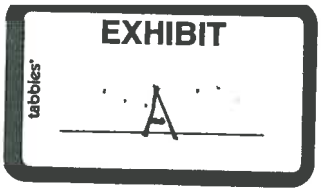

3.2 Detention/Retention Design

1. General Requirements

The design methods and criteria outlined within this section shall be used in the design and evaluation of detention/retention systems within the City of Mason. All designs must be supplemented with a detention/retention design summary report. A sample detention/retention design summary report is provided by Form 4. Detention/retention shall be required on all new development.

The release point flow, velocity, and storage volume of any detention/retention basin shall be designed such that the stormwater released shall not adversely effect the downstream property owners for the 1-, 2-, 5, 10-, 25, 50-, and 100-year storm events. The engineer must assure that there is adequate capacity in the downstream storm sewer system, ditch, culvert, stream, etc. to accept the basins discharge from all of the storm events. It may be necessary for the engineer to provide a detailed hydraulic analysis of the downstream stormwater system to assure that there is adequate capacity in the downstream system. "Adequate capacity" includes engineering analysis to confirm that downstream structures will not be adversely impacted, velocities do not increase to erosive speeds, and proposed uses of off-site properties are not impacted. If the downstream system is not adequate to accept the proposed peak discharges, the allowable detention/retention basin discharge must be reduced or the developer must upgrade the downstream system.

2. Design Criteria.

Design of any type of detention/retention basin must include hydrograph routing through the basin to size the proposed outlet structure. Refer to the Hydrology section of this policy to determine the methodology acceptable to the City. Stormwater management facilities shall be designed to the following general guidelines:

a) Stormwater management systems shall be designed for the ultimate use of the watershed, including off-site drainage. Development areas developed for subdivisions shall provide a stormwater management system for the ultimate development of all the subdivided lots.

b) A detention/retention facility is not permitted on an individual lot in a single-family residential development, unless the lot is owned and maintained by a HOA. The facility can be built as part of the subdivision green space area owned and maintained by the HOA with access to the basin by each property owner in the subdivision.

~~b~~c) Stormwater management facilities shall be designed so that they will continue to function with minimal maintenance. The facilities shall be designed and maintained in a manner that improves water quality such

that unwanted vegetation, stagnation, and mosquito colonies are prevented and the water quality remains habitable for aquatic species. In order to achieve this, the plan should include but is not limited to aquatic habitat design features, vegetation control measures, rip-rap around the basin above and below the normal pool elevations and mechanical aerators.

~~c)~~d) Stormwater management facilities shall be designed with specific regard to safety.

~~d)~~e) The design criteria shall be applied to each watershed within the development area. Post-development drainage crossing pre-development drainage divides is generally discouraged. However, if this is impractical, all pre- and post-development runoff rates and volumes shall be calculated using their respective predevelopment drainage divides and submitted to the City Engineer for review.

~~e)~~f) To protect property from flood damage and channel erosion, and to protect water resources from degradation resulting from accelerated stormwater flows, all development areas shall be designed and constructed in compliance with these regulations.

All basins must include the following design criteria:

a) The Ohio Department of Natural Resources requires a permit for dam construction if;

1) the embankment is greater than 10 feet in height, or

2) the maximum capacity of the dam is greater than 15 acre-feet

b) Other permits – additional permits may be required when constructing a detention/retention basin. The developer is responsible for obtaining all necessary state and local permits.

c) Embankment – vegetated areas 3 feet above normal water depth of wet detention basins shall have an earthen embankment constructed with side slopes no steeper than 3 (horizontal) to 1 (vertical). The embankment shall be constructed of a compacted (98% Std. Proctor) clean clay core with at least 6 inches of topsoil on any area that will support vegetation. Side slopes from 3 feet above normal water depth to 3 feet below normal water depth shall be 6:1 (6 horizontal to 1 vertical) or flatter. Sod or rock/riprap shall be used for all side slopes of the detention basin.

d) Freeboard – the maximum water surface elevation shall be at least 1.0 feet below the top of the basin.

e) Impervious runoff - all impervious area on the site shall be routed through the detention/retention facility.

f) Retention basins – the minimum normal depth of a ~~wet pond~~retention basin, calculated at the deepest point in the ~~pond~~basin, shall be eight (8) feet.

