Contents

Index of Figures

Index of Tables

1.1 Stormwater Management Overview

Land use throughout the country continues to change as more and more acres of natural land are being developed and replaced with commercial buildings, parking lots, driveways, houses & other impervious surfaces. These impervious surfaces modify the natural drainage patterns, resulting in increased volumes of surface runoff.

Stormwater management is essential to compensate for the impacts of surface runoff. These impacts include decreased groundwater recharge, overloaded municipal stormwater systems, flooding, and other pollution concerns. The focus of stormwater management is to use innovative techniques to remedy these adverse conditions while adhering to environmental regulations.

Typically, the stormwater management method used is a retention or detention system which provides temporary stormwater storage for the surface runoff so it can be released at a controlled rate. Stormwater retention/detention systems may be designed as above ground storage ponds or as underground systems utilizing either pipe or vaults to provide storage. Above ground ponds tend to occupy a large amount of space, create safety risks associated with open water, and become a breeding ground for insects and other pests.

Underground stormwater retention/detention systems provide an effective means of stormwater storage. Since the systems are underground, the valuable land above the systems can still be utilized for parking lots, playgrounds or green areas. Underground systems also decrease safety risks since they are inaccessible to the public.

An underground retention system is designed to allow stormwater runoff to be captured in a designated area where the water is then permitted to infiltrate into the ground, thereby recharging the groundwater table. A detention system also allows the stormwater runoff to be captured, however this system temporarily stores the water and releases it through an outlet at a controlled rate, effectively reducing the load on municipal storm drains. These two systems can be used individually or in combination to form an effective means of stormwater management.

Although there are numerous solutions to provide underground stormwater storage, high density polyethylene (HDPE) pipe provides an economical choice for retention/detention systems. HDPE pipe and fittings are lightweight and easy to install, highly resistant to road salts, oils, and other chemicals and provide a long service life with minimal maintenance.

1.2 Prinsco Underground Retention/Detention Systems

Prinsco has had a strong foothold in the HDPE industry for years and is committed to a continuous process of innovation, product development and quality improvement. Prinsco's underground retention/detention systems provide a solution to effectively manage and store stormwater runoff utilizing GOLDFLO® WT or ECOFLO® 100 dual wall pipe as well as many other custom fabricated components.

Prinsco's underground retention/detention systems are completely customizable with the unique ability to fit a wide variety of footprints. Providing the backbone for each system is Prinsco's corrugated HDPE pipe, which has a proven history of high-performance water conveyance and durability. The smooth inner liner allows for superior hydraulics while the corrugated exterior provides the strength necessary for heavy traffic loads with varying cover heights. HDPE is also one of the most durable materials on the market with superior resistance to rusting, corrosion, abrasion and deterioration.

GOLDFLO WT pipe features an integral bell and spigot joint that allows for quick and easy installation, reducing cost and increasing efficiency. This joining method ensures joint alignment, improves joint reliability, and eliminates the need for additional coupling materials. The GOLDFLO WT joint is available in either a watertight or soil-tight configuration depending on the project requirements. The pipe is available with perforations for retention systems or without perforations for detention systems.

ECOFLO 100 pipe also features an integral bell and spigot joint and provides the same quick and easy installation as GOLDFLO WT. However, ECOFLO 100 is produced with a minimum of 40% recycled content and engineered to provide a 100-year service life. ECOFLO 100 is the ideal choice for underground retention/detention systems where an environmentally conscious product is in demand. ECOFLO 100 joints are available in either watertight or soil-tight configurations and can be perforated or non-perforated.

The header components of the system are fabricated using the same material, with the option of watertight or soil-tight couplers as shown in Figure 1. The tee can also be custom fitted with inspection ports, inlet & outlet stubs, as well as welded end plates. With Prinsco's technical assistance, the systems can be designed to fit together like building blocks.

