Section 3 – Drainage

3.01 General

Standard

All drainage plans for proposed development shall be prepared by a Professional Engineer registered in Virginia, except as noted below. Their seal and dated signature shall be placed on the plans.

A Land Surveyor or Landscape Architect, registered under Section 54.1-408 or Section 54.1-409 of the Code of Virginia, may prepare construction plans for surface drainage, sanitary sewer, water lines, and detailed site grading, for subdivisions only, provided such work does not involve design of closed storm drainage systems, bridges, or other structures requiring detailed stress analysis, or design of sewage or water treatment plants, pump stations, or other work requiring mechanical or electrical equipment. Their seal and dated signature shall be placed on the plans.

Applicability of the Standard

This standard applies to all types of development, including subdivisions, PODs, and CIPs.

Design Requirements

3.02 Drainage Ordinances and Legal Requirements

Standard

All design and construction of site grading and drainage, both surface and subsurface systems, shall comply with all applicable drainage laws, ordinances, and standards.

All storm sewers that will carry drainage from adjacent properties through the property to be developed must be installed in private drainage easements. All storm sewers that will carry drainage from public facilities and/or public rights-of-way must be installed in an easement(s) dedicated to the County of Henrico.

A Stormwater Management (SWM) Facility Maintenance Agreement (Declaration of Covenants – Inspection and Maintenance of Stormwater Management Facilities as found in Appendix B of the Henrico County Environmental Compliance Manual) is required for all SWM facilities and must be submitted to the Department of Public Works prior to plan approval.

Drainage easements must be recorded through all SWM facilities and shown on the construction plans.

Offsite drainage easements must be recorded prior to plan approval. The Deed Book/Page Number for each off-site drainage easement must be included on the construction plans. All easement plats must be prepared by the developer and submitted to the Permit Center for approval. This is then forwarded to Real Property for routing and review of the other departments. The approved plat shall be forwarded to the Real Property Agent for preparation of the Deed of Easement and for processing of the documentation to the Clerk of the Circuit Court.

Applicability of the Standard

This standard applies to all types of development, including subdivisions, PODs, and Capital Improvement Projects.

Design Requirements

All proposed drainage easements must have a minimum width of sixteen (16) feet.

3.03 Offsite Drainage

Standard

The Department of Public Works reviews all subdivision plans, PODs, and building permits to ensure there are provisions by the developer to adequately handle drainage.

All storm sewers that will carry drainage from adjacent private properties through the property to be developed shall be installed in private drainage easements. All storm sewers that will carry drainage from public facilities and public rights-of-way through private property must be installed in an easement(s) dedicated to the County of Henrico.

Offsite drainage easements must be recorded prior to plan approval. The Deed Book/Page Number for each off-site drainage easement must be included on the construction plans. All easement plats must be prepared by the developer and submitted to the Permit Center for approval. This is then forwarded to Real Property for routing and review of the other departments. The approved plat shall be forwarded to the Real Property Agent for preparation of the Deed of Easement and for processing of the documentation to the Clerk of the Circuit Court.

Applicability of the Standard

This standard applies to all types of development, including subdivisions, PODs, and CIPs.

Design Requirements

All drainage improvements shall be adequate for the 10-year storm.

Drainage improvements that will serve off-site, upstream drainage areas shall be sized based on ultimate build-out for the upstream area based on the current Land Use Plan.

3.04 50/10 Detention

Standard

Stormwater detention facility needs were initially identified during the late 1970's as a part of a comprehensive county-wide stormwater drainage study. Stormwater detention facilities are required to be provided as a part of plans of development in those watersheds where downstream flooding problems are known to occur or if existing homes are located within the 50-year flood plain.

Storm water detention basins should be designed for future ease of maintenance. The developer shall be responsible for all required maintenance of the storm water detention facility.

A Stormwater Management (SWM) Facility Maintenance Agreement (Declaration of Covenants – Inspection and Maintenance of Stormwater Management Facilities as found in Appendix B of the Henrico County Environmental Compliance Manual) is required for all SWM facilities and must be submitted to the Department of Public Works prior to plan approval.

Applicability of the Standard

These standards apply to all regulated land-disturbing activities in the watersheds identified on Map 9-1 in the Henrico County Environmental Compliance Manual. However, the standards do not apply to (i) subdivisions or plans of development for single-family, detached residential structures, (ii) where it is demonstrated that there are no existing homes located within the 50-year floodplain downstream of the proposed development, or (iii) linear development projects.

Application of 50/10 detention requirements will be deferred if the proposed project meets either of the following conditions:

1. The proposed project results in an increase in impervious area of **½ acre** or less for the site, or
2. The post-developed 50-year peak rate of runoff (proposed runoff) for the site is an increase of **5 cfs or less** compared to the pre-developed 50-year peak rate of runoff for the site (existing runoff).

