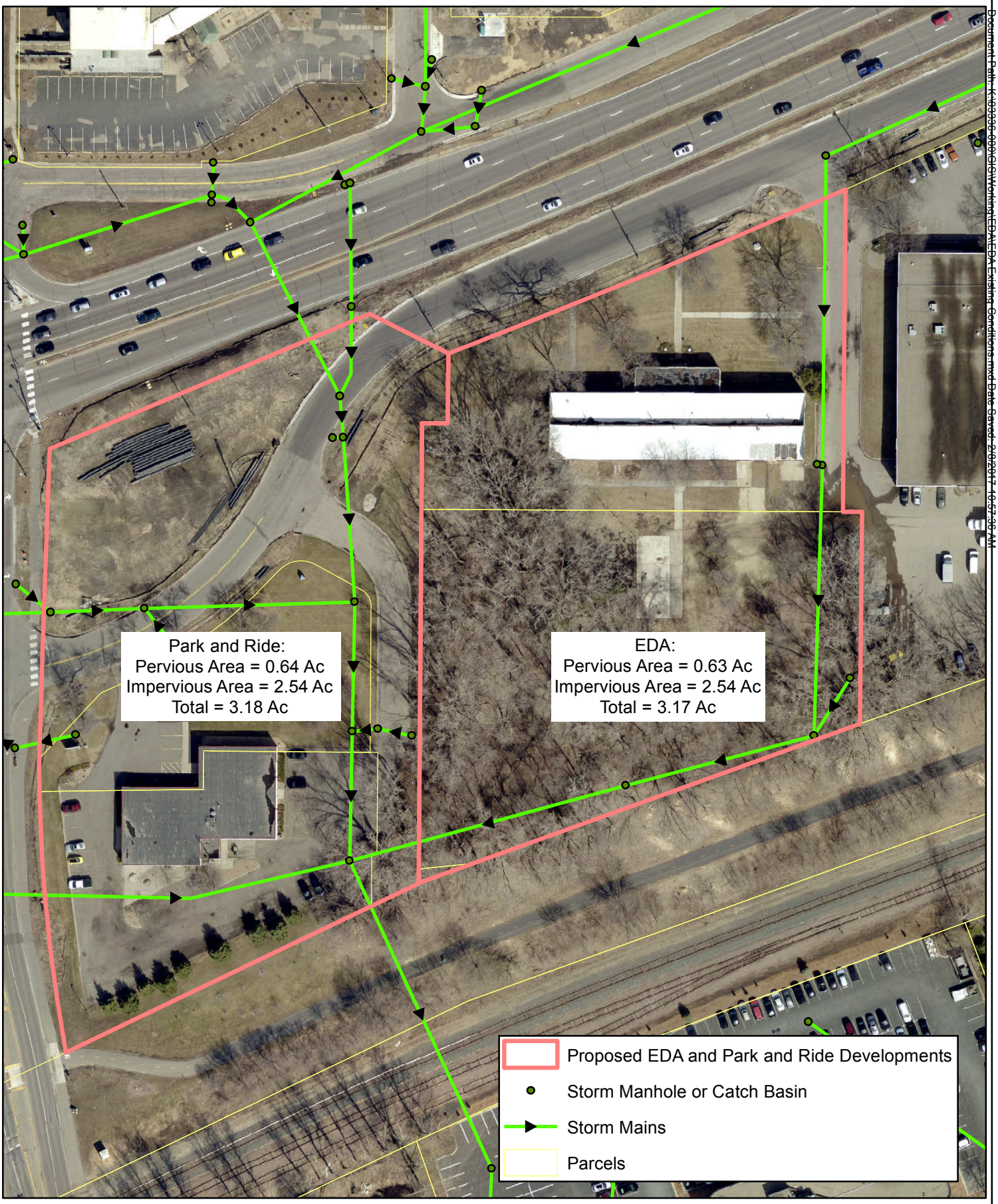


Figure 2 - Proposed Conditions
Preliminary Hydraulic Investigation for
Proposed EDA and Park and Ride Developments
City of St. Louis Park

St. Louis Park
MINNESOTA

WSB

Appendix B:

HydroCAD Report Existing and Proposed

Subcat Reach Pond Link

Routing Diagram for SLP-EDA Development Analysis 020717
Prepared by WSB & Associates, Printed 2/8/2017

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: Ex - Park and Ride Runoff Area=3.178 ac 46.16% Impervious Runoff Depth=1.16"
Tc=10.0 min CN=85 Runoff=5.61 cfs 0.308 af

Subcatchment 2S: Ex - EDA Runoff Area=3.170 ac 21.48% Impervious Runoff Depth=0.82"
Tc=10.0 min CN=79 Runoff=3.88 cfs 0.218 af

Subcatchment 3S: Prop - Park and Ride Runoff Area=3.178 ac 79.99% Impervious Runoff Depth=1.76"
Tc=10.0 min CN=93 Runoff=8.27 cfs 0.466 af

Subcatchment 4S: Prop - EDA Runoff Area=3.170 ac 80.00% Impervious Runoff Depth=1.76"
Tc=10.0 min CN=93 Runoff=8.25 cfs 0.465 af

Link 3L: Ex. Cond. Total Inflow=9.48 cfs 0.526 af
Primary=9.48 cfs 0.526 af

Link 5L: Prop. Cond. Total Inflow=16.51 cfs 0.931 af
Primary=16.51 cfs 0.931 af

Total Runoff Area = 12.696 ac Runoff Volume = 1.457 af Average Runoff Depth = 1.38"
43.08% Pervious = 5.470 ac 56.92% Impervious = 7.226 ac

Summary for Subcatchment 1S: Ex - Park and Ride

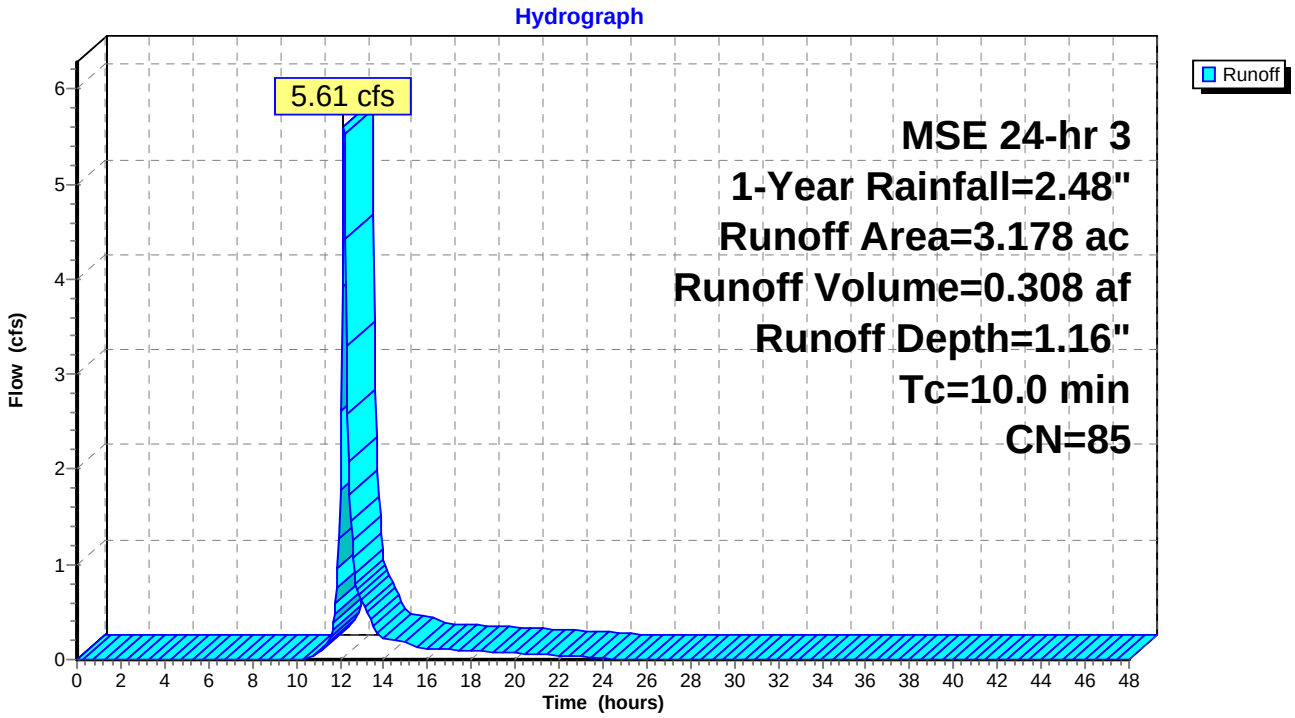
Runoff = 5.61 cfs @ 12.18 hrs, Volume= 0.308 af, Depth= 1.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 1-Year Rainfall=2.48"

Area (ac)	CN	Description
1.711	74	>75% Grass cover, Good, HSG C
1.467	98	Paved parking, HSG C
3.178	85	Weighted Average
1.711		53.84% Pervious Area
1.467		46.16% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment 1S: Ex - Park and Ride



