09.03 CONSTRUCTION, INSTALLATION AND TESTING OF WATER MAINS

09.03.01 HANDLING AND STORAGE OF MATERIALS

A. Transportation of Materials and Equipment

1. The Contractor and his Suppliers are directed to contract the North Carolina Department of Transportation to verify axle load limits on State maintained roads (and bridges) which are to be used for hauling equipment and materials to the project. The Contractor and his suppliers shall do all that is necessary to satisfy the Department of Transportation requirements and will be responsible for any damage to roads, which may be attributed to the project.

B. Loading/Unloading Materials

1. All pipe, fittings, valves, hydrants, and accessories shall be loaded and unloaded as to avoid shock or damage.

C. Material and Equipment Storage

1. Unless there is written consent from the owner of a proposed storage area, the Contractor will be required to store all equipment and materials at an approved location within the project site or the limits of the right-of-way. The materials and equipment storage shall comply with all State and Local Ordinances throughout the construction period.

2. All materials shall be placed in such a manner as to not impede any vehicular/pedestrian traffic or existing facilities. Materials strung through residential areas (or any area with maintained lawns) shall be placed in such a manner that normal lawn maintenance is not restricted and must either be installed within two (2) weeks or removed to an approved storage yard, as required by the Water Resources Engineering Manager.

3. The Contractor shall be responsible for safeguarding materials and equipment against fire, theft, and vandalism and shall not hold the City responsible in any way for the occurrence of the same.

4. PVC pipe shall be stored on the job site in accordance with the manufacturer's recommendations. Any PVC pipe that has been subjected to excessive ultraviolet radiation from the sun shall not be used. Noticeably faded materials shall not be installed and shall be promptly removed from the site.

D. Protection of Coatings and Linings

1. All piping and appurtenances shall be handled so that the coating and lining will not be damaged. If, however, any part of the coating or lining is damaged, the repair shall be made by the Contractor at his expense in a manner satisfactory to the Water Resources Engineering Manager or their authorized representative.

09.03.02 CONNECTION TO EXISTING MAINS

A. Connections to existing mains is subject to the Contractor's submittal of materials, equipment, detail procedures, and schedules. The Contractor shall have all necessary resources on site prior to beginning any shutdown or removing any existing facilities.

B. Request(s) for shutdown of facilities shall be made of the City of Monroe Water Resources Department a minimum of 72 hours in advance of any shutdown.

C. All valves, hydrants, blowoffs, etc. shall only be operated by City of Monroe personnel. The Contractor may be authorized to do so but only as directed by the Water Resources Engineering Manager or authorized representative.

D. All taps on active water mains shall be performed in the presence of an authorized representative of the Water Resources Department.

E. If connection to existing mains will necessitate an interruption of service, the Contractor shall schedule the connection for a time that is most convenient to the affected customers as determined by the Water Resources Engineering Manager.

F. All joints as part of the proposed work shall be restrained as required.

09.03.03 EXISTING UTILITIES

A. All utility owners will be notified prior to excavation as required by the most recent North Carolina Statutes regarding underground utility damage prevention. Owners who are members of North Carolina 811 may be notified in accordance with current North Carolina One-Call procedures. The Contractor will be fully responsible for damage to any utilities if the owners have not been properly notified as required by the Underground Damage Prevention Act.

B. Utility owners may, at their option, have representatives present to supervise excavation in the vicinity of their utilities. The cost of such supervision, if any, shall be borne by the Contractor.

C. The locations and depths of existing utilities as shown on the Design Plans are approximate. Other underground utilities not shown may be encountered. The Contractor shall perform test pits to verify the location and elevation of such utilities as shown, directed, or required. The Contractor shall excavate in advance of the pipe laying operation and expose all existing utilities to prevent damage during construction and determine required changes in grade necessary to install the water main to avoid conflicts. Any changes due to such conflicts shall be approved by the Water Resources Engineering Manager or their representative.

09.03.04 SEPARATION OF MAINS

A. See 09.01.15 for separation of main requirements

09.03.05 EXCAVATION

A. Earth Excavation

1. No more than 100 LF of trench shall be opened in advance of the pipe laying unless prior approval is given by the Water Resources Engineering Manager or their representative. Ground conditions and/or location will be considered by the Water Resources Engineering Manager or their representative in making this determination.

2. Trench width shall be kept to a minimum, allowing only space necessary for trench shoring and bracing, and pipe installation, in accordance with Detail 10.01.00. When unauthorized excavation is made below the grade indicated, the excavations shall be restored to the proper elevations with compacted suitable fill or NCDOT No. 67 stone.

3. The trench bottom shall be excavated slightly above grade and cut down to the pipe grade by hand in the fine grading operation. The trench bottom shall be true and even with bell holes at each joint to provide the barrel of the pipe with soil or granular bedding support for its full length.

4. If the trench passes either under or over another pipeline or previous excavation, the trench shall be backfilled with NCDOT No. 67 bedding stone.

5. All excavated material shall be piled in a manner that will not endanger the work. Excavated material will be piled a safe distance

away from the edge of the excavation allowing room for an adequate angle of repose (minimum of 3 feet from the nearest edge, assuming normal installation depth of 3-feet) and if shoring, sheeting, and bracing are used to protect the excavation.

