ARTICLE 5

STORM DRAINAGE

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ARTICLE 5

STORM DRAINAGE

SECTION 5-100 GENERAL INFORMATION

1. Except as specified below, stormwater requirements for each land development application shall be subject to the version of this DCSM in effect at the time of initial acceptance.

2. A land development application that is subject to the grandfathering provisions of Section 14-23(e)(4) of the Town Code shall meet the technical criteria of Section 5-311.5 of this DCSM as well as the following additional provisions:

   A. The land development application shall have been approved prior to July 1, 2012.

   B. The land development application shall be a proffered plan of development, Special Exception, Preliminary Plat of Subdivision, Record Plat, Construction Plans and Profiles, Site Plan, Minor Site Plan, Mini Site Plan, Site Plan Waiver, Dedication Plat, Boundary Line Adjustment, Easement and Vacation Plat, Dedication Plat as well as any Plat and Plan Revision.

   C. "Layout" means a conceptual drawing sufficient to provide for the specified stormwater management facilities required at the time of approval, as defined in 9VAC-25-870-10.

   D. The land development application has not been subsequently modified or amended in a manner resulting in an increase in the amount of phosphorus leaving each point of discharge or the volume or rate of runoff. In order to verify this condition, a comparison of the layouts between the original land development application and the modified version may be utilized. If the comparison of layouts is not conclusive, a comparison of performance based calculations found in the technical criteria of Part II.C (9VAC25-870-10) as well as water quantity engineering calculations shall be required.

   E. Land development applications on parcels or lots which are part of a residential, commercial, or industrial subdivision served by an approved stormwater management facility designed to treat the said parcel or lot shall be deemed grandfathered.

3. The overall drainage system for the 10 year and larger storm events for all plans submitted to the town will consist of a major and a minor drainage system. Any plans submitted to the town that are subject to the grandfathering provisions of Section 14-23(e)(4) of the Town Code or those plans vested prior to July 1, 2014,

shall also consider major and minor drainage systems for the less frequent 1 and 2 year storm events.

A. The minor drainage system consists of open channels and/or closed storm sewer appurtenances and conduit drainage systems such as inlets, manholes, street gutters, roadside ditches, swales, underground pipe, and small channels from the point of interception to the point of discharge in all developments.

B. The major drainage system consists of natural waterways and drainage ways such as overland relief swales and paths. The major system also includes the natural backup system which functions in case of overflow from or failure of the minor system. Therefore, the major drainage system shall be designed to provide overland relief to convey the 100-year rainfall event as if the minor system has failed to function or did not exist.

C. Overland relief requirements are found in Section 5-200.

D. Either system may include stormwater quantity and/or quality management facilities, including regional stormwater management facilities.

4. When development proposes to:

A. Relocate existing storm drainage lines/stormwater management facilities; or

B. Encroach upon existing storm drainage lines/stormwater management easements with physical improvements; or

C. Reduce cover over existing storm drainage lines to less than that specified by this DCSM; or

D. Increase cover over existing storm drainage lines to more than that specified by this DCSM;

Then the developer shall be responsible for replacement of the storm drainage line/stormwater management facility at a new location during development of the property. Such replacement shall be to the standards and specifications set

forth in this DCSM, shall be approved by the Director, and shall be at no cost to the Town.

5-110 Intent

The intent of this Article is to require that all components of the drainage system meet or exceed applicable stormwater management laws and regulations.

5-120 References

The following regulations and technical documents are included by reference for storm drainage system design and performance standards within the Town of Leesburg. Applicable provisions of these regulations and technical documents are referenced as appropriate in this DCSM. Where there is a conflict between the standards presented in this DCSM and the regulations and technical documents reference in this section, the more stringent of the standards will apply unless otherwise modified by the Director:

1. Virginia Stormwater Management Program (VSMP) Permit Regulations, 9VAC25-870 et al.

2. Virginia Erosion and Sediment Control Regulations, 9VAC25-840 et al.

3. Virginia Chesapeake Bay Preservation Area Designation and Management Regulations, 9VAC25-830 et al.

4. Virginia Erosion and Sediment Control Handbook, Virginia Department of Environmental Quality (DEQ), latest edition.

5. Virginia Department of Transportation Drainage Manual, Virginia Department of Transportation (VDOT), latest edition.

6. Virginia Department of Transportation Road and Bridge Specifications, VDOT, latest edition.

7. Virginia Department of Transportation Road and Bridge Standards, VDOT, latest edition.

8. Urban Hydrology for Small Watersheds (TR-55), Soil Conservation Services, Washington, D.C., National Technical Information Service, Springfield, Virginia 22161, latest edition, or NCRS version WIN TR-55, latest edition.

9. TR-20 Project Formulation -- Hydrology Soil Conservation Service, Lanham, Maryland, National Technical Information Service, Springfield, Virginia 22161, latest edition, or NCRS version WIN TR-20, latest edition.

10. Virginia Stormwater Management Handbook, DEQ, latest edition.

11. Virginia Stormwater BMP Clearinghouse, DEQ and the Virginia Water Resources Research Center (VWRRC) at Virginia Tech, latest edition.

12. Modern Sewer Design, American Iron and Steel Institute, latest edition.

13. Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe, ASTM Standard C76, 2013a, ASTM International, West Conshohocken, PA, 2013, DOI: 10.1520/C0076-31A.

14. Design of Riprap Revetment, Federal Highway Administration (FHWA), Hydraulic Engineering Circular No. 11 (HEC 11), FHWA-IP-89-016, Washington, DC, 1989.

15. Hydraulic Design of Energy Dissipaters for Culverts and Channels, FHWA, Hydraulic Engineering Circular No. 14 (HEC 14), FHWA-NHI-06-086, Washington, DC, 2006.

16. Design of Roadside Channels with Flexible Linings, FHWA, Hydraulic Engineering Circular No. 15 (HEC 15), FHWA-NHI-05-114, Washington, DC, 2005.

17. Methodology for Identification of Intermittent and Perennial Streams and Their Origins, North Carolina Department of Environment and Natural Resources, Division of Water Quality, latest edition.

18. Other regulations and technical documents as approved by the Director.

For additional references and definition of terms used within this Article, refer to Article 11 of this DCSM.

(End of Section)

SECTION 5-200 POLICY FOR ADEQUATE STORM DRAINAGE

5-210 General

1. An evaluation shall be performed for all proposed drainage systems to ensure adequate hydraulic capacity for conveyance of the minimum ten-year event including, but not limited to channels, stormwater management facilities, and conduits.

2. Hydraulic capacity must be verified with engineering calculations, in accordance with the procedures outlined in the Virginia Erosion and Sediment Control Handbook, the Virginia Department of Transportation Drainage Manual, the Virginia Stormwater Management Handbook, the Virginia Stormwater BMP Clearinghouse, or other methods acceptable to the Director.

3. The drainage system must have the hydraulic capacity to accommodate the maximum expected flow of surface waters from a drainage area at a point of concentration for the duration and intensity of rainfall, as specified herein.

4. Determination of the size and capacity of the drainage system shall be based on the planned development, existing zoning, or Town Plan, whichever is greater, within the watershed.

5. Due consideration must be given to infrequent events (100-year) resulting in runoff quantities greater than minor system design capacity. Therefore, the design for the major drainage system shall provide for overland relief of the 100-year event without flooding or damaging buildings and structures, generally without reliance upon the minor drainage system. Specifically, all construction plan sets shall contain provisions for the 100-year overland relief as follows:

   A. If the area draining to a low point inlet is equal to or less than one (1) acre, a minimum of one (1) foot shall be provided from the lowest opening of any building to the ground elevation at the relief point along any point of the path of overland relief. The designer shall also have the option to use engineering calculations and cross sections to determine the actual 100-year water surface for any size drainage area and provide the required freeboard as noted below for drainage areas in excess of one (1) acre.

B. If the area draining to a low point inlet is greater than one (1) acre, engineering calculations and cross sections shall be provided to verify that the lowest point of entry of all buildings will be a minimum of 6 inches vertically above the 100-year water surface at the relief point along the overland relief pathways (to a minimum 6 inches of freeboard). Where the area of overland relief is restricted and the applicant can prove that adjacent and downstream structures will not be flooded or damaged by the 100-year overland relief flow, the Director may, on a case by case basis reduce the amount of freeboard required for the 100-year overland relief water surface to zero (0) feet such that the 100-year water surface elevation is at the elevation of the lowest opening of the building or structure.

C. Unless the construction drawings depict a minimum of one foot of freeboard has been provided from the 100-year water surface to the lowest opening of an adjacent building(s), an as-built drawing shall be provided, prior to issuance of an occupancy permit, to specifically depict the controlling elevation along the path of overland relief as well as the elevation of the lowest opening of any adjacent building(s) to ensure the site has been constructed in conformance with the approved plans and that the adjacent buildings will not flood during the 100-year rain storm event.

D. On a case by case basis, the Director may approve a modification to the requirements set forth in this section of the DCSM to permit calculations associated with the proposed development to consider a portion of the upstream and/or onsite 100-year “overland” relief flow to be routed through the underground storm pipe drainage system when:

(1) The overland relief path is restricted by site constraints beyond the applicant’s control; and

(2) The underground storm drainage system consists of a RCP pipe 48 inches (or equivalent) and larger in diameter; and

(3) The storm inlets are designed to capture the portion of the 100-year storm event to be routed through the underground pipe; and

(4) The underground storm system pipe has been designed to have capacity for the required 10-year flow plus the portion of the

100-year flow to be utilized in the underground pipe drainage system; typically, no more than 50% of the 100-year overland relief flow will be allowed to be routed through the underground pipe drainage system.

*A modification request may not be required for overland relief calculations that only analyze offsite downstream properties.

6. The drainage system shall be designed:

A. To generally honor all natural drainage divides and create no adverse impact on downstream properties.

B. To account for all off-site and on-site surface water.

C. To manage, convey, and discharge surface waters as outlined in the Virginia Stormwater Management Handbook.

D. To manage, convey, and discharge surface waters to a stormwater management facility of sufficient capacity and pollutant removal efficiency to meet the requirements of Section 5-300 "Policy for Stormwater Management." The Director may require additional design criteria based on the watershed's special requirements, as identified in the Town's Stormwater Master Plan.

E. To protect residences and other occupied structures from being inundated with stormwater.

F. To not increase stormwater sheet flow (non-concentrated) into a lower-lying property.

G. To preserve adequate natural channel characteristics to the extent practicable.

H. To provide (if the above conditions are not met) a drainage system satisfactory to the Director, to provide an acceptable outfall in accordance with the stormwater requirements in this DCSM, and to preclude adverse impacts upon adjacent or downstream properties.

7. Except where prohibited by Section 14-23 of the Town Code, the owner or developer may continue to discharge stormwater as sheet flow (non-concentrated) into a lower-lying property if at the same location:

   A. The post-development peak runoff rate based on documentation and computations, including sheet flow, does not exceed the pre-development peak rate; or

   B. If the above conditions are not met, the developer must provide a drainage system satisfactory to the Director, to preclude adverse impacts upon adjacent or downstream properties.

8. The owner or developer may not discharge stormwater which has been artificially concentrated by a pipe, culvert, channel, or other drainage structure, onto or through lands of another without first obtaining and transferring to the Town a permanent storm drainage easement to guarantee continuity of an outfall from the point of discharge to the nearest stormwater conveyance system. Refer to Section 5-700.

9. If off-site downstream construction and easements are required to provide channel protection or flood protection, no plans shall be approved until such storm drainage easements have been obtained and recorded. It will be the responsibility of the developer to obtain all off-site easements.

10. Storm sewer systems shall be designed in a manner such that their outfalls:

    A. Are designed to reduce erosion of surrounding soils.

    B. Discharge at a natural watercourse:

       (1) Generally, it is better to discharge at the 100-year flood plain limits into an adequate channel leading to the main stream bed, rather than disturb the flood plain by extending the storm sewer system.

       (2) If there is no well-defined adequate receiving channel at the flood plain limits, one shall be constructed to the bed and banks of the main channel. If wetlands are encountered, the Director may on a case by case basis approve a modification to utilize a

forebay or other type of an energy dissipation device at the pipe outfall to minimize the impact to existing wetlands areas.

C. Discharge at other locations:

(1) Energy dissipation devices and/or friction channel linings shall be used when discharge velocities exceed the maximum permissible as defined by the Virginia Erosion and Sediment Control Handbook or at the discretion of the Director where non-uniform channel linings are involved. Generally, the use of natural rock located on the subject development site is encouraged when the equivalency can be met by a geotechnical engineer's written certification of the material.

a. 2 FPS to 5 FPS velocity: Sod protection (Kentucky Blue Grass or equally resistant sod or other material as approved by the Director) or VDOT CLI Rip Rap or current equivalent as noted above.

b. 5 FPS to 8 FPS velocity: VDOT CLI Rip Rap or current equivalent as noted above; Length of Rip Rap to be determined in accordance with the Virginia Erosion and Sediment Control Handbook.

c. 8 to 18 FPS velocity: VDOT CL II dry Rip Rap (VDOT Specification 418.04) or current equivalent as noted above; Length of Rip Rap to be determined in accordance with the Virginia Erosion and Sediment Control Handbook.

d. Velocities in excess of 18 FPS: Shall only be permitted with special design energy dissipation devices or impact basins and only with the approval of the Director.

D. Shall not discharge in the front yard of any single family detached or attached lot. The outfall shall discharge at the rear lot line and meet all criteria noted in this DCSM.

11. Except as set forth in Section 5-420, paragraph two, Policy on Use in Flood Plain Areas, all drainageways, including overland relief pathways, must be separated from buildings as stated in this section of this DCSM.

12. Plans shall be prepared to preclude adverse impacts due to higher flow rates that may occur during construction. Refer to Article 6 of this DCSM.

13. Drainage structures shall be designed and constructed in such a manner that they may be maintained at a reasonable cost and with methods and types of equipment currently used by the town.

    A. To facilitate design, construction, and maintenance, drainage facilities shall meet and conform to the Town of Leesburg and Virginia Department of Transportation Standards.

    B. Special alternative designs for reinforced concrete special structures and for reinforced concrete prefabricated pipe junctions (pipe 60" diameter and larger) shall be considered by the Director on a case-by-case basis provided they are designed and documented.

        (1) All structures and pipe junctions shall be by use of VDOT standard reinforced concrete structures unless a specific alternative design is approved by the Director. Specific alternative designs will not be approved if a standard structure will perform the function.

        (2) Alternative designs which have received VDOT pre-approval are required if the structure is located within a Town road right-of-way and are preferred in other locations; however, an alternative design prepared by a structural engineer licensed to practice in the Commonwealth of Virginia is acceptable under the following conditions:

            a. The structure is not located within a Town road right-of-way.

            b. The structure or junction is prefabricated by a manufacturer normally engaged in reinforced concrete pipe and structure manufacture.

c. All structural design, signed, sealed and dated (original seal affixed), is provided to the town. The structural design shall not be included on the construction drawings as the town will not review or approve the structural design which shall remain the responsibility of the engineer of record.

d. Construction details delineating how the special structure or the prefabricated pipe junction is to be incorporated into the drainage system, and detailing the assembly of the entire drainage structure shall be included in the construction drawings.

(3) Manhole access shall be provided at each special structure and at each prefabricated pipe junction:

a. Minimum 4' diameter manhole.

b. Manhole step side shall align with pipe springline to provide standard manhole steps and straight line access from pipe springline to ground surface. Manhole steps shall not span any pipe opening greater than 15".

(4) Small diameter pipe (less than 60" diameter) which enter drainage structures which contain a prefabricated pipe junction shall:

a. Enter the access manhole at the lowest elevation possible above the prefabricated pipe junction casting.

OR

b. Shall be included as an integral part of the prefabricated pipe junction casting.

c. In no case shall small diameter pipes be field connected into the prefabricated pipe junction.

14. In order to protect downstream properties from flooding, erosion, sedimentation, and/or other damages, the developer must show, with

appropriate engineering calculations approved by the Director, that the existing off-site downstream drainage system can accommodate the drainage from the developing property without damage to existing facilities, properties, or buildings in accordance with Section 5-300 of this DCSM.

5-220 Hydrologic Design (For Stormwater Conveyance)

5-221 Rational Method

1. This method is to be used for determining the design runoff for sizing all storm sewer systems, including but not limited to, culverts, conduits and man-made stormwater conveyance channels with drainage areas less than 200 acres. Refer to the Virginia Department of Transportation Drainage Manual for methodology. Refer to Detail DD-1 of this Article for "C" factors.