Summary for Subcatchment 2S: Ex - EDA

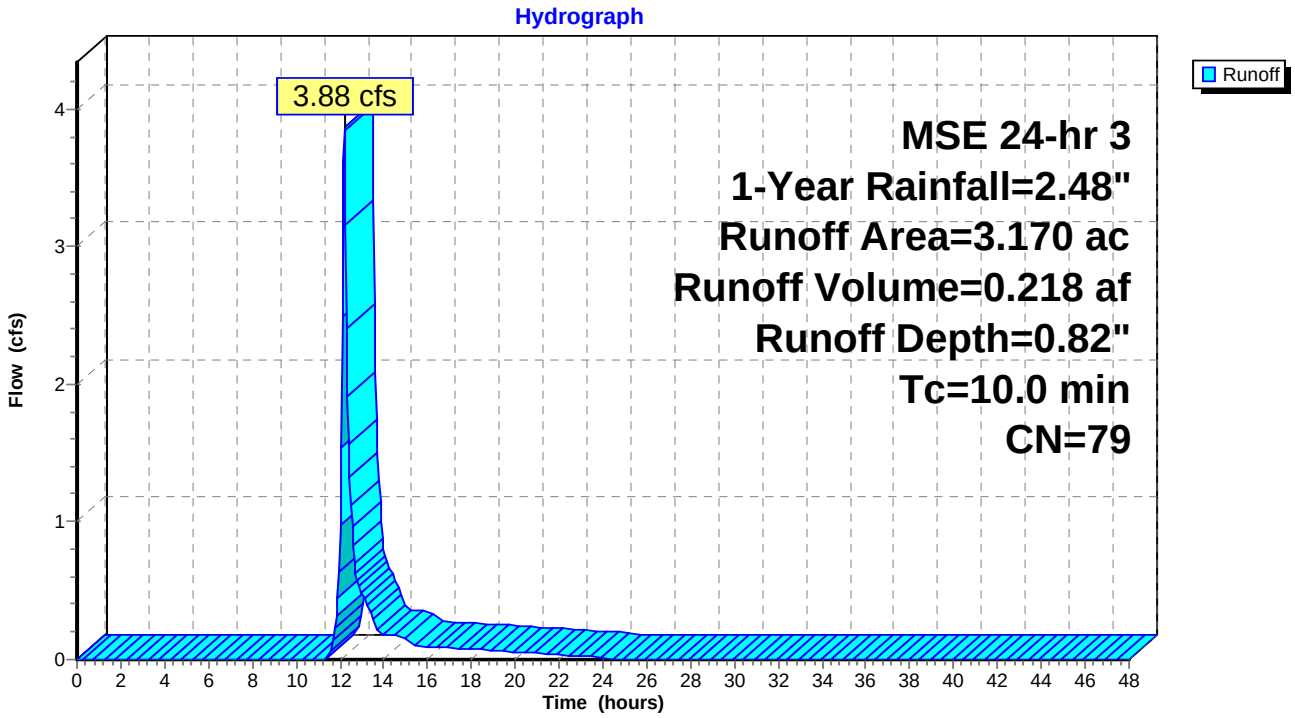
Runoff = 3.88 cfs @ 12.19 hrs, Volume= 0.218 af, Depth= 0.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 1-Year Rainfall=2.48"

Area (ac)	CN	Description
0.681	98	Paved parking, HSG C
2.489	74	>75% Grass cover, Good, HSG C
3.170	79	Weighted Average
2.489		78.52% Pervious Area
0.681		21.48% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment 2S: Ex - EDA



Summary for Subcatchment 3S: Prop - Park and Ride

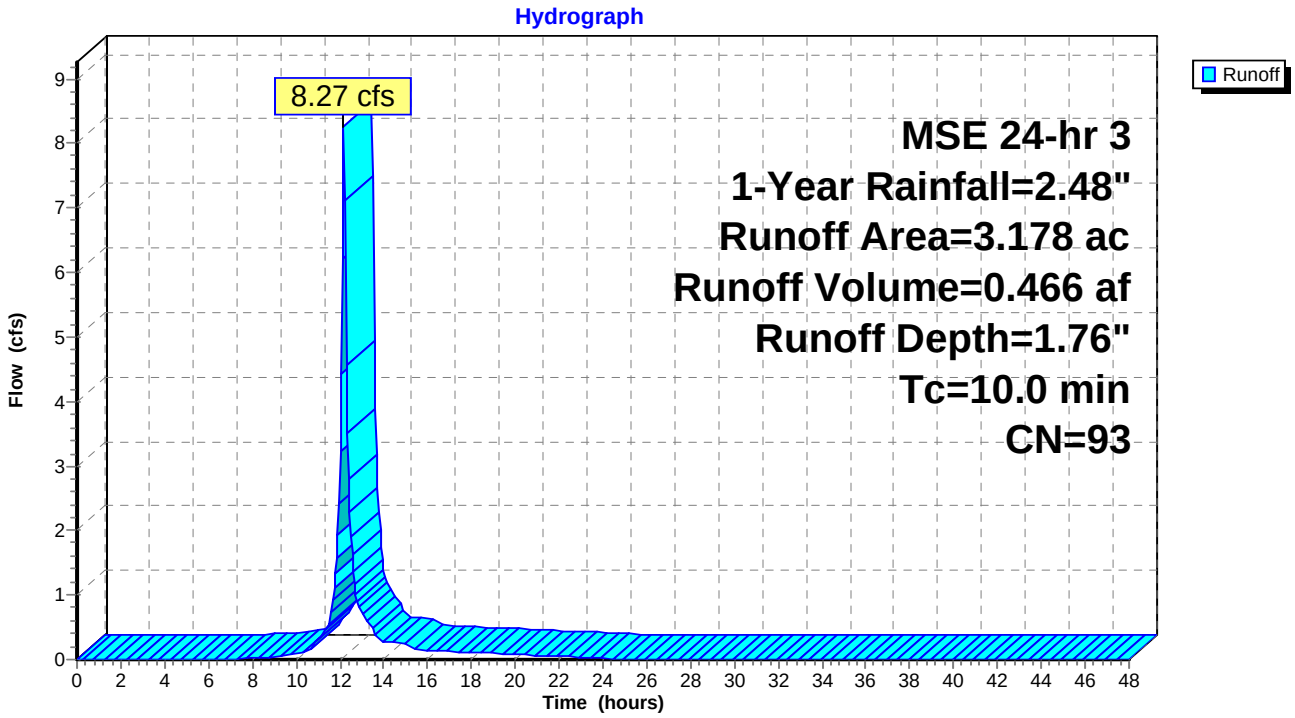
Runoff = 8.27 cfs @ 12.17 hrs, Volume= 0.466 af, Depth= 1.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 1-Year Rainfall=2.48"

Area (ac)	CN	Description
2.542	98	Paved parking, HSG C
0.636	74	>75% Grass cover, Good, HSG C
3.178	93	Weighted Average
0.636		20.01% Pervious Area
2.542		79.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment 3S: Prop - Park and Ride



Summary for Subcatchment 4S: Prop - EDA

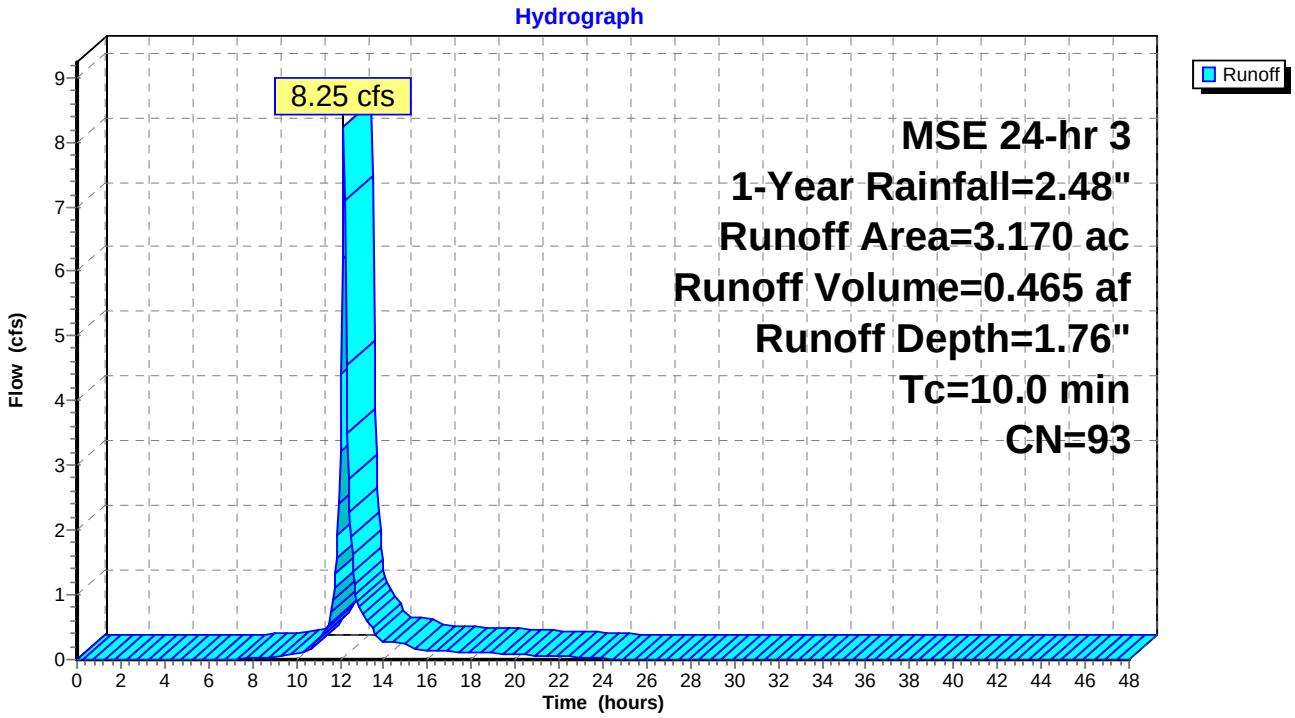
Runoff = 8.25 cfs @ 12.17 hrs, Volume= 0.465 af, Depth= 1.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 1-Year Rainfall=2.48"