g) Boundary - for basins in single-family residential developments the boundary lines for the basin must extend to the maximum flood limits. Access shall be provided for maintenance purposes and property owner access around the entire basin by providing an easement or extending the boundary of the basin. More stringent requirements for stormwater easement size and additional covenants may be made by the City Engineer based upon individual site conditions.

h) Lot Access - the basin lot must have a minimum width of twenty (20) feet lot frontage along a dedicated right-of-way for equipment access. A maintenance vehicle access way having a minimum width of 10 feet shall be provided. The access way shall be located around the perimeter of each facility, have a cross slope no steeper than 10 to 1 and be stabilized with suitable materials adequate to prevent excessive rutting by the maintenance vehicles.

~~g)~~i) Overflow – the detention basin shall be designed so that an overflow structure and path exists with the capacity of the 100-year storm. A safe overland flow path for the 100-year storm must be shown on the construction drawings.

~~h)~~j) Outlet structures – basin outlet structures should be designed so that trash and clogging is not a problem. Overly small or narrow openings should be avoided or protected by grates and trash racks.

~~i)~~k) Basin bottoms – dry basins should be sloped to drain and should include a concrete low-flow channel to aid in maintenance. The minimum slope in a dry basin should be 1.0 percent.

l) Infiltration Prevention - to prevent the permanent pool from partially or completely infiltrating into the ground, retention basins shall only be allowed under the following conditions:

1) Where existing soils are categorized as hydrologic soil group C (HSG-C) or hydrologic soil group D (HSG-D) and gravelly sands or fractured bedrock are not present, or

2) Where a liner is installed to sustain the permanent pool of water.

m) Aeration - mechanical aeration or fountains shall be provided for each retention basin. Aeration must be of sufficient number and/or size to provide water circulation for the entire basin.

n) Modification - No modifications to the facility shall be made unless approved by the City Engineer e.g., reducing the size of the facility, adding fill, trees, etc.

o) Public street rights-of-way will not be acceptable areas for construction of detention/retention facilities.

Local Basins are defined as detention/retention facilities that have a total developed watershed area of less than 5.0 acres and do not have significant downstream restrictions.

Major Basins are detention/retention facilities that have a total developed watershed area greater than 5.0 acres or have significant downstream restrictions. The City Engineer shall make the final decision on whether the downstream area has significant restrictions. The minimum hydraulic performance levels and accepted design methodologies for local and major basins shall conform to the criteria identified in the Hydrology section of this document.

All off-site flows must be taken into account. The engineer can design a conveyance system that will safely pass the off-site flows through the development. This conveyance system design must use the 100-year developed conditions storm event and must follow the open channel section requirements of this policy. However, the allowable release rate from the site must include the pre-developed discharges from both on-site and off-site watersheds.

Alternately, the design engineer may wish to pass off-site flows through the detention/retention basin. This design must provide the off-site flows an adequate conveyance system to the basin. The basin design must incorporate the pre-developed conditions flows for both on-site and off-site watersheds in calculating the allowable release rates. When designing this system, the engineer shall assure that the basin and conveyance system will safely accept the off-site flows under current conditions as well as fully developed conditions in the watershed.

Example

If the percent increase in runoff between pre- and post-development is 45%, the basin must control the developed conditions 5-year storm back to the pre-developed 1-year storm. The 10-, 25-, 50-, and 100-year developed conditions storms must also be controlled to per-developed conditions flows.

3. Outlet Structure and Routing Design

All stormwater basins must be designed using hydrograph routing through the basin. All hydrograph routing calculations must be included in the detention/retention design summary report. Stage-Storage and Stage-Discharge

graphs and backup calculations must be presented in a clear and concise manner. Drowned effects of orifices and weirs must be taken into account in the outlet structure. The principal outlet pipe must be designed taking into account inlet/outlet control and tailwater effects. Outlet protection is required and must be designed using the highest flow velocity of the 1- through 100-year peak discharges. Outlet protection design as described under the outlet protection section of this chapter shall be the minimum required for outlet structures of detention basins.