   A. To estimate Time of Concentration (Tc), refer to Detail DD-2 of this Article.

   B. Unless otherwise specified, the prescribed design storms are the one-year, two-year, and 10-year 24 hour storms using the rainfall peak intensity charts for the Town of Leesburg. *Refer to Detail DD-3 and DD-4 of this Article.*

5-222 USDA-NRCS Methodology

1. The NRCS method shall be employed for the determination of runoff for evaluation of all improvements to natural watercourses and storm sewer systems with drainage areas greater than 200 acres unless an alternative method is approved by the Director through a DCSM modification. This methodology for estimating runoff is based on a more rigorous analysis of the factors affecting runoff rates, and was developed by the United States Department of Agriculture (USDA) – Soil Conservation Service (SCS). This method, now known as the Natural Resources Conservation Service (NRCS) method, is considered more accurate than the rational method for runoff determination because more drainage shed characteristics are considered in the analysis. There are several major methods of analysis with the NRCS method:

   A. The old version TR-55 method (manual as well as computer-based) entitled "Urban Hydrology for Small Watersheds (Technical Release 55)" or new NRCS WIN TR-55 (Windows Based Program).

B. The old version TR-20 (computer-based) method entitled "TR-20 Computer Program for Project Formulation-Hydrology (Technical Release 20)" or new NRCS WIN TR-20 (Windows Based Program).

C. HEC-HMS (latest version accepted by the Corps of Engineers) may be approved by the Director on a case by case basis.

D. Other programs which utilize the methodology of TR-55 or TR-20 may be approved by the Director on a case by case basis.

E. Shed parameters to be considered and analyzed when using the NRCS method are as follows:

(1) Drainage area.

(2) Land use within the shed and associated imperviousness.

(3) For soil types, refer to Loudoun County Soils Maps.

(4) Shed response time(s).

5-230 Closed Conduit Systems

5-231 General

1. The closed drainage system will be referred to as a storm sewer system, and normally consists of curbs and/or gutters, drop inlet structures, laterals and trunk lines, junction chambers and manholes.

2. The purpose of a storm sewer system is to collect stormwater runoff within the on-site and off-site drainage divides and convey the runoff to an outfall.

5-232 Design Criteria

1. Storm sewers with drainage areas up to 200 acres may be designed using the Rational Method only as outlined in the Virginia Department of Transportation Drainage Manual.

2. Pipe placed in public easements or that are under public maintenance, shall be manufactured of reinforced concrete. Other materials such as those listed below may be used in private systems. Materials other than those listed may be considered for use in private systems with the approval of the Director.

   A. Pipe and culvert materials acceptable for storm drain construction with the accompanying Manning's roughness coefficients "n" are shown below:

Material	Manning “N”
Reinforced Concrete Pipe (RCP)	0.013
Vitrified Clay Pipe, Extra Strength (VCPX)	0.013
Cast Iron Pipe (CIP)	0.013
Polyvinyl Chloride Pipe (PVC)	0.011
Annular Corrugated Metal Pipe (CMP) (Fully Paved to Unpaved)	0.024
Helical Corrugated Metal Pipe (HCMP), Corrugations are as follows:	

	2-2/3” x 1/2"								3” x 1”
Diameter	18”	24”	36”	48”	60”	72”	84”	96”	All Diameters
Plain or Coated	.014	.016	.019	.020	.021	.021	.021	.021	.024
Paved Invert	NA	.015	.017	.018	.018	.018	.018	.018	.021
Smooth Interior Fully Paved	NA	.012	.012	.012	.012	.012	.012	0.12	.012

*The use of PVC is restricted to drains only.
** NA = Not available.

   B. Reinforced concrete pipe shall conform to ASTM Designation C-76, III and IV; a minimum of Class III or equal is required under areas subject to vehicular traffic. Class IV is required with cover less than two feet, areas subject to impact loads, or where strength computation based on depth requires the higher pipe class.

3. Distance Requirements. The distance between points of access in storm sewer trunk lines shall be limited to 50 feet for 12-inch pipe; 300 feet for 15-inch to 42-inch pipe; and 500 feet for 48-inch and larger pipe. The distance between access points may be increased to 400 feet for 15-inch to 42-inch pipe if the flow velocity exceeds five feet per second and the depth of flow is a minimum 25 percent of the pipe diameter.

4. Minimum pipe size. The minimum acceptable size pipe for publicly maintained systems shall be 15-inch or its equivalent elliptical shape. For private system designs, it is permissible to use 12-inch (or equivalent) pipe as the initial pipe in a system, or as a lateral line when necessary, provided that the distance between access points is 50 feet or less.

5. Pipes 15 inches in diameter and larger may be constructed on horizontal curves with the prior approval of the Director. Refer to Detail DD-5 of this Article for geometric information to assist in the design of concrete pipes on horizontal curves. Prefabricated bend sections may also be used for this purpose. When this option is approved, the designer shall provide direction during construction to ensure the system's integrity. Refer to Standard DS-1 in Appendix A.

6. In general, there may not be a reduction in pipe size greater than one increment moving downstream along the direction of flow unless approved by the Director.

7. Minimum cover for all round, arch, elliptical etc. storm sewer pipe as well as all Box Culverts, Conspans and other closed conveyance systems shall be two feet vertically from finish grade to the outside top of pipe and conveyance systems listed herein, except where structural correction is provided, as approved by the Director. Requests for less than two feet of cover shall be recorded on the cover sheet.

8. Maximum cover is determined from the field supporting strength. Refer to Article 4, Section 4-140, of this DCSM.

9. Storm sewers should be designed based upon actual pipe flow to provide a minimum velocity of 2.5 feet per second. If this minimum velocity cannot be achieved utilizing the actual design flows, full flow may be assumed in the pipes to achieve a velocity when running full of not less than 2.5 feet per second.

10. Storm sewers shall be designed with a minimum slope of 0.5%. Slopes less than 0.5% may be considered in specific situations on a case by case basis with the approval of the Director.

11. Storm sewers shall generally be designed so as not to exceed a design or full velocity of 15 feet per second. Special designs shall be supported by hydraulic

grade line calculations and special design pipe to account for the additional velocity when approved by the Director.

12. The need for concrete anchors shall be investigated on storm sewer lines with slopes of 20 percent or greater. If anchors are required, the design engineer shall show a detail on the plans with spacing requirements.

13. Generally storm sewers shall not have an outfall within a lot used for residential purposes. If with specific approval of the Director, an existing storm sewer outfalls on a lot, or adjacent to a lot, on which a building exists and which will remain, the building must be shown with topography of the area between the building and the outfall. The 100-year water surface elevation, the lowest point of entry, and the floor elevations of the existing building shall be provided to demonstrate compliance with Section 5-210 of this DCSM.

14. When a trunk line passes through a structure, it shall generally match crowns and the pipes may be adjusted to match to energy gradient as a maximum. Where matching the energy gradient creates drops in excess of 2.5 feet, these will be reviewed and approved by the Director on a case-by-case basis. In no case shall the crown of the inlet pipe be lower than the crown of the outlet pipe.

15. The deflection angle from the forward projection of the centerlines of an inflow trunk line pipe to the outflow trunk line pipe at any junction shall not exceed 90 degrees.

5-233 Flow in Gutters

1. Pavement gutter is defined, for purposes of this DCSM, as the portion of a roadway adjacent to the curb which conveys water during a storm runoff event; gutter in this sense would include a portion of a travel lane. Gutter cross sections generally have a triangular shape with the gutter of uniform cross slope and the curb forming the near-vertical leg of the triangle. Refer to Detail DD-6 and DD-7 of this Article.

2. The gutter pan is defined, for purposes of this DCSM, as the portion of integral concrete curb and gutter which slopes downward to the face of the curb.

3. Modification of Manning's Equation is necessary for use in computing flow in triangular channels because the hydraulic radius in the equation does not

adequately describe the gutter cross section, particularly where the top width of the water surface may be more than 40 times the depth at the curb. To compute gutter flow, horizontal spread, or gutter depth, Manning's Equation is integrated for an increment of width across the section. Refer to the Virginia Department of Transportation Drainage Manual for methodology.

5-234 Inlet Design Criteria

1. The spread of water on roadway pavements shall be limited to eight feet from the face of curb or one half of the travel lane (excluding curb and gutter) whichever is less. All design shall utilize a minimum rainfall intensity of 4.0 inches per hour. For runoff events resulting from greater rainfall intensities, the entire roadway section may be used for the conveyance of stormwater.

2. There are sites where it may reasonably be anticipated that the runoff from storms with rainfall intensities greater than 4.0 inches per hour will overtax the interception facility to the point that excess flow may result in damage to adjacent property and roadway right-of-way. In these instances, a check storm with a rainfall intensity of 6.5 inches per hour should be run. If all of the runoff is found to be contained within the roadway section, both at the site and "downstream", or if runoff escaping the road section is found to be non-damaging to adjacent property, the interception facility may be used as originally designed under the general criteria. If the interception facility fails to meet the check storm criteria, it must be redesigned to accommodate the check storm.

3. For spacing of inlets refer to Virginia Department of Transportation Drainage Manual.

4. Inlets located on continuous grade should be designed to intercept all of the gutter flow. There will be cases, however, where it is desirable to reduce the length (due to inlet inefficiency) through the use of runoff bypass. This does not infer that the bypass volume be neglected. Inlets which have bypass flows shall be clearly marked on the plans and bypass flow must be included in the total gutter flow contributing to the next downstream inlet. Generally, bypass flow should not exceed the capacity of the street gutter pan.

5. Where an inlet is located at the bottom of a sag vertical curve (referred to as a sump or low point) for roads classified as through collector or higher, all of the flow must be intercepted by the inlet.

6. To properly drain sag vertical curves, it is required on roads classified as through collector or higher to place three inlets in each curve; one inlet at the low point and one flanking inlet on each side of the low point. The flanking inlets should be placed so that they will limit the spread in the low (flatter) gradient approaches to the sag point and will act in relief of the sag inlet if it should become clogged. Refer to the Virginia Department of Transportation Drainage Manual for flanking inlet spacing.

7. Where the pavement on a continuous grade is warped in transition between super- elevated and normal sections, water conveyed along the curb shall be intercepted at the point in transition where the cross slope of the road section is equal to one percent to maintain spread requirements; further, road pavement with less than one percent cross slope towards a curb and gutter section shall not be utilized to convey flow. All flow in areas of less than one percent cross slope, except at median header curb, shall be confined to the gutter pan. Water concentrated in a pavement gutter shall not escape the gutter and cross the travelway before interception by an inlet.

8. No reverse curb and gutter (Virginia Department of Transportation CG-6R) shall be allowed in public rights-of-way without prior approval of the Director.

9. Inlets shall be placed on the high side of super-elevated sections such that flow does not leave the gutter pan.

10. Where curbs are used in cut slope areas, runoff shall be collected through a system of ditches and inlets at the top of the cut slope prior to the flow traversing the slope and entering the right-of-way.

11. No concentrated flow greater than two cubic feet per second based upon the two- year event shall cross a sidewalk or curb.

12. When stormwater is being conveyed along the pavement gutter of a street with a longitudinal slope of less than two percent, a maximum of two cubic feet per second may cross the intersection of a street with less than 500 vehicles per day. Where the longitudinal grade is two percent or greater, four cubic feet per second may cross the intersection of a street with less than 500 vehicles per day.

13. No flows will be allowed to cross the intersections of streets with 500 or more vehicles per day.

14. When bridges are located adjacent to gutter sections, it will be necessary to coordinate the drainage design with the bridge designer. For bridges without deck drains, the flow from the entire bridge plus any flow crossing the bridge shall be collected in the storm sewer system. For bridges with deck drains, it will be necessary for the drainage designer to review each drain's size, type and location. The flow capacity of deck drains as well as their potential for clogging shall be fully considered and the storm sewer system designed accordingly.

15. The interception facilities for interstate highways, limited access highways and other major arterials should be designed so that the spread (based on a rainfall intensity of 4.0 in./hr.) does not exceed one-half of the running lane width, and there is no significant damage to adjacent property during a storm whose rainfall intensity is determined by a 50-year recurrence interval and the actual time of concentration.

16. Under certain circumstances, such as underpasses or depressed roadway sections, where ponded water can only be removed through the storm sewer system, the 50- year storm (using the actual time of concentration) should be used as the check storm and excessive depth of ponding should be avoided.

5-235 Grate Inlets and Yard Inlets

1. Grate and yard inlets in a sump location shall be designed assuming 50 percent clogging. These inlets operate as weirs at shallow depths and as an orifice at greater depths. Grates of larger dimension and grates with more open area, i.e., with less space occupied by lateral and longitudinal bars, will operate as weirs to greater depths than smaller grates or grates with less open area. Refer to Virginia Department of Transportation Drainage Manual, for specific grate inlet design. Refer to Standards DS-2, and DS-3 in Appendix A.

2. Grate inlets outside the travelway of public roads on continuous grade shall be designed assuming 50 percent clogging. Flow passing over the grate, if applicable, shall be collected at the next downstream inlet. Refer to the Virginia Department of Transportation Drainage Manual.

3. Grate inlets within roadway pavement, face of curb to face of curb of public roads, are prohibited. Standard VDOT DI-2 inlets are permitted within the parallel parking lanes within the Crescent Design District. All other applications for using DI-2 inlets may be used on a case by case basis with the prior approval of the Director.

5-236 Curb-Opening Inlets

1. Interception capacity of a curb-opening inlet is largely dependent on flow depth at the curb and curb-opening length.

   A. Effective flow depth at the curb and consequently, curb-opening inlet interception capacity and efficiency, is increased by the use of a local depression at the curb-opening or a depressed gutter to increase the proportion of the total flow adjacent to the curb. Local depression shall be two inches for curb inlets with CG-6 and one inch for curb inlets with Virginia Department of Transportation CG-2.

2. Curb-opening inlets in continuous grade situations are effective in the drainage of pavements where flow depth at the curb is sufficient for the inlet to perform efficiently. Curb-openings are relatively free of clogging tendencies and offer little interference to traffic operation. Curb-opening inlets are required in the public right- of-way. Refer to Detail DD-8 of this Article.

3. The required method for determining the length of a curb-opening inlet required for total interception of gutter flow is located in the Virginia Department of Transportation Drainage Manual.

4. For curb-opening inlets in a sump condition, refer to Detail DD-9 of this Article.

5-237 End Walls and End Sections

1. End walls and end sections which have pipes 24 inches in diameter and larger which are installed in residential developments within the Town of Leesburg shall be provided with a minimum 42-inch high fence or protective railing.

2. The fence or protective railing shall be installed at the top of the end section or integrally on top of the end wall for the portion of the wall where the drop is greater than 18 inches.

3. The protective railing must have no opening greater than six inches.

4. The protective railing must be of corrosion resistant material and must not obstruct the overland relief.

5-238 General Pipe System Design

1. Before starting the detailed design of the pipe line, the design engineer must consider various controls which will govern the subsequent location, alignment, depth, size, and cost of the systems.

   A. Consideration should be given to the location of existing outfalls or natural watercourses which are to be utilized, natural drainage divides, proposed roadway design features such as low and high points in the grade, super- elevated curves, street intersections, existing and proposed utility lines; other existing and proposed storm drainage.

   B. When an existing storm sewer is to be utilized, either partially or totally, it shall be necessary to ascertain the invert elevations for all pipes, drop inlets, catch basins, manholes, etc. This information should extend well beyond the limits of the proposed project, both laterally and longitudinally, at least to the next access structure, and continuing to the point of hydraulic adequacy. The invert elevation of each pipe in a drop inlet or manhole shall be ascertained, as well as the type of pipe. Information obtained shall be based upon an as-built survey of record or actual field run elevations.

   C. It is essential that all utilities in the area of existing or proposed drainage facilities be located horizontally and all gravity utilities located vertically in order to avoid future conflicts. This is particularly important in the case of gravity sanitary sewers because adjustment of such facilities would be difficult and costly.

   D. Test pits will be required for crossings which involve gas lines, water mains 6 inches in diameter and larger, sanitary sewer crossings which have minimum clearance, and all fiber optic telephone service lines.

   E. New storm sewers should generally be designed to convey the ten-year runoff without surcharge. However, the system should be checked for

the 50-year runoff in situations where it would be necessary to prevent flooding of interstate highways, limited access highways, major arterials, and underpasses, or other depressed roadways where ponded water can only be removed through the storm sewer system.

