

SECTION 16

**STORMWATER DETENTION
DESIGN STANDARDS**

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16.1 General

The following shall govern the design of any improvement with respect to the detention of stormwater runoff. Basins shall be constructed to temporarily detain the stormwater runoff that exceeds the maximum peak release rate authorized by this Standard. The required volume of storage provided in these basins, together with such storage as may be authorized in other on-site facilities, shall be sufficient to control excess runoff from the ten (10) year or one hundred (100) year storm as explained below in **Section 16.3**. Also, basins shall be constructed to provide adequate capacity to allow for sediment accumulation resulting from development and to permit the pond to function for reasonable periods between cleanings.

16.2 Acceptable Detention Facilities

The increased stormwater runoff resulting from a proposed development should be detained on-site by the provisions of appropriate wet bottom or dry bottom detention facilities, parking lots, or other acceptable techniques. Measures that retard the rate of overland flow and the velocity in runoff channels shall also be used to partially control runoff rates.

16.3 Allowable Release Rates

A. General Release Rates

Control devices shall limit the discharge to a rate such that the post-developed release rate from the site is no greater than 0.2 cfs per acre of development for zero (0) to one hundred (100) year return interval storms. For sites where the pre-developed area has more than one (1) outlet, the release rate should be computed based on pre-developed discharge to each outlet point. The computed release rate for each outlet point shall not be exceeded at the respective outlet point even if the post developed conditions would involve a different arrangement of outlet points.

B. Site-Specific Release Rates for Sites with Depressional Storage

For sites where depressional storage exists, the general release rates provided above may have to be further reduced. If depressional storage exists at the site, site-specific release rates must be calculated according to methodology described in **Section 11**, accounting for the depressional storage by modeling it as a pond whose outlet is a weir at an elevation that stormwater can currently overflow the depressional storage area. Post developed release rate for sites with depressional storage shall be the two (2) year pre-developed peak runoff rate for the post-developed one hundred (100) year storm. In no case shall the calculated site-specific release rates be larger than general release rates provided above.

Note that by definition, the depressional storage does not have a direct gravity outlet but if in agricultural production, it is more than likely drained by a tile and should be modeled as “empty” at the beginning of a storm. The function of any existing depressional storage should be modeled using an event hydrograph model to determine the volume of storage that exists and its effect on the existing site release rate. To prepare such a model, certain information must be obtained, including delineating the tributary drainage area, the stage-storage relationship and discharge-rating curve, and identifying the capacity and elevation of the outlet(s).

The tributary area should be delineated on the best available topographic data. After determining the tributary area, a hydrologic analysis of the watershed should be performed, including, but not limited to a calculation of the appropriate composite runoff curve number and time of concentration. Stage-storage data for the depressional area should be obtained from the site topography. The outlet should be clearly marked, and any calculations performed to create a stage-discharge rating curve must be included with the stormwater submittal.

Also note that for determining the post-developed peak runoff rates, the depressional storage must be assumed to be filled unless the City and City Engineer can be assured, through dedicated easement, that the noted storage will be preserved in perpetuity.

C. Management of Off-site Runoff

Runoff from all upstream tributary areas (off-site land areas) may be bypassed around the detention/retention facility without attenuation. Such runoff may also be routed through the detention/retention facility, provided that a separate outlet system or channel is incorporated for the safe passage of such flows, i.e., not through the primary outlet of a detention facility. Unless the pond is being designed as a regional detention facility, the primary outlet structure shall be sized, and the invert elevation of the emergency overflow weir determined according to the on-site runoff only. Once the size and location of primary outlet structure and the invert elevation of the emergency overflow weir are determined by considering on-site runoff, the one hundred (100) year pond elevation is determined by routing the entire inflow, on-site and off-site, through the pond.

Note that the efficiency of the detention/retention facility in controlling the on-site runoff may be severely affected if the off-site area is considerably larger than the on-site area. As a general guidance, on-line detention may not be effective in controlling on-site runoff where the ratio of off-site area to on-site area is larger than 5:1. Additional detention (above and beyond that required for on-site area) may be required by the City or City Engineer when the ratio of off-site area to on-site area is larger than 5:1.

