Hydroworks

April 4, 2024

Mr. Leo Cosentini
California State Water Resources Control Board
P.O. Box 100
Sacramento, CA 95812-0100

**Subject: Application for Trash Treatment Control System - HydroDome® TR**

Dear Mr. Cosentini,

Hydroworks, LLC is pleased to submit this application for the HydroDome® TR separator to be included on the State Water Boards Certified Full Capture System list. Information in support of this application is being submitted in accordance with the *Application Requirements for Trash Full Capture System Certification* (Updated September 2022). The application consists of the following sections:

1. Cover Letter
2. Table of Contents
3. Physical Description
4. Hydraulic Capacity
5. Operation and Maintenance Information
6. Vector Control Accessibility
7. Reliability Information
8. Field and Laboratory Testing Information and Analysis

Please contact me if you have any questions or require additional information to complete your review.

Sincerely,

Graham Bryant, P.Eng. MSc
President

## 1. Cover Letter

### a. The system name and general description

The HydroDome® TR is designed to provide full trash capture and vector control accessibility as defined by the Trash Provisions and Mosquito Vector Control Association, respectively. The HydroDome TR is optimized to remove all trash 5mm and larger from stormwater runoff, which is its primary function. However, based on its method of action, the HydroDome TR also reduces the concentrations of oil and TSS (suspended solids and their associated pollutants) in stormwater. The HydroDome TR may be installed with either a street level solid cover or grate inlet. The grate inlet requires a solid deflector baffle as described in section 3.f. of this application.

HydroDome TR utilizes a weir to raise the water level inside the structure during storms to reduce flow velocities and maximize settling. The raised water level also creates extra separation between floatable pollutants and the submerged inlet screen (i.e., system outlet) during flow events, which significantly reduces scour and resuspension. A v-notch in the weir (or hydraulically equivalent orifice opening) allows the water level inside the structure to drain down after storm events.

The HydroDome TR is equipped with a 4.76 mm screen fully enclosing the device's inlet to ensure 100% capture and retention of all trash greater than the screen opening size.

The box-shaped screen is made of perforated plastic, with a circular opening aperture of 4.76 mm. A solid manhole cover or inlet grate will provide direct access to the screens and sump for inspection, maintenance, and cleaning, which can be performed from the surface.

## b. The name and contact information of the applicant

Graham Bryant
President
Hydroworks, LLC
257 Cox Street
Roselle, NJ 07203
info@hydroworks.com

## c. The applicant's webpage address

www.hydroworks.com

## d. The location of the system manufacturing sites

The HydroDome TR consists of a high-density polyethylene (HDPE) or copolymer polypropylene (CPP) insert installed inside a precast concrete manhole or vault structure. Plastic inserts are currently manufactured at the following locations:

Plastic Design, Inc
180 Middlesex Street
North Chelmsford, MA 01863

Hydroworks, LLC
257 Cox Street
Roselle, NJ 07203

Greyco Products
812095 East Back Line
RR #3 Dundalk Ontario N0C 1B0
Canada

Hydroworks partners with local suppliers close to project sites to provide the precast structure as well as access covers. Local plastic fabricators are also sought in some markets to promote local manufacturing and reduce lead times for product delivery.

## e. Brief summary of any field or laboratory testing results

The HydroDome TR has not been tested specifically for trash capture in the laboratory or field.

Hydraulics Testing

Since it is not feasible to test all model sizes, pipe configurations, and clogging scenarios, in the laboratory, we have developed a mathematical model to simulate hydraulics through the HydroDome TR. This model is intended to be used to assist in designing and sizing of the device.

To develop and validate the mathematical model, we performed hydraulics testing on a prototype HydroDome TR (model HDTR2-6), which we mounted inside a 2-ft diameter test tank with a 6” outlet pipe and installed in our Roselle, NJ laboratory flow loop. Water levels inside the test tank were measured at different influent flow rates and with different degrees of inlet screen blinding. Observed measurements were compared to predictions to validate the model. The results showed that the model accurately predicts the hydraulic impact of blinded inlet screens for a range of conditions. This confirms its suitability for sizing and designing units across a range of model sizes. The results and an explanation of the methodology are provided in Section 3.c. (Hydraulic Model Development).

## f. Summary of the system limitations and operational, sizing, and maintenance considerations

The HydroDome TR is designed and sized to trap trash for peak flows generated by the 1-year, 1-hour storm, which is calculated based on local hydrology. Hydroworks recommends that the unit be sized for conditions when the unit is not more than 50% blinded to ensure hydraulic capacity between maintenance events. Hydroworks also recommends that purchasers of the unit review any applicable regulatory sizing and maintenance requirements. Similar to other stormwater full capture systems, design limitations include peak flows, pipe sizes and slopes, bypass limitations, and invert elevations. Hydroworks works with design engineers to make sure each unit is appropriately designed and sized to function as intended as part of the integrated drainage system.

The HydroDome TR is designed to convey the peak design treatment flow without bypass. An open top provides a bypass flow path for high flow conditions and in case of total screen blinding. Bypass capacity is equal to or greater than the unrestricted flow through the outlet pipe. The height to the top of the insert’s solid walls provides a safety factor to limit overtopping/bypass. The hydraulic treatment capacity prior to bypass will decrease as the screens become blinded, however, the maximum hydraulic capacity of the system is determined by the inlet/outlet pipe diameters and slopes.

Inspection and maintenance are intended to be performed from the surface. Maintenance intervals and procedures are provided in the included Operations & Maintenance Manual (Appendix C).

**g. Locations where the system has been installed for capturing trash**

There are currently no HydroDome TRs installed.

**h. High flow capacity trash full capture systems**

The HydroDome TR is designed and was tested to capture and retain trash in high flows. Accordingly, we are applying for inclusion on the list of high flow capacity trash full capture systems.

**i. Certification Statement**

*I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons that manage the system or those persons directly responsible for gathering the information, to the best of my knowledge and belief, the information submitted is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.*

04/04/2024

Graham Bryant, President – Hydroworks, LLC Date

**Table of Contents**

## 3. Physical Description

The HydroDome® TR consists of a plastic insert installed in a precast concrete structure. The HydroDome TR is available in eight standard round precast manhole sizes: 3-, 4-, 5-, 6-, 7-, 8-, 10-, and 12-ft diameters. Inserts are scaled based on both manhole and outlet pipe size, and model names reference both. For example, a HydroDome HDTR4-12 is a 4-ft diameter HydroDome Trash Capture unit with the insert installed in a 12-in diameter outlet pipe. The HydroDome TR can also be installed in a rectangular vault structure. Model names for rectangular structures refer to the nearest surface-area equivalent to a round structure.

The internals of the HydroDome TR consist of a v-notch weir or hydraulically equivalent weir wall with orifice opening enclosed by plastic walls (Figure 1). The internal components of the HydroDome TR scale with the pipe size and manhole size to ensure both acceptable hydraulic characteristics and trash capture volumes. The proper unit size must be selected to trap trash for the peak flow generated from the 1-year, 1-hour storm.

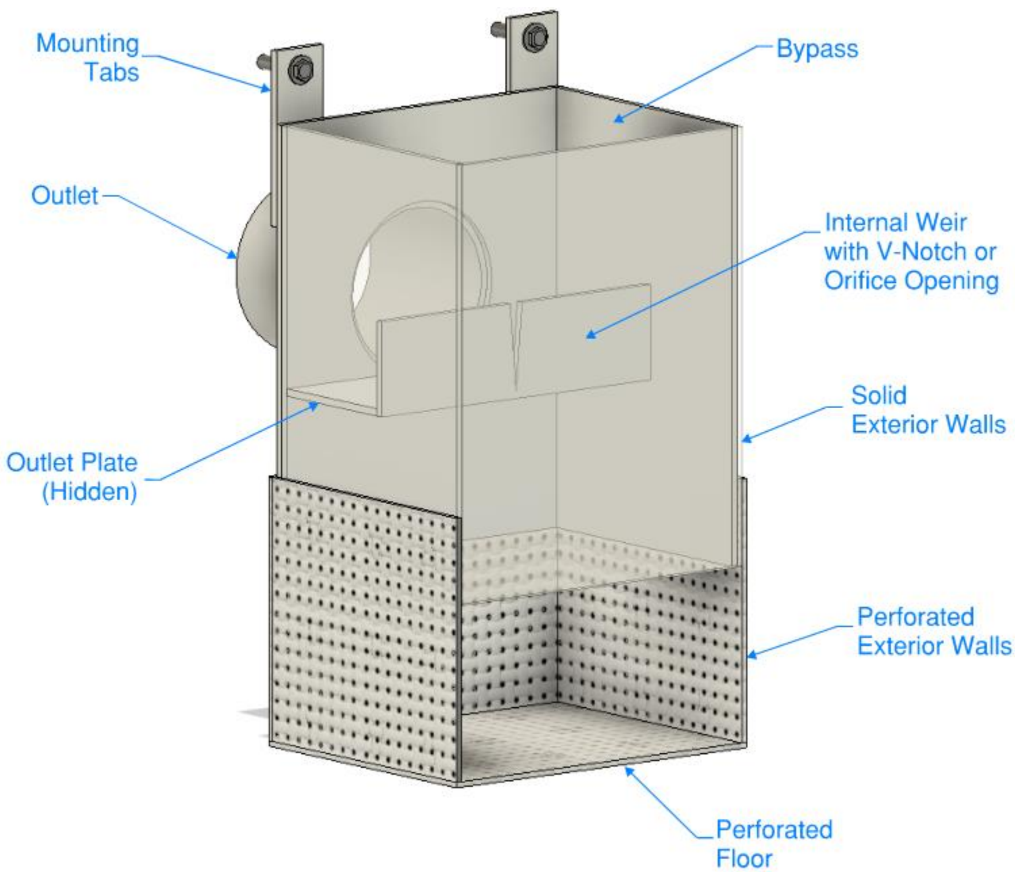



Figure 1. HydroDome® TR Insert Components with Transparent Front & Side Wall

An integrated outlet stub protruding from the insert slides into the outlet pipe and the insert is secured to the manhole wall with stainless steel anchor bolts (Figure 2).

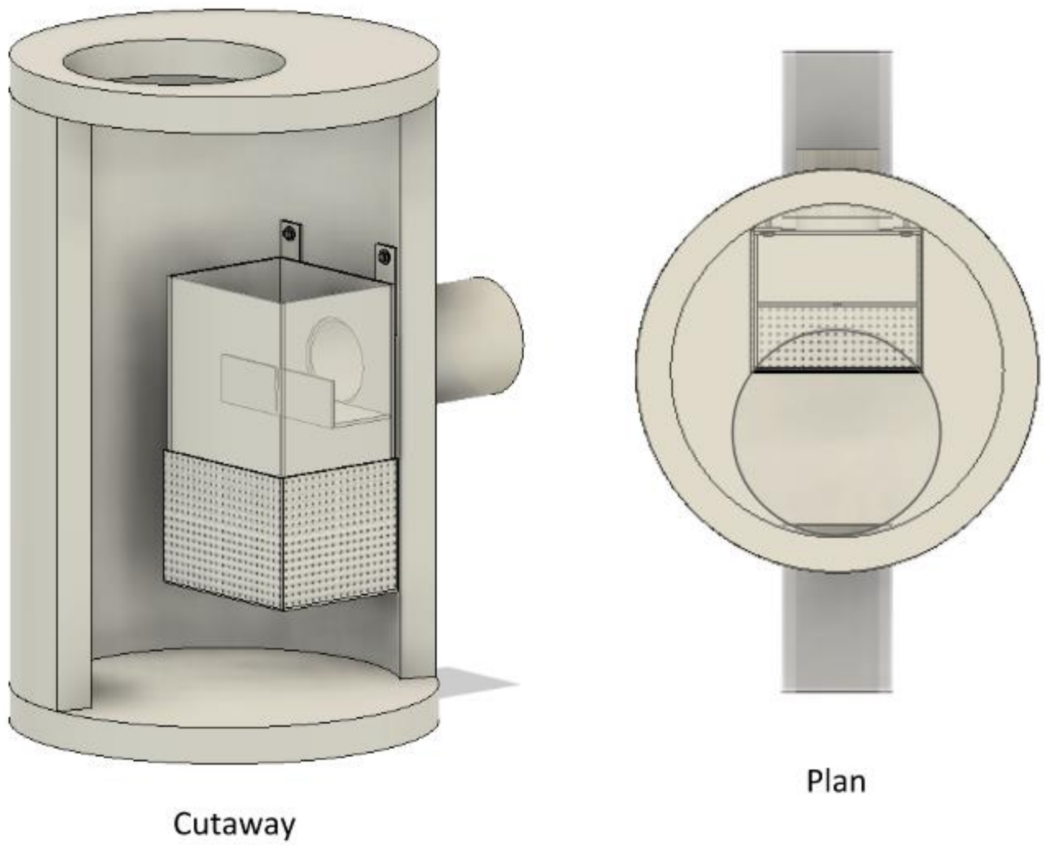



Figure 2. HydroDome TR Round Manhole Installation

Water enters the device through one or more inlet pipes and/or an inlet grate. Water then passes into the insert through a perforated plastic screen, comprising four perforated exterior walls and a perforated floor. Due to the depth of the openings below the standing water level, most oil, trash, and floatable debris is trapped between the solid insert wall and the precast structure wall. The nominal size of the perforated openings (4.75 mm) prevents any material 5mm or greater from passing into and through the unit.

If a grated inlet is installed, a sloped lid is fitted to the top of the insert to deflect any trash that enters the structure vertically from above (Figure 3). The “roof” lid is raised to allow an unrestricted bypass flow path. Hinges on the lid allow access for inspection, maintenance, and mosquito treatment inside the insert. The lid can be opened from the surface with a pole and hook by pulling upward on the handle.

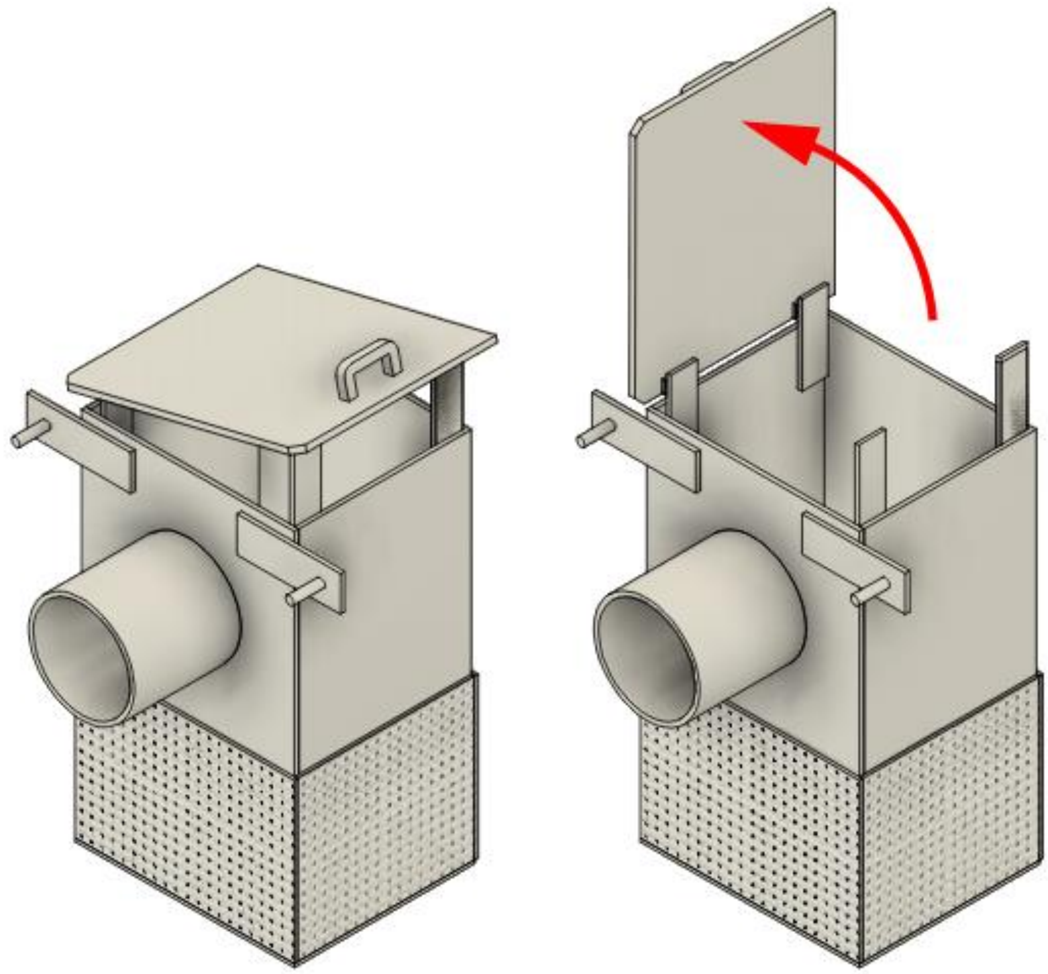


Figure 3. Alternate Configurations: Hinged Lid for Grated Inlet

CAD drawings for standard HydroDome TR model sizes including a unit with grated inlet (“HDTRi”) and hinged insert lid are provided in Appendix A.

During storm events, the water level inside the structure rises relatively gradually, depending on the flow rate, until it reaches the top of the internal weir. Only a small volume (relative to the flow volume) exits the structure (through v-notch or orifice) before it reaches the top of the weir. This reduces flow velocities to enhance settling and provides additional vertical separation between floatable trash and the submerged inlet screens. Once water reaches the top of the weir, flow is discharged over the weir to limit the hydraulic impact upstream.

After a storm event, water flows through the v-notch or orifice opening to lower the water level back down to the outlet invert elevation.

### a. Trash Capture

The solid outer shell of the HydroDome and submerged inlet prevent trash from moving into the insert. During high flows, the raised water level also prevents captured trash from being re-entrained and lost downstream. However, to ensure that all 5 mm trash is captured by the device, the HydroDome TR includes perforated polypropylene “screens” around all inlet openings. The round screen openings are 3/16” (4.76 mm) diameter, spaced 5/16” apart, and vertically staggered for a total open area of 32%. The screened flow path and bypass flow path are illustrated in Figure 4.

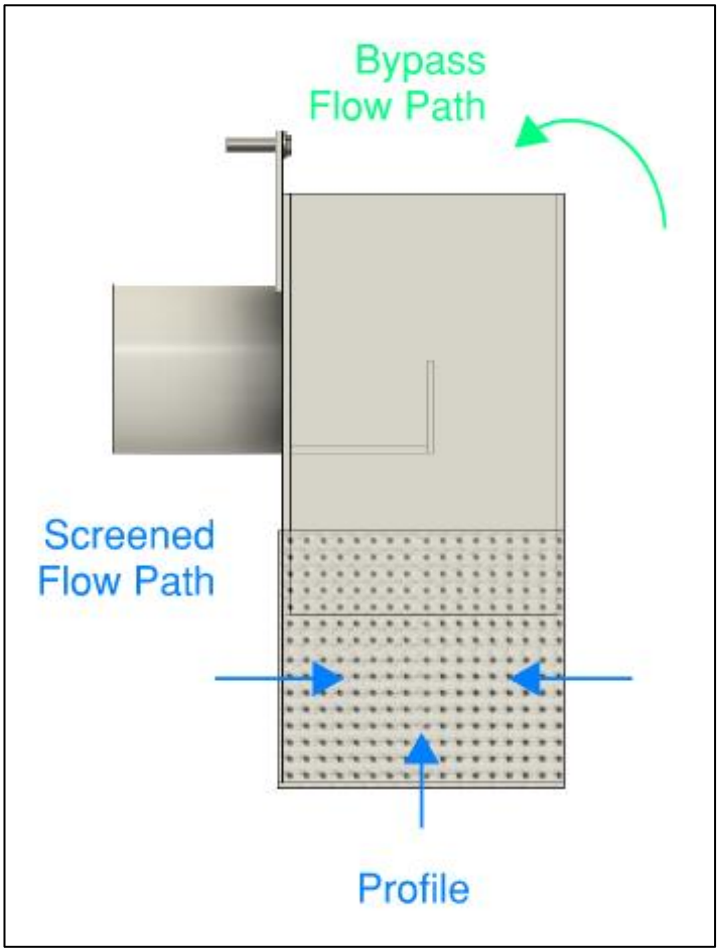



Figure 4. HydroDome TR Flow Paths

## b. Peak Flows/Trash Capture Volumes

The HydroDome TR is sized based on conveying the design treatment flow without bypass. The design treatment flow is provided by the engineer of record and must be minimally calculated based on the 1-year, 1-hour storm using local hydrology and the associated sub-drainage area. Depending on site-specific requirements, larger model size HydroDome TR units may also be selected based on anticipated trash capture volumes or to additionally remove sediment or other pollutants. Maximum flow rates are provided for standard model sizes in Table 1. This table can be used to select an appropriately sized HydroDome TR model. Hydroworks can also provide custom designs and flow rates for HydroDome TR models outside the standard range, however, such custom designs would need to be first added to this application and approved.

The HydroDome TR standard bypass elevation is set at a height equal to 1.5 times the outlet pipe diameter, relative to the outlet invert. The internal weir is set at half the height of the outlet pipe, relative to the outlet invert. Flow rates listed in Table 1 represent the flow rate through the unit when the water level inside the manhole or vault equals the bypass elevation. These values assume the outlet pipe has a slope of 0.5% or greater. Bypass elevations are customizable based on site-specific requirements (see Figure 21). However, custom bypass elevations do not affect bypass capacity, which must be equal to or greater than the peak flow rate generated by a 1-year, 1-hour storm.

Trash storage capacities for HydroDome TR models are provided in Table 2. Floatable trash storage capacity is equal to the volume between the outlet invert and the vertical midpoint of the inlet screen. Settleable trash storage capacity is equal to the volume between the bottom of the sump and the bottom of the inlet screen.

In the event that flow exceeds the peak design flow of the drainage system, the outlet pipe from the structure will act as an orifice, raising the water level inside and upstream of the structure. Maximum bypass capacity is therefore dependent on characteristics of the drainage system external to the HydroDome TR unit.

Table 1. HydroDome TR Full Trash Capture Peak Treatment Flow Rates

| Max Flow Rate Prior to Bypass (cfs) [1,2] | | | | | | | |
|---|---|---|---|---|---|---|---|
| Model | Manhole Diameter (ft) | Pipe Diameter (in) | Screen Blinding Percentage | | | | |
| | | | 0% | 25% | 50% | 75% | 90% |
| HDTR3-6 | 3 | 6 | 0.68 | 0.66 | 0.60 | 0.45 | 0.32 |
| HDTR3-8 | 3 | 8 | 1.03 | 0.97 | 0.90 | 0.81 | 0.50 |
| HDTR3-12 | 3 | 12 | 2.44 | 2.38 | 2.22 | 1.68 | 0.87 |
| HDTR3-15 | 3 | 15 | 3.93 | 3.73 | 3.34 | 2.36 | 1.18 |
| HDTR4-8 | 4 | 8 | 1.40 | 1.34 | 1.23 | 0.92 | 0.68 |
| HDTR4-12 | 4 | 12 | 2.66 | 2.66 | 2.55 | 2.11 | 1.19 |
| HDTR4-15 | 4 | 15 | 4.52 | 4.42 | 4.13 | 3.14 | 1.67 |
| HDTR4-18 | 4 | 18 | 6.71 | 6.39 | 5.75 | 4.15 | 2.08 |
| HDTR5-12 | 5 | 12 | 3.14 | 3.03 | 2.76 | 2.49 | 1.57 |
| HDTR5-15 | 5 | 15 | 4.81 | 4.81 | 4.62 | 3.73 | 2.16 |
| HDTR5-18 | 5 | 18 | 7.35 | 7.19 | 6.71 | 5.11 | 2.72 |
| HDTR5-24 | 5 | 24 | 13.42 | 12.73 | 11.36 | 8.26 | 3.79 |
| HDTR6-15 | 6 | 15 | 5.31 | 5.11 | 4.81 | 4.23 | 2.55 |
| HDTR6-18 | 6 | 18 | 7.83 | 7.67 | 7.35 | 5.91 | 3.36 |
| HDTR6-24 | 6 | 24 | 14.80 | 14.45 | 13.08 | 9.64 | 4.82 |
| HDTR6-30 | 6 | 30 | 23.71 | 21.84 | 19.34 | 13.10 | 6.24 |
| HDTR7-18 | 7 | 18 | 8.15 | 7.83 | 7.83 | 6.71 | 3.99 |
| HDTR7-24 | 7 | 24 | 15.83 | 15.49 | 14.45 | 11.01 | 5.85 |
| HDTR7-30 | 7 | 30 | 25.58 | 24.33 | 21.84 | 15.60 | 7.49 |
| HDTR7-36 | 7 | 36 | 36.53 | 34.50 | 30.44 | 20.29 | 10.15 |
| HDTR8-24 | 8 | 24 | 16.52 | 16.52 | 15.49 | 12.39 | 6.88 |
| HDTR8-30 | 8 | 30 | 27.45 | 26.21 | 24.33 | 18.09 | 9.36 |
| HDTR8-36 | 8 | 36 | 39.57 | 37.54 | 33.48 | 24.35 | 11.16 |
| HDTR8-42 | 8 | 42 | 53.57 | 50.51 | 44.38 | 29.08 | 13.77 |
| HDTR10-30 | 10 | 30 | 29.95 | 29.33 | 27.45 | 21.84 | 11.85 |
| HDTR10-36 | 10 | 36 | 44.64 | 43.63 | 39.57 | 29.42 | 15.22 |
| HDTR10-42 | 10 | 42 | 61.22 | 59.69 | 53.57 | 38.26 | 18.37 |
| HDTR10-48 | 10 | 48 | 80.85 | 76.48 | 67.74 | 45.89 | 21.85 |
| HDTR12-36 | 12 | 36 | 47.69 | 46.67 | 44.64 | 34.50 | 18.26 |
| HDTR12-42 | 12 | 42 | 67.34 | 65.81 | 59.69 | 44.38 | 22.96 |
| HDTR12-48 | 12 | 48 | 89.59 | 85.22 | 76.48 | 54.63 | 26.22 |
| HDTR12-54 | 12 | 54 | 113.67 | 107.69 | 95.73 | 65.81 | 32.91 |
| HDTR12-60 | 12 | 60 | 138.67 | 130.74 | 114.89 | 75.28 | 35.66 |

1. Based on level inverts and outlet pipe slope of 0.5%. Contact Hydroworks for other design cases.
2. Assumes no tailwater. Tailwater conditions may affect flow rate calculations.

Table 2. HydroDome TR Trash Storage Capacities

| HydroDome TR Storage Capacities | | | | | |
|---|---|---|---|---|---|
| Model | Manhole Diameter (ft) | Pipe Diameter (in) | Oil storage capacity[1] (gal) | Floatable Trash Storage Capacity[2] ($ft^3$) | Settleable Trash Storage and Sediment Capacity[3] ($ft^3$) |
| HDTR3-6 | 3 | 6 | 30 | 5.3 | 19.4 |
| HDTR3-8 | 3 | 8 | 30 | 5.8 | 18.3 |
| HDTR3-12 | 3 | 12 | 30 | 6.6 | 15.9 |
| HDTR3-15 | 3 | 15 | 30 | 7.3 | 14.1 |
| HDTR4-8 | 4 | 8 | 70 | 12.5 | 35.6 |
| HDTR4-12 | 4 | 12 | 70 | 14.1 | 31.4 |
| HDTR4-15 | 4 | 15 | 70 | 15.3 | 28.3 |
| HDTR4-18 | 4 | 18 | 70 | 16.4 | 25.1 |
| HDTR5-12 | 5 | 12 | 137 | 25.6 | 63.8 |
| HDTR5-15 | 5 | 15 | 137 | 27.4 | 58.9 |
| HDTR5-18 | 5 | 18 | 137 | 29.3 | 54.0 |
| HDTR5-24 | 5 | 24 | 137 | 32.9 | 44.2 |
| HDTR6-15 | 6 | 15 | 239 | 45.2 | 106.0 |
| HDTR6-18 | 6 | 18 | 239 | 47.9 | 99.0 |
| HDTR6-24 | 6 | 24 | 239 | 53.2 | 84.8 |
| HDTR6-30 | 6 | 30 | 239 | 58.5 | 70.7 |
| HDTR7-18 | 7 | 18 | 378 | 72.1 | 163.6 |
| HDTR7-24 | 7 | 24 | 378 | 79.4 | 144.3 |
| HDTR7-30 | 7 | 30 | 378 | 86.6 | 125.1 |
| HDTR7-36 | 7 | 36 | 378 | 93.8 | 105.8 |
| HDTR8-24 | 8 | 24 | 563 | 112.8 | 226.2 |
| HDTR8-30 | 8 | 30 | 563 | 122.2 | 201.1 |
| HDTR8-36 | 8 | 36 | 563 | 131.6 | 175.9 |
| HDTR8-42 | 8 | 42 | 563 | 141.0 | 150.8 |
| HDTR10-30 | 10 | 30 | 1103 | 221.1 | 432.0 |
| HDTR10-36 | 10 | 36 | 1103 | 235.8 | 392.7 |
| HDTR10-42 | 10 | 42 | 1103 | 250.6 | 353.4 |
| HDTR10-48 | 10 | 48 | 1103 | 265.3 | 314.2 |
| HDTR12-36 | 12 | 36 | 1910 | 382.9 | 735.1 |
| HDTR12-42 | 12 | 42 | 1910 | 404.2 | 678.6 |
| HDTR12-48 | 12 | 48 | 1910 | 425.5 | 622.0 |
| HDTR12-54 | 12 | 54 | 1910 | 446.8 | 565.5 |
| HDTR12-60 | 12 | 60 | 1910 | 468.0 | 508.9 |

1. Oil storage capacity equal to volume between top of performated screen and outlet invert.
2. Floatable trash storage capacity equal to volume between midpoint of perforated screen and outlet invert.
3. Settleable trash storage capacity equal to volume between bottom of perforated screen and bottom of sump.
4. Listed storage capacities are standard values based on an open-top design.
5. Additional storage capacity can be provided based on customized designs to meet project-specific requirements.

