City of Grovetown
Water Pollution Control Plant - Phase II
Job No. 141946
Bid Set No. 19

BID DOCUMENTS, CONTRACT DOCUMENTS

and

CONSTRUCTION SPECIFICATIONS

for

CONSTRUCTION OF

SEWERAGE SYSTEM IMPROVEMENTS

WATER POLLUTION CONTROL PLANT – PHASE II

for the

CITY OF GROVETOWN, GEORGIA

Elected Officials
Gary Jones, *Mayor*
Eric Blair
Vickie Cook
Sylvia Martin
Dennis Trudeau

Shirley Beasley, *City Administrator*
Mike Woods, *Public Works Director*
Raymond Fulcher, *Operations Manager*

JANUARY 2017
(REVISED MAY 2017)
PROJECT NO. 141946
FUNDING: GEFA CLEAN WATER SRF

GBT
G. BEN TURNIPSEED ENGINEERS
Environmental - Civil - Hydraulic
ATLANTA · AUGUSTA · ST. SIMONS ISLAND

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Prepared by:

G. BEN TURNIPSEED ENGINEERS
Environmental-Civil-Hydraulic
ATLANTA · AUGUSTA · ST. SIMONS ISLAND
770-333-0700 - 706-863-8800

ADVERTISEMENT FOR BIDS FOR CONSTRUCTION OF
SEWERAGE SYSTEM IMPROVEMENTS
WATER POLLUTION CONTROL PLANT – PHASE II
for the
CITY OF GROVETOWN, GEORGIA

Sealed proposals will be received by CITY OF GROVETOWN, GEORGIA at the City Hall, 103 Old Wrightsboro Road, Grovetown, Georgia 30813-3015, until _____ local time, _____, at which time and place they will be publicly opened and read. No submitted bid may be withdrawn after the scheduled closing time for receipt of bids for a period of sixty (60) days.

All Bidders must have a State of Georgia Utility Contractor License and must employ a state "Utility Manager" certificate holder who will have oversight of all the work.

Work to be done: The work to be done consists of furnishing all materials, equipment and labor for the construction of a new Water Pollution Control Plant – Phase II. Construction includes:

> Sequencing batch reactors, tertiary filters, ultraviolet disinfection system, effluent pump station, plant pump station, digester, sludge dewatering building, blower / maintenance building, chemical feed structure, control building and standby generator, all complete with appurtenances. Time allotted for construction is 450 consecutive calendar days for substantial completion and 480 consecutive calendar days for final completion.

Proposals for the complete work in one general contract shall be made on the proposal form provided and shall contain prices in words and figures for the work bid on.

The project is proposed to be funded with a State Revolving Fund loan. All SRF and American Iron and Steel Special Conditions requirements apply.

All proposals shall be accompanied by a Bid Bond drawn in favor of GROVETOWN, GEORGIA, in the amount of at least 10% of the lump sum bid for the complete work; such Bid Bond representing that the Bidder, if awarded the contract, will promptly enter into a contract and furnish Performance Bond and Payment Bond as provided by law and approved by the Attorney for GROVETOWN, GEORGIA. Each bond shall be equal to 100% of the contract amount. The Bid Bond shall be forfeited to GROVETOWN, GEORGIA as liquidated damages if the Bidder fails to execute the contract and provide Performance and Payment Bonds within 10 days after being notified that he has been awarded the contract.

Drawings and Specifications are open to public inspection at the office of the CITY OF GROVETOWN; at the offices of G. Ben Turnipseed Engineers, Inc., in Augusta and Atlanta, Georgia and the Atlanta Builders Exchange in Atlanta.

Copies of the plans and specifications may be obtained from G. Ben Turnipseed Engineers, Inc., 2255 Cumberland Parkway, Building 400, Atlanta, Georgia 30339, upon receipt of $650.00. Additional reduced drawings are available for $500.00, and the soils report is available for $35.00.

Digital copies of the documents are not available.

Upon receipt of all documents in undamaged condition within 30 days after the date of opening of bids, ½ of the deposit will be refunded.

The difference between the deposit and the amount refunded represents the cost of reproduction. No refund will be made for documents received after 30 days or in damaged condition.

The Owner reserves the right to reject any or all bids and to waive informalities.

CITY OF GROVETOWN, GEORGIA

By: _____

Gary Jones, *Mayor*

INSTRUCTIONS TO BIDDERS

1. INTENTION: It is intended that the Project Documents shall cover the complete work to which they relate.

2. DEFINITION: Where the following words, or the pronouns used instead, occur herein, they shall have the following meaning:

   "Owner" shall mean the **CITY OF GROVETOWN, GEORGIA**, party of the first part to the "Contract Agreement" or its authorized and legal representative.

   "Engineer" shall mean G. Ben Turnipseed Engineers, Inc. of Atlanta, Georgia acting for the Owner or other representative of such party.

   "Contractor" shall mean the party of the second part to the following agreement, or the legal authorized representatives of such party.

3. WORK TO BE DONE: The work to be done consists of furnishing all materials, labor and equipment for construction of SEWERAGE SYSTEM IMPROVEMENTS, WATER POLLUTION CONTROL PLANT – PHASE II, JANUARY 2017 (REVISED MAY 2017) complete with appurtenances, for the CITY OF GROVETOWN, GEORGIA, all as set forth in the Proposal, as specified herein, and as shown on the Drawings.

4. MATERIAL AND WORK BY THE OWNER: The Owner will neither furnish materials nor perform labor for construction of work under this contract, unless otherwise stipulated elsewhere in the Project Documents.

5. SITE EXAMINATION: The Bidder is expected and requested to examine the location of the work and to inform himself fully as to the structural and mechanical conditions; the conformation of the ground; the character, quality and quantity of the materials to be encountered; the character of equipment and facilities needed preliminary to and during the execution of the work; the general and local conditions; and all other matters which can in any way affect the work to be done under the contract.

   The Supplementary General Conditions identify any reports known to Owner of explorations and tests of subsurface conditions at or adjacent to the Site.

6. PROPOSALS: All Proposals must be made upon the Proposal forms provided and shall be for materials and work called for in the Specifications and shown for each item in the Proposal. The total amount bid for the work in the Proposal shall be given in words and figures in the spaces provided. Proposal forms shall not be detached from these Specifications. All blank spaces in the bid form shall be filled in with black ink in words and figures. The Certification must be completed and executed when submitted.

   A. Unit Price Items: The itemized quantities given in the Proposal for unit price work shall be considered by the Contractor as the quantities required to complete the work. Should the actual quantities required in the construction of the work be greater or less than the quantities shown in the items, an amount equal to the difference in quantities at the unit prices bid for the item will be added to or deducted from the contract price.

B. Lump Sum Price: Where itemized prices are not given in the Proposal, the Contractor shall consider the lump sum prices bid for the work shown on the Drawings and/or specified to be sufficient for completion of his Contract.

C. Total Amount Bid: The correct total amount bid is defined as the correct sum total of the amount bid for the items in the Proposal. The correct amount bid for each unit price item is defined as the product of the quantity listed in the Proposal for the item, multiplied by the unit price bid.

D. The bids must be enclosed in a sealed envelope addressed to the **CITY OF GROVETOWN, GEORGIA, 103 OLD WRIGHTSBORO ROAD, P.O. BOX 120, GROVETOWN, GEORGIA 30813-0120** and marked "Proposal for **SEWERAGE SYSTEM IMPROVEMENTS, W – PHASE II,** for the **CITY OF GROVETOWN, GEORGIA.**" **Georgia Utility Contractor License must be written on the outside of the envelope.** ***Bids must be submitted intact in this Book.***

7. BID SECURITY: Each Proposal must be accompanied by a certified check or by a Bid Bond in an amount equal to not less than 10% of the amount of the Bid, to guarantee that the Successful Bidder will, within 10 days from the date of the notice of award of contract, enter into an Agreement with the Owner, and execute to the Owner a Performance Bond and Payment Bond, each equal to 100% of the contract amount, the agreement and bonds to be in the form set forth in this Book. If for any reason whatsoever the Bidder withdraws from the competition after the Bid opening time, or refuses to execute the required agreement and bonds, if his Bid is accepted, the Owner may retain the amount of the certified check, or proceed on the Bid Bond. The surety on the Performance Bond and the Payment Bond shall be a surety company authorized to do business in the State of Georgia and shall be countersigned by an agent residing in the State of Georgia. The bonds and surety thereon, shall be subject to approval by the Attorney for the Owner.

8. NON-COLLUSION AFFIDAVIT OF BIDDER: The Contractor is required to execute an affidavit (Page NCA-1) verifying that neither the Contractor nor any representative thereof has colluded or conspired, directly or indirectly, in connection with the attached Bid.

9. RECEIPT AND OPENING OF BIDS: Proposals must be filed with the Owner at or before the hour specified in the advertisement, and proposals filed after the specified time will not be considered. Proposals sent by mail must be mailed with sufficient time allowed for the proposal to reach the Owner prior to the opening of bids.

   The Owner may consider informal any bid not prepared and submitted in accordance with the provisions hereof and may waive any informalities or reject all bids. Any bid may be withdrawn prior to the above scheduled time for the opening of bids or authorized postponement thereof. Any bid received after the time and date specified shall not be considered. No bidder may withdraw a bid within sixty (60) days after the actual date of the opening thereof.
   Conditional bids shall not be considered.

   Bidders are requested to be present at the opening of Proposals which will be in public.

10. RIGHT TO REJECT BIDS: The Owner reserves the right to reject all Bids, and to waive informalities. No bids will be received after the Bid opening time. Unauthorized conditions, limitations and provisions attached to the Proposal, except as provided herein, will render it informal and cause its rejection. Unbalanced bids will be subject to rejection. Any Bidder may withdraw his bid, either personally or by telegraphic or written request, at any time prior to the Bid opening time.

11. TELEGRAPHIC MODIFICATION: Any bidder may modify his bid by telegraphic communication at any time prior to the scheduled closing time for receipt of bids, provided such telegraphic communication is received by the Owner prior to the closing time, and provided further, the Owner is satisfied that a written confirmation of the telegraphic modification over the signature of the bidder was mailed prior to the closing time. The telegraphic communication should not reveal the bid price but should provide the addition or subtraction or other modification so that the final prices or terms will not be known by the Owner until the sealed bid is opened. If written confirmation is not received within two (2) days from the closing time, no consideration will be given to the telegraphic modification.

12. DETERMINATION OF LOW BID: The contract will be awarded, if it is awarded, to the low, responsible, responsive bidder. The Owner will decide which is the low, responsible, responsive bidder. Responsiveness shall be defined by (a) the completeness and regularity of the Bid Form, (b) a bid form without exclusions or special conditions, and (c) a bid form having no substitute bids for any items except as allowed under these Specifications. Responsibility will be based on whether the Bidder involved (a) maintains permanent place of business; (b) has adequate plant equipment to do the work properly and within the time limit established; (c) has suitable financial status to meet obligations incident to the work; (d) has appropriate technical experience; and (e) has appropriate utility contracting license.

    A. The Bidder is requested to list prices of at least two manufacturers for each item of major equipment if listed on the Proposal form. Use lowest price for base bid. If the make of any item listed in the base bid column does not meet specifications, the next lowest priced make listed for that item which does meet specifications will be used in determining the lowest bid price. If all of the listed makes of the item failed to meet specifications, the bid will be rejected on the grounds that it is nonresponsive.

    B. The Owner has the right to apply any or all "Deductions or Additions" (if any) listed in the proposal by the Engineer for the purpose of making an award.

13. RETURN OF BID SECURITY: Owner will, within 10 days following the Bid opening, return the Bid security of all Bidders, except the Security posted by the three lowest Bidders; upon the award and execution of the contract, the remaining Bid securities will be promptly returned.

14. INTERPRETATION OF DRAWINGS AND SPECIFICATIONS: If any person contemplating submitting a bid for the proposed contract is in doubt as to the true meaning of any part of the Drawings, Construction Specifications and other documents, and as to the scope of any part of the work, he must submit to the Engineer a written request for an interpretation thereof. The person submitting the request will be

responsible for its prompt delivery in ample time for an interpretation to be issued before the Bid opening date. Interpretations of the Project Documents will be made only by Addendum; a copy of each Addendum will be mailed or delivered to each person receiving a set of the Project Documents. The Engineer will not be responsible for other interpretations of the Project Documents.

15. COMPLETE WORK REQUIRED: The Construction Specifications, Drawings, and all other documents are essential parts of the contract; requirements occurring in one are as binding as though occurring in all. Documents are intended to be cooperative, and to describe and provide for a complete work. In case of discrepancies on the Drawings, figured dimensions shall govern. In case of omissions from the Construction Specifications as to items of equipment, and materials or quantities therefore, the Drawings shall govern. It shall be the responsibility of the Bidder to call to the attention of the Engineer obvious omissions of those magnitudes, which would affect the strength, adequacy, function, completeness (and cost of any part of the work, and in ample time for amendment by Addendum prior to the Bid opening date).

16. SUBCONTRACTS: The Bidder's attention is directed to the General Conditions concerning subcontracts. The Bidder is specifically advised that any person, firm or other party to whom it is proposed to award a subcontract under this contract:

- Must be acceptable to the Owner. Approval will not be given until the Contractor submits to the Owner a written statement concerning the proposed award to the subcontractor, which statement shall contain such information as the Owner may require.
- Must provide insurance equal to that of the bidding contractor. Approval of the proposed subcontract award cannot be given by the Owner unless and until the proposed subcontractor has submitted the Certification and or other evidence showing that it has fully complied with any reporting requirements to which it is or was subject.
- Although the bidder is not required to attach such Certifications by proposed subcontractors to his bid, the bidder is here advised of this requirement so that appropriate action can be taken to prevent subsequent delay in subcontract awards.

17. DRAWINGS: The character, location, and essential details of the work are shown upon a set of Drawings entitled:

CITY OF GROVETOWN, GEORGIA

SEWERAGE SYSTEM IMPROVEMENTS

WATER POLLUTION CONTROL PLANT – PHASE II

JANUARY 2017 (REVISED MAY 2017)

The Drawings and Specifications shall form a part of the contract for the work. The Drawings shall be supplemented by working drawings as are necessary. All authorized alterations affecting the requirement and information given on the Drawings shall be in writing.

18. EXTRA WORK ITEMS IN PROPOSAL: The Proposal contains certain unit price items entitled "Extra Work If Ordered by Engineer." In each of those items, the estimated quantity is based upon the average amount of extra work encountered in a typical job. The stated quantities are not guaranteed to be required or not to be required, but are included in the Proposal in order to determine, in advance of construction, the actual low bidder. No work described by those items will be approved for payment without advance authorization by the Engineer.

19. NOTICE OF SPECIAL CONDITIONS: Attention is particularly called to those parts of the Contract Documents and Specifications which deal with the following:

    A. Inspection and testing of material

    B. Insurance requirements

    C. Wage rates (if applicable)

20. POWER OF ATTORNEY: Attorneys-in-fact who sign Bid Bonds or Contract Bonds must file with each bond a certified and effectively dated copy of their Power of Attorney.

21. AUTHORITY TO SIGN: If a Proposal is made by an individual, his name and Post Office address must be shown. If made by a firm, or partnership, the name and Post Office address of each member of the firm or partnership must be shown. If made by a Corporation, the person or persons, signing the Proposal must show the name of the State under the laws of which the Corporation is chartered and his or their, authority for signing same, and the names, titles and addresses of the President, Secretary and Treasurer, and the Corporate Authority for doing business in this state.

22. WORKING DRAWINGS: Working drawings for any structure shall consist of such detailed plans as may be required for the prosecution of the work but not included in the plans. All necessary-working drawings shall be furnished by the Contractor. They shall include shop details, erection plans, masonry layout diagrams, and bending diagrams for reinforcing steel, approval of which by the Engineer must be obtained before any work involving these plans may be performed. Plans for false work, centering, and form work may also be required and such cases shall be likewise subject to approval by the Engineer.

    It is expressly understood, however, that approval by the Engineer of the Contractor's working drawings does not relieve the Contractor of any responsibility for accuracy of dimensions and details. The Contractor shall be responsible for agreement and conformity of his working drawings with the Drawings and Specifications.

    The contract price shall include the cost of furnishing all working drawings and the Contractor will be allowed no extra compensation for such drawings.

