SCHEDULE O
DRAINAGE, EASEMENTS AND SITE DEVELOPMENT REGULATIONS

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SECTION 1.0 PURPOSE, INTENT, LAWFULNESS, AND BEST PRACTICES

A. Purpose and Intent.
To establish herein all essential and necessary regulations, standards and information for the effective and orderly development of property specifically in regard to drainage facilities and easements for drainage. This schedule provides detailed regulations and technical specifications that are to be applied to any new or existing development that will have an impact on water flows or discharge of water within, across, or maintained within a property. This schedule is also for the regulation of any easement necessary for public drainage facility and the drainage of water to or from a public right-of-way.

B. Lawfulness.
Any deviation from the provisions of this Schedule, unless specifically stated herein or allowed by other provisions of these *LDRs* or under the authority of the Administrative Official is prohibited and unlawful.

C. Best Practices.
All reviews and determinations of the provisions within this Schedule by the Administrative Official shall be to implement the Purpose and Intent of this Schedule together with sound and generally accepted land use and growth management planning practices and principles that aim to balance the social, physical, economic and environmental needs of the City.

SECTION 2.0 GENERAL CRITERIA/PRINCIPLES OF APPROVALS

The following general criteria shall apply to all; provided however, that these regulations shall not be construed or applied to conflict with the provisions of Section 166.033, *Florida Statutes*. When the term "regulation" is used in this Schedule, it means all City codes, ordinances and regulations, and rules if rulemaking authority has been granted, which address stormwater management.

A. Maintain Predevelopment Conditions.
Development (including, but not limited to alteration or modification of a site) shall be implemented in such a manner as to preserve the pre-development direction, rate and flow characteristics of stormwater run-off. With regard to sites with positive outfall, the post-development rate of runoff shall not be greater than the pre-development condition. With regard to sites without positive outfall or in closed basins, the post-development rate and volume of runoff shall not be greater than the pre-development condition. The term "development" is used as intended in Section 163.3164 (14), *Florida Statutes*, which adopts the meaning set forth in s. Section 380.04, *Florida Statutes*, which is a comprehensive definition.

B. Provide Necessary Facilities.
All development shall provide for such water retention and settling structures and flow-attenuation devices as may be necessary to ensure compliance with all City regulations.

C. Nonstructural Approach Preferred.
When practicable, the nonstructural approach shall be used to meet both surface water quantity and quality regulations.

D. Stand-Alone Systems.
The drainage system for each phase of a development shall comply with these regulations. Such systems shall be functionally independent and not tied to future development. They may also provide for future (unbuilt) phases of the development project.

E. Upstream Runoff.
Run-off from adjacent properties shall not be blocked by site development. The drainage system for each development shall be designed to accommodate existing upstream runoff.

F. Maintain Existing Surface Drainage.
Site alteration shall not adversely affect existing surface water flow pattern. When consistent with sound and generally accepted engineering practices and principles, drainage sub-basin boundaries shall be maintained.

G. Steep Ditches Prohibited.
Open drainageways with slopes of greater than three to one (3:1) are prohibited and unlawful.

H. Natural Drainageways and Watercourses.
Developments that contain an existing natural drainage way, watercourse, floodplain and/or adjacent vegetation shall maintain and incorporate such natural features into the project design. The design shall ensure that sediments will not enter such natural drainage.

I. Rates and Volumes of Runoff.
Rates and volumes of storm water runoff, whether discharged into natural or artificial watercourses, shall meet existing water quality standards at the first downstream receiving water body for which such standards have been established.

J. Prevent Adverse Impact.
Site development shall not cause siltation of wetlands, pollution of downstream wetlands or reduce the natural retention or filtering capabilities of wetlands. Notwithstanding the foregoing provision, the City shall not be responsible for any adverse downstream impacts that are actionable under civil liability principles that may result from the development or use of upstream properties.

K. Maximize Recharge.
Developments shall be designed to maximize the amount of natural rainfall which is infiltrated into the soil and to minimize direct overland runoff into adjoining streets and watercourses. Storm water runoff from roofs and other impervious surfaces shall be diverted into swales or terraces on the lot when practicable.

L. Overland Flow.
When consistent with sound and generally accepted engineering practices and principles, runoff from impervious areas shall be diverted so as to flow over vegetated areas prior to flowing into gutters, storm drains and retention areas. A minimum slope of 1.5% needs to be maintained to drain runoff across all non-paved areas.

M. Drainage Easements, General.
Where a rational nexus exists and a rough proportionality test supports the requirement, easements for drainage facilities, shall be granted to the City and shall be in a form that is subject to approval by the City Attorney.

N. Off-site Easements.
Off-site easements necessary to the function of the drainage system shall be provided as may be needed with title to properties and drainage rights being demonstrated to exist consistent with controlling law.

O. Easements on Plans.
Easements for drainage facilities must be shown on required plans and approved in the applicable manner set forth in this Schedule. Recording information shall be inserted on the plans and a title search may be required by the City when such is deemed necessary for an adequate review of the plans which requirement may extend to abutting and downstream properties.

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P. Off-line.
The storage of a specified volume of the initial stormwater in such a manner such that subsequent runoff in excess of the specified volume does not flow into the area storing the initial stormwater is required.

Q. On-line.
The plans shall demonstrate that the storage of a specified volume of the initial stormwater in such a manner such that subsequent runoff in excess of the specified volume does flow into the area storing the initial stormwater.

S. Effect and Limitations as to Approvals.
Nothing in this Schedule nor any action taken or not taken by the City relative to any action taken or approval granted under the provisions of this Schedule shall be construed, deemed or result in any liability upon the City and the City's actions are administrative in nature and the applicant and her, his or its consultants shall bear sole and plenary responsibility for any and all damages of any type or nature, under every legal theory whatsoever, resulting from the use of system approved under this Schedule, to include, but not in any way limited to, the flooding of the property being developed, abutting and other properties, however remote, and upstream and downstream properties.

T. CCTV Requirements.

1. **Requirement.**
   All drainage infrastructure intended for dedication to the City for maintenance shall undergo a CCTV inspection.
2. **Responsibility.**
   The developer is responsible for generating the CCTV inspection report.
3. **Submission.**
   The CCTV inspection report must be submitted to the City for review prior to obtaining a Certificate of Completion.
4. **Acceptance Criteria.**
   The City will determine the acceptance of the drainage infrastructure based on the findings of the CCTV inspection report.

SECTION 3.0 SPECIFIC DESIGN CRITERIA AND STANDARDS

A. Design Standards.

1. **Facility Type by Storm Event.**
   a. Drainage for the following facility types shall be designed according to the corresponding storm events:

Facility Type	Storm Event
Retention/detention for parcels with positive outfall:	25-year, 24-hour
Retention for parcels without positive outfall:	25-year, 96-hour
Closed drainage for urban streets with piped drainage:	10-year, 24-hour
Open drainage for rural streets with swales:	10-year, 24-hour
Canals, ditches, culverts and other off-the-premise facilities:	25-year, 24-hour
Bridges and major highway crossings:	100-year, 24-hour

b. The design frequency may be increased if deemed necessary by the Administrative Official based upon sound and generally accepted engineering practices and principles.

2. Increased Size When Necessary.
The Administrative Official shall have the authority to increase the minimum required width of drainage easements, based upon sound and generally accepted engineering practices and principles, in order to provide for proper access, maintenance or functioning of the drainage system.

3. Design Based on Soils.
The design of stormwater management facilities shall be based upon soil conditions as set forth in the Soil Survey of Seminole County, Florida and any supplements thereof as prepared by the U.S. Department of Agriculture, Natural Resources Conservation Services. In areas where the soils are poorly drained or experience a high groundwater table, such facilities shall be designed for wet detention or detention with filtration. In areas where the soils are well drained, such facilities shall be designed for retention, retention/detention and/or exfiltration.

4. Drainage Easements.
When required for drainage of the area to be subdivided or otherwise developed, drainage easements shall be provided in the manner prescribed in this Schedule and shall be of such dimensions as are necessary to permit proper construction and maintenance of drainage facilities based on the drainage system of the area. The relationship between the type of drainage system and the minimum width of the easement shall be as follows subject to a rational nexus and rough proportionality analysis:

DRAINAGE SYSTEM	MINIMUM EASEMENT WIDTH [1]
Closed Drainage Systems	
Any Depth	30‘
Open Drainage Systems	
Depth = 1’	30’
Depth = 2’	35’
Depth = 3’	55’
Depth = 4’	60’
Depth = 5’	65’
Depth = 6’	70’
Depth = 7’	75’
Depth = 8’	90’
Depth = 9’	95’
Depth = 10’	100’
Notes:	
(1) Easement width may be increased dependent on size, location and depth of pipe. Easement width shall be sufficient to contain the pipe and all excavation necessary to access/replace the pipe without need for special trench shoring. Easements shall be sized such that an adequate area is available for maintenance purposes.	

