

CITY OF ALPHARETTA  
STORMWATER MANAGEMENT  
DESIGN MANUAL

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Stormwater Management Design Manual

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## Section 1 – General

1. The purpose of this manual is to be in compliance with the amended section 402 of the Clean Water Act being section 405 of the Water Quality Act of 1987, requiring the Environmental Protection Agency to establish regulations setting forth NPDES (National Pollutant Discharge Elimination System) permit application requirements for stormwater discharges. Stormwater is defined as stormwater runoff, surface runoff, street wash waters related to street cleaning or maintenance, infiltration (other than infiltration contaminated by seepage from sanitary sewers or by other discharges), and drainage related to storm events or snow melt. Georgia has been delegated the NPDES Permit Program and is therefore responsible for implementation of a program to control stormwater discharge.
2. The State of Georgia has required all applicable municipalities to comply with permit application requirements for their municipal separate storm sewers. Municipal separate storm sewers are defined as any conveyance of system of conveyances owned or operated by a local government entity and used for collecting and conveying storm water, which is not part of a public owned treatment works. The Clean Water Act mandates that permits for discharges from municipal separate storm sewers shall require controls to reduce the maximum discharge of pollutants to the maximum extent practical (MEP). The State of Georgia will issue general permits for municipal storm water discharges. The City of Alpharetta is an NPDES Phase I city.
3. This manual as established in 3.3.1D of the Unified Development Code of Alpharetta will set forth design requirements with applications being governed by the topographic conditions on a site by site basis. The Public Works Department will determine the proper application of design requirements and will coordinate the application with the other City departments. This manual will be periodically amended as new restrictions, technology, and experience dictates.
4. The City of Alpharetta has other standards and specifications that set forth design requirements for stormwater and this ordinance consolidates those requirements for stormwater management.
5. In conjunction with design requirements set forth in this manual for new development a comprehensive hydrological study may be performed in areas of existing development for evaluation of feasible improvements to conform to the new standards and to alleviate existing drainage problems to the maximum extent possible.
6. This manual should be used in conjunction with the latest revised Georgia Stormwater Management Manual. Where possible, this manual explains items in which City of Alpharetta requirements are more stringent or more detailed than the Georgia Stormwater Management Manual.

**Section 2 – The Stormwater Problem**

1. This section has been removed. Please reference the Georgia Stormwater Management Manual.

**Section 3 – Objectives of Stormwater Management**

1. This section has been removed. Please reference the latest revision of Georgia Stormwater Management Manual.

**Section 4 – Stormwater Pollutants and Their Removal**

1. This section has been removed. Please reference the latest revision of Georgia Stormwater Management Manual.

**Section 5 – Principles of Stormwater Management**

1. This section has been removed. Please reference the latest revision of the Georgia Stormwater Management Manual.

**Section 6 – Specific Stormwater Concerns for Residential Subdivision Development**

1. Detention ponds, runoff reduction, and water quality measures must be located on a separate lot with the 10' access easement completely contained within that lot. All detention pond and water quality lots must be included in a common area deeded to the homeowners association for that subdivision development.
2. No portion of any lot with residences shall contain any stream buffer. All stream buffers shall be included in a common area deeded to the homeowners association for that subdivision development.
3. All stormwater management measures will require a Special Operations and Maintenance Agreement for Homeowners' Associations or Other Associations per UDC Sec. 3.3.3 D.2. Any residential subdivision proposing the use of an underground system must receive written approval from the Department of Public Works.
4. For ease of access for maintenance, residential subdivision ponds should not be constructed with walls on all sides of the pond.

**Section 7 – Description of Acceptable Techniques for Obtaining, Calculating, and Presenting Information Required in Stormwater Management Plans.**

1. Acceptable techniques for obtaining, calculating and presenting information required in stormwater management plans are described in detail in the latest

revision of the Georgia Stormwater Management Manual and the City of Alpharetta Unified Development Code (UDC).

2. Water quality, channel protection and detention should be provided for in accordance with the latest revision of the Georgia Stormwater Management Manual in addition to the following requirements:
  - a. Modified rational method will be allowed for drainage basins under 1.0 acre. When this method is employed a pre-development c value of 0.1 must be used. Approval from the Department of Community Development is required.
  - b. Provide for detention of the 1, 2, 5, 10, 25, 50, and 100 year storms in pre-developed and post developed studies.
  - c. Runoff reduction and/or water quality shall be required for any new or redevelopment that includes the creation of 1,000 square feet impervious area or more. Detention (including channel protection) shall be required for any new or redevelopment with an increase of 5,000 square feet impervious area or more. The extent to which runoff reduction /water quality and detention must be provided (i.e. on new impervious area only, on disturbed area, or on entire site) is based on a tiered approach, and is specified in Table 1.

