
SUMMER 2018

# building experience

insights on building & site construction

## Five Factors Influencing Underground Detention

Recently, a Hixson client wanted to expand their building over an existing parking lot, and then convert an existing detention pond into a parking lot to re-gain those lost spaces. This required the conversion of a conventional above ground detention pond to an underground detention system below the new parking lot.

In cases such as this, where impervious surfaces such as buildings and parking lots replace existing pervious land, regulations require detention ponds to be put in place to address stormwater runoff and protect neighboring properties and waterways. This can be done through either conventional above ground ponds or underground detention systems. Underground systems come in many varieties, but one of the most common is a series of underground pipes connected together to form a large storage vault.

While above ground systems are generally less expensive to construct, they are not always feasible: Adequate square footage may not be available, or there may be a need to avoid attracting animals and insects. Where the use of an underground detention system may be warranted, five factors must be considered in the design of the system:

1. **Existing site**. The design must take into account the footprint of the existing (pre-developed) site, as well as the proposed site. The latter must be able to detain and release the volume of post-development run-off to the pre-developed condition.
2. **Topography**. Underground detention systems should be constructed to provide a positive outfall of the accumulated water; i.e., the system should be installed at a high enough elevation to allow the detained stormwater to drain by gravity off the site. (For more information see Building Experience Fall 2017).
3. **Ground water level**. Areas of the country with high ground water levels (e.g., Florida) may not be well suited for underground detention. Groundwater can potentially infiltrate into the underground detention system, as well as create buoyant forces which attempt to force the system to “float” out of the ground. In this case, concrete anchors may be required to hold the system down.

## experience in brief

Note that there are different underground systems available (pipes, arches, vaults). Make sure to explore all options before purchasing and to follow all applicable regulations for your locality.

## continuing education

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University of Wisconsin’s
“*Understanding Plumbing Systems in Commercial Buildings*”
Madison, WI
June 2018

Ohio Bureau of
Workers’ Compensation
“*Combustible Dust*”
June 2018

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4. **Size of Storm**. The size of the storm that must be protected against is another point to consider. Different areas of the country have different regulations regarding detention and may make one system more feasible than others. For example, it would be very cost-prohibitive to develop an underground detention system to protect against a 100-year post-development storm to a one-year pre-developed storm release rate.
5. **Pipe Size**. Pipe size also must be considered in the design of underground detention systems. In general, the more vertical space available for larger piping, the less expensive the system will be: As seen in the tables below, doubling the diameter yields four times the amount of storage for the same total length of pipe. For the client referenced above, Hixson designed an underground detention system using 72" diameter pipes. This size pipe provided the necessary volume to offset incoming water volume, while giving the client the needed parking spaces. The table below shows sample pipe diameters with associated volumes.

| | **Diameter of Pipe (Feet)** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Volume (cubic feet) per linear foot of pipe | 0.79 | 3.14 | 7.07 | 12.57 | 19.63 | 28.27 | 38.48 | 50.26 |

Based on this data, a 20,000 cubic feet detention pond would require the following amount of piping:

| | **Diameter of Pipe (Feet)** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Linear feet of pipe to store 20,000 cubic feet of water | 25466 | 6366 | 2830 | 1592 | 1019 | 707 | 520 | 398 |

Therefore, doubling the pipe diameter reduces the linear feet needed by one-fourth.



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