23. COOPERATION OF CONTRACTOR: The Contractor will be supplied with 5 copies of the Drawings and Specifications. The Contractor shall have available on the work, at all times, 1 of each of said Drawings and Specifications. He shall give the work the constant attention necessary to facilitate the progress thereof and shall cooperate with the Engineer and with other contractors in every way possible. The Contractor shall at all times have a Superintendent, satisfactory to the Engineer, capable of acting as his agent on the work,

who shall receive instructions from the Engineer or his authorized representatives. The superintendent shall have full authority to execute the orders or directions of the Engineer without delay and to promptly supply such materials, tools plant equipment, and labor as may be required.

24. CONSTRUCTION STAKES: Subsidiary lines and grades shall be laid out by the Contractor from the controlling lines and benchmarks furnished by the Engineer or from measurements shown on the Drawings. All lines and grades shall be subject to checking by the Engineer, but this checking shall in no way relieve the Contractor from responsibility for their correctness.

    The Contractor shall provide such stakes, materials, and such labor and assistance as the Engineer may require in laying out work, establishing benchmarks and checking and measuring the work.

25. AUTHORITY AND DUTIES OF INSPECTOR: Inspectors shall be authorized to inspect all work done and materials furnished, including preparation, fabrication and manufacture of the materials to be used. The Inspector shall not be authorized to alter or waive any requirements of the Specifications. He shall call the attention of the Contractor to any failure of the work or materials to conform to the Specifications and Contract. He may reject materials or suspend the work until any questions at issue can be referred to and decided by the Engineer.

    The presence of the Inspector shall in no way lessen the responsibility of the Contractor. The Contractor in no way relieves himself of responsibility for adequacy of the work by following the directives of the Inspector.

26. INSPECTION: The Contractor shall furnish the Engineer with every reasonable facility for ascertaining whether or not the work performed and materials used are in accordance with the requirements and intent of the Specifications and Contract. No work shall be done or materials used without suitable supervision or inspection by the Engineer or his representative. Failure to reject any defective work or materials shall not in any way prevent later rejection when such defect is discovered, or obligate the Owner to final acceptance.

    All materials furnished and work done when not in accordance with the Specifications and Contract will be rejected and shall immediately be removed and other work done and materials furnished in accordance therewith. If the Contractor fails to remove the work and materials as above ordered, within 48 hours, then the Engineer shall have the right and authority to stop the Contractor and his work at once and to supply men and material at the cost and expense of the Contractor to remove said work and materials.

27. DEFECTIVE WORK AND MATERIALS: The inspection of the work shall not relieve the Contractor of any of his obligations to fulfill his Contract and defective work shall be made good, notwithstanding that such work and materials have been previously inspected by the Engineer and accepted or estimated for payment. The failure of the Engineer to condemn improper materials or workmanship shall not be considered as a waiver of any defect which may be discovered later, or as preventing the Owner at any time subsequently from recovering damages for work actually defective. All work shall be

guaranteed against defects in workmanship or materials for a period of one year after final acceptance.

28. CORRECTIONS: Should any portions of the Drawings and Specifications be obscure or in dispute, they shall be referred to the Engineer and he shall decide as to the true meaning and intent. He shall also have the right to correct any errors or omissions at any time when such corrections are necessary for the proper fulfillment of said Drawings and Specifications.

29. DISAGREEMENT: Should any disagreement or difference arise as to the estimated quantities or classifications or as to the meaning of the Drawings or Specifications, on any point concerning the character, acceptability and nature of the several kinds of work, any materials and construction thereof, the decisions of the Engineer shall be final and conclusive and binding upon all parties to the Contract.

30. WEATHER: During unseasonable weather, all work must stop when the Engineer so directs, and all work must be suitably protected.

31. RIGHT OF WAY: The necessary land for the construction of the work will be furnished by the Owner. The Contractor is directed to the Owner for right of way actually acquired. The Owner will provide no right of way over other property. The Contractor shall take every possible precaution to inconvenience as little as possible the owners and tenants of adjacent property. Public highways shall not be obstructed in such a way as to cut off traffic. The Contractor shall, at his own expense, repair any damage or injury to either public or private property during the progress of the work. Wholesale cutting of trees on the right of way will not be permitted except as necessary for construction.

32. CONSTRUCTION SCHEDULE: A construction schedule showing the work in the order proposed by the Contractor and the time required to complete each phase will be required and shall be submitted to the Engineer for approval at the preconstruction conference. Approval of the construction schedule is required prior to receipt of the notice to proceed. This schedule shall include the dates for beginning and completion of all phases of the work. If, in the opinion of the Engineer, the Contractor falls behind in his schedule or will not be able to complete the project in the time limits, he may require the Contractor to revise his schedule and put additional equipment on the job as so ordered.

33. ORDER OF WORK: The order or sequence of the work shall be as provided herein or as approved by the Engineer, which approval shall in no way affect the responsibility of the Contractor.

34. COMPETENT LABOR: The Contractor shall employ only competent and skilled workers on the Project. The Contractor shall have a competent Superintendent present at all times when the work is in progress with authority to receive orders and execute the work.

    The Contractor shall, upon demand from the Engineer, immediately remove any Superintendent, Foreman or Workman whom the Engineer may consider incompetent or undesirable.

35. LAWS AND REGULATIONS: The Contractor shall keep himself fully informed of all laws, ordinances and regulations of State and County in any manner affecting those engaged or employed in the work, or the materials used in the work, or in any way

affecting the conduct of the work, and of all orders and decrees of bodies or tribunals having any jurisdiction or authority over same. If any discrepancy or inconsistency should be discovered in this Contract, or in the Drawings or Specifications herein referred to, in relation to any such law, ordinance, regulation, order or decree, he shall forthwith report the same in writing to the Owner. He shall at all times himself observe and comply with all such existing and future laws, ordinances and regulations, and shall protect and indemnify the Owner and its agents against any claims or liability arising from or based on the violation of any such law, ordinance, regulation, order of decree, whether by himself or by his employees.

36. GEORGIA WATER QUALITY CONTROL ACT: According to the *Rules and Regulations of the Georgia Water Quality Control Act*, Chapter 391-3-6, Section 12-5-51, anyone who intentionally or negligently causes or permits raw wastewater to discharge into State waters or onto the ground may be held liable for damages to the State.

37. PROTECTIVE WORKS: The Contractor shall furnish and install all necessary temporary works for the protection of the work, including barricades, warning signs and lights at night.

38. SAFETY AND OSHA REGULATIONS: The performance of work under this Contract shall comply with safety regulations prescribed by the Owner, those of the National Occupational Safety and Health Act of 1970 as amended to date (PL 91-596), and under Section 107 of the Contract Work Hours and Safety Standards Act (PL 91-054), and the requirements of the State where project is located. Each bidder shall satisfy himself as to the character and extent of such regulations.

39. SANITARY REGULATIONS: Necessary sanitary conveniences for the use of the laborers on the work shall be erected and maintained by the Contractor in such a manner and at such points as shall be approved by the Engineer. Their use shall be strictly enforced.

40. STORAGE FACILITIES: Should the Contractor so desire, he may build storage facilities or other structures for housing men, tools, machinery and supplies, but they will be permitted only at approved places, and their surroundings shall be maintained at all times in a sanitary and satisfactory manner. On or before the completion of the work, all such structures shall be removed, together with all rubbish and trash, at the expense of the Contractor.

41. WATER SUPPLY: The water for the Contractor's use shall be supplied by the Contractor. The Contractor shall make his own arrangements for obtaining a water supply for his construction operations.

42. ELECTRIC POWER: The Contractor shall make his own arrangements for electrical power supply for his construction operations.

43. SOIL EROSION AND SEDIMENT CONTROL: The Contractor shall be required to take the necessary steps to minimize siltation and soil erosion during construction. The Contractor shall utilize best management practices (BMPs) as shown and in accordance with the *Manual for Erosion and Sediment Control in Georgia*, as amended to date.

44. STORMWATER MONITORING: If required, the Contractor shall measure rainfall and perform inspections and sample discharges in accordance with NPDES Stormwater

Discharges Associated with Construction Activities, General Permit (GAR 100001, 100002, 100003).

45. ACCESS ROADS: Streets, roads and drives used by the Contractor for access to and from the site of his work shall be protected from damage in connection with construction work. Any such damage done shall be repaired immediately and left in good condition at the end of the construction period.

46. PROGRESS PAYMENT: Progress payment requests from the Contractor shall be submitted to the Engineer for approval on or before the 5th day of each calendar month. On or before the 30th day of each calendar month the Owner shall make progress payments to the Contractor on the basis of a duly certified and approved estimate of work performed during the preceding calendar month by the Contractor, including materials delivered to the site and undelivered specifically manufactured equipment, less retainage as per the General Conditions of these Specifications which is to be retained by the Owner until all work has been performed strictly in accordance with the Contract Documents and until such work has been accepted by the Owner. The terms and conditions in these documents shall supersede all provisions of the *Georgia Prompt Pay Act.*

47. ALLOWABLE TIME FOR COMPLETION: The time allowed for completion on all work to be done under this contract shall begin after notification by the Engineer to proceed with the work. Such notification will be issued upon completion of the contract arrangements, and in accordance with approved construction schedule, arranged to be within the contract time for completion. The time allowed for completion of the work is as set forth in the Contract Agreement for substantial and final completion.

48. LIQUIDATED DAMAGES: The Contractor shall pay to the Owner as liquidated damages the sum set forth in the Contract Agreement for each calendar day that he shall be in default of completing the work in his Contract within the time limit named therein for substantial completion, and the Contractor shall pay to the Owner as liquidated damages the sum set forth in the Contract Agreement for each calendar day that he shall be in default of completing the work in his Contract within the time limit named therein for final completion.

49. SALES TAX AND/OR USE TAX: Bidders shall include in amounts bid in the Proposal an allowance for payment of state Sales Tax and/or Use Tax on all taxable materials specified to be furnished by the Contractor and incorporated into the work under this Contract.

50. CONTRACTOR'S LOCAL OFFICE: The Contractor shall maintain a local office with a telephone in the general area of the work, and will be required to have a responsible representative on call at all times.

51. OFFICE SPACE AND FACILITIES FOR INSPECTORS: The Contractor shall furnish proper and adequate office space and facilities for the use of the Inspectors. A separate room shall be provided at least 12' x 14' either in connection with the Contractor's office or in a separate structure, equipped with lights, heat, air conditioning, telephone for local service, desk, chair, file cabinet, plan rack and plan table. All costs in connection with furnishing of utilities for the Resident Inspector shall be paid by the Contractor.

52. MUTUAL RESPONSIBILITY OF CONTRACTORS: If, through acts of neglect of the part of the Contractor, any other Contractor or any subcontractor shall suffer loss or damage on the work, the Contractor agrees to settle with such other Contractor or subcontractor by agreement of arbitration if such other Contractor or subcontractor shall assert any claims against the Owner, on account of any damage alleged to have been so sustained, the Owner shall notify the Contractor who shall indemnify and save harmless the Owner against such claim.

53. EMERGENCY WORK: The Contractor shall at all times, including nights, weekends or holidays, have a responsible man available to act in case of emergency repairs who the Owner may contact. Upon notification of emergency work necessary, the Contractor's representative shall immediately take steps to make such repairs.

54. INSURANCE REQUIREMENTS: The Contractor's attention is directed to requirements for insurance coverage as set forth in the General Conditions.

55. FLOOD HAZARD INSURANCE: If applicable, the Contractor will be required to acquire and maintain during the life of the contract any flood insurance made available under the National Flood Insurance Act of 1968, as amended. The insurance shall be in an amount at least equal to the contract amount costs, excluding cost of uninsurable improvements, or to the maximum limit of coverage made available under the National Flood Insurance Act of 1968, as amended, whichever is less.

56. BUILDING PERMITS AND BUSINESS LICENSE: The Contractor shall be required to obtain applicable Building Permits and Business Licenses as required by the CITY OF GROVETOWN or COLUMBIA COUNTY, GEORGIA.

57. CONSTRUCTION PERMITS, EASEMENTS AND RIGHT OF WAY: All construction permits, and easements or right of ways known to be required to begin construction have been obtained.

58. GEORGIA SECURITY COMPLIANCE ACT: The Contractor and subcontractor(s) are required to execute affidavits verifying the work eligibility of all newly hired employees. The forms are included in these Specifications. The Contractor is also required to complete the Affidavit Verifying Status for Public Benefit that verifies the applicant's lawful presence in the United States.

59. FUNDING REQUIREMENTS: The project is proposed to be funded with a Clean Water State Revolving Fund. All SRF and American Iron and Steel Special Conditions / etc. requirements apply.

PROPOSAL

TO THE MAYOR AND COUNCIL
CITY OF GROVETOWN, GEORGIA

Submitted: _____, 2017

The undersigned, as Bidder, hereby declares that the only persons interested in the Proposal as principal or principals is or are named herein and that no other person than herein mentioned has any interest in this Proposal or in the Contract to be entered into; that this Proposal is made without connection with any person, company or parties making a bid or Proposal; and that it is in all respects fair and in good faith without collusion or fraud.

The Bidder further declares that he has examined the site of the work and informed himself fully in regard to all conditions pertaining to the place where the work is to be done; that he has examined the Drawings and Specifications for the work and contractual documents relative thereto, and has read all Special Provisions and General Conditions furnished prior to the opening of bids; that he has satisfied himself relative to the work to be performed.

The Bidder proposes and agrees, if this Proposal is accepted, to contract with the **CITY OF GROVETOWN, GEORGIA** in the form of contract specified, to furnish all necessary materials, equipment, machinery, tools, apparatus, means of transportation and labor necessary and to complete the construction of the work in full and complete accordance with the shown, noted, described, and reasonably intended requirements of the Drawings, Specifications and Contract Documents to the full and entire satisfaction of the **CITY OF GROVETOWN, GEORGIA** with a definite understanding that no money will be allowed for extra work except as set forth in the attached General Conditions and Contract Documents, for the following prices:

CITY OF GROVETOWN, GEORGIA
SEWERAGE SYSTEM IMPROVEMENTS
WATER POLLUTION CONTROL PLANT - PHASE II

For furnishing all materials and performing all labor necessary for constructing the Grovetown Water Pollution Control Plant - Phase II as shown on the Drawings and as specified for the following prices and approximate quantities shown:

Item 1: For furnishing all materials, equipment, and performing all labor necessary for constructing the water pollution control plant, including earth excavation, existing structure demolition, backfilling, grading, structures, piping, electrical, HVAC, mechanical work (excluding the cost of furnishing Major Mechanical Equipment listed in Item No. 2 and Items No. 3 through No. 8) as shown on the Drawings and/or specified, the lump sum amount of:

$ _____

Item 2: For furnishing and installing Major Mechanical Equipment.