The 50/10 detention requirements can also be deferred for subsequent projects as long as one of the preceding conditions is met (considering the cumulative effects of all exceptions in comparison to the original existing conditions of the initial exception.)

Once a proposed project results in conditions when neither of the preceding conditions can be met for deferral, 50/10 detention requirements must be satisfied for the proposed project and all previously-deferred projects.

Even if the “insignificant” project conditions are met, we may deny the request based on known downstream flooding complaints/problems.

Design Requirements

These detention facilities must be designed so that the post-developed peak flow from the site for the 50-year storm does not exceed the pre-developed peak flow rate for the 10-year event. These requirements are to be calculated using the Rational Method.

A summary of the pre and post developed peak flow rates shall be shown on the construction plan.

3.05 Adequate Outfall

Standard

The outfall adequacy requirements for regulated land-disturbing activities vary, depending on whether a project is considered “grandfathered”, “previously permitted”, or if it falls under the Virginia Stormwater Management Program regulations that went into effect on July 1, 2014. For help determining which category a project falls under, please refer to Chapter 4 of the Henrico County Environmental Compliance Manual.

Projects that qualify as “grandfathered” or “previously permitted” must meet the requirements of Minimum Standard 19 of the Virginia Erosion and Sediment Control Regulations. These requirements are outlined in Section 14.3.1 of the Henrico County Environmental Compliance Manual.

All other projects must meet the Channel Protection Criteria and the Flood Protection Criteria that are outlined in Sections 9.3.4 and 9.3.5 of the Henrico County Environmental Compliance Manual.

Applicability of the Standard

This standard applies to all types of development, including subdivisions, PODs, and CIPs.

Design Requirements

Unless otherwise specified, the prescribed design storms are the 1-year, 2-year, and 10-year 24-hour storms using the site specific rainfall precipitation frequency data recommended by the U.S. National Oceanic and Atmospheric Administration (NOAA) Atlas 14. Partial duration time series shall be used for the precipitation data.

The U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) synthetic 24-hour rainfall distribution and models must be used to conduct the hydrologic analyses. These include, but are not limited to TR-55 and TR-20, hydrologic and hydraulic methods developed by the U.S. Army Corps of Engineers, or other standard hydrologic and hydraulic methods.

The Rational Method may be used to evaluate peak discharges for drainage areas of 200 acres or less.

The Modified Rational Method may be used for evaluating volumetric flows to stormwater conveyances for drainage areas of 200 acres or less.

All supporting information for outfalls (inverts, sizes, profiles, cross-sections, etc.) must be based on field-run elevations and surveys.

All storm sewer systems must be evaluated for both hydraulic grade line and pipe capacity during a 10-year storm event.

3.06 Open Channels

Standard

Open channels are not permitted with development except in the following cases:

1. Open channels with (i) drainage areas of 100 acres or more or (ii) regulated floodplain;
2. Open channels along roadsides (roadside ditches) when site characteristics or other conditions do not require the use of curb and gutter;
3. Yard swales; and
4. Existing open channels where the permitting agencies (the USCOE and/or DEQ) have claimed jurisdiction and have refused to issue the permits to authorizing the impacts necessary to eliminate them.

Applicability of the Standard

This standard applies to all types of development, including subdivisions, PODs, and CIP projects.

Design Requirements

1. Newly constructed channels must be designed such that the capacity of the channel is greater than or equal to the peak discharge to the channel associated with the 10-year storm event ($Q_{capacity} \geq Q_{10\text{-}year}$).
2. Newly constructed channels must be designed such that the velocity in the channel associated with the 2-year storm event is less than or equal to the allowable velocity of the channel lining ($V_{2\text{-}year} \leq V_{allowable}$).
3. Newly constructed vegetated channels must be designed with a minimum of one percent longitudinal slope.
4. Newly constructed vegetated channels with side slopes steeper than 3 to 1 must be lined with EC-2 or a VDOT approved equivalent.
5. Newly constructed paved channels must be constructed of reinforced concrete in accordance with VDOT specifications.
6. Newly constructed paved channels must be designed with a minimum of 0.5% longitudinal slope.
7. Channels as roadside ditches having less than 1% slope and those having sufficient slope to cause erosion shall have a concrete lining. Newly constructed concrete ditch sections shall be continuous with no intermittent break in lining for short sections between slope changes. Additional cross section evaluation/analysis shall be provided at grade breaks along the ditch profiles to justify ending concrete section once it has commenced.
8. Roadside ditches shall have sufficient depth to allow for installation of drainage structure(s), i.e. underdrain endwalls, driveway pipes, etc. in accordance with VDOT Standards. The minimum depth for a roadside ditch shall be 18”.

9. Where the permitting agencies (the USCOE and/or DEQ) have claimed jurisdiction over open channels and have refused to issue the permits to authorizing the impacts necessary to eliminate them, a 25’ wide Natural Area to Remain is required on both sides of the channel in accordance with Chapter 21 of the Henrico County Environmental Compliance Manual.

