

## Section 4: Stormwater Design Criteria

### 4.9 Detention Facilities

#### 4.9.2 Other Criteria

- B. Design guidance is provided in [Section 3.4 of the iSWM™ Hydraulics Technical Manual Document](#).

#### 4.8.3 Other Criteria

- A. Where applicable, bridges must comply with DDC Section 7.4 regarding Environmentally Sensitive Areas.

## 4.9 Detention Facilities

### 4.9.1 Design Requirements

- A. Detention facilities shall be designed for the four storms (“Water Quality”, “Streambank Protection”, “Conveyance”, and “Flood Mitigation”) for the critical storm duration that results in the maximum (or near maximum) peak flow.
- B. Dry detention basins must be sized to temporarily store the volume of runoff required to provide flood protection up to the “Flood Mitigation” storm.
- C. Routing calculations must be used to demonstrate that the storage volume and outlet structure configuration comply with [Section 4.5.5](#) of this Manual.
- D. A calculation summary shall be provided on construction plans as shown in the computation sheet in [Figure 4.9](#) or its equivalent. Stage-storage-discharge values shall be tabulated and flow calculations for discharge structures shall be shown on the construction plans. Detention design shall follow iSWM™ guidelines. It is the responsibility of the Engineer of Record to use appropriate methodologies presented in iSWM™ based on specific basin characteristics. Detailed calculations and a design narrative shall be provided for review in a supplemental report that is referenced on the construction plans. In general, the narrative shall provide basic design information, such as the hydrologic method applied, design assumptions, pre- and post-development site conditions, downstream constraints, environmental considerations, and design software version used, if applicable.
- E. Storage and dam safety design may be subject to the requirements of the Texas Dam Safety Program based on the volume, dam height, and level of hazard. Earthen embankments six (6) feet in height or greater shall be designed per the TCEQ guidelines for dam safety (See [Texas Administrative Code, Title 30, Part 1, Chapter 299 Dams and Reservoirs](#) for current dam safety criteria).
- F. An Operation and Maintenance Manual must be submitted with the civil engineering plans for all private detention basins. Private detention basins shall be inspected by Public Works Inspection to ensure compliance with the design standards required by [Section 7.5.3.F. of the DDC](#). Inspection fees will apply.

### 4.9.2 Design Criteria for Above Grade Detention Facilities

- A. Grading Standards for Above Grade Detention Facilities:
1. Vegetated channel slopes shall not exceed 4H:1V slope. Concrete-lined embankment slopes shall not exceed 2H:1V slope. Vertical walls may be allowed but must be structurally designed to account for inundation of the base and drawdown upon pond draining and must have a 6-ft. high security fence at the top.

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#### 4.9.2 Design Criteria for Above Grade Detention Facilities

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2. The side slope for any excavated detention basin, which is not in rock, shall not exceed a 4H:1V slope.
  3. Bottom slopes of detention facilities should not be less than 1%.
  4. Armored slopes shall be no steeper than 2H:1V.
  5. The embankment crown width shall be determined based on a geotechnical investigation of the detention facility site. The minimum width of the embankment crown shall be 12 feet.
  6. Earthen embankments used to impound detention water must have a non-permeable core and shall be based on a geotechnical investigation of the site. The geotechnical investigation shall be performed by a Professional Engineer (PE), licensed by the State of Texas, and shall include at a minimum the type of material on-site (or other material to be used in the embankment), moisture content, liquid limit, plasticity index, and required compaction.
  7. A Concrete pilot channel with a minimum width of 10 feet, and a minimum slope of 0.5% shall be constructed at the bottom of the detention pond. Privately maintained ponds shall have a concrete pilot channel with a minimum width of six (6) feet.
  8. Private Detention Basins shall be designed with 10-ft. wide unobstructed maintenance access around the entire perimeter of the pond.
  9. Public Detention Basins shall be designed with 20-ft. wide unobstructed maintenance access around the entire perimeter of the pond.
  10. Where deemed necessary by the City's Engineer, security fencing with a minimum height of six (6) feet shall encompass the detention storage area if the velocity, depth, or slopes create a potentially dangerous condition. The fence shall be designed to allow access for maintenance and so as not to restrict stormwater flow into or out of the detention basin. A maintenance equipment access ramp shall be provided for all detention facilities. The slope of the ramp shall not exceed 6H:1V and the minimum width shall be 12 feet.
- B. Emergency Spillway, Overflow Path, and Freeboard:
1. A freeboard of one (1) foot will be required between the "Flood Mitigation" stormwater surface elevation and top of bank.
  2. An emergency spillway shall be provided at the flood mitigation maximum storage elevation with sufficient capacity to convey "Flood Mitigation" storm inflow rates with six (6) inches of freeboard. This is the peak of the inflow hydrograph coming into the pond and must not account for attenuation effects of the pond. Spillway requirements must also meet all appropriate State and Federal criteria.
  3. An emergency overflow path, free of structures or obstructions, must be provided to convey the spillway design discharge to a downstream ROW or drainageway with adequate capacity for the discharge. No impediments to flow are allowed within the emergency overflow path (E.g., fences, trees, parking areas, or buildings). If a fence around a detention facility is needed to restrict access, the bottom of the fence must be elevated to provide a minimum of one foot of freeboard above the emergency overflow WSEL where the fence crosses the spillway. Nevertheless, fences across spillways should be avoided whenever possible. Even if the fence is elevated to the freeboard elevation, there is still the potential for the fence to catch debris floating on the water surface.
  4. An emergency spillway must be constructed of concrete.