D. Downstream Restrictions

In the event the downstream receiving channel or storm sewer system is inadequate to accommodate the post-developed release rate provided above,

then the allowable release rate shall be reduced to that rate permitted by the capacity of the receiving downstream channel or storm sewer system. Additional detention, as determined by the City or City Engineer, shall be required to store that portion of the runoff exceeding the capacity of the receiving sewers or waterways. When such downstream restrictions are suspected, the City or City Engineer may require additional analysis to determine the receiving system's limiting downstream capacity.

If the proposed development makes up only a portion of the undeveloped watershed upstream of the limiting restriction, the allowable release rate for the development shall be in direct proportion to the ratio of its drainage area to the drainage area of the entire watershed upstream of the restriction.

16.4 General Detention Basin Design Requirements

- A. The detention facility shall be designed in such a manner that a minimum of 90% of the maximum volume of water stored and subsequently released at the design release rate shall not result in a storage duration in excess of forty-eight (48) hours from the start of the storm unless additional storms occur within the period. In other words, the design shall ensure that a minimum ninety (90) percent of the original detention capacity is restored within forty-eight (48) hours from the start of the design one hundred (100) year storm.
- B. The one hundred (100) year elevation of stormwater detention facilities shall be separated by not less than twenty-five (25) feet from any building or structure to be occupied. The Lowest Adjacent Grade (including walkout basement floor elevation) for all residential, commercial, or industrial buildings shall be set a minimum of two (2) feet above the one hundred (100) year pond elevation or two (2) feet above the emergency overflow weir elevation, whichever is higher. In addition to the Lowest Adjacent Grade requirements, any basement floor must be at least a foot above the normal water level of any wet-bottom pond.
- C. No detention facility or other water storage area, permanent or temporary, shall be constructed under or within twenty (20) feet of any pole or high voltage electric line. Likewise, poles or high voltage electric lines shall not be placed within twenty (20) feet of any detention facility or other water storage area.
- D. All stormwater detention facilities shall be separated from any road right-of-way by no less than one right-of-way width, measured from the top of bank or the 100-year pool if no defined top of bank is present, using the most restrictive right-of-way possible. If the width of the right-of-way is less than 50 feet, then the minimum distance between top of bank and road right-of-way shall be increased to 50 feet. Use of guard rails, berms, or other structural measures may be considered in lieu of the above-noted setbacks.
- E. Slopes no steeper than three (3) horizontal to one (1) vertical (3:1) for safety, erosion control, stability, and ease of maintenance shall be permitted.
- F. Safety screens having a maximum opening of four (4) inches shall be provided for

any pipe or opening to prevent children or large animals from crawling into the structures.

- G. Prior to final acceptance, danger signs shall be mounted at appropriate locations to warn of deep water, possible flood conditions during storm periods, and other dangers that exist. The locations of the noted danger signs shall be shown on the plans.
- H. Use of fences around all detention ponds is strongly encouraged to assure safety. Unless specifically required by the City or City Engineer, the decision to use fencing around detention ponds are left to the owner or the developer. Recommendations contained within this document do not relieve the applicant and owner/developer from the responsibility of taking all necessary steps to ensure public safety with regards to such facilities.
- I. Outlet control structures shall be designed to operate as simply as possible and shall require little or no maintenance and/or attention for proper operation. For maintenance purposes, the outlet shall be a minimum of 0.5 foot above the normal water level of the receiving water body. They shall limit discharges into existing or planned downstream channels or conduits so as not to exceed the predetermined maximum authorized peak flow rate.
- J. Emergency overflow facilities such as a weir or spillway shall be provided for the release of exceptional storm runoff or in emergency conditions should the normal discharge devices become totally or partially inoperative. The overflow facility shall be of such design that its operation is automatic and does not require manual attention.
 - 1. Off-site flows greater than the allowable release rate for the pond shall be conveyed through the emergency spillway, not through the primary outlet structure. Unless the pond is being designed as a regional detention facility, the primary outlet structure shall be sized and the invert elevation of the emergency overflow weir determined according to the on-site runoff only and all other flows shall be either retained or safely bypassed through the emergency overflow weir.
 - 2. Emergency overflow facilities shall be designed to handle one and one-quarter (1.25) times the peak inflow discharge and peak flow velocity resulting from the one hundred (100) year design storm event runoff from the entire contributing watershed draining to the detention/retention facility, assuming post-development condition on-site and existing condition off-site.
- K. Grass or other suitable vegetative cover shall be provided along the banks of the detention storage basin. Vegetative cover around detention facilities should be maintained as appropriate.
- L. Debris and trash removal and other necessary maintenance shall be performed on a regular basis to assure continued operation in conformance to design.