3.07 Stormwater Quality

Standard

Stormwater quality requirements for regulated land-disturbing activities vary, depending on whether a project is considered “grandfathered”, “previously permitted”, or if it falls under the Virginia Stormwater Management Program regulations that went into effect on July 1, 2014. For help determining which category a project falls under, please refer to Chapter 4 of the Henrico County Environmental Compliance Manual.

Projects that qualify as “grandfathered” or “previously permitted” must comply with the technical criteria that are found in Chapter 14 of the Henrico County Environmental Compliance Manual.

All other regulated land-disturbing activities must comply with the technical criteria that are found in Chapter 9 of the Henrico County Environmental Compliance Manual.

Applicability of the Standard

This standard applies to all types of development, including subdivisions, PODs, and CIPs.

Design Requirements

All SWM facilities must be designed and constructed in accordance with the standards and specifications found in the Virginia BMP Clearinghouse and the Henrico County Environmental Compliance Manual.

3.08 Wetlands

Standard

In accordance with Section 10-32 of the Henrico County Code, all regulated land-disturbing activities must comply with the County's requirements for Waters of the United States, State Waters, and Wetlands.

These requirements can be found in Chapter 21 of the Henrico County Environmental Compliance Manual.

Applicability of the Standard

This standard applies to all types of development, including subdivisions, PODs, and CIPs.

Design Requirements

3.09 Site Grading

Standard

Site grading is considered any construction that causes changes in the elevation of existing ground surfaces or alteration of existing surfaces in any way that would affect surface drainage flow.

Applicability of the Standard

This standard applies to all types of development, including subdivisions, PODs, and CIPs.

Design Requirements

Site grading cannot be done in any manner that will restrict the normal surface flow onto or off of the property unless appropriate drainage allowances have been provided.

All grading shall be performed in such a manner as not to cause erosion and shall be in keeping with the Erosion and Sedimentation Control Ordinance.

Construction Plan Requirements - An overall lot drainage map shall be included in all subdivision construction plans at a minimum scale of 1"=200', and include the following:

a. Flow direction arrows;
b. Minimum finished floor (MFF) elevation (no less than three feet above the highest grade at the house corners and at least one foot above the 100-year floodplain elevation) for each lot based on required grading to ensure proper drainage (House locations to be shown as determined necessary by the project engineer); and
c. Necessary grading and drainage improvements that will serve multiple lots including fill for low-lying areas and wetlands~~,~~ and drainage swales.

Building Permit Special Requirements – Lots which have special building permit requirements shall be identified on the construction plans as follows: **NBP1, NBP2, NBP3**.

a. **NBP1 – All lots requiring grading and drainage improvements as defined above.** Submittal of a certification of construction compliance is required by the home builder of record prior to issuance of the certificate of occupancy (CO).
b. **NBP2 – All lots that include storm sewer outfalls.** Submittal of a certified plat identifying the location of the storm sewer easement and installed drainage improvements is required by the engineer of record prior to issuance of permit.

c. **NBP3 – All lots identified as having permit restrictions related to sediment basin/trap locations.** This includes all lots that contain or are adjacent to a sediment basin or trap. Lots adjacent to or containing a sediment basin or sediment trap that will not be converted to a permanent SWM facility must be identified on the plan sheet and with notes stating that building permits will not be issued for these lots until the basins, traps and/or diversions are removed. Building permits for lots adjacent to a sediment basin or trap may be issued once a letter has been received from the contract purchaser acknowledging the presence of the sediment basin or trap is submitted to the Department of Public Works. A copy of the letter, which can be found in the Henrico County Environmental Compliance Manual, must also be attached to the building permit application.

Building Permit Lot Grading: A minimum of 6" of fall is required over the first 10' from all sides of the house. After the first 10', a minimum of 1% of fall will be required to the property line to ensure adequate drainage away from the proposed house. Spot shots will need to be shown on the plat to demonstrate adequate drainage from the proposed house.

3.10 Underdrains

Standard

Standard Pavement Edgedrain, UD-4, are required along the entire length of all proposed public roads and/or road widening within the public right-of-way unless waived by the Director of Public Works.

Standard Combination Underdrain, CD-2, shall be installed under all vertical sags and bridge approaches including roads without curb and gutter. Standard Pavement Edgedrain, UD-4, shall be installed along each raised grass median and/or island curb line to prevent water infiltration through or under the pavement structure. See Pavement Edgedrain for Raised Grass Medians and Islands, Drawing C-33.

If approval from the Director of Public Works is obtained to install an irrigation system in or adjacent to the right-of-way of an existing roadway, a condition of approval shall be the installation of an approved underdrain system. All disturbances associated with the installation of an irrigation system shall be restored to their original condition and approved by Department of Public Works. A Maintenance Agreement, See Appendix D, from a homeowners association or other group shall also be provided.

All underdrains shall be installed in accordance with VDOT Road and Bridge Specifications and Underdrain details in this manual, See Appendix C, Drawing C-33.

Applicability of the Standard

This standard applies to all types of development, including subdivisions, PODs, and CIPs.

Design Requirements

- The outlet end of all underdrains shall terminate in drainage structures or daylight out of fill slopes with a Standard EW-12 endwall placed at the outlet end of the underdrain.

- The invert elevation at outlet end of outlet pipe shall be a minimum of 1’-0” above invert elevation of receiving drainage ditch or structure.

3.11 Bridge and Culvert Design

Standard

All bridges and culverts shall be of concrete construction and shall be HS 20-44 loading or alternate military loading, or both, in accordance with the VDOT requirements and with the current AASHTO bridge design specifications. All supporting design calculations for the structure shall be submitted with the bridge plan for approval. The construction plans, design calculations and specifications shall be signed and sealed by a professional engineer responsible for the structural design. The engineer shall be responsible for geotechnical and associated engineering during construction and shall perform independent inspections to ensure compliance of the plans and specifications. Prior to acceptance, the professional engineer responsible for the structural design shall submit a signed and sealed certification that the structure was built in accordance with the plans and specifications.

Travel lanes, clear of all obstructions, shall be in accordance with the road cross-section details for the road classification. All drainage facilities for bridges shall be in accordance with current VDOT requirements and this Manual.

Applicability of the Standard

This standard applies to all types of development, including subdivisions, PODs, and CIPs.

Design Requirements

- Box culvert minimum height of 6 feet.
- Provide upstream and downstream transition zones.
- Provide the 100-year Backwater Elevation if not in County or FEMA Flood Plain.
- Show sufficient field data on plans to develop grades for inverts and transition zone requirements.
- Headwalls/Endwalls shall be parallel to the roadway.
- Extend pre-cast box culvert units, as necessary, to ensure embankment slopes are not steeper than 2:1 as measured from the closest point of the roadway shoulder to the culvert wingwall.
- Box Culverts - Provide geotechnical report data and show foundation requirements on plans.
- Provide adequate Right-of-Way or Easements for access, installation, and maintenance of structures.
- Sufficient grading information must be provided for the transition zones above and below all culverts showing that stormwater will flow into and out of the culvert unimpeded.

3.12 Roadway Drainage

Standard

Inlets are required at the low point of all sag vertical curves and on continuous grades where the maximum allowable gutter flow spread reaches the maximum allowable width.

Applicability of the Standard

This standard applies to all types of development, including subdivisions, PODs, and CIPs

Design Requirements

The maximum allowable gutter flow spread for a two-year storm is as follows:

- Major and Minor Arterial Roads 8 feet
- Collector Roads 10 feet
- Local Roads 12 feet

Flanking inlets are required adjacent to (within 50 feet of) sag inlets where the longitudinal slope is 0.3 percent or flatter.

3.13 Drop Inlets

Standard

All inlets, junction boxes, and manholes for storm sewer must be constructed in accordance with the VDOT Road and Bridge Standards and Specifications unless otherwise specified in this Manual.

Applicability of the Standard

This standard applies to all types of development, including subdivisions, PODs, and CIPs

Design Requirements

Inlets are not permitted in the curb radius of an intersection.

Inlets in any cul-de-sac cannot have a throat length greater than 6 feet.

Inlets in tangent sections cannot have a throat length greater than 14 feet.

VDOT Standard DI-3 and DI-4 structures will use “Type B” nose.

VDOT Standard DI-2 structures are not permitted within any County maintained right-of-way.

VDOT Standard IS-1 is required in all drop inlets and manholes. Cost of inlet/manhole shaping is considered incidental and shall be included in unit cost of each inlet or manhole.

The maximum allowable distance between any two connected structures connected by storm sewer is 300 feet.

Yard Drainage

Drainage inlets are required to intercept yard drainage in lieu of open-ended pipe. ~~Front~~ All yard drainage structures are limited to VDOT Standard DI-1, DI-5, DI-7, and DI-12 structures. All yard inlets and grate inlets must be located at an elevation that is low enough to drain the surrounding area. ~~A~~appropriate grading limits must be shown on the construction plan. All yard swales must have at least a one (1) percent longitudinal slope. When DI-5 and DI-7 structures are utilized, Grate Type III (1” openings) must be installed in pedestrian areas and Grate Type I (3” openings) shall be installed in wooded areas. Load carrying grates (Grate B) must be used in areas subject to vehicular traffic. All grates and angle iron must be hot-dipped galvanized.

Structural Design

All drainage structures must be constructed of concrete and/or reinforced concrete (poured in place or precast) and designed in accordance with the VDOT standards and requirements. Smooth dowels (#4 x 8 inches) are required at approximately 12 inches on center in all areas adjacent to abutting concrete to prevent settlement. Precast drop inlets are not permitted at locations where the adjacent curb and gutter grade is less than 1.5 percent. Precast drop inlets having throats with flat inverts are not permitted in sag locations when throat length exceeds 6 feet.