F. The detailed design of the storm sewer pipe line can only proceed after taking into account the above parameters.

2. Size of storm sewer pipe shall be determined by the Manning's Equation. For explanation and use, refer to the Virginia Department of Transportation Drainage Manual and refer to Detail DD-17 of this Article.

5-239 Energy and Hydraulic Gradients

1. The hydraulic gradient for a storm sewer system shall herein be defined as a line (water surface profile) connecting points to which water will rise in pipes, manholes and inlets throughout the system during the design flow. The energy gradient is a line drawn a distance V2/2g above the hydraulic gradient of the pipes. Refer to Detail DD-10 of this Article.

A. At storm sewer junctions, the total energy loss at the junction, HL, is the difference in elevation between the energy grade lines of the upstream and downstream pipes. To establish these gradients for a system, it is necessary to start at a point where the hydraulic and energy gradients are known or can readily be determined.

B. When the energy and hydraulic gradients must be determined, the pipes are assumed to have uniform flow. For uniform gravity flow the friction loss in storm sewer pipes shall be determined by referring to the Virginia Department of Transportation Drainage Manual.

(1) If the junction incorporates surface inflow and the surface inflow comprises more than 20% of the total flow in the storm sewer, then the Ht should be increased by 30% and the adjusted value entered in column 17.

(2) The 50% reduction for IS-1 shaping is not applicable at upper terminal structures.

C. Where a proposed drainage system is connected to an existing drainage system the hydraulic gradient shall be computed through the existing system until the stormwater contained within the system outfalls to daylight into an adequate conveyance channel or a natural watercourse to demonstrate hydraulic capacity.

(1) Information, including as-built information, as well as development plan system computations for the existing system, will be made available by the Town to the engineer for those systems for which the Town has this information.

(2) The Director may waive the requirements when it has been previously determined that the receiving system is known to have sufficient capacity.

2. Storm sewer systems should generally be designed to convey the design year storm as non-pressure systems.

A. However, in specific situations, primary trunk lines of storm sewer systems may be designed for pressure flow with the approval of the Director. All proposed pressure flow systems should be coordinated with the Department of Plan Review in the preliminary design stage when tying into existing storm drainage systems. The hydraulic gradient for the design flows shall not be above an elevation of one half foot below the established ground elevation nor more than five feet above the crown of the pipe. For curb opening inlets the gutter flow line is considered the established ground elevation.

B. The hydraulic gradient shall be determined by computations and then graphically depicted on the storm profiles within the construction plan for all storm sewer systems located within the Town or VDOT right-of-way and for all closed pipe systems located within Town storm drainage easements using VDOT methodology. Refer to Detail DD-18 of this Article.

C. In general, hydraulic grade line calculations will not be required for privately maintained lateral lines serving terminal inlets, and will not be required for privately maintained secondary trunk lines which are flowing less than 80% of full capacity as determined by Manning's equation. Privately maintained storm sewer conveyance systems shall

not be located within a publicly maintained storm sewer easement nor are they to be located within Town or VDOT right-of-way.

D. Hydraulic grade line calculations shall be required for all storm sewer lines which are subject to pressure flow conditions.

3. In instances where the pressure flow is due to a restricted outfall condition entering a pond below water surface elevation, the hydraulic grade line shall not be higher than 0.5 foot below any manhole top or inlet throat opening. In cases where this design is unavoidable, the Director may approve an alternate design and allow less clearance.

5-240 Open Channels

5-241 Natural Watercourses

1. Natural watercourses are the primary facilities for conveying stormwater runoff. For purposes of this Section, the term natural watercourse shall refer to the total conveyance facility, the stream (or low flow channel) and the adjacent floodplain.

2. The policy of the Town of Leesburg relative to natural watercourses shall be as follows:

A. Generally, any encroachment into the floodplain is not permitted unless authorized by the Director.

B. Whenever a natural watercourse must be relocated or otherwise modified, the extent of channel reach and degree of modification shall be the minimum necessary to provide compatibility of the channel and development. Refer to Section 5-255 of this Article for specifics of stream modification.

C. A narrative describing the stream's morphology (form and structure) and environment shall be conducted and documented in addition to the economic and engineering alternatives available for the particular location.

D. Refer to Section 5-400, Floodplain Policy, for processing and analysis requirements.

E. Modified and relocated channels shall duplicate the existing stream and flood plain characteristics as nearly as possible. These characteristics shall include the stream width, depth, slope, flow regime, pool-riffle ratio, bank cover, side slopes and flow and velocity distribution.

F. A hydraulic analysis of the 25 and 50-year, in addition to the 100-year frequency floods may be required by the Director to comply with the Town's Stormwater Management Master Plan or design criteria contained herein.

5-242 Man Made Stormwater Conveyance Channels

1. Man-made channels are typically trapezoidal or other geometric sections and may be either natural or artificially lined. Hydraulic capacity shall be determined by the procedure outlined in the Virginia Erosion and Sediment Control Handbook. The computed velocity shall approximate the assumed velocity used to determine the Manning's "n" value.

2. All open channels shall be designed to contain the ten-year event.

3. The velocity of flow in open channels including bends is determined through the use of Manning's Equation and "n" values, and Bernoulli's equation. Refer to the Virginia Department of Transportation Drainage Manual.

4. The need, type and dimensions of lining for erosion control shall be based on the velocity associated with the ten-year event. The lining selected shall be consistent throughout the channel until it outfalls to a natural watercourse. For various channel configurations, refer to the Virginia Department of Transportation Drainage Manual.

5. Depending upon the location, safety, damage risk and environmental considerations, a less frequent event may be required for the design of these channels at the discretion of the Director.

6. Where an access strip is provided, it shall have a maximum two percent cross slope within the required easement.

7. Maximum side slope for grass lined conveyance channels shall be three to one with a minimum longitudinal slope of one percent (two percent minimum recommended).

8. Conveyance channels with side slopes steeper than 3:1 shall be stabilized by paving, riprap, gabions or other approved measures.

9. Conveyance channels with longitudinal slopes less than one percent shall be paved.

10. Paved stormwater conveyance channels or channels with side slopes steeper than 3:1 are prohibited within or through residential subdivision building lots and in no case shall the top width of the channel be within 25 feet of a residential property line; except that twelve feet of the required 25-foot open area may be contained within a lot providing the additional square footage within the 12-foot area shall not be used in the computations for determining the minimum required lot area.

11. Stormwater conveyance channels conveying more than 15 cubic feet per second are prohibited within or through residential subdivision. Temporary stormwater conveyance channels conveying more than 15 cfs may be located on vacant lands which will become future residential development only if the channels are replaced by an underground storm drainage system when the lands are developed for residential uses.

    In no case shall the top width of a permanent or temporary stormwater conveyance channel conveying more than 15 cfs channel on an adjacent property be within 25 feet of a residential property line.

12. The sides of all conveyance channels shall be extended until one foot of freeboard is provided above the ten-year event water surface elevation within the conveyance channel.

5-243 Roadside and Median Ditches

1. Roadside and median ditches shall meet the standards for stormwater conveyance channels.

2. Generally, side and median ditches shall be designed in accordance with prevailing geometric standards applicable to the particular class of roadway,

with consideration of hydraulic capacity, erosion control and safety. Refer to the Virginia Department of Transportation Drainage Manual.

3. The ditch should provide sufficient hydraulic capacity to contain the estimated runoff from a ten-year frequency storm. The estimated runoff and attendant velocity for the two-year frequency storm is to be used for determining the needs, type and dimensions of special ditch lining for erosion control. Geometric configurations shall conform to appropriate safety standards.

5-244 Lot Drainage Swales

1. Swales for lot drainage shall conform to the standards for grass-lined conveyance channels based on the ten-year event.

2. Within residential areas or subdivisions, an inlet shall be provided to intercept lot drainage flow when any of the following conditions apply:

   A. The lot drainage swale extends across three lots.

   B. The lot drainage swale extends more than 300 feet.

   C. The lot drainage swale conveys more than two cubic feet per second. Additional flow up to 4 cubic feet per second may be permitted for large lot subdivisions (average lot size over half an acre) with the approval of the Director.

3. Lot drainage swales shall not discharge in excess of two cubic feet per second across any sidewalk or curb based on the two -year event.

4. Drainage swales located outside of residential areas or subdivisions shall be designed to carry the flow from a 10-year storm event and maintain a non-erosive velocity from a 2-year storm event. The drainage design shall also consider and provide overland relief for the 100-year storm event as per Section 5-200 of this DCSM.

5-245 Stream Modification

If stream and flood plain encroachment is unavoidable (i.e., highway embankment), a detailed evaluation by a registered Professional Engineer licensed in the Commonwealth of Virginia shall be made and sealed.

5-246 Flow Design

1. The Manning equation shall be used for open channel analysis where uniform flow exists or can be reasonably assumed. The Bernoulli equation shall be used to analyze flow where changes in flow resistance, size, shape or slope of the channel occur. Refer to the Virginia Department of Transportation Drainage Manual.

2. The computation of water surface profiles for channels involving changes in roughness, slope, shape and discharge should not be based on a nomograph solution.

5-247 Water Surface Profile Computations

1. The U.S. Army Corps of Engineers, HEC-RAS River Analysis System computer program may be used to model open channels, culverts, and bridges.

2. The Virginia Department of Transportation Drainage Manual method may also be used for the calculation of water surface profiles.

3. Other methods may be utilized with prior approval of the Director.

5-248 Riprap

Riprap for channels shall be designed in accordance with the Virginia Department of Transportation Drainage Manual. Outlet protection shall be designed using Virginia Erosion and Sediment Control Handbook.

5-250 Culverts

1. Culverts shall be designed to account for ultimate right-of-way widths.

2. Within embankments, culvert headwalls and endwalls shall be located a minimum of 30 feet outside the edge of pavement of traffic lanes unless traffic is separated from the walls by a guardrail that is required due to warrants other than the walls.

5-251 Design Criteria

1. The design of culverts is dependent upon the type of control (inlet, outlet).

   A. Inlet control. Deemed to be the discharge capacity of a culvert as controlled at the culvert entrance by the depth of headwater (HW) and the entrance geometry, including the barrel shape and cross section area, and the type of inlet edge.

   B. Outlet Control. Culverts flowing with outlet control can flow with the culvert barrel full or partially full for part or the entire length of the barrel. If the entire cross section of the barrel is filled with water for the total length of the barrel, the culvert is said to be in full flow or flowing full.

   C. Both inlet control and outlet control computations must be performed.

2. Culverts located beneath interstate highways, limited access highways, or major arterials shall be designed for the 50-year event without the headwater overtopping the roadways. The 25-year headwater shall be 18 inches below the elevation of the adjacent travel lane edge of pavement.

3. For actual culvert design procedures, refer to the current edition of the U.S. Department of Transportation Hydraulic Design of Highways Culverts (HDS-5). Culvert design procedures are also provided in the current Virginia Department of Transportation Drainage Manual.

(End of Section)

SECTION 5-300 POLICY FOR STORMWATER MANAGEMENT

5-310 General

1. The design and construction for each regulated land-disturbing activity shall be in compliance with this DCSM, the Town Code, and applicable state and federal laws and regulations concerning stormwater management.

2. The design and construction of all stormwater management facilities for water quantity and water quality or modifications to existing channels shall comply with the more stringent of the requirements contained in this DCSM, the Town Code, or applicable state and federal laws and regulations unless otherwise modified by the Director.

3. Evidence shall be provided to the Town to verify all required state and federal permits have been obtained prior to the commencement of any regulated land-disturbing activity.

4. Technical guidance may be found in the Virginia Department of Transportation Drainage Manual, the Virginia Stormwater Management Handbook, and the Virginia Stormwater BMP Clearinghouse. Where conflicts arise among design criteria manuals, the more stringent of the requirements shall apply unless modified by the Director.

5-311 Applicability

1. The provisions of this section apply to all regulated land-disturbing activities governed by Chapter 14 of the Town Code.

2. The Director may grant exceptions only in accordance with the provisions of Section 14-23(g)(5) of the Town Code.

3. Stormwater management for water quantity and water quality shall meet the requirements of the Virginia Stormwater Management Program (VSMP) Permit Regulations (9VAC25-870) Part II B “Technical Criteria for Regulated Land Disturbing Activities” except as modified by this DCSM for all land disturbing activities one acre or greater.

4. Stormwater management shall meet the following requirements for all land disturbing activities under one acre unless specifically exempt by the State or Town Code whether or not a VSMP permit is required:

   A. Water Quantity shall meet all "Adequate Outfall" requirements stated within Sections 5-330 through 5-332 of this DCSM as well as all other applicable sections of this DCSM.

   B. Water Quality shall meet all required pollutant loading reductions as stated within Section 5-320, Article 6 and all other applicable sections of this DCSM.

5. Notwithstanding the subsection 3 above, regulated land-disturbing activities that are grandfathered pursuant to Section 14-23(e)(4) of the Town Code shall meet the applicable criteria found in the VSMP Permit Regulations Part II C "Technical Criteria for Regulated Land-Disturbing Activities Grandfathered Projects and Projects Subject to the Provisions of 9VAC25-870-47 B" as modified by more stringent requirements contained in the DCSM and the Town Code in effect on or before June 30, 2014.

5-312 Design Storms and Hydrologic Methods

1. The Rational Method or Modified Rational Method (as applicable) shall be used for determining the peak runoff for small drainage areas of twenty acres or less.

2. The Natural Resources Conservation Service (NRCS) method shall be used for the determination of runoff for drainage areas larger than twenty acres. The use of the NRCS methodology shall be applied but not limited to large dams, major culverts, and all ponds and dams with a permanent pool.

5-320 Water Quality

1. Indigenous vegetation should be preserved to the maximum extent practicable consistent with the proposed use, development, or redevelopment.

2. Impervious surface cover shall be minimized consistent with the proposed use, development, or redevelopment.

3. All types of construction drawings, such as but not limited to residential construction plans, public improvement plans, and all types of site plans (excluding applications for new residential homes on lots of record not associated with a bonded subdivision, site plan waivers and zoning permits), shall provide water quality in accordance with the minimum requirements of the Virginia Stormwater Management Regulations as set forth in this DCSM regardless of lot size or amount of disturbed acres, even when a formal VSMP permit is not required for the project (such as those exempt under Town Code Section 14-23(e)(6)).

5-321 Environmental Site Design

1. Each application for a regulated land-disturbing activity shall include a written assessment for the potential for the use of Environmental Site Design (ESD).

2. The Virginia Stormwater BMP Clearinghouse shall be the sole source of efficiencies and design of ESD practices being considered to meet the water quality requirements of this DCSM. However, in addition to other ESD resources that may be available, the following may be considered in the development of the written assessment:

   A. Low-Impact Design Strategies: An Integrated Design Approach, United States Environmental Protection Agency, Office of Water, EPA 841-B-00-003 dated June 1999 and subsequent modifications and updates thereof; and

   B. Low-Impact Development Hydrologic Analysis, United States Environmental Protection Agency, Office of Water, EPA 841-B-00-002 dated June 1999 and subsequent modifications and updates thereof.

5-322 Hot Spots

1. The Director may determine that a proposed land use or activity associated with a regulated land-disturbing activity constitutes a pollution hot spot, and that a greater level of stormwater quality management is necessary to prevent pollutant wash-off after construction.

2. A stormwater hot spot is defined as a land use or activity that generates higher concentrations of hydrocarbons, trace metals or toxicants than are found in typical stormwater runoff or that generates a pollutant that is subject to a

TMDL Waste Load Allocation (WLA) assigned to the Town. The maximum level of stormwater quality management, which assumes pre-development greenfield conditions regardless of actual existing site conditions, shall be required at hot spot sites to prevent pollutant wash off after construction.

3. Land uses or activities that are deemed by the Director as a hot spot shall not be exempt from the maximum requirements for water quality treatment in this DCSM even if the limits of disturbance is less than an acre and/or if the site is considered re-development.

4. Hot spots may include, but are not limited to, the following:

   A. Vehicle salvage yards and vehicle recycling facilities;

   B. Vehicle service and vehicle maintenance facilities;

   C. Vehicle equipment cleaning facilities;

   D. Fleet storage areas;

   E. Industrial sites;

   F. Outdoor liquid container storage;

   G. Outdoor loading and unloading facilities;

   H. Commercial container nurseries;

   I. Golf courses;

   J. Storing or dispensing of petroleum products and hazardous substances.

   K. Dry cleaning operations;

   L. Public works storage areas;

   M. Facilities that generate or store hazardous materials;

   N. Chemical storage areas; and

O. Areas known for the sale or transfer of contaminants

5. On making a written determination that a proposed land use or activity constitutes a pollution hotspot, the Director shall require the creation and implementation of a stormwater pollution prevention plan (SWPPP) to reduce the generation of pollutants at the source. The SWPPP shall be in addition to all other requirements in this Article. At the discretion of the Director, a SWPPP developed in conformance with 9VAC25-151-80 may be deemed sufficient to satisfy the requirements of this section.