B. Retention Facilities.

Retention Systems. Retention systems are designed to store a specific volume and regulate discharge of stormwater runoff into surface waters of the state by on-site impoundment.

Retention systems shall comply with the following:

1. **Dedicated Retention Pond Plat.**
   Retention ponds, and access ways to ponds, within platted subdivisions shall not be dedicated or conveyed in the form of an easement, but, rather shall be platted as a separate tract of land dedicated to the entity responsible for maintenance; provided, however, that, a note shall be placed on the plat that the entity to which the dedication relates may, at any time, require the fee simple owner to convey the tract to the entity.

2. **Redeveloped Sites.**
   Alterations, expansions and activities which do not cause an increase or net decrease in impervious area shall provide, as a minimum, for one of the following:
   a. Maintain or relocate existing stormwater facilities without loss of capacity that meet or exceed the requirements in subparagraphs (2.) and (3.)
   b. Off-line retention of the first 1/2” of runoff or 1-1/4” of runoff from the impervious area, whichever is greater, or
   c. On-line retention of an additional 1/2” of runoff over that volume specified in subparagraph B.2.a.

3. **Post-Storm Capacity.**
   Retention facilities shall be designed to ensure dry bottom within 72 hours after the design storm event. Dry bottom shall mean the absence of standing water. The storage volume must be provided by a decrease of stored water caused only by percolation through soil, evaporation or evapotranspiration.

4. **Retention of First Half-Inch Runoff.**
   Retention facilities shall provide for either of the following:

a. Off-line retention of the first 1/2” of runoff or 1-1/4” of runoff from the impervious area, whichever is greater, or
b. On-line retention of an additional 1/2” of runoff over that volume specified in subparagraph B.2.a.

5. **Retention Volume.**
Retention ponds shall be designed to retain the difference in runoff volume between pre- and post-development or the pollution abatement volume, whichever is greater. In Class A or B soil types, the volume of stormwater runoff which will be recovered by percolation during the storm may be considered, if the analysis includes soil properties based on specific soil borings performed in the proposed pond location.

6. **Peak Discharge.**
Retention ponds shall include an outfall structure, except where determined unnecessary by the Administrative Official, based upon sound and generally accepted engineering practices and principles, to regulate the post-development discharge rate to at or below the pre-development discharge rate. The outfall shall preserve the pre-development direction, rate and flow characteristics.

7. **Discharge to Outstanding Florida Waters.**
Retention systems which direct discharge to Class I, Class II, or Outstanding Florida Waters shall provide either of the following:
   a. At least an additional 50% of the applicable treatment volume specified in subparagraph B.4.a. Off-line retention must be provided for at least the first 1/2” of runoff or 1-1/4” of runoff from the impervious area, whichever is greater, of the total amount of runoff required to be treated; or
   b. Online retention of the runoff from the three-year, one-hour storm or an additional 50% of the treatment volume specified in subparagraph B.4.b, above, whichever is greater.

8. **Construction Requirements.**
Retention facilities shall comply with the following:
   a. **Maintenance Berms.**
   Maintenance berms shall be provided and shall be a minimum of 15’ in width for ponds with fencing and a minimum of 10” in width for ponds without fencing. For ponds serving small drainage areas (less than five-acres), where the applicant demonstrates that berm stability and access for maintenance is sufficient, the above widths may be reduced, based upon sound and generally accepted engineering practices and principles, by the Administrative Official.
   b. **Fencing.**
   Be fenced in areas utilizing retaining walls with a 30” or higher-grade differential, when side slopes exceed the 4:1 maximum or when the Administrative Official determines that it is in the Public’s best interest due to health or safety concerns. The required fence shall comply with Schedule F.
   c. **Freeboard.**
   A minimum of 1’ of freeboard above the design high water elevation shall be provided. For ponds serving small drainage areas (less than five acres), where the applicant demonstrates that a lesser freeboard is sufficient, the above freeboard may be reduced by the Administrative Official. For ponds with reduced freeboard, the applicant must demonstrate that the design will attenuate post-development discharge rates for the 100-year, 24-hour storm event at or below pre-development discharge rates.
   d. **Side Slopes.**
   Maximum allowable side slopes shall be 4:1 unless otherwise approved by the Administrative Official.

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e. **Vegetative Slope Stabilization.**
Retention systems shall be stabilized with pervious material or permanent vegetative cover. Permanent vegetative cover must be utilized except for pervious pavement systems, when Soil Conservation Service hydrologic group "A" soils underlie the retention basin.
The disturbed areas in and around the ponds shall be revegetated. Top and side slopes shall be sodded. Bottoms shall be seeded and mulched.

f. **Pond Bottom Dimension.**
Minimum pond bottom dimension shall be 4' and shall be a minimum of 24" above the seasonal high ground water table.

g. **Structure Requirements.**
All pipes entering or leaving the retention/detention ponds shall have a permanent end treatment (i.e., headwall, mitered collar, control structure, etc.) and include energy dissipation.

h. **Outfall Structures.**
An outfall structure shall be provided for retention systems unless it is proven, using sound and generally accepted engineering principles and practices, that the outfall structure is unnecessary. The location of the structure and the shape of the pond shall be designed such that no "short-circuiting" of the flow occurs and that maximum disposition of suspended solids is achieved. In all cases, retention facilities shall be designed considering the event of a possible overflow. A path for such overflow shall be determined and structures in the development so situated that no flood damage occurs either on-site or off-site.

1) When the outfall structure employs a weir within an inlet to control the water surface (diversion box), the structure shall be oversized and provide an access manhole or grate on both sides of the weir.
2) Outfall structures shall be designed to prevent floating materials and oils from being discharged into the receiving waters. Outfall structures shall be as simple as possible and shall employ fixed control elevations (i.e., no valves, removable weirs, pumps, etc.).
3) Outfall structures shall limit peak off-site discharges to pre-development rates.
4) Whenever a broad-crested weir is used as an outfall/discharge, the surface where the run-off flows over the weir shall be of a hard material, such as, concrete, geogrid, fabriform, etc., to prevent erosion and preserve the designed elevation of the weir.

i. **Design Without Positive Outfall.**
Developments without a positive outfall or which discharge directly to a landlocked basin shall retain all runoff resulting from the design storm as computed for the developed condition. The pond shall recover the required volume by percolation through soil, evaporation or evapotranspiration within 14 days after the storm event.

j. **Filled Berms.**
Where filled berms will store water in excess of 2' above surrounding grade, calculations supporting the stability of the filled berms shall be submitted, under seal, by a geotechnical engineer. In all cases of filled berms, if excess seepage may be expected through the berm, a clay core liner may be required.

k. **Retaining Walls.**
If retaining walls are utilized as part of retention ponds, they may not exceed more than 50% of the perimeter of the pond. The arrangement of walls must not impede pond access and maintenance. The wall design shall also comply with Schedule G.

C. Wet Detention Stormwater Management Systems.

Wet detention systems collect and temporarily store stormwater in a permanently wet impoundment in such a manner as to provide for treatment though physical, chemical, and biological processes with subsequent gradual release of the stormwater.

Wet detention stormwater management systems shall comply with the following:

1. **Dedicated Detention Pond Plat.**
   Detention ponds, and access ways to ponds, within platted subdivisions shall not be dedicated or conveyed in the form of an easement but rather shall be platted as a separate tract of land dedicated to the entity responsible for maintenance; provided, however, that, a note shall be placed on the plat that the entity to which the dedication relates may, at any time, require the fee simple owner to convey the tract to the entity.

2. **Redeveloped Sites.**
   Development which does not cause an increase or net decrease in impervious area shall be required to comply only with paragraph C.3, of this Section.

3. **Retention of Runoff.**
   Pollution abatement shall be accomplished by providing a treatment volume of the greater of the following:
   a. First 1” of runoff; or
   b. 2.5” of runoff from the impervious area.