Area (ac)	CN	Description
2.536	98	Paved parking, HSG C
0.634	74	>75% Grass cover, Good, HSG C
3.170	93	Weighted Average
0.634		20.00% Pervious Area
2.536		80.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment 4S: Prop - EDA

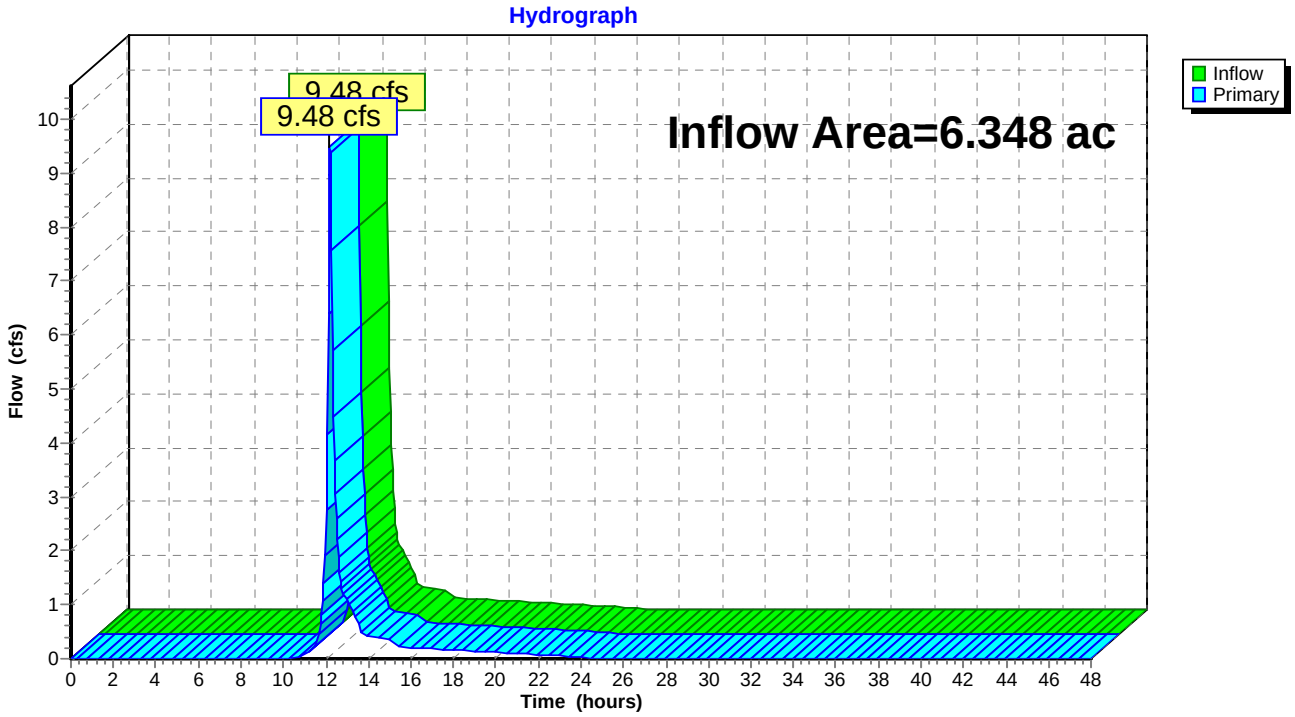


Summary for Link 3L: Ex. Cond. Total

Inflow Area = 6.348 ac, 33.84% Impervious, Inflow Depth = 0.99" for 1-Year event
Inflow = 9.48 cfs @ 12.18 hrs, Volume= 0.526 af
Primary = 9.48 cfs @ 12.18 hrs, Volume= 0.526 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Link 3L: Ex. Cond. Total

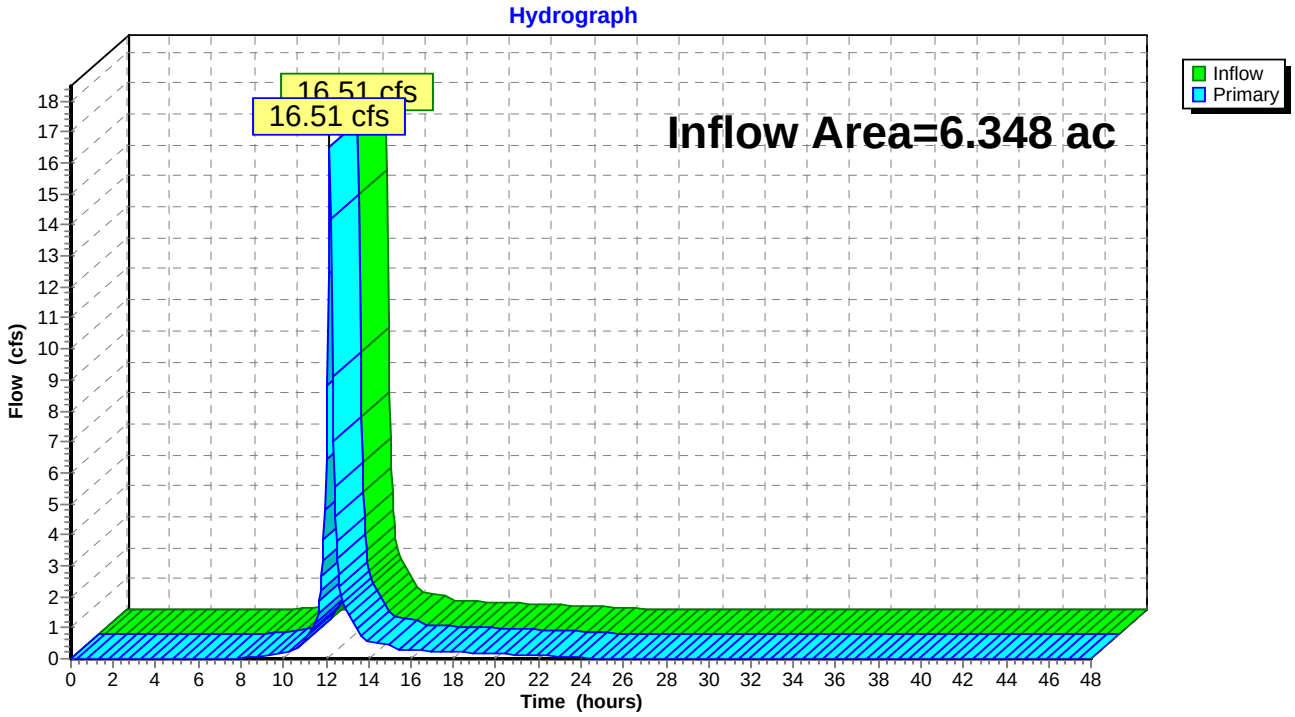


Summary for Link 5L: Prop. Cond. Total

Inflow Area = 6.348 ac, 79.99% Impervious, Inflow Depth = 1.76" for 1-Year event
Inflow = 16.51 cfs @ 12.17 hrs, Volume= 0.931 af
Primary = 16.51 cfs @ 12.17 hrs, Volume= 0.931 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Link 5L: Prop. Cond. Total



Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: Ex - Park and Ride Runoff Area=3.178 ac 46.16% Impervious Runoff Depth=2.69"
Tc=10.0 min CN=85 Runoff=12.82 cfs 0.713 af

Subcatchment 2S: Ex - EDA Runoff Area=3.170 ac 21.48% Impervious Runoff Depth=2.18"
Tc=10.0 min CN=79 Runoff=10.48 cfs 0.575 af

Subcatchment 3S: Prop - Park and Ride Runoff Area=3.178 ac 79.99% Impervious Runoff Depth=3.47"
Tc=10.0 min CN=93 Runoff=15.71 cfs 0.920 af

Subcatchment 4S: Prop - EDA Runoff Area=3.170 ac 80.00% Impervious Runoff Depth=3.47"
Tc=10.0 min CN=93 Runoff=15.67 cfs 0.918 af

Link 3L: Ex. Cond. Total Inflow=23.30 cfs 1.288 af
Primary=23.30 cfs 1.288 af

Link 5L: Prop. Cond. Total Inflow=31.38 cfs 1.837 af
Primary=31.38 cfs 1.837 af

Total Runoff Area = 12.696 ac Runoff Volume = 3.125 af Average Runoff Depth = 2.95"
43.08% Pervious = 5.470 ac 56.92% Impervious = 7.226 ac