B. Rock Excavation

1. Rock excavation shall be defined as boulders greater than one (1) cubic yard in volume and solid ledge rock, which in the opinion of the Water Resources Engineering Manager or his authorized representative, requires drilling and blasting, sledging, or barring for its removal. Soft or disintegrated rock that can be removed with a pick, or trenching machine (minimum of a Caterpillar Model 325) shall not be classified as solid rock. Loose, shaken or previously blasted rock; masses of broken stone in rock; and construction debris shall not be considered as rock excavation.

2. The trench width shall be kept to a minimum, allowing only the space necessary for pipe installation during the removal of rock. Accordingly, the minimum trench width is outside pipe diameter plus 24" (12" minimum on each side of pipe). For Contracts with the City, only this width will be considered for payment. Excavation beyond these limits shall be accounted for in the Contractor's unit price.

3. Where pipe is laid in rock cut, a minimum of 4-inches of pipe bedding material shall be carefully placed and tamped over the rock before the pipe is installed, then the balance of the backfill shall be placed in accordance with Detail 10.01.00.

4. All blasting shall be conducted in the manner as described in Section 09.03.15 as described herein.

C. Dewatering

1. The Contractor shall at all times provide and maintain ample means and equipment with which to remove and properly dispose of water entering the excavation or other parts of the work and shall keep all excavations dry until such time as pipe laying and grading is complete.

D. Temporary Sheeting, Shoring, and Bracing

1. Trenches and other excavations shall be properly cutback, sheeted, shored, and braced as necessary to prevent shifting of materials, damage to structures or pipelines, and pavement, and to provide safe

working and site conditions in accordance with the minimum requirements of OSHA.

2. If, in the opinion of the Water Resources Engineering Manager or their authorized representative, the trench/excavation is not in compliance with OSHA regulations, the Contractor may be informed that all work will not be accepted until corrective measures are taken. Continued unsafe conditions may be reported to the appropriate regulatory agency. The Contractor shall be responsible for paying all fines resulting from safety violations.

09.03.06 INSTALLATION AND ASSEMBLY

A. All pipe shall be installed in a workmanlike manner and true to line and grade. The various pipes specified shall be handled and installed in accordance with the manufacturer's recommendations and AWWA Standards

B. All pipe and fittings shall be inspected for defects.

C. All lumps, blisters and excess coatings shall be removed from the bell and spigot ends of each pipe, and the outside of the spigot and the inside of the bell shall be wire brushed and wiped clean and dry and free from oil and grease before the pipe is laid. Care shall be exercised to prevent foreign material from entering the pipe while being installed.

D. Pipe shall be laid with bell ends facing in the direction of the laying, unless otherwise approved by the Water Resources Engineering Manager or their authorized representative.

E. Whenever it is necessary to deflect pressure pipe from a straight line, either in a vertical or horizontal plane, to avoid obstruction or plumb valve stems, or where long radius curves are permitted, the amount of deflection allowed shall not exceed that required for satisfactory sealing of the joints as recommended by the manufacturer, and shall be approved by the Water Resources Engineering Manager or their authorized representative. The pipe shall be deflected, if required, after the joint is made.

F. For push-on joint pipe, the gasket groove and bell socket shall be cleaned and lubricated, and the gasket inserted as specified by the pipe manufacturer. Sterile lubricant, as furnished or specified by the manufacturer shall be applied to the gasket and beveled spigot end of the pipe. The beveled spigot end of the pipe shall be pushed straight into the bell using either a bar, jack, lever puller, or backhoe. A timber header will

be placed between the jack or backhoe bucket and the pipe to prevent damage to the pipe. At no time will the joint be made by swinging the pipe.

G. For restraint joint pipe with a factory applied weldment, make conventional push-on joint assembly, fully homing the pipe until the first assembly stripe is in the bell. Insert right-hand and left-hand locking segments and slide segment in appropriate direction. Hold the segments apart and wedge the rubber retainer into the slot between the two locking segments. Extend the joint to remove the slack in the locking segment cavity. For pipe utilizing a gasket with embedded grippers, install per (F.) above.

H. At times when pipe laying is not in progress, the open ends of the pipe shall be closed by a watertight plug or other means approved by the Water Resources Engineer. This provision shall apply during the hours as well as overnight. If water is in the trench, the seal shall remain in place until the trench is pumped completely dry.

I. Pipe shall be installed in straight horizontal trenches or through the use of bends and fittings as indicated on the Design Plans. "Snaking" of the pipe by bending sections horizontally shall not be allowed.

J. The cutting of pipe for inserting valves and fittings, or closure pieces shall be done in neat and workmanlike manner without damage to the pipe or cement lining and as to leave a smooth end at right angles to the axis of the pipe. Cut ends of a pipe shall be beveled before installation in a push-on bell joint.

K. All PVC and DIP water mains shall have both copper wire and locator tape in accordance with Detail 10.04.00. At the completion of the project, the Developer/Contractor shall test the entire length of the pipe using pipe locating equipment. Test shall be made only in the presence of the Water Resources Engineering Manager or their authorized representative.

L. Unless otherwise indicated on the Design Plans, or required by existing utility location, all pipe shall be installed with 36-inches minimum cover. The top of pipe shall not exceed 5-feet in bury to final grade established.

M. The Contractor may be required to vary the depth of pipe to achieve minimum clearance from existing utilities while maintaining the minimum cover specified, whether or not the existing pipelines, conduits, cables, mains, etc. are shown on the Design Plans.

N. Alignment:

1. New Subdivision Streets: The water main shall be laid in accordance with the City of Monroe's Standard Detail for Local

Residential Streets in Division 08 of the City Standard Specification and Detail Manual.