4. **Outfall Criteria.**
   Detention ponds and detention with filtration ponds shall have an outfall structure. The location of the structure and the shape of the pond shall be designed such that no "short-circuiting" or stagnation of the flow occurs and that maximum removal of suspended solids is achieved.
   a. When the outfall structure employs a weir within an inlet to control the water surface (diversion box), the structure shall be oversized to provide an access manhole or grate on both sides of the weir sufficient for maintenance.
   b. The outfall shall be designed to prevent floating materials and oils from being discharged into the receiving waters. Outfall structures shall be as simple as possible and shall employ fixed control elevations (i.e., no valves, removable weirs, pumps, etc.).
   c. The outfall structure shall limit peak off-site discharges to pre-development rates. The structure shall be the discharge point for the filtration system.
   d. Detention ponds shall be designed so that the outfall structures shall bleed down 50% the volume of stormwater as required by the design specifications within 24 to 30 hours following a storm event, but no more than 1/2 of this volume will be discharged within the first 24 hours.
   e. Whenever a broad-crested weir is used as an outfall/discharge, the surface where the run-off flows over the weir shall be of a hard material, such as, concrete, geogrid, fabriform, etc. to prevent erosion and preserve the designed elevation of the weir.

5. **Design Without Positive Outfall.**
   Developments without a positive outfall or which discharge directly to a landlocked basin shall retain all runoff resulting from the design storm as computed for the developed condition.

6. **Detention with Filtration.**
   Detention with filtration ponds shall be designed to attenuate peak outflows to pre-development rates and to provide filtration for the pollution abatement volume.

7. **Permanent Pool.**
   Detention with filtration ponds shall contain a permanent pool of water sized to provide an average residence time of at least 14 days during the wet season (June - October).

8. **Littoral Zone.**
   Detention with filtration ponds shall provide a littoral zone to be designed as follows:
   a. The littoral zone shall be gently sloped (6:1 or flatter). At least 30% of the wet detention system surface area shall consist of a littoral zone. The percentage of littoral zone is based on the ratio of vegetated littoral zone to surface area of the pons at the control elevation.
   b. The treatment volume should not cause the pond level to rise more than 18” above the control elevation unless the applicant demonstrates, using sound and generally accepted engineering principles and practices that the littoral zone vegetation will survive at greater depths.
   c. 80% coverage of the littoral zone by aquatic plants, approved by the City, is required within the first 24 months of completion of the system or as otherwise may be specified by permit conditions.
   d. To meet the 80% coverage requirement, planting of the entire littoral zone is recommended. As an alternative, portions of the littoral zone may be established by placement of wetland topsoil’s (at least deep) containing a seed source of desirable native plants. When utilizing this alternative, the littoral zone shall be stabilized by mulching or other means and at least the portion of the littoral zone within 25’ of the inlet and outlet structures shall be planted.
   e. In lieu of littoral zone requirements of paragraph C.8 of this Section, the applicant may provide either of the following:
      1) At least 50% additional permanent pool volume over that specified in paragraph C.7 of this section, above; or
      2) Treatment of the storm water pursuant to rules 40C-42.024(2)(B)2., 3., 4., 6., or (c), *Florida Administrative Code*, prior to the stormwater entering the wet detention pond.

9. **Pool Depth.**
   Detention with filtration ponds shall be designed so that the mean depth of the permanent pool is between 2’ and 8’ and the maximum depth does not exceed 12’ below the invert of the bleed down device, unless the applicant affirmatively demonstrates, using sound and generally accepted engineering principles and practices, that alternative depths will not inhibit the physical chemical, and biological treatment processes or cause the resuspension of pollutants into the water column due to anaerobic conditions in the bottom sediments and water.

10. **Flow Paths.**
    Detention with filtration ponds shall be designed so the flow path through the pond has an average length to width ratio of at least 2:1. The alignment and location of inlets and outlets shall be designed to maximize flow paths in the pond. If short flow paths are unavoidable, the effective flow path shall be increased by adding diversion barriers such as islands, peninsulas, or baffles to the pond. Inlet structures shall be designed to dissipate the energy of water entering the pond.

11. **Bleed Down Devices.**
    Detention with filtration ponds shall be designed so that bleed down devices incorporating dimensions smaller than 3” minimum width or less than 20 degrees for "v" notches include a device to eliminate clogging. Examples include baffles, grates and pipe elbows.

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12. Location of Bleed Down Devices.

Detention with filtration ponds shall be designed so that bleed down structure invert elevations are at or above the estimated post-development normal ground water table elevation. If the structure is proposed to be set below this elevation, ground water inflow shall be considered in the drawdown calculations, calculation of average residence time, estimated normal water level in the pond, and pollution removal efficiency of the system. Proposed peak discharge resulting from the design storm for the parcel shall not exceed predevelopment peak discharge.

13. Access.

Detention with filtration ponds shall provide for permanent maintenance easements or other acceptable legal instruments, as approved by the City Attorney, to allow for access to and maintenance of the system, including the pond, littoral zone, inlets, and outlets. The easement or other acceptable instrument must cover the entire littoral zone.

14. Discharge to Outstanding Florida Waters.

Wet detention systems which direct discharge to Class I, Class II, or Outstanding Florida Waters shall provide:

a. the requirements in paragraphs C.4, C.8 and C.11-13
b. an additional 50% of the applicable treatment volume specified in paragraph C.3, and
c. an additional 50% of the applicable permanent pool volumes specified in paragraph C.7 or paragraph C.8.e of this section.

15. Additional Construction Requirements.

Detention facilities shall comply with the following:

a. Maintenance Berms.

Adequate maintenance berms shall be provided and shall be a minimum of 15’ in width for ponds with fencing and a minimum of 10’ in width for ponds without fencing. For ponds serving small drainage areas (less than five acres), where the applicant can demonstrate, using sound and generally accepted engineering principles and practices, that berm stability and access for maintenance is sufficient, the above widths may be reduced by the Administrative Official.

b. Fencing.

Be fenced in areas utilizing retaining walls with a 30” or higher-grade differential, when side slopes exceed the 4:1 maximum or when the Administrative Official determines that it is in the public’s best interest due to health or safety concerns. The required fence shall comply with Schedule F.

c. Freeboard.

A minimum of 1’ of freeboard above the design high water elevation shall be provided. For ponds serving small drainage areas (less than five acres), where the applicant can demonstrate, using sound and generally accepted engineering principles and practices, that a lesser freeboard is sufficient, the above freeboard may be reduced by the Administrative Official. For ponds with reduced freeboard, the applicant must demonstrate that the design will attenuate post-development discharge rates for the 100-year, 24-hour storm event at or below pre-development discharge rates.

d. Side Slopes.

Maximum allowable side slopes shall be 4:1 unless otherwise approved by the Administrative Official, based on sound and generally accepted engineering principles and practices. Slopes shall be sodded to 1’ above the bleeder invert elevation.

e. Bottom Dimension.

Minimum pond bottom dimension shall be 4’.

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f. **Structure Requirements.**
All pipes entering or leaving a retention/detention ponds shall have a permanent end treatment (i.e., headwall, mitered collar, control structure, etc.) and include energy dissipation.

g. **Filled Berms.**
Where filled berms will store water in excess of 2' above surrounding grade, calculations supporting the stability of the filled berm shall be submitted by a geotechnical engineer, under seal. In all cases of filled berms, if excess seepage may be expected through the berm, a clay core liner may be required.

h. **Retaining Walls.**
If retaining walls are utilized as part of a detention pond, they may not exceed more than 50% of the perimeter of the pond. The arrangement of walls shall not impede pond access and maintenance. The wall design shall comply with Schedule G.

i. **Fountains.**
Wet detention ponds shall have a fountain, or fountains installed, which shall be decorative in nature. The size and number of fountains shall be proportional to the area of the pond and equipment used.

D. Detention With Filtration Systems.
Detention with filtration systems is the selective removal of pollutants from stormwater by the collection and temporary storage of stormwater and the subsequent gradual release of the stormwater into surface waters of the State through at least 2' of suitable fine textured granular media such as porous soil, uniformly graded sand, or other natural or artificial fine aggregate, which may be used in conjunction with filter fabric and/or perforated pipe.

Detention with filtration systems shall comply with the following:

1. **Retention of Runoff.**
Pollution abatement shall be accomplished by providing detention with filtration for the greater of the following:
   a. Off-line detention with filtration of the first 1" of runoff or 2.5" inches of runoff from the impervious area, whichever is greater; or
   b. On-line detention with filtration of an additional 1/2" of runoff over that volume specified in subparagraph D.1.a, whichever is greater.