### c. Hydraulic Capacity

The HydroDome TR is designed to be installed on-line. In the event of blinding of the inlet screen, maximum flow capacity through the screen prior to bypass (i.e., peak treatment flow) will be reduced. Table 1 shows the peak treatment capacity of the unit at various degrees of screen blinding and for different models prior to bypass. Flows in excess of these thresholds will bypass the screen. As shown in the table, the peak treatment flow at 50% screen blinding is only slightly lower than when the inlet is fully clear. This indicates that the perforated inlet screen is only minimally restrictive below 50% screen blinding.

Although the bypass capacity of the unit in isolation remains constant, peak bypass capacity through the unit is a function of the drainage system, including pipe sizes, slopes, and tailwater elevation, so this value cannot be provided on a generic basis. The HydroDome TR is sized that such the hydraulic bypass capacity always exceeds the capacity of the outlet pipe. Design engineers should use Table 1 in conjunction with calculated treatment and peak design flows to select the appropriately sized HydroDome TR model. An explanation of the methodology used for the hydraulic calculations, including formulas, test data, and example calculations is provided below.

## Hydraulics Model Development

The HydroDome TR comes in a wide range of model sizes. This makes it impractical to test the hydraulics of each unit in a laboratory. Therefore, a mathematical model was developed to estimate the water level upstream of the device's perforated inlet screen based on the full range of model dimensions and screen blinding conditions. This model was used to calculate the peak flow rates provided in Table 1 and can also be used to calculate peak flow rates for modified or non-standard model units.

The model is based on weir flow, orifice flow, and partially full pipe flow. Weir flow is based on the rectangular, broad crested weir equation:

$$Q = C_w L H^{1.5} \qquad (1)$$

where Q is the flow rate, $C_w$ is the weir coefficient, L is the weir length, and H is the distance between water surface and weir crest.

Orifice flow is based on the standard orifice equation:

$$Q = C_d A (2gH)^{0.5} \qquad (2)$$

where Q is the flow rate, $C_d$ is the coefficient of discharge, A is the cross-sectional area of the orifice, g is the acceleration due to gravity, and H is the head acting on the centerline of the orifice.

Partially full pipe flow is based on the Manning equation:

$$Q = (1.49/n)A(R_h^{2/3})S^{1/2} \quad (3)$$

Where Q is the flow rate, n is the manning roughness coefficient, A is the cross-sectional area of flow, $R_h$ ($R_h = A/P$) is the hydraulic radius, and P is the wetted perimeter of the cross-sectional area.

A sample calculation is provided on pages 24 through 29 for an HDTR4-12 with 25% screen blinding. Figures 12-16 provide a graphical illustration of the example calculation across the full range of flows, and Table 3 provides the corresponding tabulated values.

The HydroDome TR inlet screen consists of four perforated horizontal walls and a perforated floor. To simplify the calculations, it is assumed that all perforations represent horizontal orifices of a uniform 3/16” diameter. Since the perforations are fully submerged, it is assumed that the head acting on each individual hole is the same. It is further assumed that the v-notch weir can be treated as a rectangular weir except at low flow rates. Finally, it is assumed that the inlet and outlet pipe inverts are at the same elevation and the pipes have a slope of 0.5%.

Figure 5 provides an illustration of the critical water elevations inside the test tank, which represent the components of the headloss through the unit. The water level in the tank, upstream of the inlet screen (A) is the sum of the weir elevation or tailwater elevation (C) plus the head on the weir (B-C) plus the head on the inlet screen (A-B).

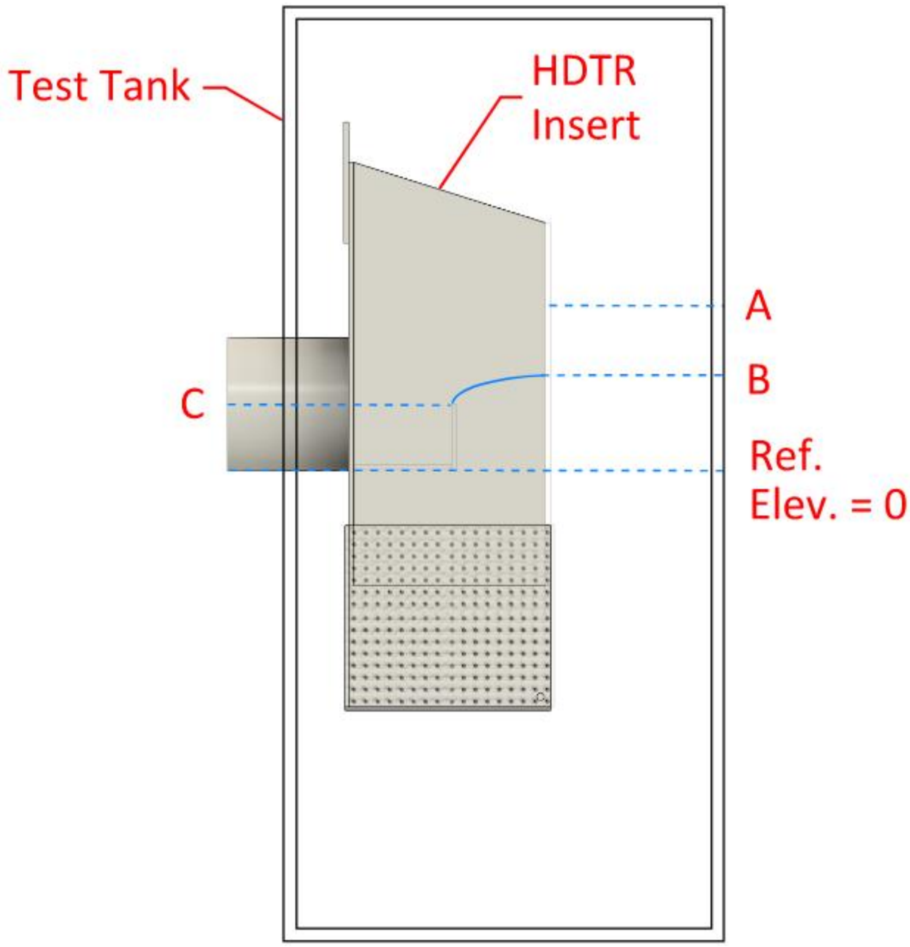



Figure 5. Reference Points for Water Level Measurements

The HydroDome TR weir elevation is set to half the height of the outlet pipe diameter for all model sizes. When the water level in the outlet pipe is below the weir elevation, only the flow over the weir and through the perforated walls (orifices) needs to be considered to calculate the water level in the tank (A). When the water level in the outlet pipe is above the weir elevation, it causes a tailwater on the weir and inlet screens, meaning that (partially full) pipe flow through the outlet also needs to be considered.

Figure 6 shows flow depth in a 6”-diameter pipe plotted as a function of flow rate and pipe slope. These curves are based on (3) and were calculated using freely available software. As pipe slope decreases, pipe flow capacity also decreases. This means that the smaller the pipe slope, the lower the flow rate required for the water level in the outlet pipe to reach the weir elevation (e.g., 3” in a 6”-diameter pipe). The HydroDome is not unique in this regard, as the outlet pipe slope will impact the upstream hydraulic grade line in any stormwater treatment device. For the purposes of hydraulic model development and calibration, a pipe slope of 0.5% was chosen as a typical value. Peak treatment rates shown in Table 1 reflect this assumption. However, it should be noted that the hydraulic impact of pipe slopes that are much smaller or larger than 0.5% will differ from the model assumption. Hydroworks should be contacted to calculate peak treatment flow rates in such cases, particularly if the outlet pipe slope is less than 0.5%.

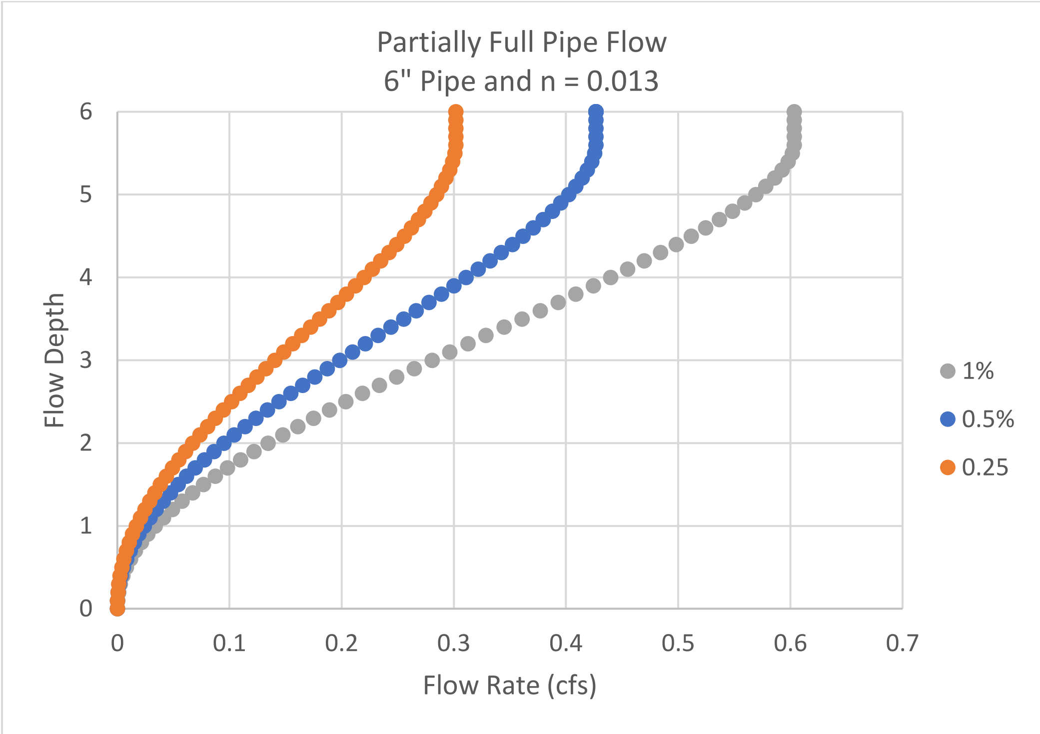


Figure 6. Flow Depth vs. Flow Rate as a Function of Pipe Slope

To assist in developing a mathematical model, we tested an HDTR2-6 in our hydraulics laboratory in Roselle, NJ. The test unit consisted of an insert scaled for a 6-inch pipe installed in a 2-ft round manhole. The test unit dimensions are provided in Figure 7 and a picture of the test setup is shown in Figure 8. During testing, flow rates ranging from approximately 0.02 cfs to 0.25 cfs were directed to the test unit controlled by a manually operated gate value and measured by a Seametrics iMAG 4700p flow meter, with an accuracy of ±1%. This flow rate upper limit represents the maximum capacity of the ½ hp Goulds submersible pump, model WS0511B, used in our test lab. Water levels were manually measured to the nearest 1/16” inside the test tank (A) and inside the insert (B) and to the nearest ¼” inside the outlet pipe (C).

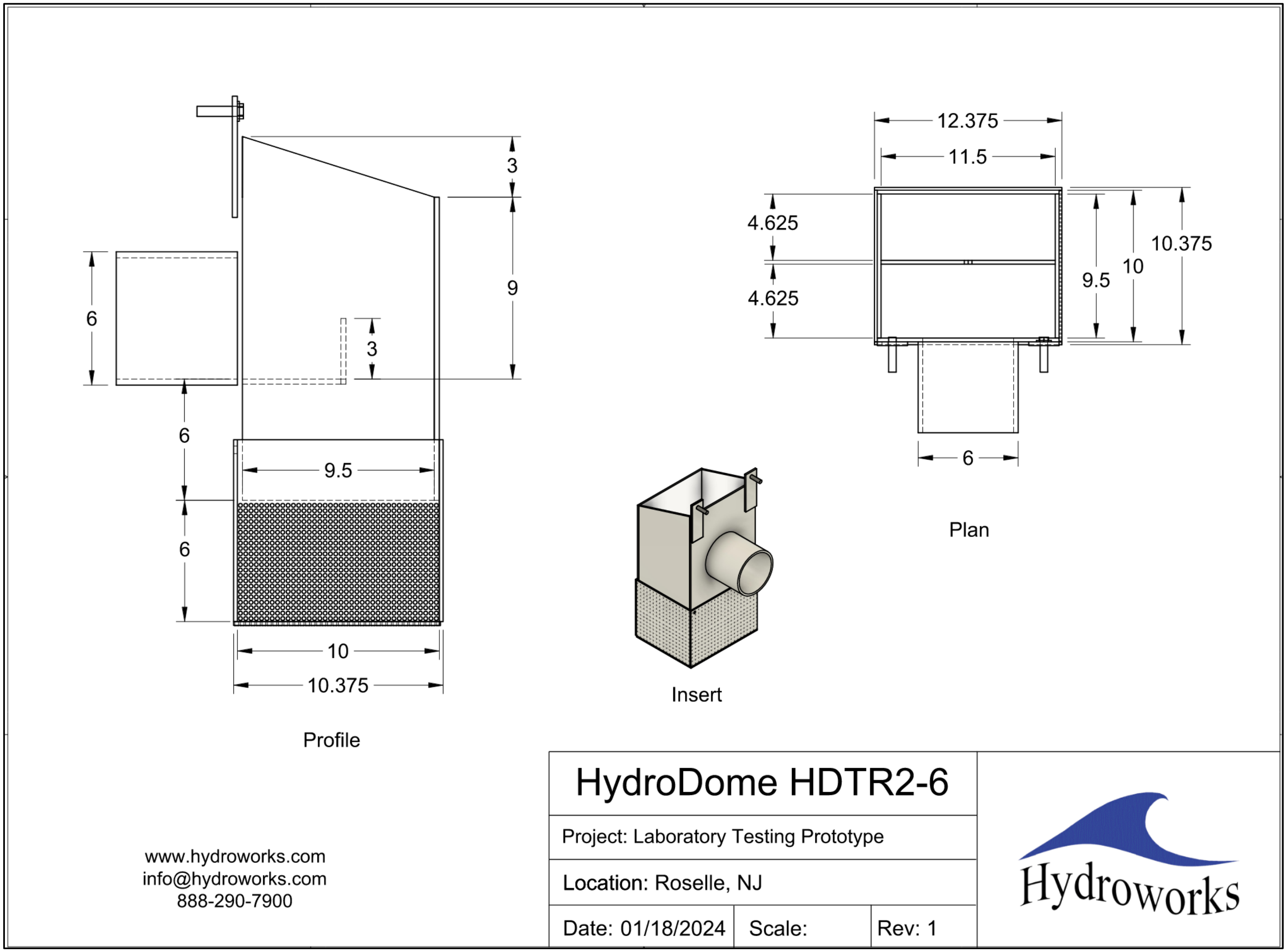



Figure 7. HDTR2-6 Test Protoype CAD Drawing

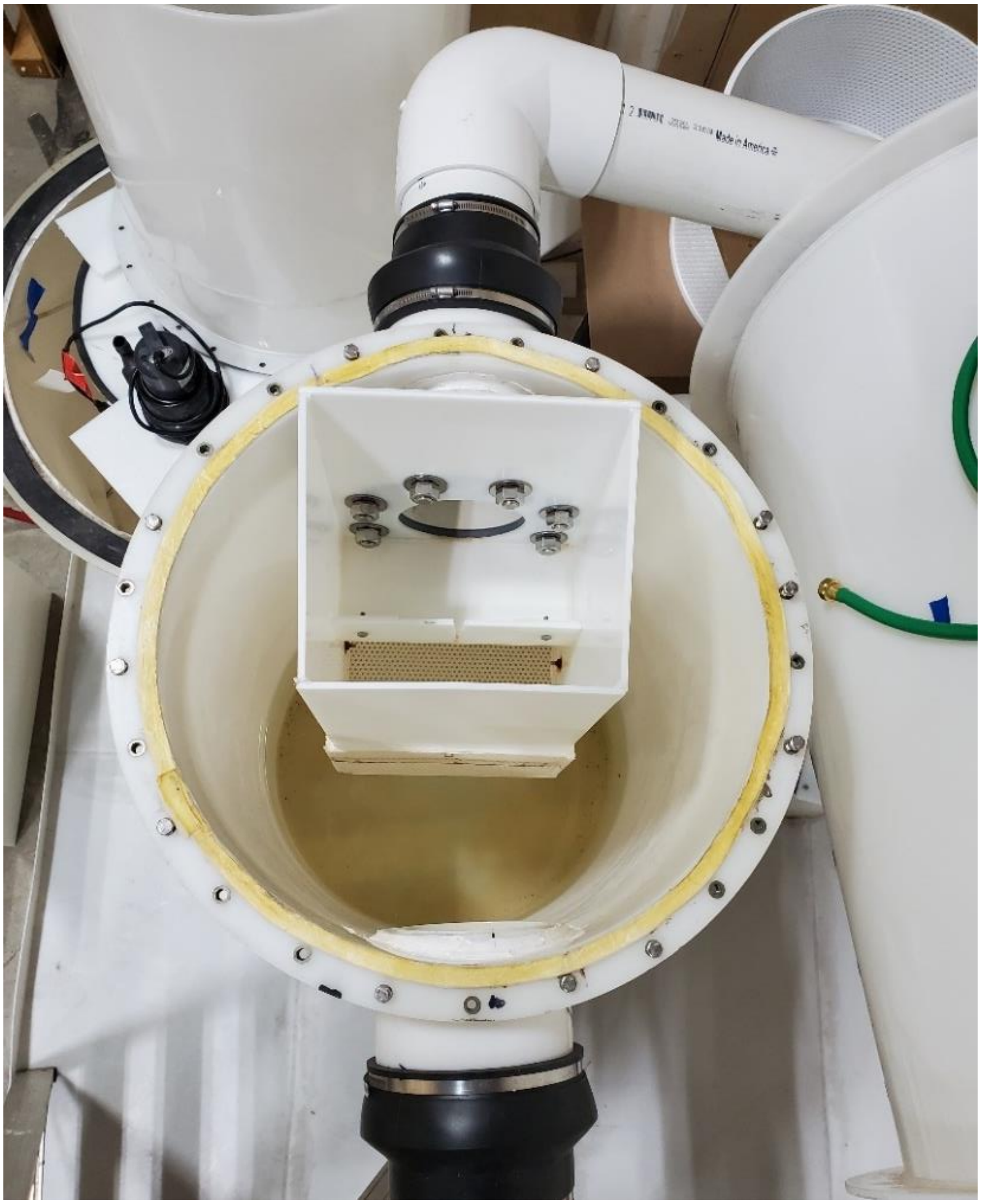


Figure 8. HDTR2-6 Installed in Hydroworks Test Laboratory

Measured water levels inside the HydroDome TR insert and in the outlet pipe are shown in Figure 9 (dots). Calculated curves representing water level in the outlet pipe (0.5% slope) and head on the weir using (1) are also shown (lines). A weir coefficient of 3.3 and a free discharge over the weir are assumed.

As shown in Figure 9, observed water elevations in the outlet pipe are well matched to the calculated curve. However, observed water elevations upstream of the weir (e.g., head on weir) are not as well matched to the calculated curve. The weir flow equation (1) overestimates head on the weir at low flows and underestimates head at the highest flows. The overestimation at low flows can be explained by flow through the v-notch weir, which reduces the flow passing over the weir and correspondingly lowers the head on the weir. At high flows, when the outlet water elevation exceeds the weir height, which is 3” in this case, it induces a tailwater condition on the weir that in turn increases the water elevation upstream of the weir. This explains the underestimation at high flows.

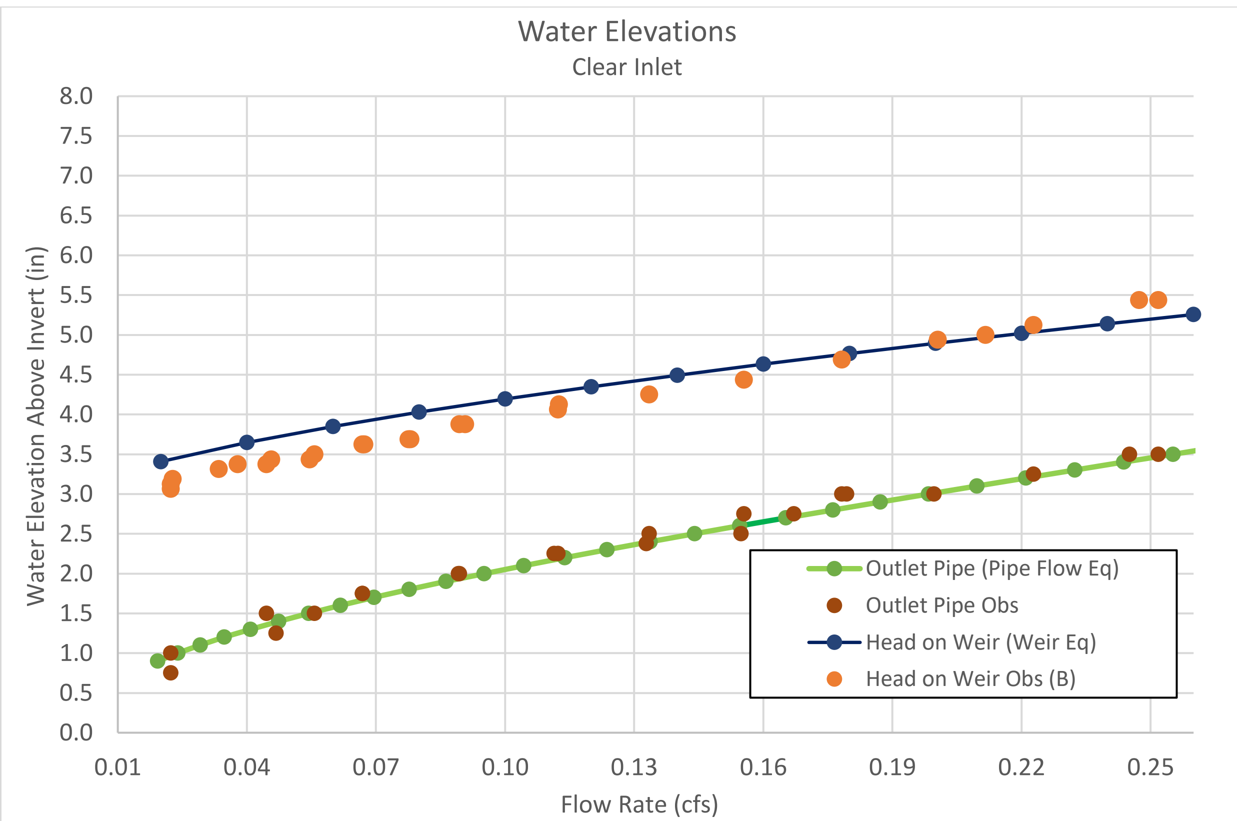



Figure 9. Observed Water Elevations in the Test Tank.

Splitting the observed (head on weir) data into two regimes, one before and one after the establishment of a tailwater condition, provides the best empirical fit (see Figure 10). When the outlet water elevation (C) is below the weir elevation (3”), the water elevation inside the insert (B) increases linearly with flow rate with a y-intercept equal to the weir height and approximately intersecting the weir flow curve at the upper end.

At relatively high flow rates, the weir equation (1) provides a reasonably accurate estimate of head on the weir since only a small percentage of flow passes through the v-notch. Adding the tailwater to the calculated head on the weir therefore provides a good estimate of water elevation upstream of the weir at higher flow rates. As illustrated in Figure 10, when the outlet water elevation (green line) is above the 3”-high weir elevation (i.e., flow is greater than ~0.20 cfs), the water elevation at (B) is best approximated by adding the height of the water in the outlet pipe above the weir (P) to the value given by the weir equation (W). Combining the linear and nonlinear portions into a single curve provides a continuous estimate of water elevation upstream of the weir across the full range of flows where the outlet pipe is not flowing full.

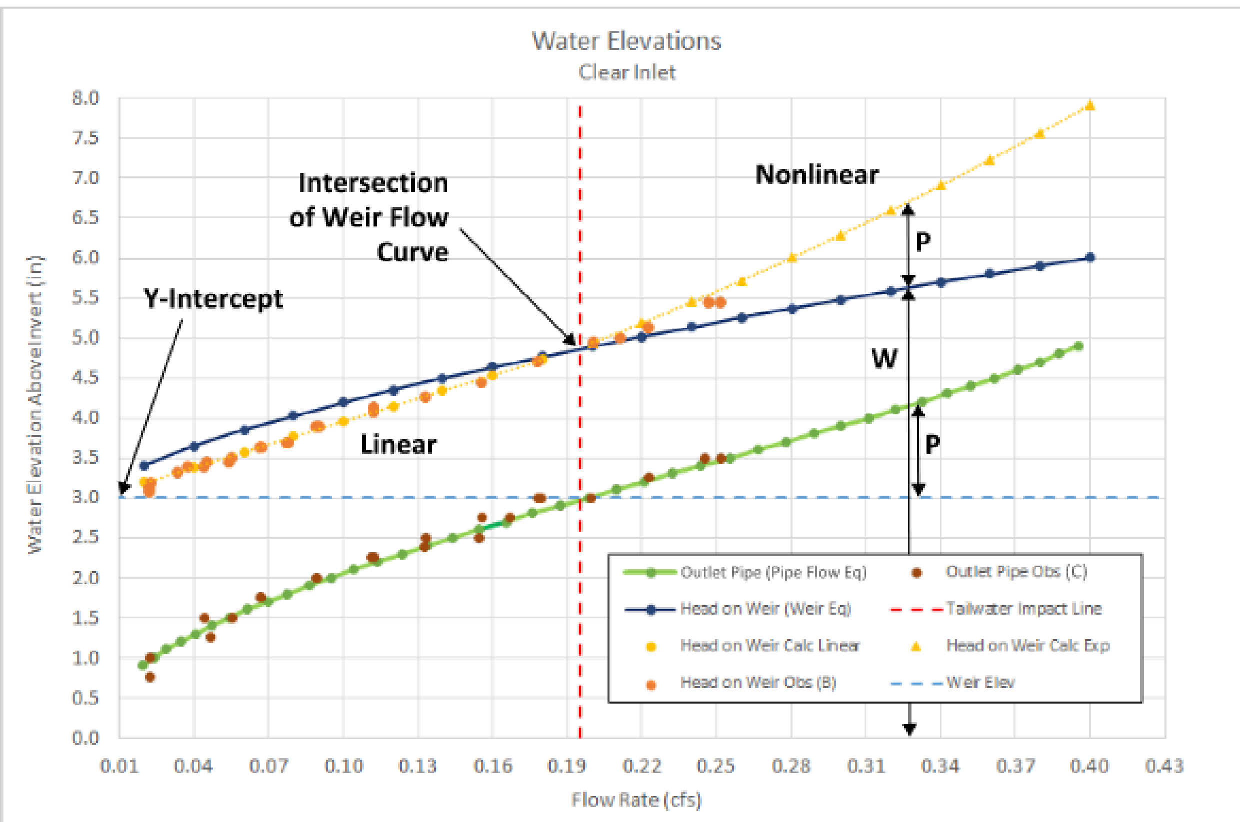



Figure 10. Relationship Between Flow Rate and Head Over Weir

With a relationship established between flow rate and water elevation inside the insert (upstream of the weir), the water elevation in the tank upstream of the insert can be estimated using the orifice equation (2). This calculation assumes the tailwater on the orifices is equal to the water level inside the insert (calculated above) and that each non-occluded hole in the inlet screen conveys an equal proportion of the total flow. The model was calibrated based on observed data to calculate a best fit for the coefficient of discharge, which was determined to be 0.55.

Figure 11 visually illustrates an example peak treatment flow calculation for an HDTR4-12 with 25% screen blinding. The reference 0" elevation is equal to the inlet and outlet inverts. The inlet obvert elevation is 12" and the bypass elevation is 18". Insert (B) and Tank (A) represent the water surface elevations inside the insert and inside the tank, respectively. The peak flow rate prior to bypass is calculated based on the intersection between the tank elevation curve (yellow) and the bypass elevation (dashed red horizontal line). The peak flow rate prior to bypass in this case is 2.66 cfs. Figure 11 also illustrates how alternate flow rate thresholds can also be calculated with the model. For example, the flow rate when the inlet to the unit becomes fully submerged is 1.63 cfs. This is graphically represented by the intersection between the tank elevation curve (yellow) and the inlet pipe obvert elevation (dashed blue horizontal line).