2. Private Streets: The water main shall be laid in accordance with the cross sectional road and utility detail on the Design Plans.

3. Existing Streets: The water main shall be laid in accordance with the Design Plans.

4. Within the General Public Utility Easement: The water main shall be laid in accordance with the Design Plans.

09.03.07 CASING PIPE INSTALLATION

A. The casing pipe shall be pushed into the fill with a boring auger rotating inside the pipe to remove the spoil. The front of the casing pipe shall be provided with a suitable device that will prevent the auger and cutting head from the leading the pipe so that there will be no unsupported excavation ahead of the pipe. As the dry boring operation progresses, each new section of encasement pipe shall be butt welded to the section previously jacked into place.

B. Continuous checks shall be made as to the elevation, grade and alignment of each successive section of encasement as well as the tracks (rails) upon which the boring rig travels.

C. The diameter of the boring hole shall be essentially the same as the outside diameter of the pipe.

D. Welding shall be done in accordance with the manufacturer’s written requirements. All operators shall be certified meeting the requirements of the American Welding Society.

E. If an obstruction is encountered, abandon the casing pipe in place and fill completely with grout. Provide whatever bulk heading is necessary to accomplish the grouting operation. The crossing will be moved to another location acceptable to the Water Resources Engineering Manager and the crossing re-bored at the Developer/Contractor's expense.

F. If voids are encountered or occur outside the encasement pipe, holes shall be installed in the top section of the encasement pipe at 10-foot centers and grouted at sufficient pressure to prevent settlement in the roadway.

G. The Developer/Contractor shall be responsible for obtaining all required permits and shall comply with all provisions thereof at his own expense.

H. Refer to Standard Detail 10.20.00 and Section 09.03.06 for installation of carrier pipe.

09.03.08 VALVES AND HYDRANTS

A. Valves

1. The valve box shall not transmit shock or stress to the valve and shall be centered and plumb over the operating nut, with the box cover flush with the surface of the pavement or other existing surfaces. Refer Standard Details 10.05.00 and 10.06.00.

2. Where the box is not set in pavement, the top section shall be anchored by an 18" x 18" x 6" concrete pad, or an approved pre-cast concrete pad, set flush with existing grade. The location of valves will be identified by the letter "V" imprinted into the curb or pavement adjacent to the mainline or hydrant valve.

3. All valves shall be provided with individual support by means of a solid concrete block as shown in Detail 10.02.00 so the weight of the valve is not carried by the pipe.

B. Hydrants

1. Hydrants shall be set with no less than three (3) foot bury on water mains 12" and smaller.

2. Each hydrant installation will include a drainage bed of clean washed stone approximately 1 cubic foot in size at the "weep hole". All hydrant piping shall be 6-inch ductile iron and restrained in accordance with Detail 10.07.00.

09.03.09 JOINT RESTRAINT

A. Refer to Specification 09.01 - Public Water Distribution Systems Section 09.01.09 and Specification 09.02 – Water Main Materials Section 09.02.03-E.

B. All joints within the stationing limits indicated to be restrained on the Design Drawings shall be harnessed for restraint.

09.03.10 WATER SERVICE CONNECTIONS

A. Existing service lines shall be maintained until such time as the proposed water main has been installed, tested, and disinfected, and approved to place

into service. New/existing services may then be transferred to the new water main.

B. Service connection to the water main shall be made on a service saddles that fit the pipe providing full support around the circumference of the pipe. The saddle shall be placed at a 45° angle to the horizontal and a tapping drill of the shell type cutter which works through the corporation shall be employed.

C. Service lines shall be installed with 20-inches of minimum cover and a maximum depth of cover of 30-inches.

D. Contractor shall use one continuous roll of copper from tap to the meter. No splicing will be permitted.

E. Contractor shall extend copper tubing after the meter box 2-feet beyond the proposed sidewalks in subdivisions on customer side.

F. In subdivisions, Contractor shall locate all meter boxes away from proposed driveways, sidewalks and low lying areas subject to surface runoff. Refer to Standard Detail 10.08.01.

G. In new streets, piping beneath pavement on the "long side" connections will be installed prior to paving. Backfill shall be compacted as specified with extreme care taken to prevent damage to the copper piping.

H. Refer to Standard Details 10.10.00 and 10.16.00 for service lines greater than 1-inch in diameter.

09.03.11 BACKFILL

A. All backfill shall be of a non-plastic nature soil, free from roots, vegetative matter, waste, construction material, or other objectionable material, including but not limited to rock larger than 6-inch in diameter. Rock shall not exceed 10% of the fill material, and shall not be placed within 2-feet of finished grade. Backfill material shall be capable of being tamped by mechanical tamps using relatively low velocity and heavy blows. The material shall have no tendency to flow or behave in a plastic manner under the tamping blows. Material deemed by the Water Resources Engineering Manager or authorized their representative as unsuitable for backfill shall be removed from the job site before backfilling operations begin.

B. Trenches shall be backfilled immediately after the pipe is laid. The method and degree of compacting backfill will be governed by the type of material and the extent to which any subsequent settlement can be permitted.

C. For excavations under NCDOT or City owned roads or traveled areas, NCDOT ABC stone shall be used as backfill.

D. Subgrade soils that become soft, loose, "quick," or otherwise unsatisfactory for support of the pipe or structures as a result of inadequate excavation, dewatering, or other construction methods shall be removed and replaced at the direction of the Water Resources Engineering Manager.

E. Pipe Bedding: Unless otherwise specified or notes on the Design Plans the following bedding classes are commonly required by the Water Resources Department.