Hydraulic Design

All inlets must be sized to handle the runoff quantities produced by a 10-year storm event.

All grate inlets must be sized under the assumption that the grate is 50% clogged.

3.14 Storm Sewers

Standard

All storm sewers shall be installed and constructed in accordance with VDOT Road and Bridge Specifications and Road and Bridge Standards unless otherwise specified in this Manual.

All storm sewers shall discharge into an adequate outfall channel, or pipe system, which has positive gravity flow to a natural outfall. If such an outfall is not available, it shall be the responsibility of the developer to obtain the outfall easements to construct the outfall system.

The storm sewers and outfalls must be designed and meet the latest standards of the Virginia Stormwater Management Program.

Pipe Materials Minimum

All storm sewer within the County right-of-way and easements must be:

Reinforced Concrete Pipe, (RCP), ASTM C-76, Class III or better with sealed joints in accordance with VDOT specifications.

Or, Polypropylene, (PP), pipe, AASHTO M330, corrugated wall with smooth interior wall, (VDOT Type S or Type D), with gasketed joints in accordance with VDOT specifications.

Abandoned Storm Sewer

Abandoned storm sewers and drainage pipe shall be removed when no longer needed. If removal is not practical, as deemed by the Department of Public Works, the pipes are to be plugged and filled with flowable fill in accordance with VDOT requirements.

Design Requirements for Storm Sewers

The minimum design frequency for storm sewer shall be a 10-year storm.

The minimum pipe size within road right-of-way and public easements will be 15 inches in diameter.

The minimum design velocity in storm sewers shall be two feet per second based on a two-year storm. In no instance, shall the storm sewer design be less than a 0.3% slope.

The maximum slope allowed in the storm sewer is 16%

When velocity exceeds five feet per second, based on a 10-year storm, at the storm sewer discharge, energy dissipation methods are required.

Radial pipe and/or special bends may be used where the design permits or dictates and on approval of the Director of Public Works.

Hydraulic grade lines are required with all proposed storm sewer.

Installation

All drainage pipes and structures shall be installed on a firm foundation as required by the VDOT Road and Bridge Specifications and Road and Bridge Standards. A minimum of 4 inches of pipe bedding (No. 5 Stone) shall be required under all storm sewer pipes, paved ditches and drainage structures.

Post Installation Pipe Inspection

A post installation visual/video camera inspection shall be conducted by the Contractor on all pipes identified on the plans as storm sewer pipe and any culverts as determined by DPW.

Post installation inspection shall be conducted in accordance with Virginia Test Method (VTM) 123 and section 302 of the VDOT Road and Bridge Specifications. Recorded observation shall include detailed annotation for each deficiency observed and a summary of locations identified (with annotations) included with the submittal. A copy of the video inspection with summary and annotation shall be submitted to DPW prior to acceptance of the project or roadways. In the case of subdivision street acceptance, DPW may elect to allow repairs to be completed during the defect period depending on severity of deficiencies.

Excavation & Backfill

Trench width shall not be less than the outside diameter of the pipe plus 18 inches on each side unless, otherwise approved.

The minimum cover for Class III concrete pipe in roadside ditch sections shall be 9 inches from the top of pipe to finished grade.

The minimum cover for polypropylene, (PP), pipe in roadside ditch sections shall be 12 inches from the top of pipe to finished grade and be compacted per pipe manufacture's guidelines.

A County Inspector must be present to witness the backfill and compaction operations for polypropylene, (PP), pipe installed under roadways with a 24-hour notice requirement. Storm sewer pipe must be installed at depths that will accommodate minimum height requirements for drop inlets. Note: Detail C-30 depths will not meet this 9" requirement

Unless otherwise approved, all pipe under public travel ways shall be backfilled with an approved crushed aggregate to a minimum elevation of 12 inches over top of the pipe or to finished subgrade where there is an overlap in elevations for the subsequent layer of pavement structure (provided that the total cover over the pipe is at least 12 inches when the subgrade depth is considered). See Detail C-30

Pipes in easements or right-of-way not subject to vehicular traffic must be backfilled with an approved crushed aggregate to the top of the pipe. The remainder of backfill shall be placed and compacted in accordance with the latest edition of the VDOT Road and Bridge Specifications to prevent settlement.

All pipes must be installed to grade as specified on an approved plan. When required by the Department of Public Works, as-built profiles shall be submitted for revie

3.15 Erosion and Sediment Control

Standard

In accordance with Section 10-34 of the Henrico County Code, all Virginia Erosion and Sediment Control Program (VESCP) land-disturbing activities must comply with Chapter 8 of the Henrico County Environmental Compliance Manual.

For help determining if a project is a VESCP land-disturbing activity, please refer to Chapter 3 of the Henrico County Environmental Compliance Manual.

Applicability of the Standard

This standard applies to all types of development, including subdivisions and PODs, and CIPs.