2. **Post-Storm Capacity.**
Detention with filtration systems shall provide the capacity for the specified treatment volume of stormwater within 72 hours following a storm event.

3. **Filter Material.**
Detention with filtration systems shall have pore spaces large enough to provide sufficient flow capacity so that the permeability of the filter is equal to or greater than the surrounding soil. The design shall ensure that the particles within the filter do not move. When sand or other fine textured aggregate, other than natural soil, is used for filtration, the filter material shall be of quality sufficient to satisfy the following requirement:
   a. Filter material shall be washed (less than 1% silt, clay and organic matter) unless filter cloth is used which is suitable to retain the silt, clay and organic matter within the filter:
   b. Filter material shall have a uniformity coefficient of 1.5 or greater, but not more than 4.0.
   c. Filter material shall have an effective grain size of 0.20 to 0.55 millimeters in diameter. These criteria are not intended to preclude the use of multilayered filters nor the use or materials to increase ion exchange, precipitation or the pollutant absorption capacity of the filter.

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4. **Maintenance and Inspection.**
Detention with filtration systems shall include, at a minimum, capped and sealed inspection and cleanout ports which extend to the surface of the ground at the following locations for each drainage pipe:
    a. The terminus; and
    b. Every 400' or every bend of 45 or more degrees, whichever is less.

5. **Filter Stabilization.**
Detention with filtration systems shall utilize filter fabric or other means to prevent the filter material from moving or being washed out through the perforated pipe.

6. **Safety Factor.**
Detention with filtration systems shall be designed with a safety factor of at least 2 unless the applicant affirmatively demonstrates based on plans, test results, calculations or other information that a lower safety factor is appropriate for the specific site conditions. Examples of applying safety factors include, but are not limited to, the following:
    a. Reducing the design percolation rate by half;
    b. Doubling the length of the filtration system; or
    c. Designing for the required draw down within 36 instead of 72 hours.

7. **Invert Elevation of the Perforated Pipe.**
Detention with filtration systems shall be designed so that the invert elevation of the perforated pipe is above the seasonal high ground water table elevation. If the pipe is proposed to be set below this elevation, the pipe should be separated by structural means from the hydraulic contribution of the surrounding water table or groundwater inflow must be considered in the drawdown calculations.

8. **Discharge to Outstanding Florida Waters.**
Filtration systems which direct discharge to Class I, Class II, or Outstanding Florida Waters shall provide either of the following:
    1. At least an additional 50% of the applicable treatment volume specified in subparagraph D.1.a., above. Off-line detention with filtration shall be provided for at least the first 1" of runoff or 2.5" of runoff from the impervious area, whichever is greater, of the total amount of runoff required to be treated; or
    2. On-line detention with filtration of the runoff from the three-year, one-hour storm or an additional 50% of the treatment volume specified in subparagraph D.1.b., whichever is greater.

9. **Additional Construction Requirements.**
Detention with filtration facilities shall comply with the following:
    a. **Outfall Criteria.**
    Have an outfall structure, except where deemed unnecessary by the Administrative Official, based upon sound and generally accepted engineering practices and principles. The location of the structure and the shape of the pond shall be designed such that no "short-circuiting" of the flow occurs and that maximum disposition of suspended solids is achieved.
        1) When an outfall structure employs a weir within an inlet to control the water surface (diversion box), the structure shall be oversized and provide an access manhole or grate on either side of the weir. Outfall structures shall be designed to prevent floating materials and oils from being discharged into the receiving waters. Unless otherwise approved by the Administrative Official, based upon sound and generally accepted engineering practices and principles, outfall structures shall be as simple as possible and shall employ fixed control elevations (i.e., no valves, removable weirs, pumps, etc.).
        2) Each outfall structure shall limit peak off-site discharges to pre-development rates and shall be the discharge point for the filtration system.

3) Detention with filtration ponds shall be designed to attenuate peak outflows to pre-development rates and to provide filtration for the pollution abatement volume.

b. Maintenance Berms.
Provide adequate maintenance berms which are a minimum of 15' in width for ponds with fencing and a minimum of 10' in width for ponds without fencing. For ponds serving small drainage areas (less than five acres), where the applicant can demonstrate that berm stability and access for maintenance is sufficient, based upon sound and generally accepted engineering practices and principles, the above widths may be reduced by the Administrative Official, based upon sound and generally accepted engineering practices and principles.

c. Fencing.
Be fenced in areas utilizing retaining walls with a 30" or higher-grade differential, when side slopes exceed the 4:1 maximum or when the Administrative Official determines that it is in the public's best interest due to health or safety concerns. The required fence shall comply with Schedule F.

d. Freeboard.
Be designed to have a minimum of 1' of freeboard above the design high water elevation shall be provided. For ponds serving small drainage areas (less than five acres), where the applicant demonstrates that a lesser freeboard is sufficient, the above freeboard may be reduced with the approval of the Administrative Official, based upon sound and generally accepted engineering practices and principles. For ponds with reduced freeboard, the applicant must demonstrate that the design will attenuate post-development discharge rates for the 100-year, 24-hour storm event at or below pre-development discharge rates.

e. Side Slopes.
Provide maximum allowable side slopes are 4:1 unless otherwise approved by the Administrative Official, based upon sound and generally accepted engineering practices and principles.

f. Bottom Dimension.
Provide minimum bottom dimension of 4'.

g. Structure Requirements.
Ensure that pipes entering or leaving the retention/detention ponds shall have a permanent end treatment (i.e., headwall, mitered collar, control structure, etc.) which include energy dissipation.

h. Filled Berms.
Where filled berms will store water in excess of 2' above surrounding grade, calculations supporting the stability of the filled berm shall be submitted by a geotechnical engineer. In all cases of filled berms, if excess seepage may be expected through the berm, a clay core liner may be required.

i. Retaining Walls.
If retaining walls are utilized as part of a detention pond, they may not exceed more than 50% of the perimeter of the pond. The arrangement of walls shall not impede pond access and maintenance. The wall design shall also comply with Schedule G.

E. Underground Exfiltration Trench Systems.
An underground exfiltration system is the below-ground system consisting of a conduit such as perforated pipe surrounded by natural or artificial aggregate which is utilized to percolate stormwater into the ground.

Underground exfiltration trench systems shall:

1. Retention of Runoff.
Ensure pollution abatement by providing for either of the following:

a. Off-line storage of the first 1/2" of runoff or 1-1/4 inches of runoff from the impervious area, whichever is greater, or

b. On-line storage of an additional 1/2” of runoff over that volume specified in subparagraph E.1.a.

2. **Post-Storm Capacity.**
Provide the capacity for the specified treatment volume of stormwater within 72 hours following a storm event. The storage volume shall be provided by a decrease of stored water caused only by percolation into subparagraph E.1.a, above.

3. **Safety Factor.**
Be designed with a safety factor of at least two unless the applicant affirmatively demonstrates based on plans, test results, calculations or other information that a lower safety factor is appropriate for the specific site conditions. Examples of how to apply this factor include, but are not limited to, reducing the design percolation rate by half or designing for the required draw down within 36 hours instead of 72 hours.

4. **Pipe Standards.**
Be designed to percolate surface runoff through a sub-surface system. The exfiltration system shall consist of a minimum 6” diameter perforated pipe. The perforated pipe shall be surrounded by a minimum of 12” of coarse and calcium free aggregate. The coarse aggregate shall be completely wrapped by a filter fabric and the trench shall be backfilled with good, clean sand. Exfiltration systems shall be designed such that the bottom of the trench is not below the high groundwater table elevation.

5. **Sediment Sumps.**
Provide sediment sumps prior to the trench which shall:
    a. Remove a particle of 0.1 millimeter in diameter (approximately a No. 100 sieve size) unless the applicant affirmatively demonstrates that another grain size is more appropriate for the site.
    b. Be designed for an inflow rate equal to the design peak flow rate of the project's internal storm water system conveying water to the exfiltration trench.

6. **Maintenance and Inspection.**
Be designed considering maintenance requirements. which provide cleanout and inspection sumps at the terminus of each pipe.

7. **Invert Elevation of Trench.**
Be designed so that the invert elevation of the trench must be at least two feet above the seasonal high ground water table elevation unless the applicant demonstrates based on plans, test results, calculations or other information that an alternative design is appropriate for the specific site conditions.

8. **Capacity to Retain Treatment Volume.**
Be designed so that the system shall have the capacity to retain the required treatment volume without considering discharges to ground or surface waters.