- M. No residential lots or any part thereof, shall be used for any part of a detention basin or for the storage of water, either temporary or permanent.

16.5 **Additional Requirements for Wet-Bottom Facility Design**

Where part of a detention facility will contain a permanent pool of water, all the items required for detention storage shall apply. Also, a controlled positive outlet will be required to maintain the design water level in the wet bottom facility and provide required detention storage above the design water level. However, the following additional conditions shall apply:

- A. Facilities designed with permanent pools or containing permanent lakes shall have a water area of at least one-half (0.5) acre. If fish are to be used to keep the pond clean, a minimum depth of approximately ten (10) feet shall be maintained over at least twenty-five (25) percent of the pond area. The remaining pond area shall have no extensive shallow areas, except as required to install the safety ramp, safety ledge, and BMPs as required below. Construction trash or debris shall not be placed within the permanent pool.
- B. A safety ledge six (6) to ten (10) feet in width, depending on the presence of a security fence, is required and shall be installed in all lakes approximately 18 inches below the permanent water level (normal pool elevation). In addition, a similar maintenance ledge twelve (12) inches above the permanent water line shall be provided. The slope between the two ledges shall be stable and of a material such as stone or riprap which will prevent erosion due to wave action. The slopes below the safety ledge shall be 3:1 (horizontal to vertical) or flatter. The slopes above the safety ledge shall be 6:1 or flatter, unless a safety fence is used, in which case the side slopes above the safety ledge (except for the safety ramp area) shall be 3:1 or flatter.

As illustrated in **Standard Detail ST-7** and **ST-8**, the safety ledge is currently required to be 18 inches below the normal pool and six (6) to ten (10) feet wide, depending on the presence of a security fence. As an alternative to providing a security fence, the depth of safety ledge could be changed to be anywhere from zero (0) to six (6) inches below normal pool to encourage vegetation growth. Wetland plants can be installed as container grown plants or as seed at the time of construction, or the area can be left to be naturally colonized. When a vegetated ledge is used in lieu of a security fence, the safety ledge width shall be increased to fifteen (15) feet to allow more room to stop in the event of accidental entry into the pond. The vegetated ledge might discourage play near the edge of the pond and help stop a wayward bike or sled. Additional benefits to the vegetated ledge are stormwater quality improvement and goose deterrence. In lieu of a vegetated safety ledge, a zone of dense shrubs could be installed around the perimeter of the pond to discourage access. Shrubs and vines with briars and thorns or dense growth patterns make good deterrents.

Special Regulatory Note:

Detention ponds that include wetland features will not fall within the jurisdiction of IDEM or COE as long as:

- The pond is clearly identified on plans and in accompanying documentation as a stormwater treatment Best Management Practice (BMP).

The pond has not been abandoned and is maintained as originally designed.

The pond is not part of required wetland mitigation.

Construction of the pond does not impact existing jurisdictional wetlands or waterways.

Therefore, detention pond maintenance would not require a permit just because wetland features have been included in their construction.

In lieu of a vegetated safety ledge, a zone of dense shrubs could be installed around the perimeter of the pond to discourage access. Shrubs and vines with briars and thorns or dense growth patterns make good deterrents.

