6.11 Subsurface Infiltration System

Overview

Figure 6-52: Photo of subsurface retention/infiltration system installation under a parking lot (Credit: CONTECH Engineered Solutions)

Best uses
- Residential or commercial projects with large parking lots or common areas
- Large drainage areas

Advantages
- Can be located beneath at grade features
- Systems are modular, allowing flexible design
- Multi-benefit attributes: groundwater recharge, flood mitigation, pollutant load reduction

Limitations
- Not recommended for poorly infiltrating soils or highly polluted runoff with potential for groundwater contamination
- Requires pretreatment
- Can be high cost
- Potential for standing water and mosquito production

Description

Subsurface infiltration systems, also known as infiltration galleries, are underground vaults or pipes that store and infiltrate stormwater. Storage can take the form of large-diameter perforated metal or plastic pipe, or concrete arches, concrete vaults, plastic chambers or crates. These systems allow infiltration into surrounding soil while preserving the land surface above for parking lots, parks or playing fields. A number of vendors offer prefabricated, modular infiltration galleries in a variety of material types, shapes and sizes. Many of these options can be made strong enough for heavy vehicle loads, if needed.

Another type of subsurface infiltration system is an exfiltration basin or trench, which consists of a perforated or slotted pipe laid in a bed of gravel. It is similar to an infiltration basin or trench with the exception that it can be placed below paved surfaces such as parking lots and streets. Stormwater runoff is temporarily stored in perforated pipe or coarse aggregate and allowed to infiltrate into the trench walls bottom for disposal and treatment.

Subsurface infiltration systems are appropriate for residential and commercial sites where soil conditions and groundwater depths allow for safe infiltration of stormwater into the ground and no risk of groundwater contamination exists. These systems are not appropriate for industrial sites, locations where chemical spills may occur, fill sites or steep slopes. Pretreatment of runoff to remove sediment and other pollutants is typically required to maintain the infiltration capacity of the facility, reduce the cost and frequency of maintenance, and protect groundwater quality. A "subsurface fluid distribution system" is considered a Class V injection well that is regulated by EPA's Underground Injection Control Program[44]

[44] See EPA Region 9's website: https://www.epa.gov/uic/underground-injection-control-regulations-and-safe-drinking-water-act-provisions

These systems are "authorized by rule" and do not require a permit if they do not endanger underground sources of drinking water and comply with federal UIC requirements (see Appendix E of this Guide).

Siting

For strategies and examples of how to retrofit sites and parcels to include subsurface infiltration systems, ***see Sections 3.2 and 3.3 of the GI Design Guide***.

Remember that stormwater control measures should be located in areas that can be accessible at any given time for the purpose of operation and maintenance and inspections.

A permit may be required from San Mateo County Environmental Health if the system is more than 10 feet deep or if groundwater is encountered during excavation.[45]

Table 6-15: Recommended locations for subsurface infiltration systems

Recommended Locations	Subsurface Infiltration System
Parking Lot	●
Roof	
Driveway	●
Podium-level	
Close to building	
Away from Buildings	●
Underground	●

[45] https://www.smchealth.org/gpp

Design and Sizing Guidelines

Drainage Area and Setback Requirements

- In-situ/undisturbed soils should have a low silt and clay content and have permeability greater than 0.5 inches per hour. Hydrologic soil groups C and D are generally not suitable. Soil testing should be performed to confirm the permeability, and an appropriate safety factor (minimum of 2) applied as directed by the municipality.
- A 10-foot separation between the bottom of the Class 2 Perm and seasonal high groundwater levels is required to avoid the risk of groundwater contamination.
- A setback of 18 feet from building foundations is recommended, or a 1:1 slope from the bottom of the foundation, unless a different setback is allowed by a geotechnical engineer or local standard, or a cutoff wall is provided.
- Refer to Infiltration Guidelines (Appendix E) for additional setback and separation requirements.

