LINCOLN COUNTY
STANDARD SPECIFICATIONS

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TECHNICAL SPECIFICATIONS

These specifications shall be used for water and sewer construction projects in which ownership will be transferred to Lincoln County Public Works. Additional specifications may be added by the Engineer to address items specific to the particular project. However, any deviations from the specifications herein shall be approved by Lincoln County Public Works.

NOTE:

1. The Engineer referred to in these specifications is the Engineer of Record for the Project. The Engineer shall be responsible for observing the methods and materials and certifying that construction was in conformance with the approved plans and specifications.

2. Lincoln County Public Works is not responsible for any cost or claims associated with construction projects not specifically owned by Lincoln County Public Works.

LINCOLN COUNTY STANDARD SPECIFICATIONS
SECTION 02110
CLEARING AND GRUBBING

1. DESCRIPTION

1.1 The clearing work covered by this section consists of cutting, removing and properly disposing of vegetation and debris. Trees specifically identified on the plans to be preserved shall be adequately delineated and flagged by the CONTRACTOR, such that the balance of the work may be performed in a safe and harmless manner in the vicinity of preserved trees. Such tree preservation will be considered part of the work and shall be in conformance with applicable local codes and regulations. Clearing and grubbing shall be performed in areas as called for on the plans, the limits of which shall coincide with the construction limits and in general shall extend five (5) feet beyond top of cut and toe of fill, not to exceed the limits of Lincoln County Public Works' property or easement.

1.2 Related Work
Any reference to standard specifications refers to the most current published date of the following specification unless otherwise noted.

1.2.1 Reference the following specifications for related work:
02210 Unclassified Excavation and Grading

1.2.2 Clearing and grubbing activities shall conform to the applicable sections of the most recent publication of "Standard Specifications for Roads and Structures", published by the North Carolina Department of Transportation, except that grubbing shall be performed on all cleared excavation and embankment areas and shall include the complete removal of all stumps, roots and embedded debris.

1.3 The grubbing work covered by this section consists of removing and properly disposing of all surface vegetation and debris. Where the material being removed is high in organic matter content, such as root mat and other vegetative matter, it shall be considered vegetation and removed as part of the work of grubbing.

1.4 The work of clearing and grubbing shall also include the removal and satisfactory disposal of crops, weeds and other annual growth, fences, steps, walls, chimneys, column footings, other footings, foundation slabs, basements, other foundation components, signs, junked vehicles, and other rubble and debris, and the filling of holes and depressions. This work shall also be performed in all non-wooded areas within the construction limits, shown on the project plans upon which seeding and mulching, sprigging or sodding is to be performed.

As a part of the work of clearing and grubbing, the CONTRACTOR will be required to cut off and plug at the right of way or construction limits, as directed by the ENGINEER, any private water or sewer line intercepted during the construction of the project, as well as cut off and remove from the construction area any septic tank or portion thereof during the construction of the project.

1.5 Clearing and grubbing operations shall be completed sufficiently in advance of grading operations as may be necessary to prevent any of the debris from the clearing and grubbing operations from interfering with the excavation or embankment operations.

2. MATERIALS

Topsoil shall be considered to mean original surface soil, typical of the area, which is capable of supporting native plant growth, and shall be free of large stones, roots, brush, waste construction debris and other undesirable material.

3. INSTALLATION

3.1 Clearing and grubbing shall be performed in areas as called for on the plans, the limits of which shall coincide with the construction limits and in general shall extend 5 feet beyond top of cut or toe of fill, not to exceed the limits of the OWNER's property. Clearing and grubbing activities shall conform to applicable Sections of the most current edition of "Standard Specifications for Roads and Structures", published by the North Carolina Department of Transportation, except that grubbing shall be performed on all cleared excavation and embankment areas and shall include the complete removal of all stumps, roots and embedded debris.

3.2 The CONTRACTOR shall perform all clearing and grubbing operations before construction operations begin.

3.2.1 Where adjacent areas within the site but outside the limits of construction are disturbed as a result of clearing and grubbing activities, the CONTRACTOR shall remove all debris and restore to the original grades and equal or better condition.

3.2.2 The CONTRACTOR shall exercise caution to protect and maintain all existing utilities and underground works which are to remain. Any existing utilities or underground works which are to remain that are disturbed during construction shall be repaired or replaced at the CONTRACTOR's expense.

3.2.3 The CONTRACTOR must comply with all local, state and federal laws, ordinances and regulations in the removal and disposal of clearing and grubbing of all vegetation, timber, waste and all surface debris that must be hauled from the Project Site. No burning of materials will be allowed on site. The CONTRACTOR shall properly dispose of all cleared materials at his expense, in conformance with all applicable local and state laws and ordinances with the exception of any materials to be reused or recycled as directed elsewhere in this contract.

3.3 Stripping and Storage of Topsoil
All topsoil suitable for reuse, in the opinion of the ENGINEER, shall be stripped to its full depth; all topsoil to be moved shall be free of large stone, roots, brush, waste construction materials and other undesirable matter.

3.3.1 Topsoil stripping shall be accomplished from all topsoiled areas to be disturbed.

3.3.2 Existing lawn sods may be left to decompose with the topsoil. Heavier stands of weeds and grasses shall be removed as directed by the ENGINEER prior to the stripping operations.

3.3.3 The topsoil shall be kept separate from other excavated materials and stored in stockpiles, the location of which shall be as directed by the ENGINEER. Topsoil shall be stockpiled so that it shall not be subject to abnormal erosion and loss, and so that it does not impede the flow of drainage runoff. The directed locations of topsoil stockpiles will, when construction sequence permits, be located in areas that have previously been graded to design rough grade.

END OF SECTION

SECTION 02210
UNCLASSIFIED EXCAVATION AND GRADING

PART 1 – GENERAL

1.1 DESCRIPTION
Work in this section includes the excavation, undercut excavating, grading, earthwork and compaction required as shown on the plans and all other associated miscellaneous items of earthwork construction, as shown on the plans. The CONTRACTOR shall furnish all materials, labor, equipment and incidental items necessary to complete this portion of the work as detailed on the plans and as called for in these Specifications.

1.2 Any reference to standard specifications refers to the most current published date of the following specification unless otherwise noted.

1.2.1. All unclassified excavation shall be in accordance with the applicable sections of the most recent publication of the "Standard Specifications for Roads and Structures", published by the North Carolina Department of Transportation, unless otherwise directed herein.

1.3 RELATED WORK
Any reference to standard specifications refers to the most current published date of the following specification unless otherwise noted.

Reference the following specifications for related work:

02110	Clearing and Grubbing
02222	Excavating, Backfilling & Compacting for utilities
02933	Seeding and Mulching
ASTM D698C	
State Highway Specifications referred to in Section 1.2.1	

1.4 DEFINITIONS

Trench Rock: That rock within the trenching limits that must be removed for utility construction.

Mass Rock: That rock which must be removed by blasting to permit reaching one foot below the design finish grade.

Geotechnical Engineer, also, know as the "Project Geotechnical Engineer": Professional soils engineer hired by the contractor and approved by the Engineer for this project.

Surveyor: Licensed surveyor hired by the Contractor and approved by the Engineer for this project.

PART 2 - PRODUCT

2.1 Topsoil shall be considered to mean original surface soil, typical of the area, which is capable of supporting native plant growth, and shall be free of large stones, roots, brush, waste, construction debris and other undesirable material or contamination.

2.2 All fill used for site grading operations should consist of a clean (free of organics and debris) low plasticity soil (plasticity index less than 30).

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

3.1.1 In the event a subsurface investigation report has been prepared for the project, all excavation, filling and grading shall be performed in accordance with the recommendations of the subsurface report, and under the direction of the project geotechnical engineer.

3.1.2 Construction stakeout will be by a licensed survey firm provided by the CONTRACTOR. Exact locations and grade points are to be staked or fixed by the surveying firm before construction. The CONTRACTOR shall not disturb any benchmarks, reference stakes or property line monuments. In the event it becomes necessary to remove any benchmark, reference stake or property line monument in the performance of the work, the CONTRACTOR shall reference such points in preparation for replacement. If any such points are disturbed or damaged, they shall be replaced by a Registered Land Surveyor in the state where the work is located.

3.1.3 Existing utility lines (either overhead or underground), sidewalks, fencing, pavement or other structures shown on the drawings, shown to the CONTRACTOR or mentioned in the plans and specifications shall be kept free of damage by the CONTRACTOR's operations. It shall be the responsibility of the CONTRACTOR to verify the existence and location of all underground utilities within the Project Site. Any existing construction damaged by the CONTRACTOR shall be restored to an equal condition as that existing at the time prior to damage. If any existing utility is inadvertently damaged during construction, the CONTRACTOR shall notify the utility, the ENGINEER and Lincoln County Public Works of said damaged utility at once so that emergency repairs may be made.

3.2 UNCLASSIFIED EXCAVATION

3.2.1 Upon completion of the stripping operations, and after all excavation of the site has been completed to the lines and grades shown on the drawings, the exposed subgrade in cut areas should be proofrolled as specified herein for areas to receive fill. Any areas which deflect, rut or pump excessively during the proofrolling or fail to "tighten up" after successive passes should be undercut to suitable soils and replaced with compacted fill.

3.2.2 Rock in the bottom of roadway cuts shall be excavated to a depth of 1 foot below the roadbed and ditches. Rock in building pad areas shall be excavated to a depth of 1 foot below finished grade or as indicated on the grading plans.

3.2.3 The CONTRACTOR shall provide all sheeting, shoring, underpinning and bracing required to hold the sides of the excavation and for the protection of all adjacent structures.

3.3 BLASTING

3.3.1 Any and all blasting operations shall be conducted in strict accordance with existing ordinances and regulations relative to storage and use of explosives. Blasting shall be done only by experienced men and extreme caution and care shall be exercised to prevent injury to persons or damage to any pipe, mains, wires, drains, buildings, railroad tracks or other property above or below the surface of the ground. The CONTRACTOR shall use safety nets or other equivalent measures to reduce the possibility of flying rock as a result of blasting operations.

3.3.2 The CONTRACTOR shall submit blasting plans to the ENGINEER for review and shall not proceed with blasting operations until approval has been granted. As directed by the ENGINEER, blasting operations shall be monitored to insure that vibration levels produced by blasting are within tolerable limits.

3.3.3 All Federal, State and Local permits required to perform blasting operations shall be obtained.

3.4 DEWATERING

3.4.1 The CONTRACTOR shall control the grading in all areas so that the surface of the ground will be properly sloped, diked or ditched to prevent water from entering into excavated areas. The CONTRACTOR shall maintain sufficient personnel and equipment to promptly and continuously remove all water, from any source, entering or accumulating in the excavation or other parts of the work. All water pumped or drained from these areas shall be disposed of in a suitable manner without damaging adjacent property or other work under construction.

3.5 EMBANKMENTS, FILLS, AND BACKFILLS

3.5.1 Upon completion of the stripping operations, the exposed subgrade in areas to receive fill should be proofrolled with a loaded dump truck or similar pneumatic-tired vehicle with a minimum loaded weight of 20 tons, under the supervision of the geotechnical engineer. The proofrolling procedure should consist of four complete passes of the exposed areas with two of the passes being in a direction perpendicular to the preceding ones. Any areas which deflect, rut or pump excessively during the proofrolling or fail to "tighten up" after successive passes should be undercut to suitable soils and replaced with compacted fill.

3.5.2 Embankments and fills shall be constructed at the locations and to the lines and grades indicated on the drawings. Material shall be placed in horizontal layers not to exceed 8 inches in loose depth and thoroughly compacted prior to placing each following layer. All fill material shall be free from roots or other organic material, trash, and from all stones having any one dimension greater than 6 inches. Stones larger than 4 inches, maximum dimension, shall not be permitted in the upper 6 inches of fill or embankment. Fill areas shall be kept level with graders or other approved devices.

3.5.3 Embankment and fill compaction shall be accomplished by thoroughly compacting each layer with sheep foot rollers, pneumatic rollers, and mechanical tampers in places inaccessible to rollers, or other equipment. When material has too much moisture, grading operations shall be limited to drying soil by spreading and turning for drying by the sun and aeration. When material is dry, moisture shall be added by sprinkling by approved means.

3.5.4 All embankments and fills shall be compacted to the following percentages of the maximum dry density as determined by the Standard Proctor Density Test, ASTM D-698, Method C.

3.5.5 The following table shall be used unless otherwise specified:

TABLE OF COMPACTION

Type Fill or Embankment	Zone	Minimum Density %
Structure	All Depths	100
Roadway and	Top 12 Inches	100
Parking	Remainder	95

Embankment types are defined as follows:

Structure - beneath concrete slabs of buildings, floors, foundations, etc.

Roadway and Parking - beneath all roads, streets, truck operations, and automobile parking lots.

3.5.6 Where backfilling is required after the completion of drainage structures, all forms, trash, and construction debris shall be removed from excavation before backfilling begins. Backfill shall be placed in horizontal layers of 6 inches in loose depth. Compaction shall conform to requirements in the above table. Heavy rollers, crawler equipment, trucks or other heavy equipment shall not be used for compacting backfill within 5 feet of structure walls or other facilities which may be damaged by their weight or operation. No backfilling shall begin until concrete and masonry walls are properly cured.

3.5.7 The CONTRACTOR shall carry the top of embankments, fills, or backfills to the surrounding grade so that upon compaction and subsequent settlement, the grade will be at proper elevation. Should settlement occur during the guarantee period of the contract, the CONTRACTOR shall provide sufficient fill to bring area up to finished grade and shall reseed as required.

3.6 PROOFROLLING SCHEDULE

3.6.1 Proofrolling under the observation of the Geotechnical Engineer will be performed using a loaded dump truck or similar pneumatic-tired vehicle with a minimum loaded weight of 25 tons as specified herein and as follows:

3.6.2 Immediately following stripping, all areas to receive fill shall be proofrolled as specified herein.

3.6.3 Immediately following the completion of excavation to proposed grades in cut areas, proofrolling shall be performed as specified herein.

3.6.4 Immediately prior to stone base course placement in pavement areas and following final floor slab preparation, all subgrade areas will be proofrolled. Any local areas which deflect, rut or pump under the roller shall be undercut and replaced with compacted fill material as specified herein.

3.7 SOIL INSPECTION AND TESTS

3.7.1 All excavated and fill material shall be removed, selected, placed and compacted under supervision of a representative of a commercial soils testing laboratory, at no cost to Lincoln County Public Works. A commercial soils testing laboratory shall be a Firm properly equipped to perform such compaction tests and who has in their employment a Professional Engineer experienced in testing and soil mechanics. The laboratory representative shall have the authority to approve or disapprove the condition of the subgrade on which fill is to be placed, filled material, placement methods, compaction methods, and shall make compaction density tests as necessary to determine that the specified density is obtained. The laboratory shall be notified before any cut is made or fill is placed in order that the laboratory representative may be present during all grading operations. The Contractor shall remove, replace, recompact and retest all fills failing to meet the density requirements at no cost to Lincoln County Public Works.

3.7.2 Field density tests shall be performed by Lincoln County Public Works' testing agency for each one foot of fill material placed at the following frequency:

3.7.3 A minimum of one field density test shall be made for each 5,000 square feet of fill placement in building areas.

3.7.4 A minimum of one field density test shall be made for each 10,000 square feet of fill placement in all other areas where pavement is to be placed.

3.7.5 Prior to final acceptance, the Geotechnical Engineer and Surveyor shall submit certification specifying that the project compaction criteria and subgrading elevations have been satisfactorily obtained. This certification should be in the form of a letter accompanied by a stamped as-built drawing showing spot elevations.

3.8 BORROW AND WASTE MATERIALS

3.8.1 Borrow: In the event borrow material is required, the borrow material shall be checked for suitability for compaction and approved by the soils testing laboratory. Borrow excavation shall be performed in accordance with the most current referenced State Highway construction Specification in which State the project is located except where modified herein.

3.8.2 Waste: Excavated materials not suited for backfill and excavated material in excess of that needed to complete the work shall be wasted on the project site where directed by the ENGINEER or hauled off the property. Waste areas shall be left in a graded and sloped condition to allow natural drainage of surrounding area.

3.9 RESIDUAL SOIL AREAS

3.9.1 If proofrolling indicates that on-site virgin soils supporting any roadway, parking, building or other structural areas are not adequate as determined by the Geotechnical Engineer, then these unsuitable areas shall be repaired. The necessary repair procedure shall be determined by the Soils Engineer and may include scarifying, drying and recompaction procedures or undercutting and replacement procedures.

3.10 FINAL GRADING

3.10.1 On completion of all grading, all graded areas (except building pads and pavement areas in rough grading contracts and all cut slopes steeper than 4:1 slope) shall be provided with 4 inches of topsoil and brought to the finished grades shown on the drawings. Areas disturbed by operations of the CONTRACTOR shall be properly returned to their original condition with a topsoil covering of 4 inches.

3.10.2 After the entire graded area has been brought to the finished grades shown on drawings, all areas shall be left smooth and free from erosion, ridges, ditches and evidence of ponding. Final grades shall be free from all roots, debris, rock and soil lumps and left in readiness for seeding.

3.10.3 Prior to acceptance of the entire project, the CONTRACTOR shall correct all embankments and graded areas of all damages due to washes, settlement, erosion, equipment ruts or any other cause at his expense.

3.10.4 The CONTRACTOR shall stabilize all disturbed areas, unless otherwise directed, by seeding and mulching per Section 02933 of these specifications or other means of stabilization called for by the contract drawings.

3.11 CLEAN-UP

3.11.1 Upon completion or termination of the work, the CONTRACTOR shall remove from site all equipment, waste materials and rubbish resulting from his operations.

END OF SECTION

LINCOLN COUNTY STANDARD SPECIFICATIONS
SECTION 02222
EXCAVATING, BACKFILLING & COMPACTING FOR UTILITIES

1. DESCRIPTION

The CONTRACTOR shall furnish all labor, material, equipment, and supplies, and shall perform all earthwork including excavation and backfill, pavement removal, sheathing, bracing, shoring, pumping or bailing, dewatering, restoration and cleanup, all as indicated, specified and/or necessary to complete the work.

1.1 Any reference to standard specifications refers to the most current published date of the following specification unless otherwise noted.

1.2 Related Work

Reference the following specifications for related work:

02575 Pavement Repair and Resurfacing
02933 Seeding and Mulching

1.2.1. Any reference to NCDOT standard specifications was obtained from the "Standard Specifications for Roads and Structures" published by the North Carolina Department of Transportation. Unless otherwise noted, the most current date published applies.

2. MATERIALS

2.1 Fill Material shall be classified as ML-low plasticity silt or better by the Unified Soil Classification System and tabulated below:

	Unified Class	Description
Class I		1/4" - 1-1/2" well graded stone including coral, slag, cinders, crushed stone and crushed shells
Class II	GM	Coarse gravel well graded
	GP	Coarse gravel poorly graded
	SW	Coarse sands well graded
	SP	Coarse sands poorly graded
Class III	GM	Silty-sandy gravel
	GC	Clayey-sandy gravel
	SM	Silty-sands
	SC	Clayey-sands
Class IV	ML	Inorganic silts and fine sands

Fill material shall exhibit a plasticity index of less than 20 and Standard Proctor maximum density at optimum moisture greater than 90 pounds per cubic foot. The following materials are unacceptable

	Unified Class	Description
Class IV	CL	Inorganic clays - low plasticity
	MH	Inorganic elastic silts
	CH	Inorganic clays - high plasticity
Class V	OL	Organic silts
	OH	Organic clays
	PT	Highly organic soil

2.2 Washed Stone
Stone material where indicated shall be crushed stone or gravel of strong, durable nature and shall conform to standard size No. 57 per NCDOT Section 1000.

2.3 Class C Concrete
Minimum 28-day compressive strength of 2000 psi.

3. CONSTRUCTION

3.1 Existing Facilities

3.1.1 Existing Utilities Shown on the Drawings
It shall be the CONTRACTOR's responsibility to conduct the work in such a manner as to avoid damage to or interference with any utilities services shown on the drawings. If such damage, interference, or interruption of service shall occur as a result of his work, then it shall be the CONTRACTOR's responsibility to promptly notify the ENGINEER of the occurrence and to repair or correct it immediately, at his own expense, and to the satisfaction of the ENGINEER and Lincoln County Public Works.

3.1.2 Existing Utilities Not Shown on the Drawings
It shall be the CONTRACTOR's responsibility to exercise all reasonable precaution in the performance of the work to avoid damage to or interference with any utilities services, even though not shown on the drawings. If such damage, interference, or interruption of service shall occur as the result of this work, then the CONTRACTOR's responsibility will be the same as stipulated in Paragraph 3.1.1 above.

3.2 Excavation and Backfill - General Requirements

3.2.1 Pavement, gutters, sidewalks, aprons and curbs which will be disturbed by excavation shall be removed and disposed of as a part of ordinary excavation. That which is to be removed shall be cut or sawn along clean straight lines from that which is to remain. Remove enough such that a minimum of twelve inches of undisturbed earth remain between the excavation and that which is to remain.

3.2.2 Where required, and as approved by the ENGINEER, sheeting and bracing shall be used to prevent injury to persons, caving of trench walls and to conform with all governing laws and ordinances. Sheeting and bracing shall be left in place until the trench is refilled to a safe limit. The top portion may then be removed, but the lower portion shall remain undisturbed.

3.2.3 It is the responsibility of the CONTRACTOR to provide an adequate dewatering system where required. The system shall be capable of removing any water that accumulates in the excavation and maintaining the excavation in a dry condition while construction is in progress. The surface of the ground shall be sloped away from the excavation or piping provided to prevent surface water from entering the excavation. Disposal of water resulting from the dewatering operation shall be done in a manner that does not interfere with normal drainage, and does not cause damage to any portion of the work or adjacent property. All drains, culverts, storm sewers and inlets subject to the dewatering operation shall be kept clean and open for normal surface drainage. The dewatering system shall be maintained until backfilling is completed or as otherwise directed by the ENGINEER. All damage resulting from the dewatering operation shall be repaired by the CONTRACTOR to the satisfaction of the ENGINEER and Lincoln County Public Works and at no cost to Lincoln County Public Works.

3.2 The CONTRACTOR shall erect, maintain, and safeguard temporary bridges, walkways, or crossings where it is necessary to maintain traffic. Where trenches are open in the vicinity of pedestrian or vehicular travel lanes, suitable carriers will be constructed and maintained and the

work will be further protected from sunset to sunrise with a sufficient number of lights or flares to fully protect the public from accidents on account of construction.

3.3 If the specified depth for foundations proves insufficient to reach firm ground, the ENGINEER shall be notified and will furnish instructions for proceeding with the work.

3.4 Rock, wherever used as a name for excavation material, shall mean boulders exceeding one-half cubic yard in volume or solid ledge rock, which in the opinion of the ENGINEER, requires for its removal drilling and blasting, or wedging or sledging and barring. The CONTRACTOR shall excavate the same as near the neat lines of the trench as practicable and he shall take all due precautions in the pursuance of the work. The CONTRACTOR will be held strictly responsible for all injury to life, to public and private property.

3.4.1 Rock shall be removed from the excavation to the following limits:

Trenches - The diameter of the pipe plus 12-inches on each side, extending eight inches below the pipe wall and bell.

Structures - 12-inches beyond the vertical plane of the structure on all sides and on the bottom only to the depth necessary for proper installation.

3.5 Blasting

Prior to commencing any blasting operations the CONTRACTOR shall notify the ENGINEER and either the Local Fire Department - Fire Prevention Section or the Lincoln County Fire Marshal (as applicable) and obtain blasting permits as required. The CONTRACTOR must furnish proof (certification) of insurance specifically covering any and all obligations assumed pursuant to the use of explosives.

All blasting operations shall be conducted in strict accordance with any and all decrees, rules, regulations, ordinances, 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 done only by competent and experienced men whose activities shall be conducted in a workmanlike manner. Satisfactory information must be provided to the ENGINEER, that the blaster meets or exceeds the qualifications enumerated in the most current edition of OSHA Regulations Part 1926, Subpart U, Section 1926.901 - Blaster Qualifications.

The CONTRACTOR shall protect all structures from the effects of the blast and repair any resulting damage. If the CONTRACTOR repeatedly uses excessive blasting charges or blasts in an unsafe or improper manner, the ENGINEER may direct the CONTRACTOR, at no cost to Lincoln County Public Works, to employ an independent blasting consultant to supervise the preparation for each blast and approve the quantity of each charge.

3.5.1 Overburden

Undisturbed overburden may be deemed adequate in lieu of matting but only after the actual depth of the undisturbed overburden has been determined and adjudged sufficient by the ENGINEER. Under no circumstances will loose or fill overburden be adequate without the use of weighted mats.

3.5.2 Permission to Blast

The CONTRACTOR shall not be allowed to blast before 9 a.m. or after 3 p.m. without approval of the ENGINEER and Lincoln County Public Works. Blasting will not occur within any rights-of-way maintained by any agency (D.O.T., R.R., Gas, Lincoln County Public Works, etc.) without specific approval of the controlling agency and only in accordance with their respective requirements (as exceeded herein). The CONTRACTOR shall be held responsible for any and all injury to persons or damage to public or private property.

3.5.3 The CONTRACTOR shall not use excavated rock as backfill material. Dispose of rock which is surplus or not suitable for use as rip rap.

3.5.4 Monitoring

The CONTRACTOR shall notify the ENGINEER prior to any blasting. Additionally, the CONTRACTOR and/or ENGINEER shall notify Lincoln County Public Works before any charge is set. Following review by the Lincoln County Public Works regarding the proximity of permanent structures to the blasting site, the Lincoln County Public Works may direct the CONTRACTOR to employ, at the expense of the CONTRACTOR, an independent, qualified specialty sub-contractor, approved by Lincoln County Public Works, to monitor the blasting by use of seismograph, identify the areas where light charges must be used, conduct pre-blast and post-blast inspections of structures, including photographs or videos, and maintain a detailed written log.

3.6. Structure Excavation and Backfill

3.6.1 Structure Excavation shall be made at the locations shown on the plans and to the exact subgrade required. Bottom of excavations shall be level and in firm, solid material, with soft material or voids treated as specified. Excavated areas shall be kept free of water during the construction period. Where earth will stand, footing trenches may be cut to the exact size of the footings; otherwise, forms shall be used. Where necessary, sides of excavations shall be shored and sheathed, or cofferdams built, as required for protection of the work and personnel.