1. Water Main Bedding Detail: Shaped bottom bedding shall be such that the pipe bears uniformly upon undisturbed native earth. Soil is then backfilled by hand around the pipe and completely under the pipe haunches in uniform layers not exceeding 6-inches in depth to an elevation 1-foot above the top of the pipe bell. For water mains installed under NCDOT or City owned roads, NCDOT No. 67 stone shall be used a "pipe zone" material under the pipe (minimum 4-inches) up to 1/3 of the pipe diameter.

2. Concrete Encasement and Cradles: Concrete encasement or cradles will be used only as designed for individual cases or as directed by the Water Resources Engineering Manager or their representative.

09.03.12 COMPACTION REQUIREMENTS

A. All materials shall be properly placed and compacted to correct any deficiencies resulting from insufficient or improper compaction of such materials. The Developer/Contractor shall determine the type, size, and weight of compaction best suited to the work at hand, select and control the lift thickness, exert proper control over the moisture content of the material, and other details necessary to obtain satisfactory results. The selection of compaction equipment is the Developer/Contractor's responsibility but shall be subject to the approval of the Water Resources Engineering Manager.

B. Moisture content and density testing of backfill shall be performed by a duly appointed agency of the City of Monroe. The Contractor will cooperate fully with the soils technicians in providing access to backfill at any requested depth for the purpose of performing moisture content/density testing. When requested, the Contractor shall excavate a backfilled ditch to any specified depth for a compaction test and shall insure that the ditch meets all OSHA safety standards before the technician enters to perform the test.

C. Compact soil to not less than the following percentages of maximum density for soils which exhibit a well-defined moisture-density relationship determined in accordance with ASTM Standards:

1. Under lawn or paved areas: All material shall have a minimum in-place density of 95% maximum density.

2. Under slabs, structures, pavement, shoulders, and curb: All material from the bottom of the trench to six (6) inches of the subgrade shall have an in place density of 95% of the maximum dry density. All material within six (6) of subgrade level shall have in an in-place density of 100% of the maximum dry density.

09.03.13 RESTORATION OF PAVEMENT AND ROAD SURFACES

A. CITY OF MONROE ROADS

1. As a minimum, asphalt repair on priority streets shall be either (1) a minimum of 6 inches in thickness, 4 inches of asphalt base and 2 inches top surfacing course; or (2) equal to the existing asphalt thickness plus half of the existing stone thickness, whichever is greater, not to exceed a total of 10 inches. Cuts that cannot be repaired the same day on priority streets shall be covered with steel plates. All commercial and industrial streets shall meet the pavement structural requirements for priority streets.

2. Asphalt repair on minor residential streets shall be either (1) a 2 inch minimum asphalt top surfacing course; or (2) equal to the existing asphalt thickness, whichever is greater. Base material shall be 8-inches of aggregate base course (ABC). Asphalt base may be substituted for ABC. Maximum asphalt thickness should not exceed 8-inches.

3. The current pavement condition rating (PCR) can be obtained by contacting the Engineering Department at (704) 282-4667.

4. For minor residential streets included on the 3 year reclamation list, updated annually by the Engineering Department, an l-inch top surfacing course with 6-inches of ABC base course shall be provided. Trenches or tap repairs that cannot be repaired same day shall be backfilled with a minimum of 7-inches of ABC stone to allow for 1-inch asphalt cap at a later date. Note, Compaction of 95 percent is acceptable in these instances because the reclamation process wi11 involve re-compacting the entire street to achieve a final compaction of 100 percent prior to resurfacing.

5. When cuts are to be made in street rights-of-way under maintenance by the City of Monroe, the Contractor shall contact the Superintendent of Streets or his designated representative before each separate pavement cut is made and secure a permit. Cuts and replacement shall meet or exceed City requirements as stipulated in the permit or required by Superintendent of Streets or his designated representative.

B. NCDOT ROADS

1. All construction and materials shall conform to the Standard Specifications and Details of the North Carolina Department of Transpiration, Office of Engineering and all conditional requirements set forth in the Encroachment Agreement issued by such agency.

C. Installation of Asphalt Pavement (City and NCDOT Roads)

1. Bituminous pavement shall be cut in a smooth and straight line. This includes cutting a rebate along the edges of the existing asphalt pavement at excavations. The Contractor shall contact the Superintendent of Streets and/or NCDOT District Engineer for a determination of the limits of replacement and location of cuts. As a minimum, the width of pavement left between the edge of the ditch and the existing edge of the pavement or the front line of the gutter, shall be at least 2 feet. Residual strips of pavement less than 2 feet in width must be removed and replaced. The edge of existing pavement shall be cut a minimum of one foot beyond the excavation or disturbed base.

2. The Contractor shall remove and replace pavement which, in the opinion of the Water Resources Engineering Manager, has been cracked or displaced by the operation of the Contractor.

3. All material above the sub-base level shall be hot-mix bituminous asphalt conforming to North Carolina Department of Transportation standard specifications for roads and structures for both mix design and placement. The asphalt pavement as placed shall be as described above. The asphalt shall be placed in lifts not greater than 4 inches and shall be hot mix bituminous asphalt binder I-19.0A. The last two (2) inches in either instance shall be S-9.5A “Super Pave” suitable to the appropriate controlling agency. S-9.5A “Super Pave” asphalt pavement resurfacing shall be placed with paving machines and/or rollers of a size and type currently approved by the North Carolina Department of Transportation for use on resurfacing contracts.