	Equipment and Manufacturer	Price	Base Price
a.	Sequential Batch Reactor System - Section 10.13		
	Mfr. _____	_____	
	Mfr. _____	_____	
b.	Tertiary Filter System - Section 10.14		
	Mfr. _____	_____	
	Mfr. _____	_____	
c.	Ultraviolet Disinfection System - Section 10.15		
	Mfr. _____	_____	
	Mfr. _____	_____	
d.	Sludge Dewatering Equipment - Section 10.16		
	Mfr. _____	_____	
	Mfr. _____	_____	
e.	Submersible Pumps - Section 10.17		
	Mfr. _____	_____	
	Mfr. _____	_____	
f.	Vertical Turbine Pumps - Section 10.18		
	Mfr. _____	_____	
	Mfr. _____	_____	
g.	Chemical Feed Equipment - Section 10.19		
	Mfr. _____	_____	
	Mfr. _____	_____	

Equipment and Manufacturer	Price	Base Price
h. Floating Aerators - Section 10.20		
Mfr. _____		
Mfr. _____		
i. Floating Mixers - Section 10.21		
Mfr. _____		
Mfr. _____		
j. Post Air Equipment - Section 10.22		
Mfr. _____		
Mfr. _____		
k. Instrumentation - Section 11		
Mfr. _____		
Mfr. _____		
l. Generator - Section 13		
Mfr. _____		
Mfr. _____		

Subtotal, Item 2 inclusive, the amount of: $ _____

ITEM NO.	QTY.	UNIT	DESCRIPTION	UNIT PRICE	TOTAL PRICE
3.			SOIL EROSION CONTROL DEVICES		
a.	4,500	LF	Silt Fence (Type Sd-1c)		
b.	25	EA	Stone Check Dam (Cd-s)		
c.	6	CY	Riprap (Ch-Rp)		
d.	1	LS	Grassing of Disturbed Areas		
4.			STORMWATER MONITORING		
a.	1	EA	Monitoring Site (establish, construct and operate all sites)		
b.	16	EA	Sampling Events		
5.	1	LS	SPARE PARTS ALLOWANCE	$10,000.00	$10,000.00
6.	1	LS	LABORATORY EQUIPMENT ALLOWANCE	$25,000.00	$25,000.00

ITEM NO.	QTY.	UNIT	DESCRIPTION	UNIT PRICE	TOTAL PRICE
7.	1	LS	LANDSCAPING AND IRRIGATION ALLOWANCE	$25,000.00	$25,000.00
8.	1	LS	ELECTRONIC SECURITY ALLOWANCE	$50,000.00	$50,000.00

Subtotal Items 3 through 8, inclusive, the amount of: $ _____

EXTRA WORK, IF ORDERED BY ENGINEER

(To cover authorized changes in scope of lump sum work under Item No. 1)

ITEM NO.	QTY.	UNIT	DESCRIPTION	UNIT PRICE	TOTAL PRICE
9.			EXCAVATION AND BACKFILL		
a.	10	CY	Hand Dry		
b.	10	CY	Hand, Wet and Dewatering		
c.	10	CY	Machine Dry		
d.	10	CY	Machine Wet and Dewatering		
e.	10	CY	Crusher Run Stone Backfill		
10.			CONCRETE WORK		
a.	10	CY	Class 'A' Concrete		
b.	10	CY	Class 'B' Concrete		
c.	10	CY	Class 'C' Concrete		
d.	500	LBS	Reinforcing Steel		
e.	100	SF	Contact Forms		
11.			PLANT SEWER LINES		
a.	20	LF	8" Ductile Iron Pipe		
b.	20	LF	10" Ductile Iron Pipe		
c.	20	LF	12" Ductile Iron Pipe		
d.	20	LF	16" Ductile Iron Pipe		
e.	20	LF	24" Ductile Iron Pipe		
12.			DUCTILE IRON PIPE, IN PLACE (FLANGED JOINT)		
a.	10	LF	4" Ductile Iron Pipe		
b.	10	LF	6" Ductile Iron Pipe		
c.	10	LF	8" Ductile Iron Pipe		

ITEM NO.	QTY.	UNIT	DESCRIPTION	UNIT PRICE	TOTAL PRICE
d.	10	LF	10" Ductile Iron Pipe		
e.	10	LF	12" Ductile Iron Pipe		
f.	10	LF	16" Ductile Iron Pipe		
g.	10	LF	20" Ductile Iron Pipe		
h.	10	LF	24" Ductile Iron Pipe		
13.			DUCTILE IRON PIPE, IN PLACE (MECHANICAL JOINT)		
a.	10	LF	4" Ductile Iron Pipe		
b.	10	LF	6" Ductile Iron Pipe		
c.	10	LF	8" Ductile Iron Pipe		
d.	10	LF	10" Ductile Iron Pipe		
e.	10	LF	12" Ductile Iron Pipe		
f.	10	LF	16" Ductile Iron Pipe		
g.	10	LF	20" Ductile Iron Pipe		
h.	10	LF	24" Ductile Iron Pipe		
14.			DUCTILE IRON PIPE FITTINGS		
a.	0.2	Tons	Bell and Spigot		
b.	0.2	Tons	Mechanical Joint		
c.	0.2	Tons	Flanges		
15.			PVC PIPE IN PLACE		
a.	10	LF	¾" SDR 13.5 PR315		
b.	10	LF	1" SDR 21 PR 200		
c.	10	LF	2" SDR 21 PR 200		
d.	10	LF	3" SDR 21 PR 200		

Subtotal Items 9 through 15, inclusive, the amount of: $ _____

TOTAL AMOUNT BID, ITEMS 1 THROUGH 15, INCLUSIVE, THE AMOUNT OF:

_____

_____ **Dollars** **($** _____ **)**

ADDITIONS / DEDUCTIONS

The Owner reserves the right to add any or all of the following additions/deduction of the work for the purpose of making contract award. Award of the contract may be with one or more of these items. Each bidder must fill in the unit price amount for each item below.

D-1 In lieu of poured in place concrete construction for SBR Basins, provide prestressed concrete tanks in accordance with ACI 350 AWWA Standard D110-04 and all applicable state and local standards.

	Equipment and Manufacturer	Price	Base Price
a.	Prestressed Concrete Tanks - Section 10.23		
	Mfr. _____	_____	
	Mfr. _____	_____	
	Total deduction, Deduct D-1, the amount of:		$ _____

D-2 To delete the paving where shown on the Drawings and provide gravel access to the treatment plant, deduct the following amount:

Total deduction, Deduct D-2, amount: $ _____

D-3 To provide shingled roofs in lieu of standing seam metal roofs for all structures, deduct the following amount:

Total deduction, Deduct D-3, amount: $ _____

D-4 To delete the maintenance building as shown on the Drawings, deduct the amount of:

Total deduction, Deduct D-4, amount: $ _____

D-5 In lieu of a 1,000 kW generator, provide and install a 750kW generator, deduct the amount of:

Total deduction, Deduct D-5, amount: $ _____

D-6 To delete the dissolved oxygen probe from the Aerobic Digester, deduct the amount of:

Total deduction, Deduct D-6, amount: $ _____

D-7 To delete the effluent pump station flow meter, deduct the amount of:

Total deduction, Deduct D-7, amount: $ _____

D-8 In lieu of the three-belt sludge dewatering press Charter Model 3BTP17.93S, provide and install a two-belt sludge dewatering press Charter Model TP17.43 or approved equal.

	Equipment and Manufacturer	Price	Base Price
a.	Two-Belt Sludge Dewatering Press		_____
	Mfr. _____	$ _____	
	Mfr. _____	$ _____	
	Total deduction, Deduct D-8, amount:		$ _____

A-1 To remove the existing sprayfield riser pipes and return the valves and sprinklers to the Owner in the sprayfield areas outside the construction limits shown on the Drawings Sheet 3 of 77, add the amount of:

Total addition, Addition A-1, amount: $ _____

SUBSTITUTE EQUIPMENT

The Bidder may offer at his own option the bid price and name of other makes of equipment which he desires to substitute for specified named designated by him in Item 2 in the Proposal. The Bidder is referred to Sections 10, 11 and 13 of these Specifications for "Substitute Equipment" required.

Item	Equipment and Manufacturer	Price	Base Price
_____	_____		_____
	Mfr. _____	_____	
_____	_____		_____
	Mfr. _____	_____	
_____	_____		_____
	Mfr. _____	_____	
_____	_____		_____
	Mfr. _____	_____	
_____	_____		_____
	Mfr. _____	_____	
_____	_____		_____
	Mfr. _____	_____	

The Bidder further proposes and agrees hereby to commence work under contract, with adequate force and equipment, on a date to be specified in a written order of the Engineer, and shall fully complete all work thereunder within the number of consecutive calendar days setforth in the Contract Agreement.

BIDDER ACKNOWLEDGES RECEIPT OF THE FOLLOWING ADDENDA.

No. _____ Date _____ No. _____ Date _____

No. _____ Date _____ No. _____ Date _____

The Bidder further proposes and agrees to construct all work under lump sum items of the Proposal for the lump sum price bid, and understands that certain quantities as listed under Extra Work If Ordered By Engineer will be used in case of minor authorized increase or decrease in quantities to adjust by direct increase or decrease the lump sum bid for the complete work.

The Bidder declares that he understands that the unit price quantities shown in the Proposal are subject to adjustment by either increase or decrease, and that should quantities of any of the items of the work be increased, the undersigned proposes to do the additional work at the unit prices stated herein; and should the quantities be decreased, he also understands that payment will be made on actual quantities at the unit price bid and will make no claim for anticipated profits for any decrease in the quantities and that quantities will be determined upon completion of the work at which time adjustment will be made to the contract amount by direct increase or decrease.

The undersigned further agrees that, in case of failure on his part to execute the said Contract and the Bond within ten (10) consecutive calendar days after written notice being given of the award of the Contract, the check or bid bond accompanying this bid and the monies payable thereto, shall be paid into the funds of the Owner as liquidated damages for such failure otherwise, the check or bid bond accompanying this Proposal shall be returned to the undersigned.

Attached hereto is a certified check on the _____ Bank of _____, or a Bid Bond by the _____ in the amount of _____ Dollars ($_____) made payable to **CITY OF GROVETOWN, GEORGIA** in accordance with the conditions of the advertisement and provisions herein.

Submitted By: _____

Georgia Utility Contractor License No. _____

DBE Certified Contractor (yes or no) _____

By: _____ L.S.

Title: _____

Address: _____

_____

Telephone No. _____ Fax No. _____

(Note: If the Bidder is a Corporation, the Proposal shall be signed by an officer of the Corporation; if a Partnership, it shall be signed by a Partner. If signed by others, authority for signature shall be attached.)

The full names and residences of persons and firms interested in the foregoing bid, as principal, are as follows:

EXPERIENCE AND REFERENCES

The bidder shall here state what work he has done of similar nature to that bid for, and give references that will afford the Owner opportunity to judge as to experience, skill, business standing and financial ability.

BID BOND

STATE OF GEORGIA
COLUMBIA COUNTY

KNOW ALL MEN BY THESE PRESENTS: THAT WE _____(herein called the "Bidder") submitted a Bid to **CITY OF GROVETOWN, GEORGIA** (herein called the "Owner") dated the _____ day of _____, 2017 for procuring and installing products for a project entitled **"SEWERAGE SYSTEM IMPROVEMENTS, WATER POLLUTION CONTROL PLANT – PHASE II, JANUARY 2017 (REVISED MAY 2017)"** (herein called the "Project") and the testing and starting up of that project; that the Bidder and we, _(herein called the "Surety") are firmly bound to the Owner in the sum of:

_____

_____ Dollars ($ _____)

in lawful United States currency; and that we, the Bidder and Surety jointly and severally, bind our respective assigns, successors, heirs, executors, and administrators to our obligations to pay the Owner that sum.

THE CONDITION OF THIS OBLIGATION is that if the Bid is not selected by the Owner as being the lowest, or lower, responsible Bid, then this obligation shall be void, otherwise this obligation shall remain in full force and effect.

THE FURTHER CONDITION OF THIS OBLIGATION is that the Surety, for value received, stipulates and agrees that extensions to the time limit in which the Owner may accept Bids shall not invalidate the Surety's obligation under this bond, and that the Surety does hereby waive notice of extensions to that time limit.

IN WITNESS WHEREOF the Bidder and the Surety have executed this BID BOND on this _____ day of _____, 2017

_____ (Bidder's Seal if Corporation)
(Bona Fide Bidder's Name)

By: _____ L.S.
(Print Name and Title of Signer)

_____

(Surety's Name)

By: _____ (Surety's Seal)

(Print Name and Title of Signer)

Countersigned

By: _____ L.S.

(Agent, Resident of the State of Georgia)

NON-COLLUSION AFFIDAVIT OF BIDDER

State of _____

County of_____

I, _____ (name of individual), being first duly sworn, deposes and says that:

(1) He is _____ (title) of _____ (Company) the Bidder that has submitted the Bid on the following;

Project Name: City of Grovetown, Sewerage System Improvements, Water Pollution Control Plant – Phase II, January 2017 (Revised May 2017)

Project Number: 141946

(2) He makes an oath that O.C.G.A. 36-91-21 (e) has not directly or indirectly been violated;

(3) Such Bid is genuine and is not a collusive or sham Bid;

(4) Neither the said Bidder nor any of its officers, partners, owners, agents, representatives, employees, or parties in interest, including this affiant, has in any way colluded, conspired, connived or agreed, directly or indirectly, with any other Bidder, firm or person to submit a collusive or sham Bid in connection with the Contract for which the attached Bid has been submitted or to refrain from bidding in connection with such Contract, or has in any manner, directly or indirectly, sought by agreement or collusion or communication or conference with any other Bidder, or to fix any overhead, profit or cost element of the Bid price or the Bid of any other bidder, or to secure through any collusion, conspiracy, connivance or unlawful agreement any advantage against the City of Grovetown, Georgia or any person interested in the proposed Contract; and

(5) The price or prices quoted in the attached Bid are fair and proper and not tainted by any collusion, conspiracy, connivance, or unlawful agreement on the part of the Bidder or any of its agents, representatives, owners, employees, or parties in interest, including this affiant.

(Signed)_____

Title_____

Subscribed and sworn to before me,

This _____ day of _____, 2017

Notary Public: _____*(Notary Seal)*

My commission expires: _____

CONTRACT AGREEMENT

This Agreement made and entered into on the _____ date of _____, 2017, by and between the **CITY OF GROVETOWN, GEORGIA**, party of the first part (hereinafter called the "Owner"), and _____, party of the second part (hereinafter called the "Contractor").

WITNESSETH:
That the Contractor, for the consideration hereinafter fully set out hereby agrees with the Owner as follows:

That the Contractor will furnish all equipment, tools, materials, skill and labor of every description, necessary to carry out and complete in a good, firm, substantial, and workmanlike manner the construction of all the work specified under:

CITY OF GROVETOWN, GEORGIA

SEWERAGE SYSTEM IMPROVEMENTS

WATER POLLUTION CONTROL PLANT – PHASE II

JANUARY 2017 (REVISED MAY 2017)

In strict conformity with Drawings and the Construction Specifications hereinafter set forth, which Drawings and Specifications together with the foregoing Bid, Advertisement for Bid, Instructions to Bidder and Special Provisions, General Conditions, Supplemental General Conditions, Performance and Payment Bonds, this Agreement, and all addenda, hereto annexed, shall form essential parts of this Agreement, as if fully contained herein. The work covered by this construction Agreement includes all work as shown on the Drawings, specified, and listed in the attached Proposal.

That the Contractor shall commence the work to be performed under this Agreement on a date to be specified in a written order of the Owner's Engineer and shall within 450 consecutive calendar days from said date substantially complete all work hereunder, except as otherwise provided in these documents for extension of the time limit, and shall within 480 consecutive calendar days from said date achieve final completion with 100% of punch list items complete. Time is of the essence in this contract, and the Contractor shall pay to the Owner, not as a penalty, but as liquidated damages, the sum of $1,000.00 for each calendar day that he shall be in default of substantial or final completion of the work within the time limits named herein.

Because of the difficulty of fixing damages suffered by the Owner on account of such default, damages are herein agreed upon as stated.

The Contractor shall perform and comply with all conditions, stipulations and requirements specified in the deeds, easements or other documents pertaining to all aspects of this Project.

The Owner hereby agrees to pay to the Contractor for the faithful performance of this Agreement, subject to additions and deductions as provided in the Specifications and Proposal, in lawful money of the United States, the sum of:

_____

_____ DOLLARS ($ _____)

On or before the 30th day of each calendar month, the Owner shall make partial payments to the Contractor on the basis of a duly certified and approved estimate of work performed during the preceding calendar month by the Contractor, including materials delivered to the site, less retainage as per the General Conditions, which is to be retained by the Owner until all work has been performed strictly in accordance with this Agreement, and until such work has been accepted by the Owner. The terms and General Conditions in the Contract Documents shall supersede all provisions of the *Georgia Prompt Pay Act*.

Upon submission by the Contractor of evidence satisfactory to the Owner that all payrolls, material bills and other costs incurred by the Contractor in connection with the construction of the work have been paid in full, final payment on account of this Agreement shall be made within thirty (30) days after the completion by the Contractor of all work covered by this Agreement and the acceptance of such work by the Owner.

It is further mutually agreed between the parties hereto that if, at any time after the execution of this Agreement and the surety bonds hereto attached for its faithful performance, the Owner shall deem the surety or sureties upon such bond to be unsatisfactory, or if, for any reason, such bond ceases to be adequate to cover the performance of the work, the Contractor shall, at his expense, within five (5) days after the receipt of notice from the Owner to do so, furnish an additional bond or bonds in such form and amount, and with such surety or sureties as shall be satisfactory to the Owner. In such event no further payment to the Contractor shall be deemed to be due under this Agreement until such new or additional security for the faithful performance of the work shall be furnished in manner and form satisfactory to the Owner.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement under their respective seals on the day and date first above written in six (6) counterparts, each of which shall without proof or accounting for the other counterparts, be deemed an original contract.

