Appendix H2 Low Impact Development Study

Appendices

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LOW IMPACT DEVELOPMENT (LID) STUDY

City of Hope Campus Plan
1500 East Duarte Road
Duarte, CA 91010
KPFF Job # 114186

Revised August 16, 2016

OWNER:

City of Hope
1500 East Duarte Road
Duarte, CA 91010
(626) 757-9018

PREPARED BY:

KPFF Consulting Engineers
6080 Center Drive, Suite 700
Los Angeles, California 90045
(310) 665-2800

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APPENDICES

I. Introduction

In conjunction with the proposed City of Hope Campus Plan, a long-term development plan for City of Hope's approximately 110-acre property ("Campus"), City of Hope retained KPFF to conduct a low impact development (LID) study to analyze the pre- and post- improvement conditions of the Campus, calculate and compare stormwater runoff generated under those conditions, and propose non-structural and structural BMPs that would be feasible for the Campus. The proposed structural BMPs described herein are adequately sized to treat the peak stormwater runoff calculated.

A. Project Location

The Campus is located at 1500 East Duarte Road, Duarte, CA 91010. Located just northeast of Los Angeles, the Campus is situated at the eastern edge of the City of Duarte and the northwestern edge of the City of Irwindale. The Campus is bounded by Duarte Road to the north, and Cinco Robles Drive, LA County Flood Control Channel, and Buena Vista Street to the west. The undeveloped Santa Fe Flood Control Basin is located to the east and south.

B. Project Description

The Campus is approximately 110 acres. Ground cover at the Campus is predominately hardscape and structures, with some grass and planter areas. There is also a park and garden space within the Campus, along Duarte Road, which measures about 11 acres of land, and is mostly covered with grass.

The analysis presented herein examines the potential changes in stormwater runoff for the Campus due to the development of the proposed City of Hope Campus Plan ("Project"), which would include the development of additional outpatient, inpatient, research, office, industrial, warehouse, and hospitality uses, as well as a new access roadway. The Project would include the construction of new buildings, surface and parking lots, open space improvements and a new fire access roadway. Upon full build-out, implementation of the Project would result in a total of 2,639,350 square feet of total development at the Campus, an overall increase of 1,038,500 net new square feet of development from existing conditions. Exhibit 1 shows the proposed areas of development at the Campus under an Illustrative Development Scenario presented in the proposed Specific Plan.

II. Drainage Concepts

A. Existing Drainage Patterns

Based on site visits, record drawings, as-builts, and available survey data, the existing site stormwater was found to flow from the northeast to the southwest of the Campus. There is an approximate 47 foot elevation difference from the highest point to the lowest point of the Campus. The existing storm drain system consists of inlets and pipes that discharge to the private, on-site storm drain lines; one 30"-36" RCP storm drain main runs from east to west near the center of the Campus, and the other 24"-30" RCP storm drain main runs along the south border of the Campus.

Additionally, there is a Los Angeles County Flood Control Chanel (aka the Duarte Flood Control Channel) that runs from north to south and passes through the southern portion of the Campus. The

channel is highlighted in Exhibit 1. The existing hydrology is such that all of the stormwater on the Campus east of the channel eventually ends up in the channel either by means of sheet flow or through a pipe network that connects to the flood control channel at the southern corner of the site.

Under existing conditions at the Campus, KPFF calculates that the total runoff generated by a 10-year storm and 50-year storm would be 136 cubic feet per second (cfs) and 221 cfs, respectively. The 10-year and 50-year storm events were used as a metric consistent with LA County's methodology. Hydrology calculations for existing conditions are based on existing building and site plan documents as well as satellite survey information, and can be found in the hydrology report prepared by KPFF and submitted in conjunction with this LID study.

B. Proposed Drainage Patterns

This study provides calculations for runoff under full build-out of the Specific Plan as proposed under the Illustrative Development Scenario, as well as concepts to mitigate that runoff to meet current LID standards. Under the County of Los Angeles MS4 permit, since less than 50% of the existing impervious surface at the Campus would be altered by Specific Plan development, only the proposed alteration must comply with LID requirements. See Appendix A for area tabulations. Current LID standards require the on-site retention of the runoff from the 0.75-inch, 24-hour rain event or the 85th percentile, 24-hour rain event, whichever is greater, through infiltration, biofiltration/bioretention, and/or rainfall harvest and use.

Under the Illustrative Development Scenario provided in the proposed Specific Plan, KPFF calculated the anticipated stormwater runoff rates for the 10-year and 50-year storm to be 141 cfs and 225 cfs, respectively. These hydrology calculations for proposed full build-out conditions at the Campus can be found in the hydrology report prepared by KPFF and submitted in conjunction with this LID study.

The hydrology report analyzes the stormwater runoff changes in the overall imperviousness of a site and the overall changes in stormwater runoff due to the development of the Project. The LID report examines the new and altered impervious areas on site and show how the stormwater runoff generated from those newly developed areas will be treated. As previously mentioned, under the County of Los Angeles MS4 permit since less than 50% of the existing impervious surface at the Campus would be altered by Specific Plan development, only the proposed alteration must comply with LID requirements. The three drainage areas shown in the hydrology report reflects the drainage within the entire site including proposed and existing areas. For purposes of this LID report, the proposed Campus is divided into four main drainage areas—DA1 through DA4—based on the way the stormwater is conveyed and treated from those areas. Exhibit 1 shows the site drainage areas as well as potential treatment locations.

The primary treatment system to mitigate stormwater runoff under the Project would be the development of a Contech subsurface perforated corrugated metal pipe (CMP) stormwater infiltration system at the southwest portion of the Campus, just east of the flood control channel, and located in an area most suitable to receive drainage from other areas of the Campus. This CMP infiltration system will receive stormwater from drainage areas DA1 and DA2, which will be conveyed via underground pipes directly to the vicinity of the system. This stormwater will first be pretreated by a Contech CDS unit and then discharged into the CMP infiltration system, where it will infiltrate into the groundwater. This primary CMP infiltration system is shown on Exhibit 1.

In addition, and as discussed below, although KPFF proposes to treat stormwater from drainage area DA3 in a CMP infiltration system within that drainage area, stormwater from DA3 could alternatively be routed to the primary CMP infiltration system at the southwest portion of the Campus if desired. Overall, given that development at the Campus under the Specific Plan may proceed with a building-by-building approach, the primary CMP infiltration system could either be implemented in phases as new buildings are constructed, or be fully constructed up front to be able to capture the necessary amount of runoff currently required to be retained under full build-out of the Project.

With respect to drainage areas DA3 and DA4, KPFF proposes to treat stormwater locally within those respective drainage areas with modified bioswales, which would function as pretreatment systems, and individual (smaller) CMP infiltration systems. If, however, bioswales are not desired as a pre-treatment system in drainage areas DA3 and/or DA4, mechanical pretreatment systems such as CDS unit could be used alternatively, prior to stormwater being discharged into the CMP infiltration systems.

Moreover, KPFF has proposed optional stormwater pretreatment systems for drainage area DA2. Although the entire volume of stormwater run-off from drainage area DA2 will be mitigated in the primary CMP infiltration system at the southwest corner of the Campus, modified bioswales in medians (or parkways) could be installed to act as pretreatment for stormwater before it is conveyed to the primary CMP infiltration system. Under such a scenario, stormwater from the roadways would be collected in modified bioswales in the center of the roads via sheet flow. The modified bioswales would filter the stormwater before it is conveyed it via underground pipes to the primary CMP infiltration system proposed in the southwest corner of the site.

C. Peak Stormwater Runoff Discharge Rates

As described above, as required by the most current Los Angeles County MS4 Permit, the entire post-development Stormwater Quality Design volume (SWQDv) must be treated for the 0.75-inch, 24-hour rain event or the 85th percentile, 24-hour rain event, whichever is greater. Based on these calculations, the structural and non-structural BMPs for the Project have been designed to treat stormwater runoff from all storms up to and including the 85th percentile 24-hour storm event. The SWQDv for drainage areas DA1 and DA2 would be collected and treated by infiltration at the primary CMP infiltration system at the southwest corner of the Campus. The SWQDv for drainage areas DA3 and DA4 would be retained in those areas.

The infiltration system footprint required for each drainage area is based on the treatment system parameters provided in Appendix A. The pipe diameter selected for the corrugated infiltration metal pipes is 96 inches. The length of pipe required is based on a system of four rows of these 96-inch pipes. The footprints of the systems for each drainage areas are based on the system layouts defined in Appendix A.

Table 1 shows the proposed infiltration footprint for each drainage area based on the preliminary information available for the Project. Calculations for BMP sizing can be found in Appendix A. However, it is worth noting that prior to finalizing appropriate BMP sizing, one or more percolation tests would be required to better understand subsurface conditions and proper infiltration rate(s). All BMPs meet the design criteria in Attachment H of the most current MS4 Permit. Input parameters and calculations for BMP sizing are shown in Appendix A.

Table 1: Summary of Treatment Calculations

Drainage Area	New and Altered Impervious Area (Acres)	Volume to be Treated/Retained On-Site (CF)	Flow to be Treated (CFS)	Infiltration Footprint[1] (LF x LF)
DA1	26.0	94,117	8.06	40 x 470
DA2	13.8	49,890	4.27	40 x 250
DA3	3.4	12,395	1.06	40 x 65
DA4	5.2	18,623	1.60	40 x 95
Total	48.4	175,025	14.99	40 x 880

[1] These footprints are preliminary determinations based on the Illustrative Development Scenario included for the Project. Actual sizing will require percolation testing.

III. Best Management Practices (BMPs)

Detailed operation and maintenance plans for structural BMPs will be developed in accordance with the concepts set forth in Appendix D.

A. Non-structural BMPs

1. Open Paved Areas and Planter Areas

a. Regular sweeping of all open hardscape areas, at a minimum, on a weekly basis in order to prevent dispersal of pollutants that may collect on those surfaces.

b. Regular pruning of the trees and shrubs in the planter areas to avoid formation of dried leaves and twigs, which are normally blown by the wind during windy days. These dried leaves are likely to clog the surface inlets of the drainage system when rain comes, which would result to flooding of the surrounding area due to reduced flow capacities of the inlets.

c. Trash and recycling containers shall be used such that, if they are to be located outside or apart from the principal structure, are fully enclosed and watertight in order to prevent contact of stormwater with waste matter, which can be a potential source of bacteria and other pollutants in runoff. These containers shall be emptied and the wastes disposed of properly on a regular basis.

2. Education and Training

The Operation and Management Manual will include education and training standards to ensure training of COH staff as to proper maintenance of on-site BMPs. Such training will include information on proper methods of handling and disposal of wastes..

3. Monitoring and Maintenance

a. All BMPs shall be operated, monitored, and maintained for the life of the Project and at a minimum, all structural BMPs shall be inspected, cleaned-out, and where necessary, repaired, at the following minimum frequencies: 1) prior to October 15th each year; 2)

during each month between October 15th and April 15th of each year and, 3) at least twice during the dry season (between April 16 and October 14 of every year).

b. Debris and other water pollutants removed from structural BMPs during cleanout shall be contained and disposed of in a proper manner.

c. The drainage system and the associated structures and BMPs shall be maintained according to manufacturer's specification to ensure maximum pollutant removal efficiencies (see Appendix D for detailed Operation and Maintenance of Contech CDS and CMP systems).

B. Structural BMPs

1. Contech CDS Unit

A Contech CDS stormwater treatment device is proposed to treat the stormwater runoff prior to discharging to the primary CMP infiltration system. The CDS unit would be used as pretreatment for stormwater before treatment by infiltration. The CDS unit is a mechanical device that acts as a hydrodynamic separator to clean stormwater before it is directed to the CMP infiltration system by removing large particles and debris from the stormwater. The CDS unit is considered a highly effective BMP to capture the Project's potential and anticipated pollutants. Installation procedures, maintenance procedures and recommendations outlined by CDS shall be followed by the owner to ensure proper performance of the CDS unit. These procedures include keeping maintenance records, regular sweeping and removal of debris within the drainage areas, regular and visual inspections, and replacement/proper disposal/replenishment of adsorbent materials.

2. Modified Bioswale

The modified bioswales proposed, but not required, would pretreat stormwater before it is infiltrated. Stormwater will sheet flow to the top of the modified bioswales and then percolate through planting medium, soil, and gravel into a perforated pipe and the bottom of the swale. The pipe will then convey the stormwater to the proposed locations for infiltration.

3. Infiltration

Contech's CMP stormwater infiltration system stores stormwater exceeding a site's allowable discharge rate and release it slowly over time through infiltration. Systems are sized and shaped to meet site-specific needs, and are available fully or partially perforated. CMP infiltration systems are available in all AASHTO M-36 types, with various coatings to achieve 75-100 year design service life. Infiltration of the water means that the water is released from the storage system and allowed to seep through the soil below it until it reaches and joins the groundwater below it.

C. Anticipated Potential Pollutants

The proposed build-out of the City of Hope Campus Plan has the potential for suspended sediments, floatable trash, minimal pesticides and nutrients, oil and grease, and gasoline entering the storm runoff system. As mentioned, stormwater will discharge to and be treated by modified bioswales, CDS units, and infiltration which are to be properly maintained for adequate treatment.

D. Storm Drain Stenciling

Catch basins on site shall be stenciled to indicate that no substance other than stormwater is to be collected by the storm drain system. The legibility of the stencils is to be maintained by the above mentioned party. Stencils shall be redrawn as necessary. See Appendix C.