6. In order to adequately protect surface water and groundwater quality, land uses and activities that propose storing, handling and/or dispensing petroleum products and hazardous substances shall at a minimum meet the following standards:

A. Oil/water separators shall be required for all facilities that engage in activities (other than agricultural) that potentially generate oily wastewater, including but, not limited to, vehicle maintenance/washing/detailing, fuel storage/dispensing, and machine and paint shops. When available, the discharge generated from activities not exposed directly to stormwater runoff (such as but not limited to car washing facilities and interior building operations) shall be to the Town's sanitary sewer system. If a sanitary sewer outfall is not available or if the facility is directly exposed to stormwater runoff (such as a refueling station or outdoor storage area), ~~and~~ the discharge must be to the storm sewer and a Virginia Pollutant Discharge Elimination System (VPDES) permit will be required.

B. Secondary containment shall be required for activities that propose storing, handling and/or dispensing of petroleum products (except for liquefied petroleum gas) and hazardous substances. The secondary containment shall be designed to provide a means of detecting material loss from the primary container; sufficient/compatible containment of the loss; retrieving the loss; and correcting the deficiency. For groups of tanks/containers, the secondary containment must be able to hold the contents of the largest container plus precipitation (if there is no roof). This precipitation shall not be re-directed to the storm sewer. Temporary secondary containment shall be provided for construction sites that use petroleum products or hazardous substances.

C. The applicant shall provide evidence that an approved Emergency Response Plan has been filed with and approved by the Town as well as the Loudoun County Department of Fire and Rescue Services.

7. Specifically, all types of site plans for new (or proposed renovations to) gas stations, other type of fuel dispensing facilities or fuel storage sites shall at a minimum meet all hot spot requirements stated herein and include the following items:

A. Plans shall include the following BMP Hot Spot Narrative:

"This site will operate as a fuel storage and / or dispensing station and is considered a Hot Spot per DCSM (5-640.4J). An oil water separator such as a Baysaver or equivalent approved product is required to contain minor spills on site. The designed system will provide a primary separation manhole, secondary storage manhole (or facility) and oil water separator such as a Baysaver separator (or approved equivalent). A shutoff valve, visible to on duty staff, easily accessible and properly signed, is to be installed on the downstream side of Baysaver or equivalent. In the event of a fuel spill, the valve is to be closed immediately and the spill contained within the onsite (water tight) pipes and structures which will be over-sized to hold the contaminated rainwater and material until HAZMAT teams reach the site. These "secondary" storage systems shall be designed to contain a minimum of 2,500 gallons."

B. Plans shall include the following notes and details:

1) BMP Hot Spot structure details to be provided on Final Site Plan.
2) BMP Hot Spot Maintenance Plan to be provided on Final Site Plan.
3) BMP Hot Spot site specific Narrative to be provided on Final Site Plan.
4) BMP Hot Spot structure sizing computations to be provided on Final Site Plan.
5) BMP Hot Spot structure capacities to be provided on Final Site Plan.

C. Emergency Response Plan:

The Applicant shall provide evidence that an approved Emergency Response Plan has been filed with and approved by the Town as well as the Loudoun County Department of Fire and Rescue Services.

5-323 Stream Delineation and Buffer Criteria

1. All regulated land-disturbing activities subject to this Article shall clearly delineate perennial and intermittent streams on or directly adjacent to the site. Such determination shall be made using a reliable, site-specific, and scientifically valid system of in-field indicators acceptable to the Director such as but not limited to determinations from the Army Corps of Engineers or the Virginia Department of Environmental Quality or determinations based upon and in accordance with Identification Methods for the Origins of Intermittent and Perennial Streams (latest version) published by the North Carolina Division of Water Quality. The condition of the water features, including whether they are natural or engineered, shall also be noted.

2. Any site with a perennial or intermittent stream within a natural channel shall meet the following additional performance criteria:

   A. Measures shall be taken to protect the perennial stream from non-concentrated stormwater runoff from adjacent impervious surfaces.

      (1) A minimum 50 foot wide vegetated area preserved where present, or established where not present, shall be provided on both sides of the stream (measured from the centerline of the stream). Larger buffers may be required for a Creek Valley Buffer as defined by the Zoning Ordinance in specific situations.

      (2) If the required vegetated buffer area is in poor condition, as determined by the Director, the vegetated buffer area shall be enhanced to prevent erosion and ensure proper functioning of the area as a buffer to pollution.

      (3) If the required vegetated buffer area does not exist or cannot be provided by a proposed development, an adequate buffer may (with prior approval of the Director) alternatively be met

through the use of a smaller vegetated buffer area in combination with equivalent on-site stormwater treatment as long as such a reduction is not prohibited by other Town Ordinances and / or Regulations such as but not limited to the Creek Valley Buffer criteria as defined by the Zoning Ordinance.

(4) See Section 5-700 for vegetated buffer easement requirements.

3. Establishment, enhancement, or replacement of the buffer area shall be in accordance with Chapter 5.1 “Buffer Area Establishment, Replacement, and Restoration” of the most recent version of Riparian Buffer Maintenance and Mitigation Guidance Manual published by the Department of Environmental Quality, as amended or as modified by the Director.

4. Physical relocation, alteration, or undergrounding of a perennial or intermittent stream will be considered on a case-by-case basis.

5. Construction plans shall not be approved until proof is provided to the Director that all required federal, state, and local environmental permits have been obtained.

5-330 Water Quantity

In addition to the water quantity requirements of Section 5-311, the following design criteria shall be applied to all types of subdivision and site plans regardless of whether a VSMP permit is required or not, unless specifically exempted within this DCSM:

1. The determination of flooding and channel erosion impacts to receiving streams shall be measured at each point of discharge and based upon:

   A. Runoff volumes that consider proposed land use and includes runoff from the balance of the upstream watershed contributing to each specific point of discharge.

   B. Complete calculations and analysis.

   C. On-Site field shot cross sections.

D. Offsite field shot cross sections (where permission cannot be obtained to obtain these sections, the Town will consider alternate means of obtaining the required topography such as but not limited to aerial topography and field shot topography transposed from approved plans of record).

2. Subdivision plans and site plans shall be designed such that properties and receiving waterways downstream of any land-disturbing activity shall be protected from erosion and associated damage due to changes in runoff rate of flow and hydrologic characteristics, including but not limited to changes in volume, velocity, frequency, duration, and peak flow rate of stormwater runoff.

5-331 Detention Measures

1. On-site detention of stormwater is desirable in many cases to alleviate existing downstream drainage problems and to preclude the development of new ones. In some areas of the watershed, detention may cause increased peak flows to occur on the major streams and tributaries. Therefore, the downstream impact must be carefully investigated. The Director may prohibit detention of stormwater for larger stormwater events including but not limited to the 10 year and or 100 year storm events where and when it is identified in the Town's Stormwater Management Master Plan (in the Town Branch and Lower Tuscarora subwatersheds only) as not being in the best interest of the Town.

2. Special stormwater management design is required within the Tuscarora drainage shed to address downstream flooding concerns in accordance with the Town's Stormwater Management Master Plan (see DCSM Section 5-341).

5-332 Adequate Outfall

1. Where an adequate channel or an adequate closed stormwater conveyance system is not available adjacent to the site, the developer shall provide a drainage system satisfactory to the Director to preclude an adverse impact (e.g. soil erosion; sedimentation; yard flooding; duration of ponding water; inadequate overland relief) on down-stream properties and receiving channels. In addition, the stormwater management facility shall be required at a minimum to restrict the flow to any outfall channel to predevelopment conditions.

2. Concentrated stormwater runoff leaving a development site shall not aggravate or create a condition where an existing dwelling or a building constructed under an approved building permit floods from storms less than or equal to the 100-year storm event. If such a dwelling or building exists, detention for the 100-year storm event shall also be provided; and

3. Concentrated surface waters shall not be discharged on adjacent or downstream property, unless an easement expressly authorizing such discharge has been granted by the owner of the affected land or unless the discharge is into a natural watercourse, or other appropriate discharge point as set forth above.

4. An adequate outfall within the Town shall be defined as:

    A. A well-defined (i.e., with bed and banks) natural or man-made channel which is capable of conveying the post development runoff for the design-year event, as defined herein for the particular shed in which the development is proposed, without eroding or overtopping its banks.

    B. A well-defined (i.e., with bed and banks) natural or man-made channel shall be considered adequate at any point where the total contributing drainage area is at least 100 times greater than the drainage area of the development site in question.

    C. An analysis shall be performed downstream of the site subject to proposed development to verify the adequacy of the receiving system. This analysis shall be performed for a minimum distance of 300 feet downstream, and shall continue until the flow is discharged into a natural watercourse of sufficient capacity to convey the design-year event without overtopping or eroding its banks.

5. Concentrated stormwater leaving a development site shall only be discharged into a well-defined (i.e., with bed and banks) natural or man-made outfall channel of sufficient hydraulic capacity, such that there is no overtopping or erosion downstream of the subject development for the release rate of the concentrated stormwater. This shall be required regardless of whether or not the peak discharge rate is changed by the development.

    A. Where an adequate channel or an adequate closed stormwater conveyance system is not available adjacent to the site, the developer shall provide an outfall drainage system satisfactory to the Director to

preclude an adverse impact (e.g. soil erosion; sedimentation; yard flooding; duration of ponding water; inadequate overland relief) on downstream properties and receiving channels.

B. Concentrated surface waters shall not be discharged on adjacent or downstream property, unless an easement expressly authorizing such discharge has been granted by the owner of the affected land or unless the discharge is into a natural watercourse, or other appropriate discharge point as set forth above.

5-333 Pro-Rata Share Program

1. In lieu of or in addition to on-site stormwater quantity management required in this Article, the Town may require pro-rata share contributions in areas where downstream pro-rata share improvements have been installed and/or stormwater detention is not in the best interest of the overall drainage system as defined in the Stormwater Management Master Plan.

2. Notwithstanding (1) above, in lieu of on-site stormwater quantity management required in this Article, a developer may:

   A. Contribute his proportionate share toward the correction of off-site outfall deficiencies in those instances where pro-rata share policies have been adopted by the Town and construction of the downstream improvements is completed or where construction of the downstream improvements will occur concurrently with the subject development.

   B. Construct or to provide the funds for the construction of more than his proportionate share of the downstream off-site drainage improvements, so that he may proceed with the improvement of his land without damaging the properties of others.

      In such cases, at the request of the Developer and based upon calculations prepared by the Developer's engineer and approved by the Director, the Town may establish a pro-rata share policy to collect, on a pro-rata basis, any excess funds expended beyond the Developer's proportionate share of the cost of such improvements from other properties within the watershed served by such drainage improvements.

3. Any requests for nutrient offsets shall be done in strict accordance with the Town Code.

5-340 Stormwater Management Facilities

5-341 Design of Stormwater Management Facilities within Tuscarora Creek Watershed

Design of stormwater management facilities within the Town of Leesburg's Tuscarora Creek watershed shall be based upon all of the following three criteria:

1. Flood Control Criteria

   A. All designs for stormwater management and determination of adequate outfall for flood control shall at a minimum be in compliance with the Town of Leesburg Stormwater Management Master Plan adopted June 1990 as well as all criteria set forth below.

   B. Design Criteria for the Tuscarora Creek Watershed

      (1) Town Branch Subbasin

      Town Branch, Channel. Stormwater management within the channel of Town Branch shall be provided such that the channel will be protected for the 25-year event. In areas designated by the Director as having a high potential for flooding, the channel and adjacent properties shall be protected from the 100-year event.

      Town Branch, On-site. Stormwater management facilities (detention) shall be provided for all areas within the watershed exclusive of the Town Branch conveyance channel such that the post development peak runoff will not exceed the predevelopment peak runoff for the ten and 25-year storm events. Further, additional stormwater management measures shall be incorporated into the detention facility design so as not to exceed the allowable post development peak runoff from the site for the more frequent one and two year (24 hour) storm events as defined within the Virginia Stormwater Management Handbook in accordance with this DCSM as well as other applicable state and federal regulations.

(2) Upper Tuscarora Creek Subbasin

Upper Tuscarora Creek, Channel. Stormwater management for the Upper Tuscarora Creek shall be by the use of regional facilities as delineated in the Master Plan.

Upper Tuscarora Creek, On-site. Stormwater management (detention) shall be provided by utilization of the regional facility for all areas within the watershed which drain to a regional facility. Design of regional facilities shall be such that the post development peak runoff will not exceed 0.3 cfs/acre, and 0.4 cfs/acre for the ten, and 25-year events, respectively. Further, additional stormwater management measures shall be incorporated into the regional facility / site design so as not to exceed the allowable post development peak runoff from the site for the more frequent one and two year (24 hour) storm events as defined within the Virginia Stormwater Management Handbook in accordance with this DCSM as well as other applicable state and federal regulations.

a. Where a proposed development is served by an existing regional stormwater management facility, Stormwater management measures shall be provided for all areas of the development within the watershed exclusive of the Tuscarora Creek conveyance channel such that the post development peak runoff shall not exceed the allowable post development peak runoff from the site for the more frequent one and two year (24 hour) storm events as required by the Virginia Stormwater Management Handbook and this DCSM.

b. If a regional facility does not exist to serve a proposed development and if the Director concurs in writing that it is not required to construct an on-site regional facility, then an on-site Stormwater management facilities (detention) shall be provided for all areas of the development within the watershed exclusive of the Tuscarora Creek conveyance channel such that the post development peak runoff will not exceed the predevelopment peak runoff for the ten and 25-year

storm events. Further, additional measures must be incorporated into the onsite stormwater management design so as not to exceed the allowable post development peak runoff from the site for the more frequent one and two year (24 hour) storm events as defined within the Virginia Stormwater Management Handbook in accordance with this DCSM as well as other applicable state and federal regulations.

(3) Lower Tuscarora Creek Subbasin. On-site stormwater management measures shall be provided for all areas within the watershed exclusive of the Tuscarora Creek conveyance channel such that the post development peak runoff ~~will~~ shall not exceed the allowable post development peak runoff from the site for the more frequent one and two year (24 hour) storm events as defined within the Virginia Stormwater Management Handbook in accordance with this DCSM as well as other applicable state and federal regulations.

2. Discharge Control Criteria

In addition to the flood control criteria above, all concentrated discharges of stormwater from road or site drainage systems, designed for the ten-year event, from all developing sites shall be discharged into an adequate channel (extending from the point of discharge to the main channel of the watershed listed above) for the ten-year storm event or greater at arterial road crossings, or stormwater management (detention) shall be provided. Refer to Section 5-240 concerning required channels for concentrated discharges.

3. Erosion Control Criteria

In addition to the flood control and discharge control criteria above, all discharges of stormwater from all developing sites shall be discharged in a manner that complies with the requirements set forth by this DCSM as well as other applicable state and federal regulations.

5-342 General

1. The Director may preclude the onsite use of any stormwater management facilities, or require more stringent design, construction, and/or maintenance

provisions if based on a review of the stormwater management plan the proposed facility cannot function as designed due to actual project site conditions.

2. Stormwater management facilities shall not be located on any single family attached or detached residential lot unless specifically approved, in writing, by the Director. However, lots may extend into a wet pond to the permanent pool elevation. All lots which are constructed in accordance with the above shall comply with the setbacks required for the 100-year flood plain.

3. If existing structural stormwater management facilities are employed to meet the water quality criteria in whole or part, an onsite inspection report certified by a person who is licensed as a professional engineer, architect, landscape architect, or land surveyor pursuant to Article 1 (54.1-400 et seq.) of Chapter 4 of Title 54.1 of the Code of Virginia shall be provided as evidence to prove that the existing stormwater management facility was designed and constructed in accordance with proper design standards and specifications, and that facilities are currently in good working order, properly functioning and performing at their designed levels of service. A review of both the original structural design and maintenance plans may be required to verify this provision. A new maintenance agreement may also be required to ensure compliance with Town codes and ordinances.

4. Detention facilities (wet and dry), except those which are underground, shall be designed utilizing both a primary spillway and a separate, independent emergency spillway. Combined spillways shall only be permitted when approved by the Director and shall conform to Section 521.9.D, Combined Spillways

5. Any embankment constructed for purposes of impounding stormwater shall be designed in accordance with the requirements in Section 5-500, Dams Design and Construction.

