ADDENDUM NO. 1

20 June 2024

LEWEY DRIVE UTILITIES AND STREET IMPROVEMENT PROJECT
Project No. WT1178/ST3210

The following items shall be taken into consideration when preparing bids for this project and this addendum shall become a part of and take precedence over anything contrarily shown or described in the Contract Documents.

If there are any further questions regarding the bid opening or the plans, specifications and Contract Documents, please contact Brian J. Drake at (919) 462-3836. Contractor questions received prior to the deadline for questions are answered below.

Item 1: The Pre-Bid Meeting Minutes (dated June 18 2024) are attached and made part of the contract documents.

Item 2: Revised Plan Sheets PP-1:PP-7 to replace spool pieces with sleeves, clarify combination bends, revise labels for consistency in units,

Item 3: Question from bidder: What is the procedure to close Castlebury Creek Ct while the sewer is installed in that area?

Answer: The design anticipates a 10'x10' manhole box which would allow access to remain to Castlebury Creek Ct during construction. Access to Castlebury Creek Ct. shall remain during construction.

Item 4: Question from bidder: What is the required wall thickness of the 48" casing under 55?

Answer: Please refer to Standard Specification Section 6000, attached for reference, for casing thickness.

Item 5: Question from bidder: Will any traffic control plan changes have to be PE stamped?

Answer: Deviations from the approved traffic control plan will require Town approval prior to construction, may require a PE stamp, and/or DOT approval.

Item 6: Question from bidder: What are the time restrictions for blocking/closing the driveway near the bore pit?

Answer: Contractors shall coordinate with property owners a minimum of 48 hours ahead of any scheduled driveway closures to ensure adequate access to property during the project.

Item 7: The approved products list for water and sewer are attached and made part of the contract documents

Item 8: The record drawing checklist is attached and made part of the contract documents.

Item 9: Vendor question: Cary spec for DI Fitting gaskets state you prefer EPDM over SBR. For this project, will you please advise if EPDM is required over SBR?

Ref: Section: 06000 TOC spec B.3 sheet 6000-9

Answer: Cary only requires SBR gaskets for DI Fittings.

6-20-24

Brian J. Drake, P.E.
Senior Project Manager

6/20/24
Date of Issuance

Seal

6.18.24 Minutes
PRE-BID MEETING MINUTES
ST3210/WT1178 – LEWEY DRIVE UTILITY AND STREET IMPROVEMENTS
TOWN HALL 316 N. Academy Street
Conference Room 21275
June 14, 2024 – 10:30 AM

SIGN-IN SHEET

I. Introductions

- Brian Drake PE, Sr. Utilities Project Manager WT1178
- Amir Nezarati, PE Sr. Transportation Project Manager ST3201 (not in attendance)
- See sign-in sheet for additional attendees.

II. Pre-Bid Meeting

All discussions at the meeting are non-binding to the contract. The only changes that will occur will be issued via Addendum to all plan holders.No addenda have been issued to date.

III. Project Overview

This bid package combines a Cary Utility Project, Cary Sidewalk Project and Cary Street Improvements project.

IV. Project Description

This project consists of the construction of approximately 4,200-linear feet of 24-inch ductile iron water main, , approximately 1,900 linear feet of 12-inch ductile iron water main, approximately 125-linear feet of 30-inch ductile iron water main, approximately 95-linear feet 48-inch steel encasement, bored and jacked, approximately 700-linear feet of 8-inch PVC gravity sewer main, approximately 658-linear feet of new concrete sidewalk in addition to replacement of sections of existing sidewalk and curb ramps, street milling and resurfacing, concrete flatwork, pavement markings, traffic control, intersection improvements and associated traffic signal upgrades, as described in the Contract Documents.

V. Bid Opening

Bids are due no later than 2:00 PM on Tuesday, June 25, 2024. Please drop off sealed bids at the reception desk in the main lobby of Town Hall. All SEALED bids will be date & time stamped by the receptionist. If you are attending the bid opening, please check-in on the sign-in tablet at the reception desk. Bid opening is occurring in Town Hall (2nd floor, Room 21275). Please note nearby train schedules for the downtown train station as they can occasionally affect transit to Town Hall.

VI. Addenda

Addendum #1 will contain:

- Updated plans to replace spool pieces with sleeves, clarify DI bends near NC55
- Pre-bid meeting minutes including questions received with answers provided
- Will be posted on the Contractor's Plan Rooms as well as NC eVP
- All questions must be submitted by June 18th at 4:00 PM.

VII. Safety

Cary's number one priority for all construction projects is safety.

VIII. Bid Structure

The project is a Unit Price Bid based on the items and quantities listed in the Bid Form. No bid alternates are included in the bid. The Bid is considered a formal bid. The Bid Form and items as detailed in the Instructions to Bidders must be submitted with the bid. The Bids will be opened and publicly read aloud on bid day at the location and time indicated above.

IX. Examination of Contract Documents and Site

Bidder shall provide written notice to Engineer of all discovered conflicts, errors, or discrepancies in the Contract Documents.

X. Construction Contract Periods and Schedules

The Work shall be Finally and Fully Complete with 540 consecutive calendar days from date of Notice to Proceed. Cary intends to issue a NTP as soon as possible, with Bid Award Recommendation to Council anticipated for July 25, 2024.

XI. Liquidated Damages

$1,000/day

XII. Package Requirements

THE FOLLOWING FORMS ARE INCLUDED IN SECTION 00300 – BID PROPOSAL AND SHALL BE COMPLETELY FILLED OUT AND SUBMITTED WITH THE BIDS. Failure to submit all of the forms below with the Proposal may be just cause for rejection of the Proposal by the Owner.

1. Bid Bond (using forms provided on pages 00300-3 and 00300-10) or other allowable bid security;
2. Photocopy of Bidder's North Carolina Contractors License;
3. Enter Contractor's License Number where called for in proposal and on the outside of sealed envelope containing the proposal;
4. Statement of Compliance with requirement of the Supplementary Conditions that the Bidder will ensure that at least half of the Work is performed with the Bidder's employees (provide statement on bidder's letterhead);
5. Certified List of Major Subcontractors;
6. Certified List of Equipment/Material Manufacturers (including anticipated lead time);
7. Bidder's Certificate as to Organization and Authority;
8. Equal Employment Opportunity Addendum;
9. Qualifications of Bidders including Questionnaire;
10. Non-Collusive Affidavit;
11. Nondiscrimination Clause.

XIII. Geotechnical/SUE Data

No geotechnical investigations were performed as part of the project. SUE investigations were performed as a part of this design and the results of these investigations are included as an appendix in the specifications. The information is in no way part of the contract and is for the contractor's convenience only. The contractor shall perform any additional geotechnical/SUE investigation they deem necessary in developing their bid.

XIV. Permits and Encroachments

The following permits and encroachments have been obtained for the project and are included in Section 22000 – Appendix in the Project Manual.

1. NCDEQ Erosion Control Plan Approval
2. NCDOT Encroachments for Water Line
    a. These approvals include plans for Traffic Management and Temporary Signal Modifications.
3. Town of Cary Water System Extension Permit
4. Town of Cary Gravity Sewer, Pump Station and Forcemain Permit

Bidders shall review all provisions of the encroachment agreements and take note of compaction and testing requirements, along with work hour restrictions, etc. All encroachment and permit conditions are a part of the contract.

XV. Right of Way, Easements, Etc.

Permanent rights-of-way, Temporary Construction Easements and NCDOT Encroachment Permits have been acquired. Copies of the permits and recorded easements will be provided to the Contractor and will be required to be kept on the site.

- **Easements**
    - **Temporary Construction Easement (Herndon) DB019518 PG 287**
    - **Permanent Utility Easement (Brookstone Community Association, Inc.) DB019546 PG 2420**
    - **Sidewalk, Streetlights and Stormwater Improvement Easement (Brookstone Community Association, Inc.) DB019546 PG 02416**
    - **Permanent Utility Easement (Herndon) DB017781 PG 01480**
    - **Permanent Utility Easement (Lewey) DB017781 PG 01485**
    - **Permanent Utility Easement (Brookstone Community Association, Inc.) DB017684 PG 01039**
    - **Grant of Right of Entry, Herndon Property, 2240 NC55 HWY**

XVI. Project Specifics

- Cary anticipates construction beginning approximately January 2025.
- The successful bidder shall anticipate some coordination with existing utility companies (AT&T, Spectrum/Charter, Google Fiber, and Duke Energy) and the Cary Traffic Signal Department for

relocation of existing underground cables, light poles, boxes/handholes, and transformers ahead of the sidewalk construction.

- Construction surveying and staking is the responsibility of the Contractor and shall be paid for at the lump sum price in the Bid Form.
- Town of Cary will be providing Construction Administration and Observation services through a consultant.
- The new waterline is required to remain isolated from the distribution system until it has been flushed, disinfected, and has passed all required water quality tests. Existing or new water valves, remaining in the closed position are an acceptable means of isolation.
- Keeping a clean and neat project site will be especially important throughout the area. All sidewalks, pavers, grass, etc. will need to be returned to match pre-existing conditions.
- We are not planning on conducting a site visit as the project is along existing rights-of-way. If there are any specific questions or concerns, please contact Brian Drake.
- Traffic Control - There are traffic control plans and signal plans for the work proposed. The Contractor is expected to propose overall traffic control for each work area and any differing road closures/detours will be evaluated by Cary, provided requests for road closure are submitted at least 14-days prior to the requested closure. These measures should be tailored to the successful Contractor's operation and schedule and coordinated with the surrounding area. Verifications from planned traffic control plans may not be approved.

  Traffic Control Details are included in the Project Drawings for general guidance, but the Contractor is responsible for implementing all traffic control for vehicle and pedestrian traffic in accordance with the current NCDOT specifications and Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD).
- Public Coordination - The Contractor shall have an employee designated for communicating with residents/businesses in the project area. Cary requires the Contractor refer all inquiries about the Town to the Project Manager. Refer to the "Working with the Town of Cary" Guide for Contractors. Notices shall be submitted to Cary for approval prior to use and provided before work begins in each work area in accordance with the Contract Documents. Early contact with each property owner would be advised.
  - Noise minimization, especially near residences, will be of the utmost importance. Work hours are between 7 AM and 6 PM, Monday through Friday unless otherwise stipulated or approved.
  - Access for residents and the general public shall be maintained at all times.
- As-Builts and Record Drawings - Contractor shall note as-built timeline requirements listed in the contract documents. It is the Contractor's responsibility to prepare accurate record drawing information per the requirements of the specifications (red-lined drawings). As part of this project final record drawing and closeout (as on all Cary Utility projects) as-built surveys, signed and sealed by a registered NC PLS are required along with the final record drawings. Record Drawings shall be prepared in accordance with the Record Drawings Checklist published on Cary's website.
- Project Specifications and Details - The Project Manual distributed with the Bid Documents contains project-specific requirements and general contract requirements as well as standard details for the project. These specifications and details are specific to the project and approved by the Town for the project, therefore the Contractor shall use these and not other versions that may be posted on Cary's website or otherwise published.

- Approved products list – Cary Utilities Department maintains an approved manufacturer list on the Town's website. All material shall meet the requirements of this approved products list. Note that for the water mains and fittings larger than 12-inch diameter, Zinc coating is required.
- Bidders are to contact Brian Drake (brian.drake@carync.gov) if there are technical questions regarding the plans and specifications and for general bidding questions. All questions must be submitted in writing. Questions received less than five (5) calendar days prior to the date for opening of Bids may not be answered.
- The Town's Project Manager shall be notified prior to any tree cutting >3" diameter. The Project Manager must be notified once clearing limits are staked, but prior to when clearing begins to allow proper notice to residents and other town departments. Clearing limits are a maximum - less vegetation removal and disturbance is preferred.
- Notice is called to the replacement of Driveway at 2240 NC55 HWY.

  The Contractor shall repair the driveway at 2240 NC55 HWY to include removal of 6-inches of existing driveway material and the installation of 4-inches of ABC stone base and 2-inches of asphalt concrete in accordance with specifications. Payment for this item shall be paid at the contract unit price bid per square yard of material as indicated in the Itemized Proposal. Unit price shall be full compensation for all labor, equipment, and materials to repair gravel driveways. Payment for this item shall not be made until work is complete, including compaction, and has been inspected and accepted by the Engineer.

  The owner has obtained a right of entry for this work. The right of entry is included in the contract manual.
- All marked crosswalks must be high visibility crosswalks.
- Generally, NCDOT has not completed final inspections on sidewalks unless DOT maintenance is expected, however the Contractor and Subcontractors need to be aware that NC 55 Hwy and Jenks Carpenter Road are NCDOT roads that could be subject to final NCDOT approval.

XVII. RPR Overtime

The resident project representative will be paid by the Town for a 40-hour work week. All hours beyond a 40-hour work week shall be paid by the contractor at $135/hr. The contractor is subject to the working hours of the contract and permission from the OWNER/ENGINEER is required to work outside normal workings hours. Payment shall be for the actual invoice amount paid by Contractor.

XVIII. Engineer's Field Office/Laydown Area

- Contractor shall provide Field Office.
- Potential Laydown Area shown on drawings however may be under construction by the time project starts.
- Contractor shall met the requirements of ESC permit for any laydown areas.

XIX. Landscaping:

Disturbed areas must be replaced with to match existing grass type along entire project. A landscape allowance is included for the area around Brookstone's entrance sign.

XX. Street Resurfacing

- Speed Humps

    - Key in speed humps, milling incidental to speed humps
    - Follow 2024 NCDOT ramp standard details
- Clean up
    - Regenerative air sweeper truck on the resurfacing maps and immediate haul routes or any y-lines that have collected debris
    - Sand Screenings at project limits to reduce tracking required
    - Debris needs to be removed from haul route, especially thoroughfares.
- Final Pavement Markings
    - within 24 hours @ Signals for a minimum of 100 LF from the stop bar, or as directed by the Project Engineer.
    - within 3 days @ collector/throughfare intersections
    - within 3 weeks for all others
- Final surface in 48 hours of milling
- A landscaper is required
- Leaf debris removal shall be at the expense of the contractor if encountered.
- Asphalt Pavements
    - All asphalt production and placement shall be performed in accordance with Division 6 of the most recent version of the NCDOT specifications and current NCDOT QMS Manual.

XXI. Construction Meetings

Progress meetings will be held weekly. Some meetings will be held in person in the field and others virtually.

XXII. Miscellaneous Items

Variable message boards are anticipated for the project and location/quantity will be coordinated with the successful bidder once phasing and schedule is worked out.

XXIII. Questions and Concerns from Bidders

Will be answered via addendum:

1. What is the procedure to close Castleburry Creek Ct while the sewer is installed in that area?
2. What is the required wall thickness of the 48” casing under 55?
3. Will any traffic control plan changes have to be PE stamped?
4. What are the time restrictions for blocking/closing the driveway near the bore pit?

ATTENDANCE SHEET FOR PRE-BID MEETING
LEWEY DRIVE UTILITY AND STREET IMPROVEMENT PROJECT
TOWN OF CARY - UTILITIES DEPARTMENT
CARY, NORTH CAROLINA

DATE/TIME: Friday, June 14, 2024 at 10:30 a.m.

TOC Project WT1178/ST3210

NAME	COMPANY	PHONE #	EMAIL
Nick Melvin	Browne Construction Company	919.631.7126	Nick.Melvin@Brownecon.com
Seamus McCarthy	PUI / TA Loving	984 323 1538	smccarthy@pui-nc.com
Dustin Futrell	Mersino	252-286-6837	dustin.futrell@mersino.com
Brad Keeley	Moffat Pipe Inc	919-295-4630	Bids@Moffatpipe.Com
Jacob King	Moffat Pipe Inc	919-295-4630	bids moffetpipe.com
Cam Turner	Sanford Contractors	910-303-4117	tturner@Sanfordcontractors.com
CHARLES CHEN	TOC	919-462-3935	charles.chen@carync.gov
Brian Drake	Town of Cary	919-462-3836	Brian.Drake@CaryNC.gov

APPROVED PRODUCTS LIST - POTABLE WATER DISTRIBUTION SYSTEM

updated: October 17, 2023

Product Category	Approved Manufacturer	Model/Series	Pressure/Load Rating	Website	Reference/Standard	Requirements
Ductile Iron Pipe	US Pipe	Tyton Joint	250-350 psi see specification	http://www.uspipe.com/Main/	AWWA C150 and AWWA C151	Cement Mortar Lined with Exterior Bituminous Coating McWane Pipe stamped: McWane by Atlantic States or Clow only
	American (ACIPCO)	Fastite Joint		http://www.acipco.com		
	McWane	Tyton Joint		http://mcwaneductile.com/		
Ductile Iron Fittings	Sigma	Mechanical Joint	250-350 psi see specification	http://www.sigmaco.com/Products/Fittings.htm	AWWA C110/C111 and AWWA C153	Shall always meet or exceed pipe pressure rating
	Tyler Union	Mechanical Joint		http://www.tylerunion.com/		
	SIP Industries	Mechanical Joint		http://www.sipindustries.com/main/default.asp		
	Star	Mechanical Joint		http://www.starpipeproducts.com/		
	American	Mechanical Joint		http://www.acipco.com		
Ductile Iron Restrained Joint Pipe	American	Flex Ring	250-350 psi see specification	http://www.acipco.com	AWWA C150 and AWWA C151	Boltless restraint unless otherwise specified
	McWane	TR Flex (pipes ≤24")		http://mcwaneductile.com/		
	US Pipe	TR Flex		http://www.uspipe.com/Main/		
Fire Hydrants	Mueller	Super Centurion	250-psi	http://www.muellercompany.com/water/default.aspx	AWWA C502	Must be Equipped with Non-Kinking Chain In Morrisville, Storz connection required near FDC
	AFC (American Flow Control)	Mark 73-5 with flanged or ALPHA ends		http://www.acipco.com		
	Clow	Medallion, F2545		http://www.clowvalve.com/		
	M&H	Model 129		http://www.mh-valve.com/		
Vertical Hydrant Shoe	Mueller	A-421 Vertical Shoe	250-psi	http://www.muellercompany.com/water/default.aspx		For new installations with a maximum bury depth of 5.5-ft
	Clow	Vertical Shoe		http://www.clowvalve.com/		
	AFC (American Flow Control)	Vertical Shoe		http://www.acipco.com		
	M&H	Vertical Shoe		http://www.mh-valve.com		
Post Indicator Valve	Clow		250-psi	http://www.clowvalve.com/		Must include electronic tamper switch
	Mueller	Series 2300,A-20806		http://www.muellercompany.com/water/default.aspx		
	AFC (American Flow Control)	Model 2500		http://www.acipco.com		
	M&H	C515		http://www.mh-valve.com/		
Gate Valves, Less than 4-inches, threaded end connections	Mueller	Series 2360	250-psi	http://www.muellercompany.com/water/default.aspx	AWWA C509	Left opening & Valves less than 2-inches shall meet 'no lead' requirements
	Clow	2639 - F6103		http://www.clowvalve.com/		
	AFC (American Flow Control)	Series 2500		http://www.acipco.com		
	M&H	C509		http://www.mh-valve.com/		
Gate Valves, 4-inch through 6-inch w/ handwheel & flange connections	Mueller	Series 2360-6	250-psi	http://www.muellercompany.com/water/default.aspx	AWWA C509	Handwheel operators with non-rising stem
	AFC (American Flow Control)	Series 2500		http://www.acipco.com		
	Clow	2639 - F6102		http://www.clowvalve.com/		
	M&H	C515		http://www.mh-valve.com/		

