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501 Design

A. General

The following Standard Specifications and associated Standard Detail Drawings shall apply to all storm drainage system development. Any deviations from this specification, or sections noting approval required by the ENGINEER, shall require submittal of an Exception Review Request for consideration.

Storm drainage facilities shall be designed to convey stormwater generated upon or passing through the project location. The determination of the quantities of water which must be accommodated will be based upon peak flows from storms having the following return periods:

<i>Drainage Structure</i>	<i>Design Storm Event - Return Frequency</i>
Roadside Ditches	10-year
Curb Inlet Gutter Spread	4 inches/hour
Drop Inlet Ponding (sag condition)	100-year
Storm Sewer Collector	10-year
Cross Street Storm Drainage	25-year
Greenways	25-year
Offsite Bypass System	25-year
Structures in Floodplain	100-year *

*Drainage structures in the floodplain, and all culverts under roads located at stream crossings shall pass 100-year storm without over-topping the roadway.

1. Runoff rates shall be calculated by the Rational Method (for drainage areas less than 100 acres), SCS Method or other acceptable procedures. Runoff computations shall be based on rainfall data published by the National Weather Service NOAA Atlas 14 for this area.
2. Time of concentration (t_c) shall be determined using standard acceptable methods and the storm duration shall equal t_c .
3. Pipe shall be sized in accordance with the Manning Equation and applicable nomographs to carry the design flow and to provide a velocity of at least 2.5 feet per second during the 2-year storm event.
4. Culverts shall be sized in accordance with the Energy Equation and applicable nomographs to carry the design flow and to provide a velocity between 2-10 feet per second during the 2-year storm event.

5. Channels and ditches shall be designed to carry the design flow at nonerosive velocities. Calculations indicating design velocities shall be provided along with typical channel cross-sections. The maximum allowable design velocity in grass channels is 4 feet per second.
6. A Hydraulic Grade Line (HGL) study shall be performed for all public storm drainage systems using the design storm table in 501.A. Where the public storm drainage system conveys stormwater into a private SCM, the Q_{10} staging elevation shall be used as the starting point for the study. The study or plans shall include storm pipe profiles that show inverts, slopes, proposed finished grade and HGL. The HGL shall be required to stay within the crown of the pipe to ensure no surcharge on the system. ASTM Standard C443 (O Ring or Single Groove) water tight sealed pipe shall be used in cases where it is not practicable.
7. Stream crossings will necessitate a backwater study on the 100-year storm event. The localized 100-year flood elevation at each crossing is not allowed to stage onto an individual lot.
8. The minimum allowable slope is 0.50%.
9. The following criteria for headwater shall be used (based on the design storm):
 - a. Minimum 12-inch freeboard for culverts up to 36"
 - b. Minimum 18-inch freeboard for culverts greater than 36"
 - c. Elevations established will delineate localized floodplain
 - d. $HW/D \leq 1.2$

Prediction of the peak flow rates shall be calculated using the procedure in the USDA Soil Conservation Service Method, the Rational Method, or other acceptable calculation procedures as determined by the TOWN. The size of stormwater conduits shall be determined by utilizing the standard energy equation for inlet control or outlet control and headwater nomographs as published by various federal agencies – US FHWA - H.E.C. #5, Soil Conservation Service, etc. The minimum pipe size to be used shall be 15-inch diameter.

Discharge from the stormwater drainage systems shall not be of such a velocity as to cause damage after leaving the pipe. Calculations shall be submitted with plan review.

B. Location

Accessible drainage structures shall be installed at each deflection of line, grade, and change in pipe material. Acute angle junctions (angles less than 90 degrees) between pipe runs should be avoided. No inaccessible drainage structures shall be permitted. Open-throated yard inlets shall have a manhole lid incorporated into the concrete lid for accessibility. The maximum distance between structures shall not exceed 400 feet. Stormwater shall not be allowed to flow across the roadway. Any deviation shall require pre-approval by the ENGINEER. Catch basins shall be provided to intercept the flow prior to the radius of an intersection, or the design of the roadway shall indicate a continuous grade around the radius to allow the flow to continue down the intersecting street. Inlet spacing shall be sufficient to limit gutter spread to no more than half the width of a through lane during a 4-inch per hour rain event. The width of the gutter may be added to the width of the lane. For curb inlets located in a sag condition, a 50% clogging factor shall

be applied when calculating spread. No catch basin shall be installed in an intersection corner radius or in a driveway apron. Proposed driveway locations shall be shown on construction drawings to demonstrate they do not conflict with catch basin locations.