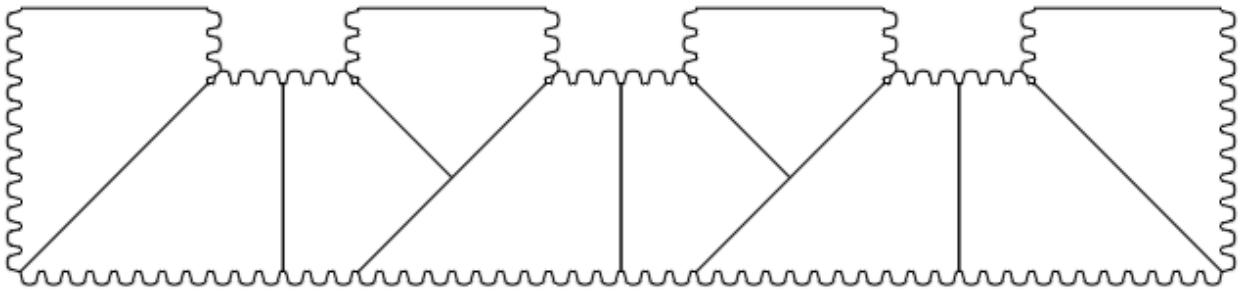

Figure 1: Standard Fittings

Prinsco's watertight joints provide a level of performance meeting the laboratory requirements of ASTM D3212. In field applications, watertight pipe configurations are subject to allowable leakage rates and may be considered watertight per some storm drain requirements. Prinsco detention systems are intended for non-pressure, gravity flow storm water detention but may not be appropriate for pressurized applications or those requiring a zero-leakage fluid containment. For additional information, contact your local Prinsco Representative.

Prinsco's underground storage systems can be tailored to meet the project specific size, shape, and storage requirements. Table 1 details a list of the features and benefits of Prinsco's underground retention/detention systems.

Table 1: Retention/Detention System Features and Benefits

Subsurface Retention/Detention Design	• Allows for an efficient use of land • Allows for groundwater recharge • Minimizes frequency and cost of maintenance • Minimizes health and safety risks
HDPE Material	• Resistant to rusting, corrosion and deterioration which leads to a longer service life • Resistant to freeze/thaw cycles • Resistant to extremes in Ph • Lightweight and easy to handle
GOLDFLO WT & ECOFLO 100	• Rated for H-25 and HS-25 loading with minimum cover • Diameters from 4" - 60" available • Lengths up to 20' to meet application requirements • Perforated or non-perforated • Watertight or soil-tight joints
Fabricated Fittings	• Variety of fittings available • Fittings can be customized to meet specific application requirements • Allows for minimal labor and easy installations

1.3 Designing a RETENTION/DETENTION SYSTEM

The following is a list of general guidelines that provide a systematic approach to designing an underground retention/detention stormwater management system.

1. Check Regulations for Stormwater Management Systems

Check with federal, state and local agencies regarding the design requirements and necessary permits for construction of underground storage. There may be variability between states and regions in the design requirements and permissible construction practices. Some questions to consider are:

- Should a system be a retention system, a detention system, or a combination of both?
- Are water quality structures required? If so, what type of structures can be used?
- Does the system require a water-tight or soil-tight joint?

2. Determine Storage Volume Required

A number of methods are available for estimating the required storage volumes. The basis of these methods is the ratio of the storage volume to the runoff volume and/or the ratio of the pre-development and post-development discharges. Some of the most commonly used methods include Rational method, Hydrographs, TR-55, and low-impact design (LID) method. The designer should choose a method based on their experience and the requirements established by the local authorities.

3. Calculate System Size Based on Storage Volume and Site Conditions

Retention/Detention systems can achieve needed storage capacity by either utilizing a short overall system length with large diameter pipe or with a long overall system length with smaller diameter pipe. Placement of an underground stormwater storage system will be dictated by the site characteristics. It will largely depend on the landscape, groundwater table, the excavation depth and the outlet locations to the municipal storm sewers. A typical cross-section of a retention/detention system is shown in Figure 2. Table 2 summarizes the retention and detention volumes and other system dimensions.