5-343 Excavated Ponds

1. General. Excavated ponds, with contributing watershed areas of more than ten acres which create a failure hazard, shall be designed as embankment ponds. Excavated ponds that are normally dry (SWM ponds) and include a pipe outlet control system shall be designed using the principal and emergency spillways design criteria as that for embankment ponds.

2. Side Slopes. Side slopes of excavated ponds shall be such that they will be stable and shall not be steeper than three horizontal to one vertical.

3. Pond bottom (Dry Ponds) shall be graded to provide a minimum 1% slope to the lowest opening of the pond structure unless a lesser slope is approved by the Director.

4. Inlet Protection. Where surface water enters the pond in a natural or excavated channel, the side slope of the pond shall be protected against erosion.

5. Placement of Excavated Material. The material excavated from the pond shall be placed in one of the following ways so that its weight will not endanger the stability of the pond side slopes and where it will not be washed back into the pond by rainfall: Refer to Standard DS-5 in Appendix A.

   A. Uniformly spread to a height not exceeding three feet with the top graded to a continuous slope away from the pond.

   B. Uniformly placed or shaped reasonably well with side slopes no steeper than three horizontal feet to one vertical foot for the excavated material behind a berm width equal to the depth of the pond but not less than 12 feet.

   C. Shaped to a designed form that blends visually with the landscape. D. Used for low embankment and leveling.

   D. Hauled away.

5-344 Stormwater Management Pond Plans

The following information shall be shown on the design drawings for all stormwater management ponds:

1. Watershed Map. Watershed maps shall be shown on plans submitted for approval. Bar scales shall be used. The map shall show the watershed boundary; the drainage pattern; location of bridges and culverts and other structures that affect the flow of water; location of roads, buildings, property lines and fences and north arrow.

2. Plan View. The plan view should indicate the, center line of dam and cross section of the dam as well as a profile of the outlet structure and outfall pipe with corresponding station numbers. The plan will contain an accurate contour map of the structure site and adjacent area. When this map is shown on a plan-profile sheet, the plan scale should be the same as the profile. The contour interval should be one or two feet. The plan view should show in detail the following:

   A. The spillways and fill locations.

   B. All benchmarks, soil borings, borrow pits, fences, buildings, roads, bridges, springs, wells or other improvements that influence the design or construction of the proposed work.

   C. Property lines.

   D. Name of property owners.

   E. Contour at normal pool and design stormwater surface elevations.

   F. Contour map of flooded area. The scale of this map may be one inch = 20 feet where it can incorporate the details of the local plan, to one inch = 100 feet where a separate map would be required. The size, as determined by the scale and required details, vary from a one sheet combination of all maps and the profile, to an individual sheet for this map alone. The object of this map is to indicate with reasonable accuracy:

      (1) Contours of the normal pool elevation at a maximum contour interval of two feet when needed for design.

      (2) Contour of the spillway design flood water surface elevation. These contours shall be on a one foot vertical interval.

   G. The applicant shall on the construction plan set, provide a reference to the geotechnical report and include all applicable geotechnical notes regarding liner, embankment, seepage controls, etc.

3. Profile of Principal and Emergency Spillway. The profile shall be plotted at a scale of one inch equals ten feet horizontally and one inch equals five feet vertically on profile paper. The following shall be shown:

   A. Principal Spillway. The spillway must be shown on the profile at the correct station and elevation. The following elevations shall be clearly labeled:

      (1) The crest of the spillway.

      (2) The top of outlet apron or invert of pipe spillway at the outlet.

      (3) The water surface at maximum stage of design storm.

      (4) The top of the earthfill (settled height).

   B. Emergency spillway. The spillway must be shown on the profile at the correct station and elevation. The following shall be clearly shown:

      (1) Crest of the spillway.

      (2) Length of the control section.

      (3) Slope of the approach channel.

      (4) Slope of the exit channel.

      (5) The existing ground elevation along the centerline.

   C. For both spillway profiles, the location and elevation of rock, gravel or soil strata that affects the design or location of the structure shall be shown.

4. Cross Sections. Cross sections should be plotted as viewed looking downstream. The profile station for each cross section plotted should be centered directly below the cross section on the data sheet. When possible, the cross section should be plotted to the same horizontal and vertical scale, thereby giving an undistorted cross section.

A. The cross section along the centerline of the proposed earthfill shall show the following information:

(1) Elevations and important dimensions of the principal spillway in proper relation to the cross section showing the elevations of crest, apron, and top of weir or headwall.

(2) The top of the earthfill as constructed and its final settled height.

(3) The elevation of earthfill berms, if applicable.

(4) The elevation and dimensions of the emergency spillway.

(5) The location and descriptions of soil borings taken along or near the centerline of the proposed structure.

(6) The dimensions of and the depth of the cutoff trench.

B. Cross sections through the fill or embankment area shall show the following information:

(1) The side slopes of the fill.

(2) The top width of the embankment.

(3) The elevation of top of fill as constructed and its settled height.

(4) The existing and proposed ground lines.

(5) Property line, if applicable.

(6) Core trench dimensions and location.

(7) Foundation drain.

(8) The elevation of earthfill berms, if applicable.

(9) The location of any fences,

(10) Stations and centerline or baseline.

It may be possible to show this information on the profile of the principal spillway.

5. Other Details as Needed.

A. Seeding and mulching specifications for the fill, spillway, and borrow areas.

B. Pipe and riser construction details supplemented with details of appurtenant structures including but not limited to trash racks, anti-seep collars, propped outlet, concrete reinforcing, fencing.

C. Construction notes required to assist in layout, construction, and checking of the completed practice.

D. Notes and details from qualified soils engineer.

5-345 Rooftop Detention

1. Design Criteria

A. Roof top storage shall be an appropriate design to detain up to the ten-year, two-hour event, and emergency overflow provisions shall be adequate to discharge the 100- year, 30-minute event.

(1) A roof design in the Town of Leesburg is currently based on a snow load of 30 pounds per square foot or 5.8 inches of water. Assuming a reasonable factor of safety, properly designed roofs are structurally capable of holding three inches of detained stormwater.

(2) Roofs calculated to store depths greater than three inches shall be required to show structural adequacy of the roof design and to be approved by the Loudoun County Building Official prior to approval by the Director.

B. No less than two roof drains shall be installed in roof areas of 10,000 square feet or less, and at least four drains in roof areas over 10,000 square feet in area. Roof areas exceeding 40,000 square feet shall have

one drain for each 10,000 square foot area. Refer to Detail DD-14 of this Article.

C. Emergency overflow measures adequate to discharge the 100-year, 30-minute event without unnecessary risk to life or property must be provided.

(1) If parapet walls exceed three inches in height, the designer shall provide openings (scuppers) in the parapet wall sufficient to discharge the 100-year, 30-minute storm flow at a water level not exceeding five inches.

(2) A scupper shall be provided for every 20,000 square feet of roof area, and the invert of the scupper shall not be more than 3.5 inches above the roof level. (If such openings are not practical, then detention rings shall be sized accordingly).

D. Detention rings shall be placed around all roof drains that do not have controlled flow. Refer to Standard DS-9 in Appendix A.

(1) The number of holes or size of openings in the rings shall be computed based on the area of roof drained and runoff criteria.

(2) The minimum spacing of sets of holes is two inches center-to-center.

(3) The height of the ring is determined by the roof slope and in no case shall the height of the ring exceed three inches.

(4) The diameter of the rings shall be sized to allow the 100-year design storm to overtop the ring (overflow design is based on weir computations with the weir length equal to the circumference of the detention ring).

(5) Conductors and leaders shall also be sized to pass the expected flow from the 100-year design storm.

E. The maximum draw down time of the roof shall not exceed 17 hours.

F. The Town of Leesburg will accept Josam Manufacturing Company and Zurn Industries, Inc. market "controlled-flow" roof drains, or other approved equivalents.

G. Access for inspection shall be provided for all roof drains.

2. Plan Preparation

A. Computations required on all development plans:

(1) The roof area in square feet.

(2) The storage volume provided at three-inch depth.

(3) The maximum allowable and calculated discharge rate.

(4) Inflow-outflow hydrograph analysis or acceptable charts (For Josam Manufacturing Company and Zurn Industries, Inc. standard drains, the peak discharge rates as given in their charts are acceptable for drainage calculation purposes without requiring full inflow-outflow hydrograph analysis).

(5) The number of drains required.

(6) The size of openings required in detention rings.

(7) The size of rings to accept openings and to pass the 100-year design storm.

5-346 Underground Detention

1. General

A. All underground detention facilities that are to be publicly maintained or associated with a residential subdivision shall have prior approval of the Director.

B. Private underground stormwater management facilities utilizing corrugated metal pipe (CMP) will be approved, if the conditions listed below are satisfied:

(1) Pipe must be aluminum CMP or aluminized steel CMP. Other materials may be considered on a case by case basis with prior approval from the Director.

(2) All access structures, manholes, inlets, and control structures must be reinforced concrete meeting Virginia Department of Transportation standards and conform with OSHA Confined Space Regulations.

(3) Calculations must be submitted to demonstrate that the structure will withstand the expected traffic loading in a paved area.

(4) All construction details must be provided.

(5) Structures must not be placed under the main site accessways or adjacent to the public right-of-way.

C. Underground systems conveyed to the Town must be constructed entirely of reinforced concrete.

2. Design Criteria

A. Underground detention shall be a closed tank or pipe system.

B. Sediment traps and trash racks shall be provided. These should be placed near maintenance access points.

C. All underground facilities shall have at least two points of access to facilitate maintenance. The Director, on the recommendation of the Director of Public Works, may require additional access points if it is necessary for the required maintenance.

D. All underground detention facilities shall have spillways designed to accommodate the design-year event, while providing detention for the one-year, two-year and ten-year event(s) as required.

E. All facilities shall provide for adequate overland relief for runoff in excess of the ten-year event. Routing of the 100-year event through the underground detention facility is not required.

F. Peak runoff rates from the facility shall meet detention requirements as set forth in this DCSM.

G. See Section 5-700 for easement requirements.

3. Plan Preparation

A. Plans shall accurately show the alignment of the structure and all appropriate easements.

B. All corners and junctions of conduits shall be shown on all plans. These shall include the invert elevations of the tank if applicable.

C. A profile of the tank or conduit, including sufficient sections, shall be shown.

D. Details of gravel bed, tank, or conduit construction and entrance and outfall structures shall be shown.

E. Plan views of structures consisting of multiple sections shall include flow arrows.

5-347 Porous Pavement

1. General

A. The use of the following porous pavement surfaces shall be allowed on private property with all required design elements as appropriate for individual site conditions and a privately maintained maintenance agreement acceptable to the Town:

(1) Pervious Pavers

(2) Pervious Concrete

(3) Other materials may be considered on a case by case basis and shall require prior approval of the Director.

B. The use of porous pavement shall not be allowed for any public facility without prior approval of the Director of Public Works.

2. Design Criteria

A. Soil tests shall be conducted in accordance with Section 9-300.

(1) In addition to these tests, a percolation test shall be performed.

(2) An outflow "hydrograph" shall be developed based on the absorption and percolation rate of both subgrade and pavement and supplemental subdrainage.

B. Projected traffic counts and live loading calculations are required.

C. The mix (gradation) including density of both the subgrade and the porous pavement, shall be designed and sealed by a professional registered engineer certified by the State of Virginia with background in pavement design.

D. Preparation of the site and the placement of the pavement shall be done under the direct supervision of a professional engineer registered in the State of Virginia.

E. Pavement density tests shall be made within three hours of placement and shall be compared with engineer's calculations.

F. Prior to final inspection, a second density test shall be made and results compared with the previous test.

G. The construction plans shall contain:

(1) Engineering calculations, including design mix criteria and specifications.

(2) Calculation of the ten-year peak inflow rate.

(3) Storm routing calculations shall be provided as required by the Director.

(4) Calculations for nominal percolation rates based on the closure of voids due to sediment deposition.

(5) Provisions for freeze/thaw action and approved deicing chemicals shall be noted.

H. All future repairs (sealing, overlays) shall be done only with the prior approval of the Director of Plan Review and shall be in accordance with guidelines outlined above.

5-350 Regional Facilities

1. Regional facilities shall be determined based on the area of the drainage shed associated with the specific structure as follows:

   A. The drainage area to the structure shall be no less than 100 acres to be considered for a regional facility.

   B. The facility shall serve more than two sites.

2. The Director of Plan Review shall ultimately decide, based on the above criteria and the future benefit to the public, whether the facility is to be accepted as a regional facility.

3. These facilities shall be located such that they conform to those areas outlined within the Stormwater Management Master Plan for possible regional facilities. Other sites may be approved at the discretion of the Director of Plan Review.

4. Sites which are conveying their stormwater to a regional facility shall convey their stormwater through closed conduit, or adequate open channels. These systems shall have duly recorded easements.

5. Regional facilities shall be designed such that they retain a permanent pool of water with continuous release, and be of adequate volume and depth to become an amenity to the community.

6. For guidelines for dam design, refer to Section 5-520 of this Article.

7. If buildings are to be constructed downstream from the facility where failure may result in loss of life, the appropriate portion of the Probable Maximum Flood (PMF) or the 100 year storm event or the spillway design flood (whichever is applicable to the specific stormwater management facility design) elevation shall be determined and a building restriction zone set, similar to the restrictions for flood plains. Refer to Section 5-420 of this Article.

5-360 Waivers and Exemptions

1. Stormwater management waivers and exemptions shall be considered in accordance with the process established in Section 14-23 of the Town Code.

2. The following are examples of when a waiver may be considered by the Director:

   A. The hydraulic characteristics of the receiving stream or the environmental characteristics of the existing stream and the site are such that on-site management or detention of flows are contrary to sound engineering practices or detrimental to the environment.

   B. Existing off-site stormwater management facilities provide the required control. In such cases, on-site stormwater management may be waived provided that the delivery system from the developing site to the off-site stormwater management facility is designed based on Articles 5 and 6 of this DCSM.

   C. An off-site stormwater management facility has been identified for construction in the Capital Improvements Program, and the applicant will agree to a financial contribution or dedicated an easement or land for the construction thereof.

   D. Two or more developments, including that of the applicant, have provided jointly, through reciprocal easements, or other means, for the management of the stormwater facility.

3. Any new projects which are additions, extensions and modifications to those developments listed in the above categories which have been granted a prior waiver under this policy shall be required to provide stormwater management

for the entire site where the acreage limitations listed for each are exceeded by the subsequent addition, extension and modification thereto.

4. Owners and developers who have projects falling within these categories or the following conditions and who desire not to provide stormwater management for the site, must request in writing to the Director, that the requirements be waived.

5. Each request will be considered individually by the Director. All applications for a waiver will receive a written response outlining the reasons for approval or denial of the application within 45 days of receipt of a complete application.

6. It should be noted that in reviewing the waiver application, all storm drainage out- falls, receiving channels and channel capacities, velocities and other related storm drainage discharge considerations will be closely examined to determine the need for additional outfall treatment and/or channel protection needs. Further, the developer's engineer shall furnish the Director a signed and sealed document prior to granting a stormwater management waiver, stating that the receiving storm drain system in question is adequate.

5-370 Inspection and Maintenance Provisions

1. Engineers in the preparation of plans for construction shall include inspections, maintenance and operation of these facilities as one of the primary design considerations. All construction and site plans shall be accompanied by a separate Inspection Schedule and Maintenance Plan that identifies the owner, the responsible parties for inspections and maintenance as well as the inspection requirements and maintenance plan schedule that must be approved and recorded prior to plan approval. A separate Maintenance Agreement shall also be required to have been approved in a format approved by the Town Attorney and recorded prior to plan approval.

2. The following shall be included in the design of detention facilities:

   A. Access-ways shall be designated on plans and cleared, graded, and constructed along with the facility. These access-ways shall be a minimum of 12 feet in width with a maximum cross slope of 2% and a maximum longitude slope of 12%.

B. Proximity of facilities to public right-of-way shall be determined in order to minimize the length of required access-way.

C. Access shall be provided such that all portions of a facility are accessible.

D. Standard drainage easement agreements are not acceptable for access; therefore, special access easement agreements are to be executed which shall preclude planting of shrubs, construction of fences and other structures within the easement.

E. Grading of access ways to facilities and grading around facilities shall leave slopes which do not exceed eight percent to allow for access by maintenance vehicles.