Stormwater that is piped, or is conveyed as open channel flow, and originates within or passes through the public street right-of-way shall be conveyed through a contiguous public drainage easement. The public drainage easement shall extend from the public street right-of-way the minimum distance needed directly from public street right-of-way to a point of open discharge adjacent to the public street right-of-way. Stormwater conveyance systems that originate within or pass through the public street right-of-way shall be designed to minimize distance crossing through private property to the discharge point. At the discretion of the TOWN, if the point of open discharge extends into private property greater than that minimal distance needed to daylight, a drainage structure shall be provided within 10 feet of the public street right-of-way to transition the public drainage easement to a private drainage easement. Pipes shall not outfall in the front yard of a lot but should instead extend to the rear third of the lot or property line in residential subdivisions.

In natural drainage ways, a storm drain main shall be extended to the property lines to readily enable future connection to adjoining upstream property. Storm design shall account for future upstream development based on the current land use plan and shall include an evaluation of the existing downstream storm capacity. To the maximum extent practicable, the storm drainage system in these natural drainage ways shall be designed to bypass the off-site flow around the on-site SCMs, and to where the natural drainage way currently discharges.

Private storm drainage systems will be permitted, provided that: (1) such systems collect and discharge impounded stormwater wholly within the same lot; or (2) such systems collect water from one single lot and discharge into the public storm drainage system; or (3) such systems are properly engineered and approved on the signed set of construction drawings. Private storm drainage systems that connect to the public storm drainage system shall have the connecting leg of such a system, which crosses into the public street right-of-way or easement, constructed in accordance with TOWN specifications, including but not limited to: the necessary easements, piping, inlets and junction boxes. Connection of plastic pipe, such as HDPE or PVC, to TOWN infrastructure is prohibited. Piped private storm drainage systems may not cross property lines, convey stormwater from one lot to another unless criterion #3 is met, or point discharge adjacent to curb. Private storm drainage systems, whether piped or open channel flow, that cross more than two lots shall be located within a private drainage easement. Where permitted by topography and site conditions, storm drainage systems that serve a single non-residential lot (i.e., parking lots, private streets, vehicular use areas), shall be privately maintained.

C. Easements

All storm sewers shall be installed in dedicated street right-of-way or easements.

Minimum width of permanent storm drainage easements for public storm drain pipe shall be 20 feet. Where storm drain pipes are installed at a depth in excess of 10 feet or for pipes greater than or equal to 36-inch diameter, the easement widths shall be increased in accordance with the following table:

<i>Pipe Diameter (in)</i>	<i>Pipe Depth (D, ft)</i>	<i>Easement Width (ft)</i>
36 -- 48	10 < D ≤ 15	30
54 -- 72	15 < D ≤ 20	40
> 72	> 20	To be determined by the TOWN

No encroachments are allowed within any public easement, unless approved in accordance with Section 200. The Town of Apex is not liable for any damage to personal property located on public easements that may occur resulting from enactment of official duties.

Where multiple pipes are installed, the edges of the easement shall be a minimum of 10 feet from the centerline of the outside pipe with 3 feet clearance between the exterior of the parallel storm sewer pipes.