Summary for Subcatchment 1S: Ex - Park and Ride

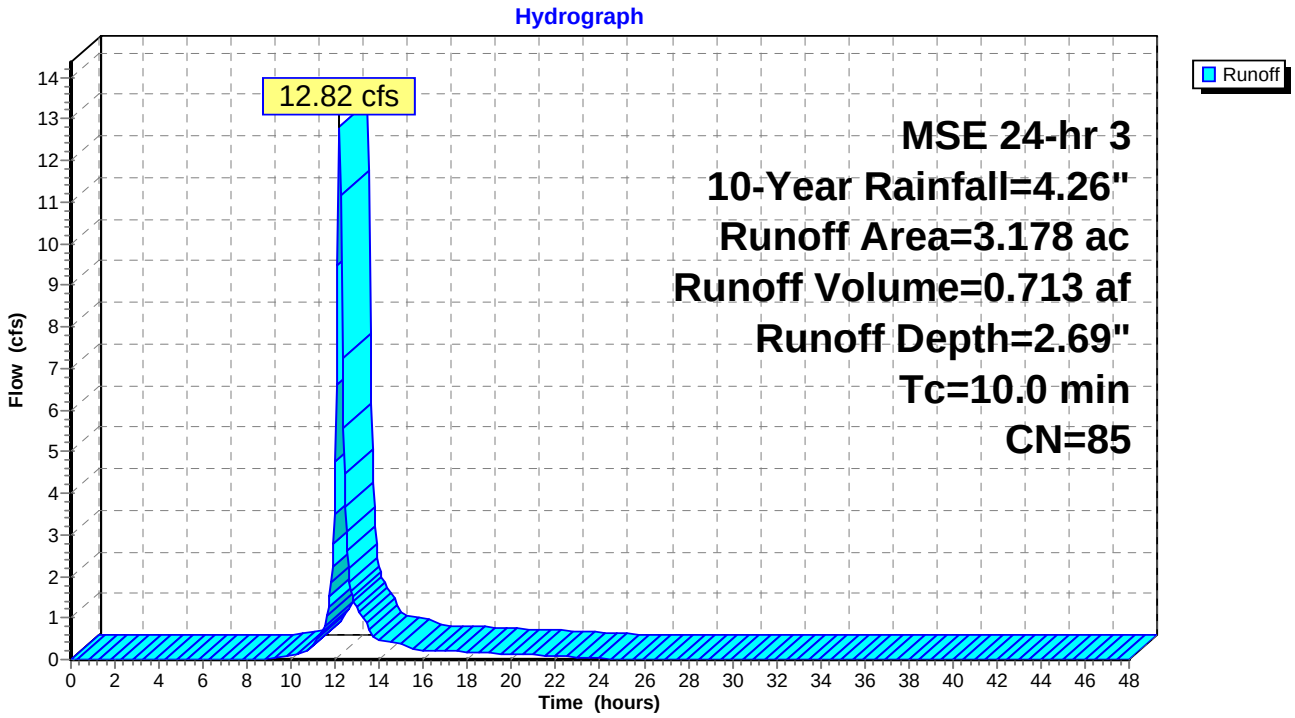
Runoff = 12.82 cfs @ 12.18 hrs, Volume= 0.713 af, Depth= 2.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-Year Rainfall=4.26"

Area (ac)	CN	Description
1.711	74	>75% Grass cover, Good, HSG C
1.467	98	Paved parking, HSG C
3.178	85	Weighted Average
1.711		53.84% Pervious Area
1.467		46.16% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment 1S: Ex - Park and Ride



Summary for Subcatchment 2S: Ex - EDA

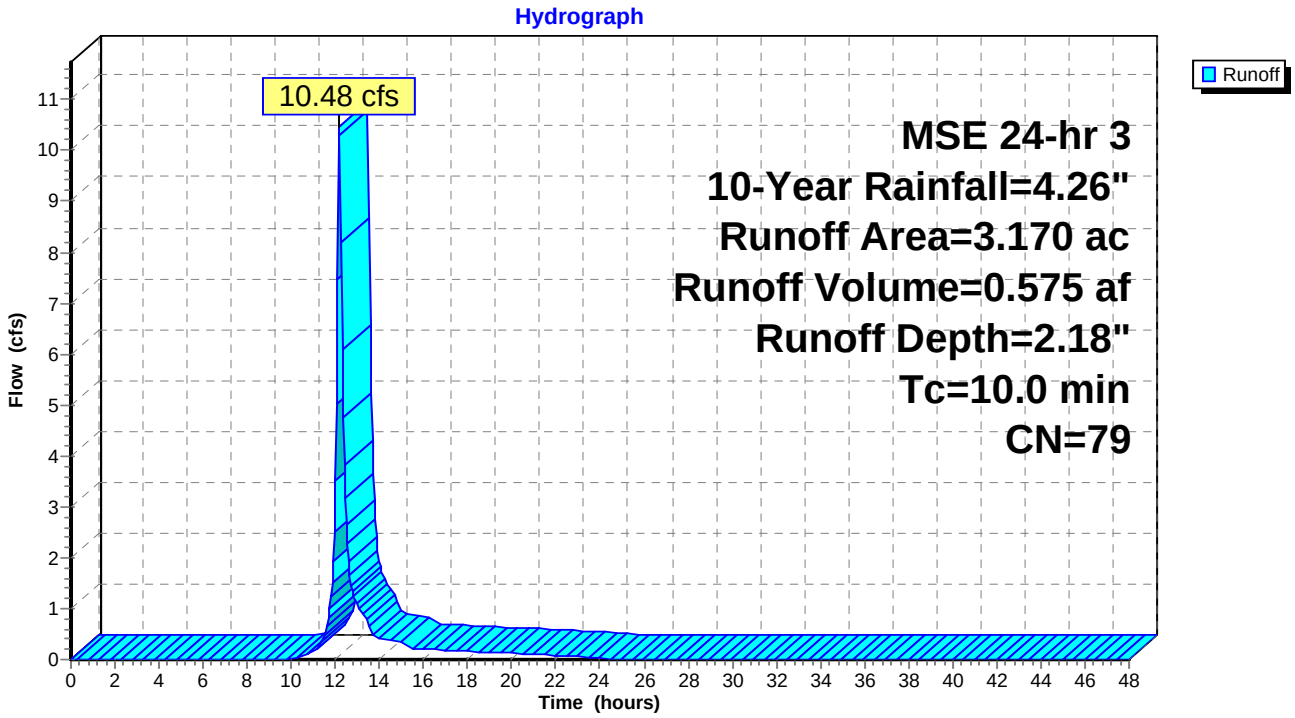
Runoff = 10.48 cfs @ 12.18 hrs, Volume= 0.575 af, Depth= 2.18"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-Year Rainfall=4.26"

Area (ac)	CN	Description
0.681	98	Paved parking, HSG C
2.489	74	>75% Grass cover, Good, HSG C
3.170	79	Weighted Average
2.489		78.52% Pervious Area
0.681		21.48% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment 2S: Ex - EDA



Summary for Subcatchment 3S: Prop - Park and Ride

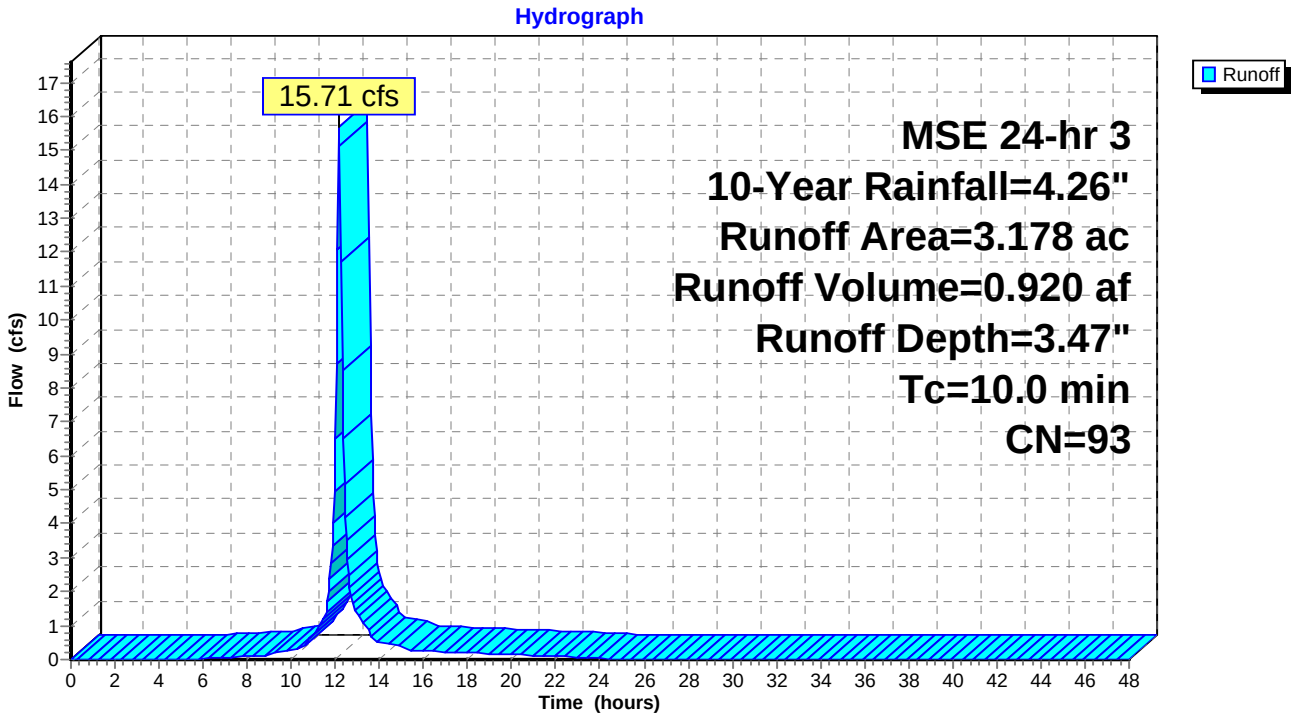
Runoff = 15.71 cfs @ 12.17 hrs, Volume= 0.920 af, Depth= 3.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-Year Rainfall=4.26"