3.6.1.1 Wherever excavation for a foundation extends below the water table or where specifically indicated on the plans, washed stone shall be placed to a minimum thickness of 12 inches, unless otherwise shown, prior to placing the foundation. The washed stone shall be compacted to 90% of maximum as determined by the Standard Proctor test (ASTM D698).

3.6.1.2 If the specified depth for foundations proves insufficient to reach firm ground, the ENGINEER shall be notified for furnishing instructions and proceeding with the work.

3.6.1.3 An adequate dewatering system shall be provided at all structure excavations and elsewhere as directed by the ENGINEER. If a well-point system is used, the CONTRACTOR shall submit plans to the ENGINEER for approval. The system shall be capable of removing any water that accumulates in the excavation and maintaining the excavation in a dry condition while construction is in progress. The surface of the ground shall be sloped away from the excavation or piping provided to prevent surface water from entering the excavation. Disposal of water resulting from the dewatering operation shall be done in a manner that does not interfere with normal drainage, and does not cause damage to any portion of the work or adjacent property. All drains, culverts, storm sewers and inlets subject to the dewatering operation shall be kept clean and open for normal surface drainage. The dewatering system shall be maintained until backfilling is complete or as otherwise directed by the ENGINEER. All damage resulting from the dewatering operation shall be repaired by the CONTRACTOR to the satisfaction of the ENGINEER and Lincoln County Public Works and at no cost to Lincoln County Public Works.

3.7. Structure Backfill shall be done with material free from large clods, frozen earth, organic material or any foreign matter, and shall evenly and carefully be placed and tamped in horizontal layers. Compaction equipment specifically designed for these purposes must be present and operational at the job site and shall be utilized throughout to obtain uniform compaction. The degree of compaction and the density shall be determined by the most current Standard Proctor Test (ASTM D698), with compaction requirements as follows:

Percent of Maximum Density at Optimum Moisture	Location
100	Top 12" of fill under pavement, surfacing or structures
95	Full depth beneath all roads - paved or unpaved, driveways, sidewalks and undercut backfill for structure excavation
95	All other areas not defined above

3.7.1 No backfill shall be placed against a structural wall until all connecting structural members are in place. It shall be the CONTRACTOR's responsibility to provide compaction to such a degree that subsidence after placing shall not be detrimental to the stability or appearance of the structure, adjacent ground, or paved areas. The CONTRACTOR shall provide adequate protection to all structures during backfilling and shall use every precaution to avoid damaging or defacing them in any way. CONTRACTOR shall be responsible for the protection of all structures from damage or flotation prior to backfill being placed.

3.7.2 Unless otherwise approved by the ENGINEER, liquid-retaining structures shall not be backfilled until tested for leakage.

3.8. Unstable Subgrade

Should unstable soil, organic soil, or soil types classified as fine-grained soils (silts and clays) by ASTM D-2487 be encountered in the bottom of pipe trenches or structure excavations, such soils shall be removed to a depth and width determined by the ENGINEER, properly disposed of and shall be backfilled with crushed stone conforming to the most current Department of Transportation Specifications, Size 57. Placement shall not exceed 12-inches loose and compacted to 90% of the dry density determined by the most current Standard Proctor Test ASTM D698 (Class C concrete may be substituted in place of #57 stone at the CONTRACTOR's option. A 24-hour cure must be given before proceeding with the work).

3.9. Site Grading

Site grading shall conform to the grades indicated by the finish contours on the plans. Where topsoil, pavement, gravel or crushed stone surfacing and other items are shown, rough grade shall be finished to such depth below finish grade as necessary to accommodate these items. All areas where structures are to be built on fill shall be stripped to such depth as necessary to remove turf, roots, organic matter and other objectionable materials.

3.9.1 Excavation shall be made to the exact elevations, slopes and limits shown on the plans. Material excavated may be used as fill material as long as it meets the material requirements established herein. Acceptable material must be stockpiled neatly onsite and clear of all unsuitable materials to be removed from the site.

3.9.2 Fill shall incorporate only acceptable materials defined herein. It shall not contain organic material, roots, debris or rock larger than 6 inches in diameter.

3.9.2.1 Where fill is to be placed, all existing vegetation, roots and other organic matter down to 12 inches below grade shall be stripped and disposed of as directed.

3.9.2.2 After clearing existing vegetation, at the ENGINEER's discretion, the site may require proof rolling to insure that all unstable material has been removed. Proof rolling shall be done in the ENGINEER's presence, utilizing a loaded dumptruck or similar pneumatic-tired vehicle with a minimum loaded weight of 25 tons.

3.9.2.3 Fill shall be placed in successive compacted layers not to exceed 6 inches compacted thickness. Each layer shall be spread evenly and compacted as specified below before the next layer is placed.

3.9.2.4 Rock shall not be incorporated in fill sections supporting pavement or structures.

3.9.2.5 Where natural slopes exceed 3:1, horizontal benches shall be cut to receive fill material. Slopes of less than 3:1 and other areas shall be scarified prior to placing fill material.

3.9.2.6 Borrow material, as required, shall be provided by the CONTRACTOR at his own expense. Borrow material on site may be utilized provided it complies with these specifications.

3.10. Compaction

Unless otherwise noted, each layer of fill and backfill and the top 12 inches of existing subgrade material in cuts shall be compacted by approved equipment as specified below. The degree of compaction and the density shall be determined by the most current Standard Proctor Test (ASTM D698).

	Percent of Max. Dry Density at Optimum Moisture Content
Top 12 inches of fill under Pavement, structures or surface	100%
Fill under roads and structures	95%
Fill and backfill in other areas	95%

Material too dry for proper compaction shall be moistened by suitable watering devices, turned and harrowed to distribute moisture, and then properly compacted. When material is too wet for proper compaction, operations shall cease until such material has sufficiently dried.

3.11. Compaction Tests

The CONTRACTOR shall provide compaction tests by an independent testing agency selected by the CONTRACTOR and approved by the ENGINEER. The compaction tests shall be taken at appropriate locations and frequency to demonstrate that the backfill (or fill) has been placed to meet the minimum compaction density required. The testing agency shall submit written test records to the ENGINEER for all compaction tests performed. Minimum testing shall be one test per 500 CY of material placed at the ENGINEER's option and one test per 10,000 square feet of fill placed for every foot of fill thickness.

In the event that the soil compaction is not in compliance with these specifications, then the CONTRACTOR shall take corrective action, at no cost to Lincoln County Public Works, to compact the soils within the limits of the specifications. The ENGINEER shall be notified within 24 hours of any failing compaction tests. Any retesting of failed areas shall be performed only after corrective measures have been made by the CONTRACTOR to bring the compacted soils into compliance. All retesting shall be performed with the ENGINEER present.

3.12. Site Restoration

3.12.1 General

All surfaces disturbed by the CONTRACTOR in the work shall be restored to a condition equal to or better than that which existed prior to commencement of the work, except as otherwise specified herein.

3.12.2 Pipe drains, headwalls, catch basins, curbs and gutters, and all incidental drainage structures shall be restored using like materials and details at no additional cost to the Lincoln County Public Works. The CONTRACTOR shall maintain drainage during construction.

3.12.3 All cuts, fills and slopes shall be neatly dressed off to the required grade or subgrade, as indicated on the plans.

3.12.4 Grassed areas shall be restored at no additional cost to Lincoln County Public Works. Disturbed areas shall be covered with two (2) inches of topsoil, furnished by the CONTRACTOR from an approved source and of approved quality, then shall be fertilized, and seeded to match existing adjoining areas. All ditches shall be restored to their existing grade, line and cross section.

3.12.5 Paved surfaces shall be restored in accordance with the provisions of Section 02575.

END OF SECTION

LINCOLN COUNTY STANDARD SPECIFICATIONS
SECTION 02512
GRAVEL SURFACE ACCESS ROADS AND PARKING AREAS

1. DESCRIPTION

This section covers surfacing for access roads and parking areas, as shown on the plans and as specified herein. Any reference to standard specifications refers to the most current published date published of the following specification unless otherwise noted.

1.1. Related Work

See Section 02222, Excavating, Backfilling & Compacting and AASHTO T-99 Base Testing for Utilities for related specifications.

1.1.1. Any reference to type of aggregate base course shall be in accordance with Section 1010 Type B and Section 1005 of the "Standard Specifications for Roads and Structures", published by the North Carolina Department of Transportation. Unless noted, the most current date published applies.

2. MATERIALS

2.1. Aggregate Base Course Surfacing

Shall be in accordance with the state specifications referenced in Section 1.1.1. Aggregate base course materials shall consist of crushed stone, crushed or uncrushed gravel or other similar material displaying hard, strong durable particles free from adherent coatings. The fraction passing the No. 200 sieve shall not exceed 11% and all aggregate shall be from approved sources in accordance with the referenced state specifications in Section 1.1.1.

3. CONSTRUCTION

Roads, drives and parking areas shall be graded to subgrade, and fills shall be compacted as specified in Section 02222. Roads, drives and parking areas shall be finished by fine grading to the required grades and sections, and by recompacting the subgrade with heavy rollers.

3.1. Drainage Ditches

Shall be properly installed at the locations shown on the plans

3.2. Base Course Surfacing

Shall be placed to the thicknesses shown on the plans and compacted to 95% of maximum density as determined by AASHTO T-99. Construction of the aggregate base course shall not begin until the subgrade preparation has been completed in accordance with Section 02222.

3.2.1. The aggregate material shall be placed on the subgrade with a mechanical spreader capable of placing the material to a uniform loose depth and without segregation, except those areas inaccessible to a mechanical spreader. The aggregate material may be placed by other methods, but only with prior approval of the ENGINEER. Where the required compacted thickness is 8-inches or less, the aggregate material may be spread and compacted in one layer.

3.2.2 The base material shall be compacted at a moisture content which is approximately required to produce maximum density indicated by AASHTO T-99. The CONTRACTOR shall dry or add moisture to the material when required to provide a uniformly compacted and acceptable surface.

3.2.3 The final surface shall be smooth, hard, dense and well bonded and shall be sloped to conform to the lines and grades shown on the plans or established by the ENGINEER.

END OF SECTION

LINCOLN COUNTY STANDARD SPECIFICATIONS
SECTION 02575
PAVING REPAIR AND RESURFACING

1. DESCRIPTION

This section covers cutting and replacing pavement for the installation of utilities as shown on the plans and as specified herein. Any reference to sections of state specifications shall be in conformance with the state specifications referred to in the Section 1.2.1 Related Work.

1.1. Any reference to standard specifications refers to the most current published date of the following specification unless otherwise noted.

1.2. Related Work

See the following sections for related specifications:

02222	Excavating, backfilling & Compacting for Utilities
03300	Cast-in-Place Concrete:
MP 1	AASHTO
M81	AASHTO
M82	AASHTO
T96	AASHTO
T176	AASHTO

1.2.1. Any reference to NCDOT standard specifications was obtained from the "Standard Specifications for Roads and Structures" published by the North Carolina Department of Transportation. Unless noted, the most current date published applies.

2. MATERIALS

2.1 Aggregate Base Course shall be in accordance with the NCDOT 1010 Type B. Aggregate base course material shall consist of crushed stone, crushed stone, crushed or uncrushed gravel and other similar materials displaying hard, strong durable particles free from adherent coatings. All aggregate shall be from and approved sources in accordance with NCDOT Section 1005.

2.2 Bituminous Paving

2.2.1 Bituminous Prime Coat: Cut-back asphalt used as prime coat shall conform to NCDOT Section 600.

2.2.2 Bituminous Base Course: Shall conform to NCDOT Section 630, Articles 1 through 4, Type HB.

2.2.3 Bituminous Tack Coat: Shall conform to NCDOT Section 605, Articles 1 through 9.

2.2.4 Bituminous Surface Coat: Shall conform to NCDOT Section 645, Type 1-2.

2.3. Portland Cement Course

Shall be composed of Portland Cement, coarse aggregate, fine aggregate and air entraining agent in accordance with Section 03300. Other admixtures may be added with the ENGINEER's approval. All concrete shall be Class A concrete with a minimum of 3500 psi compressive strength at 28 days. The concrete shall be air entrained to provide an air content of 4.5 percent plus or minus 1.5 percent.

3. CONSTRUCTION

3.1 Pavement Cutting: Where the existing pavement is to be cut for installation of pipe or other utilities, the CONTRACTOR shall cut the pavement neatly in advance of trenching. All pavement shall be cut to a straight edge with the method of cutting subject to approval of the ENGINEER. Pavement shall be cut 12 inches wider on each side of the excavated area. Ragged or irregular edges will be redone at no cost to Lincoln County Public Works. Concrete pavement shall be cut with a suitable concrete saw cutting equipment.

3.2 Trench Backfilling: Shall be in accordance to plans or as specified elsewhere herein.

3.3 Aggregate Base Course shall be placed and compacted in accordance with NCDOT Section 520, Article 8. The base course shall be placed at the same time with the trench backfilling.

3.3.1 If the base course is designed to be used as a temporary travel surface, the additional thickness shall be placed, compacted and maintained until the permanent surface is placed. When preparing the base course for the final surface course, the base course material shall be undercut to the thickness to accommodate the surface course(s) and removed from the site, unless otherwise directed by the ENGINEER. The final thickness of the base shall be within a tolerance of plus or minus 1/2 inch of the base thickness required on the plans.

3.3.2 Backfilling with soil above an elevation to accommodate the final base thickness, to be cut-out and replaced with base material at a later date, will not be allowed.

3.4 Prime Coat

Shall be applied to non-bituminous base course beneath bituminous plant mixed pavements unless otherwise shown in the plans. The prime coat shall be applied only when the surface to be treated is dry and the atmosphere temperature in the shade is 40° F or above. Prime coat shall not be applied when the weather is foggy or rainy. The base shall be clear of debris, dirt, clay or other deleterious material prior to placing the prime coat.

3.4.1 Application of the prime coat shall consist of asphalt grade AASHTO 81 for Grade RC-70 except Kinematic viscosity at 140° F, centistokes shall be a minimum of 30 and a maximum of 60; the distillate, percentage of volume of total distillate to 680°F, shall be as follows:

To 374°F	15 minimum
To 437°F	55 minimum
To 500°F	75 minimum
To 600°F	90 minimum

and the residue from the distillate to 680°F volume percentage of sample difference shall be a minimum of 50 or of shall be of asphalt grade AASHTO 82. The prime coat shall be applied at a rate of 0.18 to 0.45 gallons per square yard at an application temperature of 90° to 130°F.

3.5 Bituminious Concrete Surface Course, Type I-2

The surface course shall conform to NCDOT Type I-2. Pavement shall be replaced within the same week that it is cut. If inclement weather delays pavement replacement, the CONTRACTOR shall not cut additional pavement until he has notified the ENGINEER and received specific permission and instructions. Any deviation from this schedule could subject the CONTRACTOR to immediate shut-down or non-payment of additional work performed until pavement repair is complete.

3.5.1 The bituminous plant mix placement and compaction shall conform to NCDOT Section 610, Section 401.11 through 401.39. If directed by the ENGINEER, density control and determination shall be in Accordance to NCDOT Section 610, Article 11.

3.6 Portland Cement Concrete shall be placed over a compacted sub-base of CABC stone with the surface damp at time of placement. The concrete patch shall equal the thickness of the surrounding pavement, but shall not be less than 4 inches thick. The concrete shall be handled to prevent segregation and kept free from mud, soil or other foreign matter.

3.6.1 Concrete placement shall not be undertaken or shall be discontinued when any of the following conditions exist:

3.6.1.1. When the descending air temperature in the shade and away from artificial heat reaches 40°F.

3.6.1.2. When the subgrade or base course is frozen.

3.6.1.3. When the temperature of the concrete mix exceeds 90°F.

3.6.1.4..When the time after batching exceeds 90 minutes.

3.6.2 Concrete finishing shall consist of screeding and floating to assist consolidation. The surface texture shall closely resemble the texture of the surrounding pavement. A uniform surface texture shall be applied by burlap dragging or other method acceptable to the ENGINEER. The use of excessive water during finishing will not be permitted.

3.6.3 Concrete curing shall be accomplished with spray compounds, polyethylene film or other methods acceptable to the ENGINEER. In no instance shall the method of curing be allowed to damage the finished surface. Any concrete with excessive surface damage will be considered defective work and removed and replaced at the CONTRACTOR's expense.

3.6.4 Concrete shall be protected from cold for a minimum of 72 hours through thermal blankets or other means acceptable to the ENGINEER. Thermal protection will be required whenever the air temperature is expected to fall below 40°F. Concrete damaged as the result of freezing shall be removed and replaced at the CONTRACTOR's expense.

END OF SECTION

LINCOLN COUNTY STANDARD SPECIFICATIONS
SECTION 02601
MANHOLES, DROP CONNECTIONS AND CONFLICT MANHOLES

1. DESCRIPTION
The CONTRACTOR shall furnish all labor, materials, equipment and supplies and shall perform all work necessary for the construction of all manhole drop connections and conflict manholes complete and ready for use. The manhole drop connections and conflict manholes shall be constructed at the locations and grades shown or established by the ENGINEER and shall conform to the details shown on the Plans.

1.1. Related Work
See Section 02730, Force Mains and Gravity Sewers for related specifications.

1.2. References
Any reference to standard specifications refers to the most current published date of the following specifications unless noted:

ASTM	Specifications as listed.
AWWA	Specifications as listed.

1.2.1. Any reference to NCDOT standard specifications was obtained from "Standard Specifications for Roads and Structures", published by the North Carolina Department of Transportation. Unless otherwise noted, the most current date published applies.

2. MATERIALS
Materials for manholes shall be new and furnished by the CONTRACTOR in accordance with the following requirements:

2.1. Manholes shall be precast reinforced concrete sections conforming to ASTM C-478 and to the following:

2.1.1. Tops shall be eccentric cone where cover permits unless shown otherwise on the drawings and flat slab tops otherwise. Bottoms shall be integrally cast unless the CONTRACTOR proposes to use specialty bases ("Dog-House") at points of connection to existing sewer mains. Any special bases or riser used must be detailed in shop drawings and submitted to Lincoln County Public Works for approval. Manhole wall and base dimensions shall conform to C-478 or to the minimum dimensions shown on the drawings.

2.1.2. Manhole supplier shall design manhole sections to resist earth loads and to resist uplift resulting from buoyant forces calculated with ground water table at the ground surface. Wall and/or base dimensions shall be increased accordingly.

2.1.3. Pipe connection shall consist of an approved continuous boot of 3/8 inch minimum thickness neoprene as shown on the drawings conforming to ASTM C-923. Boots shall be either cast into the manhole wall or installed into a cored opening using internal compression rings. Installed boot shall result in a water-tight connection meeting the performance requirements of ASTM C-443.

2.2. Frames and Covers shall be of domestic manufacture good quality cast iron of uniform grain, conforming to ASTM A48, Class 30 or better, constructed in accordance with Lincoln County Public Works Standard Detail SS-1 and as shown on the Plans.

2.3. Concrete (poured in place)
Air entrained Portland Cement Concrete having minimum twenty-eight (28) day compressive strength of 3000 psi.

2.4. Joint Sealant
Butyl Rubber based conforming to AASHTO M-198, type B - butyl rubber, suitable for application temperatures between 10 and 100 degrees F

2.5. O-Ring or Gasket (CONTRACTORs Option)
ASTM C-443

2.6. Sand Cement
Portland Cement: ASTM C50, Type I
Sand: Clear, sharp, graded from fine to coarse, ASTM C-144
Water: Clean and potable
Mixture: One (1) part cement, two (2) parts sand

2.7. Pipe and Fittings
Same as sewer pipe

2.8. Precast Grade Rings shall be no less than 4" in height and conform to ASTM C 478.

2.9. Washed Stone
Stone material, crushed stone or gravel shall be strong, durable and conform to standard size No. 57 per NCDOT Section 1000.

2.10. Coatings
CONTRACTOR shall submit a coating proposal for approval by Lincoln County Public Works and the ENGINEER for all force mains and low pressure sewer force mains connecting to all new and existing receiving manholes and the next two "downstream" manholes.

3. CONSTRUCTION

3.1. Excavation for all sanitary manholes shall be carried to a depth such as to provide a minimum of 6 inches of washed stone bedding material below the bottom of structures and extend to a minimum width of 8 inches beyond each side of structures.

3.2. Should unstable soil, organic soil, or soil types classified as fine-grained soils (silts and clays) by ASTM D-2487 be encountered at the bottom of excavations, such soils shall be removed to a depth and width determined by the ENGINEER and properly disposed of. The resulting undercut shall be backfilled with washed stone. Placement and compaction shall conform to applicable earthwork specifications.

3.3. Manholes shall be constructed of precast reinforced concrete with cast iron frames and covers in accordance with details shown on the Plans.

3.4. Invert channels shall be smooth and accurately shaped to semi-circular bottom conforming to the inside of the adjacent sewer sections. Inverts shall be formed of concrete, and no laying pipe through manholes will be permitted. Changes in size and grade shall be made gradually and evenly. The minimum bending radius of the trough centerline shall be 1.5 times the pipe I.D. A minimum ½" radius shall be provided at the intersection of 2 or more channels. Depressions, high spots, voids, chips or fractures over ¼" in diameter or depth shall be filled with sand cement and finished to a texture reasonable consistent with that of the formed surface.

3.5. Precast concrete bottom sections, risers, and top sections shall be fabricated such that when assembled, they provide a manhole conforming to the depth required. The CONTRACTOR shall be responsible for the furnishing and constructing manholes such that the completed assembly is flush (0.1 foot above) finished grade or at other elevations as may be shown on the drawings. No manhole assembly will be accepted or paid for that will allow surface water inflow to occur through the cover due to poor attention to construction grades.

3.6. Sections are to be assembled so as to provide a plum structure with uniform bearing at all joints and at the base slab. Joints shall be thoroughly cleaned to remove dirt and foreign material. The butyl rope sealant shall be unrolled directly against the base of the spigot. Leave the protective paper in place until the sealant is fully in place. Overlap rope from side to side, not top to bottom. Joints to be plastered smooth inside and outside of manhole with a cement grout. Joints shall be water-tight.

3.7. Pipes shall project into the manhole 2-inches and shall be mechanically sealed with a molded neoprene boot.

3.8. Manhole frames and covers shall be set flush (0.1 foot above) with the finished grade or as otherwise shown on the drawings. Precast adjustment (grade) rings shall be used as required. No more than 8 vertical inches of grade ring will be allowed per manhole. Seal frame to adjustment ring, or cone section with butyl sealing rope and completely grout the ring to the top manhole section.

3.9. Drop connections shall be constructed in accordance with Lincoln County Public Works Standard Detail SS-4 and as shown on the Plans.

3.10.1. Conflict Manholes and Manhole Alternates shall be constructed in accordance with details shown on the plans.

3.11. Force main or Low Pressure Sewer Force Main receiving manholes and the next two "downstream" manholes, shall be cleaned, prepared, a moisture barrier applied, and coated, in accordance with coating manufacturer's specifications, with a corrosion barrier. This applies to both new and existing manholes.

4. TESTING

All manholes shall be tested in accordance with the Infiltration/Exfiltration Test in Section 02730, unless otherwise directed by the ENGINEER. Testing results shall be provided to Lincoln County Public Works. Lincoln County Public Works shall be notified 72 hours in advance of any testing.

END OF SECTION

LINCOLN COUNTY STANDARD SPECIFICATIONS
SECTION 02665
WATER LINES, VALVES, AND APPURTENANCES

1. DESCRIPTION

The CONTRACTOR shall furnish all labor, materials, equipment and supplies and shall perform all work necessary for the construction of water lines, valves and appurtenances; complete, disinfected, tested and ready for use. The water lines and valves shall be constructed of the size and at the locations shown on the plans.

1.1. Related Work

See the following Sections for related specifications
02222, Excavating, Backfilling & Compacting for Utilities
02933, Seeding & Mulching

1.2. References

Any reference to standard specifications refers to the most current published date of the following specifications unless noted:

AWWA	Specifications as listed.
ASTM	Specifications as listed.
NSF	Specifications as listed.

2. MATERIALS

All materials for water line shall be new and shall be furnished by the CONTRACTOR in accordance with the following requirements unless shown otherwise on the plans.

2.1. Water Lines, 2 Inch Through 24 Inch

2.1.1. Ductile Iron Pipe, 3 Inch and 4 Inch

Pipe: AWWA C151 "Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand Lined Molds, for Water and Other Liquids." Thickness Class 51 unless shown otherwise on the drawings
Fittings: AWWA C110, grey or ductile iron; or AWWA C153, ductile iron compact fittings
Joints: AWWA C111 push-on or mechanical for general buried service; AWWA C115 flanged for exposed service unless shown otherwise. Flange material shall match pipe material.
Linings: AWWA C104 cement lining, standard thickness, bituminous exterior seal coat

2.1.2. Ductile Iron Pipe, 6 Inch through 24 Inch

Pipe: AWWA C151 "Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand Lined Molds, for Water and Other Liquids." Thickness Class 50 unless shown otherwise on the drawings.
Fittings: AWWA C110, grey or ductile iron; or AWWA C153, ductile iron compact fittings
Joints: AWWA C111 push-on or mechanical for general buried service; AWWA C115 flanged for exposed service unless shown otherwise. Flange material shall match pipe material
Linings: AWWA C104 cement lining, standard thickness, bituminous exterior seal coat

2.1.3. PVC Pipe, 2 Inch and 3 Inch

Pipe: ASTM D-2241 "Polyvinyl Chloride (PVC) Pressure Water Pipe". Pipe provided shall be iron pipe size. Pipe shall be pressure rating 200 (SDR 21) unless otherwise shown on the drawings. All PVC pipe shall bear the National Sanitation Foundation (NSF) potable water logo.
Fittings: Cement lined, gray-iron or ductile iron conforming to AWWA C104 and C110 or compact ductile iron fittings conforming to AWWA C153 for fittings size 4-inch through 12-inch. Fittings less than 4-inch shall be PVC, Class 200, IPS with bells conforming to ASTM 3139 and gaskets conforming to ASTM F477.

Joints: Pipe; elastomeric gasket, push-on joints, conforming to ASTM F477 and ASTM 3139. Joints may be either integral bell and spigot or couplings.

2.1.4. PVC Pipe, 4 Inch through 12 Inch
Pipe: AWWA C900 "Polyvinyl Chloride (PVC) Pressure Pipe for Water." Pipe provided shall be cast iron pipe equivalent O.D. Pipe shall be working pressure rated **Class 200 (DR 14)** unless shown otherwise on the drawings. All PVC pressure pipe shall bear the National Sanitation Foundation Seal (NFS).
Fittings: Cement lined, cast or ductile iron fittings conforming to AWWA C110, or compact ductile iron fittings conforming to AWWA C153
Joints: Pipe; elastomeric gasket, push-on joints, conforming to AWWA C900 and C111. Joints may be either integral bell and spigot or couplings.

2.2. Valves

2.2.1. Gate Valves - 2" through 24" shall be resilient-seated, cast iron body, conforming to AWWA C509, latest revision. Sealing mechanism shall provide zero leakage at the water working pressure against the line flow from either direction and be designed such that no exposed metal seams, edges, screws, etc. are within the waterway in the closed position. The gate shall not be wedged into a pocket nor slide across the seating surface to obtain tight closure. All internal and external ferrous surfaces of the valve, including the interior of the gate, shall be coated with a protective coating conforming to AWWA C550, latest revision. Coating shall be applied to castings prior to assembly to assure all exposed areas will be covered. Valves shall be rated at 250 psi working pressure. Unless otherwise noted, underground valves shall have an operating nut and exposed valves shall have a hand wheel operator. Operating nut shall be 2”x2”, open left.

2.2.2. Gate Valve Actuators (16” and larger”)
Valves 16" and larger, for working pressures greater than 50 psi shall be provided with a spur or bevel gear operator and a bypass. Bypass valves shall be the same design as the parent valve. Gear ratios and bypasses shall conform to AWWA C509. Valves shall be rated at 250 psi working pressure. Valves shall be Kennedy, Mueller, US Pipe, or approved equal.

2.2.3. Tapping Sleeves and Valves shall be the type designed for making connections to existing water lines without loss of water or interruption of service. Sleeves shall be either a stainless steel tapping sleeve and shall conform to AWWA C223 or the cast iron split repair type which shall conform to AWWA C110 suitable for 250 psi working pressure. **The cast iron split repair type shall be used for any size on size connection to existing water lines.** All tapping sleeves shall be installed per manufacturer’s recommendations and shall comply with all current applicable AWWA Standards. Joints shall be suitable for the intended use. Valves shall be the same construction as standard AWWA gate valves, complete with operating nut and suitable for 250 psi working pressure. Tapping valves to be Mueller T-2360-16 or approved equal. All Tapping Sleeves shall be **hydrostatically pressure tested** to 200 psi for a minimum of 1 hour prior to conducting a tap on existing water lines. Lincoln County Public Works and the ENGINEER shall be notified 72 hours in advance of any tap on existing water lines.

2.2.4. Butterfly Valves (Larger than 24 Inch)
All valves on water mains larger than 24-inches in diameter, except tapping valves, shall be direct bury butterfly valves with mechanical joint ends conforming to all requirements of AWWA C504. Unless otherwise shown on the construction plans, all butterfly valves shall be Class 250B.

Each butterfly valve shall be furnished with a manual operator equipped with a 2" square operating nut. The operator shall open the valve when the operating nut is turned to the left or counterclockwise. The valve and operator shall be assembled for installation in a horizontal line with the main valve shaft horizontal and the operator shaft and operating nut aligned vertically to

accept a valve key operated from the surface. Butterfly valves shall be shop painted for buried service in accordance with AWWA C504.

2.2.5. Valve Boxes

2.2.5.1. Each valve buried in the ground shall be provided with an approved type of valve box and cover. The boxes shall be adjustable screw type, Southern Meter 562-S, 24-inch, 36-inch or approved equal.

2.2.5.2. The valve boxes shall be made of close-grained gray cast iron, in three pieces, comprising the lower or base pieces which shall be belled at the bottom to fit around the stuffing box gland and rest on the valve bonnet, the upper part of which shall be flared on the lower end to telescope on a socket to receive the cap or cover. The cap or cover shall have the word "Water" cast on the upper surface in raised letters. All castings shall be thoroughly cleaned and heavily coated with asphalt or coal-tar varnish.

2.2.5.3. Each valve box shall be provided with a concrete valve marker/protector as detailed on the plan.

2.2.5.4. Each valve box shall be fitted with an extension stem for use with the buried service non-rising stem valves. The stem shall be of solid metal and used to extend the position of the 2" operating nut within 6 inches of grade. Each stem shall be fitted with a self-centering disk below the operating nut to keep the stem aligned in the valve box and minimize the amount of grit that can enter the valve box.

2.2.6. Air Valves for water lines shall be A.R.I. Flow Control Accessories, Model #D-040 designed for a minimum of 200 psi pressure and installed as shown in Lincoln County Public Works Standard Detail WL-5.

2.2.7. Air Valve Manholes shall be precast concrete sections conforming to ASTM C-478 as shown in Lincoln County Public Works Standard Detail WL-5. All air valve manholes shall be 5 feet in diameter. Tops shall be eccentric cone where cover permits unless otherwise shown. Frame and cover shall be good quality domestic manufacture conforming to ASTM A48, Class 30 or better. Cover shall be a solid heavy duty casting with the word "Water" cast in the lid.

2.3. Fire Hydrants

2.3.1. Fire Hydrants shall conform to the standard specifications of the American Water Works Association (C502-80) and shall be of the three (3) way type. The hydrant valve opening shall not be less than four and one-half - (4-½) inches. Each hydrant shall be equipped with two (2) two and one-half - (2-½) inch hose connections and one (1) steamer connection. The hydrants shall be fitted with bell ends to accommodate the spigot end of six (6) inch ductile iron or PVC Plastic Pipe and have the standard one and one-half inch pentagon left opening operating nut. Hydrants to be Mueller Centurion A-421 or A-423, Kennedy Guardian K-81. All hydrants shall be painted yellow prior to approval and acceptance. All hydrants shall be new and manufactured within the same year as installation in accordance with Lincoln County Public Works Standard Detail WL-1.

2.3.2. The barrel of the hydrant shall be of proper length to permit a three-and-one half (3-½) foot bury. The valve shall be designed to close against the pressure of the distribution system and remain closed in the event of the upper part of the barrel being broken.

2.3.3. A flange shall be provided, above ground level, to permit adjusting the facing of the hydrant. The hydrant shall be so designed and constructed as to permit replacement of the upper portion of the barrel without digging in accordance with Lincoln County Public Works Standard Detail WL-1.

2.3.4. Each nozzle shall have a cast iron cap, suitably attached to the hydrant barrel by means of a chain. Nozzle caps shall be provided with leather gaskets.

2.3.5. Hose nipples shall be of the removable type and shall conform to the existing hose nipples in use by Lincoln County Public Works. On a new system they shall have National Standard Threads on the hose connection side unless otherwise directed by the ENGINEER. The CONTRACTOR shall check existing nipples before ordering.

2.3.6. Fire hydrants shall be spaced at a maximum distance of 1,000 feet so as to provide coverage from any single hydrant of 500 feet.

2.3.7. All fire hydrants furnished for this project shall be of the type known as "breakable" in order that the hydrant barrel may be broken without damaging the lower portion of the hydrant in case of an accident.

2.3.8. All fire hydrants shall have a blaze orange metal ring placed on the pumper nozzle (4-1/2") opening or "bagged" out of service at the time the hydrant is set in place. Only Lincoln County Public Works personnel shall remove the ring or bag after the hydrant is accepted Lincoln County.

2.4. Steel Encasing Pipe shall be smooth wall, meeting or exceeding ASTM A-139 Grade B 35,000 psi minimum yield strength with minimum wall thickness as defined below and in accordance with Lincoln County Public Works Standard Detail WS-4.

CARRIER PIPE	Casing Pipe	Wall Thickness D.O.T.	RR	Recommended Min. Tunnel
6-Inch Ductile Iron	12"	.250"	.281"	48"
8-Inch Ductile Iron	16"	.250"	.312"	48"
10-Inch Ductile Iron	16"	.250"	.344"	48"
12-Inch Ductile Iron	20"	.250"	.375"	48"
16-Inch Ductile Iron	24"	.312"	.469"	48"
18-Inch Ductile Iron	30"	.312"	.469"	48"
20-Inch Ductile Iron	30"	.375"	.501"	48"
24-Inch Ductile Iron	36"	.375"	.532"	48"

2.5. Carrier Pipe Supports within Steel Casing shall be steel plate, cold formed structural collar with flanges and a minimum of four support legs welded to the collar. Each support leg shall have a foot or skid welded on the end extending beyond the front and back edge of the collar. The front and rear of each foot shall be angled inwardly towards the collar to serve as a stable, effective skid during installation of the carrier pipe. The carrier support shall be securely fastened to the carrier pipe with a heavy duty ½" grade 5 bolt and locking nut passing between the flanges, compressing the collar against the carrier pipe. The support device shall be a "Spider" or approved equal.

2.6. Bedding Material shall consist of washed coarse gravel. Gravel material shall be crushed stone or gravel of strong durable nature and shall conform to the standard size No. 57 per the most current State Department of Transportation or Highways Construction Specifications.

2.7. Utility Line Marking Tape shall be acid and alkali resistant polyethylene film six inches wide and 4 mil thick. The tape shall be manufactured with integral wires for backing or other means to enable detection by a metal detector when the tape is buried up to three feet. The metallic core of the tape shall be encased in a protective jacket or by other means to prevent corrosion. The tape shall bear a continuous printed marking describing the specific utility, i.e. "water". The tape shall be accessible through all valve boxes.

3. INSTALLATION

3.1. Trench Excavation and Backfill

3.1.1. Excavation shall conform to the lines and grades shown on the drawings. The lines of excavation of trenches shall be made so there will be a clearance of at least eight (8) inches on each side of the barrel of the pipe. The depth of the trench shall be such that the top of the pipe shall not be less than three feet below finished grade. Excavation shall not be carried below the established grades and any excavation below the required level shall be backfilled and thoroughly tamped at the CONTRACTOR's expense. Bell holes shall be excavated accurately by hand as required by manufacturer's specifications.

3.1.2. During excavation, the CONTRACTOR shall separate materials suitable for backfill from those which are not as defined in Paragraph 3.5 of this section. Suitable material shall be stockpiled near the trench for use as backfill. Unsuitable material shall be removed immediately or shall be stockpiled separately for dewatering or drying or for later removal.

3.1.3. Should unstable soil, organic soil, or soil types classified as inorganic clays or inorganic silts (Class IV, Unified soil classification CL or lower) be encountered at the bottom of pipe trenches or structure excavations, such soils shall be removed to a depth and width determined by the ENGINEER and properly disposed of offsite. The resulting undercut shall be backfilled and compacted with sandy soils which meet or exceeds the requirements of Class I or Class II soils, Unified Class SP or better. Placement and compaction shall conform to specifications herein.

3.1.4. All necessary dewatering, pumping, and bailing shall be performed in such a manner as to keep the trench in a satisfactory condition for pipe laying.

3.1.5. Do not use the following materials for pipe foundation or trench backfill within the zones indicated below.
All zones: material classified as peat (PT) or organic (OL)(OH) under the Unified Soil Classification (USC) System, ASTM D2487 or material too wet or too dry to achieve minimum compacted density requirements
Six inches beneath pipe: soft or unstable material and rock
Beside pipe: Any material containing more than 75% fines passing #200 sieve

Where no excavated material is suitable for backfill, furnish suitable material from borrow sites.

3.1.6. Backfilling shall be done with material free from large clods, frozen earth, organic material or any foreign matter.

3.1.6.1. Around the pipe and to a depth of 12 inches above the pipe the backfill shall be carefully placed and compacted in layers not to exceed 6-inches compacted thickness. The backfill material shall be select and free of rock. Do not place backfill material on either side of the water main that is finer than the material upon it is placed. Backfill with coarser material to the top of the pipe.

3.1.6.2. Twelve (12) inches above the crown of the pipe the backfill may contain rock but less than 6 inches in diameter. Backfill layers shall be horizontal and not exceed 12 inches loose thickness or 8 inches compacted.

3.1.6.3 Compaction shall be performed with suitable pneumatic compactors or approved equal. Compaction equipment specifically designed for trench compaction shall be present and operational at the jobsite and shall be utilized throughout the length and depth of the trench to achieve uniform compaction density.

3.1.6.4. Compaction Density shall be determined by the Standard Proctor Test (ASTM D698) and shall meet the minimum standards in Section 02222, Excavating, Backfilling & Compacting for Utilities.

3.1.6.5. Surplus material shall be disposed of by the CONTRACTOR at his expense.

3.1.6.6. Clean shoulders and pavement of excess material immediately after backfilling is complete.

3.2. LAYING WATER MAINS, HYDRANTS AND SPECIALS

Proper and suitable tools for the safe and convenient handling and laying of pipe shall be used, and great care shall be taken to prevent the pipe coating from being damaged, particularly on the inside of the pipes.

3.2.1. All pipe shall be carefully examined for cracks and other defects and no pipe or castings shall be laid which is known to be defective. If any pipe or other casting is discovered to be cracked, broken or defective, after being laid, it shall be removed and replaced by sound pipe, without further charge.

3.2.2. Before laying the inside of the bell, the outside of the spigot of the pipe shall be thoroughly cleaned.

3.2.3. Pipe shall be laid to conform accurately to the lines and grades established by the ENGINEER. The pipe shall be properly bedded as shown on the plans and per manufacturer recommendations.

3.2.4. Lateral Separation of Sewers and Water Mains

Water mains shall be laid at least 10 feet laterally from existing or proposed sewers, unless local conditions or barriers prevent a 10-foot lateral separation--in which case the water main is laid in a separate trench, with the elevation of the bottom of the water main at least 18 inches above the top of the sewer, or the water main is laid in the same trench as the sewer with the water main located at one side on a bench of undisturbed earth, and with the elevation of the bottom of the water main at least 18 inches above the top of the sewer.

3.2.5. Crossing a Water Main Over a Sewer

Whenever it is necessary for a water main to cross over a sewer, the water main shall be laid at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer, unless local conditions or barriers prevent an 18 inch vertical separation--in which case both the water main and sewer shall be constructed of ferrous materials and with joints that are equivalent to water main standards for a distance of 10 feet on each side of the point of crossing. Where this vertical separation cannot be obtained, the sewer shall be constructed of AWWA approved water pipe, pressure tested in place without leakage prior to backfilling. The sewer manhole shall be of water-tight construction and tested in place.

3.2.6. Crossing a Water Main Under a Sewer

Whenever it is necessary for a water main to cross under a sewer, both the water main and the sewer shall be constructed of ferrous materials and with joints equivalent to water main standards for a distance of 10 feet on each side of the point of crossing. A section of 10 feet on each side of the point of crossing. A section of water main pipe shall be centered at the point of crossing.

3.2.7. Water lines shall not pass through or come into contact with any sewer manhole.

3.2.8. Concrete Blocking

All bends, tees and plugs, shall be blocked with 3000 psi concrete from the pipe to undisturbed ground to the dimensions shown in the Standard Details. Plant mix concrete is preferred although field mix concrete (Sacrete or equal) may be used as long as it is properly mixed in clean containers with potable water. The concrete shall receive a 24-hour cure before being backfilled. The concrete placed against a plug shall contain a weakness plane (using heavy paper to make this joint), so that when struck with a hammer, it will separate and allow the plug to be removed. If the ground is soft, restrained joint fittings shall be used as directed by the ENGINEER. Restrained joint shall be Megalug, Series 1100 as manufactured by EBAA Iron.

3.2.9. Valves, Specials and All Other Appurtenances are to be placed as shown on the drawings or at the location and in the manner designated by the ENGINEER. Any omissions of any of these appurtenances shall be corrected by the CONTRACTOR and the same set as originally planned without expense to Lincoln County. Over each valve a valve box is to be firmly set. Each valve box shall be provided with a standard concrete valve box protector/marker as shown in the Standard Details and fitted with an operating nut extension, as required.

3.2.10. Hydrants shall be set true to grade, with the standpipe plumb. The base of the hydrant shall rest upon a slab of stone or concrete not less than 3.2 inches thick and 12 inches square. Beneath and around the base of the hydrant and to a point one foot above drip, at least a quarter of a yard of clean, crushed stone shall be placed, and the trench filled with earth. All other construction requirements shall be according to the detail on the plans.

3.2.11. Boring and Jacking

Where required, smooth wall steel pipe shall be jacked through dry bores slightly larger than the pipe, bored progressively ahead of the leading edge of the advancing pipe. As the boring and jacking operation progresses, each new section of the encasement pipe shall be butt-welded to the section previously jacked in place.

3.2.11.1. Unacceptable bores are those with excessive deflection or deflections in the bore resulting in less than 30 inches of soil cover above the casing or the bore has a defection of more than 12 inches from target location per the lines and grades established by the ENGINEER, where upon the direction of the ENGINEER, shall require the bore to be abandoned. The abandonment procedure will consist of cutting off the excess pipe, capping the remaining pipe in place, then filling the abandoned pipe with Portland cement grout (1:3 parts cement to sand) at sufficient pressure to fill all voids before moving to a new location.

3.2.11.2. The carrier pipe shall be fully supported along its entire length within the casing pipe. Support may be accomplished by securely fastening pressure treated lumber to the carrier pipe or by using "spiders." Either method shall be first submitted to the ENGINEER for approval, detailing the means of fastening the support devices and spacing of supports.

3.2.11.3. Length of encasements shall be determined as follows
Cut sections - Ditch line to ditch line
Fill sections - 5 feet beyond toe of slope
Curb sections - 3 feet beyond curb
Future highway or railroad R/W - Extend full width of R/W or unless otherwise advised

3.2.11.4. Materials and workmanship shall also be governed by the requirements set for by the agency issuing the encroachment (Railroad, Department of Transportation, Pipeline Co., etc.). Any specific conditions other than listed herein pertaining to the encroachment are listed in the Special Conditions.

3.2.12. Utility Line Marking Tape shall be placed above all PVC pipe used. The marking tape shall be laid continuously in the trench backfill approximately 12" above the pipe.

3.2.13. Tests

3.2.13.1 The Lincoln County Public Works Department shall be notified 72 hours prior to testing. All tests shall be witnessed by Lincoln County Public Works personnel. In addition, ENGINEER shall provide a written report of test results to Lincoln County Public Works Department for approval prior to placing water line in service. The pressure/leakage test of water mains shall be in accordance with Standard AWWA C600-10/C605-13. The quantity of makeup water shall not exceed that determined by the following formula:

$$Q = \frac{LD\sqrt{P}}{148{,}000}$$

Q	=	Quantity of makeup water, in gallons per hour
L	=	Length of line tested in feet
D	=	Nominal diameter of pipe, in inches
P	=	Average test pressure, in psi - 1.50 average system pressure in the area, but not less than 200 psi.

3.2.13.2. Where practicable, pipe lines shall be tested in lengths between line-valves or plugs of no more than 2,000 feet.

3.2.13.3. Pipe lines shall be tested before backfilling at joints, except where otherwise required by necessity, local ordinance or public convenience.

3.2.13.4. Duration of test shall be not less than 2 hours where joints are exposed, and not less than 24 hours where joints are covered, unless directed by the ENGINEER and approved by Lincoln County Public Works.

3.2.13.5. All visible leaks at exposed joints, and all leaks evident on the surface where joints are covered, shall be repaired, regardless of the amount of leakage.

3.2.13.6. All pipe, fittings, and other material found to be defective under test shall be removed and replaced at the CONTRACTOR's expense.

3.2.13.7. Lines which fail to meet tests shall be repaired and retested as necessary, until test requirements are complied with.

3.2.13.8. Pipe lines with resilient gasket materials should be held under normal operating pressure at least 3 days before testing.

3.3. Disinfection

Before being placed in service, all new mains and repaired portions of, or existing mains shall be thoroughly flushed then chlorinated according to AWWA Standard C651-05 or (latest revision) Section 4.4.3, Continuous-Feed Method. This method shall be followed as outlined below with the exception that the lines shall be disinfected by the addition and thorough distribution of a chlorine solution in concentration sufficient to produce a chlorine residual of at least 50 milligrams per liter (or PPM), in accordance with Section .1003 of the North Carolina Administrative Code Title 15A Subchapter 18C .

3.3.1. Preliminary Flushing

Before being chlorinated, the main shall be filled to eliminate air pockets and shall be flushed to remove particulates. The flushing velocity in the main shall not be less than 2.5 ft/s unless the Lincoln County Public Works, ENGINEER or job superintendent determines that conditions do not permit the required flow to be discharged to waste. Table 1 shows the rates of flow required to produce a velocity of 2.5 ft/s in pipes of various sizes. Note that flushing is no substitute for preventive measures during construction. Certain contaminants, such as caked deposits, resist flushing at any feasible velocity.

Table 1. Required Flow and Openings to Flush Pipelines (40 psi Residual Pressure in Water Main)

Pipe Diameter In.	Flow Required to Produce 2.5 ft/s (approx.) Velocity in Main gpm
4	100
6	200
8	400
10	600
12	900
16	1600

3.3.1.1. Water from the existing distribution system or other approved source of supply shall be made to flow at a constant, measured rate into the newly laid water main. In the absence of a meter, the rate may be approximated by methods such as placing a Pitot gauge in the discharge or measuring the time to fill a container of known volume.

3.3.1.2. At a point not more than 10 ft downstream from the beginning of the new main, water entering the new main shall receive a dose of chlorine fed at a constant rate such that the water will have not less than 3.30 mg/L chlorine residual. To assure that this concentration is provided, measure the chlorine concentration at regular intervals using appropriate chlorine test kits.

3.3.1.3. During the application of chlorine, valves shall be positioned so that the strong chlorine solution in the main being treated will not flow into water mains in active service. Chlorine application shall not cease until the entire main is filled with heavily chlorinated water. The chlorinated water shall be retained in the main for at least 24-hours, during which time all valves and hydrants in the treated section shall be operated to ensure disinfection of the appurtenances. A 24-hour residual of 10-mg/L shall be produced in all parts of the line.

3.3.1.4. Direct-feed chlorinators, which operate solely from gas pressure in the chlorine cylinder, shall not be used for application of liquid chlorine. The preferred equipment for applying liquid chlorine is a solution-feed, vacuum-operated chlorinator and a booster pump. The vacuum-operated chlorinator mixes the chlorine gas in solution water; the booster pump injects the chlorine-gas solution into the main to be disinfected. Hypochlorite solutions may be applied to the water main with a gasoline or electrically powered chemical-feed pump designed for feeding chlorine solutions. Feed lines shall be of such material and strength as to safely withstand the corrosion caused by the concentrated chlorine solutions and the maximum pressures that may be created

3.3.1.5. Highly chlorinated water shall not be released into the distribution system or to the environment. The chlorinated water shall remain in the line until the chlorine residual drops below 5 PPM or dissipated by other prior approved method. After this period, the water will be wasted by pumping into the air to dissipate the remaining chlorine residual. Pumping shall be at a rate not to exceed 25 GPM. Pressure and nozzle size shall be such as to produce an 8 foot (vertical) spray. If dissipation cannot be achieved by pumping into the air the CONTRACTOR shall dechlorinate by an approved method, approved by NCDENR, Lincoln County Public Works, and the ENGINEER, which allows no chlorine residual to be discharged to the environment, at no cost to Lincoln County Public Works. The system should then be flushed with potable water and the sampling program started. Sampling shall consist of taking one representative sample every 5000 feet and at each blow-off. The samples shall then be tested by a state-approved laboratory for indication of bacteriologically satisfactory water. Three (3) copies of this laboratory test shall be submitted to the ENGINEER and to Lincoln County Public Works Department.

END OF SECTION

LINCOLN COUNTY STANDARD SPECIFICATIONS
SECTION 02668
WATER SERVICE CONNECTIONS

1. DESCRIPTION

Water service connections shall include tapping the main line and providing all saddles, corporation stops, fittings, service lines, copper setters, meters, meter boxes and other incidentals required for proper installation.

1.1 References

Any reference to standard specifications refers to the most current published date of the following specifications unless noted:

AWWA	Specifications as listed.
ASTM	Specifications as listed.

2. MATERIALS

Shop drawings, catalog cuts and related data for service pipe and appurtenances shall be submitted to the ENGINEER for approval.

2.1. Copper Setter (Meter Setter) shall be of copper and brass, domestic manufacture and of the proper size for the service on which they are installed. The setters shall be equipped with a dual check valve outlet and padlock wings on the key valve. Suitable adapters for coupling to service pipe shall be provided. Copper setters shall be Mueller or approved equal.

2.2. Corporation Stops shall be of brass, domestic manufacture and of the proper size for the service on which they are installed. Where dictated by the tapping angle, eighth or quarter bend couplings shall be provided. Suitable brass adapters for coupling to service pipe shall be provided. Corporation stops shall be Mueller H-15008 or approved equal in 3/4 inch and 1 inch sizes.

2.3. Tapping Saddles shall be of 85-5-5-5 brass with flat hinged single strap. Straps shall be the wide flat type with bottom plate width not less than one-half the pipe diameter on which it is to be installed. Top plates shall have a thick boss to permit full thread length. The seal between the pipe and top plate shall be provided through a neoprene gasket, permanently cemented to the underside of the clamp body in accordance with the most current Lincoln County Public Works Standard Detail WL-6.

2.4. Service Pipe and Fittings

2.4.1. Copper Tubing

Tubing:	ASTM Specification B-88 for Type K seamless annealed
Fittings:	AWWA C800 Compression Fittings

2.5 Pipe Connection Clamps shall be of stainless steel.

2.6. Meters

2.6.1. General
Water meters shall be approved type as manufactured by Master Meter that has met the requirements of the Standard Specifications for Water Meters, as adopted by the American Water Works Association and in accordance with the most current Lincoln County Public Works Standard Detail WL-6 and WL-7.

2.7. Meter Boxes sized ¾" thru 2" shall be Mueller McCullough E-Z setter in accordance with the most current Lincoln County Public Works Standard Detail WL-6.

2.7.1 Meter Vaults sized 3" and larger shall be in accordance with the most current Lincoln County Public Works Standard Detail WL-7.

3. INSTALLATION

3.1. Taps
Proper size taps shall be made on the distribution line. A corporation stop, with the proper bend and service pipe adapter, shall be installed in the tap. As shown in the most current Lincoln County Public Works Standard Detail WL-6, WL-7, and WL-9.

3.2. Service Pipe shall be connected to the corporation stop adapter with a suitable compression fitting. Pipe shall be cut to the required length and properly laid in the service ditch. Adequate provisions shall be made to protect against expansion and contraction.

3.3. Backfill of ditches and cleanup of the work area shall meet approval of the ENGINEER.

END OF SECTION

LINCOLN COUNTY STANDARD SPECIFICATIONS
SECTION 02730
FORCE MAINS AND GRAVITY SEWERS

1. DESCRIPTION

The CONTRACTOR shall furnish all labor, materials, equipment and supplies and shall perform all work necessary for the construction of the sewers, complete, tested and ready for use. The sewers shall be constructed to the lines and grades shown and shall be the size shown on the plans.

1.1. Related Work

See the following sections for related specifications.
02222, Excavating, Backfilling & Compacting for Utilities
02933, Seeding and Mulching

1.2. References

Any reference to standard specifications refers to the most current published date of the following specifications unless noted:

AWWA	Specifications as listed.
AEC	MILP –23236
WEF	Manual of Practice No. FD-5

2. MATERIALS

All materials for sewer pipe shall be new and shall be furnished by the CONTRACTOR in accordance with the following requirements unless shown otherwise on the plans.

2.1. Gravity Sewers (8-Inch Through 16-Inch)

2.1.1. Ductile Iron Pipe

Pipe: AWWA C151 "Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand Lined Molds, for Water and Other liquids." Thickness Class 51 for push-on and MJ pipe and Class 53 for flanged pipe, unless shown otherwise on the drawings
Fittings: AWWA C110, grey or ductile iron, or compact ductile iron conforming to AWWA C153
Joints: AWWA C111 push-on unless shown otherwise
Linings: AWWA C104 cement lining, standard thickness, bituminous seal coat

2.1.2. PVC Pipe

Pipe: ASTM D3034; "Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings." SDR 35 with a minimum cell classification of 12454-B
Fittings: ASTM D3034. Fittings in sizes through 8" shall be molded in one piece with elastomeric joints and minimum socket depths as specified in Sections 6.2 and 7.3.2. Fittings 10" and larger shall be molded or fabricated in accordance with Section 7.11 with manufacturer's standard pipe bells and gaskets
Joints: ASTM D3212, Elastomeric gaskets conforming to ASTM F477

2.1.3. PVC Ribbed Sewer Pipe

Note: Must obtain approval from Lincoln County Public Works prior to use.

2.1.4. High Strength Steel Pipe

2.1.4.1. Pipe: Welded or seamless, manufactured in accordance with ASTM A-53 for welded and seamless pipe and/or ASTM 139 for welded straight-seam steel pipe. All steel shall be grade B, 35,000 psi yield strength with wall thickness 0.250" unless otherwise specified on plans.

2.1.4.2. Linings: One of the following shop applied linings shall be applied on the inside of the pipe barrel.
Coal tar lining 3/32-inch minimum thickness in accordance with AWWA 203
Coal tar epoxy lining 20 mils (dry) minimum thickness conforming to Mil-P-23236 Type I, Class II

2.1.4.3. Couplings: Shall be a reducing steel coupling when making a reduction in pipe size, changing class of pipe, or for making connections between any two kinds of pipe. The coupling shall consist of one cylindrical steel middle ring, two steel follower rings, two resilient gaskets and a set of steel trackhead bolts. The middle ring shall have a conical flare at each end to receive the wedge portion of the gaskets. The follower rings shall confine the outer ends of the gaskets. Tightening the bolt shall draw the follower rings toward each other, compressing the gaskets in the spaces formed by follower rings, middle ring flares and pipe surface. This shall make a flexible leak-proof seal. Bolts and nuts shall be of high grade, high strength steel. Center ring, glands, bolts and nuts shall receive one coat of primer.

2.1.4.4. Protective Coating: The outside of steel pipe, nuts, bolts and couplings shall receive one coat coal tar epoxy to 10 mils minimum thickness. Coatings shall be shop applied to pipe and field applied to couplings.

2.2. Force Mains

2.2.1. Ductile Iron Pipe (3-Inch Through 12-Inch)
Pipe: AWWA C151 "Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand Lined Molds, for Water and Other Liquids." Thickness Class 51 for push-on and MJ pipe and Class 53 for flanged pipe
Fittings: AWWA C110, grey or ductile iron
Joints: AWWA C111 push-on or mechanical for general buried service; flanged for exposed service
Lining: Protecto 401™ Ceramic Epoxy Lining or Equivalent

2.2.2. PVC Pipe (4-Inch Through 12-Inch)
Pipe: AWWA C900 "Polyvinyl Chloride (PVC) pressure pipe. Pipe provided shall be cast iron pipe equivalent O.D. Pipe shall be pressure Class 200 (DR=14)
Fittings: Cement lined, cast or ductile iron fittings conforming to AWWA C110, or compact ductile iron conforming to AWWA C153
Joints: Pipe, elastomeric gasket, push-on joints, conforming to AWWA C900. Joints may be either integral bell and spigot or couplings. Fittings; AWWA C111, push-on

2.2.3. PVC Pipe (1-Inch Through 4-Inch)
Pipe: ASTM D-2241 "Polyvinyl Chloride (PVC) pressure water pipe. Pipe provided shall be iron pipe size. Pipe shall be pressure Class 200 (SDR 21).
Fittings: Cement lined, gray-iron or ductile iron conforming to AWWA C104 and C110 for fittings size 4-inch through 12-inch or compact fittings conforming to AWWA C153. Fittings less than 4-inch shall be PVC, Class 200, IPS with bells conforming to ASTM F477.
Joints: Pipe or compact ductile iron fittings conforming to AWWA C153, elastomeric gasket, push-on joints, conforming to ASTM F477 and ASTM 3139. Joints may be either integral bell and spigot or couplings.

2.3. VALVES FOR LOW PRESSURE SEWER

All valves on pressure sewer mains shall be plug or ball valves as specified below. Valve operation shall be open left.

2.3.1 PLUG VALVES: All valves on pressure sewer mains shall be eccentric plug valves as follows:

Plug valves shall be as manufactured by Dezurik Corporation, Milliken Valve Co., Keystone Valve, or approved equal.

Buried valves four-inches and larger and other valves specifically indicated shall have mechanical joint ends conforming to ANSI A21.11. Buried valves three inches and smaller shall have schedule 80 threaded ends and shall be connected to the pressure main by schedule 80 PVC threaded by socket adapters.

Buried plug valves shall have 2-inch operating nuts within 10-inches to 15-inches below finish grade. Extension stems, stem guides, operating levers, and other miscellaneous items required for a complete installation shall be provided in accordance with the requirements and recommendations of the manufacturer. Buried plug valves shall be provided with adjustable valve boxes. Valve boxes shall be cast iron conforming to ASTM A-48, Class 30. Valve box castings shall be fully bituminous seal coated. Valve box shall be Tyler 462A or approved equal. All valve boxes shall be supported independently from the valve so that no force or weight is transferred to the valve or pipe connections.

2.3.2 Thermoplastic ball valves**:** Thermoplastic ball valves shall be used at each service connection and shall be made of PVC Thermoplastic. The valves shall be furnished with Teflon seats smooth true union ends. Thermoplastic ball valves shall be a manufactured by Hayward, Incorporated or approved equal.

2.3.3 Thermoplastic ball check valves: Thermoplastic ball check valves shall be used at each service connection and shall be made of PVC Thermoplastic. The valves shall be furnished with elastomeric seats and true union ends. Thermoplastic ball check valves shall be as manufactured by Hayward, Incorporated or approved equal.

2.3.4 Valve Boxes: A valve box shall be installed at every buried plug valve. The box shall not transmit shock or stress to the valve or adjacent piping and shall be centered and plumb over the operating nut, with the box cover flush with the pavement or other existing surface.

2.4 Air Valves

2.4.1. Sewage Air and Vacuum Valves in sewer force mains shall be the type specifically designed for use with sewage. Valves shall be designed to vent large quantities of air when the line is being filled and to allow air to re-enter the line when it is being drained. Overall height of valve body without accessories shall be not less than 15 inches. Materials shall include cast iron body and cover, bronze float stem and guide, rubber seat and stainless steel float. Valves shall be furnished with provisions for backflushing. Valves shall be designed for working pressure of 200 psi. All Combination Air Relief Valves shall be in compliance with Lincoln County Public Works Standard Detail SS-9.

2.4.2. Sewage Air Release Valves in sewer force mains shall be the type designed for use with sewage. Valves shall be designed to operate (open) while pressurized allowing entrained air in a sewage force main to escape through the air release orifice and prevent media from escaping. Materials shall include cast iron body and cover, rubber seat, stainless steel float stem and internal linkages. The valves shall be sized according to the detail drawings and designed for minimum working pressures of 200 psi. All Sewage Air Release Valves shall be in compliance with Lincoln County Public Works Standard Detail SS-9.

2.5. Steel Encasing Pipe shall be smooth wall meeting or exceeding ASTM A-139, Grade B 35,000 psi minimum yield strength with a minimum wall thickness as defined below:

CARRIER PIPE	Casing Pipe	Thickness D.O.T.	R.R	Recommended* Min. Tunnel
6-Inch Ductile Iron	14"	.250“	.281"	48"
8-Inch Ductile Iron	18”	.250”	.281”	48”
10-Inch Ductile Iron	20"	.250"	.344"	48"
12-Inch Ductile Iron	22"	.250"	.375"	48"
16-Inch Ductile Iron	28"	.312"	.469”	48"
18-Inch Ductile Iron	30"	.312"	.469"	48"
20-Inch Ductile Iron	32"	.375"	.501"	48"
24-Inch Ductile Iron	36"	.375"	.532"	48"

2.6. Carrier Pipe Supports within Steel Casing shall be steel plate, cold formed structural collar with flanges and a minimum of four support legs welded to the collar. Each support leg shall have a foot or skid welded on the end extending beyond the front and back edge of the collar. The front and rear of each foot shall be angled inwardly towards the collar to serve as a stable, effective skid during installation of the carrier pipe. The carrier support shall be securely fastened to the carrier pipe with a heavy duty ½" grade 5 bolt and locking nut passing between the flanges, compressing the collar against the carrier pipe. The support device shall be a “Spider” or approved equal.

2.7. Utility Line Marking Tape shall be acid and alkali resistant polyethylene film six inches wide and 4 mil thick. The tape shall be manufactured with integral wires, foil backing or other means to enable detection by a metal detector when the tape is buried up to three feet. The metallic core of the tape shall be encased in a protective jacket or by other means to prevent corrosion. The tape shall bear a continuous printed marking describing the specific utility, i.e. "SEWER."

2.8. Trench Excavation and Backfill

2.8.1. Excavation shall conform to the lines and grades shown on the drawings. The lines of excavation of trenches shall be made so there will be a clearance of at least eight (8) inches on each side of the barrel of the pipe. Excavation shall not be carried below the established grades and any excavation below the required level shall be backfilled and thoroughly tamped at the CONTRACTOR's expense. Bell holes shall be excavated accurately by hand.

2.8.2. During excavation, CONTRACTOR shall separate materials suitable for backfill from those defined unsuitable. Do not use the following materials for pipe foundation or trench backfill within the zones indicated below:

All zones: material classified as peat (PT), organic soil (OL)(OH) under the Unified Soil Classification (USC) System, ASTM D2487 and all materials too wet or too dry to achieve minimum compacted density requirements.
Six inches beneath pipe: soft or unstable material and rock.
Beside pipe: any material containing more than 75% fines passing #200 sieve.

Suitable material shall be stockpiled near the trench for use as backfill. Unsuitable material shall be removed immediately or shall be stockpiled separately for dewatering or drying and later removal. Where no excavated material is suitable for backfill, furnish suitable material from borrow sites at no additional cost to Lincoln County Public Works.

2.8.3. All unstable soil, organic soil, or soil types classified as inorganic clays and inorganic elastic silts (Class IV, Unified Class CL or lower) that are encountered at the bottom of pipe trenches or structure excavations shall be removed to a depth and width determined by the ENGINEER and properly disposed of. The resulting undercut shall be backfilled and compacted with sandy soils which meets or exceeds the requirements of Class I or Class II soil, Unified Class SP or better. Placement and compaction shall conform to the compaction specifications herein and on the plans.

2.8.4. All necessary dewatering pumping, and bailing shall be performed in such a manner as to keep the trench in a satisfactory condition for pipe laying.

2.8.5. Backfilling shall be done with material free from large clods, frozen earth, organic material and any foreign matter.

2.8.5.1. Around the pipe and to a depth of 12-inches above the pipe the backfill shall be carefully placed and compacted in layers not-to-exceed 6-inches compacted thickness. The backfill shall be select and free of rock. Do not place backfill material on either side of the gravity sewer that is finer than the material upon which it is placed. Backfill with coarser material to the top of the pipe.

2.8.5.2. Twelve (12) inches above the crown of the pipe the backfill may contain rock but less than 6-inches in diameter. Backfill layers shall be horizontal and not exceed 12-inches loose or 8-inches compacted.

2.8.5.3. Compaction shall be performed with suitable pneumatic compactors or approved equal equipment. Compaction equipment specifically designed for trench compaction shall be present, operational and at the jobsite at all times. Compaction equipment shall be utilized throughout the length and depth of the trench to achieve uniform compaction density.

2.8.5.4. Compaction density shall be determined by the Standard Proctor Test (ASTM D698) and shall meet the minimum standards in Section 02222, Excavating, Backfilling & Compacting for Utilities.

2.8.5.5. Surplus material shall be disposed of by the CONTRACTOR at his expense.

2.8.5.6. Clean shoulders and pavement of excess material immediately after backfilling is complete.

2.9. Laying Sewers

2.9.1. Gravity Sewers
All sewers shall be laid and jointed in accordance with approved manufacturer's recommendations and shall be laid true to line and grade proceeding upgrade with the spigot pointing in the direction of flow. The sections of pipe shall be laid and fitted together so that, when complete, the sewer will have smooth and uniform invert, with full-length of the barrel resting on the trench bottom or bedding prepared for the pipe. Holes shall be excavated to accommodate pipe bells. The pipe

shall be kept thoroughly clean. Each pipe shall be inspected for defects before lowering pipe into trench. Water shall not be allowed to rise around joints until they have been made tight.

2.9.1.1. All gravity sewer shall be bedded in accordance with Section D, Pipe Bedding and Backfilling Chapter 9 Section D Page 183 in WPCF (WEF) manual of Practice NO. FD-5 (ASCE Manual No. 60), ASTM D2321 for Flexible Pipe (PVC) and Section F2.9 page 202 in WPCF (WEF) Manual No. FD-5 for Rigid Pipe (Ductile Iron) Chapter 9, Section F2.9 for the proposed depth of sewer, and as detailed in the contract drawings.

2.9.1.2. The exposed end of all pipes shall be closed by means of an approved plug to prevent earth or other substances from entering the pipe. The interior of the sewer shall be kept free from all dirt, cement or superfluous materials of every description as the work progresses.

2.9.2. Force Mains

All pipe for force main sewers shall be laid and jointed in accordance to approved manufacturer's recommendations, contract drawings and as specified herein.

2.9.2.1. Each pipe shall be inspected for defects before lowering pipe into the trench. Any defective pipe shall be immediately removed from the site.

2.9.2.2. Water shall not be allowed to rise around the joints until they have been made tight. The exposed end of all pipes shall be closed by means of an approved plug to prevent earth or other foreign substances from entering the pipe. The interior of the pipe shall be kept clean and free of all dirt, stone or foreign material as work progresses.

2.9.2.3. The force mains shall be properly bedded according to the manufacturer's recommendations, contract drawings and the minimum standards defined below.

All Pipe IN ROCK OR WET TRENCHES: Washed stone bedding from 4-inches below pipe to springline of pipe.

ALL OTHER CONDITIONS: Hand carve trench to shape of lower quadrant of barrel

2.9.2.4. Concrete Blocking

All bends, tees and plugs shall be blocked with 3000 psi concrete from the pipe to undisturbed ground to the dimensions shown on the plans. Plant mix concrete is preferred although field mix concrete (Sacrete or equal) may be used as long as it is properly mixed outside of the trench in clean containers with potable water. The concrete mix shall be placed and rodded or consolidated by suitable means to minimize voids and shall receive a 24-hour cure before being backfilled. If the ground is soft, restrained joint fittings shall be used as directed by the ENGINEER.

2.9.2.5. Utility Line Marking Tape shall be placed above all PVC pipe used in the force main construction. It shall be placed between lifts of backfill approximately 12" above the top of the pipe.

2.9.3 LOW PRESSURE SEWER

2.9.3.1 Lincoln County Public Works will NOT be the Permittee or accept any responsibility for new Low Pressure Sewer Systems. Lincoln County Public Works will only be the receiving entity for permitting thru NCDENR. The “private” low pressure sewer system will be responsible for maintaining compliance with the NCDENR Permit.

2.9.3.2 Pressure sewer main shall be installed in accordance with the Standard Recommended Practices for UNDERGROUND INSTALLATION OF FLEXIBLE THERMOPLASTIC SEWER PIPE, ASTM D-2321. The following exceptions shall be taken to the Standard:

2.9.3.3 Installing Valves and Fittings: Valves and fittings shall be installed in the manner specified for cleaning laying and jointing pipe. Valves shall be installed at locations shown on the Plans and/or as directed by the Engineer.

2.9.3.4 Alignment and Grade: Unless specifically approved by the Engineer, the curb must be in place and backfilled, and the area between curb and street right-of-way line graded smooth and to finished grade before the pressure sewer mains are installed. The pressure sewer mains shall be installed on the opposite side of the road from the water main and six feet behind the curb except as shown on the approved plans or as directed by the Engineer. The pressure sewer shall be laid and maintained at the required lines and grades with fittings and valves at the required locations, spigots centered in bells, and valve stems plumb.

2.9.3.5 Depth of Pipe Installation: Unless otherwise indicated on the Plans, or required by existing utility location, all pipes shall be installed with the top of the pipe at least 4.0' below the edge of the adjacent roadway pavement or 4.0' below the ground, about the pipe, whichever is greatest.

2.9.3.6 The contractor is instructed to check construction plans and Lincoln County Public Works Standard Details for additional requirements. The Contractor may be required to vary the depth of the 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 plans. Pressure sewer shall be installed with 12 inches clearance above other utilities or 18-inches clearance below other utilities.

2.9.3.7 Service Connections: On 3-inch and smaller mains, the 1.5" laterals shall be connected to the street main with schedule 80 PVC solvent weld wyes. On 4-inch and larger mains, the 1.5 inch laterals shall be connected to the street main with a MJ tee plugged and tapped for a threaded by solvent weld schedule 80 PVC Adapter. The 1.5" service lateral shall be completed to the property line where a service connection box shall be installed. The service connection shall contain the following fittings in accordance with the Details: 45 degree solvent weld elbow, solvent weld nipple, two (2) true union solvent weld ball valves, solvent weld 1.5" x 1.5" x 1.5" tee, true union ball check valve. The top of the 1.5" tee shall have 1.5" x .75" reducing bushing and a brass .75" hose bib

2.9.3.8 Service Boxes and Lids: All service connections and clean outs shall be placed in an appropriately sized box, in accordance with the Details, and shall be as manufactured by Brooks Products Company (36 Series) or approved equal. Plastic lids shall be furnished with "snap lock" taps, and imprinted with the words "PRESSURE SEWER."

2.9.4. Boring and Jacking

Where required, smooth wall or spiral weld steel pipe shall be jacked through dry bores slightly larger than the pipe, bored progressively ahead of the leading edge of the advancing pipe. As the boring and jacking operation progresses, each new section of the encasement pipe shall be butt-welded to the section previously jacked in place.

2.9.4.1. Obstructions encountered during the boring and jacking operation or deflections in the bore resulting in less than 30 inches of soil cover above the casing, shall require the bore to be abandoned. The abandonment procedure consists of cutting off the excess pipe, capped then filled with Portland cement grout (1:3 parts cement to sand) at sufficient pressure to fill all voids before moving to a new location.

2.9.4.2. The carrier pipe shall be fully supported along its entire length within the casing pipe. Support may be accomplished by using "spiders." This method shall be first submitted to the ENGINEER for approval, detailing the means of fastening the support devices and spacing of supports.

2.9.4.3. Length of encasements shall be determined as follows.

Cut sections - Ditch line to ditch line
Fill sections - 5 feet beyond toe of slope
Curb sections - 3 feet beyond curb
Future highway or railroad R/W - Extend full width of R/W or unless otherwise noted.

2.9.4.4. Materials and workmanship shall also be governed by the requirements set for by the agency issuing the encroachment (Railroad, Department of Transportation, Pipeline Co., Etc.). Any specific conditions other than listed herein pertaining to the encroachment are listed in the Special Conditions.

3. INSTALLATION OF JOINTS

3.1. Mechanical Joints
The socket, gasket or spigot of the pipe shall be cleaned of all foreign matter. The gland shall be slipped on the spigot end, followed by the gasket and the pipe end pushed into the bell. The ring gasket shall be properly seated so that it is totally confined under pressure within the bell. The loose gland shall be moved into position against the face of the gasket and the nuts and bolts loosely assembled with the fingers and then made up tight with a suitable ratchet wrench.

3.2. Push-On Joints
The joint shall be thoroughly cleaned, prepared, lubricated and installed in accordance with the requirements, instructions and recommendations of the manufacturer and ENGINEER.

3.3. Solvent Cements Joints
The joint shall be thoroughly cleaned, prepared and installed in accordance with the requirements, instructions and recommendations of the manufacturer and ENGINEER.

3.4. Grooved Joints
Joints shall be installed in accordance with manufacturers' published installation instructions.

3.5. TESTING
All pipe installations shall be tested as specified herein. Tests shall be performed by CONTRACTOR in the presence of the ENGINEER and Public Works Department representative or his representative and a Public Works Department representative. Testing shall not be performed until such time that all work which may affect the results of the testing has been completed. Where a test section fails to meet test requirements, CONTRACTOR shall make corrections as specified herein and retest the section. The correct/retest procedure shall continue until such time as test requirements are met. All gravity lines will be lamped by the ENGINEER or his representative, and a testing report shall be provided to the Public Works Department. No gravity sewer lines shall be tested for a minimum of 30 days from the date of installation.

3.5.1. Air Test: All gravity sewer pipe

3.5.1.1. Procedure

3.5.1.1.1. Air test shall be conducted in strict accordance with the testing equipment manufacturer's instructions, including all recommended safety precautions. No one will be allowed in the manholes during testing. Equipment used for air testing shall be equipment specifically designed for this type of test, and is subject to approval of the ENGINEER.

3.5.1.1.2. The test shall be performed only on clean sewer mains after services are installed and the pipe is completely backfilled. Clean sewer mains by propelling snug fitting inflated rubber ball through the pipe with water. After completely cleaned, plug all pipe outlets with suitable test plugs. Brace each plug securely.

3.5.1.1.3. For pipe within test sections above the ground water table, add air slowly to the portion of the pipe installation under test until the internal air pressure is raised to the starting pressure of 4 psig. After the starting pressure is obtained, allow at least two minutes for air temperature to stabilize, adding only the amount of air required to maintain pressure. When pressure decreases to 3.5 psig, start stopwatch. Determine the time that is required for the internal air pressure to reach 2.5 psig.

3.5.1.1.4. For pipe with test sections below the ground water table, determine the starting pressure for the test section, in psig, as follows.
Determine the maximum depth of pipe within the test section in feet.
Multiply this depth by 0.67 and add 9.3 feet.
Multiply the result in part 2 by 0.43 and round to the nearest 0.5 psig. After this starting pressure is obtained, continue the test in accordance with the procedure in the paragraph above.

3.5.1.2. Requirement
The test section shall be acceptable if the elapsed time for pressure drop of 1.0 psig is greater than the sum of the times shown below for all pipe sizes within the test section. No test shall be less than one minute in duration.

	PIPE DIAMETER (INCHES)								
LENGTH	4	6	8	10	12	15	18	21	24
25	0:04	0:10	0:18	0:28	0:40	1:02	1:29	2:01	2:38
50	0:09	0:20	0:35	0:55	1:19	2:04	2:58	4:03	5:17
75	0:13	0:30	0:53	1:23	1:59	3:06	4:27	6:04	7:55
100	0:18	0:40	1:10	1:50	2:38	4:08	5:56	8:05	10:34
125	0:22	0:50	1:28	2:18	3:18	5:09	7:26	9:55	11:20
150	0:26	0:59	1:46	2:45	3:58	6:11	8:30	"	"
175	0:31	1:09	2:03	3:13	4:37	7:05	"	"	"
200	0:35	1:19	2:21	3:40	5:17	"	"	"	12:06
225	0:40	1:29	2:38	4:08	5:40	"	"	10:25	13:36
250	0:44	1:39	2:56	4:35	"	"	8:31	11:35	15:07
275	0:48	1:49	3:14	4:43	"	"	9:21	12:44	16:38
300	0:53	1:59	3:31	"	"	"	10:12	13:53	18:09
350	1:02	2:19	3:47	"	"	8:16	11:54	16:12	21:10
400	1:10	2:38	"	"	6:03	9:27	13:36	18:31	24:12
450	1:19	2:50	"	"	6:48	10:38	15:19	20:50	27:13
500	1:28	"	"	5:14	7:34	11:49	17:01	23:09	30:14

3.5.1.3. Corrective Measures
If elapsed time is less than the specified amount, CONTRACTOR shall locate and repair leaks and repeat the test until elapsed time exceeds the specified amount.

3.5.2. Infiltration/Exfiltration Test (Use All Manholes)

3.5.2.1. The use of this method for sewer pipe, in lieu of air tests may be used as an alternate test method with prior approval from Lincoln County Public Works Department.

3.5.2.2. Procedure

3.5.2.2.1. Infiltration: Immediately following a period of heavy rain, a test of work constructed up until that time shall be made. Three measurements shall be made at one (1) hour intervals to compute the amount of the infiltration. Tests for manholes only shall be conducted on individual manholes. Tests for pipe and manholes shall be performed on test sections not exceeding 600 linear feet of collector sewer and shall include both pipe and manholes. In the event that sufficient rain does not occur before the date of completion, the CONTRACTOR shall be required to conduct the tests at any time during a 30-day period following this date. Should the ENGINEER determine that certain pipe or manholes cannot be tested by infiltration methods; the ENGINEER may direct the filling of lines and the measurement of exfiltration. The allowable rate of exfiltration shall be the same as for infiltration.

3.5.2.2.2. Exfiltration: Determine test sections as outlined for infiltration tests. Install a temporary water plug at the inlet and outlet of the test section. Fill test section with clean water up to the bottom of the lowest manhole frame within the test section. Allow time for saturation of pipe and manholes refilling test section as required. Beginning with a full test section, allow at least eight (8) hours to elapse without adding water. Measure the water level at the beginning and end of the elapsed time above. Compute the volume of water lost in gallons per hour.

3.5.2.3. Test Requirements

The rate of water loss/gain shall be less than the rate, in gallons per hour, calculated for the test section using the following allowances:

Sewer main and manholes with or without service laterals; 100 gallons per 24 hours per inch of sewer main diameter per mile of sewer main (gpd/in-mi)

Manholes only; 1 gallon per 24 hours per vertical foot of manhole

3.5.2.4. Corrective Measures

If actual leakage rate is greater than required leakage rate, CONTRACTOR shall locate and repair leaks and repeat the test until actual leakage is less than the required rate.

3.5.3. <u>Deflection Test</u>

3.5.3.1. Use all gravity sewer, 8-inch diameter through 15-inch diameter except ductile iron.

3.5.3.2. Procedure

Tests shall be performed by the CONTRACTOR in the presence of the ENGINEER and a Lincoln County Public works Representative no sooner than thirty (30) days after completion of backfill. The Lincoln County Public Works Department may require a second test within the guarantee period of the project. A nine (9) arm mandrel and proving ring, as manufactured by Wortco, Inc. or an approved equal, will be provided by the contractor. The mandrel shall be manually pulled, from manhole, through the entire length of mainline pipe. The mandrel and proving ring shall remain the property of the CONTRACTOR.

3.5.3.3. Requirement

All pipes shall allow passage of the test mandrel. The mandrel and proving ring shall be sized at 5% less than the ASTM dimension for the pipe in accordance with the following table:

NOM. DIA	L	ASTM D3034 SDR 35 D	ASTM D2680 D
8"	8"	7.28"	7.40"
10"	10"	9.09"	9.31"
12"	12"	10.79"	11.22"
15"	15"	13.20"	14.09"

L = Mandrel Contact Length
D = I.D. of Proving Ring

3.5.3.4. Corrective Measures
All pipe that fails the deflection test shall be removed, replaced and retested at no additional expense to Lincoln County Public Works.

3.5.4. Force Main Pressure Test

3.5.4.1 The pressure/leakage test of water mains shall be in accordance with Standard AWWA C3.500-82. The allowable leakage shall not exceed that determined by the following formula:

L = $SDP^{0.5}$ / 148,000
L = Allowable leakage in gallons per hour
S = Length of line tested in feet
D = Nominal diameter of pipe, in inches
P = Average test pressure, in psi - 1.50 average system pressure in the area, but not less than 100 psi.

3.5.4.2. Where practicable, pipe lines shall be tested in lengths of no more than 2,000 feet.

3.5.4.3. Duration of test shall be not less than 2 hours where joints are exposed, and not less than 24 hours where joints are covered, unless directed by the ENGINEER.

3.5.4.4. All visible leaks at exposed joints, and all leaks evident on the surface where joints are covered, shall be repaired and leakage minimized, regardless of total leakage as shown by test.

3.5.4.5. All pipe, fittings, and other material found to be defective under test shall be removed and replaced at the CONTRACTOR's expense.

3.5.4.6. Lines which fail to meet tests shall be repaired and retested as necessary, until test requirements are complied with.

3.5.5 Low Pressure Sewer Testing: The water for testing purposes can be taken from the nearest available water main under the supervision of the Engineer's Inspector and leakage will be measured by the Inspector with a meter furnished by the Contractor. If a service connection or other openings are not available for the purposes of expelling air, the Contractor shall provide air release of sufficient size (as determined by the ENGINEER).

The test pressure will be 100 PSI at the low point of the section under test. Allowable leakage will be determined by Table 6, AWWA C-600 (See Section XIV.Q-1.b.) or by the formula 1=0.000083 DS where S is the length of pipe under test and D is the pipe diameter. Add 0.0050 gal/hr. for each 1 ½ inch lateral. During the last stages of the test and without any reduction in pressure

progressing from the end opposite the test pump, each mainline valve will be closed and pressure released to determine if the valve is holding pressure (minimum 10 minutes per valve closing).

END OF SECTION

LINCOLN COUNTY STANDARD SPECIFICATIONS
SECTION 02731
SEWER SERVICE LATERALS

1. DESCRIPTION

This section covers the installation of sewer service laterals. Sewer laterals shall be installed at the locations shown on the plans or where directed by the ENGINEER of record.

1.1 Related Work

See Section 02933, Seeding and Mulching and Section 02575, Paving Repair and Resurfacing for related specifications.

1.2. References

Any reference to standard specifications refers to the most current published date of the following specifications unless noted:

CISPI	Specifications as listed.
ASTM	Specifications as listed.

2. MATERIALS

2.1. Wyes or Saddles shall be standard 45 degree pattern fittings or saddles as specified herein. For ductile iron use factory made wye fittings with 0-ring joints on the run of the wye. For ABS composite sewers, PVC composite sewers, or SDR 35 PVC sewers use either field installed solvent cemented saddles or factory made wye fittings with either solvent cemented saddles or 0-ring joints on lateral pipe. Branch joint shall be as specified for lateral pipe or shall be fitted with an approved adapter at the bell of the branch.

2.2. Pipe, 6 inch and smaller

Use one of the following.

CISPI 301 "No-Hub" cast iron soil pipe with joints consisting of neoprene gasket and stainless steel clamp and shield

ABS plastic sewer pipe conforming to ASTM D2751, SDR 35, with solvent cement joints and all required marking

PVC plastic sewer pipe conforming to ASTM D3034, SDR 35, with either solvent cement or elastomeric gasket joints and all required marking

2.3. Bends shall be either one (1) 1/8 bend (45 degree) or two (2) 1/l6 bends (22 l/2 degree) of the same material and joint as used for pipe. Use Sweep (long radius) bends if available.

2.4. Adapters shall be approved type, submittal required. Adapters shall be rubber coupling with stainless steel clamps or shall utilize compressible donut designed for the purpose. Adapters shall be equal to those made by Fernco.

3. INSTALLATION

Service laterals shall be properly installed at the locations designated or as required to best service the property. All wyes, bends, stacks or service pipe and other appurtenances shall be provided as required for each connection. The location of service lateral shall be marked on curb.

3.1. Field Engineering
The CONTRACTOR shall be responsible for detailed design of each service lateral using approved materials, criteria as specified in this section and shown on the drawings and the following procedure:
Use alignment, minimum slope and minimum cover criteria to install the laterals as shown in the Standard Details.

3.2. Wyes shall be installed with the branch turned to the proper direction and to the angle determined above. Wyes shall be firmly supported.

3.3. Bends shall be placed in the wyes using care to obtain proper alignment. Bends shall be adequately supported.

3.4. Stack pipe shall be installed at wye connections, to the elevation determined above. Pipe shall be carefully aligned and adequately supported.

3.5. Service pipe shall be installed to the proper line and grade from the sewer line to each property line. Suitable plugs or caps shall be placed in the end of the service lines and suitable markers installed for location purposed. Care should be taken during installation to minimize disturbing the developed lots. Laterals should be located to minimize the amount of service line set and bends used.

3.6. Connection to manholes shall be similar to sewer connections to existing manholes as shown in the Lincoln County Public Works Standard Detail SS-7.

3.7. Record Drawings
CONTRACTOR shall keep and provide the Lincoln County Public Works an accurate record of each service location according to the Lincoln County Standard Detail SS-7. Such information should be maintained during construction on a field set of bluelines and should also include all wyes, bends, length of service line, whether or not a stack was installed, and length and angle of stack.

3.8. Tests
Sewer service laterals shall pass infiltration and/or air test as specified for gravity sewers.

END OF SECTION

LINCOLN COUNTY STANDARD SPECIFICATIONS
SECTION 02831
CHAIN LINK FENCING

1. DESCRIPTION

This section covers the installation of chain link fence and gate materials as shown on the plans. The CONTRACTOR shall furnish all labor, material, equipment, supplies and cleanup to complete the fence installation as specified herein.

1.1. Related Work

Reference the following specifications for related work:

Chain Link Fence Manufacturers Institute (CLMI) Standards:
- Industrial Steel Specification for Fence-posts, Gates, and Accessories
- Standards for Chain Link Fence Installation

Federal Specifications:
- FS RR-F-191/A Fencing, Wire and Post, Metal (Chain Link Fence Fabric)

Any reference to standard specifications refers to the most current published date of the following specifications unless noted.

1.2. Submittals

Shop drawings covering design, complete layout and installation details for the work of this section.

2. MATERIALS

All materials shall be new and be furnished by the CONTRACTOR in accordance with the following requirements.

2.1. Framework

Posts, rails, braces and fittings shall be hot-dip galvanized, 2.0 oz/sq.ft. coating.

2.1.1. Line Posts

2.50 inch OD Schedule 40 steel pipe; steel "H" columns, nominal weight 4.1 lb/ft, or 2.25 x 1.70-inch steel "C" Sections, nominal weight 2.73 lb/ft.

2.1.2. Terminal and Gate Posts

3.0-inch OD Schedule 40 steel pipe; or 3.5 x 3.5-inch steel roll formed sections, nominal weight 5.14 lb/ft; except that double-leaf gate posts shall be 4.00-inch OD Schedule 40 steel pipe or larger as recommended by the fence manufacturer.

2.1.3. Top and Brace Rails

1.625-inch OD Schedule 40 steel pipe or 1.625 x 1.25-inch steel channel sections with suitable couplings

2.1.4. Gate Frame

2.0-inch OD Schedule 40 steel pipe welded at corners or assembled with fittings

2.1.5. Post Tops

Cast steel or malleable iron combination type with barbed wire extension arms; tops shall be designed to exclude moisture from posts and to hold top rail.

2.1.6. Fittings

Pressed steel or malleable cast iron

2.1.7. Extension Arms
Cast steel designed to hold three strands of barbed wire at a 45 degree angle with the top strand 12 inches above the fence fabric and 12 inches out from the fence line

2.1.8. Truss Rod
0.375-inch OD

2.2. Fabric
9 gage steel wire woven in 2 inch mesh, 0.40 oz/sq.ft. aluminum coated, knuckled at one selvage and twisted at the other

2.3. Tension Wire
7 gage spiraled or crimped steel wire, 0.40 oz/sq. ft. aluminum coated

2.4. Barbed Wire
Three 12 gage steel stranded line wires with 14 gage steel wire barbs in a four-point pattern spaced 5 inches on center, 0.3 oz/sq. ft. aluminum coating

2.5. Gate Hardware
Fork-type with gravity drop, center gate stop and drop rod, mechanical keepers and two 180 degree gate hinges per leaf

2.6. Footing Concrete
Class B, 2500 psi 28-day compressive strength

3. INSTALLATION
Line posts shall be evenly spaced at intervals not exceeding 8 feet and in true alignment with the designed fence line. All posts shall be set plumb at least 36 inches deep in a concrete footing. Footings shall not be less than 9-inch diameter for line posts and 12-inch diameter for terminal and gateposts. Top of footings should be crested slightly to shed water.

3.1. Top Rails shall pass through line post tops to form a continuous brace. Corner posts shall be provided with a center brace rail installed midway between the top rail and ground level extending to the first line post and securely trussed diagonally from the line post back to the terminal post. All rails shall be securely fastened to posts.

3.2. Fence Fabric shall be stretched between terminal posts or at maximum intervals of 100 feet; whichever is less. The bottom of the fabric shall be positioned 2 inches above finish grade. Fabric shall be fastened to the top rail, line posts and branches with wire ties spaced not more than 15 inches on center and attached to terminal and gate posts with tension bars and tension chips. Tension wire shall be stretched along fabric bottom six inches above finish grade. Fabric shall be attached to tension wire with tie wires spaced 24 inches on center.

3.3. Extension Arms shall be installed with the arms inclined outward. Barbed wire shall be properly stretched and securely fastened to the extension arm.

3.4. Gates shall be installed with fabric and barbwire overhang to match fence. Fabric shall be securely fastened to the frame. Diagonal truss rods shall be provided as required to prevent sag or twist. Gates shall be properly installed with all hardware and accessories to insure that they

open and close freely without binding. A concrete footing at least 12 inches deep and drop rod retainer shall be provided at the center of double gate openings.

3.5. Submittals

Shop drawings and catalog cut sheets showing the complete layout and details of the fence and gate installation shall be submitted for review to the Lincoln County Public Works Department.

END OF SECTION

SECTION 02933
SEEDING AND MULCHING

1. DESCRIPTION

The work covered by this section consists of furnishing all labor, materials, and equipment to perform all necessary operations to topsoil, fine grade, fertilize, mulch and maintain temporary and permanent seeding of all graded, cleared, or disturbed areas during construction. The work covered by this section shall be in conformance with the latest version of local and state Department of Transportation requirements.

1.1. Related Work

See following sections for related work.

02110, Clearing and Grubbing
02210, Unclassified Excavation and Grading
SS-A617A, FS Liquid Mulch Binder

The work covered by this section shall be in conformance with the applicable sections of the most recent publication of the "Standard Specifications for Roads and Structures", published by the North Carolina Department of Transportation and with Section 6.11 of the "Erosion and Sediment Control Planning and Design Manual" published by the Land Quality Section of the North Carolina Department of Natural Resources and Community Development unless otherwise stated herein. All seed shall be certified by the N.C. Crop Improvement Association.

2. MATERIALS

2.1. Topsoil

Topsoil shall be from stockpiles created from stripping and required excavation. Should additional topsoil be required in excess of that obtained from stripping and excavation, the contractor shall obtain material from other sources on the site where authorized by Lincoln County Public Works, or from approved sources off the site. The topsoil shall be natural, friable soil, possessing characteristics of representative soils in the vicinity which produce heavy growths of crops of grass. It shall be obtained from naturally well-drained areas, shall be reasonably free from subsoil, brush, objectionable weeds, and other litter and shall be free from toxic substances, clay lumps, stones, roots and other objects larger than 1 inch in diameter, or any other material which might be harmful to plant growth or be a hindrance to grading, planting, and maintenance operations.

2.2. Fertilizer

Fertilizer shall be the product of an approved commercial fertilizer manufacturer and shall be 5-10-5 grade, uniform in composition, free-flowing material suitable for application with approved standard equipment. The fertilizer shall conform to the applicable State fertilizer laws and shall be delivered to the site in bags or other convenient containers each fully labeled and bearing the name, trademark, and warranty of the producer.

2.3. Lime

Lime shall be ground limestone containing not less than 85% of total carbonates and shall be ground to such fineness that at least 50% will pass through a 100-mesh sieve and at least 90% will pass through a 20-mesh sieve. Coarser materials will be acceptable provided the specified rates of application are increased proportionately on the basis of quantities passing the 100-mesh sieve, but no additional payment will be made for the increased quantity.

2.4. Mulch

Mulch shall be straw from wheat or oats. Materials for securing mulch may be one of the following.

Mulch Netting: Lightweight plastic, cotton, jute, wire orpaper nets shall be used.

Peg and Twine: Bailing twine and soft wood pegs 1/2" x 1" x 12".

Liquid Mulch Binder: RC-2 cut back asphalt conforming to the requirements of Federal Specifications SS-A67IA, and asphalt emulsion shall conform to the requirements of Federal Specification SS-A-674, Type V.

Seed: Seed used shall bear the official "certified seed" label inspected by North Carolina Crop Improvement Association. Seed that has become wet, moldy, or otherwise damaged in transit or storage will not be acceptable.

3. INSTALLATION

3.1. Seedbed Preparation

3.1.1. Clearing

Prior to or during grading and tillage operations, the ground surface shall be well drained, cleared of all brush, roots, stones larger than 2 inches in diameter, or any other material which may hinder proper grading, tillage, or subsequent maintenance operations.

3.1.2. Fine Grading

Areas to be seeded shall be graded as shown on the drawings or as directed and all surfaces shall be left in an even and properly compacted condition so as to prevent the formation of depressions where water will stand. Areas to be topsoiled shall be graded to a smooth surface and to a grade that will allow topsoiling to finished grade.

3.1.3. Topsoiling

Immediately prior to placing topsoil, the subgrade, where excessively compacted by traffic or other causes, shall be loosened by scarifying to a depth of at least 2 inches to permit bonding of the topsoil to the subgrade. Topsoil shall be uniformly spread by approved equipment in sufficient quantity to provide a compacted layer of 4 inches in thickness over the designated areas and in such manner that planting can proceed with little additional soil preparation or tillage. Topsoil shall not be placed when the subgrade is frozen, excessively wet, extremely dry, or in a condition otherwise detrimental to the proposed planting or to proper grading. Topsoil shall be graded to the lines indicated or as directed and any irregularities in the surface resulting from topsoiling or other operations shall be corrected to prevent formations of depressions where water will stand.

3.1.4. Tillage

After topsoiled areas required to be seeded have been brought to the grades shown on the plans and as specified, they shall be thoroughly tilled to a depth of 3 inches by approved methods, until the condition of the soil is acceptable to the ENGINEER. Any objectionable undulations or irregularities in the surface resulting from tillage or other operations shall be removed before planting operations are begun. The work shall be performed only during periods when satisfactory results are likely to be obtained. When conditions are such, by reason of drought, excessive moisture or other factors that results are not likely to be satisfactory, the ENGINEER will stop the work and it shall be resumed only when, in his opinion, the desired results are likely to be obtained.

3.2. Limestone, Fertilizer and Seed

3.2.1. General
Seasonal limitations for seeding operations, the kinds and grades of fertilizers, the kinds of seed, and the rates of application of limestone, fertilizer, and seed shall be as shown in the seeding schedule.

3.2.2. Limestone, fertilizer, and seed shall be applied within 24 hours after completion of seedbed preparation unless weather and soil conditions are unfavorable for such operations.

3.3. Limestone and Fertilizer
Limestone may be applied as a part of the seedbed preparation, provided it is immediately worked into the soil. If not so applied, limestone and fertilizer shall be distributed uniformly over the prepared seedbed at a specified rate of application and then harrowed, raked, or otherwise thoroughly worked or mixed into the seedbed.

3.3.1. If liquid fertilizer is used, storage containers for the liquid fertilizer shall be located on the project and shall be equipped for agitation of the liquid prior to its use. The storage containers shall be equipped with approved measuring or metering devices which will enable the ENGINEER to record at any time the amount of liquid that has been removed from the container. Application equipment for liquid fertilizer, other than a hydraulic seeder, shall be calibrated to insure that the required rate of fertilizer is applied uniformly.

3.4. Seeding
Seed shall be distributed uniformly over the seedbed at the rate indicated in the seeding schedule, and immediately harrowed, dragged, raked, or otherwise worked so as to cover the seed with a layer of soil. The depth of covering shall be as directed by the ENGINEER. If two kinds of seed are to be used which require different depths of covering, they shall be sown separately.

3.4.1. When a combination seed and fertilizer drill is used, fertilizer may be drilled in with the seed after limestone has been applied and worked into the soil. If two kinds of seed are being used which require different depths of covering, the seed requiring the lighter covering may be sown broadcast or with a special attachment to the drill, or drilled lightly following the initial drilling operation.

3.4.2. When a hydraulic seeder is used for application of seed and fertilizer, the seed shall not remain in water containing fertilizer for more than 30 minutes prior to application.

3.4.3. Immediately after seed has been properly covered, the seedbed shall be compacted.

3.5. Modifications
When adverse seeding conditions are encountered due to steepness of slope, height of slope, or soil conditions, the ENGINEER may direct or permit that modifications be made in the above requirements which pertain to incorporating limestone into the seedbed; covering limestone, seed, and fertilizer; and compaction of the seedbed.

3.5.1. Such modifications may include but not be limited to the following.

3.5.1.1. The incorporation of limestone into the seedbed may be omitted on (a) cut slopes steeper than 2:1 (b) on 2:1 cut slopes when a seedbed has been prepared during the excavation of the cut and is still in an acceptable condition; or (c) on areas of slopes where the surface of the area is too rocky to permit the incorporation of the limestone.

3.5.1.2. The rates of application of limestone, fertilizer, and seed on slopes 2:I or steeper or on rocky surfaces may be reduced or eliminated.

3.5.1.3. Compaction after seeding may be reduced or eliminated on slopes 2:1 or steeper, on rocky surfaces, or on other areas where soil conditions would make compaction undesirable.

3.6. Mulch

3.6.1. General
All seeded areas shall be mulched.

3.6.2. Mulching
Mulch shall be applied within 36 hours after the completion of seeding. Care shall be exercised to prevent displacement of soil or seed or other damage to the seeded area during the mulching operations.

3.6.3. Mulch shall be uniformly spread by hand or by approved mechanical spreaders or blowers that will provide an acceptable application. An acceptable application will be that which will allow some sunlight to penetrate and air to circulate but also partially shade the ground, reduce erosion, and conserve soil moisture.

3.6.4. Mulch Binding
Mulch shall be held in place using devices approved by the ENGINEER as per manufacturer's recommendations. During application, the CONTRACTOR shall take adequate precautions to prevent damage to structures or appurtenances.

3.7. Maintenance

3.7.1. General
The CONTRACTOR shall be responsible for the proper care and maintenance of the seeded areas until the work under the entire contract has been completed and accepted by the ENGINEER and Lincoln County Public Works. Maintenance shall consist of repair and replacement of eroded areas, watering, refertilizing, reliming, reseeding, and remulching as necessary to provide an even, fixed growth of grass. In addition, the CONTRACTOR shall provide protection against traffic and shall erect the necessary barricades and warning signs immediately after planting is completed.

3.7.2. Mowing
The seeded areas shall be mowed with approved mowing equipment. If weeds or other undesirable vegetation threaten to smother the planted species, such vegetation shall be removed.

3.8 Inspection and Testing

3.8.1 Fertilizer and Lime
The ENGINEER shall be furnished with duplicate copies of invoices for all fertilizer and lime used on the project. Invoices for fertilizer shall show the grade furnished. Invoices for lime shall show total minimum carbonates and minimum percentages of the material furnished that pass 100-mesh and 20-mesh sieve. Upon completion of the project, a final check of the total quantities of fertilizer and lime used will be made against the total area topsoiled and seeded, and if the minimum rates of application have not been met, the ENGINEER may require the distribution of additional quantities of these materials to make up the minimum application specified.

3.8.2 Seed

The ENGINEER shall be furnished duplicate signed copies of a statement from the Vendor, certifying that each container of seed delivered is fully labeled and in full accordance with the specifications in this section.

END OF SECTION

LINCOLN COUNTY STANDARD SPECIFICATIONS
SECTION 03300
CAST-IN-PLACE CONCRETE

1. DESCRIPTION

1.1. The work covered by this section consists of all cast-in-place concrete work and related items as shown on the plans and as specified herein.

1.2. The CONTRACTOR shall furnish all equipment, tools, labor and materials necessary to complete the work in accordance with the plans and specification.

1.3 Related Work

1.3.1 These Specification Documents affecting work in this Section include, but are not necessarily limited to, General Conditions, Special Conditions, and Sections in Division 1 of these Specifications.

1.3.2 National Codes affecting work in this Section of the Specifications:

ACI Codes as stated in Part 2 and 3 of this Section
ASTM Codes as stated in Part 2 and 3 of this Section
U. S Army Corps of ENGINEERs Standard Specifications as stated in Part 2 and 3 of this Section
National Ready Mixed Concrete Association's Plant Certification Check List

1.4 Quality Assurance

1.4.1 Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.4.2 An independent testing laboratory shall be retained by the Contractor and approved by Lincoln County Public Works to perform material evaluation tests as required by these Specifications, and all test reports or results shall be submitted to Lincoln County Public Works for evaluation and approval prior to final acceptance.

1.4.3 The CONTRACTORs performing the concrete work shall have a minimum of two (2) years experience on comparable concrete projects.

1.4.4 The concrete supplier's plant equipment and facilities shall meet all requirements of the "Check List for Certification of Ready Mixed Concrete Production Facilities" of the National Ready Mixed Concrete Association and ASTM C94.

1.5 Submittals

1.5.1 Comply with the pertinent provisions of Section 01340 (Shop Drawings, Product Data and Samples).

1.5.2 Submit proposed concrete mix designs for approval. Submit two copies of each laboratory trial mix design proposed in accordance with ACI 301, Method 1, which is based on trial batches and requires an average strength 1200 psi greater than the specified strength; or ACI 301, Method 2,

which is based on at least 30 consecutive strength tests of a similar mix obtained within the past year. The cost of this work is to be borne by the CONTRACTOR.

1.5.3 Submit manufacturer's specification with application instructions for proprietary materials and items, including curing compounds, form release agents, admixtures, patching compounds and others as required by the ENGINEER.

1.5.4 Submit reinforcing steel shop drawings and manufacturer's data for approval to the ENGINEER before work is started.

1.5.4.1 Metal Reinforcement: Shop drawings shall show complete information for placing reinforcement, including type or shape of each bar, dimensions to ends of bars, amount of concrete (clear) cover, spacing of bars, number of bars at each location and other pertinent dimensions. All wall reinforcing steel shall be detailed and shown in elevations of the walls. Shop Drawings of the following items shall be submitted to the ENGINEER for review prior to fabrication or delivery to the job site.

1.5.5 Concrete Tests: Two copies of all concrete test results shall be submitted to the ENGINEER. Each test report shall indicate the specific structure where the concrete was placed.

1.5.6 Other: For each batch (truckload) of concrete, the concrete supplier shall provide a delivery ticket in accordance with ASTM C94. The ticket shall also indicate the time the concrete is placed. One copy of each delivery ticket shall be furnished to the ENGINEER or his representative. CONTRACTOR shall keep another copy of each delivery ticket at the job site until final acceptance.

2. MATERIALS

2.1. General

2.1.1. Class of Concrete: All concrete shall be Class A, as hereinafter specified, except where specifically noted otherwise.

2.1.2. References: Materials and work shall conform to the requirements of all specifications, standards, codes and recommended practices referenced herein. References to specifications, standards, codes, etc., shall mean the latest edition or revision in effect at the time of bid opening, unless otherwise specified. In conflicts between referenced standards and this specification, or this specification and the local building code, the more stringent requirements shall govern.

2.1.3. Publications: CONTRACTOR shall keep the following publications on file at the site at all times during construction.

ACI SP 15	Field Reference Manual; Specification for structural concrete for buildings with selected ACI and ASTM references.
ACI 311	Recommended Practice for Concrete Inspection
ACI 315	Manual of Standard Practice for Detailing Reinforced Concrete Structures
ACI 318	Building Code Requirements for Reinforced Concrete
ACI 350R	Concrete Sanitary Engineering Structures

2.1.4. General Specifications: Concrete work shall conform to all requirements of ACI 301, "Specifications for Structural Concrete for Buildings," except as modified by these contract documents.

2.2. Testing and Inspection

Materials and operations shall be tested and inspected as work progresses. Failure to detect defective work will not prevent rejection when the defect is discovered, nor shall it obligate the ENGINEER or Lincoln County for final acceptance. Testing agencies will be selected or approved by the ENGINEER, and shall meet the requirements of ASTM E329.

2.2.1. Concrete Testing: CONTRACTOR shall have a qualified technician from an independent laboratory take samples, prepare specimens and perform on-site testing, at the CONTRACTOR's expense. Technician shall be on site prior to starting the pour and shall remain on site until the pour is completed. He shall immediately notify the CONTRACTOR and ENGINEER of any concrete that does not meet the specifications. CONTRACTOR shall also pay the cost of qualification of proposed materials, establishment of mix designs in accordance with ACI 301, shipment of specimens to the testing laboratory, laboratory testing and reports, and additional testing required if initial tests indicate that the material may be substandard (even if the additional test reveals that the material is satisfactory). A copy of all reports shall be provided to the Lincoln County Public Works Department. The following tests shall be the minimum required.

2.2.1.1. Samples from which test specimens are made shall be secured in accordance with ASTM C172 requirements for composite samples. Specimens shall be molded and cured in accordance with ASTM C31. Specimens shall be tested in accordance with ASTM C39. Four strength specimens shall be taken for each 50 cu. yd., or fraction thereof, of each mix design of concrete placed in any one day; one tested at 7 days, two tested at 28 days and one to be retained as a spare.

2.2.1.2. Slump test shall be made in accordance with ASTM C143. One test shall be made from each sample taken for a strength test specimen, or whenever the consistency of concrete appears to vary. If the slump in any test is outside the design range, at least one strength specimen shall be taken from that sample.

2.2.1.3. Entrained air content shall be determined in accordance with ASTM C231 or ASTM C173, as applicable. One test shall be made from each sample taken for a strength test specimen.

2.2.1.4. Temperature of each sample taken for a strength test specimen shall be determined.

2.2.1.5. Unit weight, yield and air content (gravimetric) of concrete shall be determined in accordance with ASTM C138.

2.3. Evaluation and Acceptance

2.3.1. Field Conditions: Concrete materials and operations shall be tested and inspected prior to concrete being placed. Whenever a concrete truckload is rejected for any reason, the truck will not be allowed on the site for at least three hours. The contents of rejected truckloads shall remain the property of the concrete supplier and shall be disposed of properly off the site.

2.3.2. Failure to meet the maximum time limits as specified in ASTM C94 for mixing and placing of concrete, or if concrete has attained its initial set before placing, will result in rejection of each individual truckload. No tests shall be performed and the delivery ticket shall remain at the site with the reason for rejection written thereon.

2.3.3. Failure to meet the requirements of the tests specified herein will result in rejection of each individual truckload.

2.3.4. Laboratory Testing: Evaluation and acceptance based on laboratory testing shall be in accordance with ACI 318, except that the ENGINEER will be the referenced "building official".

2.4. Submittals

CONTRACTOR shall make the following submittals to the ENGINEER. The ENGINEER shall provide one (1) copy to the Public Works Department once approved.

2.4.1. Mix Designs: Submit two copies of each laboratory trial mix design proposed in accordance with ACI 301, Method 1, which is based on trial batches and requires an average strength 1200 psi greater than the specified strength; or ACI 301, Method 2, which is based on at least 30 consecutive strength tests of a similar mix obtained within the past year.

2.4.2. Shop Drawings of the following items shall be submitted to the ENGINEER for review prior to fabrication or delivery to the job site.

2.4.2.1. Metal Reinforcement: Shop drawings shall show complete information for placing reinforcement, including type or shape of each bar, dimensions to ends of bars, amount of concrete (clear) cover, spacing of bars, number of bars at each location and other pertinent dimensions. All wall reinforcing steel shall be detailed and shown in elevations of the walls.

2.4.2.2. Other Materials and Products: Catalog cuts and other descriptive data shall be submitted for all manufactured materials and products to be used in the work.

2.4.3. Concrete Tests: Two copies of all concrete test results shall be submitted to the ENGINEER. Each test report shall indicate the specific structure where the concrete was placed.

2.4.4. Other: For each batch (truckload) of concrete, the concrete supplier shall provide a delivery ticket in accordance with ASTM C94. The ticket shall also indicate the time the concrete is placed. One copy of each delivery ticket shall be furnished to the ENGINEER or his representative. CONTRACTOR shall keep another copy of each delivery ticket at the job site until final acceptance.

2.5. Materials and Products

2.5.1. Cement: ASTM C150, Type I or II. Air-entraining cement shall not be used. Cement used in the work shall correspond to that upon which the selection of concrete proportions was based. Only one brand and manufacture of approved cement shall be used for exposed concrete.

2.5.1.1. Type III cement shall be used where specifically noted on the plans or when prior written approval has been obtained by the CONTRACTOR from the ENGINEER.

2.5.2. Aggregates: ASTM C33. Local aggregates not complying with ASTM C33 may be used provided it can be shown by special test or a record of past performance that these aggregates produce concrete of adequate strength and durability.

2.5.2.1. Fine Aggregate shall be clean, sharp, natural sand.

2.5.2.2. Coarse Aggregate shall be Size No. 57, 67 or 467.

2.5.3. Water shall be fresh, clean and potable.

2.5.4. Admixtures: When requested, a qualified concrete technician employed by the admixture manufacturer shall be available to assist in proportioning concrete materials for optimum use, and to advise on proper use of the admixture and adjustment of concrete mix proportions to meet job-site and climatic conditions.

2.5.4.1. Water Reducing Admixture: "Eucon WR-75" by Euclid Chemical Co., "Pozzolith 122N" by Master Builders, "Plastocrete" by Sika Chemical Corp., or equal. Admixture shall conform to ASTM C494, Type A, and shall not contain more than 1% chloride ions.

2.5.4.2. High Range Water Reducing (HRWR) Admixture (Superplasticizer): "Eucon 37" by Euclid Chemical Co., "Sikament" by Sika Chemical Corp., "Melment" by American Admixtures Co., or equal. Admixture shall conform to ASTM C494, Type F or G, and shall not contain more than 1% chloride ions.

2.5.4.3. Non-Corrosive Accelerator: "Accelguard 80" by Euclid Chemical Co., "Daraset" by W. R. Grace, or equal. Admixture shall conform to ASTM C494, Type C or E, and shall not contain more than 1% chloride ions.

2.5.4.4. Air-Entraining Admixture: ASTM C260

2.5.4.5. Retarding Admixture: "Eucon Retarder 75" by Euclid Chemical Co., "Pozzolith 300R" by Master Builders, or equal. Admixture shall conform to ASTM C494, Type B or D, and shall not contain more than 1% chloride ions.

2.5.4.6. Fly Ash: ASTM C618. Quantity of fly ash shall be less than 25% of the combined weight of cement and fly ash.

2.6. Curing Materials

2.6.1. Waterproof Sheet Material: ASTM C171.

2.6.2 Curing Compounds: "Super Pliocure" by Euclid, "Super Floor Coat" by Euclid, or "Masture Kure-CRC" by Master Builders or equal. Product shall be a curing, sealing and hardening product with approximately 30% solids and shall meet the requirements of ASTM C-309.

2.7. WATERSTOPS shall be steel plate, 1/8 x 6-inch; except where non-metallic waterstops are specified or noted on the plans.

2.7.1 Waterstops at submerged expansion joints shall be the dumbbell or center bulb type, and shall be of rubber, PVC, styrenebutadiene or neoprene. Unless otherwise noted, dumbbell type shall be 3/8 x 6-inch with 3/4-inch end bulbs and center bulb type shall be 1/4 x 6-inch with 5/8-inch end bulbs and 1-1/8 inch center bulb.

2.8. Non-Shrink Grout
Non-metallic conforming to "Corps of ENGINEERs Specification for Non-Shrink Grout" CRD-C-621, Type D; "Euco N-S" by Euclid Chemical Co., "Masterflow 713" by Master Builders, Crystex" by L & M Construction Chemicals, or equal.

2.9. Bonding Compound

2.9.1. Not Exposed to Water after Placement: Polyvinyl acetate, rewettable type; "Euco Weld" by Euclid Chemical Co., "Weldcrete" by Larsen, "Everbond" by L & M Construction Chemicals, or equal.

2.9.2 Exposed to Water after Placement: "SBR Latex" or "Flex-Con" by Euclid Chemical Co., "Sikatop" polymer when used with "Sikatop" by Sika Chemical Corp., "Everbond" by L & M Construction Chemicals, or equal. Epoxy adhesives may also be used.

2.10. METAL REINFORCEMENT shall be reinforcing steel or welded wire fabric, as shown on the plans. If requested, manufacturer's certificates showing conformance with the specifications shall be furnished to the ENGINEER.

2.10.1. Reinforcing Steel shall be deformed steel bars conforming to ASTM A615, Grade 60 unless otherwise noted.

2.10.2. Welded Wire Fabric: ASTM A185.

2.11. JOINT FILLERS shall be preformed bituminous self-sealing type conforming to ASTM D994, unless otherwise noted.

2.12 Formwork

2.12.1. Forms for Exposed Concrete shall be of plywood, and shall provide continuous, straight, smooth surfaces. Plywood shall be B-B Plyform, Class I Exterior, 5/8-inch thick minimum. Metal and other types of forms shall be used only upon approval of the ENGINEER. Symons forms with plywood, or equivalent, shall be acceptable.

2.12.2. Forms for Unexposed Concrete may be of undressed square-edge tongue-and-groove lumber, or of plywood.

2.12.3. Form Oil shall be a light colored, non-staining form coating compound. Form oil for steel forms shall be rust-preventive type.

2.12.4. Form Ties shall be factory fabricated, adjustable length type designed to prevent from deflection and spalling of concrete surfaces upon removal. Ties shall be of the type to have metal not less than 1 inch from exposed concrete surfaces. Wire ties will not be permitted where wire is embedded in finished concrete. Form ties fabricated at the job site will not be acceptable. Ties in liquid-retaining structures shall have a waterstop in the middle of the tie.

2.12.5. Vertical sides of excavations may be used for placing concrete in lieu of forms, provided that the sides are clean cut and remain stable while the concrete work is being accomplished.

2.13. MATERIAL STORAGE: Storage of materials shall be subject to approval of the ENGINEER and shall be such that damage from water, freezing and other sources is prevented. No damaged or deteriorated material shall be used for concrete.

2.13.1. Cement shall be stored in enclosed shelters to prevent damage from moisture. Supporting floors shall be at least 1 foot above ground or otherwise suitably protected against moisture penetration.

2.13.2. Aggregates shall be stored in separate piles, and in such manner as to prevent inclusion of dirt and other foreign materials.

2.13.3. Admixtures: Dry admixtures shall be stored as specified for cement. Liquid admixtures shall be protected from freezing and from settling out of solution.

2.13.4. Metal Reinforcement shall be stored off the ground, protected from the weather, and so that it can be easily identified.

2.13.5. Other Materials shall be suitably stored to prevent damage or misuse.

2.14. Selection of Proportions

Concrete shall be composed of cement, fine and coarse aggregate, water and the required admixtures. Proportions of ingredients shall produce concrete of the proper consistency that works readily into corners and angles of forms and around reinforcement without excessive segregation or bleed water forming on the surface; concrete that provides resistance to freezing, thawing and other aggressive actions; and concrete that meets the strength and other requirements specified herein. Proportioning of materials shall be in accordance with ACI 211.1, ACI 318 and ACI 301 (Method 1 or Method 2).

2.15. Concrete Quality

Concrete work shall conform to all requirements of ACI 301, except where specifically modified by the plans and specifications for this project. Concrete shall be composed so as to obtain the following compressive strengths at 28 days.

Class AA	4000 psi
Class A	3500 psi
Class B	2500 psi
Class C	2000 psi

Note: Water-cement ratio requirements may be more restrictive than the strength requirements.

2.15.1. Minimum Cement Content for Class A Concrete shall be 517 lb./cu. yd. for coarse aggregate size No. 467, and 564 lb./cu. yd. for coarse aggregate size No. 57 or 67.

2.15.2. Air-Entrained Concrete: Concrete exposed to the weather or in liquid-retaining structures shall be air-entrained. Total air content required shall be 5-1/2% + 1% for coarse aggregate size No. 467, and 6% + 1% for coarse aggregate size No. 57 or 67. The design mix shall be based on the midpoint of the applicable range, and the field delivered concrete shall be within that range.

2.15.3. Air content shall be measured in accordance with ASTM C173, or ASTM C231.

2.15.4. Slump shall be determined in accordance with ASTM C143.

2.15.5. Maximum slump for walls shall be 3 inches prior to addition of the HRWR admixture. Admixture shall be added in sufficient quantities to provide a minimum slump of 5 inches prior to placement of concrete.

2.15.6. The maximums specified above may be increased to 8 inches by using the HRWR admixture. However, slump will be checked prior to the addition of the HRWR admixture, and shall meet the restrictions specified above.

2.16. HARDENING OF CONCRETE: Concrete shall be adjusted to produce the required rate of hardening for various climatic and job-site conditions. The rate of hardening shall be as follows:

Ambient Temperature	Admixture (ASTM C494)
Under 50 degrees F	Type E (accelerating)
Over 80 degrees F	Type D (retarding)
50 degrees F to 80 degrees F	Type A (normal rate of hardening)

2.17. Admixtures

All other concrete shall contain a water reducing admixture. All thin slabs, less than 8 inches thick, placed at air temperatures below 50 degrees F, shall contain the specified non-corrosive accelerator. All concrete required to be air-entrained shall contain an approved air-entraining admixture. When increased ultimate and/or early strengths are required, the appropriate admixture shall be used.

2.18. Water-Cement Ratio

Class A concrete or better shall have a maximum water-cement ration of 0.45. When used, fly ash shall be included with the cement to determine the water-cement ratio.

3. INSTALLATION

3.1. Construction of Forms

Forms for concrete shall conform to the shapes, lines and dimensions of the members as shown on the plans, and shall be sufficiently tight to prevent leakage of mortar. Forms shall have sufficient strength to withstand forces from the placement and vibration of concrete, and shall be properly braced or tied together to maintain position and shape.

3.1.1. Design: Formwork shall be designed for loads, lateral pressure and allowable stresses in accordance with ACI 347. All tolerances, preparation of form surfaces, removal of forms, reshoring and removal strength shall be in accordance with ACI 301. Design, Engineering and construction of formwork shall be the responsibility of the CONTRACTOR.

3.1.2. Erection of Forms:

3.1.2.1. Forms shall be erected to the sizes, shapes and dimensions shown on the plans, true to line and grade. Forms shall be fabricated to permit easy removal without damage to concrete.

3.1.2.2. All formwork shall be provided with adequate cleanout openings to permit inspection and easy cleaning. Wood chips, sawdust, dirt and other debris shall be removed just before concrete is placed.

3.1.2.3. All exposed corners and edges of forms shall be provided with a 3/4-inch chamfer. Chamfer strips shall be of wood, metal, PVC or rubber.

3.1.2.4. Contact surfaces of forms shall be oiled and allowed to dry before reinforcement is placed. Form oil shall be applied in accordance with the manufacturer's instructions. All excess oil shall be removed.

3.1.2.5. Forms to be re-used in the work shall be thoroughly clean and free of splits, distortion and other damage. Re-used forms shall be oiled as specified for new forms.

3.1.3. Extreme Weather Requirements: During cold weather, forms shall be kept free from frost or ice. In hot weather, forms shall be properly prepared to prevent loss of water prior to placing concrete, and shall be well oiled and sprinkled as necessary to keep them cool.

3.2. Concrete Reinforcement

Reinforcement shall be accurately formed to the required lengths, dimensions and shapes as shown on the plans, prior to shipment to the job site. Shop drawings shall be reviewed prior to fabrication. All bars shall be bent cold, unless otherwise directed by the ENGINEER. Bars partially embedded in concrete shall not be field bent, unless otherwise shown on the plans or

specifically permitted by the ENGINEER. All requirements for reinforcement not shown on the plans or specified herein shall be in accordance with ACI 315.

3.2.1. Shipping and Handling: Reinforcement shall be delivered to the job site tied in bundles so as to be easily handled, and tagged with non-rusting metal tags showing shop drawing numbers.

3.2.2. Placing: Reinforcement shall be carefully and accurately placed as shown on the plans, and adequately secured in position by concrete, metal or other approved chairs, spacers or ties to prevent displacement during the concreting operation. At the time concrete is placed, reinforcement shall be free from thick rust, mill scale, ice, frost, oil, grease or other coatings that destroy or reduce the bond.

3.2.3. Splices: Unless otherwise noted, splices in reinforcement shall be Class C in accordance with ACI 318. All splices shall be approved by the ENGINEER, and shall be securely tied with wire or cable clamps.

3.2.4. Cutting of reinforcement in the field will not be allowed, unless specifically approved by the ENGINEER.

3.2.5. Concrete Protection: Unless otherwise noted, the minimum cover of concrete over reinforcement shall be in accordance with ACI 318 or shall be as shown on the plans.

3.2.6. Exposed Reinforcing Bars intended for bonding with future work shall be adequately protected against corrosion.

3.2.7. Field Bending of reinforcement is strictly prohibited, except where specifically approved by the ENGINEER on a limited basis for each particular case. When approved, field bending shall be done using cold bends conforming to all applicable codes; heat will not be allowed.

3.3. JOINTS AND EMBEDDED ITEMS shall be provided where shown on the plans or as directed by the ENGINEER.

3.3.1. Joints not shown on the plans shall be made and located to least impair the strength of the structure, and shall be approved by the ENGINEER.

3.3.1.1. All reinforcement shall be continued across construction and contraction joints, unless noted otherwise; keys and dowels shall be provided as directed by the ENGINEER.

3.3.1.2. Joint filler shall be placed in all expansion and isolation joints.

3.3.1.3. Contraction joints shall be formed, tooled or sawed approximately equal to 1/4 the thicknesses of the member.

3.3.1.4. All joints in liquid-retaining structures shall be provided with a waterstop, unless otherwise directed in each instance by the ENGINEER.

3.3.1.5. Dowel length into adjoining concrete shall be considered a minimum of full splice length, and shall conform to all requirements for splices as specified above.

3.4. SUBMERGED EXPANSION AND CONTRACTION JOINTS shall be provided as detailed on the plans. All manufactured products shall be applied in accordance with the manufacturer's instructions.

3.4.1. Other Embedded Items: All sleeves, wall pipe, nipples, inserts, anchors, hangers and other embedded items required for adjoining work or for its support shall be placed prior to placing concrete, and shall be positioned accurately and supported against displacement.

3.5. Mixing and Placing

CONTRACTOR shall provide access for delivery and sufficient equipment and manpower to rapidly place all concrete. All work shall be done in accordance with ACI 304.

3.5.1. Preparation of Equipment and Place of Deposit: Before placement of concrete, equipment used for mixing and transporting concrete shall be thoroughly cleaned. All formwork shall be complete; snow, ice, water and debris shall be removed from within forms. Expansion joints material, anchors and other embedded items shall be properly secured in position. Subgrades shall be sprinkled sufficiently to eliminate water loss from the concrete. Concrete shall not be placed on frozen ground. All laitance and other unsound material shall be removed from hardened concrete before additional concrete is placed.

3.5.2. Ready-Mixed Concrete shall be batched, mixed and transported in accordance with ASTM C94. Plant equipment and facilities shall conform to the "Checklist for Certification of Ready Mixed Concrete Production Facilities" of the National Ready-Mixed Concrete Association.

3.5.3. Job-Mixed Concrete: For job-mixed concrete, mixer shall be rotated at a speed recommended by the manufacturer. If mixer performance tests are not made, each batch of 1 cu. yd. or less shall be mixed for at least 1 minute after all materials are in the mixer. Mixing time shall be increased 15 seconds for each additional cubic yard or fraction thereof. Entire batch shall be discharged before the mixer is recharged.

3.5.4. Conveying: Concrete shall be handled from the mixer to final deposit rapidly by methods that will prevent segregation or loss of ingredients to maintain the required quality of concrete.

3.5.5. Depositing: Concrete shall be deposited continuously; when continuous placement is not possible, construction joints shall be located as approved by the ENGINEER. Concrete shall be placed as nearly as possible to its final position to avoid rehandling or flowing. A tremie, pump or chute shall be used where a lift is between 5 and 12 feet. A pump shall be used where a lift is more than 12 feet.

3.5.5.1. Concrete shall be consolidated by vibration. Concrete shall be worked around reinforcement, embedded items and into corners to eliminate all air or stone pockets and other causes of honeycombing, pitting or planes of weakness. Internal vibrators shall be used on concrete 6 inches or more in thickness. Form or surface vibration may be used on sidewalks or concrete less than 6 inches thick, instead of internal vibration. Consolidation shall be done in accordance with the recommendations of ACI 309.

3.5.5.2. Internal vibrators shall be inserted and withdrawn approximately every 18 inches for 5 to 15 seconds. Vibrators shall have a minimum frequency of 8000 rpm, with amplitude to consolidate effectively. Vibrators shall be operated by competent workmen. Use of vibrators to transport concrete will not be allowed.

3.5.5.3. Flat chutes shall not be used. Chutes shall be deep with rounded bottoms and constructed of or lined with metal.

3.5.5.4. Concrete shall not be dumped in piles and then spread horizontally. Concrete shall be placed in uniform layers 1 to 1-1/2 feet thick and rodded or vibrated to consolidate the various layers.

3.5.5.5. Construction joints shall be limited to those shown on the plans, unless additional construction joints are approved by the ENGINEER. Surface shall be roughened to remove the soft mortar and expose the coarse aggregate. Prior to placing new concrete, hardened concrete shall be cleaned and dampened. On horizontal joints, first layer of new concrete shall be 4 to 5 inches thick and shall be of the same mix as the concrete in the wall, except that the coarse aggregate is omitted.

3.5.5.6. Waterstops shall be provided at all construction joints of liquid-retaining structures. Joints of steel waterstops shall be butt welded; joints of non-metallic waterstops shall be made by gluing or vulcanizing.

3.6 Cold Weather Conditions

All concrete work during cold weather shall be done in accordance with ACI 306. Calcium chloride will not be permitted as an accelerator.

3.6.1. Temperature of concrete delivered at the job site shall conform to the following:

Air Temperature	Concrete Temperature
30 to 45 degrees F	55 to 80 degrees F
0 to 30 degrees F	60 to 80 degrees F
Below 0 degrees F	65 to 80 degrees F

3.6.2. Water heated to above 100 degrees F shall be combined with the aggregates before cement is added. Cement shall not be added to water to aggregates having a temperature greater than 100 degrees F.

3.6.3. When the outdoor temperature is less than 40 degrees F, the temperature of the concrete shall be maintained at not less than 50 degrees F for the required curing time. Arrangements shall be made before placement to maintain the required temperature without injury from excessive heat. Where combustion heaters are used, precautions shall be taken to prevent exposure of concrete and workmen to exhaust gases containing carbon dioxide and carbon monoxide.

3.7 Hot Weather Conditions

All concrete work during hot weather shall be done in accordance with ACI 305.

3.7.1. Temperature of concrete delivered at the job site shall not exceed 90 degrees F. Ingredients shall be cooled before mixing to prevent concrete temperature in excess of 90 degrees F.

3.7.2. Provisions shall be made for windbreaks, shading, fog spraying, sprinkling or wet cover when necessary.

3.7.3. Concrete exposed or subject to rapid evaporation due to hot weather, drying winds and sunlight may be protected by a set-retarding admixture, applied in accordance with the manufacturer's recommendations.

3.8. Curing and Protection

Immediately following placement, concrete shall be protected from premature drying, hot and cold temperatures, rain, flowing water and mechanical injury. Materials and methods of curing shall be approved by the ENGINEER. Final curing shall continue for not less than 7 days.

3.8.1. Approved methods of curing include ponding, continuous sprinkling, fog spray, wet burlap or mats, clean sand kept continuously wet, curing compound and waterproof sheet material.

3.8.2. If a waterproof sheet material is used for curing, it shall be placed over the wetted surface of fresh concrete as soon as practicable without marring the surface. Each sheet shall be overlapped and firmly secured in placed to insure moisture seal.

3.8.3. If a curing compound is used, two coats shall be applied at right angles to each other. The product shall meet the requirements for curing compounds in the materials and products section of these specifications. The product shall be applied in accordance with the manufacturer's recommendations.

3.9. Removal of Forms
Forms shall be removed in such a manner as to insure complete safety of the structure and to prevent damage to concrete. Unless specifically approved otherwise by the ENGINEER, form removal shall be as specified below.

3.9.1. Wall and Column Forms: Formwork not supporting the weight of the concrete, such as wall and column forms and side forms of beams and girders shall remain in place a minimum of 12 hours.

3.9.1.1. On vertical surfaces of liquid-retaining structures, forms shall be left in place, or the surface covered with burlap and the concrete kept wet, for at least seven days.

3.9.2. Bottom Forms for beams and girders shall not be disturbed for at least six days, and auxiliary supports shall be maintained until the concrete reaches its design strength.

3.9.3. Elevated Slab Forms shall not be disturbed for at least seven days, and slabs shall be adequately supported for at least 28 days. Auxiliary slab supports, acceptable to the ENGINEER, may be provided to support slabs at the center of the clear span.

3.10. CONCRETE FINISHES: All exposed concrete surfaces shall be true to the required lines and contours, and shall be free from stone pockets or honeycomb.

3.10.1. Patching and Repair: All imperfect or honeycomb spots and tie holes shall be chipped out to firm concrete and patched with cement grout immediately after form removal and before concrete is thoroughly dry. Fins shall be removed and repaired as necessary. Patching and repair shall be done so that the patched and repaired areas appear as a homogeneous part of the main concrete.

3.10.1.1. Edges of honeycomb spots shall be perpendicular to the surface or slightly undercut; no featheredges will be permitted. Area to be patched, including adjacent surfaces extending at least 6 inches in all directions from the patched area, shall be dampened to prevent absorption of water from the patching mortar. If patching is not done within seven days after form removal, an approved bonding compound (as specified) shall be applied prior to patching. Defective areas shall not be patched until permission is obtained from the ENGINEER in each specified case. Cement and sand shall be obtained from the concrete supplier so as to match adjacent work.

3.10.2. Formed Concrete: Concrete which is not formed as shown on the plans, is out of level or alignment, or is defective in appearance, shall be corrected or replaced to the ENGINEER's satisfaction at the CONTRACTOR's expense.

3.10.2.1. Concrete surfaces not exposed to view; surfaces more than 1 foot below finished grade and interior surfaces of tanks and basins more than 1 foot below the water level need not be finished except for correcting imperfect spots.

3.10.2.2. Unless otherwise noted, all exposed concrete surfaces, including exterior and interior of buildings and exposed basin and tank walls, shall be given a trowel and float finish using a cement-base waterproof coating material such as Thoroseal Plaster Mix or equal. The material shall be mixed and applied in accordance with the manufacturer's instructions to provide a smooth uniform dense finish without holes, voids, uneven surfaces or other defects. Work shall be done to the satisfaction of the ENGINEER. Rubbing concrete with stones or similar abrasives will not be permitted.

3.10.2.3. Tops of walls and walk beams shall be screeded to a uniform surface and finished with a wood float.

3.10.3. Flatwork: Surfaces shall be screeded to the elevations and profiles indicated before bleedwater accumulates. Finishing shall not be started until all bleedwater has disappeared from the surface.

3.10.3.1. Float Finish: Bottoms of tanks and slabs not otherwise specified shall be power floated to a true plane so that depressions between high spots will not exceed 5/16-inch under a 10-foot straightedge. Surfaces shall be refloated immediately to a uniform texture. Hand float shall be used in areas inaccessible to power floats.

3.10.3.2. Broom or Belt Finish: Exterior slabs shall be given a float finish as specified above. A broom or burlap belt shall then be drawn at right angles to the long dimension to obtain a textured finish.

3.11. Walks

Concrete walks shall be provided where shown on the plans. Walks shall be 4 inches thick, unless otherwise noted. Contraction joints shall be provided every 5 or 6 linear feet, cut to a depth of 1-inch with a small radius-jointing tool. Expansion joints shall be provided at 50-foot intervals and at crosswalks, curbs and other structures, and shall be made with premolded bituminous joint filler. Walks shall be brought to the proper grade and cross section with a float, and finished with a broom or brush at right angles to the direction of traffic. All edges shall be tooled with a small radius-edging tool.

3.12. Additional Foundation Concrete

If required by foundation conditions, additional concrete shall be placed under footings of structures, as directed by the ENGINEER. This additional concrete shall be Class C. The joint between the Class C concrete and foundation concrete shall be coated with a bonding compound.

3.13. Grout

Cement-sand grout shall be pumped into existing pipes being abandoned in place shown on the plans. Grout shall consist of 1 part Portland cement and 2½ parts sand by weight. Sand shall be a maximum diameter of 1/8-inch.

END OF SECTION

LINCOLN COUNTY STANDARD SPECIFICATIONS
SECTION 11307
SEWAGE SUBMERSIBLE PUMPING STATION

1. DESCRIPTION

The CONTRACTOR shall furnish all labor, materials, equipment and supplies and shall perform all work necessary for the complete construction of submersible pumping station as shown on the plans and specified herein.

1.1 Related Work

See the following specifications for related work:

Section 02222	Excavating, Backfilling & Compacting for Utilities
Section 02512	Gravel Surface Access Roads and Parking Lots
Section 02601	Force Mains and Gravity Sewers
Section 02831	Chain Link Fences and Gates
Section 02933	Seeding and Mulching
Section 03300	Cast-in-Place Concrete

1.2. References

Any reference to standard specifications refers to the most current published date of the following specifications unless noted:

AWWA	Specifications as listed.
ASTM	Specifications as listed.

1.4 Submittals

1.4.1 Shop Drawings shall be submitted to the ENGINEER and Lincoln County Public Works for approval and shall include:

1.4.1.1 Outline drawings showing equipment and shipping dimensions and weights, location of accessories, and clearances required.

1.4.1.2 Certified factory test and characteristic curves showing field performance for each pump.

1.4.1.3 Wiring and schematic diagrams including accessories.

1.4.1.4 Recommended spare parts list.

1.4.2 Service Manual shall be furnished for all mechanical equipment specified in this section. The manual shall contain a description of the equipment, a complete accessory and parts list, and complete installation, operation and maintenance instructions. Two copies of the manual shall be submitted for approval within 30 days after approval of the shop drawings. After approval of the manual, six (6) additional copies shall be furnished.

2. MATERIALS

All materials for the pumping stations shall be new and shall be furnished by the CONTRACTOR in accordance with the following requirements:

2.1 Pumps

CONTRACTOR's shall furnish two (2) non-clog submersible centrifugal type sewage pumps conforming to the following:

2.1.1. The pump volute, motor and seal housing shall be high quality gray cast iron, ASTM A-48, Class 25. The pump discharge shall be fitted with a 4" standard ASA 125 lb. flange, faced and drilled. All external mating parts shall be machined and Buna N Rubber O-ring sealed on a beveled edge. Gaskets shall not be acceptable. All fasteners exposed to the pumped liquids shall be 304 stainless steel.

2.1.2 Bearings and shaft: The pump shaft shall rotate on two (2) permanently lubricated bearings. These shall be heavy-duty single row ball bearings, double row sealed grease pack bearings are not acceptable.

The pump shaft shall be solid 303 stainless steel, designed with a sufficient diameter with minimum overhang to reduce shaft deflection and bearing wear.

2.1.3 Seals: Each pump shall have a tandem mechanical shaft seal system. The upper set of the tandem seals shall operate in an oil chamber located below the stator housing. The set shall contain one stationary tungsten carbide ring and one positively driven rotating carbon ring, functioning as an independent secondary barrier between the pumped liquid and the stator housing. The lower tandem set shall function as the primary barrier between the pumped liquid and the stator housing. This set shall consist of a stationary ring and a positively driven rotating ring both being tungsten carbide.

Each seal interface shall be held in contact by its own spring system. The seals shall not require maintenance or adjustment, but shall be easily replaceable.

The pump shall be equipped with a seal leak detection probe and warning system. This shall be designed to alert maintenance personnel of lower seal failure without having to take the unit out of service for inspection or requiring access for checking seal chamber oil level and consistency.

There shall be an electric probe or seal failure sensor installed in the seal chamber between the two tandem mechanical seals. If the lower seal fails, contaminants which enter the seal chamber shall be detected by the sensor and send a signal to operate the specified warning device.

Units equipped with opposed mechanical seals shall not be acceptable.

2.1.4 Impeller: The impeller shall be two vane, enclosed non-clogging and have pump out vanes to prevent grit and other materials from collecting in the seal area. The impeller shall be capable of passing a minimum 3-inch solid sphere and shall not be coated to improve efficiency.

Impellers must be dynamically balanced and shall be slip fit to a tapered shaft and key driven. The impeller shall be fastened to the shaft with a 300 series stainless steel washer and bolt.

A volute case wear ring shall be provided to minimize impeller wear. The wear ring shall be alloy 230 brass ASTMB-43 and held by 300 stainless steel fasteners. The wear ring shall be field replaceable.

2.1.5 Pump Performance

Each pump must have the necessary characteristics, be approved by Lincoln County Public Works, and be properly selected to perform under the following operating conditions:

Capacity of _____ gpm at a TDH of _____ feet
Capacity of _____ gpm at a TDH of _____ feet
With a shut off head of _____ feet
Speed: _____ RPM

Impeller Diameter: _ inches
Maximum Sphere passage: _____ inches

Pump specifications shall be designated by the Project ENGINEER.

2.1.6. Motors: Each pump shall have a U/L listed, hermetically sealed, submersible type, electric motor of ____hp,___rpm for operation at___volt,____phase,___hertz power designed for use in hazardous locations and for general use in pumping sewage. The motor shaft shall be stainless steel. The motor shall be provided with thermal overload protection and a moisture detection system. The motor shall be designed for continuous duty, capable of sustaining a minimum of 10 starts per hour.

2.1.7. Rail Assembly: The pumps shall be mounted on rail assembly for removal without entering the wetwell. The pump shall be connected vertically to the stationary discharge elbow by use of a hydraulic sealing flange with no metal-to-metal contact.

2.1.8. Pump Controls: Control Panel shall be provided as specified and shown on the electrical plan. The pump control panel shall contain all operating controls and instruments which include circuit breakers, pump run indicators, alternating relay, pump mode selector (H-O-A), high pump temperature indicator, high water level indicator with reset, high water level alarm (audible and visual) with silence button, elapsed time meters, motor starters and overload relays. Separate circuit breakers shall also be provided for each pump and auxiliary device.

2.1.9 Lubricants: Equipment manufacturer shall furnish, for initial operation for each piece of equipment, the proper lubricants, of each type needed. Each type of lubricant shall be furnished in a separate sealed container which shall be clearly labeled showing the type of lubricant, equipment for which its use is intended, and instructions for use.

2.1.10 Spare Parts: The manufacturer is to furnish the OWNER, the following spare parts for each piece of equipment.

- Bearings
- Seals
- Starter Coil
- Relay

2.1.11 SCADA: All sewage pumping stations shall be equipped with and connected to internet telemetry SCADA equipment. Controllers at the pump stations shall be from Dorsett Technologies with the following control points:

Location	Point	Use	Description	DI	DO	AI	AO
RTU	Pump 1,2	Status	120 VOLT RELAY	2			
	Pump 1,2	Pump Fail	120 VOLT RELAY	2			
	Pump 1,2	Call to Run	120 VOLT RELAY	2			
	Start/Stop	Control	120 VOLT RELAY		2		
	System	Power Fail	120 VOLT RELAY	1			
	Floats	Status	120 VOLT RELAY	4			
	High Level	Alarm	120 VOLT RELAY	1			
	Transfer Switch	Utility/Back Up	120 VOLT RELAY	1			
	Generator Status	Status	120 VOLT RELAY	1			

2.1.12 Odor Control: The DEVELOPER shall submit an Odor Control System Proposal for approval by Lincoln County Public Works and install the approved, sized based on the design parameters, as set forth by the pump station design ENGINEER and by final approval of Lincoln County Public Works.

All units are to be installed per the manufacturer's recommendations and operational prior to the Lift Station being placed into service.

2.2 Wetwell

Shall be constructed of precast reinforced concrete manhole sections conforming to ASTM C-478. Joints shall be made to receive rubber gasket, butyl mastic rope sealer, or a non-shrink type grout especially made for this purpose. Wetwell bottom shall be integrally cast with extended base and walls shall conform to C-478 or to minimum dimensions shown on the drawings. On any new or existing wetwell that receives sewage from a force main or low pressure sewer system, the CONTRACTOR shall submit a coating proposal for approval by Lincoln County Public Works and the ENGINEER. This shall apply also to the next two "upstream" manholes, which shall be cleaned, prepared, a moisture/corrosion barrier applied, and coated, in accordance with coating manufacturer's specifications. This shall apply to both new and existing manholes and wetwells.

2.2.1. Wetwell supplier shall design manhole sections to resist earth loads and to resist uplift resulting from buoyant forces calculated with groundwater table at finished grades. Wall and/or base dimension shall be increased accordingly.

2.2.2. Concrete and Mortar: 3000 psi

2.2.3. Manhole Steps: Section 02601

2.2.4. Wetwell Cover: Shall be constructed of aluminum with ¼" thick one-piece aluminum extruded frame, having a continuous concrete anchor as part of the frame. Door panels shall be ¼" thick aluminum diamond plate capable of withstanding 300 pounds per square foot. All hardware and hinges shall be stainless steel with tamper-proof fasteners. Doors shall open 90 degrees and be locked in this position with a stainless steel positive locking arm and aluminum release handle. Doors shall close flush with the top of the frame and be fully supported around the perimeter on a ½" wide lip.

2.3 Piping

All piping shall be ductile iron.

2.4. Valves

Valves and appurtenances shall be the type, size and class shown on the plans. Valves shall have a heavy cast iron body with standard flanged ends, Class 125 with operating devices as specified or shown. Valves shall be at least the same class as the pipe on which they are used. All exposed valves shall be shop primed. Insofar as possible, all valves shall be by the same manufacturer.

2.4.1. Plug Valves: Shall be eccentric of the nonlubricated type with resilient faced plugs. Valve bodies shall be ASTM A126 Class B cast iron according to AWWA C504. Valves shall include the following features:

2.4.1.1. Plugs shall be resilient faced cast iron, ASTM A126 Class B. The resilient covering shall be neoprene or hycar and suitable for use with sewage.

2.4.1.2. Sleeve metal bearings shall be used which are sintered, oil impregnated and permanently lubricated stainless steel conforming to type 316 ASTM A743 Grade CF-8M or AISI Type 317 L. Non-metallic bearings are not acceptable.

2.4.1.3. Valve shaft seals shall conform to AWWA C504 and AWWA C507 utilizing a multiple v-ring that is externally adjustable and repackable under pressure.

2.4.1.4. Valve actuators shall be of the lever type for all valves 6" and smaller.

2.4.2. Swing Check Valves: Shall be bronze mounted with rubber faced bronze clapper disc seated by a bronze clapper arm against a bronze seat ring. The clapper shall have a lever and spring to assist closure. The spring tension shall be adjustable to set the speed of closure of the valve to the operating conditions in field. The clapper shall be secured to a stainless steel shaft set in bronze bushings. Bushings shall be secured to the valve body with cap screws and sealed with O-rings.

2.5 Level Control System

The level control system shall start and stop the pump motors in response to changes in wet well level, as set forth herein.

2.5.1 Pump Controls: Control Panel shall be a NEMA 4X enclosure and shall be provided by the pump manufacturer as specified and shown on the plan. The pump control panel shall contain all operating controls and instruments which include circuit breakers, pump run indicator, pump mode selector (H-O-A), high pump temperature indicator, high water level indicator with reset, high water level alarm (audible and visual) with silence button, elapsed time meter, motor starter

and overload relay. Separate circuit breakers shall also be provided for each pump and auxiliary device.

2.5.2 Pump operation shall be controlled by level floats in the wetwell as shown in the Lincoln County Public Works Details. The pump shall start when the water level in the wetwell reaches the pump on float elevation. The pump shall stop when the water level in the wetwell reaches the pump off level. The lag pump shall start when the water level in the wetwell reaches the lag pump on float elevation. The high level alarm shall start when the level in the wetwell reaches the ENGINEERS design elevation.

2.6. Fencing: Section 02831.

2.7. Pump Hoist: Shall consist of a boom and winch assembly with a minimum capacity of 2 times the weight of specified pump and motor. The hoist assembly must be removable from a mounting base permanently attached to the wetwell. The hoist shall be stainless steel construction containing 30 feet of stainless steel cable and safety hook, having a 24-inch minimum with enclosed gears and a 4:1 ratio. The pump hoist shall be a Thern Stainless Steel, Series 5124 portable davit crane, capacity to 2000 lbs., with a M3 model stainless steel winch, a 304 stainless steel wire rope for the ENGINEER designed length, and a stainless steel pedestal base installed to manufacturer's specifications.

3. HANDLING AND INSTALLATION

3.1. Handling: All equipment shall be carefully handled and protected from damage while in storage and during installation. Equipment shall be protected from the weather at all times. Equipment damaged by the weather, handling or construction shall be immediately repaired or replaced to the ENGINEER's and/or Lincoln County Public Works' satisfaction.

3.2. Installation: Equipment shall be installed in strict accordance with the manufacturer's instructions and approved shop drawings. All anchor bolts, piping, valves and appurtenances required for a complete installation shall be provided.

3.3. Excavation, Backfilling, and Compacting of Pumping Station
All excavation, backfilling and compaction for the pumping station shall be done in accordance with Section 02222 of these specifications.

3.4 Access Road and Parking Area
All construction of the indicated road and parking area shall be installed in accordance with Section 02512 of these specifications.

3.5. Fencing
All fencing installation shall be installed in accordance with Section 02831 of these specifications.

3.6. Electrical Work
All electrical installation work shall be done in accordance with the requirements of Division No. 16 of these specifications.

4. SERVICE
Equipment manufacturer shall furnish all instructional and assistance necessary for proper installation and operation of all equipment specified herein and in related sections. After installation, a qualified service representative of the equipment manufacturer shall inspect the complete installation, make adjustments as needed and place the equipment in permanent

operation. Field tests shall be performed with the ENGINEERs and a representative of Lincoln County Public Works present to insure proper operation.

After assured of proper performance the service representative shall review with Lincoln County Public Works and the ENGINEER the equipment installed demonstrating the operating methods and standard maintenance practices for the equipment installed.

4.1 Shop Drawings shall be submitted to the ENGINEER. ENGINEER shall obtain approval of shop drawings from Lincoln County Public Works before approving the shop drawings. Shop drawings shall include:

4.1.1 Outline drawings showing equipment and shipping dimensions and weights, location of accessories, and clearances required.

4.1.2 Certified factory test and characteristic curves showing field performance for each pump.

4.1.3 Wiring and schematic diagrams including accessories.

4.1.4 Spare parts list.

4.2 Service Manual two copies shall be furnished to Lincoln County Public Works for all mechanical equipment specified in this section. The manual shall contain a description of the equipment, a complete accessory and parts list, and complete installation, operation and maintenance instruction.

END OF SECTION

LINCOLN COUNTY STANDARD SPECIFICATIONS
SECTION 11309
SEWAGE GRINDER PUMPING STATION

1. **DESCRIPTION:** Contractors/plumbers shall furnish all labor, materials, equipment and supplies and shall perform all work necessary for the complete installation of sewage grinder pumping stations in Lincoln County. A complete system for each individual residence shall be provided by a single manufacturer to ensure compatibility of the equipment and single source responsibility for the equipment. In addition, a Subdivision Developer shall ensure that all pumps within a given subdivision are compatible within the County low pressure sewer system. All contractors/plumbers shall be approved by Lincoln County Public Works for the installation of grinder pump systems covered by these specifications.

2. **MATERIALS:** All pumping station materials shall be new and shall be furnished by the Contractor/Plumber in accordance with the following requirements:

2.1. New Installations: Contractors shall furnish a grinder sewage pump conforming to the following:

2.1.1. Pump Construction: Each pump shall have a recessed type impeller, an integrally built in grinder unit and submersible type motor. Grinder assembly shall consist of a grinder impeller and a shredding ring. The impeller shall be of the recessed "Tornado" type to provide an open unobstructed passage through the volute.

2.1.2. Pump Performance: Each pump must have the necessary characteristics and be properly selected to perform under the following operating conditions:

Capacity(GPM)	TDH(feet)
0	100
15	88-90

2.1.3. Motors: Each pump shall have a U/L listed, hermetically sealed, submersible type, electric motor of the following specifications:

HP	2
RPM	3500
Voltage/Phase/Hrtz	240/1/60

The motors shall be designed for use in hazardous locations and for general use in pumping sewage. The motor shall have thermal overload protection.

2.1.4. Pump Control Panel: The pump control panel shall be provided as specified in a UL labeled NEMA 4X weather-proof enclosure. A high-water level alarm sensor with a visible and audible alarm shall be provided. The audible alarm shall be equipped with silence and reset switches.

2.2. Wetwell: Shall be constructed of fiberglass reinforced plastic, high density polyethylene, concrete or other approved material suitable for wastewater applications. The wetwell shall be designed to resist uplift resulting from buoyant forces calculated with groundwater table at finished grades.

2.3 Force Main: The force main shall be constructed of 1-1/2" Schedule 40 PVC pipe from the wetwell discharge to the service connection box located on the property line. The pipe shall be installed with as few bends as possible and no bends sharper than 45 degrees. The force main shall be installed with a minimum of 18" of clean backfill.

2.4. Maintenance and Repair: Contractors/Plumbers shall be approved by Lincoln County Public Works before providing maintenance and repair services. These services shall be provided in accordance with these specifications to maintain or restore pumping station to a like new, fully operating condition. Maintenance and repair work shall be warranted for a period of one year from the date of service.

3. HANDLING AND INSTALLATION:

3.1. Handling: All equipment shall be carefully handled and protected from damage while in storage and during installation. Equipment shall be protected from the weather at all times.

3.2. Installation: Equipment shall be installed in strict accordance with the manufacturer instructions and approved shop drawings by a trained installer. All anchor bolts, piping, valves and appurtenances required for a complete installation shall be provided. The installer shall be responsible for the complete installation of each grinder unit and shall guarantee proper operation of each unit. All new pump station installations shall include a 1-year warranty period from the day the pump station is placed in service. The warranty shall include all parts and labor.

4. **SERVICE:** The equipment manufacturer shall furnish all instruction and assistance necessary for proper installation and operation of equipment. After installation, a qualified service representative of the equipment manufacturer shall inspect the complete installation, place the equipment in permanent operation, instruct the Owner's personnel in operation and maintenance, and perform field tests to insure proper operation.

The local service representative or maintenance provider shall respond to calls for service within one (1) hour of receiving a call for service. Furthermore, the local service representative or maintenance provider shall maintain sufficient spare parts and spare pumps to provide replacement or repair within 24 hours of receiving a call for service. All work performed should carry a one year warranty. Lincoln County Public Works assumes no responsibility for pump service, installation, maintenance, or repair.

5. **PREQUALIFICATION:** Pump station suppliers/system installers shall have at least 25 installations of similar size. Pre-qualification information shall be submitted to Lincoln County Public Works by each supplier/system installer before work is performed.

5.1. Shop drawings shall be submitted to Lincoln County Public Works for approval and shall include:

5.1.1. Outline drawings showing equipment, location of accessories and clearances required.

5.1.2. Wiring and schematic diagrams including accessories.

5.1.3. A complete parts and spare parts list.

5.1.4. A complete 24-hour call for service personnel list with emergency contact information.

5.1.5. A complete list of qualified installers and service representatives with emergency contact information.

5.1.6. A certification letter which states that the unit meets the minimum requirements and that the local representative will keep and maintain a 10% minimum replacement inventory.

5.1.7. A certified factory pump performance curve for the specified unit based on the minimum requirements of this specification.

5.2. Service Manual shall be furnished for all equipment. The manual shall contain a description of equipment, complete accessory and parts list, and complete installation, operation and maintenance instructions. Two copies of the manual shall be submitted with the shop drawings.

5.3. If the equipment supplied deviates from this specification, the supplier shall provide a list of specific deviations from these specifications, including paragraph number and the nature of the deviation.

END OF SECTION

LINCOLN COUNTY STANDARD SPECIFICATIONS
SECTION 16231
PACKAGED ENGINE GENERATORS, DIESEL

1.1 General Requirements

It is the intent of this specification to secure emergency standby generators that have been prototype tested, factory built, production tested, site tested, of the latest commercial design, together with all accessories necessary for a complete installation as detailed in the specifications herein.

A. The equipment supplied shall meet the requirements of NFPA 70, National Electrical Code (latest version), along with applicable local and state codes and regulations.

B. All equipment shall be new from a firm which manufactures the generator and assembles the standby generator sets in the United States as a matched unit so that there is one-source responsibility for warranty, parts, and service through a local manufacturer's authorized distributor with factory-trained and certified service personnel.

C. Equipment shall meet the applicable UL standard(s) as a system or as component system parts as required by the local authority having jurisdiction.

1.2 Approved Manufacturers

Equipment and services required in this specification shall be provided by Detroit Diesel, Caterpillar, Kohler, or Olympian Power Systems. The system sizing shall be based on pumps and other loads the systems will be required to power. Equipment shall be provided that can adequately supply the loads indicated.

1.3 Submittals

Submittals to be included with the proposal shall include items A through D. Project close-out submittals shall include items E & F.

A. Six sets of submittal data shall include prototype test certification and specification sheets showing all standard and optional accessories to be supplied; schematic wiring diagrams; dimension drawings; and interconnection diagrams identifying by terminal number, each required interconnection between the generator set and a future automatic transfer switch. Submittal drawings shall clearly show equipment plan view dimensions and mounting details.

B. A mark-up copy of this specification with notations clearly showing all deviations and / or exceptions to these Specifications.

C. Voltage drop calculations under worst case motor starting for loads at each site as indicated on the plans.

D. A letter detailing local service capability and service response guarantee.

E. Four sets of operating and maintenance instruction manuals shall be supplied for the engine, generator, governor, voltage regulator, and auxiliary system components as specified herein.

F. Testing Results.

1.4 To assure that the equipment has been designed and built to the highest reliability and quality standards, the manufacturer and local representative shall be responsible for three separate tests: design prototype tests, final production tests, and site tests.

A. Design Prototype Tests: The engine / generator set and accessories shall not be subjected to prototype tests since the tests are potentially damaging. Rather, similar design prototypes and pre-production models, which will not be sold, shall have been used for the tests. Testing shall be performed to nameplate ratings and prototype test programs shall include the requirements of NFPA 110 and the following:

1. Maximum power (kW).
2. Maximum motor starting (kVA) at 25% instantaneous voltage dip.
3. Alternator temperature rise by embedded thermocouple and by resistance method per NEMA MG1-22.40.
4. Governor speed regulation under steady-state and transient conditions.
5. Voltage regulation and generator transient response.
6. Fuel consumption at 1/4, 1/2, 3/4, and full load.
7. Harmonic analysis, voltage waveform deviation, and telephone influence factor.
8. Three-phase short circuit tests.
9. Alternator cooling air flow.
10. Torsional analysis testing to verify that the generator set is free of harmful torsional stresses.
11. Endurance testing.

B. Final Production Tests: Each generator set shall be tested under varying loads with guards and exhaust system in place. Testing shall be performed to nameplate ratings and tests shall include:

1. Single-step load pickup.
2. Transient and steady--state governing.
3. Safety shutdown device testing.
4. Voltage regulation.
5. Rated Power.
6. Maximum Power.
7. Upon request, arrangements to either witness these tests will be made, or certified test records shall be sent to the Owner prior to shipment.

C. Site Tests: Installation check, start-up, and load bank tests shall be performed by the manufacturer's local representative. Lincoln County Public Works, ENGINEER, regular operators, and the maintenance staff shall be notified of the time and date of the site tests. Provide necessary fuel for testing. The tests shall include:

1. Fuel, lubricating oil, and antifreeze shall be checked for conformity to the manufacturer's recommendations, under the environmental conditions present and expected.
2. Accessories that normally function while each set is standing by shall be checked prior to cranking the engines. These shall include: block heaters, battery chargers, generator strip heaters, etc.
3. Start-up under test mode to check for exhaust leaks, path of exhaust gases outside buildings, cooling air flow, movement during starting and stopping, vibration during running, normal and emergency line-to-line voltage, and phase rotation.
4. NFPA-110 testing with an external load bank connected to the system to load the generator to the nameplate kW rating with verification of single-step load pickup.
5. Perform automatic start-up by means of simulated power outage to test automatic starting, transfer of the load, and automatic shutdown. Engine coolant temperature, oil pressure, and battery charge level along with generator voltage, amperes, and frequency shall be monitored throughout the test.

1.5 Warranty and Service

A. The emergency generator systems shall be warranted individually for 1 year from the date of the site start-up to be free from defects in material and workmanship in accordance with the manufacturers published warranty. Optional 2-year and 5-year warranties shall be available upon request.

B. Service Contract: The engine-generator distributor shall furnish factory trained, certified, and warranted personnel and maintain a 24-hour parts and service capability, and show, at time of submittal, that they are regularly engaged in a maintenance contract program to semi-annually inspect and test run the engines to perform manufacturers recommended preventative maintenance service on the equipment furnished. This service agreement shall include operation of the equipment under simulated power failure conditions, adjustment of generator and switchgear controls as required, and certification in Lincoln County Public Works' maintenance log of repairs made and proper functioning of all engine and auxiliary systems. This service contract shall be provided at no additional charge to Lincoln County Public Works for a period of 2 years from date of start-up of the generator set. At Lincoln County Public Works' option, the service agreement shall be renewable on a year-to-year basis, thereafter, with the costs being paid by Lincoln County Public Works.

C. Service Response: A factory certified service shop with factory trained and certified personnel shall be located within a one hour radius of Lincoln County, North Carolina. Service response shall be guaranteed to be eight hours or less upon receipt of service call notification.

1.6 Equipment

A. The standby generator sets shall be rated continuous standby, __ kW / __ kVA, ____ /____ volts, __ phase, __ wire, 80% power factor, at 1000 feet altitude, 100°F:

(To be specified by Project Engineer).

B. Oversized alternators shall be provided as required for motor starting capability.

C. Each generator set shall be capable of starting motors indicated on the plans with a maximum voltage dip of 25%. Generators will power primarily motor loads with some miscellaneous loads. Maximum voltage dip shall be determined for worst case scenario.

D. Vibration isolators shall be provided between the engine-generators and heavy-duty steel bases.

1.7 Engine

Each engine shall operate at a governed speed of 1800 rpm. Each engine shall be equipped with the following:

A. Engine-driven or electric fuel transfer pump capable of lifting fuel 4.7 feet, fuel filters, and a fuel distribution system with an electronic isochronous governor capable of +/-0.5% steady-state frequency regulation over an operating temperature range of -40°C to +85°C.

B. Cast iron sleeved cylinders.

C. 2 flexible fuel lines with single wire braid sheath, rated 300°F and 100 psi ending in pipe thread.

D. 12-Volt positive engagement solenoid shift-starting motor.

E. Automatic battery charging alternator with solid-state voltage regulation, 25-ampere minimum.

F. Battery(ies) capable of delivering the manufacturer's recommended minimum cold-cranking amps required at 0°F, per SAE standard J-537 shall be supplied along with the required battery rack(s) and battery cables mounted within the generator weather protective housing.

G. 10-Ampere automatic float and equalize battery charger mounted inside the weather protective housing with +/-1% constant voltage regulation from no load over +/-10% AC input line variation, current limited during engine cranking and short circuit conditions, temperature compensated for ambient conditions from -40°C to 60°C, 5% accurate voltmeter and ammeter, fused, reverse polarity and transient protected. Alarm circuit board for low battery voltage, high battery voltage,

and battery charger malfunction shall be provided and wired to provide annunciation on the control panel. Battery charger shall be 3rd party listed.

H. Positive displacement, full pressure lubrication oil pump, cartridge oil filters, dipstick, and oil drain.

I. The generator set supplier shall furnish lubricating oil to fill the crankcase as recommended by the manufacturer.

J. Dry-type replaceable air cleaner elements for heavy-duty application.

K. Each naturally aspirated or turbocharged engine shall be fueled with No. 2 diesel, liquid-cooled by a unit-mounted radiator. Blower fan, water pump, thermostat, and radiator duct flange shall properly cool the engines in 105°F ambient with up to 0.5 inches H_2O static pressure on the fan. Radiator shall include a duct flange adapter for connection to the discharge air vent.

L. The generator set supplier shall furnish 50% ethylene glycol antifreeze solution to fill the engines cooling system.

M. Block heater: Thermostatically controlled to maintain engine coolant at not less than 90°F in a 32°F ambient. Block heater(s) shall be 3rd party listed. Coordinate branch circuitry requirements of block heaters with installing contractor.

N. Gas proof, stainless steel, flexible exhaust bellows with threaded NPT or flanged connections shall be supplied.

O. Critical grade exhaust silencer(s) shall be coated to be temperature and rust resistant with integral condensate drain. Exhaust silencers shall limit noise to 85 dBA at 10'.

P. Each engine shall be equipped with prealarm switches and safety shutdown switches to protect the engines from the following:

1. Low oil pressure prealarm.
2. High coolant temperature prealarm.
3. Low coolant temperature prealarm.
4. Low oil pressure shutdown.
5. High coolant temperature shutdown.
6. Low coolant level shutdown.

1.8 Generator

A. The alternator shall be salient-pole, brushless, 12-lead reconnectable, of 2/3 pitch to eliminate the third harmonic, self-ventilated of drip-proof construction with amortisseur rotor windings and skewed for smooth voltage waveform. The insulation shall meet the NEMA standard (MG1-22.40) for Class H and be vacuum impregnated with epoxy varnish to be fungus resistant per MIL 1-24092. Temperature rise of the rotor and stator shall be limited to NEMA Class F, 130°F / 40°C. The excitation system shall be of brushless construction controlled by a solid-state voltage regulator located in the controller.

1. The voltage regulator must be capable of maintaining voltage within +/- 1% at any constant load from 0 to 100% of rating. The regulator must be isolated to prevent tracking when connected to SCR loads, and provide individual adjustments for voltage range, stability, and volts-per-hertz operation, and be protected from the environment by conformal coating.
2. Voltage level adjusting rheostat shall be furnished external to the automatic voltage regulator. Minimum adjustment range shall be +/-10%.

B. Upon 1-step application of any load up to 100% of the rated load at 0.8 power factor, the voltage dip shall not exceed 20% and shall recover to +/- 2% of rated voltage within 1 second.

C. The generator shall be capable of sustaining at least 250% of rated current for at least 10 seconds under a 3-phase symmetrical short by inherent design or by the addition of an optional current boost system.

D. A resettable line current sensing circuit breaker with inverse time versus current response shall be furnished which protects the generator from damage due to its own high current capability. This breaker shall not trip within the 10 seconds specified above to allow selective tripping of down-stream fuses or circuit breakers under a fault condition. This breaker shall not automatically reset, preventing restoration of voltage if maintenance is being performed. Field current-sensing breaker will not be acceptable.

E. Line circuit breaker rated for full load output of the generator unit or as indicated on the plans. Line circuit breaker shall not exceed the rating of the automatic transfer switch. Line circuit breaker shall be mounted in the generator set outlet box.

F. The generator, having a single maintenance-free bearing, shall be directly connected to the flywheel housing with a semi-flexible coupling between the rotor and the flywheel.

1.9 Fuel System

Sub-base tank, 3rd party listed, dual wall, minimum capacity for 72 hours runtime at full load. Tank shall be equipped with overfill protection, lockable fuel filler cap, tank rupture alarm, fuel line check valve, fuel level gauge, low fuel level alarm contact, low fuel level shutdown contact, leak detection contact, and fittings for fuel supply, return, fill and vent. Tanks larger than the minimum capacity specified are acceptable. The tank shall feature all welded construction and have the structural integrity to support the genset, accessories, and the weather-protective enclosure. Installer shall provide a full tank of fuel with each installation. Fuel tank shall be full prior to acceptance by Lincoln County Public Works.

1.10 Enclosure

Drip-proof, weather-protective enclosure shall be constructed of prepainted 14 gauge aluminum alloy to provide superior corrosion resistance. The enclosure shall be fabricated and mounted to the sub-base fuel tank prior to delivery. The enclosure roof shall be peaked to direct water run-off.

A. Two doors per side and one rear door shall be provided for operator and service access. Hinges shall allow the doors to swing open or be removed easily for access and service. Door locks shall be stainless steel, all units keyed alike.

B. Critical grade silencer shall be mounted on top of the enclosure with exhaust piping directed downstream of the radiator discharge air flow. Engine exhaust gases shall discharge through a screened opening.

C. Cooling and combustion air shall enter the enclosure through louvers sized adequately for sufficient air. Cooling air shall discharge through a screened opening.

1.11 Controller

A. Standards: Controller shall be listed in compliance with UL508 and meet the requirements of the NEC.

B. Operating conditions:

1. Environment:
   a. Temperature: -40°C to +70°C operating range.
   b. Humidity: 5-95%, non condensing.
2. The controller must be usable on 12- or 24-volt starting systems.

3. Mount the controller on the generator set and provide vibration isolation for the controller with the ability to mount in any of 4 orientations no higher than 60" above grade. It shall be possible to mount the controller remotely within 40 feet of the generator set.

C. Equipment requirements:

1. A run-off/reset-auto three-position selector switch.
2. A latch type emergency stop push button.
3. Alternator output voltage adjustment.
4. Five indicating lights:
   a. System ready (green).
   b. Not in auto (yellow).
   c. Programming mode (yellow).
   d. System warning (yellow).
   e. System shutdown (red).
5. Lighted display with two lines of 20 alphanumeric characters for messages.
6. Sixteen position snap action sealed keypad for menu selection and data entry.
7. An operating guide on the controller faceplate.
8. An audible alarm.

D. Control functional requirements:

1. Field programmable time delay for engine start. Adjustment range, 0-5 minutes in 1 second increments.
2. Field programmable time delay engine cool down. Adjustment range, 0-10 minutes in 1 second increments.
3. Real time clock and calendar for time stamping of events.
4. Programmable cyclic cranking that allows up to six crank cycles and up to 45 seconds of crank time per crank cycle.
5. The controller firmware shall provide alternator protection for overload and short circuit matched to each individual alternator and duty cycle.
6. A ± 0.25% digital voltage regulator must be incorporated into the controller software.
7. It shall be possible to exercise the generator by programming a running time into the controller.

E. Generator system monitoring requirements:

1. All monitored functions shall be viewable on the digital display.
2. The following generator functions shall be monitored:
   a. Output voltages - single phase, three phase, line to line, and line to neutral, 0.25% accuracy.
   b. Output currents - single phase and three phase, 0.25% accuracy.
   c. Output frequency, 0.25% accuracy.
   d. Power factor by phase with leading/lagging indication.
   e. Total instantaneous loading and per phase loading (kW & kVA), 0.5% accuracy.
3. The following engine parameters shall be monitored:
   a. Coolant temperature.
   b. Oil pressure.
   c. Battery voltage.
   d. RPM.
   e. Lube oil temperature*.

f. Lube oil level*.
g. Crankcase pressure*.
h. Coolant level*.
i. Coolant pressure*.
j. Fuel pressure*.
k. Fuel temperature*.
l. Fuel rate*.
m. Fuel used during the last run*.
n. Ambient temperature*.

(* Required for ECM [engine control module] equipped engines only.)

4. Permanent operational records stored from start-up in the controller:
   a. Run time hours.
   b. Run time loaded.
   c. Run time unloaded.
   d. Number of starts.
   e. Factory test date.
   f. Last run data including date, duration, and whether loaded or unloaded.
   g. KW hours.
5. Operational records available in a resettable form:
   a. Run time hours.
   b. Run time loaded.
   c. Run time unloaded.
   d. Number of starts.
   e. KW hours.
   f. Days of operation.
   g. Start date after reset.
6. The following information shall be stored in the controller and displayed on demand:
   a. Manufacturer's model and serial number.
   b. Battery voltage.
   c. Generator set kW rating.
   d. Rated current.
   e. System voltage.
   f. System frequency.
   g. Number of phases.
7. The controller shall store the last one hundred generator system events with date and time of the event.
8. The controller shall be capable of detecting the following shutdown conditions and annunciate the situation, using words and phrases, on the digital display:
   a. Customer programmed digital auxiliary input ON (any of the 21 inputs available).
   b. Customer programmed analog auxiliary input out of bounds (any of 7 inputs for ECM equipped engines and 5 inputs for non ECM engines).
   c. Emergency stop.
   d. High coolant temperature.
   e. High oil temperature.
   f. Controller internal fault.
   g. Locked rotor - fail to rotate.
   h. Low coolant level.
   i. Low oil pressure.
   j. Master switch error.
   k. NFPA common alarm.
   l. Overcrank.

m. Overspeed with user adjustable level, range 65-70 Hz on 60 Hz systems and 55-70 Hz on 50 Hz systems.
n. Generator overvoltage with user adjustable level, range 105% to 135%.
o. Overfrequency with user adjustable level, range 102% to 140%.
p. Uunderfrequency with user adjustable level, range 80% to 90%.
q. Generator undervoltage with user adjustable level, range 70% to 95%.
r. Coolant temperature signal loss.
s. Oil pressure gauge signal loss.

9. The controller shall be capable of detecting the following warning conditions, but leave the generator running and annunciate the situation, using words and phrases, on the digital display:
   a. Battery charger failure.
   b. Customer programmed digital auxiliary input on (any of the 21 inputs available).
   c. Customer programmed analog auxiliary input on (any of the 7 inputs available on ECM engines and 5 inputs for non ECM engines).
   d. Power system supplying load.
   e. Ground fault detected - detection by others.
   f. High battery voltage - Level must be user adjustable, range 14.5 to 16.5 volts for 12-volt systems and 29-33 volts for 24-volt systems.
   g. High coolant temperature.
   h. Loss of AC sensing.
   i. Underfrequency.
   j. Low battery voltage – level must be user adjustable, range 10-12.5 volts for 12-volt systems and 20-25 volts for 24-volt systems.
   k. Low coolant temperature.
   l. Low fuel level or pressure.
   m. Low oil pressure.
   n. NFPA common alarms.
   o. Overcurrent.
   p. Speed sensor fault.
   q. Weak battery.
   r. Alternator protection activated

F. Inputs and Outputs

1. Inputs:
   a. There shall be 21 dry contact inputs that can be user configured to shutdown the generator or provide a warning.
   b. There shall be 7 user programmable analog inputs for ECM engines (5 for non ECM engines) for monitoring and control:
      i. Each analog input can accept 0-5 volt analog signals.
      ii. Resolution must be 1 part in 10,000.
      iii. Each input can be programmed to provide up to 4 trip values – 2 warnings and 2 shutdowns.
      iv. It shall be possible to view the analog value on the display.
   c. It shall be possible to define each user-configured input using words or phases that will be viewable on the digital display.
   d. Additional standard inputs required:
      i. Input for an external ground fault detector. Digital display must show "ground fault" upon detection of a ground fault.
      ii. Reset of system faults.
      iii. Remote two wire start.

iv. Remote emergency stop.
v. Idle mode enable

2. Outputs:
   a. NFPA 110 Level 1 outputs shall be available.
   b. There shall be thirty outputs available for interfacing to other equipment:
      i. Any of these outputs shall be able to be user configured from a list of over 25 functions and faults.
      ii. These outputs shall drive optional dry contacts.
   c. A programmable user defined common fault output with over 40 selections shall be available.

G. System Programming

1. It shall be possible to disable programming so the system can only be monitored.
2. It shall be possible to program the controller with the controller keypad or using an IBM compatible personal computer.
3. Programming access is to be enabled only at the controller and shall be password protected.
4. The following shall be programmable from the controller keypad:
   a. Time delay settings:
      i. Generator run time (0 to 72 hours) – exercise.
      ii. Load shed.
      iii. Engine start.
      iv. Engine cool down.
      v. Overvoltage and undervoltage delays.
      vi. Starting aid.
      vii. Crank on and crank pause time.
      viii. Idle time.
   b. Trip point settings:
      i. High battery voltage.
      ii. Low battery voltage.
      iii. Overspeed.
      iv. Underfrequency.
      v. Overfrequency.
      vi. Overvoltage.
      vii. Undervoltage.
      viii. Load shed.

H. Communications

1. If the generator engine is equipped with an ECM (engine control module), the controller must communicate to the ECM for control, monitoring, and diagnostics. SAE J1939 standard communications is required.
2. Industry standard Modbus RTU communication shall be available:
   a. A Modbus master will be able to monitor controller data.
   b. A Modbus master will be able to alter parameters.
   c. The Modbus master must be capable of starting and stopping the generator.
3. The controller shall have the capability to communicate to a personal computer (IBM or compatible) running Windows '9X or Windows NT.
4. Both RS-232 and RS-485 communication formats shall be available.

1.12 Execution

Each generator set shall be shipped as a "single-source" item for which responsibility for overall maintenance, spare parts, and service is available through a local factory representative.

A. Delivery of permanent generators shall be to the project site. Delivery shall include mounting of all accessories specified elsewhere in this specification.

B. Testing shall be provided as specified in Site Tests above at each specific installation site. Lincoln County Public Works and the ENGINEER shall be notified seven days prior to testing for the option to witness the site tests.

END OF SECTION

LINCOLN COUNTY STANDARD SPECIFICATIONS
SECTION 16415
AUTOMATIC TRANSFER SWITCHES

1.1 General: It is the intent of this specification to secure automatic transfer switches (ATS) that have been prototype tested, factory built, production tested, and site tested, together with all accessories necessary for a complete installation as shown on the plans and drawings and specified herein.

A. Compliance With Codes and Standards: The ATS shall conform to the requirements of:

1. UL 1008--Standard for Automatic Transfer Switches.
2. NFPA 70--National Electrical Code, including use in emergency and standby systems in accordance with Article 700.
3. NFPA 110--Standard for Emergency and Standby Power Systems.
4. IEEE Standard 446--Recommended Practice for Emergency and Standby Power Systems (Orange Book).
5. IEEE Standard 241--Recommended Practice for Electric Power Systems in Commercial Buildings (Gray Book).
6. NEMA Standard ICS 2-447 Automatic Transfer Switches.

B. Each ATS shall consist of an inherently double-throw power transfer switch unit and a control module interconnected to provide complete automatic operation.

C. All equipment shall be new and of current production by a company that will assume responsibility for factory-backed and approved warranty, parts and service through a local representative with factory-trained personnel, with 24-hour response time.

1.2 Approved Manufacturers: ASCO, Russelectric, Spectrum, Zenith.

1.3 Submittals

A. Six sets of submittal data shall include specification sheets showing all standard and optional accessories to be supplied; schematic and wiring diagrams; dimension drawing;, and interconnection diagrams identifying by terminal number each required interconnection between the generator set and the transfer switch.

B. Four sets of operating and maintenance instruction manuals shall be supplied for the ATS and components as specified herein

1.4 Warranty and Service

Each ATS shall be warranted by the manufacturer for one year from the date of the site start-up to be free from defects in material and workmanship in accordance with the manufacturers published warranty. Where manufacturer's standard guarantees or warranties are written for a period of more than one year, at no additional cost to Lincoln County Public Works, such longer terms shall apply.

1.5 Mechanical Requirements:

A. ATS shall be furnished in a NEMA Type enclosure as indicated on the plans.

B. Mechanical lugs shall be provided for normal power input, backup power input, and load power output.

C. All moveable parts of the operating mechanism shall remain in positive mechanical contact with the main contacts during the transfer operation without the use of separate mechanical interlocks.

D. All main contacts shall be of silver composition.

E. All contacts, coils, springs, and control elements shall be conveniently removable from the front of the transfer switch without major disassembly or disconnection of power conductors.

1.6 Electrical Requirements:

A. Ratings: ____/____ volts, 4 poles, _____ amps. To be specified by Project Engineer.

B. Automatic transfer switches not intended for continuous duty or repetitive load transfer switching are not acceptable.

C. The ATS shall be rated in amperes for total system transfer including control of motors, electric-discharge lamps, electric heating, and tungsten-filament lamp load.

1.7 Transfer Switch Control System:

A. The control module shall direct the operation of the transfer switch. The module's sensing and logic shall be a built-in microprocessor-based system for maximum reliability, minimum maintenance, and inherent digital communications capability. The control settings shall be stored in nonvolatile EEPROM. The module shall contain an integral programmable clock and calendar. The control module shall have a keyed disconnect plug to enable the control module to be disconnected from the transfer mechanism for routine maintenance.

The control module shall be mounted separately from the transfer mechanism unit for safety and ease of maintenance. Interfacing relays shall be industrial control grade plug-in type with dust cover.

B. The control module shall include programming keypad, alpha-numeric display for monitoring settings and diagnostic values, key-lockable program selector switch, light-emitting diode status indication, and user instructions. These features shall be user accessible when the enclosure door is closed.

C. The control module shall be capable of storing the following records in memory for access either locally (at the control module) or remotely (at a computer):

1. Number of hours transfer switch is in the emergency position (total and since record reset).
2. Number of hours the emergency is available (total and since record reset).
3. Total days that control has been energized (total and since record reset).
4. Total transfers in either direction (total and since record reset).
5. Date of record reset.

6. Date of last exercise period.
7. Date, time, and description of the last four source failures.
8. Elapsed time during the most recent source outage.

1.8 Operation:

A. Source Voltages:

1. The voltage of each phase of the normal source and a single phase of the emergency source shall be monitored with pickup adjustable from 75% to 100% and dropout adjustable from 70% to 95% of nominal. Adjustment must be digital.
2. An automatic minimum differential of 2% shall be maintained between pickup and dropout settings.
3. Repetitive accuracy of the setting shall be "2% or better over an operating temperature range of -20°F to 150°F.
4. The settings shall be fully field-adjustable by keypad or keyboard (local or remote) in increments of 1 Volt without opening the enclosure door and without the use of special tools or separate meters.
5. Factory settings shall be pickup at 90% and dropout at 85%.
6. A light-emitting diode shall indicate that normal and/or emergency voltage is within the set point parameter. The indication shall be viewable when the enclosure door is closed.

B. Time Delays:

1. The control module shall include time delays that are fully field-adjustable by keypad or keyboard in increments of 1 second over the entire range.
2. Adjustments and viewing of the time delay values shall be accessible when the enclosure door is closed.
3. Light emitting diodes shall indicate when the timing feature is running and when the time delay has ended.
4. Required Time Delays:
   a. Time delay for engine start to delay initiation of transfer for momentary source outages: Range 0-60 seconds. Factory set at 5 seconds.
   b. Time delay for transfer to emergency: Range 0-30 minutes. Factory set at 15 minutes. Coordinate setting of this time delay for each site with the Owner.
   c. Time delay for transfer back to normal: Range 0-30 minutes. Factory set at 15 minutes. Coordinate setting of this time delay for each site with the Owner.
   d. Time delay for engine cool down: Range 0-30 minutes. Set time shall be 5-minutes.
   e. Time delay for neutral load: Range 0-60 seconds.
5. Input values outside the allowable parameters shall cause a "range error" message to be displayed.

C. The user shall have the ability to manually program an engine start and run for a period of up to 72 hours in the loaded or unloaded mode of operation. The time delay transfer to emergency and/or normal may be bypassed during the run period. A numeric indication shall be displayed of the run time remaining in hours and minutes. The run period may be stopped at any time with a single key- stroke. After the run period has stopped, the engine shall run unloaded for the cool-down time.

D. User terminals shall be available to:

1. Connect a normally closed contact that, when opened, signals the control module to start and transfer load to the engine-generator. Closing this contact shall initiate a retransfer and engine cool down sequence.
2. Monitor an external normally open contact that, when closed, signals the control module via the ATS to start and transfer load to the engine-generator. Opening this contact shall initiate a retransfer and engine cool-down sequence. This feature would be used to monitor an external peak shaving controller, for example.

The load shall transfer to an available utility source immediately upon failure of the generator source.

E. The following features shall be built into the control module logic. These features shall be enabled at the factory or in the field by installing an insulated program jumper provided by the vendor as standard.

1. Extended Time Delay: Allows the time delay settings to be extended to 99 minutes.
2. Plant Exerciser: Programmable seven day, fourteen day or calendar exerciser. Each exerciser mode shall be capable of performing up to two exercise runs in up to five exercise event periods. The exerciser period shall be programmed with the enclosure door closed. The exercise time may be reset at any time with a single key stroke. The engine shall be allowed to run when the exercise period is terminated.
3. All phases of normal and all or single phases of emergency shall be monitored for over voltage and single phase of normal and emergency for over- and under-frequency. The values shall be programmed with the enclosure door closed.
4. Anti-single phasing protection shall detect regenerative voltage as a failed source condition.
5. In-phase monitoring shall continuously monitor the contactor transfer times, source voltage, frequency and phase angle to provide a self-adjusting, zero crossing contactor transfer signal.
6. Manual operation override shall function to bypass any manual switch accessories if the source to which the transfer switch is positioned fails. This program jumper shall be factory installed.

F. Status Indicators: Light-emitting diodes shall indicate the status of the following:

1. Contactor Position.
2. System Status:
   a. Transfer Switch Position Sensing Fault.
   b. Transfer Switch Fail to Transfer.
   c. Internal Control Module Fault.
   d. Manual Transfer Operation.
   e. External Fault Condition (two inputs).
   f. Not In Automatic.
   g. Programming Switch Not In Off.

   The system status messages shall also be shown on the alpha-numeric display.
3. Accessory Active:
   a. Plant Exerciser.
   b. In-Phase Monitor.

c. Area Protection.

4. A lamp test push button shall light all light-emitting diodes.

G. The control module shall have a three-position, key-operated, programming control switch. The key shall be removable in any position. The positions shall be:

1. Off--Allows all enabled accessories to be monitored only. Settings cannot be changed while in this position.
2. Local--Allows all enabled accessory settings to be changed by local keypad entry.
3. Remote--Allows all enabled accessories to be altered via the remote communications port.

H. A momentary-type test switch shall be provided to simulate a normal source failure.

I. A set of gold-flashed contacts rated 10 amps, 28VDC shall be provided for a low-voltage engine start signal when the normal source fails.

1.9 Withstand Ratings:

A. The ATS shall be rated to withstand available RMS symmetrical short-circuit current at the ATS terminals with the type of overcurrent protection shown on the plans.

B. The control panel shall meet or exceed the voltage surge withstand capability in accordance with IEEE Standard 472-1974 (ANSI C37.90a-1974) and the impulse withstand voltage test in accordance with the proposed NEMA Standard ICS 1-109. The control panel shall conform to the test requirements of UL 991 for transient overvoltage, electromagnetic susceptibility, and electrostatic discharge.

1.10 Test and Certification: All production units shall be subjected to the following factory tests:

A. The complete ATS shall be tested to ensure proper operation of the individual components and correct overall sequence of operation and to ensure that the operating transfer time, voltage, frequency and time delay settings are in compliance with the specification requirements.

B. The switch shall be subjected to a dielectric strength test per NEMA Standard ICS 1-109.21.

1.11 Manufacturer's Responsibility:

A. The supplier shall provide the services of a field technician to test and adjust the system for satisfactory operation. The supplier shall be factory warranted and trained to work the complete system.

B. Lincoln County Public Works shall have the option of witnessing the testing of the equipment. Notification shall be provided one week prior to the test.

END OF SECTION