NAME OF CONTRACTOR

Georgia Utility Contractor

License No. _____

Signed, sealed and delivered
in the presence of:

BY: _____ (L.S.)

_____ TITLE: _____

Unofficial Witness

_____ WITNESSED:

Notary Public

My Commission Expires: BY: _____ (L.S.)

_____ TITLE: _____

(NOTARY SEAL) (CORPORATE SEAL)

CITY OF GROVETOWN, GEORGIA

_____ (L.S.)

Signed, sealed and delivered
in the presence of: MAYOR

_____

Unofficial Witness

_____ WITNESSED:

Notary Public

My Commission Expires: BY: _____ (L.S.)

_____ Clerk

(NOTARY SEAL)

(CITY SEAL)

APPROVED AS TO FORM BEFORE EXECUTION

BY: _____ (L.S.)

Attorney for Owner

*Note: If Contractor is a corporation, the Agreement shall be signed by the President, or Vice-President, attested by the Secretary and the corporate seal affixed. If the Contractor is a partnership, the Agreement shall be signed in the partnership name by one of the partners, with indication that he is a general partner.

PERFORMANCE BOND

KNOW ALL PERSONS BY THESE PRESENTS: that

_____
(Name of Contractor)

_____
(Address of Contractor)

a _____ hereinafter called Principal, and
(Corporation, Partnership, or Individual)

_____
(Name of Surety)

_____
(Address of Surety)

hereinafter called Surety, are held and firmly bound unto the **CITY OF GROVETOWN, GEORGIA**, hereinafter called OWNER, the total aggregate penal sum of:

_____

_____ DOLLARS ($)

of lawful money of the United States, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION is such that whereas, the PRINCIPAL entered into a certain contract with the OWNER, dated the _____ day of _____, 2017 a copy of which is hereto attached and made a part for the construction of:

CITY OF GROVETOWN, GEORGIA

SEWERAGE SYSTEM IMPROVEMENTS

WATER POLLUTION CONTROL PLANT – PHASE II

JANUARY 2017 (REVISED MAY 2017)

NOW, THEREFORE, if the PRINCIPAL shall well, truly and faithfully perform its duties, all the undertakings, covenants, terms, conditions, and agreements of said contract during the original term thereof, and any authorized extensions or modifications thereof which may be granted by the OWNER, with or without notice to the SURETY and during the one (1) year

guaranty period and if the PRINCIPAL shall satisfy all claims and demands incurred under such contract, and shall fully, indemnify and save harmless the OWNER from all costs and damages which it may suffer by reason of failure to do so, and shall reimburse and repay the OWNER all outlay and expenses which the OWNER may incur in making good any default, then this obligation shall be void, otherwise to remain in full force and effect.

PROVIDED, FURTHER, that the said SURETY, for value received hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the contract or to WORK to be performed thereunder shall in any way affect its obligation on this BOND, and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the contract or to the WORK.

PROVIDED, FURTHER, that no final settlement between the OWNER and the CONTRACTOR shall abridge the right of the other beneficiary hereunder, whose claim may be unsatisfied.

IN WITNESS WHEREOF, this instrument is executed in six (6) counterparts, each one of which shall be deemed an original, this the _____ day of _____, 2017.

_____

NAME OF PRINCIPAL

Signed, sealed and delivered
in the presence of:

BY: _____

TITLE: _____

_____

Unofficial Witness

WITNESSED:

BY: _____ (L.S.)

TITLE: _____

(CORPORATE SEAL)

_____

Notary Public

My Commission Expires:

_____

(NOTARY SEAL)

NAME OF SURETY

Signed, sealed and delivered
in the presence of:

BY: _____

TITLE: _____

_____

Unofficial Witness

WITNESSED:

BY: _____ (L.S.)

(SURETY SEAL)

_____

Notary Public

My Commission Expires:

_____

(NOTARY SEAL)

Note: Date of BOND must not be prior to date of Contract. If CONTRACTOR is partnership, all partners should execute BOND.

Important: Surety companies executing BONDS must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the state where the Project is located. In addition the bonds must be signed or countersigned by an agent residing in Georgia.

PAYMENT BOND

KNOW ALL PERSONS BY THESE PRESENTS: that

_____
(Name of Contractor)

_____
(Address of Contractor)

a _____ hereinafter called Principal, and
(Corporation, Partnership, or Individual)

_____
(Name of Surety)

_____
(Address of Surety)

hereinafter called Surety, are held and firmly bound unto the **CITY OF GROVETOWN, GEORGIA**, hereinafter called OWNER, the total aggregate penal sum of:

_____

_____ DOLLARS ($ _____)

of lawful money of the United States, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION is such that whereas, the PRINCIPAL entered into a certain contract with the OWNER, dated the _____ day of _____, 2017 a copy of which is hereto attached and made a part for the construction of:

CITY OF GROVETOWN, GEORGIA

SEWERAGE SYSTEM IMPROVEMENTS

WATER POLLUTION CONTROL PLANT – PHASE II

JANUARY 2017 (REVISED MAY 2017)

NOW, THEREFORE, if the PRINCIPAL shall promptly make payment to all persons, firms, and corporations furnishing materials for or performing labor in the prosecution of the WORK provided for in such contract, and any authorized extensions or modification thereof, including all amounts due for materials, lubricants, oil, gasoline, coal and coke, repairs on machinery, equipment and tools, consumed or used in connection with the construction of such WORK, and

for all labor cost incurred in such WORK including that by a SUBCONTRACTOR, and to any mechanic or material man lien holder whether it acquires its lien by operation of State or Federal law; then this obligation shall be void, otherwise to remain in full force and effect.

PROVIDED, FURTHER, that the said SURETY, for value received hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the contract or to WORK to be performed thereunder shall in any way affect its obligation on this BOND, and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the contract or to the WORK.

PROVIDED, FURTHER, that no final settlement between the OWNER and the CONTRACTOR shall abridge the right of the other beneficiary hereunder, whose claim may be unsatisfied.

IN WITNESS WHEREOF, this instrument is executed in six (6) counterparts, each one of which shall be deemed an original, this the _____ day of _____, 2017.

_____

NAME OF PRINCIPAL

Signed, sealed and delivered
in the presence of:

BY: _____

TITLE: _____

_____

Unofficial Witness

WITNESSED:

BY: _____ (L.S.)

TITLE: _____

(CORPORATE SEAL)

_____

Notary Public

My Commission Expires:

_____

(NOTARY SEAL)

NAME OF SURETY

Signed, sealed and delivered
in the presence of:

BY: _____

TITLE: _____

_____

Unofficial Witness

WITNESSED:

BY: _____ (L.S.)

(SURETY SEAL)

_____

Notary Public

My Commission Expires:

_____

(NOTARY SEAL)

Note: Date of BOND must not be prior to date of Contract. If CONTRACTOR is partnership, all partners should execute BOND.

Important: Surety companies executing BONDS must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the state where the Project is located. In addition the bonds must be signed or countersigned by an agent residing in Georgia.

CONTRACTOR AFFIDAVIT AND AGREEMENT

By executing this affidavit, the undersigned contractor verifies its compliance with O.C.G.A. 13-10-91, stating affirmatively that the individual, firm or corporation which is contracting with City of Grovetown, Georgia has registered with, is authorized to use and is participating in a federal work authorization program* [any of the electronic verification work authorization programs operated by the United States Department of Homeland Security or any equivalent federal work authorization program operated by the United States Department of Homeland Security to verify information of newly hired employees, pursuant to the Immigration Reform and Control Act of 1986 (IRCA), P.L. 99-603], in accordance with the applicability provisions and deadlines established in O.C.G.A. 13-10-91. The user identification number and the date of authorization for the affiant are set forth below. The undersigned contractor is using and will continue to use the federal work authorization program throughout the contract period.

The undersigned further agrees that, should it employ or contract with any subcontractor(s) in connection with the physical performance of services pursuant to this contract with City of Grovetown, Georgia, that undersigned shall require as a condition of such employment or contract that contractor or subcontractor registers and participates in a federal work authorization program to verify information of all newly hired employees. In addition, contractor will secure from such contractor(s) or subcontractor(s) similar verification of compliance with O.C.G.A. 13-10-91 on the Subcontractor Affidavit provided in Rule 300-10-01-.08 or a substantially similar form. Contractor further agrees to maintain records of such compliance and provide a notice of identity of such contractor or subcontractor together with a copy of each such verification to City of Grovetown, Georgia within five (5) business days after the time the contractor(s) or subcontractor(s) is retained to perform such service.

_____ _____

E-Verify* User identification Number Date of Authorization for Contractor

_____

Company Name

_____ _____

By: Authorized Officer or Agent Date

_____

Title of Authorized Officer or Agent of Contractor

_____

Printed Name of Authorized Officer or Agent

SUBSCRIBED AND SWORN BEFORE ME THIS
_____ DAY OF_____, 2017

Notary Public:_____
My Commission expires: _____ (SEAL)

**As of the effective date of O.C.G.A. 13-10-91, the applicable federal work authorization program is "E-Verify" operated by the U.S. Citizenship and Information Services Bureau of the U.S. department of Homeland Security, in conjunction with the Social Security Administration (SSA).*

SUBCONTRACTOR AFFIDAVIT

By executing this affidavit, the undersigned subcontractor verifies its compliance with O.C.G.A. 13-10-91, stating affirmatively that the individual, firm or corporation which is engaged in the physical performance of services as a subcontractor for _____, the contractor which has a contract with City of Grovetown, Georgia, has registered with, is authorized to use and is participating in a federal work authorization program* [any of the electronic verification work authorization programs operated by the United States Department of Homeland Security or any equivalent federal work authorization program operated by the United States Department of Homeland Security to verify information of newly hired employees, pursuant to the Immigration Reform and Control Act of 1986 (IRCA), P.L. 99-603], in accordance with the applicability provisions and deadlines established in O.C.G.A. 13-10-91. The user identification number and the date of authorization for this subcontractor to use the federal work authorization program are set forth below. The undersigned subcontractor is using and will continue to use the federal work authorization program throughout the contract period.

_____ _____

E-Verify* User identification Number Date of Authorization for Subcontractor

_____

Company Name

By: _____ _____

Authorized Officer or Agent of Subcontractor Date of signing this Affidavit

_____

Title of Authorized Officer or Agent of Subcontractor

_____

Printed Name of Authorized Officer or Agent of Subcontractor

SUBSCRIBED AND SWORN BEFORE ME THIS
_____ DAY OF_____, 2017

Notary Public:_____

My Commission expires: _____ (NOTARY SEAL)

**As of the effective date of O.C.G.A. 13-10-91, the applicable federal work authorization program is "E-Verify" operated by the U.S. Citizenship and Information Services Bureau of the U.S. department of Homeland Security, in conjunction with the Social Security Administration (SSA).*

CITY OF GROVETOWN, GEORGIA
AFFIDAVIT VERIFYING STATUS FOR PUBLIC BENEFIT

By executing this affidavit under oath, as an applicant for a City of Grovetown, Georgia public benefit as referenced in O.C.G.A. § 50-36-1, I am stating the following with respect to my application for a City of Grovetown, Georgia public benefit for _____.
(Name of natural person applying on behalf of individual, business, corporation, partnership, or other private entity)

1) _____ I am a United States citizen

OR

2) _____ I am a legal permanent resident eighteen (18) years of age or older or I am an otherwise qualified alien or non-immigrant under the Federal Immigration and Nationality Act eighteen (18) years of age or older and lawfully present in the United States.*

In making the above representation under oath, I understand that any person who knowingly and willfully makes a false, fictitious, or fraudulent statement or representation in an affidavit shall be guilty of a violation of O.C.G.A. § 16-10-20.

_____
Signature of Applicant

_____
Printed Name of Applicant

_____
Date

_____
*Alien registration number for non-citizens

Sworn to and subscribed

Before me this _____Day of _____, 2017

_____
Notary Public
My Commission Expires:
(NOTARY SEAL)

*Note: O.C.G.A. § 50-36-1(e)(2) requires that aliens under the federal Immigration and Nationality Act, Title 8 U.S.C., as amended, provide their alien registration number. Because legal permanent residents are included in the federal definition of "alien," legal permanent residents must also provide their alien registration number. Qualified aliens that do not have an alien registration number may supply another identifying number below:

_____

CERTIFICATE OF OWNER'S ATTORNEY

I, the undersigned _____, the duly authorized and acting legal representative of **CITY OF GROVETOWN, GEORGIA**, do hereby certify as follows:

I have examined the attached Contract(s) and Performance and Payment Bond(s) and the manner of execution thereof, and I am of the opinion that each of the aforesaid agreements has been duly executed by the proper parties thereto acting through their duly authorized representatives; that said representatives have full power and authority to execute said agreements on behalf of the respective parties named thereon; and that the foregoing agreements constitute valid and legally binding obligations upon the parties executing the same in accordance with terms, conditions, and provisions thereof.

_____
Attorney for Owner

Date: _____

GEORGIA ENVIRONMENTAL FINANCE AUTHORITY

SUPPLEMENTAL GENERAL CONDITIONS

for

FEDERALLY ASSISTED
STATE REVOLVING LOAN FUND
CONSTRUCTION CONTRACTS

May 9, 2014

The following standard language must be incorporated into construction contract documents and in all solicitations for offers and bids for all construction contracts or subcontracts in excess of $10,000 to be funded in whole or in part by the Federally-assisted State Revolving Fund in the State of Georgia.

These Supplemental General Conditions shall not relieve the participants in this project of responsibility to meet any requirements of other portions of this construction contract or of other agencies, whether these other requirements are more or less stringent. The requirements in these Supplemental General Conditions must be satisfied in order for work to be funded with the State Revolving Fund.

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INSTRUCTIONS & GENERAL REQUIREMENTS

It is the policy of the State Revolving Loan Fund (SRF) to promote a fair share of subcontract, materials, equipment and service awards to small, minority, and women-owned businesses for equipment, supplies, construction, and services. Compliance with these contract provisions is required in order for project costs to be eligible for SRF funding. The fair share objective is a goal, not a quota. Failure on the part of the apparent successful bidder to submit required information to the loan recipient (Owner) may be considered by the Owner in evaluating whether the bidder is responsive to bid requirements.

THE PRIME CONTRACTOR MUST SUBMIT THE FOLLOWING ITEMS TO THE OWNER:
A. Before beginning the work of any contract:

1) **DBE Compliance Form and related documentation.** The Owner must submit this information to the Georgia Environmental Finance Authority (GEFA) to demonstrate compliance with Disadvantaged Business Enterprise (DBE) requirements. GEFA concurrence is recommended prior to award of the construction contract and is required prior to commencement of any SRF-funded construction. (Pages GEFA-4&5)
2) **Certification Regarding Equal Employment Opportunity.** This form is required for the Prime Contractor and for all subcontractors. The Prime Contractor form should be submitted with the DBE Compliance Form, and the subcontractor forms should be submitted as the subcontracts are executed. (Page GEFA-9)
3) **Certification Regarding Debarment, Suspension, & Other Responsible Matters.** This form is required for the Prime Contractor and for all subcontractors. The Prime Contractor form should be submitted with the DBE Compliance Form and the subcontractor forms should be submitted as the subcontracts are executed. (Page GEFA-10)
4) ***EPA Form 6100-2 DBE Subcontractor Participation Form.** This form gives a DBE subcontractor the opportunity to describe the work the DBE subcontractor received from the Prime Contractor, how much the DBE subcontractor was paid, and any concerns the DBE subcontractor might have. The Prime Contractor must provide this form to each DBE subcontractor. The DBE subcontractor can, as an option, complete and submit this form to the GEFA DBE Coordinator, who will also forward the form to the EPA DBE Coordinator. (Page GEFA-11)
5) ***EPA Form 6100-3 DBE Subcontractor Performance Form.** This form captures the description of work to be performed by an intended DBE subcontractor and the price of the work. This form is to be provided by the Prime Contractor to each DBE subcontractor and submitted with the DBE Compliance Form. (Page GEFA-12)
6) ***EPA Form 6100-4 DBE Subcontractor Utilization Form.** This form captures intended or anticipated use of an identified DBE subcontractor by the Prime Contractor and the estimated dollar amount of the work. This form is to be completed by the Prime Contractor and submitted with the DBE Compliance Form. (Page GEFA-13)

*** 6100 FORMS ARE NOT REQUIRED WHEN ALL OF THE WORK IS SELF-PERFORMED BY THE PRIME CONTRACTOR.**

B. During the performance of the contract:

7) **Changes to Subcontractors Form.** If any changes, substitutions, or additions are proposed to the subcontractors included in previous GEFA concurrences, the Owner must submit this information to GEFA for prior concurrence in order for the affected subcontract work to be eligible for SRF funding. (Page GEFA-14)
8) **DBE Annual Report.** The Owner must submit this information to GEFA no later than October 20th of any year that the construction contract is active. (Page GEFA-15)
9) **Certified Payrolls.** These should be submitted to the Owner weekly for the Prime Contractor and all subcontractors. The Owner must maintain payroll records and make these available for inspection. Use Department of Labor form WH-347 or a similar form that contains all of the information on the Department of Labor.