Area (ac)	CN	Description
2.542	98	Paved parking, HSG C
0.636	74	>75% Grass cover, Good, HSG C
3.178	93	Weighted Average
0.636		20.01% Pervious Area
2.542		79.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment 3S: Prop - Park and Ride



Summary for Subcatchment 4S: Prop - EDA

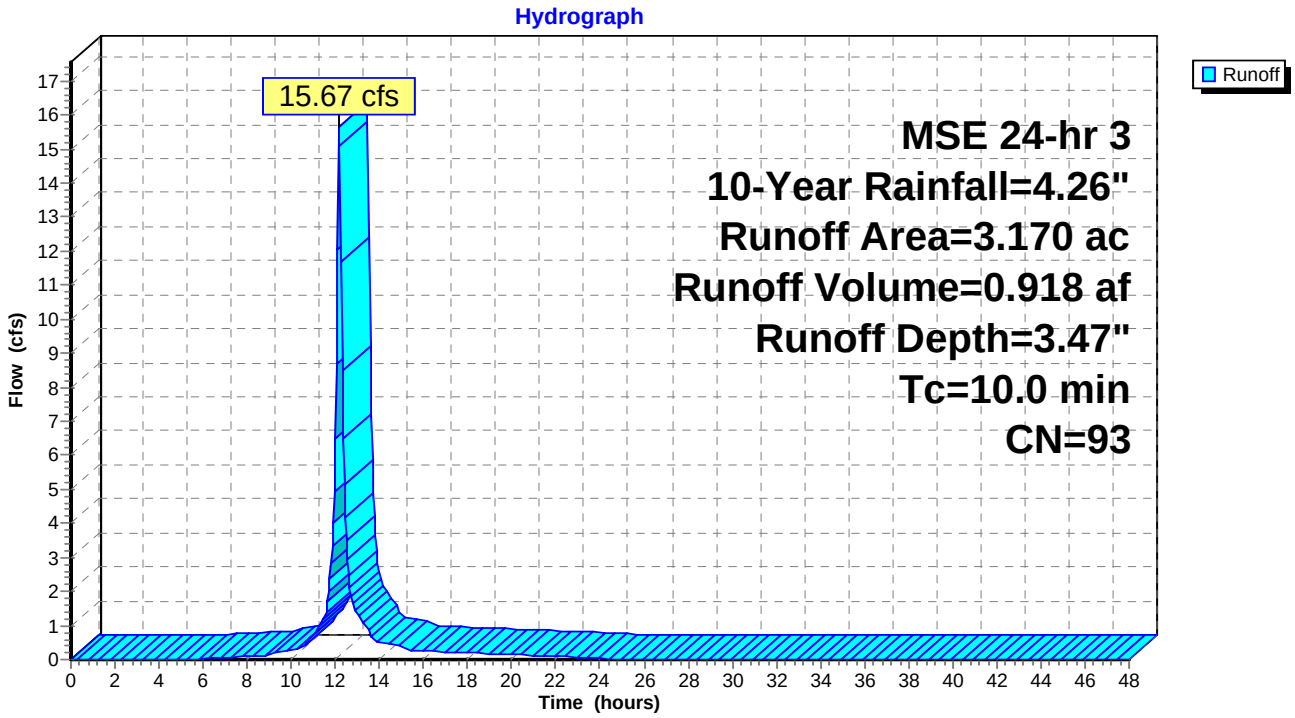
Runoff = 15.67 cfs @ 12.17 hrs, Volume= 0.918 af, Depth= 3.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-Year Rainfall=4.26"

Area (ac)	CN	Description
2.536	98	Paved parking, HSG C
0.634	74	>75% Grass cover, Good, HSG C
3.170	93	Weighted Average
0.634		20.00% Pervious Area
2.536		80.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment 4S: Prop - EDA

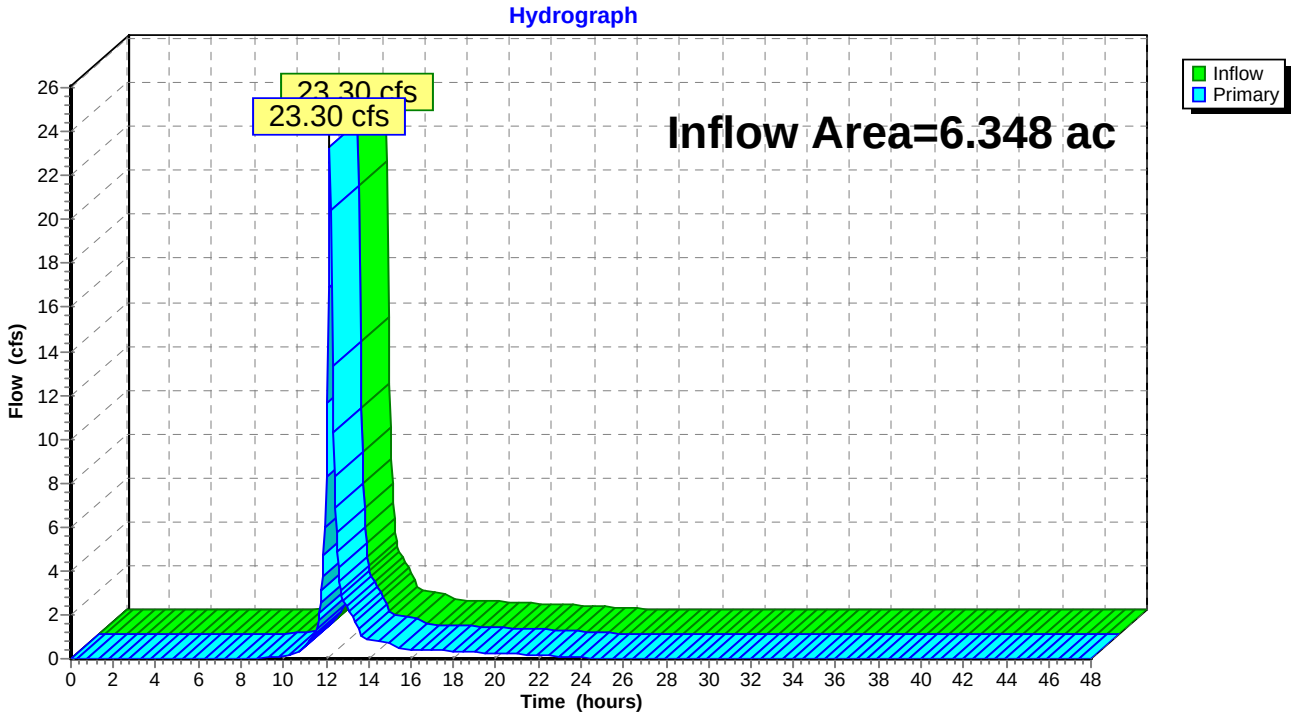


Summary for Link 3L: Ex. Cond. Total

Inflow Area = 6.348 ac, 33.84% Impervious, Inflow Depth = 2.43" for 10-Year event
Inflow = 23.30 cfs @ 12.18 hrs, Volume= 1.288 af
Primary = 23.30 cfs @ 12.18 hrs, Volume= 1.288 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Link 3L: Ex. Cond. Total