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#### 4.9.3 Design Criteria for Underground Detention Facilities

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5. Design calculations shall be provided for all spillways and outlet structures.
- C. Landscaping Requirements:
1. All detention basins shall be designed with plantings that minimize erosion based on expected inundation frequencies. Design guidance is provided in the [iSWM™ Landscape Technical Manual Document](#).
- D. Multiple Use Guidance
- Limited recreational equipment (such as picnic tables or playground equipment) and trees may be permitted in private detention facilities with the following restrictions:
1. User access must be provided at a maximum 10% slope in at least two (2) locations, or one (1) location that comprises not less than 20% of the perimeter of the facility.
  2. No recreational equipment is permitted in any portion of the facility that lies more than 18 inches below the flood mitigation water surface elevation level of the facility.
  3. Recreational structures including, but not limited to, picnic tables and playground equipment, must be rust-resistant and anchored to the ground.
  4. Mulch, wood chips, gravel, or rubberized pellets are not permitted within a detention facility due to the likelihood of their floating into the outlet structure.
  5. Trees, shrubs, and other woody vegetation will not be permitted in the embankment of any detention facility or in the maintenance access area around such a facility.
  6. A maximum of one (1) isolated tree per 5,600 sq. ft. may be permitted in the recreational area of the pond. A trash rack must be used to prevent clogging of the outlet structure. No bark mulch may be used around trees.
- E. Retaining Walls
1. Any freestanding retaining wall used to detain water must be designed by a structural engineer to withstand the expected hydraulic forces when the detention area is filled to capacity. These walls must be constructed using reinforced concrete.
  2. Any inlet or pipe connections to retaining walls must be designed with a reinforced concrete headwall. The height of this headwall shall match the height of the adjacent retaining wall. The most recent TxDOT details for concrete headwalls shall be used to determine other headwall dimensions and reinforced schedule.

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#### 4.9.3 Design Criteria for Underground Detention Facilities

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Underground detention is highly discouraged because of the potential for deferred maintenance, the difficult and potentially hazardous nature of access for maintenance, and issues related to anaerobic conditions and pollutant mobility from devices that retain water between events. In any instance where underground detention is contemplated, thorough consideration must be given to the concerns described above to ensure ongoing inspection, maintenance, and functionality. Care should be taken to address material selection for underground detention due to the potential for adverse soil conditions to inhibit the system from functioning properly. A geotechnical engineer shall be consulted to ensure soil and other conditions are appropriate for the selected detention material.

- A. Underground detention facilities shall be designed with reinforced concrete and have a minimum pipe diameter of 30 inches to allow for safe access and maintenance of the facility.