Not Achieving Runoff Reduction Standard. The applicant must demonstrate that one or more of the following criteria have been met to show that the entire 1.0 inch runoff reduction standard cannot be achieved on site.

1. Soils with very low infiltration rates (less than 0.05 in/hour or 0.1 ft/day)
  2. High ground water
  3. Shallow bedrock
  4. Other hardship as approved by the Director of Community Development. A cost based hardship will be reviewed by the City if the cost of providing RRV is greater than three times the cost of providing the WQv.
- d. Redevelopment sites that include removal of an existing stormwater management facility will be required to bring the entire site up to today's standards unless the designer can show that the existing pond volume and release rate (per the approved hydrology study) does not negatively impact downstream development and can be replaced in kind on the site with all additional stormwater management requirements. See Table 1 for Summary of Stormwater Management Requirements

3. Private vendor devices not identified in the Georgia Stormwater Management Manual shall be evaluated by the City Development Services Stormwater Engineer and Senior Stormwater Engineer to determine the stormwater management credit allowed. Generally, a proprietary devices may receive up to 40 percent TSS removal credit, with each subsequent device in a series shall receive 50 percent of the TSS credit allotted to the previous device (i.e. the first device shall receive 40 percent credit, the second device 20 percent credit, and the third device 10 percent credit.) Per UDC Sec. 3.3.3.D all private vendor devices require a long-term stormwater management inspection and maintenance agreement. For higher removal rates, the City Development Services Stormwater Engineer will consider vendor provided removal rates showing testing results for product use in Georgia under similar construction, rainfall, and soils conditions, or approved for use by other states with similar construction, rainfall, and soils conditions.
4. Best management practices with a micropool or other feature that that would collect standing water that would allow mosquitoes to breed in the practice should only be used if there is no other feasible alternative. Any practice approved by the City with a design allowing standing water more than 72 hours shall require mosquito breeding prevention measures such as fountains, plants that attract dragonflies, etc.
5. Runoff Reduction Credit Percentages should follow the latest edition of the Georgia Stormwater Management Manual with the following changes: Bioretention; pervious, porous, and permeable pavers and pavement; and other infiltration methods with an upturned underdrain will be allowed 100% RRv credit for all volume below the upturn discharge. Volume above the discharge will be provided at a rate of 50%. Stormwater planters / tree boxes and vegetated filter strips both receive 75% credit.

**Table 1. Summary of Stormwater Management Requirements**

<b>Redevelopment on 50% of the lot or less</b>		
<b>New impervious</b>	<b>Runoff Reduction</b>	<b>Channel Protection, Overbank Flood Protection, and Extreme Flood Protection (1-100 year)</b>
1-999 sf	No	No
1000-4999 sf	Yes (on new impervious area only)	No
5000 sf or greater	Yes (on new impervious area only)	Yes (on new impervious area only)
1 acre or more of disturbance, regardless of new impervious area	Yes (on disturbed area)	Yes (for disturbed area)
<b>Redevelopment on greater than 50% of the lot</b>		
<b>New impervious</b>	<b>Runoff Reduction</b>	<b>Channel Protection, Overbank Flood Protection, and Extreme Flood Protection (1-100 year)</b>
1-999 sf	No	No
1000-4999 sf	Yes (on disturbed area)	No
5000 sf or greater	Yes (on disturbed area)	Yes (on disturbed area)
1 acre or more of disturbance, regardless of new impervious area	Yes (for entire site)	Yes (for disturbed area)
<b>New Development</b>		
<b>New impervious</b>	<b>Runoff Reduction</b>	<b>Channel Protection, Overbank Flood Protection, and Extreme Flood Protection (1-100 year)</b>
1-999 sf	No	No
1000-4999 sf	Yes	No
5000 sf or greater	Yes	Yes
1 acre or more of disturbance, regardless of impervious area	Yes	Yes
<p><b>Runoff reduction standard.</b> Runoff reduction practices shall be sized and designed to retain the first 1.0 inch of rainfall on the site to the maximum extent practicable. If the entire 1.0 inch of rainfall can be retained onsite using runoff reduction methods, the City may waive the water quality volume. If the entire 1.0 inch runoff reduction standard cannot be achieved, the remaining runoff from the 1.2-inch rainfall event must be treated by BMPs to remove at least 80% of the calculated average annual post-development TSS loading from the site per the Water Quality criteria.</p>		
<p><b>Removal of an existing stormwater management facility.</b> Redevelopment sites that include removal of an existing stormwater management facility will be required to bring the entire site up to today's standards unless the designer can show that the existing pond volume and release rate (per the approved hydrology study) does not negatively impact downstream development and can be replaced in kind on the site with all additional requirements shown above.</p>		
<p><b>Existing conditions hydrologic analysis.</b> The existing conditions hydrologic analysis can take into account the existing development when defining curve numbers and calculating existing run off, unless the existing development causes a negative impact on downstream property.</p>		