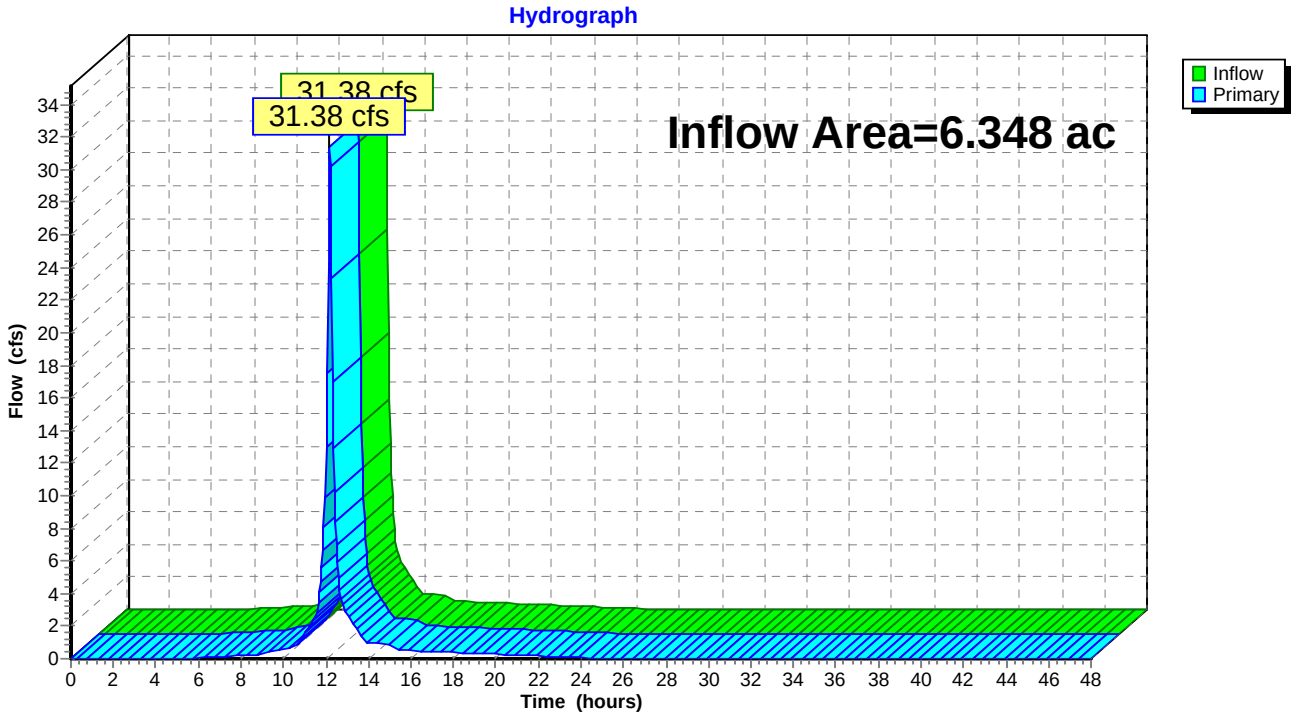


Summary for Link 5L: Prop. Cond. Total

Inflow Area = 6.348 ac, 79.99% Impervious, Inflow Depth = 3.47" for 10-Year event
Inflow = 31.38 cfs @ 12.17 hrs, Volume= 1.837 af
Primary = 31.38 cfs @ 12.17 hrs, Volume= 1.837 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Link 5L: Prop. Cond. Total



Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: Ex - Park and Ride Runoff Area=3.178 ac 46.16% Impervious Runoff Depth=5.56"
Tc=10.0 min CN=85 Runoff=25.71 cfs 1.472 af

Subcatchment 2S: Ex - EDA Runoff Area=3.170 ac 21.48% Impervious Runoff Depth=4.88"
Tc=10.0 min CN=79 Runoff=23.09 cfs 1.289 af

Subcatchment 3S: Prop - Park and Ride Runoff Area=3.178 ac 79.99% Impervious Runoff Depth=6.49"
Tc=10.0 min CN=93 Runoff=28.28 cfs 1.718 af

Subcatchment 4S: Prop - EDA Runoff Area=3.170 ac 80.00% Impervious Runoff Depth=6.49"
Tc=10.0 min CN=93 Runoff=28.21 cfs 1.714 af

Link 3L: Ex. Cond. Total Inflow=48.79 cfs 2.761 af
Primary=48.79 cfs 2.761 af

Link 5L: Prop. Cond. Total Inflow=56.48 cfs 3.432 af
Primary=56.48 cfs 3.432 af

Total Runoff Area = 12.696 ac Runoff Volume = 6.193 af Average Runoff Depth = 5.85"
43.08% Pervious = 5.470 ac 56.92% Impervious = 7.226 ac

Summary for Subcatchment 1S: Ex - Park and Ride

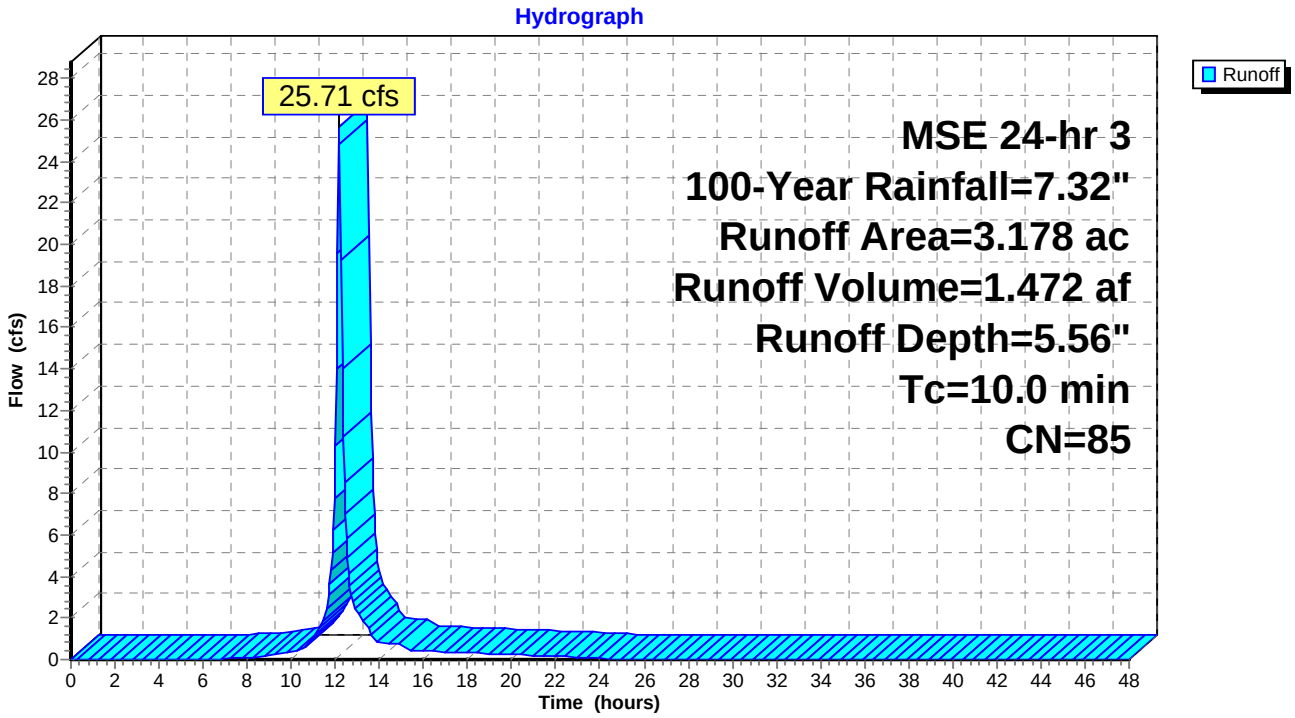
Runoff = 25.71 cfs @ 12.17 hrs, Volume= 1.472 af, Depth= 5.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100-Year Rainfall=7.32"

Area (ac)	CN	Description
1.711	74	>75% Grass cover, Good, HSG C
1.467	98	Paved parking, HSG C
3.178	85	Weighted Average
1.711		53.84% Pervious Area
1.467		46.16% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment 1S: Ex - Park and Ride



Summary for Subcatchment 2S: Ex - EDA

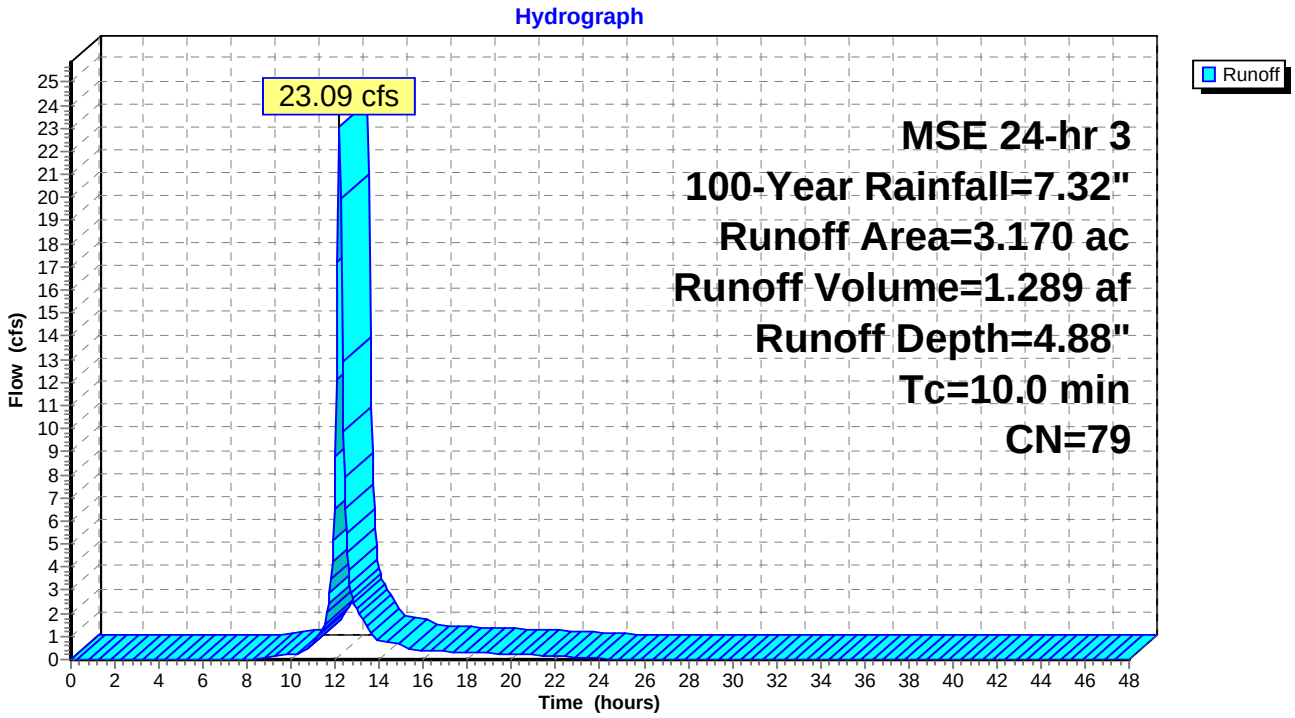
Runoff = 23.09 cfs @ 12.17 hrs, Volume= 1.289 af, Depth= 4.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100-Year Rainfall=7.32"

