

Project: Wingate Residences
 Location: Haverhill, MA
 Prepared For: Alyssa Peck - Weston & Sampson



Purpose: To calculate the water quality flow rate (WQF) over a given site area. In this situation the WQF is derived from the first 0.50" of runoff.

Reference: Massachusetts Dept. of Environmental Protection Wetlands Program / United States Department of Agriculture Natural Resources Conservation Service TR-55 Manual

Given:

Structure Name	Impv. (acres)	A (miles ²)	t _c (min)	t _c (hr)	WQV (in)
SWTU1	0.20	0.0003122	6.0	0.100	0.50
SWTU2	0.40	0.0006275	6.0	0.100	0.50

Procedure: Determine unit peak discharge using Figure 1 or 2. Figure 2 is in tabular form so is preferred. Using the t_c, read the unit peak discharge (qu) from Figure 1 or Table in Figure 2. qu is expressed in the following units: cfs/mi²/watershed inches (csm/in).

Structure Name	qu (csm/in.)
SWTU1	752.00
SWTU2	752.00

1. Compute Q Rate using the following equation:

$$Q_{0.5} = (qu) (A) (WQV)$$

where:

- Q_{0.5} = flow rate associated with first 1/2" of runoff
- qu = the unit peak discharge, in csm/in.
- A = impervious surface drainage area (in square miles)
- WQV = water quality volume in watershed inches (1/2" in this case)

Structure Name	Q _{0.5} (cfs)
SWTU1	0.22
SWTU2	0.24

* SWTU 1 for structure w/ Rim = 138.80
 SWTU 2 for structure w/ Rim = 127.95

VortSentry® HS Estimated Net Annual TSS Reduction



**WINGATE RESIDENCES
HAVERHILL, MA
Model VSHS36
System SWTU1**

Rim = 138.80

Design Ratio¹ = $\frac{0.2 \text{ acres} \times 0.9}{27 \text{ ft}^3} = 0.007$

<u>Rainfall Intensity</u> "/hr	<u>Flow Rate</u> cfs	<u>Operating Rate²</u> cfs/ft ³	<u>% Total Rainfall</u> Depth ³	<u>Rmvl. Effcy⁴</u> (%)	<u>Rel. Effcy</u> (%)
0.02	0.00	0.00014	10.2%	98.0%	10.0%
0.04	0.01	0.00027	9.6%	98.0%	9.5%
0.06	0.01	0.00041	9.4%	98.0%	9.3%
0.08	0.01	0.00054	7.7%	98.0%	7.6%
0.10	0.02	0.00068	8.6%	98.0%	8.4%
0.12	0.02	0.00081	6.3%	98.0%	6.2%
0.14	0.03	0.00095	4.7%	98.0%	4.6%
0.16	0.03	0.00109	4.6%	98.0%	4.5%
0.18	0.03	0.00122	3.5%	98.0%	3.5%
0.20	0.04	0.00136	4.3%	98.0%	4.3%
0.25	0.05	0.00170	8.0%	98.0%	7.8%
0.30	0.05	0.00204	5.6%	98.0%	5.5%
0.35	0.06	0.00238	4.4%	98.0%	4.3%
0.40	0.07	0.00272	2.5%	98.0%	2.5%
0.45	0.08	0.00306	2.5%	98.0%	2.5%
0.50	0.09	0.00340	1.4%	98.0%	1.4%
0.75	0.14	0.00509	5.0%	98.0%	4.9%
1.00	0.18	0.00679	0.5%	98.0%	0.5%
1.50	0.27	0.01019	0.0%	95.7%	0.0%
2.00	0.36	0.01358	0.0%	89.4%	0.0%
3.00	0.54	0.02037	0.5%	80.9%	0.4%
					97.4%
					% rain falling at >3"/hr = 0.5% Removal Efficiency Adjustment ⁴ = 6.5% Predicted Net Annual Load Removal Efficiency = 90.9%

1 - Design Ratio = (Total Drainage Area x Runoff Coefficient) / VortSentry HS Treatment Volume
= The Total Drainage Area and Runoff Coefficient are specified by the site engineer.