**Section 8 – Review of Structural Best Management Practices**

1. This section has been removed. Please reference the latest revision of the Georgia Stormwater Management Manual.

**Section 9 – Detail on Development and Use of Techniques Which Emphasize Use of Natural Systems**

1. This section has been removed. Please reference the latest revision of the Georgia Stormwater Management Manual.

**Section 10 – Development Restrictions Along Stream Corridors**

1. This section has been removed. Please reference the City of Alpharetta UDC 3.3.6.

**Section 11 – Wetlands**

1. This section has been removed. Please reference the City of Alpharetta UDC 3.3.7.

**Section 12 – Minimum Easement Requirements**

1. Drainage easements shall be provided where a subdivision is traversed by a water course, drainage way, natural stream, or channel. It shall conform substantially to the limits of such water course plus any additional width as is necessary to accommodate future maintenance and/or construction as determined by the Department of Public Works.
2. Drainage easements off the street right-of-way shall be clearly identified on the plat and deed of the individual property owner and said property owner will be required to keep easement free of obstructions and will maintain same in such a way as to assure free and maximum flow at all times.
3. All easements shall be cleared of debris, excess dirt, and other materials.
4. The minimum width of any drainage easement is 20' centered on the drainage structure.
5. Ponds and water quality devices will require a minimum 10' access easement around the perimeter to provide access for maintenance equipment. It shall be understood that the entire pond will be included within the easement. This access easement shall extend from the public right-of-way.
6. Drainage ways and easements on residential lots shall be centered on the property lines unless otherwise approved by the City Engineer.

**Section 13 – Criteria for 100-Year Floodplain Analysis**

1. This section has been removed. Please reference City of Alpharetta UDC Section 3.4 Floodplain Management

#### **Section 14 – Methodology / Criteria for Evaluating Downstream Impacts**

1. The Georgia Stormwater Management Manual provides the currently approved methodology required by the City of Alpharetta for downstream analysis.
2. The City of Alpharetta requires analysis of the 1, 2, 5, 10, 25, 50, and 100 year storms.
3. The City of Alpharetta may require additional downstream analysis on individual sites when known downstream flooding problems exist.

#### **Section 15 – Additional Pretreatment for Intensive Land Uses**

1. This section has been removed. Please reference the latest revision of the Georgia Stormwater Management Manual.

#### **Section 16 – Minimum Specifications for Construction of Drainage Facilities**

1. For general grading of residential subdivisions, lots shall be arranged and/or designed such that lots with higher elevations will not drain onto lots with lower elevations with a flow of magnitude that will create erosion, flooding, or be a nuisance. If velocity of overland flow exceeds 1.5 feet per second protective measures shall be incorporated to prevent scouring and erosion.
2. For residential and open areas, detention ponds shall have maximum side slope of three feet horizontal to one foot vertical, with four feet horizontal to one foot vertical or flatter being the preferred, on the inside face of the pond and a maximum slope of three feet horizontal to one foot vertical on the outside face of the pond. For commercial areas slopes on detention ponds shall be approved on a case by case basis.
3. Sizing and location of drainage structures shall be the responsibility of a registered professional engineer as per accepted standard design procedures, subject to approval by the City of Alpharetta.
4. Storm pipe slopes shall be equal to or greater than one percent.
5. Approved formulas shall be used to calculate the runoff in determining the size of drainage structures. Use the 25 year storm frequencies for all street drainage structures such a catch basins, inlet cross drains, etc. Use the 1, 2, 5, 10, 25, 50, and 100 year storm frequencies for all main drainage structures such as retention basins, detention ponds, principal storm sewers, and all types of flood protection works. All designs are subject to the approval of the Department of Community Development.

