



Targeted Constituents

● Significant Benefit		◐ Partial Benefit		○ Low or Unknown Benefit	
◐ Sediment	○ Heavy Metals	◐ Floatable Materials	○ Oxygen Demanding Substances		
○ Nutrients	○ Toxic Materials	○ Oil & Grease	○ Bacteria & Viruses	○ Construction Wastes	

Description

Underground detention is the use of large underground structures to provide necessary volumes for attenuating stormwater peak flows. Underground detention is sometimes desired in areas where the cost of land is high enough to justify the additional construction, maintenance and operating costs. Underground detention structures generally provide little or no stormwater quality benefits. Potential applications could include very large development projects (such as regional shopping malls), for which the cost of providing underground detention structures would not be prohibitive.

Approach

The City of Knoxville Engineering Department has a policy against underground detention structures, due to many observed problems in local applications and the potential for future problems. Underground detention structures are very strongly discouraged for several reasons:

- The cost of building underground structures is usually prohibitive when compared to dry detention basins, and this may cause some developers and contractors to illegally reduce detention volume or alter construction details in an effort to contain costs.
- It is very difficult to inspect underground structures, particularly if entering the structure qualifies as confined space entry (which is controlled by OSHA safety regulations). Cleanout and maintenance costs will need to be provided for and budgeted indefinitely.
- The Knoxville region generally has clay soils (which reduces overall stormwater infiltration and creates high groundwater tables). The Knoxville region also has many karst and sinkhole formations, for which underground detention structures could potentially cause additional stormwater flow volumes without an adequate means of inspection.
- Underground structures may not receive enough air and proper ventilation to avoid anaerobic conditions and dangerous flow conditions.
- Stormwater runoff quality is not substantially improved or enhanced by underground detention. Underground structures do not allow grass or other vegetation to absorb nutrients, minerals or pollutants from stormwater runoff. Underground structures do not take advantage of natural stormwater infiltration into the ground surface.

Therefore in most instances, underground detention facilities are not allowed.

The Engineering Director could potentially allow such a facility if designed and constructed in accordance with good engineering practices by reliable and proven contractors of local reputation. The following minimum requirements must be followed in the potential design and construction of an underground detention facility:

1. The entire area of the underground detention structure must be open to the air surface directly above, either with no cover or by installing continuous grates across the top. This allows for inspection and maintenance of the entire facility with sunlight to provide the primary means of illumination. The facility will consider public safety and access (locks, fences, curbs) and is often designed to withstand truck loading such as HS-15 or HS-20.
2. The underground detention structure must be constructed of durable materials with a typical 100-year lifetime. Detention storage volume shall not include the porous space within a stone or gravel bed (commonly done in many states for a series of pipes or pipe arches under parking lots).
3. The underground detention structure shall be designed to have positive drainage into the receiving channel, assuming that there is a 10-year flood in the receiving channel. This ensures that the designed volume is used for onsite detention rather than containing offsite floodwaters.
4. The underground detention structure shall not receive surface runoff directly from parking lots through the top opening. Surface runoff shall be directed to a BMP that improves stormwater quality, such as an oil/water separator or grass filter strips. The underground structure will usually have a curb or other barrier around the top to prevent this.
5. Design measures must be taken to trap and store sediments in locations where cleanout and maintenance can be easily performed. This generally requires that some type of water quality inlet or other stormwater treatment BMP must be installed upstream from the underground detention facility.
6. Good design practices also require that structural measures shall be in place to prevent blockages. Floatable waste materials shall be collected by trash racks for periodic removal. The underground detention structure shall have a positive means of being dewatered for inspection and maintenance purposes.
7. A detailed maintenance and inspection plan must be submitted and approved (including inspection schedules and guidelines). Evidence of responsibility and financial budgeting must be presented, in addition to the usual bonds and agreements necessary for all detention structures.

The above requirements do not allow for the use of large-diameter pipes in a gravel layer or envelope. Arch culverts filled with stone and gravel, or even masonry block structures, were frequently used to provide stormwater detention/infiltration underneath parking lots. Underground detention structures were promoted a few decades ago as a common means of detention in many areas of the country, particularly under parking lots. Most states and cities now discourage underground detention.

References **103, 153, 154, 180, vendor data** (see BMP Manual Chapter 10 for list)