4. If a bituminous surfacing overlays a concrete base, the Water Resources Engineering Manager may direct the Contractor to omit all concrete and to replace the pavement with bituminous materials.

5. Tack coats shall be employed with each lift and prior to overlays. Tack coats shall be placed on both horizontal and vertical surfaces (pavement cuts or face of concrete gutters) in accordance with the manufacturer's application rates and written instructions.

6. Under normal conditions, asphalt binder will be placed in pavement cuts at the end of each work day. S-9.5A shall be replaced weekly or within five days following completion of pipeline construction along a continuous section of pavement. During inclement weather, the Water Resources Engineering Manager or their representative may permit the use of temporary asphalt (cold mix) to seal the trench until permanent asphalt can be placed.

7. Prior to placing permanent pavement, all castings within the area shall be adjusted to established grade and cross section.

09.03.14 CONCRETE CONSTRUCTION

A. The Water Resources Engineering Manager or their authorized representative shall make or require any tests to be performed by an independent testing laboratory at the Contractor's expense that he deems necessary to insure that the concrete meets specifications. Testing shall include:

1. Compressive strength in accordance with ASTM C-31 and ASTM C-39. Test cylinders which are formed in the field will be left in the field until compression testing (7 day, 14 day, 28 day) is completed thereby more closely approximating the curing conditions of the field placed concrete.

2. Slump test in accordance with ASTM C-143

3. Air Content Test in accordance with either ASTM C-173 or ASTM C-231.

B. Placement: Concrete will not be accepted if it cannot be placed within (90) minutes of dispatch time. Time requirements may fluctuate marginally due to temperature. Concrete shall be deposited in such a manner so as to prevent contamination by foreign material and segregation due to rehandling or flowing. Concrete shall not be placed when the ambient temperature is below 45ºF and falling or below 40ºF without permission of the Water Resources Engineering Manager. Hot and cold weather

protection shall be in accordance with ACI 305R and 306.1, respectively. All frozen concrete shall be removed and replaced by the Contractor as directed by the Water Resources Engineering Manager.

C. Joints: Expansion and contraction joints shall be placed as directed by the Water Resources Engineering Manager. At locations where replacing section of existing concrete driveway or walkway, sawcut existing concrete to provide a clean edge at the nearest adjacent construction joint, provided that the joint is beyond one foot from the edge of the trench or excavation or to a point to create control joints equidistant from one another.

D. Forms: Forms exposed to concrete surfaces shall be plywood, metal, metal frames, plastic-faced, or any other materials acceptable to the Water Resources Engineering Manager to provide continuous straight, smooth exposed surfaces. Forms shall be of sufficient thickness to withstand pressure of newly placed concrete without bow or deflection. Forms will normally be left for the entire (7) day period. Exposed surfaces not covered by forms shall be treated as specified below.

E. Wire Fabric Reinforcement: Wire fabric shall be placed 2-inch below the top surface or at the mid-point of slabs supported and lapped as required as directed by the Water Resources Engineering Manager.

F. Finishing: The surfaces shall be finished with a float and troweled by skilled workmen. After the surface has been leveled and finished and before the concrete takes its final set, the surface shall be textured to a uniform finish as approved by the Water Resources Engineering Manager.

G. Curing: After concrete is placed and finished, it shall be protected by applying a colorless curing compound as approved by the Water Resources Engineering Manager.

09.03.15 BLASTING

A. Prior to commencing any blasting operations the Contractor shall obtain a permit through the City of Monroe Public Safety Department and obtain written permission from the Water Resources Engineering Manager.

B. All blasting operations shall be conducted in strict accordance with any and all decrees, rules, regulations, ordinances, and laws as may be imposed by any regulatory body and/or agency having jurisdiction over the work relative to handling, transporting, use and storage of explosives. Blasting shall be performed only by competent and experienced personnel and monitored by an experienced seismologist. Satisfactory information must

be provided to the Engineer that the blaster satisfies the requirements of OSHA.

C. All rock dirt and debris from blasting shall be contained within the excavation by use of weighted mats or undisturbed overburden. The Contractor's blaster shall be fully responsible for determining the method of containment and the weight, size and placement of material required to contain the charge he is using.

D. Charges shall be sized such that no damage to houses, structures, utilities, roadways etc. outside the limits of excavation will occur. Where there is a possibility of such damage, the charge will initially be set at very low level and increased in small increments until the proper charge is determined. The Contractor shall be held responsible for any and all injury to persons or damage to public or private property.

E. The Contractor shall not be allowed to blast within any rights-of-way maintained by any agency (NCDOT, Railroad, etc.) other than the City without specific approval of the controlling agency and only in accordance with their respective requirements.

F. If blasting is conducted within 300 feet of any structure, the Contractor shall employ specialists to conduct pre-blasting surveys of structures and water wells in the vicinity of the work and to monitor the effects of blasting by obtaining and interpreting seismic records.

09.03.16 HYDROSTATIC AND LEAKAGE TESTING

A. General

1. Conduct all tests in accordance with AWWA C-600 and C-651, latest revisions, in the presence of the Water Resources Engineering Manager or their authorized representative.

2. The Contractor shall submit proposed materials, methods, and operations regarding testing to the Water Resources Engineering Manger prior to the start of testing.

3. All fittings, hydrants, valves, and appurtenances must be properly braced and harnessed before the pressure is applied.