Gate Valves, 4-inch and greater w/ MJ or RJ end connections	Mueller	Series 2360 or 2361	250-psi	http://www.muellercompany.com/water/default.aspx	AWWA C509 or C515	Sealing gaskets shall be EPDM. Gear operators as follows: 18"-2:1, 20" & 24"-3:1, ≥30"-4:1
	AFC (American Flow Control)	Series 2500 (alpha ends also allowed for 12" and under)		http://www.acipco.com		
	Clow	2638 or 2639 - F6100		http://www.clowvalve.com/		
	M&H	C515		http://www.mh-valve.com/		
Combination Air Valve	Vent-O-Mat	RBX	230-psi	http://www.ventomat.com/	AWWA C512	ARV's with spheres are not approved
	Vent-Tech	Series C - WTR		http://www.internationalvalve.com/		
	ARI	2" only -- D-040 STST		http://www.arivalves.com		
Check Valve	AFC (American Flow Control)	Series 2100	250-psi	http://www.acipco.com	AWWA C508 NSF 61	EPDM or Viton encapsulated disc. FBE coated DI body. SS bolts.
	Val-Matic	Swing-Flex 500A		http://www.valmatic.com/		
Ball Drip Valve	tyco	AD-2	175-psi	http://www.tyco-fire.com	UL/FM approved	Only install vertically with the arrow pointed down.
Insertion Valve 12" and under	Team	InsertValve	250-psi	www.teamvalve.com	AWWA C515	Resilient Wedge must Seat on Valve Body, not Pipe
Insertion Valve 16" to 24"	AVT	EZ Valve	250-psi	https://www.cs-nri.com/brands/avt/	AWWA C515	Installed by AVT installers. Requires 2" coupon from pipe prior to valve installation.
Valve Box	E. Jordan Iron Works	Screw Type 8550 (or 8560)	N/A	http://www.ejco.com/		Telescoping Box Assembly & 6" lid height with 4" skirt
	Bingham & Taylor	Screw Type 4905		http://www.binghamandtaylor.com/		
Curb Stop Box	Bingham & Taylor	I4B142RWHVTRI	N/A	http://www.binghamandtaylor.com/		#142 Roadway Box w/ Arched Base and heavy duty tri-skirt lid
Wedge Action Retainer Glands	EBAA	Mega-Lug	350-psi through 12" 250-psi through 48"	http://www.ebaa.com/	UL/FM approved through 12"	All retainer glands shall be epoxy coated or polyester powder coated
	Ford	Uni-Flange Series 1400		http://www.fordmeterbox.com/		
	Romac	RomaGrip		http://www.romac.com/		
	Sigma	One Lok Model SLDE		http://www.sigmaco.com		
	SIP	EZ-Grip		http://www.sipindustires.com		
	Star	Stargrip		http://www.starpipeproducts.com		
	Tyler Union	TUFGrip TLD		http://www.tylerunion.com/		
Wide Range Restrained Fitting	Romac	ALPHA	350-psi through 12"	http://www.romac.com/		Coupling/End Cap/Flanged Coupling
	Krausz USA	Hymax Grip	350-psi through 16"	https://krauszusa.com/		
Sampling Stations	Kupferle	Eclipse #88-SS	200-psi	http://www.hydrants.com/		All Piping to be Stainless Steel

Mechanical Joint, Full Body Tapping Sleeves	Mueller	H-615 (≤ 24")	200-psi	http://www.muellercompany.com/water/default.aspx	AWWA C110/C111	Full body Ductile Iron Tapping Sleeves approved for all applications
	AFC, American Flow Control	Series 2800 (≤24")		http://www.acipco.com		
	Tyler Union	Full Body (≤12")		http://www.tylerunion.com/		
Stainless Steel Tapping Sleeves (w/ Stainless Steel Flange)	Ford	FTSS-xxx-x-Z	200-psi	http://www.fordmeterbox.com/	AWWA C223	See specs for approved sizes. Stainless Steel Flange req'd
	Mueller	H-304		http://www.muellercompany.com/water/default.aspx		
	Romac	6"-12" only -- SST-III		http://www.romac.com		
Tapping Saddles	US Pipe	Ductile Iron Saddle Outlet	250-psi	http://www.uspipe.com/Main/		Available for 14" to 24" mains
Curb Stop w/ Lock Wing	AY McDonald	76102WQ	300-psi	http://www.aymcdonald.com/index.cfm		"No Lead" Brass meeting UNS/CDA C89833 per ASTM B584
	Mueller	B25209N		http://www.muellercompany.com/water/default.aspx		
	Ford	B44-444W[Q or G]-NL		http://www.fordmeterbox.com/		
	Cambridge	212NL-H4H4		http://www.cambridgebrass.com/		
Corporation Stops, 1-inch	Mueller	B-25008N	300-psi	http://www.muellercompany.com/water/default.aspx	AWWA C800	"No Lead" Brass meeting UNS/CDA C89833 per ASTM B584
	Ford	FB1000-4-[Q or G]-NL		http://www.fordmeterbox.com/		
	AY McDonald	74701-BQ		http://www.aymcdonald.com/index.cfm		
	Cambridge	301NL-A4H4		http://www.cambridgebrass.com/		
Service Saddles	Smith Blair	Model 325	200-psi	http://www.smith-blair.com/water.php	AWWA C800	Requires 2 silicon bronze straps with brass body
	Mueller	BR2B		http://www.muellercompany.com/water/default.aspx		
	AY McDonald	3825		http://www.aymcdonald.com/index.cfm		
	Cambridge	810		http://www.cambridgebrass.com/		
	Ford	202B		http://www.fordmeterbox.com/		
	Romac	202B		http://www.romac.com/		
Meter Boxes, 1-inch Service Long Yokebox	Ford	LYLBB111-444-T-NL	AASHTO H-10 Rated	http://www.fordmeterbox.com/	ASSE 1024 Dual Check Valve	45 degree MIP x Compression fitting is required on box inlet
	AY McDonald	776-409BBGG 443		http://www.jmeagle.com/		
1-1/2 inch Custom Setters	Ford	VBB76-18B-11-66-NL	200-psi	http://www.fordmeterbox.com/	UNS/CDA C89833 per ASTM B584	Use 300-psi rated full port ball valves. Ground key valves are not approved at inlet and outlet. Residential applications may use an angled check valve outlet or have a separate backflow preventer.
	Mueller	B2423-1N		http://www.muellercompany.com/water/default.aspx		
	Cambridge	6020NL-618-F6F6-UUB		http://www.cambridgebrass.com/		
	AY McDonald	720B618WWFF 665		http://www.aymcdonald.com/index.cfm		
2-inch Custom Setters	Ford	VBB77-18B-11-77-NL	200-psi	http://www.fordmeterbox.com/	UNS/CDA C89833 per ASTM B584	
	Mueller	B2423-1N		http://www.muellercompany.com/water/default.aspx		
	Cambridge	6020NL-718-F7F7-UUB		http://www.cambridgebrass.com/		
	AY McDonald	720B718WWFF 775		http://www.aymcdonald.com/index.cfm		

Meter Vaults, 1-1/2 & 2 inch services	CDR	A142436518	Assembly Tier 15 or greater	http://www.cdrsystems.com		Two bolt lid with 2" transmitter hole & 4"x4" Mouse Holes & Knockouts
	Quazite	PG2436Z960		http://www.hubbell.com		
Dismantling Joint	Romac	DJ405	175-psi	http://www.romac.com/	AWWA C219, NSF 61, NSF 372	Install next to meter in 3", 4", & 6" meter vault installations. Dismantling Joints must be coated. Hymax, Ford & JCM with Tie Rods.
	Smith Blair	Model 975	150-psi	http://www.smith-blair.com/water.php		
	Ford	FDJ-DxxR-R	150-psi	http://www.fordmeterbox.com/		
	Krausz USA	Hymax	175 psi	https://www.hymaxusa.com/products-main/dismantling-joint/dismantling-joint-3		
	JCM	Model 309	150-psi	http://www.jcmindustries.com/		
Flange Coupling Adaptor (Restrained)	Star	3200	3"-16" 350-psi 18"-36" 250-psi	http://www.starpipeproducts.com/	UL/FM approved NSF-61 & NSF-372	Install next to bypass valve in 3", 4", & 6" meter vault installations. Flange coupling adapters must be FBE coated. Sizes approved as noted. Note EPDM gasket shall be specified when ordering.
	Ford	RFAD	4"-12" 350-psi	http://www.fordmeterbox.com/		
	SIP	EZ Grip	3"-12" 350 -psi	http://www.sipindustires.com		
	Hymax Grip	130-56-xxxxx-16	1.5"-12" DIP 350-psi	https://krauszusa.com/products-main/hymax-grip-wide-range-restraint-couplings/hymax-grip-flange-adaptor/		
	Romac	ALPHA	4"-12" 350-psi	http://www.romac.com/		
Precast Concrete Meter Vaults for 3, 4 & 6 inch services	Lindsay Precast	8X10 & 9 X12	N/A	http://www.stayright.com/	ASTM C913	8X10 will be standard for 3" and 4" meter vault installations, 9 X 12 will be standard for 6" meter vaults. Height will vary to meet specs.
	Mack Industries	8X10 & 9 X12		http://www.mackconcrete.com/		
	Precast Solutions	8X10 & 9 X12		http://www.precast-solutions.com/		
	CP&P (Hanson, Carolina Precast)	8X10 & 9 X12		http://www.concretePandP.com/		
	Tindall	8X10 & 9 X12		http://www.tindallcorp.com/		
	OldCastle (NC Products)	8X10 & 9 X12		http://www.oldcastleprecast.com/plants/ncproductsraleigh/Pages/default.aspx		
	Foltz	8X10 & 9 X12		http://www.foltzconcretepipe.com		
Meter Vault Doors	Halliday	48" X 48"	N/A	http://www.hallidayproducts.com/	H20 Loading, no exceptions	All hatch doors shall include slam lock and lockable assembly for owner's padlock
	Bilco	48" X 48"		http://www.bilco.com/		
	US Foundry	48" X 48"		http://www.usfoundry.com/		
Repair Clamps	Smith Blair	Full Circle Repair Clamp - 261	150-psi	http://www.smith-blair.com/water.php	AWWA C230 for Clamps ≤12"	Type 304 Stainless Steel Body, SS Fasteners, and SS cast finger lug
	JCM	Full Circle Repair Clamp, #131		http://www.jcmindustries.com/		
	Mueller	Full Seal Clamp - 540 or 550		http://www.muellercompany.com/water/default.aspx		
	Krausz	Hymax or Hymax Versa		http://www.krauszusa.com		
	Romac	SS Repair Clamp - SS1		http://www.romac.com/		
	Ford	All Stainless Repair Clamp FS1		http://www.fordmeterbox.com/		

Transition Coupling	Krausz	Hymax or Hymax Grip (rest.) 890	250-psi	http://www.krauszusa.com	AWWA C219 NSF 61	For Connections Between AC and PVC or DIP, Macro HP shall be used. Utilize stainless steel fasteners.
	Smith Blair	Quantum		http://www.smith-blair.com/water.php		
	JCM	Model 242, Optimum Range		http://www.jcmindustries.com/		
	Ford	FC2W		http://www.fordmeterbox.com/		
	Romac	XR-501 or Macro HP or ALPHA		http://www.romac.com/		ALPHA - For Connections Between Cast Iron, PVC or DIP only.
Marking Tape & Marker Balls	3M Marker Ball	1403-XR	N/A	http://solutions.3m.com/en_US/	APWA	Blue for Potable Water
	3M Marking Tape	7903 EMS				
Automatic Flushing Device Controller	Hunter Industries	Node 100 Controller	N/A	http://www.hydrants.com/	Brass components shall meet UNS/CDA C89833	Install with Hunter 1"-2" PGV Valve
Reduced Pressure Principle Backflow Assembly [RP]	Febco	LF825Y, LF860 or LF880V	175-psi	www.febcoonline.com	ASSE 1013 AWWA C511 UL/FM	All Brass components shall be lead free. See cross connection ordinance.
	Zurns/Wilkins	375 or 475		http://www.zurn.com		
	Watts/Ames	Colt, Deringer		www.watts.com/products/plumbing-flow-control-solutions/backflow-preventers		
	Apollo	4A Series		https://apollovalves.com/products#/criteria		
Double Check Valve Assembly [DCVA]	Febco	LF850 or LF870V	175-psi	www.febcoonline.com	ASSE 1015 AWWA C510 UL/FM	All Brass components shall be lead free. See cross connection ordinance.
	Zurns/Wilkins	350 or 450		http://www.zurn.com		
	Watts/Ames	Colt, Deringer		www.watts.com/products/plumbing-flow-control-solutions/backflow-preventers		
	Apollo	4A Series		https://apollovalves.com/products#/criteria		
Double Check Detector Assembly [DCDA]	Febco	LF856 or LF876V	175-psi	www.febcoonline.com	ASSE 1048 AWWA C510 UL/FM	All Brass components shall be lead free. See cross connection ordinance.
	Zurns/Wilkins	350DA or 450DA		http://www.zurn.com		
	Watts/Ames	Colt, Deringer		www.watts.com/products/plumbing-flow-control-solutions/backflow-preventers		
	Apollo	4A Series		https://apollovalves.com/products#/criteria		
Reduced Pressure Principle Detector Assembly [RPDA]	Febco	LF866 or LF886V	175-psi	www.febcoonline.com	ASSE 1047 AWWA C550 UL/FM	All Brass components shall be lead free. See cross connection ordinance.
	Zurns/Wilkins	375DA, 475DA, 475DAV, 475STDA, 475 STDAV		http://www.zurn.com		
	Watts/Ames	Colt, Deringer, or M500 Series		www.watts.com/products/plumbing-flow-control-solutions/backflow-preventers		
	Apollo	4A Series		https://apollovalves.com/products#/criteria		
Polyethylene Pipe Encasement (Polywrap)	Vbio	N/A	N/A	https://dipra.org/technical-resources/design-steps/planning-and-design/pipe-features/coatings-and-linings	ANSI/AWWA C105/A21.5	Enhanced with anti-microbial layer
	VB3	N/A		https://aathread.com/vb3		

APPROVED PRODUCTS LIST - WASTEWATER COLLECTION SYSTEM

updated: July 14, 2023

Product Category	Approved Manufacturer	Model/Series	Pressure/Load Rating	Website	Reference/Standard	Requirements
Ductile Iron Pipe 8-inch & 10-inch Diameter (and 4-inch & 6-inch services) Cement Mortar Lined	US Pipe	Tyton Joint	350 psi	http://www.uspipe.com/Main/	AWWA C150 and AWWA C151	Cement Mortar Lined with Exterior Bituminous Coating McWane Pipe stamped: 'McWane by Atlantic States or Clow' only
	American (ACIPCO)	Fastite Joint		http://www.acipco.com		
	McWane	Tyton Joint		http://atlanticstates.com/		
Ductile Iron Pipe 12-inch & Larger Diameter Epoxy Lined	US Pipe	Tyton Joint	250-350 psi see specification	http://www.uspipe.com/Main/	AWWA & DIPRA Standards	40-mils of approved Interior Lining with Exterior Bituminous Coating (protecto 401 < 1yr old) McWane Pipe stamped: 'McWane by Atlantic States or Clow' only
	American (ACIPCO)	Fastite Joint		http://www.acipco.com		
	McWane	Tyton Joint		http://atlanticstates.com/		
Ductile Iron Fittings 8-inch to 10-inch Diameter (and 4-inch and 6-inch services) Cement Mortar Lined	Sigma	Mechanical Joint	350 psi	http://www.sigmaco.com/Products/Fittings.htm	AWWA C110/C111 and AWWA C153	Shall always meet or exceed pipe pressure rating
	Tyler Union			http://www.tylerunion.com/		
	SIP Industries			http://www.sipindustries.com/main/default.asp		
	Star			http://www.starpipeproducts.com/		
	American (ACIPCO)			http://www.acipco.com		
Ductile Iron Fittings 12-inch & Larger Diameter Epoxy Lined	Sigma	Mechanical Joint	250-350 psi see specification	http://www.sigmaco.com/Products/Fittings.htm	AWWA & DIPRA Stds	Shall always receive approved interior lining to meet or exceed main line pipe standards. P401 lining must be less than 1 year old.
	Tyler Union			http://www.tylerunion.com/		
	SIP Industries			http://www.sipindustries.com/main/default.asp		
	Star			http://www.starpipeproducts.com/		
	American (ACIPCO)			http://www.acipco.com		
DIP epoxy coating	Induron	Protecto 401	NA	www.protecto401.com	ASTM and DIPRA Stds.	40-mil thickness required. Pipe must be installed within 1 year of date of lining. High pressure cleaning shall not exceed 1800psi. Lined carrier pipe shall be pulled through casing.
PVC Pipe, SDR 35, 8-inch to 15-inch diameter Install depth of 4-ft to 14-ft	JM Eagle	ASTM D3034 Ring Tite Joint with Rieber Gasket	N/A	http://www.jmeagle.com/	ASTM and UNIBELL Stds.	ASTM D3034 Pipe with Cell Classification of 12454 or 12364.
	Diamond Plastics	ASTM D3034 Sewer Pipe with Rieber Gasket		http://www.dpcpipe.com/		
	National Pipe & Plastics			http://www.nationalpipe.com/		
	Sanderson Pipe			Sandersonpipe.com		
	North American Pipe			http://www.northamericanpipe.com/		
PVC Pipe, Heavy Wall SDR 26 (Minimum Pipe Stiffness of 115) 8-inch to 27-inch Diameter and Depth of Install 4-ft to 20-ft	JM Eagle	ASTM D3034 or F679 Ring Tite Joint with Rieber Gasket Joint	N/A	http://www.jmeagle.com/	ASTM and UNIBELL Stds.	ASTM D3034 or ASTM F679 Pipe with Cell Classification of 12454 or 12364.
	Diamond Plastics	ASTM D3034 or F679 Sewer Pipe with Rieber Gasket Joint		http://www.dpcpipe.com/		
	National Pipe & Plastics			http://www.nationalpipe.com/		
	Sanderson Pipe			Sandersonpipe.com		
	North American Pipe			http://www.northamericanpipe.com/		
Precast Concrete Manholes	Lindsay Precast	4-ft, 5-ft, & 6-ft diameter	H-20 Rating	http://www.stayright.com/	ASTM C478 and C923	All manhole bottoms greater than 5' diameter shall be a minimum of 8-inches thick. A minimum of 6inches for 4' diameter.
	Mack Industries			http://www.mackconcrete.com/		
	Precast Solutions			http://www.precast-solutions.com/		
	CP&P (Hanson, Carolina Precast)			http://www.carolinaprecast.com/		
	Tindall			http://www.tindallcorp.com/		
	OldCastle (NC Products)			oldcastleprecast.com/plants/ncproductsraleigh/Pages/c		
	Eastern Vault Co. Inc.			http://easternvault.net		
	Foltz			http://www.foltzconcretepipe.com		
Polymer Concrete Manholes	Armorock	4-ft, 5-ft, & 6-ft diameter	H-20 Rating	https://armorock.com/manholes	ASTM C478, ASTM C990, ASTM C478, ASTM C857, ACI 350-06, ACI 440.1R-06, ASTM C923	May be used where epoxy lined manholes are required. Shall be domestically manufactured. Cary standards for ring and cover shall apply - cast iron covers required.
Manhole Frame and Cover for Paved Areas w/ 1 Vent Hole	EJ	Model # V1384	40,000 lb proof load per AASHTO M306	www.ejco.com	CL35B ASTM-A48 Cover=120 lb min.	Type 1 - for installation in and near roadways
	US Foundry	669 Ring and LX Cover		www.usfoundry.com		