F. Major facilities including wet ponds, underground chambers, etc., shall be accessible with at least one all-weather access roadway to include a minimum of a 12-foot wide surface to the satisfaction of the Director.

G. As these facilities are generally in close proximity to dwellings and may be subject to vandalism, principal spillways and other devices shall be designed to minimize unauthorized entry or tampering.

H. Underground chambers shall provide for two or more access points for ventilation and cleaning and be large enough to accommodate cleaning equipment. Generally, the access, where possible, shall be a minimum of 24 inches in diameter to facilitate maintenance and conform to Town standards for access.

3. Maintenance responsibility for stormwater management facilities that control only water quantity shall be as listed below:

Type of Zoning Use	**Maintenance**		**Guarantor of Drainage**	**Owner of Facility**	**Easement to Town**
	Aesthetics	**Drainage**			
SFD	Lot Owners	Town	Town	Lot Owners or HOA	Yes
SFA	HOA	Town	Town	HOA	Yes
Multi-Family	Lot Owner	Lot Owner	Town	Lot Owner	Yes

	HOA	HOA		HOA	
Commercial Industrial Institutional	Lot Owner	Lot Owner	Town	Lot Owner	Yes

SFD: Single Family Detached

SFA: Single Family Attached

4. Maintenance responsibility for stormwater management facilities that control both water quantity and water quality or just water quality shall be as listed below:

Type of Zoning Use	**Maintenance**		**Guarantor of Drainage**	**Owner of Facility**	**Easement to Town**	**Maint. Agreement Required**
	Aesthetics	**Drainage**				
SFD	Lot Owners HOA	Town	Lot Owners HOA	Lot Owners HOA	Yes*	Yes
SFA	Lot Owners HOA	Town	Lot Owners HOA	Lot Owners HOA	Yes*	Yes
Multi-Family	Lot Owner HOA	Lot Owner HOA	Lot Owners HOA	Lot Owner HOA	Yes*	Yes
Commercial Industrial Institutional	Lot Owner	Lot Owner	Town	Lot Owner	Yes*	Yes

*Private Stormwater Management easement with clause for Town to be maintainer of last resort.

SFD: Single Family Detached

SFA: Single Family Attached

(End of Section)

SECTION 5-400 FLOODPLAIN POLICY AND GUIDELINES

5-410 Applicability

Without prior approval of the Director and all other required approvals under Town ordinance, there shall be no construction permitted within floodplains. This shall include all stormwater management facilities. Floodplain, for the purpose of this DCSM, shall mean a drainage area of 100 acres or more that is inundated by the 100-year water surface elevation along any natural and/or manmade watercourse permanent or intermittent. For the purpose of this DCSM, a major floodplain is defined as a floodplain which has been displayed as a Federal Emergency Management Agency (FEMA) Special Flood Hazard Area (SFHA) with a Zone A or Zone AE designation. A minor floodplain is defined as a floodplain with a watershed greater than 100 acres and has not been displayed as a FEMA SFHA with a Zone A or Zone AE designation.

5-420 Construction Requirements

1. The following requirements for buildings are as follows:

   A. Residential: Under no circumstances shall any residence be located adjacent to a 100-year water surface such that its lowest point's nearest edge is within two vertical feet and 15 horizontal feet of the defined floodplain.

   B. Non-residential: Non-residential buildings shall be located no closer to the adjacent 100-year water surface such that its lowest point's nearest edge is within two vertical feet and 15 horizontal feet of the defined floodplain. However, non-residential buildings may be located closer than 15 feet horizontal and 2 feet vertical with the appropriate floodproofing mechanisms and with prior approval from the Director.

2. All non-residential structures that are floodproofed, if deemed permissible by the Director via a DCSM modification, shall provide the following:

   A. A design of floodproofing measures certified by a professional engineer or licensed architect to be in general conformance with design and methods of construction requirements set forth in the latest version of the Federal Code 44CFR § 60.3(c)(ii). A FEMA floodproofing

certificate shall be completed and submitted, as applicable, for design certification prior to floodplain alteration approval.

B. The floodproofing design shall not be included on the construction drawings as the town will not review or approve the structural design. It shall be the responsibility of the applicant to have a third party professional engineer or architect (acceptable to the Director) to review and certify that the final designs meet all applicable standards.

C. Upon completion of construction, an updated FEMA floodproofing certificate shall be completed and certified by a professional engineer or architect to ensure the building meets the design requirements prior to occupancy.

3. For all new structures and substantial improvements to existing structures that are located in a major floodplain, fully enclosed areas below the lowest floor, when permitted by the Zoning Ordinance, shall not be designed or used for human habitation, but shall only be used for parking of vehicles, building access, or limited storage of maintenance equipment used in connection with the premises. These areas below the lowest floor shall have permanent openings to allow the entry and exit of flood waters in accordance with the specifications of the latest edition of the Federal Code 44CFR § 60.3(c)(5). Any incidental structure, as described within Article 7 of the Zoning Ordinance, which is 600 square feet or greater, must be “dry” floodproofed in accordance with the latest FEMA Regulations.

4. All manufactured homes (where permitted by the Zoning Ordinance) located within major floodplains, or are substantially improved, on individual lots or parcels must meet all requirements for new construction, including elevation and anchoring requirements.

5. No development may adversely impact the existing 100-year water surface elevation by more than a 0.00 foot rise within the floodway portion of a floodplain. On a case-by-case basis, the Director may approve a modification of the no rise requirement for areas of the floodplain exclusive of the floodway. Any increases to the water surface elevation shall be discussed at the pre-application meeting. At a minimum, a floodplain easement and a CLOMR/LOMR processed through FEMA shall be provided for any and all properties (both on and offsite) impacted prior to the approval of a floodplain alteration study. Furthermore, approval of any floodplain study and/or

modification shall be conditioned upon a CLOMR/LOMR being processed and approved by FEMA.

6. Stormwater management best management practices (BMP) in the floodplain, as permitted by the Zoning Ordinance, must meet all the requirements as specified in the Virginia Department of Environmental Quality BMP Design Specifications. Some examples of permitted practices are as follows:

   A. Rooftop disconnection. Associated soil amendments shall be located outside of areas of existing tree cover and shall not require the clearing of existing tree cover or change the land cover value. All disturbed areas within the floodplain to allow soil amendments shall be approved by the Director.

   B. Sheet flow to conservation area.

   C. Sheet flow to vegetated filter and associated soil amendments located outside of areas of existing tree cover and not requiring the clearing of existing tree cover or change in land cover value. All disturbed areas within the floodplain to allow soil amendments shall be approved by the Director.

   D. Grass channel and associated soil amendments. All disturbed areas within the floodplain to allow soil amendments shall be approved by the Director.

   E. Soil amendments located outside of areas of existing tree cover and not requiring the clearing of existing tree cover or change in land cover value. All disturbed areas within the floodplain to allow soil amendments shall be approved by the Director.

   F. Other stormwater management facilities shall not be located within a floodplain unless adequate computations prove that the facility will function properly and will not adversely impact upstream or downstream properties and will not cause a rise any greater than a 0.00 foot rise in the 100-year water surface elevation. These computations shall include, at a minimum, a hydraulic analysis using HEC-RAS. The applicant shall submit a formal DCSM modification that requires approval from the Director.

7. Stormwater management facilities discharging into a floodplain shall be verified to meet all applicable design requirements while utilizing the proper tailwater condition for all computations. Computations shall utilize the greater elevation between the normal depth of the outfall and the receiving channel for the corresponding storm event.

8. The flood carrying capacity within an altered or relocated portion of any channel or watercourse within a floodplain shall be maintained. Under no circumstances shall any development adversely affect the water carrying capacity of any channel or watercourse within a floodplain.

9. There shall be no development or encroachment either permanent or temporary within a floodway unless a unique situation, such as, but not limited to, a stream restoration, bridge abutment, or bridge pier, can be justified by the applicant via a formal DCSM modification that requires approval from the Director. At a minimum the conditions of approval shall be:

    A. The proposed development or encroachment shall show no greater than an increase of 0.00 feet in the base flood level (100-year water surface elevation) during the base flood (100-year storm event) discharge based on a hydrologic and hydraulic analysis using HEC-RAS.

    B. A CLOMR/LOMR shall be processed and approved through the standard FEMA process.

    C. Floodplain easements shall encompass and be recorded for all areas (both on and offsite) of all impacted properties.

10. New development or encroachment shall not be permitted in a FEMA Zone AE without a designated floodway unless a unique situation can be justified by the applicant via a formal DCSM modification that requires approval from the Director. If approved, the proposed development or encroachment shall show no greater than an increase of 0.00 feet in the base flood level during the base flood discharge based on a hydrologic and hydraulic analysis using HEC-RAS. At a minimum, a floodplain easement and a CLOMR/LOMR processed through FEMA shall be provided for any and all properties impacted prior to the approval of a floodplain alteration study.

11. Temporary development and temporary encroachment into the major floodplain shall follow all requirements as new development and

encroachments unless can be justified by the applicant via a formal DCSM modification that requires approval from the Director. At a minimum, the proposed temporary development and/or temporary encroachment must show the following:

A. Minimal impacts to the base flood elevation.

B. No adverse impacts to upstream and downstream properties.

5-421 Emergency Access

1. In any case, where a road, public or private, which provides access to a development, subdivision, or residence is inundated by the floodplain or is inundated by more than twelve inches for the 100-year overland relief for the storm drainage system, the Developer shall provide an emergency vehicle access study. This study shall demonstrate that an alternate emergency vehicular access route is available to bring emergency services to the area beyond 12 inches of flooding of the road during the 100-year storm event and include the following:

   A. The alternate emergency vehicle access route must be along public streets or private streets only.

   B. The alternate emergency vehicle route must be less than one mile long.

   C. The alternate emergency vehicle route must not exceed 12 inches of inundation above the 100-year flood elevation at all points.

5-422 Warning and Disclaimer of Liability

1. No land shall hereafter be developed and no structure shall be located, relocated, constructed, reconstructed, enlarged, or structurally altered except in full compliance with the terms and provisions of this ordinance and any other applicable ordinances and regulations which apply to uses within the jurisdiction of this ordinance.

2. The degree of flood protection sought by the provisions of this ordinance is considered reasonable for regulatory purposes and is based on acceptable engineering methods of study, but does not imply total flood protection.

Larger floods may occur on rare occasions. Flood heights may be increased by man-made or natural causes, such as ice jams and bridge openings restricted by debris. This ordinance does not imply that districts outside of the floodplain district or land uses permitted within such district will be free from flooding or damage.

3. This ordinance shall not create liability on the part of the Town of Leesburg or any officer or employee thereof for flood damages that result from reliance on this ordinance or any administrative decision lawfully made thereunder.

5-430 Hydrologic and Hydraulic Design Requirements

1. The best available existing information shall be used as the basis for any floodplain study.

2. For all major floodplains, flows from the effective FEMA Flood Insurance Study shall be used for all floodplain modeling.

3. For areas not within a major floodplain and without pre-existing detailed modeling, flows shall be determined by the SCS or new NRCS methodology or rational method up through twenty acres (see Section 5-231 of this DCSM) unless otherwise approved by the Director.

4. Flows shall be determined assuming ultimate condition land use in the watershed. The ultimate condition land use is the future condition that will generate the highest peak discharge between the following plans: Town of Leesburg Comprehensive Plan, Town of Leesburg Zoning, and current land use.

5. Water surface elevations shall be determined using HEC-RAS or other Director approved methods. Computations shall be based on physical properties of the drainage shed and sound engineering judgment.

6. The Manning "n" values for each cross section, and supporting justification, shall be approved by the Director prior to submission of computed water surface elevations.

7. Spacing of cross sections shall not exceed 300 feet and at a minimum shall be cut at all significant changes in:

A. Horizontal alignment,

B. Channel gradient,

C. Channel width, and

D. At any obstruction in the channel which significantly affects the flow.

8. Topography for cross sections shall be field run for floodplain studies. Other certified topography at a minimum two foot contour interval accuracy may be utilized outside of the project limits and must be field verified to ensure accuracy to the extent practicable. The certified topography is subject to approval by the Director and shall be agreed upon during the pre-application meeting.

9. Cross sections shall extend both upstream and downstream of the subject site to the point where the post development water surface elevations are identical to the existing predevelopment water surface elevations and shall continue a minimum of 300 feet beyond said point or to a critical point further downstream as may be designated by the Director at the pre-application meeting.

10. Cross sections along major floodplains shall extend, notwithstanding other requirements in this section, both upstream and downstream to a point where the post development water surface elevations tie-into the effective FEMA water surface elevations within 0.5 feet.

11. All floodplain modeling shall adhere to standard engineering practices including but not limited to the procedures outlined in the HEC-RAS Hydraulic Reference Manual, VDOT Drainage Manual, and FEMA guidance such as HEC-RAS Procedures for HEC-2 Modelers.

12. All unique floodplain modeling assumptions, methods, and approaches shall require concurrence of the Director at the pre-application meeting and may require additional justification.

13. All HEC-RAS models shall be georeferenced utilizing a coordinate system consistent with the effective FEMA Flood Insurance Study.

14. All elevations within hydraulic models and floodplain studies must utilize the NAVD 88 vertical datum.

15. Additional floodplain study requirements and regulations can be found in the Town's Subdivision & Land Development Regulations (SLDR) Division 7, Article 7 of the Zoning Ordinance, and Section 14 of the Town Code.

(End of Section)

SECTION 5-500 DAMS DESIGN AND CONSTRUCTION

5-510 Regulations

5-511 Virginia Department of Historic Resources, Division of Soil and Water Conservation (VDHR SWC)

1. Construction of impoundments requires compliance with this DCSM as well as the State of Virginia standards under the Virginia Dam Safety Act, Article 2, Chapter 6, Title 10.1 (10.1-604 et seq) of the Code of Virginia and Dam Safety Regulations established by the Virginia Soil and Water Conservation Board (VS&WCB). Permits for construction and operation of dams regulated by DCR shall be issued by the Virginia Department of Conservation and Recreation.

2. All dam designs regulated by DCR can be submitted directly to DCR by the applicant as long as the applicant simultaneously copies all correspondence submitted to DCR to the Town of Leesburg. The Applicant shall provide proof to the Town of Leesburg that all required dam permits have been issued before scheduling a preconstruction meeting. All dam designs not regulated by DCR shall be made part of the site plan or construction plans submitted to the Town of Leesburg.

5-512 Town of Leesburg Regulations

1. It is the policy of the Town of Leesburg that compliance with the criteria set forth within this Article shall be required for the design and construction of dams within Town limits that are not under the jurisdiction of the Virginia Department of Conservation and Recreation.

2. The design procedures and criteria in this Article have been compiled for the use of persons involved in the design and construction of impoundment structures of sufficient size to represent a potential hazard to downstream properties.

3. The Town of Leesburg will review all dam designs and regulate those intended to impound water except as exempted below:

   A. Any existing or proposed dam regulated by the Federal Government or the Virginia Department of Conservation and Recreation.

B. All dams formed by highway embankments

(1) The Virginia Department of Transportation has special design criteria for permanently impounding water upstream of highway embankments.

(2) The Director shall approve such impoundments only upon favorable recommendation from the Virginia Department of Transportation.

4. Refer to Detail DD-11 of this Article for a graphical representation of impoundments which are regulated by the Town of Leesburg or regulated by the Virginia Department of Conservation and Recreation.

5. Except as exempted above, highway embankments shall not be used as dam embankments within the Town. This does not restrict the use of culverts with a headwater condition during rainfall events without a permanent surface elevation.

6. An inspection and maintenance agreement shall be executed with the Town by the owner and recorded among the land records of the Town of Leesburg prior to plan approval.

7. A permit from the Town shall also be required for dam construction.

8. Dams regulated by the Town of Leesburg shall be designed by a Professional Engineer licensed in the State of Virginia with expertise in the fields of geotechnical engineering, hydraulics, and dam design.

9. During construction, the owner shall employ an engineer licensed in the State of Virginia to inspect the construction of the dam, to file weekly reports with the Director covering construction progress including soil and compaction test data.

10. Record drawings with as-built information shall be submitted to the Director at the completion of construction and shall include soil classification, compaction and density test results, and concrete test results, to document the physical and structural soil characteristics of the facility.

11. After completion of construction, the owner's construction engineer shall certify, in writing, that the dam was constructed in accordance with the approved plans and specifications.

