Chapter 4

RUNOFF TREATMENT AND CONTROL

Chapter 4

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4.01 General Provisions

a. The provisions of this chapter shall apply to all development projects within District and City jurisdiction. Interpretations of such provisions and their application in specific circumstances shall be made by the District and City.

b. Any City operating a local program may adopt stricter design specifications within its jurisdiction than the specifications stated in this chapter.

c. Where District and City standards conflict, the District's standards shall apply.

d. The use of development techniques that mimic natural systems, including Low Impact Development Approaches (LIDA) and green infrastructure, shall be emphasized.

4.02 General Requirements

4.02.1 Erosion Protection

a. Inlets to water quality and quantity approaches shall be protected from erosive flows through the use of an energy dissipater or rip rap stilling basin of appropriate size based on flow velocities. Flow shall be evenly distributed across the treatment area.

b. All exposed areas used for water quality treatment and/or quantity management shall be protected using coconut matting or District approved alternative. Matting shall be used in the treatment area of swales and below the water quality volume levels of ponds, and all other zones.

4.02.2 Vegetation

a. Except as specified in Section 4.06 or the LIDA Handbook, vegetation shall be in accordance with Appendix A: Planting Requirements.

b. No invasive species shall be planted or permitted to remain within an area used for water quality treatment or water quantity management which may affect its function, including, but not limited to invasive species identified in the most current version of the District's Integrated Pest Management Plan.

4.02.3 Fencing

a. Unless otherwise approved by the District or City, delineation fencing shall be required around facilities and/or tracts containing facilities.

b. When a facility is fenced, the fence shall be 4-foot high, vinyl-clad chain link fence conforming to CWS Standard Drawing No. 740. The fence shall include a 12-foot wide lockable gate for maintenance access conforming to CWS Standard Drawing No. 740.

c. If a facility is located adjacent to a Vegetated Corridor, wildlife friendly fencing shall be utilized.

d. If, in the opinion of the District or City, risk of damage to the facility and/or public safety is minimal, split rail fencing, dense vegetated hedges, or other approved method may be used to delineate the facility boundary.

4.02.4 Access

a. General Access Requirement

Unless otherwise approved by the District or City, access roads shall be provided for maintenance of all water quality and quantity facilities. The following criteria are considered to be the minimum required for facilities maintained by the District or Cities. Other permitting jurisdictions may have more restrictive requirements. If the design Engineer anticipates that any of the requirements will not be met due to the configuration of the proposed development, the design Engineer is advised to meet with District or City staff to gain approval for the deviation prior to submittal.

b. Standard Road Design

1. The road section shall be three (3) inches of class “C” asphaltic concrete; over two (2) inches of ¾”-0” compacted crushed rock; over six (6) inches of 1½”-0” compacted crushed rock; over subgrade compacted to 95-percent AASHTO T-99; or, the design Engineer may submit an alternate design certified as capable of supporting a 30-ton maintenance vehicle in all weather conditions.

2. Strengthened sidewalk sections shall be used where maintenance vehicles will cross.

3. Maximum grade shall be 10-percent with a maximum 3-percent cross-slope.

4. Minimum width shall be 12 feet on straight runs and 15 feet on

curves.

5. Curves shall have a minimum 40-foot interior radius.

6. Access shall extend to within 10-feet of the center of all structures unless otherwise approved by the District or City.

7. The District or City may require a curb or other delineator at the edge of the road for drainage, a curb stop, or to demarcate the road where the road edge is not apparent.

8. The side slope for road embankments shall be 2H:1V or flatter.

9. A vehicle turnaround shall be provided when the access road exceeds 40’ in length.

c. Alternate Access Road

An alternate access road design meeting the requirements of this section may be approved by the District or City for facilities in which access is required for general maintenance and long term care of the facility, but where there is no structure, as determined by the District or City, requiring regular maintenance.

1. The road section shall meet the requirements of 4.02.4(b)(1) or an alternate section certified as capable of supporting AASHTO HS-20 loading.

2. As an alternative to the requirements of 4.02.4(c)(1)), a concrete grid paver surface may be constructed by removing all unsuitable material, laying a geotextile fabric over the native soil, placing a structural border and pavers, filling the honeycombs/grids with soil, and planting appropriate grasses.

3. Strengthened sidewalk sections shall be required where maintenance vehicles will cross.

4. Maximum grade shall be 20-percent with a maximum 3-percent cross-slope.

5. Minimum finished width shall be 12 feet.

6. The District or City may require a curb or other delineator at the edge of the road for drainage, a curb stop, or to demarcate the road where the road edge is not apparent.