2 - Operating Rate (cfs/ft³) = Rainfall Intensity ("/hr) x Design Ratio

3 - Based on 10 years of hourly precipitation data from NCDC Station 770, Boston WSFO AP, Suffolk County, MA

4 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

Calculated by: CJA Date: 06/21/16 Checked by: Date:

**CDS ESTIMATED NET ANNUAL TSS REDUCTION
BASED ON THE RATIONAL RAINFALL METHOD**



**WINGATE RESIDENCES
HAVERHILL, MA
for SYSTEM: SWTU2**

Rim = 127.95

Area 0.4 acres
Weighted C 0.90
Tc 6 minutes

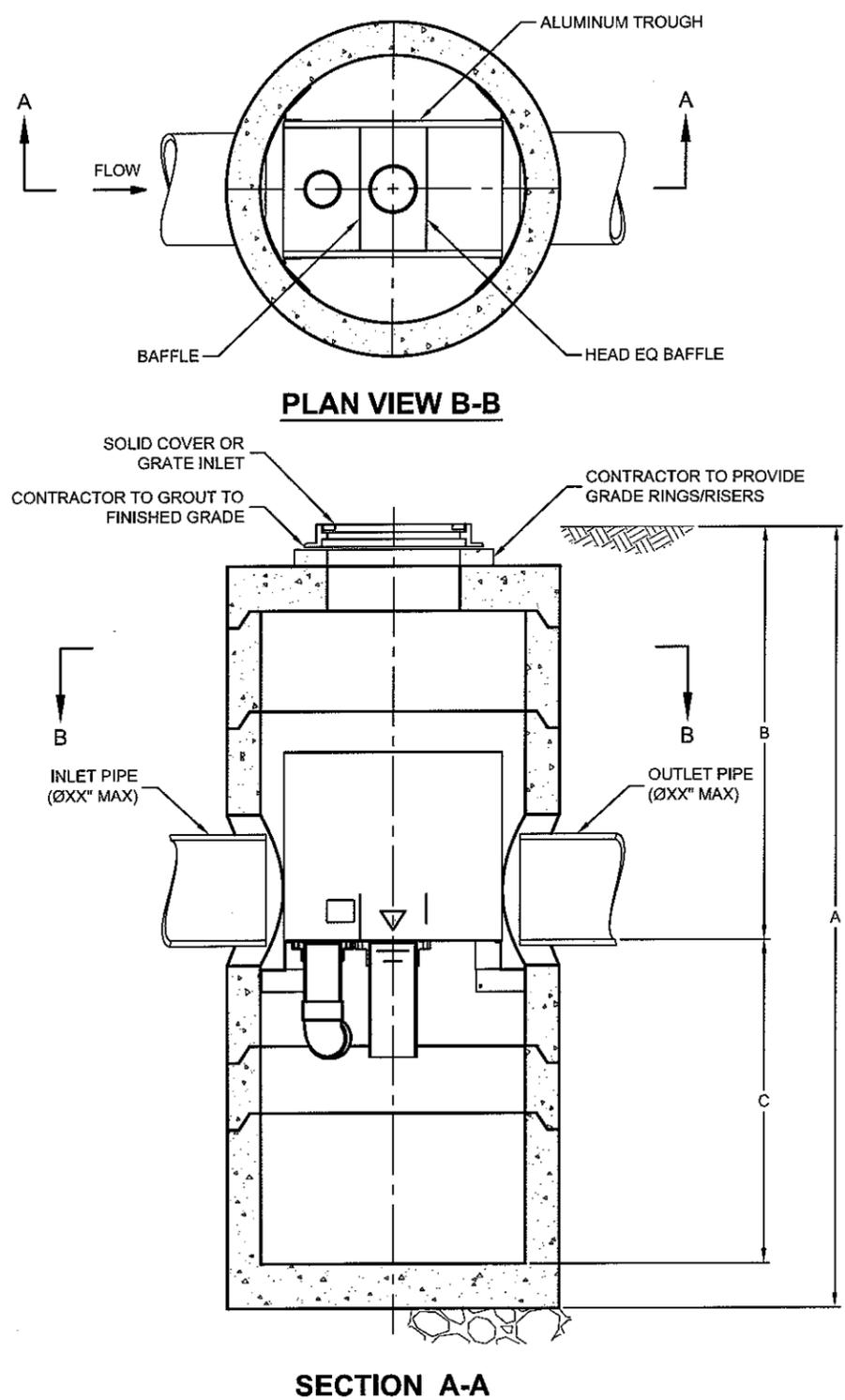
CDS Model 2015-4
CDS Treatment Capacity 1.4 cfs