4. Outlet Hydraulics

The outlet hydraulics of a detention/retention basin typically consist of two types of flow, orifice and weir flow. The basic equation for determination of orifice flow is as follows:

$$Q = C_D A\sqrt{2gH}$$

Where:

Q = peak discharge rate, cfs
C_D = coefficient of discharge, dimensionless
A = cross sectional area of orifice, square feet
g = acceleration due to gravity (32.2 ft/sec^2)
H = head on the orifice, feet.

The value of H is determined by different methods depending upon the location of the water surface as follows:

Free Discharge: H is the difference in elevation between upstream water surface and center of flow of the orifice.

Submerged Orifice: H is the difference in elevation between upstream and downstream water surfaces.

The value of the coefficient of discharge C_D is a function of the size and shape of the orifice, the head on the orifice, the sharpness of the orifice's edge, the roughness of the inner Surface, and the degree to which the contraction of flow is suppressed (Reference King's Handbook of Hydraulics). A nominal value of 0.60 may be used for the standard types of orifices and head ranges used for outlet control structures, however, sound engineering judgement must be used in the practical application of this value.

Weir structures may be sharp-crested, rounded, or broad-crested. The means by which a weir functions can change depending upon the depth of head above the weir. A broad-crested weir may become a sharp-crested weir at higher heads, depending upon its physical configuration.

The general equation for weir flow is as follows:

$$Q = C_D L H^{1.5}$$

Where:

Q = peak discharge rate, cfs
C_D = coefficient of discharge, dimensionless
L = length of the weir, feet
H = head on the weir, the difference in elevation between the weir crest and the water surface measured upstream of the crest a short distance, feet.

Values of C_D for sharp-crested, rectangular weirs can range from about 3.3 to 4.9. This coefficient is dependent upon the head on the weir, the height of the weir crest above the streambed, and the degree of submergence. Values of C_D can be selected from tables in King's Handbook of Hydraulics or other suitable references. Sound engineering judgement must be used in the interpretation of C_D values for various design conditions.

5. Maintenance

~~The property owners shall be responsible for permanent maintenance of stormwater management facilities and other facilities designed to manage stormwater runoff, including maintaining the hydraulic integrity of stormwater management facilities. If the stormwater management facilities fail to function as designed, the City has the right to enter onto the property and take any corrective action necessary to assure that the system functions properly.~~
It is essential that detention/retention facilities are properly maintained in order to assure its performance; therefore, the developer shall prepare a facility maintenance plan as part of the construction drawing and stormwater design calculations. The maintenance plan shall be submitted to the City Engineer for approval at the time of the site construction plan approval process.

Maintenance plans shall include a method and frequency for inspection of all permanent structures; debris/clogging control through appropriate removal and disposal; vegetation control (mowing, harvesting, wetland plants); erosion

repair; non-routine maintenance including sediment removal, the rejuvenation or replacement of filters and appropriate soils. Mosquito monitoring and abatement, encompassing inspections for conditions conducive to mosquito breeding, routine (e.g., vegetation control, debris, and sediment removal) and non-routine (e.g., restoration of grade to eliminate ponding) activities to address these conditions, and conditions where the use of insecticides may be warranted.

Every homeowner in the subdivision shall be equally financially responsible to provide maintenance in accordance with the approved maintenance plan.

When the detention/retention facility is built a sign shall be placed near the facility identifying maintenance responsibility of this facility. When the facility is transferred from the developer/builder to HOA the sign shall be replaced accordingly.

Before the basin is transferred to the HOA for maintenance responsibilities an inspection report shall be furnished to the City Engineer. This inspection must be performed by a licensed professional engineer certifying that the detention/retention facility has full storage capacity, all inlet and outlet structures are fully functional, and the facility is maintained in accordance with the approved construction and maintenance plans. Approved maintenance plans and all maintenance records shall be transferred to the homeowners association (HOA) when the property and other documents are transferred to HOA.

Each year on or before June 30, the owner of the detention/retention facility shall provide to the City a certification that the facility appears to be maintained in accordance with the approved plan. A compliance certification shall be completed by a company or person trained in the maintenance of detention/retention facilities.

If the stormwater management facilities fail to function as designed or if the above maintenance requirements have not been adhered to the City has the right to enter onto the property and take any corrective action necessary to assure the system functions properly. Costs associated with such work shall be assessed back to the developer through the performance or maintenance bond or each property owner in the subdivision or to the HOA.