6. Minimum 20-foot storm drainage easement shall be given on all lines (pipes and swales) which lie outside of the normal right-of-way.
7. The drainage pipe cover shall be 12 inches or one-half the inside pipe diameter, whichever is greater.
8. Catch basins shall be located at low points of the streets.
9. All storm drain inlets and channels must be designed and located so as to prevent flooding of any buildings during the 100-year event.
10. All storm drain pipes shall be minimum 18 inches in diameter.
11. Not less than 50 percent of each proposed lot area shall be above the 100-year storm elevation.
12. Any existing channel flow shall not be constricted.
13. Sub-drainage will be installed to control surplus ground water by intercepting side hill seepage or by lowering or regulating ground water level where such conditions exist.
14. A certification of the pipe specifications for each pipe shall be required before installation.
15. Bridges and culverts shall be designed for the 100-year storm frequencies and 100-year flood.
16. Cross drain pipes:
  - a. Shall have headwalls of approved type on inlet and outlet ends of the pipe.
  - b. When the construction of a proposed public road makes it necessary to cross a storm drain, the developer shall provide and install the required size and length of an acceptable grade of pipe. The length of the pipe required shall extend to the rear building setback lines and in so case shall the extension be less than 30 feet from the rear of any proposed dwelling; provided however the drain runs through building lots proposed to be platted. These criteria will be strictly adhered to unless otherwise approved by the Public Works Department. This does not apply to cross drains containing live streams.
  - c. Maximum continuous length of pipe shall be 300 feet unless otherwise approved by the City Engineer.
  - d. Class of concrete pipe and gage of corrugated metal pipe shall comply with Georgia Department of Transportation specifications.

## 17. Materials and installation:

- a. All concrete pipe shall be reinforced.
- b. All pipe within public right-of-way shall be RCP. And all structures shall be installed with row-lock inverts.
- c. Flat bottom and circular pipe sections shall be laid in a prepared trench with the socket ends pointing upstream. Sections may be joined by rubber type gasket joints, O-ring gasket joints, or pre-formed plastic gasket joints. Rubber type, O-ring, and preformed gasket joints shall be installed in accordance with the manufacturer's recommendations.
- d. Metal pipe is not permitted under roadways. Where used the pipe shall be fully bituminous, aluminized or asphalt coated with paved invert, unless approved otherwise.
- e. HDPE is allowed on private property as long as is it installed in accordance with manufacturer's recommendations.
- f. The Department will consider stormwater pipe made of materials as introduced to the market.

## 18. Workmanship and Finish:

- a. Culvert pipe on which the coating has been bruised or broken either in the shop or in shipping or which shows defective workmanship shall be rejected. Among others, the following defects are specified as constituting poor workmanship and the presence of any or all of them in any culvert pipe shall constitute sufficient cause for rejection.
  - i. uneven laps
  - ii. elliptical shape (unless designed and manufactured as elliptical)
  - iii. variation from a straight center line
  - iv. ragged or diagonal sheared edges
  - v. loose, uneven lines or spaced rivets
  - vi. poorly formed rivet heads
  - vii. unfurnished ends
  - viii. illegible brand
  - ix. lack of rigidity

- x. bruised, slated or broken coating
  - xi. dents or bends in the metal itself
- b. Coupling bands: Field joints shall be made with bands of the same base metal as the culverts. The bands shall not be less than 7 inches wide for diameters of 8 inches to 30 inches, inclusive; not less than 13 inches wide for culverts with diameters 36 inches to 60 inches inclusive; and not less than 24 inches wide for culverts with diameters greater than 60 inches. Such bands shall be constructed so as to lap on an equal portion of each of the culvert sections to be connected at the ends by galvanized angles having minimum dimensions of two inches by two inches by 3/16 inch. The seven inch band shall have at least two galvanized bolts not less than ½ inch diameter. The 12-inch band shall have three and the 24-inch band shall have five ½ inch bolts. Other equally effective methods of connecting the coupling bands may be used if approved by the City Engineer.
- c. Gauge determination. The gauge of the culvert metal will be determined from the thickness of the galvanized sheets. The mean thickness must meet the requirements set forth by the City of Alpharetta Public Works Department.
- d. Corrugated metal pipe and pipe arches. Corrugated metal pipe shall conform to the requirements of AASHTO M36, sizes, shapes, types, base metal, and gauges.
- e. All joints and couplings shall be in accordance with the manufacturer's recommendations.
- f. Pipe sections shall be laid in a prepared trench with outside laps of circumferential joints pointing upstream and with longitudinal joints at the side. Coupling bands fastened by two or more bolts shall join the sections. The space between adjoining sections shall be not more than width of one corrugation.
- g. Before any traffic over a storm drain is allowed, the developer shall provide adequate depth and width of backfill to protect the structure from damage or displacement in accordance with the requirements of the City of Alpharetta Public Works Department. All pipe structures shall be cleaned before the work is accepted. Any damage or displacement that may accrue due to traffic or erosion shall be repaired or corrected at the developer's expense.
- h. Minimum clearances are:

- i. One foot between the bottom of the base or sub base, if used, and the exterior crown of culvert in accordance with the requirements of the City of Alpharetta Public Works Department.
- ii. A minimum of 0.5 foot between underground utilities and exterior crown of the culvert.
- iii. Trench construction for storm drainage pipe shall be in accordance with the requirements of the City of Alpharetta Public Works Department.
- iv. Bridge piling shall be driven to Georgia Department of Transportation load standards for loading. Certification of pile load shall be by a registered professional engineer.

### **Section 17 – Contents of Stormwater Management Plan**

1. This section has been removed. Storm Water Management Plan should include the items described in detail in the City of Alpharetta UDC Section 3.3.3C.

### **Section 18 – Stormwater Management Plan Approval Process**

1. This section has been removed. The approval process is described in detail in the City of Alpharetta UDC Section 3.3.3.

### **Section 19 – Surveying and Mapping**

1. Surveying and mapping are described in detail in the City of Alpharetta UDC.

### **Section 20 – Underground Detention**

1. Underground detention must meet the pre-treatment requirements. Underground detention shall receive the following water quality credit if it has an open-bottom design that allows for infiltration, the site meets minimum infiltration requirements, and any manufacturers' pretreatment requirements are met:

60% TSS  
30% TN  
10% TP

2. If a sand filter is used in the underground detention facility, additional water quality credits may be provided as determined by the Director of Public Works and Community Development.

### **Section 21 – Offsite Mitigation Program**

1. The Offsite Mitigation program allows for the provision of stormwater management offsite, in a regional facility that serves multiple parcels.
2. Applicability
  - a. Available city-wide for new development and redevelopment, contingent upon approval by the City Development Services Engineer in coordination with the City Senior Stormwater Engineer
  - b. Parcels using an offsite / regional facility must drain to that facility.
3. Sizing / Volume Requirements
  - a. When applied to master developments, the regional facility will be sized for the planned build out of the subdivided properties. (Except in residential subdivisions, runoff reduction or water quality measures or portions of detention may be required on individual parcels, lots or subdivided properties to meet overall requirements.) The maximum impervious area for each parcel or max impervious percentage for each parcel shall be provided. If there is not sufficient volume provided for future developments, future buildings must account for additional runoff reduction / water quality or detention on-site or by modifying the master pond.
  - b. The off-site or regional facility must be designed and adequately sized to provide a level of stormwater quantity and quality control that is equal to or greater than that which would be afforded by on-site practices.
4. Operation and Maintenance
  - a. Regional facilities require an operation and maintenance agreement. This may be addressed through property deeds and covenants.
5. Tracking
  - a. The City will maintain a database noting what parcels are associated with a shared facility and their individual volume requirements (proportionate share of the facility).
6. City Owned Regional Stormwater Management
  - a. The City reserves the right to collect the following fees on parcels serviced by an existing City-owned regional facility:
    1. A one-time payment paid by the developer during the planning / permitting process to defray the capital cost of the existing off-site treatment facility. Cost / cubic yard for each facility will be set

when the facility is built and will be publically available from the Public Works Department.

2. Operations and maintenance costs will be funded through an independent recurring O&M fee that will be assessed by the City annually to owners of properties where stormwater management is provided through the off-site mitigation option.

## **Section 22 – Stormwater Fee-In-Lieu Program**

1. The Stormwater Fee-in-Lieu program allows parcels being redeveloped to reduce on-site stormwater management requirements by paying a fee to the City. The fee-in-lieu consists of both a one-time payment paid by the developer during the planning process to defray the capital cost of the off-site treatment facilities and an annual assessed O&M cost. The one-time fee is based on the construction cost of the specific facility where volume credits are available. Operation and maintenance (O&M) costs of these facilities will be funded through an independent recurring O&M fee that will be assessed annually to owners of properties where stormwater management is provided through the fee-in-lieu option.
2. Applicability
  - a. Available for re-development projects contingent upon approval by the Community Development Director, in coordination with the City Development Services Engineer and the City Senior Stormwater Engineer.
  - b. The fee-in-lieu option is not available for parcels where a downstream property is negatively impacted by the current conditions (i.e. currently flooding from the existing runoff) or where the increased runoff rate or volume from the new development will negatively impact a downstream property (i.e. downstream infrastructure does not have capacity for the increased volume).
  - c. Parcels must be located within a HUC-12 watershed in which the City has constructed stormwater improvement projects with available credit volume or where the City has fully funded construction of stormwater improvement projects designed with available credit volume.
  - d. A parcel is eligible for the fee-in-lieu program no more than once every five years.
3. Minimum On-Site Requirement