D. Depth of Cover

Cover heights shall be as follows:

- Reinforced Concrete Pipe (RCP)
- Polypropylene Pipe (PP)
- Corrugated Steel Pipe - Type 2 (CSP)
- Corrugated Aluminum Alloy Pipe (CAAP)

<i>CLASS</i>	<i>RCP</i>	
	<i>MIN (ft)</i>	<i>MAX (ft)</i>
III	2	20
IV	1	30

Pipe Diameter (in)	PP		CSP		CAAP	
	MIN (in)	MAX (ft)	MIN (in)	MAX (ft)	MIN (in)	MAX (ft)
15	12	28	12	158	12	98
18	12	28	12	131	12	81
21	--	--	12	113	12	69
24	12	26	12	98	12	60
30	12	26	12	79	12	57
36	12	20	12	65	12	47
42	12	20	12	55	12	40
48	12	20	12	48	12	35
54	--	--	12	56	15	31
60	24	20	12	50	15	28

502 Materials – Storm Drainage Pipe

A. General

All storm sewer pipes to be installed in projects within the jurisdictional limits of the TOWN shall conform to the specifications presented herein. In special cases where material other than those listed below is requested, the applicant's plan submittal must contain a formal request to use other material and complete background data to justify its use. Pipe producer/supplier shall be on the NCDOT approved producer/supplier list.

B. Reinforced Concrete Pipe (RCP)

RCP shall be as per ASTM C76 (or the latest revision), Class III or Class IV with a minimum 15-inch diameter. All joints shall include rubber gaskets conforming to ASTM C 1628. All RCP installed on thoroughfare routes shall be approved and marked by the NCDOT Materials and Tests Unit at the manufacturer's facility prior to delivery.

Inspection, evaluation, and acceptance of RCP materials shall be guided by AASHTO R73.

Any of the following criteria will be grounds for rejection of RCP material:

- 1) Any fracture or crack that visibly passes through the wall of pipe;
- 2) Any fracture or crack that is 0.01-inch wide or greater at the surface and 12 inches or longer regardless of position in the wall of the pipe;
- 3) Offsets in form seam that would prevent adequate concrete cover over reinforcing steel;
- 4) Delamination in the body of the pipe when viewed from the ends;
- 5) Evidence of inadequate concrete cover for reinforcing steel;
- 6) Any severe surface condition that affects the majority of the pipe section surface and could reduce the durability and service life of the pipe;

- 7) Damaged or cracked ends where such damage would prevent making a satisfactory joint.

C. Polypropylene Pipe (PP)

The pipe and fittings shall be an annular corrugated wall and a smooth interior wall (double-wall) or pipe and fittings with an annular corrugated wall and a smooth interior and exterior wall (triple-wall), conforming to the requirements of ASTM F2764 and AASHTO Specifications M330 (latest edition) for Polypropylene Pipe.

Bell and spigot joints are required on all pipes. Bells shall cover at least two full corrugations on each section of pipe. The spigot shall be double-gasketed. The bell and spigot joint shall have "O"-ring rubber gaskets meeting ASTM F477 with the gaskets factory installed and placed on the spigot end of the pipe. Pipe joints shall meet all requirements of AASHTO M330. Transitions from PP to RCP shall be made with the appropriate adapter. Refer to Section 505 A.

D. Corrugated Steel Pipe - Type 2 (CSP)

Aluminized Steel Type 2 pipe shall be 14 gauge minimum for 15-inch and 18-inch diameters, 12 gauge for all other sizes. Coils shall conform to the applicable requirements of ASTM A929. CSP shall be manufactured in accordance with the applicable requirements of ASTM A760. All fabrication of the product shall occur within the United States. Coupling bands shall be made of the same base metal and coatings as the CSP to a minimum of 18 gauge.

E. Corrugated Aluminum Alloy Pipe (CAAP)

Aluminum pipe shall be 14 gauge minimum. Coils shall conform to the applicable requirements of ASTM B744. CAAP shall be manufactured in accordance with the applicable requirements of ASTM B745. All fabrication of the product shall occur within the United States. Coupling bands shall be made of the same base metal and coatings as the CAAP to a minimum of 18 gauge.

F. Reinforced Concrete Box Culvert (RCBC)

RCBC shall conform to ASTM C1433, C1504, or C1786. Joints shall be sealed in conformance with ASTM C990 (preformed flexible sealant) and/or C877 (external sealing bands), based on manufacturer's recommendations for the specific application.