Design Requirements

3.16 Dams

Standard

Any newly constructed or existing dam which is regulated under the Virginia Dam Safety Act shall obtain approval under the Virginia Dam Safety Regulations and the Virginia Department of Conservation and Recreation (DCR), as well as the Department of Public Works (DPW). Dams which are not regulated under the Virginia Dam Safety Regulations shall comply with the latest edition of the Virginia Storm Water Management Program Manual. The project engineer shall be responsible for associated geotechnical and civil engineering during construction and shall perform independent inspections to ensure compliance of the design. A signed and sealed certification of compliance shall be submitted to the Department of Public Works upon completion and prior to acceptance.

Virginia Regulated Dams

"Impounding structure" means a man-made structure, whether a dam across a watercourse or other structure outside a watercourse, used or to be used to retain or store waters or other materials. DCR Dam Safety regulations (4 VAC 50-20) apply to any impounding structure or dam over 6' high with over 50 acre-ft of impoundment and over 25' high with over 15 acre-ft. of impoundment. There are exemptions for dams regulated by the State Corporation Commission (SCC), for dams specifically for agriculture purposes as long as the dam is less than 25 ft in height and less than 100 acre-ft impounding capacity; silt retaining dams and obstructions in canals.

The height of an impounding structure is measured from the top of the dam, not at the typical water level or spillway elevation, down to the natural bed of the stream. This provision may make additional structures regulated.

Regulated dams are classified into three categories, **High** hazard (probable loss of life upon failure), **Significant** (potential loss of life upon failure) and **Low** (no expected loss of life). The dam owner is required to determine the dam's hazard classification and meet the DCR regulatory requirements. The Division of Dam Safety and Floodplain Management within the Virginia Department of Conservation and Recreation enforces the Virginia Dam Safety regulations and approves the owner’s hazard classification.

DCR requires the owners of regulated dams to obtain a 6 year Operating and Maintenance Certificate, (O&M). In order to get a regular O&M certificate, the dam must be in compliance with DCR regulations listed in 4 VAC 50-20 section 10 through 400. These regulations require development and distribution of Emergency Action Plans and Dam Break Inundation Zone (DBIZ) Maps. No trees or woody vegetation are allowed on the crest or slopes of dam or within 25' of toe of dam.

Inspections by a Professional Engineer are required to be submitted to DCR for regulated dams at a frequency determined by the hazard classification - high hazard are once per year - significant is less, low is once per 6-year O&M renewal cycle. The owner must inspect the dam every year it's not inspected by a PE.

If a dam is not in compliance with DCR regulations, the owner may apply for a 2-year (renewable) conditional O&M certificate. Any structural modification of a regulated dam must obtain an alteration permit.

DPW Controlled Regulated Dams

Henrico DPW controls and maintains the dams at Cox Road in Innsbrook (middle Innsbrook Lake), at Pump Road near Canterbury subdivision, at Park Terrace Drive in the Wellesley subdivision, and at Dominion Club Drive in the Wyndham subdivision.

Applicability of the Standard

This standard applies to all types of development, including subdivisions and PODs.

Design Requirements

Development within DBIZs

DCR regulations require that the locality control development within identified DBIZs; the Planning Department must review submitted DBIZ maps. Virginia state legislative code 10.1-606.3 identifies requirements for any developer within a DBIZ. The developer may have an obligation to assist with the upgrade of a dam spillway if the development changes the hazard classification of the impounding structure. Any DBIZ maps that are obtained by DPW staff must be submitted to the Planning Department.

If development (defined by Henrico County code as three or more residential structures or a single commercial structure) is proposed within a DBIZ, County code section 24-106.4 requires suspension of permitting activities and notification of the Dam Safety Division of DCR. DCR will evaluate whether the hazard classification will change and notify the department within 45 days.

Non-Regulated Dams

Non-regulated dams include BMPs and recreational lakes owned by HOAs or others.

For non-regulated dams, the Dam Break Inundation Zones must be identified for a Sunny Day failure. Residential development within the sunny day DBIZ and adjacent to BMP is restricted.

Roads over Dams

Roadways get special attention in permitting regulated dams. The presence of a roadway over a regulated dam will almost certainly force the dam into the Significant or High hazard category. New public or private roads should not be allowed over new or existing dams.

If a public roadway is proposed on a dam, an agreement acceptable to the Director of Public Works, the County Attorney's Office and the Real Property Office shall be provided prior to plan approval. Other requirements and conditions particular to the proposed dam may apply in addition to the requirements of this Manual. The use of the roadway as an emergency spillway shall not be allowed.

3.17 Floodplain Management

Standard

Flooding is a recurrent issue in some areas of Henrico County. In order to prevent development and land-disturbing activities from increasing flood damages and to make federally subsidized flood insurance available for property within the county, development is controlled and managed in areas identified as subject to flooding.