<u>Rainfall Intensity¹</u> (in/hr)	<u>Percent Rainfall Volume¹</u>	<u>Cumulative Rainfall Volume</u>	<u>Total Flowrate (cfs)</u>	<u>Treated Flowrate (cfs)</u>	<u>Removal Efficiency (%)</u>	<u>Incremental Removal (%)</u>
0.02	10.2%	10.2%	0.01	0.01	96.9	9.9
0.04	9.6%	19.8%	0.01	0.01	96.5	9.3
0.06	9.4%	29.3%	0.02	0.02	96.2	9.1
0.08	7.7%	37.0%	0.03	0.03	95.8	7.4
0.10	8.6%	45.6%	0.04	0.04	95.5	8.2
0.12	6.3%	51.9%	0.04	0.04	95.1	6.0
0.14	4.7%	56.5%	0.05	0.05	94.8	4.4
0.16	4.6%	61.2%	0.06	0.06	94.4	4.4
0.18	3.5%	64.7%	0.06	0.06	94.1	3.3
0.20	4.3%	69.1%	0.07	0.07	93.7	4.1
0.25	8.0%	77.1%	0.09	0.09	92.8	7.4
0.30	5.6%	82.7%	0.11	0.11	92.0	5.1
0.35	4.4%	87.0%	0.13	0.13	91.1	4.0
0.40	2.5%	89.5%	0.14	0.14	90.2	2.3
0.45	2.5%	92.1%	0.16	0.16	89.3	2.3
0.50	1.4%	93.5%	0.18	0.18	88.5	1.2
0.75	5.0%	98.5%	0.27	0.27	84.1	4.2
1.00	1.0%	99.5%	0.36	0.36	79.7	0.8
1.50	0.0%	99.5%	0.54	0.54	70.9	0.0
2.00	0.0%	99.5%	0.72	0.72	62.2	0.0
3.00	0.5%	100.0%	1.08	1.08	44.7	0.2
						93.6
						Removal Efficiency Adjustment ² = 6.5%
						Predicted % Annual Rainfall Treated = 93.5%
						Predicted Net Annual Load Removal Efficiency = 87.2%

1 - Based on 10 years of hourly precipitation data from NCDC Station 770, Boston WSFO AP, Suffolk County, MA

2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

I:\STORMWATER\COMMO\OPS\28 VORTSENTRY HS\40 STANDARD DRAWINGS\DWG\SHS-DTL.DWG 5/16/2014 4:31 PM



SECTION A-A

VortSentry

THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS: 6,991,114; 7,296,692; RELATED FOREIGN PATENTS, OR OTHER PATENTS PENDING.

VORTSENTRY HS DESIGN NOTES

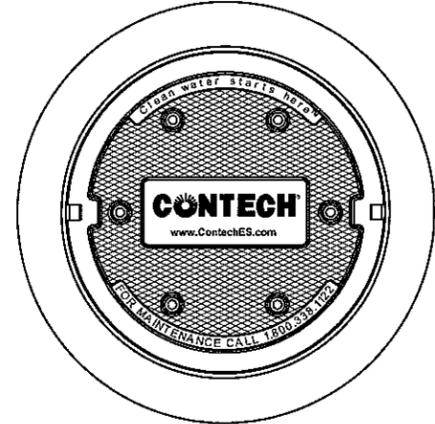
VSHS RATED TREATMENT CAPACITY IS SHOWN IN THE TABLE BELOW, OR PER LOCAL REGULATIONS. MAXIMUM HYDRAULIC INTERNAL BYPASS CAPACITY VARIES. CONTACT YOUR CONTECH REPRESENTATIVE FOR ADDITIONAL INFORMATION.

THE STANDARD SOLID COVER CONFIGURATION IS SHOWN. ALTERNATE CONFIGURATIONS ARE AVAILABLE AND ARE LISTED BELOW.