7. The side slope for road embankments shall be 2H:1V or flatter.

8. A vehicle turnaround shall be provided when the access road exceed 40’ in length.

4.02.5 Maintenance Responsibilities

a. Unless otherwise approved by the District, newly constructed water quality or quantity approaches serving multiple parcels or public roads shall be publicly maintained.

b. Publicly maintained water quality or quantity approaches shall be covered by a surface and stormwater management easement dedicated to the District or City. The District or City shall also be granted an access easement to maintain the approaches. The District will typically not own the land the approach is on.

c. Unless otherwise approved by the District or City, development creating multiple parcels intended for separate ownership shall enclose the publicly maintained water quality and quantity approaches in a tract.

d. Unless otherwise approved by the District or City, private water quality and quantity approaches shall be maintained by the Owner.

4.03 Water Quantity Control Requirements

4.03.1 Mitigation Requirement for Quantity

Each new development shall incorporate techniques for mitigating its impacts on the public stormwater system in accordance with Section 5.05. The District or City shall determine which of the following techniques may be used to satisfy this mitigation requirement.

a. Construction of permanent on-site stormwater quantity detention facilities designed in accordance with this Chapter; or

b. Enlargement or improvement of the downstream conveyance system in accordance with this Chapter and Chapter 5;
or

c. Payment of a Storm and Surface Water Management System Development Charge (SWM SDC), as provided in CWS Ordinance 28, which includes a water quantity component to meet these requirements.

4.03.2 Criteria for Requiring On-Site Detention

a. If District or City requires that an on-site detention facility be constructed, the development shall be eligible for a credit against SWM SDC fees, as provided in District Ordinance and Rules.

b. On-site facilities shall be constructed when any of the following conditions exist:

1. There is an identified downstream deficiency, and the District or City determines that detention rather than conveyance system enlargement is the more effective solution.

2. There is an identified regional detention site within the boundary of the development.

3. Water quantity facilities are required by District-adopted watershed management plans or adopted subbasin master plans.

4.03.3 Hydraulic Design Criteria

a. Detention design shall be assessed by dynamic flow routing through the basin. Documentation of the proposed design shall be included in the drainage report. Acceptable analysis programs include those listed below, as well as others using the SBUH or TR-55 methodology, provided the considerations outlined in Section 5.04.2 are followed.

1. HYD
3. HEC-1
4. HEC-HMS
5. SWMM
6. HYDRA
7. Others as approved by the District

b. Peak runoff rates shall not exceed pre-development rates for the specific range of storms, per Subsection 4.03.4(b).

c. A pond overflow system shall provide for discharge of the design storm event without overtopping the pond embankment or exceeding the capacity of the emergency spillway.

d. Provide an emergency spillway sized to pass the 100-year storm event or an approved hydraulic equivalent. Emergency spillway shall be located in existing soils when feasible and armored with riprap or other approved erosion protection extending to the toe of the embankment.

4.03.4 Other Requirements

a. All water quantity facilities shall be designed in accordance with District guidance documents and be consistent with this Chapter.

b. When required, stormwater quantity on-site detention facilities shall be designed to capture runoff so the post-development runoff rates from the site do not exceed the pre-development runoff rates from the site, based on 24-hour storm events ranging from the 2-year return storm to the 25-year return storm. Specifically, the 2, 10, and 25-year post-development runoff rates will not exceed their respective 2, 10, and 25-year pre-development runoff rates; unless other criteria are identified in an adopted watershed management plan or subbasin master plan.

c. When required because of an identified downstream deficiency, stormwater quantity on-site detention facilities shall be designed such that the peak runoff rates will not exceed pre-development rates for the specific range of storms where the downstream deficiency is evident.

d. Construction of on-site detention shall not be allowed as an option if such a detention facility would have an adverse effect upon receiving waters in the basin or subbasin in the event of flooding, or would increase the likelihood or severity of flooding problems downstream of the site.

e. Low impact development approaches, designed in accordance with this Chapter, can be utilized to meet all or part of any detention requirements on a site.

4.04 Water Quantity Facility Design Standards

4.04.1 Facility Design Criteria

a. The facility can be a combined water quality and quantity facility provided it meets all relevant criteria.

b. Interior side slopes up to the Maximum Water Surface: 3H:1V or flatter.

c. If interior slopes need to be mowed side slope: 4H:1V or flatter.

d. Exterior Side Slopes: 2H:1V or flatter, unless analyzed for stability by a geotechnical engineer.

e. Minimum Freeboard: 1-foot from 25-year design water surface elevation.

f. Provide an approved outlet structure for all flows.

g. Certain situations require use of multiple orifice plates to achieve desired outflow rates.

4.04.2 Walls in Water Quantity Facilities

a. Retaining walls may serve as pond walls if the design is prepared and stamped by a registered professional engineer and a fence is provided along the top of the wall. At least 25% of the pond perimeter shall be vegetated to a side slope of 3H:1V or flatter.

b. Walls that are 4 feet or higher shall meet all of the following criteria:

1. Be approved by a licensed structural or geotechnical engineer; and

2. The District shall not have maintenance responsibility for the wall. The party responsible for maintenance of the walls within the water quantity tract or easement shall be clearly documented on the plat or in alternate form as approved by the District.

4.05 Water Quality Treatment Requirements

4.05.1 General

Owners of new development and other activities which create or modify 1,000 square feet or greater of impervious surfaces, or increase the amount of stormwater runoff or pollution leaving the site, are required to implement or fund permanent water quality approaches to reduce contaminants entering the storm and surface water system.

4.05.2 Criteria for Requiring Implementation of a Water Quality Approach

a. A water quality approach shall be implemented on-site unless, in the judgment of the District or City, any of the following conditions exist:

1. Due to topography, soils or other site conditions, implementation of an on-site approach is impractical, ineffective or results in the inefficient use of District or City resources for long-term operations and maintenance; or

2. There is a more efficient and effective regional approach within the subbasin that was designed to incorporate the development, or there is an approach in the subbasin which is demonstrated to have the capacity to treat the site.

b. If construction or implementation of a water quality approach is not required as a result of meeting any condition outlined in Section 4.05.2 (a)

(1)-(2), the Owner of the development shall pay a Fee-In-Lieu of construction or implementation of Water Quality Approaches in accordance with District Rates and Charges.

4.05.3 Required Treatment Design Efficiency

a. Stormwater quality approaches shall be designed to remove 65 percent of the total phosphorous from the runoff from the impervious area that is tributary to the facility.

b. The phosphorous removal efficiency specifies only the design requirements and is not intended as a basis for performance evaluation or compliance determination of the stormwater quality control approach installed or constructed pursuant to this Chapter.

c. The following approaches are available for meeting the treatment design efficiency standard in this section:

1. Pretreatment as specified in Section 4.05.7 in combination with one of the following vegetated water quality LIDA:
   A) Vegetated Swale
   B) Extended Dry Basin
   C) Constructed Water Quality Wetland
   D) Structural Infiltration Planter
   E) Non-structural Infiltration Planter (rain garden)
   F) Flow-through Planter
   G) LIDA Swale
   H) Street-Side Planter
   I) Landscape Filter Strip
   J) Vegetated Corridor as a Filter Strip

2. Proprietary treatment systems meeting the requirements of Section 4.05.8.

3. Alternative water quality approaches that can be demonstrated, to the satisfaction of the District, to meet the removal efficiency standard in this section.

4.05.4 Design Considerations

a. If an onsite water quality approach cannot be constructed or implemented to treat the runoff from the development's impervious surface, then with District or City approval, an on- or off-site water quality approach may be designed to treat runoff from an equivalent area of existing untreated impervious surfaces.

b. Approaches shall be designed so that flow from the development is treated off-line from the storm conveyance system and reconnected to upstream flows following treatment. If an off-line approach is not feasible, additional capacity in the approach may be required for upstream flow.

c. Discharges to sensitive areas shall maintain the hydro period and flows of pre-development site conditions to the extent necessary to protect the characteristic functions of the sensitive area. Conversely, discharge of flows that may be critical to downstream water quality sensitive areas into other catchments will not be permitted unless addressed in the applicant's Service Provider Letter.

d. The stormwater quality approaches shall be designed for a dry weather storm event totaling 0.36 inches of precipitation falling in 4 hours with an average storm return period of 96 hours.

e. All water quality approaches shall be designed in accordance with this Chapter.

4.05.5 Impervious Area Used In Design

The following apply for development which creates or modifies 1,000 square feet or greater of impervious surface. Development which results in both new and modified impervious surface will result in a combined treatment requirement, as described below:

a. For new home construction on a single family or duplex lot of record the water quality approach shall be sized based on 2,640 square feet of impervious surface per dwelling unit. The actual impervious surface may be utilized when the lot size is less than 2,000 square feet, or the development creates or modifies impervious surface not associated with new home construction, up to a maximum of 2,640 square feet.

b. For single family and duplex residential partitions and subdivisions, stormwater quality approaches shall be sized for all impervious area created by the development and for all existing impervious area proposed to remain on site. All existing and proposed residences on individual lots shall be sized at the rate of 2,640 square feet of impervious surface area per dwelling unit. For the purpose of design calculations, the actual impervious surface can be utilized as an alternative to 2,640 square feet per dwelling unit when the average lot size on a single-family residential project is less than 2,000 square feet.

c. For all developments other than single family and duplex, including row houses and condominiums, the stormwater quality approaches shall be sized to treat all new impervious surfaces and three times the modified

impervious surface, up to the total existing impervious surface on the site. The area requiring treatment is shown in the formula below:

Treatment = New Impervious + 3(Modified Impervious)

When modification results in the permanent removal of 1,000 square feet or greater of impervious surface, the treatment approach shall be sized for three times the replaced impervious surface, in addition to the new impervious surface. In this case, the area requiring treatment is shown in the formula below:

Treatment = New Imp. + 3(Modified Imp. - Permanently Removed Imp.)

Impervious areas shall be determined based upon building permits, construction plans, or other appropriate methods of measurement deemed reliable by District and/or City.