Manhole Frame and Rotating Cover for Outfall Areas (watertight)	EJ US Foundry	41384037R01 8021464	12,000 lb proof load	www.ejco.com www.usfoundry.com	CL35B ASTM-A48 Ring=80 lb min. Cover=50 lb min	Type 2A - watertight for outfalls with elevated manholes (non-traffic bearing)
Manhole Frame and Rotating Cover w/ 1 vent hole for Outfall Areas (vented)	EJ US Foundry	41384038R01 8021472	12,000 lb proof load	www.ejco.com www.usfoundry.com	CL35B ASTM-A48 Ring=80 lb min. Cover=50 lb min	Type 2B - vented for outfalls with elevated manholes (non-traffic bearing)
Manhole Frame and Cover with 36-inch clear span opening for Large Diameter Manholes	EJ US Foundry	Frame: 1581 Outer Cover: 1580EGS Inner Cover: 1040AGS Assembly: 8021054 Ring: 8020503 Outer Cover: 8015454 Inner Cover: 8015455	40,000 lb proof load per AASHTO M306	www.ejco.com www.usfoundry.com	CL35B ASTM-A48 Minimum Weights: Ring=232lb Outer Cover=245lb Inner Cover=145lb	Type 3 - for large diameter outfall manholes
Manhole Steps	M.A. Industries Meadow Burke Bowco American Step Co.	PS1-PF or PS1-PF-DF 93810R ML-10-TDS-NCR	Horizontal Pull-out Load of 1000 lbs. when installed	www.maind.com www.meadowburke.com www.americanstep.com	ASTM C478	Spaced 16" on center
Riser Grade Rings	Cretex Ladtech	Pro Rings HDPE Adjusting Rings	HS-25 Loaded	https://www.cretexseals.com/product/pro-ring-concrete-grade-ring-alternative/ www.Ladtech.com	AASHTO M-306	Butyl Rubber Sealant Required
Exterior Joint Wrap for Manholes	ConSeal Henry Infi-Shield	CS-212 RN103 - RAM-NEK	N/A	www.conseal.com www.henry.com www.infi-shield.com	ASTM C990, E1745, C877	
Butyl Rubber Sealant	ConSeal	CS-102	N/A	www.conseal.com	SS-S-210 ASTM C990	
Manhole Epoxy Coating (Interior)	RLS Sherwin Williams	Raven 405 Duraplate 5900	120-mils	www.ravenlining.com www.sherwin-williams.com	Installed by: Installed by:	www.dun-rightservices.com/ www.cmtcoatings.com
Exterior Manhole Coating for Wet Areas	Pro-Tech Coatings Carboline International	EP-214 Bitumastic 300M Devtar 5A	N/A	www.pro-techcoating.com www.carboline.com www.international-pc.com	Corps of Engineers C-200	40-mil minimum thickness required. Interior epoxy coatings may also be used.
Mini Manhole Frame and Cover for Cleanout in Paved Areas	US Foundry EJ	Ring: 8090167 Cover: 8090179 Model # 1566	40,000 lb proof load	www.usfoundry.com www.ejco.com	CL35B ASTM-A48 Ring=39 lb min. Cover=14 lb min.	Domestically Made
Marking Tape	3M Marking Tape	7904 EMS	N/A	http://solutions.3m.com/en_US/	APWA	Green for Wastewater
4-inch and 6-inch Service Saddle for existing 8-inch thru 12-inch DIP	Romac Ford	Model "CB" FSS-1440-4 & FSS-1440-6	N/A	www.romac.com www.fordmeterbox.com	ASTM A536 ASTM D2000 MBA 710	Service Line shall be DIP. Strap and Hardware shall be 304 Stainless Steel
Ductile Iron Service Tee for PVC Main x 4" or 6" DIP Service line	Harco	280523-0804P 280523-0806P	350 psi	www.harcofittings.com	ASTM A536,F477 AWWA C153	Lined with approved epoxy lining

SECTION 6000
WATER DISTRIBUTION SYSTEM

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6010 WATER DISTRIBUTION PIPE

A. DESIGN

1. The following Standard Specifications and associated Detail Drawings shall apply to all water system extensions and development of the Cary municipal water system. The Standard Specifications and Detail Drawings included herein shall apply to all aspects of the Cary water system that extend into Morrisville, RTP, Wake County, Chatham County, and any other areas outside the corporate limits in which the water system is otherwise owned, operated, and maintained by Cary. All utility extension permits must be obtained prior to construction. Refer to General Provisions in Section 2000 for further requirements.

2. Location: Water transmission lines shall be located and sized in accordance with the current "Water System Master Plan" or as directed by Cary and shall extend to the adjacent properties to provide an adequate network. All public water mains shall be located under the roadway within dedicated right of way or dedicated easements with a minimum width of 20 feet. Dedicated easements for water mains and appurtenances shall be recorded as "Cary Utility and Pipeline Easement." Cary utility and pipeline easements shall contain only Cary utilities unless otherwise approved by an approved development plan or encroachment agreement. See Section 2100 for allowable landscape plantings within a Cary easement.

3. Easement Areas: No permanent structures, equipment, retaining walls, embankments, impoundments, or other elements that would inhibit maintenance operations shall be constructed within a utility and pipeline easement. Fences may be allowed across easements provided that appropriate access gates have been installed to allow utility maintenance. Fill or cut slopes greater than 5:1 are not allowed to extend into easements

4. Sizing: Major transmission lines shall be sized in accordance with the "Water System Master Plan" or as directed by Cary. Six (6) inch mains may be used on a case-by-case basis when Cary has determined that a good grid exists, and the existing network supports using six (6) inch mains. The total maximum length of 6 inch and 8-inch lines, without connecting to a larger main, is 1200 feet and 2000 feet, respectively. Four (4) inch water mains are permitted on residential cul-de-sacs less than 400 feet long. Where the existing network is lacking connectivity, lines shall be upsized to provide adequate fire flow as directed by the Director of Utilities. The Utilities Department may require a fireflow test, hydraulic modeling and/or a water main loop to provide adequate fireflow and water quality. All lines shall be designed in accordance with Policy Statement 129, Minimum Water Supply Pressure.

5. Second Connection Required: In support of Cary Standard Operating Procedure 008, a second connection to the distribution system is required for any development proposing 100 or more service connections.

6. No service taps are allowed on a fire hydrant line.

7. In instances where water mains are extended to accommodate a service line installation an auto-flusher shall be installed as required by the Utilities Department.

8. All utility crossings within Cary streets shall be made by trenchless methods. State-maintained streets within the Cary ETJ should also be crossed using trenchless methods. In cases where utility conflicts, rock, or other obstructions prevent trenchless crossings, Cary may consider approving other methods.

9. Construction involving Existing Mains:

a) The existing water main must remain active and protected during all phases of construction. The contractor must provide a plan for the structural protection of the existing water main.

b) A proposed construction sequence must be submitted for any demolition of a portion of existing water main. The plan must be reviewed and approved by Utilities and Public Works.

10. Restraint: All valves and fittings shall be restrained. Pipe joints shall also be restrained an adequate length away from valves and fittings in accordance with AWWA manual M41 (or the latest edition of Thrust Restraint Design for Ductile Iron Pipe as published by the Ductile Iron Pipe Research Association). The standard joint restraint method shall be to use manufacturer provided restrained joint pipe and fittings. Pipe up to and including 12-inches in diameter may also utilize mechanical joint pipe with approved wedge action retainer glands (for the specified distance).

a) 4” to 8” Diameter Pipe: For pipe 4-inches through 8-inches, the following table may be used to determine the required restrained length of pipe for single occurrences of valves or fittings within the pipe system. The table may not be used for combined bends or offsets where a series of fittings occur. In lieu of using the below table, a pipe restraint plan detailing all assumptions and calculations may be provided by the NC Professional Engineer sealing the plan drawings. In either case, the method of restraint to be used and the length of pipe to be restrained (if applicable) shall be clearly identified on the plans at all necessary locations.

Required Restrained Lengths for Single Fittings and Valves for Pipe 4-inches to 8-inches in Diameter (in Feet, Both Directions unless otherwise noted)

	4”	**6”**	**8”**
90° Horizontal **90° Vertical Up** **90° Vertical Down**	59’ 59’ 91’	84’ 84’ 130’	108’ 108’ 168’
45° Horizontal **45° Vertical Up** **45° Vertical Down**	24’ 24’ 38’	35’ 35’ 54’	45’ 45’ 70’
22½° Horizontal **22½° Vertical Up** **22½° Vertical Down**	12’ 12’ 18’	17’ 17’ 26’	21’ 21’ 33’
11¼° Horizontal **11¼° Vertical Up** **11¼° Vertical Down**	6’ 6’ 9’	8’ 8’ 13’	11’ 11’ 17’
	4”	**6”**	**8”**
Tee ***(Restrain the Branch)***	89’	*4” branch* – 88’ *6” branch* – 128’	*4” branch* – 87’ *6” branch* – 127’ *8” branch* – 166’
Reducer ***(Restrain Larger Pipe)***	N/A	67’	8” x 4” – 121’ 8” x 6” – 70’
Valves, Caps and Plugs (Dead Ends)	91’	130’	168’

b) All pipe and fittings: **Projects with pipe diameters greater than 8-inches, polywrapped pipe, or combined bends must have a pipe restraint plan with the method of restraint to be used and the length of pipe to be restrained clearly identified on the plans at all necessary locations.** The pipe restraint plan must be calculated in accordance with AWWA manual M41 (or the latest edition of *Thrust Restraint Design for Ductile Iron Pipe* as published by the Ductile Iron Pipe Research Association). The plan must also account for the actual soil types that exist at the project site.

c) Valves: All valves shall be restrained in a manner consistent with operation as a dead end. This includes restraining the valve to the pipe and restraining a sufficient number of pipe joints on both sides of the valve to accommodate dead end restraint. There shall be no joints between the valve and fitting. Restraint at intersections may be achieved by using stainless steel rods (through 16” diameter) or approved wedge action retainer glands (through 48” diameter).

d) Dead Ends: All MJ cap and plug fittings, including tapped caps, shall be restrained with approved wedge action retainer glands. The adjacent pipe shall be restrained the distances specified above (or on the sealed pipe restraint plan). Reaction blocking shall not be used to restrain caps and plugs.

Restraining systems not included within this Specification shall require written approval prior to utilization. All joint restraint products that include the means of restraint within the joint gasket shall be prohibited in Cary's water system.

11. Depth of Installation:

    All water mains shall have a minimum cover of 4 feet measured from the top of the pipe to the finished grade. When water lines are installed along a roadway they shall be installed at sufficient depth to maintain four (4) feet of cover to the subgrade of any future road improvements including potential vertical alignment changes.

12. Relation to Sanitary, Storm Sewers and Reclaimed Water Lines:
    a) Separation between Potable Water Mains and Sanitary Sewer Mains or Storm Sewers.

    - Parallel Installations: 10-ft lateral separation (pipe edge to pipe edge) or minimum 5-ft lateral separation and water line at least 18-inches above sanitary or storm sewer line measured vertically from top of sewer pipeline to bottom edge of water main. In unique cases where the sanitary sewer and the water main are installed with at least 5-ft of lateral separation but less than 10-ft of horizontal separation, and less than 18-inches of vertical separation, both the water main and sanitary sewer shall be constructed of ductile iron pipe with joints in full compliance with water main standards.

    - Crossings (Water Main over Sanitary or Storm Sewer): All water main crossings of sanitary sewer lines shall be constructed over the sewer or storm line in conformance with Cary Specifications. At a minimum, 18-inches of clearance shall be maintained between the bottom edge of the water main and the top edge of the sanitary or storm sewer main. If 18-inches of clearance is not maintained, the water main and sanitary sewer main shall both be constructed of ductile iron pipe with joints in conformance with water main construction standards. The sanitary sewer pipe shall be ductile iron the entire run from manhole to manhole. When the separation between pipelines is 18-inches or less, the void space between the pipes shall be filled with minimum 500-psi, quick setting, and non-excavatable flowable fill extending 3-ft on both sides of the crossing. Regardless of pipe material, at least 12-inches of vertical separation is required for both sanitary and/or storm sewer crossings of potable water mains.

	Water	Storm water	Sewer (Gravity and Forcemain)	Reclaimed
Water	18-inches vertical	**Parallel Installations**: 10-feet horizontal **Crossings**: 18 inches vertical	**Parallel Installations:** 10 feet horizontally **Crossings:** 18-inches vertical separation water main over sewer	**Parallel Installations**: 10-feet horizontal and water line at least 18-inches above reclaimed **Crossings (water main over reclaimed water pipeline)**: Min. 18-in vertical separation
Storm water	**Parallel Installations**: 10-feet horizontal **Crossings**: 18 inches vertical		24-inches vertical	Min. 18-inches vertical.
Sewer (Gravity & Forcemain)	**Parallel Installations:** 10 feet horizontally **Crossings:** 18-inches vertical separation water main over sewer	24-inches vertical	7-feet horizontal separation, increasing with depth	**Parallel Installations:** 10-feet horizontal **Crossings (reclaimed water pipes over sewer pipes**): 18-inches
Reclaimed	**Parallel Installations**: 10-feet horizontal and water line at least 18-inches above reclaimed **Crossings (water main over reclaimed water pipeline)**: Min. 18-in vertical separation	Min. 18-inches vertical.	**Parallel Installations:** 10-feet horizontal **Crossings (reclaimed water pipes over sewer pipes**): 18-inches	18 inches vertical

- Crossings (Water Main under Sanitary Line): Allowed only as approved by Cary, when it is not possible to cross the water main above the sanitary line. At a minimum, 18-inches of separation shall be maintained, (measured from pipe edge to pipe edge) and both the water main and sanitary sewer shall be constructed of ductile iron in conformance with water main construction

- standards. The sanitary sewer pipe shall be ductile iron the entire run from manhole to manhole. If local conditions prevent providing 18-inches of clearance, then at least 12-inches of clearance shall be provided and the void space between the pipes shall be filled with minimum 500-psi, quick setting, and non-excavatable flowable fill extending at least 3-ft on both sides of the crossing.
- Crossings (Water Main under Storm Sewer Line): Allowed only as approved by Cary, when it is not possible to cross the water main above the storm sewer line. At a minimum, 18-inches of separation shall be maintained, (measured from pipe edge to pipe edge) and the water main shall be constructed of ductile iron in conformance with water main construction standards. If local conditions prevent providing 18-inches of clearance, then at least 12-inches of clearance shall be provided and the void space between the pipes shall be filled with minimum 500-psi, quick setting, and non-excavatable flowable fill extending at least 3-ft on both sides of the crossing.

b) Separation between Potable Water Mains and Reclaimed Water Mains

- Parallel Installations: Preferred 10-ft lateral separation (pipe edge to pipe edge) AND water line at least 18-inches above reclaimed water line measured vertically from top of reclaimed water pipeline to bottom edge of water main. Because all reclaimed water mains in Cary's municipal system are required to fully comply with water system testing and integrity standards as described by 15A NCAC 18C, when the 10-ft lateral separation standard cannot be met, a minimum of 5-ft lateral separation, shall be provided.

- Crossings (Water Main over Reclaimed Water Pipeline): All water main crossings of reclaimed water mains shall be constructed over the reclaimed water line in conformance with Cary Specifications. At a minimum, 18-inches of clearance shall be maintained between the bottom edge of the water main and the top edge of the reclaimed water main. When the minimum 18-inch clearance cannot be maintained, the reclaimed main shall be constructed of ductile iron pipe in conformance with water main construction standards extending at least 10-ft on both sides of the crossing. The void space between the pipes shall be filled with minimum 500-psi, quick setting, and non-excavatable flowable fill extending at least 3-ft on both sides of the crossing. Reclaimed water mains crossing more than 18-inches under potable water service lines may be constructed of either C900 or C905 PVC as typically required for reclaimed water pipeline construction.

- Crossings (Water Main under Reclaimed Water Pipeline): Allowed only on a case-by-case basis and design shall be approved by Cary prior to construction. At a minimum, 18-inches of separation shall be maintained and both potable water and reclaimed mains shall be constructed of ductile

iron pipe in conformance with water main construction standards extending at least 10-ft on both sides of the crossing. If local conditions prevent 18-inches of clearance between the pipelines, the void space between the pipes shall be filled with minimum 500-psi, quick setting, and non-excavatable flowable fill extending at least 3-ft on both sides of the crossing.

B. MATERIALS

General: All water main distribution pipe shall be ductile iron and comply with NSF/ANSI/CAN 61 (latest edition) and NSF/ANSI/CAN 600 (latest edition) Drinking water system components-Health Effects and latest revisions. Any newly installed ductile iron water mains (and fittings) larger than 12-inch in diameter shall be zinc-coated ductile iron pipe. The zinc-coated ductile iron pipe shall be sprayed with an arc-sprayed zinc per ISO 8179 zinc coating on the outside of the pipe and covered with an asphaltic topcoat. The mass of the zinc applied shall be 200 g/m2 of pipe surface area. A finishing layer topcoat shall be applied to the zinc. The coating system shall conform in every respect to ISO 8179-1 “Ductile iron pipes – External zinc-based coating – Part 1: Metallic zinc with finishing layer. Second edition 2004-06-01.

1. The Utilities Department maintains a list of approved manufacturers for all water distribution products. The zinc coated ductile iron pipe shall be manufactured by a manufacturer listed on Cary’s Approved Products List. New manufacturers must submit requests for approval to the Utilities Department in accordance with Standard Procedure 120, Manufacturer Approval Guidelines.

