

# EXHIBIT PC-4: APPLICANT STORMWATER MANAGEMENT REPORT



**FROELICH**  
ENGINEERS

## **(Land Use) Stormwater Management Report**

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### Kaady Car Wash – West Linn

18850 Willamette Dr  
West Linn, OR 97068

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Froelich Project Number: 25-C007  
Date: 8/1/2025

(Land Use) Stormwater Management Report

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## I. Project Overview and Description

This stormwater report has been prepared in accordance with the City of West Linn's Stormwater Management Manual (WLSWMM) to support the Building Permit application for the proposed project improvements.

Kaady Car Wash – West Linn is a site redevelopment project to convert an existing fast food site. The site is located on tax lot 6900 in the Clackamas County tax map 21E14DD. The existing development will be removed and a new automatic drive thru car wash, with a queuing line and vacuum equipped parking stalls will be constructed. There are no expected frontage improvements to be required with this on-site work.

### Existing Conditions

#### Onsite

This site is located at 18850 Willamette Dr. West Linn, Oregon (See Appendix A: Vicinity Map) and is zoned for General Commercial use (GC). The existing site is approximately 1.30 acres and currently consists of a non-operational McDonalds drive-thru and parking lot. The topography of the majority of the site is a north to south sloping topography with a perpendicular running retaining wall along the north side of the drive aisle. The slope increases significantly beyond the retaining wall. The site is accessible by driveway on Willamette Drive and a driveway along Walling Way. The existing soil is classified as Cascade silt loam with 8 to 15 percent slopes based on a Soil Resource Report for the NRCS with a **Group C** type soil (See Appendix D: Soil Resource Report). Stormwater from the existing site is collected in a series of catch basins and is conveyed into an on-site water quality vault and detention pond. Runoff is managed through a flow control structure and then discharged into the stormwater main in Walling Way. The stormwater is then conveyed into Fern Creek which then outfalls to the Willamette River. The site is within the Willamette River watershed.

'Table 1A: Predeveloped Catchment Basins' provides the predeveloped basin characteristics for the various catchment areas under the predeveloped conditions.

### Proposed Conditions

#### Onsite

The proposed development will construct water quality, water quantity, and storm water detention facilities to meet the requirements in WLSWMM. The onsite development will collect and manage stormwater through trench drains, roof drains, and a catch basin. The captured runoff is then conveyed through a water quality manhole and then piped into a buried detention structure. The proposed stormwater system will tie into the existing stormwater manhole and discharge to the same location.

'Table 1B: Proposed Catchment Basins' provides the proposed basin characteristics for the various catchment areas under the proposed conditions.

A proposed condition Basin Map is provided in Appendix B: Basin Maps and Areas.

## II. Methodology

The WLSWMM requires that all new construction resulting in at least 10,000 square feet of impervious area created or replaced to comply with stormwater requirements. Infiltration on site is not feasible due to existing soil conditions and steep slope conditions.

The water quality requirements consist of providing stormwater treatment for the water quality event of 1 inch per 24-hour period for a time of concentration of 10 minutes for the impervious area. This is roughly 80% of the average annual rainfall for the City of West Linn.

The flow control requirements consist of limiting the 2-year, 10-year, and 25-year post development peak flows to their respective pre-development peak. Predeveloped flows are based on a grassland/forested topography with a time of concentration of 5 minutes.

A summary of the stormwater treatment requirements facilities is provided in 'Table 2: Catchment and Facility Table' and a summary of the flow rate results is provided in 'Table 3: Pre- vs Post-Construction Stormwater Flow Rate Table.'

The conveyance calculations were designed for the 25-year storm event (3.9 in/24-hr). See Appendix H: Conveyance Calculations for conveyance sizing calculations.

## (Land Use) Stormwater Management Report

### III. Analysis

The analysis for the onsite stormwater system design is based on Santa Barbara Urban Hydrograph (SBUH) Method using a NRCS Type 1A rainfall distribution for a 24-hour storm. The system was designed using HydroCAD software.

The proprietary water quality manhole design is based on water quality flow of 1 inch per 24-hour storm event, using HydroCAD software (See Appendix F: Water Quality Calculations).

The detention facility design is based on the 2-year, 10-year, and 25-year storm events, using HydroCAD. The WLSSMM requires that detention systems be designed with concrete detention pipes unless the use of such pipe is not practical. Due to the footprint size of using concrete pipes, the project was required to explore the use of an alternative product. The proposed system is currently shown using the ADS SC-800 Chamber Detention system. An analysis of a concrete pipe detention system with a similar depth was considered, and an exhibit for the use of the concrete pipe is provided. (See Appendix G: Water Quantity Calculations.)

Conveyance calculations are based on the Manning Formula for uniform pipe flow (See Appendix I: Stormwater Conveyance Calculations). The peak runoff event can be conveyed by an 6-inch pipe with a minimum slope of 1.50% and an 8-inch pipe with a minimum slope of 1.00%.

Table 1A: Predeveloped Catchment Basins

Predeveloped

Basin	Area				Total	
	Pervious		Impervious		sf	ac
	sf	ac	sf	ac		
Basin A	31,100	0.714	0	0.000	31,100	0.714

Table 1B: Proposed Catchment Basins

Proposed

Basin	Area				Total		Flow Q (25-YR)
	Pervious		Impervious		sf	ac	cfs
	sf	ac	sf	ac			
Basin A	314	0.007	30,786	0.707	31,100	0.714	0.65

Table 2: Catchment and Facility table

Catchment/ Facility ID	Drainage Source	Area Managed (sf)	Ownership (private/ public)	Facility Type	Facility Size
WQMH72"-1	Basin A	30,786	Private	Water Quality Manhole	96" Dia Manhole with (9) 18" StormFilters
ADS SC-800 Detention System	Basin A	31,100	Private	Underground Detention Chambers	25.3'x89.3'x3.8' (60) ADS SC-800 Chambers

Table 3: Pre- vs Post-Construction Stormwater Flow Rate Table

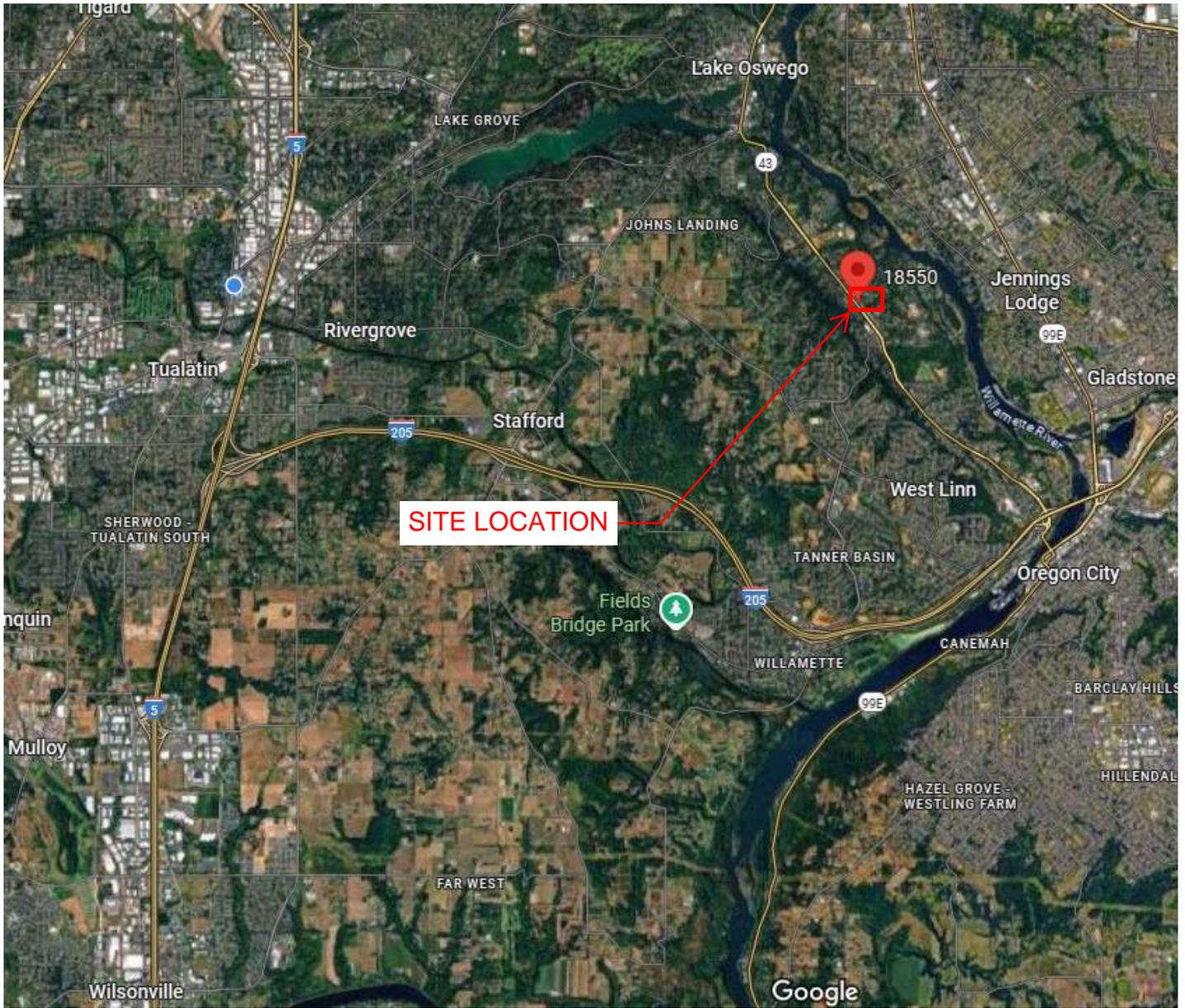
Catchment/ Facility ID	Peak Flow Rate (cfs) for a 24-hour storm					
	2-year		10-year		25-year	
	Pre	Post	Pre	Post	Pre	Post
Basin A	0.02	0.02	0.11	0.09	0.15	0.12

## **IV. Engineering Conclusion**

Based on the requirements of the City of West Linn, all facilities and conveyance components have enough capacity to manage the runoff from the required storm event and should be approved as designed.

## V. Appendices

## Appendix A: Vicinity Map



## **Appendix B: Basin Maps and Areas**



## **Appendix C: Assumptions**



**Santa Barbara Unit Hydrograph (SBUH) Assumptions:**

(used for Water Quality, Flow Control, Conveyance)

**Storm Events:**

Water Quality (WQ) Storm Event\* = **1.00\*** in/24-hours per West Linn Design Standards 5/25  
2-year Storm Event = **2.50** in/24-hours per West Linn Design Standards 5/25  
10-year Storm Event = **3.45** in/24-hours per West Linn Design Standards 5/25  
25-year Storm Event = **3.90** in/24-hours per West Linn Design Standards 5/25  
\*80% of Average Annual Runoff for West Linn

Time of Concentration **10.0** minutes

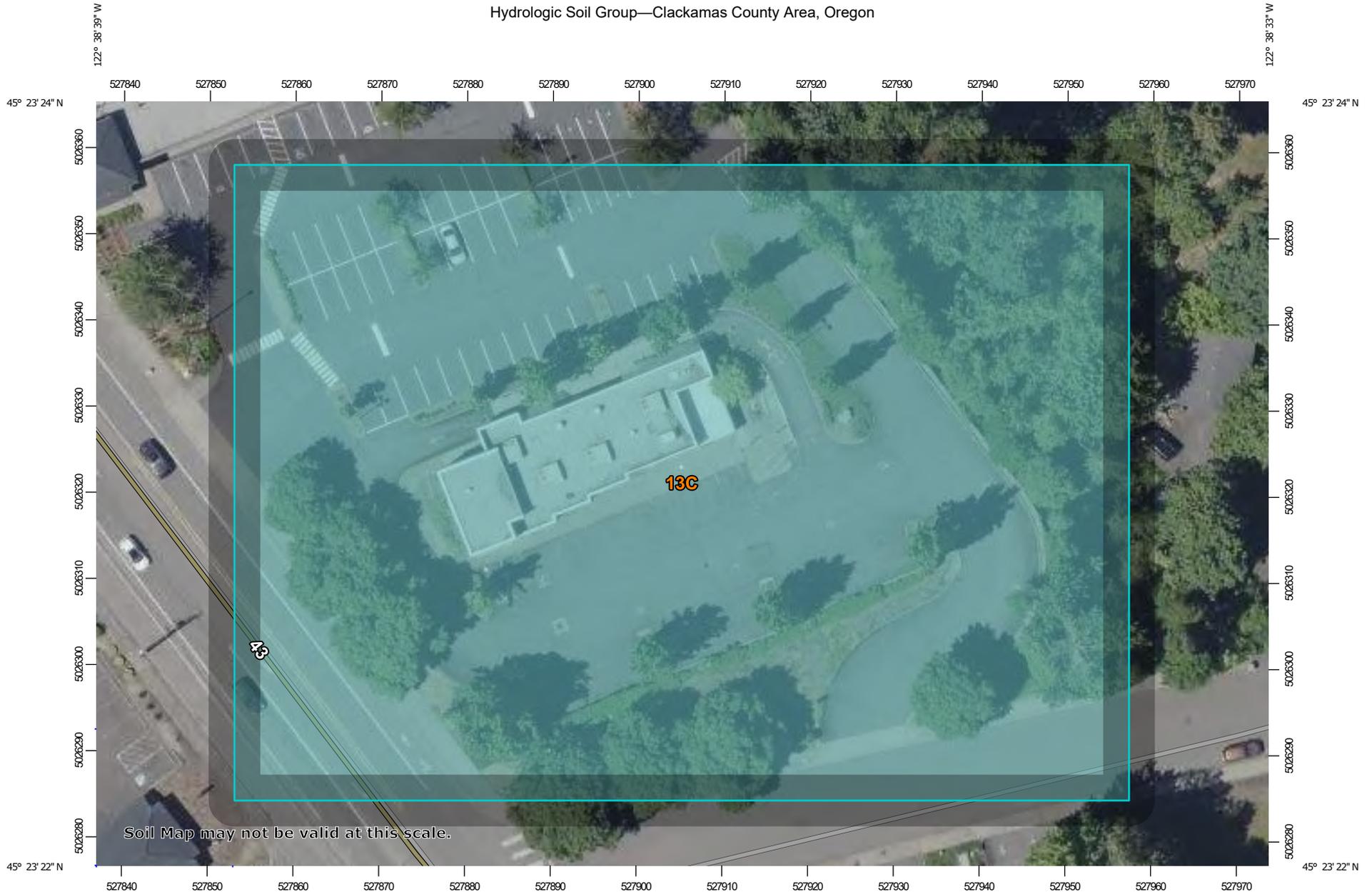
Roughness Coefficient **0.013**

**Curve Number Assumptions:**

NRSC Soil Group = **C**  
Impervious Area = **98** per West Linn Design Standards 5/25  
Existing Pervious Area = **86** per West Linn Design Standards 5/25  
Proposed Pervious Area = **74** per West Linn Design Standards 5/25  
Pre-development Area = **70** per West Linn Design Standards 5/25

## **Appendix D: Soil Resource Report**

Hydrologic Soil Group—Clackamas County Area, Oregon



Soil Map may not be valid at this scale.

Map Scale: 1:625 if printed on A landscape (11" x 8.5") sheet.

0 5 10 20 30 Meters

0 30 60 120 180 Feet

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84



### MAP LEGEND

**Area of Interest (AOI)**

 Area of Interest (AOI)

**Soils**

**Soil Rating Polygons**

-  A
-  A/D
-  B
-  B/D
-  C
-  C/D
-  D
-  Not rated or not available

**Soil Rating Lines**

-  A
-  A/D
-  B
-  B/D
-  C
-  C/D
-  D
-  Not rated or not available

**Soil Rating Points**

-  A
-  A/D
-  B
-  B/D

-  C
-  C/D
-  D
-  Not rated or not available

**Water Features**

 Streams and Canals

**Transportation**

-  Rails
-  Interstate Highways
-  US Routes
-  Major Roads
-  Local Roads

**Background**

 Aerial Photography

### MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

**Warning:** Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service  
 Web Soil Survey URL:  
 Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Clackamas County Area, Oregon  
 Survey Area Data: Version 21, Aug 30, 2024

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Mar 1, 2024—Jul 1, 2024

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

## Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
13C	Cascade silt loam, 8 to 15 percent slopes	C	1.9	100.0%
<b>Totals for Area of Interest</b>			<b>1.9</b>	<b>100.0%</b>

### Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

### Rating Options

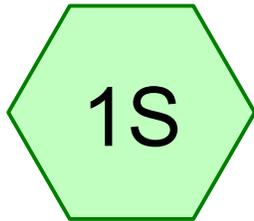
*Aggregation Method: Dominant Condition*

*Component Percent Cutoff: None Specified*

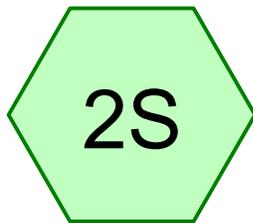
## Appendix E: Geotechnical Report

To be provided in final stormwater report

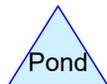
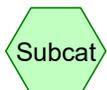
## **Appendix F: Water Quality Calculations**



Total Site (PreDev)



Total Site (PostDev)



**Routing Diagram for 25-C007 Kaady Car Wash**  
Prepared by Froelich Engineers, Printed 7/23/2025  
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**25-C007 Kaady Car Wash**

Type IA 24-hr Water Quality Rainfall=1.00"

Prepared by Froelich Engineers

Printed 7/23/2025

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Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points

Runoff by SBUH method, Split Pervious/Imperv.