4.05.6 Water Quality Approach Sizing Methods

a. Water Quality Volumes and Flows (applies to approaches in Section 4.05.3.c.1 (A)-(C))

1. Water Quality Storm
The water quality storm is the storm required by regulations to be treated. The storm defines both the volume and rate of runoff. The water quality storm is defined in Subsection 4.05.4 (d).

2. Water Quality Volume (WQV)
The WQV is the volume of water that is produced by the water quality storm. The WQV equals 0.36 inches over the impervious area that is required to be treated as shown in the formula below:

$$\text{Water Quality Volume (cu.ft.)} = \frac{0.36\text{ (in.)} \times \text{Area (sq.ft.)}}{12\text{ (in./ft.)}}$$

3. Water Quality Flow (WQF)
The WQF is the average design flow anticipated from the water quality storm as shown in the formulas below:

$$\text{Water Quality Flow (cfs)} = \frac{\text{Water Quality Volume (cu.ft.)}}{14{,}400\text{ seconds}}$$

or

$$\text{Water Quality Flow (cfs)} = \frac{0.36\text{ (in.)} \times \text{Area (sq.ft.)}}{12\text{(in/ft)}(4\text{ hr})(\text{ 60 min/hr})(60\text{ sec/min})}$$

b. Water Quality Surface Area (applies to facilities in Section 4.05.3.c.1(D)-(I))

A 6% sizing factor shall be used to calculate the required water quality surface area of the selected treatment facility. A sizing factor of 6% assumes the site infiltration rate is less than 2 inches/hour. A site specific design for the site shall be required for any of the following situations:

1. An alternate sizing factor is used;

2. The impervious area contributing to an individual water quality approach is greater than 15,000 square feet; or

3. The treatment facility is used for quantity control.

c. Water Quality for Vegetated Corridor as a Filter Strip (applies to Section 4.05.3.c.1(J)).

The sizing of a Vegetated Corridor as a Filter Strip must meet all of the following criteria:

1. The maximum contributing impervious surface is 2,640 square feet per 50 feet of Vegetated Corridor width.

2. The contributing impervious surface must be adjacent to the Vegetated Corridor, or within the outer 40% and approved as an allowed use consistent with the Service Provider Letter.

3. The minimum depth is three times the depth of the contributing impervious surface, or one single family residence. The depth of the Vegetated Corridor treatment area shall be measured from the edge of the Sensitive Area and in the direction of stormwater flow.

4.05.7 Pretreatment

a. Pretreatment Required

Unless approved by the District, flow from impervious surfaces to water quality approaches shall not be allowed without pretreatment or as specified in the design criteria for specific approaches in Section 4.06. Incoming flows to the water quality approach shall be pretreated using a water quality manhole in accordance with Subsection 4.06.1 or as specified within the design criteria for specific approaches. Other pre-treatment methods such as proprietary devices, filter strip, or trapped catch basin may be approved by the District or City.

b. Proprietary Pre-Treatment Devices

1. The use of proprietary pre-treatment devices shall be permitted on a case by case basis with approval by the District or City.

2. The devices will be sized in accordance with the manufacturer's recommendations; however, the minimum treatment flow must be the water quality flow.

3. Technical submittals from the manufacturer are required, including hydraulic design criteria, particulate removal efficiency, and maintenance requirements and schedule.

4.05.8 Proprietary Treatment Systems

a. Proprietary treatment systems shall meet the removal efficiency requirement defined in Section 4.05.3(a) and be approved by the District for use in the situations identified in Subsection (c) below.

b. Maintenance
1. Proprietary treatment systems shall be maintained by the District or Cities except those systems used in the situations specified in Section 4.05.8(c)(1) and (2) below.
2. Proprietary systems require a long-term maintenance plan identifying maintenance techniques, schedule, and responsible parties. This maintenance plan shall be submitted and approved with the drainage report for a project.

c. Proprietary treatment systems shall be allowed in situations meeting one of the following criteria:

1. Treatment of runoff from a single parcel.
2. Treatment of runoff from an adjoining commercial, industrial, or multi-family, or condominium parcels which share a common parking lot.
3. Treatment of runoff from new and expanded collector and arterial roadways where no other opportunities exist for treatment without necessitating the removal of homes or businesses.
4. Treatment of runoff from new developments in transit-oriented or similar high-density zoning classifications where the development is primarily single-family residential and the average lot size is less than 2,500 square feet.
5. Treatment of runoff as part of a master planned regional facility approved by the District.

4.06 Water Quality Approach Design Standards

4.06.1 Water Quality Manholes

a. Hydraulic Criteria:

1. Minimum Design Flow: Water Quality Flow per Section 4.05.6.a
2. Upstream flow splitter may be used to bypass conveyance flows in excess of the Water Quality Flow.

b. Design Criteria:

1. Shall conform to CWS Standard Drawing No. 250 or an equivalent detail approved by the District or City.
2. Minimum Manhole Diameter: 60-inch
3. Maximum size of incoming pipe: 18-inch
4. Sump Depth: No deeper than 5 feet from invert out to bottom of sump
5. Volume of sump: 20 cubic feet/ 1.0 cfs of flow into the water quality manhole, up to the 25-year flow. Flow calculations shall include the effect of an upstream flow splitter.
6. Maintain a 3-foot clear access zone between the inside structure and manhole walls.
7. Orient access to structure in a clear zone.

4.06.2 Vegetated Swale

a. Hydraulic Design Criteria

1. Design Flow: Water Quality Flow per Section 4.05.6.a
2. Minimum Hydraulic Residence Time: 9 minutes
3. Maximum Water Design Depth: 0.5 feet
4. Minimum Freeboard: 1.0 foot (for facilities not protected from high flows)
5. Manning “n” Value: 0.24
6. Maximum Velocity: 2.0 fps based on 25-year flow

b. Design Criteria

1. Provide an energy dissipater at the entrance to the swale, with a minimum length of 4 feet. It will be designed to reduce velocities and spread the flow across the treatment cross section.
2. The use of intermediate flow spreaders may be required.
3. Minimum Length: 100 feet
4. Minimum Slope: 0.5%
5. Minimum Bottom Width: 2 feet
6. Maximum Treatment Depth (measured from top of media): 0.5 feet
7. Side Slope:

A) In Treatment Area: 4H:1V or flatter
B) Above Treatment Area: 2.5H:1V or flatter

8. The treatment area shall have 2"-¾" river run rock placed 2.5 to 3 inches deep on coconut matting over 12 inches of topsoil or base stabilization method as approved by the District or City. Extend topsoil and coconut matting to the top of the top of the slope.
9. Provide an approved outlet structure for all flows.
10. Where swales wrap 180-degrees forming parallel channels, freeboard shall be provided between each of the parallel channels. A 1-foot (above ground surface) wall may be used above the treatment area to provide freeboard while enabling a narrower system. As an alternative, a soil-based berm may be used. The berm shall have a minimum top width of 1 foot and 2.5H:1V or flatter side slopes.
11. Where swales are designed with ditch inlets and outlet structures and design of maintenance access to such structures may be difficult due to swale location, swales may be designed as flow-through facilities with unsumped structures. Maintenance access to one end of the facility will still be required.

4.06.3 Extended Dry Basin

a. Hydraulic Design Criteria:

1. Permanent Pool Depth: 0.4 feet
2. Permanent pool is to cover the entire bottom of the basin.
3. Minimum Water Quality Detention Volume: 1.0 x Water Quality Volume (WQV)
4. Water Quality Drawdown Time: 48 hours
5. Orifice Size:
   USE: $D = 24 * [(Q/ (C[2gH]^{0.5}) / \pi]^{0.5}$
   Where:
   D (in) = diameter of orifice
   Q(cfs) = WQV(cf) /(48*60*60)
   C = 0.62
   H(ft) = 2/3 x temporary detention height to centerline of orifice.
6. Maximum Depth of Water Quality Pool (not including Permanent Pool): 4 feet or as limited by issuing jurisdiction.

b. Design Criteria:

1. Provide a stilling basin designed to dissipate outfall energy and spread flows.
2. Inlet and outlet structures shall be designed to avoid direct flow between structures without receiving treatment (i.e. short circuiting of flow).
3. Minimum Bottom Width: 4 feet

4. Side Slopes in Basin Treatment Area: 3H:1V
5. Minimum Freeboard: 1 foot from 25-year design water surface elevation.
6. The treatment area shall have coconut matting over 12 inches of topsoil or base stabilization method as approved by the District or City. If required by the District or City, 2"-¾" river run rock shall be placed 2.5 to 3 inches deep in areas where sustained flow is anticipated to occur. Extend topsoil and coconut matting to the top of the slope.
7. Provide an approved outlet structure for all flows.
8. The Engineer shall certify that the pond storm sewer design is in compliance with Chapter 5 and that at normal design water surface that the upstream storm sewer will not be in a surcharged condition for longer than 24 hours.

4.06.4 Constructed Water Quality Wetland

a. Hydraulic Design Criteria:

1. Permanent Pool Volume: 0.55 x Water Quality Volume (WQV)
2. Water Quality Detention Volume: 1.0 x Water Quality Volume (WQV)
3. Water Quality Drawdown Time: 48 hours
4. Orifice Size:
   USE: $D = 24 * [(Q/ (C[2gH]^{0.5}) / \pi]^{0.5}$
   Where:
   D (in) = diameter of orifice
   Q(cfs) = WQV(cf) /(48*60*60)
   C = 0.62
   H(ft) = 2/3 x temporary detention height to centerline of orifice.
5. Maximum Depth of Permanent Pool: 2.5 feet or as limited by issuing jurisdiction
6. Maximum velocity through the wetland should average less than 0.01-fps for the water quality flow. Design should distribute flows uniformly across the wetland.
7. Provide for a basin de-watering system with a 24-hour maximum drawdown time.

b. Design Criteria:

1. Provide a stilling basin designed to dissipate outfall energy and spread flows.
2. Permanent pool depth to be spatially varied throughout wetland.
3. Provide a perimeter zone 10 to 20 feet wide, which is inundated during storm events.
4. Side Slopes for Wetland Planting: 5H:1V or flatter
5. Side Slopes for Non-Wetland Planting: 3H:1V or flatter

6. Over-excavate by a minimum of 20 percent to allow for sediment deposition.
7. Minimum Freeboard: 1 foot from 25-year design water surface elevation.
8. The treatment area and exposed side slopes shall be stabilized with coconut matting to the top of the slope.
9. Provide an approved outlet structure for all flows.

4.06.5 Structural Infiltration Planter

a. Hydraulic Design Criteria

1. Design Flow: Water Quality Surface Area per Section 4.05.6.b
2. Maximum Water Design Depth: 0.5 feet.
3. Minimum Freeboard: 2 inches.

b. Design Criteria

1. Provide pretreatment when contributing impervious area is greater than 15,000 square feet.
2. Provide an energy dissipater at the outfall designed to reduce scour.
3. Minimum Bottom Width: 30 inches regardless of shape.
4. Minimum Length: to be calculated based on incoming flows.
5. Maximum Slope: 0.5% in any direction.
6. Minimum Cross-sectional Depths:
   A) Growing Medium: 18 inches
   B) Choker Course: 3 inches
   C) Drain Rock: 9 inches
7. Provide an approved outlet (overflow) structure for all flows. Piping to a minimum of the plumbing code or to convey the 25-year storm.
8. If using the native soil infiltration for sizing, the rate shall be determined by ASTM standard testing methods.
9. Rain drains and overflow structure to maintain maximum linear separation.
10. Building jurisdiction approval required for building setback distance and impermeable liners.
11. Vegetation quantities per 100 square feet:
    A) 115 herbaceous plants, 1 foot on center spacing, ½-gallon container size; or
    B) 100 herbaceous plants, 1 foot on center, and 4 shrubs, 1-gallon container size, 2 feet on center.
12. Treatment area shall have coconut matting over the entire surface, or District approved equivalent.
13. Refer to the LIDA Handbook for additional guidance.

4.06.6 Non-Structural Planter (Rain Garden)

a. Hydraulic Design Criteria

1. Minimum Design Flow: Impervious Surface Area per Section 4.05.6.b
2. Minimum Freeboard: 6 inches

b. Design Criteria

1. Provide pretreatment when contributing impervious area is greater than 15,000 square feet.
2. Minimum length: Facility length to be calculated based on incoming flows and facility width, and on shape of facility)
3. Maximum slope: Planters are designed to evenly distribute and filter flows. Surface longitudinal slopes should be less than 0.5%
4. Minimum Bottom Width: 30 inches
5. Maximum Treatment Depth (measured from top of soil medium): 0.5 foot.
6. Minimum Cross-Sectional Depths:
   A) Growing medium: 18 inches
   B) Choker course: 3 inches
   C) Drain rock: 9 inches
7. Maximum Side Slopes: 3H:1V
8. Flow dissipaters should be used if entry slope to the basin is greater than 3:1 or for sheet flow in landscape filter strips. Flow dissipaters shall be constructed out of rock or gravel per design flow velocity at entry of the facility.
9. Provide an approved outlet (overflow) structure for all flows. Piping to a minimum of the plumbing code or to convey the 25-year storm.
10. If using the native soil infiltration for sizing, the rate shall be determined by ASTM standard testing methods.
11. Rain drains and overflow structure to maintain maximum linear separation.
12. Building jurisdiction approval required for building setback distance and impermeable liners.
13. Vegetation quantities per 100 square feet:
   A) 115 herbaceous plants, 1 foot on center spacing, ½-gallon container size; or
   B) 100 herbaceous plants, 1 foot on center, and 4 shrubs, 1-gallon container size, 2 feet on center.
14. Treatment area shall have coconut matting over the entire surface, or District approved equivalent.
15. Refer to the LIDA Handbook for additional guidance.

4.06.7 Flow-through Planter

a. Hydraulic Design Criteria

1. Design Flow: Impervious Surface Area per Section 4.05.6.b
2. Minimum Freeboard: 2 inches

b. Design Criteria

1. Provide pretreatment when contributing impervious area is greater than 15,000 square feet.
2. Minimum length: Facility length to be calculated based on incoming flows and facility width.
3. Maximum slope: Planters are designed to evenly distribute and filter flows. Surface longitudinal slopes should be less than 0.5%.
4. Minimum Width: 30 inches
5. Maximum Treatment Depth (measured from top of soil medium): 0.5 feet
6. Minimum Cross-Sectional Depths:
   A) Growing medium: 18 inches
   B) Choker course: 3 inches
   C) Drain rock: 9 inches
7. Provide an energy dissipater at the entrance to the planter. It will be designed to reduce velocities and prevent scour.
8. Provide an approved outlet (overflow) structure for all flows.
9. Rain drains and overflow structure to maintain maximum linear separation.
10. Building jurisdiction approval required for: building setback distance, impermeable liner, structural wall and when depth of the facility is below the building footing.
11. The sides and bottom of the facility will be lined to prevent infiltration. Approved impermeable layers include waterproof coated concrete and 60 mil PVC liner
11. A perforated pipe system under the planter drains water that has filtered through the topsoil to prevent long-term ponding.
12. Vegetation quantities per 100 square feet:
   A) 115 herbaceous plants, 1 foot on center spacing, ½-gallon container size; or
   B) 100 herbaceous plants, 1 foot on center, and 4 shrubs, 1-gallon container size, 2 feet on center.
13. Refer to the LIDA Handbook for additional guidance.