9. **Access Manholes.**
Locate access manholes at terminal ends, turns and changes in grade and shall be spaced no greater than 300’ apart.

10. **Discharge to Outstanding Florida Waters.**
Direct discharge to Class I, Class II, or Outstanding Florida Waters shall provide either of the following:
    a. At least an additional 50% of the applicable treatment volume specified in subparagraph E.1.a. Off-line storage must be provided for at least the first 1/2” of runoff or one and 1-1/4” inches of runoff from the impervious area, whichever is greater, of the total amount or runoff required to be treated; or
    b. On-line storage of the runoff from the three-year, one-hour storm or an additional 50% of the treatment volume specified in subparagraph E.1.b, whichever is greater.

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F. Underdrain Stormwater Management Systems.

An underdrain is a drainage system installed beneath a stormwater holding area to improve the infiltration and percolation characteristics of the natural soil when permeability is restricted due to periodic high water table conditions or the presence of layers of fine textured soil below the bottom of the holding area. These systems usually consist of a system of interconnected below-ground conduits such as perforated pipe, which simultaneously limit the water table elevation and intercept, collect, and convey stormwater which has percolated though the soil.

Natural environmental features in the City primarily associated with soil limitations and high groundwater conditions normally necessitate the provision of underdrains in order to comply with these drainage requirements. Underdrains shall:

1. **Runoff.**
   Accomplish pollution abatement by providing for either of the following:
   a. Off-line storage of the first 1/2” of runoff or 1-1/4” of runoff from the impervious area, whichever is greater; or
   b. On-line storage of an additional 1/2” of runoff over that volume specified in subparagraph F.1.a.
   c. Underdrain systems may contain areas of standing water only following a rainfall.

2. **Post-Storm Capacity.**
   Provide the capacity for the specified treatment volume of stormwater within 72 hours following a storm event. The storage volume shall be provided by a decrease of stored water caused only by percolation through soil with subsequent transport through the underdrain pipes, evaporation or evapotranspiration.

3. **Safety Factor.**
   Be designed with a safety factor of at least two unless the applicant affirmatively demonstrates based on plans, test results, calculations or other information that a lower safety factor is appropriate for the specific site conditions. Examples of how to apply this factor include but are not limited to reducing the design percolation rate by half or designing for the required drawdown within 36 hours instead of 72 hours.

4. **Groundwater Drawdown Criteria.**
   Ensure that the water table shall not be lowered more than 3’ below the high-water table for the parcel, or the water table shall not be lowered more than 5’ below the high-water table at the location of the underdrain.

5. **Pond Underdrain Criteria.**
   Be designed to provide a drawdown for detention basins and to provide detention with filtration for purposes of pollution abatement. The design of all pond underdrains shall be approved by the Administrative Official based upon sound and generally accepted engineering practices and principles.

6. **Underdrain Outlet.**
   Be designed such that the tailwater elevation shall not exceed the top of the underdrain outlet pipe.

7. **Cleanouts.**
   Cleanouts shall be provided at the ends of each run and at intervals not to exceed 100’.

8. **Maintenance and Inspection Requirements.**
   All privately maintained pond underdrains shall be inspected and maintained on an annual basis to ensure proper operation. Written confirmation of inspection must be received by the City within 30 days of the inspection. If the underdrain system no longer functions as designed and approved, such underdrains shall be removed, replaced or repaired.

   Include, at a minimum, a capped and sealed inspection and cleanout ports which extend to the surface of the ground at the following locations of each drainage pipe:

a. The terminus; and
b. Every 400’ or every bend of 45 or more degrees, whichever is less.

9. Tree Clearance.
Not be located within 15’ from any proposed or existing tree.

10. Pond Underdrain Standards.
Be designed as either a flexible, fine aggregate filter system or a rigid, coarse aggregate filter system adhering to the following requirements:

a. Flexible, Fine Aggregate Filter.
The flexible, fine aggregate filter system shall consist of a minimum 6” diameter, perforated, and corrugated tubing continuously surrounded with a filter fabric envelope (sock) to prevent the soil from moving and being washed out through the underdrain pipe. The tubing shall be covered by a minimum of 2’ of fine aggregate conforming to the size and gradation specified in Section 902, Florida Department of Transportation (FDOT) Standard Specifications for Road and Bridge Construction, latest edition. The filter aggregate shall be backfilled with a blanket of crushed stone or equivalent material.

b. Rigid, Coarse Aggregate Filter.
The rigid, coarse aggregate filter system shall consist of a minimum 6” diameter perforated PVC pipe. The pipe shall be surrounded by a minimum of 6” of calcium-free, coarse aggregate meeting Section 901, FDOT Standard Specifications for Road and Bridge Construction, latest edition. The coarse aggregate shall be completely wrapped in a filter fabric and backfilled with a minimum of 2’ of fine aggregate conforming with Section 902, FDOT Standard Specifications for Road and Bridge Construction, latest edition.

c. Indigenous Soil.
Provide at least 2’ of indigenous soil between the bottom of the stormwater holding area and the underdrain pipe(s).

d. Discharge Points.
Underdrains shall be designed with free gravity outlet at carefully selected discharge points. Erosion control measures shall be stabilized with permanent vegetative cover at all discharge points.

11. Adjacent Property Protection.
Not significantly affect water table conditions on adjacent property. The Administrative Official may require the applicant to implement specific measures deemed necessary to avoid or correct any adverse impact of drainage facilities upon adjacent property based upon sound and generally accepted engineering practices and principles.

12. Discharge to Outstanding Florida Waters.
Underdrain systems which direct discharge to Class I, Class II, or Outstanding Florida Waters shall provide either of the following:

a. At least an additional 50% of the applicable treatment volume specified in subparagraph F.1.a. Off-line storage must be provided for at least the first 1/2” of runoff or 1-1/4” of runoff from the impervious area, whichever is greater, of the total amount of runoff required to be treated; or
b. On-line storage of the runoff from a 3-year, 1-hour storm or an additional 50% of the treatment volume specified in subparagraph F.1.b., whichever is greater.

13. Roadway Underdrains.

Be designed to control the high groundwater elevation to within one foot of the bottom of the road base. In developments with more than 500' of roadway underdrain, the flow shall not be routed through the retention/detention facility but shall discharge to the receiving waters through an independent system unless otherwise approved by the Administrative Official based upon sound and generally accepted engineering practices and principles.

a. Unless otherwise approved the slope of roadway underdrains shall conform with the curb slope. Wherever roadway construction reveals unexpected water bearing strata that would cause deterioration of the pavement, underdrains or other acceptable alternative that will provide necessary measures to maintain the structural integrity of the road will be required even though not shown on the approved plans. The Administrative Official shall be notified of the presence of such water bearing strata and shall approve measures to overcome such natural limitations to roadway construction.

b. All roadway underdrains shall be placed 2' from the back of curb.

c. Roadway underdrains shall not be placed deeper than 6" above the seasonal low water table level.

d. All roadway underdrains and underdrains located along lot lines shall be clearly identified on the plans and in the field to prevent their disturbance during utility installation.

e. Wherever road cuts in otherwise suitable soils indicate that the finish grade will result in a road-surface-to-water table relationship that adversely exceeds the degree of limitation stated above, underdrains or other acceptable alternative that will provide necessary measures to maintain the structural integrity of the road will be required.

f. Filtering media shall consist of stone, gravel, or slag, contain no friable materials, or be cementous in nature.

g. Underdrain pipe specifications shall be in accordance with the American Society for Testing and Materials, Designation D3033-5. Such pipe shall consist of a minimum 6" diameter perforated PVC pipe and shall be surrounded by a minimum of 6" of calcium-free aggregate. The coarse aggregate shall be completely wrapped in a filter fabric and backfilled with good, clean sand.

h. The City will not accept for maintenance any new roadway which is dependent on underdrains to control the water table. This includes, but is not limited to, roadways designed without underdrain but found to require them during the bonding period. The subdivision home/property owner association shall maintain all roadways utilizing this design and a development order and subdivision plat, or both, as appropriate shall so clearly state.

SECTION 4.0 ROADWAY DRAINAGE DESIGN

A. All Roads.

All roads shall be designed in accordance with the following standards (see Section 334.03, *Florida Statutes*, for pertinent definitions):

1. Cross-Slope.

All roads shall be designed using a standard crown section (runoff directed from the centerline toward the edge of pavement). Super elevated curves may direct runoff across all travel lanes. The minimum allowable cross-slope for all roads shall be 0.02' per foot.

2. Minimum Groundwater and Highwater Clearances.

All roads shall be designed to provide a minimum clearance of one foot between the bottom of the base and the estimated seasonal highwater table, or the artificial water table induced by an underdrain or exfiltration system. See Section 3.0.F.13.h

B. Rural Sections.

Rural sections, if approved by the City Commission, shall comply with the following standards.

1. **Post-Storm Capacity.**
   Provide the capacity for the given volume of stormwater within 72 hours following the storm event assuming average antecedent conditions. The storage volume shall be provided by a decrease of stormwater caused only by percolation through soil, evaporation or evapotranspiration.

2. **Runoff Percolation.**
   Provide swale systems which percolate 80% of the runoff from the three-year, one-hour storm.

3. **Slope.**
   Design with swale section in accordance with the following standards:

Flush ribbon curb:	6” minimum
Swale front slope:	10:1 maximum
Swale back slope:	10:1 maximum

4. **Discharge to Outstanding Florida Waters.**
   Direct discharge by means of swale systems to Class I, Class II, or Outstanding Florida Waters shall percolate the runoff from the three-year, one-hour storm.

5. **State Swale Criteria.**
   Provide for swales which meet the criteria in subsection 40C-42.021(29), *Florida Administrative Code*.

C. Urban Sections.
All urban sections shall:

1. **Curb, Gutter and Grades.**
   Be designed using either Miami curb and gutter or standard curb and gutter with the minimum allowable centerline grade for all streets with curb and gutter shall be 0.30%, except in intersections where flatter grades shall be allowable.

2. **Allowable Length of Gutter Flow.**
   Unless the design requires shorter distance, provide maximum distance in which surface water will be allowed to run in the gutter shall be as follows:

Miami curb and gutter:	800’
Standard curb and gutter:	1,200’

3. **Inlet Interception Rates.**
   Space inlets in such a manner that 90% of the approaching gutter flow shall be intercepted.

4. **Low Point Inlets.**
   On arterial and collector roads, in order to prevent siltation and to provide for a safety factor against clogging of a single inlet in a sump location, it is required to construct multiple inlets at all sump locations. Preferably three inlets should be constructed on each side of the roadway, one at a low point and one each side of a point 0.2’ higher than the low point. On all other roads, inlets in sump locations shall be designed with an extra-large throat.

5. **Inlets.**
   Provide curb inlets of heavy construction design which shall not be constructed within the radii of curb returns and which:

   a. Are placed at all points where the cross slope on a roads reverses from a negative to a positive to prevent stormwater from crossing the road.
   b. Wherever possible, placed in front of lot corners.

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c. Do not allow storm water runoff to enter the roads gutter from areas outside of the roadway limits. Off-site flows from directly connected impervious areas more than 1/2 acre shall be intercepted prior to the right-of-way line.
d. Have grates which are designed to minimize clogging with debris such as leaves.
e. Have top elevations of inlets flush with adjacent sidewalks and have slopes between inlet tops and sidewalks shall be 0.02’ per foot as a maximum.

6. **Tolerance.**
The tolerance for ponded water in curb construction is 1/4" maximum and if exceeded, the section of curb shall be removed and constructed to grade.

SECTION 5.0 CLOSED STORM DRAINAGE SYSTEMS

A. Storm Sewer Design Criteria.
All storm sewers shall be designed as follows:

1. **Allowable Velocities.**
All storm sewers shall be designed and constructed to produce velocities within the following range when flowing full:

Minimum velocity:	2.5’ per second
Maximum velocity:	10’ per second

2. **Energy Dissipation.**
All systems shall consider exit velocities. Energy dissipation structures shall be provided when exit velocities become excessive.

3. **Hydraulic Gradient.**
All storm sewers shall be designed considering the hydraulic gradient of the system. The hydraulic grade line shall be calculated utilizing pipe friction losses and entrance and exit losses in each manhole. The maximum allowable hydraulic gradient for roads shall be as follows:

Arterial and collector roads:	1.0’ below gutter line
Local and interior roads:	0.5’ below gutter line

4. **Design Tailwater.**
All storm sewer systems shall be designed considering the tailwater condition of the receiving waters. When information is unavailable, maximum tailwater elevations shall be determined based upon a 25-year storm.

B. Culvert Design Criteria.
All culverts shall be designed as follows:

1. **Minimum Allowable Slope.**
All culverts shall be designed and constructed to produce a minimum velocity of 2.5’ per second (fps) when flowing full. Culverts which are parallel to roadways shall be placed at a grade not less than the minimum road grade.

2. **Energy Dissipation.**
All culverts shall be designed considering exit velocities. Energy dissipation structures shall be provided when exit velocities become extreme.

3. **Allowable Headwater.**
   The allowable headwater of a culvert installation shall be:

Arterial and collector roads:	1.0’ below edge of pavement
Local and interior roads:	0.5’ below edge of pavement

4. **Design Tailwater.**
   All culverts shall be designed considering the tailwater condition of the receiving waters. Where information is unavailable, maximum tailwater elevations shall be determined based upon the storm event utilized in the culvert design.

C. Drainage Pipes and Structures.

1. **Pipe Size.**
   The minimum allowable drainage pipe size shall be 15”.

2. **Length.**
   The relationship between pipe size and maximum length of pipe allowable without an access structure shall be as follows:

Pipe Size:	Maximum Length:
< 18”	300’
>18” to < 36”	400’
42" and Larger	500’

3. **Structure Requirements.**
   All storm pipes shall have an end structure such as but not limited to headwalls, mitered collars, inlets and manholes.

4. **Pipe Clearance.**
   Unless otherwise authorized by the Administrative Official, the minimum clearance for all storm pipes shall be:

Description:	Clearance:
From bottom of roadway base to crown of pipe:	1.0’
Utility crossing, outside edge to outside edge:	0.5’

5. **Public Roads.**
   All pipes crossing roads within public rights-of-way shall be either reinforced concrete pipe or elliptical reinforced concrete pipe or Class II Polypropylene as approved by FDOT. All pipes shall be rated for a 100-year service life per FDOT standards.

6. **Conflict Manholes.**
   Conflict manholes shall be used only when there is no reasonable alternate design based on sound and generally accepted engineering principles and practices. Where it is necessary to allow a sanitary line or other utility to pass through a manhole, inlet or junction box, the utility line shall be ductile iron or another suitable material. No joints are to be inside the manhole.
   a. Where utility lines pass through manholes, the utility line shall be placed in such a manner as to provide a minimum of 1’ clearance between the bottom of the manhole and the bottom of the shell of the utility pipe.
   b. Conflict manholes shall be over-sized to accommodate the decreased maneuverability inside the structure and flow retardance.

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7. **Storm Sewer Alignment.**
   All storm sewer layouts shall avoid abrupt changes in direction or slope and shall maintain reasonable consistencies in flow velocity unless specially designed and accounted for in head loss calculations.

   All storm sewer systems shall maintain a reasonable slope through all manholes. Manholes shall be required wherever there is a change in pipe size, material, slope or vertical or horizontal alignment.

8. **Inlets, Manholes and Junction Boxes.**
   a. All inlets, manholes and junction boxes shall conform to the latest edition of the FDOT Roadway and Traffic Design Standards. Inlets which require heavy tops shall be either FDOT Types 1, 2, 3 or 4.
   b. Pipes shall extend through the wall and be flush with inside wall. Concrete shall be constructed around them neatly. All surfaces shall be plastered so as to prevent leakage. Water-stop materials shall be used whenever practicable. Plastered areas shall not crack and shall be properly prepared to bond to old surfaces. Paved inverts are required.
   c. For all concrete structures, all fins and irregular projections shall be chipped off flush with the surface immediately following the removal of forms. All projecting wires and nails shall be cut off at least 1/2” under the surface. All cavities produced by metal spacers, form ties, bolts, honeycomb spots, etc., shall be carefully cleaned, saturated with water and then carefully painted with mortar. All construction and expansion joints in the completed work shall be left carefully tooled and free of mortar and concrete. Joint filler shall be left exposed for its full length, with clean edges. Mortar topping for upper horizontal surfaces shall not be used.
   d. For all concrete surfaces which are to receive a surface finish, the contractor shall remove the forms and immediately finish the concrete after the concrete has set sufficiently.

SECTION 6.0 OPEN STORM DRAINAGE SYSTEMS

Open drainage systems are considered to be grassed swales, ditches and canals. This section applies to all such open drainage systems except roadside swales.

A. Soils Conditions.
Open storm drainage systems are permittable only within areas that do not contain high water table soils. The bottom of the drainage facility shall not be located below the seasonal high-water table elevation.

B. Allowable Velocities.
All open storm drainage systems shall be designed and constructed to produce velocities not greater than 2.5’ per second.

C. Minimum Longitudinal Grade.
The longitudinal grade of open drainage systems shall not be less than 0.05%.

D. Design Tailwater.
All open channels shall be designed considering the tailwater condition of the receiving waters. Where information is unavailable, maximum tailwater elevation shall be determined based upon the storm event utilized in the channel design.

E. Channel Curvature.
Without channel protection, a minimum centerline radius of 50’ or 10 times the bottom width, whichever is larger, shall be utilized.

F. Fencing.
Open drainage systems shall be fenced when the water depth exceeds two 2’ for a period greater than 24 hours or the depth of the ditch exceeds 5’. Open drainage ways with slopes of greater than 4:1 shall be fenced with fences which comply with Schedule G.

G. Side Slopes.

The maximum allowable side slopes shall be:

Ditch or Canal Depth	Side Slopes
3' or less:	4:1
Greater than 3'	3:1

H. Bottom.

The minimum bottom dimension of open drainage systems shall be 4'. Swales 1' deep or less may have a triangular cross-section.

I. Maintenance Berm.

All open drainage systems shall have an unobstructed, stabilized maintenance berm on one or both sides. The minimum requirement for maintenance berm is shall be as follows:

Ditch or Canal Top Width	Maintenance Berm Required
20' or less:	15' one side
20' to 40':	15' both sides
Greater than forty 40':	20' both sides

J. Freeboard.

A minimum freeboard of 1' shall be maintained between the design water surface and the top of slope for all open channels.

K. Slope Protection.

All side slopes and maintenance berms of open drainage systems shall be vegetated to provide a dense stand of grass within 30 days. The following is a list of acceptable materials:

Season:	Material:
May-September	Sod
October-April	Seed and Mulch

L. Channel Protection.

Unless otherwise approved by the Administrative Official, the following minimum requirements shall be provided for protection of the wetted perimeter during design flows:

Ditch Grade:	Protection Required:
0.05% - 1.00%	Seed and Mulch
1.00% - 2.00%	Sod
2.00% - Greater	Paving or suitable alternative

M. Utility Crossing.

Where it is necessary for a utility to cross an open drainage system, the following shall be adhered to:

1. Minimum of a 3' of cover from the design grade of the waterway.
2. Utilities shall be adequately marked to protect against accidental damage during maintenance operations.
3. Aerial supports are prohibited within in the confines of the waterway.
4. All sleeves or crossings shall meet the minimum standards and specifications according to the FDOT utility accommodation guidelines.

SECTION 7.0 DRAINAGE STRUCTURE MATERIAL SPECIFICATIONS

Drainage structures and materials shall conform to the latest edition of the Florida Department of Transportation's Roadway and Traffic Design Standards and Standard Specifications for Road and Bridge Construction. Drainage structures and materials not detailed in aforementioned standards and specifications shall be designed to conform with sound and generally accepted engineering principles and practices and shall require approval by the Administrative Official. The Administrative Official may require a drainage structure design differing from FDOT standards when necessary.

A. Pipe Materials.

1. Shall meet the requirements of the latest edition of the FDOT Standard Specifications for Road and Bridge Construction.
2. All metal pipes not employing a water-tight band at the joints shall have all joints wrapped with filter fabric.

B. Underdrains.

The following is a list of underdrain materials acceptable for use in the:

1. Perforated Corrugated Tubing. Corrugated, polyethylene tubing perforated throughout and meeting the requirements of Section 948, FDOT Standard Specifications for Road and Bridge Construction, latest edition.
2. Perforated PVC Pipe. Polyvinyl-chloride pipe conforming to the requirements of Section 948, FDOT Standard Specifications for Road and Bridge Construction, latest edition.

C. Exfiltration Pipe.

The following is a list of pipe materials acceptable for use in exfiltration systems:

1. Aluminum pipe perforated 360 degrees, meeting the requirements of AASHTO M-196.
2. Perforated Class III reinforced concrete pipe with perforations meeting the requirements of ASTM C-444.
3. Polyvinyl-chloride pipe perforated 360o, meeting the requirements of ASTM D-3033.

D. Fine Aggregate.

Sand filter media shall be of a quality sufficient to satisfy the following requirements:

1. Washed: (less than 1% silt, clay and organic matter).
2. Uniformity coefficient: 1.5 or greater.
3. Effective grain size: 0.2-0.55 mm.

E. Coarse Aggregate.

Clean, calcium-free stone containing no friable materials and a gradation equivalent to FDOT size number 56 or 57. Some of the acceptable material types are as follows:

1. Calcium-free limestone.
2. River gravel.
3. Railroad ballast.
4. Blast furnace slag.

F. Filter-Fabric Envelope (Sock).

Be a strong, porous, polyester knitted fabric. The envelope shall be a continuous one-piece material that fits over the tubing like a sleeve. It shall be knitted of continuous 100-200 denier yarn and shall be free from chemical treatment or coating that might significantly reduce porosity and permeability. The fabric envelope shall conform to the following:

1. Equivalent opening size (U.S. Standard sieve):	100 (0.150 mm.)
2. Tensile strength (pounds):	50
3. Bursting strength (per square inch):	90-125

G. Filter Fabric.
Pervious sheet of monofilament yarn woven, knitted or bonded to form a fabric shall conform with the following:

1. Equivalent (U.S. Standard sieve):	100 (0.150 mm.)
2. Tensile strength (pounds):	50
3. Bursting strength (per square inch):	200
4. Puncture strength (pounds):	32

H. Rip-Rap.
Riprap shall not be used as material for drainage structures and it is prohibited and unlawful to do so.

SECTION 8.0 DRAINAGE CALCULATION AND COMPUTATION CRITERIA

All drainage calculations and computations shall be based on Table O-1, and Table O-2 of this schedule as applicable and unless otherwise determined by the Administrative Official based on sound and generally accepted engineering principles and practices.

SECTION 9.0 EASEMENTS – GENERAL

Easements shall be provided for the installation of, access to and/or maintenance of public utilities and drainage systems and other publicly owned or maintained improvements and facilities that are not located within public street right-of-way or upon land otherwise owned, controlled or legally accessible by the responsible public entity. Furthermore, easements shall be required when necessary for the functioning of the effected system, facility or improvement. The City shall comply with the constitutional requirement of a rational nexus and rough proportionality analysis as well as Section 70.45, *Florida Statutes*.

A. Review and Approval.
Required easements shall be accurately portrayed on all applicable plans or drawings. Such easements shall be reviewed and approved by the City Attorney in accordance with applicable procedures set forth in this Schedule and the real estate interests conveys shall be insurance consistent with generally accepted title insurance standards. Unless otherwise prescribed as a condition or stipulation of approval, easements shall be executed, accepted by the City, and recorded prior to issuance of development approval authorizing the commencement of development.

B. Subdivisions.
Easements which are required within a platted subdivisions shall be clearly identified on the face of the plat and included in the dedication as approved by the City Attorney.

C. Off-Site.
Easements shall be required when access to, maintenance of and/or utilization of off-site improvements is necessary and not otherwise provided to ensure the proper functioning of the effected improvement.

SECTION 10.0 SITE PREPARATION, EXCAVATION, LAND CLEARING, DREDGING AND FILLING

A site development permit shall be required prior to any activity which involves digging, filling, excavating, clearing, removing, placing, displacing, relocating, dumping, moving, pumping, and/or depositing any material greater than 400 cubic yards in quantity, provided however, that when such activity is predicated upon a foundation permit or a building permit, a site development permit for such activity will not be required. The issuance of a site development permit for such activities will be based on an application submitted to and approved by the Administrative Official. The following information, at a minimum, shall be submitted with said application when applicable:

A. Scaled Drawing.
Depict in the proposed work, existing and proposed elevations and conditions in terms of elevations, average surface/ground water level, type and quantities of materials on a scaled drawing.

B. Protection of Adjacent Land.
If activity is adjacent to lands under a different ownership than applicant, explain and illustrate methods to protect adjacent owners and uses.

C. Protection of Environmentally Sensitive Lands.
If the proposed activity is to be conducted upon environmentally sensitive lands as described in Schedule M, the Administrative Official may require the applicant to submit information set forth in Schedule M.