Exhibit 1

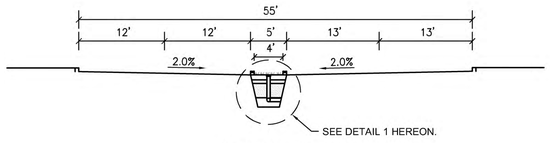
Site Drainage Areas and Treatment Locations

LEGEND:

- DRAINAGE AREA 1
- FIRE ACCESS / NEW ROADWAY (DRAINAGE AREA 2)
- DRAINAGE AREA 3
- DRAINAGE AREA 4
- BMP TYPE 1 (SEE DETAIL 1)
- BMP TYPE 2 (SEE DETAIL 2)
  : SURFACE AREA MAY VARY DEPENDING ON TRIBUTARY SERVICE AREA, BMP TYPE & DEPTH, ETC.
- SD — STORM DRAIN

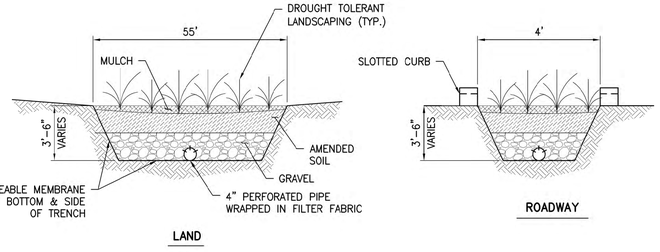
NOTES

- BMP CALCULATIONS ARE BASED ON THE LA. COUNTY HYDROLOGY / SUSMP (LID) MANUAL.
- PROPOSED DEVELOPMENTS ARE ESTIMATED APPROXIMATELY 44.1% OF THE ENTIRE PROPERTY. THEREFORE, IT IS REQUIRED TO TREAT THE STORM WATER RUNOFF FROM THE IMPROVEMENT AREAS ONLY, NOT THE ENTIRE SITE.
- IT IS REASONABLY ASSUMED THAT THE SITE IS FEASIBLE FOR INFILTRATION.
- BIOFILTRATION VS. INFILTRATION (UNDERGROUND)
  BIOFILTRATION BMPS REQUIRE SURFACE AREAS ON-GRADE, BUT CAN BE INCORPORATED WITH LANDSCAPE THAT IT IS AESTHETICALLY PLEASING AND CONTRIBUTE TO SUSTAINABLE DESIGN.
  INFILTRATION BMPs (UNDERGROUND) MAY / MAY NOT TAKE UP MORE OF UNDERGROUND SURFACE AREAS, BUT SAVE THE LAND VALUE ABOVE GROUND, AND STILL MEET THE MS4 REQUIREMENTS.
- BMP TYPE 1 AND TYPE 2 ARE APPROXIMATELY SIZED TO HANDLE THE ENTIRE RUNOFF FROM THE NEW IMPROVEMENTS. THEY CAN BE SEPARATED BY PHASES, GRADING, AND SITE DESIGN/LAYOUT ETC.



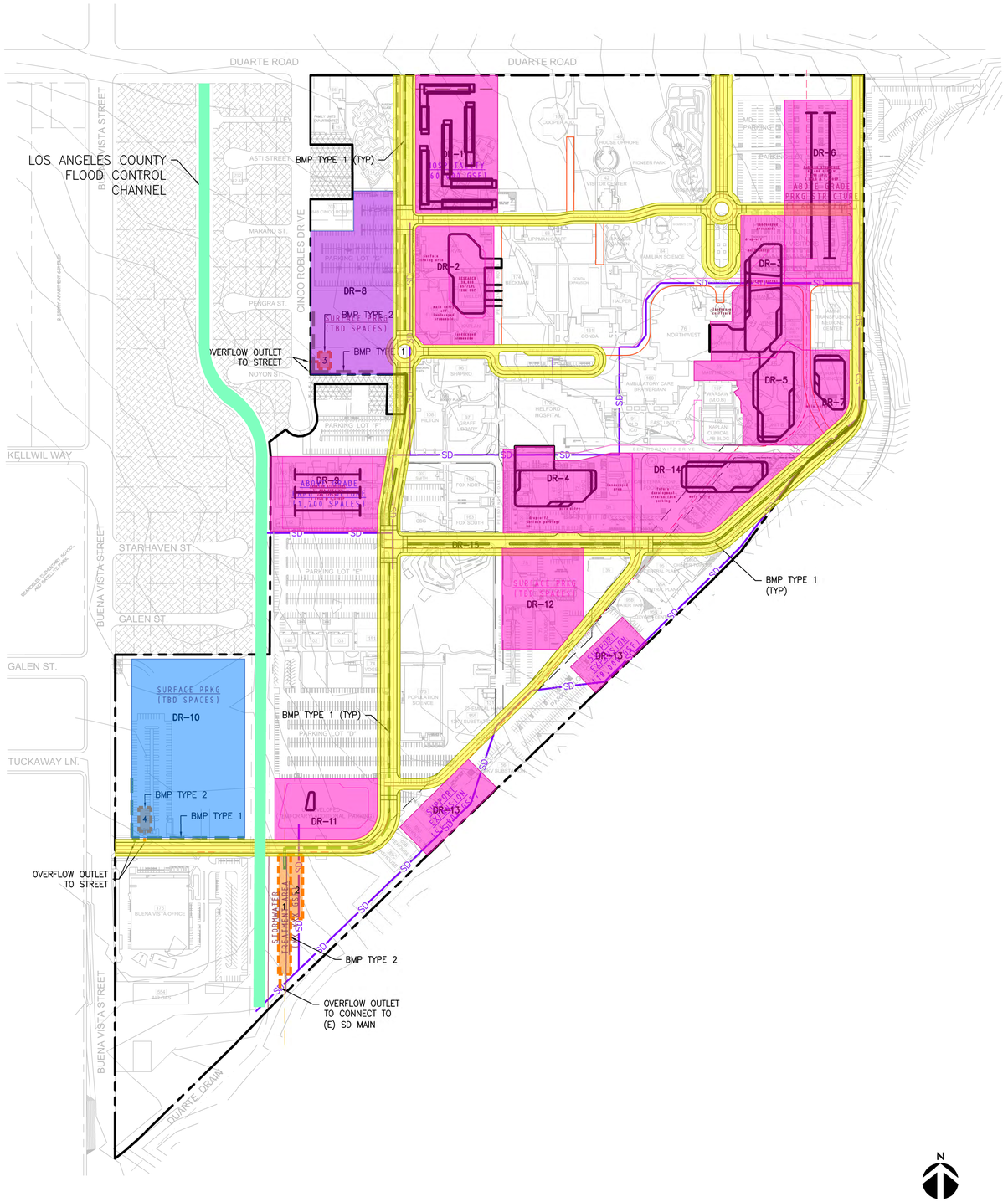
WITH BMP TYPE 1

1 **55 FOOT ROADWAY SECTION**



1 **BMP TYPE 1: MODIFIED BIOSWALE** N.T.S.

2 **BMP TYPE 2: SUBSURFACE PERFORATED CMP INFILTRATION SYSTEM** N.T.S.



kpff
6080 Center Dr., Suite 700
Los Angeles, CA 90045
O: 310.665.2800
F: 310.655.9075
www.kpff.com

CONSULTANTS

STAMP

REVISIONS

DATE	08/24/15
PROJECT NUMBER	114186
DESIGNED BY	KP
DRAWN BY	KP
CHECKED BY	DC
SCALE	AS SPECIFIED

KEY MAP

PROJECT DESCRIPTION
CITY OF HOPE

1500 E. DUATRE ROAD
DUARTE, CA 91010

DRAWING TITLE
STORM WATER MITIGATION

SHEET NUMBER (EXHIBIT NUMBER)

EXHIBIT 1
LID EXHIBIT

Appendix A - Design Calculations

LID Calculations
Proposed BMP Design Calculations

BMPs Sizing												
Drainage Area	Bldg. ID	Area (AC)	% Imp	Length of Water Flow (FT)	Slope	Rainfall (Inch)	Soil Type	85th% Rainfall (Inch)	Cu	85th% Qpm (CFS)	85th% Vm (CF)	Req. Infiltration Footprint Area (SF)
DA 1												
1	Hospitality	2.91	96%	500	0.012	7.1	7	1.2	0.1	0.94	10,984	
2	Research	2.36	91%	460	0.013	7.1	7	1.2	0.1	0.73	8,527	
3	Outpatient	2.36	74%	540	0.013	7.1	7	1.2	0.1	0.73	8,525	
4	Inpatient	2.65	74%	500	0.014	7.1	7	1.2	0.1	0.82	9,542	
5	Outpatient	1.87	74%	385	0.014	7.1	7	1.2	0.1	0.58	6,738	
6	PRKG Structure - E	3.19	91%	635	0.011	7.1	7	1.2	0.1	0.99	11,515	
7	Office	0.77	91%	345	0.035	7.1	7	1.2	0.1	0.24	2,795	
9	PRKG Structure - W	2.11	91%	450	0.014	7.1	7	1.2	0.1	0.65	7,593	
11	Research	1.55	91%	385	0.021	7.1	7	1.2	0.1	0.48	5,595	
12	Surface PRKG - SE	1.99	91%	425	0.011	7.1	7	1.2	0.1	0.62	7,191	
13	Support Expansion	1.67	91%	300	0.020	7.1	7	1.2	0.1	0.51	6,006	
14	Office	2.52	91%	590	0.016	7.1	7	1.2	0.1	0.78	9,106	
∑		26.0								8.06	94,117	40 x 470
DA 2												
15	Fire Access/New Roadway	13.8	91%	500	0.011	7.1	7	1.2	0.1	4.27	49,890	
												40 x 250
DA 3												
8	Surface PRKG - N	3.4	91%	650	0.009	7.1	7	1.2	0.1	1.06	12,395	
												40 x 65
DA 4												
10	Surface PRKG - SW	5.2	91%	700	0.009	7.1	7	1.2	0.1	1.60	18,623	
												40 x 95
	∑	48.4									∑	40 x 880

Peak mitigated flow (Qpm) and Mitigated Volume (Vm) are greater based on the 85th Percentile calculations. Thus, the 85th Percentile method governs and the required BMP sizing is based on the 85th Percentile volume and flow.

Percent impervious are based on Los Angeles County Hydrology Mannual, Appendix D Proportion Impervious Data

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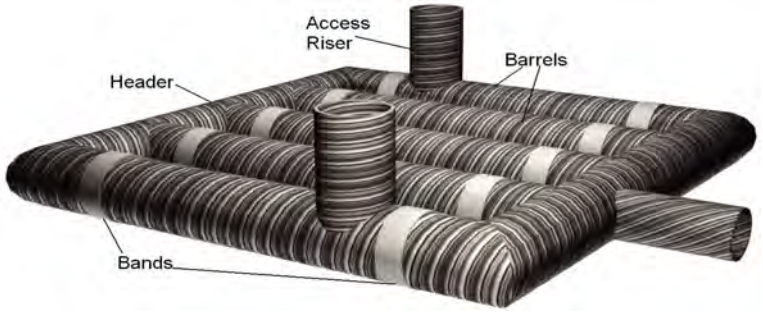


Project Summary

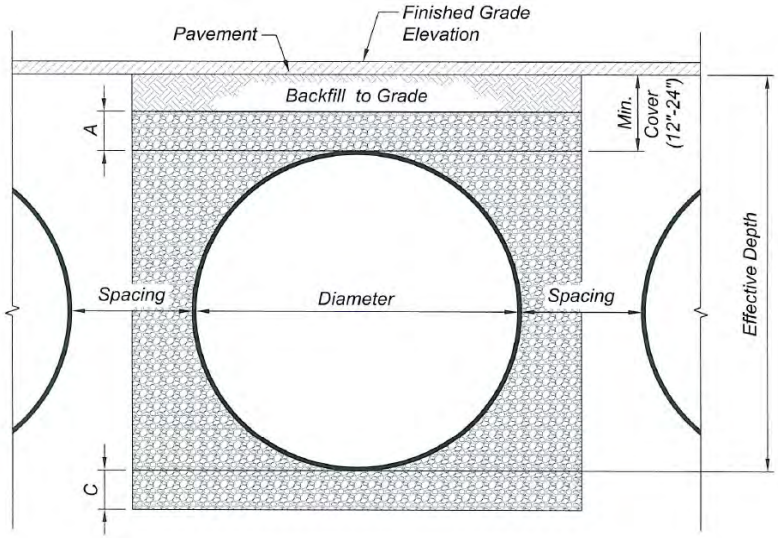
Date:	8/16/2016
Project Name:	City of Hope - DA1
City / County:	Duarte/ Los Angeles
State:	California
Designed By:	KP
Company:	KPFF
Telephone:	(310) 665-2800

Enter Information in Blue Cells

Corrugated Metal Pipe Calculator

Storage Volume Required (cf):	94,117
Limiting Width (ft):	50.00
Effective Depth Below Asphalt (ft):	10.00
Solid or Perforated Pipe:	Solid
Shape Or Diameter:	96
Spacing between Barrels (ft):	3.00
Stone Width Around Perimeter of System (ft):	0
Depth A: Porous Stone Above Pipe (in):	12
Depth C: Porous Stone Below Pipe (in):	12
Stone Porosity (0 to 40%):	20

50.27 ft^2 Pipe Area



System Sizing

Use Custom Layout (at right) for layout adjustment

Pipe Storage:	94,298	cf	
Porous Stone Storage:	0	cf	
Total Storage Provided:	94,298	cf	100.2% Of Required Storage
Number of Barrels:	4	barrels	
Length Per Barrel:	469.00	ft	
Rectangular Footprint (W x L):	41. ft x 469.	ft	

CONTECH Materials

Total CMP Footage:	1,876	ft
Approximate Total Pieces:	80	pcs
Approximate Coupling Bands:	76	bands
Approximate Truckloads:	40	trucks

Construction Quantities**

Total Excavation:	7122	cy
Porous Stone Backfill For Storage:	0	cy Stone
Backfill to Grade Excluding Stone:	3629	cy Fill

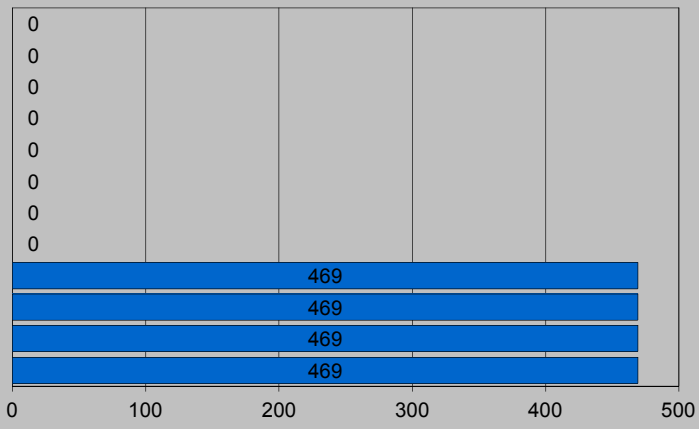
***Construction quantities are approximate and should be verified upon final design*

Custom Layout

To adjust layout, enter desired barrel length in the light blue boxes below.