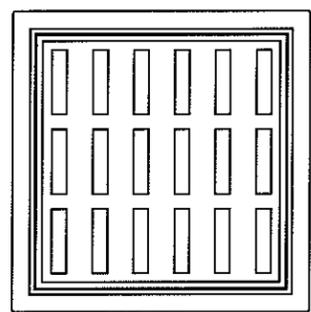
CONFIGURATION OPTION DESCRIPTION	
	GRATE INLET (NO INLET PIPE)
	GRATE INLET WITH INLET PIPE

VORTSENTRY HS GENERAL INFORMATION

Model	Manhole Diameter (ID)		Total Treatment Flow Rate		Typical Total Distance Rim to Outside Bottom A		Typical Distance Rim to Invert B		Typical Depth Below Invert (inside) C		Approximate Minimum Distance Rim to Invert		Maximum Pipe Diameter (ID)	
	FT	mm	CFS	L/S	FT	m	FT	m	FT	mm	FT	m	IN	mm
HS36	3	900	0.55	15.6	10.16	3.10	4.08	1.24	5.58	1702	3.00	0.91	18	450
HS48	4	1200	1.20	34.0	13.25	4.04	6.00	1.83	6.75	2057	4.00	1.22	24	600
HS60	5	1500	2.20	62.3	15.13	4.61	6.50	1.98	7.96	2426	4.82	1.47	30	750
HS72	6	1800	3.70	104.8	16.56	5.05	6.75	2.06	9.15	2788	5.59	1.70	36	900
HS84	7	2100	5.60	158.6	18.85	5.75	7.75	2.36	10.35	3156	5.00	1.52	42	1050
HS96	8	2400	8.10	229.4	20.87	6.36	8.50	2.59	11.54	3518	6.91	2.11	48	1200



FRAME AND COVER
(DIAMETER VARIES)
N.T.S.



FRAME AND GRATE
(24" SQUARE)
N.T.S.

SITE SPECIFIC DATA REQUIREMENTS			
STRUCTURE ID			
WATER QUALITY FLOW RATE (CFS)			
PEAK FLOW RATE (CFS)			
RETURN PERIOD OF PEAK FLOW (YRS)			
PIPE DATA:	I.E.	MATERIAL	DIAMETER
INLET PIPE 1	*	*	*
OUTLET PIPE	*	*	*
RIM ELEVATION			
ANTI-FLOTATION BALLAST	WIDTH	HEIGHT	
	*	*	
NOTES/SPECIAL REQUIREMENTS:			
* PER ENGINEER OF RECORD			

GENERAL NOTES

- CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
- DIMENSIONS MARKED WITH () ARE REFERENCE DIMENSIONS. ACTUAL DIMENSIONS MAY VARY.
- FOR FABRICATION DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHT, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.ContechES.com
- VORTSENTRY HS WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
- STRUCTURE SHALL MEET AASHTO HS20 AND CASTINGS SHALL MEET AASHTO M306 LOAD RATING, ASSUMING GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION.

INSTALLATION NOTES

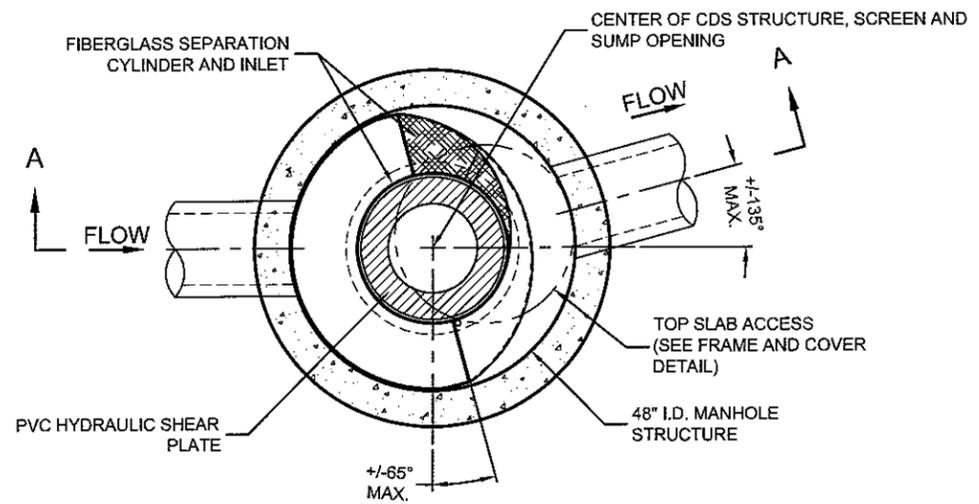
- ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
- CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE VORTSENTRY HS MANHOLE STRUCTURE (LIFTING CLUTCHES PROVIDED).
- CONTRACTOR TO INSTALL JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS AND ASSEMBLE STRUCTURE.
- CONTRACTOR TO PROVIDE, INSTALL, AND GROUT PIPES. MATCH PIPE INVERTS WITH ELEVATIONS SHOWN.
- CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ASSURE UNIT IS WATER TIGHT, HOLDING WATER TO FLOWLINE INVERT MINIMUM. IT IS SUGGESTED THAT ALL JOINTS BELOW PIPE INVERTS ARE GROUTED.

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

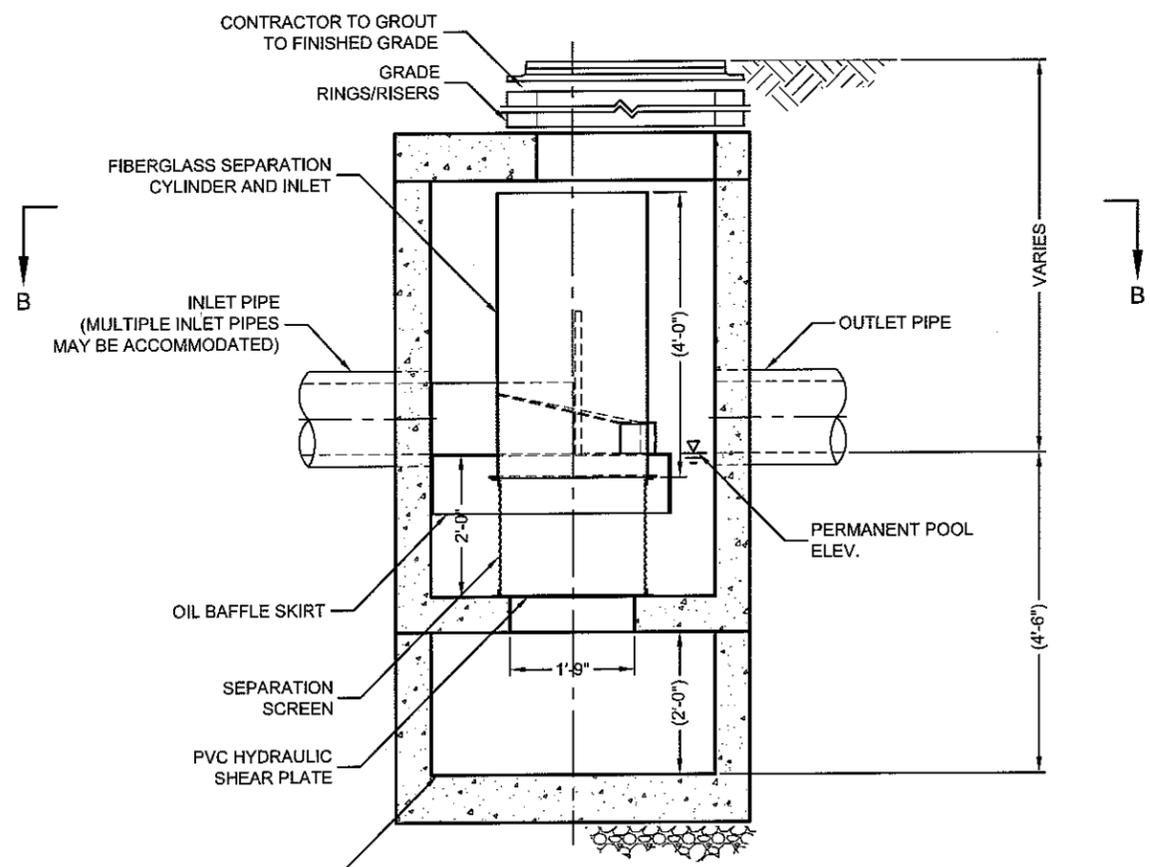
VORTSENTRY HS
STANDARD DETAIL

SWTU 1
Rim= 138.80

CAUSERS\CALLEN\DESIGN\TOP\MASSACHUSETTS\REPORTS\CDS\STANDARD DETAIL.SVD\2015-4-C-DTL.DWG 10/9/2014 9:24 AM



PLAN VIEW B-B
N.T.S.



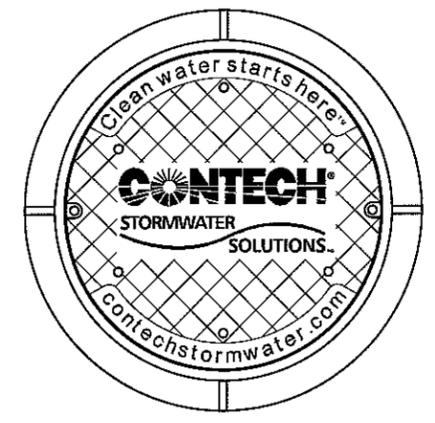
ELEVATION A-A
N.T.S.



CDS2015-4-C DESIGN NOTES

CDS2015-4-C RATED TREATMENT CAPACITY IS 1.4 CFS, OR PER LOCAL REGULATIONS.
THE STANDARD CDS2015-4-C CONFIGURATION IS SHOWN. ALTERNATE CONFIGURATIONS ARE AVAILABLE AND ARE LISTED BELOW. SOME CONFIGURATIONS MAY BE COMBINED TO SUIT SITE REQUIREMENTS.

CONFIGURATION DESCRIPTION
GRATED INLET ONLY (NO INLET PIPE)
GRATED INLET WITH INLET PIPE OR PIPES
CURB INLET ONLY (NO INLET PIPE)
CURB INLET WITH INLET PIPE OR PIPES



FRAME AND COVER
(DIAMETER VARIES)
N.T.S.

SITE SPECIFIC DATA REQUIREMENTS			
STRUCTURE ID			
WATER QUALITY FLOW RATE (CFS)			*
PEAK FLOW RATE (CFS)			*
RETURN PERIOD OF PEAK FLOW (YRS)			*
SCREEN APERTURE (2400 OR 4700)			*
PIPE DATA:	I.E.	MATERIAL	DIAMETER
INLET PIPE 1	*	*	*
INLET PIPE 2	*	*	*
OUTLET PIPE	*	*	*
RIM ELEVATION			*
ANTI-FLOTATION BALLAST	WIDTH	HEIGHT	
	*	*	
NOTES/SPECIAL REQUIREMENTS:			
* PER ENGINEER OF RECORD			

- GENERAL NOTES**
- CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
 - DIMENSIONS MARKED WITH () ARE REFERENCE DIMENSIONS. ACTUAL DIMENSIONS MAY VARY.
 - FOR FABRICATION DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH CONSTRUCTION PRODUCTS REPRESENTATIVE. www.contech-cpi.com
 - CDS WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
 - STRUCTURE SHALL MEET AASHTO HS20 AND CASTINGS SHALL MEET AASHTO M306 LOAD RATING, ASSUMING GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION.
 - PVC HYDRAULIC SHEAR PLATE IS PLACED ON SHELF AT BOTTOM OF SCREEN CYLINDER. REMOVE AND REPLACE AS NECESSARY DURING MAINTENANCE CLEANING.

- INSTALLATION NOTES**
- ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
 - CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CDS MANHOLE STRUCTURE (LIFTING CLUTCHES PROVIDED).
 - CONTRACTOR TO ADD JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS, AND ASSEMBLE STRUCTURE.
 - CONTRACTOR TO PROVIDE, INSTALL, AND GROUT PIPES. MATCH PIPE INVERTS WITH ELEVATIONS SHOWN.
 - CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ASSURE UNIT IS WATER TIGHT, HOLDING WATER TO FLOWLINE INVERT MINIMUM. IT IS SUGGESTED THAT ALL JOINTS BELOW PIPE INVERTS ARE GROUTED.

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www.contech-cpi.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

CDS2015-4-C
CDS INLINE
STANDARD DETAIL
SWTU 2
Rim = 127.95