5-520 Design Criteria

1. All dam and embankment designs shall conform to the practices accepted by the Virginia Department of Conservation and Recreation (DCR), the Army Corps of Engineers, or others as approved by the Director. All dam and embankment designs shall conform to the requirements of Sections: 5-323, 5-324, 5-325, 5-326, 5-327, and 5-328 of this DCSM.

2. Storage volume. An evaluation of the topography of the drainage area to the proposed wet pond is necessary to ensure that an adequate base flow exists to maintain a permanent pool of water in accordance with DCR guidelines.

3. Dams shall be designed based on hydrology methods developed in the old SCS TR-55, NRCS WIN TR-55 (Windows Based Program), the old SCS TR-20, NRCS WIN TR-20 (Windows Based Program), or HEC-HMS as well as other programs which utilize the general methodology of TR-55 or TR-20 which may be approved by the Director on a case by case basis.

    A. All designs shall incorporate emergency spillways, the design of which shall provide the required stormwater management detention and shall pass the full volume of that portion of the Probable Maximum Flood (PMF) shown in DD-11 based upon dam height and impoundment. (The PMF is defined in Article 11). In no case shall the emergency spillway elevation be lower than the computed ten-year water surface elevation. An examination and determination of the flood plain created by the passing of the DD-11 PMF shall also be conducted and the limits of the area so flooded shall be delineated on submitted plans.

    B. All embankments shall be designed with a top width and side slopes appropriate for the material used to construct them.

    C. Compaction standards to be employed are to be stated on the plans.

    D. The embankment design shall take into account settlement based on compaction and type of material used.

E. Side slopes above the permanent pool elevation shall be no steeper than three to one.

F. The top of the embankment shall be a minimum of one foot and a maximum of two feet above the computed water surface elevation when passing through the emergency spillway the full volume of that portion of the Probable Maximum Flood (PMF) shown in DD-11 based upon dam height and impoundment. (The PMF is defined in Article 11).

G. Core trench, anti-seep collars or alternate measures, erosion protection on upstream face and outlet protection shall be considered in the design and a detail per the recommendations within the approved geotechnical report shall be included on the plans.

H. Any riser employed shall be designed to overcome buoyant forces. Risers shall also incorporate trash racks with anti-vortex devices.

4. Dam Failure.

A. As determined by the Director, a dam failure analysis is required for facilities with embankments between six and 25 feet with a capacity greater than 15 acre feet.

B. As part of the overall dam design, the engineer shall determine the segment of stream valley downstream from the dam that would experience an increased flood depth resulting from a potential dam failure.

C. Two types of danger reach analyses are to be investigated.

(1) For the first analysis, the engineer shall route the next highest design storm through the proposed spillway system. Refer to Detail DD-11 of this Article.

a. If the dam may fail as a result of overtopping, a danger reach analysis shall be performed.

b. If overtopping does not occur, a downstream analysis is not required.

(2) The second analysis shall consider a dam failure as a result of internal erosion with the pond or lake level at normal pool elevation. Analysis of this type will not be required for dams without a permanent pool.

D. Where required, the analysis shall be conducted to a point downstream where the dam break flood depth, danger reach length, has attenuated to within one foot or less of the flood depth that would be experienced without the dam.

E. If the dam break analysis shows a potential for flooding of habitable structures, the engineer and owner shall increase the spillway capacity and downstream channel capacity where applicable.

F. References used in dam design, construction, and maintenance include the latest versions of:

(1) Virginia Stormwater Management Handbook, (Latest edition).

(2) Virginia Erosion & Sediment Control Handbook, (Latest edition).

(3) Army Corps of Engineers Technical Manuals.

(4) Virginia Department of Conservation and Recreation Technical Manuals

(5) Nonstructural Urban BMP Handbook, Northern Virginia Regional Commission Technical Manuals, (Latest edition).

(6) Northern Virginia BMP Handbook; Northern Virginia Regional Commission Technical Manuals, (Latest edition).

G. Easements

Easements shall be provided for vehicular access for maintenance of the facility and its appurtenances.

5-521 Embankment Ponds

1. Embankment ponds shall conform to all of the following Town Standards as well as the "Virginia Impounding Structures Regulations (Dam Safety)", Virginia's updated "Dam Safety and Floodplain Management Programs and Regulations" and all related SCS or new NRCS "Technical Bulletins" or other written State requirements as applicable:

   A. Failure of the dam will not result in loss of life, in damage to homes, commercial or industrial buildings, highways classified as through collectors or higher, railroads; or in interruption of the use or service of public utilities.

   B. The product of the storage times the effective height of the dam is less than 2,000. Storage is the volume, in acre-feet, in the reservoir below the elevation of the crest of the emergency spillway. The effective height of the dam is the difference in elevation in feet between the lowest open channel emergency spillway crest and the lowest point in the original cross section on the centerline of the dam. If there is no open channel emergency spillway, the top of the dam becomes the upper limit.

   C. The Maximum Dam height allowed in the Town of Leesburg shall be less than 25 feet without prior approval from the Director.

   D. The Geotechnical Engineer shall determine if a site has the characteristics to support a dam and shall certify to any methods required to remediate the site to a condition that would support a dam.

   E. Approval is required by the Director for use of any impoundments regulated under the Virginia Impounding Structures Regulations (4VAC 50-20-10 et seq.)

      1. Permits for construction and operation of State regulated dams are issued by the Virginia Soil and Water Conservation Board.

      2. A copy of any state-approved design also must be submitted to the Director in order to receive Director approval for the construction plans.

F. Side Slopes: Side slopes shall be stable and shall not be steeper than three horizontal feet to one vertical foot without Director approval.

G. Pond bottoms (Dry Ponds) shall be graded to provide a minimum 1% slope to the lowest opening of the pond structure unless the Director approves a flatter slope.

2. Structure Classification. All structures (dams) will be reviewed and classed according to factors and procedures outlined in the National Engineering Manual and supplemented herein. The class of risk hazard as contained in this document is related to the damage that might result from a sudden major breach of the earth embankment. Structure classification and land use for runoff determination must take into consideration the anticipated changes in land use throughout the expected life of the structure. The valley downstream and the relationship of the site to industrial and residential areas all have a bearing on the amount of potential damage in the event of a failure. The classification of a dam is determined only by the potential hazard from failure, not by the criteria selected for design.

A. Classification factors in the National Engineering Manual

(1) Class “Low Risk” Structures located in rural, agricultural, or urban areas dedicated to remain in flood tolerant usages where failure may damage non-resident buildings, agricultural land, flood plains, or Town and County roads.

(2) Class “Significant Risk” Structures located in predominantly rural or agricultural areas where failure may damage isolated homes, main highways, or minor railroads or cause interruption of use or service of relatively important public utilities.

(3) Class “High Risk” Structures located where failure may cause loss of life, serious damage to homes, industrial, and commercial buildings, important public utilities, main highways, or railroads.

B. When structures are spaced so that the failure of an upper structure could endanger the safety of a lower structure, the possibility of a multiple failure must be considered in assigning the structure

classification of the upstream structure. Additional safety can be provided in either structure by:

(1) Increasing the retarding storage, and/or

(2) Increasing the emergency spillway capacity.

C. The following types of embankment structures are prohibited in the Town of Leesburg:

(1) Class "a" structures with a storage height product of 2000 or greater, and/or an effective dam height of 35 feet and greater.

(2) Class "b" Structures.

(3) Class "c" Structures.

3. Impoundment Laws

A. Virginia Impounding Structures Regulations (Dam Safety) criteria require that dams regulated by the State of Virginia must be certified by the state agency responsible for dam safety (currently the Virginia Department of Conservation and Recreation).

B. This requirement excludes impoundments having a dam height less than six feet and having less than 50 acre-feet of storage. Refer to Detail DD-11 of this Article.

4. Approximate method for determining Dam Breach Inundation Zone:

A. This method is based on information contained in the Soil Conservation Service TSC - Technical Note - Engineering UD16, which was issued on July 3, 1969, and shall be performed for all embankment structures which have an embankment height exceeding 15 feet and or those which impound more than 25 acre-feet of water. Refer to Section 5-520 for dam failure analysis requirements.

B. This method is based on the following:

(1) The dam is assumed to fail when the water depth is at the top of the dam.

(2) The peak rate of the breached hydrograph is based on data supplied by the Bureau of Reclamation for actual dam failures.

(3) The method is based upon a valley flood routing method taken from the Journal of the Proceedings of the ASCE, Hydraulics Division, May 1964, "Hydrology of Spillway Design", by Franklin F. Snyder.

C. The graph, as shown in Detail DD-12 of this Article, has the width of the valley below the dam in feet versus the length of reach per acre-foot of storage behind the dam for a depth (above bank full stage) at the lower end equal to one foot. Actual storage is to be calculated from the top of dam and the width of the valley would normally be the 100-year frequency storm flood plain.

D. Two examples of how to use this graph are as follows:

Example 1
A Developer wishes to build a lake for stormwater management and recreation. It has been determined that the height of the dam will be ten feet, and that there would be approximately eight acre-feet of storage behind the dam. From visual observation, it is noted that there are some homes located on the flood plain 1,500 feet below the dam site. It has also been determined that the average width of the valley is 400 feet. An analysis must be made to determine if there would be a danger to these homes if the dam failed.

Using the above information, enter the left side of the graph with a valley width of 400 feet, move horizontally to the curve labeled H = ten feet, go down vertically and read 160 feet at the bottom of the graph. This value is for one acre-foot of storage. It is determined that there are eight acre-feet of storage, so multiply 160 feet by eight and obtain 1,280 feet. This is the distance below the dam where the depth of flow in the flood plain would be one foot if the dam would fail.

Since the homes were located 1,500 feet downstream from the dam, this would indicate that there would be little, if any, damage to these

homes as a result of a sudden breach of the dam. This would indicate that the dam would be a low hazard, and that Class "a" design criteria could be used in the design of the dam if the flood plain is to remain in flood tolerant usage.

Example 2
Same as Example 1, except that the height of the dam is 15 feet. Entering the graph again with a valley width of 400 feet and going across to the curve labeled H = 15 feet and then going vertically down, the length of reach would be equal to 210 feet for one acre-foot of storage for depth (lower) = one foot. Eight acre-feet of storage is necessary, therefore multiply 210 times eight and obtain 1,680 feet. This is the distance below the dam where the depth of flow in the flood plain would be one foot if the dam would fail.

Since the homes were located 1,500 feet downstream from the dam, this would indicate that the depth of flow at the homes would be greater than one foot and would probably cause serious damage to these homes. This would indicate that the dam would be a higher hazard structure than Class "a" and would therefore be prohibited within the Town of Leesburg.

This is an approximate method and more detailed valley routings will give more precise answers. This method should not be used if there is not a uniform valley width, or if there is any downstream obstruction, such as a road fill, an undersized pipe, etc.

5. Selecting the Stormwater Management Pond Site

A. The selection of a suitable stormwater management pond site should begin in the preliminary stage of the development, with a view of selecting the site that proves most practical and economical.

B. A pond with a normal pool planned as a site amenity, may incorporate the required stormwater management function; or a stormwater management pond may, with modification, be utilized as a site amenity.

C. A wet pond utilized as a site amenity should be located at a site where the valley is narrow, side slopes are relatively steep, and the slope of the valley floor will permit a large deep basin. Such sites tend to

minimize the area of shallow water if a permanent pool is being considered; however, they should be examined carefully for adverse geologic conditions. In urban and suburban areas, large areas of shallow water should be avoided due to excessive evaporation losses and the growth of aquatic plants.

D. Consideration must also be given to any legal requirements. The landowner is responsible for obtaining all necessary and required easements of rights to discharge.

E. As previously noted the pond should not be located where sudden release of the water, due to failure of the dam, would result in loss of life, injury to persons, damage to residences or industrial buildings, railroads or highways, or cause interruption of use or service of public utilities. A site which presents one or more of these hazards is unsuitable and will not be approved.

F. A check should be made to ensure that no buried pipelines, cables, or other utilities exist in the construction area. Where such a site must be used, the utility owners shall be contacted prior to foundation investigation and utility relocation out of the embankment and impoundment area will be the responsibility of the developer.

G. No part of any pond shall be located within a minor or major floodplain without specific prior approval from the Director (and FEMA within FEMA SFHA).

H. The outfall from all BMP and/or SWM Facilities shall be at an elevation equal to or greater than the 100-year Floodplain elevation. With approval from the Director, the outfall pipe may extend into the 100 year floodplain as long as provisions are made for the pipe to have gaskets and the 100 year water surface elevation is lower than the bottom of the SWM facility.

6. Engineering Surveys. Once the location of the pond or reservoir has been determined, sufficient engineering surveys shall be performed so that the information required for stormwater management pond design can be obtained.

7. Geologic Investigations

A. All designs for wet ponds shall have a geologic investigation performed. Analysis shall be performed for dry ponds which have an embankment height greater than 15 feet and/or those which impound more than 25 acre-feet and/or those whose draw down time exceeds 24 hours.

B. The requirements of a foundation for an earthfill dam are that it provide stable support for the embankment under all conditions of saturation and loading, and that it provide sufficient resistance to seepage to prevent excessive loss of water. Adverse foundation conditions can lead to failure of a dam due to cracking, piping, sliding, settlement or uplift.

C. The foundation conditions under the proposed dam sites shall be investigated to ensure that the site is suitable and that a safe structure can be designed. The extent of the foundation examination will depend on the complexity of the conditions encountered and on the height of the dam. The "Unified System of Soil Classification" shall be used in foundation investigations and these logs shall be accurately located and shown on the final design plans.

D. Borings should be taken or test pits excavated at intervals along the centerline of the dam. The depth and spacing of the borings or pits should be sufficient to determine the suitability of the foundation.

E. Borings should also be taken along the centerline of the principal spillway to ensure an adequate foundation for the pipe and riser.

F. If a permanent pool is being considered, adequate soils investigations will be needed in the proposed pool area to be assured that excessive seepage will not be a problem.

G. In most cases, it is necessary to bypass excess storm runoff around the embankment of a pond through an excavated spillway. For economic reasons, suitable material excavated from the spillway should be used in the earthfill. Therefore, soil borings should be made along the approximate centerline of the proposed spillway to determine the type of material that will be encountered, its erodibility, and its suitability for use in the embankment. If additional borrow is needed, soil

borings should be made in the selected borrow areas in order to estimate the kinds and amounts of suitable fill materials available.

H. Materials selected for construction of a dam must have sufficient strength for the dam to remain stable and provide sufficiently low permeability, when compacted, to prevent harmful seepage through the dam.

I. A record or log of each boring or test pit should be made showing the location depth and classes of materials encountered. The location of each boring should be marked on the ground, so it can be referenced to other or more detailed surveys.

J. All information developed during the design process should be recorded in the form of an engineering plan for the pond.

8. Earth Embankment

A. Top Width. The minimum top width of the dam is shown below. When the embankment top is to be used as a maintenance access road, the minimum top width is to be the width of the proposed access road plus the top width as determined below.

Total Height of Embankment (Feet)	**Minimum Top Width (Feet)**
14 or less	12
15 - 19	12
20 - 24	12
25 – 34	*
35	*

* or larger as may be required by the State approval agency

B. Side Slopes. The upstream and downstream side slopes of the settled embankment shall not be less than:

Fill Material	Slope	
	Upstream	**Downstream**
Clayey Sand, Clayey Gravel, Sandy Clay, Silty Sand, Silty Gravel…	3:1	3:1
Silty Clay, Clayey Silt>>>	3:1	3:1

C. Wave Erosion Protection. Where needed to protect the face of the dam, special wave protection measures such as berms, riprap, sand-gravel, soil cement or special vegetation shall be provided. Refer to the Virginia Department of Transportation Drainage Manual.

D. Freeboard. The vertical interval between the elevation of the water surface in the reservoir with the emergency spillway flowing at design depth and the minimum elevation at the top of the settled embankment is the freeboard, and shall equal or exceed one foot; in addition, the minimum difference in elevation between the crest of the emergency spillway and the settled top of dam shall be two feet.

E. Allowance for Settlement. The design height of the dam shall be increased by the amount needed to ensure that the design top elevation will be maintained after all settlement has taken place. If a minimum required density is specified, the increase shall be five percent.

F. Foundation Cutoff. A cutoff trench of relatively impervious material shall be provided under the dam and into the abutments, as required, and be deep enough to extend into a relatively impervious layer except:

(1) In those cases where a layer of relatively impervious material thick enough to provide stability exists at the surface of the foundation; or

(2) In those cases where a layer of such material does not exist at a reasonable depth.

(3) Where the Geotechnical Engineer certifies (to the satisfaction of the Director) that it is not necessary.