County Code restricts construction of buildings within areas subject to flooding. Floodplain requirements for land development are in accordance with Chapter 24 of the County Code. Evidence of FEMA approval may be required for all regulated development within FEMA floodplains.

National Flood Insurance Program (NFIP)

The National Flood Insurance Program (NFIP) is managed by the Federal Emergency Management Agency (FEMA) and makes federal flood insurance available to homeowners, renters, businesses, and community associations in NFIP participating communities. Henrico County participates in the NFIP, so flood insurance coverage is available to all County residents, whether they are located in a high-risk flood area or not. Most homeowners and renter's insurance policies do not cover flood damages, so flood insurance coverage is recommend for all properties in flood-prone areas. Flood insurance coverage may be mandatory in FEMA floodplains. Lower cost flood insurance coverage is also available in moderate to low-risk flood areas.

The NFIP has three components:

- Floodplain Management requirements for communities that choose to participate. The NFIP is a voluntary program. Henrico County has participated in the program since the early 1980's.
- Flood Insurance Rate Maps (FIRMs) and Flood Insurance Study (FIS) showing the inundation boundaries and elevations of the 100-year flood.
- Flood Insurance Requirements. Federal rules require that any structure that touches the boundary of the 100-year flood and is covered by a federally backed mortgage maintain flood insurance. FEMA underwrites flood insurance policies. Flood Insurance is sold by most insurance agents.

When a community participates in the NFIP, it is required to manage development in 100-year floodplains identified by FEMA. Henrico County also manages development in county-mapped 100-year floodplains.

Definitions

Base Flood Elevation (BFE) is the water surface elevation of the base flood as shown on either the most recent Federal Emergency Management Agency Flood Insurance Rate Map or Flood Insurance Study or on the county's most recent comprehensive drainage study map, whichever is higher. The county engineer may amend the county's

comprehensive drainage study map at any time upon review of additional engineering studies of floodplain areas. For areas without mapped base flood elevations, the developer shall use the 100-year flood elevations and floodway information from federal and state sources, if available, or, when such information is not available, flood elevations derived from sufficiently detailed hydrologic and hydraulic computations by a professional engineer who certifies the correct use of currently accepted technical concepts.

County comprehensive drainage study map is the most recent map approved by and maintained by the county engineer designating the 100-year floodplain in the county.

Development means any man-made change to improved or unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations or storage of equipment or materials.

Dwelling means any building or portion thereof occupied or designed to be occupied exclusively for residential purposes, but not including a tent, cabin or travel trailer or a room in a hotel or motel.

Floodproofing means any combination of structural and non-structural additions, changes, or adjustments to structures which reduce or eliminate flood damage to real estate or improved real property, water and sanitary facilities, structures and their contents.

Floodway is the channel of a river or other watercourse and the adjacent land areas shown on the most recent Flood Insurance Study or Federal Emergency Management Agency Flood Insurance Rate Map that must be reserved from encroachment in order to discharge a base flood without cumulatively increasing the water surface elevation of the flood by more than one foot.

Freeboard means a factor of safety usually expressed in feet above a flood level for purposes of floodplain management. “Freeboard” tends to compensate for the many unknown factors that could contribute to flood heights greater than the height calculated for a selected size flood and floodway conditions, such as wave action, bridge openings, and the hydrological effect of urbanization of the watershed.

Lowest floor is the lowest floor of the lowest enclosed area (including basement). An unfinished or flood-resistant enclosure, usable solely for parking of vehicles, building access or storage in an area other than a basement area, is not considered a building's lowest floor; provided, that such enclosure is not built so as to render the structure in violation of the applicable nonelevation design requirements of the County Code or other applicable codes and ordinances.

Special Flood Hazard Area (SFHA), also referred to as the 100-year floodplain, is used to identify areas subject to inundation by the 1% annual chance storm event. SFHA is also referred to as the 100-year floodplain. The SFHA includes FEMA-identified floodplains and County-identified floodplains.

Water Surface Elevation (WSE) means the height, in relation to a specified datum, of floods of various magnitudes and frequencies in the floodplains of coastal or riverine areas.

Variable Width Drainage Easement is that area on a plan that is identified as 100-year floodplain. Plans and plats must show the SFHA boundaries if it is part of a parcel or adjacent to a parcel being developed.

County Code

- Section 24-3 & Sec. 24-106.1 contain other definitions used in managing development within identified floodplains.
- Section 24-8 outlines the requirements for the enlargement, extension, reconstruction, substitution, or structural alteration of a non-conforming structure.
- Section 24-95(u)(1) prohibits new dwellings within the SFHA, requires a setback from the floodplain boundary, and requires elevation of the lowest floor if the structure is within a specified distance from the floodplain.
- Section 24-106.1 contains the detailed requirements for floodplain management, including the requirement that the lowest floor (including basement) for new construction must be at least one foot above the Base Flood Elevation. Also within this section is a No-Rise requirement that does not allow development to raise the 100-year water surface elevation.