4.06.8 LIDA Swale

a. Hydraulic Design Criteria

1. Design Flow: Impervious Surface Area per Section 4.05.6.b
2. Minimum Freeboard: 6 inches

b. Design Criteria

1. Provide minimum 18 inch sumped inlet with a minimum 18 inch diameter drain basin for pretreatment.
2. Minimum length: 15 feet.
3. Slope: At least 0.5% and no more than 6%. LIDA Swale not recommended for longitudinal slopes greater than 2%. On street-side swales, slope to match street.
4. Minimum Bottom Width: 24 inches
5. Maximum Treatment Depth (measured from top of soil medium): 0.5 feet
6. Side Slope
   A) With 1 foot shelf: 3H:1V
   B) Without 1 foot shelf: 4H:1V
7. Minimum Cross-Sectional Depths:
   A) Growing medium: 18 inches
   B) Choker course: 3 inches
   C) Drain rock: 9 inches
8. Inflow structure to be provided per location jurisdiction and approved District structure types.
9. Provide an energy dissipater at the entrance to the swale. It will be designed to reduce velocities and spread flow across the treatment cross section.
10. Provide an approved overflow structure sized to jurisdictional plumbing code or to convey the 25-year storm.
11. Check dams will be provided for slopes in excess of 5%.
12. Street-side swales will have a 30 mil impermeable liner, or approved equivalent per jurisdictional road authority, along the street-side.
13. Vegetation quantities per 100 square feet:
   A) Treatment Area: 115 herbaceous plants, 1 foot on center spacing, ½-gallon container size; or 100 herbaceous plants, 1 foot on center, and 4 shrubs, 1-gallon container size, 2 feet on center.
   B) Vegetation to be used in the swale bottom conforms to plantings approved for the wet moisture regime.
   C) Vegetation to be used along the swale side conforms to plantings approved for the moist moisture regimes.
14. Treatment area shall have high density jute or coconut matting over

the entire surface or other base stabilization method as approved by the District.

15. Refer to the LIDA Handbook for additional guidance.

4.06.9 Street-side Planter

a. Hydraulic Design Criteria

1. Design Flow: Impervious Surface Area per Section 4.05.6.b
2. Minimum Freeboard: 2 inches

b. Design Criteria

1. Provide minimum 18 inch sumped inlet with a minimum 18 inch diameter drain basin for pretreatment.
2. Minimum length: Facility length to be calculated based on incoming flows and facility width.
3. Maximum slope: Planter shall be flat bottom in all directions to within 1 inch. Check dams shall be placed according to individual project plans per detail 406 in the LIDA Handbook.
4. Minimum Bottom Width: 30 inches. 6 feet typical
5. Minimum Treatment Depth: 4-inch pond depth with 2 inches compost mulch
6. Maximum Treatment Depth (measured from top of soil medium): 18 inches
7. Minimum Cross-Sectional Depths:
   A) Growing medium: 18 inches
   B) Choker course: 3 inches
   C) Drain rock: 15 inches
8. Inflow structure to be provided per approved District structure types.
9. Provide minimum 6-inch wide splash rock around inlet structure to reduce velocities and spread flow across the treatment cross section.
10. Provide an approved overflow structure sized according to detail 795.1 in the LIDA Handbook.
11. Inlet/outlet elevations to allow overflow to drain to street or piped overflow system as applicable.
12. Minimum of 4 feet of 8-inch perforated drain pipe required to direct flows to overflow conveyance.
    A) Unlined facilities: bottom of pipe shall be set at 2 ½ inches above subgrade.
    B) Lined facilities: Bottom of pipe shall be set at the base of the drain rock layer
13. 30 mil impermeable liner or approved equal shall be used if required on project plans per road authority.
14. Vegetation quantities per 100 square feet: 115 herbaceous plants, 1

foot on center spacing, ½-gallon container size; or 100 herbaceous plants, 1 foot on center, and 4 shrubs, 1-gallon container size, 2 feet on center.