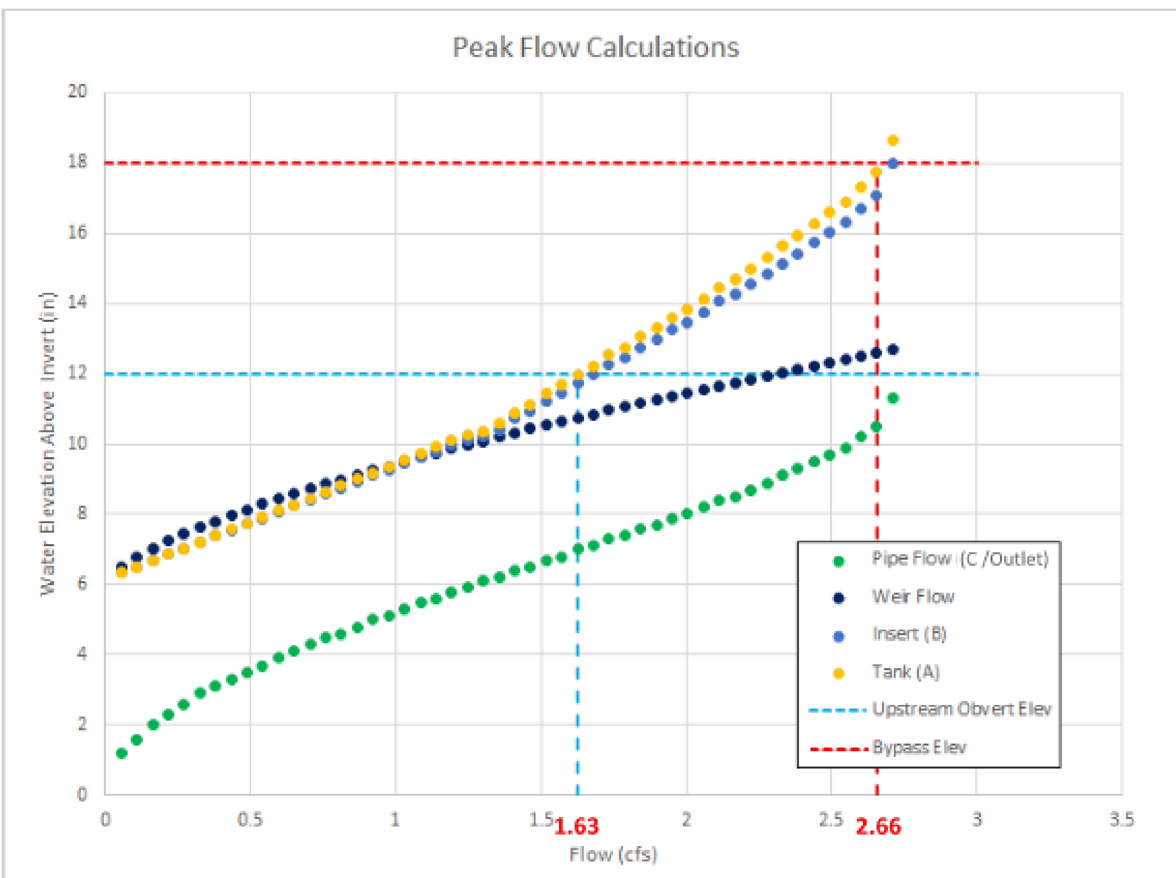



Figure 11. Illustrated Example of Peak Treatment Flow Calculation

Detailed steps to perform this calculation are described below and illustrated in Figures 12-16.

Step 1: Calculate water elevations in the outlet pipe (C) for the full range of non-full pipe flow rates. In this example, the range of flows is discretized into fifty equally spaced points. The values for flow depth in a partially full 12”-diameter pipe at 0.5% slope can be calculated with software or looked up in tables. They are plotted in Figure 12. Since we are primarily interested in flow depth in the outlet pipe when it is above the weir (e.g., tailwater), the weir elevation is also plotted.

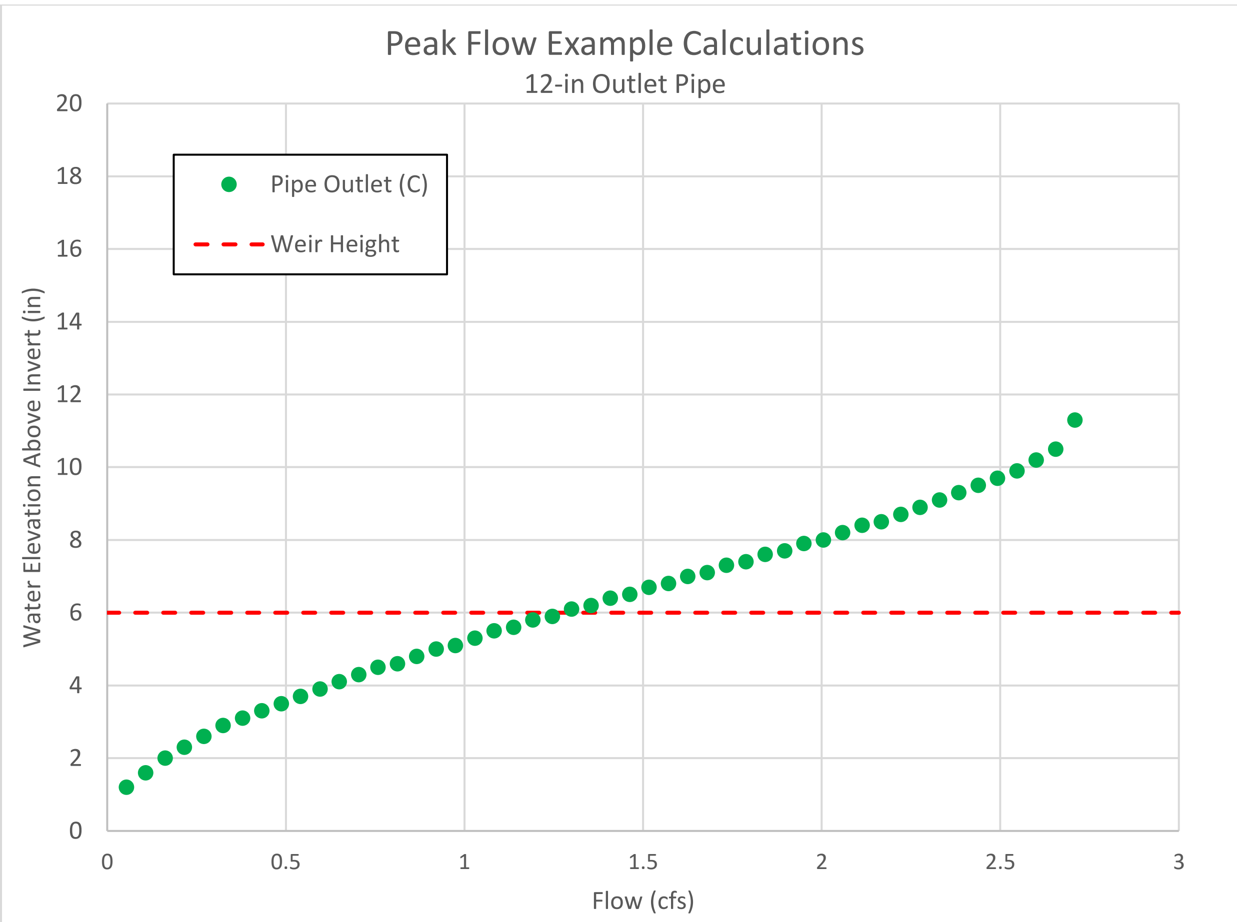



Figure 12. Step 1 – Calculation of Outlet Pipe Water Elevation (C)

Step 2. Calculate the height over the weir using the weir equation (1) and add it to the weir height (6”). Since we are only interested in flows corresponding to tailwater in the outlet pipe, lower flows are ignored. These values are plotted in Figure 13.

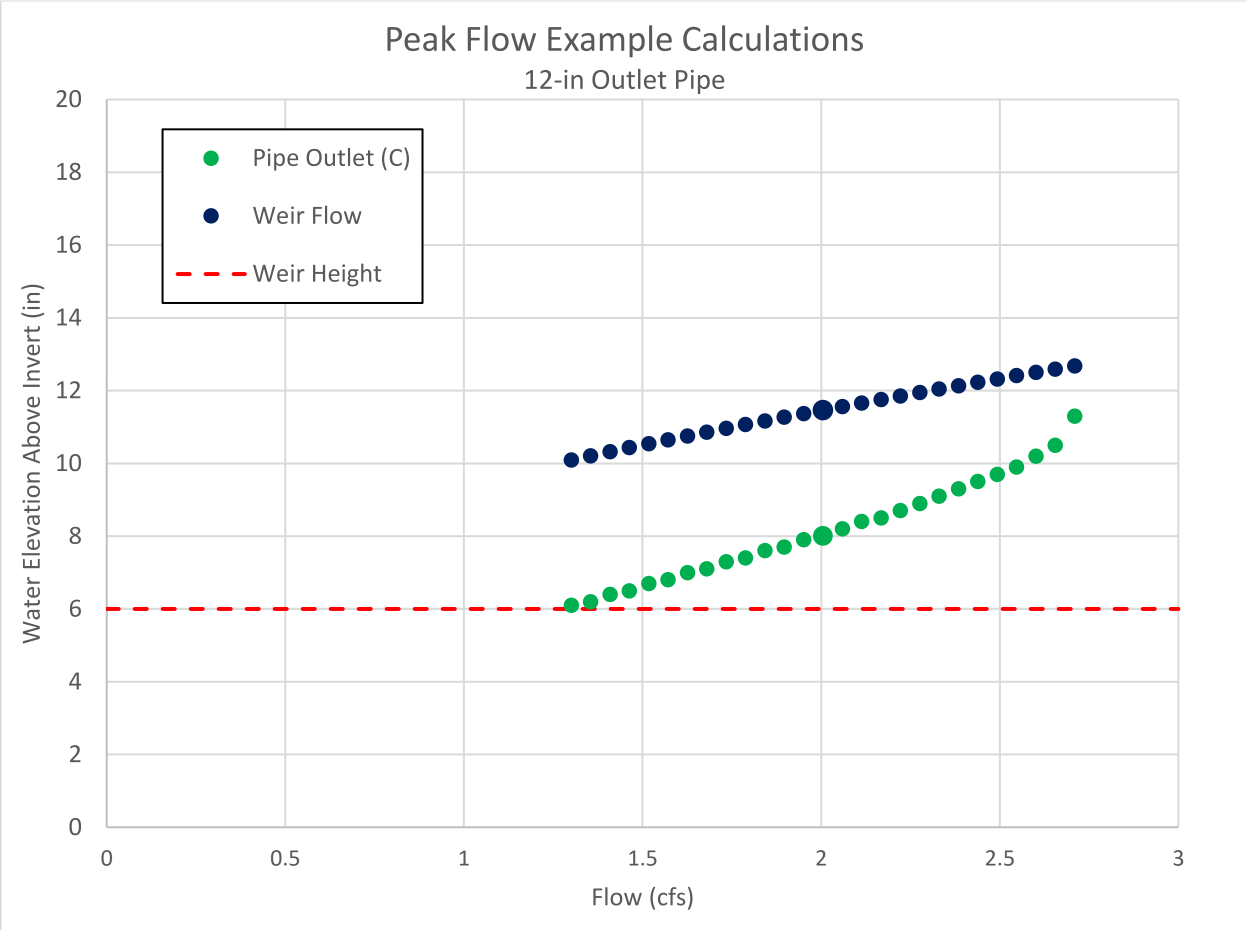


Figure 13. Step 2 – Calculation of the Head on the Weir

To demonstrate the calculation of a single point value, the flow depth in the 12" outlet pipe at 0.5% slope and a flow rate of 2.0 cfs is given by software calculation as 8.0." The water elevation upstream of the weir is given by (1) and is equal to:

$$W = [Q/(C_w L)]^{(2/3)} + \text{Weir Height} = [\,[2.0/(3.3\text{x}1.96)]^{(2/3)}\,] \text{ x } 12\,[in] + 6.0\,[in] = 11.47" .$$

Step 3: Calculate the water elevations inside the insert and upstream of the weir (B) by summing the values calculated in steps 1 & 2.These water elevations are plotted in Figure 14.

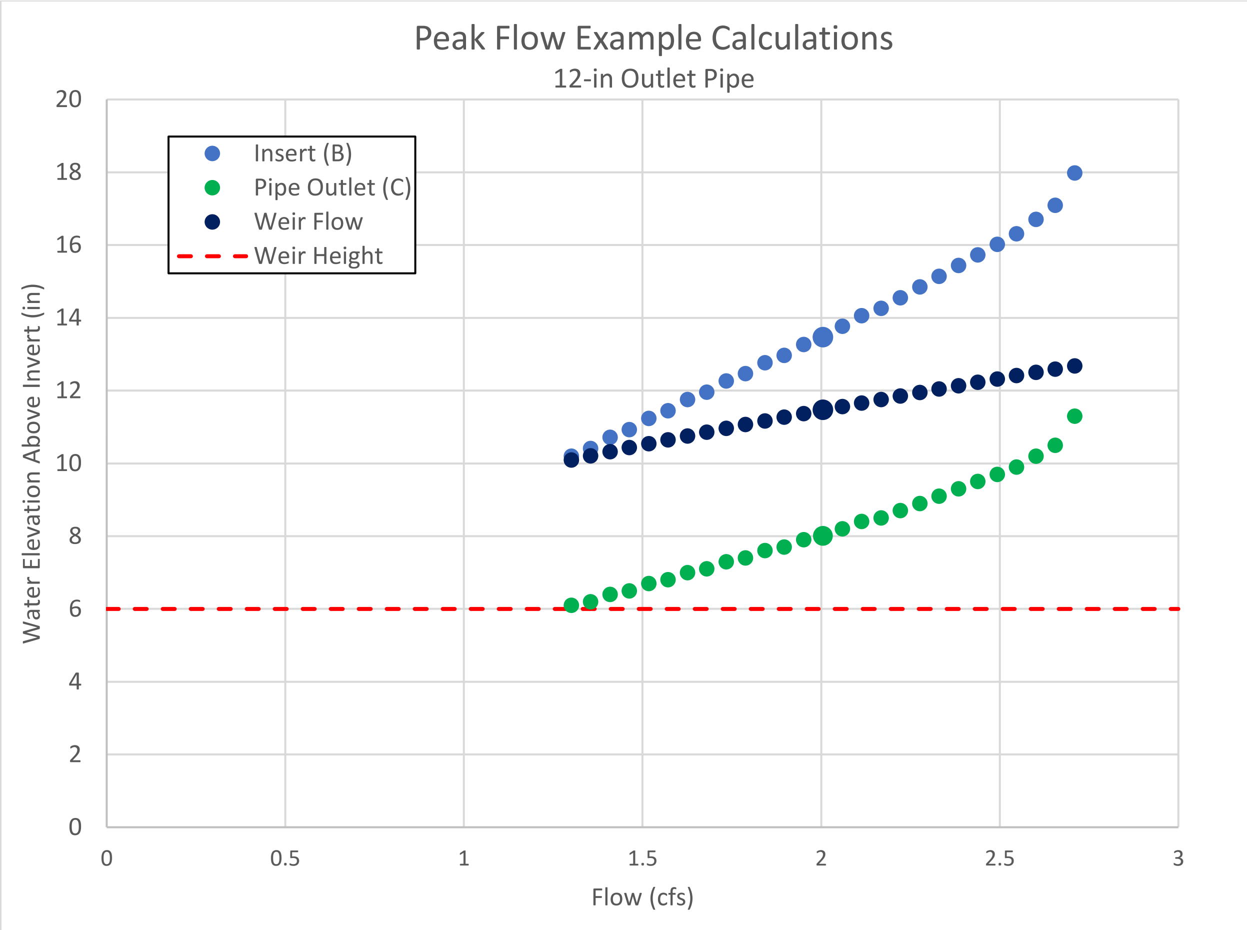


Figure 14. Step 3 – Calculation of the Water Elevation Inside Insert (B)

The water elevation inside the insert (B) at a flow rate of 2.0 cfs is calculated by adding the tailwater depth (outlet pipe – weir height) to the water elevation upstream of the weir, calculated in step 3:

*B = (8.0 – 6.0) + 11.47 [in] = 13.47".*

Step 4: Determine the total number of perforated (orifice) openings in the unit and then calculate the total number that are not blinded. These numbers are calculated in a spreadsheet based on the specifications of the perforated plastic walls and the dimensions of the HydroDome TR model. In this example, based on the HDTR4-12, there are 18102 total openings, which leaves 13576 open when 25% are blinded.

Step 5: Calculate the water elevation in the tank (A) using the orifice equation (2) and assuming the values calculated in step 3 (i.e., elevations inside insert (B)) represent a tailwater on the orifices. Assume the flow is proportioned equally through all 13576 openings and treat them as horizontal orifices. The resulting values are plotted in Figure 15.

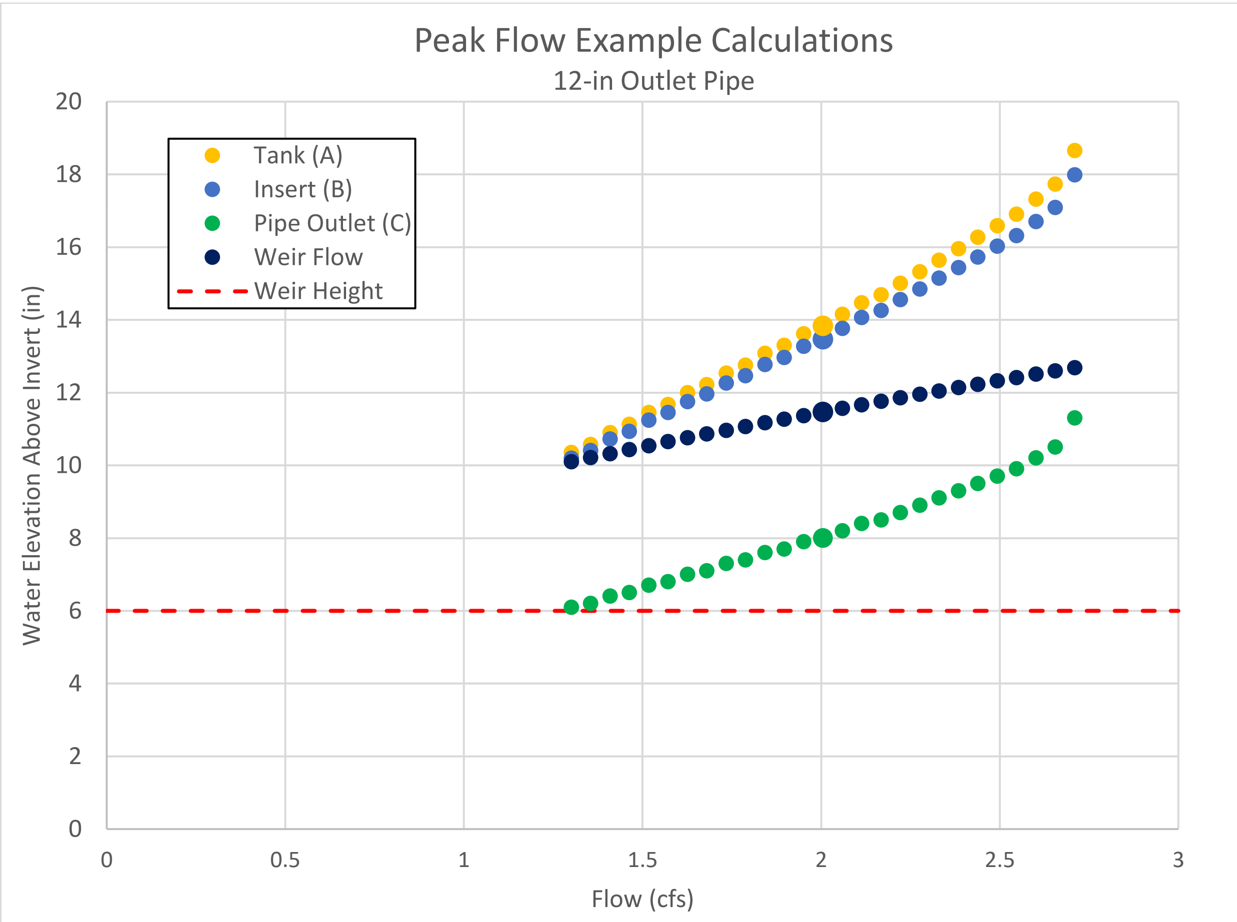



Figure 15. Step 5 – Calculation of the Water Elevation Inside Tank (A)

At a flow rate of 2.0 cfs, the water elevation inside the tank (A) is given by (2) and is equal to:

$A = [Q/(C_d A)]^2 / 2g$ + Insert (B) Elevation, where $Q = 2.0\ cfs / 13576$ orifices. So,

$A = [\ [(2.0/13576)/(0.55 x 0.000192)]^2 / (2 \times 32.17)\ ]\ \ x\ 12\ [in] + 13.47\ [in] = 13.83"$

Step 6: Identify the bypass elevation, which is equal to 1.5 x the outlet pipe diameter (18"). Using a spreadsheet or a polynomial fit of the plotted curve, solve for the peak flow rate before the water elevation in the tank (A) exceeds the bypass elevation, which is 18". The peak treatment flow rate without bypass in this scenario is 2.66 cfs.

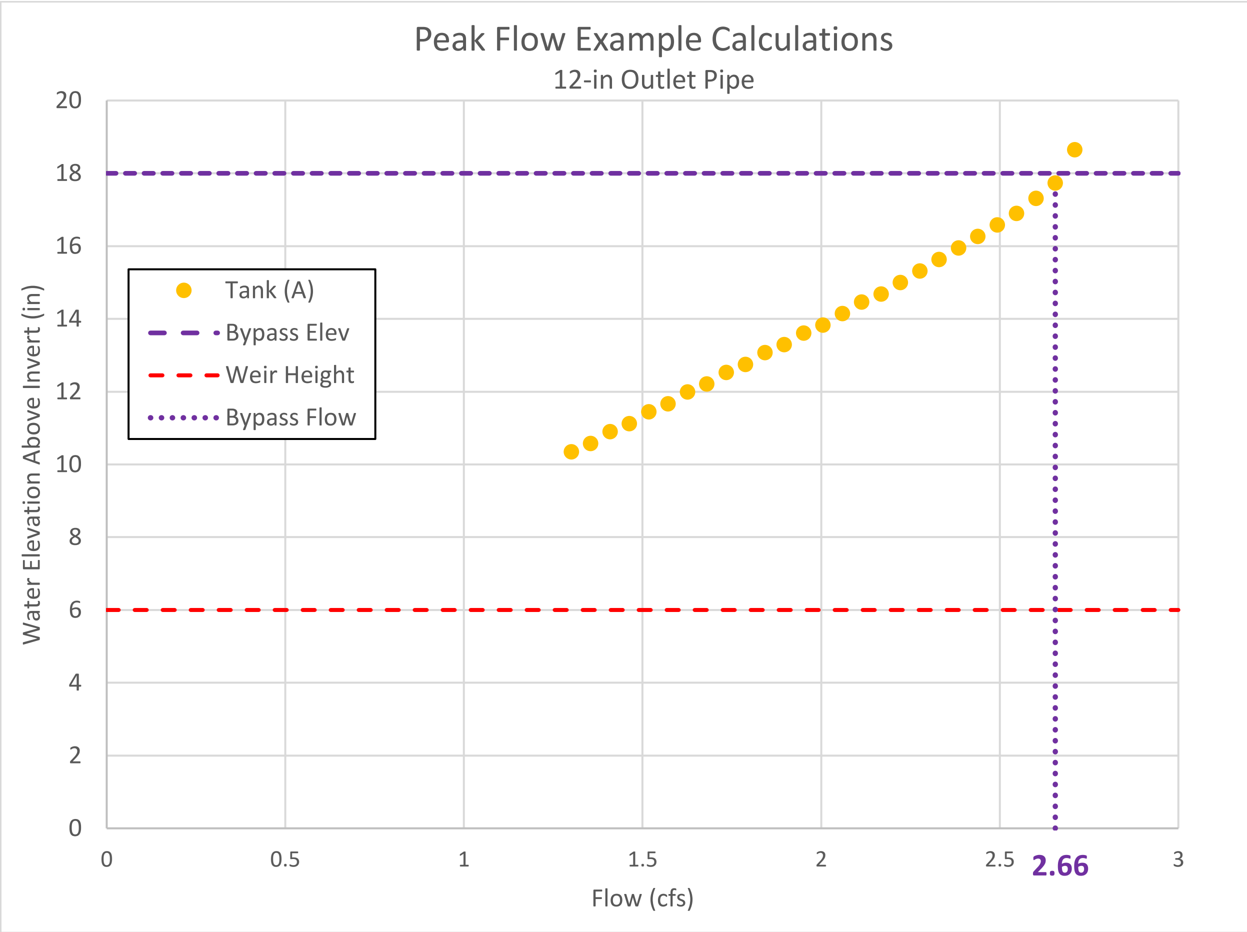


Figure 16. Step 6 – Calculation of the Peak Treatment Flow Rate

The tabulated values described and illustrated in the previous steps to demonstrate a calculation of peak treatment flow based on an HDTR4-12 with 25% screen blinding are provided in Table 3. The calculated maximum water elevation in the tank at 2.66 cfs is 17.73", which is slightly less than the bypass elevation of 18". A finer discretization of flows in the calculation would result in a slightly higher peak treatment flow, but we have chosen to select a slightly conservative peak value.

Table 3. Tabulated Values for Water Elevations from Example Peak Flow Calculation

| HDTR | |
|---|---|
| Model Size | 4 |
| Pipe Size (in) | 12 |
| Blocked % | 25 |

| | |
|---|---|
| Weir length (ft) | 1.95833 |
| Weir Height (ft) | 0.5 |
| Bypass Elev. (in) | 18 |

| Perforated Openings | |
|---|---|
| Total | 18102 |
| # Open | 13576 |

| Orifice Equation | | |
|---|---|---|
| Q = CdA(2gh)^.5 | | |
| Cd | A | g |
| 0.55 | 0.000192 | 32.174 |

| Weir Equation |
|---|
| Q = CwLh^1.5 |
| Cw |
| 3.33 |

| Peak Treatment Flow Rate | |
|---|---|
| **2.66** | (cfs) |

| Flow Rate (cfs) | Outlet (C) (in) | H Weir [in] | H (B) [in] | H (A) [in] |
|---|---|---|---|---|
| 1.30 | 6.10 | 10.10 | 10.20 | 10.35 |
| 1.35 | 6.20 | 10.21 | 10.41 | 10.58 |
| 1.41 | 6.40 | 10.32 | 10.72 | 10.90 |
| 1.46 | 6.50 | 10.43 | 10.93 | 11.13 |
| 1.52 | 6.70 | 10.54 | 11.24 | 11.45 |
| 1.57 | 6.80 | 10.65 | 11.45 | 11.67 |
| 1.63 | 7.00 | 10.75 | 11.75 | 11.99 |
| 1.68 | 7.10 | 10.86 | 11.96 | 12.22 |
| 1.73 | 7.30 | 10.96 | 12.26 | 12.54 |
| 1.79 | 7.40 | 11.07 | 12.47 | 12.76 |
| 1.84 | 7.60 | 11.17 | 12.77 | 13.08 |
| 1.90 | 7.70 | 11.27 | 12.97 | 13.30 |
| 1.95 | 7.90 | 11.37 | 13.27 | 13.61 |
| 2.01 | 8.00 | 11.47 | 13.47 | 13.83 |
| 2.06 | 8.20 | 11.56 | 13.76 | 14.15 |
| 2.11 | 8.40 | 11.66 | 14.06 | 14.47 |
| 2.17 | 8.50 | 11.76 | 14.26 | 14.69 |
| 2.22 | 8.70 | 11.85 | 14.55 | 15.00 |
| 2.28 | 8.90 | 11.95 | 14.85 | 15.32 |
| 2.33 | 9.10 | 12.04 | 15.14 | 15.64 |
| 2.38 | 9.30 | 12.14 | 15.44 | 15.95 |
| 2.44 | 9.50 | 12.23 | 15.73 | 16.27 |
| 2.49 | 9.70 | 12.32 | 16.02 | 16.59 |
| 2.55 | 9.90 | 12.41 | 16.31 | 16.90 |
| 2.60 | 10.20 | 12.50 | 16.70 | 17.32 |
| 2.66 | 10.50 | 12.59 | 17.09 | 17.73 |
| 2.71 | 11.30 | 12.68 | 17.98 | 18.65 |
| 2.76 | 11.30 | 12.77 | 18.07 | 18.77 |

To validate this mathematic model, we performed hydraulics testing on a prototype HydroDome TR (model HDTR2-6) in our Roselle, NJ laboratory flow loop. The water level inside the test tank was measured at different influent flow rates and with four scenarios representing 0% (clear), 81%, 94%, and 98% screen blinding. High blinding percentages were chosen to simulate a condition with a significant hydraulic impact since our laboratory pumping capacity limited the generation of data in the flow region where the screens were restrictive when running with a clear inlet (see Figures 9 and 10). At higher levels of screen blinding, we were able to generate significant data in the flow region where the screens were restrictive in order to test our mathematical model and assumptions. In addition, significantly clogged screens are the condition of primary hydraulic interest for device performance. Due to the limitations of our experimental setup, we were not able to raise the water level to the bypass elevation. We relied on matching the flow vs. elevation curves generated by observations and with our model to evaluate the comparison and estimate peak treatment flow at bypass.

Screen blinding was achieved by sealing off portions of the inlet screen with waterproof duct tape to fully prevent flow through these portions of the screen. Water levels in the tank were also calculated with the mathematical model for the same four scenarios. Figures 17, 18, 19, and 20 show the comparison between observed and calculated water elevations for each case.