- C. A safety ramp exit from the lake shall be required in all cases and shall have a minimum width of twenty (20) feet and exit slope of 6 horizontal to 1 vertical (6:1). The safety ramp shall be constructed of suitable material to prevent structural instability due to vehicles or wave action.
- D. Periodic maintenance is required in lakes to control weed and larval growth. The facility shall also be designed to provide for the easy removal of sediment that will accumulate during periods of reservoir operation. A means of maintaining the designed water level of the lake during prolonged periods of dry weather may also be required.
- E. Methods to prevent pond stagnation, including but not limited to aeration facilities, shall be included on all wet-bottom ponds. Design calculations to substantiate the effectiveness of proposed aeration facilities shall be submitted with final engineering plans. Agreements for the perpetual operation and maintenance of aeration facilities shall be prepared to the satisfaction of the City or City Engineer.
- F. For visual clarification, refer to **Standard Detail ST-7** and **ST-8**.

16.6 Additional Requirements for Dry-Bottom Facility Design

In addition to general design requirements, detention facilities that will not contain a permanent pool of water shall comply with the following requirements:

- A. Provisions shall be incorporated into facilities for complete interior drainage of dry bottom facilities, including the provisions of natural grades to outlet structures, longitudinal and transverse grades to perimeter drainage facility, paved gutters, or the installation of subsurface drains.

- B. For residential developments, the maximum planned depth of stormwater stored shall not exceed four (4) feet.
- C. In excavated detention facilities, a minimum side slope of 3:1 shall be provided for stability. In the case of valley storage, natural slopes may be considered to be stable.

16.7 Parking Lot Storage

Paved parking lots may be designed to provide temporary detention storage of stormwater on all or a portion of their surfaces. Outlets for parking lot storage of stormwater will be designed so as to empty the stored waters slowly. Depths of storage shall be limited to a maximum depth of seven (7) inches so as to prevent damage to parked vehicles and so that access to parked vehicles is not impaired. Ponding should in general, be confined to those positions of the parking lots farthest from the area served.

16.8 Detention Facilities in Floodplains

If detention storage is provided within a 100-year floodplain, only the net increase in storage volume above that which naturally existed on the floodplain shall be credited to the development. In order to be hydraulically effective, the rim elevation of such detention pond, including any open spillways, should be at or above the 100-year floodplain elevation and, unless the detention pond storage is provided entirely above the 100-year flood elevation, any pipe outlets must be equipped with a backflow prevention device. A detention pond constructed within the 100-year floodplain and utilizing a backflow prevention device will eliminate the floodplain storage that existed on the detention pond site and will therefore require compensatory floodplain storage. The detention analysis for a detention pond in the floodplain must consider appropriate tailwater impacts and the effect of any backflow prevention device.

16.9 Joint Development of Control Systems

Stormwater control systems may be planned and constructed jointly by two or more developers as long as compliance with this Standard is maintained.

16.10 Diffused Outlets

When the allowable runoff is released in an area that is susceptible to flooding or erosion, the developer may be required to construct appropriate storm drains through such area to avert increased flood hazard caused by the concentration of allowable runoff at one point instead of the natural overland distribution. The requirement of diffused outlet drains shall be at the discretion of the City or City Engineer.

16.11 IDNR Requirements

All designs for basins to be constructed in the floodway of a stream with a drainage area of one square mile or more must also satisfy IDNR permit requirements.

16.12 Allowance for Sedimentation

Detention basins shall be designed with an additional ten (10) percent of available capacity to allow for sediment accumulation resulting from development and to permit the pond to function for reasonable periods between cleanings. Basins should be designed to collect sediment and debris in specific locations, such as a forebay, so that removal costs are kept to a minimum. For wet-bottom ponds, the sediment allowance may be provided below the permanent pool elevation. No construction trash or debris shall be allowed to be placed within the permanent pool. If the pond is used as a sediment control measure during active construction, the performance sureties will not be released until sediment has been cleaned out of the pond and elevations and grades have been reestablished as noted in the accepted plans.