2. Ductile Iron Pipe

   a) Ductile iron pipe shall be designed and manufactured in accordance with AWWA C150 and C151 and provided in nominal 18-ft or 20-ft lengths. The minimum required pressure ratings for ductile iron pipe and required laying conditions are tabulated below. For all other installations other than specified, the laying condition, bedding requirements or the minimum pressure class rating and/or thickness class shall be increased in accordance with AWWA C151. A pipe thickness design shall be submitted for external loading in all cases where the pipe depth exceeds the specified range of depths outlined in the following table.

Pressure Class, Max. Depth and Laying Condition for DI Water Mains

Pipe Diameter	AWWA C-150, Laying Condition	Pressure Class	Maximum Depth of Cover
4-8 -inch	type 1	350 psi	3-16 feet
4-8 -inch	type 4	350 psi	16-34 feet
10-12 -inch	type 1	350 psi	3-10 feet
10-12 -inch	type 4	350 psi	14-28 feet
10-12 -inch	type 5	350 psi	28-44 feet
14-20 -inch	type 4	250 psi	3-22 feet
14-20 -inch	type 5	250 psi	22-30 feet
14-20 -inch	type 5	350 psi	30-41 feet
24-30 -inch	type 4	250 psi	3-19 feet
24-30 -inch	type 5	300 psi	19-29 feet
24-30 -inch	type 5	350 psi	29-33 feet
36-42 -inch	type 4	300 psi	3-20 feet
36-42 -inch	type 5	350 psi	20-32 feet

Note: For cases not specified, a ductile iron pipe and bedding design certified by a Professional Engineer licensed in the State of North Carolina shall be required in compliance with AWWA C150 and the Ductile Iron Pipe Research Association.

b) Pipe joints shall be mechanical joint or push-on type as per AWWA C111. Pipe lining shall be cement mortar in accordance with AWWA C104. All buried ductile iron pipe shall have a bituminous exterior coating in accordance with AWWA C151.

3. Ductile Iron Fittings

All ductile iron fittings shall be provided in conformance with AWWA C110 for standard ductile iron fittings and AWWA C153 for compact ductile iron fittings. All fittings shall be pressure rated for a minimum 350-psi through 24-inches in diameter and 250-psi for fittings greater than 24-inches in diameter. In cases where minimum pressure standards are less than the pipe specification, fittings shall always be pressured rated to meet or exceed the pressure ratings for the specified pipe. All fittings for potable water service shall be provided with cement mortar linings and asphaltic seal coats in accordance with AWWA C104. All ductile iron fittings shall have an asphaltic exterior coating in accordance with AWWA C151. All ductile iron fittings shall be provided with mechanical joint end connections or proprietary restrained joints from an approved manufacturer. Gaskets shall be provided in conformance with AWWA C111 with EPDM rubber gaskets preferred over SBR.

4. Restrained Joint Ductile Iron Pipe

All restrained joint ductile iron pipe unless otherwise specified shall be of the boltless restrained joint type. For installations requiring welded locking rings, the rings shall be factory welded. The restrained joints shall provide a minimum of 4-degrees of deflection for pipe sizes, 4-inches through 12-inches in diameter.

All proprietary pipe restraint systems shall be approved by Cary and provided in compliance with all standards for coatings, linings, pressure classes, etc. as required for ductile iron pipe. All restrained joint pipe shall be installed based on laying conditions, pressure class, etc. as required for typical ductile iron pipe.

5. Encasement Pipe

a) Encasement pipe shall be new and manufactured of grade 'B' steel with minimum yield strength of 35,000-psi in accordance with ASTM A139 and A283.

b) All casing pipe shall have machine cut, bevel ends that are perpendicular to the longitudinal axis of the casing.

c) Size and minimum wall thickness of smooth wall or spiral welded steel encasement pipe shall be as shown in the below table. Actual wall thicknesses shall be determined by the casing installer based on their evaluation of the required forces to be exerted on the casing when it is installed.

Minimum Wall Thickness of Steel Encasement Pipe

Encasement Pipe Outside Diameter *(inches)*	Minimum Wall Thickness *(inches)*
12-3/4	0.188
14	0.250
16	0.250
18	0.250
20	0.250
24	0.250
26	0.312
28	0.312
30	0.312
36	0.375
42	0.500
48	0.500
54	0.500
60	0.500
66	0.625

d) Encasement pipe installed for railroad bores shall meet the requirements of the American Railway Engineering Association (AREA) for boring under railroads.

e) Encasement pipe shall have the following minimum sizes:

Minimum Allowable Steel Encasement Diameter Per Carrier Size

Carrier Pipe Size Inside Diameter (inches)	Carrier Pipe Outside Bell Diameter Typ. (inches)	Steel Encasement Nominal Diameter (inches)
6	9.19	12-3/4
8	11.33	16
10	13.56	18
12	15.74	20
14	19.31	24
16	21.43	26
18	23.70	28
20	25.82	30
24	29.88	36
30	36.34	42
36	42.86	48
42	49.92	60
48	56.36	66

6. Casing Pipe Spacers and End Closures

a) The carrier pipe shall rest on steel pipe alignment spacers. The spacers shall have either a bituminous or epoxy coating. A minimum of 2 steel spacers per joint shall be required on carrier pipe less than 36-inches. Carrier pipe greater than or equal to 36-inches shall have a third spacer. The steel spacers shall be located evenly along the carrier pipe alignment in such a manner that each spacer supports the same unit weight of carrier main. The spacing interval of the steel spacers shall assure the necessary grade, clearance, and support of the carrier main. The spacers shall be manufactured for the specific carrier pipe and casing pipe diameters being used such that the risers do not allow the pipe to float within the casing.

b) In cases where the encasement pipe is installed near facilities with stray current, such as gas lines, high voltage power transmission lines, petroleum lines, railroad tracks, etc., the steel spacers shall be provided with composite contacts on the runners such as an EPDM rubber liner or an ultra-high molecular weight polyethylene plastic skid to prevent transmitting the stray current to the carrier pipe.

c) The carrier pipe bells shall not be allowed to contact the interior of the encasement pipe under any circumstances.

d) No blocks or temporary spacers shall be wedged between the carrier pipe and the top of the encasement pipe.

e) The ends of the encasement pipe shall be sealed using 8-inch bricks and a non-shrink grout.

f) A 2-inch galvanized vent pipe shall be provided on the upper end of the casing on all stream and railroad crossings.

C. INSTALLATION

1. Excavation and Preparation

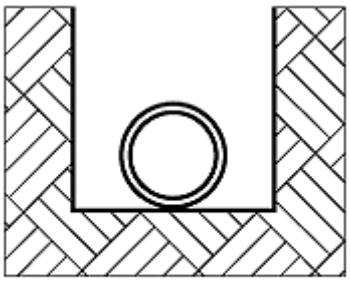
a) Ductile iron pipe shall be installed in accordance with the requirements of AWWA C600 and the Ductile Iron Pipe Handbook published by the Ductile Iron Pipe Research Association. Materials at all times shall be handled with mechanical equipment or in such a manner to protect them from damage. At no time shall pipe and fittings be dropped or pushed into ditches.

b) Pipe and fitting interiors shall be protected from foreign matter and shall be inspected for damage and defects prior to installation. In the event foreign matter is present in pipe and fittings, it shall be removed before installation. Open ends of pipe shall be plugged or capped when pipe laying is not in progress.

c) All pipe shall be constructed with at least 48 inches of cover below the finished surface grade. Pipe shall be laid on true lines as directed by the Engineer. Trenches shall be sufficiently wide to adjust the alignment. Bell holes shall be dug at each joint to permit proper joint assembly. The pipe shall be laid and adjusted so that the alignment with the next succeeding joint will be centered in the joint and the entire pipeline will be in continuous alignment both horizontally and vertically. Pipe joints shall be fitted so that a thoroughly watertight joint will result. All joints will be made in conformance with the manufacturer's recommendations for the type of joint selected. All transition joints between different types of pipe shall be made with transition couplings approved on shop drawings showing the complete assembly to scale.

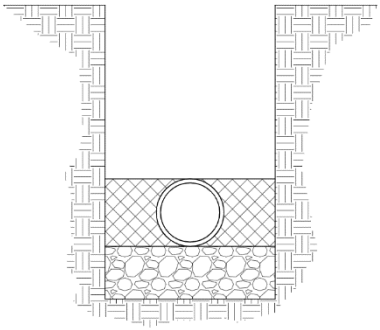
d) Pipe shall be installed at laying conditions as specified by the plans. Laying conditions for ductile iron pipe shall be as described in AWWA C151 and the Ductile Iron Pipe Research Association. Laying conditions shall be defined as follows:

Type 1: Flat Bottom Trench with Pipe Resting on Stable Undisturbed Earth. Unstable conditions such as wet trench bottoms, intermediate rock layering, partially weathered rock, and other unsuitable soil conditions shall require utilizing more stringent laying conditions. At a minimum, Type 4 laying condition shall be utilized with a minimum of 4-inches of bedding to overcome unstable conditions. For severe unstable soil conditions, undercut excavation and an engineer designed foundation plan shall be provided prior to pipeline installation.



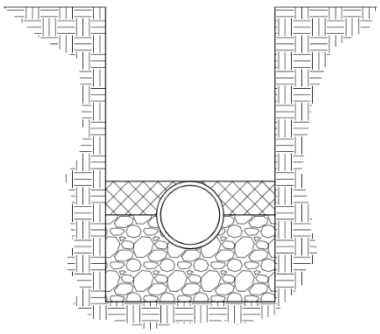
Type 1*

Type 4: Pipe bedded in Class 1 material, No. 67 or No. 78 crushed stone to a depth of 1/8 pipe diameter or a minimum of 4-inches. Embedment material, consisting of Class 1, Class 2 or Class 3 materials, (as defined in Section 7000), shall be compacted greater than 95% Proctor to the top of the pipe. Careful attention must be allocated to compacting embedment material under the bottom edges of the pipe.



Type 4

Type 5: Pipe bedded in Class 1 material, No. 67 or No. 78 crushed stone to the center of the pipe and extending a minimum of 4-inches under the pipe. Granular or select embedment, consisting of Class 1 or Class 2 materials, compacted to greater than 95% Proctor installed to the top of the pipe.



Type 5

e) For installations below the water table, a single layer of engineering fabric shall be installed between the pipe and trench floor/trench wall. The fabric shall fully encapsulate the waterline, bedding, and embedment material with a minimum of 12-inch overlap at the top of the embedment material.

f) Prior to beginning construction, the Contractor shall contact local utility companies and verify the location of existing utilities. The Contractor shall be completely and solely responsible for locating all existing buried utilities inside the construction zone before beginning excavation. The Contractor shall be solely responsible for scheduling and coordinating the utility location work. When an existing utility is in conflict with construction, it shall be exposed prior to beginning construction to prevent damage to the existing utility.

g) All valves that are under the ownership and acceptance of Cary's municipal water system shall be operated only by trained personnel of Cary. Existing valves in Cary's water system will not be operated without a minimum notice of 24 hours to the Engineer and the Public Works Department. Contractor's personnel shall only be responsible for operating valves within new construction areas that are not directly connected with the existing municipal water supply. At such time when the valves in new construction areas are connected with the municipal water supply, the valves shall only be operated by Cary personnel or in limited circumstances by Contractor's personnel after receiving authorization from the Operator in Responsible Charge of the water distribution system. For all other cases, the Contractor shall operate valves only in accordance with Cary Policy Statement No. 49, Water Valves, Control of Closing and Opening.

h) Trenching for pipelines (water, sewer, pressure, natural gas and liquid petroleum), communication and power lines and drainage and irrigation pipes shall be excavated to the required depth to permit the installation of the pipe (inclusive of pipes, wires, cables, ducts, and conduit) along the lines and grades shown on the construction drawings.

i) Prior to trenching for the construction of any utility mains or connections, the Contractor shall locate all existing utilities within the construction zone. This may include at a minimum contacting the North Carolina One Call Center at 811 or 1-800-632-4949. Where critical Cary water and sewer utilities cannot be located by traditional means, specialized utility locating, such as vacuum excavation or ground penetrating radar (GPR) may be required to locate existing utilities before excavating.

j) In all cases where trenchless methods are planned to cross an existing utility corridor with water, sewer, force main, reclaimed water and/or other Cary maintained pipelines, an SUE (subsurface utility exploration) services

firm shall be contracted to verify the depths of existing utilities prior to boring. Where SUE involves survey work, the survey shall be in accordance with the requirements of Section 10050 of these Standard Specifications.

k) The Contractor shall be responsible for implementing all required safety provisions for trenching in compliance with the Occupational Safety and Health Administration (OSHA) regulations and all other applicable safety requirements and procedures.

l) Trench Dimensions

i. The minimum trench width at the top of the pipe shall be at least 24-inches greater than the outside diameter of the pipe. Rock shall be removed to a depth of at least 6-inches below the bottom of the pipe and the trench backfilled with suitable material.

ii. Open trenches shall not exceed 100-feet.

iii. All trenches shall be confined to the limits of the right-of-way or utility easement. Trenches in paved areas shall not be sloped.

iv. All trenches in or along roadways shall be properly backfilled at the end of each working day.

m) Trench Protection

i. Wet trenches shall be stabilized with a base layer of #78 M or #57 stone. The bottom of the trench shall be shaped to provide uniform support along the entire length of the pipeline. Severely unstable trench bottoms requiring undercut excavation shall receive a foundation support system for the pipeline designed by a registered Geotechnical Engineer licensed in the State of NC.

ii. A space shall be excavated at each bell to provide ample space to join the pipes with no misalignment.

iii. The Contractor shall take all necessary measures to prevent water from entering the trench.

2. Pipe laying and backfilling

a) Open ends of pipe shall be plugged when pipe laying is not in progress to prevent trench water, soil, and debris from entering.

b) All pipe shall be laid in accordance with the manufacturer's recommendations and all applicable Cary Standards, Specifications and Details.

c) Pipe laying shall be accomplished in a manner and with the required resources to provide a properly aligned and sealed pipeline and joints.

d) Pipe deflection limits shall not be exceeded in accordance with manufacturer requirements.

e) All gravity mains shall be installed beginning with the downhill section at the lowest elevation, and advanced upgrade to the terminus of the main. All bell ends shall be oriented facing the uphill direction.

f) Backfill material shall be free from construction material, frozen material, organic material, or unstable material. Backfill with a high clay content or high shrink-swell potential that cannot meet compaction requirements shall be deemed unsuitable and replaced as directed by a professionally licensed Geotechnical engineer.

g) Backfill materials that have been allowed to become saturated or with moisture contents non-conducive to meeting compaction requirements shall be deemed unsuitable and replaced.

h) When original excavated materials have been deemed unsuitable, granular material must be imported to the site to backfill utility trenches and meet compaction requirements. The following materials shall be acceptable forms of granular backfill: aggregate base course, soil type base course, select backfill material, sand or screenings in accordance with NCDOT Specifications.

i) In all open utility trenches, backfill shall be compacted to 95% maximum dry density as measured by AASHTO method T99. The Contractor shall be responsible for verifying that compaction requirements have been met or exceeded by providing soils testing data from an approved Geotechnical Firm. The soil test results shall be certified by a licensed Geotechnical Engineer.

j) Backfill for utility trenches shall be placed in 8-inch lifts or less of uncompacted soil and compacted with a mechanical tamp before placing additional layers.

3. Pavement repairs

a) All pavement cuts shall be repaired within a maximum of three (3) days from the date the cut is made. If conditions do not permit a permanent repair

within the given time limit, permission to make a temporary repair must be obtained from the Infrastructure Field Technician.

b) Pavement repairs shall be made in accordance with Cary Standard Details.

c) All asphalt pavement utilized to repair open trenches shall comply with all applicable Cary asphalt pavement material and installation Specifications.

d) All pavement patches shall be provided in such a manner that a uniform and smooth driving surface free of depressions and/or bumps is obtained. Pavement patches not meeting this standard shall be milled and replaced.

4. Trenchless pipe installation

a) The preferred trenchless method shall be auger boring. Alternate trenchless methods including microtunneling, guided boring, conventional tunneling, horizontal directional drilling or hand tunneling may be approved after thorough evaluation by the Utilities Department.

b) In addition to meeting or exceeding all Cary requirements, all trenchless crossings shall be approved by and meet the requirements of all controlling legal authorities, such as NCDOT, Norfolk Southern Railway and CSX Corporation.

c) Direct bores may be made without a casing pipe on pipelines 6-inches in diameter and smaller.

d) Encasement pipe shall be installed with all trenchless construction methods (excluding horizontal directional drilling when it is approved and as noted above). There shall be a minimum cover of 4-ft between the pavement subgrade and the top of the casing pipe. Under no circumstances shall the pavement subgrade be disturbed.

e) Permanent easements (UPE) shall be provided at all trenchless pits to allow for future access to casing pipes.

f) All carrier pipe shall be manufacturer provided restrained joint ductile iron pipe except for reclaimed water mains in which restrained PVC C900 or C905 pipe in compliance with Section 6500 is utilized.

g) As the trenchless operation progresses, each new section of encasement pipe shall be joined using full penetration seal welds prior to installation of the casing. Joints shall be electric-fusion welded by operators qualified in accordance with the American Welding Society's standard procedure for arc welds. The welds shall be capable of transmitting all thrust and other loads across the joints.

h) If voids are encountered while installing encasement pipe thirty (30) inches and larger, 2-inch or larger grout holes shall be installed at ten (10) foot centers in the top section of the encasement pipe. The grout holes shall be used to fill the void spaces with 1:3 Portland cement grout at sufficient pressure to prevent settlement of the roadway, unless NCDOT approval stipulates otherwise. Other grout mixtures may be submitted for approval.

i) In the event that an obstruction is encountered during the trenchless operations, the equipment shall be withdrawn. The pipe shall be cut off, capped, and filled with 1:3 Portland cement grout at a sufficient pressure to fill all voids before moving to another boring site.

j) Restrained joint ductile iron carrier pipe shall be pulled into the casing pipe.

k) For all trenchless operations of 100-ft or more, the ground surface elevations shall be recorded prior to beginning work.
    i. At a minimum, survey points shall be identified with a nail or hub located as follows:
        - Road crossings: Centerline and each shoulder/curb
        - Utility and Pipeline Crossings: Directly above and 10-ft each side of the crossing
        - All locations: Points shall not exceed 50-ft spacing.
    ii. Elevations at each point shall be recorded with an accuracy of 0.01-feet.

l) Settlement observations shall be made each day until the pipe/casing is fully installed.

m) Readings shall be reported to the Infrastructure Field Technician.

n) In the case of observed settlement, the monitoring points and observation frequency shall be increased as determined by Cary.