THE OWNER MUST SUBMIT INFORMATION FOR GEFA REVIEW AND CONCURRENCE TO:

Georgia Environmental Finance Authority
Attention: DBE Compliance Coordinator
233 Peachtree Street, N.E.
Harris Tower, Suite 900
Atlanta, Georgia 30303
(404)584-1000; (404)584-1069 (fax)
dbe_compliance@gefa.ga.gov

DBE COMPLIANCE FORM

ALL INFORMATION OUTLINED ON THIS FORM IS REQUIRED FOR DBE COMPLIANCE REVIEW. THE PROPOSED PRIME CONTRACTOR AND OWNER SHOULD ENSURE THAT THIS INFORMATION IS COMPLETE PRIOR TO SUBMITTAL.

Loan Recipient City of Grovetown, Georgia SRF Loan Number CW 2016l01WQ

PRIME CONTRACTOR'S AND OWNER'S CERTIFICATIONS:

I certify that the information submitted on and with this form is true and accurate and that this firm has met and will continue to meet the conditions of this construction contract regarding DBE solicitation and utilization. I further certify that criteria used in selecting subcontractors and suppliers were applied equally to all potential participants and that EPA Forms 6100-2 and 6100-3 were distributed to all DBE subcontractors.

_____ Date_____
(Prime Contractor signature)

_____
(Printed name and title)

I certify that I have reviewed the information submitted on and with this form and that it meets the requirements of the Owner's State Revolving Fund loan contract.

_____ Date_____
(Signature of Owner or Owner's representative)

_____
(Printed name and title)

CONTACT INFORMATION

Owner contact Shirley Beasley, City Administrator

Owner phone number & email 706-863-4576

Consulting Engineer contact John McClellan, P.E.

Consulting Engineer phone number & email 770-333-0700, jmcclellan@gbtengineers.com

Proposed Prime Contractor _____

Prime Contractor contact _____

Prime Contractor phone number & email _____

Proposed total contract amount $ _____

Proposed total MBE participation $ _____ Percentage _____ Goal: 4.0 percent

Proposed total WBE participation $ _____ Percentage _____ Goal: 4.0 percent

CONTINUED ON NEXT PAGE

Please submit the following with the DBE Compliance Form:

1) List of all committed and uncommitted subcontractors by trade, including company name, address, telephone number, contact person, dollar amount of subcontract, and DBE/MBE/WBE status.

2) Indicate in writing if no solicitations were made because the Prime Contractor intends to use only its own forces to accomplish the work.

3) Proof of certification by EPA, SBA, DOT (or by state, local, Tribal, or private entities whose certification criteria match EPA criteria) for each subcontractor listed as a DBE, MBE, or WBE.

4) Documentation of solicitation efforts for prospective DBE firms, such as fax confirmation sheets, copies of solicitation letters and e-mails, printout of online solicitations, printouts of online search results and copies and affidavits of publication in newspapers or other publications. (see also, "**Six Good Faith Efforts**", page GEFA-7).

    a. The Prime Contractor shall use the necessary resources to identify and directly solicit no less than 3 certified MBE firms and 3 certified WBE firms to bid in each expected subcontract trade or area. If a diligent and documented search of the recommended directories does not identify 3 potential certified MBE firms and 3 potential certified WBE firms, then the Prime Contractor shall post an advertisement in the Owner's local legal organ, the Owner's official website, a regional newspaper in a larger community in the proximity, the Prime Contractor's website, or some other appropriate resource.
    b. The Prime Contractor is encouraged to follow-up each written, fax, or e-mail solicitation with at least 1 logged phone call.
    c. Whenever possible, post solicitations for bids or proposals for a minimum of 30 calendar days before the bid or proposal closing date.

5) Written justification for not selecting a certified DBE subcontractor that submitted a low bid for any subcontract area.

6) Certification By Proposed Prime Contractor or Subcontractor Regarding Equal Employment Opportunity (GEFA-9)

7) Certification By Proposed Prime or Subcontractor Regarding Debarment, Suspension, and Other Responsible Matters. (GEFA-10)

8) *EPA Form 6100-3 DBE Subcontractor Performance Form for all DBE subcontracts. (GEFA-12)

9) *EPA Form 6100-4 DBE Subcontractor Utilization Form for all DBE subcontracts. (GEFA-13)

*6100 forms are not required when all of the work is self-performed by the prime contractor.

END OF DBE COMPLIANCE FORM

DBE COMPLIANCE CHECKLIST

THE PRIME CONTRACTOR MUST SUBMIT THE FOLLOWING ITEMS TO THE OWNER BEFORE THE WORK BEGINS:

Loan Recipient City of Grovetown, Georgia SRF Loan Number CW 2016I01WQ

Include in Package Submittal

PRIME CONTRACTOR ONLY	TOTAL CONTRACT AMOUNT

ALL SUBCONTRACTORS, INCLUDING DBE FIRMS	TRADE	AMOUNT

ALL SUBCONTRACTORS, INCLUDING DBE FIRMS	TRADE	AMOUNT

DBE SUBCONTRACTORS ONLY	TRADE	AMOUNT

DBE SUBCONTRACTORS ONLY	TRADE	AMOUNT

PRIME CONTRACTOR ONLY *(Not applicable if self-performing all work, with no subcontracting)*

1. **DBE Compliance Form.** The Owner must sign and submit this information to the Georgia Environmental Finance Authority (GEFA) to demonstrate compliance with DBE requirements. GEFA concurrence is recommended prior to award of the construction contract and is required prior to commencement of any SRF-funded construction. **(Pages GEFA-4&5)**

2. **Certification Regarding Equal Employment Opportunity.** This form is required for the Prime Contractor and for all subcontractors. The Prime Contractor's form should be submitted with the DBE Compliance Form and the subcontractors' forms should be submitted as the subcontracts are executed. **(Page GEFA-9)**

3. **Certification Regarding Debarment, Suspension, & Other Responsible Matters.** This form is required for the Prime Contractor and for all subcontractors. The Prime Contractor's form should be submitted with the DBE Compliance Form and the subcontractors' forms should be submitted as the subcontracts are executed. **(Page GEFA-10)**

4. **EPA Form 6100-2 DBE Subcontractor Participation Form.** This form gives a DBE subcontractor the opportunity to describe the work the DBE subcontractor received from Prime Contractor, how much the DBE subcontractor was paid, and any other concerns the DBE subcontractor might have. The Prime Contractor must provide this form to each DBE subcontractor. The DBE subcontractor can, as an option, submit this form to the GEFA DBE Coordinator, who will forward the form to the EPA DBE Coordinator. **(Page GEFA-11)**

5. **EPA Form 6100-3 DBE Subcontractor Performance Form.** This form captures an intended DBE subcontractor's description of work to be performed for the Prime Contractor and the price of the work. This form is to be provided by the Prime Contractor to each DBE subcontractor and submitted with the DBE Compliance Form. **(Page GEFA-12)**

6. **EPA Form 6100-4 DBE Subcontractor Utilization Form.** This form captures the Prime Contractor's intended use of an identified DBE subcontractor and the estimated dollar amount of the work. This form is to be completed by the Prime Contractor and submitted with the DBE Compliance Form **(Page GEFA-13)**

Uncommitted Trades

Documentation of Good Faith Efforts

Newspaper ads		Internet Websites	Fax Confirmation	Copies of Solicitation Emails/letters	Copies of phone logs

PROOF OF CERTIFICATION FOR EACH SUBCONTRACTOR LISTED AS A DBE, MBE, OR WBE	

SIX GOOD FAITH EFFORTS

These good faith efforts are required methods to ensure that DBEs have the opportunity to compete for procurements funded by EPA financial assistance dollars. Such good faith efforts are described as follows:

1. Ensure DBEs are made aware of contracting opportunities to the fullest extent practicable through outreach and recruitment activities. This will include placing DBEs on solicitation lists and soliciting them whenever there are potential sources.

2. Make information on forthcoming opportunities available to DBEs and arrange time frames for contracts and establish delivery schedules, where the requirements permit, in a way that encourages and facilitates participation by DBEs in the competitive process. This includes, whenever possible, posting solicitation for bids or proposals for a minimum of 30 calendar days before the bid or proposal closing date.

3. Consider in the contracting process whether firms competing for large contracts could subcontract with DBEs. This will include dividing total requirements when economically feasible into smaller tasks or quantities to permit maximum participation by DBEs in the competitive process.

4. Encourage contracting with a consortium of DBEs when a contract is too large for one of these firms to handle individually.

5. Use the resources, services, and assistance of the Department of Transportation (DOT), Small Business Administration (SBA), and the Minority Business Development Agency of the Department of Commerce (MBDA).

6. If the Prime Contractor awards subcontracts, it must take the steps described in items (1) through (5) listed above.

Please note that DBEs, MBEs, and WBEs must be certified by EPA, SBA, or DOT (or by state, local, Tribal, or private entities whose certification criteria match EPA's). DBEs must be certified in order to be counted toward the Prime Contractor's MBE/WBE goals. "Self-certified" DBE subcontractors will not be counted toward the Prime Contractor's MBE/WBE goals. Depending upon the certifying agency, a DBE may be classified as a DBE, a Minority Business Enterprise (MBE), or a Women's Business Enterprise (WBE).

The Prime Contractor must employ and document the **Six Good Faith Efforts** for all subcontracts, even if the Prime Contractor has achieved the fair share objectives.

The documentation of solicitations for the **Six Good Faith Efforts** must be detailed in order to allow for satisfactory review. Such documentation might include fax confirmation sheets, copies of solicitation letters/emails, printouts of the online solicitations, printouts of online search results and affidavits of publication in newspapers or other publiccations. The Prime Contractor is encouraged to follow up each written, fax, or e-mail solicitation with at least 1 logged phone call.

The Prime Contractor should attempt to identify and solicit DBEs in the geographic proximity of the project before soliciting those located farther away.

If a DBE subcontractor fails to complete work under the subcontract for any reason, the Prime Contractor must notify the Owner in writing prior to any termination and must employ the Six Good Faith Efforts described above if using a replacement subcontractor. Any proposed changes from the approved DBE subcontractor list must be reported to the Owner and to GEFA on the *Changes to Approved Subcontractors Form* (GEFA-14) prior to initiation of the action. EPA Forms Nos. 6100-3 and 6100-4 must also be submitted to GEFA for new DBE subcontracts.

RESOURCES FOR IDENTIFYING DBE SUBCONTRACTORS

RESOURCES FOR IDENTIFYING DBE SUBCONTRACTOR'S FOR DIRECT SOLICITATION:

Georgia Department of Transportation (GDOT)
Disadvantaged Business Enterprise Program
(404) 631-1972
http://tomcat2.dot.state.ga.us/ContractsAdministration/uploads/rptDBE_Directory_CA_New.pdf

City of Atlanta, Georgia
Office of Contract Compliance
(404) 330-6010
http://pro.prismcompliance.com/

DeKalb County, Georgia
Office of Purchasing and Contracting
(404) 371-4730
http://www.co.dekalb.ga.us/purchasing/pdf/supplierList.pdf

Fulton County, Georgia
Purchasing and Contract Compliance
(404) 612-5800
http://www.fultoncountyga.gov/plugins/content/external_links/frameset.php?url=http%3A%2F%2Fwww.occfultoncountyga.com%2FDirectory%2FMFBEDirectoryExternal.aspx

Metropolitan Atlanta Rapid Transit Authority (MARTA)
Disadvantaged Business Enterprise Program
(404) 848-4656
http://www.itsmarta.com/vendor-opportunities.aspx

United States Environmental Protection Agency
http://www.epa.gov/osbp/dbe_team.htm
Teree Henderson
National DBE Program Coordinator
(202) 566-2222
henderson.teree@epa.gov

Georgia Environmental Finance Authority
DBE Compliance Coordinator
(404) 584-1000
www.gefa.ga.gov
dbe_compliance@gefa.ga.gov

NOTES:

(1) The Prime Contractor shall use the necessary resources to identify and directly solicit no less than 3 certified MBE firms and 3 WBE firms to bid in each expected subcontract area or trade.

(2) If a diligent and documented search of the recommended directories does not identify 3 potential certified MBE firms and 3 potential certified WBE firms, then the Prime Contractor shall post an advertisement in the Owner's local legal organ, the Owner's official website, a regional newspaper in a larger community in the proximity, the Prime Contractor's website, or some other appropriate resource. Whenever possible, post solicitation for bids or proposals for a minimum of 30 calendar days before the bid or proposal closing date.

(3) Expenditures to a DBE that acts merely as a broker or passive conduit of funds, without performing, managing, or supervising the work of its subcontract in a manner consistent with normal business practices may not be counted.

(4) The Prime Contractor should attempt to identify and first solicit DBEs in the geographic proximity of the project before soliciting those located farther away.

(5) Contact the GEFA DBE Compliance Coordinator at (404) 584-1000 or dbe_compliance@gefa.ga.gov for further assistance or resources.

CERTIFICATION BY PROPOSED PRIME CONTRACTOR OR SUBCONTRACTOR REGARDING EQUAL EMPLOYMENT OPPORTUNITY

Proposed Prime Contractor
Proposed Subcontractor

This certification is required pursuant to Executive Order 11246, Part II, Section 203 (b), (30 F.R. 12319-25). Any bidder or prospective prime contractor, or any of the proposed subcontractors, shall state as an initial part of the bid or negotiations of the contract whether it has participated in any previous contract or subcontract subject to the equal opportunity clause; and, if so, whether it has filed all compliance reports due under applicable instructions.

Where the certification indicated that the prime or subcontractor has not filed a compliance report due under applicable instruction, such contractor shall be required to submit a compliance report.

(1) Bidder has participated in a previous contract or subcontract subject to the Equal Opportunity Clause.
YES _____ NO _____

(2) Compliance Reports were required to be filed in connection with such contract or subcontract.
YES _____ NO _____ (If YES, state what reports were filed and with what agency.)

(3) Bidder has filed all compliance reports due under applicable instructions, including SF-100 (EEO-1 Report).
YES _____ NO _____ (If NO, please explain in detail.)

The information above is true and complete to the best of my knowledge and belief. (A willfully false statement is punishable by law – U.S. Code, Title 18, Section 1001.)

_____
PRINTED NAME & TITLE OF AUTHORIZED REPRESENTATIVE OF CONTRACTOR OR SUBCONTRACTOR

_____ _____
SIGNATURE OF AUTHORIZED REPRESENTATIVE **DATE**

CERTIFICATION BY PROPOSED PRIME CONTRACTOR OR SUBCONTRACTOR REGARDING DEBARMENT, SUSPENSION, AND OTHER RESPONSIBLE MATTERS

Proposed Prime Contractor
Proposed Subcontractor

Under Executive Order 12549 individuals or organizations debarred from participation in Federal Assistance Programs may not receive an assistance award under federal program or sub-agreement there under for $25,000 or more. Accordingly each recipient of a State loan or a contract (engineering or construction) awarded under a loan must complete the following certification (see 40 CFR 32.510).

The prospective participant certifies to the best of its knowledge and belief that it and its principals;

(a) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency.

(b) Have not within a three year period preceding this proposal been convicted of or had a civil judgement rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

(c) Are not presently indicted for or otherwise criminally or civilly charged by a government entity (Federal, State or local) with commission of any of the offenses enumerated in paragraph (1) (b) of this certification; and

(d) Have not within a three year period preceding this application/proposal had one or more public transactions (Federal, State or local) terminated for cause of default.

I understand that a false statement on this certification may be grounds for rejection of this proposal or termination of the award. (A willfully false statement is punishable by law – U.S. Code, Title 18, Section 1001.)