Inspection, evaluation, and acceptance of RCBC materials shall be in accordance with AASHTO R73.

503 Materials - Storm Drainage Structures

A. General

All structures (manholes, curb inlets, catch basins, junction boxes, etc.) shall be constructed of concrete brick masonry units, cast-in-place reinforced concrete, or pre-cast concrete. Structures shall be repaired and re-built with solid concrete brick and mortar. Materials such as broken concrete pipe, clay brick, and rock are prohibited. Structure walls shall be repaired to original manufacturer conditions. Waffle boxes are not permitted. All pre-cast boxes shall be solid boxes.

Curb inlets in streets with curb and gutter shall be NCDOT type standard frame, grate, and hood.

B. Concrete Brick Masonry Units

Concrete brick masonry units shall be solid units meeting the requirements of ASTM C55, Grade S-II. Clay brick shall not be permitted for any drainage structure.

C. Precast Concrete Manholes

Pre-cast concrete manholes shall meet the requirements of ASTM C478. Manholes shall have joints sealed with a pre-formed rope-type gasket per ASTM C990. Manhole base diameters shall conform to the following for the various storm sewer pipe sizes:

<i>Pipe Diameter (in)</i>	<i>Manhole Base Diameter (ft)</i>
15 - 36	5
42 - 48	6
54	8

For pipes greater than 54 inches, manhole base sections shall be sized as required and shall be approved by the ENGINEER. All precast manholes installed on thoroughfare routes shall be approved and marked by the NCDOT Materials and Tests Unit at the manufacturer's facility prior to delivery.

Transition reducing slabs may be used to enable the use of 4-foot diameter eccentric cones at the top. All pre-cast manholes for storm sewers in traffic areas shall be of the eccentric type for ease of access. Manholes in non-traffic areas shall be flat-top type.

D. Mortar

Mortar shall be proportioned as shown below for either Mix No. 1 or Mix No. 2. All proportions are by volume. Water shall be added only in the amount required to make a workable mixture.

MIX NO. 1	1 part Portland Cement 1/4 part Hydrated Lime 3 3/4 parts Mortar Sand (maximum)
MIX NO. 2	1 part Portland Cement 1 part Masonry Cement 6 parts Mortar Sand (maximum)

Portland cement shall be ASTM C-150, Type 1. Hydrated lime shall conform to ASTM C207, Type S. Masonry cement shall meet the requirements of ASTM C91. Mortar sand shall be standard size 4S, per requirements of the NCDOT.

E. Castings

- 1) General – All castings shall meet the requirements of ASTM A48, Grade 35B iron and shall be manufactured in the USA. Country of origin shall be embossed on each casting.

At a minimum, manufacturers shall submit the following to substantiate to the ENGINEER that castings meet the minimum criteria:

- a. Bar tensile test reports from an independent testing laboratory. The results must confirm that the material meets ASTM A48 Class 35B.
 - b. Casting proof load test report on the subject casting. Proof load tests shall be conducted in accordance with AASHTO M306, Section 7.0. During proof load testing, castings shall maintain a 40,000 lbs. proof load for one minute without experiencing any cracking or detrimental deflection.
 - c. A written statement of certification by a qualified licensed engineer, employed by the producing foundry, that castings meet these specifications.
- 2) Curb Inlet - Grates, frames, and hoods shall be in accordance with NCDOT Standard 840.02 and 840.03. Curb inlet hoods shall be embossed with “Dump No Waste! Drains to Waterways”.
 - 3) Grates & Frames - Cast iron grates and frames for yard inlets shall be of the size indicated on the approved plans. Grates and frames shall be in compliance with NCDOT Standards.
 - 4) Manhole Rings & Cover - Cast iron manhole rings and covers shall be in compliance with the Standard Detail with the words “STORM SEWER” cast on the cover. Covers shall have two 1-inch holes. Manhole castings shall be machined to provide a continuous bearing around the full periphery of the frame.