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment1S: Total Site (PreDev)**

Runoff Area=31,100 sf 0.00% Impervious Runoff Depth=0.00"  
Tc=10.0 min CN=70/0 Runoff=0.00 cfs 0.000 af

**Subcatchment2S: Total Site (PostDev)**

Runoff Area=31,100 sf 98.99% Impervious Runoff Depth=0.78"  
Tc=5.0 min CN=74/98 Runoff=0.14 cfs 0.047 af

water quality flow



**25-C007 Kaady Car Wash**

Prepared by Froelich Engineers

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Type IA 24-hr Water Quality Rainfall=1.00"

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**Summary for Subcatchment 2S: Total Site (PostDev)**

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.14 cfs @ 7.92 hrs, Volume= 0.047 af, Depth= 0.78"  
 Routed to Pond 3P : Det SC-800

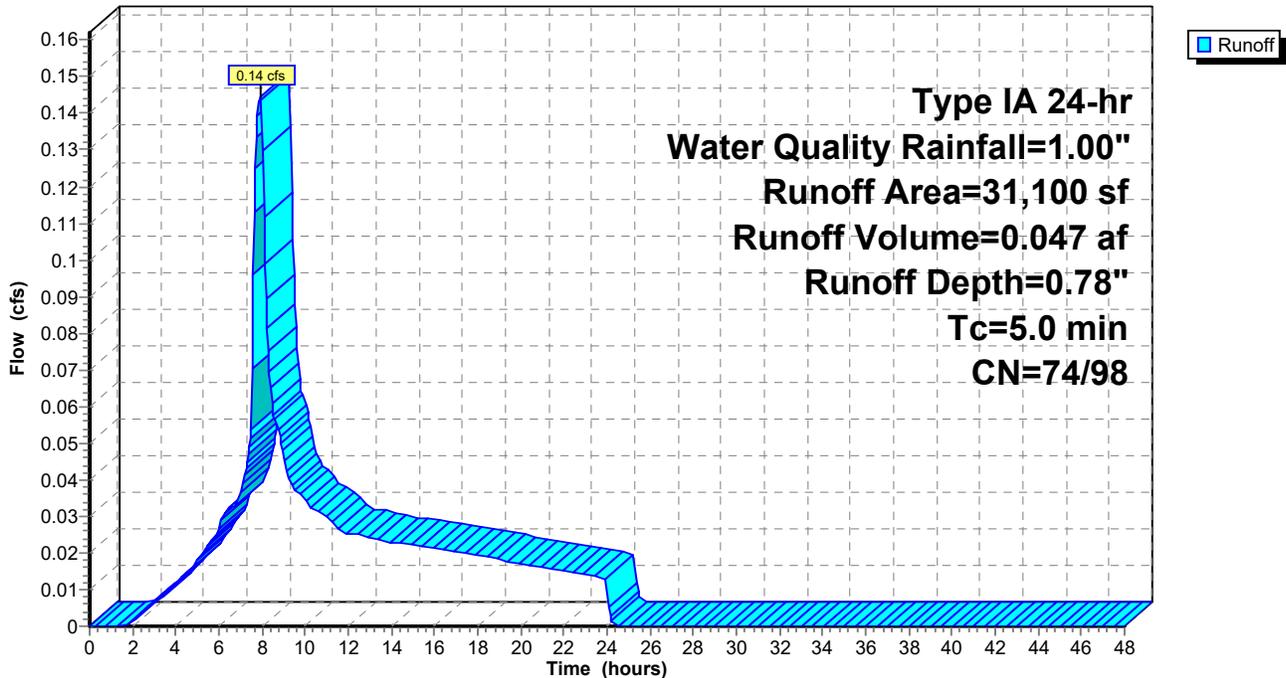
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
 Type IA 24-hr Water Quality Rainfall=1.00"

	Area (sf)	CN	Description
*	30,786	98	
*	314	74	
	31,100	98	Weighted Average
	314	74	1.01% Pervious Area
	30,786	98	98.99% Impervious Area

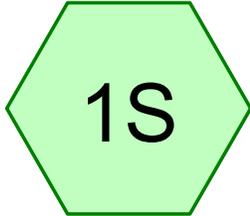
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry,

**Subcatchment 2S: Total Site (PostDev)**

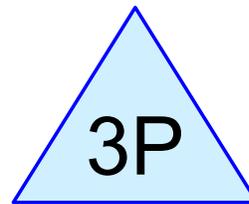
Hydrograph



## **Appendix G: Water Quantity Calculations**

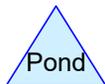
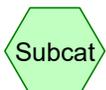


Total Site (PreDev)



Total Site (PostDev)

Det SC-800



**Routing Diagram for 25-C007 Kaady Car Wash**  
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# 25-C007 Kaady Car Wash

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## Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	Type IA 24-hr		Default	24.00	1	2.50	2
2	10-Year	Type IA 24-hr		Default	24.00	1	3.45	2
3	25-Year	Type IA 24-hr		Default	24.00	1	3.90	2

**25-C007 Kaady Car Wash**

Type IA 24-hr 2-Year Rainfall=2.50"

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predev flowrate

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points  
Runoff by SBUH method, Split Pervious/Imperv.  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment1S: Total Site (PreDev)**      Runoff Area=31,100 sf   0.00% Impervious   Runoff Depth=0.46"  
Tc=10.0 min   CN=70/0   **Runoff=0.02 cfs   0.027 af**

**Subcatchment2S: Total Site (PostDev)**      Runoff Area=31,100 sf   98.99% Impervious   Runoff Depth=2.25"  
Tc=5.0 min   CN=74/98   Runoff=0.41 cfs   0.134 af

**Pond 3P: Det SC-800**      Peak Elev=103.24'   Storage=0.109 af   Inflow=0.41 cfs   0.134 af  
Outflow=0.02 cfs   0.057 af

**Total Runoff Area = 1.428 ac   Runoff Volume = 0.161 af   Average Runoff Depth = 1.35"**  
**50.50% Pervious = 0.721 ac   49.50% Impervious = 0.707 ac**

**25-C007 Kaady Car Wash**

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Type IA 24-hr 2-Year Rainfall=2.50"

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**Summary for Subcatchment 1S: Total Site (PreDev)**

Runoff = 0.02 cfs @ 8.23 hrs, Volume= 0.027 af, Depth= 0.46"

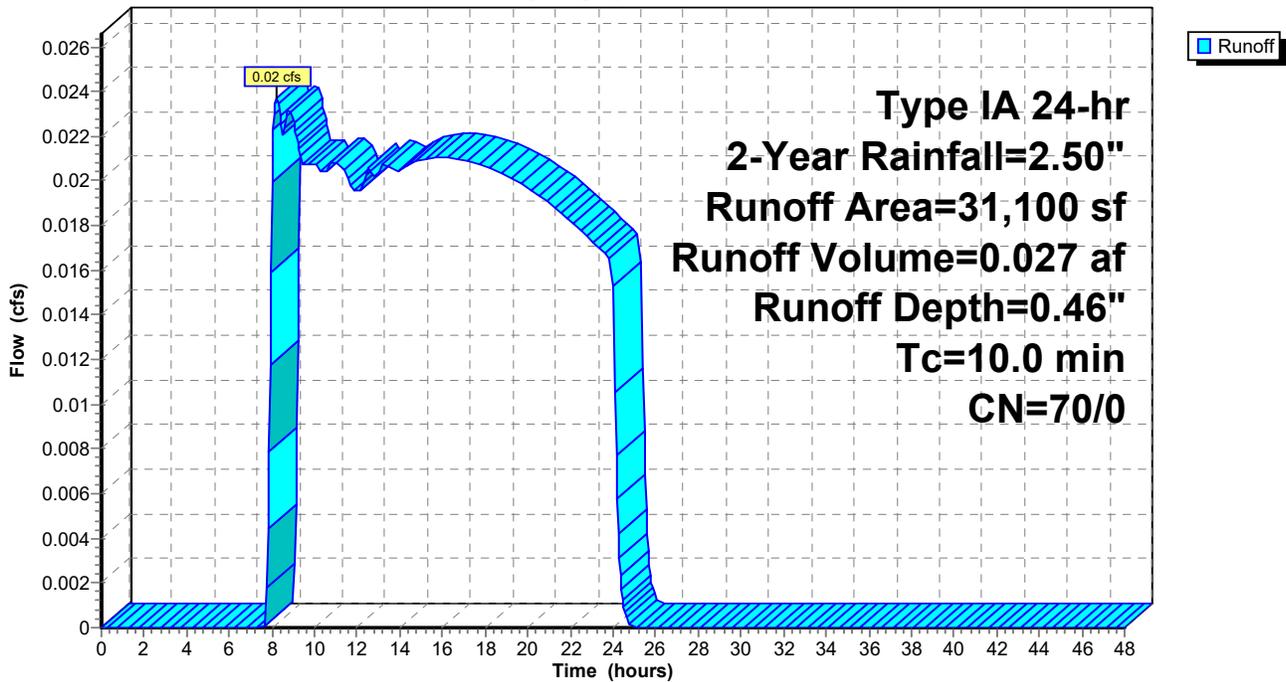
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
Type IA 24-hr 2-Year Rainfall=2.50"

Area (sf)	CN	Description
* 31,100	70	
31,100	70	100.00% Pervious Area

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

**Subcatchment 1S: Total Site (PreDev)**

Hydrograph



**25-C007 Kaady Car Wash**

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Type IA 24-hr 2-Year Rainfall=2.50"

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**Summary for Subcatchment 2S: Total Site (PostDev)**

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.41 cfs @ 7.90 hrs, Volume= 0.134 af, Depth= 2.25"  
 Routed to Pond 3P : Det SC-800

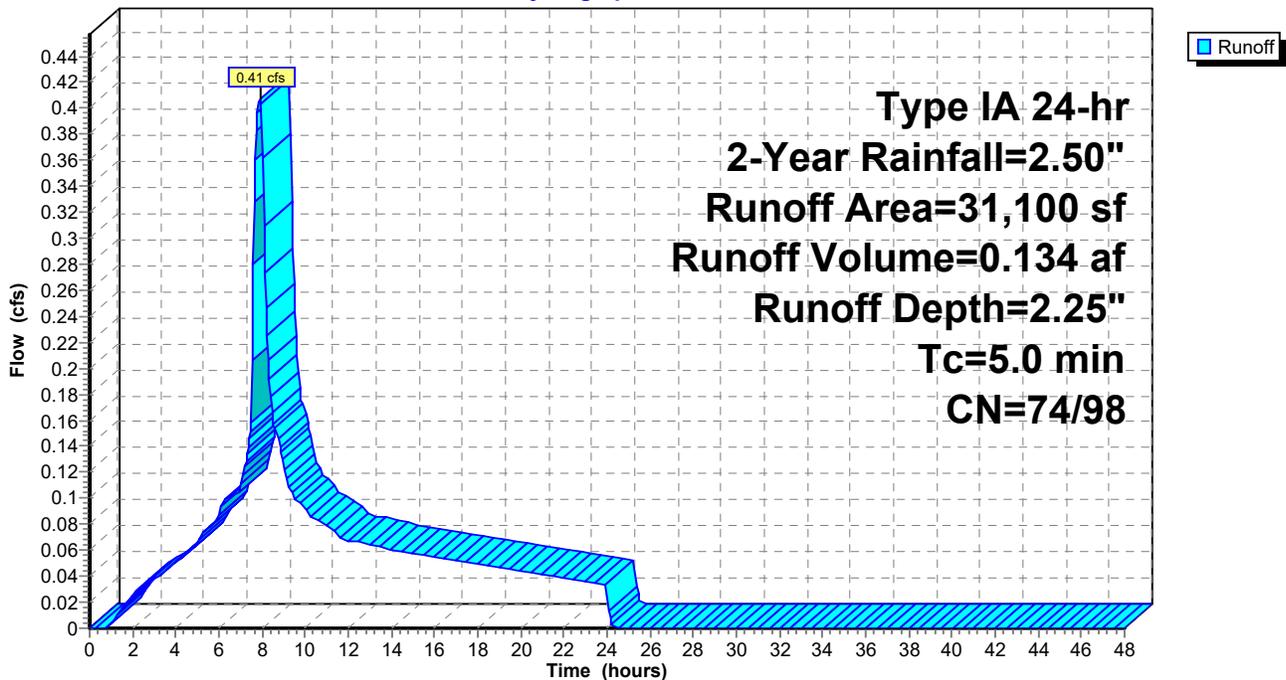
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
 Type IA 24-hr 2-Year Rainfall=2.50"

	Area (sf)	CN	Description
*	30,786	98	
*	314	74	
	31,100	98	Weighted Average
	314	74	1.01% Pervious Area
	30,786	98	98.99% Impervious Area

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

**Subcatchment 2S: Total Site (PostDev)**

Hydrograph



**25-C007 Kaady Car Wash**

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Type IA 24-hr 2-Year Rainfall=2.50"

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**Summary for Pond 3P: Det SC-800**

Inflow Area = 0.714 ac, 98.99% Impervious, Inflow Depth = 2.25" for 2-Year event  
 Inflow = 0.41 cfs @ 7.90 hrs, Volume= 0.134 af  
 Outflow = 0.02 cfs @ 24.08 hrs, Volume= 0.057 af, Atten= 95%, Lag= 971.0 min  
 Primary = 0.02 cfs @ 24.08 hrs, Volume= 0.057 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
 Peak Elev= 103.24' @ 24.08 hrs Surf.Area= 0.052 ac Storage= 0.109 af

Plug-Flow detention time= 1,215.7 min calculated for 0.057 af (43% of inflow)  
 Center-of-Mass det. time= 930.2 min ( 1,604.6 - 674.4 )

Volume	Invert	Avail.Storage	Storage Description
#1A	100.00'	0.049 af	<b>25.25"W x 89.17'L x 3.75'H Field A</b> 0.194 af Overall - 0.070 af Embedded = 0.123 af x 40.0% Voids
#2A	100.50'	0.070 af	<b>ADS_StormTech SC-800 +Cap</b> x 60 Inside #1 Effective Size= 45.0"W x 33.0"H => 7.11 sf x 7.12'L = 50.6 cf Overall Size= 51.0"W x 33.0"H x 7.55'L with 0.43' Overlap 60 Chambers in 5 Rows Cap Storage= 3.4 cf x 2 x 5 rows = 34.2 cf
		0.120 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	100.00'	<b>0.625" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#2	Primary	103.65'	<b>8.000" Horiz. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads

**Primary OutFlow** Max=0.02 cfs @ 24.08 hrs HW=103.24' (Free Discharge)

1=Orifice/Grate (Orifice Controls 0.02 cfs @ 8.63 fps)

2=Orifice/Grate ( Controls 0.00 cfs)

**25-C007 Kaady Car Wash**

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Type IA 24-hr 2-Year Rainfall=2.50"

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**Pond 3P: Det SC-800 - Chamber Wizard Field A**

**Chamber Model = ADS\_StormTechSC-800 +Cap (ADS StormTech®SC-800 with cap volume)**

Effective Size= 45.0"W x 33.0"H => 7.11 sf x 7.12'L = 50.6 cf

Overall Size= 51.0"W x 33.0"H x 7.55'L with 0.43' Overlap

Cap Storage= 3.4 cf x 2 x 5 rows = 34.2 cf

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

12 Chambers/Row x 7.12' Long +0.88' Cap Length x 2 = 87.17' Row Length +12.0" End Stone x 2 = 89.17' Base Length

5 Rows x 51.0" Wide + 6.0" Spacing x 4 + 12.0" Side Stone x 2 = 25.25' Base Width

6.0" Stone Base + 33.0" Chamber Height + 6.0" Stone Cover = 3.75' Field Height

60 Chambers x 50.6 cf + 3.4 cf Cap Volume x 2 x 5 Rows = 3,069.7 cf Chamber Storage

8,443.0 cf Field - 3,069.7 cf Chambers = 5,373.2 cf Stone x 40.0% Voids = 2,149.3 cf Stone Storage

Chamber Storage + Stone Storage = 5,219.0 cf = 0.120 af

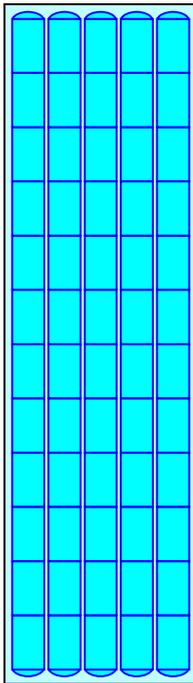
Overall Storage Efficiency = 61.8%

Overall System Size = 89.17' x 25.25' x 3.75'