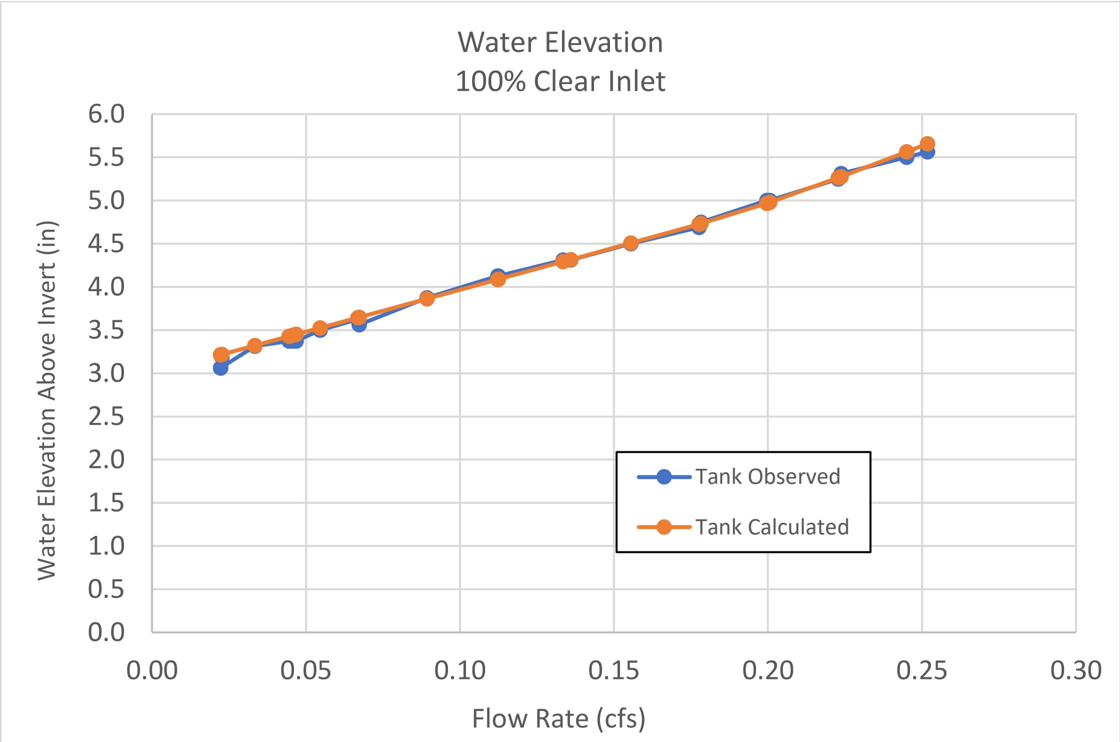



Figure 17. Observed vs Calculated Water Elevations - Fully Clear Inlet

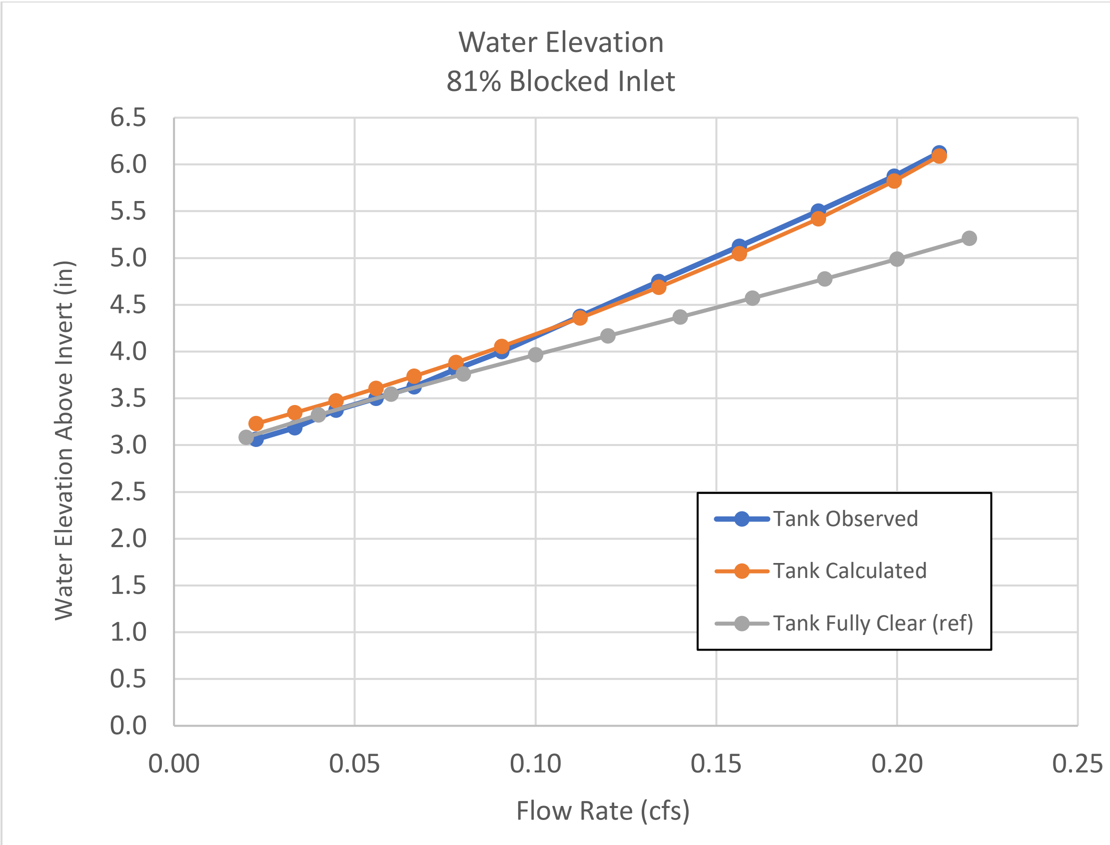


Figure 18. Observed vs Calculated Water Elevations – 81% Screen Occlusion

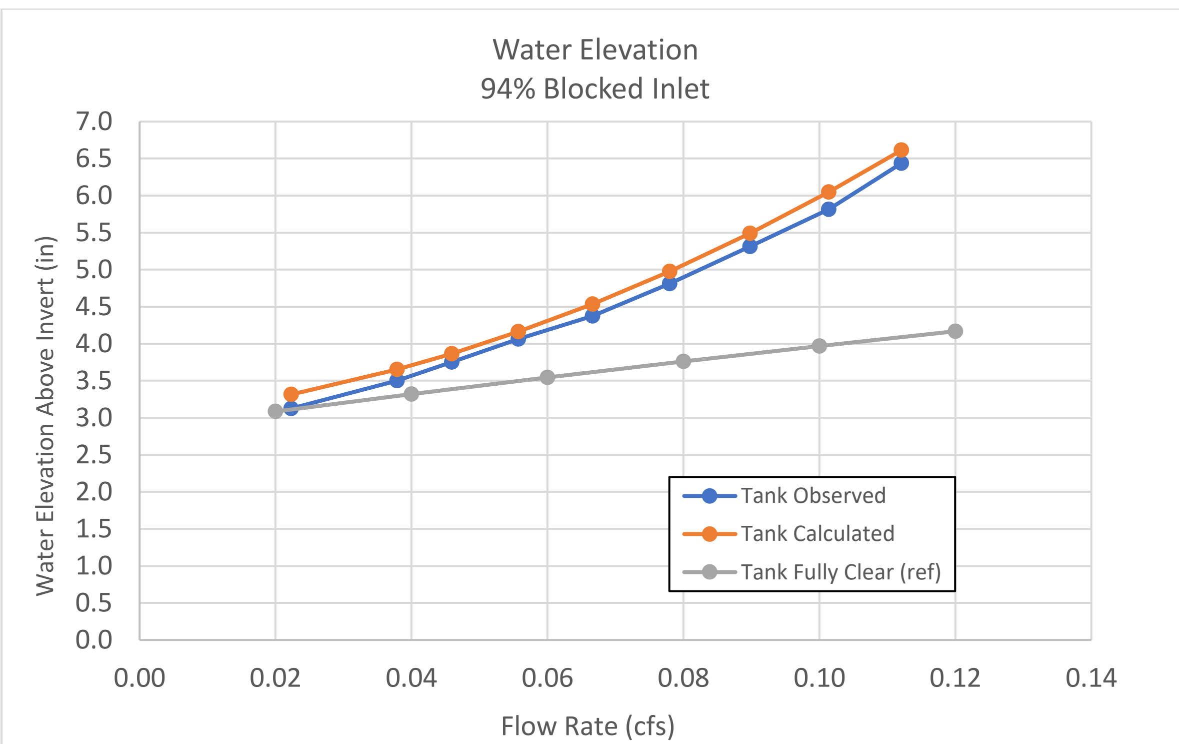


Figure 19. Observed vs Calculated Water Elevations – 94% Screen Occlusion

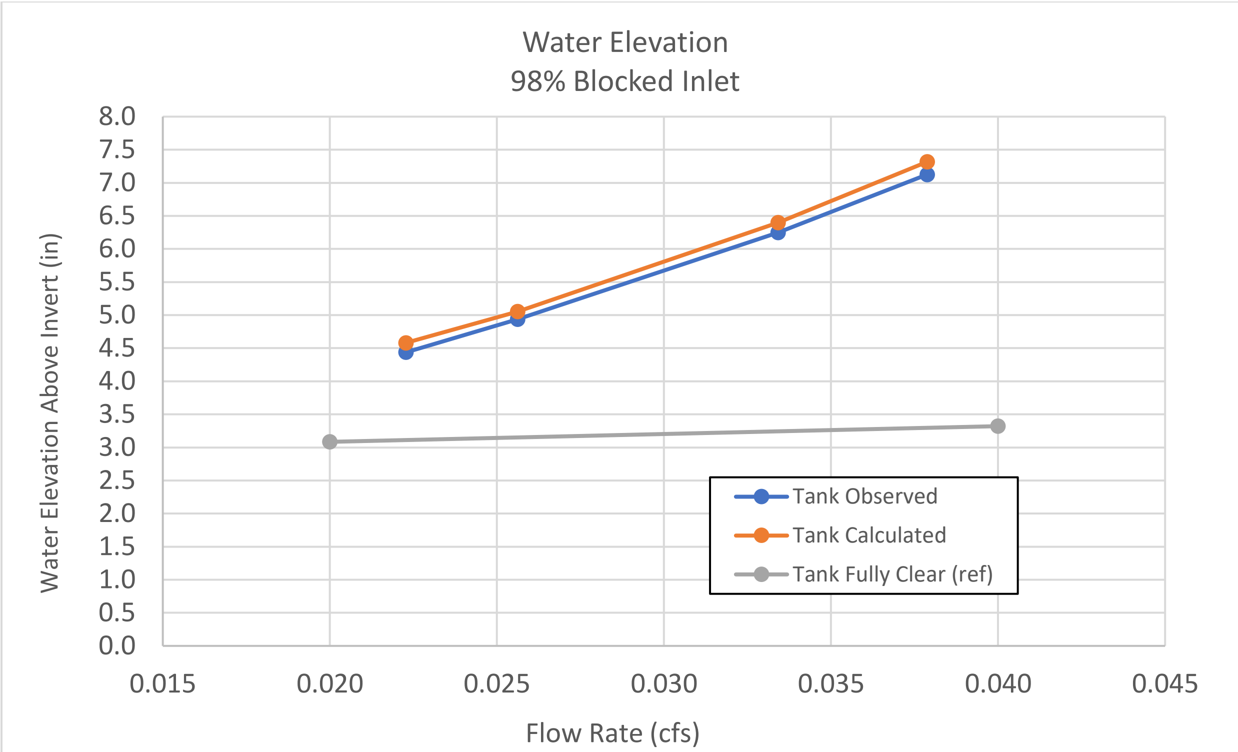


Figure 20. Observed vs Calculated Water Elevations – 98% Screen Occlusion

As demonstrated by the plotted data comparisons, the model-predicted water elevations match the observed water levels to a high degree for all four scenarios. The observed water elevations were slightly lower than predicted for the 94% and 98% screen blinded scenarios, which is conservative. It is also noted that at low flow rates when the inlet screen is not restricted, the model overestimates tank water level. However, this has no impact on the predicted water levels near the peak flow rates, which is the area of interest.

The demonstrated validation of the mathematical model and resulting tabulated treatment flow rates (Table 1) confirms its suitability for sizing and designing units across a range of model sizes.

**d. Comparison Table**

See Tables 1-2

**e. Design Drawings**

Design drawings for standard HydroDome TR model sizes are provided in Appendix A. Customized drawings will be provided for each project to reflect site-specific requirements and conditions.

**f. Alternative Configurations**

If a grated inlet is installed on the manhole structure, a solid lid must be installed on top of the insert to deflect trash into the sump and prevent it from passing downstream. If the solid lid is not installed, the installation does not satisfy the certification requirements and does not comply with the Trash Provisions. The lid requires a minimum slope of 30% and is hinged to provide visual access inside the insert (Figure 3). A handle on the lid can be hooked from the surface to pivot it open.

**g. Internal Bypass**

The open top of the HydroDome TR insert provides a bypass for flows in excess of the peak treatment flow. The height of the bypass (i.e., height of insert walls) is standardized based on model size, and the peak treatment flow rates provided in Table 1 reflect this standardized design dimension. However, the wall heights and therefore bypass elevation and peak treatment flow rates can be modified (see Figure 21) in consultation with the design engineer based on site-specific requirements. For example, if the upstream drainage system cannot accommodate the HGL in the HydroDome TR unit during high flows, the bypass elevation could be lowered. Alternatively, a higher bypass elevation could be set to increase the peak treatment flow rate prior to bypass, but would also increase the upstream hydraulic impact.

Custom designs for the bypass elevation are developed in consultation with the design engineer and any regulatory authority having jurisdiction. Hydroworks can provide calculated peak treatment flows based on custom bypass elevations. In all cases, however, the bypass capacity must be equal to or greater than the peak flow rate generated by a 1-year, 1-hour storm in order to meet the certification requirements and comply with the Trash Provisions.

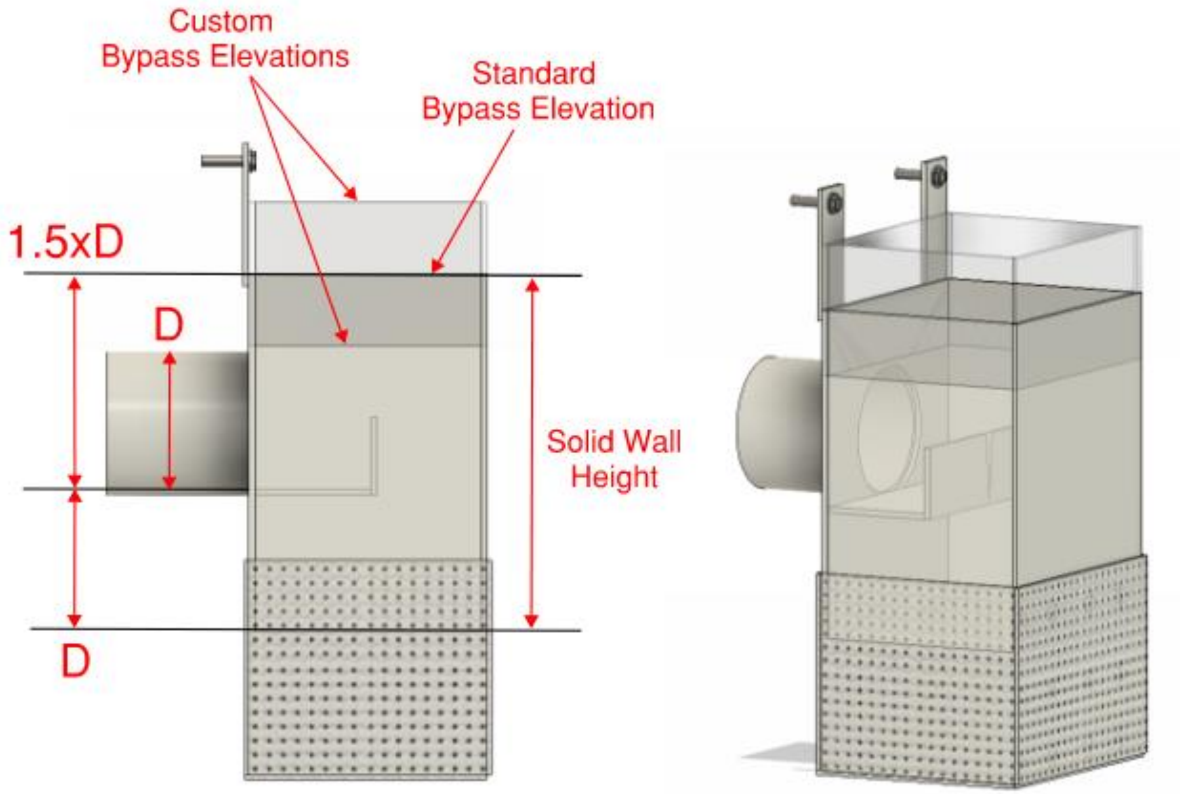



Figure 21. Illustration of Standard and Custom Bypass Elevations

**h. Previously Trapped Material**

The HydroDome TR is designed to retain all captured trash. However, the unit will re-introduce previously captured trash to the system under the following conditions:

i. Extreme storm event where flows to the unit exceed the peak design flow of the drainage system
ii. Total or near total blinding of the screens (e.g., due to poor maintenance of unit)

**i. Calibration Feature**

N/A

**j. Photos**

Since there are no current installations, no photos of installed units are available. Figure 22 shows the prototype used for laboratory testing (model HDTR2-6). The test prototype consists of a plastic insert housed in a 2-ft diameter tank and installed in a 6-in outlet pipe. The test prototype has a Van Stone flange bolted to the back wall to allow quick connection and disconnection to the test tank outlet pipe. However, typical HydroDome TR units include mounting tabs for anchor bolts and an integrated outlet stub that slides into the outlet pipe of the precast structure to form a permanent connection.

Figure 22. Laboratory Test Prototype Model HDTR2-6

**k. Material Type**

<u>Insert</u>

The internal components of the HydroDome TR are made out of high-density polyethylene (HDPE) or copolymer polypropylene (CPP) plastic.

<u>Structure</u>

The insert is installed in a manhole typically made of precast concrete. The precast is designed to meet ASTM C478 standards and AASHTO HS-20 loading.

<u>Hardware</u>

All hardware used in the inserts or to secure the inserts to the housing structure are made of grade 304 stainless steel.

Screens

The perforated inlet screens are made of polypropylene plastic, with maximum opening size of 3/16” (4.76 mm).

Access Covers

Manhole frames, covers, and inlet grates are cast iron and meet ASTM A48 and AASHTO M-306 loading.

### l. Design Life

The design life of all components used in HydroDome is between 50 and 100 years. Actual service life depends on proper design, installation, and maintenance.

## 4. Installation Guidance

### a. Standard System installation procedures

Installation of the precast manhole structure should be performed separately from the HydroDome TR insert. The installation steps for the insert are summarized below:

- Caulk the outlet stub (generously) with Pro-Seal34
- Lower the HydroDome TR into the structure with lifting straps
- Gently slide the outlet stub into the structure outlet pipe as far as it will go
- Secure the insert to the wall with anchor bolts through the mounting tabs

Detailed installation procedures for the standard HydroDome TR, with illustrations, are provided in Appendix B.

### b. Description of System installation limitations and/or non-standard System installation procedures

The HydroDome TR cannot be installed until the manhole is set and the outlet pipe is in place (since it installs into the outlet pipe). The structure top cap should not be placed on the manhole until after HydroDome TR installation is complete.

If the HydroDome TR is installed in a round manhole, the outlet pipe should be radially centered.

Deviations from these standard requirements will require custom modifications to the insert and/or the installation procedures.

### c. Methods for diagnosing and correcting installation errors

Most installation errors are caused by installing a unit in the wrong manhole or damage during transportation that goes unreported.

The HydroDome TR insert should be inspected for damage or defects such as cracked welds etc. before installation.

The project name and unit number are routed into the plastic lid of the insert or otherwise marked such that each unit can be clearly identified. Confirming that this information matches the structure identifier prevents most installation errors before they happen.

Installation of the HydroDome TR shall conform to recommended procedures (Appendix B) as well as all engineering plans. Hydroworks should be contacted to answer any questions regarding installation or to evaluate corrective actions in case of errors.

## 5. Operation and Maintenance Information

### a. Inspection procedures and frequency considerations

The O&M Manual for the HydroDome TR, including procedures for inspection and maintenance, is provided in Appendix C. The general inspection procedure is described below.

Visual inspection can be performed from the surface to assess accumulation of floatables (trash), sediment, and oil. Visual inspection of the condition of the structure and insert should also be performed simultaneously to identify any possible damage or defects to the unit.

Inspection should be performed at minimum twice per year. The initial inspections will indicate the required frequency of future inspections and maintenance.

The procedure involves quantifying the captured trash, sediment, and oil inside the structure. Maintenance/cleanout is required once accumulated pollutants reach the volumes indicated in the O&M manual.

The HydroDome TR is designed to convey the peak treatment flow without bypass when 50% or more of the inlet screen in blinded. However, as the percentage of screen clogging increases, the hydraulic impact upstream will also increase. As the screens progressively clog, during storm events, the upstream water level will eventually rise to the point where influent flow bypasses the screens by overtopping the HydroDome TR insert walls.

Any evidence of premature bypass, e.g., significant accumulation of trash inside the insert or distinct water stains on the structure wall above the bypass elevation may indicate the need for maintenance. These observations should be correlated with recent rainfall observations to determine if the peak treatment rate was exceeded or if the unit requires maintenance. A standing water level above the outlet invert 24 hours after rainfall also indicates that the screens are clogged and require maintenance. All observations should be recorded in the inspection log.

**b. Description of maintenance frequency considerations related to the System's hydraulic capacity at various levels of trash capture volumes**

The HydroDome TR is capable of conveying high flows at clogging percentages up to and exceeding 90%. However, it is recommended to maintain the HydroDome TR when the screen is 50% blinded to preserve near-optimal hydraulic capacity. Since floatables capture volumes do not correlate perfectly to screen clogging percentages, inspections are important for characterizing typical volume and type of trash as well as required maintenance frequencies.

**c. Maintenance procedures, including procedures to clean the trash capture screen**

Floatable and settleable trash/sediment are typically removed from the HydroDome TR at the same. Maintenance can typically be performed from the surface, through the access opening, without entering the structure. Sediment, trash, and water should be removed together using a vactor truck. The inlet screens should be hosed down to flush any trapped debris into the sump while continuing to vacuum the sump. The local municipality should be consulted for the allowable disposal options for both water and sediments prior to any maintenance operation. All maintenance activities should be documented, and reports archived.

Detailed maintenance procedures are provided in the O&M manual in Appendix C.

**d. Essential equipment and materials for proper maintenance activities**

Recommended equipment for maintenance includes a manhole hook, vactor truck, tape measure, sludge/sediment sampler, inspection log, and safety equipment.

**e. Description of the effects of deferred maintenance**

Deferred maintenance may result in blinded screens, which will cause bypass at progressively lower flow rates. Bypass will result in the loss of some previously captured floatable trash and oil as well as a higher upstream hydraulic grade line. Decomposition of organic material may also cause the release of bacteria, nutrients, and odors.

**f. Repair procedures for the System's structural and screening components**

The screening components of the HydroDome TR are made of 3/16" thick perforated plastic sheet and are therefore intended to last for at least 50 years or the product's full lifetime without repairs. This assumes proper sizing and installation as well as typical trash loading.

The device's structural components are similarly robust and repairs are not anticipated. However, small repairs to any insert components can be performed in place provided the structure is pumped down first. Larger repairs or the replacement of the full insert may require removal of the precast top cap. Hydroworks should be contacted to evaluate potential repairs before attempting to perform any such work.

## 6. Vector Control Accessibility

### a. The date the System application was submitted for vector control accessibility design verification via email to the Mosquito Vector Control Association of California at Trashtreatment@mvcac.org

MVCAC verification was provided in a letter dated April 18, 2024. The letter is attached in section c. below.

### b. The description and/or video that demonstrates how mosquito vector control personnel can readily access the bottom of the storm water vault and/or System for visual observation and mosquito treatment

The open design of the HydroDome TR provides unobstructed access to all areas where standing water may exist inside the HydroDome TR for vector inspection and treatment.

Figure 23 shows sight lines into a 4-ft diameter round manhole structure housing a HydroDome TR unit (model HDTR4-12). Since a precast manhole was not available for demonstration, Autodesk Fusion 360 was used to model a HydroDome TR unit and illustrate the sight lines for visual inspection and mosquito treatment.

The access opening is 30” in diameter for all model sizes. For units installed in round manholes 8-ft in diameter and larger, two 30”-diameter access openings are provided, which further improves visibility and access. Since insert footprint scales with manhole size, sight lines for all model sizes are similar. Sight lines into the structure improve as the depth of the insert below the access opening increases. For the modeled unit pictured in Figure 23, the top of the insert is 12” below the bottom of the manhole flat top, which is a relatively shallow depth.

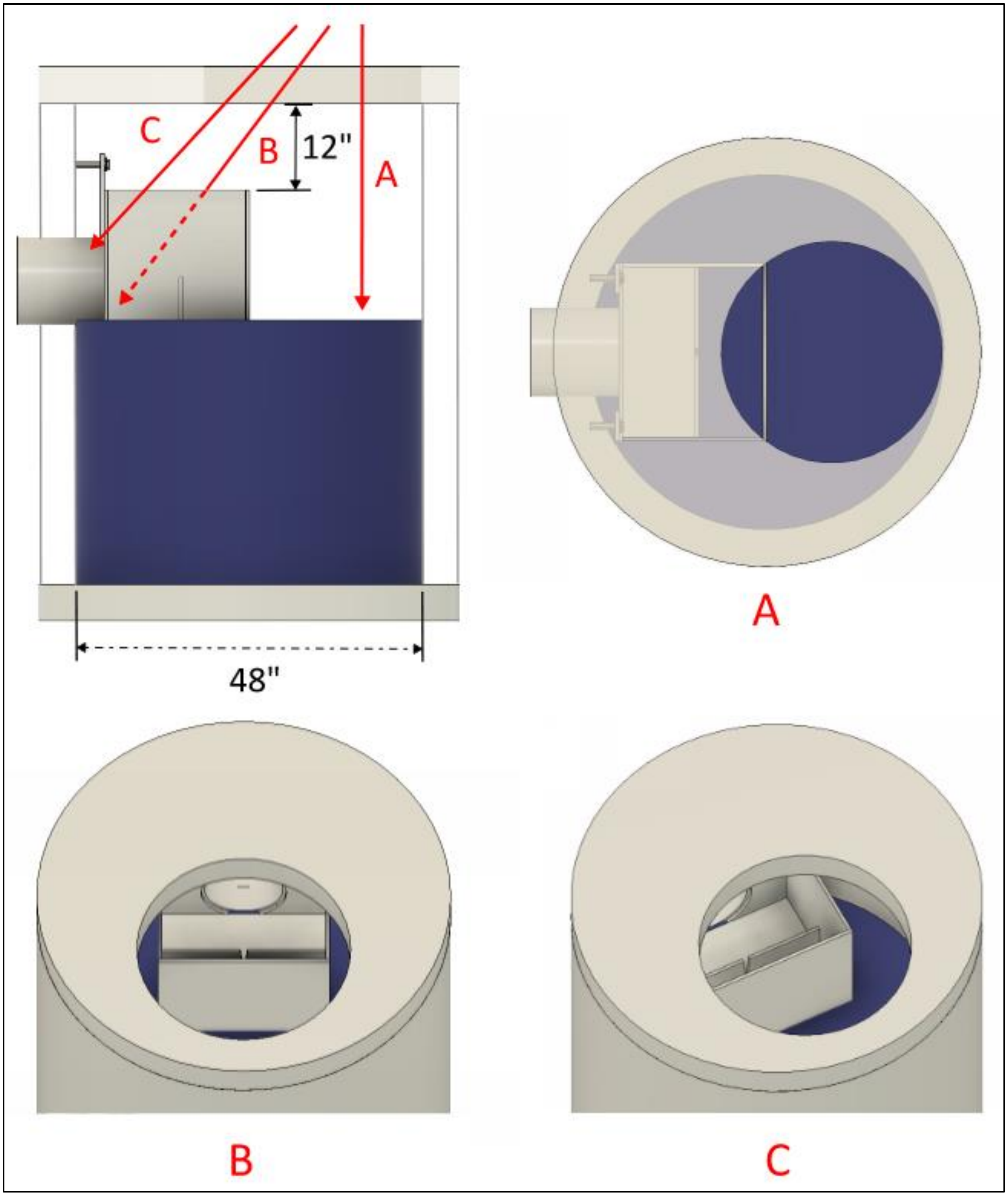


Figure 23. Sight Lines into HydroDome TR Round Manhole

**c. The Mosquito Vector Control Association of California Letter of Verification as an attachment to the application when it becomes available**

MVCAC
Mosquito and Vector Control Association of California
One Capitol Mall, Suite 320 • Sacramento, CA 95814 • p: (916) 440-0826 • f: (916) 444-7462 • e: mvcac@mvcac.org

Hydroworks, LLC
257 Cox Street
Roselle, NJ 07203

April 18, 2024

Dear Mr. Bryant,

Thank you for the submission of the Hydroworks HydroDome TR for review by the Mosquito and Vector Control Association of California pursuant to the SWRCB Trash Treatment Control Device Application Requirements. The Association has reviewed the conceptual drawings for the HydroDome TR and verifies that provisions have been included in the design that allow for full visual access to all areas for presence of standing water, and when necessary, allows for treatments of mosquitoes.

While this verification letter confirms that inspection and treatment for the purpose of minimizing mosquito production should be possible with the HydroDome TR as presented, it does not affect the local mosquito control agency's rights and remedies under the State Mosquito Abatement and Vector Control District Law. For example, if the installed device or the associated stormwater system infrastructure becomes a mosquito breeding source, it may be determined by a local mosquito control agency to be a public nuisance in accordance with California Health and Safety Code sections 2060-2067.

> "Public nuisance" means any of the following:
> 1. Any property, excluding water, that has been artificially altered from its natural condition so that it now supports the development, attraction, or harborage of vectors. The presence of vectors in their developmental stages on a property is prima facie evidence that the property is a public nuisance.
> 2. Any water that is a breeding place for vectors. The presence of vectors in their developmental stages in the water is prima facie evidence that the water is a public nuisance.
> 3. Any activity that supports the development, attraction, or harborage of vectors, or that facilitates the introduction or spread of vectors. (Heal. & Saf. Code § 2002 (j).)

Declaration of a facility or property as a public nuisance may result in penalties as provided under the Health and Safety Code. Municipalities and the vendors they work with are encouraged to discuss the design, installation, and maintenance of stormwater trash capture devices with their local mosquito control agency to reduce the potential for disease transmission and public nuisance associated with mosquito production.

Sincerely,

Megan MacNee
MVCAC Executive Director

## 7. Reliability Information

### a. Estimated design life of System components before major overhaul

The estimated design life of all components is between 50 and 100 years depending on proper design, installation, and maintenance.

### b. Warranty information

Hydroworks, LLC provides a one (1) year limited warranty. A copy of the warranty is included in the O&M Manual (Appendix C).

### c. Customer support information

Hydroworks can be reached at:

Address: Hydroworks, LLC
257 Cox Street
Roselle, NJ 07203

Email: support@hydroworks.com

Phone: 888-290-7900

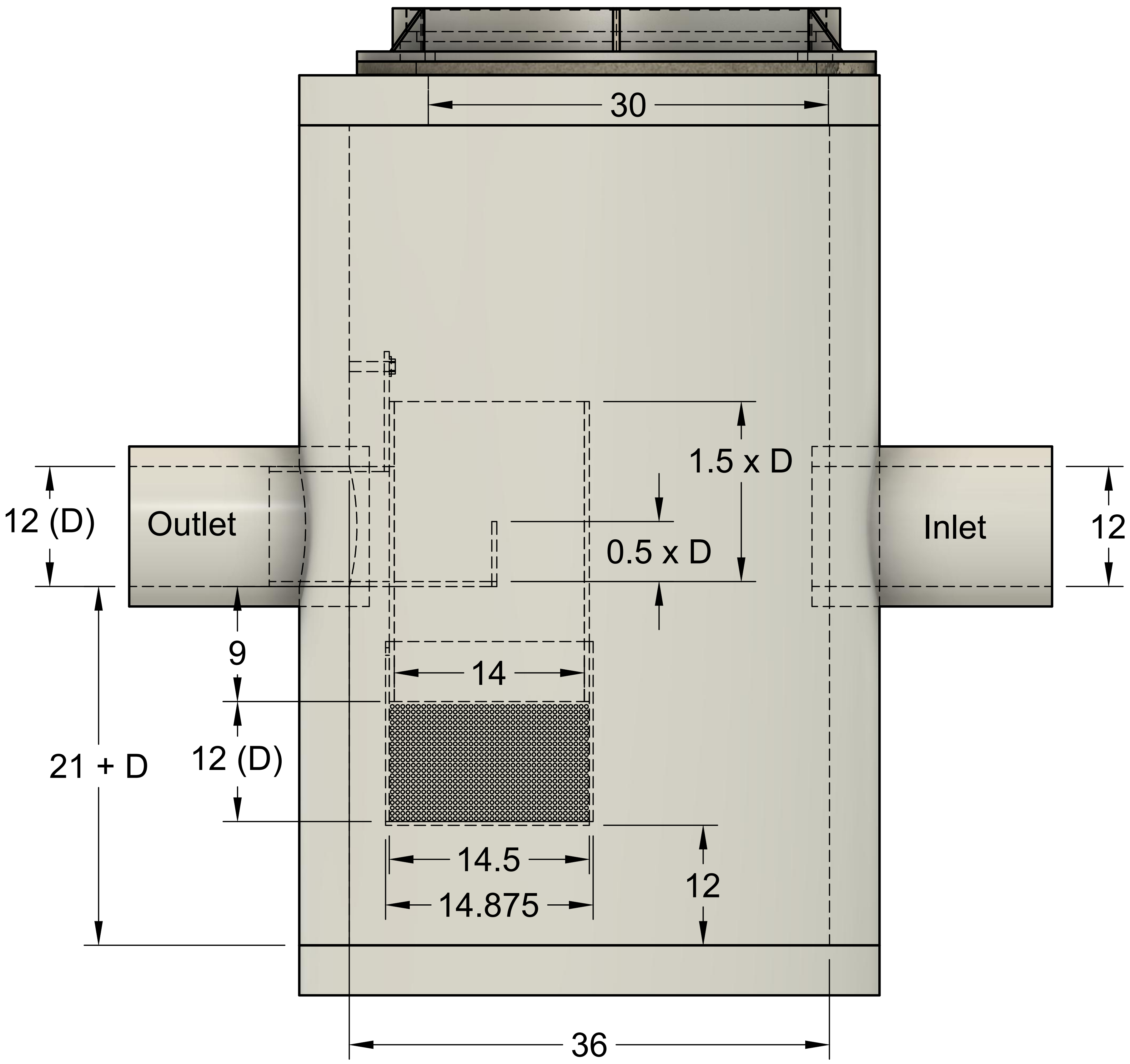
## 8. Field and Laboratory Testing Information

### a. For Systems with 5-millimeter screening, any available field or laboratory testing information that demonstrates the System functionality and performance; and

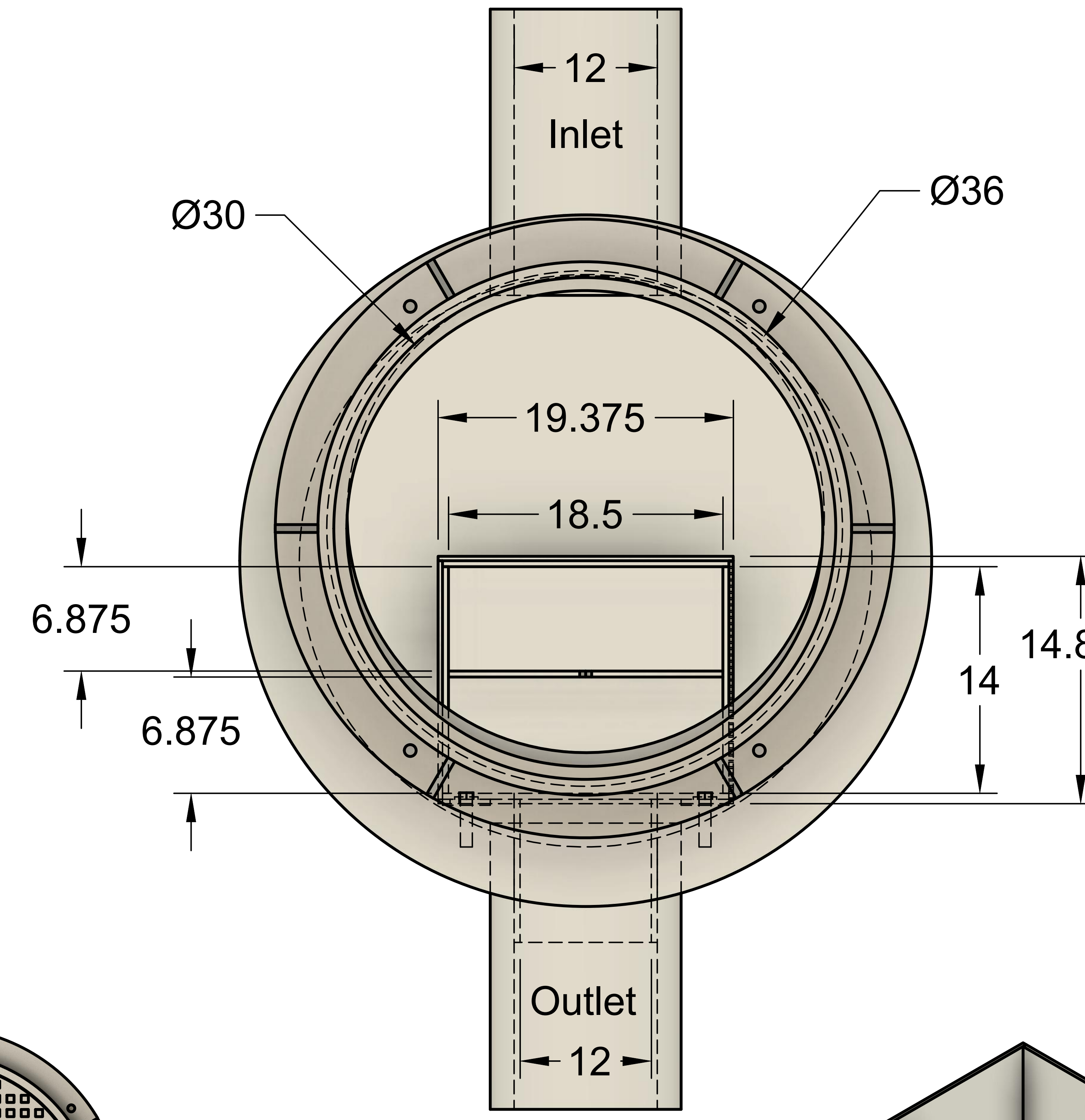
### b. If the System does not include a 5-millimeter screen, adequate field or laboratory testing information that demonstrates the System captures trash particles of 5 millimeters or greater.

The HydroDome TR has not been laboratory tested specifically for trash capture.

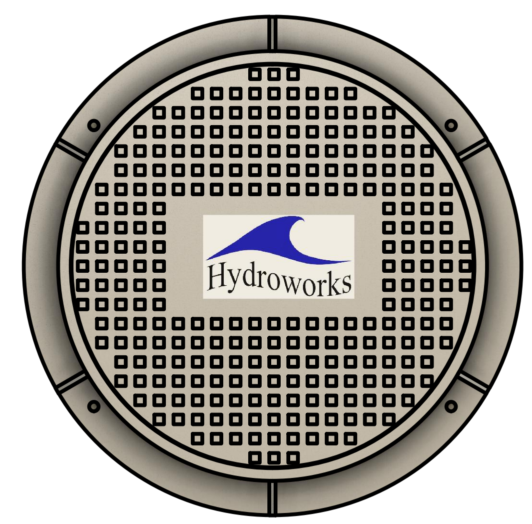
# Appendix A
# Standard Drawings




Profile




Plan

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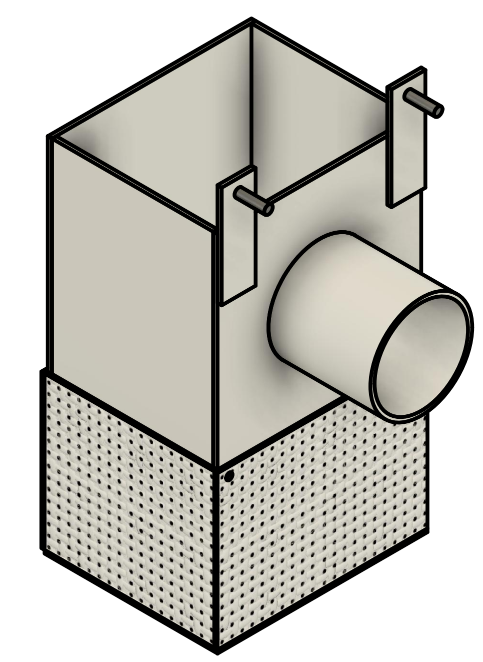

Insert

Notes:

1. Generic layout shown. Contact Hydroworks for site-specific drawing.
2. Insert and structure height dimensions based on outlet pipe diameter (D).
3. Multiple inlet pipes possible
4. Drops through structure possible
5. Mounting tabs and anchor bolts not drawn to scale
6. Sump depth not drawn to scale
7. Peak flow rate dependent on pipe diameter and slope
8. Increased peak treatment flows and storage capacities can be provided based on custom designs.
9. Contact Hydroworks for more information.

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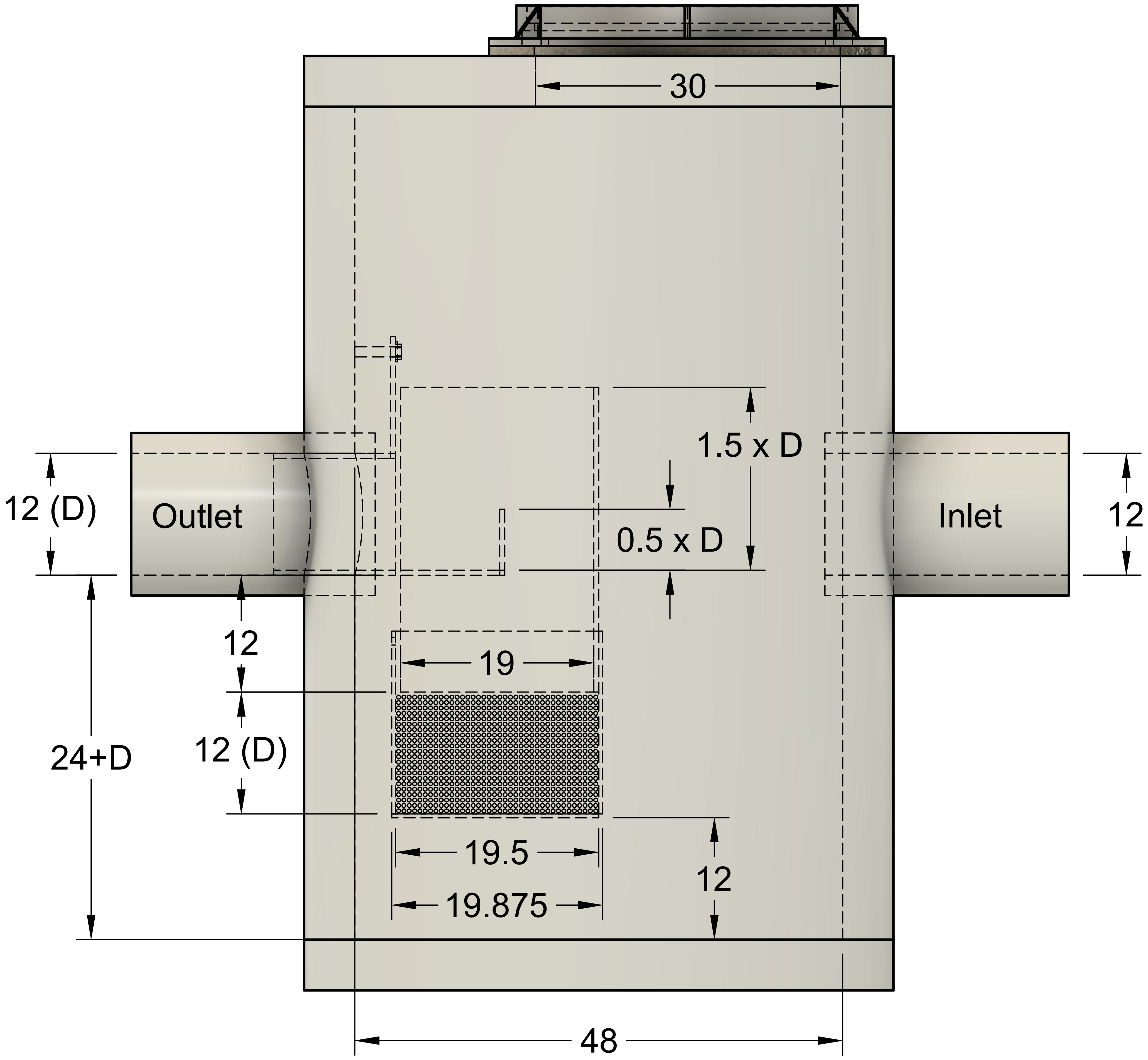
# HydroDome HDTR3-12

Project: Full Trash Capture - Standard Drawing

Location:

| Date: 03/04/2024 | Scale: | Rev: 1 |
|---|---|---|

Hydroworks

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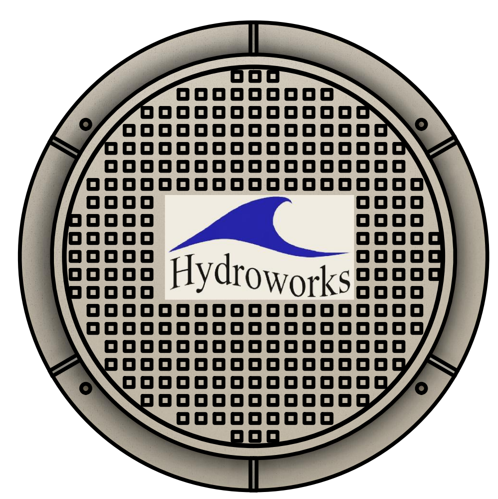


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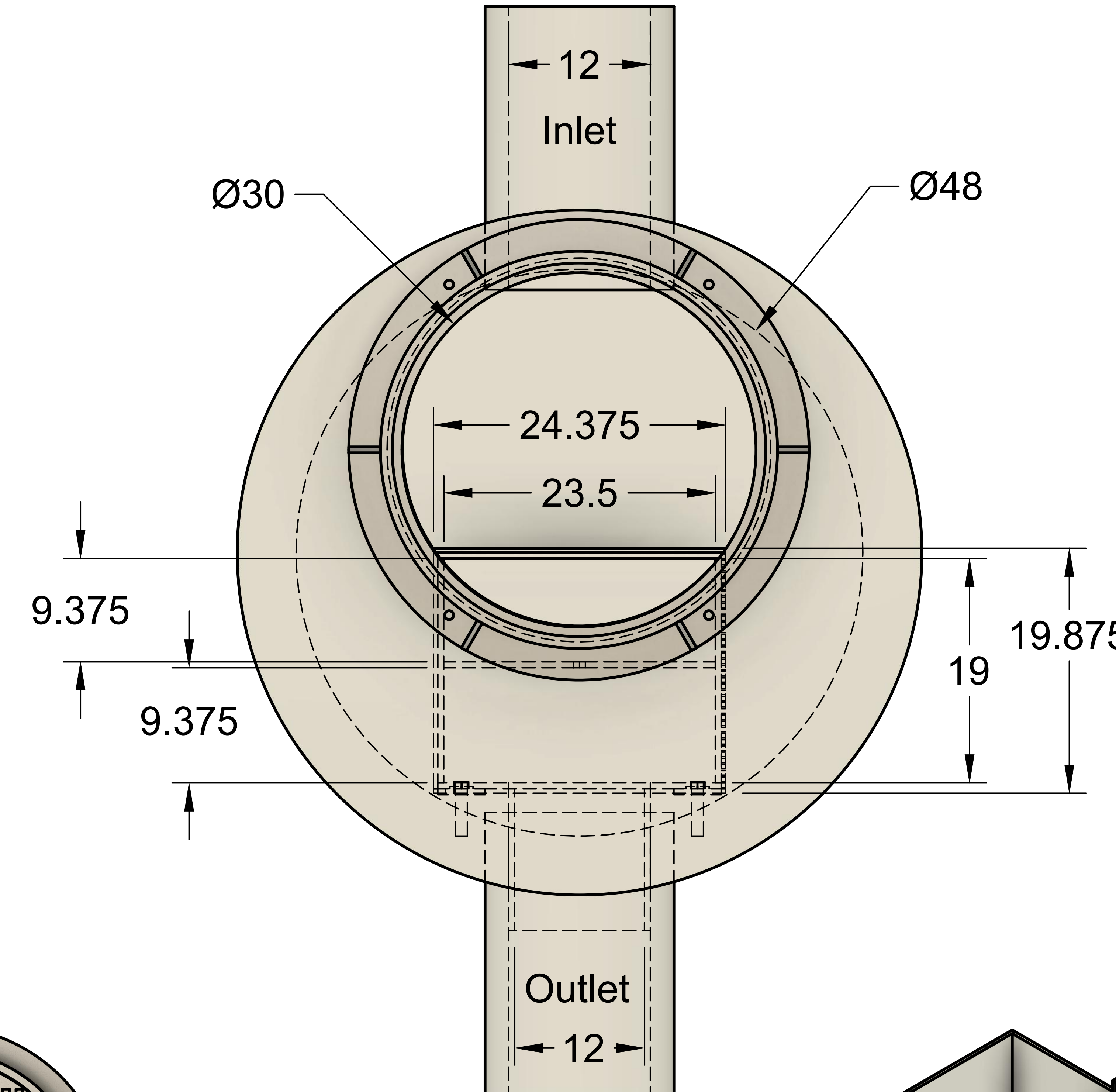


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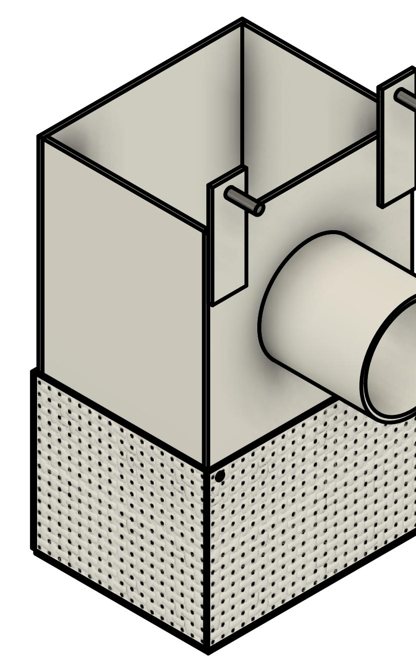

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Notes:

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3. Multiple inlet pipes possible
4. Drops through structure possible
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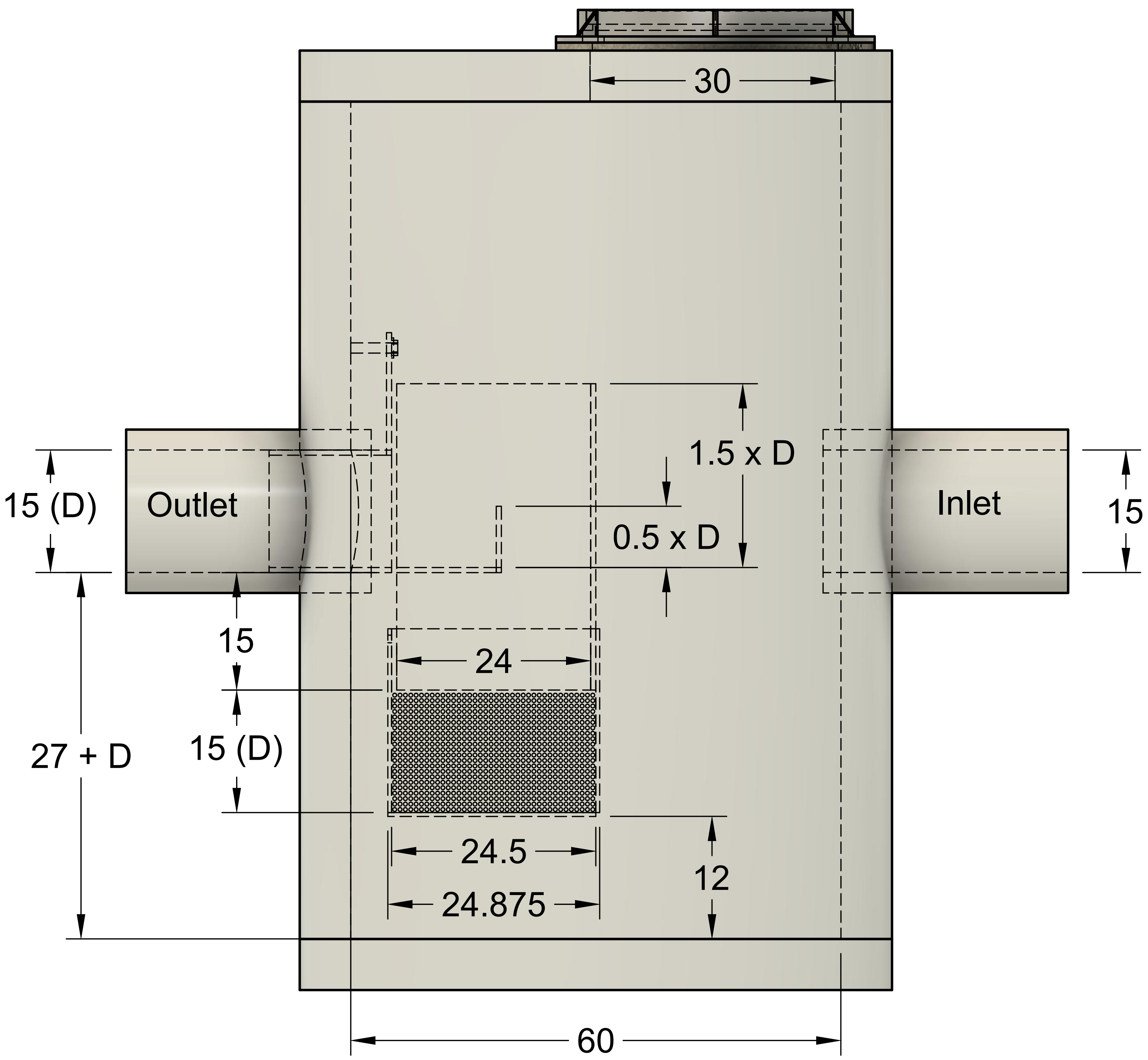
# HydroDome HDTR4-12

Project: Full Trash Capture - Standard Drawing

Location:

| Date: 03/04/2024 | Scale: | Rev: 1 |
|---|---|---|

Hydroworks

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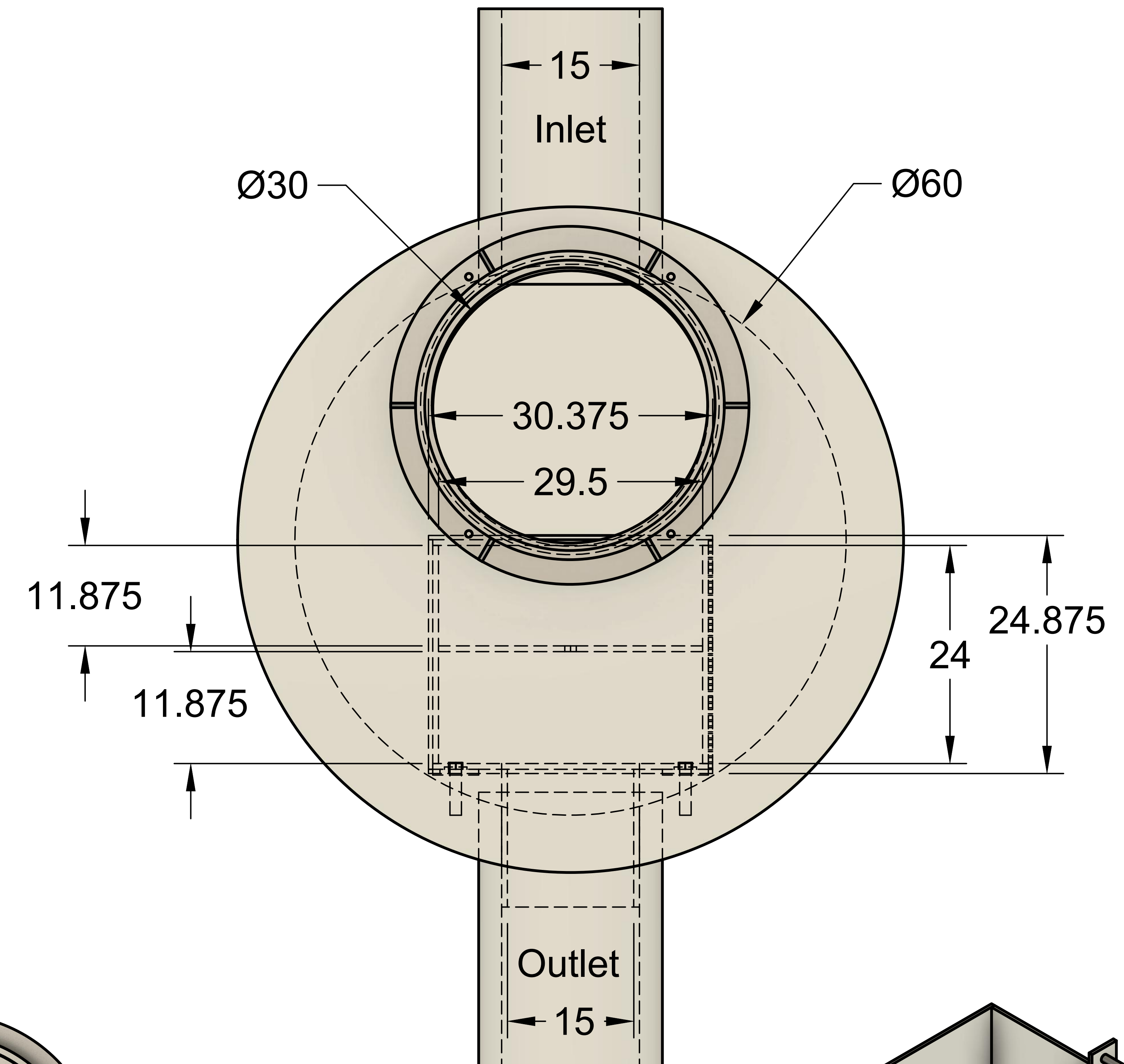


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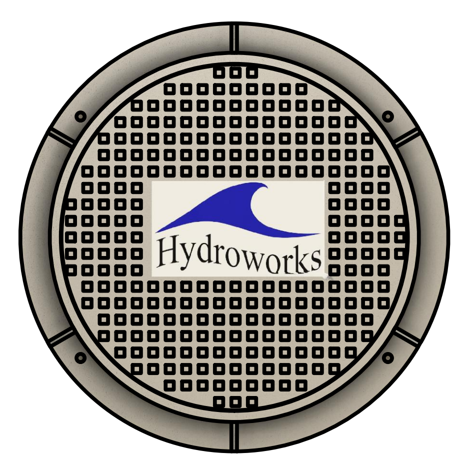


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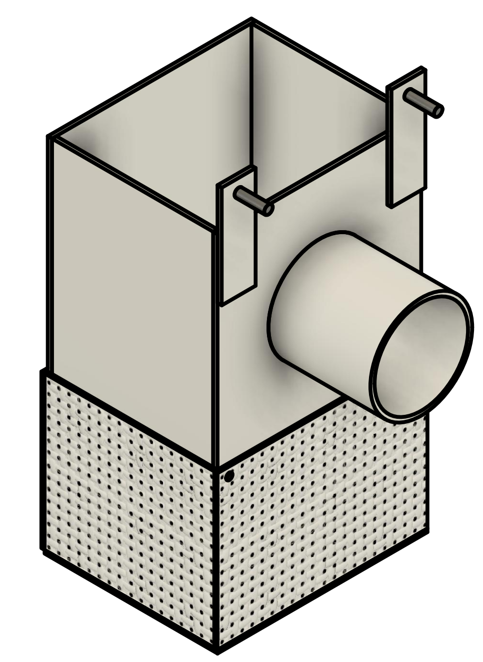

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Notes:
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2. Insert and structure height dimensions based on outlet pipe diameter (D).
3. Multiple inlet pipes possible
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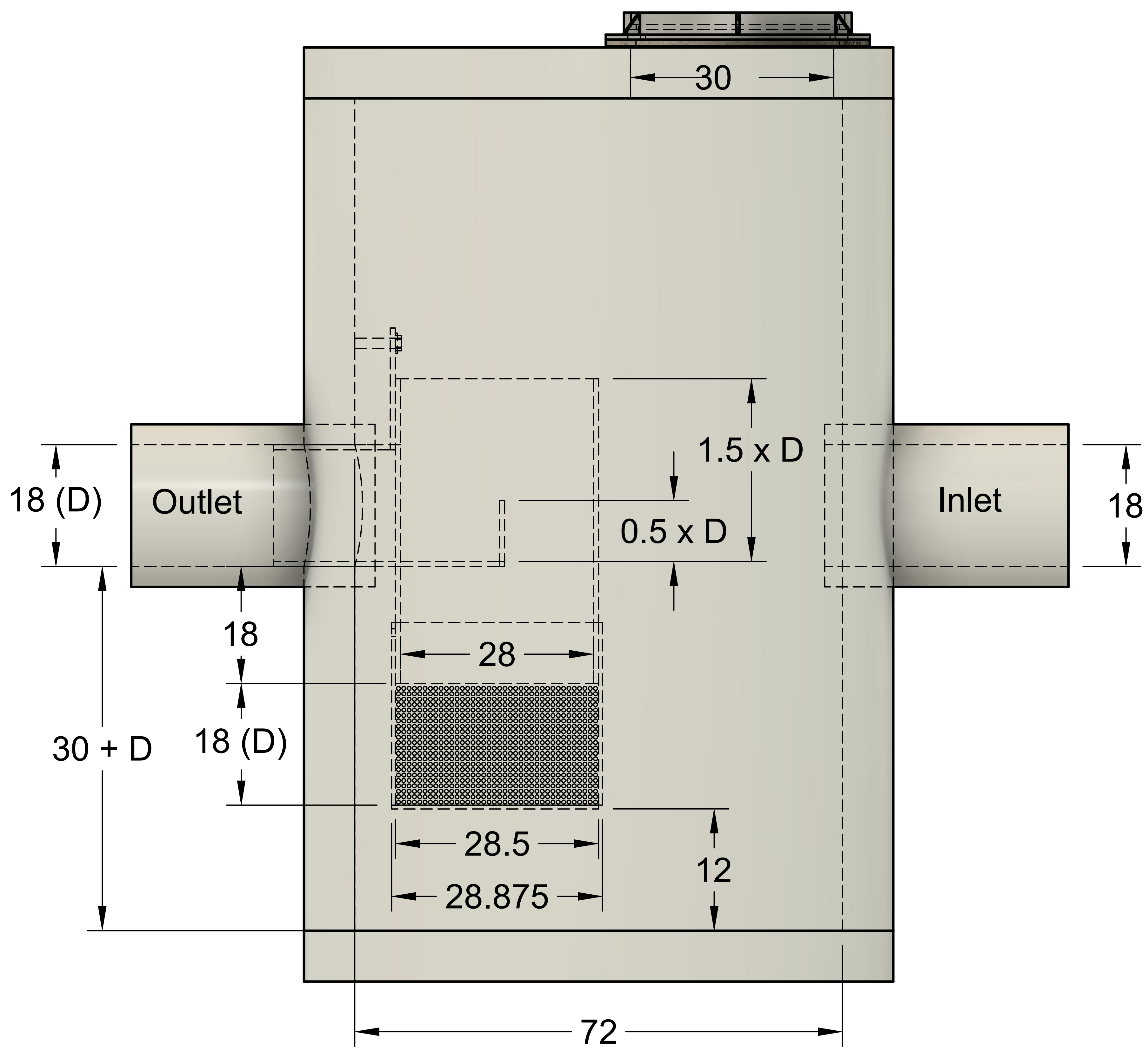
# HydroDome HDTR5-15

| | | |
|---|---|---|
| Project: Full Trash Capture - Standard Drawing | | |
| Location: | | |
| Date: 03/04/2024 | Scale: | Rev: 1 |

Hydroworks

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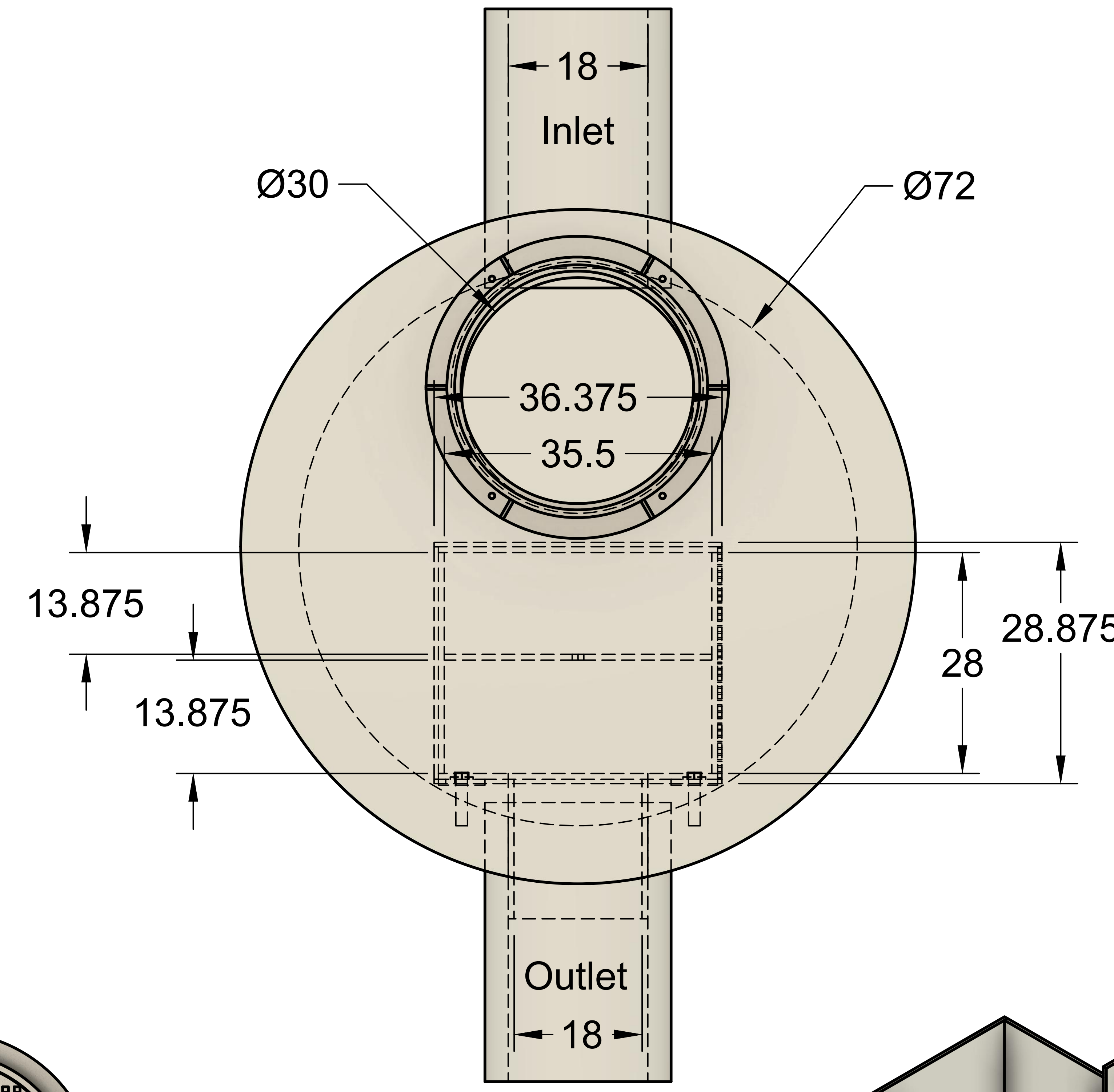


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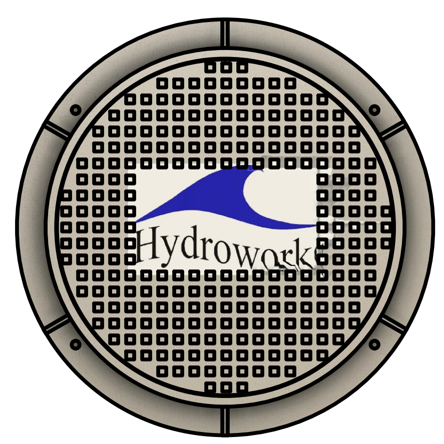


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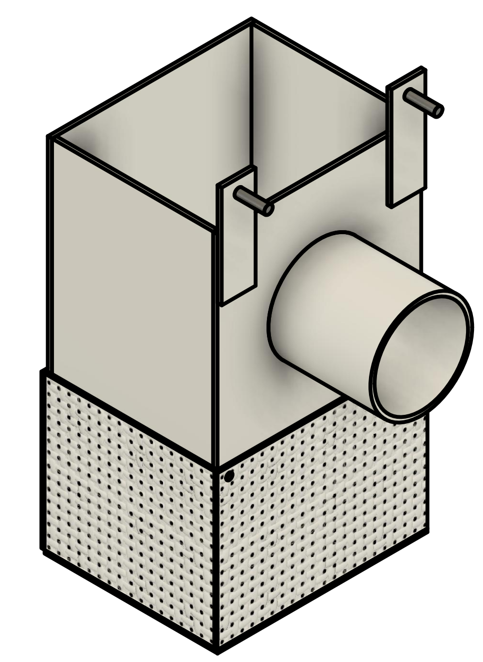

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Notes:
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2. Insert and structure height dimensions based on outlet pipe diameter (D).
3. Multiple inlet pipes possible
4. Drops through structure possible
5. Mounting tabs and anchor bolts not drawn to scale.
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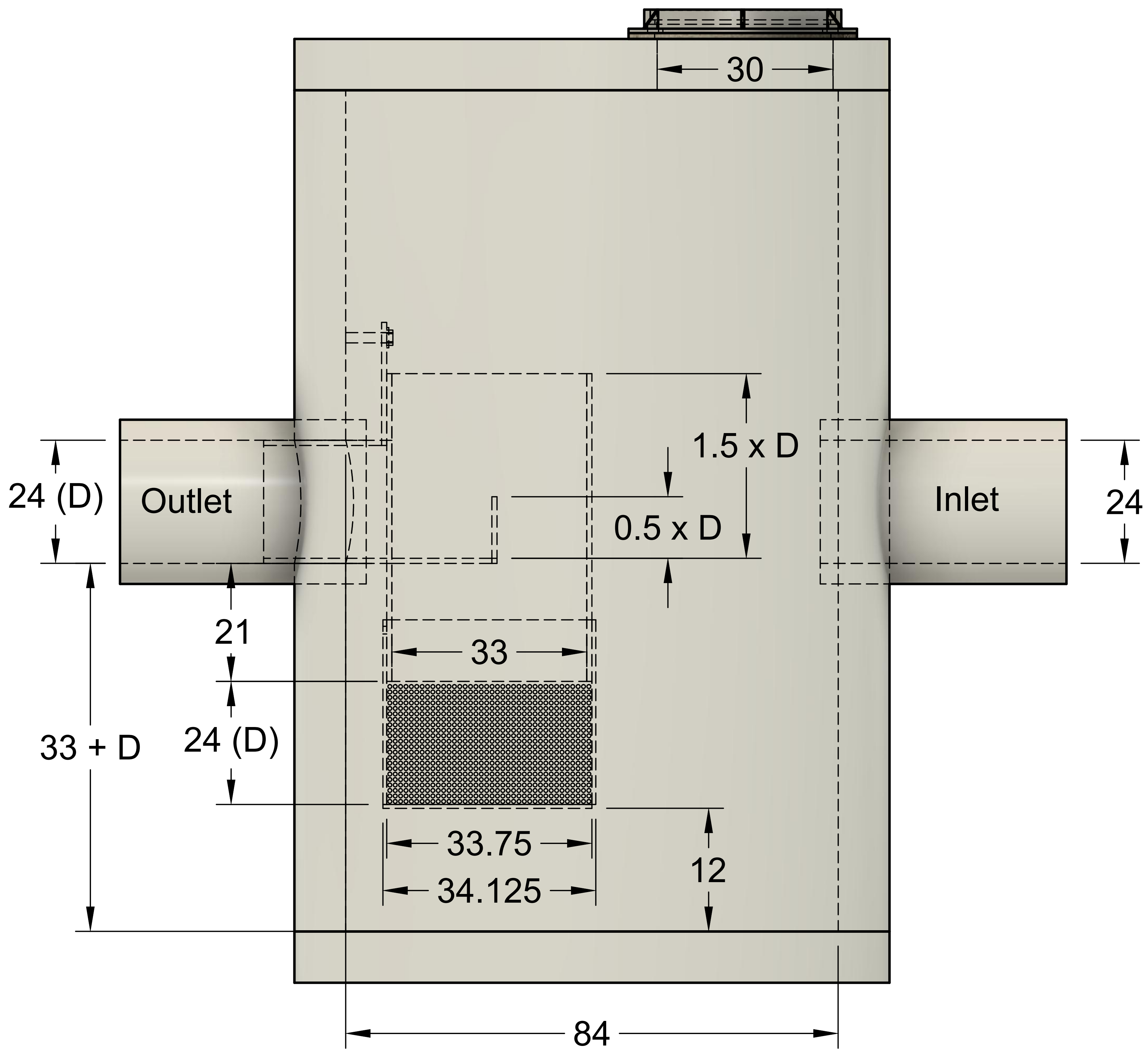
# HydroDome HDTR6-18

Project: Full Trash Capture - Standard Drawing

Location:

| Date: 03/04/2024 | Scale: | Rev: 1 |
|---|---|---|

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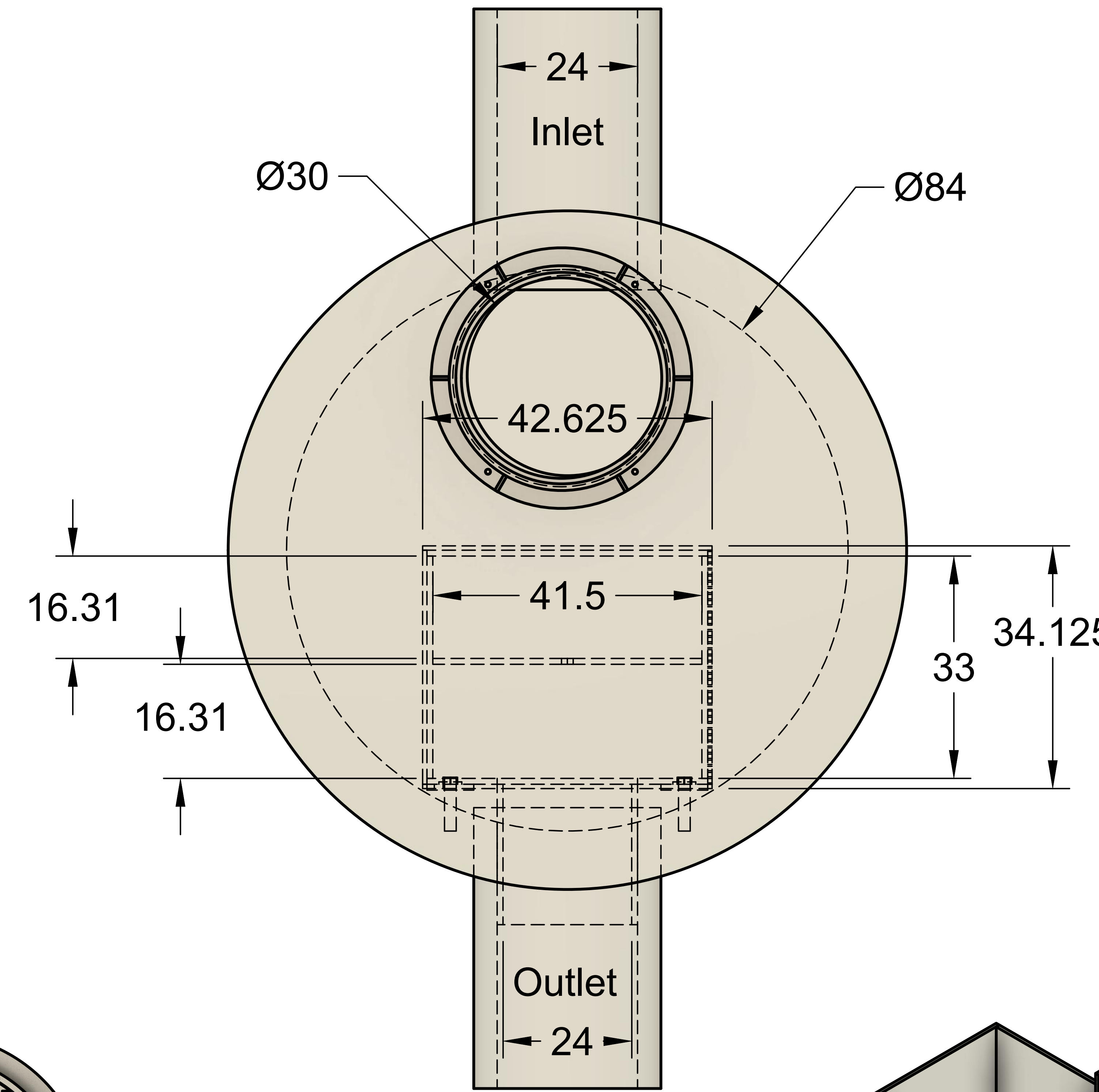


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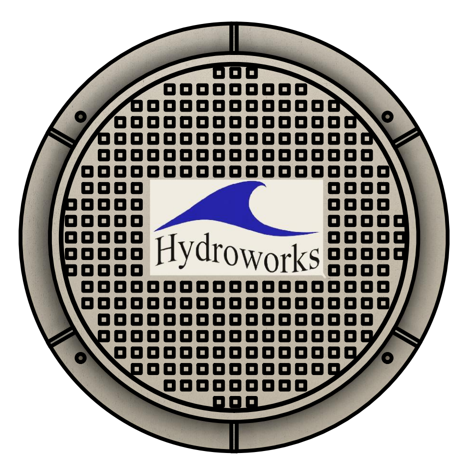


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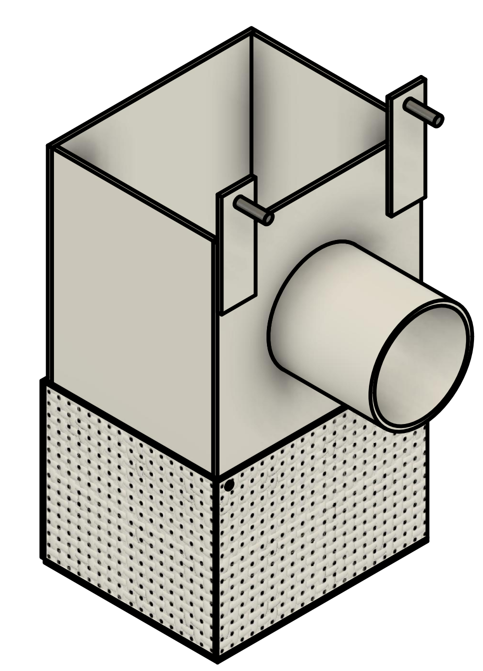

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Notes:
1. Generic layout shown. Contact Hydroworks for site-specific drawing.
2. Insert and structure height dimensions based on outlet pipe diameter (D).
3. Multiple inlet pipes possible
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5. Mounting tabs and anchor bolts not drawn to scale.
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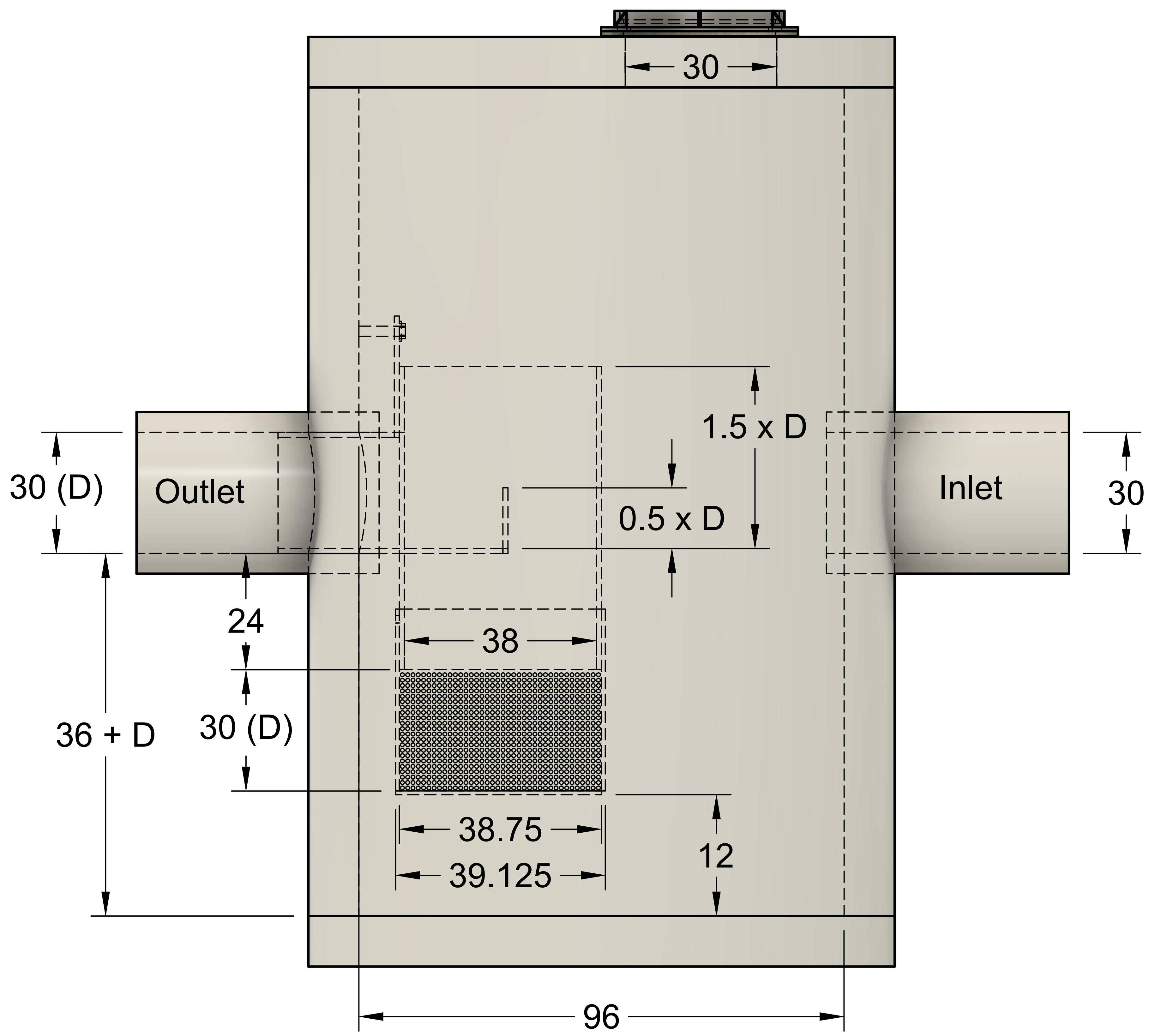
# HydroDome HDTR7-24

Project: Full Trash Capture - Standard Drawing

Location:

Date: 03/04/2024 | Scale: | Rev: 1

Hydroworks

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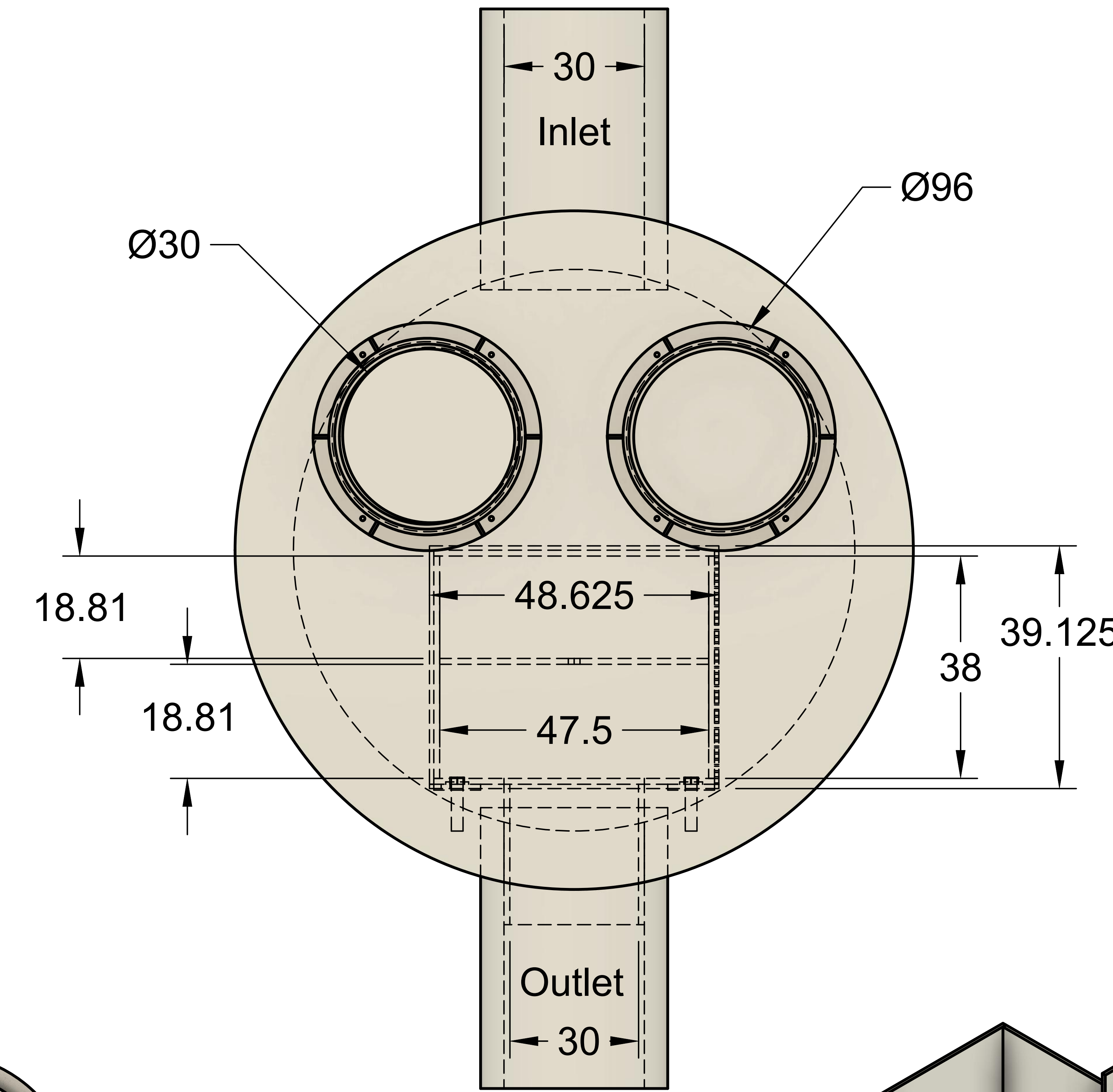


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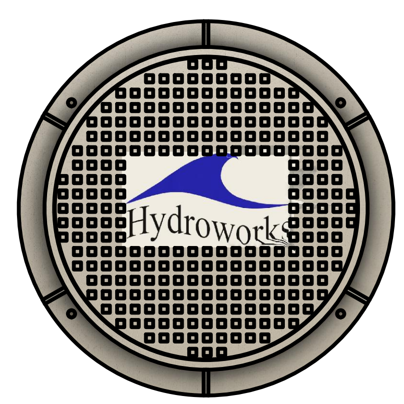
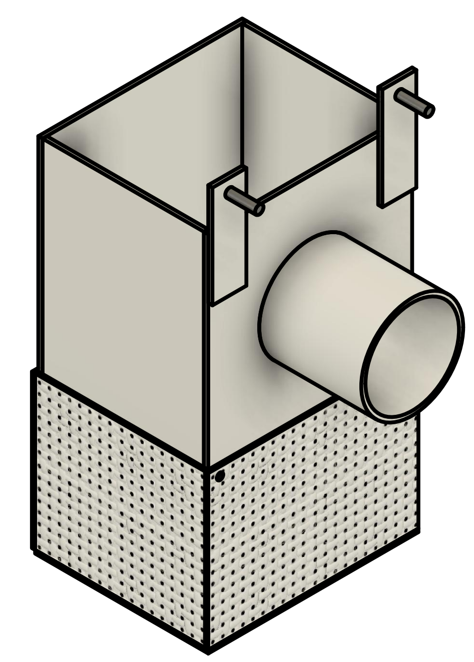



Hydroworks Frames and Covers (Included)



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Notes:
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2. Insert and structure height dimensions based on outlet pipe diameter (D).
3. Multiple inlet pipes possible
4. Drops through structure possible
5. Mounting tabs and anchor bolts not drawn to scale
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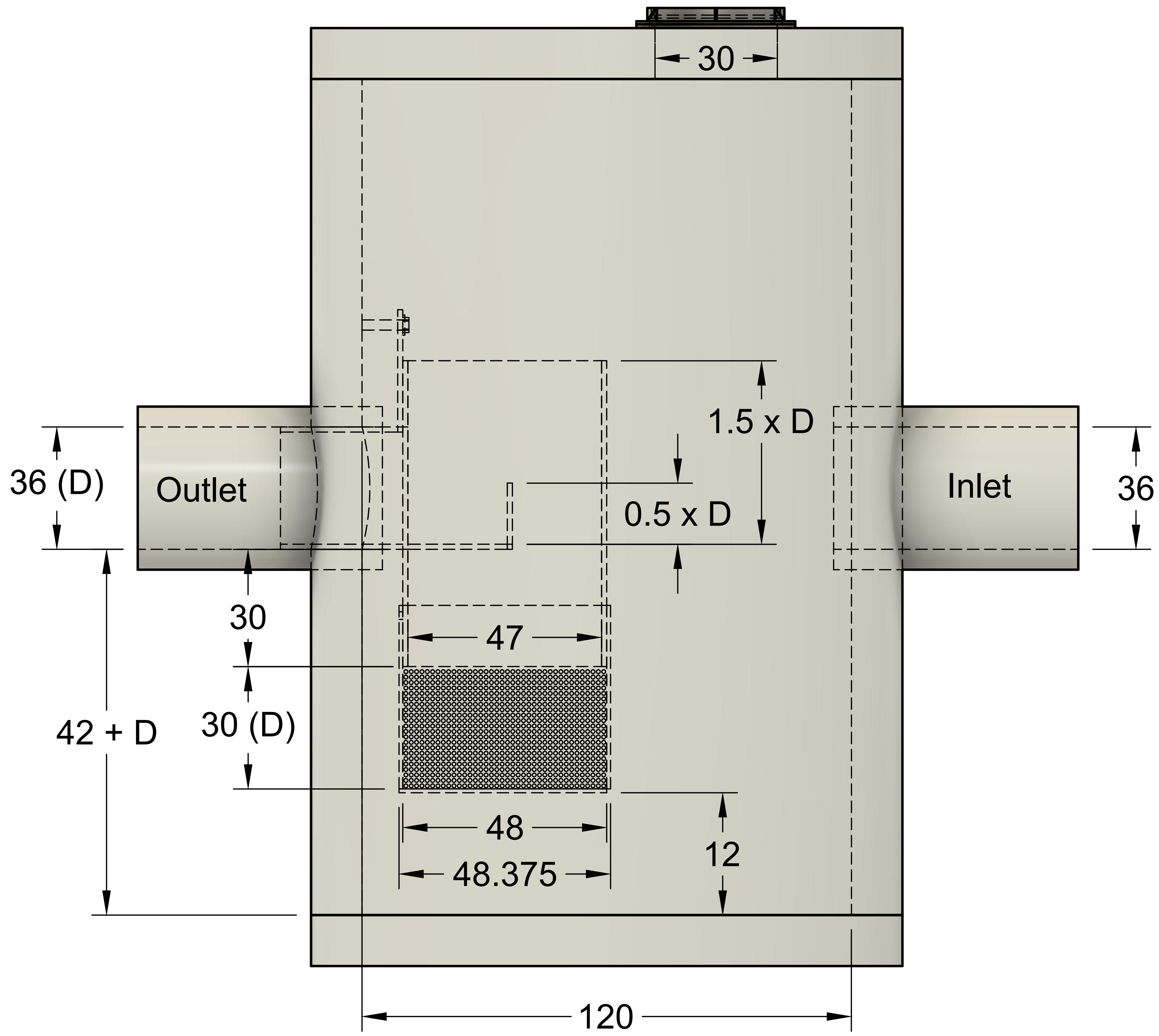
# HydroDome HDTR8-30

Project: Full Trash Capture - Standard Drawing

Location:

Date: 03/04/2024 | Scale: | Rev: 1



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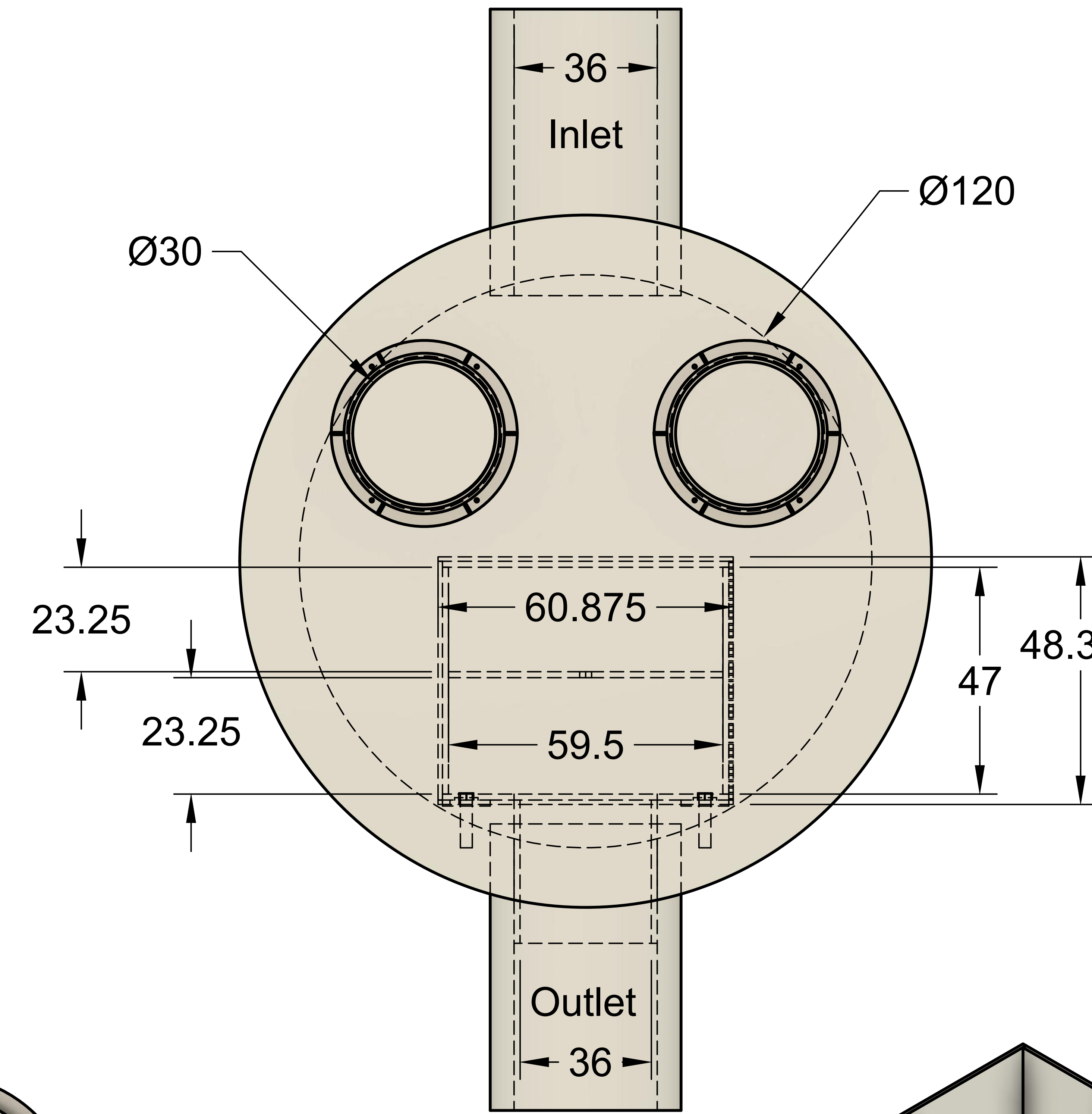
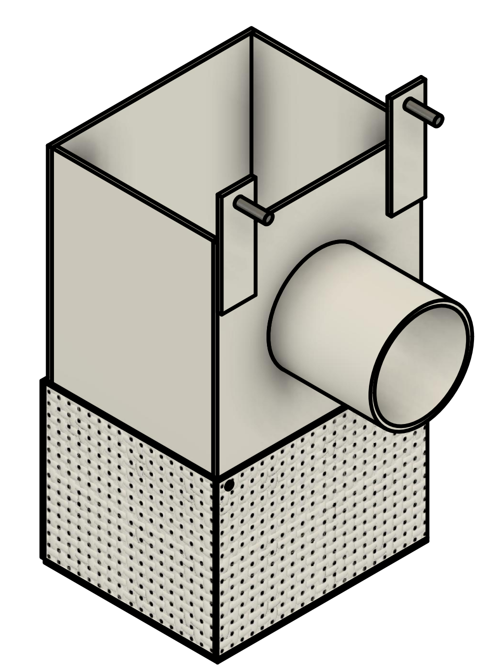


Plan

Hydroworks Frames and Covers (Included)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2. Insert and structure height dimensions based on outlet pipe diameter (D).
3. Multiple inlet pipes possible
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5. Mounting tabs and anchor bolts not drawn to scale
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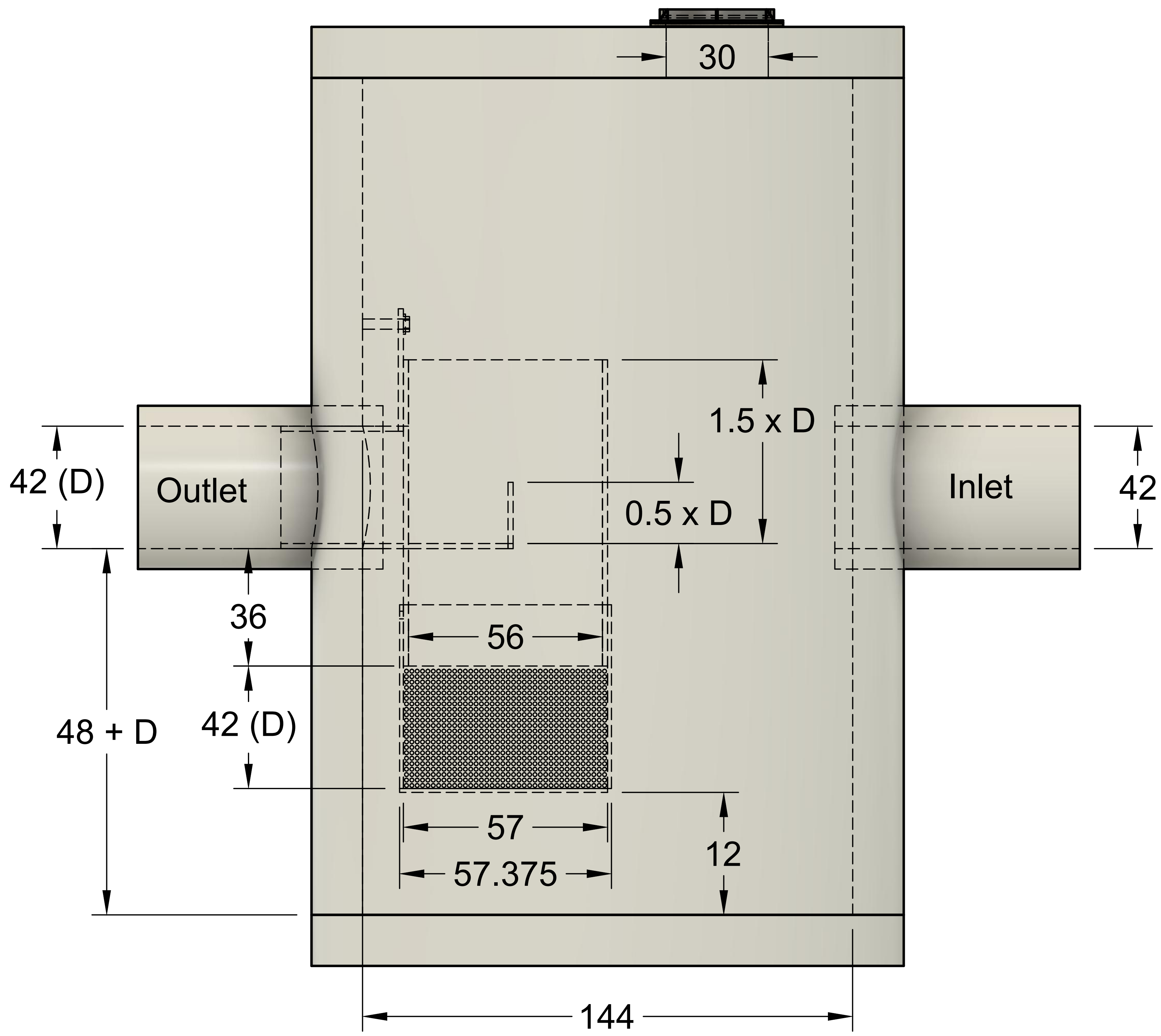
# HydroDome HDTR10-36

Project: Full Trash Capture - Standard Drawing

Location:

| Date: 03/04/2024 | Scale: | Rev: 1 |
|---|---|---|

Hydroworks

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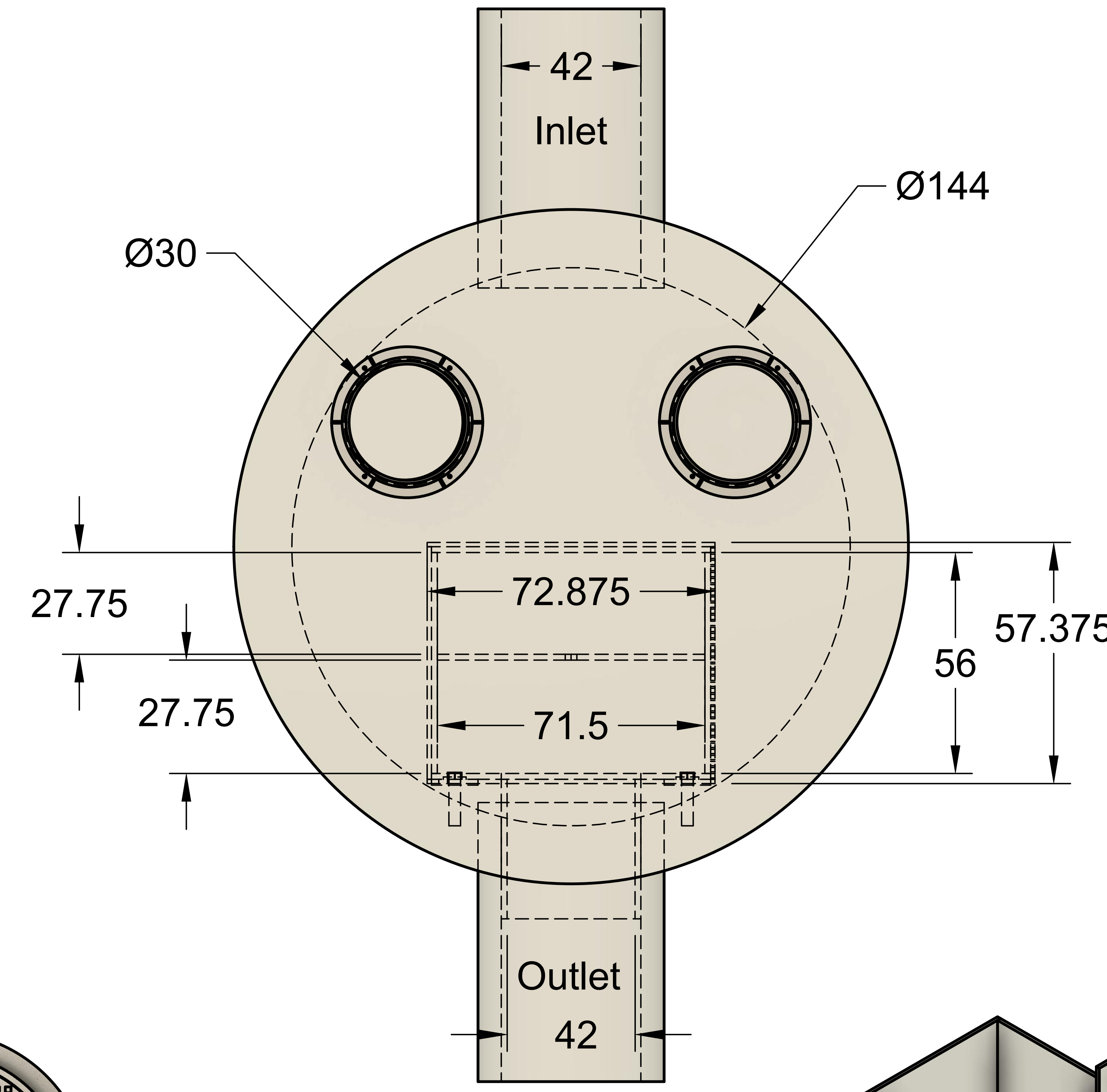
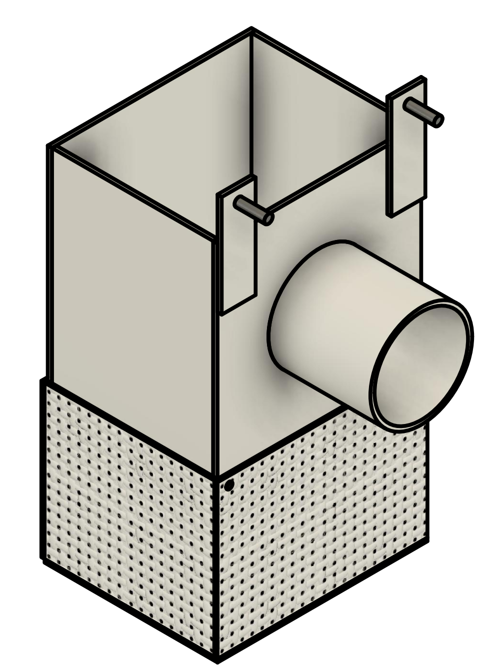



Plan


Hydroworks Frames and Covers (Included)



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Notes:
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2. Insert and structure height dimensions based on outlet pipe diameter (D).
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5. Mounting tabs and anchor bolts not drawn to scale
6. Sump depth not drawn to scale
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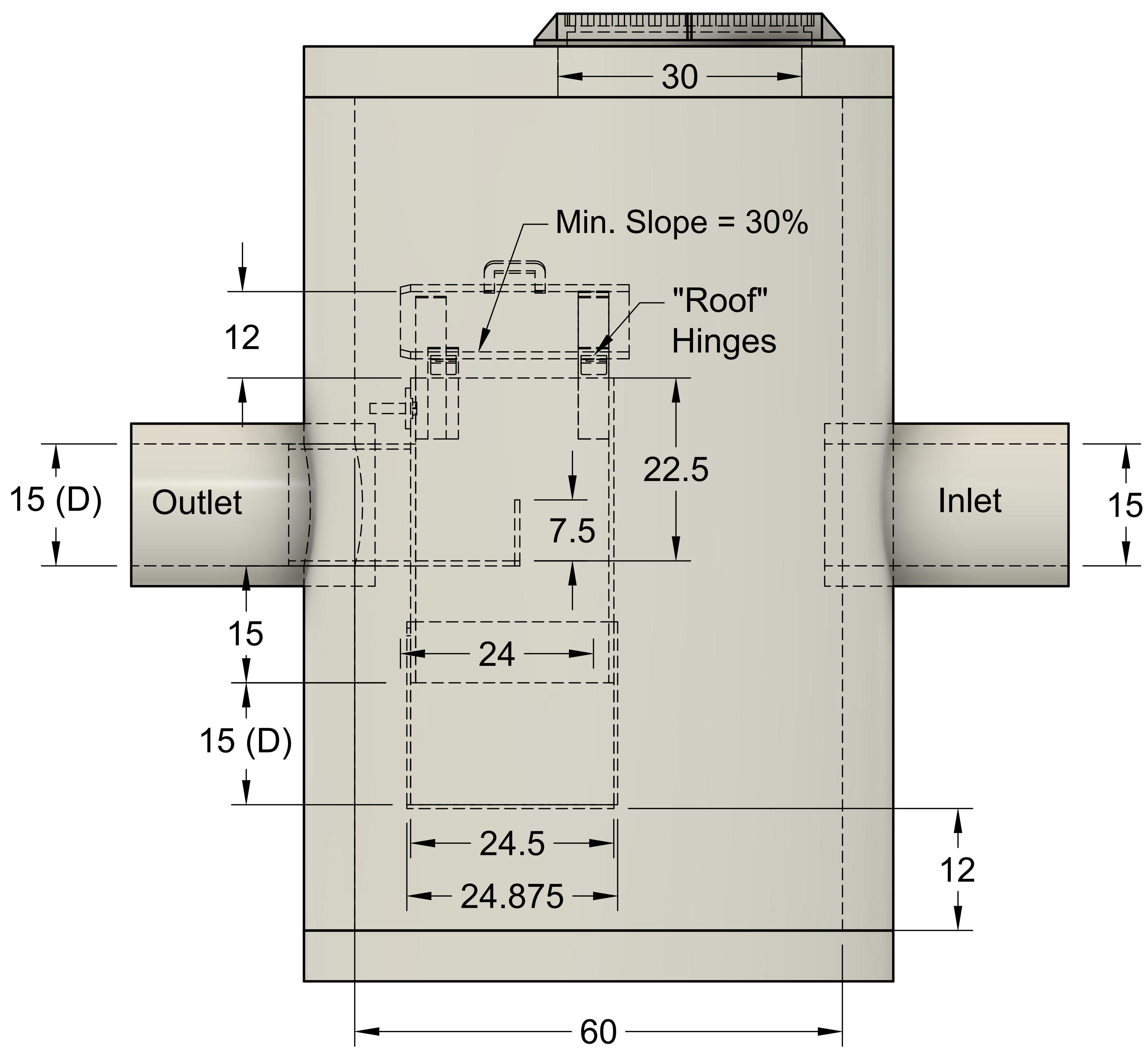
# HydroDome HDTR12-42

| | | |
|---|---|---|
| Project: Full Trash Capture - Standard Drawing | | |
| Location: | | |
| Date: 03/04/2024 | Scale: | Rev: 1 |

Hydroworks



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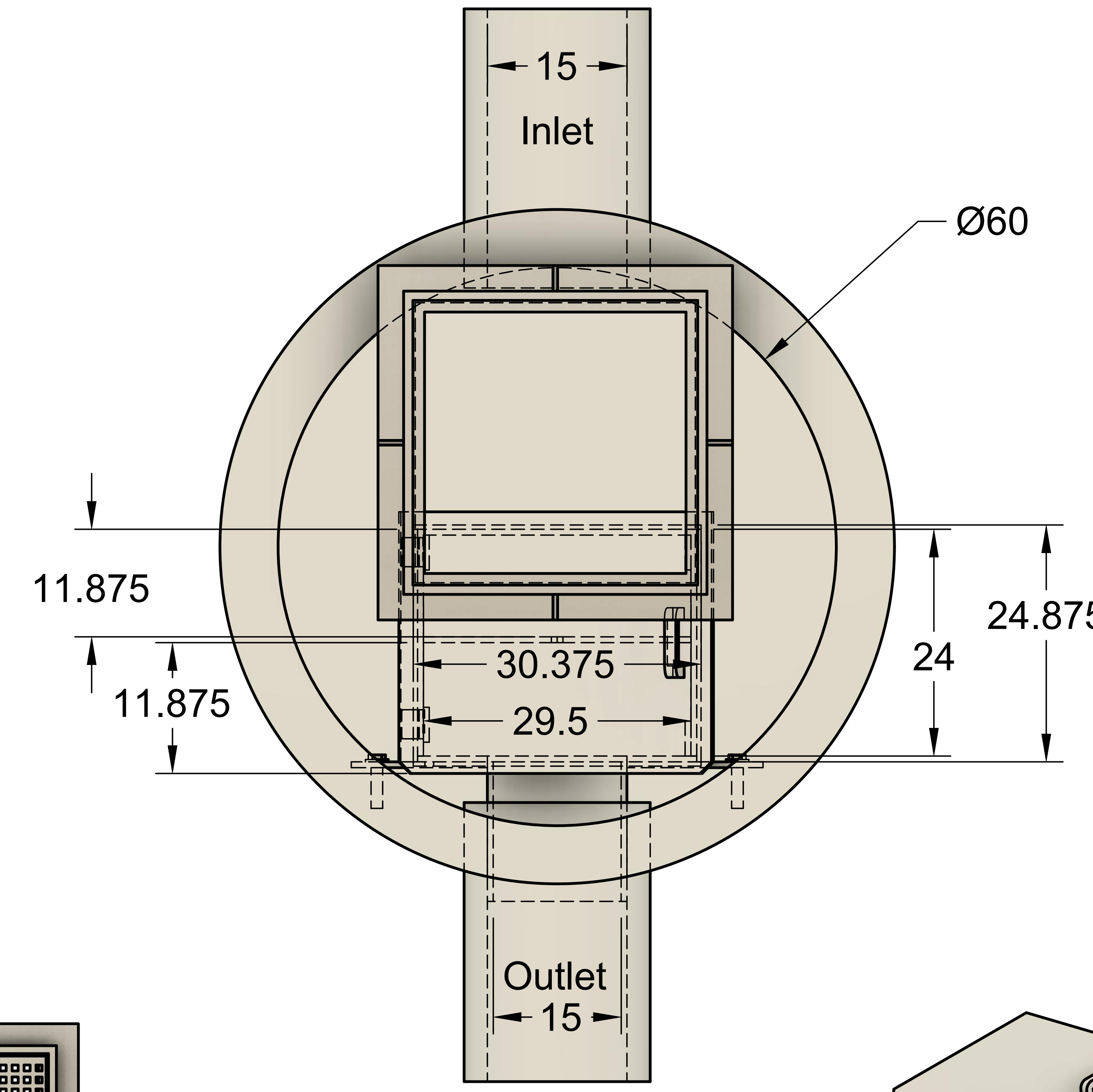

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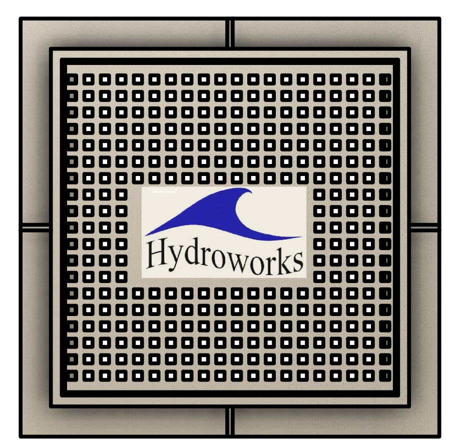

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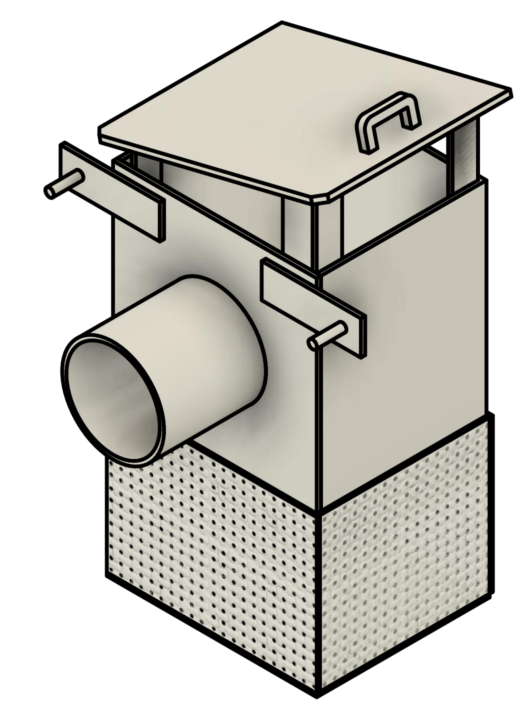
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# HydroDome HDTRi5-15

| | | |
|---|---|---|
| Project: Full Trash Capture - Standard Drawing | | |
| Location: | | |
| Date: 03/04/2024 | Scale: | Rev: 1 |

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# Appendix B
# Installation Procedures

# HYDRODOME TR INSTALLATION INSTRUCTIONS

**HYDRODOME TR CANNOT BE INSTALLED UNTIL THE MANHOLE IS SET AND THE OULTET PIPE IS IN PLACE. THE TOP CAP SHOULD NOT BE PLACED ON THE MANHOLE UNTIL AFTER HYDRODOME INSTALLATION IS COMPLETE. HYDRODOME TR SHOULD ONLY BE LIFTED BY PASSING TWO LIFTING STRAPS UNDER THE UNIT.**

1. 