F. Portland Cement Concrete

Portland cement concrete used for storm drainage structures, end walls, etc. shall conform to the technical requirements presented in Section 200 of these Specifications, and shall have a minimum compressive strength of 3,000 psi at 28 days. Primary structures, such as box culverts, may require concrete having a compressive strength greater than 3,000 psi, and may require the submission of mix designs and testing of the concrete by an independent laboratory. These special requirements may be imposed by the ENGINEER for all such structures where deemed necessary.

G. Reinforcing Steel

Reinforcing steel shall be new billet steel conforming to ASTM A615 for grade 60. Reinforcing steel shall be deformed per current ASTM standards.

H. Connections

All storm drain connections shall be made with non-shrink grout.

504 Miscellaneous Materials

A. Rip Rap

Riprap shall be large aggregate of the size and class shown on the approved drawings. Stormwater calculations shall be submitted with the construction plan review application.

505 Inlets and Outlets

A. Headwalls, Endwalls, and Flared End Sections

Headwalls, endwalls, and flared end sections shall be constructed of structural cast-in-place concrete or pre-cast concrete in accordance with NCDOT Roadway Standard Drawings and shall be installed at all discharge points and inlets where there is not a structure. Details and design of headwalls, endwalls, and flared end sections shall be in accordance with NCDOT requirements. Details shall be shown on all plan submissions.

Flared end sections shall be installed on single pipe culverts up to and including 36 inches in diameter, and on multiple pipe culverts less than 30 inches in diameter. Flared end sections shall also be installed at the outlet point of all storm drainage systems. Dissimilar pipe couplers shall be used to connect PP, CSP, or CAAP pipe to end sections.

Headwall and endwall shall be installed on single pipe culverts greater than 36 inches in diameter, and on multiple pipe culverts greater than and including 30 inches in diameter.

The slope from pipe invert to top of berm shall not exceed 2:1. Any deviation from NCDOT standard drawings requires pre-approval of the Transportation & Infrastructure Development Director.

B. Dissipaters and Scour Protection

Energy dissipaters shall be installed at all discharge points and shall be properly sized to ensure that stormwater is released at a non-erosive velocity.

Scour protection shall be provided for all drainage ways where, in the opinion of the ENGINEER, erosive velocities or other factors require the use of protective measures. All protective measures shall be shown on all plan submissions.

Additional information on the impact of stormwater discharge onto adjacent properties may be required by the ENGINEER.

506 Stormwater Control Measures (SCMs)

Stormwater Control Measures (SCMs) shall be designed and constructed per the guidelines and minimum design criteria (MDC) presented in the State of North Carolina Department of Environmental Quality (NCDEQ) Stormwater Design Manual, latest revisions. These structures shall be designed to meet all stormwater requirements presented in Section 6.1 of the TOWN Unified Development Ordinance (UDO).

In addition to the guidelines and MDC presented in the NCDEQ Stormwater Design Manual, the following specifications shall be used for all SCMs:

1. The invert elevation for the inlet to the SCM shall be set no lower than the normal/permanent pool elevation controlled by the water quality orifice(s). Refer to Section 501.B.6 of this document for inlet pipe network HGL requirements.
2. The outlet structure shall be constructed of precast reinforced concrete and the outlet pipe shall be either reinforced concrete pipe (RCP) or polypropylene pipe (PP).
3. All vegetated side slopes (interior & exterior) and tops of dams shall be sodded with non-clumping turf grass.
4. All SCM side slopes stabilized with vegetated cover shall be no steeper than 3:1 (horizontal to vertical).
5. When the proposed impervious area is unknown for residential subdivision projects, a 70% impervious assumption per lot should be made when sizing proposed SCMs.

Prior to the approval of a final plat (with respect to a subdivision), issuance of a certificate of occupancy (with respect to a site plan), or commencement of a use for any development upon which an SCM is required, the applicant shall certify that the completed project is in accordance with the approved stormwater management plans and designs, and shall submit actual "as-built" plans and corresponding as-built supplements for all SCMs.