60 Chambers

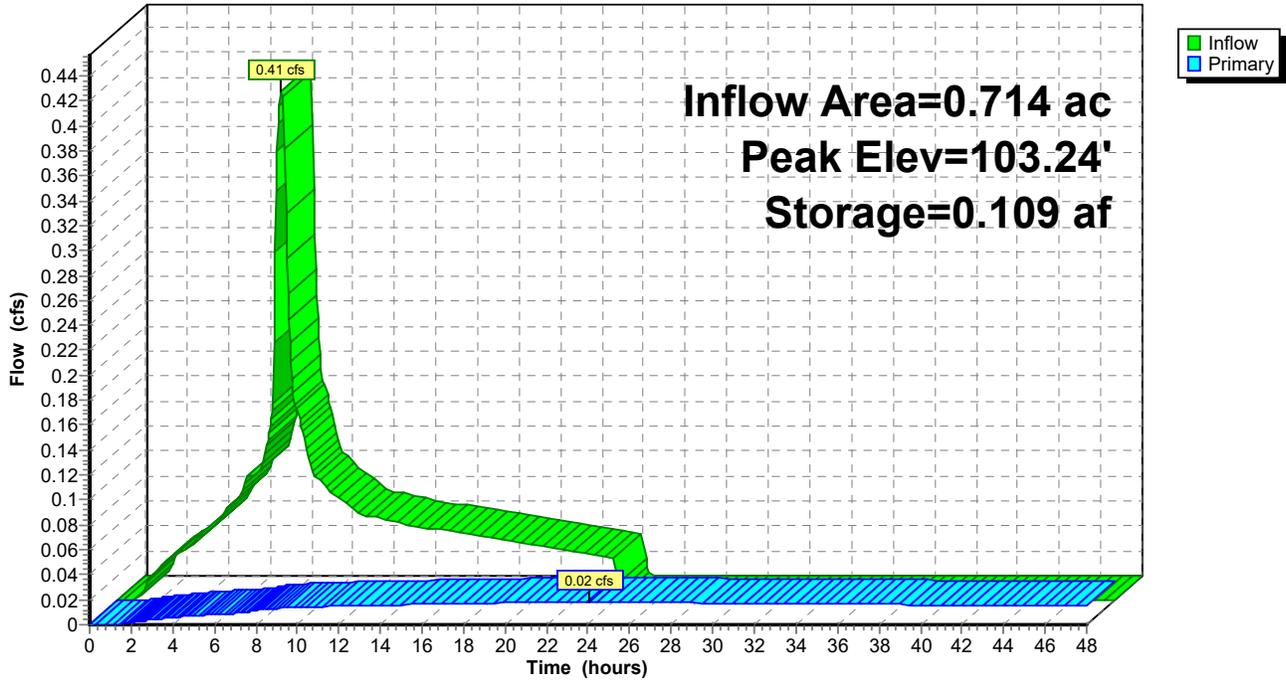
312.7 cy Field

199.0 cy Stone



Pond 3P: Det SC-800

Hydrograph



**25-C007 Kaady Car Wash**

Type IA 24-hr 10-Year Rainfall=3.45"

Prepared by Froelich Engineers

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predev flowrate

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points  
Runoff by SBUH method, Split Pervious/Imperv.  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment1S: Total Site (PreDev)**      Runoff Area=31,100 sf   0.00% Impervious   Runoff Depth=0.98"  
Tc=10.0 min   CN=70/0   **Runoff=0.11 cfs   0.058 af**

**Subcatchment2S: Total Site (PostDev)**      Runoff Area=31,100 sf   98.99% Impervious   Runoff Depth=3.20"  
Tc=5.0 min   CN=74/98   Runoff=0.57 cfs   0.190 af

**Pond 3P: Det SC-800**      Peak Elev=103.69'   Storage=0.119 af   Inflow=0.57 cfs   0.190 af  
Outflow=0.09 cfs   0.106 af

**Total Runoff Area = 1.428 ac   Runoff Volume = 0.248 af   Average Runoff Depth = 2.09"**  
**50.50% Pervious = 0.721 ac   49.50% Impervious = 0.707 ac**

**25-C007 Kaady Car Wash**

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Type IA 24-hr 10-Year Rainfall=3.45"

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**Summary for Subcatchment 1S: Total Site (PreDev)**

Runoff = 0.11 cfs @ 8.03 hrs, Volume= 0.058 af, Depth= 0.98"

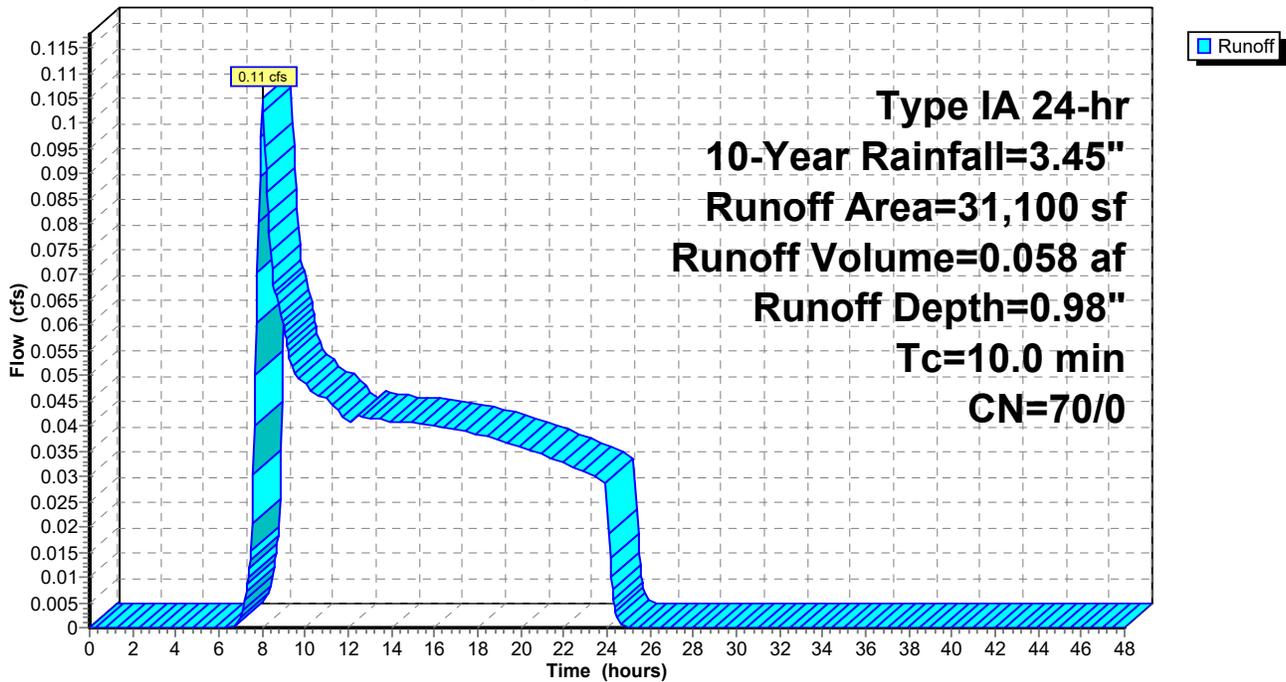
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
Type IA 24-hr 10-Year Rainfall=3.45"

	Area (sf)	CN	Description
*	31,100	70	
	31,100	70	100.00% Pervious Area

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

**Subcatchment 1S: Total Site (PreDev)**

Hydrograph



**25-C007 Kaady Car Wash**

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Type IA 24-hr 10-Year Rainfall=3.45"

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**Summary for Subcatchment 2S: Total Site (PostDev)**

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.57 cfs @ 7.90 hrs, Volume= 0.190 af, Depth= 3.20"  
 Routed to Pond 3P : Det SC-800

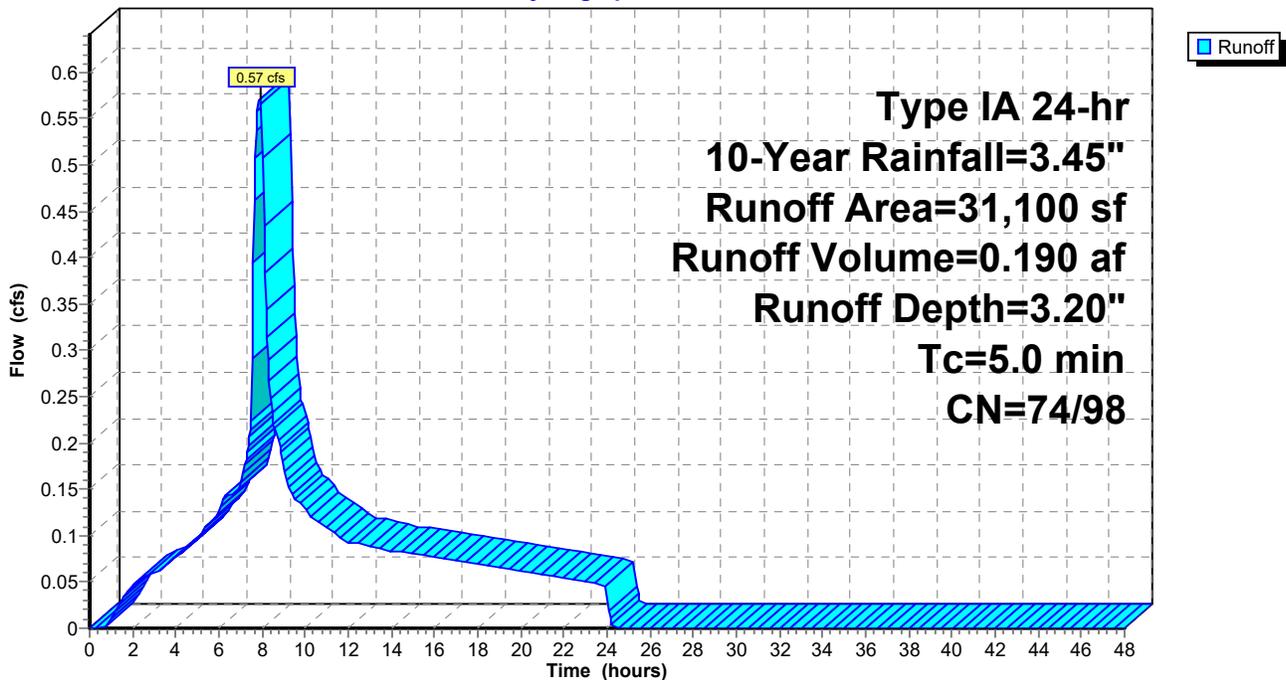
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
 Type IA 24-hr 10-Year Rainfall=3.45"

	Area (sf)	CN	Description
*	30,786	98	
*	314	74	
	31,100	98	Weighted Average
	314	74	1.01% Pervious Area
	30,786	98	98.99% Impervious Area

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

**Subcatchment 2S: Total Site (PostDev)**

Hydrograph



**25-C007 Kaady Car Wash**

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Type IA 24-hr 10-Year Rainfall=3.45"

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**Summary for Pond 3P: Det SC-800**

Inflow Area = 0.714 ac, 98.99% Impervious, Inflow Depth = 3.20" for 10-Year event  
 Inflow = 0.57 cfs @ 7.90 hrs, Volume= 0.190 af  
 Outflow = 0.09 cfs @ 13.62 hrs, Volume= 0.106 af, Atten= 85%, Lag= 343.6 min  
 Primary = 0.09 cfs @ 13.62 hrs, Volume= 0.106 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
 Peak Elev= 103.69' @ 13.62 hrs Surf.Area= 0.052 ac Storage= 0.119 af

Plug-Flow detention time= 945.2 min calculated for 0.106 af (56% of inflow)  
 Center-of-Mass det. time= 700.6 min ( 1,365.7 - 665.1 )

Volume	Invert	Avail.Storage	Storage Description
#1A	100.00'	0.049 af	<b>25.25"W x 89.17'L x 3.75'H Field A</b> 0.194 af Overall - 0.070 af Embedded = 0.123 af x 40.0% Voids
#2A	100.50'	0.070 af	<b>ADS_StormTech SC-800 +Cap</b> x 60 Inside #1 Effective Size= 45.0"W x 33.0"H => 7.11 sf x 7.12'L = 50.6 cf Overall Size= 51.0"W x 33.0"H x 7.55'L with 0.43' Overlap 60 Chambers in 5 Rows Cap Storage= 3.4 cf x 2 x 5 rows = 34.2 cf
		0.120 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	100.00'	<b>0.625" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#2	Primary	103.65'	<b>8.000" Horiz. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads

**Primary OutFlow** Max=0.08 cfs @ 13.62 hrs HW=103.69' (Free Discharge)

1=Orifice/Grate (Orifice Controls 0.02 cfs @ 9.22 fps)

2=Orifice/Grate (Weir Controls 0.06 cfs @ 0.68 fps)

**25-C007 Kaady Car Wash**

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Type IA 24-hr 10-Year Rainfall=3.45"

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**Pond 3P: Det SC-800 - Chamber Wizard Field A**

**Chamber Model = ADS\_StormTechSC-800 +Cap (ADS StormTech®SC-800 with cap volume)**

Effective Size= 45.0"W x 33.0"H => 7.11 sf x 7.12'L = 50.6 cf

Overall Size= 51.0"W x 33.0"H x 7.55'L with 0.43' Overlap

Cap Storage= 3.4 cf x 2 x 5 rows = 34.2 cf

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

12 Chambers/Row x 7.12' Long +0.88' Cap Length x 2 = 87.17' Row Length +12.0" End Stone x 2 = 89.17' Base Length

5 Rows x 51.0" Wide + 6.0" Spacing x 4 + 12.0" Side Stone x 2 = 25.25' Base Width

6.0" Stone Base + 33.0" Chamber Height + 6.0" Stone Cover = 3.75' Field Height

60 Chambers x 50.6 cf + 3.4 cf Cap Volume x 2 x 5 Rows = 3,069.7 cf Chamber Storage

8,443.0 cf Field - 3,069.7 cf Chambers = 5,373.2 cf Stone x 40.0% Voids = 2,149.3 cf Stone Storage

Chamber Storage + Stone Storage = 5,219.0 cf = 0.120 af

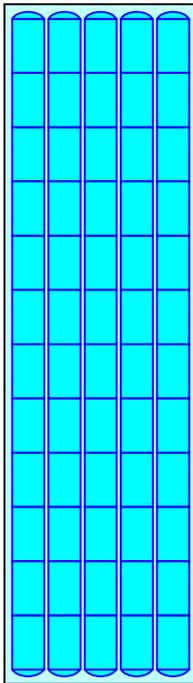
Overall Storage Efficiency = 61.8%

Overall System Size = 89.17' x 25.25' x 3.75'

60 Chambers

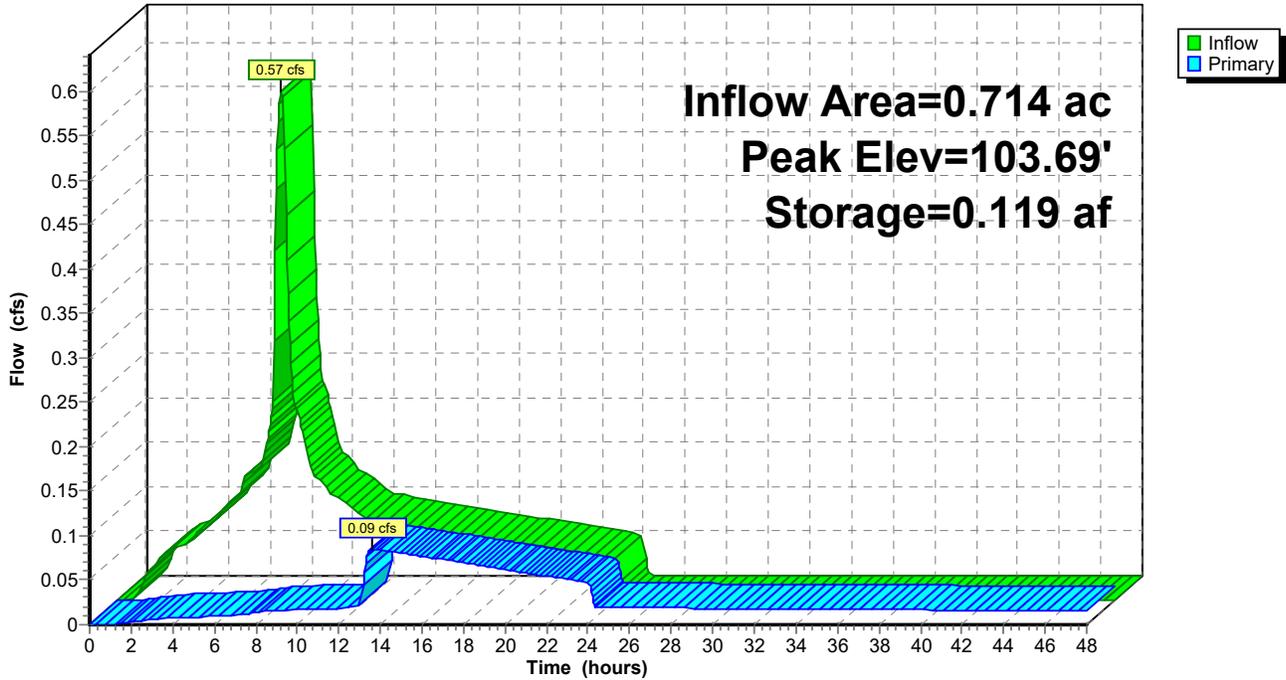
312.7 cy Field

199.0 cy Stone



### Pond 3P: Det SC-800

Hydrograph



**25-C007 Kaady Car Wash**

Type IA 24-hr 25-Year Rainfall=3.90"