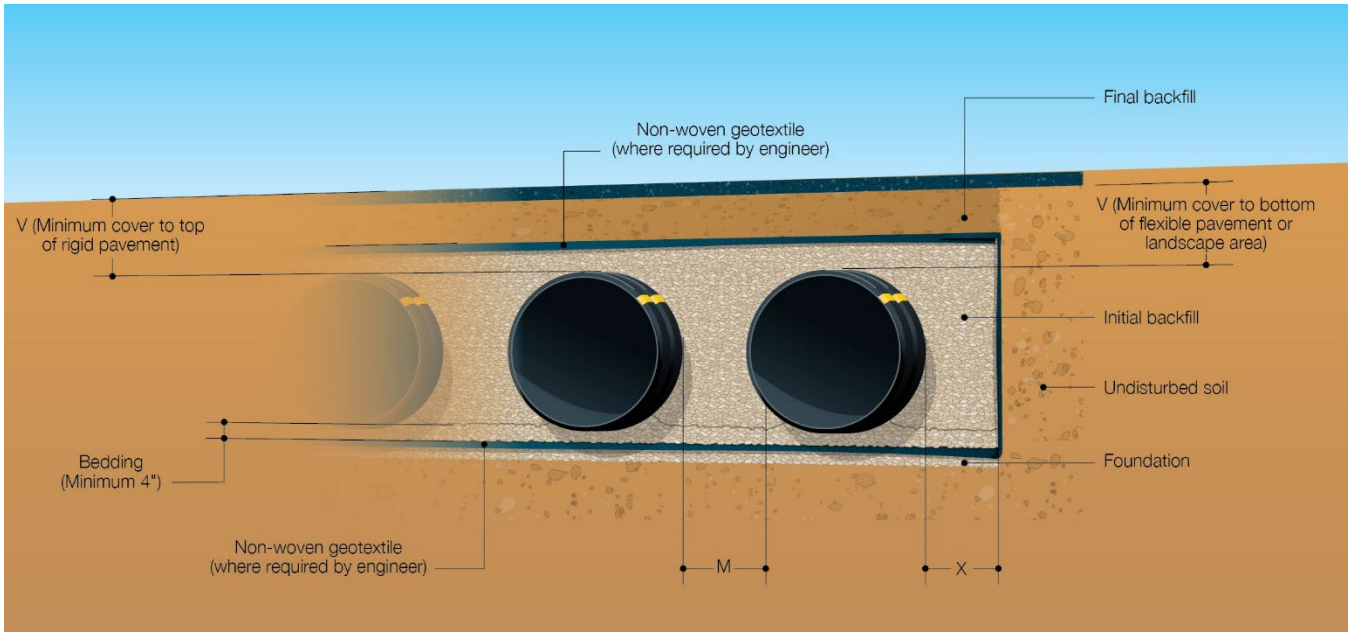

Figure 2: Typical Retention/Detention Cross Section

Note:

1) Minimum cover for up to H-25 traffic applications is 12” for pipe diameters up to 36”, 15” for 42” pipe, and 18” for 48”-60” pipe.

Table 2: System Dimensions and Storage Capabilities

Nominal I.D.	Approximate O.D.	"X" Spacing	"M" Spacing	Pipe Volume	Stone Void Volume	Total Retention Storage
(in)	(in)	(in)	(in)	(ft^3/ft)	(ft^3/ft)	(ft^3/ft)
12	14.5	8	9	0.8	0.7	1.5
15	17.7	8	11	1.2	1	2.3
18	21.5	9	14	1.8	1.5	3.3
24	28.2	10	19	3.1	2.5	5.6
30	34.7	18	20	4.9	3.3	8.2
36	40.6	18	21	7.1	4.0	11.1
42	47.5	18	23	9.6	5.6	15.2
48	54.1	18	23	12.6	6.5	19.1
60	66.8	18	27	19.6	9.2	28.9

Notes:
1) Calculation based on nominal pipe ID.
2) Stone porosity assumed 40%
3) Bedding Depth assumes 4” for 12”-36” pipe and 6” for 42”-60” pipe.
4) Storage volume based on average OD of pipe.
5) Any stone height above crown of the pipe is not included in void volume calculations.

4. Determine System Layout

Sizing the system to fit the project requirements and providing the most cost-effective solution can be done by reviewing the various pieces of the system. For example, by increasing the length of the lateral runs and reducing the number of fittings for the header, the cost will be decreased. Also, by utilizing only one header and placing end caps at the ends of the laterals can be more cost effective that having headers at both ends. Risers and cleanouts should be strategically placed throughout the system to allow for system cleaning and maintenance.

5. Select Products

Once the general layout of the system is determined, the appropriate products for the system can be selected. Contact your local Prinsco Representative for technical assistance and system modeling for your project.

The main system components consist of the laterals and the header(s). The laterals can be created with either GOLDFLO WT or ECOFLO 100 dual wall pipe. The header components of the system can be comprised of Prinsco’s fabricated fittings or custom manifolds. An example of the various components of an underground system are shown in Figure 3.

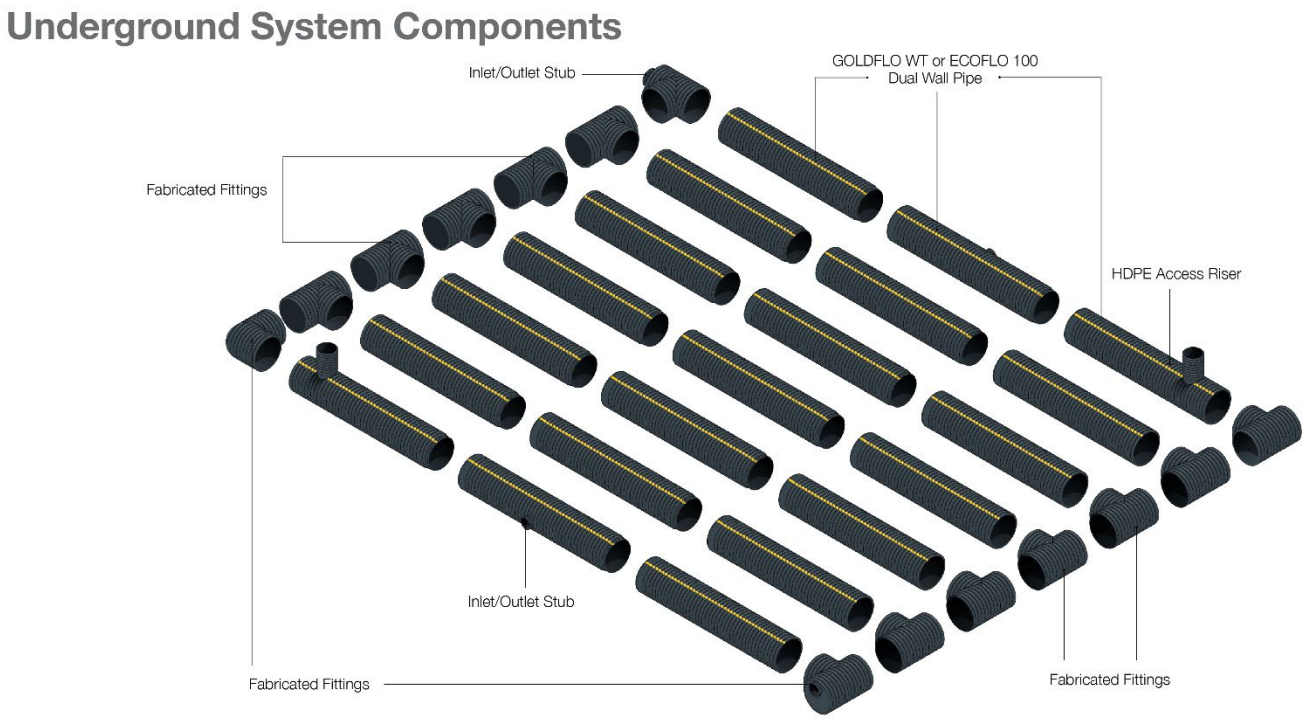

Figure 3: Underground System Components

- Standard fabricated fittings, including tees and elbows, can be utilized in a system as well. Refer to the *Dual Wall Prinsco Fitting Manual* located on Prinsco's website www.prinsco.com for a complete list of the standard fabricated fittings and dimensions.
- Custom fittings and manifolds can allow for a unique system design. Spacing of lateral connections can be modified provided the minimum spacing requirements are met. Custom fittings may require special installation considerations. For assistance with custom fittings and manifolds, contact your local Prinsco Representative.
- Maximum fill heights for fabricated fittings are typically limited to 8 feet. For installations over 8 feet, special design and installation considerations may be necessary. Contact your local Prinsco Representative for more information.

For retention systems, the standard perforation patterns are based on project requirements and geographic location. Perforation patterns for individual pipe sizes can be found on Prinsco's website under the *Perforation Pattern Technical Note*. Note that each perforation pattern may vary slightly depending on location. For information on custom perforations or location specific perforations contact your local Prinsco Representative.

6. Evaluate System Maintenance Requirements

As the storm water moves through the retention/ detention systems, if there is no stormwater pre-treatment device, sediment and debris will tend to settle out of the water and collect within the system. This will require the system to be regularly inspected and cleaned for the system to perform as

originally designed. Designing a system that is conducive to regular maintenance will allow the system to function efficiently and extend the service life.

A good maintenance program is just as important as proper design and installation. There are several components that can be incorporated into a system that are conducive to regular maintenance. These components may be used exclusively or in tandem to allow for ease of maintenance. Figures 4 – 8 highlight the various system components.

- A Prinsco Stormwater Quality Unit (SWQU), shown in Figure 4, may be used upstream of the system to treat the storm water and reduce the amount of sediment and debris entering the system. This will allow the system to function more efficiently. Located at Prinsco.com, reference drawings D-4-100, D-4-101, D-4-102, and D-4-103 for more information on SWQU's and bypass structures.

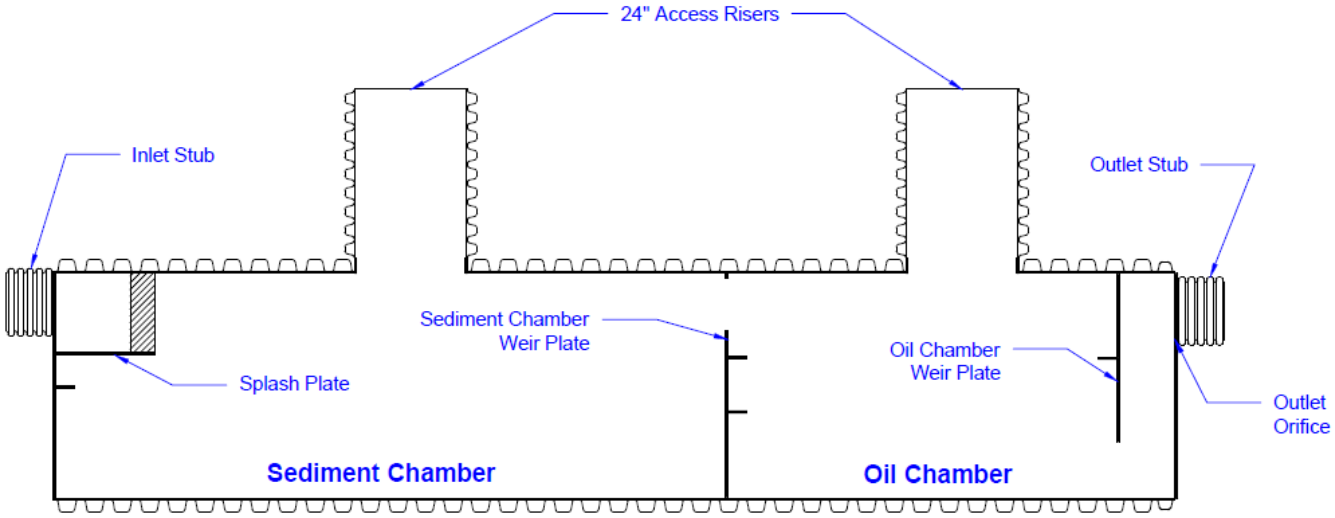

Figure 4: Stormwater Quality Unit (SWQU)

- Cleanout stubs and access risers, shown in Figure 5, should be strategically placed throughout the system to allow for ease of maintenance and allow for manned entrance into the system. Cleanout stubs are typically located on the headers of the system and risers are located on the laterals.
- Vent ports may be needed to prevent any airlock from occurring within the system.

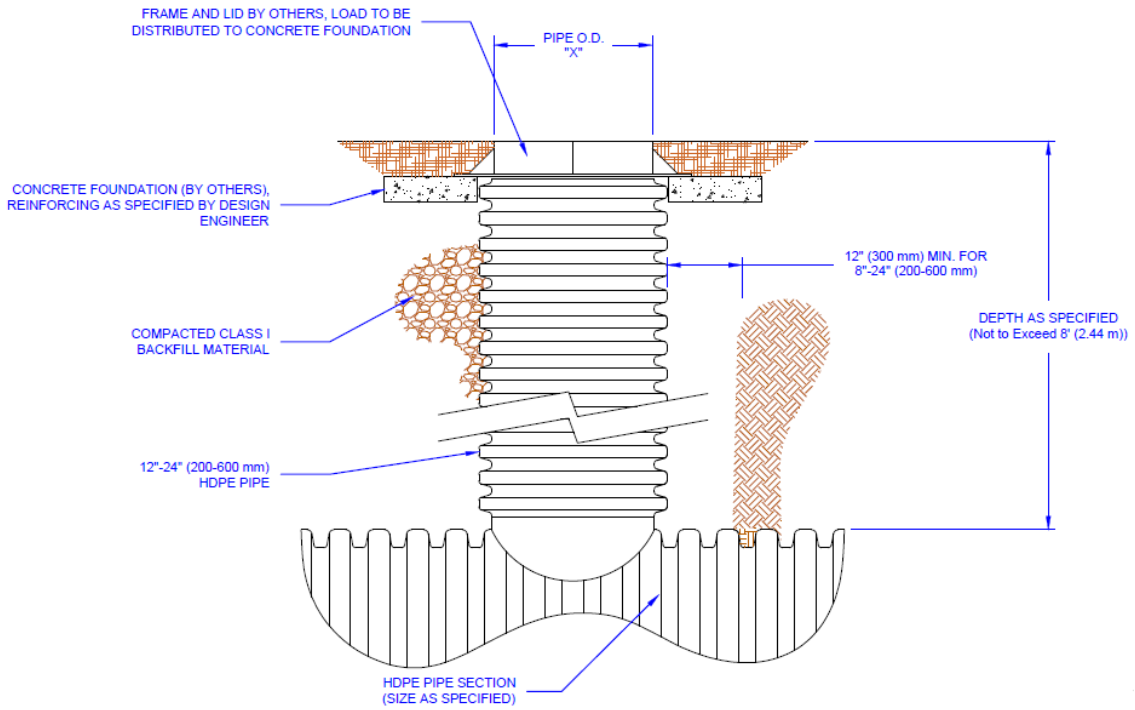

Figure 5:Typical HDPE Cleanout or Riser

- Concentric Reducers (components where the reducing stub is positioned in the center of the main fitting, so the flow lines don't match), shown in Figure 6, promote trapping the sediment and debris in designated areas of the system.

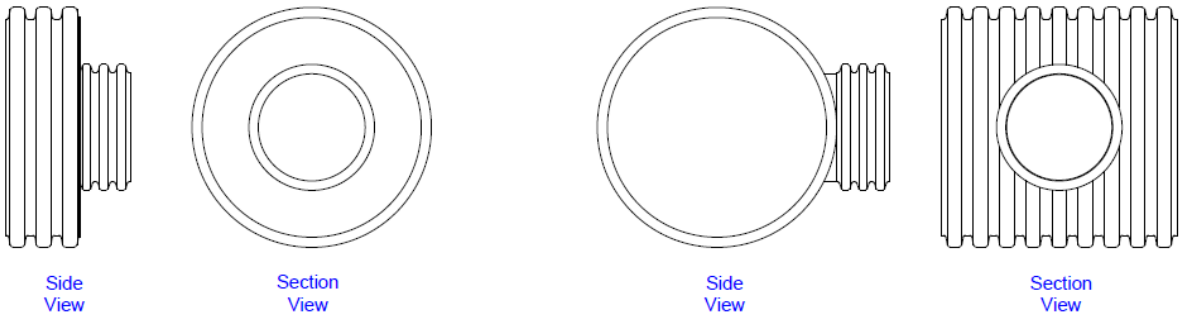

Figure 6: Concentric Reducers

- Catch Basins with sumps, shown in Figure 7, can be installed upstream of the system to promote trapping the sediment and debris.

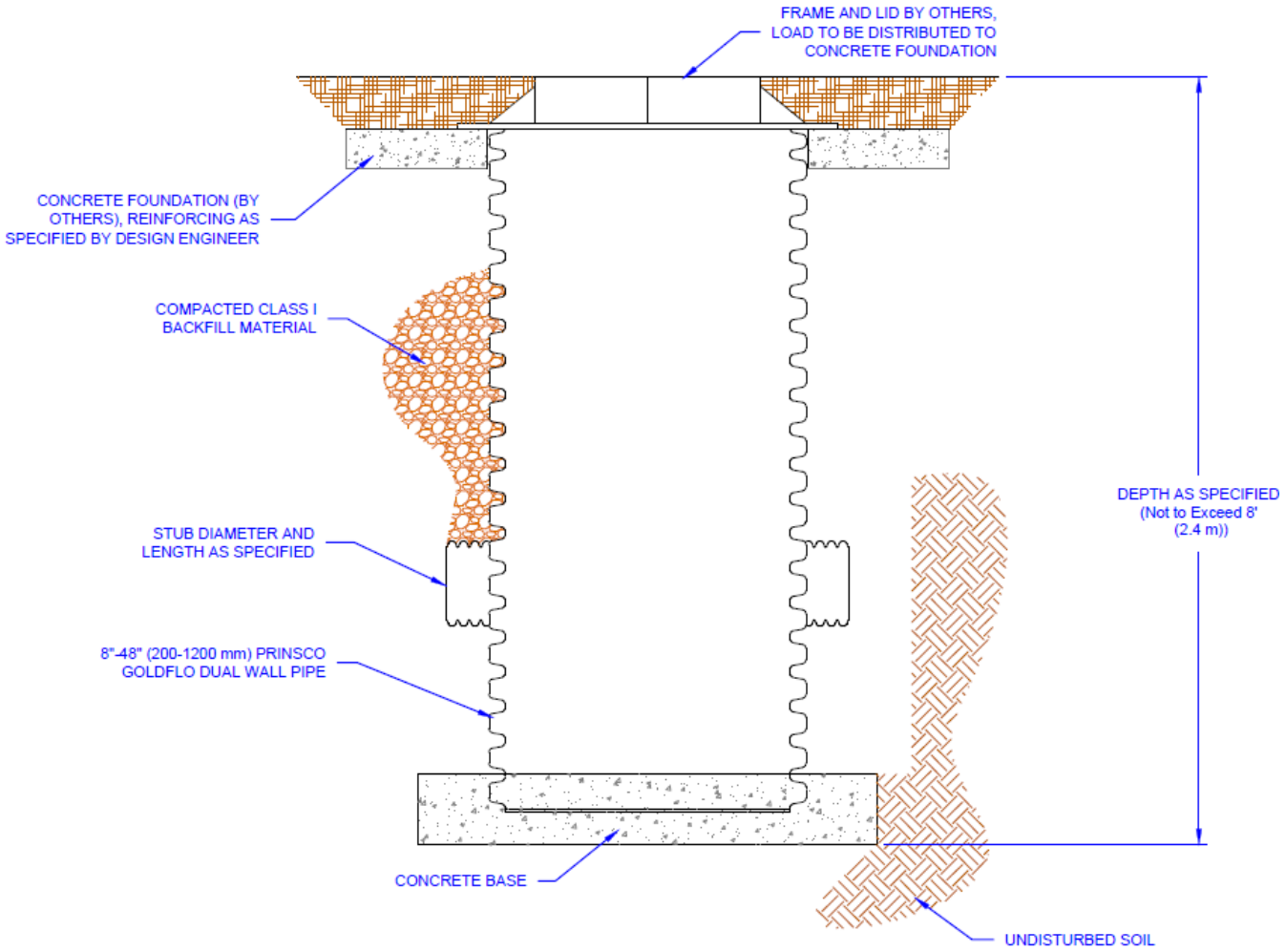

Figure 7: Typical Catch Basin

For additional information regarding the inspection and maintenance of retention/detention systems, contact your local Prinsco Representative.

1.4 Technical Assistance

Prinsco is continuously innovating to improve the performance of stormwater conveyance and storage solutions. A Prinsco Representative can assist with a variety of technical issues throughout the system design procedure to provide the most up to date and efficient solutions. Some of the technical assistance includes:

- System sizing and layout (based on provided design storage volume and available footprint).
- Product performance information and specifications.
- Existing product modifications (custom fittings).
- Installation Guides and Recommendations.
- Suggestions to minimize cost while maximizing efficiency.
- Complete system layout and component drawings.

Prinsco has partnered with HydroCAD Stormwater Modeling to allow for simplified calculations of the storage and infiltration behavior of a retention/detention system using GOLDFLO, GOLDFLO WT or

ECOFLO 100. HydroCAD's interactive chamber wizard utilizes Prinsco's installation recommendations and product dimensions to create a system layout and storage capacity to meet the specific project requirements. For more information about HydroCAD and its features and benefits, visit www.hydrocad.net or contact your local Prinsco representative.

A Retention/Detention Calculator is also available on Prinsco's website www.prinsco.com which can aid in the design and layout of an HDPE pipe retention or detention system. Some of the information provided in this calculator includes system storage volume, system and excavation footprint, estimated excavation volume, and estimated backfill quantities. Contact your local Prinsco Representative for more information.

1.5 Additional Resources

- HDPE Chemical Resistance Tech Note - TN-2-015_A
- Rubber Chemical Resistance Tech Note - TN-2-031_A
- Perforation Patterns Tech Note - TN-2-020_A
- Pipe System Tech Drawing - Standard Layout - D-5-100
- Pipe System Tech Drawing - Standard Cross-Section - D-5-101
- Pipe System Tech Drawing - Riser & Cleanout Detail - D-5-102