_____

PRINTED NAME & TITLE OF AUTHORIZED REPRESENTATIVE OF CONTRACTOR OR SUBCONTRACTOR

_____ _____

SIGNATURE OF AUTHORIZED REPRESENTATIVE DATE

_____ **I am unable to certify to the above statements. My explanation is as follows:**

United States Environmental Protection Agency

OMB Control No: 2090-0030
Approved: 8/13/2013
Approval Expires: 8/31/2015

Disadvantaged Business Enterprise (DBE) Program
DBE Subcontractor Participation Form

An EPA Financial Assistance Agreement Recipient must require its prime contractors to provide this form to its DBE subcontractors. This form gives a DBE[1] subcontractor[2] the opportunity to describe work received and/or report any concerns regarding the EPA-funded project (e.g., in areas such as termination by prime contractor, late payments, etc.). The DBE subcontractor can, as an option, complete and submit this form to the EPA DBE Coordinator at any time during the project period of performance.

Subcontractor Name		Project Name
Bid/ Proposal No.	Assistance Agreement ID No. (if known)	Point of Contact
Address		
Telephone No.		Email Address
Prime Contractor Name		Issuing/Funding Entity:

Contract Item Number	Description of Work Received from the Prime Contractor Involving Construction, Services , Equipment or Supplies	Amount Received by Prime Contractor

[1] A DBE is a Disadvantaged, Minority, or Woman Business Enterprise that has been certified by an entity from which EPA accepts certifications as described in 40 CFR 33.204-33.205 or certified by EPA. EPA accepts certifications from entities that meet or exceed EPA certification standards as described in 40 CFR 33.202.

[2] Subcontractor is defined as a company, firm, joint venture, or individual who enters into an agreement with a contractor to provide services pursuant to an EPA award of financial assistance.

United States Environmental Protection Agency

OMB Control No: 2090-0030
Approved: 8/13/2013
Approval Expires: 8/31/2015

Disadvantaged Business Enterprise (DBE) Program
DBE Subcontractor Performance Form

This form is intended to capture the DBE[1] subcontractor's[2] description of work to be performed and the price of the work submitted to the prime contractor. An EPA Financial Assistance Agreement Recipient must require its prime contractor to have its DBE subcontractors complete this form and include all completed forms in the prime contractors bid or proposal package.

Subcontractor Name	Project Name	
Bid/ Proposal No.	Assistance Agreement ID No. (if known)	Point of Contact
Address		
Telephone No.	Email Address	
Prime Contractor Name	Issuing/Funding Entity:	

Contract Item Number	**Description of Work Submitted to the Prime Contractor Involving Construction, Services , Equipment or Supplies**	**Price of Work Submitted to the Prime Contractor**
DBE Certified By: ___ DOT ___SBA ___ Other: _____	Meets/ exceeds EPA certification standards? ___YES ___NO ___Unknown	

[1] A DBE is a Disadvantaged, Minority, or Woman Business Enterprise that has been certified by an entity from which EPA accepts certifications as described in 40 CFR 33.204-33.205 or certified by EPA. EPA accepts certifications from entities that meet or exceed EPA certification standards as described in 40 CFR 33.202.

[2] Subcontractor is defined as a company, firm, joint venture, or individual who enters into an agreement with a contractor to provide services pursuant to an EPA award of financial assistance.

United States Environmental Protection Agency

OMB Control No: 2090-0030
Approved: 8/13/2013
Approval Expires: 8/31/2015

Disadvantaged Business Enterprise (DBE) Program
DBE Subcontractor Utilization Form

This form is intended to capture the prime contractor's actual and/or anticipated use of identified certified DBE[1] subcontractors[2] and the estimated dollar amount of each subcontract. An EPA Financial Assistance Agreement Recipient must require its prime contractors to complete this form and include it in the bid or proposal package.
Prime contractors should also maintain a copy of this form on file.

Prime Contractor Name		Project Name
Bid/ Proposal No.	Assistance Agreement ID No. (if known)	Point of Contact
Address		
Telephone No.		Email Address
Issuing/Funding Entity:		

I have identified potential DBE certified subcontractors	___ YES	___ NO
If yes, please complete the table below. If no, please explain:		

Subcontractor Name/ Company Name	**Company Address/ Phone/ Email**	**Est. Dollar Amt**	**Currently DBE Certified?**

Continue on back if needed

[1] A DBE is a Disadvantaged, Minority, or Woman Business Enterprise that has been certified by an entity from which EPA accepts certifications as described in 40 CFR 33.204-33.205 or certified by EPA. EPA accepts certifications from entities that meet or exceed EPA certification standards as described in 40 CFR 33.202.

CHANGES TO APPROVED SUBCONTRACTORS FORM

Loan Recipient _____ SRF Loan Number _____

CERTIFICATIONS:

I certify that the information submitted on and with this form is true and accurate and that this firm has met and will continue to meet the conditions of this construction contract regarding DBE solicitation and utilization. I further certify that criteria used in selecting subcontractors and suppliers were applied equally to all potential participants.

_____ Date_____

(Prime Contractor signature)

_____

(Printed name and title)

I certify that I have reviewed the information submitted on and with this form and that it meets the requirements of the Owner's State Revolving Fund loan contract.

_____ Date_____

(Signature of Owner or Owner's representative)

_____

(Printed name and title)

GENERAL INFORMATION:

1) If an approved subcontractor is terminated or replaced, please identify this company and briefly state reason.

Subcontractor Name::	**Trade**
Reason Terminated or Replaced	

2) For new or additional subcontractors, list name, trade, address, telephone number, contact person, dollar amount of subcontract, and DBE status.

New Subcontractor Name and Contact Person	**Trade**
Address	**Telephone Number**
Dollar Amount	**DBE Status**

1) Attach proof of certification by EPA, SBA, DOT (or by state, local, Tribal, or private entities whose certification criteria match EPA's) for each subcontractor listed as a DBE, MBE, or WBE.

2) Attach documentation of Six Good Faith Efforts solicitation effort for all new subcontracts.

3) Provide justification for not selecting any certified DBE subcontractor that submitted a low bid for any subcontract area.

4) For each subcontractor, attach certifications regarding Equal Employment Opportunity (GEFA-9) and certifications regarding Debarment, Suspension, and Other responsible Matters (GEFA-10)

DBE ANNUAL REPORT
FORM (5700-52A)

This form must be completed by recipients of federal financial assistance for procurement of supplies, equipment, construction or services. SRF loan recipients are required to submit this report to GEFA by the 20th of October for the previous period of October 1 through September 30. Please submit a "negative" report even if $0 is the amount paid to MBE/WBE subcontractors during the reporting period.

<table>
<tr><td colspan="4">ANNUAL REPORT FORM (5700-52A)</td></tr>
<tr><td colspan="2">1. PRIME CONTRACTOR</td><td colspan="2">2. REPORTING PERIOD (Complete date using current year.)
Period Ending (September 30, _____)</td></tr>
<tr><td colspan="2">3. SUBMIT TO:
Georgia Environmental Finance Authority
Attention: DBE Compliance Coordinator
233 Peachtree Street, N.E.
Harris Tower, Suite 900
Atlanta, Georgia 30303
dbe_compliance@gefa.ga.gov</td><td colspan="2">4. LOAN RECIPIENT (Name, Address and Telephone)</td></tr>
<tr><td>5. LOAN RECIPIENT (OWNER)
REPORTING CONTACT</td><td>PHONE:</td><td>6. TYPE OF FEDERAL FINANCIAL ASSISTANCE PROGRAM (Check one)
CWSRF _____ DWSRF_____</td><td>7. SRF LOAN NUMBER</td></tr>
<tr><td colspan="2">8. CONTRACTOR NAME & TOTAL CONSTRUCTION CONTRACT AMOUNT</td><td colspan="2">9. ACTUAL DOLLAR AMOUNT PAIDTO MBE/WBE SUBCONTRACTORS THIS PERIOD
$ MBE_____ $ WBE_____ NEGATIVE REPORT ($0) ___</td></tr>
<tr><td colspan="2">10. RECIPIENT'S MBE/WBE GOALS
MBE 4.0 % WBE 4.0 %</td><td colspan="2">11. TOTAL DOLLARS SPENT THIS PERIOD
MBE $_____
WBE $_____
NON MBE/WBE $_____
TOTAL $_____</td></tr>
<tr><td colspan="2">12. NAME & TITLE OF AUTHORIZED REPRESENTATIVE OF LOAN RECIPIENT (OWNER).</td><td>13. SIGNATURE OF AUTHORIZED REPRESENTATIVE OF LOAN RECIPIENT.</td><td>14. DATE</td></tr>
<tr><td colspan="4">MBE/WBE PAYMENTS MADE DURING PERIOD</td></tr>
<tr><td colspan="3">NAME & ADDRESS of DBE (SUB)CONTRACTOR (indicate if MBE or WBE firm)</td><td>TOTAL DOLLAR AMOUNT PAID & DATE PAID
$_____ DATE_____</td></tr>
<tr><td colspan="3"></td><td></td></tr>
<tr><td colspan="3"></td><td></td></tr>
<tr><td colspan="3"></td><td></td></tr>
</table>

SPECIAL PROVISIONS

(a) The Prime Contractor is required to pay its subcontractors in accordance with the Georgia Prompt Payment Act (OCGA 13-11).

(b) The Prime Contractor is required to insert the entirety of the Davis Bacon contract requirements into all subcontracts

(c) Sewer line and water line crossing of all roads and streets shall be done in accordance with the Georgia Department of Transportation (D.O.T.) Policies and Procedures and must comply with the Ga. D.O.T. Standard Specifications, Construction of Roads and Bridges, 1993 Edition.

(c) Construction shall be carried out so as to prevent bypassing of wastewater flow and to prevent interruption of drinking water treatment during construction. EPD must receive written notification prior to any reduction in the level of treatment and must approve all temporary modifications to the treatment process prior to the activity.

(d) Erosion and Sedimentation Control shall be accomplished in accordance with the Georgia Erosion and Sedimentation Control Act of 1975 as currently amended and NPDES General Permits (Storm Water from Construction Sites). See also www.gaepd.org and www.gaswcc.georgia.gov for information regarding permits.

(e) Use of Chemicals: All chemicals used during project construction or furnished for project operation, whether herbicide, pesticide, disinfectant, polymer reactant or of other classification, must show approval of either EPA or USDA. Use of all such chemicals and disposal of residues shall be in conformance with State and local regulations as appropriate.

(f) It is the duty of the Prime Contractor, the Owner and the Engineer to ensure the construction of the project, including the letting of contracts in connection therewith, shall comply with all applicable laws and regulations and requirements of the United States of America or any agency thereof, the state of Georgia or any agency thereof, territorial, or any local government laws or political subdivision and ordnances to the extent that such requirements do not conflict with Federal laws and this subchapter.

(g) EPD, EPA, and GEFA shall have access to the site and the project work at all times.

BONDS

Bonding requirements for Contracts of $100,000 or less are contained in the General Conditions. Bond requirements of contracts in excess of $100,000 are:

1. Bid guarantee equivalent to five percent of the bid price. The bid guarantee shall consist of a firm commitment such as a certified check or bid bond submitted with the bid.

2. Performance bond equal to 100 percent of the contract price and;

3. Payment bond equal to 100 percent of the contract price. Bonds must be obtained from companies holding Certificates of Authority as acceptable sureties, issued by the U.S. Treasury.

SPECIAL NOTICE TO BIDDERS

By the submission of this bid, each bidder acknowledges that he understands and agrees to be bound by the equal opportunity requirements of EPA regulations (40 CFR Part 8, particularly Section 8.4 (b)), which shall be applicable throughout the performance of work under any contract awarded pursuant to this solicitation. Each bidder agrees that if awarded a contract, it will similarly bind contractually each subcontractor. In implementation of the foregoing policies, each bidder further understands and agrees that if awarded a contract, it must engage in affirmative action directed at promoting and ensuring equal employment opportunity in the workforce used under the contract (and that it must require contractually the same effort of all subcontractors whose subcontracts exceed $10,000.00). The bidder understands and agrees that "affirmative action" as used herein shall constitute a good faith effort to achieve and maintain minority employment in each trade in the on-site workforce used on the project.

EQUAL EMPLOYMENT OPPORTUNITY NOTICE

NOTICE OF REQUIREMENT FOR AFFIRMATIVE ACTION TO ENSURE EQUAL OPPORTUNITY (EXECUTIVE ORDER 11246)

1. The Offeror's or Bidder's attention is called to the Equal Opportunity Clause which is included in the nondiscrimination Provision and Labor Standards, EPA Form 5720-4 and the Standard Federal Equal Employment Opportunity (EEO) Construction Contract Specifications set forth herein.

2. The goals for minority and female participation, expressed in percentage terms for the Contractor's aggregate workforce in each trade on all construction work in the covered area, are as follows:

Goals for minority participation for each trade	**4.0 percent**
Goals for female participation for each trade	**4.0 percent**

These goals are applicable to all the Contractor's construction work (whether or not it is Federal or federally assisted) performed in the covered area.

The Contractor's compliance with the Executive Order and the regulations in 41 CFR Part 60-4 shall be based on its implementation of the Equal Opportunity Clause, specific affirmative action obligations required by the specifications set forth in 41 CFR 60-4.3(a), and its efforts to meet the goals established for the geographical area where the contract resulting from this solicitation is to be performed. The hours of minority and female employment and training must be substantially uniform throughout the length of the contract, and in each trade, and the contractor shall make a good faith effort to employ minority and women evenly on each of its projects. The transfer of minority or female employees or trainees from Contractor to Contractor or from project to project for the sole purpose of meeting the Contractor's goals shall be a violation to the contract, the Executive Order and the regulations in 41 CFR Part 60-4. Compliance with the goals will be measured against the total work hours performed.

3. The contractor shall not discriminate on the basis of race, color, national origin or sex in the performance of this contract. The contractor shall carry out applicable requirements of 40CFR Part 33 in the award and administration of contracts awarded under EPA financial assistance agreements. Failure by the contractor to carry out these requirements is a material breach of this contract, which may result in the termination of this contract.

4. As used in this Notice, and in the contract resulting from this solicitation, the "covered area" is (insert description of the geographical area where the contract is to be performed giving the state, county and city, if any).

EEO Construction Contract Specifications (Executive Order 11246)

EEO Specifications:

1. As used in these specifications:

   a. "Covered area" means the geographical area described in the solicitation from which this contract resulted;

   b. "Director" means Director, Office of Federal Contract Compliance Program, United States Department of Labor, or any person to whom the Director delegates authority;

   c. "Employer identification number" means the Federal Social Security number used on the Employer's Quarterly Federal Tax Return, U.S. Treasury Department Form, 941.

   d. "Minority" includes:

      (i) Black (all persons having origins in any of the Black African racial groups not of Hispanic origin);

      (ii) Hispanic (all persons of Mexican, Puerto Rican, Cuban, Central or South American or other Spanish Culture or origin, regardless of race);

      (iii) Asian and Pacific Islander (all persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian Subcontinent, or the Pacific Islands); and

      (iv) American Indian or Alaskan Native (all persons having origins in any of the original peoples of North America and maintaining identifiable tribal affiliations through membership and participation or community identification).

2. Whenever the contractor, or any subcontractor at any tier, subcontracts a portion of the work involving any construction trade, it shall physically include in each subcontract in excess of $10,000 the provisions of these specifications and the Notice which contains the applicable goals for minority and female participation and which is set forth in the solicitations from which this contract resulted.

3. If the Contractor is participating (pursuant to 41 CFR 60-4.5) in a Hometown Plan approved by the U.S. Department of Labor in the covered area either individually or through an association, its affirmative action obligations on all work in the Plan area (including goals and timetables) shall be in accordance with that Plan for those trades which have unions participating in the Plan. Contractors must be able to demonstrate their participation in and compliance with the provisions of any such Hometown Plan. Each Contractor or Subcontractor participating in an approved Plan is individually required to comply with its obligations under the EEO clause, and to make a good faith effort to achieve each goal under the Plan in each trade in which it has employees. The overall good faith performance by other Contractors or Subcontractors toward a goal in an approved Plan does not excuse any covered Contractor's or Subcontractor's failure to take good faith efforts to achieve the Plan goals and timetables.

4. The Contractor shall implement the specific affirmative action standards provided in paragraphs 7(a) through (p) of these specifications. The goals set forth in the solicitation from which this contract resulted are expressed as percentages of the total hours of employment and training of minority and female utilization the Contractor should reasonably be able to achieve in each construction trade in which it has employees in the covered area. The Contractor is expected to make substantially uniform progress toward its goals in each craft during the period specified.

5. Neither the provisions of any collective bargaining agreement, nor the failure by a union with whom the Contractor has a collective bargaining agreement, to refer either minorities or women shall excuse the Contractor's obligations under these specifications, Executive Order 11246, or the regulations promulgated pursuant thereto.

6. In order for the non-working training hours of apprentices and trainees to be counted in meeting the goals, such apprentices and trainees must be employed by the Contractor during the training period, and the Contractor must have made a commitment to employ the apprentices and trainees at the completion of their training, subject to the availability of employment opportunities. Trainees must be trained pursuant to training programs approved by the U.S. Department of Labor.

7. The Contractor shall take specific affirmative actions to ensure equal employment opportunity. The evaluation of the Contractor's compliance with these specifications shall be based upon its effort to achieve maximum results from its actions. The Contractor shall document these efforts fully, and shall implement affirmative action steps at least as extensive as the following:

   a. Ensure and maintain a working environment free of harassment, intimidation, and coercion at all sites, and in all facilities at which the Contractor's employees are assigned to work. The Contractor, where possible, will assign two or more women to each construction project. The Contractor shall specifically ensure that all foremen, superintendents, and other on-site supervisory personnel are aware of and carry out the Contractor's obligation to maintain such a working environment, with specific attention to minority or female individuals working at such sites or in such facilities.

   b. Establish and maintain a current list of minority and female recruitment sources, provide written notification to minority and female recruitment sources and to community organizations when the Contractor or its unions have employment opportunities available, and maintain a record of the organizations responses.

   c. Maintain a current file of the names, addresses and telephone numbers of each minority and female off-the-street applicant and minority or female referral from a with respect to each such individual. If such individual was sent to the union hiring hall for referral and was not referred back to the Contractor by the union or, if referred, not employed by the Contractor, this shall be documented in the file with the reason therefore, along with whatever actions the Contractor may have taken.

   d. Provide immediate written notification to the Director when the union or unions with which the Contractor has a collective bargaining agreement has not referred to the Contractor a minority person or woman sent by the Contractor, or when the Contractor has other information that the union referral process has impeded the Contractor's efforts to meet its obligations.

   e. Develop on-the-job training opportunities and/or participate in training programs for the area which expressly include minorities and women, including upgrading programs and apprenticeship and trained programs relevant to the Contractor's employment needs, especially those programs funded or approved by the Department of Labor. The Contractor shall provide notice of these programs to the sources complied under 7(b) above.

   f. Disseminate the Contractor's EEO policy by providing notice of the policy to unions and training programs and requesting their cooperation in assisting the Contractor in meeting its EEO obligations by including it in any policy manual and collective bargaining agreement; by publicizing it in the company newspaper, annual report, etc.; by specific review of the policy with all management personnel and with all minority and female employees at least once a year; and by posting the company EEO policy on bulletin boards accessible to all employees at each location where construction work is performed.

g. Review, at least annually, the company's EEO policy and affirmative action obligations under these specifications with all employees having any responsibility for hiring, assignment, layoff, termination or other employment decisions including specific review of these items with on-site supervisory personnel such as Superintendents, General Foremen, etc., prior to the initiation of construction work at any job site. A written record shall be made and maintained identifying the time and place of these meetings, persons attending, subject matter discussed, and disposition of the subject matter.

h. Disseminate the Contractor's EEO policy externally by including it in any advertising in the news media, specifically including minority and female news media, and providing written notification to and discussing the Contractor's EEO policy with other Contractors and Subcontractors with whom the Contractor does or anticipates doing business.

i. Direct its recruitment efforts, both oral and written, to minority, female and community organizations, to schools with minority and female students and to minority and female recruitment and training organizations serving the Contractor's recruitment area and employment needs. Not later than one month prior to the date for the acceptance of applications for apprenticeship or other training by any recruitment source, the Contractor shall send written notification to organizations such as the above, describing the openings, screening procedures, and tests to be used in the selection process.

j. Encourage present minority and female employees to recruit other minority persons and women and, where reasonable, provide after school, summer and vacation employment to minority and female youth both on the site and in other areas of a Contractor's workforce.

k. Validate all tests and other selection requirements where there is an obligation to do so under 41 CFR Part 60-3.

l. Conduct, at least annually, an inventory and evaluation at least of all minority and female personnel for promotional opportunities and encourage these employees to seek or to prepare for, through appropriate training, etc., such opportunities.

m. Ensure that seniority practices, job classifications, work assignments and other personnel practices, do not have a discriminatory effect by continually monitoring all personnel and employment related activities to ensure that the EEO policy and the Contractor's obligations under these specifications are being carried out.

n. Ensure that all facilities and company activities are non-segregated except that separate or single-user toilet and necessary changing facilities shall be provided to assure privacy between the sexes.

o. Document and maintain a record of all solicitations of offers for subcontracts from minority and female construction contractors and suppliers, including circulation of solicitations to minority and female contractor associations and other business associations.

p. Conduct a review, at least annually, of all supervisors' adherence to and performance under the Contractor's EEO policies and affirmative action obligations.

8. Contractors are encouraged to participate in voluntary associations which assist in fulfilling one or more of their affirmative action obligations 7(a) through (p). The efforts of a contractor association, joint contractor-union, contractor-community, or other similar group of which the contractor is a member and participant may be asserted as fulfilling any one or more of its obligations under 7(a) through (p) of these Specifications provided that the contractor actively participates in the group, makes every effort to assure that the group has a positive impact on the employment of minorities and women in the industry, ensures that the concrete benefits of the program are reflected in the Contractor's minority and female workforce participation, makes

a good faith effort to meet its individual goals and timetables, and can provide access to documentation which demonstrates the effectiveness of actions taken on behalf of the Contractor. The obligation to comply, however, is the Contractor's and failure of such a group to fulfill an obligation shall not be a defense for the Contractor's noncompliance.

9. A single goal for minorities and a separate single goal for women have been established. The Contractor, however, is required to provide equal employment opportunity and to take affirmative action for all minority groups, both male and female, and all women, both minority and non-minority. Consequently, the Contractor may be in violation of the Executive Order if a particular group is employed in a substantially disparate manner (for example, even though the Contractor has achieved its goals for women generally, the Contractor may be in violation of the Executive Order if a specific minority group of women is underutilized).

10. The Contractor shall not use the goals and timetables or affirmative action standards to discriminate against any person because of race, color, religion, sex, or national origin.

11. The Contractor shall not enter into any Subcontract with any person or firm debarred from Government contracts pursuant to Executive Order 11246.

12. The Contractor shall carry out such sanctions and penalties for violation of these specifications and of the Equal Opportunity Clause, including suspension, termination and cancellation of existing subcontracts as may be imposed or ordered pursuant to Executive Order 11246, as amended, and its implementing regulations, by the Office of Federal Contract Compliance Programs. Any Contractor who fails to carry out such sanctions and penalties shall be in violation of these specifications and Executive Order 11246, as amended.

13. The Contractor, in fulfilling its obligations under these specifications, shall implement specific affirmative action steps, at least as extensive as those standards prescribed in paragraph 7 of these specifications, so as to achieve maximum results from its efforts to ensure equal employment opportunity. If the Contractor fails to comply with the requirements of the Executive Order, the implementing regulations, or these specifications, the Director shall proceed in accordance with 41 CFR 60-4.8.

14. The Contractor shall designate a responsible official to monitor all employment related activity to ensure that the company EEO policy is being carried out, to submit reports relating to the provisions hereof as may be required by the Government and to keep records. Records shall at least include for each employee the name, address, telephone numbers, construction trade, union affiliation, if any, employee identification number when assigned, social security number, race, sex, status (e.g., mechanic, apprentice, trainee, helper, or laborer), dates of changes in status, hours worked per week in the indicated trade, rate of pay, and locations at which the work was performed. Records shall be maintained in an easily understandable and retrievable form; however, to the degree that existing records satisfy this requirement, contractors shall not be required to maintain separate records.

15. Nothing herein provided shall be construed as a limitation upon the application of other laws which establish different standards of compliance or upon the application of requirements for the hiring of local or other area residents (e.g., those under the Public Works Employment Act of 1977 and the Community Development Block Grant Program).

Davis-Bacon and Related Acts

Labor Standards Provisions for Federally Assisted Contracts

Contract Provision for Contracts in Excess of $2,000.

(1) Minimum wages.

(i) All laborers and mechanics employed or working upon the site of the work will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor and such laborers and mechanics.

Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph (a)(1)(iv) of this section; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in § 5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein: Provided that the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under paragraph (a)(1)(ii) of this section) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

Subrecipients may obtain wage determinations from the U.S. Department of Labor's web site, http://www.dol.gov/whd/govcontracts/dbra.htm (E-tools)

(ii)(A) The subrecipient(s), on behalf of EPA, shall require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The State award official shall approve a request for an additional classification and wage rate and fringe benefits therefore only when the following criteria have been met:

(1) The work to be performed by the classification requested is not performed by a classification in the wage determination; and

(2) The classification is utilized in the area by the construction industry; and

(3) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(B) If the contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the subrecipient(s) agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), documentation of the action taken and the request, including the local wage determination shall be sent by the subrecipient (s) to the State award official. The State award official will transmit the request, to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, DC 20210 and to the EPA DB Regional Coordinator concurrently. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification request within 30 days of receipt and so advise the State award official or will notify the State award official within the 30-day period that additional time is necessary.

(C) In the event the contractor, the laborers or mechanics to be employed in the classification or their representatives, and the subrecipient(s) do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the award official shall refer the request and the local wage determination, including the views of all interested parties and the recommendation of the State award official, to the Administrator for determination. The request shall be sent to the EPA DB Regional Coordinator concurrently. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt of the request and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(D) The wage rate (including fringe benefits where appropriate) determined pursuant to paragraphs (a)(1)(ii)(B) or (C) of this section, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

(iii) Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

(iv) If the contractor does not make payments to a trustee or other third person, the contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, Provided, That the Secretary of Labor has found, upon the written request of the contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

(2) Withholding. The subrecipient(s), shall upon written request of the EPA Award Official or an authorized representative of the Department of Labor, withhold or cause to be withheld from the contractor under this contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work, all or part of the wages required by the contract, the (Agency) may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

(3) Payrolls and basic records.

(i) Payrolls and basic records relating thereto shall be maintained by the contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work. Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in section 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

(ii)(A) The contractor shall submit weekly, for each week in which any contract work is performed, a copy of all payrolls to the subrecipient, that is, the entity that receives the sub-grant or loan from the State capitalization grant recipient. Such documentation shall be available on request of the State recipient or EPA. As to each payroll copy received, the subrecipient shall provide written confirmation in a form satisfactory to the State indicating whether or not the project is in compliance with the requirements of 29 CFR 5.5(a)(1) based on the most recent payroll copies for the specified week. The payrolls shall set out accurately and completely all of the information required to be maintained under 29 CFR 5.5(a)(3)(i), except that full social security numbers and home addresses shall not be included on the weekly

payrolls. Instead the payrolls shall only need to include an individually identifying number for each employee (e.g., the last four digits of the employee's social security number). The required weekly payroll information may be submitted in any form desired. Optional Form WH-347 is available for this purpose from the Wage and Hour Division Web site at http://www.dol.gov/whd/forms or its successor site. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors. Contractors and subcontractors shall maintain the full social security number and current address of each covered worker, and shall provide them upon request to the subrecipient(s) for transmission to the State or EPA if requested by EPA, the State, the contractor, or the Wage and Hour Division of the Department of Labor for purposes of an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this section for a prime contractor to require a subcontractor to provide addresses and social security numbers to the prime contractor for its own records, without weekly submission to the subrecipient(s).

(B) Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:

(1) That the payroll for the payroll period contains the information required to be provided under § 5.5 (a)(3)(ii) of Regulations, 29 CFR part 5, the appropriate information is being maintained under § 5.5 (a)(3)(i) of Regulations, 29 CFR part 5, and that such information is correct and complete;

(2) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in Regulations, 29 CFR part 3;

(3) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.

(C) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the "Statement of Compliance" required by paragraph (a)(3)(ii)(B) of this section.

(D) The falsification of any of the above certifications may subject the contractor or subcontractor to civil or criminal prosecution under section 1001 of title 18 and section 231 of title 31 of the United States Code.

(iii) The contractor or subcontractor shall make the records required under paragraph (a)(3)(i) of this section available for inspection, copying, or transcription by authorized representatives of the State, EPA or the Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the contractor or subcontractor fails to submit the required records or to make them available, the Federal agency or State may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

(4) Apprentices and trainees--

(i) Apprentices. Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship Training, Employer and Labor Services, or with a State Apprenticeship Agency recognized by the Office, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Office of Apprenticeship Training, Employer and Labor Services or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed.

In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the contractor's or subcontractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination. In the event the Office of Apprenticeship Training, Employer and Labor Services, or a State Apprenticeship Agency recognized by the Office, withdraws approval of an apprenticeship program, the contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(ii) Trainees. Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(iii) Equal employment opportunity. The utilization of apprentices, trainees and journeymen under this part shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR part 30.

(5) Compliance with Copeland Act requirements. The contractor shall comply with the requirements of 29 CFR part 3, which are incorporated by reference in this contract.

(6) Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clauses contained in 29 CFR 5.5(a)(1) through (10) and such other clauses as the EPA determines may by appropriate, and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in 29 CFR 5.5.

(7) Contract termination; debarment. A breach of the contract clauses in 29 CFR 5.5 may be grounds for termination of the contract, and for debarment as a contractor and a subcontractor as provided in 29 CFR 5.12.

(8) Compliance with Davis-Bacon and Related Act requirements. All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR parts 1, 3, and 5 are herein incorporated by reference in this contract.

(9) Disputes concerning labor standards. Disputes arising out of the labor standards provisions of this contract shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 CFR parts 5, 6, and 7. Disputes within the

meaning of this clause include disputes between the contractor (or any of its subcontractors) and Subrecipient(s), State, EPA, the U.S. Department of Labor, or the employees or their representatives.

(10) Certification of eligibility.

(i) By entering into this contract, the contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(ii) No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(iii) The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001.

Contract Provision for Contracts in Excess of $100,000.

(a) Contract Work Hours and Safety Standards Act. The subrecipient shall insert the following clauses set forth in paragraphs (a)(1), (2), (3), and (4) of this section in full in any contract in an amount in excess of $100,000 and subject to the overtime provisions of the Contract Work Hours and Safety Standards Act. These clauses shall be inserted in addition to the clauses required by Item 3, above or 29 CFR 4.6. As used in this paragraph, the terms laborers and mechanics include watchmen and guards.

(1) Overtime requirements. No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.

(2) Violation; liability for unpaid wages; liquidated damages. In the event of any violation of the clause set forth in paragraph (a)(1) of this section the contractor and any subcontractor responsible therefore shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph (a)(1) of this section, in the sum of $10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph (a)(1) of this section.

(3) Withholding for unpaid wages and liquidated damages. The subrecipient, upon written request of the EPA Award Official or an authorized representative of the Department of Labor, shall withhold or cause to be withheld, from any moneys payable on account of work performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph (b)(2) of this section.

(4) Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraph (a)(1) through (4) of this section and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs (a)(1) through (4) of this section.

(b) In addition to the clauses contained in Item 3, above, in any contract subject only to the Contract Work Hours and Safety Standards Act and not to any of the other statutes cited in 29 CFR 5.1, the Subrecipient shall insert a clause requiring that the contractor or subcontractor shall maintain payrolls and basic payroll records during the course of the work and shall preserve them for a period of three years from the completion of the contract for all laborers and mechanics, including guards and watchmen, working on the contract. Such records shall contain the name and address of each such employee, social security number, correct classifications, hourly rates of wages paid, daily and weekly number of hours worked, deductions made, and actual wages paid. Further, the Subrecipient shall insert in any such contract a clause providing that the records to be maintained under this paragraph shall be made available by the contractor or subcontractor for inspection, copying, or transcription by authorized representatives of the (write the name of agency) and the Department of Labor, and the contractor or subcontractor will permit such representatives to interview employees during working hours on the job

(5) Compliance Verification:

(a) The subrecipient shall periodically interview a sufficient number of employees entitled to DB prevailing wages (covered employees) to verify that contractors or subcontractors are paying the appropriate wage rates. As provided in 29 CFR 5.6(a)(6), all interviews must be conducted in confidence. The subrecipient must use Standard Form 1445 (SF 1445) or equivalent documentation to memorialize the interviews. Copies of the SF 1445 are available from EPA on request.