The "as-built" plans shall show the final design specifications for all SCMs and practices and the field location, size, elevations, and planted vegetation of all measures, controls, and devices, as installed. The designer of the SCMs shall certify, under seal, that the as-built SCMs, controls, and devices are in compliance with the approved plans and designs

as required by the TOWN UDO. Dam compaction geotechnical reports, and photographic evidence of the outlet pipe cradle and anti-seep device installation shall be included with the SCM as-builts. See Section 106 of this document for additional “as-built” submittal requirements.

A final inspection and approval by the TOWN Stormwater Engineering Manager or his/her designee must occur before the release of any performance and/or maintenance securities.

507 Construction Methods

A. Trenching & Bedding for Storm Sewers

The trench shall be constructed per the Standard Detail. Where the foundation is found to be of poor supporting value, the pipe foundation shall be conditioned by undercutting the unacceptable material to the required depth as directed by the INSPECTOR, and backfilling with stone or other approved material. Where necessary, surface water shall be temporarily diverted in order to maintain the pipe foundation in a dry condition. The flow of water from such temporary diversions shall be directed into suitable erosion control devices.

B. Pipe Laying

Concrete pipe culverts shall be laid carefully with bells or grooves upgrade and ends fully and closely jointed.

C. Backfilling

The trench shall be backfilled per the Standard Detail. The backfill materials shall be moistened when necessary in the opinion of the INSPECTOR to obtain maximum compaction. Water setting or puddling shall not be permitted. When backfilling around corrugated pipe, the maximum stone diameter of the fill shall be less than the width of the pipe corrugations.

All trash, forms, debris, etc., shall be cleared from the backfill material before backfilling. Backfilling around structures shall be done symmetrically and thoroughly compacted in 6-inch layers with mechanical tampers to the specified 95% density (Standard Proctor).

D. Masonry Structures

Excavations shall be made to the required depth, and the foundation, on which the brick masonry is to be laid, shall be approved by the TOWN. The brick shall be laid so that they will be thoroughly bonded into the mortar by means of the “shove-joint” method. Buttered or plastered joints will not be permitted. The headers and stretchers shall be so arranged as to thoroughly bond the mass. Brickwork shall be of alternate headers and stretchers with consecutive courses breaking joint. All mortar joints shall be at least 3/8 inches in thickness. The joints shall be completely filled with mortar. No spalls or bats shall be used

except for shaping around irregular openings or when unavoidable to finish out a course. All details of construction shall be in accordance with approved practice and to the satisfaction of the ENGINEER.

Steps as shown on the plans shall be placed in all catch basins and inlets when they are greater than five feet in depth. The steps shall be set in the masonry as the work is built up, thoroughly bonded, and accurately spaced and aligned.

Inverts in the structures shall be shaped to form a smooth and regular surface free from sharp or jagged edges. They shall be sloped adequately to prevent sedimentation. The castings shall be set in full mortar beds. All castings when set shall conform to the finish grade shown on the drawings. Any castings not conforming shall be adjusted to the correct grade.

Two (2) 2-inch diameter weep holes shall be installed above the upstream pipe invert in all storm drain structures. Protect weep holes with screen wire or fabric outside the structure to prevent clogging.

E. Concrete Construction

The forming, placing, finishing, and curing of Portland cement concrete shall be performed in strict accordance with all applicable requirements as contained in the Standard Specifications for Road & Structures latest edition, as published by the NCDOT and pertinent ACI (American Concrete Institute) codes and guidelines.

F. Installation of Precast Concrete Structures

Pre-cast concrete manholes, junction boxes, etc. shall be installed level and upon a firm, dry foundation, approved by the INSPECTOR. Structures shall be backfilled with suitable materials, symmetrically placed and thoroughly compacted so as to prevent displacement. Castings shall be set in full mortar beds to the required finished grade. Refer to the Standard Detail.

Two (2) 2-inch diameter weep holes shall be installed above the upstream pipe invert in all storm drain structures. Protect weep holes with screen wire or fabric outside the structure to prevent clogging.