5. External corrosion protection

a) External corrosion can occur at an accelerated rate in metallic pipelines such as steel and ductile iron when they are installed in aggressive soils or when they are installed near other structures or utilities that carry impressed currents. Such facilities that typically utilize impressed current cathodic protection are gas pipelines, such as owned by Colonial Pipeline, Cardinal Pipeline and Dixie Pipeline. Other potential sources that may create stray currents that contribute to accelerated pipeline corrosion are high voltage power transmission lines and railroad crossings.

b) In cases where metallic steel and ductile iron pipelines or encasement pipes are planned for installation in close proximity to any potential sources of stray current or aggressive soils, zinc coated pipe shall be specified and a field analysis consisting of stray current evaluation and soil testing shall be conducted by an experienced technician, as certified by the National Association of Corrosion Engineers, (NACE), to determine the potential for external corrosion and the need for additional protection measures. In cases where stray current conditions and/or aggressive soils are prevalent, a corrosion specialist certified by the NACE or other applicable certification board shall be consulted regarding the design of pipeline protection measures.

c) At a minimum, all stray current protection systems should include bonded joints and sacrificial anodes with a 50-year or longer design life and test facilities in lieu of polyethylene encasement, unless otherwise approved by Cary. The cathodic protection element of the pipeline design package shall be sealed by Professional Engineer licensed in the State of NC.

d) Full impressed current cathodic protection shall only be utilized when extreme corrosion potential has been proven and/or as otherwise directed by the Utilities Department and the certified corrosion engineer of record.

D. PIPE IDENTIFICATION AND MARKING

1. Marking Tape
   a) Installation: Marking tape shall be installed continuously and longitudinally along all water mains and water services for new construction and for any repair or retrofit construction using open trench methods. For service connections, the marking tape shall extend from the main line to the water meter. Marking tape shall be installed directly above the center of the pipe and at least 24-inches deep from final grade to a maximum depth of 36-inches below final grade.

   b) Specifications: The water main marking tape shall be an approved product identified in Cary's Approved Products List. The marking tape shall be made of polyethylene (or approved equivalent) material, 6-inches wide and a minimum of 6 millimeters thick. The marking tape shall have detectable markers embedded in the tape and spaced adequately to provide continuous detection along the tape from above the buried pipe at final grade. The tape shall be blue in color and shall be marked with words "CAUTION WATER LINE BURIED BELOW" (or an approved equivalent wording). The wording shall be repetitive along the full length of the tape.

2. Marker Balls
   a) Installation: Non-programmable marker balls are required at the ends of all casing pipe, fittings and reducers. Marker balls shall be used in addition to

marking tape within thoroughfares and within 100-ft of a signalized intersection. Through signalized intersections, marker balls shall be spaced at 25-ft intervals. They shall also be installed along and directly above all water mains in conditions where marking tape cannot be installed due to restrictions or conflicts. In these conditions, non-programmable marker balls shall be placed, at all vertical and horizontal deflection points, at all tees and crosses and at a spacing along the main no greater than 100 feet apart. Each marker ball shall be installed directly above the center of the pipe and at least 24-inches deep from final grade to a maximum depth of 36-inches below final grade. Any sections where tape cannot be accurately placed at time of backfilling sufficient survey data shall be collected to reestablish location for tape installation. A table of marker ball locations, with description, must be submitted as part of the record drawing.

b) Specifications: The Marker Ball is a non-programmable ball and shall be an approved product identified in Cary's Approved Products List. The marker ball shall be blue in color for potable water and conform to APWA standards. It shall have a minimum detectable depth of 5 feet.

6020 FIRE PROTECTION

A. FIRE HYDRANTS

1. Location

a) All fire hydrants shall be installed on a minimum 6-inch public water line. New fire hydrants are not permitted on private water lines. Only one fire hydrant may be installed when the line is served by a 6-inch tap and is not looped to another main. There shall be at least one fire hydrant at each street intersection. The minimum acceptable flow for fire hydrants is 1000-gpm at minimum 20-psi residual in residential areas and 1500-gpm at minimum 20-psi residual in other districts. Hydrants at intersections shall be located in accordance with the Standard Details. Valves provided on the fire hydrant branch supply line shall be located within 5-ft of the main line. The fire hydrant shall be a minimum of 24-inches from the valve.

b) In residential districts the maximum distance between hydrants, measured along street centerlines, shall be 500 feet. When residential intersections are less than 700 feet apart, a hydrant is not required between the intersections.

c) In business, office and institutional, and industrial zoning the maximum distance between hydrants, measured along street centerline, shall be 300 feet. When business, office and institutional, and industrial intersections are less than 450 feet apart, a hydrant is not required between intersections

d) On thoroughfares and collector streets with access points only at street intersections, hydrants shall be located at each street intersection and at 1000-foot intervals along the street. Where these intersections are less than 1200 feet apart, no hydrant is required between the intersections. Fire hydrants shall be placed in a staggered arrangement on both sides of any roadway classified as a major or minor thoroughfare with the hydrant spacing as referenced above.

e) Where sprinkler systems are used, a fire department connection shall be within 50 feet of an accessible fire hydrant except within the *Business Improvement District* where greater lengths may be permitted. See Section 6020 B for other sprinkler system requirements.

2. Specifications: Hydrants shall conform to AWWA C502 with a minimum valve opening of 4 1/2 inches. Hydrants shall be furnished with a 4 1/2-inch steamer* and double 2 1/2 inch hose connections with caps and chains, National Standard Threads, mechanical joint, 1 1/2 inch pentagon operating nut, open left, painted fire hydrant red, bronze to bronze seating, a minimum 4 foot bury depth with a break away ground line flange and break away rod coupling. The hydrant bonnet will be designed with a sealed oil or grease reservoir with O-ring seals and a Teflon thrust bearing. Fire hydrant caps shall be attached to the body of the hydrant with a minimum 2/0 twist link, heavy duty, non-kinking, machine chain. All fire hydrants shall be designed and rated for a working pressure of 250-psi or greater.

   * For hydrants located within the Town of Morrisville only: Where Fire Department Connections are provided to buildings, the hydrant closest to the FDC shall be supplied with a 5-inch Storz connection in lieu of the 4 1/2 inch steamer connection. The Storz connection shall be by the hydrant manufacturer only and come as part of the hydrant assembly. No adapters for the Storz connection are allowed.

3. Installation: Hydrants shall be set plumb, properly located with the pumper nozzle facing the closest curb of a fire lane or street, but not a parking space. The back of the hydrant opposite the pipe connection shall be firmly blocked against the vertical face of the trench with 1/3 cubic yard of concrete. Double bridle rods and collars shall be connected from the tee to the hydrant. All joints between the tee and the hydrant shall be mechanical joints restrained with wedge action retainer glands. Stainless steel rods not less than 3/4 inch diameter may also be used to restrain the assembly. A minimum of 8 cubic feet of stone shall be placed around the drains. The backfill around the hydrants shall be thoroughly compacted and closely match the elevation on the approved plans. Hydrant extensions will not be allowed on new or retrofit installations. Hydrant installation shall be in accordance with Cary Standard Details. Hydrant tees may be used upon approval of the Utilities Department.

4. Depth of Bury:

   Typical 90-Degree Hydrant Shoe Installations:
   The maximum depth of bury for all new fire hydrants with 90-degree hydrant shoes shall be 5-ft from the breakaway flange connection. The breakaway flange or safety coupling shall be oriented vertically just above finished grading and bolted directly to the fire hydrant in compliance with manufacturer standards. The breakaway flange or safety coupling shall not be buried.

   Vertical Shoe Hydrant Installations:
   For installations requiring depth of bury greater than 5-ft, the fire hydrant shall be equipped with a vertical shoe arrangement that provides for full extension of the lower valve plate against a stopping mechanism located inside the vertical shoe to maximize hydraulic flow conditions through the hydrant. The vertical shoe shall be equipped with flanged connections. The maximum depth of bury for vertical shoe installations shall not exceed 4-ft measured from the breakaway flange to the bottom of the vertical hydrant shoe. The vertical shoe and all piping included in the hydrant supply line shall be restrained with blocking and rodding or blocking with wedge action retainer glands or standard Aquagrip connections.

   In all cases where the vertical shoe is utilized, typical washed stone bedding extending at least 12-inches on all sides of the central axis and extending from the top of the vertical shoe downward to at least 12-inches below the vertical shoe shall be provided surrounding the vertical hydrant shoe assembly to assure positive drainage. In cases where Aqua-grip connections are not utilized, piping below the vertical shoe shall be provided in a flanged by plain end configuration and restrained with wedge action retainer glands to the lower mechanical joint fitting or the lower fitting shall be blocked and rodded to the vertical shoe connection. The entire assembly shall be restrained and support blocking shall be provided under the vertical bend assembly.

5. Hydrant Relocations: For installations where hydrants will be relocated, all hydrants with greater than 10-years of operational service, as indicated by the date of manufacture provided on the hydrant, shall be replaced with new fire hydrants. The existing fire hydrant shall be turned over to Cary's Public Works Department.

   For installations where the hydrant to be relocated has less than 10-years of operational service, the existing hydrant may be relocated. The existing hydrant shall still be disinfected, flushed and pressure tested.

B. AUTOMATIC FIRE SPRINKLER SYSTEMS

1. General: Working plans and calculations for all automatic fire sprinkler and standpipe systems shall be submitted to Cary's permitting department through the electronic plan review portal for review and approval before installation. If 20

sprinkler heads or more are modified or added to an existing sprinkler system, if any modifications occur in the hydraulically calculated remote area, or the hazard classification changes, a plan submittal including complete calculations and a permit will be required. All fire sprinkler systems shall be installed with an alarm check valve installed in each riser with all required appurtenances (example: retard chamber, water motor gong, pressure gauges, etc.). Exception: NFPA 13 D and 13 R residential sprinklers when approved by a fire official. All installations, minor repairs, or minor replacements shall be performed by a licensed fire sprinkler contractor. Contact the Inspections and Permits Department for a permit application.

2. Design: Approved working plans shall be in complete compliance with NFPA No. 13, 13D, 13R, 14, 16, 20, 22, 24 and Cary Specifications. An NFPA above ground material and test certificate and NFPA underground material and test certificate are required after completion of designated, approved work.

3. Hydraulic Design: If a system is hydraulically designed, the following design criteria must be followed:

   a) Safety Margin: In all cases, a fixed minimum safety margin of at least 10-psi shall be applied to the design calculations. (Example: Demand = 70 psi, Supply $\geq$ 80 psi)

   b) Hose Allowances: Both exterior and interior hose allowances shall comply with NFPA 13 requirements.

   c) Water Supply Pressure: The sprinkler system designer shall be responsible for verifying system pressure. Refer to Cary Policy Statement 129l regarding Minimum Water Supply Pressure.

4. Backflow Prevention: When a fire protection system is proposed, with a Fire Dept. connection or as otherwise required by the Cross Connection Ordinance a reduced pressure principle detector assembly (RPDA) shall be installed on the supply side of the sprinkler fire protection line inside the riser room. These backflow prevention devices must be UL listed and/or listed by Factory Mutual Research Corporation. Reduced pressure principle detector assemblies shall not be arranged vertically. For all RPDA's, a relief valve fill cup piped outside the building shall be provided. The relief valve drain may be piped to the main building drain.

5. Post Indicator Valve (PIV): A post indicator valve shall be provided at the right of way or edge of easement no more than 40 feet from the building if space permits. Each connection into the building shall have a post indicator valve. The top of the PIV shall be 30-42 inches above finished grade and 36-inches of unobstructed access perimeter shall be maintained around the PIV. See Cary's Approved Backflow List at www.CaryNC.gov.

In urban settings, a wall mounted indicator valve may be used where there is no suitable location for a post mounted indicator valve. Wall mounted indicator valves shall be centered 30–42 inches above the finished grade. It shall be greater than 10-ft from any door, window, or other protected opening along the wall.

All indicator valves regardless of type shall have an electronically controlled tamper switch. All PIVs shall be made of ductile iron construction and shall be UL listed and FM approved. The standpipe of all PIV's shall be painted red. Cary shall maintain up to the post indicator valve. Where wall mounted indicator valves are used, Cary shall maintain up to a location 10 feet outside of the building or as designated on the approved plans.

6. Fire Department Connection: Where standpipe systems or combination sprinkler/standpipe systems are used, a fire department connection with 5-inch Storz connections shall be provided within 50-ft of an approved fire hydrant. All 5-inch Storz FDC's shall be installed in accordance with Cary Standard Detail 6000.35 or 6000.36.

   a) Except, where buildings are only protected by automatic fire sprinkler systems, a 2.5-inch Siamese fire department connection with National Standard threads shall be provided within 50-ft of an approved fire hydrant, except for townhomes, apartment buildings, and within urban settings where greater lengths may be permitted. All 2.5" Siamese FDC's shall be installed in accordance with Cary Standard Detail 6000.28.

   b) When a sprinkler system serves only part of a large structure, the fire department connection shall be labeled, with minimum 2-inch letters on a permanent sign, as to which section of the structure that sprinkler riser serves.

   c) Automatic sprinkler systems and/or standpipe systems that require 150 psi and above, shall have a sign indicating the pressure required at the inlets to deliver the system demand at all Fire Department Connections.

7. Dedicated Riser Room: A dedicated sprinkler riser room is required providing an entry door to the room from the exterior of the building. All dedicated riser rooms shall be equipped with a floor drain sized appropriately to prevent flooding. The floor drain shall be piped to storm system or main building drain. The floor drain shall be provided with a circular raised ring/hub around the floor drain to prevent debris and/or chemicals from entering the drain during an emergency spill. The hub shall be fabricated of cast iron or other corrosion resistant material and extend at least 3-inches above floor elevation.

8. Alarm Communication: All sprinkler systems are to have alarm communication equipment to fully comply with NFPA 72. Equipment must be fully functional and

reporting to a UL listed central receiving station before a Certificate of Occupancy is issued for the facility.

9. Access: All buildings which have an elevator, a fire alarm system monitored by a central receiving station, or a fire sprinkler protection system shall provide a “Knox Box” key entry system (Knox Co.). This “Knox Box” shall be mounted on the exterior entrance to the dedicated riser room or at the normal fire department entrance when no fire sprinkler system is provided and there is no dedicated riser room. Mount “Knox Box” on wall at 5 feet A.F.F. on door handle side of dedicated riser room door or entrance door. This “Knox Box” shall be ordered through the Cary Fire Department and shall be in place before a Certificate of Occupancy is issued. Keys to access the facility shall be provided to the Fire Department by the owner/manager.

10. Identification: The exterior door leading to the dedicated sprinkler riser room shall be labeled with minimum 2-inch lettering designating “SPRINKLER RISER ROOM” in a contrasting color. Durable vinyl lettering is suggested.

11. Fire Alarm Panel Location: When a building is protected by an automatic sprinkler system and has a fire alarm system, the fire alarm control panel or a remote annunciation of the fire alarm control panel shall be placed in the sprinkler riser room. This control panel shall have the capacity of silencing and resetting. Adjacent to the fire alarm control panel shall be a framed zone map. Nomenclature shall correspond with the zone map. All plans and specifications must be submitted to Cary’s permitting department through the electronic plan review portal for approval prior to installation of equipment or wiring. When there is no sprinkler system in a building, the fire alarm control panel or remote annunciator shall be located at the normal fire department entrance.

C. FIRE PROTECTION DURING CONSTRUCTION

The fire protection water supply system, including fire hydrants, shall be installed and be in at least the functional status prior to placing combustible materials on the project site. In addition, functional status includes adequately installed and maintained access to the construction project, with the first layer of asphalt installed. If phased construction is planned, coordinated installation of the fire protection water system is permitted. Coordination of the water system will be done through the Utilities Department. Functional status would include meeting all standards set forth in Section 6060 "Testing and Inspections".

6030 VALVES AND APPURTENANCES

A. VALVES

1. General

   a) Valves shall be installed on all branches from feeder mains and hydrants according to the following schedule: 4 valves at crosses; 3 valves at tees; one valve on each hydrant branch and elsewhere as directed by the Director of Utilities. When a loop section of water line is connected back into the feeder main within a distance of 200 feet or less, only one valve will be required in the feeder main. In all cases where new water mains are connected to an existing water distribution line, valves shall be located at all end points and at intermediate points throughout the new system extension to assure testing requirements can be met without interfering with the operation of the existing system.

   b) Where no water line intersections are existing, a main line valve shall be installed at every 100 feet per 1 inch diameter main up to a maximum distance of 2000 feet between valves.

   c) Valves shall be properly located, operable and at the correct elevation. The maximum depth of the valve nut shall be 6 feet without an extension kit. When valve extension kits are used, they must be manufactured by the same company which manufactured the valve.

2. Combination Air Valves

   a) Combination air valves shall be provided to purge air from the system at startup, vent small pockets of air while the system is being pressurized and running, and prevent critical vacuum conditions during draining. Combination air valves rated for potable water use shall be installed at all high points of water lines 8 inches in diameter or larger and at other locations such as major changes in grade as directed by Cary. A high point shall be determined as any high location where the difference between the high elevation and adjacent low elevation exceeds 10-ft, unless otherwise determined by the Director of Utilities based on special circumstances.

      All combination air valves shall be provided in conformance with AWWA C-512. The water main shall be installed at a grade which will allow the air to migrate to a high point where the air can be released through an air valve. A minimum pipe slope of 1 foot in 500 feet should be maintained.

   b) The combination air valve shall be sized by the Engineer and approved by Cary. Combination air valves shall be of the single housing style with Type 304 or 316 stainless steel body that combines the operation of both an air/vacuum and air release valve. The valve shall be rated for minimum 230 PSI working

pressure. The combination air valve shall be provided with cylindrical shaped floats and anti-shock orifice made of high-density polyethylene. Combination air valves with spherical floats shall not be accepted. All combination air valves shall be installed in accordance with Cary Standard Details.

c) 2-inch combination air valves shall be installed in a standard 4-foot diameter eccentric manhole. The 2-inch valve shall have a 2-inch male NPT inlet. Connection to the main shall be with a saddle tap in the same sizing as the combination air valve assembly and isolated with a gate valve also of the same size. The isolation gate valve shall be provided with NPT threads and connected with "no lead" brass (meeting UNS C89833 as per ASTM B584) or bronze piping. Brass or bronze ball valves may be used in lieu of gate valves for 2-inch installations. The isolation valve shall be rated for 200-psi service or greater.

d) Combination air valves 3-inches and greater shall be installed in a flat top manhole sized according to the water main diameter. Mains less than or equal to 20" shall utilize a 5-foot diameter manhole and larger mains shall utilize a minimum 6-foot diameter manhole. All connections shall be by flange joints. Connection to the main shall be by an MJ x FLG tee with the branch diameter equal to at least half of the main diameter. If needed due to larger diameters, a flanged reducer shall be provided prior to the flanged gate valve sized equally to the flanged combination air valve.

e) Precast concrete manholes shall meet the requirements of section 7020. Manholes shall be provided <u>without</u> steps.