Area (ac)	CN	Description
0.681	98	Paved parking, HSG C
2.489	74	>75% Grass cover, Good, HSG C
3.170	79	Weighted Average
2.489		78.52% Pervious Area
0.681		21.48% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment 2S: Ex - EDA



Summary for Subcatchment 3S: Prop - Park and Ride

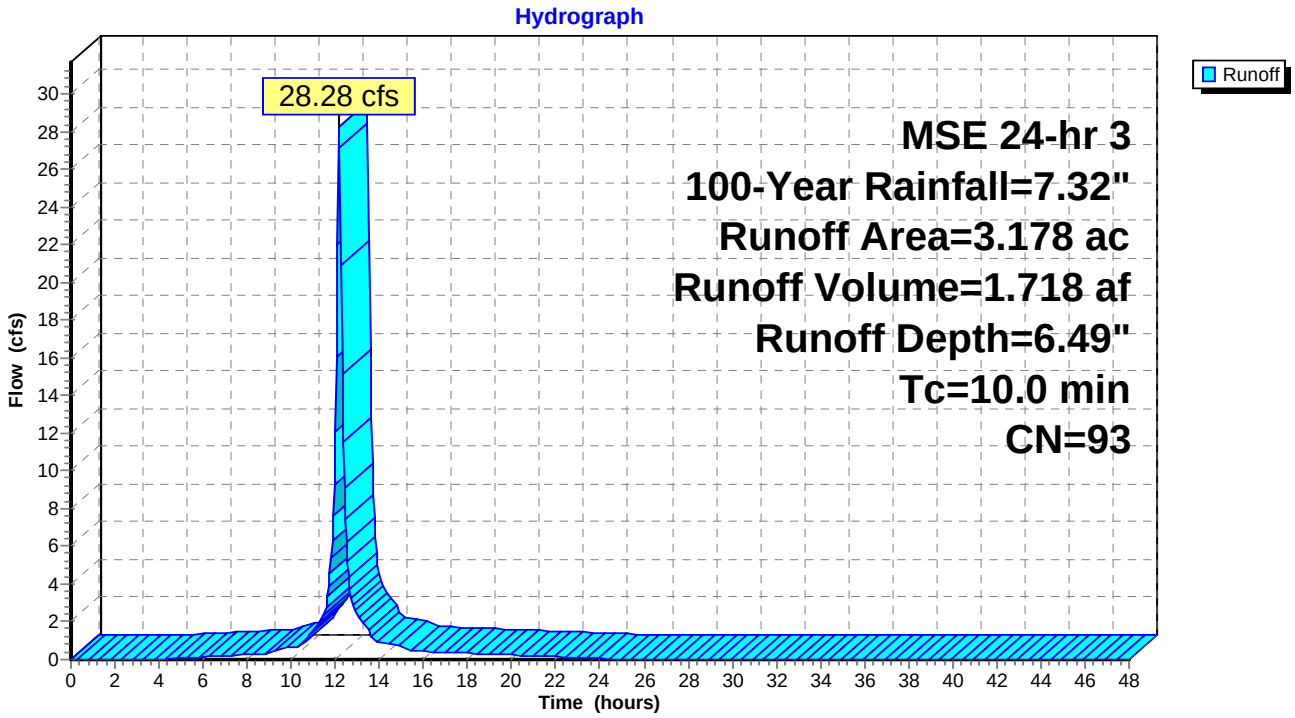
Runoff = 28.28 cfs @ 12.17 hrs, Volume= 1.718 af, Depth= 6.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100-Year Rainfall=7.32"

Area (ac)	CN	Description
2.542	98	Paved parking, HSG C
0.636	74	>75% Grass cover, Good, HSG C
3.178	93	Weighted Average
0.636		20.01% Pervious Area
2.542		79.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment 3S: Prop - Park and Ride



Summary for Subcatchment 4S: Prop - EDA

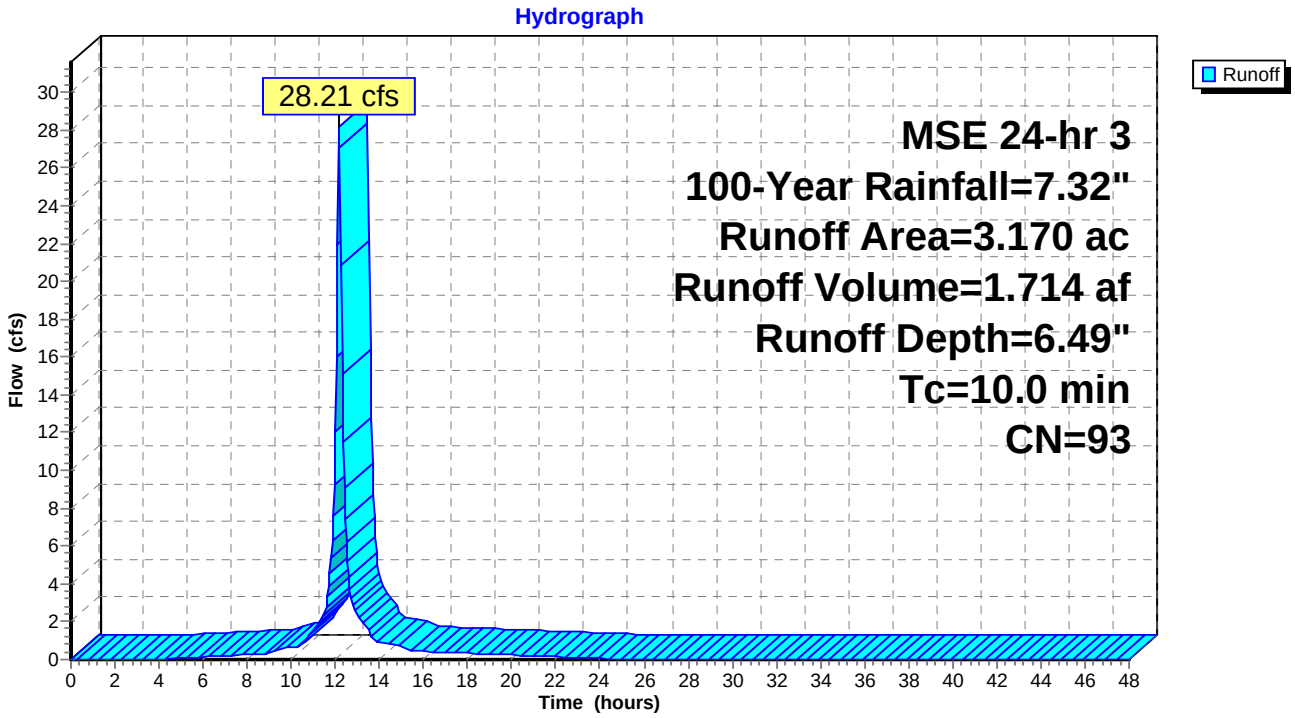
Runoff = 28.21 cfs @ 12.17 hrs, Volume= 1.714 af, Depth= 6.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100-Year Rainfall=7.32"

Area (ac)	CN	Description
2.536	98	Paved parking, HSG C
0.634	74	>75% Grass cover, Good, HSG C
3.170	93	Weighted Average
0.634		20.00% Pervious Area
2.536		80.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment 4S: Prop - EDA