508 Inspection Prior to Acceptance

Prior to acceptance of any development with public storm drainage infrastructure, the utility contractor shall arrange a camera inspection of all public storm drainage lines with a 3rd party camera service and then coordinate the results with the Infrastructure Inspector or Manager within the *Water Resources Department*. Any discrepancies found in violation of these Specifications shall be repaired to the satisfaction of the INSPECTOR prior to acceptance and prior to issuance of any Certificates of Occupancy. When inspection indicates possible excessive deflection in PP, CSP, or CAP, the contractor shall complete a deflection test using a laser profiler device, or by mandrel using a rigid device approved

by the INSPECTOR. The mandrel size shall be clearly labeled and shall be sized so as to provide a diameter of at least 95% of the inside pipe diameter. If deflection exceeds 5%, the pipe shall be evaluated to determine what corrective measures are required. Cracks and gaps shall be measured during video inspections using a laser micrometer, or similar with prior approval by the INSPECTOR.

Video Assessment and Cleaning

- a) As a final measure required for acceptance the Contractor shall clean and televise all newly installed public storm drain lines installed from the upstream to downstream manhole with no reverse setups or cutaways. Throughout shooting, the camera shall be panned and tilted for a complete view of the line. Lighting shall be adequate to view the entire storm drain line from beginning to end. The video inspection shall be submitted to the Town on a CD/DVD and formatted with software compatible and readable by the Town. The Town shall not be responsible for purchasing additional software necessary to view the CD/DVD.
- b) The camera shall be advanced at a uniform rate not to exceed 20 feet per minute that allows a full and thorough inspection of the new storm drain line. The camera shall be a color, pan and tilt camera capable of producing a five hundred line resolution picture. Lighting for the camera shall be sufficient to yield a clear picture of the entire periphery of the pipe. The picture quality shall be acceptable and sufficient to allow a complete inspection with no lapses in coverage. The length of the storm drain line shall be measured and recorded on the video screen. The distance counter shall be calibrated before shooting the inspection video.
- c) The Contractor shall clean the storm drain lines ahead of video inspection with a high-velocity water jet. The video inspection shall take place within 2-hours of cleaning operations as witnessed by the Town. All construction debris shall be collected in the downstream manhole and shall not be released into the storm drain system.
- d) The TOWN shall be present throughout the cleaning and televising of the storm drain lines to verify that the video work complies with the Specifications. The camera operator shall stop, reverse, pan, and tilt the camera to view any area of interest during the inspection as directed from the Town.
- e) It is recommended that site grading and all utilities be installed and complete prior to final inspection to ensure that damages to the storm drain lines do not occur. Damages found after final inspection would require re-inspection by the Town.

- f) Prior to submitting the CD/DVD to the TOWN, the Contractor shall label the CD/DVD with the following information:
- Name of the Project/Development.
 - Name and contact information of responsible party.
 - Date of televising.
 - Manhole identification as shown on the design plans.

509 Maintenance of Municipal Separate Storm Sewer System (MS4)

The TOWN shall maintain all piping and structures within TOWN street right-of-way and Town of Apex Public Drainage Easements. The easements must be labeled as the following: “Town of Apex Public Drainage Easement”. Easements labeled as “Drainage Easement” or “Private” shall be maintained by the responsible party or property owner where such system is located.

TOWN maintenance will stop just beyond one half the distance of the total recorded easement width which is measured from the end of the pipe or the center of a flared end section. TOWN maintenance responsibilities are summarized in the following table.

<i>Easement Width (ft)</i>	<i>Maintenance Distance (ft)</i>
20	10
30	15
40	20

When an approved private drainage system is designed and installed onto private property and connects to the TOWN street right-of-way, a TOWN approved stormwater structure will be required and placed no further than 10 feet from the recorded or proposed street right-of-way. A TOWN approved easement will be placed around the stormwater structure that meets the current TOWN specifications. The TOWN shall stop all maintenance activities at this point. A private easement boundary shall be shown beyond this point and recorded to describe and allow ownership inspection and maintenance activities. The TOWN shall not be responsible for any infrastructure, grassed swales, or other stormwater conveyances located within private easements.