- a. All of the required detention (including channel protection) must be met onsite. A minimum of 75% of the runoff reduction/water quality treatment must be provided on-site. The remainder of the runoff reduction/water quality treatment may be met by a fee-in-lieu payment.

#### 4. Allowable Projects

- a. Stormwater improvement projects that can be implemented by the City to provide volume credits include those structural stormwater best management practices with quantitative and qualitative measurements identified in the latest edition of the Georgia Stormwater Management Manual.
- b. Projects must be constructed/implemented in the same HUC-12 watershed as the projects served by the runoff reduction.

#### 5. Timing

- a. Collected fees-in-lieu shall apply to the specific project that has been constructed by the City with available volume credits or that is fully funded for construction by the City and designed with available volume credits.
- b. The City should identify and track the available runoff reduction volume and water quality volume provided by the improvement projects.

#### 6. Administration

- a. The Public Works Department will be responsible for administering the program (construct and maintain ponds and BMPs, collect fees, track, and report).
- b. Funds will be put into stormwater accounts to defray construction costs or operation and maintenance costs.

#### 7. Fee Structure and Amount

- a. The fee-in-lieu permit fee shall be based on the specific project construction cost. The operation and maintenance annual fee shall be based on the specific project.

### **Section 23 – City Funded Linear Projects**

- a. **Applicability** - Up to 100% of the stormwater management requirement for eligible transportation projects may be reviewed for feasibility. Only transportation projects funded and managed by the City, or through

grants obtained by the City, are eligible. Ineligible projects include: private development of public or private roads; alleyways; highways; trails; greenways; sidewalks; intersections; roadway improvements; subdivision roads; driveways; and access roads. Common Interest Development (CID) Georgia Department of Transportation (GDOT), and non-city utility projects are also ineligible. Projects eligible for this provision shall demonstrate that it is not feasible to meet the stormwater management requirements on site. Criteria for determining that meeting the requirement is not feasible are similar to the Infeasibility Criteria set forth in the Georgia Department of Transportation Policy on Post-construction Stormwater Management BMP Design on State Routes for structural BMPs:

- The cost of construction and maintenance of the BMP equals or exceeds twenty five percent of the construction cost.
  - The project is delayed by 90 days or greater due to the implementation of post-construction BMPs. Examples of this is when a project could be built without a right of way phase, but the inclusion of post construction BMPs means that a right of way phase is necessary then the delay criteria can be used.
  - The use of BMPs will impact threatened or endangered species habitat.
  - The use of BMPs will significantly damage a community resource such as a historical area, a park, a wildlife refuge, a nature trail, or school facilities.
  - The BMP implementation would result in the violation of a Federal or State law
  - The project has shallow bedrock, contaminated soils, high groundwater, utilities, or underground facilities and avoidance or relocation cost of the utility equals the cost of the BMP.
  - The soil hydraulic conductivity (K) is less than 10<sup>-4</sup> cm/second can be considered infeasible (while 10<sup>-5</sup> cm/second is the absolute lower limit) when considering infiltration BMPs.
  - The BMP implementation will impact a specimen tree.
- b. Funding Requirements** - The money budgeted by council for stormwater water quality projects will be considered the City's fee toward providing stormwater management for linear projects. The volume allocation for transportation projects will be tracked by the City and assigned to specific stormwater improvement projects so there is an

accounting system that identifies the remaining volume available for allocation.

#### **Section 24 - Cisterns**

- a. Cisterns may receive runoff reduction credit up to 90% if all water from storms with rainfall of 1 inch or less is used through demand, and the tank is sized such that no overflow from this size event occurs. The total credit may not exceed 90%. The actual runoff reduction rates for rainwater harvesting systems are “user defined,” based on tank size, configuration, demand drawdown, and use of secondary practices. North Carolina State’s Rainwater Harvesting Model, or other comparable tools may be used to calculate runoff reduction rates.