3. <u>Gate Valves, less than 4-inches for Blowoff Assemblies</u>

Gate valves for blowoff installations sized smaller than 4-inches, shall be resilient seated wedge type with a non-rising stem and a 2-inch operating nut in compliance with AWWA C509. The smaller diameter gate valves shall be provided with triple O-ring seals and threaded end connections in compliance with ANSI B2.1. Gate valves smaller than 2-inches shall be identified "no lead" and consist of brass components designated under UNS C89833 as per ASTM B584. The small diameter gate valves shall be rated for a minimum pressure rating of 200-psi.

4. <u>Gate Valves, 4-inches to 12-inches</u>

All valves for potable water applications, 12-inches in diameter and smaller shall be resilient seated wedge gate valves in conformance with the requirements of AWWA C509, (grey or ductile iron body) or AWWA C515, (reduced wall ductile iron body). All coating materials used in the construction of gate valves for potable water applications must comply with NSF 61 to assure lead free construction and meet the requirements for extractables. All gate valves shall be designed for a working pressure of 250-psi with a minimum UL listing and FM approval rating of

200-psi. Gate valves shall be fusion bonded epoxy (FBE) coated both interior and exterior at a nominal thickness of 6-8-mils and the FBE coating shall be provided in conformance with AWWA C550. All gate valves shall be assembled with stainless steel bolts.

All gate valves 12-inches in diameter and smaller shall be installed in the vertical position and shall be provided with mechanical joint fittings. Gate valves shall be restrained by wedge action retainer glands or other approved manufacturer provided restraining systems. All gate valves shall open left with a non-rising stem (NRS) and be provided with a 2-inch square operating nut. All gate valves shall be constructed with triple O-ring seals in which 2 O-rings are located above the thrust collar and 1 O-ring is located below the thrust collar. The two upper O-rings shall be replaceable with the valve fully open and subjected to full rated working pressure.

The gate valve wedge shall be fully encapsulated in rubber. All valves shall be rated for bi-directional flow. All sealing gaskets shall be made of EPDM rubber materials.

5. Gate Valves, 14-inches through 48-inches

   Gate valves 14-inches through 48-inches shall be resilient seated wedge gate valves in conformance with the requirements of AWWA C515, (reduced wall ductile iron body) and shall comply with all Specifications outlined for gate valves 4 through 12 inches. Gate valves installed vertically shall be provided with a minimum of 2-ft of overhead clearance between the top of the operator nut and the finished grade. All gate valves 18-inches and greater shall be provided with a geared actuator. Vertical gate valve installations shall have spur gear actuators and horizontal installations shall have bevel gears.

   Gate valves 18 inches in diameter shall be provided with a gear operator at a minimum 2:1 ratio and larger valves through 24-inches shall be provided with a gear operator at a minimum 3:1 ratio.

   Gate valves installed in a horizontal position shall only be provided as permitted by the Director of Utilities for special circumstances where vertical alignment is not possible. All horizontal gate valves shall meet or exceed the Specifications outlined herein for vertical gate valves including the 250-psi pressure rating. All horizontal gate valves shall be equipped with bevel gears resulting in a minimum 4:1 turn ratio for valves 30 through 48-inches in diameter.

6. Insertion Valves, 12-inches and under: Insertion valves shall only be used as permitted by the Utilities Department. Insertion valves shall meet the requirements of AWWA C515, seat on the valve body and be rated for a working pressure of 250-psi or greater. All insertion valves shall be made of ductile iron in conformance with ASTM A-536 Grade 65-45-12 and epoxy coated at a minimum of 10-mils.

Insertion valves under this section are available for pipe sizes through 12-inches in diameter. Larger insertion valves shall meet requirements for Insertion Valves, 16-inches through 24-inches, below. In cases where insertion valves are being installed to shut down water to a work zone area, the insertion valve shall be located a minimum of 100-ft from the work zone or greater as determined by the Engineer of Record to assure the insertion valve can safely operate as a dead end without dislodging from the pipeline or otherwise causing the existing pipeline to shift.

Disinfection – During installation of any insertion valve, positive pressure in the distribution system shall be maintained at all times. Once the water main is exposed and the trench is adequately dewatered, the exterior of the main and all insertion valves and equipment, including the cutter head and valve gate shall be cleaned and disinfected pursuant to AWWA C651-14 by spraying or swabbing with a minimum 1% chlorine solution.

Insertion Valves shall be Resilient Wedge Gate Valves, designed for use in potable water systems and be listed on Cary's Approved Products List. The body, bonnet and wedge shall be ductile iron meeting or exceeding AWWA C515. Insert Valves shall be ductile iron construction meeting ASTM A536 Grade 65-45-12. The pressure rating markings must be cast into the body of the insert valve.

Chemical and modularity tests shall be performed as recommended by the Ductile iron Society, on a per ladle basis. Testing for tensile, yield and elongation shall be done in accordance with ASTM E8.

Sizes 12" and smaller must be capable of working on Cast/Grey Iron or Ductile Iron Class A, B, C and D, IPS PVC, C900 and C909 PVC, Steel, AC pipe diameters without changing either top or bottom portion of split valve body.

After the installation of the insert valve body on to the existing pipe a pressure test of 1.1 times that of the contents shall sustained for 15 minutes. Once the pressure test is effectively achieved the insert valve body must not be moved in accordance with AWWA Standards. If the insert valve is moved the pressure test must be completed again. The insert valve must not be moved or repositioned once the pressure test is achieved.

The construction of the Resilient Wedge shall comply with AWWA C509 requirements. The ductile iron wedge shall be fully encapsulated with EPDM rubber by a high pressure and high temperature compression or injection mold process. The ductile gate shall be fully coated with molded rubber with no exposed iron.

The resilient wedge shall seat on the valve body and not the pipe to obtain the optimum seating and flow control results. The resilient wedge shall be totally independent of the carrier pipe. The resilient wedge shall not meet the carrier pipe

or depend on the carrier pipe to create a seal. Pressure equalization on the down or upstream side of the closed wedge shall not be necessary to open the valve. The wedge shall be symmetrical and seal equally well with flow in either direction.

The Resilient wedge must ride inside the body channels to maintain wedge alignment throughout its travel to achieve maximum fluid control regardless of high or low flow pressure or velocity. Insertion valve shall provide an unobstructed flow way.

The insert valve shall be fully epoxy coated with minimum of 8 mils of epoxy on the interior and the exterior, including bolt holes and body-to-bonnet flange surfaces, prior to assembly, in compliance with AWWA C550 and certified to ANSI/NSF-61.

The insert valve shall include triple O-Ring stem seals with two O-Rings located above, and one O-Ring below the thrust collar. Side flange seals shall be of the O-Ring type of either round, oval, or rectangular cross-sectional shape.

The gate valve stem and wedge nut shall be copper alloy in accordance with Section 4.4.5.1 of the AWWA C515 Standard. The stem shall be NRS with AWWA standard turns and must have an integral thrust collar in accordance with Section 4.4.5.3 of AWWA C515 Standard. Two-piece stem collars are not acceptable. Operated by 2” square wrench nut according to ASTM A126 CL.B and open left.

The wedge nut shall be independent of the wedge and held in place on three sides by the wedge to prevent possible misalignment. Two thrust washers are required. One shall be located above, and one located below the stem thrust collar.

All parts and components to be exclusively and completely assembled, manufactured, machined, and coated in the USA. All physical and chemical test results shall be recorded such that they can be accessed via the identification number on the casting. These Material Traceability Records (MTR’s) are to be made available to the purchaser that requests such documentation. All components shall be manufactured and assembled in the United States. The purchaser shall, with reasonable notice, have the right to plant visitation at his/her expense.

Bolting materials shall meet the requirements of ASTM A307 with dimensions conforming to ANSI B18.2.1.

The stuffing box, operating stem, and resilient wedge (complete bonnet and all moving parts) shall be removable, repairable and or replaceable under pressure without additional pipe penetration taps or foreign methods. While the valve is fully pressurized in the system all moving components shall be fully removable under pressure. In the event the valve stem is broken or damaged the bonnet shall be removable under pressure.

Restraint devices shall consist of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of ANSI/AWWA C110/A21.10 Restraint devices shall have a working water pressure rating of 350 psi for 4-12 inch and must include a minimum safety factor of 2 to 1 in all size and be approved by Cary. Gland body wedges and wedge actuating components shall be cast from grade 65-45-12 ductile iron material in accordance with ASTM A536. Mechanical joint restraint shall require conventional tools and installation procedures per AWWA C600, while retaining full mechanical joint deflection during assembly as well as allowing joint deflection after assembly. Proper actuation of the gripping wedges shall be ensured with torque limiting twist off nuts. Set screw pressure point type hardware shall not be used. Restraint devices shall be listed by Underwriters Laboratories and Approved by Factory Mutual (3" through 12" inch size).

Manufacturer's installation procedures shall be strictly adhered to, including the installation of vacuum flange, checking, removing and confirmation of removal of shavings in the valve body. Installation procedures shall be approved by Cary prior to installation of insertion valve.

Prior to installation, the operating pressure shall be confirmed with Cary Utilities Department. Valve pressure testing procedures shall be approved by Cary Utilities Department, Cary Inspection Department and Manufacturer prior to installing.

Contractor shall confirm existing pipe outside diameter prior to purchasing insertion valve.

7. Insertion Valves, 16-inches through 24-inches: Insertion valves shall only be used as permitted by the Utilities Department. Disinfection procedures listed in item 6 above shall be required.

8. Valve boxes

   a) Valve Boxes shall be cast iron, screw type, with a 5-inch opening, and "water" stamped on the cover. The cover shall be 6-inches in depth. All valve box assemblies and covers shall be cast from Class 35 gray iron and domestically made and manufactured in the USA.

   b) Valve box ring adjustments will not be allowed. The valve box shall be centered over the wrench nut and seated on compacted backfill without touching the valve assembly. All valve boxes in pavement shall be flush with the top of the pavement or flush with the finished grade. Outside of paved areas precast concrete valve box encasements or a trowel finished 2' x 2' x 6" pad of 3000-psi concrete may be used for valve box encasement provided the assembly is buried flush with the surface grade and compacted properly to prevent movement of the precast encasement.

9. Actuators: All valves shall be provided with standard 2-inch operating nuts. Unless otherwise specified, the direction of rotation to open the valves shall be to the left, (counterclockwise), when viewed from the top. Each valve body or actuator shall have cast thereon the word “OPEN” and an arrow indicating the direction to open.

B. APPURTENANCES

1. Blowoffs:

   a) Blowoffs shall be a minimum of 2 inches and installed at the end of all dead-end water lines. Where there is not sufficient pressure or fire hydrants to thoroughly flush the system, a larger blowoff shall be required.

   b) Blowoff Assemblies shall be constructed as shown in Cary Standard Details. The valves shall be gate type with a non-rising stem and a 2-inch operating nut, O-ring seals and screwed ends. A full-size gate valve is required on water mains that are planned to be extended.

2. Reaction Blocking: Material for reaction blocking shall be 3000 psi concrete, poured in place. The reaction areas are shown in Cary Standard Details. A minimum 4 mil plastic shall cover the fitting to ensure that no concrete will interfere with removal of the fitting.

3. Rodding: All rodding shall be constructed with type 304 stainless steel rods at the number and sizing specified in the following table. Rod coupling shall not be allowed. All hardware shall also be stainless steel type 304.

   Stainless Steel Rod Requirements are as follows:

4-inch branch	2, ¾-inch stainless steel rods
6-inch branch	2, ¾-inch stainless steel rods
8-inch branch	4, ¾-inch stainless steel rods
12-inch branch	6, ¾-inch stainless steel rods
16-inch branch	8, ¾-inch stainless steel rods

4. Wedge Action Retainer Glands:
   All wedge action retainer glands shall be manufactured as a one-piece retainer gland for use with mechanical joints and shall be rated to provide restraint up to 350-psi pressure rating for sizes through 16-inches. For sizing above 16-inches, the wedge action retainer gland shall be rated to provide restraint up to 250-psi. Approved wedge action retainer glands shall be made of ductile iron, coated with a manufacturer applied epoxy coating or polyester powder coating.

   In cases where wedge action retainer glands are approved for pipe restraint of fire hydrant supply lines or other applications, the entire hydrant supply line shall be restrained.

Wedge action retainer gland connections to push on pipe are not approved.

5. Sampling Stations:
   Sampling Stations shall be provided at all new residential and commercial development areas at the rate of 1 sampling station per development complex consisting of at least 200-homes or 1- per 10 acre or greater commercial complex or 1 per institutional facility with more than 100,000 square feet or as otherwise required by the Director of Utilities. Padlocks for sampling stations shall be provided by Cary's Public Works Dept. The sampling station requirement may be waived in cases where area sampling is already deemed sufficient by the Water System Operator.

Sampling stations shall be provided as a self-contained manufactured assembly with locking aluminum housing, stainless steel tube and unthreaded spigot. Sampling stations shall not be connected to a service line.

6040 WATERMAIN TAPS AND SERVICES

A. DESIGN

1. Individual water services shall be provided from the main to each water meter for single family residences in accordance with the Details. All connections shall be made by wet taps. Service connections shall be made perpendicular to the main and shall run straight to the meter.

2. Individual taps to the main shall be provided for the domestic service, fireline service and hydrant lateral in accordance with the Standard Details.

3. All water service lines shall be installed with a minimum depth of cover of 24-inches or greater.

4. All water service lines shall be installed with a minimum distance to adjacent infrastructure of 5 feet on either side of the service. This shall include both domestic and fire service lines.

5. All water meter boxes and vaults shall be located at the edge of the serviced lot's right of way or easement. Water meter boxes shall not be placed in streets, sidewalks, parking areas or obstructed by fencing or buildings. A 10-foot clear zone shall be maintained behind meter boxes and vaults. In addition, within townhouse developments, water services shall be located within 4-feet of driveways in order to minimize conflicts between service lines and trees.

6. All meter boxes shall be protected during construction by installation of tree protection fencing or some other acceptable material. Material will be adequately maintained throughout the construction period to prevent damage and contamination of the sewer system.

7. Provisions for backflow prevention shall be in accordance with existing Cary policies and the NC Plumbing Code.

8. The water meter shall be sized based on water demand. All water service lines shall be minimum 1 inch diameter. Multiple branches up to a maximum of 2 potable water services per multiple branch assembly for a single residential use shall be sized by the Engineer of Record in accordance with AWWA M22 but shall not be less than 1.5-inches in diameter. Gang Service Boxes are prohibited.

9. Service taps 2 inches or less to existing water lines shall be made by Cary except if approved on development plans. Service taps greater than 2 inches to existing water lines shall be made by a Contractor of the Developer after obtaining applicable permits and paying applicable fees.

10. Service taps to new water lines shall be made by the Contractor in accordance with the Specifications after obtaining applicable permits and paying applicable fees.

11. All taps shall be in accordance with Policy Statement 95.

12. No taps shall be made within 3-feet of the bell or spigot end of the pipe.

B. MATERIALS

1. Disinfection – During installation of any tapping sleeve or saddles, positive pressure in the distribution system shall be maintained at all times. Once the water main is exposed and the trench is adequately dewatered, the exterior of the main, all materials and equipment, including tapping sleeves and tapping valves, shall be cleaned and disinfected pursuant to AWWA C651-14 by spraying or swabbing with a minimum 1% chlorine solution.

2. Full Body Tapping Sleeves: Mechanical Joint tapping sleeves shall be fabricated of ductile iron construction in a two-piece assembly with mechanical joint connections to the main line and flanged connection to the tapping valve. All MJ tapping sleeves shall be rated for a working pressure of 200-psi or greater and provided with a ¾-inch test plug for testing. All tapping sleeves shall be hydrostatically tested up to 200-psi before a tap is made. Tapping sleeves shall not be air tested.

   All mechanical joint tapping sleeves shall be manufacturer fabricated and approved for installation on the specific main line pipe material, whether ductile iron, plastic, cast iron or asbestos cement.

   Full body tapping sleeves must be used when the main line is greater than 24-inches. Tapping sleeves fabricated of carbon steel in a two-piece assembly with

mechanical joint connections to the main line and flanged connection to the tapping valve will be considered for approval on a case-by-case basis for mains that are greater than 24-inches. Carbon steel sleeves should be rated for a working pressure of 250-psi or greater and be provided with a ¾-inch test plug. A fusion bonded epoxy coating shall be applied to all carbon steel sleeves.

3. Stainless Steel Tapping Sleeves, 6-inch through 12-inch main lines:
   Stainless steel tapping sleeves may be used in lieu of mechanical joint tapping sleeves for ductile iron or asbestos cement water mains through 12-inches in diameter with branch sizing as shown in the following table. All stainless-steel tapping sleeves shall be manufactured in conformance with AWWA C223. All stainless-steel tapping sleeves shall have a stainless-steel flange and be provided in a two-piece assembly with a full circumferential gasket with tabbed gasket holding assembly and ¾-inch test plug. The back band shall be a minimum 14-gauge stainless steel and the front band (where the outlet is located) shall be a minimum 12-gauge stainless steel. The bolt bars shall be a minimum 7-gauge stainless steel. All stainless-steel tapping sleeves shall be manufacturer rated for a working pressure of 200-psi or greater and hydrostatically tested to 200-psi before a tap is made. Stainless steel tapping sleeves shall not be air tested.

Stainless Steel Tapping Sleeve Sizes Allowed

Nominal Main Size (inches)	Nominal Branch Size (inches)
6	4
8	4
10	4
10	6
12	4
12	6
12	8

4. Stainless Steel Tapping Sleeves, 14-inch through 24-inch main lines:
   For larger diameter water mains, stainless steel tapping sleeves approved by Cary may be used in lieu of a mechanical joint tapping sleeve for cases where the branch line is 50% or less in diameter than the main line diameter. All the previous Specifications described for tapping sleeves from 6 to 12 inches shall be met for stainless steel tapping sleeves for larger diameter water mains. Additionally, the outlet band for stainless steel tapping sleeves 14-inches through 24-inches shall be a minimum 7-gauge stainless steel. The back half of the sleeve shall be a minimum 12-gauge stainless steel.

5. Tapping Saddles, 14-inch through 24-inch main lines:
   Tapping Saddles may be used in lieu of mechanical joint tapping sleeves to tap mains 14 inches through 24-inches when the branch line is 50% or less in diameter than the main line diameter. Saddles shall be made of ductile iron providing a factor of safety of 2.5 with a working pressure of 250-psi. Saddles shall be equipped with an AWWA C110 flange connection on the branch. Sealing gaskets

shall be O-ring type, high quality molded rubber having an approximate 70 durometer hardness, placed into a groove on the curved surface of the saddles. Straps shall be alloy steel. The minimum strap count for branch sizing from 4-12 inches is shown below.