15. Refer to the LIDA Handbook for additional guidance.

4.06.10 Landscape Filter Strip

a. Hydraulic Design Criteria

1. Design Flow: Impervious Surface Area per Section 4.05.6.b
2. Flows must be distributed in uniform sheet flow that will not cause channelization or erosion.

b. Design Criteria

1. Provide pretreatment when contributing impervious area is greater than 15,000 square feet, or when flows are concentrated within conveyance system prior to sheet flow distribution.
2. Slope: At least 0.5% and no more than 6%
3. Minimum Width: 5 feet, measured in direction of flow.
4. Minimum Amended Growing Medium Depth: 18 inches
5. A grade board, spreader, or sand/gravel trench may be required to disperse the runoff evenly across the filter strip to prevent point of discharge/channelization.
6. Check dams shall be placed according to the facility design and:
   A) Equal to the width of the filter
   B) Placed every 10 feet where slope exceeds 5%, 2.5 to 3 inches deep.
7. Collection and conveyance of overflow from filter strip shall be specified on plans to the approved public conveyance system.
8. Entire filter strip must have 100% coverage by approved native grasses, wildflower blends, ground covers or any combination thereof.
9. Coconut matting shall cover the growing medium except in check dam and flow spreader locations.
10. Refer to the LIDA Handbook for additional guidance.

4.06.11 Vegetated Corridor as a Filter Strip

a. Hydraulic Design Criteria

1. Design Flow: Water Quality Vegetated Corridor per Section 4.05.6.c.
2. Flows must be distributed in uniform sheet flow that will not cause channelization or erosion.

b. Design Criteria

1. Provide pretreatment when contributing impervious area is greater than 15,000 square feet, or when flows are concentrated within a conveyance system prior to sheet flow distribution.
2. A grade board, spreader, or sand/gravel trench may be required to disperse the runoff evenly across the vegetated area
3. Slope: At least 0.5% and no more than 6%
4. Vegetation: the vegetated corridor shall be enhanced to Good Corridor condition in accordance with Appendix A, Planting Requirements.

4.06.12 Walls in Water Quality Approaches

a. Walls are not allowed in the treatment areas of any water quality approach.

b. Walls that are 4 feet or higher or that are periodically inundated shall meet all of the following criteria:

1. Be approved by a licensed structural or geotechnical engineer.

2. The District shall not have maintenance responsibility for the wall. The party responsible for maintenance of the walls within the tract shall be clearly documented on the plat or in alternate form as approved by the District.

4.07 Low Impact Development Approaches (LIDA)

4.07.1 Purpose

The advantages of LIDA continue to be documented for providing pollutant reduction associated with urban development. Generally, the first priority for LIDA is to conserve existing resources and minimize stormwater runoff generated from urban development to mimic natural hydrologic processes.

Selection of appropriate LIDA, including surface infiltration, should ensure there are no adverse downstream drainage impacts and an appropriate maintenance program can be developed to sustain the functionality of the LIDA.

4.07.2 LIDA Design Considerations

Through conservation of natural resources, minimization of impervious surface, and mimicking natural hydrologic processes, each development shall reduce its hydrologic impacts through approaches described in Section 4.07.3, unless any of the following criteria apply:

a. Due to topography, soils or other site conditions, implementation of an onsite approach is impractical or inefficient.

b. Stormwater quality treatment is being provided by a regional approach.

c. The water quality treatment requirement is being met through a Fee-In-Lieu in accordance with Section 4.05.2.b.

4.07.3 LIDA Approvable by the District

a. Vegetated water quality treatment as specified in Section 4.05.3.c.1.

b. Vegetated Corridor preservation and enhancement consistent with the Service Provider Letter issued for the project.

c. Green roofs and green walls.

d. Pervious surfaces such as porous pavement and boardwalks.

e. On-site tree preservation when protecting significant habitat or as a result of City or County plans, programs or requirements.

f. Rainwater catchment and harvesting systems for re-use.

g. When approved by the District or City, other approaches that provide stormwater infiltration, evapotranspiration, runoff reuse, or otherwise mimic natural hydrologic processes.

4.08 Summary of Water Quality and Quantity Approaches

Table 4-1 shows the approaches the District may approve to meet the requirements of this Chapter and when these approaches can be used in a publicly maintained system.

TABLE 4-1
SUMMARY OF APPROVABLE APROACHES

Approach	Public System	Water Quantity Control Approach	Water Quality Treatment Approach	Low Impact Development Approach
Infiltration Planter/Rain Garden	Yes	Yes	Yes	Yes
Flow-through Planter	Yes	No	Yes	Yes
LIDA Swale	Yes	No	Yes	Yes
Landscape Filter Strip	Yes	No	Yes	Yes
Vegetated Swale	Yes	No	Yes	Yes
Extended Dry Basin	Yes	Yes	Yes	Yes
Constructed Water Quality Wetland	Yes	Yes	Yes	Yes
Vegetated Corridor as a Filter Strip	Yes	No	Yes	Yes
Proprietary Treatment System	Per 4.05.8	Yes	Yes	No
Vegetated Corridor Preservation	No	No	No	Yes
Green Roof	No	Yes	No	Yes
Porous Pavement	No	Yes	No	Yes
Tree Preservation	No	No	No	Yes
Rainwater Harvesting	No	Yes	No	Yes
Boardwalk	No	No	No	Yes