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Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points  
Runoff by SBUH method, Split Pervious/Imperv.  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

predev flowrate

**Subcatchment1S: Total Site (PreDev)** Runoff Area=31,100 sf 0.00% Impervious Runoff Depth=1.26"  
Tc=10.0 min CN=70/0 Runoff=0.15 cfs 0.075 af

**Subcatchment2S: Total Site (PostDev)** Runoff Area=31,100 sf 98.99% Impervious Runoff Depth=3.64"  
Tc=5.0 min CN=74/98 Runoff=0.65 cfs 0.217 af

**Pond 3P: Det SC-800** Peak Elev=103.71' Storage=0.119 af Inflow=0.65 cfs 0.217 af  
Outflow=0.12 cfs 0.133 af

**Total Runoff Area = 1.428 ac Runoff Volume = 0.292 af Average Runoff Depth = 2.45"**  
**50.50% Pervious = 0.721 ac 49.50% Impervious = 0.707 ac**

Peak flowrate for conveyance

**25-C007 Kaady Car Wash**

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Type IA 24-hr 25-Year Rainfall=3.90"

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**Summary for Subcatchment 1S: Total Site (PreDev)**

Runoff = 0.15 cfs @ 8.02 hrs, Volume= 0.075 af, Depth= 1.26"

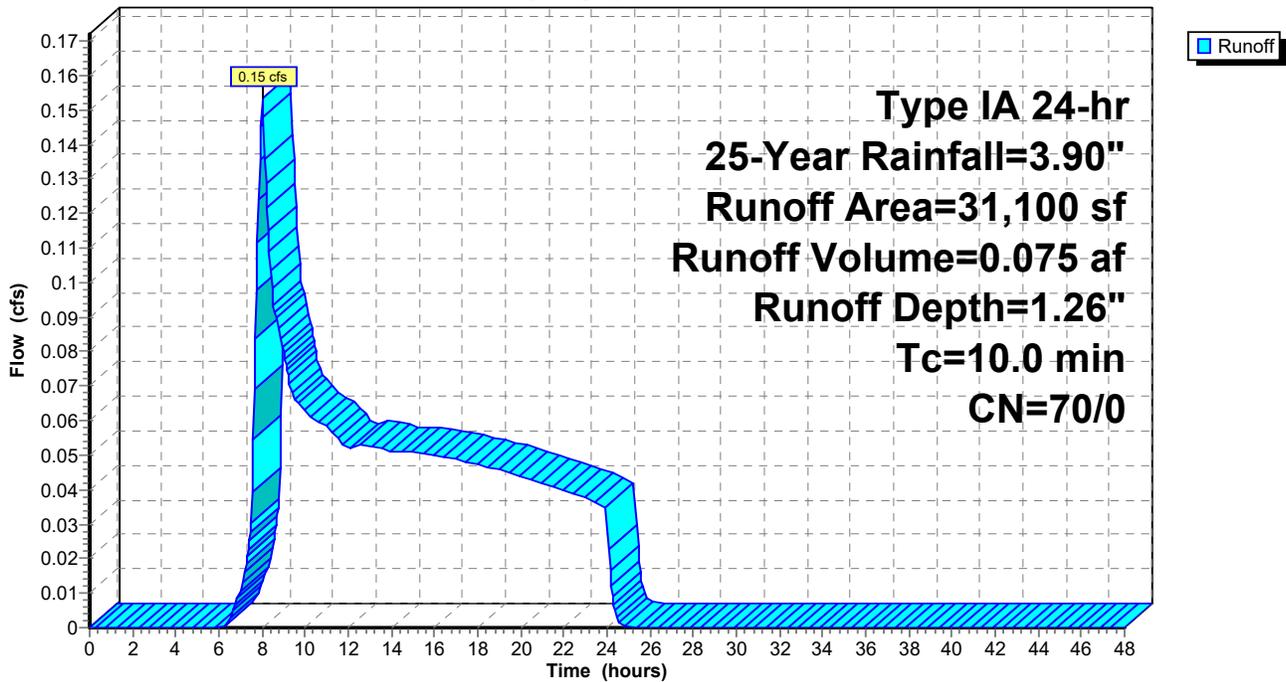
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
Type IA 24-hr 25-Year Rainfall=3.90"

	Area (sf)	CN	Description
*	31,100	70	
	31,100	70	100.00% Pervious Area

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

**Subcatchment 1S: Total Site (PreDev)**

Hydrograph



**25-C007 Kaady Car Wash**

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Type IA 24-hr 25-Year Rainfall=3.90"

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**Summary for Subcatchment 2S: Total Site (PostDev)**

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.65 cfs @ 7.90 hrs, Volume= 0.217 af, Depth= 3.64"  
 Routed to Pond 3P : Det SC-800

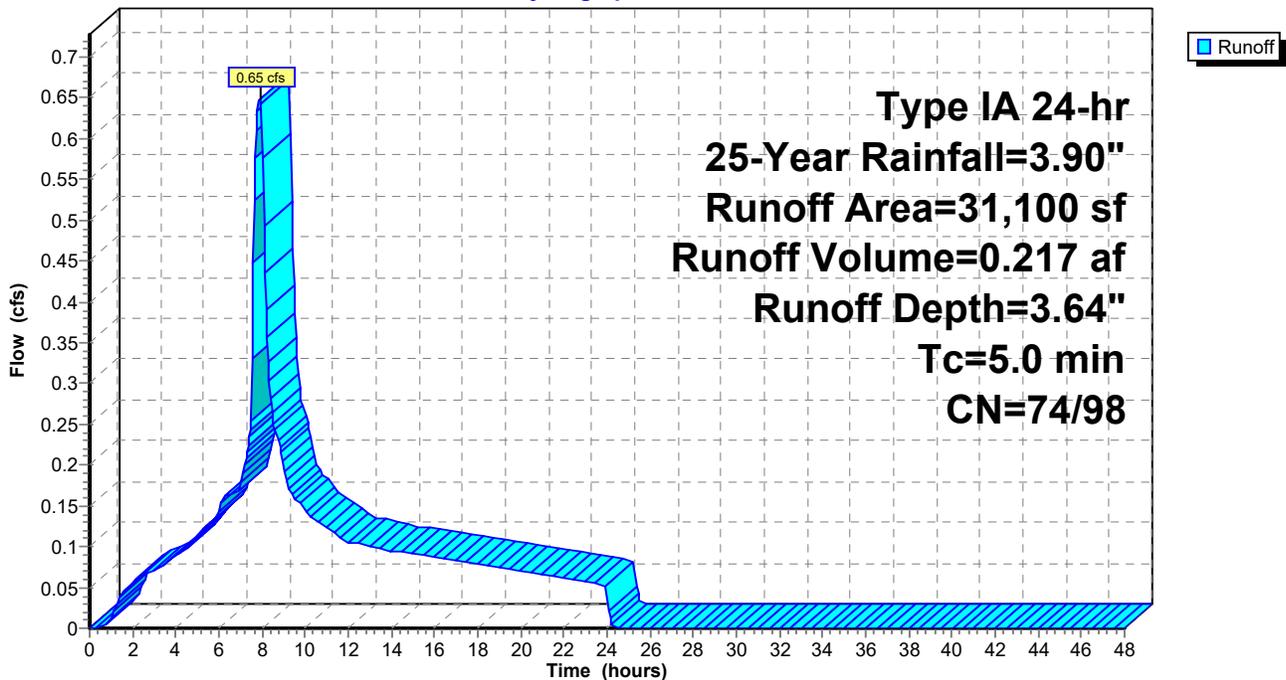
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
 Type IA 24-hr 25-Year Rainfall=3.90"

	Area (sf)	CN	Description
*	30,786	98	
*	314	74	
	31,100	98	Weighted Average
	314	74	1.01% Pervious Area
	30,786	98	98.99% Impervious Area

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

**Subcatchment 2S: Total Site (PostDev)**

Hydrograph



**25-C007 Kaady Car Wash**

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Type IA 24-hr 25-Year Rainfall=3.90"

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**Summary for Pond 3P: Det SC-800**

Inflow Area = 0.714 ac, 98.99% Impervious, Inflow Depth = 3.64" for 25-Year event  
 Inflow = 0.65 cfs @ 7.90 hrs, Volume= 0.217 af  
 Outflow = 0.12 cfs @ 11.21 hrs, Volume= 0.133 af, Atten= 82%, Lag= 198.8 min  
 Primary = 0.12 cfs @ 11.21 hrs, Volume= 0.133 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
 Peak Elev= 103.71' @ 11.21 hrs Surf.Area= 0.052 ac Storage= 0.119 af

Plug-Flow detention time= 819.7 min calculated for 0.133 af (61% of inflow)  
 Center-of-Mass det. time= 595.3 min ( 1,257.4 - 662.1 )

Volume	Invert	Avail.Storage	Storage Description
#1A	100.00'	0.049 af	<b>25.25"W x 89.17"L x 3.75"H Field A</b> 0.194 af Overall - 0.070 af Embedded = 0.123 af x 40.0% Voids
#2A	100.50'	0.070 af	<b>ADS_StormTech SC-800 +Cap</b> x 60 Inside #1 Effective Size= 45.0"W x 33.0"H => 7.11 sf x 7.12'L = 50.6 cf Overall Size= 51.0"W x 33.0"H x 7.55'L with 0.43' Overlap 60 Chambers in 5 Rows Cap Storage= 3.4 cf x 2 x 5 rows = 34.2 cf
		0.120 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	100.00'	<b>0.625" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#2	Primary	103.65'	<b>8.000" Horiz. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads

**Primary OutFlow** Max=0.12 cfs @ 11.21 hrs HW=103.71' (Free Discharge)

1=Orifice/Grate (Orifice Controls 0.02 cfs @ 9.24 fps)

2=Orifice/Grate (Weir Controls 0.10 cfs @ 0.80 fps)

**25-C007 Kaady Car Wash**

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Type IA 24-hr 25-Year Rainfall=3.90"

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**Pond 3P: Det SC-800 - Chamber Wizard Field A**

**Chamber Model = ADS\_StormTechSC-800 +Cap (ADS StormTech®SC-800 with cap volume)**

Effective Size= 45.0"W x 33.0"H => 7.11 sf x 7.12'L = 50.6 cf

Overall Size= 51.0"W x 33.0"H x 7.55'L with 0.43' Overlap

Cap Storage= 3.4 cf x 2 x 5 rows = 34.2 cf

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

12 Chambers/Row x 7.12' Long +0.88' Cap Length x 2 = 87.17' Row Length +12.0" End Stone x 2 = 89.17' Base Length

5 Rows x 51.0" Wide + 6.0" Spacing x 4 + 12.0" Side Stone x 2 = 25.25' Base Width

6.0" Stone Base + 33.0" Chamber Height + 6.0" Stone Cover = 3.75' Field Height

60 Chambers x 50.6 cf + 3.4 cf Cap Volume x 2 x 5 Rows = 3,069.7 cf Chamber Storage

8,443.0 cf Field - 3,069.7 cf Chambers = 5,373.2 cf Stone x 40.0% Voids = 2,149.3 cf Stone Storage

Chamber Storage + Stone Storage = 5,219.0 cf = 0.120 af

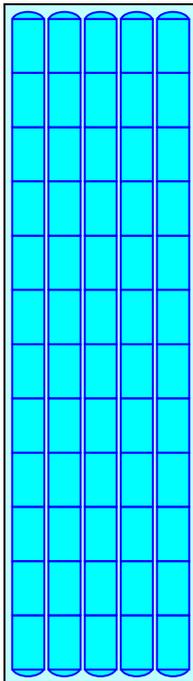
Overall Storage Efficiency = 61.8%

Overall System Size = 89.17' x 25.25' x 3.75'

60 Chambers

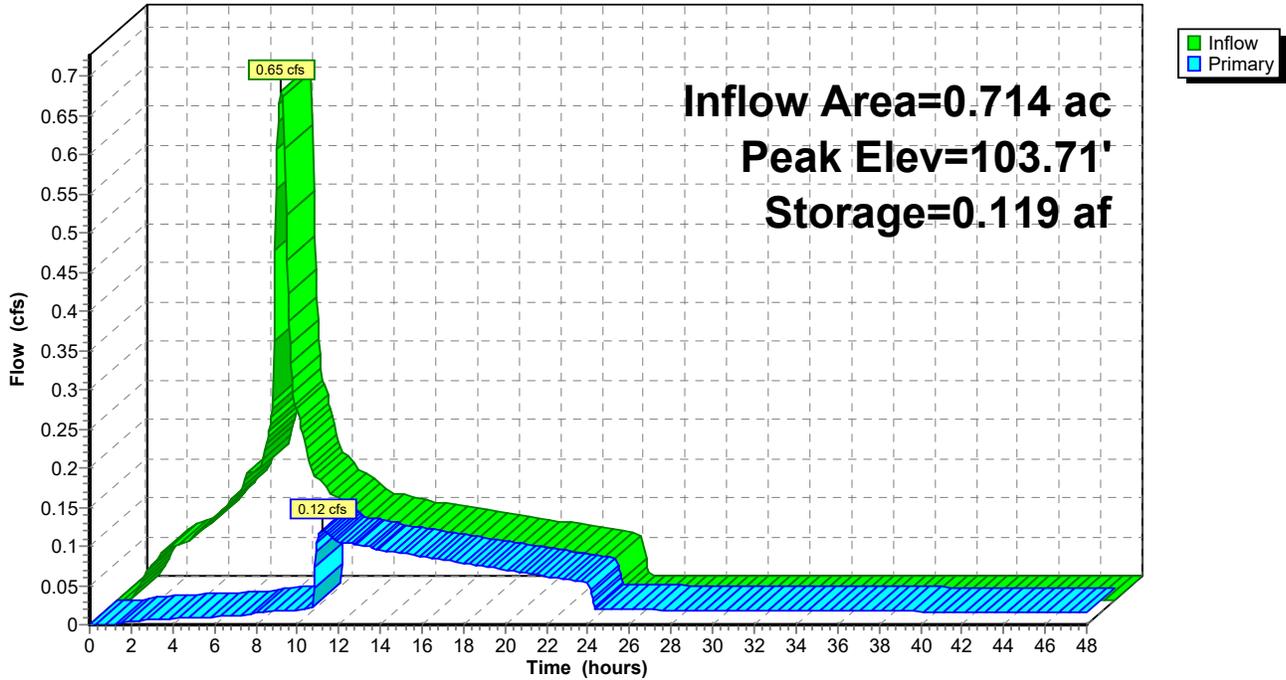
312.7 cy Field

199.0 cy Stone



### Pond 3P: Det SC-800

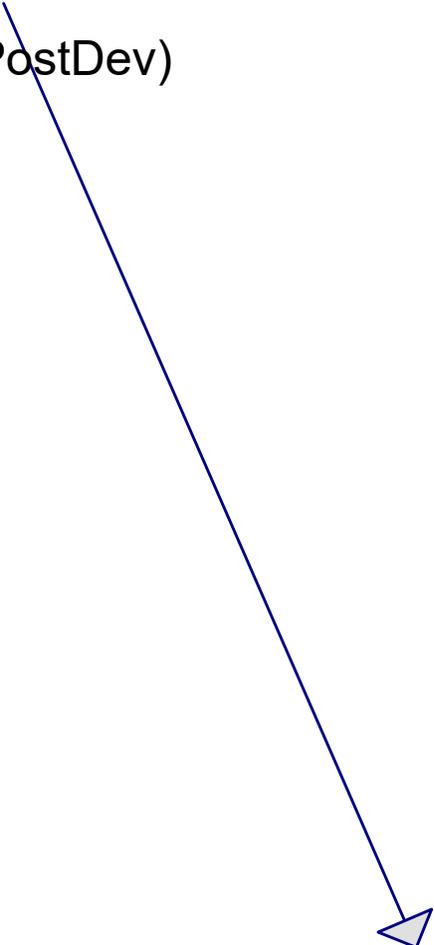
Hydrograph



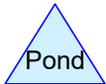
CONCRETE DETENTION PIPE ANALYSIS



Total Site (PostDev)



Det Conc Pipe



Routing Diagram for 25-C007 Kaady Car Wash  
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## 25-C007 Kaady Car Wash

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### Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	Type IA 24-hr		Default	24.00	1	2.50	2
2	10-Year	Type IA 24-hr		Default	24.00	1	3.45	2
3	25-Year	Type IA 24-hr		Default	24.00	1	3.90	2



**25-C007 Kaady Car Wash**

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Type IA 24-hr 2-Year Rainfall=2.50"

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**Summary for Subcatchment 2S: Total Site (PostDev)**

[49] Hint:  $T_c < 2dt$  may require smaller dt

Runoff = 0.41 cfs @ 7.90 hrs, Volume= 0.134 af, Depth= 2.25"  
 Routed to Pond 6P : Det Conc Pipe