Apply two generous beads of Pro-Seal34 caulk around the outlet stub of the HydroDome insert directly next to the weather stripping furthest from the back of the HydroDome.


2. 

Lower the HydroDome so that the outlet pipe stub is level with the **outlet** pipe of the manhole.

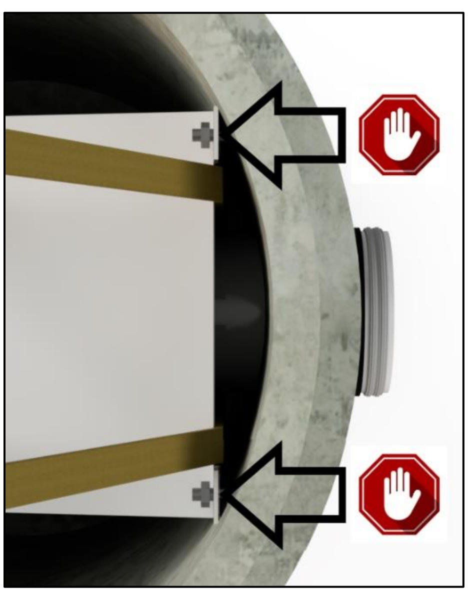
3.

Gently slide the HydroDome outlet stub into the manhole outlet as far as possible without forcing it, until the HydroDome insert is close to the wall.

4.

Drill 0.5” holes, no more than 3” into the manhole wall, through the holes in the attachment tabs. Tabs may be on the top and/or sides of the HydroDome. Only two holes for anchor bolts are necessary. Avoid drilling into precast joints.

5.



Use the supplied stainless steel concrete anchor bolts, washers and nuts to fasten the HydroDome flanges to the structure wall. STOP TIGHTENING AS SOON AS BOLT MEETS PLASTIC. DO NOT OVERTIGHTEN.

# Appendix C
# Operation & Maintenance

# Hydroworks® HydroDome® TR

# Operations & Maintenance Manual

Version 1.1

Please call Hydroworks at 888-290-7900 or email us at support@hydroworks.com if you have any questions regarding the Inspection Checklist. Please email a copy of the completed checklist to Hydroworks at support@hydroworks.com for our records.

## Introduction

HydroDome TR (Figure 1) is the trash variant of the HydroDome hydrodynamic separator, optimized to be a full trash capture device. It can also be used for water quality and quantity flow control if desired.

Full trash capture devices are designed to remove trash from stormwater. Trash is typically defined as material greater than 5mm in diameter. Hydrodynamic separators remove solids, debris and lighter than water (oil, trash, floating debris) pollutants from stormwater. Trash capture devices, hydrodynamic separators, and other water quality measures are mandated by regulatory agencies (Town/City, State, Federal Government) to protect storm water quality from pollution generated by urban development.

Screens that remove trash from stormwater runoff may eventually clog with organic matter or debris. In addition, as stormwater treatment structures fill up with pollutants, they become less effective at removing additional pollution. Therefore, it is important that stormwater treatment structures be maintained on a regular basis to ensure that they are operating at optimum performance. The HydroDome TR is no different in this regard and this manual has been assembled to provide the owner/operator with the necessary information to inspect and maintain their HydroDome TR.

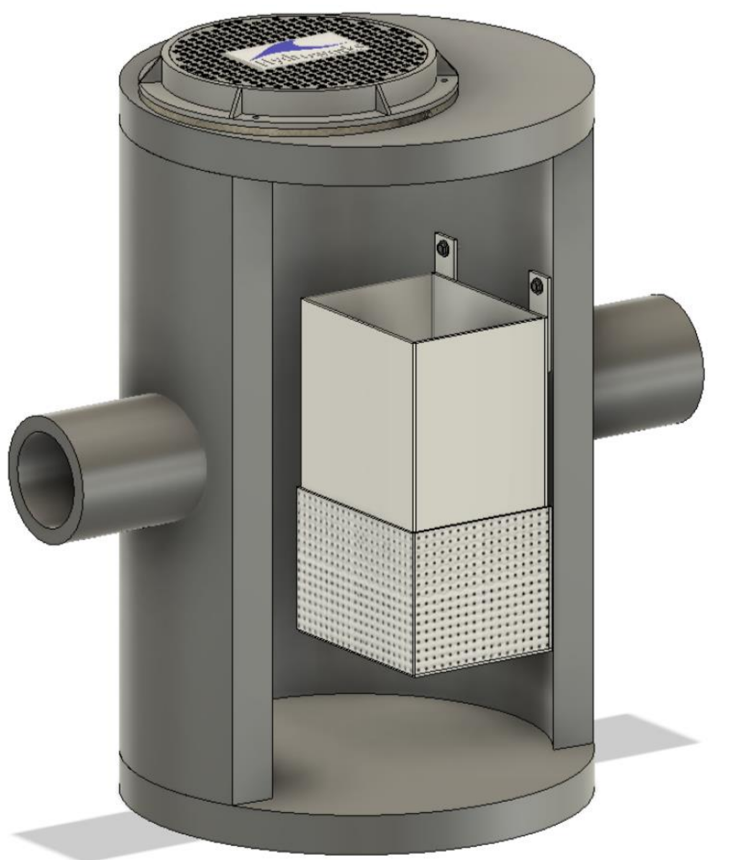


**Figure 1. Hydroworks HydroDome TR**

Hydroworks

The HydroDome TR consists of a plastic insert installed in a precast concrete structure. An integrated outlet stub protruding from the insert slides into the outlet pipe, and the insert is secured to the manhole wall with stainless steel anchor bolts (Figure 2). The outlet stub comes pre-gasketed, and the connection is caulked during installation to ensure watertightness.

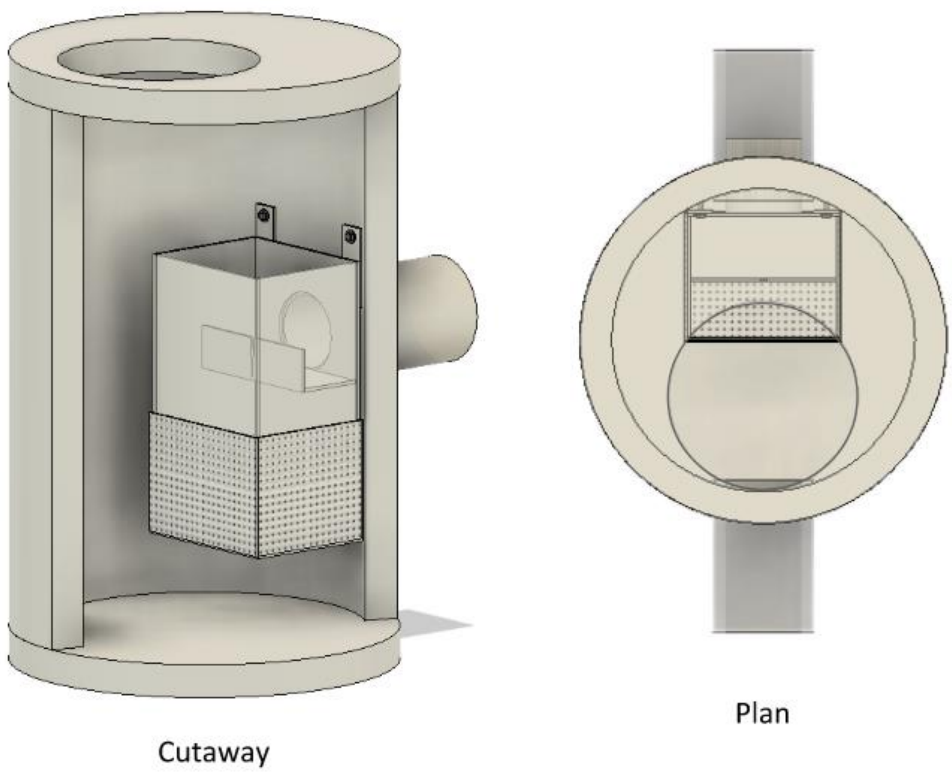



**Figure 2 HydroDome TR Round Manhole Installation**

Water enters the device through one or more inlet pipes and/or an inlet grate. Water then passes into the insert through a box-shaped perforated plastic screen. Due to the depth of the perforated openings well below the standing water level, most oil, trash, and floatable debris is trapped between the insert and the precast structure wall. Any trash 5mm or greater that does become submerged is prevented from passing downstream by the perforated plastic screen, which has a nominal opening aperture of 4.75 mm. Settleable trash and sediment is captured and retained in the structure sump.

The internals of the HydroDome TR consist of a v-notch weir (or hydraulically equivalent weir wall with orifice opening) enclosed by solid plastic walls (Figure 3). The insert is equipped with a sloped lid for installations with an inlet grate to deflect floatables into the sump (Figure 4). Hinges attached to the lid allow for access inside the insert. During storm events, the water level inside the structure rises relatively gradually, depending on the flow rate, until it reaches the top of the internal weir. This reduces flow velocities to enhance settling and provides additional vertical separation between floatable trash and the submerged inlet screens. Once water reaches the top of the weir, flow is discharged over the weir to limit the hydraulic impact upstream.

During peak flows, water may overtop the insert walls, thereby bypassing the inlet screens. After a storm event, water flows through the v-notch or orifice opening to lower the water level back down to the outlet invert elevation.

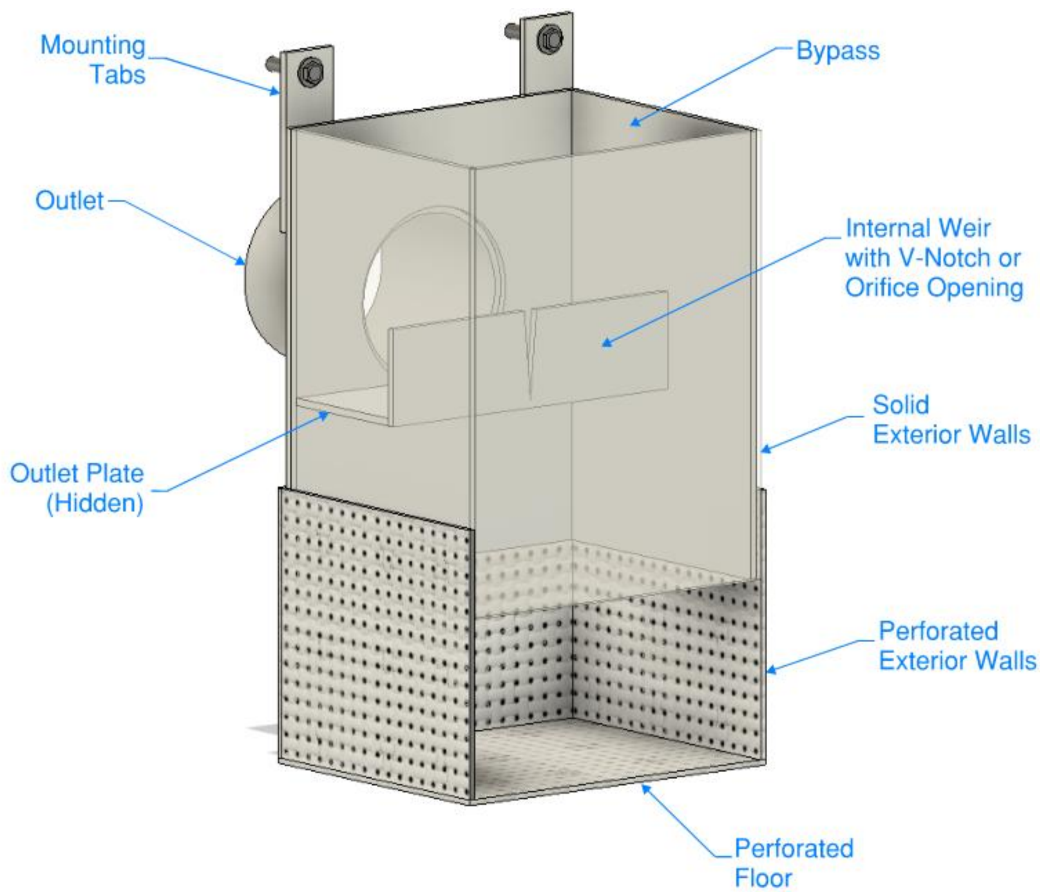



**Figure 3 HydroDome TR Components (transparent front wall to show internals)**

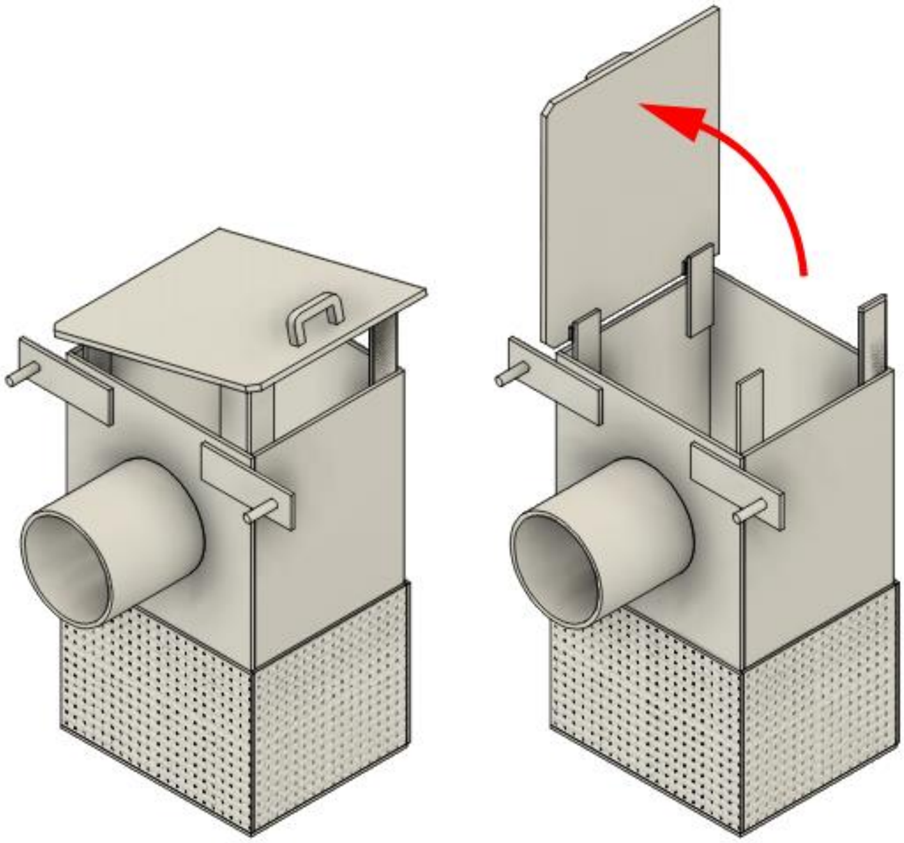


**Figure 4. Hinged Lid for Grated Inlet**

## Inspection

### Procedure

Floatables

A visual inspection can be conducted for floatables by removing the cover/grate and looking down into the structure. Entry into the structure is not required.

TSS/Sediment

Inspection for TSS build-up can be conducted using a Sludge Judge®, Core Pro®, AccuSludge® or equivalent sampling device that allows the measurement of the depth of TSS/sediment in the unit. These devices typically have a ball valve at the bottom of the tube that allows water and TSS to flow into the tube when lowering the tube into the unit. Once the unit touches the bottom of the device, it is quickly pulled upward such that the water and TSS in the tube forces the ball valve closed allowing the user to see a full core of water/TSS in the unit. Several readings (2 or 3) should be made at different locations of the structure to ensure that an accurate TSS depth measurement is recorded.

Operation

The standing water level inside the structure during periods without rain should be near the outlet invert. If the water level remains above the outlet invert 24 hours after a storm event, this may indicate that the inlet screens are occluded and require cleaning.

The HydroDome TR is designed to convey the peak treatment flow without bypass when 50% or more of the inlet screen is occluded. However, as the percentage of screen clogging increases, the upstream hydraulic impact will increase, particularly during high flows. Depending on degree of clogging and flow rate, the influent flow will eventually bypass the inlet screens by overtopping the insert walls. Any evidence of unacceptable upstream hydraulic impact or internal bypass (accumulation of trash or oil inside the insert) would indicate that maintenance is required.

## Frequency

Construction Period

The HydroDome TR should be inspected every four weeks and after every large storm (over 0.5” [12.5 mm] of rain) during the construction period.

Post-Construction Period

Typically, HydroDome TR will have a maintenance frequency of twice per year. Each site is different, however, and sites with upstream construction activities, exposed materials on-site, a high potential for spills, or high average daily traffic can expect to have more frequent maintenance. Therefore, initial inspections are important to determine the proper maintenance frequency for the site in question.

The HydroDome TR should be inspected twice during the first year of operation for normal stabilized sites (grassed or paved areas). If the unit is subject to oil spills or runoff from unstabilized areas (storage piles, exposed soils), the HydroDome TR should be inspected more frequently (4 times per year). The initial annual inspection will indicate the required frequency of inspection and maintenance. All inspection reports should be kept and used as a guide to monitor changes in site conditions, unit performance, and maintenance requirements.

### Reporting

Reports should be prepared as part of each inspection and include the following information:

1. Date of inspection
2. GPS coordinates of Hydroworks unit
3. Time since last rainfall
4. Date of last inspection
5. Installation deficiencies (missing parts, incorrect installation of parts)
6. Structural deficiencies (concrete cracks, broken parts)
7. Operational deficiencies (leaks, elevated water level)
8. Presence of oil sheen or depth of oil layer
9. Estimate of depth/volume of floatables (trash, leaves) captured
10. Quantitative or qualitative description of degree of inlet screen clogging if visible or during cleanout
11. Sediment depth measured
12. Recommendations for any repairs and/or maintenance for the unit

A sample inspection checklist is provided at the end of this manual.

## Maintenance

### Procedure

The local municipality should be consulted for the allowable disposal options for both water and sediments prior to any maintenance operation.

Floatable and settleable trash/sediment are typically removed from the HydroDome TR at the same time. Floatables can be netted with a skimmer and pole if permitted by local regulation. Sediment, settleable trash, and water should be removed together using a vactor truck. The inlet screens should be hosed down to flush any trapped debris into the sump while continuing to vacuum the sump. The plastic insert and inlet screens are robust, however, care should be taken not to damage the components with excessively high powered washing. The vacuumed water is then separated from the sediment on the truck or at the disposal facility.

The open area around the HydroDome TR insert provides clear access to the bottom of the structure (Figure 5). This is the area where a vacuum hose should be lowered to clean out the unit.

In instances where a vactor truck is not available, other maintenance methods (i.e. clamshell bucket) can be used, but they will be less effective. If a clamshell bucket is used, the water must be decanted prior to cleaning since the sediment is under water and typically fine in nature.

Maintenance of a HydroDome TR unit will typically take 1 to 2 hours using a vactor truck, depending on size of unit. Cleaning may take longer for other cleaning methods (i.e. clamshell bucket).

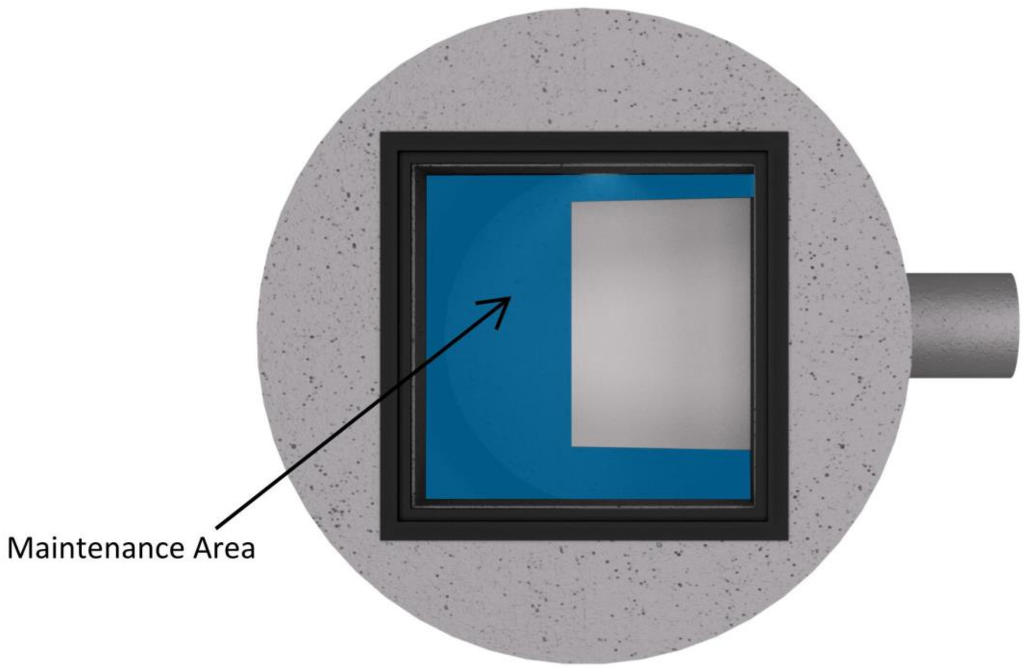



**Figure 5. HydroDome TR Maintenance Access**

## Frequency

Construction Period

Trash capture devices and hydrodynamic separators can fill with construction sediment quickly during the construction period. The HydroDome TR must be maintained during the construction period when the depth of TSS/sediment reaches the indicated maintenance depth listed in Table 1. It must also be maintained during the construction period if there is an appreciable depth of oil in the unit (more than a sheen) or if the standing water level is above the outlet invert 24 hours after a storm event.

The HydroDome TR should be fully cleaned out at the end of the construction period, prior to operation for the post-construction period.

Post-Construction Period

The HydroDome TR is designed to capture a significant volume of floatable trash. Stored trash may coalesce into a layer that extends well below the water surface without impairing the functioning of the device. Recommended maintenance floatables depths are listed in Table 1. However, since estimating the depth of trash from the surface is challenging, it is recommended to use surface coverage of trash as a maintenance trigger. If floatable trash covers more than 90% of the water surface inside the structure, the water surface should be disturbed with a pole to assess the depth of the trash layer. If floating trash is easily displaced to reveal open water, the trash layer represents only minor surface coverage and maintenance is not required. Alternatively, if the bottom of the trash layer is not visible after displacing surface trash or if a significant layer depth is observed, the unit should be maintained.

The unit should also be maintained if there is an appreciable depth of oil in the unit (more than a sheen) or if the standing water level in the structure is higher than the outlet invert 24 hours after a storm event.

Table 1 provides the standard sediment maintenance depths for the HydroDome TR. Maintenance for sediment accumulation is needed if captured sediment fills the volume of the sump below the perforated inlet screens.

Some HydroDome TR units are designed with increased sediment, floatables/trash, and/or oil storage based on specifications or site-specific criteria. Please contact Hydroworks at 888-290-7900 to inquire whether your HydroDome TR was designed with extra storage capacity to extend the frequency of maintenance.

**Table 1. Standard Maintenance Depths for HydroDome TR Models**

| Model | Diameter (ft /mm) | Maintenance Floatables Depth[1,2] (in/mm) | Maintenance Sediment Depth[1,2] (in/mm) |
|---|---|---|---|
| HDTR3 | 3 (900) | 9 (225) | 12 (300) |
| HDTR4 | 4 (1200) | 12 (300) | 12 (300) |
| HDTR5 | 5 (1500) | 15 (375) | 12 (300) |
| HDTR6 | 6 (1800) | 18 (450) | 12 (300) |
| HDTR7 | 7 (2100) | 21 (525) | 12 (300) |
| HDTR8 | 8 (2400) | 24 (600) | 12 (300) |
| HDTR10 | 10 (3000) | 30 (750) | 12 (300) |
| HDTR12 | 12 (3600) | 36 (900) | 12 (300) |

1. Maintenance depths are recommended values and do not reflect maximum capacities
2. Custom inserts may have greater or lesser maintenance depths

# HYDRODOME TR INSPECTION SHEET

**Date** ______________________________
**Date of Last Inspection** ______________________________

**Site** ______________________________
**City, State** ______________________________
**Owner** ______________________________

**GPS Coordinates** ______________________________

**Date of last rainfall** ______________________________

| **Site Characteristics** | **Yes** | **No** |
|---|---|---|
| Soil erosion evident (upstream) | ☐ | ☐ |
| Exposed material storage on site | ☐ | ☐ |
| Large exposure to leaf litter (lots of trees) | ☐ | ☐ |
| High traffic (vehicle) area | ☐ | ☐ |
| High trash (people) area | ☐ | ☐ |

| **HydroDome TR** | **Yes** | **No** |
|---|---|---|
| Obstructions in the inlet pipe | ☐ * | ☐ |
| Damage to HydroDome TR (cracked, broken, loose pieces) | ☐ ** | ☐ |
| Improperly installed outlet pipe | ☐ *** | ☐ |
| Floating debris (trash) <u>inside</u> insert | ☐ * | ☐ |
| Significant layer of floating debris (trash, leaves) <u>outside</u> insert | ☐ * | ☐ |
| Large debris visible in the structure | ☐ * | ☐ |
| Defined layer of oil inside manhole | ☐ * | ☐ |
| Concrete cracks/deficiencies | ☐ *** | ☐ |
| Exposed rebar | ☐ ** | ☐ |
| Raised water level (standing water above outlet invert) | ☐ * | ☐ |
| Water seepage (standing water below outlet invert) | ☐ *** | ☐ |

* Maintenance required
** Repairs required
*** Further investigation required

**Routine Measurements**

Floating debris depth (in) ____________

Floating debris surface coverage (%) ____________

Sludge depth (in) ____________

Note: Inspections should not be made within 24 hours of a storm to allow water to drain from the structure in order to identify a raised standing water level or seepage.

Hydroworks

**Other Comments:**

Hydroworks

Hydroworks® HydroDome® TR

One Year Limited Warranty

Hydroworks, LLC warrants, to the purchaser and subsequent owner(s) during the warranty period subject to the terms and conditions hereof, the Hydroworks HydroDome TR to be free from defects in material and workmanship under normal use and service, when properly installed, used, inspected and maintained in accordance with Hydroworks written instructions, for the period of the warranty. The standard warranty period is 1 year.

The warranty period begins once the separator has been manufactured and is available for delivery. Any components determined to be defective, either by failure or by inspection, in material and workmanship will be repaired, replaced or remanufactured at Hydroworks' option provided, however, that by doing so Hydroworks, LLC will not be obligated to replace an entire insert or concrete section, or the complete unit. This warranty does not cover shipping charges, damages, labor, any costs incurred to obtain access to the unit, any costs to repair/replace any surface treatment/cover after repair/replacement, or other charges that may occur due to product failure, repair or replacement.

This warranty does not apply to any material that has been disassembled or modified without prior approval of Hydroworks, LLC, that has been subjected to misuse, misapplication, neglect, alteration, accident or act of God, or that has not been installed, inspected, operated or maintained in accordance with Hydroworks, LLC instructions and is in lieu of all other warranties expressed or implied. Hydroworks, LLC does not authorize any representative or other person to expand or otherwise modify this limited warranty.

The owner shall provide Hydroworks, LLC with written notice of any alleged defect in material or workmanship including a detailed description of the alleged defect upon discovery of the defect. Hydroworks, LLC should be contacted at 136 Central Ave., Clark, NJ 07066 or any other address as supplied by Hydroworks, LLC. (888-290-7900).

This limited warranty is exclusive. There are no other warranties, express or implied, or merchantability or fitness for a particular purpose and none shall be created whether under the uniform commercial code, custom or usage in the industry or the course of dealings between the parties. Hydroworks, LLC will replace any goods that are defective under this warranty as the sole and exclusive remedy for breach of this warranty.

Subject to the foregoing, all conditions, warranties, terms, undertakings or liabilities (including liability as to negligence), expressed or implied, and howsoever arising, as to the condition, suitability, fitness, safety, or title to the Hydroworks HydroDome TR are hereby negated and excluded and Hydroworks, LLC gives and makes no such representation, warranty or undertaking except as expressly set forth herein. Under no circumstances shall Hydroworks, LLC be liable to the Purchaser or to any third party for product liability claims; claims arising from the design, shipment, or installation of the HydroDome TR, or the cost of other goods or services related to the purchase and installation of the HydroDome TR. For this Limited Warranty to apply, the HydroDome TR must be installed in accordance with all site conditions required by state and local codes; all other applicable laws; and Hydroworks' written installation instructions.

Hydroworks, LLC expressly disclaims liability for special, consequential or incidental damages (even if it has been advised of the possibility of the same) or breach of expressed or implied warranty. Hydroworks, LLC shall not be liable for penalties or liquidated damages, including loss of production and profits; labor and materials; overhead costs; or other loss or expense incurred by the purchaser or any third party. Specifically excluded from limited warranty coverage are damages to the HydroDome TR arising from ordinary wear and tear; alteration, accident, misuse, abuse or neglect; improper maintenance, failure of the product due to improper installation of the concrete sections or improper sizing; or any other event not caused by Hydroworks, LLC. This limited warranty represents Hydroworks' sole liability to the purchaser for claims related to the HydroDome TR, whether the claim is based upon contract, tort, or other legal basis.