County and FEMA floodplains are identified based on the 1% annual chance (100-year recurrence interval) storm event.

FEMA performs engineering studies using the rainfall and run-off flow based on 100-year storm events and maps the resulting inundations zones. The results are published on Flood Insurance Rate Maps (FIRMs) and in a Flood Insurance Study (FIS). Henrico County's latest FIRMs and FIS became effective in December of 2007.

FEMA FIRMS typically identify 100-year floodplain areas down to one square mile (640 acres) of drainage. In some areas, the FEMA FIRM may also identify areas based on the 500-year (0.2% annual chance) storm event.

County-identified 100-year floodplains are usually mapped for drainage areas down to 100 acres. County-identified floodplains do not typically identify areas based on the 500-year storm event.

Floodplain studies are done with different levels of complexity. FEMA and County-identified floodplains designate inundation areas as "A" Zones when they are based on "Approximate" studies. Approximate studies typically do not include the effects of bridges or culverts. "AE" flood zones are based on detailed studies which typically include the effects of bridges and culvert; detailed studies can include a floodway.

Plan Review and Approval

The Engineering and Environmental Services Division of the Department of Public Works uses a checklist in the review and approval of Plans of Development and other development proposals. The checklist has sections for development projects in or adjacent to identified 100-year floodplains. The following comments are made when a Plan of Development or other development proposal is submitted for approval, as appropriate:

- The County or FEMA 100-year floodplain boundary must be shown on the plans.
- The 100-year Base Flood Elevation must be identified and shown on the plans.
- If the flood study for the area is approximate, the study must be detailed for the effects of a culvert or bridge. This study must be approved by the Henrico County DPW. The 100-year water surface elevation model must use the hydrology of the area based on the approved Henrico County Land-Use plan and the final topography based on the proposed development.
- The proposed detailed study cannot be approved if it shows any increase in 100-year water surface elevations from the approved detailed study. A "No-rise" certification (form accessed through the Henrico County website) must be included in the plan submittal for approval.

FEMA Floodplain Boundary or BFE Changes

FEMA acknowledges that the 100-year floodplains identified on the FIRMs may be modified by improved topographic data, or require changes based on development and changes in the drainage area. The first and simplest Letter of Map Change is called a Letter of Map Amendment (LOMA). This is typically obtained when the published floodplain boundary is incorrect as proven by measuring the elevation of the ground around a structure and comparing it to the BFE at that location. If the Lowest Adjacent Grade (LAG) at a structure is higher than the BFE, then the 100-year event will not inundate the structure. FEMA has published the MT-EZ form which is used to apply for a LOMA.

If the plan requires fill in a FEMA delineated 100-year floodplain, FEMA's approval is required. A Conditional Letter of Map Revision (CLOMR) is required prior to doing the balanced cut and fill work with a final "as-built" Letter of Map Revision (LOMR) after the work is complete. DPW will review the CLOMR/LOMR application submittal and get the Community Acknowledgement form (part of the MT-2 LOMR application package) signed by the County Engineer.

Henrico County can approve the proposed plan with changes in the 100-year floodplain based on an approved CLOMR, but the final plat will not be approved without the physical changes completed and submittal of as-built plans with the approved LOMR. The procedure is as follows:

- Prior to proposed plan approval, prepare & submit the "No Rise" certificate with the technical justification for county review and approval, including cross sections and volume calculations.
- Prior to proposed plan approval, an application for a Conditional Letter of Map Revision (CLOMR) must be prepared and submitted to the County for review and approval.
- Upon approval by Henrico County, the FEMA Community Acknowledgement (CA) form will be signed by the County Engineer and the developer will submit the CLOMR application to FEMA.

- Prior to final plat recordation, FEMA must issue the CLOMR, the fill placed (including all fill within the 100-year floodplain, an as-built certification of fill in floodplain performed, and a final Letter of Map Revision (LOMR) must be issued by FEMA. When FEMA approves the LOMR, all affected landowners must be notified.

County Floodplain Boundary or BFE Changes

County floodplain boundaries or base flood elevations may be modified by improved study methods. These changes must comply with the Guidelines for Amending Special Flood Hazard Areas in Henrico County and approved by the County Engineer.

- Culvert or bridge backwater calculations may be required where a County floodplain has not been studied in detail including the effects of a culvert or bridge.
- When a County floodplain is modified, there is no requirement for FEMA involvement, but affected landowners must be notified.
- Fill in any 100-year floodplain is not allowed without approval from the County Engineer/Director of Public Works. A developer must make an exception request, including a "No-Rise" certification, that includes justification for the request prior to plan approval. Adequate justification includes engineering data supporting a no-rise certification.
- If the area has not been studied in detail, field topography should be used in creating a detailed study or updating an existing study. The hydrology must be adjusted to the land use in the most recently approved Henrico County Land-Use plan.

Applicability of the Standard

This standard applies to all types of development, including subdivisions and Plans of Development (PODs), and CIPs.