Strap Requirements for Tapping Saddles

Nominal Saddle Outlet (inches)	Number of Straps
4	3
6	3
8	4
12	7

6. Service Line Taps: The maximum size of direct taps for ductile iron water mains 6-inches to 12-inches without a fitting, tapping sleeve or saddle shall be 1-inch. Any taps larger than 1-inch or any size tap on mains larger than 12-inches shall be provided with a saddle tap.

7. Corporation Stops:

   a) Corporation Stops shall be ball type, made of “no lead” brass (meeting UNS C89833 as per ASTM B584). Corp stops shall be complete with a compression coupling and AWWA Standard threads as per AWWA C800. Taps shall be located at 10:00 or 2:00 o'clock on the circumference of the pipe. Service taps shall be staggered alternating from one side of the water main to the other and at least 12 inches apart. The taps must be a minimum of 24 inches apart if they are on the same side of the pipe. All corporation stops shall be rated for a working pressure of 300-psi.

   b) No burned taps will be allowed and each corporation stop will be wrapped with Teflon tape for ductile iron pipe water mains. No taps are allowed on a fire hydrant line. No tapping shall be made where rodding is placed.

8. Service Saddles:
   Service Saddles shall be used for service taps larger than 1-inch on all ductile iron water mains 14-inches and greater, or when direct taps cannot be made. Service saddles shall also be used for all taps on existing water mains other than ductile iron, such as asbestos cement, PVC, etc. Service Saddles shall be provided with brass body and fasteners (85-5-5-5 waterworks brass or “no lead” brass meeting UNS C89833 as per ASTM B584) conforming to AWWA C800 and double straps made of silicon bronze (single strap for PVC mains) conforming to ASTM A98 and factory installed grade 60 rubber gaskets. Service saddles shall be provided with AWWA standard threads per AWWA C800.

9. Copper Service Tubing: Copper service tubing shall be type K soft copper tubing per ASTM B88. No union shall be used in the installation of the service connection of 100-feet or less. Service lines more than 100 feet shall use a three (3) piece compression coupling. Only one (1) compression coupling shall be used for each 100 feet or fraction thereof.

10. Meter boxes for 1-inch services: 1-inch meter boxes shall be cast iron per ASTM A48 Class 25 or ASTM A126 Class B. Meter boxes for 1-inch water services shall provide a cover opening of 8 X 18 1/8 inches and boxes shall measure at least 12.5 inches in depth. Lids shall also be cast iron and have the words "Water Meter" cast into them. They shall also be lockable. Lids shall be provided with a 2 inch (maximum) diameter hole to accommodate a transmitter. All meter boxes and lids shall be installed as shown in the Details and have a black E-coating.

    Meter boxes shall have 45-degree compression connections outside the box on the inlet side. There shall be a lockable ball valve inside the box on both the inlet and outlet which shall be permanently affixed to ensure proper spacing and alignment for the meter. Meter boxes shall also be provided with an ASSE 1024 approved inline, dual check valve located behind the meter. All fittings and connections shall be "no lead" brass conforming to UNS C89833 as per ASTM B584.

    A "no lead" brass curb stop with compression connections shall be installed within 2 feet of the inlet connection. The curb stop may be buried without a box above it.

    One 2 inch or 6-inch grade adjuster may be used when needed to meet final grade, however, no grade adjusters are permitted on new construction projects. Grade adjusters shall be cast iron. Grade adjuster and box shall be by the same manufacturer.

    In isolated cases and when approved by the Director of Utilities, meter boxes may be located in driveways, alleys and/or parking areas. In these cases, a street rated box capable of withstanding a 40,000-lbs proof load shall be specified.

11. 1 ½ and 2-inch Water Services: 1 1/2" and 2" meter boxes shall be light weight polymer concrete as indicated in the Standard Details. Meter boxes for 1 ½ and 2-inch water services shall provide a cover opening of 24 X 36 inches and boxes shall measure at least 30-inches in depth and provided in straight wall arrangement. Standard meter box covers shall bolt down to the box, and all polymer cement covers shall be provided in solid configuration with a 2-inch diameter transmitter hole, and with the words, "Water Meter" cast into the lid. The meter box covers shall be provided with 2 stainless steel bolts in penta head configuration for security. To ensure positive discharge, the box should be tied into the existing storm drain system or shall have an open bottom to allow drainage through a 12-inch stone base. All meter box covers for potable water service shall be provided in standard concrete gray or black color.

Custom setter piping and fittings for 1 ½ and 2-inch water meters shall be constructed from “no lead” brass (meeting UNS C89833 as per ASTM B584) and copper tubing and shall be equipped with a lockable by-pass flanged ball valve and flanged angle meter ball valves. All applications shall have a separate above ground backflow preventer.

12. Water services greater than 2-inches: Water services greater than 2-inches shall have the meter and bypass line located within a precast concrete vault. All piping and valves shall have flanged connections. There shall be isolation gate valves on both sides of the meter as well as one on the bypass line. Gate valves within the vault shall meet the above requirements of AWWA C509 for non-rising stem gate valves but shall be provided with hand wheel operators. A standard buried gate valve with 2-inch nut shall be provided between the main and the vault. Link seals shall be used where the pipe enters and exits the vault.

13. Meter Vaults: Meter vaults and access doors shall meet HS-20 loading requirements and shall be located outside of travel areas. Pedestrian-rated covers shall not be used regardless of where they are located. The access double doors shall be aluminum with a flush drop lift handle, stainless steel hinges and bolts, a stainless-steel slam lock, an automatic hold open arm, and compression springs to allow for easy opening. Vaults for 3- and 4-inch meters shall be approximately 8-feet by 10-feet in size. Six-inch meter vaults shall be approximately 9-feet by 12-feet. To ensure positive drainage, the vault shall be tied into the existing storm drainage system. If positive drainage is unobtainable, a sump pump shall be located and operated in the vault.

6050 IRRIGATION SYSTEMS

A. All irrigation systems shall be provided with privately maintained reduced pressure principle backflow prevention installed in accordance with the NC Plumbing Code and the Foundation for Cross Connection Control and Hydraulic Research. Reduced pressure zone backflow preventers shall be installed above ground in an insulated box as shown by the details.

B. All irrigation systems within public street right of way require an encroachment agreement from Cary or NCDOT prior to installation. Plans designating the location, size, material, and depth shall be submitted with the agreement application to the Inspection & Permits Department. If there is an approved development plan, it shall be referenced with the encroachment submittal to Cary.

C. Pipe material for the mainline proposed to be used within the public right of way shall be Schedule 40 PVC or greater. A distance of at least 3-feet shall be provided from the back of curb or edge of asphalt in a ditch section. A minimum depth of 2-feet of cover shall be provided and all heads shall spray away from the street.

D. All street crossings of irrigation systems shall be encased in ductile iron or steel conduit. Irrigation systems installed in the medians of Cary maintained roadways must also have French drains installed behind the curb and gutter which are piped to a storm system.

6060 TESTING AND INSPECTIONS

A. GENERAL

1. All materials must be approved by the Infrastructure Field Technician prior to installation. Materials rejected by the Infrastructure Field Technician shall be immediately removed from the job site.

2. The Contractor shall furnish all materials, labor, and equipment to perform all testing and inspections to the satisfaction of the Infrastructure Field Technician or Water Quality representative. Cary shall provide water for testing purposes on water mains in accordance with Cary Standard Procedure 4, Control and Monitoring of Water System Flow Activity.

B. TESTING

1. Hydrostatic Testing

   a) No valve in the Cary water system shall be operated without authorization in accordance with Cary Policy Statement 49 "Water Valves, Control of Closing and Opening" A section of line that is to be hydrostatically tested, shall be slowly filled with water at a rate which will allow complete evacuation of air from the line. Hand pumps shall not be used for the pressure testing of water mains. Taps used for testing purposes shall be removed after testing and repaired using a "no lead" brass plug.

   b) When filling the pipeline, it is very important to fill the line slowly to avoid undue impacts associated with surge and to allow air to evacuate the pipeline. After all air has been expelled from the water main, the line shall be tested to a pressure of 200 psi as measured at the lowest elevation of the line for a duration of 2 hours. The testing period shall not commence until all air has been evacuated and the pressure has stabilized. The pressure gauge used in the hydrostatic test shall be calibrated in increments of 10-psi or less. The pressure gauge shall be liquid-filled and indexed for an operating range of 300-psi or less with a minimum dial size of 4 inches. At the end of the test period, the leakage shall be measured with an accurate water meter.

   c) Any measured leakage not within the allowable limits as specified in the following table shall require repair of the water main and additional testing until the standards are met. For pipe sizes other than those shown, the Contractor

shall test within the allowable leakage amounts as specified by AWWA C600-99. All visible leaks shall be repaired regardless of the amount of leakage.

Maximum Leakage Allowed with Hydrostatic Testing

Pipe Size (Inches)	Allowable Leakage at 200-psi (Gal./Hr. per 1000 feet of pipe)
4	0.38
6	0.57
8	0.76
10	0.96
12	1.15
16	1.53
20	1.91
24	2.29
30	2.87
36	3.44
42	4.01

2. Disinfection

a) All additions or replacements to the water system shall be disinfected with chlorine in conformance with AWWA C651 before being placed in service under the supervision of the Cary's Infrastructure Field Technician in the following manner:

i. Taps shall be made at the control valve at the upstream end of the line and at all extremities of the line including valves.

ii. A solution of water containing 70% High Test Hypochlorite (HTH) available chlorine shall be introduced into the line by regulated pumping at the control-valve tap. The solution shall be of such a concentration that the line shall have a uniform concentration of not less than 50-ppm and not more than 100-ppm total chlorine immediately after chlorination. The chart below shows the required quantity of 70% HTH compound to be contained in solution in each 1000 feet section of line to produce the desired concentration from 50-ppm to 100 ppm.

Required Hypochlorite Concentration

Pipe Size (inches)	Pounds of High Test Hypochlorite (70%) to reach 50-ppm *per 1,000 feet of line*	Pounds High Test Hypochlorite (70%) to reach 100-ppm *per 1000 feet of line*
6	0.88	1.76
8	1.56	3.12
10	2.42	4.84
12	3.50	7.00
14	4.76	9.52
16	6.22	12.44
20	9.76	19.52
24	14.00	28.00
30	21.86	43.72
36	31.47	62.94
42	42.85	85.70

iii. The HTH Solution shall be circulated in the main by opening the control valve and systematically manipulating hydrants and taps at the line extremities. The HTH solution must be pumped in at a constant rate for each discharge rate so a uniform concentration will be produced in mains.

iv. HTH solution shall remain in lines for no less than 24 hours or as directed by Cary's Infrastructure Field Technician.

v. Extreme care shall be exercised at all times to prevent the HTH solution from entering existing mains.

vi. Free residual chlorine after 24 hours shall be at least 10 ppm or the Infrastructure Field Technician will require that the lines be re-chlorinated.

3. Flushing

a) Flushing of lines may only proceed after 24 hours of disinfection contact time and as directed by Cary staff, provided the free residual chlorine analysis is satisfactory.

b)

c) At the completion of disinfection, chlorinated water flushed from the water main shall be disposed of in conformance with all Federal, State and local regulations.

d) In accordance with all applicable regulations, a neutralizing chemical shall be applied to minimize chlorine residual in the flushing water before discharging from the water main, unless an alternate plan is submitted in writing and approved by Cary.

e) Water used for disinfection shall be flushed from the water main until the chlorine residual concentration is below 5-ppm before initiating sampling.

4. Bacteriological and Turbidity Sampling

a) Bacteriological sampling shall be utilized to verify disinfection prior to placing a newly constructed water main in operational service. Bacteriological sampling shall consist of 2 consecutive sets of acceptable samples taken at least 24-hours apart and collected from each 1,200-ft section of water main and all dead ends and branches as outlined by ANSI/AWWA C651.

b) For the first round of sampling, the requested laboratory analysis shall be specified as follows: “Bacteriological Test and Turbidity.” For the second round of testing, the laboratory analysis shall be specified as, “Bacteriological Test Only.”

c) Samples for laboratory analysis shall be witnessed by Cary’s Infrastructure Field Technician after flushing is completed. The Contractor shall furnish the sample bottles, the testing agency and shall secure these samples. The Contractor shall make arrangements with the laboratory that all test results be submitted directly to the Cary’s Infrastructure Field Technician or other designee approved by the Utilities Department. All costs for laboratory testing shall be borne by the Contractor.

d) The laboratory secured for testing shall be certified by the State Laboratory of Public Health. All sample bottles for bacteriological sampling provided by the laboratory shall be sterilized and treated with a dechlorinating agent, such as sodium thiosulfate. Samples for turbidity shall be taken in plain sterilized bottles from the lab, which are separate from the bottles provided for bacteriological testing. The sample bottles shall be provided with tamper proof seals that will be adhered to the bottles by the Cary’s Infrastructure Field Technician. The Infrastructure Field Technician shall provide a sample identification number, job title and an identification of Phase 1 or Phase 2 sampling that will be provided on the tamper proof custody seal. The bottles and tamper proof custody seals shall be accompanied by a chain of custody form provided by the certified laboratory conducting the testing. All sample identification numbers, job titles, and Phase 1 or Phase 2 testing identification from the custody seal shall be recorded on the chain of custody forms by the Infrastructure Field Technician.

e) All samples shall be collected in compliance with the sampling protocols provided by the certified laboratory. The samples shall be kept in a cooler provided by the Contractor at approximately 40-degrees Fahrenheit or 4-degrees Celsius and delivered to the certified lab for testing as soon as possible. The time at which the sample is taken shall be recorded on the chain of custody form by the Infrastructure Field Technician. Any samples processed at the laboratory more than 30 hours following collection shall be declared invalid, i.e. samples shall be submitted to the lab within 24-hours of collecting them.

f) All first-round samples shall be tested for bacteriological quality and turbidity in accordance with standards established by NCDENR and AWWA. If turbidity exceeds 1.0 NTU, the sample shall fail and the system shall be re-flushed before initiating a new round of testing.

g) If the phase 1 sample results for bacteriological quality and turbidity are acceptable, then a second set of samples can be collected at least 24-hours following the first sample collection. No additional flushing other than required to obtain a representative sample will be allowed prior to collecting the second set of samples.

h) The second set of samples shall be tested for bacteriological quality only. All custody seals and chain of custody forms shall identify the second-round samples as “Phase 2” testing to notify the lab that the first set of samples have already been evaluated and received a satisfactory laboratory analysis.

i) At the completion of sampling, the total chlorine concentration shall be at least 2-mg/L and no higher than 4-mg/L before the system can be made operational.

j) If test results are unsatisfactory, the Contractor shall immediately re-chlorinate lines and proceed with such measures as are necessary to properly disinfect the lines.

k) The new water system shall be valved off from the existing system until a satisfactory bacteriological laboratory analysis has been obtained and the Infrastructure Field Technician has authorized the use of the new water system.

5. Marker Ball and Marker Tape Testing

Testing of the marker balls and tape shall be performed by the Contractor at the completion of the project to assure they are all working properly. It is the Contractor’s responsibility to provide the necessary equipment to test the markers. Any defective, missing, or otherwise non-locatable units shall be replaced.

6070 REPAIR,REHABILITATION AND ABANDONMENT

A. Joint leaks of Ductile Iron Pipe shall be repaired by using a bell joint leak repair clamp approved by Cary or otherwise replacing the damaged pipe and reconnecting with a mechanical joint sleeve connection.

B. Line Breaks or Punctures shall be repaired by a full circle repair clamp as approved by Cary or otherwise replacing the damaged pipe and reconnecting with a mechanical joint sleeve connection.

C. Line Splits or Blow Outs shall be repaired by replacing the damaged section with ductile iron pipe with a restrained sleeve connection at each end.

D. Asbestos Cement Pipe to PVC or Ductile Iron Pipe transitions shall use coupling listed on Cary's Approved Products List with different end diameters sized specifically for the pipe materials and pipe outside diameter at each end.

E. All water main point repairs shall be replaced with DIP in accordance with these Specifications and backfilled with crush and run stone compacted to 95% maximum dry density as specified elsewhere in the Standard Specifications.

F. Water Service Line Repairs

1. A water service line severed between the water main and the water meter shall be repaired using new type K copper tubing and bronze or "no lead" brass 3 piece compression unions.

2. A corporation stop pulled out of a PVC pipe water main shall have a new service saddle and a new "no lead" brass corporation stop installed on the water main.

3. A corporation stop pulled out of a ductile iron pipe shall have a full circle repair clamp placed over the old tap hole. A new tap shall be made and a new "no lead" brass corporation stop installed on the water main.

G. Water Main Abandonment

1. General
   a) Water distribution pipe abandonment involves removing the pipe and any related appurtenances from service and leaving them in such a manner that no risk is posed to public health and safety. Pipe and appurtenances that are to be removed because they present a conflict with the proposed work shall be drained of all contents, removed and disposed of as part of the excavation process.
   b) If the pipe or appurtenances to be abandoned are related to water distribution pipe replacement the abandonment shall commence once the replacement

water distribution pipe has been installed, tested, and all water services have been transferred to the new pipe.

c) The Contractor shall notify the Fire Marshall prior to any fire hydrant abandonment.

d) The Contractor shall note the exact location of abandoned water distribution pipe, fire hydrants, and valves on the as-built drawings.

2. Abandonment

a) Water Distribution Pipe Removal: Water distribution pipe specified for removal shall be physically disconnected and the active water distribution pipe capped and thrust restrained. Once separated from the active pipe, the pipe specified for abandonment shall be drained, removed, and disposed of.

b) Water Distribution Pipe Abandonment: Water distribution pipe specified for abandonment shall be physically disconnected and the active water distribution pipe capped and thrust restrained. Once separated from the active pipe, the pipe specified for abandonment shall be drained and pumped entirely full with cement grout. The cement grout shall have a compressive strength of 500-psi and shall be of an appropriate consistency to completely fill the water distribution pipe.

c) Gate Valve Assembly Abandonment: The gate valve specified for abandonment shall be completely closed, the valve box removed and disposed of, the resultant void space backfilled with a minimum 500-psi compressive strength, quick setting, non-excavatable flowable fill, and a standard asphalt repair patch installed.

d) Fire Hydrant Assembly Abandonment: The fire hydrant assembly specified for abandonment shall have the associated gate valve completely closed, the valve box removed and disposed of, the resultant void space backfilled with a minimum 500-psi compressive strength, quick setting, non-excavatable flowable fill, and a standard asphalt repair patch installed. The hydrant shall then be removed, salvaged and returned to the Public Works Department and the existing water main capped and thrust blocked. The void space shall be backfilled with flowable fill and the final 2-ft below ground level backfilled with topsoil and restored.

e) Blowoff Assembly Abandonment: The blowoff assembly specified for abandonment shall have the associated gate valve completely closed, the blowoff assembly removed and disposed of, the resultant void space backfilled with a minimum 500-psi compressive strength, quick setting, non-excavatable flowable fill, and a standard asphalt repair patch installed.

f) Combination Air Valve Abandonment

i. Paved Area: The air valve specified for abandonment in a paved area or within 5-ft of a roadway shall have the valve completely closed and the associated manhole ring, cover, and chimney removed and disposed of. The barrel of the manhole shall then be filled with non-excavatable flowable fill from the bottom of the manhole to within 8-inches of the surface of the roadway. The pavement shall be replaced as specified elsewhere in the Contract Documents.

ii. Unpaved Area: The air valve specified for abandonment in an unpaved area more than 5-ft from a roadway shall have the valve completely closed and the associated manhole ring, cover, and chimney removed and disposed of. The uppermost barrel sections of the manhole shall be removed up to a depth of at least 6-ft from the ground surface. The manhole barrel shall be filled with aggregate base course to within 12-inches of the ground surface. The manhole barrel shall be filled and tamped in 8-inch lifts with aggregate base course and compacted to a minimum of ninety percent (90%) Standard Proctor density. The upper 12-inches shall be filled with screened topsoil and graded uniformly with the surrounding area. The area shall be seeded and mulched as specified elsewhere in the Standards.