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#### 4.9.4 Design Criteria for Parking Lot Detention

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- B. If an underground vault has multiple chambers, access openings with a maximum spacing of 500 feet must be provided for each chamber.
- C. Underground facilities must be located to enable safe access for maintenance and minimize disruption of aboveground uses during maintenance. Access openings shall not be placed in areas that are routinely used for parking.
- D. Easements must be provided for all underground detention facilities. If underground detention facilities are bound by private property, the easements must include an additional four (4) feet from the perimeter of the facilities.
- E. Underground detention and water quality facilities are prohibited underneath buildings, walls, or other structures.
- F. Every SWFMA involving underground detention and water quality facilities must include inspection and maintenance requirements to be performed quarterly and following any rainfall event of 0.5 inches or more. The inspection and maintenance frequency may be reduced after five (5) years of operation, if the owner demonstrates that a lesser frequency is appropriate.
- G. A surface emergency overflow path, free of obstructions, must be provided for all underground detention facilities. The emergency overflow path must have sufficient capacity to convey the “*Flood Mitigation*” storm inflow rates to the underground detention facility. This is the peak of the inflow hydrograph coming into the underground detention facility, and must not account for any attenuation effects from the facility. The criteria for emergency overflow paths for surface detention facilities denoted in Section 4.9.2 above also apply to underground detention facilities.
- H. Outlets from underground detention must consist of a pipe that can convey 120% of the 100-year outflow, with a minimum diameter of 12 inches. The invert of the outlet pipe must be at the lowest point in the detention facility to ensure that it fully drains.
- I. Underground detention facilities shall be sloped to drain at a minimum floor slope of one (1) %.

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#### 4.9.4 Design Criteria for Parking Lot Detention

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Parking lot detention may be allowed if the following minimum criteria are met:

- A. Use of parking lot surface area as detention is permitted, but only up to the lowest curb elevation of the parking lot.
- B. The maximum ponding depth for the 100-year storm must be no more than 12 inches at the deepest point.
- C. The outlet must be designed to minimize modifications that affect detention functions. The applicant must evaluate potential future resurfacing activities for impacts to detention volumes and release rates.
- D. Ponding water in frequently used portions of parking lots must be avoided. At least two signs are required for all parking lot detention areas. The signs must have a minimum area of 1.5 sq. ft. and contain the following message:

**WARNING**

**This area is a detention basin and is subject to periodic  
flooding to a depth of (provide design depth).**

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#### 4.9.6 Design Criteria for Pumped Detention

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Sign materials, geometry, and location must be submitted to Development Facilitation and approved by the City's Engineer.

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#### 4.9.5 Design Criteria for Pumped Detention

- A. A detention facility may not rely on a pump or other mechanical equipment to drain water during a design storm.

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#### 4.9.6 Outlet Structures for Detention Facilities

##### A. Design Frequency

1. "Water Quality" storm
2. "Streambank Protection" storm
3. "Conveyance" storm
4. "Flood Mitigation" storm

##### B. Design Criteria

1. Outlet structures shall be designed in accordance with Section 2.2 of the [iSWM™ Hydraulics Technical Manual](#). For water quality, refer to Section 2.2.3 for design of extended detention outlets.
2. The required storage volumes for "Water Quality", "Streambank Protection", "Conveyance", and "Flood Mitigation" storm events must be estimated.
3. If a detention facility includes extended detention, refer to Section 2.2.3 of the [iSWM™ Hydraulics Technical Manual](#) for design requirements.
4. All outlet orifices must be adequately protected from clogging and designed to ensure that people and large animals are kept out of confined outlet areas. Refer to Sections 2.2.5-*Extended Detention Outlet Protection* and 2.2.6-*Trash Racks and Safety Grates* of the [iSWM™ Hydraulics Technical Manual](#) for design guidance.
5. Any top orifice on an outlet riser must be designed with a grate to prevent fall injuries.
6. Outlet velocities shall be within the maximum allowable range based on channel material, as shown in [Table 4.6-D](#) and [Table 4.6-E](#).
7. Outlet protection and energy dissipation facilities must be designed to avoid erosion problems downstream from outlet devices and emergency spillway(s).
8. Buoyancy calculations must be performed for the outlet structure and footing to ensure the outlet structure will not float. Flotation will occur when the weight of the structure is less than or equal to the buoyant force exerted by the water.
9. Any outflow structure that conveys water through an embankment in a conduit shall be reinforced concrete designed to support the external loads. The conduit shall be able to withstand the internal hydraulic pressure without leakage under full external load or settlement and must convey water at the design velocity without damage to the interior surface of the conduit.
10. The minimum opening of an inlet shall be six (6) inches in diameter or a 6-in. by 6-in. square. Smaller inlet openings may be used with a junction box and properly sized outlet structure.



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11. A concrete headwall and wingwalls shall be constructed at the outlet pipe opening. Orientation of the wingwalls will be governed by site specific conditions. Headwalls and wingwalls shall be designed to TxDOT standards.