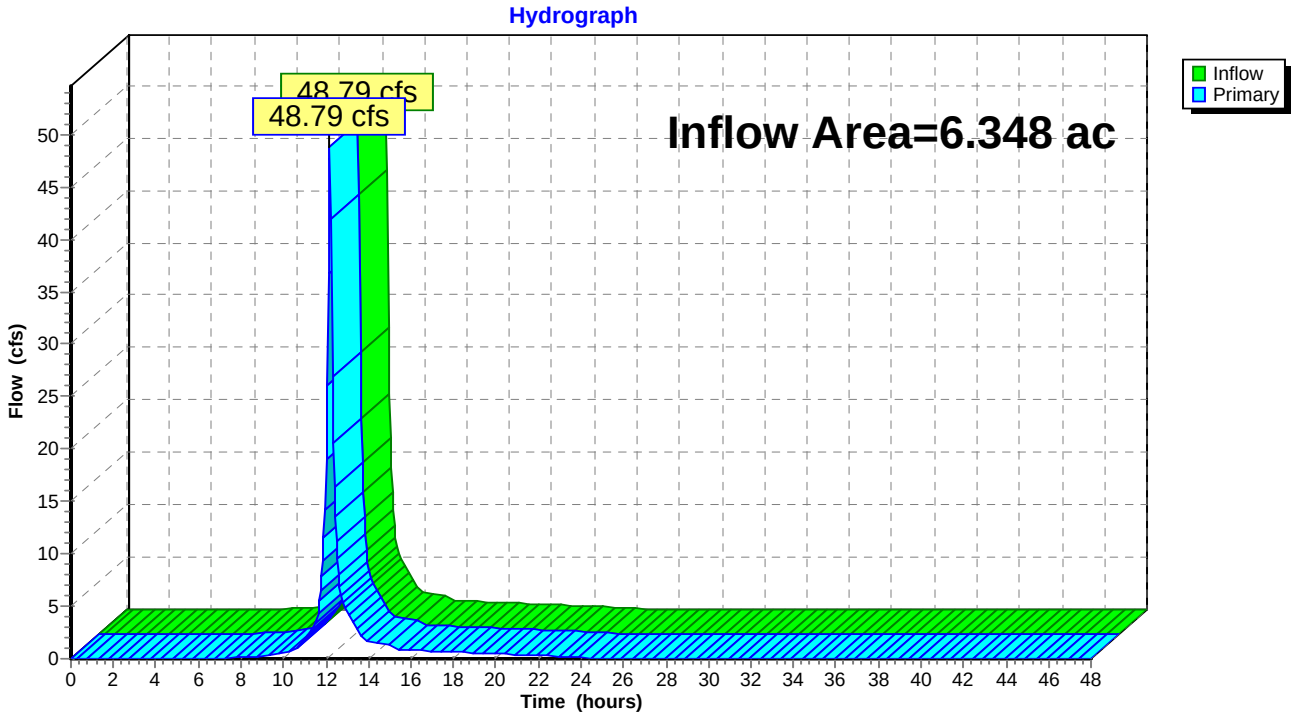


Summary for Link 3L: Ex. Cond. Total

Inflow Area = 6.348 ac, 33.84% Impervious, Inflow Depth = 5.22" for 100-Year event
Inflow = 48.79 cfs @ 12.17 hrs, Volume= 2.761 af
Primary = 48.79 cfs @ 12.17 hrs, Volume= 2.761 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Link 3L: Ex. Cond. Total

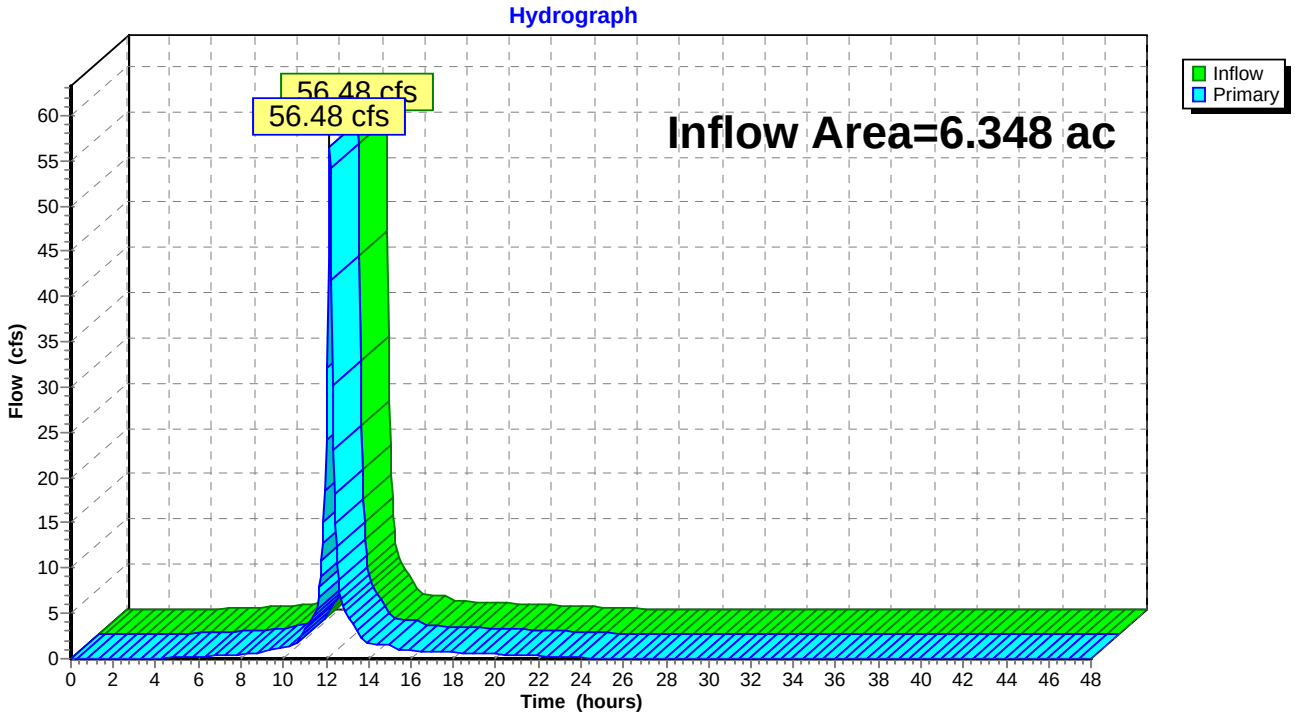


Summary for Link 5L: Prop. Cond. Total

Inflow Area = 6.348 ac, 79.99% Impervious, Inflow Depth = 6.49" for 100-Year event
Inflow = 56.48 cfs @ 12.17 hrs, Volume= 3.432 af
Primary = 56.48 cfs @ 12.17 hrs, Volume= 3.432 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Link 5L: Prop. Cond. Total



Appendix C:

MIDS Calculator

EDA Existing Site Details from MIDS Calculator

Annual Volume and Pollutant Load Reductions

Post development annual runoff volume	2.7773	acre-ft
Annual runoff volume removed by BMPs:		acre-ft
Percent annual runoff volume removed:		**%**
Post development annual particulate P load:	1.25	lbs
Annual particulate P removed by BMPs:		lbs
Post development annual dissolved P load:	1.02	lbs
Annual dissolved P removed by BMPs:		lbs
Percent annual total phosphorus removed:		**%**
Post development annual TSS load:	412	lbs
Annual TSS removed by BMPs:		lbs
Percent annual TSS removed:		**%**

Park and Ride Existing Site Details from MIDS Calculator

Annual Volume and Pollutant Load Reductions

Post development annual runoff volume	4.1154	acre-ft
Annual runoff volume removed by BMPs:		acre-ft
Percent annual runoff volume removed:		**%**
Post development annual particulate P load:	1.85	lbs
Annual particulate P removed by BMPs:		lbs
Post development annual dissolved P load:	1.51	lbs
Annual dissolved P removed by BMPs:		lbs
Percent annual total phosphorus removed:		**%**
Post development annual TSS load:	610	lbs
Annual TSS removed by BMPs:		lbs
Percent annual TSS removed:		**%**

EDA Proposed Site Details from MIDS Calculator

Performance Goal Requirement

Performance goal volume retention requirement:	9206	ft3
Volume removed by BMPs towards performance goal:	9204	ft3
Percent volume removed towards performance goal	**100**	**%**

Annual Volume and Pollutant Load Reductions

Post development annual runoff volume	5.9257	acre-ft
Annual runoff volume removed by BMPs:	5.6706	acre-ft
Percent annual runoff volume removed:	**96**	**%**
Post development annual particulate P load:	2.66	lbs
Annual particulate P removed by BMPs:	2.55	lbs
Post development annual dissolved P load:	2.18	lbs
Annual dissolved P removed by BMPs:	2.09	lbs
Percent annual total phosphorus removed:	**96**	**%**
Post development annual TSS load:	878	lbs
Annual TSS removed by BMPs:	840	lbs
Percent annual TSS removed:	**96**	**%**

Park and Ride Proposed Site Details from MIDS Calculator

Performance Goal Requirement

Performance goal volume retention requirement:	9227	ft3
Volume removed by BMPs towards performance goal:	9204	ft3
Percent volume removed towards performance goal	**100**	**%**

Annual Volume and Pollutant Load Reductions

Post development annual runoff volume	5.94	acre-ft
Annual runoff volume removed by BMPs:	5.6829	acre-ft
Percent annual runoff volume removed:	**96**	**%**
Post development annual particulate P load:	2.67	lbs
Annual particulate P removed by BMPs:	2.55	lbs
Post development annual dissolved P load:	2.18	lbs
Annual dissolved P removed by BMPs:	2.09	lbs
Percent annual total phosphorus removed:	**96**	**%**
Post development annual TSS load:	881	lbs
Annual TSS removed by BMPs:	843	lbs
Percent annual TSS removed:	**96**	**%**