H. Water Service Abandonment: Water service laterals shall be completely abandoned, including the corporation stop, by removing the corporation stop at the main after locating the service connection and turning off the water main. An approved repair band shall be used to repair the water main after removal of corporation stop. All service abandonments shall be coordinated with Cary Utilities and Public Works Departments a minimum of 14 days in advance of anticipated removal. A plan for the isolation of the required section of water main shall be approved by Cary prior to work proceeding. Contractor is responsible for any applicable regulatory approvals necessary to perform the water service abandonment and repair the road to regulatory standards, if applicable.

END OF SECTION 6000

SECTION 10000 RECORD DRAWING CHECKLIST

All entities who construct public infrastructure, private streets, private storm drain collection systems, and/or travel lanes shall submit to Cary a record drawing set. **The record drawing submittal set must be approved prior to acceptance of the improvements and/or issuance of a certificate of occupancy**. In general, the submittal set shall consist of the following items:

- **Record Drawing Checklist** – A completed copy of this checklist in (.PDF) format.
- **Record Drawings** - A certified set of record drawings, signed and sealed by a North Carolina PE or RLA, in (.PDF) format.
- **As-Built Survey Submittals**
    - **As-Built Survey** – A certified post-construction as-built survey, signed and sealed by an NCPLS, in (.PDF) format.
    - **Survey Point File** – A comma-delimited point file of the NCPLS certified post-construction as-built survey in (.TXT) format.
    - **ACAD Survey File** - An electronic CADD drawing file of the NCPLS certified post-construction as-built survey in (.DWG) format.
    - **Stormwater Pipe and Structure Table File** - An electronic Microsoft Excel file in (.XLS) format updated from as-built survey.
- **Easement/Encroachment Submittals**
    - **Recorded Plat** – A recorded plat indicating all easements (including sight distance, greenway easements, and off-site utility extensions) and right-of-way in (.PDF) format.
    - **Off-site Easement Plat (If Applicable)** - A separate, recorded easement dedication plat for off-site utility extensions outside of the right-of-way in (.PDF) format.
    - **NCDOT Encroachment Agreements (If Applicable)** – All NCDOT encroachment agreements for the project, executed by all parties, in (.PDF) format.
- **PE Certification of Utilities (If Applicable)** - Separate 8.5”x11” sheets with certification by NCPE of construction in accordance with the water, sewer, forcemain and/or reclaimed extension permits in (.PDF) format.
- **Stormwater Control Measure Submittals (If Applicable)**
    - **Stormwater Control Measure Record Drawing** – A certified record drawing of all permanent stormwater control measures, signed and sealed by a North Carolina PE, RLA, or PLS in (.PDF) format.
    - **Certification of Engineered Stormwater Control Measures** - A separate 8.5”x11” sheet with North Carolina PE, RLA, or PLS certification of any engineered stormwater control measure(s).

The following checklist provides additional detail regarding the precise requirements for each component of the record drawing submittal set. Each blank must be initialed by the applicant as being included with the record drawing submittal set or marked N/A if not

applicable to the project. All applicable information listed below must be included with the record drawing submittal set.

10010 PROJECT INFORMATION

Please fill out the following project information for this record drawing checklist:

Project Name: _____
Project Phase: _____
Project #: _____
Submitted by: _____
Sealing NCPE/RLA: _____
NCPE/RLA License #: _____
Phone #: _____
Date: _____

10020 RECORD DRAWING COVERSHEET

The Record Drawing Plan Set shall have a coversheet including, at a minimum, the following information:

10021 GENERAL INFORMATION

_____ Project Name
_____ Project Phase(s)
_____ Project #
_____ Firm Name, Address, and Contact Info
_____ Developer/Owner Name
_____ Vicinity Map – 500 scale with all project phases identified as well as the phase(s) applicable for the Record Drawing Plan Set.
_____ Sheet Index
_____ PE Utility Certification(s) – Certification(s) by NCPE of construction in accordance with the water, sewer, forcemain and/or reclaimed extension permit(s).
_____ Record Drawing Certification - Completed, signed, and sealed by the N.C. registered PE or RLA responsible for the Record Drawing Plan Set.

RECORD DRAWING CERTIFICATION

Firm Name : _____

Address : _____

Name / Title : _____

Signature : _____

SEAL

I hereby certify to the best of my knowledge and belief that this record drawing is based on actual field survey information provided by _____ dated_____ and accurately represents the final condition of this project. The constructed improvements have been field verified and conform to all the provisions of the Town of Cary.

Water Permit # _____

Sewer Permit # _____

Reclaimed Water Permit # _____

10022 AS-BUILT QUANTITY TABLE

Included on Cover Sheet shall be an As-Built Total Quantity of Infrastructure Table indicating, at a minimum, the following information:

_____ Streets (List lengths individually: Public, Private and/or Fire Lane)
_____ Water mains (Identify diameter, material (including wrapping and/or coating (if applicable), pressure class and length)
_____ Sewer mains (Identify diameter, material (including wrapping and/or coating (if applicable), pressure class and length)
_____ Storm pipe (Identify diameter, material and length)
_____ Reclaimed water mains (Identify diameter, material, pressure class, and length)
_____ Number of water/sewer/reclaimed services (including service diameter/material and tap type (direct/saddle))
_____ Number of and manufacturer of valves (For each size)
_____ Number of and manufacturer of fire hydrants
_____ Number of and manufacturer of manholes
_____ Other (Any additional appurtenances)
_____ Number of stop signs
_____ Sidewalks
_____ Greenways & Street-side trails
_____ Greenway structures (bridges & culverts)
_____ Greenway signs, benches & trashcans

10030 RECORD DRAWINGS

The Record Drawing plan sheets shall include the following:

10031 GENERAL

_____ **A.** The record drawing certification stamp (Page 10000-2) is to be placed on each sheet, the information filled in, stamped and certified by

the North Carolina registered PE or RLA responsible for the Record Drawing Plan Set.

_____ **B.** Scale of drawings and bar scale
_____ **C.** North arrow
_____ **D.** All easements identified and dimensioned. Include legal reference (deed, BOM, page #)
_____ **E.** Record drawing files in PDF format, named to indicate sheet title, type of sheet, and sheet number
_____ **F.** Plan sheets in 24" X 36" or 22" X 34" format

10032 STREETS (Public, Private, Off-Road Greenway, Street-Side Trail, Sidewalk or Fire Lane)

_____ **A.** Horizontal alignment with radii, P.C.'s, and P.T.'s of all curves
_____ **B.** Vertical alignment with centerline grades, vertical curve lengths and station and elevation of all PVC's and PVT's and centerline profile
_____ **C.** Dimensioned right-of-way and street widths
_____ **D.** Pavement design (actual) and typical cross section
_____ **E.** Horizontal and vertical sight lines
_____ **F.** Engineering Certification for retaining walls (if applicable)
___ Statement "built as designed" or include sealed record drawing
_____ **G.** Official street names on each applicable sheet
_____ **H.** Curb ramp slope labeled (from as-built survey)

10033 STORM DRAINAGE

_____ **A.** Plan and profiles
_____ **B.** Updated pipe and structure table (from as-built survey)
_____ **C.** Pipe slope and length labeled (greater than or equal to 12" only)
_____ _ **D.** Pipe/Box/End treatment material labeled
_____ _ **E.** Pipe shape & size (diameter or height & width) labeled
_____ _ **F.** Box size (height & width) labeled (ex: 12'6"W x 9'0"H)
_____ _ **G.** End treatment labeled (ex: headwall, FES, etc…)
___ __ **H.** Structure top\rim elevations labeled (from as-built survey)
1.)Grated yard inlet—lowest elevation on top of grate
2.)Slab-top yard inlet—structure surface inlet (lowest opening/weir)
3.)Grated curb inlet—lowest elevation on top of grate
4.)Curb inlet (old style)—surface inlet (weir)
5.)Flume—flow line elevation in gutter
_____ _ **I.** Structure invert elevations labeled (from as-built survey) —If more than one pipe enters structure, include reference to North beside elevation (SE XXX.XX'); *include all roof and area drains*
_____ **J.** Dissipation pad type, dimensions & riprap size classification (if applicable)
_____ **K.** Permanent stormwater control measures (SCM) labeled
_____ _**L.** Permanent SCM record drawing submittal, upon SCM completion (see Section 10040)
_____ **M.** Post-Construction CCTV submitted and approved, including any repairs (see Standard Specification Section 8000)

____ _ **N.** Certification by NCPE of construction in accordance with the approved plans, calculations, and hydraulic grade lines on the plans (includes repairs from CCTV review comments)

10034 WATER SYSTEM

_____ **A.** Plan and profile
_____ **B.** Pipe material and pressure class labeled
_____ **C.** Pipe size labeled
_____ **D.** Pipe encasement material labeled (if applicable)
_____ **E.** Restrained joint pipe length labeled (if applicable)
_____ **F.** Appurtenances (Valves, Fittings, Fire Hydrants, Blow-offs, Air Release Valves, Meters, Marker Balls, etc.)
_____ **G.** Marker tape labeled (if applicable)
_____ **H.** Separation from sanitary sewer, storm, reclaimed water and gas shown on plans
_____ **I.** Existing pipe material when tying into an existing water main.
_____ J. Existing water service material on the customer side when tying into an existing water service.

10035 SANITARY SEWER SYSTEM

_____ **A.** Plan and profile
_____ **B.** Pipe slope and length labeled
_____ **C.** Pipe material and dimension ratio/pressure class labeled
_____ **D.** Pipe size labeled
_____ **E.** Manhole rim elevations labeled (from as-built survey)
_____ **F.** Manhole invert elevations labeled (from as-built survey)
_____ **G.** Manhole material and coating material labeled (if applicable)
_____ **H.** Cleanouts
_____ **I.** Separation from potable water, storm, reclaimed water and gas shown on plans
_____ **J.** 100-year flood plain elevation
_____ **K.** Horizontal control (angles at manholes)

10036 RECLAIMED WATER SYSTEM

_____ **A.** Plan and profile
_____ **B.** Pipe material and dimension ratio/pressure class labeled
_____ **C.** Pipe size labeled
_____ **D.** Appurtenances (Valves, Fittings, Blow-offs, Air Release Valves, Meters, Marker Balls, etc.)
_____ **E.** Marker tape labeled (if applicable)
_____ **F.** Separation from potable water, sanitary sewer, storm and gas shown on plans

10037 FORCE MAINS

_____ **A.** Plan and profile
_____ **B.** Pipe material and dimension ratio/pressure class labeled
_____ **C.** Pipe size labeled
_____ **D.** Restrained joint pipe length labeled (if applicable)
_____ **E.** Appurtenances (Valves, Air Release Valves, Meters, Marker Balls, etc.)
_____ **F.** Marker tape labeled (if applicable)
_____ **G.** Separation from potable water, gravity sanitary sewer, storm, reclaimed water, and gas shown on plans

10038 PUMP STATIONS

_____ **A.** Site plan and design drawings
_____ **B.** Pump station design capacity
_____ **C.** Pump type and manufacturer
_____ **D.** Manhole/wet well top/rim elevation labeled (from as-built survey)
_____ **E.** Invert elevations labeled (from as-built survey)

10039 STANDARD DETAILS

_____ **A.** The standard detail sheets from the approved construction plans.

10040 STORMWATER CONTROL MEASURE RECORD DRAWING

All entities that construct engineered stormwater control measures (SCM) shall submit to the Cary Stormwater Division, an as-built record drawing set as a part of Cary's acceptance process. Record drawings must be submitted prior to acceptance of the stormwater control measure(s) and issuance of a certificate of occupancy.

10041 SITE DATA

_____ **A.** Acreage in total site
_____ **B.** Acreage of impervious surface
_____ **C.** Percent of impervious surface
_____ **D.** All information from Section 10021 Record Drawing Coversheet: General Information

10042 GENERAL INFORMATION

_____ **A.** Copy of recorded plat (all sheets) or deed of easements
_____ **B.** All information from Section 10031 Record Drawings: General
_____ **C.** All information from Section 10050 As-Built Survey, items A, B, C, D, F and G
_____ **D.** Tie to N.C. grid coordinate system
_____ **E.** Location of benchmark with M.S.L elevations

10043 SCM AND STORM DRAINAGE

_____ **A.** Outline of 100-year floodplain, Urban Transition Buffers and Riparian Buffers
_____ **B.** Identify all materials used for construction of SCM and storm drain
_____ **C.** Invert and top elevations for riser structure and all catch basins, inlets and junction boxes immediately upstream and downstream from the SCM
_____ **D.** Topographic drawing of SCM, including elevation shots, showing interior slopes, top of dam, exterior slopes to toe of slope, emergency spillway, bottom of pond, deep pools, forebay berms, shallow areas and littoral shelves
_____ **E.** Pipe information: material, shape, slope, distance and size in diameter or height and width
_____ **F.** Dimensions and stone class of riprap dissipation pads
_____ **G.** Cross section of the SCM and structures with elevations
_____ **H.** Statement of stormwater velocities at all outlets
_____ **I.** Volume and storage capacity of SCM
_____ **J.** As-built SCM calculations (Routing – model or hand calculations)
_____ **K.** Soil report for soil mix in bioretention for information on phosphorus index needs to meet requirements for NCDEMLR Minimum Design Criteria (MDC)
_____ **L.** Plant list and planting plan for bioretention cells, stormwater wetlands and wet ponds
_____ **M.** Grass Swale – Slope of swale and cross section elevations
_____ **N.** Level Spreader – Elevations of level spreader lips

10044 LICENSED PROFESSIONAL CERTIFICATION

_____ **A.** A separate 8.5”x11” sheet with North Carolina PE, RLA, or PLS certification of any engineered stormwater control measure(s) (as applicable), following the template provided below

LICENSED PROFESSIONAL CERTIFICATION OF ENGINEERED STORMWATER CONTROL MEASURE

Specific type of Engineered Stormwater Control Measure(s):

_____

I _____ as a duly licensed Professional, do hereby certify that the Stormwater Control Measure for the project entitled: _____ with Cary Development Plan #: _____ has been constructed within substantial compliance and intent of the approved construction plans, drawings, and specifications and that the associated infrastructure has been installed in compliance with the approved construction plans, drawings, and specifications. This statement is based upon reference and reviews of the record drawings prepared for this site and upon periodic field inspections and project reviews completed during the construction of the referenced Stormwater Control Measure, including a final inspection of the stormwater control measure made within 30-days prior to the signature date outlined below.

_____ _____

Signature *Date*

PE/RLA/PLS REGISTRATION #: _____ SEAL:

10050 AS-BUILT SURVEY

The certified post-construction as-built survey that supports the record drawing set shall be submitted. The survey shall be produced in accordance with the requirements of 21 NCAC, Chapter 56, Section 1600 and include, at minimum, the following:

_____ **A.** All easements identified and dimensioned. Include legal references (deed, Book of Maps, page #).
_____ **B.** Horizontal tie to North American Datum (NAD83/Suffix year). This datum to be consistent with the approved project plans.
_____ **C.** Vertical tie to North American Vertical Datum of 1988 (NAVD88).
_____ **D.** Certificate block in accordance with 21 NCAC 56.1600, completed, signed and sealed by the North Carolina registered PLS responsible for the as-built survey.
_____ **E.** Survey grade NAD83 coordinates and NAVD88 elevations per 21 NCAC 56.1600 for each of the following:

STORMWATER
- _____ Structure Tops \ Rims (with elevations labeled on record drawing profile)
- _____ Structure Inverts (with elevations labeled on record drawing profile and included in survey text file)

WATER
- _____ Valves
- _____ Fittings
- _____ Fire Hydrants
- _____ Blow-offs
- _____ Meters
- _____ Air Release Valves
- _____ Marker Balls

SEWER
- _____ Clean Outs
- _____ Manhole Rims (with elevations labeled on record drawing profile)
- _____ Manhole Inverts (elevations only, labeled on record drawing profile and included in survey text file)

RECLAIMED WATER
- _____ Valves
- _____ Fittings
- _____ Blow-offs
- _____ Meters
- _____ Air Release Valves
- _____ Marker Balls

FORCE MAINS

_____ Valves
_____ Meters
_____ Air Release Valves
_____ Marker Balls

PUMP STATIONS

_____ Manholes/Wet Well Top/Rim (with elevation labeled on record drawing plan)
_____ Inverts (elevations only, labeled on record drawing profile)
_____ Wetwell Floor Elevation (elevation only, labeled on record drawing plan)

_____ **F.** Survey Point File - A comma-delimited (.TXT) file of all the NCPLS certified post-construction survey points listed above in P,N,E,Z,D format (Point #, Northing, Easting, Elevation, Description). The descriptions used shall be common industry abbreviated terms (MH,CB, FH, WV, WM, CO, etc.)

_____ **G.** ACAD Survey File - An electronic CADD drawing file of the NCPLS certified post-construction survey in (.DWG) format.

10060 ADDITIONAL SUPPORTING INFORMATION

The following additional information shall be submitted with the Record Drawing Submittal Set in order to be deemed complete:

_____ **A.** A recorded plat indicating all easements (including sight distance & greenway easements) and right-of-way.

_____ **B.** A separate, recorded easement dedication plat for utility extensions outside right-of-way or offsite (if applicable).

_____ **C.** Any NCDOT encroachment agreements, executed by all parties (if applicable).

_____ **D.** Separate 8.5”x11” sheets with certification by NCPE of construction in accordance with the water, sewer, forcemain and/or reclaimed extension permit (as applicable), following the template provided below.

PROFESSIONAL ENGINEERS UTILITY CERTIFICATION

PROJECT NAME: _____

PROJECT #: _____

PERMIT #: _____ DATE ISSUED: _____

I, _____, as a duly registered Professional Engineer in the State of North Carolina, hereby certify that construction of these permitted facilities has been completed in accordance with the approved plans and specifications.

_____ _____

Signature *Date*

P.E. REGISTRATION #: _____ SEAL: