

4.11. Subsurface Vaults

Subsurface Vaults are specialized underground structures designed similarly as above ground detention or retention basins. These underground basins can be utilized for groundwater recharge by allowing infiltration. They are usually constructed of either concrete or plastic and must account for the potential loading from the expected bearing weight from the intended land use above them. Subsurface vaults are used commonly for storm water storage for small parcels where it is infeasible to have adequate surface storage via an open basin. It is also very common to design such facilities for various vehicle loadings as parking lots or for recreational surfaces, such as tennis and basketball courts. Water quality structures are required to treat storm water runoff and remove debris before filling a subsurface vault. Subsurface vaults are typically dry systems, primarily used for storm water quantity control. Less common are wet water quality systems designed to maintain a permanent pool to dissipate energy and settle particulate storm water pollutants. The City of Fort Wayne does not allow for subsurface quantity control vaults to act as water quality control treatment facilities, therefore wet systems are typically not utilized locally.

Key elements:

- Effective for urban areas with high valued land and limited space.
- Equally effective in areas of combined sewer and separate storm sewers areas.
- Provides peak rate control.
- Pretreatment water quality facilities are required before storm water can discharge into subsurface vaults.
- Weight bearing loading capabilities for anticipated land use above vault.
- Maintenance required periodically to remove sediment and debris.



STORMTRAP® SUBSURFACE VAULT WITH INFILTRATION, GARY, IN

Table 4.11.1: Subsurface Vaults Potential Application and Storm Water Regulation

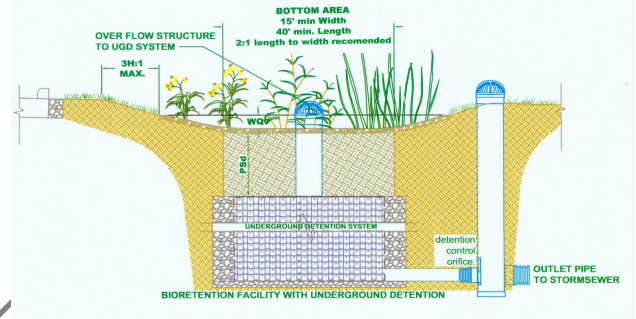
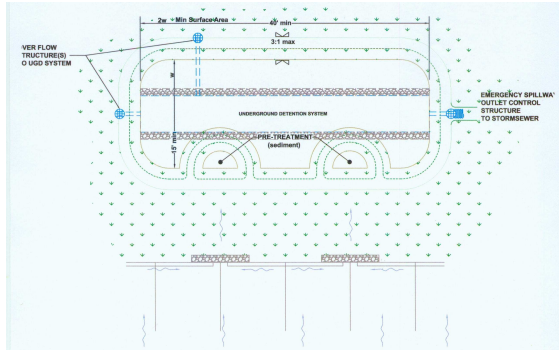
Potential applications		Storm water regulations		
			Infiltration	No Infiltration
Residential Subdivision:	Yes	Water Quality Benefit	Yes	No
Commercial:	Yes	Volume Reduction	Yes	Yes
Ultra Urban:	Yes	Attenuation Benefit	Yes	Yes
Industrial:	Yes			
Retrofit:	Yes			
Highway Road:	Yes			

Acceptable forms of pre-treatment

- Sediment chamber or wet subsurface vault
- Sediment forebay (rain gardens, bioretention, open basin, etc.)
- Appropriate prefabricated mechanical and propriety designs

Subsurface Vaults in the Urban Landscape

Subsurface vault systems are suitable for projects where space is limited and other storm water management systems are not feasible. Subsurface vaults may be used for commercial, industrial, or roadway projects. The presence of a subsurface vault in most cases does not alter the intended land use at the surface. The subsurface vault must meet structural requirements for overburden support and land use loading to be applicable in urban settings. Some applications of subsurface vaults are provided; however, examples are not limited to this list.



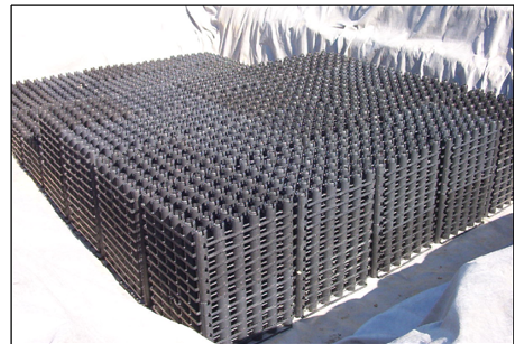
BIORETENTION USED FOR PRETREATMENT, WATER QUALITY VOLUME AND INLET CONTROL PRIOR TO INFILTRATIVE SUBSURFACE VAULT DETENTION - ZIONSVILLE, IN

Components of a Subsurface Vault

Subsurface vault systems contain a combination of the following components:

Pretreatment

Pretreatment can include a forebay/grit chamber, subsurface wet vault, or water quality treatment structure. Pretreatment is required to also include features to trap floatables and where land use dictates an oil/water separator. Baffles or walls within the subsurface vault separates the entire volume into multiple chambers. Storage volume present in a pretreatment structure may be considered part of the total design storage volume required.



Inlet Control

The inlet control of a subsurface vault should be connected to the storm water water quality pretreatment facilities. The subsurface vault should be sized according to the area entering into the system. Parking lots, roadways, and large rooftop areas are typically the drainage areas contributing to the subsurface vault system. The inlet control may include a flow splitter to regulate the rate and volume of water entering the vault.

INVISIBLE STRUCTURES® INFILTRATION FEATURE – PORTER COUNTY JAIL, VALPARAISO, IN

Storage Structure

Storage often provided by a concrete structure, a large pipe, or a group of pipes.

Infiltration Feature

Infiltration is typically not a major function of a subsurface vault; however, some designs may allow it. The designer must consider soil conditions and maximize the ratio of infiltration area to drainage area.

Permanent Pool

A permanent pool of water may be incorporated to dissipate energy. When a permanent pool is incorporated in a design, the design may be referred to as a “wet vault”. This design provides a benefit similar to that of a surface wet pond. Wet subsurface vaults can not be used for water quality treatment and the permanent pool area can not be utilized for storm water quantity control.

Slow Release Structure

The slow release structure regulates the rate of outflow for storms up to the design capacity. The storage volume and slow release together allow a subsurface vault to meet channel protection and peak release rate criteria.



CONTECH® SUBSURFACE VAULT,
FEDERAL EXPRESS® FACILITY –
INDIANAPOLIS AIRPORT

Overflow Structure

An overflow structure allows storms in excess of the design storm to pass through the structure without being detained. An overflow structure at the outlet, a flow splitter at the inlet, or a combination may be used to safely convey large storms.

Access Feature

This feature is used for maintenance and inspection purposes and most commonly consists of a panel or manhole entry port leading to the storage area.

Recommended Design Procedure

- Determine the water quality/recharge, stream bank protection, and peak rate control requirements for the site.
- Create a Conceptual Site Plan for the entire site, and determine what portion of the sizing requirements the subsurface vault will meet.
- Create a conceptual design for the subsurface vault, including enough volume to meet storage requirements.
- Estimate the total storage volume and adjust facility sizing as needed to provide required storage. Any permanent pool areas should not be included in the storage volume estimation.
- Choose and design pretreatment as appropriate. The pretreatment volume is part of the total volume. An oil/water separator should be considered to treat incoming flow from industrial sites or parking lots.

- Decide whether to design for infiltration. The procedure followed is similar to that for bioretention or infiltration basin design.
- Design the release structure to comply with site release rate requirements.
- Design a positive overflow or bypass system for large storms. The outlet structure and design head should provide adequate flow to avoid overtopping the vault.
- Design adequate maintenance access for each vault to connect to ground level.
- Complete construction plans and specifications. At a minimum, plans should include plan view, cross sections, and inlet and outlet details.



**CONTECH® SUBSURFACE VAULT –
KMART, BLOOMINGTON, IN**



**STORMTRAP® SUBSURFACE VAULT -
MUNICIPAL BUILDING, LEBANON, IN**

Maintenance Guidelines

The systems must be designed so that the vault can have easy access for inspection and maintenance. Subsurface vaults can be considered confined spaces. All maintenance procedures must comply with all local, state and federal requirements.

Table 4.11.2: Subsurface Vaults Maintenance Guidelines	
Activity	Schedule
Removal of sediment and debris from subsurface vault chamber(s) when the sediment zone is full. Sediments should be tested for toxicants in compliance with current disposal requirements if land uses in the catchments include commercial or industrial zones, or if indications of pollution are noticed.	As needed
Inspection of subsurface vault and control structures. Floating debris and accumulated petroleum products should be removed.	Quarterly
Maintain records of all inspections and maintenance activity	Ongoing

Note:

The designs of subsurface vaults are not limited to the examples shown within this text. Successful storm water management plans will combine appropriate materials and storm water quantity and quality designs specific to each site.

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4.11.1. Subsurface Vault Designer/Reviewer Checklist

Item	Yes	No	N/A	Notes
Level infiltration area (e.g., trench bottom, bed bottom)?				
Excavation in infiltration area minimized?				
Hotspots/pretreatment considered?				
Feasible construction process and sequence?				
Geotextile specified?				
Pretreatment provided?				
Slow release structure used?				
Appropriate pipe, if applicable?				
Storage requirements met?				
Observation well/clean out provided, if applicable?				
Maintenance accounted for and plan provided?				

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