D. Guarantee.
The Administrative Official may require a bond or other type of performance guarantee to ensure that, once commenced, the activity will be completed and/or the site restored in a satisfactory manner.

SECTION 11.0 RESIDENTIAL LOT GRADING REQUIREMENTS

A. Master Drainage Plan Lot Grading.
Individual lots within a Master Drainage Plan shall be graded to direct stormwater runoff into the street or alley right-of-way or into a drainage easement or facility designed for conveyance or storage. A grading plan, sufficient to verify conformance with slope requirements, shall be provided with the Master Drainage Plan and included as an exhibit for individual lot development.

1. **Finished Floor Elevation.**
   All lots that are located within a subdivision with an approved master lot drainage plan shall have a finished floor elevation as follows:
   a. Minimum of 2’ above the determined 100-year flood elevation.
   b. On all lots the finished floor elevation shall be no more than 1/10’ below the approved design elevation on the grading plan.
   c. A sealed elevation survey performed by a Florida registered surveyor, under seal, shall be provided to the Building Official at the form board stage prior to pouring the slab.
   d. A final sealed survey including the finished floor elevation and final grading elevations which shows compliance with the approved grading plan, performed by a registered Florida surveyor, shall be provided to the Building Official prior to issuance of a certificate of occupancy.
   e. Lots that are partially or wholly within a Special Flood Hazard Area (100 Year Floodplain), as identified on the most recent Flood Insurance Rate Maps, shall also provide an Elevation Certificate as promulgated by the U.S. Department of Homeland Security, Federal Emergency Management Agency, National Flood Insurance Program (OMB No. 1660-0008, Expiration Date: November 30, 2022, or latest edition) prepared and sealed by a registered Florida land surveyor to the Building Official prior to issuance of a certificate of occupancy.

B. Infill Lot Grading.

The City has a number of existing subdivisions that do not have a master lot drainage plan or did not have the benefit of a drainage review and approval by the City and its lots are 1/2 acre or less in size. Residential lots located within these subdivisions shall be required to meet the following minimum requirements to protect adjacent properties from impacts from stormwater run-off.

1. **Grading Plan.**

   For those residential lots that are located within platted subdivisions (infill lots) that do not have a master lot drainage plan or did not have the benefit of a drainage review and approval by City and that is one half acre or less in size, an individual lot grading plan shall be submitted to the Building Official prior to the issuance of a building permit. Such plan shall not adversely impact adjacent lands. The Administrative Official may require the plan be signed and sealed by a Florida registered engineer. A topographic survey (spot elevations) including sufficient portions of adjacent lots performed by a registered surveyor shall be included and be the basis of the grading plan. Elevations shall be consistent with North American Vertical Datum 88 datum.

2. **Finished Floor Elevation.**

   All lots that are located within a subdivision without an approved master lot drainage plan shall have a finished floor elevation as follows:

   a. 16” above the highest adjacent crown of the road for lots with full or partial positive flow to the street right-of-way.
   b. 8” above the highest adjacent crown of the road for lots that drain away from the roadway and toward a lake, stream or other water collection area.
   c. Finished floor elevation as determined by the Health Department based upon controlling law.
   d. 2’ above the determined 100-year flood elevation.
   e. On all lots the finished floor elevation shall be no more than 1/10’ below the approved design elevation on the grading plan.
   f. A sealed elevation survey performed by a Florida registered surveyor shall be provided to the Building Official at the form board stage prior to pouring the slab.
   g. A final sealed survey including the finished floor elevation and final grading elevations which shows compliance with the approved grading plan, performed by a registered Florida surveyor, shall be provided to the Building Official prior to issuance of a certificate of occupancy.
   h. Lots that are partially or wholly within a Special Flood Hazard Area (100 Year Floodplain), as identified on the most recent Flood Insurance Rate Maps, shall also provide an Elevation Certificate as promulgated by the U.S. Department of Homeland Security, Federal Emergency Management Agency, National Flood Insurance Program (OMB No. 1660-0008, Expiration Date: November 30, 2022, or latest edition) prepared and sealed by a registered Florida land surveyor to the Building Official prior to issuance of a certificate of occupancy.

3. **Side Yards.**

   On all lots where the side yard setback is less than 10’, stem wall construction is required. The foundation plan shall include a detail showing the difference in elevation between the finished floor and the finished grade. This detail shall match the required grading plan. On lots for which the side yard setback is 10’ or more, the finished floor elevation shall be no more than 1’ above the approved design elevation unless stem walls are used to allow side yard slope to remain 6:1 or less.

C. Grading Requirements Associated with Swimming Pool and/or Septic System Construction.

All swimming pools, including associated structures, must be located outside drainage and utility easements and setbacks. Any proposed deviation from such criteria must be accompanied by a lot drainage plan demonstrating no adverse drainage impact to adjacent lands. Such encroachment, if approved, may require a vacation by the City Commission conducted through the processes of the City relative to the vacation of easements.

D. Finished Floor Waivers.

All finished floor waivers are subject to approval by the Administrative Official. Applicants may request a deviation from the Administrative Official prior to pad construction. Such request must be accompanied with justification typically relating to extreme conditions of the land topography. After the fact finished floor deviations shall not be granted for those structures that are constructed below the required elevation located within the Special Flood Hazard Area as indicated on the current Flood Insurance Rate Maps. All determinations shall be based upon non-economic hardships and whether the request will adversely impact the public health, safety or welfare.

E. Certification.

At the completion of construction, all residential lots shall be certified, under seal, by a Florida registered engineer as to compliance with the approved grading plan prior to issuance of a certificate of occupancy.

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SECTION 12.0 TABLES

TABLE O-1
RAINFALL DEPTHS

Duration:	Frequency / Depth (in inches)		
	10 Year	25 Year	100 Year
5 minutes	0.7	0.8	0.9
10 minutes	1.2	1.4	1.6
15 minutes	1.6	1.8	2.1
30 minutes	2.3	2.8	3.0
60 minutes	3.0	3.4	4.0
2 hours	3.6	4.3	5.2
3 hours	4.3	4.8	5.9
6 hours	5.1	6.0	7.3
12 hours	6.3	7.2	9.0
24 hours	7.5	8.6	11.0
48 hours	8.2	10.0	12.4
72 hours	9.0	11.0	13.8
96 hours	9.8	11.9	15.2

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TABLE O-2
MODIFIED SCS TYPE II 24 HOUR DISTRIBUTION

1\2 Hour Time Steps	Time (Hours)	Design Storm Incremental Depth (Px/P24)	Design Storm Accumulative Depth
1	0.5	0.0060	0.0060
2	1.0	0.0062	0.0121
3	1.5	0.0064	0.0185
4	2.0	0.0066	0.0251
5	2.5	0.0038	0.0319
6	3.0	0.0071	0.0391
7	3.5	0.0074	0.0465
8	4.0	0.0077	0.0542
9	4.5	0.0081	0.0623
10	5.0	0.0085	0.0708
11	5.5	00090	0.0797
12	6.0	0.0095	0.0892
13	6.5	0.0101	0.0993
14	7.0	0.0108	0.1101
15	7.5	0.0116	0.1217
16	8.0	0.0126	0.1342
17	8.5	0.0138	0.1481
18	9.0	0.0154	0.1635
19	9.5	0.0174	0.1809
20	10.0	0.0203	0.2012
21	10.5	0.0247	0.2259
22	11.0	0.0322	0.2580
23	11.5	0.0494	0.3075
24	12.0	0.2994	0.6068
25	12.5	0.1116	0.7185
26	13.0	0.0386	0.7571
27	13.5	0.0278	0.7849
28	14.0	0.0222	0.8071
29	14.5	0.0187	0.8259
30	15.0	0.0163	0.8422
31	15.5	0.0146	0.8568
32	16.0	0.0132	0.8700
33	16.5	0.0121	0.8820
34	17.0	0.0112	0.8932
35	17.5	0.0104	0.9086
36	18.0	0.0098	0.9134
37	18.5	0.0092	0.9226
38	19.0	0.0087	0.9313
39	19.5	0.0083	0.9396
40	20.0	0.0079	0.9475
41	20.5	0.0076	0.9551
42	21.0	0.0073	0.9623
43	21.5	0.0070	0.9693
44	22.0	0.0067	0.9760
45	22.5	0.0065	0.9825
46	23.0	0.0063	0.9887
47	23.5	0.0061	0.9948
48	24.0	0.0052	1.0000