4. The Water Resources Engineering Manager shall be notified 72 hours in advance of testing.

B. Procedure

1. When filling of the new water main is achieved by accepting water from an existing main, the Contractor shall furnish and install a reduced pressure zone backflow preventer at the source of the supply. This device shall remain in place until the Water Resources Engineering Manager has certified the main for acceptance.

2. The pipe shall be slowly filled with water and the specified test pressure, measured at the point of lowest elevation, shall be applied by means of a pump connected to the pipe. The pump, pipe connections, all necessary apparatus, taps, gauges, and measuring devices shall be furnished by the Contractor.

3. The test pressure shall be 200 psi. At no point along the test section shall pressures during the test exceed the allowable pressure of the pipe or fittings.

4. The maximum length of section tested at one time shall be 3,000 feet with section end points defined at main line valve locations or blow-offs.

5. The new section shall be filled with water furnished by and under the direction of the City from the existing water system through the control point, with the flushing rate achieving a velocity of 2.5 to 3 feet per second through the main. Before applying the test pressure, air shall be expelled completely from the pipe, valves, and hydrants. If hydrants or blowoffs are not located at each high point. Taps shall be made at such points for air release. Hydrants and valves shall be operated to insure air is not trapped within these fittings. After all air has been expelled, all hydrants, corporation stops, and blow-off valves shall be closed for the hydrostatic test.

6. To obtain a scour velocity (3fps) in the water main, the Contractor shall achieve the following flowrates or pressures at the nozzle of the blowoff. The Developer/Contractor shall provide calculations if connection is other than a cap and pipe at the end of the main (blowoff).

Nominal Pipe Size (inches)	Required Flow (GPM)	2'' Pressure (PSI)	3'' Pressure (PSI)
6	275	7	2
8	500	22	5
10	750	50	10

7. All concrete reaction blocking on the test section shall be high early strength concrete to achieve 90% strength before placing the water main into service.

8. All pipes, joints, and fittings which are exposed when the test is conducted shall be carefully examined for visible leakage. Those portions of the pipeline covered by backfill shall be walked to observe leakage appearing on the ground surface. Any leaks discovered in the joints shall be corrected until watertight.

C. Leakage Test

1. Provided no visible defects are observed after test pressure is applied, a leakage test shall be performed. The leakage test shall be conducted for a minimum period of two (2) hours while line pressure is maintained in the test section continuously within 5 PSI of the pressure at the beginning of the test. If the pressure drop is greater than 5 PSI, the main may be suspect and the Contractor shall explore the cause for excessive leakage and make necessary repairs.

2. Leakage shall be defined as the metered quantity of water added to the test section in order to maintain pressure within 5 PSI of the test pressure during the leakage test period.

3. Allowable leakage shall be calculated from the following Tables by adjusting the value in the table for the actual length of pipe tested and duration of the test at the pipe size and test pressure found.

Allowable Leakage for PVC Pipe – Per 1000 ft. in Gallons/Hour

	Test Pressure in Line - PSI				
Nominal Pipe Size (inches)	50	100	150	**200**	250
4	0.19	0.27	0.33	**0.38**	0.43
6	0.29	0.41	0.50	**0.57**	0.64
8	0.38	0.54	0.66	**0.76**	0.85
10	0.48	0.68	0.83	**0.96**	1.07
12	0.57	0.81	0.99	**1.15**	1.28

Allowable Leakage for Ductile Iron Pipe Per 1000 ft. of Pipeline in Gallons/Hour

Test Pressure	**Nominal Pipe Diameter – in**												
PSI	**2**	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**	**20**	**24**	**30**	**36**
250	.24	.47	.71	.95	1.19	1.42	1.66	1.91	2.14	2.37	2.85	3.56	4.27
225	.23	.45	.68	.90	1.13	1.35	1.58	1.80	2.03	2.25	2.70	3.38	4.05
200	**.21**	**.43**	**.64**	**.85**	**1.06**	**1.28**	**1.48**	**1.70**	**1.91**	**2.12**	**2.55**	**3.19**	**3.82**

175	.20	.40	.59	.80	.99	1.19	1.39	1.59	1.79	1.98	2.38	2.98	3.58
150	.18	.37	.55	.74	.92	1.10	1.29	1.47	1.66	1.84	2.21	2.76	3.31

4. The leakage test shall be approved provided that the actual leakage is less than the allowable leakage at the completion of the test, and provided no visible leaks were found during the test. All visible leaks shall be repaired. If the leakage test fails, the Contractor shall locate and repair defective areas and repeat the test until satisfactory results are achieved.

5. Testing of New Intermediate Valves

    1. Following the approval of the leakage test, with test pressure maintained in the new section, each intermediate main line and hydrant branch valve which remained open during the initial hydrostatic test and leakage test shall be closed one-at-a-time, beginning with the furthest valve from the control point. As each valve is closed, pressure on the backside of the valve shall be released by opening blow-offs at the end of the system and each valve previously tested. The test pressure shall be maintained in the new system on the side of the valve facing the control point as it is tested in 9-32the closed position. Ten minutes shall be allowed for each valve tested within which period the pressure shall not drop by greater than 5 PSI. This test shall be repeated until successful, and the Contractor shall make any repairs required at his expense.

D. Water Use

1. Water usage and the City's labor costs for observing excessive retests (2 or more) may be billed to the Contractor at the City's standard water rates and actual labor and overhead costs.

E. Pressure Relief

1. Except during the specific period when tests are being conducted on the new main under the on-site observation and concurrence of the Water Resources authorized representative, the new main shall be relieved to atmospheric pressure at the end of the blow-off or hydrant located at the highest point in the section being tested and then this blow-off valve and/or hydrant closed. The high point shall be carefully selected to insure that air pockets are not reformed in the test section.