Treatment Measure Dimensions and Sizing (Infiltration Galleries)

- The subsurface infiltration system should be sized to store and infiltrate the water quality design volume per MRP Provision C.3.d. The system may also be sized to store a larger volume for hydromodification management, if site conditions allow.
- Design the system to drain down (infiltrate) within 48-72 hours.
- The maximum allowable effective depth of water (inches) stored in the system can be calculated by multiplying the drawdown time (hours) by the design permeability of the native soils adjusted by the safety factor (in./hr.) The required footprint of the system can then be calculated by dividing the storage volume by the effective depth. Consult with the manufacturer for sizing of various components to achieve storage and infiltration of the water quality design volume.
- One or more observation wells should be installed to monitor water levels (drain time) in the facility. The well should be a minimum 6-inch diameter perforated PVC pipe, which is anchored vertically to a foot plate at the bottom of the facility.
- Maintenance access to the underground galleries must be provided, as periodic cleaning may be necessary to maintain performance. Open systems such as large diameter pipe or concrete structures can more easily be inspected and entered for maintenance if necessary than low profile or crate-type systems. The access should be large enough to allow equipment to be lowered into each gallery.
- Provide a layer of aggregate between the subsurface storage component or galleries and native soils to prevent migration of native soils into the storage component.

Treatment measure Dimensions and Sizing (exfiltration trenches)

- The exfiltration trench should be sized to store and infiltrate the water quality design volume per MRP Provision C.3.d. It is designed similar to an infiltration trench.
- A site-specific trench depth can be calculated based on the soil permeability, aggregate void space, and the trench storage time. The stone aggregate used in the trench is typically 1.5 to 2.5 inches in

diameter, which provides a void space of approximately 35 percent. Trenches may be designed to provide temporary storage of storm water, but should drain within 72 hours.

- The trench depth should maintain the required separation from seasonal high groundwater, and the depth should be less than the widest surface dimension.
- The invert of the trench should be flat (no slope).
- Place permeable filter fabric around the walls and bottom of the trench and top of the aggregate layer. The filter fabric should overlap each side of the trench in order to cover the top of the aggregate. The filter fabric prevents sediment in the runoff and soil particles from the sides of the trench from clogging the aggregate.
- A layer of filter fabric or sand should be placed at the bottom of the trench to keep the rock matrix from settling into the subgrade over time.
- An observation well should be installed to monitor water levels (drain time) in the trench. The well should be a minimum 6-inch diameter perforated PVC pipe, which is anchored vertically to a foot plate at the bottom of the trench.

Inlets to Treatment Measure

- Flow may enter the treatment measure in the following ways:
    - Through a pipe
    - Through a drop inlet or catch basin
    - Through roof leader or other conveyance from building roof

Pre-Treatment Measures

- The pretreatment measure(s) should be selected based on the expected pollutants on site and the infiltration system's susceptibility to clogging. Sediment removal is important for maintaining the long-term infiltration capability of the system.
- Hydrodynamic separators or media filters are most commonly used for subsurface systems, and are allowed as part of a treatment train with the infiltration system. Landscaped-based treatment, such as swales or bioretention areas may also be used upstream of subsurface systems if appropriate and if space allows.
- If a media filter is selected, refer to the discussion of media filter design in Section 6.10.

Construction and Maintenance Plans

Construction Considerations

- The drainage area must be fully developed and stabilized with vegetation before constructing an infiltration trench. High sediment loads from unstabilized areas will quickly clog the infiltration trench. During project construction, runoff from unstabilized areas should be diverted away from the trench into a sedimentation control BMP until vegetation is established.
- Avoid spreading fines of the soils on bottom and side slopes while excavating. Loosen soils at the bottom of the excavation prior to constructing the infiltration trench.
- Avoid compaction of existing soils in the area of the infiltration. Protect from construction traffic.

Remember

Maintenance Considerations

- Provide a Maintenance Agreement (or other document or mechanism) that states the parties' responsibility for maintenance and upkeep.
- Prepare a maintenance plan and submit with Maintenance Agreement.