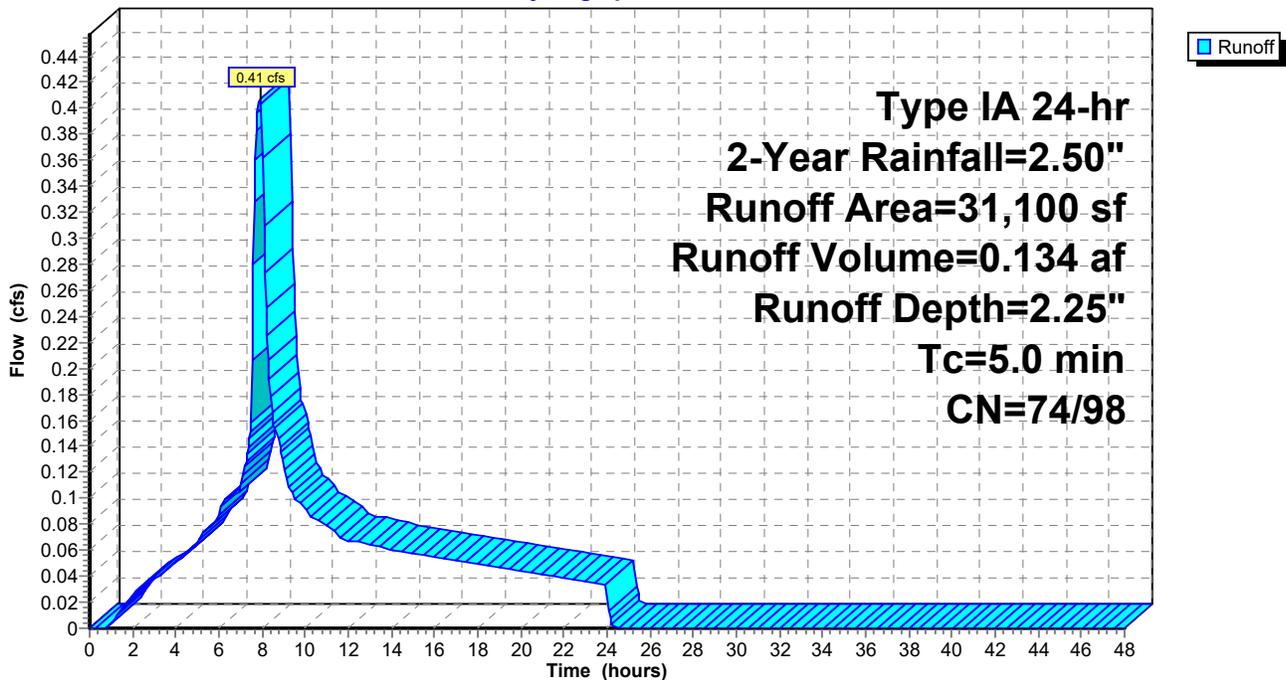
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
 Type IA 24-hr 2-Year Rainfall=2.50"

	Area (sf)	CN	Description
*	30,786	98	
*	314	74	
	31,100	98	Weighted Average
	314	74	1.01% Pervious Area
	30,786	98	98.99% Impervious Area

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

**Subcatchment 2S: Total Site (PostDev)**

Hydrograph



**25-C007 Kaady Car Wash**

Type IA 24-hr 2-Year Rainfall=2.50"

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**Summary for Pond 6P: Det Conc Pipe**

Inflow Area = 0.714 ac, 98.99% Impervious, Inflow Depth = 2.25" for 2-Year event  
 Inflow = 0.41 cfs @ 7.90 hrs, Volume= 0.134 af  
 Outflow = 0.02 cfs @ 24.07 hrs, Volume= 0.066 af, Atten= 95%, Lag= 970.2 min  
 Primary = 0.02 cfs @ 24.07 hrs, Volume= 0.066 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
 Peak Elev= 102.63' @ 24.07 hrs Surf.Area= 0.065 ac Storage= 0.105 af

Plug-Flow detention time= 1,181.4 min calculated for 0.066 af (49% of inflow)  
 Center-of-Mass det. time= 915.5 min ( 1,590.0 - 674.4 )

Volume	Invert	Avail.Storage	Storage Description
#1A	100.00'	0.028 af	<b>22.00"W x 129.00'L x 3.08'H Field A</b> 0.201 af Overall - 0.132 af Embedded = 0.069 af x 40.0% Voids
#2A	100.00'	0.087 af	<b>RCP Round 30 x 96 Inside #1</b> Inside= 30.0"W x 30.0"H => 4.91 sf x 8.00'L = 39.3 cf Outside= 37.0"W x 37.0"H => 7.46 sf x 8.00'L = 59.7 cf 96 Chambers in 6 Rows
		0.114 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	100.00'	<b>0.700" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#2	Primary	102.90'	<b>8.000" Horiz. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads

**Primary OutFlow** Max=0.02 cfs @ 24.07 hrs HW=102.63' (Free Discharge)  
 1=Orifice/Grate (Orifice Controls 0.02 cfs @ 7.76 fps)  
 2=Orifice/Grate ( Controls 0.00 cfs)

**25-C007 Kaady Car Wash**

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Type IA 24-hr 2-Year Rainfall=2.50"

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**Pond 6P: Det Conc Pipe - Chamber Wizard Field A**

**Chamber Model = RCP Round 30 (Round Reinforced Concrete Pipe)**

Inside= 30.0"W x 30.0"H => 4.91 sf x 8.00'L = 39.3 cf

Outside= 37.0"W x 37.0"H => 7.46 sf x 8.00'L = 59.7 cf

37.0" Wide + 6.0" Spacing = 43.0" C-C Row Spacing

16 Chambers/Row x 8.00' Long = 128.00' Row Length +6.0" End Stone x 2 = 129.00' Base Length

6 Rows x 37.0" Wide + 6.0" Spacing x 5 + 6.0" Side Stone x 2 = 22.00' Base Width

37.0" Chamber Height = 3.08' Field Height

96 Chambers x 39.3 cf = 3,769.9 cf Chamber Storage

96 Chambers x 59.7 cf = 5,732.0 cf Displacement

8,750.5 cf Field - 5,732.0 cf Chambers = 3,018.5 cf Stone x 40.0% Voids = 1,207.4 cf Stone Storage

Chamber Storage + Stone Storage = 4,977.3 cf = 0.114 af

Overall Storage Efficiency = 56.9%

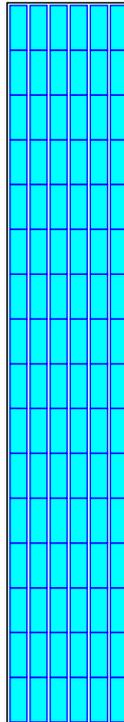
Overall System Size = 129.00' x 22.00' x 3.08'

**OVERALL SIZE**

96 Chambers

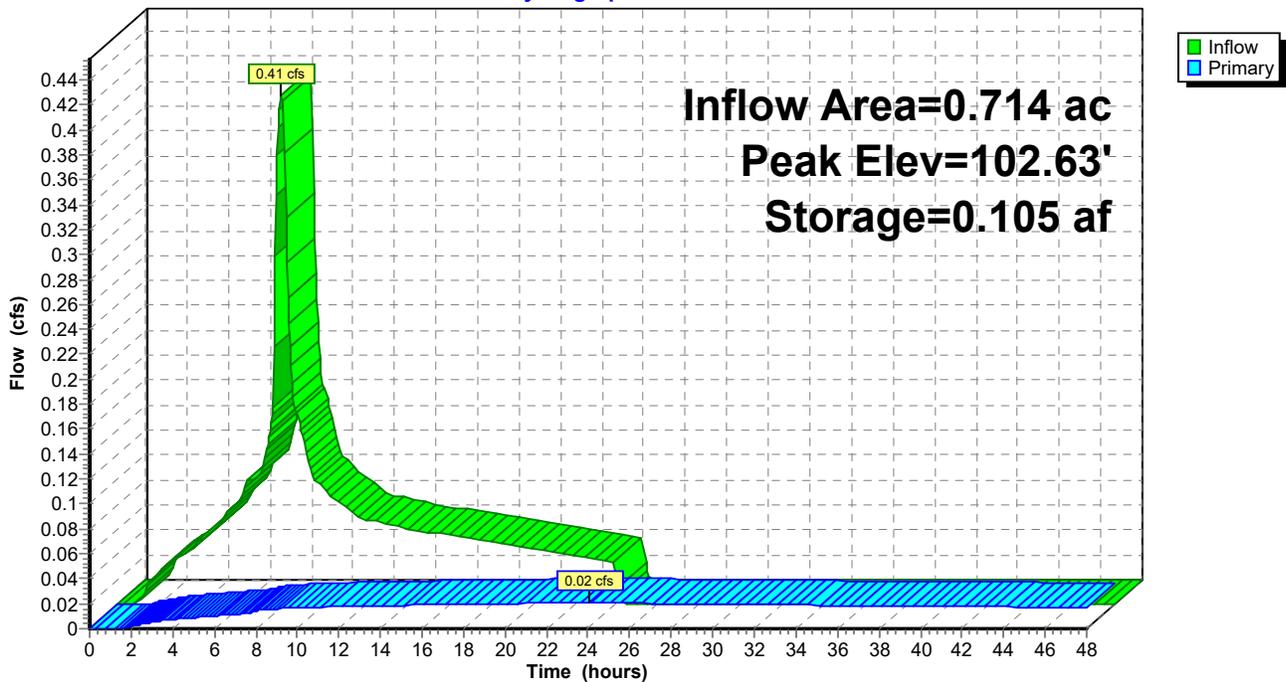
324.1 cy Field

111.8 cy Stone



### Pond 6P: Det Conc Pipe

Hydrograph



**25-C007 Kaady Car Wash**

Type IA 24-hr 10-Year Rainfall=3.45"

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Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points

Runoff by SBUH method, Split Pervious/Imperv.

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment2S: Total Site (PostDev)**

Runoff Area=31,100 sf 98.99% Impervious Runoff Depth=3.20"  
Tc=5.0 min CN=74/98 Runoff=0.57 cfs 0.190 af

**Pond 6P: Det Conc Pipe**

Peak Elev=102.95' Storage=0.111 af Inflow=0.57 cfs 0.190 af  
Outflow=0.09 cfs 0.117 af

**Total Runoff Area = 0.714 ac Runoff Volume = 0.190 af Average Runoff Depth = 3.20"**  
**1.01% Pervious = 0.007 ac 98.99% Impervious = 0.707 ac**

**25-C007 Kaady Car Wash**

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Type IA 24-hr 10-Year Rainfall=3.45"

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**Summary for Subcatchment 2S: Total Site (PostDev)**

[49] Hint:  $T_c < 2dt$  may require smaller  $dt$

Runoff = 0.57 cfs @ 7.90 hrs, Volume= 0.190 af, Depth= 3.20"  
 Routed to Pond 6P : Det Conc Pipe

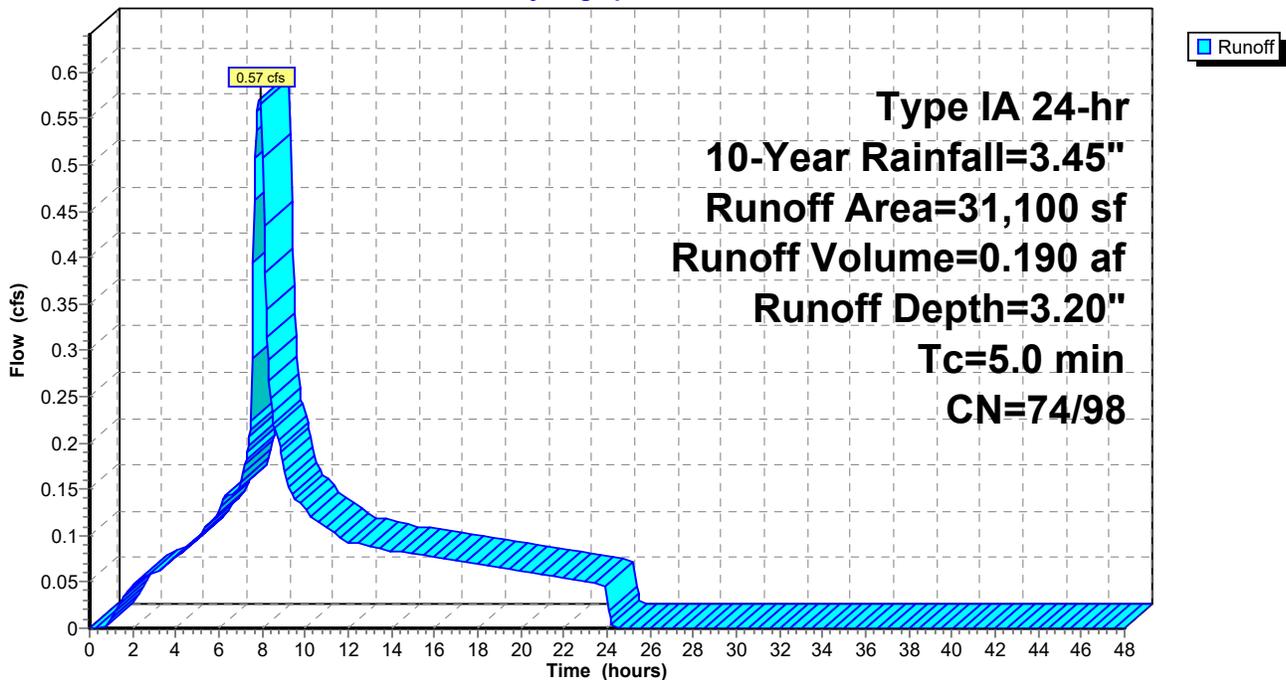
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs,  $dt= 0.05$  hrs  
 Type IA 24-hr 10-Year Rainfall=3.45"

	Area (sf)	CN	Description
*	30,786	98	
*	314	74	
	31,100	98	Weighted Average
	314	74	1.01% Pervious Area
	30,786	98	98.99% Impervious Area

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

**Subcatchment 2S: Total Site (PostDev)**

Hydrograph



**25-C007 Kaady Car Wash**

Type IA 24-hr 10-Year Rainfall=3.45"

Prepared by Froelich Engineers

Printed 7/29/2025

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**Summary for Pond 6P: Det Conc Pipe**

Inflow Area = 0.714 ac, 98.99% Impervious, Inflow Depth = 3.20" for 10-Year event  
 Inflow = 0.57 cfs @ 7.90 hrs, Volume= 0.190 af  
 Outflow = 0.09 cfs @ 12.65 hrs, Volume= 0.117 af, Atten= 84%, Lag= 285.2 min  
 Primary = 0.09 cfs @ 12.65 hrs, Volume= 0.117 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
 Peak Elev= 102.95' @ 12.65 hrs Surf.Area= 0.065 ac Storage= 0.111 af

Plug-Flow detention time= 908.7 min calculated for 0.117 af (62% of inflow)  
 Center-of-Mass det. time= 684.7 min ( 1,349.8 - 665.1 )

Volume	Invert	Avail.Storage	Storage Description
#1A	100.00'	0.028 af	<b>22.00"W x 129.00'L x 3.08'H Field A</b> 0.201 af Overall - 0.132 af Embedded = 0.069 af x 40.0% Voids
#2A	100.00'	0.087 af	<b>RCP Round 30 x 96 Inside #1</b> Inside= 30.0"W x 30.0"H => 4.91 sf x 8.00'L = 39.3 cf Outside= 37.0"W x 37.0"H => 7.46 sf x 8.00'L = 59.7 cf 96 Chambers in 6 Rows
		0.114 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	100.00'	<b>0.700" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#2	Primary	102.90'	<b>8.000" Horiz. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads

**Primary OutFlow** Max=0.09 cfs @ 12.65 hrs HW=102.95' (Free Discharge)  
 1=Orifice/Grate (Orifice Controls 0.02 cfs @ 8.22 fps)  
 2=Orifice/Grate (Weir Controls 0.07 cfs @ 0.70 fps)

**25-C007 Kaady Car Wash**

Prepared by Froelich Engineers

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Type IA 24-hr 10-Year Rainfall=3.45"

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**Pond 6P: Det Conc Pipe - Chamber Wizard Field A**

**Chamber Model = RCP Round 30 (Round Reinforced Concrete Pipe)**

Inside= 30.0"W x 30.0"H => 4.91 sf x 8.00'L = 39.3 cf

Outside= 37.0"W x 37.0"H => 7.46 sf x 8.00'L = 59.7 cf

37.0" Wide + 6.0" Spacing = 43.0" C-C Row Spacing

16 Chambers/Row x 8.00' Long = 128.00' Row Length +6.0" End Stone x 2 = 129.00' Base Length

6 Rows x 37.0" Wide + 6.0" Spacing x 5 + 6.0" Side Stone x 2 = 22.00' Base Width

37.0" Chamber Height = 3.08' Field Height

96 Chambers x 39.3 cf = 3,769.9 cf Chamber Storage

96 Chambers x 59.7 cf = 5,732.0 cf Displacement

8,750.5 cf Field - 5,732.0 cf Chambers = 3,018.5 cf Stone x 40.0% Voids = 1,207.4 cf Stone Storage

Chamber Storage + Stone Storage = 4,977.3 cf = 0.114 af

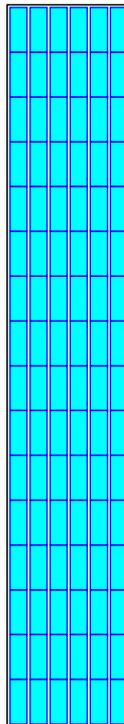
Overall Storage Efficiency = 56.9%

Overall System Size = 129.00' x 22.00' x 3.08'

96 Chambers

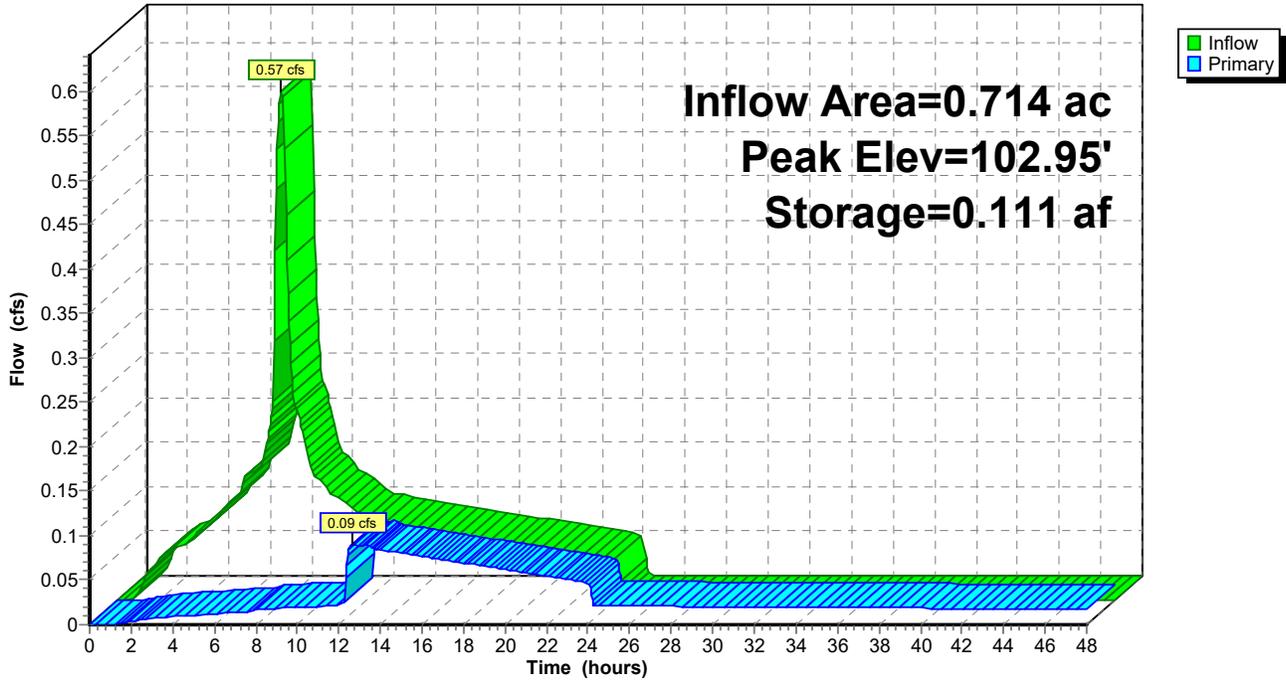
324.1 cy Field

111.8 cy Stone



### Pond 6P: Det Conc Pipe

Hydrograph





**25-C007 Kaady Car Wash**

Prepared by Froelich Engineers

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Type IA 24-hr 25-Year Rainfall=3.90"

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**Summary for Subcatchment 2S: Total Site (PostDev)**

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.65 cfs @ 7.90 hrs, Volume= 0.217 af, Depth= 3.64"  
 Routed to Pond 6P : Det Conc Pipe

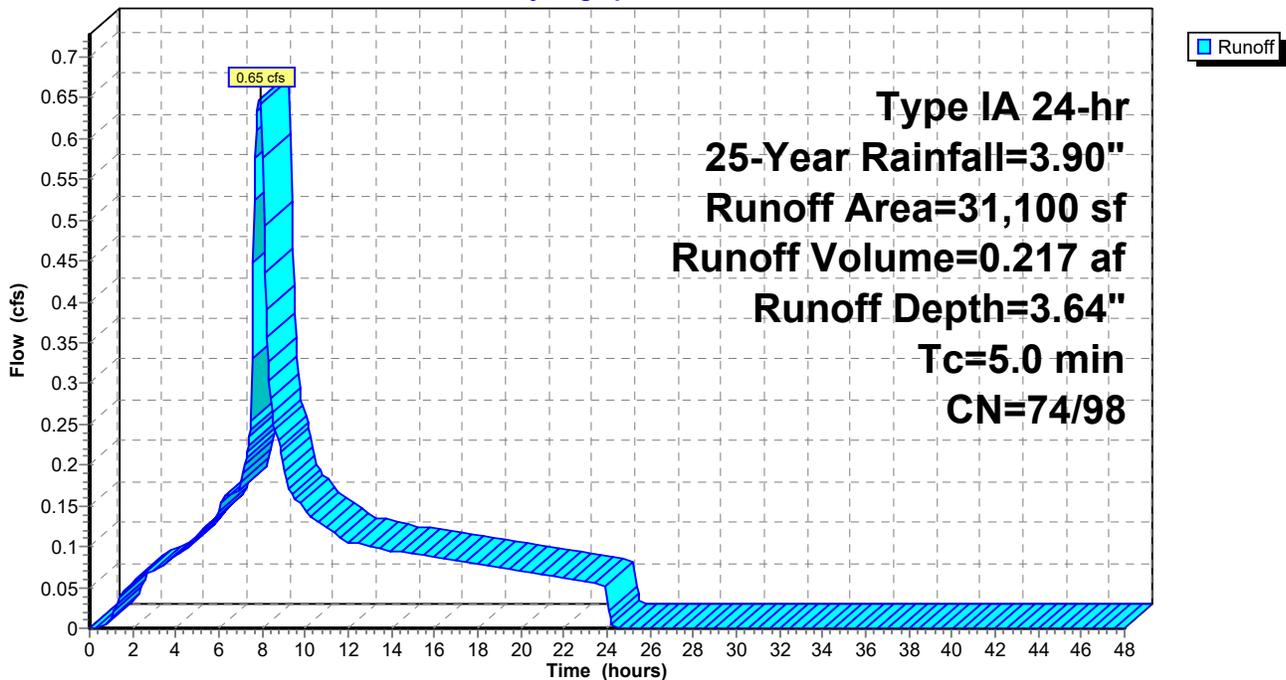
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
 Type IA 24-hr 25-Year Rainfall=3.90"

	Area (sf)	CN	Description
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	30,786	98	98.99% Impervious Area

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

**Subcatchment 2S: Total Site (PostDev)**

Hydrograph



**25-C007 Kaady Car Wash**

Type IA 24-hr 25-Year Rainfall=3.90"

Prepared by Froelich Engineers

Printed 7/29/2025

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**Summary for Pond 6P: Det Conc Pipe**

Inflow Area = 0.714 ac, 98.99% Impervious, Inflow Depth = 3.64" for 25-Year event  
 Inflow = 0.65 cfs @ 7.90 hrs, Volume= 0.217 af  
 Outflow = 0.13 cfs @ 10.69 hrs, Volume= 0.144 af, Atten= 80%, Lag= 167.5 min  
 Primary = 0.13 cfs @ 10.69 hrs, Volume= 0.144 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
 Peak Elev= 102.96' @ 10.69 hrs Surf.Area= 0.065 ac Storage= 0.112 af

Plug-Flow detention time= 789.5 min calculated for 0.144 af (66% of inflow)  
 Center-of-Mass det. time= 585.3 min ( 1,247.4 - 662.1 )

Volume	Invert	Avail.Storage	Storage Description
#1A	100.00'	0.028 af	<b>22.00"W x 129.00'L x 3.08'H Field A</b> 0.201 af Overall - 0.132 af Embedded = 0.069 af x 40.0% Voids
#2A	100.00'	0.087 af	<b>RCP Round 30 x 96 Inside #1</b> Inside= 30.0"W x 30.0"H => 4.91 sf x 8.00'L = 39.3 cf Outside= 37.0"W x 37.0"H => 7.46 sf x 8.00'L = 59.7 cf 96 Chambers in 6 Rows
		0.114 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	100.00'	<b>0.700" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#2	Primary	102.90'	<b>8.000" Horiz. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads

**Primary OutFlow** Max=0.13 cfs @ 10.69 hrs HW=102.96' (Free Discharge)  
 1=Orifice/Grate (Orifice Controls 0.02 cfs @ 8.25 fps)  
 2=Orifice/Grate (Weir Controls 0.11 cfs @ 0.82 fps)

**25-C007 Kaady Car Wash**

Prepared by Froelich Engineers

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Type IA 24-hr 25-Year Rainfall=3.90"

Printed 7/29/2025

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**Pond 6P: Det Conc Pipe - Chamber Wizard Field A**

**Chamber Model = RCP Round 30 (Round Reinforced Concrete Pipe)**

Inside= 30.0"W x 30.0"H => 4.91 sf x 8.00'L = 39.3 cf

Outside= 37.0"W x 37.0"H => 7.46 sf x 8.00'L = 59.7 cf

37.0" Wide + 6.0" Spacing = 43.0" C-C Row Spacing

16 Chambers/Row x 8.00' Long = 128.00' Row Length +6.0" End Stone x 2 = 129.00' Base Length

6 Rows x 37.0" Wide + 6.0" Spacing x 5 + 6.0" Side Stone x 2 = 22.00' Base Width

37.0" Chamber Height = 3.08' Field Height

96 Chambers x 39.3 cf = 3,769.9 cf Chamber Storage

96 Chambers x 59.7 cf = 5,732.0 cf Displacement

8,750.5 cf Field - 5,732.0 cf Chambers = 3,018.5 cf Stone x 40.0% Voids = 1,207.4 cf Stone Storage

Chamber Storage + Stone Storage = 4,977.3 cf = 0.114 af

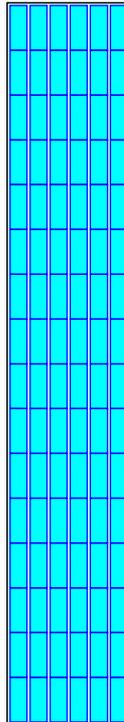
Overall Storage Efficiency = 56.9%

Overall System Size = 129.00' x 22.00' x 3.08'

96 Chambers

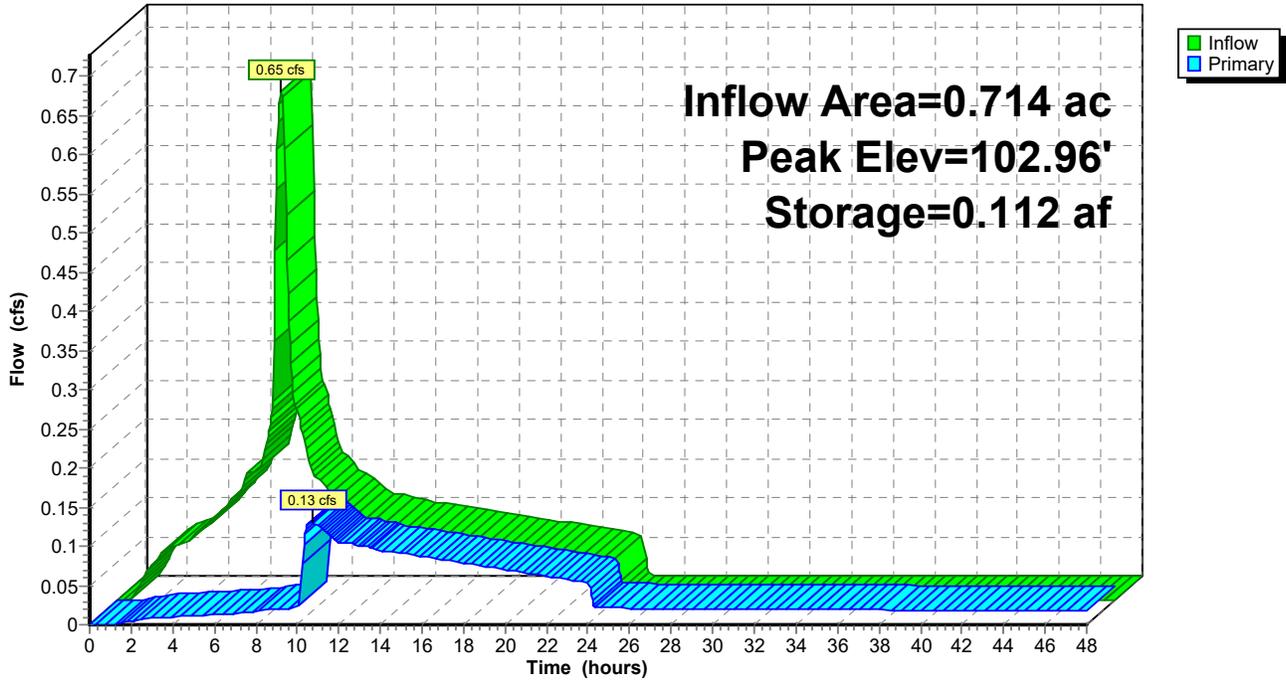
324.1 cy Field

111.8 cy Stone

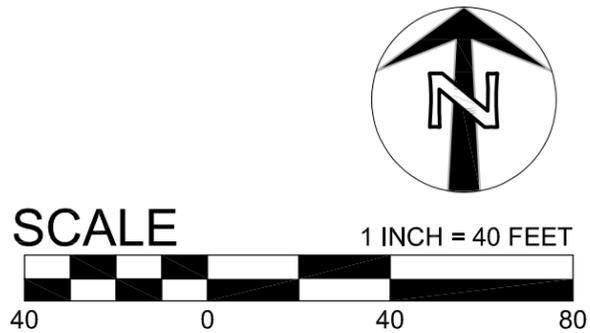
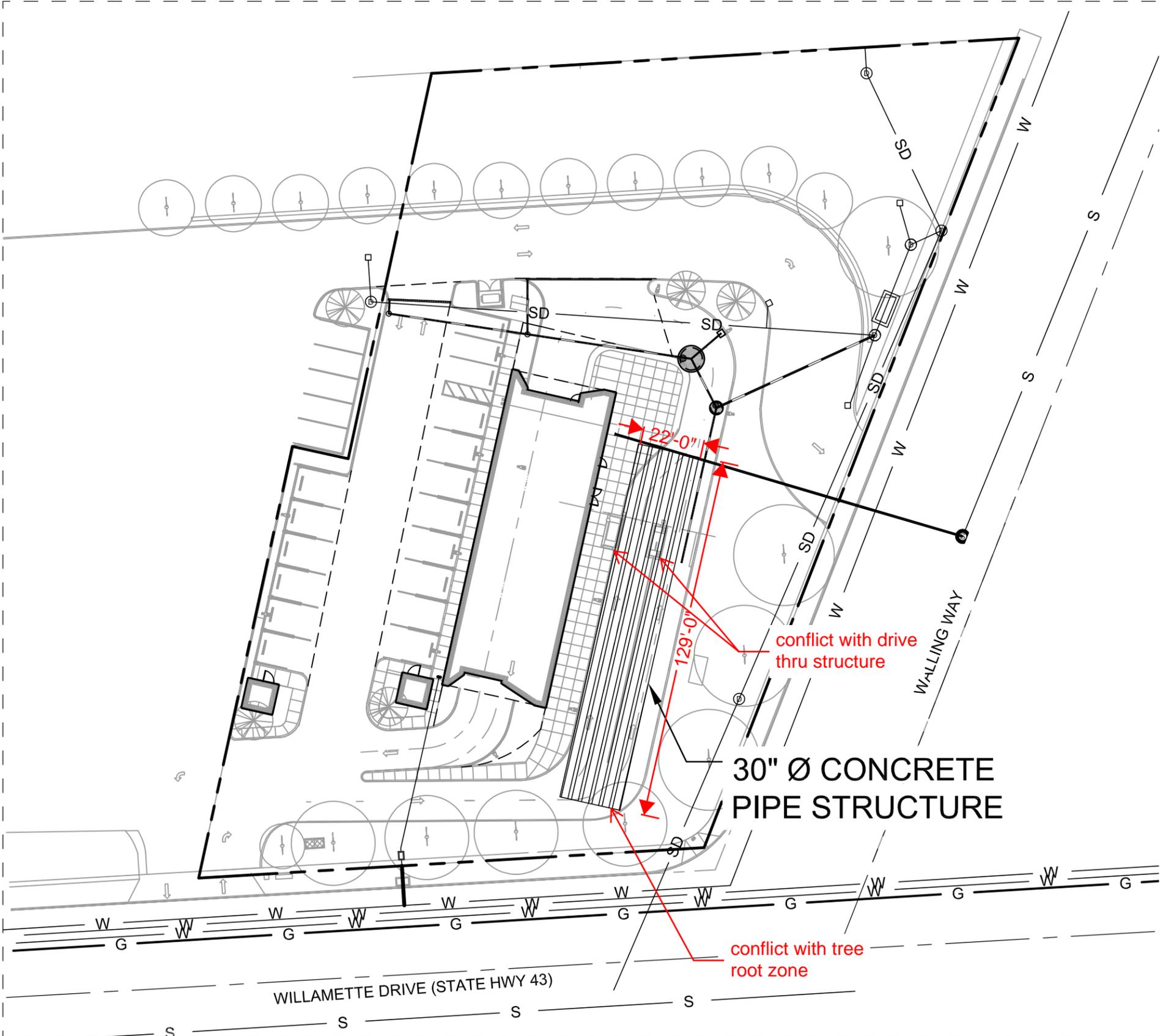


### Pond 6P: Det Conc Pipe

Hydrograph



File: P:\2025\25-C007 (Kaady Car Wash - West Linn)\300 Civil Design Documents - Froelich\302 CAD\Plot\25-C007\_C4.0-UTL.dwg TAB:C4.0 (exhibit)



**tva** architects inc.  
 920 sw sixth avenue | suite 1500 | portland, oregon 97204  
 phone: 503 220 0668 | www.tvaarchitects.com  
 Exhibit PC-4  
 Plotted: 7/31/25 at 4:08pm By: atomlinson

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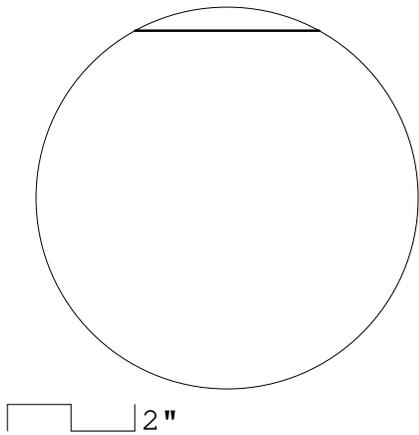
**APPENDIX G EXHIBIT**  
**UTILITY PLAN**

**KAADY CAR WASH - WEST LINN**  
 18850 WILLAMETTE DRIVE WEST LINN, OR  
 CUP-25-03/DR-25-03/VAR-25-02

## **Appendix H: Stormwater Conveyance Calculations**

**Project** 25-C007  
Kaady Car Wash

**GRAVITY PIPE FLOW (Chezy-Manning)**  
6-inch Pipe @ 1.5%

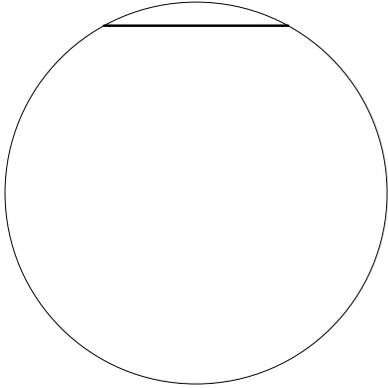


diameter = 6.0"  
slope = 1.50%  
material: ABS, PVC  
Manning's n = 0.013  
depth of flow = 93.82% of diameter (max)

wetted perimeter = 1.32'  
area = 0.19 s.f.  
hydraulic radius = 0.14'  
velocity = 3.87 fps  
flow = 0.74 cfs

**Project** 25-C007  
Kaady Car Wash

**GRAVITY PIPE FLOW (Chezy-Manning)**  
8-inch Pipe @ 1.0%



┌┐ 2"

diameter = 8.0"  
slope = 1.00%  
material: ABS, PVC  
Manning's n = 0.013  
depth of flow = 93.82% of diameter (max)

wetted perimeter = 1.76'  
area = 0.34 s.f.  
hydraulic radius = 0.19'  
velocity = 3.83 fps  
flow = 1.30 cfs

## **Appendix I: Utility Plan / Details**



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1750 sw yamhill st | suite 150  
portland, oregon 97205  
phone: 503 220 0668  
www.tvaarchitects.com



KAADY CAR WASH  
WEST LINN, OREGON

Revisions

### SHEET NOTES

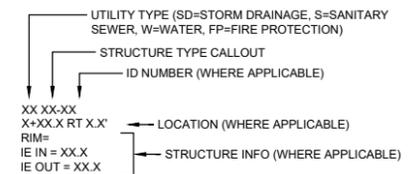
- PIPE BEDDING AND BACKFILL FOR ALL UTILITIES SHALL BE DONE PER DETAIL X/C5.X.
- STRUCTURES LOCATIONS ARE BASED ON CENTER OF STRUCTURE.
- INSTALL TRUST BLOCK ON FIRE AND WATER LINES PER DETAIL X & X/CX.X.

### KEY NOTES

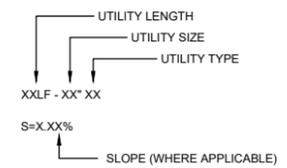
- COORDINATE WATER SERVICE POINT OF CONNECTION TO EXISTING "X" LATERAL WITH CITY OF WEST LINN.
- FIELD VERIFY LOCATION AND IE OF EXISTING "X" LATERAL PRIOR TO CONSTRUCTION.
- IRRIGATION BACKFLOW ASSEMBLY VAULT, SEE LANDSCAPE PLANS.

### UTILITY LABEL LEGEND

#### STRUCTURE LABEL



#### PIPE LABEL

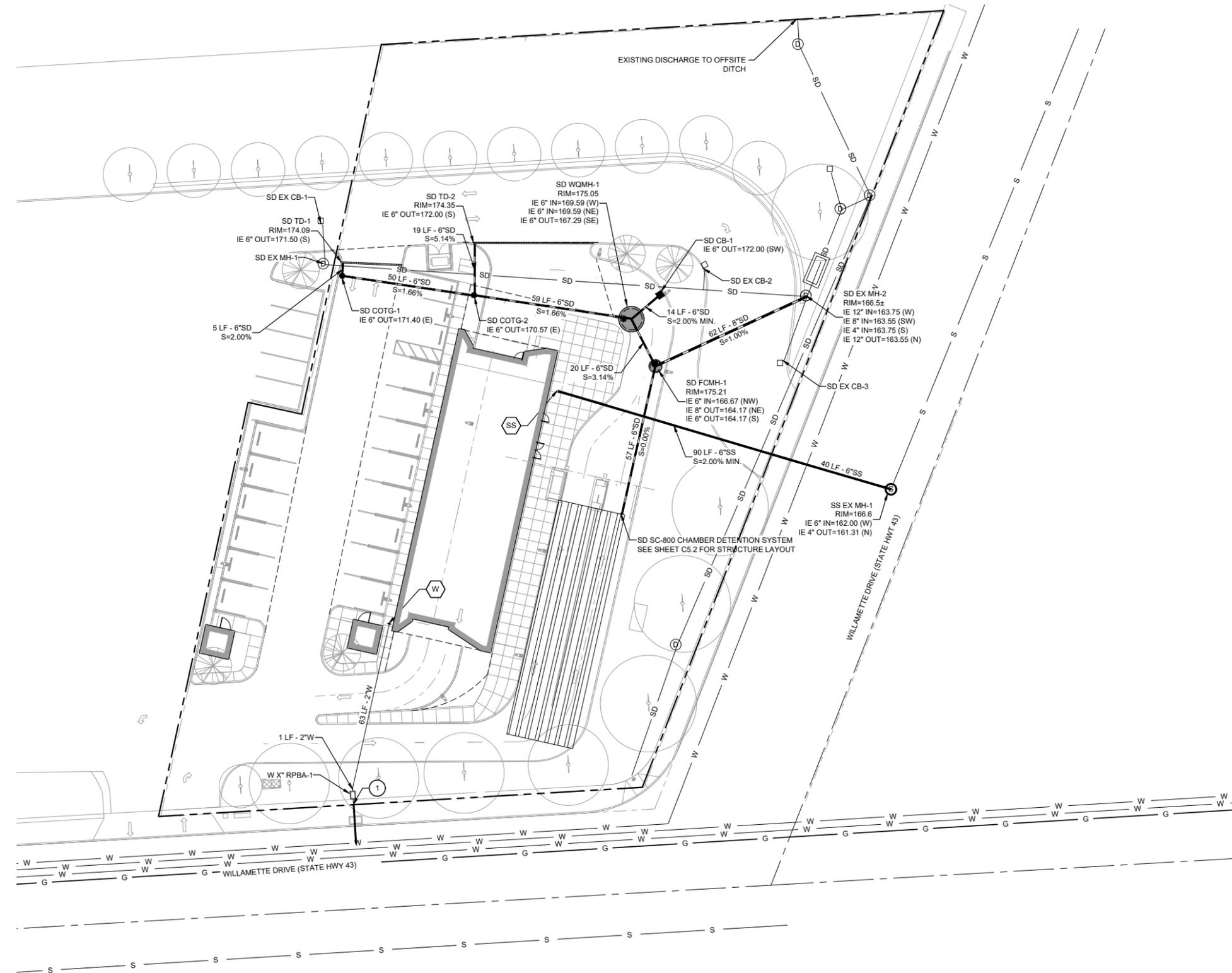


#### STRUCTURE TYPE

CALLOUT	DESCRIPTION	DETAIL REF.
BEND	BEND, USE FITTING IF APPLICABLE	(X)
BWV	BACKWATER VALVE	(XX)
CB	TRAPPED CATCH BASIN	(XX)
CO	CLEANOUT TO GRADE	(XX)
CONN	CONNECTION	
DW	DRYWELL	
FCMH	FLOW CONTROL MANHOLE	
FD	FOUNDATION DRAINAGE POINT OF CONN.	
FH	FIRE HYDRANT	
GV	GATE VALVE	
OF	OUTFALL	
OV	OVERFLOW INLET	
SDMH	48" DIA. STORM DRAIN MH	
TD	TRENCH DRAIN	
TEE	TEE CONNECTION	
WYE	WYE CONNECTION	
WQMH	WATER QUALITY MANHOLE	

### SHEET LEGEND

- (SS) CONNECT TO WASTE LINE. SEE PLUMBING PLANS FOR CONTINUATION. SIZE AS NOTED.
- (RD) CONNECT TO STORM DRAIN/ROOF DRAIN. SEE PLUMBING PLANS FOR CONTINUATION. SIZE AND IE AS NOTED.
- (W) CONNECT TO COLD WATER SYSTEM. SEE PLUMBING PLANS FOR CONTINUATION. SIZE AS NOTED.
- (||) UTILITY CROSSING. PROVIDE 12" MIN. CLEARANCE, U.N.O.



CONSTRUCTION SET

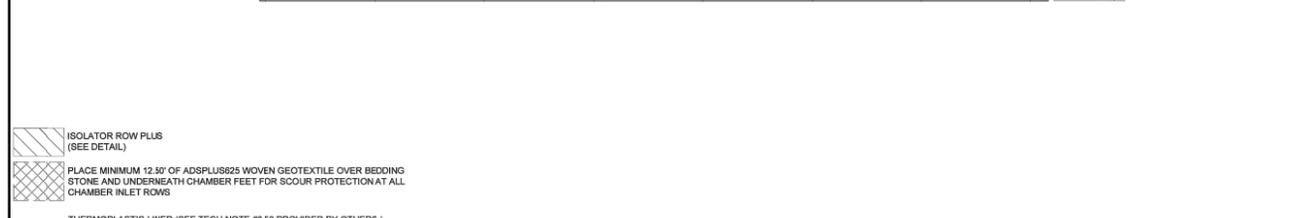
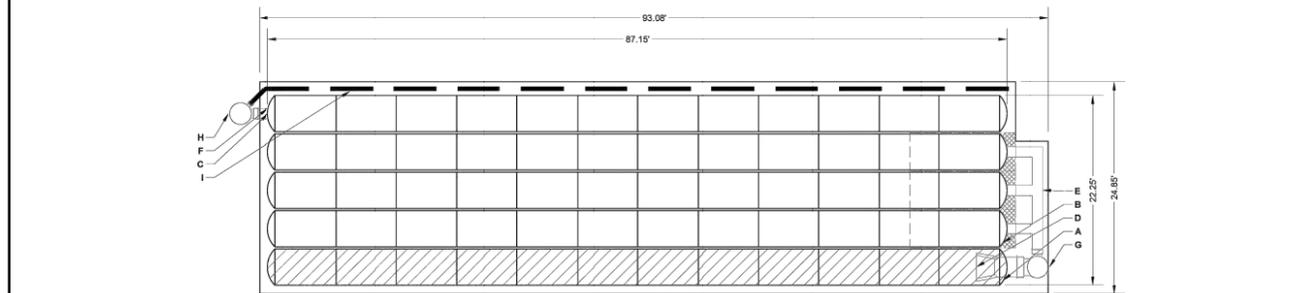
UTILITY PLAN

Project # 22005

C4.0



PROPOSED LAYOUT	PROPOSED ELEVATIONS	PART TYPE	ITEM ON LAYOUT	DESCRIPTION	*INVERT ABOVE BASE OF CHAMBER	MAX FLOW
60 STORMTECH SC-800 CHAMBERS	MAXIMUM ALLOWABLE GRADE (TOP OF PAVEMENT/UNPAVED)	111.2'			2.30'	
10 STORMTECH SC-800 END CAPS	MINIMUM ALLOWABLE GRADE (UNPAVED WITH TRAFFIC)	108.9'				
8 STONE ABOVE (a)	MINIMUM ALLOWABLE GRADE (UNPAVED NO TRAFFIC)	104.0'	A	24" BOTTOM PREFABRICATED END CAP PART# SC800CEZ / TYP OF ALL 24" BOTTOM CONNECTIONS AND ISOLATOR PLUS ROWS		
8 STONE BELOW (b)	MINIMUM ALLOWABLE GRADE (TOP OF RIGID CONCRETE PAVEMENT)	102.0'	B	12" TOP PRE-CORED END CAP PART# SC800PE12TPC / TYP OF ALL 12" TOP CONNECTIONS	14.40'	
40 STONE VOID	MINIMUM ALLOWABLE GRADE (BASE OF FLEXIBLE PAVEMENT)	92.0'	C	12" BOTTOM PRE-CORED END CAP PART# SC800PE12BPC / TYP OF ALL 12" BOTTOM CONNECTIONS	1.60'	
5272 INSTALLED SYSTEM VOLUME (CF) (PERIMETER STONE INCLUDED) (COVER STONE INCLUDED)	TOP OF STONE	111.2'	D	INSTALL FLAMP ON 24" ACCESS PIPE / PART# SC80024RAMP		
2288 SYSTEM AREA (SF)	TOP OF SC-800 CHAMBER	108.9'	E	12" x 12" TOP MANIFOLD INVERT		
235.9 SYSTEM PERIMETER (ft)	12" ISOLATOR ROW PLUS INVERT	106.5'	F	12" x 12" TOP MANIFOLD ADS N-12	14.40'	
423 THERMOPLASTIC LINER (SY) (20% OVERAGE)	12" BOTTOM CONNECTION INVERT	104.0'	G	12" PIPE CONNECTION	1.60'	
	BOTTOM OF SC-800 CHAMBER	100.0'	H	30" DIAMETER (24.00" SLUMP MIN) NYLOPLAST (INLET W/ ISO PLUS ROW)		5.9 CFS IN
	UNDERDRAIN INVERT	100.0'	I	NYLOPLAST (OUTLET)		2.3 CFS OUT
	BOTTOM OF STONE	100.0'		UNDERDRAIN		



**NOTES**

1. THE SITE DESIGN ENGINEER MUST REVIEW ELEVATIONS AND IF NECESSARY ADJUST GRADING TO ENSURE THE CHAMBER COVER REQUIREMENTS ARE MET.

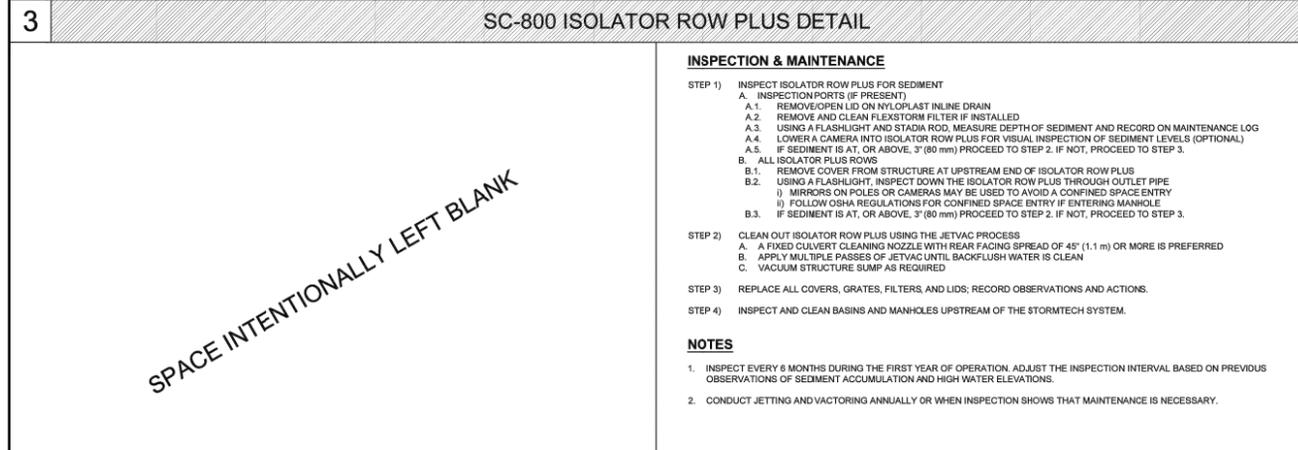
2. NOT FOR CONSTRUCTION: THIS LAYOUT IS FOR DIMENSIONAL PURPOSES ONLY TO PROVIDE CONCEPT & THE REQUIRED STORAGE VOLUME CAN BE ACHIEVED ON SITE.

3. THERMOPLASTIC LINER (SEE TECH NOTE #6.50 PROVIDED BY OTHERS / DESIGN BY OTHERS)

4. PLACE MINIMUM 12.50' OF ADSPLUS825 WOVEN GEOTEXTILE OVER BEDDING STONE AND UNDERNEATH CHAMBER FEET FOR SCOUR PROTECTION AT ALL CHAMBER INLET ROWS

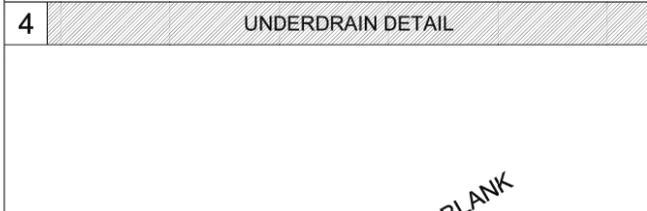
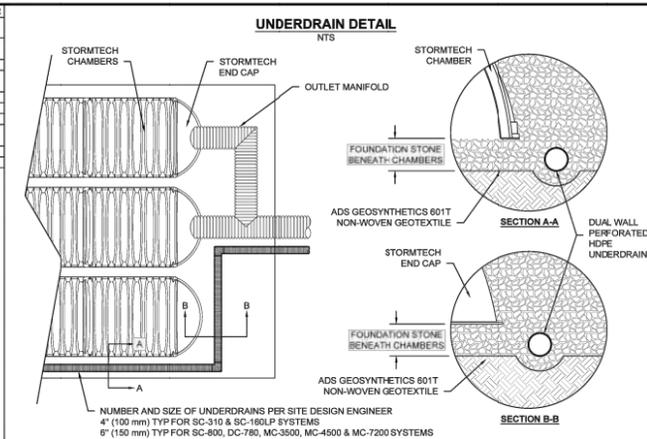
5. ISOLATOR ROW PLUS (SEE DETAIL)

ACCEPTABLE FILL MATERIALS: STORMTECH SC-800 CHAMBER SYSTEMS	MATERIAL LOCATION	DESCRIPTION	AASHTO MATERIAL CLASSIFICATIONS	COMPACTION / DENSITY REQUIREMENT
D	FINAL FILL: FILL MATERIAL FOR LAYER 'D' STARTS FROM THE TOP OF THE 'C' LAYER TO THE BOTTOM OF FLEXIBLE PAVEMENT OR UNPAVED FINISHED GRADE ABOVE. NOTE THAT PAVEMENT SUBBASE MAY BE PART OF THE 'D' LAYER.	ANY SOIL/ROCK MATERIALS, NATIVE SOILS, OR PER ENGINEER'S PLANS. CHECK PLANS FOR PAVEMENT SUBGRADE REQUIREMENTS.	N/A	PREPARE PER SITE DESIGN ENGINEER'S PLANS. PAVED INSTALLATIONS MAY HAVE STRINGENT MATERIAL AND PREPARATION REQUIREMENTS.
C	INITIAL FILL: FILL MATERIAL FOR LAYER 'C' STARTS FROM THE TOP OF THE EMBEDMENT STONE ('B' LAYER) TO 15" (375 mm) ABOVE THE TOP OF THE CHAMBER. NOTE THAT PAVEMENT SUBBASE MAY BE A PART OF THE 'C' LAYER.	GRANULAR WELL-GRADED SOIL/AGGREGATE MIXTURES, <35% FINES OR PROCESSED AGGREGATE. MOST PAVEMENT SUBBASE MATERIALS CAN BE USED IN LIEU OF THIS LAYER.	AASHTO M145 A-1, A-2, A-3 OR AASHTO M43 3, 357, 4, 467, 5, 56, 57, 6, 67, 68, 7, 78, 8, 86, 9, 10	BEGIN COMPACTIONS AFTER 12" (300 mm) OF MATERIAL OVER THE CHAMBERS IS REACHED. COMPACT ADDITIONAL LAYERS IN 6" (150 mm) MAX LIFTS TO A MIN. 95% PROCTOR DENSITY FOR WELL GRADED MATERIAL AND 95% RELATIVE DENSITY FOR PROCESSED AGGREGATE MATERIALS. ROLLER GROSS VEHICLE WEIGHT NOT TO EXCEED 12,000 lbs (53 kN). DYNAMIC FORCE NOT TO EXCEED 20,000 lbs (89 kN).
B	EMBEDMENT STONE: FILL SURROUNDING THE CHAMBERS FROM THE FOUNDATION STONE ('A' LAYER) TO THE 'C' LAYER ABOVE.	CLEAN, CRUSHED, ANGULAR STONE OR RECYCLED CONCRETE*	AASHTO M43 3, 357, 4, 467, 5, 56, 57	NO COMPACTION REQUIRED.
A	FOUNDATION STONE: FILL BELOW CHAMBERS FROM THE SUBGRADE UP TO THE FOOT (BOTTOM) OF THE CHAMBER.	CLEAN, CRUSHED, ANGULAR STONE OR RECYCLED CONCRETE*	AASHTO M43 3, 357, 4, 467, 5, 56, 57	PLATE COMPACT OR ROLL TO ACHIEVE A FLAT SURFACE.†



**NOTES:**

- CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F2418, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
- SC-800 CHAMBERS SHALL BE DESIGNED IN ACCORDANCE WITH ASTM F2787 "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
- THE SITE DESIGN ENGINEER IS RESPONSIBLE FOR ASSESSING THE BEARING RESISTANCE (ALLOWABLE BEARING CAPACITY) OF THE SUBGRADE SOILS AND THE DEPTH OF FOUNDATION STONE WITH CONSIDERATION FOR THE RANGE OF EXPECTED SOIL MOISTURE CONDITIONS. REFERENCE STORMTECH DESIGN MANUAL FOR BEARING CAPACITY GUIDANCE.
- PERIMETER STONE MUST BE EXTENDED HORIZONTALLY TO THE EXCAVATION WALL FOR BOTH VERTICAL AND SLOPED EXCAVATION WALLS.
- REQUIREMENTS FOR HANDLING AND INSTALLATION:
  - TO MAINTAIN THE WIDTH OF CHAMBERS DURING SHIPPING AND HANDLING, CHAMBERS SHALL HAVE INTEGRAL, INTERLOCKING STACKING LUGS.
  - TO ENSURE A SECURE JOINT DURING INSTALLATION AND BACKFILL, THE HEIGHT OF THE CHAMBER JOINT SHALL NOT BE LESS THAN 2".
  - TO ENSURE THE INTEGRITY OF THE ARCH SHAPE DURING INSTALLATION, THE ARCH STIFFNESS CONSTANT AS DEFINED IN SECTION 6.2.8 OF ASTM F2418 SHALL BE GREATER THAN OR EQUAL TO 750 LBS/FT<sup>2</sup> AND b) TO RESIST CHAMBER DEFORMATION DURING INSTALLATION AT ELEVATED TEMPERATURES (ABOVE 73° F / 23° C), CHAMBERS SHALL BE PRODUCED FROM REFLECTIVE GOLD OR YELLOW COLORS.



SC-800 TECHNICAL SPECIFICATION	STUB	B	C
SC800PE01TPC	6" (150 mm)	21.4" (544 mm)	0.9" (23 mm)
SC800PE06BPC	---	---	---
SC800PE06TPC	6" (200 mm)	19.2" (488 mm)	---
SC800PE08BPC	---	---	1.0" (25 mm)
SC800PE10TPC	10" (250 mm)	17.0" (432 mm)	---
SC800PE10BPC	---	---	1.2" (30 mm)
SC800PE12TPC	---	14.4" (365 mm)	---
SC800PE12BPC	12" (300 mm)	---	1.6" (41 mm)
SC800PE15TPC	15" (375 mm)	11.3" (287 mm)	---
SC800PE15BPC	---	---	1.7" (43 mm)
SC800PE18TPC	---	8.0" (203 mm)	---
SC800PE18BPC	18" (450 mm)	---	2.0" (51 mm)
SC800PE24BPC	24" (600 mm)	---	2.3" (58 mm)
SC800EPE	NONE	---	SOLID END CAP

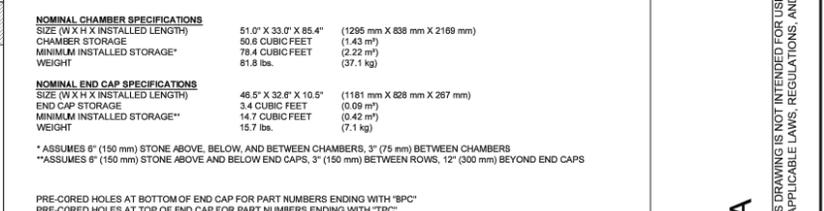
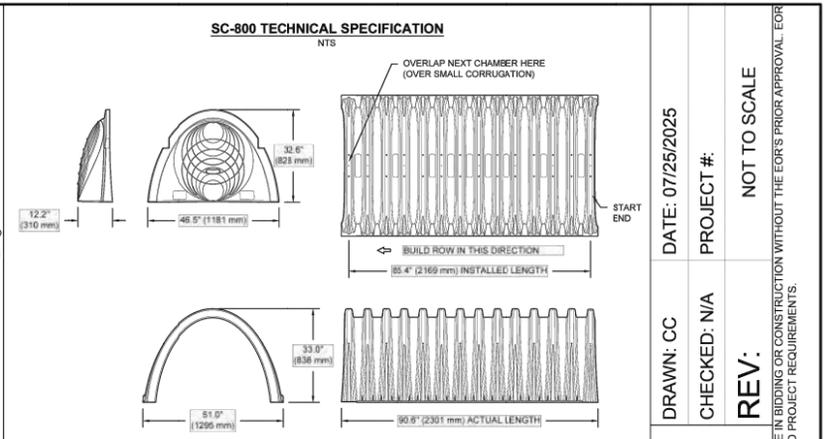
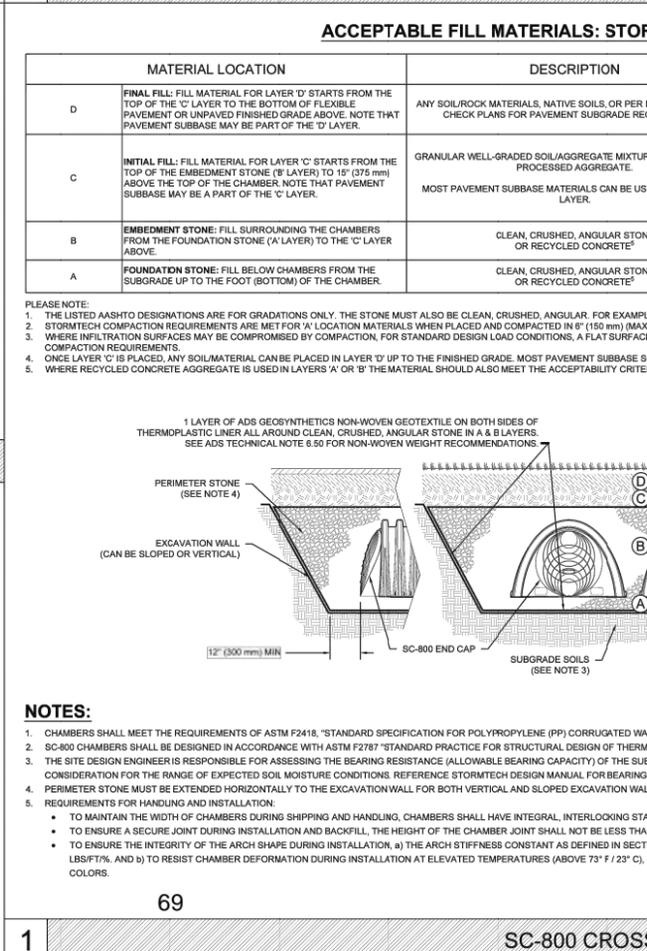
**NOTES:**

\* ASSUMES 6" (150 mm) STONE ABOVE, BELOW, AND BETWEEN CHAMBERS, 3" (75 mm) BETWEEN CHAMBERS

\*\* ASSUMES 6" (150 mm) STONE ABOVE AND BELOW END CAPS, 3" (75 mm) BETWEEN ROWS, 12" (300 mm) BEYOND END CAPS

PRE-CORED HOLES AT BOTTOM OF END CAP FOR PART NUMBERS ENDING WITH "BPC"

PRE-CORED HOLES AT TOP OF END CAP FOR PART NUMBERS ENDING WITH "TPC"



SC-800 TECHNICAL SPECIFICATION	STUB	B	C
SC800PE01TPC	6" (150 mm)	21.4" (544 mm)	0.9" (23 mm)
SC800PE06BPC	---	---	---
SC800PE06TPC	6" (200 mm)	19.2" (488 mm)	---
SC800PE08BPC	---	---	1.0" (25 mm)
SC800PE10TPC	10" (250 mm)	17.0" (432 mm)	---
SC800PE10BPC	---	---	1.2" (30 mm)
SC800PE12TPC	---	14.4" (365 mm)	---
SC800PE12BPC	12" (300 mm)	---	1.6" (41 mm)
SC800PE15TPC	15" (375 mm)	11.3" (287 mm)	---
SC800PE15BPC	---	---	1.7" (43 mm)
SC800PE18TPC	---	8.0" (203 mm)	---
SC800PE18BPC	18" (450 mm)	---	2.0" (51 mm)
SC800PE24BPC	24" (600 mm)	---	2.3" (58 mm)
SC800EPE	NONE	---	SOLID END CAP

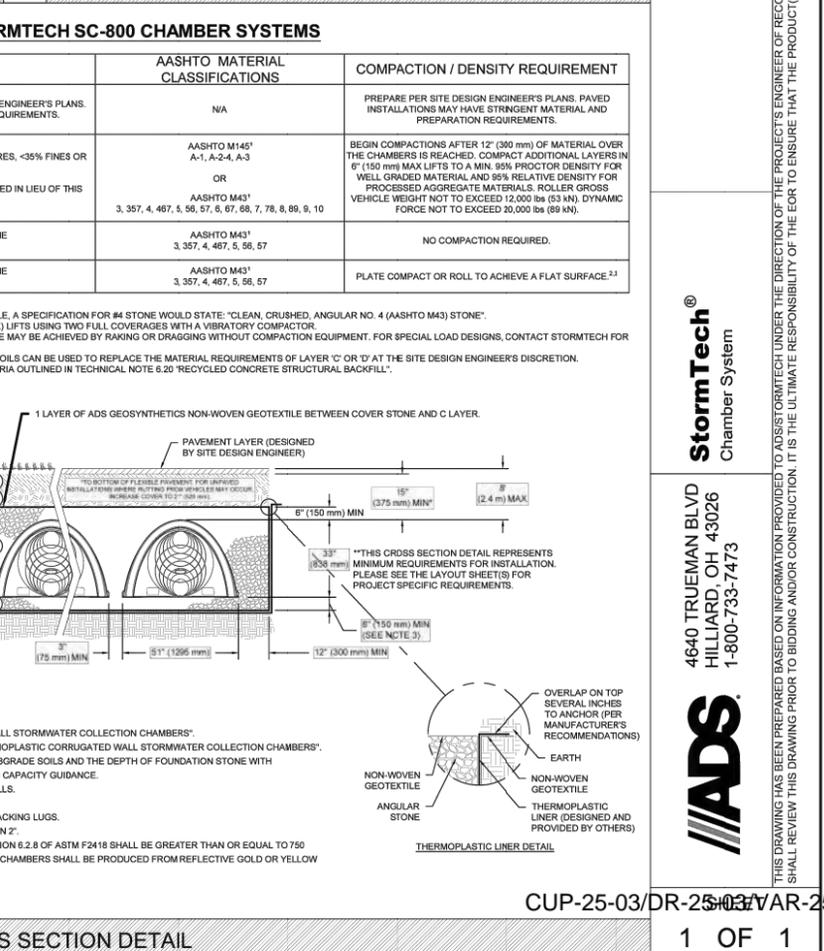
**NOTES:**

\* ASSUMES 6" (150 mm) STONE ABOVE, BELOW, AND BETWEEN CHAMBERS, 3" (75 mm) BETWEEN CHAMBERS

\*\* ASSUMES 6" (150 mm) STONE ABOVE AND BELOW END CAPS, 3" (75 mm) BETWEEN ROWS, 12" (300 mm) BEYOND END CAPS

PRE-CORED HOLES AT BOTTOM OF END CAP FOR PART NUMBERS ENDING WITH "BPC"

PRE-CORED HOLES AT TOP OF END CAP FOR PART NUMBERS ENDING WITH "TPC"



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KAADY CAR WASH  
WEST LINN, OREGON

StormTech Chamber System

4640 TRUJEMAN BLVD  
HILLIARD, OH 43026  
1-800-733-7473

CONSTRUCTION SET DETAILS

Project # 22005

C5.2  
Date: 7.9.2025

DATE: 07/25/2025  
PROJECT #: NOT TO SCALE  
DRAWN: CC  
CHECKED: N/A  
REV: 1  
25-C007 KAADY  
WEST LINN, OR, USA  
StormTech Chamber System  
4640 TRUJEMAN BLVD  
HILLIARD, OH 43026  
1-800-733-7473  
CUP-25-03/DR-25-0317/AR-25-02  
1 OF 1

## **Appendix J: Operations and Maintenance Plan**

to be provided in final stormwater report