09.03.17 DISINFECTION AND BACTERIOLOGICAL TESTING OF MAINS

A. Disinfection

1. All new water mains shall be disinfected in accordance with AWWA Standard C651-14, latest revision.

2. Before disinfection, the line shall be cleaned and flushed with clean water as mentioned under Hydrostatic and Leakage Testing.

3. A chlorine solution shall be uniformly introduced into the new main under the direct observation and control of the Water Resources authorized representative until there is a uniform concentration with a minimum free residual of 50 mg/l. The Contractor shall use an approved test method to determine chlorine levels are being maintained.

4. The chlorinated solution shall be retained in the system for at least 24 hours, during which time all intermediate valves and hydrants shall be operated several times to insure disinfection of these appurtenances. At the end of the 24 hour period, the retained solution in all portions of the main shall have a free chlorine residual of not less than 10 mg/l.

B. Final Flushing

1. At the end of the sterilization period the chlorine solution shall be thoroughly flushed from the new main. Flushing shall continue until the residual chlorine at all end points of the disinfected new main is approximately the same as the residual in the existing main from which the flushing water was provided.

2. Heavily chlorinated waters may be discharged into the sanitary sewer only upon approval of the Water Resources Engineering Manager. Emptying of said flushing waters in other facilities and/or properties may be subject to the approval the Water Resources Engineering Manager or his authorized representative.

C. Bacteriological Testing

1. After completion of final flushing, bacteriological water samples shall be collected from an acceptable outlet(s) of the treated piping system. Bacteriological analyses may either be performed by the City of Monroe or a certified independent testing laboratory. If laboratory testing of the sample shows results that are not satisfactory, the chlorine treatment shall be repeated until all samples show safe results. The City may, at its discretion, require physical cleaning (pigging) of the new main, at the Contractor's

expense if a test fails two (2) or more times. Water usage, laboratory costs, and the City's labor costs for observing retests (after 2nd retry) may be billed to the Contractor at the City's standard water rates and actual labor and overhead costs.

2. One (1) sample shall be collected at each sample location after final flushing.

3. A set of samples shall be collected every 1,200 feet of the new main, plus one set from the end of the line and at least one from each branch greater than one pipe length.

4. All samples collected for laboratory testing shall be witnessed by the Water Resources Engineering Manager or their authorized representative.

09.03.18 LANDSCAPE RESTORATION

A. Topsoil

1. Topsoil shall consist of friable, natural earth of loamy character, without admixture of subsoil, uniform in quality, and free of refuse of any nature, hard clods, stiff clay sods, hard pan, pebbles larger than 3/4 inch in diameter, coarse sand, noxious weeds, sticks, brush and other rubbish. The pH shall range between 6.0 and 7.0 and shall contain not less than 5 percent and no more than 8 percent organic matter.

B. Fertilizer

1. Fertilizer shall be commercial mixed free flowing granules or pelleted fertilizer, 11-8-4 grade for lawn and naturalized areas. Fertilizer shall be applied at a rate of 20 lbs/1,000 sq ft or as determined by the soil test.

C. Lime

1. Lime shall be ground limestone containing not less than 85 percent calcium and magnesium carbonates and be ground to such fineness that at least 50 percent shall pass a 100-mesh sieve and at least 90 percent shall pass a 20 percent sieve. Lime shall be applied at a rate of 150 lbs/1,000 sq ft or as determined by the soil test to bring topsoil pH to a range of 6.0 to 7.0.

D. Seed

1. Seed shall be furnished in sealed bags or containers bearing the date of the last germination and free from noxious weeds. Seed mixtures shall consists of see proportioned by weight as follows:

a.	Kentucky 31 Fescue	40 percent
b.	Palmer Perennial Ryegrass	30 percent
c.	Birds Foot Trefoil	15 percent
d.	Red Clover	5 percent
e.	White Clover	5 percent
f.	Redtop	5 percent

2. Seed shall be applied at a rate of 5 lbs/1,000 sq ft.

E. Erosion Control Blankets/Jute Matting

1. The area to be covered shall be properly prepared, fertilized, and seeded before the blanket is applied. The blankets shall be applied in the direction of water flow, butted at the ends and side and stapled.

F. Gravel Areas

1. All areas (shoulders, side streets, drive, parking areas, etc.) which exhibit a gravel surface at the time of construction will be re-graveled with a minimum depth of six (6) inches of ABC stone compacted in place for the width and length of the disturbed area and then feathered gradually into the existing cross section. When a driveway is finished with other than ABC stone, a one-inch finish coating to match existing gravel gradation and appearance shall be placed.

G. Execution

1. Topsoil shall be placed, spread and finish graded within the job limits in order to provide a smooth surface without depressions or ridges and properly graded for drainage. Topsoil shall be placed to a depth of 4" (as measured after rolling and compaction). After placing the topsoil, the area shall be raked and all stones, rocks and weeds removed.

2. Fertilizing and seeding installation shall be accomplished within the recommended seasons per the USDA.

3. In order to prevent unnecessary erosion of newly topsoiled and graded areas, place and secure mulch or jute matting immediately after seeding.

4. Seeding and mulching may be applied hydraulically and sprayed over the area according to the manufacturers recommended proportions and application rates.

2. The Contractor shall maintain the seeded areas until there is a uniform growth three (3) inches high. Maintenance shall consist of watering, weed and pest control within established lawns, fertilization, erosion repair, reseeding and all else necessary to establish a vigorous healthy and uniform strand of grass. All areas and spots, which do not show a uniform strand of grass, for any reason, shall be treated repeatedly until a uniform strand is attained.

09.03.19 WORK WITHIN CITY RIGHTS-OF WAY, DEDICATED DEVELOPER-FUNDED/PUBLIC IMPROVEMENT PROJECTS

A. It shall be understood that the quality of workmanship and materials entering into the work shall conform to the pertinent sections within these Specifications and the accepted industry standard of quality (i.e. AWWA, ACI, PPI, DIPRA, etc.).

B. The Contractor shall coordinate water supply interruptions with the City of Monroe Water Resources Department as referenced in Section 09.03.02.

C. The Contractor shall maintain emergency vehicle access throughout the project site at all times. The Contractor shall also provide access for local traffic, the normal collection of garbage, commercial deliveries, and school bus traffic.

D. The hours of work shall be limited to the hours between 8:00 A.M. to 5:00 P.M., Monday through Friday, unless otherwise approved in writing by the Water Resources Engineering Manager. Written request to deviate from the aforementioned hours shall be submitted a minimum of three (3) working days in advance.

09.03.20 WORK WITHIN NCDOT RIGHTS-OF-WAY

A. The Contractor will be required to participate in a 3-party encroachment agreement to perform any work within the NCDOT right-of-way in the City of Monroe limits. The Contractor shall abide by all additional requirements set forth in the Agreement not mentioned herein.

B. Traffic control shall be in accordance with the NCDOT Standard Specifications and the Manual of Uniform Traffic Control Devices. All

traffic control plans shall be submitted for review and approval of the NCDOT Division Engineer and Water Resources Engineering Manager.

C. No storage of material or equipment will be permitted within the right-of-way without approval of the NCDOT Division Engineer.

D. Excavations with the exception of boring pits must be backfilled during non-working hours. Boring pits must be fenced at all times.

E. When cutting of pavement is permitted, only one half of the road width shall be opened at any time. Full traffic flow is to be maintained between dusk and dawn and at other peak hours of traffic.

F. The Contractor is informed to contact NCDOT to verify axle load limits on State maintained roads and bridges, which will be used for hauling equipment or materials to the project site. The Contractor shall do all that is necessary to satisfy NCDOT's requirements and will be responsible for any damage to roads and bridges resulting from project construction.

G. All disturbed areas shall be restored in accordance with NCDOT Standard Specifications and meet the approval of the NCDOT Division Engineer.

H. A representative from the NCDOT shall be invited to final inspections of all work within the NCDOT right-of-way along with the Water Resources Engineering Manager or their authorized representative. The Contractor will be responsible for providing an acceptance letter from the NCDOT prior to dedication of the water main to the City. The Contractor shall then end the encroachment agreement as stipulated within.

09.03.21 CITY OF MONROE JOB CLOSE-OUT

A. Final Inspection: On receipt of a request for final inspection, the Water Resources Engineering Manager or their authorized representative will deem the project substantially complete and proceed or will advise the Developer/Contractor of unfilled requirements. Any part of the work found to be incomplete or defective shall be addressed prior to final acceptance. The Water Resources Engineering Manager or their authorized representative will repeat inspection to insure that any punch list items have been addressed. The request for a final inspection will then be granted. The Developer/Contractor is referred to the Final Water Facilities Inspection Checklist at the end of this document.

B. As-Builts and Engineering Certification: Dedication of the new water main shall not take place until the Professional Engineer in responsible charge has furnished the Water Resources Department with an Engineering Certification of the Project and submitted record drawings, final project

photographs, property surveys, or similar final record information for review and approval to the Water Resources Department. The City will then issue the Certificate of Operation.

Final Water Facilities Inspection Checklist

1. Valve Boxes & Blowoff's

- ☐ Boxes centered over the valve or blow off
- ☐ Box is installed plumb
- ☐ Tracer wire wrapped around valve
- ☐ Top of valve box flush with final compacted grade (lawn or pavement)
- ☐ Donuts are in place on all valve boxes and blow off in lawn area
- ☐ Caps on all blow off
- ☐ All valves marked on curb with “V”
- ☐ Verify all valves are 100% open
- ☐ Opens to the left or counterclockwise
- ☐ Covers are free from hot mix asphalt

2. Water Meter Boxes:

- ☐ Protection provided around meter box
- ☐ Meter boxes shall be flush with final compacted grade
- ☐ Meter boxes clean with stone in the box
- ☐ Meter yoke in the proper location (Level and Upright)
- ☐ Room to operate shutoff valve
- ☐ Location of meter box marked on curb with "W"
- ☐ Verify bypass is closed and locked on 2-inch and larger meters
- ☐ Verify meter box has doghouse for service line.

3. Fire Hydrants:

- ☐ Painted Yellow (Silver on private Fire lines)
- ☐ Hydrant riser installed plumb
- ☐ Breakaway flange within allowable clearance from finished grade
- ☐ Caps chains removed
- ☐ Opens to the left or counterclockwise

4. Tracer Wire:

- ☐ Verified with locating equipment

Note: A final inspection is for the convenience of the developer so that water main can be activated after receiving engineering certifications. No water meter will be set until certification and as-builts are received. Warranty on water facilities will not begin until the subdivision final inspection is complete and all punch list items are addressed and warranty letter as shown in 07.16 of the Standard Details Manual is issued.