Excess Footage = 0

Barrel 12	0
Barrel 11	0
Barrel 10	0
Barrel 9	0
Barrel 8	0
Barrel 7	0
Barrel 6	0
Barrel 5	0
Barrel 4	469
Barrel 3	469
Barrel 2	469
Barrel 1	469



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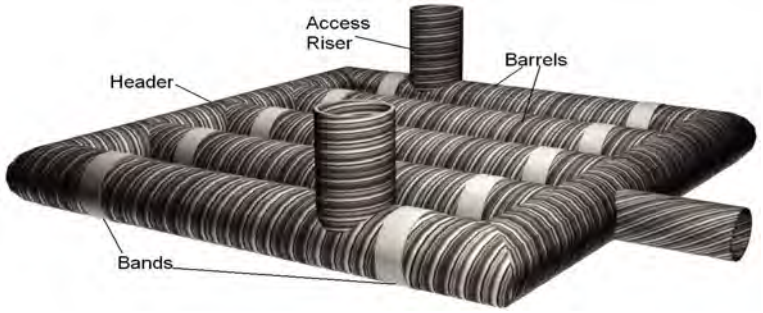


Project Summary

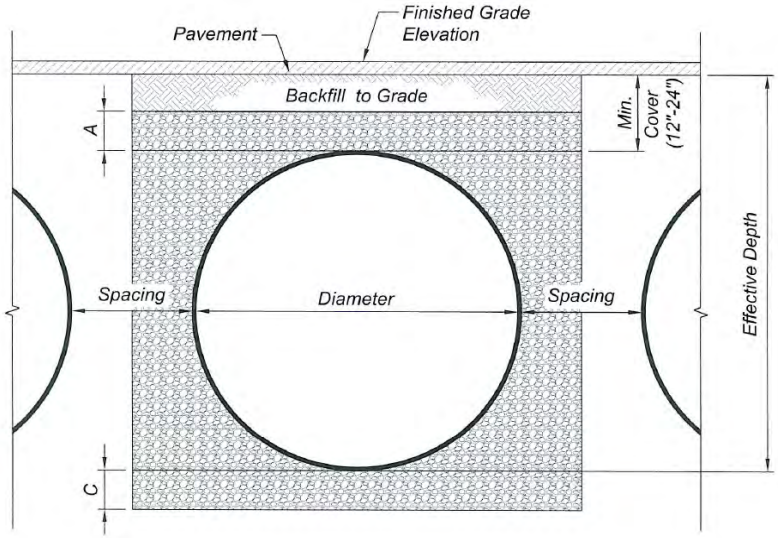
Date:	8/16/2016
Project Name:	City of Hope - DA2
City / County:	Duarte/ Los Angeles
State:	California
Designed By:	KP
Company:	KPFF
Telephone:	(310) 665-2800

Enter Information in Blue Cells

Corrugated Metal Pipe Calculator

Storage Volume Required (cf):	49,890
Limiting Width (ft):	50.00
Effective Depth Below Asphalt (ft):	10.00
Solid or Perforated Pipe:	Solid
Shape Or Diameter:	96
Spacing between Barrels (ft):	3.00
Stone Width Around Perimeter of System (ft):	0
Depth A: Porous Stone Above Pipe (in):	12
Depth C: Porous Stone Below Pipe (in):	12
Stone Porosity (0 to 40%):	20

50.27 ft^2 Pipe Area



System Sizing

Use Custom Layout (at right) for layout adjustment

Pipe Storage:	50,064	cf	
Porous Stone Storage:	0	cf	
Total Storage Provided:	50,064	cf	100.3% Of Required Storage
Number of Barrels:	4	barrels	
Length Per Barrel:	249.00	ft	
Rectangular Footprint (W x L):	41. ft x 249.	ft	

CONTECH Materials

Total CMP Footage:	996	ft
Approximate Total Pieces:	44	pcs
Approximate Coupling Bands:	40	bands
Approximate Truckloads:	22	trucks

Construction Quantities**

Total Excavation:	3782	cy
Porous Stone Backfill For Storage:	0	cy Stone
Backfill to Grade Excluding Stone:	1928	cy Fill

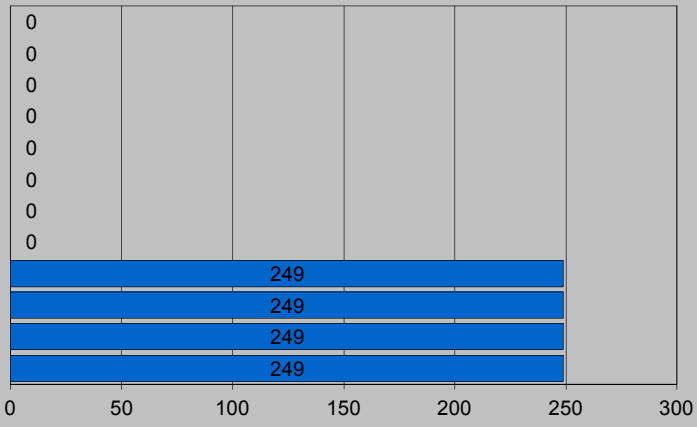
***Construction quantities are approximate and should be verified upon final design*

Custom Layout

To adjust layout, enter desired barrel length in the light blue boxes below.

Excess Footage = 0

Barrel 12	0
Barrel 11	0
Barrel 10	0
Barrel 9	0
Barrel 8	0
Barrel 7	0
Barrel 6	0
Barrel 5	0
Barrel 4	249
Barrel 3	249
Barrel 2	249
Barrel 1	249



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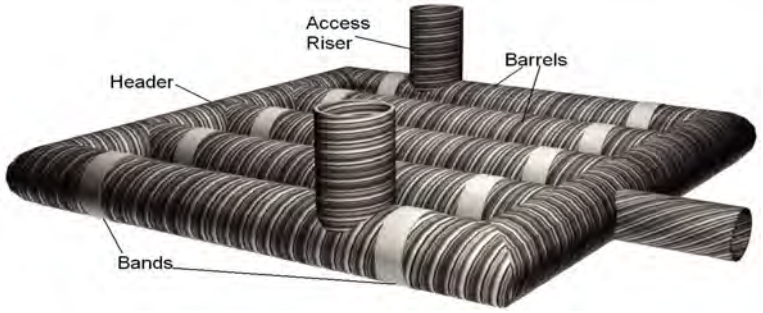


Project Summary

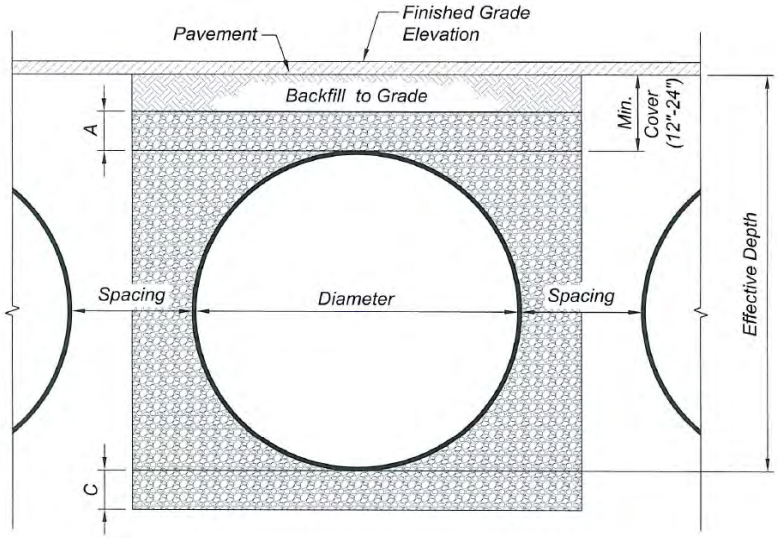
Date:	8/16/2016
Project Name:	City of Hope - DA3
City / County:	Duarte/ Los Angeles
State:	California
Designed By:	KP
Company:	KPFF
Telephone:	(310) 665-2800

Enter Information in Blue Cells

Corrugated Metal Pipe Calculator

Storage Volume Required (cf):	12,395
Limiting Width (ft):	50.00
Effective Depth Below Asphalt (ft):	10.00
Solid or Perforated Pipe:	Solid
Shape Or Diameter:	96
Spacing between Barrels (ft):	3.00
Stone Width Around Perimeter of System (ft):	0
Depth A: Porous Stone Above Pipe (in):	12
Depth C: Porous Stone Below Pipe (in):	12
Stone Porosity (0 to 40%):	20

50.27 ft^2 Pipe Area



System Sizing

Use Custom Layout (at right) for layout adjustment

Pipe Storage:	12,466	cf	
Porous Stone Storage:	0	cf	
Total Storage Provided:	12,466	cf	100.6% Of Required Storage
Number of Barrels:	4	barrels	
Length Per Barrel:	62.00	ft	
Rectangular Footprint (W x L):	41. ft x 62. ft		

CONTECH Materials

Total CMP Footage:	248	ft
Approximate Total Pieces:	12	pcs
Approximate Coupling Bands:	8	bands
Approximate Truckloads:	6	trucks

Construction Quantities**

Total Excavation:	942	cy
Porous Stone Backfill For Storage:	0	cy Stone
Backfill to Grade Excluding Stone:	480	cy Fill

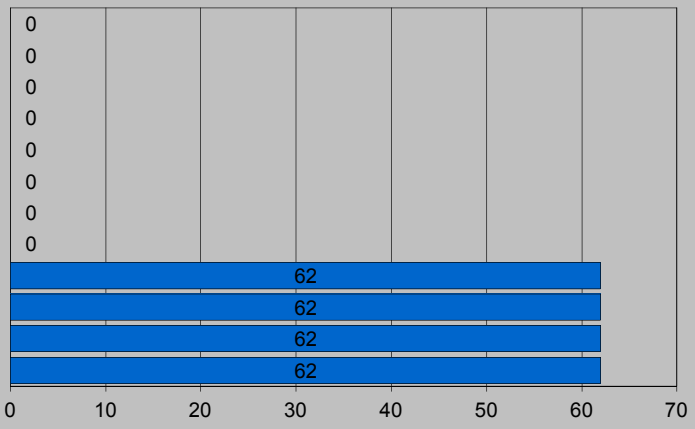
***Construction quantities are approximate and should be verified upon final design*

Custom Layout

To adjust layout, enter desired barrel length in the light blue boxes below.

Excess Footage = 0

Barrel 12	0
Barrel 11	0
Barrel 10	0
Barrel 9	0
Barrel 8	0
Barrel 7	0
Barrel 6	0
Barrel 5	0
Barrel 4	62
Barrel 3	62
Barrel 2	62
Barrel 1	62

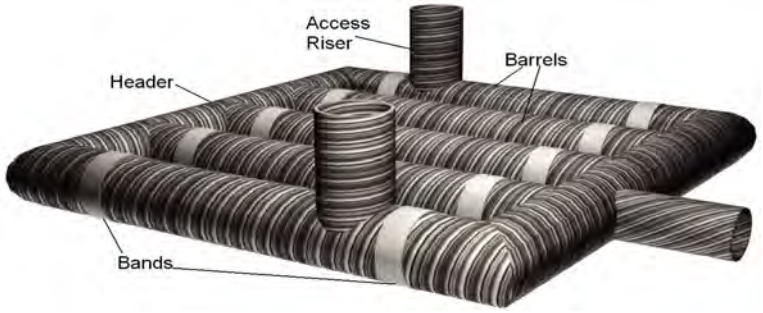


DYODS™
Design Your Own Detention System

CONTECH CMP DETENTION SYSTEMS

CONTECH CONSTRUCTION PRODUCTS INC.

For design assistance, drawings,
and pricing send completed worksheet to:
dyods@contech-cpi.com



Project Summary

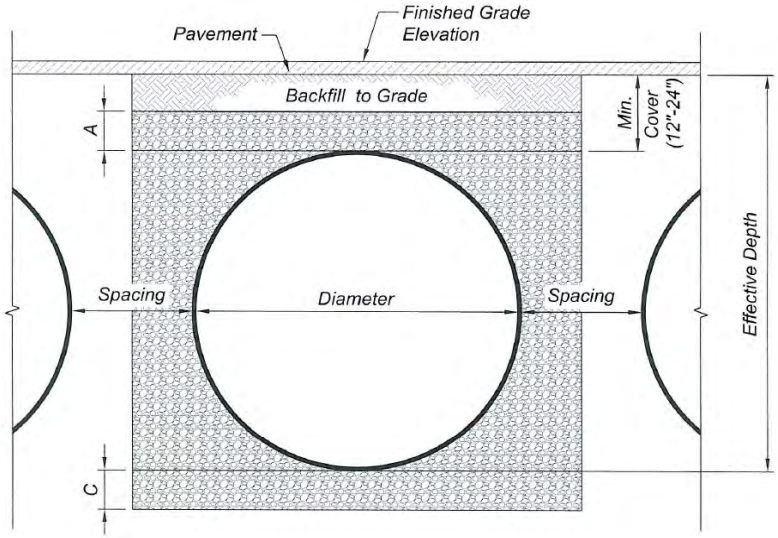
Date:	8/16/2016
Project Name:	City of Hope - DA4
City / County:	Duarte/ Los Angeles
State:	California
Designed By:	KP
Company:	KPFF
Telephone:	(310) 665-2800

Enter Information in Blue Cells

Corrugated Metal Pipe Calculator

Storage Volume Required (cf):	18,623
Limiting Width (ft):	50.00
Effective Depth Below Asphalt (ft):	10.00
Solid or Perforated Pipe:	Solid
Shape Or Diameter:	96
Spacing between Barrels (ft):	3.00
Stone Width Around Perimeter of System (ft):	0
Depth A: Porous Stone Above Pipe (in):	12
Depth C: Porous Stone Below Pipe (in):	12
Stone Porosity (0 to 40%):	20

50.27 ft^2 Pipe Area



System Sizing

Use Custom Layout (at right) for layout adjustment

Pipe Storage:	18,699 cf	
Porous Stone Storage:	0 cf	
Total Storage Provided:	18,699 cf	100.4% Of Required Storage
Number of Barrels:	4 barrels	
Length Per Barrel:	93.00 ft	
Rectangular Footprint (W x L):	41. ft x 93. ft	

CONTECH Materials

Total CMP Footage:	372 ft
Approximate Total Pieces:	16 pcs
Approximate Coupling Bands:	12 bands
Approximate Truckloads:	8 trucks

Construction Quantities**

Total Excavation:	1413 cy
Porous Stone Backfill For Storage:	0 cy Stone
Backfill to Grade Excluding Stone:	720 cy Fill

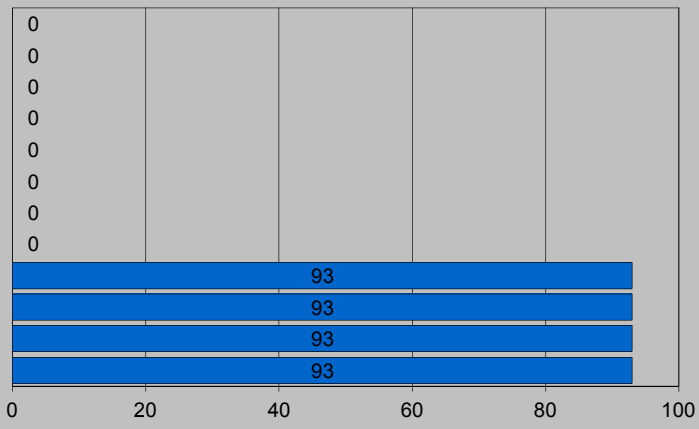
***Construction quantities are approximate and should be verified upon final design*

Custom Layout

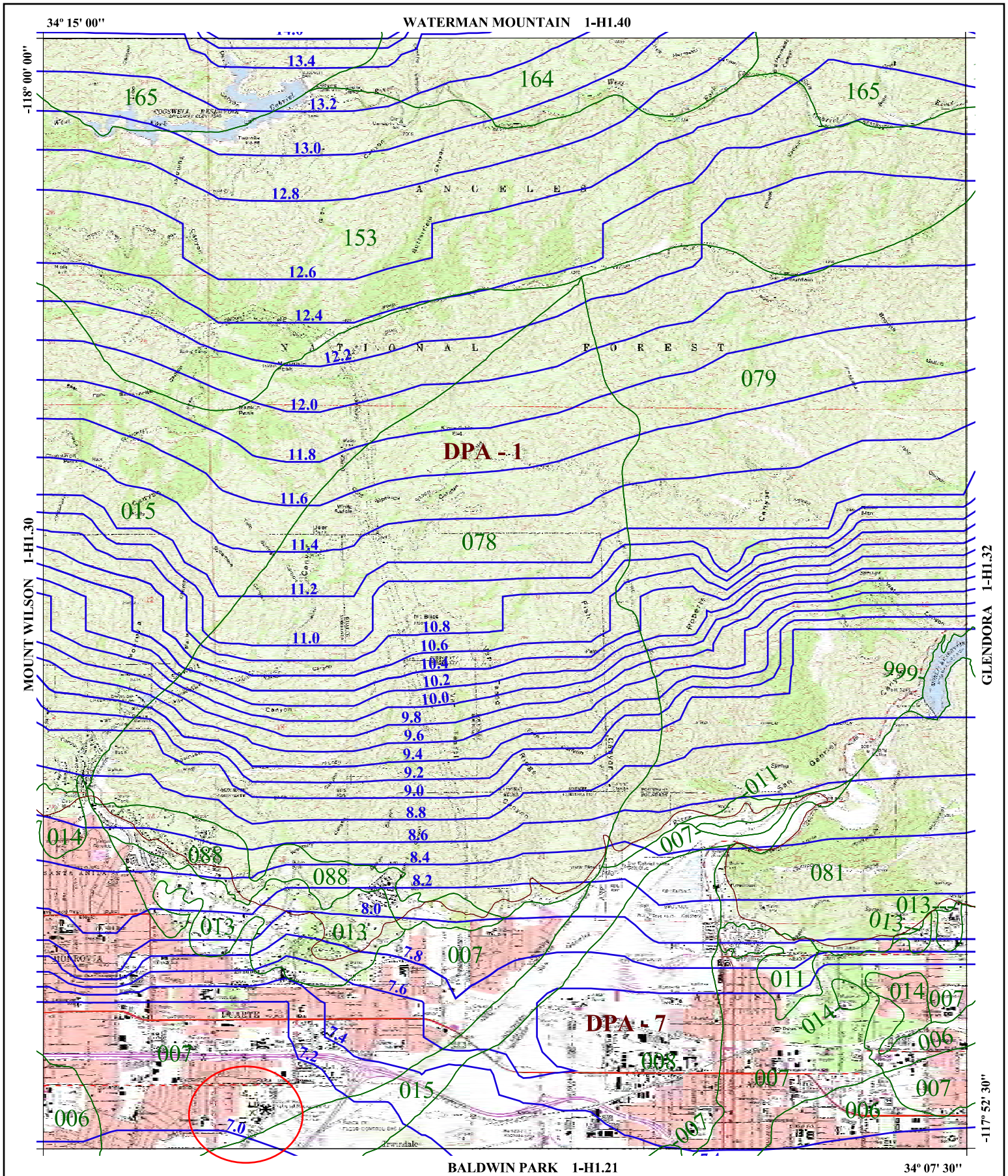
To adjust layout, enter desired barrel length in the light blue boxes below.

Excess Footage = 0

Barrel 12	0
Barrel 11	0
Barrel 10	0
Barrel 9	0
Barrel 8	0
Barrel 7	0
Barrel 6	0
Barrel 5	0
Barrel 4	93
Barrel 3	93
Barrel 2	93
Barrel 1	93



Appendix B – Los Angeles County Soils Maps and Runoff Curve



N
W E
S

016 SOIL CLASSIFICATION AREA

7.2 INCHES OF RAINFALL

DPA - 6 DEBRIS POTENTIAL AREA

1 0 1 2 Miles

25-YEAR 24-HOUR ISOHYET REDUCTION FACTOR: 0.878
10-YEAR 24-HOUR ISOHYET REDUCTION FACTOR: 0.714

A Z U S A
50-YEAR 24-HOUR ISOHYET

Soil 007
Rainfall 7.1

1-H1.31

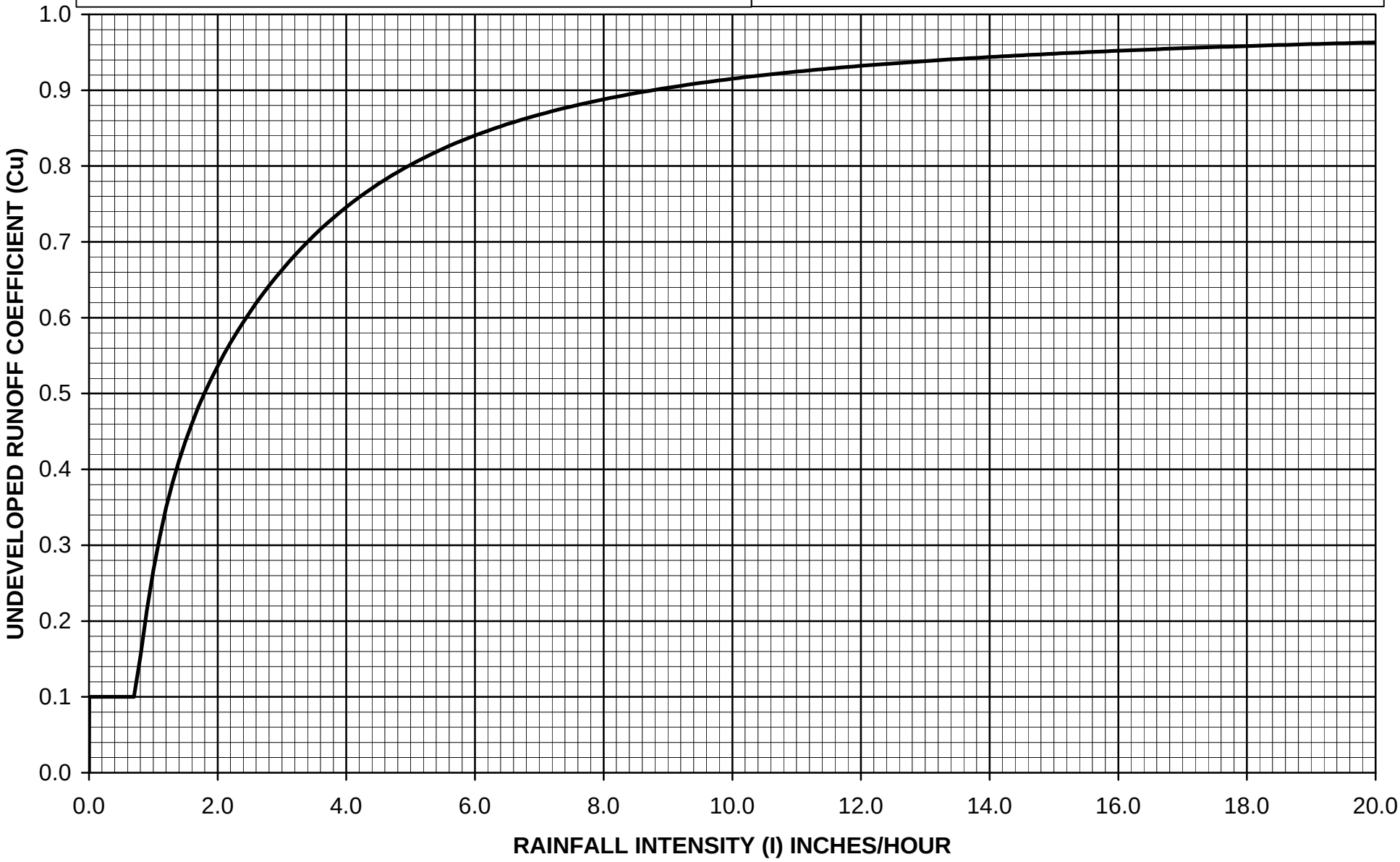
LOS ANGELES COUNTY PUBLIC WORKS Public Service That Works

$C_D = (0.9 * IMP) + (1.0 - IMP) * C_U$

Where: C_D = Developed Runoff Coefficient
IMP = Proportion Impervious
C_U = Undeveloped runoff coefficient

Los Angeles County Department of Public Works

RUNOFF COEFFICIENT CURVE
SOIL TYPE NO. 007



Department of Public Works
dpw.lacounty.gov

search our site...

Hydrology Map

A GIS viewer application to view the data for the hydrology manual.

LAYERS

- 50yr Two Tenths (Rainfall)
- DPA Zones
- Soils 2004
- TG Page
- Final 85th Percentile, 24-hr Rainfall
- Final 95th Percentile, 24-hr Rainfall
- 1-year, 1-hour Rainfall Intensity

SEARCH

Zoom to TG Page:

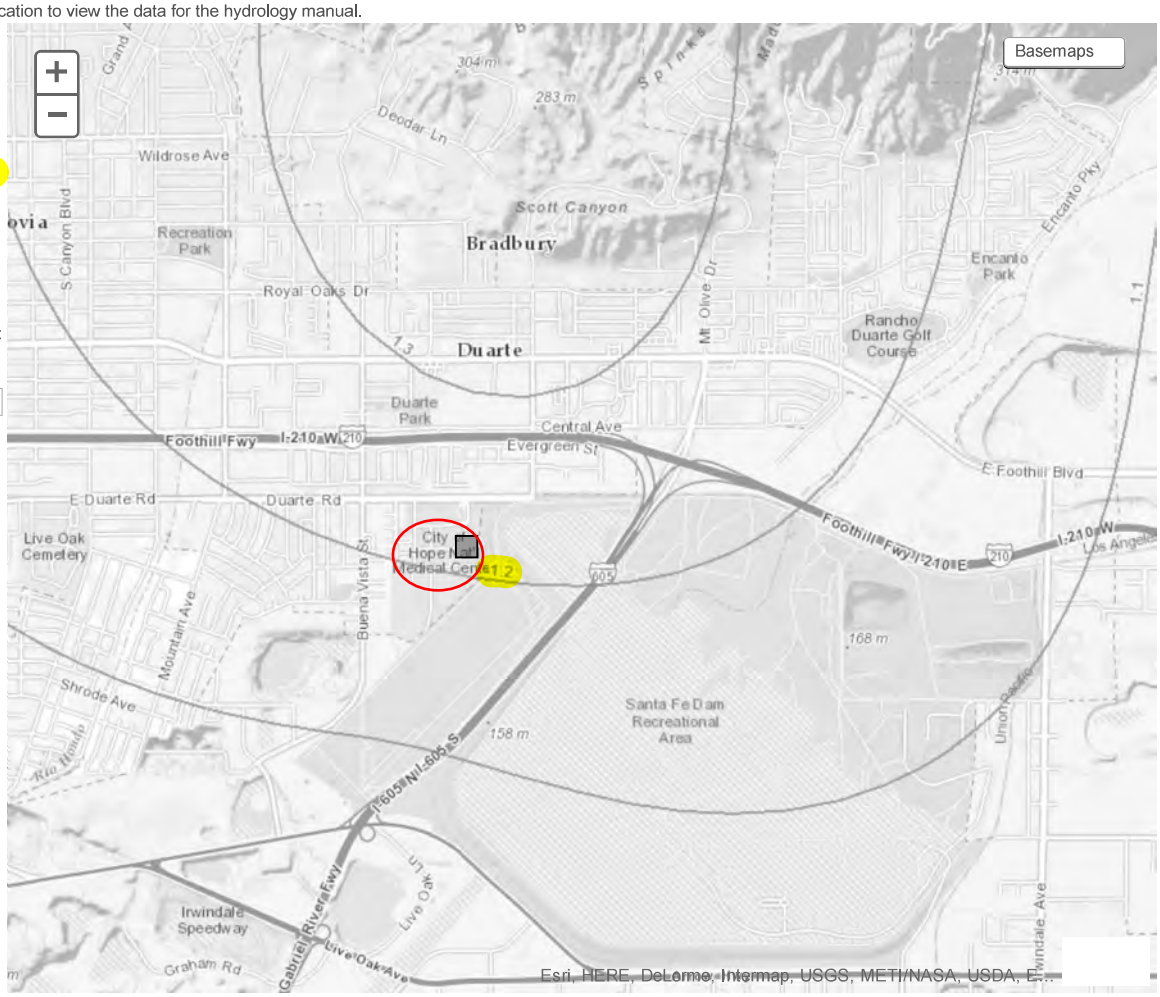
Enter Address, Cross Street, or Parcel No.:
(ex: 900 S. Fremont Ave., Fremont@Valley, 5342005904)

1500 east duarte road

Search

Address Search Results:

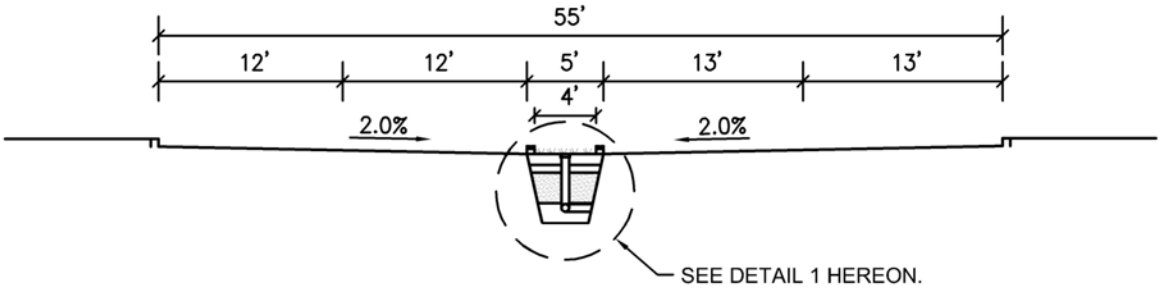
1500 east duarte road



Map Tips

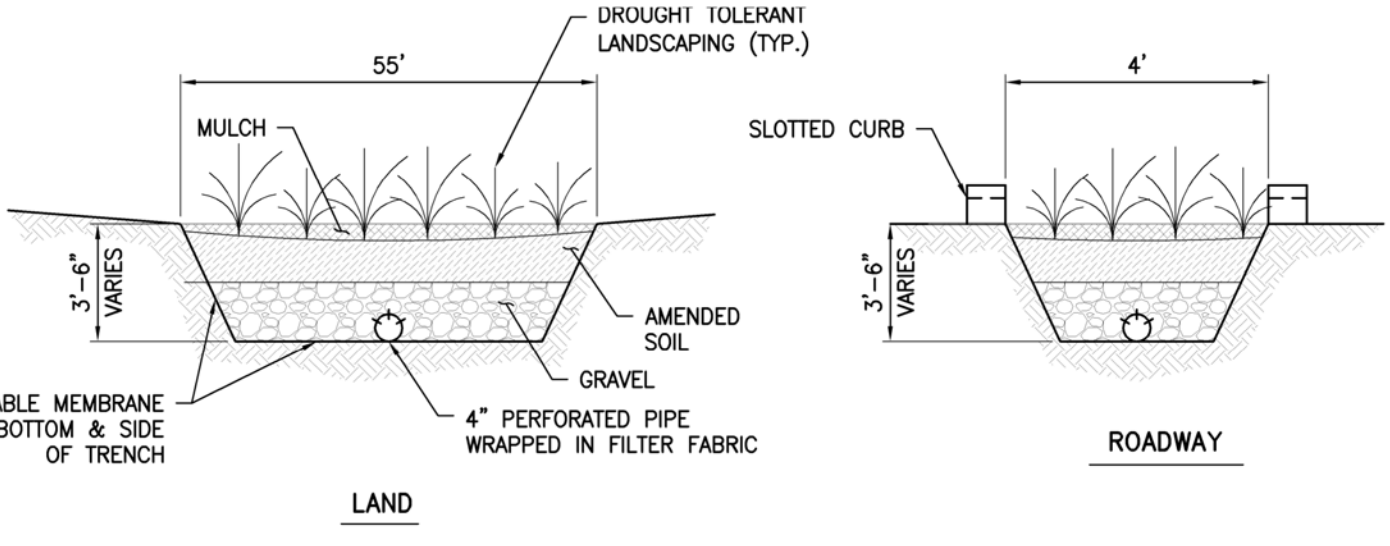
Appendix C - LID Details

APPENDIX 3



WITH BMP TYPE 1

1 **55 FOOT ROADWAY SECTION**



1 **BMP TYPE 1: MODIFIED BIOSWALE** N.T.S.

UrbanGreen® Hydrodynamic Separation

Pretreatment for Green Stormwater Solutions

Before CDS®

A bank by a stormwater retention pond in Pinellas County, Florida was fouled with cigarettes and other debris.

After CDS®

Two and a half months later after a CDS was installed, the bank was clean.

HDS Benefits

- Cost-effective method of gross pollutant removal
- Pretreatment reduces size and increases longevity of land based BMPs
- Variety of sizes to meet range of applications and flows
- Easy, low-cost maintenance

HDS Applications

- Pre-treatment for rainwater harvesting/stormwater reuse
- Pre-treatment for infiltration and bioretention
- Urban retrofit/redevelopment
- Sediment and trash protection for ponds/lakes
- Pump protection

CDS Features

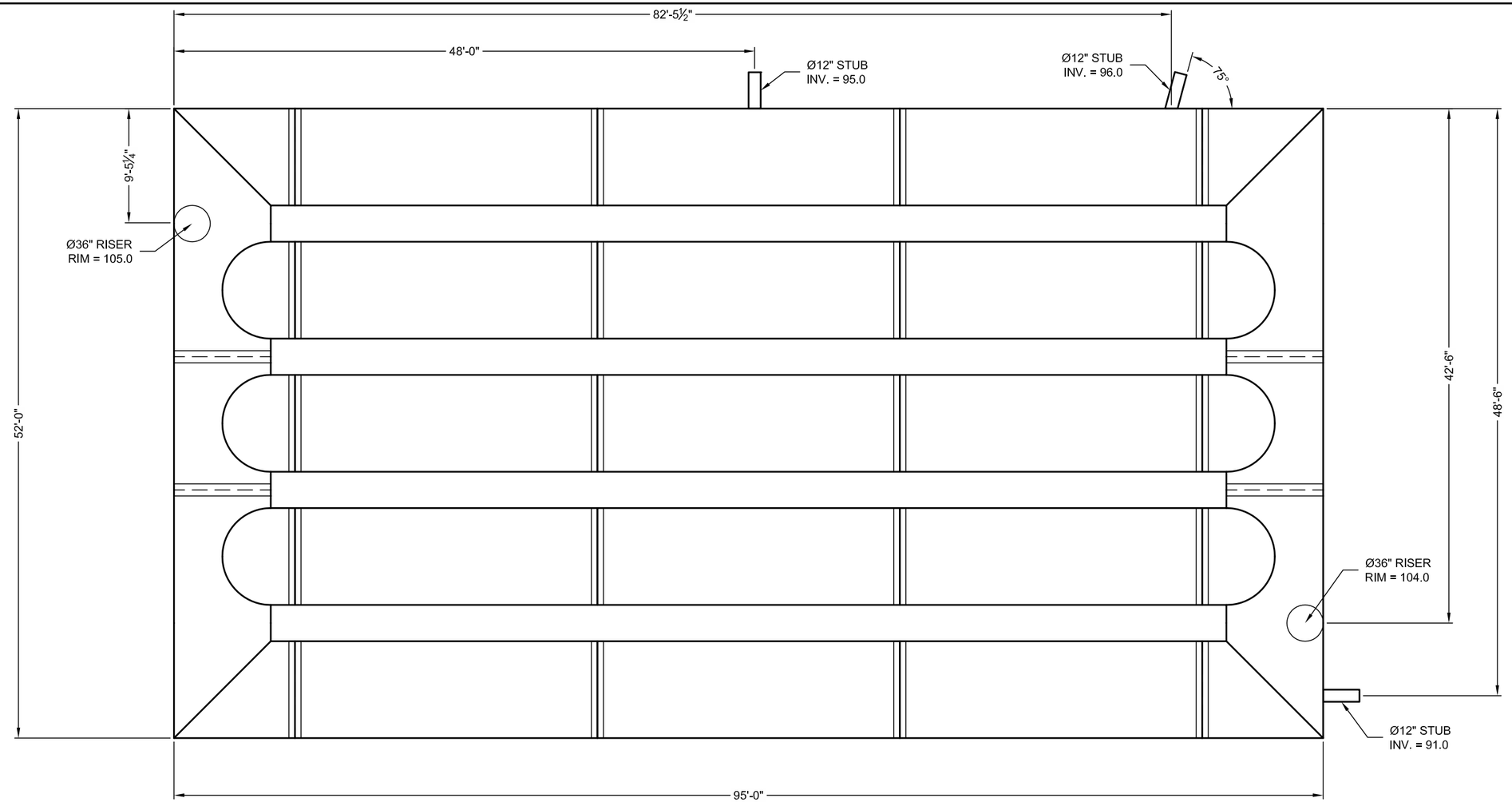
- Captures and retains 100% of floatables and neutrally buoyant debris 2.4 mm or larger
- Proven removal of solids, oil and grease
- Patented indirect screening capability keeps screen from clogging
- Retention of all captured pollutants, even at high flows
- Easy access to remove captured pollutants
- Performance verified by NJCAT and WA Ecology
- Flexible design
  - Allows for multiple inlet pipes
  - In-line, grate and curb inlet configurations
  - Easily installed in existing storm drain

CONTECH® ENGINEERED SOLUTIONS

800.338.1122
www.ContechES.com

H2-24

URBANGREEN®



THE UNDERSIGNED HEREBY APPROVES THE ATTACHED (4) PAGES INCLUDING THE FOLLOWING:

- **VOLUME = 33,906 C.F.**
- **MAINLINE PIPE GAUGE = 16**
- **WALL TYPE = PERFORATED**
- **DIAMETER = 96"**
- **FINISH = ALT2**

CUSTOMER _____ DATE _____

ASSEMBLY

SCALE: 1" = 10'
VOLUME: 33,906 C.F.
LOADING: H20/H25
SYSTEM INV = 91.0

Sample Project

NOTES

- ALL RISER AND STUB DIMENSIONS ARE TO CENTERLINE.
- ALL ELEVATIONS, DIMENSIONS, AND LOCATIONS OF RISERS AND INLETS, SHALL BE VERIFIED BY THE ENGINEER OF RECORD PRIOR TO RELEASING FOR FABRICATION.
- ALL FITTINGS AND REINFORCEMENT COMPLY WITH ASTM A998.
- ALL RISERS AND STUBS ARE 2⅔" x ½" CORRUGATION AND 16 GAGE UNLESS OTHERWISE NOTED.
- RISERS TO BE FIELD TRIMMED TO GRADE.
- QUANTITY OF PIPE SHOWN DOES NOT PROVIDE EXTRA PIPE FOR CONNECTING THE SYSTEM TO EXISTING PIPE OR DRAINAGE STRUCTURES. OUR SYSTEM AS DETAILED PROVIDES NOMINAL INLET AND/OR OUTLET PIPE STUB FOR CONNECTION TO EXISTING DRAINAGE FACILITIES. IF ADDITIONAL PIPE IS NEEDED IT IS THE RESPONSIBILITY OF THE CONTRACTOR.

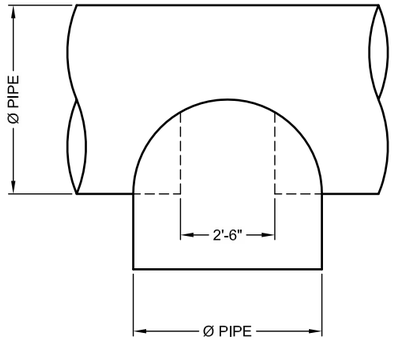
MARK	DATE	REVISION DESCRIPTION	BY

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

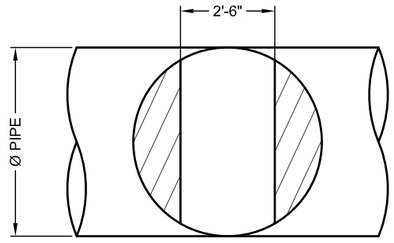
CONTECH CMP DETENTION SYSTEMS
CONTECH CONTRACT DRAWING
H2-25

Ø96" UNDERGROUND RETENTION SYSTEM - 000000-001
SAMPLE PROJECT
ANYTOWN, USA
SITE DESIGNATION: URS

PROJECT No.:	SEQ. No.:	DATE:
XXXXX	001	1/13/2014
DESIGNED: XXX	DRAWN: RTF	
CHECKED:	APPROVED:	
SHEET NO.: C1 OF 4		



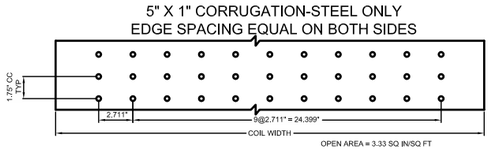
PLAN



FRONT

TYPICAL MANWAY DETAIL

SCALE: N.T.S.



NOTES:

1. PERFORATIONS MEET AASHTO AND ASTM SPECIFICATIONS.
2. PERFORATION OPEN AREA PER SQUARE FOOT OF PIPE IS BASED ON THE NOMINAL DIAMETER AND LENGTH OF PIPE.
3. ALL DIMENSIONS ARE SUBJECT TO MANUFACTURING TOLERANCES.
4. ALL HOLES 3/8"Ø.

EXFILTRATION AREA
STANDARD PERFORATION PATTERNS
AASTHO M-36 AND ASTM A760, B745

APPROXIMATE AREA PER LINEAR FOOT OF PIPE				
PIPE Ø (INCHES)	CORRUGATION PATTERN			
	2-2/3"X1/2" (SQ. INCHES)	3"X1" (SQ. INCHES)	5"x1" (SQ. INCHES)	ULTRA-FLO (SQ. INCHES)
96	94.5	104.6	83.7	103.3

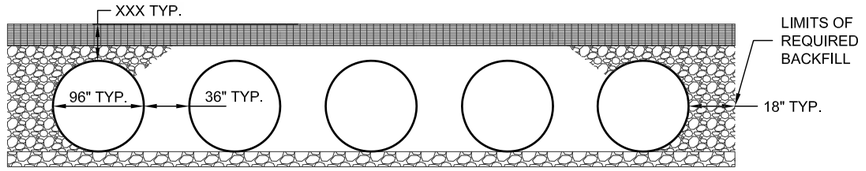
NOTES:

1. ALL HOLES ARE 3/8" DIAMETER,AND ARE NOTED AS 'CLASS 2 PERFORATIONS' PER AASHTO AND ASTM.
2. GAGE AND COATING LIMITATIONS APPLY. 5" X 1" IS NOT AVAILABLE IN ALUMINUM.
3. ALL DIMENSIONS ARE SUBJECT TO MANUFACTURING TOLERANCES.

**TYPICAL PERFORATION DETAIL

SCALE: N.T.S.

** MULTIPLE PERFORATION PATTERNS ARE AVAILABLE BASED UPON REGIONAL/PROJECT SPECIFIC REQUIREMENTS.



TYPICAL SECTION VIEW

SCALE: N.T.S.

FABRICATION BoM									
FITTING	TYPE	QTY	Ø	CORRUGATION	GAGE	FINISH	WALL TYPE	LENGTH	TOTAL
BAND FASTENER	12" HUGGER		96	w/BAR BOLT & STRAP	16	ALT2			
GASKETS	FLAT		96	12" WIDE					

PROJECT SPECIFIC BILL OF MATERIALS TO BE COMPLETED AT TIME OF CONTRACT DRAWINGS

MARK	DATE	REVISION DESCRIPTION	BY

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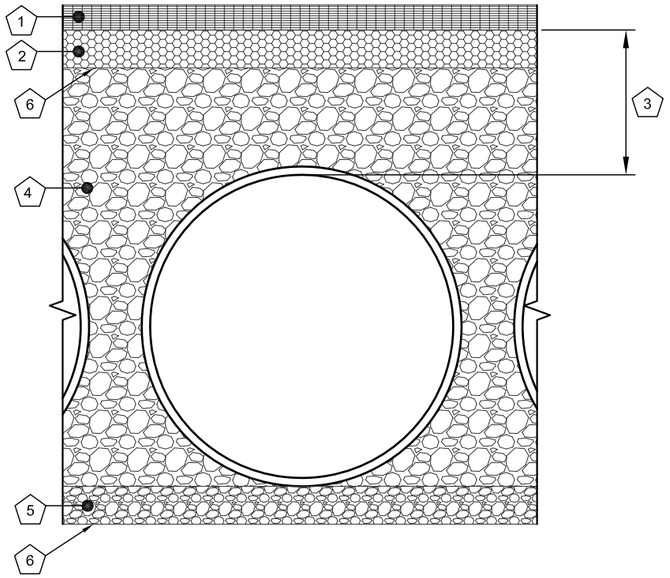
CONTECH CMP DETENTION SYSTEMS
CONTECH CONTRACT DRAWING
H2-26

Ø96" UNDERGROUND RETENTION SYSTEM - 000000-001
SAMPLE PROJECT
ANYTOWN, USA
SITE DESIGNATION: URS

PROJECT No.:	SEQ. No.:	DATE:
XXXXX	001	1/13/2014
DESIGNED:	DRAWN:	
XXX	RTF	
CHECKED:	APPROVED:	
SHEET NO.:		
C2 OF 4		



KEY

1.) RIGID OR FLEXIBLE PAVEMENT

2.) GRANULAR ROAD BASE

3.) 12" MIN. FOR DIAMETERS THROUGH 96"
18" MIN. FOR DIAMETERS FROM 102"
AND LARGER MEASURED TO TOP OF
RIGID OR BOTTOM OF FLEXIBLE
PAVEMENT.

4.) FREE DRAINING ANGULAR WASHED
STONE 3/4" - 2" MIN. PARTICLE SIZE.

5.) GRANULAR BEDDING, ROUGHLY
SHAPED TO FIT THE BOTTOM OF PIPE,
4"- 6" IN DEPTH.

6.) CONTECH C-40 OR C-45
NON-WOVEN GEOTEXTILE
REQUIRED, WRAPPING TRENCH
ONLY.

FOUNDATION/BEDDING PREPARATION

PRIOR TO PLACING THE BEDDING, THE FOUNDATION MUST BE CONSTRUCTED TO A UNIFORM AND STABLE GRADE. IN THE EVENT THAT UNSUITABLE FOUNDATION MATERIALS ARE ENCOUNTERED DURING EXCAVATION, THEY SHALL BE REMOVED AND BROUGHT BACK TO THE GRADE WITH A FILL MATERIAL AS APPROVED BY THE ENGINEER. ONCE THE FOUNDATION PREPARATION IS COMPLETE, THE 4 INCHES OF A WELL-GRADED GRANULAR MATERIAL SHALL BE PLACED AS THE BEDDING.

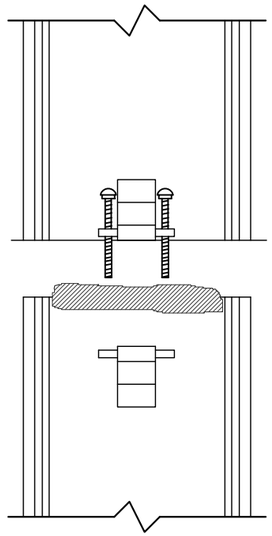
BACKFILL

THE BACKFILL MATERIAL SHALL BE FREE-DRAINING ANGULAR WASHED STONE 3/4" - 2" PARTICLE SIZE. MATERIAL SHALL BE PLACED IN 8"-10" MAXIMUM LIFTS. MATERIAL SHALL BE WORKED INTO THE PIPE HAUNCHES BY MEANS OF SHOVEL-SLICING, RODDING, AIR-TAMPER, VIBRATORY ROD, OR OTHER EFFECTIVE METHODS COMPACTION IS CONSIDERED ADEQUATE WHEN NO FURTHER YIELDING OF THE MATERIAL IS OBSERVED UNDER THE COMPACTOR, OR UNDER FOOT, AND THE PROJECT ENGINEER OR HIS REPRESENTATIVE IS SATISFIED WITH THE LEVEL OF COMPACTION. INADEQUATE COMPACTION CAN LEAD TO EXCESSIVE DEFLECTIONS WITHIN THE SYSTEM AND SETTLEMENT OF THE SOILS OVER THE SYSTEM. BACKFILL SHALL BE PLACED SUCH THAT THERE IS NO MORE THAN A TWO-LIFT DIFFERENTIAL BETWEEN THE SIDES OF ANY PIPE IN THE SYSTEM AT ALL TIMES DURING THE BACKFILL PROCESS. BACKFILL SHALL BE ADVANCED ALONG THE LENGTH OF THE SYSTEM AT THE SAME RATE TO AVOID DIFFERENTIAL LOADING ON ANY PIPES IN THE SYSTEM.

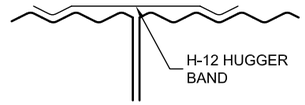
EQUIPMENT USED TO PLACE AND COMPACT THE BACKFILL SHALL BE OF A SIZE AND TYPE SO AS NOT TO DISTORT, DAMAGE, OR DISPLACE THE PIPE. ATTENTION MUST BE GIVEN TO PROVIDING ADEQUATE MINIMUM COVER FOR SUCH EQUIPMENT, AND MAINTAINING BALANCED LOADING ON ALL PIPES IN THE SYSTEM, DURING ALL SUCH OPERATIONS.

OTHER ALTERNATE BACKFILL MATERIAL MAY BE ALLOWED DEPENDING ON SITE SPECIFIC CONDITIONS. REFER TO TYPICAL BACKFILL DETAIL FOR MATERIAL REQUIRED.

1 / C3 BACKFILL DETAIL
SCALE: N.T.S.



CONNECTION DETAIL
SINGLE BOLT, BAR AND STRAP



NO GASKET

GENERAL NOTES

1. BANDS ARE NORMALLY FURNISHED AS FOLLOWS:
   12" THRU 48", 1-PIECE
   54" THRU 96", 2-PIECE
   102" THRU 144", 3-PIECES

2. BAND FASTENERS ARE ATTACHED WITH SPOT WELDS, RIVETS OR HAND WELDS

3. REROLLED ANNULAR END CORRUGATIONS ARE NORMALLY 2⅔" x ½". DIMENSIONS ARE SUBJECT TO MANUFACTURING TOLERANCES

2 / C3 H-12 HUGGER BAND DETAIL
SCALE: N.T.S.

MARK	DATE	REVISION DESCRIPTION	BY

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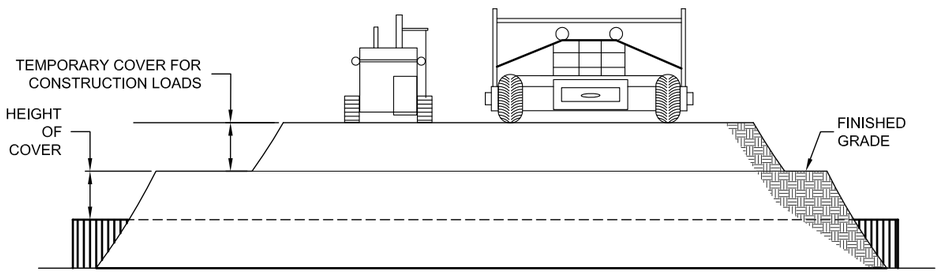
CONTECH CMP DETENTION SYSTEMS
CONTECH CONTRACT DRAWING
H2-27

Ø96" UNDERGROUND RETENTION SYSTEM - 000000-001
SAMPLE PROJECT
ANYTOWN, USA
SITE DESIGNATION: URS

PROJECT No.:	SEQ. No.:	DATE:
XXXXX	001	1/13/2014
DESIGNED: XXX	DRAWN: RTF	
CHECKED:	APPROVED:	
SHEET NO.: C3 OF 4		



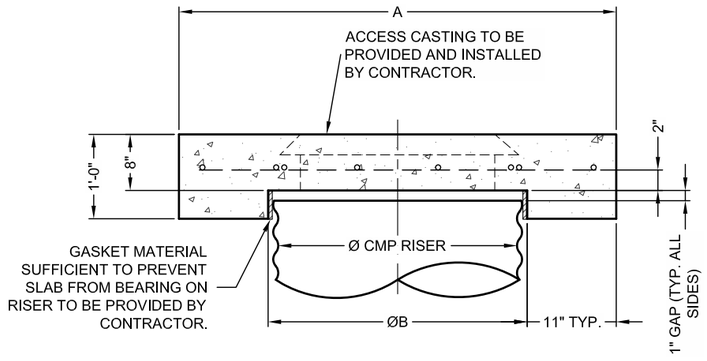
CONSTRUCTION LOADS

FOR TEMPORARY CONSTRUCTION VEHICLE LOADS, AN EXTRA AMOUNT OF COMPACTED COVER MAY BE REQUIRED OVER THE TOP OF THE PIPE. THE HEIGHT-OF-COVER SHALL MEET THE MINIMUM REQUIREMENTS SHOWN IN THE TABLE BELOW. THE USE OF HEAVY CONSTRUCTION EQUIPMENT NECESSITATES GREATER PROTECTION FOR THE PIPE THAN FINISHED GRADE COVER MINIMUMS FOR NORMAL HIGHWAY TRAFFIC.

PIPE SPAN, INCHES	AXLE LOADS (kips)			
	18-50	50-75	75-110	110-150
	MINIMUM COVER (FT)			
12-42	2.0	2.5	3.0	3.0
48-72	3.0	3.0	3.5	4.0
78-120	3.0	3.5	4.0	4.0
126-144	3.5	4.0	4.5	4.5

*MINIMUM COVER MAY VARY, DEPENDING ON LOCAL CONDITIONS. THE CONTRACTOR MUST PROVIDE THE ADDITIONAL COVER REQUIRED TO AVOID DAMAGE TO THE PIPE. MINIMUM COVER IS MEASURED FROM THE TOP OF THE PIPE TO THE TOP OF THE MAINTAINED CONSTRUCTION ROADWAY SURFACE.

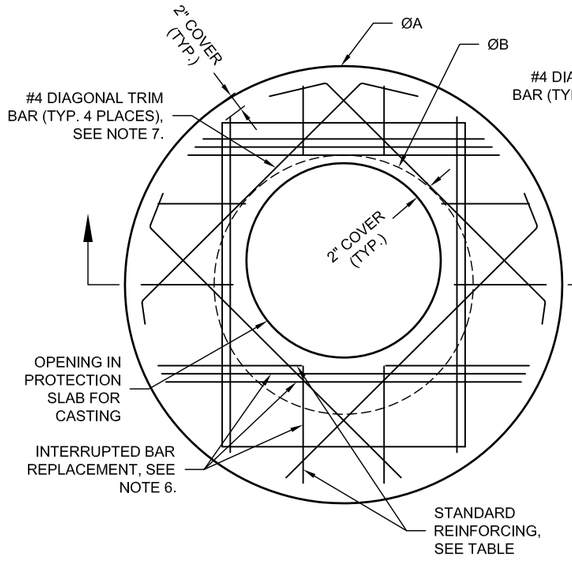
3 / C4 CONSTRUCTION LOADING DIAGRAM
SCALE: N.T.S.



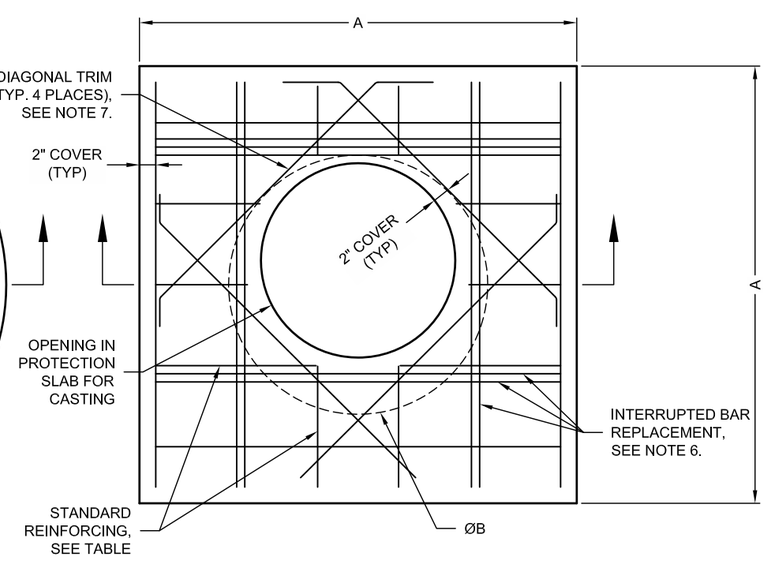
SECTION VIEW

REINFORCING TABLE				
Ø CMP RISER	A	Ø B	REINFORCING	**BEARING PRESSURE (PSF)
24"	Ø 4' 4'X4'	26"	#5 @ 12" OCEW #5 @ 12" OCEW	2,410 1,780
30"	Ø 4'-6" 4'-6" X 4'-6"	32"	#5 @ 12" OCEW #5 @ 12" OCEW	2,120 1,530
36"	Ø 5' 5' X 5'	38"	#5 @ 10" OCEW #5 @ 10" OCEW	1,890 1,350
42"	Ø 5'-6" 5'-6" X 5'-6"	44"	#5 @ 10" OCEW #5 @ 9" OCEW	1,720 1,210
48"	Ø 6' 6' X 6'	50"	#5 @ 9" OCEW #5 @ 8" OCEW	1,600 1,100

** ASSUMED SOIL BEARING CAPACITY



ROUND OPTION PLAN VIEW



SQUARE OPTION PLAN VIEW

NOTES:

1. DESIGN IN ACCORDANCE WITH AASHTO, 17th EDITION.
2. DESIGN LOAD HS25.
3. EARTH COVER = 1' MAX.
4. CONCRETE STRENGTH = 3,500 psi
5. REINFORCING STEEL = ASTM A615, GRADE 60.
6. PROVIDE ADDITIONAL REINFORCING AROUND OPENINGS EQUAL TO THE BARS INTERRUPTED, HALF EACH SIDE. ADDITIONAL BARS TO BE IN THE SAME PLANE.
7. TRIM OPENING WITH DIAGONAL #4 BARS, EXTEND BARS A MINIMUM OF 12" BEYOND OPENING, BEND BARS AS REQUIRED TO MAINTAIN BAR COVER.
8. PROTECTION SLAB AND ALL MATERIALS TO BE PROVIDED AND INSTALLED BY CONTRACTOR.
9. DETAIL DESIGN BY DELTA ENGINEERING, BINGHAMTON, NY.

4 / C4 MANHOLE CAP DETAIL
SCALE: N.T.S.

SPECIFICATION FOR CORRUGATED STEEL PIPE-ALUMINIZED TYPE 2 STEEL

SCOPE

THIS SPECIFICATION COVERS THE MANUFACTURE AND INSTALLATION OF THE CORRUGATED STEEL PIPE (CSP) DETAILED IN THE PROJECT PLANS.

MATERIAL

THE ALUMINIZED TYPE 2 STEEL COILS SHALL CONFORM TO THE APPLICABLE REQUIREMENTS OF AASHTO M274 OR ASTM A929.

PIPE

THE CSP SHALL BE MANUFACTURED IN ACCORDANCE WITH THE APPLICABLE REQUIREMENTS OF AASHTO M36 OR ASTM A760. THE PIPE SIZES, GAGES AND CORRUGATIONS SHALL BE AS SHOWN ON THE PROJECT PLANS.

ALL FABRICATION OF THE PRODUCT SHALL OCCUR WITHIN THE UNITED STATES.

HANDLING AND ASSEMBLY

SHALL BE IN ACCORDANCE WITH RECOMMENDATIONS OF THE NATIONAL CORRUGATED STEEL PIPE ASSOCIATION (NCSPA)

INSTALLATION

SHALL BE IN ACCORDANCE WITH AASHTO STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES, SECTION 26, DIVISION II OR ASTM A798 AND IN CONFORMANCE WITH THE PROJECT PLANS AND SPECIFICATIONS. IF THERE ARE ANY INCONSISTENCIES OR CONFLICTS THE CONTRACTOR SHOULD DISCUSS AND RESOLVE WITH THE SITE ENGINEER.

IT IS ALWAYS THE RESPONSIBILITY OF THE CONTRACTOR TO FOLLOW OSHA GUIDELINES FOR SAFE PRACTICES.

MARK	DATE	REVISION DESCRIPTION	BY

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

CONTECH CMP DETENTION SYSTEMS
CONTECH CONTRACT DRAWING
H2-28

Ø96" UNDERGROUND RETENTION SYSTEM - 000000-001
SAMPLE PROJECT
ANYTOWN, USA
SITE DESIGNATION: URS

PROJECT No.:	SEQ. No.:	DATE:
XXXXX	001	1/13/2014
DESIGNED:	DRAWN:	
XXX	RTF	
CHECKED:	APPROVED:	
SHEET NO.:		
C4 OF 4		

C:\USERS\FOWLER\DESKTOP\SAMPLE PROJECT - PERFORATED.DWG 1/13/2014 4:36 PM

Appendix D - OPERATION AND MAINTEANCE (O&M)

Refer to Section III for the recommended monitoring and maintenance of all BMPs utilized for the Project. Proposed structure BMPs shall be maintained according to the manufacturer's specification to ensure maximum pollutant removal efficiencies. See attached.

CONTECH®
ENGINEERED SOLUTIONS

CDS® Inspection and Maintenance Guide

CDS TECHNOLOGIES

Maintenance

The CDS system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend more heavily on site activities than the size of the unit. For example, unstable soils or heavy winter sanding will cause the grit chamber to fill more quickly but regular sweeping of paved surfaces will slow accumulation.

Inspection

Inspection is the key to effective maintenance and is easily performed. Pollutant transport and deposition may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. At a minimum, inspections should be performed twice per year (e.g. spring and fall) however more frequent inspections may be necessary in climates where winter sanding operations may lead to rapid accumulations, or in equipment washdown areas. Installations should also be inspected more frequently where excessive amounts of trash are expected.

The visual inspection should ascertain that the system components are in working order and that there are no blockages or obstructions in the inlet and separation screen. The inspection should also quantify the accumulation of hydrocarbons, trash, and sediment in the system. Measuring pollutant accumulation can be done with a calibrated dipstick, tape measure or other measuring instrument. If absorbent material is used for enhanced removal of hydrocarbons, the level of discoloration of the sorbent material should also be identified during inspection. It is useful and often required as part of an operating permit to keep a record of each inspection. A simple form for doing so is provided.

Access to the CDS unit is typically achieved through two manhole access covers. One opening allows for inspection and cleanout of the separation chamber (cylinder and screen) and isolated sump. The other allows for inspection and cleanout of sediment captured and retained outside the screen. For deep units, a single manhole access point would allows both sump cleanout and access outside the screen.

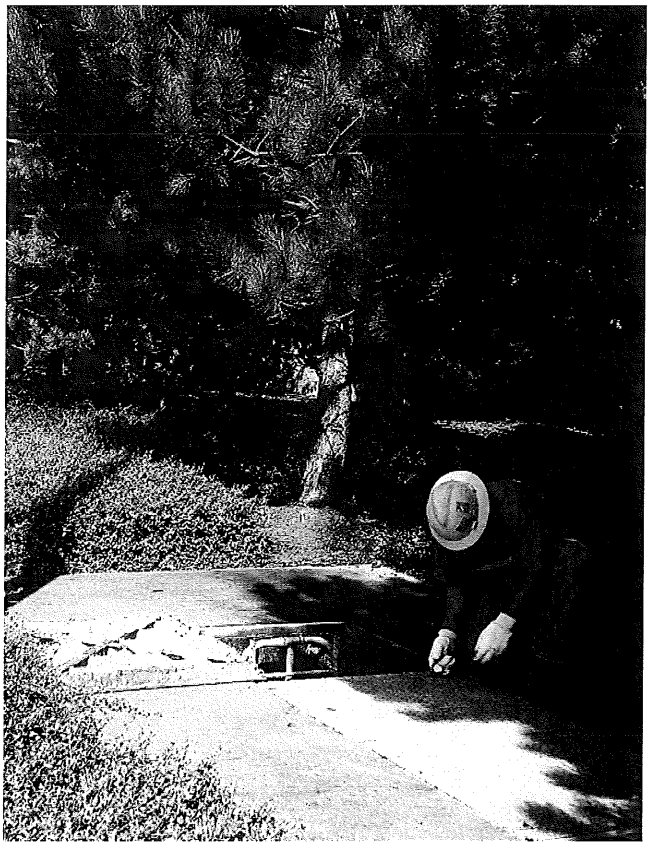
The CDS system should be cleaned when the level of sediment has reached 75% of capacity in the isolated sump or when an appreciable level of hydrocarbons and trash has accumulated. If absorbent material is used, it should be replaced when significant discoloration has occurred. Performance will not be impacted until 100% of the sump capacity is exceeded however it is recommended that the system be cleaned prior to that for easier removal of sediment. The level of sediment is easily determined by measuring from finished grade down to the top of the sediment pile. To avoid underestimating the level of sediment in the chamber, the measuring device must be lowered to the top of the sediment pile carefully. Particles at the top of the pile typically offer less resistance to the end of the rod than consolidated particles toward the bottom of the pile. Once this measurement is recorded, it should be compared to the as-built drawing for the unit to determine weather the height of the sediment pile off the bottom of the sump floor exceeds 75% of the total height of isolated sump.

Cleaning

Cleaning of a CDS systems should be done during dry weather conditions when no flow is entering the system. The use of a vacuum truck is generally the most effective and convenient method of removing pollutants from the system. Simply remove the manhole covers and insert the vacuum hose into the sump. The system should be completely drained down and the sump fully evacuated of sediment. The area outside the screen should also be cleaned out if pollutant build-up exists in this area.

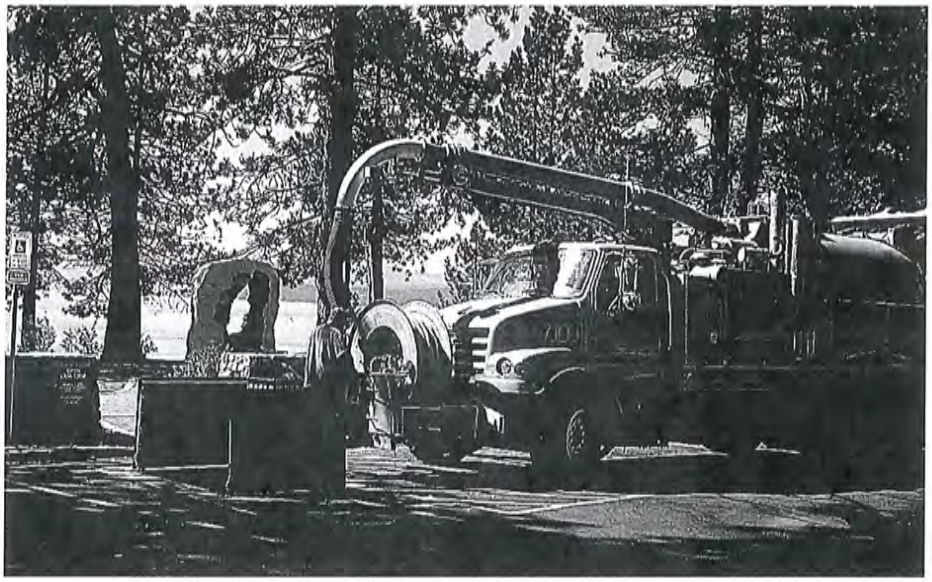
In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, the system should be cleaned out immediately in the event of an oil or gasoline spill should be cleaned out immediately. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use absorbent pads since they are usually less expensive to dispose than the oil/water emulsion that may be created by vacuuming the oily layer. Trash and debris can be netted out to separate it from the other pollutants. The screen should be power washed to ensure it is free of trash and debris.

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and also to ensure that proper safety precautions have been followed. Confined space entry procedures need to be followed if physical access is required. Disposal of all material removed from the CDS system should be done in accordance with local regulations. In many jurisdictions, disposal of the sediments may be handled in the same manner as the disposal of sediments removed from catch basins or deep sump manholes.



CDS Model	Diameter		Distance from Water Surface to Top of Sediment Pile		Sediment Storage Capacity	
	ft	m	ft	m	yd3	m3
CDS2015-4	4	1.2	3.0	0.9	0.9	0.7
CDS2015	5	1.5	3.0	0.9	1.3	1.0
CDS2020	5	1.5	3.5	1.1	1.3	1.0
CDS2025	5	1.5	4.0	1.2	1.3	1.0
CDS3020	6	1.8	4.0	1.2	2.1	1.6
CDS3030	6	1.8	4.6	1.4	2.1	1.6
CDS3035	6	1.8	5.0	1.5	2.1	1.6
CDS4030	8	2.4	4.6	1.4	5.6	4.3
CDS4040	8	2.4	5.7	1.7	5.6	4.3
CDS4045	8	2.4	6.2	1.9	5.6	4.3
CDS5640	10	3.0	6.3	1.9	8.7	6.7
CDS5653	10	3.0	7.7	2.3	8.7	6.7
CDS5668	10	3.0	9.3	2.8	8.7	6.7
CDS5678	10	3.0	10.3	3.1	8.7	6.7

Table 1: CDS Maintenance Indicators and Sediment Storage Capacities



Support

- Drawings and specifications are available at www.contechstormwater.com.
- Site-specific design support is available from our engineers.

Contech Engineered Solutions LLC provides site solutions for the civil engineering industry. Contech's portfolio includes bridges, drainage, sanitary sewer, stormwater, earth stabilization and wastewater treament products. For information, visit www.ContechES.com or call 800.338.1122

The product(s) described may be protected by one or more of the following US patents: 5,322,629; 5,624,576; 5,707,527; 5,759,415; 5,788,848; 5,985,157; 6,027,639; 6,350,374; 6,406,218; 6,641,720; 6,511,595; 6,649,048; 6,991,114; 6,998,038; 7,186,058; 7,296,692; 7,297,266; 7,517,450 related foreign patents or other patents pending.

cdsMaintenance 11/14

CONTECH ENGINEERED SOLUTIONS
800.925.5240
www.ContechES.com

CDS Inspection & Maintenance Log

CDS Model: _____ Location: _____

Date	Water depth to sediment[1]	Floatable Layer Thickness[2]	Describe Maintenance Performed	Maintenance Personnel	Comments

1. The water depth to sediment is determined by taking two measurements with a stadia rod: one measurement from the manhole opening to the top of the sediment pile and the other from the manhole opening to the water surface. If the difference between these measurements is less than the values listed in table 1 the system should be cleaned out. Note: to avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile.

2. For optimum performance, the system should be cleaned out when the floating hydrocarbon layer accumulates to an appreciable thickness. In the event of an oil spill, the system should be cleaned immediately.

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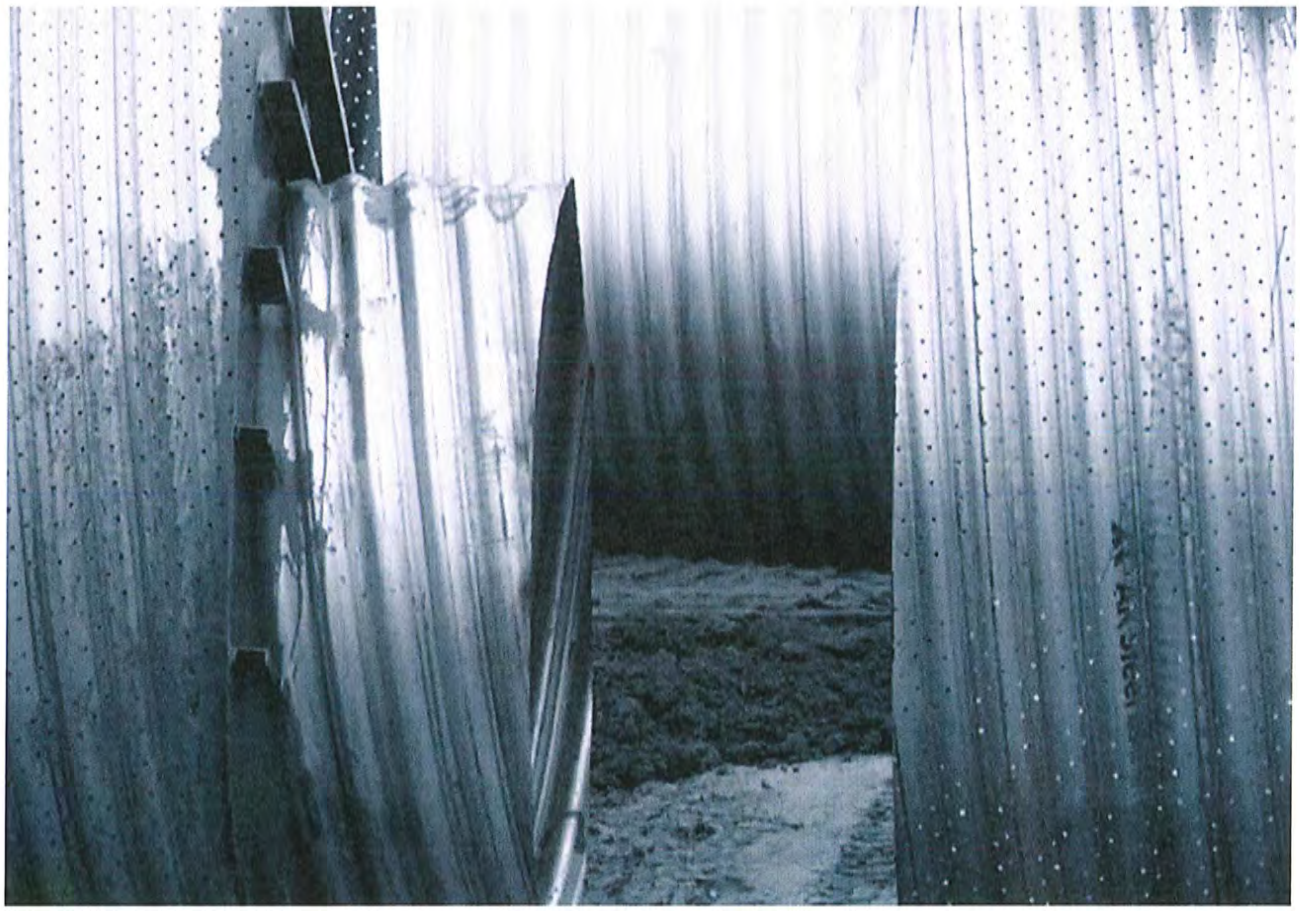
Contech® CMP Detention & Infiltration Maintenance Guide



CONTECH®
CMP DETENTION SYSTEMS

Maintenance

Underground storm water detention and retention systems should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend more heavily on site activities than the size or configuration of the system.

Inspection

Inspection is the key to effective maintenance and is easily performed. CONTECH recommends ongoing quarterly inspections of the accumulated sediment. Sediment deposition and transport may vary from year to year and quarterly inspections will help insure that systems are cleaned out at the appropriate time. Inspections should be performed more often in the winter months in climates where sanding operations may lead to rapid accumulations, or in equipment washdown areas. It is very useful to keep a record of each inspection. A sample inspection log is included for your use.

Systems should be cleaned when inspection reveals that accumulated sediment or trash is clogging the discharge orifice. CONTECH suggests that all systems be designed with an access/inspection manhole situated at or near the inlet and the outlet orifice. Should it be necessary to get inside the system to perform maintenance activities, all appropriate precautions regarding confined space entry and OSHA regulations should be followed.

Cleaning

Maintaining an underground detention or retention system is easiest when there is no flow entering the system. For this reason, it is a good idea to schedule the cleanout during dry weather.

Accumulated sediment and trash can typically be evacuated through the manhole over the outlet orifice. If maintenance is not performed as recommended, sediment and trash may accumulate in front of the outlet orifice. Manhole covers should be securely seated following cleaning activities.

Inspection & Maintenance Log Sample Template

_____" Diameter System			Location: Anywhere, USA		
Date	**Depth of Sediment**	**Accumulated Trash**	**Maintenance Performed**	**Maintenance Personnel**	**Comments**
12/01/10	2"	None	Removed Sediment	B. Johnson	Installed
03/01/11	1"	Some	Removed Sediment and Trash	B. Johnson	Swept parking lot
06/01/11	0"	None	None		
09/01/11	0"	Heavy	Removed Trash	S. Riley	
12/01/11	1"	None	Removed Sediment	S. Riley	
04/01/12	0"	None	None	S. Riley	
04/15/01	2	Some	Removed Sediment and Trash	ACE Environmental Services	

SECTION [_____]

STORMWATER TREATMENT DEVICE

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope

The Contractor shall furnish all labor, equipment and materials necessary to install the stormwater treatment device(s) (SWTD) and appurtenances specified in the Drawings and these specifications.

B. Related Sections

Section 02240: Dewatering
Section 02260: Excavation Support and Protection
Section 02315: Excavation and Fill
Section 02340: Soil Stabilization

1.2 QUALITY ASSURANCES

A. Inspection

All components shall be subject to inspection by the Engineer at the place of manufacture and/or installation. All components are subject to be rejected or identified for repair if the quality of materials and manufacturing do not comply with the requirements of this specification. Components which have been identified as defective may be subject for repair. Final acceptance of the component is contingent upon the discretion of the Engineer.

B. Warranty

The manufacturer shall guarantee the SWTD components against all manufacturer originated defects in materials or workmanship for a period of twelve (12) months from the date the components are delivered to the owner for installation. The manufacturer shall be notified of repair/replacement issues in writing within the referenced warranty period. The manufacturer shall, upon its determination of repair, correct or replace any manufacturer originated defects identified by written notice within the referenced warranty period. The use of SWTD components shall be limited to the application for which it was specifically designed.

C. Manufacturer's Performance Certificate

The SWTD manufacturer shall submit to the Engineer of Record a "Manufacturer's Performance Certification" certifying that each SWTD is capable of achieving the specified removal efficiencies as listed in these specifications. The certification shall be supported by independent third-party research.

1.3 SUBMITTALS

A. Shop Drawings

The contractor shall prepare and submit shop drawings in accordance with Section **[_____]** of the contract documents. The shop drawings shall detail horizontal and vertical dimensioning, reinforcement and joint type and locations.

PART 2 – PRODUCTS

2.1 MATERIALS AND DESIGN

A. Precast Concrete Components

Precast concrete components shall conform to applicable sections of ASTM C 478, ASTM C 857 and ASTM C 858 and the following:

1. Concrete shall achieve a minimum 28-day compressive strength of 4,000 pounds per square-inch (psi);
2. Unless otherwise noted, the precast concrete sections shall be designed to withstand lateral earth and AASHTO H-20 traffic loads;
3. Cement shall conform to ASTM C 150;
4. Aggregates shall conform to ASTM C 33;
5. Reinforcing steel shall be deformed billet-steel bars, welded steel wire or deformed welded steel wire conforming to ASTM A 615, A 185 or A 497, respectively;
6. Joints shall be sealed with preformed joint sealing compound conforming to ASTM C 990 and
7. Shipping of components shall not be initiated until a minimum compressive strength of 4,000 psi is attained or five (5) calendar days after fabrication has expired, whichever occurs first.

B. Internal Components and Appurtenances

Internal Components and appurtenances shall conform to the following:

1. Screen and support structure shall be manufactured of Type 316 and 316L stainless steel conforming to ASTM F 1267-01;
2. Hardware shall be manufactured of Type 316 stainless steel conforming to ASTM A 320;
3. Fiberglass components shall conform to the National Bureau of Standards PS-15 and coated with an isophalic polyester gelcoat and
4. Access system(s) conform to the following:
   a. Manhole castings shall be designed to withstand AASHTO H-20 loadings and manufactured of cast-iron conforming to ASTM A 48 Class 30.

b. Hatch systems shall be designed to withstand AASHTO H-20 loadings. Hatch systems not subject to direct traffic shall be manufactured of Grade 5086 aluminum. Hatch systems subject to direct traffic loads shall be manufactured of steel conforming to ASTM A36-93a, supplied with a hot-dip galvanized finish conforming to ASTM A 123 and access doors bolted to the frame.

2.2 PERFORMANCE

A. Removal Efficiencies

1. The SWTD shall be capable of achieving an 80 percent average annual reduction in the total suspended solid load.
2. The SWTD shall be capable of capturing and retaining 100 percent of pollutants greater than or equal to **[**4.7 millimeters (mm) or 2.4 millimeters (mm)**]** regardless of the pollutant's specific gravity (i.e.: floatable and neutrally buoyant materials) for flows up to the device's rated-treatment capacity. The SWTD shall be designed to retain all previously captured pollutants addressed by this subsection under all flow conditions.
3. The SWTD shall be capable of capturing and retaining total petroleum hydrocarbons. The SWTD shall be capable of achieving a removal efficiency of 92 and 78 percent when the device is operating at 25 and 50 percent of its rated-treatment capacity. These removal efficiencies shall be based on independent third-party research for influent oil concentrations representative of storm water runoff (20 ± 5 mg/L). The SWTD shall be greater than 99 percent effective in controlling dry-weather accidental oil spills.

   The SWTD shall be capable of utilizing sorbent media to enhance removal and retention of petroleum based pollutants.

B. Hydraulic Capacity

1. The SWTD shall provide a rated-treatment capacity, which is consistent with governing water treatment regulations. At its rated-treatment capacity, the device shall be capable of achieving greater than 65 percent removal of particles typically found in roadside sediments. This removal efficiency shall be supported by independent third-party research utilizing samples consistent with the NURP gradation or finer.
2. The SWTD shall maintain the peak conveyance capacity of the drainage network as defined by the Engineer.

C. Storage Capacity

1. The SWTD shall be designed with a sump chamber for the storage of captured sediments and other negatively buoyant pollutants in between maintenance cycles. The minimum storage capacity provided by the sump chamber shall be in accordance with the volume listed in Table 1. The boundaries of the sump chamber shall be limited to that which do not degrade the SWTD's treatment efficiency as captured pollutants accumulate. The sump chamber shall be separate from the treatment processing portion(s) of the SWTD to minimize the probability of fine

particle re-suspension. In order to not restrict the Owner's ability to maintain the SWTD, the minimum dimension providing access from the ground surface to the sump chamber shall be 20 inches in diameter.

2. The SWTD shall be designed to capture and retain Total Petroleum Hydrocarbons generated by wet-weather flow and dry-weather gross spills. The minimum storage capacity provided by the SWTD shall be in accordance with the volume listed in Table 1 below.

TABLE 1

CDS Model	Treatment Capacity (cfs)/(L/s)	Minimum Sump Storage Capacity (yd^3)/(m^3)	Minimum Oil Storage Capacity (gal)/(L)
CDS2015-G	0.7 (19.8)	0.5 (0.4)	70 (265)
CDS2015-4	0.7 (19.8)	0.5 (1.4)	70 (265)
CDS2015	0.7(19.8)	1.3 (1.0)	92 (348)
CDS2020	1.1 (31.2)	1.3 (1.0)	131 (496)
CDS2025	1.6 (45.3)	1.3 (1.0)	143 (541)
CDS3020	2.0 (56.6)	2.1 (1.6)	146 (552)
CDS3030	3.0 (85.0)	2.1 (1.6)	205 (776)
CDS3035	3.8 (106.2)	2.1 (1.6)	234 (885)
CDS4030	4.5 (127.4)	5.6 (4.3)	407 (1540)
CDS4040	6.0 (169.9)	5.6 (4.3)	492 (1862)
CDS4045	7.5 (212.4)	5.6 (4.3)	534 (2012)
CDS2020-D	1.1 (31.2)	1.3 (1.0)	131 (495)
CDS3020-D	2.0 (56.6)	2.1 (1.6)	146 (552)
CDS3030-D	3.0 (85.0)	2.1 (1.6)	205 (776)
CDS3035-D	3.8 (106.2)	2.1 (1.6)	234 (885)
CDS4030-D	4.5 (127.4)	4.3 (3.3)	328 (1241)
CDS4040-D	6.0 (169.9)	4.3 (3.3)	396 (1499)
CDS4045-D	7.5 (212.4)	4.3 (3.3)	430 (1627)
CDS5640-D	9.0 (254.9)	5.6 (4.3)	490 (1854)
CDS5653-D	14.0 (396.5)	5.6 (4.3)	599 (2267)
CDS5668-D	19.0 (538.1)	5.6 (4.3)	733 (2774)
CDS5678-D	25.0 (708.0)	5.6 (4.3)	814 (3081)
CDS3030-DV	3.0 (85.0)	2.1 (1.6)	205 (776)
CDS5042-DV	9.0 (254.9)	1.9 (1.5)	294 (1112)
CDS5050-DV	11.0 (311.5)	1.9 (1.5)	367 (1389)
CDS7070-DV	26.0 (736.3)	3.3 (2.5)	914 (3459)
CDS10060-DV	30.0 (849.6)	5.0 (3.8)	792 (2997)
CDS10080-DV	50.0 (1416.0)	5.0 (3.8)	1057 (4000)
CDS100100-DV	64.0 (1812.5)	5.0 (3.8)	1320 (4996)

D. Alternate Treatment Technologies and Sizing Criteria

The sizing criteria for treatment systems must conform to the recommended loading rate and 3rd party testing data requirements as mentioned below:

1. CDS Screening Systems – designed for full treatment of the runoff rate at a loading rate not to exceed the critical flow in the inlet, in order to achieve 80% TSS removal efficiency. (80% TSS removal based on a average particles size of 63 micron)
2. Vortex separation systems – designed for full treatment of the runoff rate at a loading rate not to exceeding 24 gpm/ft2, in order to achieve 80% TSS removal efficiency. The hydraulic capacity should not exceed a loading rate of 100 gpm/ft2 to prevent scouring of previously captured particles. 80% TSS removal based on a average particles size of 63 micron)
3. Gravity systems – designed for full treatment of the runoff rate at a loading rate not to exceeding 10 gpm/ft2, in order to achieve 80% TSS removal efficiency. The gravity units will not exceed luminar flow condition parameters in the treatment unit but will provide a bypass system to prevent turbulence from accruing in the system. (See "Stokes Law" for gravity settling requirements of particles. 80% TSS removal based on a average particles size of 63 micron)

Additionally, the performance of the unit must be evaluated by a third party and verified in a program that allows a more-or-less direct comparison to other technologies. Performance should be third party verified, and removal efficiencies across the spectrum of particle sizes reported, at a range of hydraulic loading rates varying over a range of at least 25 to 125% of the manufacturer's advertised 'water treatment' loading rate.

2.3 MANUFACTURER

The manufacturer of the SWTD shall be one that is regularly engaged in the engineering design and production of systems deployed for the treatment of storm water runoff for at least five (5) years and which have a history of successful production, acceptable to the Engineer. In accordance with the Drawings, the SWTD(s) shall be a CDS® device manufactured by:

Contech Engineered Solutions
9025 Centre Pointe Dr., Suite 400
West Chester, OH 45069
(800) 338-1122

PART 3 – EXECUTION

3.1 HANDLING AND STORAGE

1. The contractor shall exercise care in the storage and handling of the SWTD components prior to and during installation. Any repair or replacement costs associated with events occurring after delivery is accepted and unloading has commenced shall be born by the contractor.

3.2 INSTALLATION

1. The SWTD shall be installed in accordance with the manufacturer's recommendations and related sections of the contract documents. The manufacturer shall provide the contractor installation instructions and offer on-site guidance during the important stages of the installation as identified by the manufacturer at no additional expense. A minimum of 72 hours notice shall be provided to the manufacturer prior to their performance of the services included under this subsection.
2. The contractor shall fill all voids associated with lifting provisions provided by the manufacturer. These voids shall be filled with non-shrinking grout providing a finished surface consistent with adjacent surfaces. The contractor shall trim all protruding lifting provisions flush with the adjacent concrete surface in a manner which leaves no sharp points or edges.

END OF SECTION

STORM WATER SWALE AND DETENTION TRENCH
OPERATION & MAINTENANCE

The maintenance program will include the following key components:

1. Inspect before and after storm events.

2. Inspect a minimum of two times a year.

3. If standing water is observed 48 hours after a storm event, excavate and replace the top 12" of draining stones constituting the trench.

MAINTENANCE LOG:

Keep a log of all inspection and maintenance performed. Keep the log on-site.