The cutoff shall be located at or upstream from the centerline of the dam. Where such a layer does not exist at a reasonable depth, the engineer responsible for the technical design shall provide a geotechnical analysis, demonstrating that the site is feasible for the construction of a dam.

The cutoff trench shall have a bottom width adequate to accommodate the equipment used for excavation, backfill and compaction operations, with the minimum width being four feet, and shall have side slopes no steeper than one foot horizontal to one foot vertical.

G. Seepage Control.

(1) Seepage control is to be included:

a. If pervious layers are not intercepted by the cutoff;

b. If seepage may create swamping downstream;

c. If needed to ensure a stable embankment; or

d. If special problems, such as fractured rock, etc., require drainage for a stable dam

e. If recommended by the geotechnical engineer.

(2) Seepage control may be accomplished by

a. Foundation, abutment or embankment drains;

b. Reservoir blanketing; or

c. A combination of these measures.

Foundation drains are to be considered when the normal water depth in the pond is greater than 15 feet (measured from the low point at the centerline of the dam).

9. Spillways

A. Emergency spillways for all ponds will be designed to provide the required detention and to pass the full volume of that portion of the Probable Maximum Flood (PMF) shown in DD-11 based upon dam height and impoundment. (The PMF is defined in Article 11).

B. Principal Spillways. A conduit, with needed appurtenances, shall be placed under or through the dam except where a weir type structure is used.

(1) The principal spillway shall be designed to provide the detention required and control the release rate for those design-year events stipulated for each major watershed.

(2) The crest elevation of the inlet or riser shall be at least one foot below the crest elevation of the earth emergency spillway.

(3) The inlet or riser size for pipe drops shall be such that the flow through the structure goes from weir-flow control to pipe control flow without going into orifice flow control in the riser. The inlets and outlets shall be designed and analyzed to function satisfactorily for the full range of flow and hydraulic head anticipated. The riser shall be analyzed for flotation, using water at the principal spillway crest elevation, and assuming all orifices and pipes are plugged. The factor of safety against flotation shall be 1.2 or greater.

(4) Size. The capacity of the pipe conduit shall be adequate to discharge long duration, continuous, or frequent flows without flow through the emergency spillways. The diameter of the pipe shall not be less than 12 inches.

(5) Conduits under or through the dam shall be reinforced concrete. The conduits shall be capable of withstanding the external loading without yielding, buckling or cracking. Conduit strength shall not be less than Class III. The inlets and outlets shall be structurally sound and made from materials compatible

with the pipe. All conduit joints are to be made watertight by the use of gaskets.

(6) Excavation for Placement. Where excavation into existing or compacted ground is required in order to obtain the proper elevation for the conduit, this excavation shall be of sufficient width to accommodate the conduit, anti-seep collars, earth hauling and hand operated compaction equipment. The side slopes of the excavation shall not be steeper than one to one.

(7) Multiple Conduits. Where multiple conduits are used, there shall be sufficient space between the conduits and the installed anti-seep collars to allow for backfill material to be placed between the conduits by the earth moving equipment and for easy access by hand operated compaction equipment. This distance between conduits shall be equal to or greater than the pipe diameter or width opening but not less than two feet.

(8) Anti-Seep Collars. Anti-seep collars shall be installed around all conduits through earth fills of all wet ponds and for all dry ponds whose draw down time exceed 24 hours unless the Geotechnical Engineer certifies (to the satisfaction of the Director) that it is not necessary. Impoundment structures incorporating anti-seep collars shall use the following criteria:

a. Sufficient collars shall be placed to increase the seepage length along the conduit by a minimum of 15 percent of the pipe length located within the saturation zone.

b. The assumed normal saturation zone shall be determined by projecting a line with a slope of four horizontal to one vertical from the point where the normal water elevation touches the upstream slope of the fill to a point where this line intersects the invert of the conduit. All fill located below this line may be assumed to be saturated.

c. For ponds that are normally dry, the starting elevation shall be the maximum water surface elevation in the

pond when the principal spillway storm is routed through the structure.

d. Maximum collar spacing shall be 14 times the minimum projection of the collar measured perpendicular to the pipe.

e. Minimum collar spacing shall be five times the minimum projection of the collar measured perpendicular to the pipe.

f. All anti-seep collars and their connections to the conduit shall be water tight.

g. Alternate designs (designed to the satisfaction of the Director and certified by the Geotechnical Engineer) will also be permitted.

(9) Antivortex Devices. Drop inlet spillways are to have adequate antivortex devices in accordance with the latest edition of the Virginia Stormwater Management Handbook.

(10) Safety Guardrails and Trash Racks. Trash racks shall have openings no larger than 3/4 of the conduit diameter or width opening, but in no case less than six inches in its smallest dimension. Racks and rails should be used when it is necessary to prevent clogging or when a safety hazard exists. Flat grates for trash racks are not acceptable, side openings must be provided.

(11) All ponds in urban areas shall be analyzed for safety. Low stage inlets on ponds that are normally dry shall have adequate trash racks. Velocity of water through the trash rack opening at design flows shall not exceed three feet per second.

(12) Drain Pipe. A pipe with a suitable valve should be provided to drain the pool area where needed for maintenance. The principal spillway conduit may be used as a pond drain when so located as to accomplish this function.

(13) A narrative detailing how the pond is to be drained for maintenance and who is responsible shall be part of all plan sets submitted to the Town.

C. Emergency Spillways

(1) A separate, independent emergency spillway shall be provided for each dam, the purpose of which is to provide for safe passage of the appropriate portion of the Probable Maximum Flood (PMF) or the 100 year storm event or the spillway design flood (whichever is applicable to the specific stormwater management facility design) without damage to the embankment.

(2) Capacity. The minimum capacity of emergency spillways shall be that required to pass the peak flow expected from the appropriate portion of the Probable Maximum Flood (PMF) or the 100 year storm event or the spillway design flood (whichever is applicable to the specific stormwater management facility design). The routing shall start with the design water surface at the elevation of the crest of the principal spillway. Refer to Detail DD-11 at the end of this Article.

(3) Emergency spillways are to provide for passage of the design flow at a non-erosive velocity to a point downstream where the dam will not be endangered.

(4) Cross Section. Excavated earth spillways shall be trapezoidal and shall be located in undisturbed earth. The side slopes shall be stable for the material in which the spillway is to be constructed but not steeper than 3:1. For dams having effective heights exceeding 20 feet, the emergency spillway shall have a bottom width of not less than ten feet.

(5) When natural spillways are used, a dike shall be constructed from the end of the dam to prevent the flow from impinging on the toe of the dam. The dike shall have a freeboard of one foot above design flow.

(6) Permissible Velocities

a. Earth spillways shall be designed for non-erosive velocities through the control section and for a reasonable distance below the spillway. The maximum permissible velocity for the grass or grass mixture to be used shall be selected from the following table:

PERMISSIBLE VELOCITY FOR VEGETATED SPILLWAYS[1]				
Vegetation	**Permissible Velocity**			
	Erosion-Resistant Soils[2] Slope of Exit Channel		**Easily Eroded[3] Slope of Exit Channel**	
	pct 0-5	pct 5-10	pct 0-5	pct 5-10
	ft/s	ft/s	ft/s	ft/s
Kentucky Bluegrass Smooth Broome Tall Fescue Reed Canarygrass	7	6	5	4
Sod-Forming Grass-Legume Mixtures	5	4	4	3
Lespedeza Sericea Weeping Lovegrass Yellow Bluestem Native Grass Mixtures	3.5	3.5	2.5	2.5

[1] SCS-TP-61

[2] Those with higher clay content and higher plasticity. Typical soil textures are silty clay, sandy clay, and clay.

[3] Those with a high content of fine sand or silt and lower plasticity, or non-plastic. Typical soil textures are fine sane, silt, sandy loam, and silty loam.

b. The capacity of the spillway shall be determined using vegetal retardants representing an unmowed condition. The maximum velocity shall be determined with vegetal retardants representing a closely mowed condition.

GUIDE TO SELECTION OF VEGETAL RETARDANTS					
Stand	Average Height of Vegetation in Inches	Degree of Retardants	Stand	Average Height of Vegetation in Inches	Degree of Retardants
Good	Higher than 30	A	Fair	Higher than 30	B
	11 to 24	B		11 to 24	C
	6 to 10	C		6 to 10	D
	2 to 6	D		2 to 6	D
	Less than 2	E		Less than 2	E

(7) Excavated earth spillways shall have an inlet channel, control section, and an exit channel. Upstream from the control section, the inlet channel shall be level for the minimum distance of 25 feet and shall have side slopes equal to three to one or greater.

(8) The flow shall enter the spillway through the inlet channel. The maximum depth of flow (Hp) located upstream from the level part shall be controlled by the inlet channel, level part, and exit channel. Refer to Detail DD-13 of this Article.

Excavation of the inlet channel or the exit channel, or both, may be omitted where the natural slopes meet the minimum slope requirements. The direction of slope of the exit channel must be such that discharge will not flow against any part of the dam. Wing dikes, sometimes called kicker levees or training levees, can be used to direct the outflow to a safe point of release. The spillway should be excavated into the earth for the full length and width of the spillway. Refer to Standard DS-4 in Appendix A.

If this is not practical, the end of the dam and any earthfill constructed to confine the flow shall be protected by vegetation or riprap. The entrance to the inlet channel should be widened so it is at least 50 percent greater than the bottom width of the level part. The inlet channel should be reasonably short and shall be planned with smooth, easy curves for alignment. It

shall have a slope toward the reservoir of not less than two percent to ensure drainage.

(9) The inlet channel may be curved to fit existing topography, but exit channels shall be straight for a minimum distance well beyond the downstream toe of the dam at the lowest point in the valley.

(10) The grade of the exit channel of an excavated earth spillway shall fall within the range established by discharge requirements and permissible velocities. The exit channel shall terminate only where the design flow may be discharged without damage to the earth embankment.

(11) With the required discharge capacity, the degree of retardance, permissible velocity, and the natural slope of the exit channel known, the bottom width of the level and exit sections and the depth of the flow (Hp) can be computed from figure in Detail DD-13 of this Article which show discharge per foot of width. The natural slope of the exit channel should be altered as little as possible.

D. Combined Spillways

(1) Combined spillways (a single structure that combines the primary and emergency spillways) shall require approval of the Director and shall only be permitted when adequate provisions for the release of flows based upon the appropriate portion of the Probable Maximum Flood (PMF) or the 100 year storm event or the spillway design flood (whichever is applicable to the specific stormwater management facility design) can be accommodated downstream of the structure's outfall and when protection of the embankment is employed. Refer to Detail DD-11 of this article for spillway design requirements.

(2) The combined spillway (when approved by the Director) shall be designed to provide the detention required and control the release rate for those design-year events stipulated for each major water shed and adequately control the outflow of the less

frequent events of the appropriate portion of the Probable Maximum Flood (PMF) or the 100 year storm event or the spillway design flood (whichever is applicable to the specific stormwater management facility design).

(3) The combined spillway (when approved by the Director) shall provide for a minimum of 24 inches of freeboard from the elevation of the appropriate portion of the Probable Maximum Flood (PMF) or the 100 year storm event or the spillway design flood (whichever is applicable to the specific stormwater management facility design) to the Top of the Dam.

(4) Any design which utilizes a combined spillway shall incorporate a secondary all weather access route for the facility.

E. Structural Emergency Spillways

(1) Pipes, culverts, chutes or drops, when used for principal spillways or principal-emergency or emergency spillways, shall be designed in accordance with the principles set forth in the National Engineering Handbook, "Drop Spillways"; and "Chute Spillways." The minimum capacity of a structural spillway shall be that required to pass the peak flow expected. The routing shall start with the water surface at the elevation of the design storm.

(2) Structural emergency spillways may only be approved after an independent structural review of the design is completed by a structural engineer familiar with hydraulic structures, selected by the Director. All costs of this review shall be borne by the Developer.

(End of Section)

SECTION 5-600 INSPECTION AND ACCEPTANCE

5-610 Inspection

1. All storm sewers shall be inspected by the Town of Leesburg Inspectors (or their designee) and/or the Virginia Department of Transportation at periodic intervals during construction.

2. These inspections shall include a visual check of all storm sewer and appurtenances for damage related to construction.

5-620 Acceptance

1. All damage as determined by the above inspection shall be corrected, (replaced or repaired) to the satisfaction of the Director before acceptance.

2. Testing as required by the Director prior to acceptance shall be done in the same manner as that in Article 4, Section 150 of this DCSM.

3. Storm sewers shall be clean and free of debris and sediment prior to acceptance by the Town.

4. The Director shall approve and recommend for acceptance all storm sewer, appurtenances, and stormwater management facilities when it has been determined that the field engineering and construction has been completed as stated in the approved plans, the structures are in place, the ground around them stabilized in accordance with the final plans, a stormwater facility maintenance agreement has been executed, the performance bond for maintenance is provided, and a site as-built drawing has been submitted by the applicant and approved by the Town. Once the paper copies of the Final Site As-Built has been approved by the Town, the applicant shall, prior to acceptance and bond release, provide the Town with additional paper copies as well as an electronic version (in a format determined acceptable by the Town) of the As-Built drawings.

(End of Section)

SECTION 5-700 EASEMENTS

5-701 General

1. The easement requirements of this section are in addition to other easement requirements contained in this Article.

2. Storm drainage, stormwater management facility, natural channel, and vegetated buffer area easements shall be required in accordance with the table in Section 5-702.

3. Flood plain easements shall be required in accordance with Section 5-400.

4. All easements shall be conveyed to the Town and shall be in a form approved by the Town Attorney. Easement widths shall be in one foot increments.

5. All stormwater management facility easements and vegetated buffer area easements must include a separate maintenance agreement in accordance with this Article and the Town Code.

6. The dedication of a vegetated buffer area easement is not to be construed as requiring the Town to maintain the vegetated buffer area.

7. Only publicly maintained structures shall be located in the Town's right-of-way, Town-owned property, or public easements unless granted written permission from the Director.

8. All privately maintained structures shall be located within private easements that guarantee the Town maintenance rights and access as the maintainer of last resort.

9. Standard easements are not acceptable for access to detention facilities; therefore, special access easement agreements are to be executed that preclude planting of shrubs and the construction of fences and other structures within the easement.

5-702 Easement Applicability and Width

Easement Type	Applicability	Width
Storm Drainage – Pipes	Minimum	15 feet
	Maximum	Single Pipes – 30 feet Multiple Pipes – 15 feet each side
	Single pipes less than or equal to 24 inches in diameter	1:1 side slope from the pipe invert to the elevation of the finished grade on both sides of the pipe
	Single pipes greater than 24 inches in diameter	1:1 side slope from the pipe invert to the elevation of the finished grade on both sides of the pipe plus the outside diameter of the pipe
	Multiple pipes	1:1 side slope from the lowest pipe invert to the elevation of the finished grade on the most outside pipe, plus the combined outside pipe diameters, plus the width of space between each pipe.
Storm Drainage – Channels	Top width of the channel bank less than or equal to 5 feet	Minimum 15 feet
	Top width of the channel bank between 5 and 10 feet	Top width plus a ten foot access strip immediately adjacent to one side of the channel
	Top width of the channel bank greater than 10 feet; side slopes exceeding 3:1	Top width plus a ten foot access strip immediately adjacent to both sides of the channel
	Top width of the channel bank greater than 10 feet; side slopes not exceeding 3:1	Top width plus a ten foot access strip immediately adjacent to one side of the channel

Easement Type	**Applicability**	**Width**
Storm Drainage – Yard Inlets and End Sections	Yard inlets and end sections (or headwalls)	Minimum width set at the limits of the 10-year water surface elevation
Storm Drainage – 100-year Overland Relief	100-year overland relief flow path, not including ponded areas contiguous to the flow path	Minimum width set at the limits of the 100-year overland relief flow path
Stormwater Management Facility	Above ground structures	10 feet beyond engineered structural components and the 100-year water surface elevation
	Underground structures	10 feet beyond periphery of the structure
	Access roadways	1 foot on each side of the entire length of the roadway
Natural Channel	Minimum	Limits of the 100-year water surface
Vegetated Buffer Area	Minimum	Width of vegetated buffer area required in Section 5-323
100-Year Floodplain Easement	All Major and Minor Floodplains as defined by Town Ordinances	Minimum width set 1 feet beyond the 100-year floodplain limits as defined by a formal floodplain study

CONSTRUCTION DETAILS
ASSOCIATED WITH CHAPTER 5