(b) The subrecipient shall establish and follow an interview schedule based on its assessment of the risks of noncompliance with DB posed by contractors or subcontractors and the duration of the contract or subcontract. At a minimum, the subrecipient should conduct interviews with a representative group of covered employees within two weeks of each contractor or subcontractor's submission of its initial weekly payroll data and two weeks prior to the estimated completion date for the contract or subcontract. Subrecipients must conduct more frequent interviews if the initial interviews or other information indicates that there is a risk that the contractor or subcontractor is not complying with DB. Subrecipients shall immediately conduct necessary interviews in response to an alleged violation of the prevailing wage requirements. All interviews shall be conducted in confidence.

(c) The subrecipient shall periodically conduct spot checks of a representative sample of weekly payroll data to verify that contractors or subcontractors are paying the appropriate wage rates. The subrecipient shall establish and follow a spot check schedule based on its assessment of the risks of noncompliance with DB posed by contractors or subcontractors and the duration of the contract or subcontract. At a minimum, if practicable, the subrecipient should spot check payroll data within two weeks of each contractor or subcontractor's submission of its initial payroll data and two weeks prior to the completion date the contract or subcontract. Subrecipients must conduct more frequent spot checks if the initial spot check or other information indicates that there is a risk that the contractor or subcontractor is not complying with DB. In addition, during the examinations the subrecipient shall verify evidence of fringe benefit plans and payments thereunder by contractors and subcontractors who claim credit for fringe benefit contributions.

(d) The subrecipient shall periodically review contractors and subcontractors' use of apprentices and trainees to verify registration and certification with respect to apprenticeship and training programs approved by either the U.S Department of Labor or a state, as appropriate, and that contractors and subcontractors are not using disproportionate numbers of, laborers, trainees and apprentices. These reviews shall be conducted in accordance with the schedules for spot checks and interviews described in Item 5(b) and (c) above.

(e) Subrecipients must provide a report of compliance to the Georgia Environmental Finance Authority detailing compliance efforts and results. This report will be submitted with or prior to the loan recipient's first request for funding of construction costs, prior to final disbursement of funds from the loan, and as requested by the GEFA during the project.

(f) Subrecipients must immediately report potential violations of the DB prevailing wage requirements to the EPA DB coordinator and to the appropriate DOL Wage and Hour District Office listed at http://www.dol.gov/whd/america2.htm.

INSERT WAGE RATE DETERMINATION HERE

Wage Rates (for *Heavy Construction*) are state/county specific can be found at:

http://www.dol.gov/whd/govcontracts/dbra.htm

Sample Payroll Form (WH-347) is found at:

http://www.dol.gov/whd/forms/wh347.pdf

Labor Standards Interview Form (SF-1445) is found at:

http://www.gsa.gov/portal/forms/download/115910

Davis-Bacon (WH-1321) poster is found at:

http://www.dol.gov/whd/regs/compliance/posters/fedprojc.pdf
(*English*)

http://www.dol.gov/whd/regs/compliance/posters/davispan.pdf
(*Spanish*)

Fair Labor Standards Act Minimum Wage poster is found at:

http://www.dol.gov/whd/regs/compliance/posters/minwagebwp.pdf
(*English*)

http://www.dol.gov/whd/regs/compliance/posters/minwagespbwP.pdf
(*Spanish*)

"EEO Is the Law" poster is found at:

http://www.eeoc.gov/employers/upload/eeoc_self_print_poster.pdf
(*English*)

http://www.eeoc.gov/employers/upload/eeoc_self_print_poster_spanish.pdf
(*Spanish*)

"EEO Is the Law" poster supplement is found at:

http://www.eeoc.gov/employers/upload/eeoc_gina_supplement.pdf
(*English*)

http://www.eeoc.gov/employers/upload/eeoc_gina_supplement_spanish.pdf
(*Spanish*)

OSHA poster is found at:

http://www.osha.gov/Publications/osha3165low-res.pdf
(*English*)

http://www.osha.gov/Publications/osha3167.pdf
(*Spanish*)

CERTIFIED PAYROLL REVIEW CHECKLIST

(This is a *recommended Certified Payroll Review Checklist for the Owner's use.*)

CONTRACT ID	PRIME CONTRACTOR/SUBCONTRACTOR
City of CW/DWSRF#00 - 000	X Construction
GENERAL WAGE DECISION AND DATE (Insert number & date)	**PAYROLL PERIOD ENDING**

INSTRUCTIONS: This checklist is to be used in conjunction with projects requiring Davis-Bacon Wage Rates and compliance reviews. All certified payrolls are to be date stamped upon receipt from the prime contractor.

Payroll Information Checklist:

_____ Prime Contractor's or subcontractor's name and address
_____ Contract ID numbers (GEFA SRF No.)
_____ Week ending.
_____ Project location.

_____ Employee ID or Last 4 digits of Social Security Number
- _____ Social Security Number removed
- _____ Employee's work classification
- _____ Identification of OJTs, apprentices and program levels (%) on payrolls.
- _____ Verify that OJT and Apprentice Program documentation is in project files.

_____ Daily and weekly employee hours worked in each job classification.
- _____ Daily and weekly employee overtime (or premium) hours worked
- _____ Total weekly hours worked on all jobs (prevailing and non-prevailing wage).
- _____ Base rate shown for each employee, overtime (or premium) rate shown when worked.
- _____ Verify correct wage rates are being paid.
- _____ Verify overtime is being paid correctly (over 40 hrs/wk, and Time and a half)
- _____ Week's gross wages
- _____ Week's itemized deductions.
- _____ Week's net wages paid

_____ Compliance statement attached.
- _____ Method of fringe benefit payment described by checking either box (4)(a) or (4)(b).
- _____ Fringe benefit package information in file and updated as needed (if 4(a) is checked)
- _____ Exceptions explanation for fringe benefit (4)(c).
- _____ Signature.

Compliance Review Checklist (for field reviews):

_____ Verify work classifications reported are consistent with the work performed.
_____ Compare payrolls with wage rate interviews when conducted.
_____ Compare number of employees and hours worked with project documentation.

REVIEWED BY:	DATE

General Decision Number: GA170080 03/31/2017 GA80

Superseded General Decision Number: GA20160080

State: Georgia

Construction Type: Heavy
Heavy Construction, Includes Water and Sewer Lines, and Heavy Construction on Treatment Plant Sites and Industrial Sites (Refineries, Power Plants, Chemical and Manufacturing Plants, Paper Mills, Etc.)

County: Columbia County in Georgia.

Note: Under Executive Order (EO) 13658, an hourly minimum wage of $10.20 for calendar year 2017 applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least $10.20 (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in calendar year 2017. The EO minimum wage rate will be adjusted annually. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/06/2017
1	03/31/2017

* ELEC1579-002 10/01/2016

	Rates	Fringes
ELECTRICIAN	$ 24.34	12.58

ENGI0474-026 07/01/2013

	Rates	Fringes
POWER EQUIPMENT OPERATOR:		
Crane: 119 Tons and Under	$ 24.55	12.30
Crane: 120 to 249 Tons	$ 25.55	12.30
Crane: 250 to 499 Tons	$ 26.55	12.30
Crane: 500 Tons and Larger	$ 27.55	12.30
Mechanic	$ 24.55	12.30

SUGA2012-098 08/11/2012

	Rates	Fringes
CARPENTER (Form Work Only)	$ 15.44	0.00
CARPENTER, Excludes Form Work	$ 14.76	0.00
CEMENT MASON/CONCRETE FINISHER	$ 16.96	0.00

IRONWORKER, REINFORCING	$ 13.30	1.66
LABORER: Common or General	$ 9.84	0.00
LABORER: Pipelayer	$ 9.52	0.00
OPERATOR: Backhoe/Excavator/Trackhoe	$ 12.00	0.00
OPERATOR: Bulldozer	$ 14.58	0.00
OPERATOR: Grader/Blade	$ 20.24	0.00
OPERATOR: Loader	$ 16.59	4.13
OPERATOR: Piledriver	$ 18.72	2.06
OPERATOR: Roller	$ 12.04	0.69
TRUCK DRIVER: Dump Truck	$ 12.79	0.00
TRUCK DRIVER: Lowboy Truck	$ 17.28	1.84

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage

determination. The classifications are listed in alphabetical order of "identifiers" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than "SU" or "UAVG" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the "SU" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current

negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination
* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISION

General Decision Number: GA170135 02/03/2017 GA135

Superseded General Decision Number: GA20160135

State: Georgia

Construction Type: Building

County: Columbia County in Georgia.

Note: Under Executive Order (EO) 13658, an hourly minimum wage of $10.20 for calendar year 2017 applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least $10.20 (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in calendar year 2017. The EO minimum wage rate will be adjusted annually. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/06/2017
1	02/03/2017

BOIL0026-001 01/01/2013

	Rates	Fringes
BOILERMAKER	$ 24.91	19.69

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* ELEV0032-001 01/01/2017

	Rates	Fringes
ELEVATOR MECHANIC	$ 38.88	31.585+a+b

PAID HOLIDAYS:

a. New Year's Day, Memorial Day, Independence Day, Labor Day, Vetern's Day, Thanksgiving Day, the Friday after Thanksgiving, and Christmas Day.

b. Employer contributes 8% of regular hourly rate to vacation pay credit for employee who has worked in business more than 5 years; 6% for less than 5 years' service.

ENGI0474-003 07/01/2013

	Rates	Fringes
POWER EQUIPMENT OPERATOR: Backhoe/Excavator, Bobcat/Skid Steer/Skid Loader, Bulldozer,		

Forklift (under 15 tons), and Loader	$ 22.72	12.30
Crane (over 10 tons) and Forklift (15 tons and over)	$ 24.55	12.30
Crane (over 120 tons)	$ 25.55	12.30
Crane (over 250 tons)	$ 26.55	12.30
Oiler	$ 20.38	12.30

PLUM0150-006 10/01/2015

	Rates	Fringes
PLUMBER/PIPEFITTER	$ 23.77	14.11

SHEE0085-008 08/01/2012

	Rates	Fringes
SHEET METAL WORKER (Including HVAC Duct Installation; Excluding Metal Roof)	$ 28.34	11.55

SUGA2012-042 08/11/2012

	Rates	Fringes
BRICKLAYER	$ 16.00	0.00
CARPENTER (Drywall Hanging and Metal Stud Installation Only)	$ 16.00	0.00
CARPENTER, Excludes Drywall Hanging, and Metal Stud Installation	$ 15.29	0.00
CEMENT MASON/CONCRETE FINISHER	$ 16.58	0.00
DRYWALL FINISHER/TAPER	$ 17.00	0.00
ELECTRICIAN	$ 19.71	3.60
HVAC MECHANIC (Installation of HVAC Unit Only, Excludes Installation of HVAC Pipe and Duct)	$ 18.00	3.89
IRONWORKER, REINFORCING	$ 17.94	0.00
IRONWORKER, STRUCTURAL	$ 20.00	0.35
LABORER: Common or General	$ 12.25	0.47
LABORER: Mason Tender - Brick	$ 9.00	0.00
LABORER: Pipelayer	$ 12.00	0.23
OPERATOR: Grader/Blade	$ 17.52	0.00
PAINTER: Brush, Roller and		

Spray	$ 16.00	1.62
ROOFER (Installation of Metal Roofs Only)	$ 15.02	0.00
ROOFER, Excludes Installation of Metal Roofs	$ 10.76	0.00
TILE FINISHER	$ 10.31	0.00
TILE SETTER	$ 19.50	0.00
TRUCK DRIVER: Dump Truck	$ 12.70	0.00
TRUCK DRIVER: Lowboy Truck	$ 17.41	0.00

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of "identifiers" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

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Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the "SU" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination
* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISION

GEORGIA ENVIRONMENTAL FINANCE AUTHORITY

AMERICAN IRON AND STEEL SPECIAL CONDITIONS AND INFORMATION

For

FEDERALLY ASSISTED STATE REVOLVING LOAN FUND CONSTRUCTION CONTRACTS

April 11, 2014

The following standard language must be incorporated into construction contract documents and in all solicitations for offers and bids for all construction contracts or subcontracts to be funded, in whole or in part, through the Federally-assisted State Revolving Fund in the State of Georgia for projects subject to the American Iron and Steel requirements.

These Special Conditions shall not relieve the participants in this project of responsibility to meet any requirements of other portions of this construction contract or of other agencies, whether these other requirements are more or less stringent. The requirements in these Special Conditions must be satisfied in order for work to be funded with the State Revolving Fund.

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GENERAL REQUIREMENTS

These Special Conditions are based on guidance provided by the United States Environmental Protection Agency (EPA). Public Law 113-76, the Consolidated Appropriations Act, 2014 (Act), includes an "American Iron and Steel" (AIS) requirement that requires State Revolving Loan Fund (SRF) assistance recipients to use iron and steel products that are produced in the United States for projects in this project. A copy of Section 436 of the Act is found in Appendix 3.

The products and materials subject to these requirements will be defined in Appendix 1 of these special conditions.

The Owner must maintain documentation of compliance with the AIS requirements. The documentation that the Owner maintains will be subject to review and audit by representatives of the state of Georgia, the EPA, the EPA Office of the Inspector General, and other federal authorities.

The Prime Contractor must provide certifications of compliance for all products subject to AIS requirements to the Owner prior to requesting payments for those products. The Owner or the Engineer may require certifications of compliance with submittals and shop drawings for these products as part of the submittal review process.

All manufacturing processes for a covered iron or steel product, as further defined in Appendix 1, must take place in the United States. If a covered product is taken out of the US for any part of the manufacturing process, it becomes foreign source material.

The EPA recommends the use of a step certification process to document the locations of the manufacturing processes involved with the production of steel and iron materials. A step certification is a process under which each handler (supplier, fabricator, manufacturer, processor, etc.) of the iron and steel products certifies that its step in the process was domestically performed. Each time a step in the manufacturing process takes place, the manufacturer delivers its work along with a certification of its origin. A certification should include the name of the manufacturer, the location of the manufacturing facility where the product or process took place (not its headquarters), a description of the product or item being delivered, and a signature by a manufacturer's responsible party. Attached in Appendix 2 is a sample step certification.

Alternatively, the final manufacturer that delivers the iron or steel product to the worksite, vendor, or contractor, may provide a certification asserting that all manufacturing processes for the product and for its iron and steel components occurred in the United States. The EPA states that additional documentation may be needed if the certification lacks important information and recommends step certification as the best practice. A sample final manufacturer certification is attached in Appendix 2.

The Prime Contractor may document that incidental and generally low cost components, as defined in Appendix 1, are compliant with AIS requirements under the De Minimis Waiver issued by the EPA. For these items, the Contractor must provide the Owner with documentation of costs for these items, including invoices, and a report of types and categories of materials to which the waiver is applied, the total cost of incidental components covered by the waiver for each category, and the calculations by which the total cost of materials incorporated into the project was determined. A sample De Minimis report is attached is Appendix 2.

Contractor, supplier, and manufacturer records are subject to review and audit by the EPA, its Inspector General, and other federal authorities.

Failure to comply with these requirements may delay, limit, or prevent the disbursement of SRF funds to the Owner. Violations of AIS requirements will require correction by the Contractor as determined by the Owner and Engineer, including replacement of deficient products with compliant products and compensation for costs and other damages that may result. Violations may also subject the Owner, the Contractor, and suppliers to other enforcement actions within the discretion of the EPA and other federal authorities.

The Act permits EPA to issue waivers for a case or category of cases in which EPA finds (1) that applying these requirements would be inconsistent with the public interest; (2) iron and steel products are not produced in the US in sufficient and reasonably available quantities and of a satisfactory quality; or (3) inclusion of iron and steel products produced in the US will increase the cost of the overall project by more than 25 percent. The Contractor should notify the Owner and Engineer immediately if it finds that a waiver may be required.

By submitting a bid for this project and by executing this construction contract, the Contractor acknowledges to and for the benefit of the Owner and the state of Georgia that it understands that the goods and services under this Agreement are being funded with monies made available by the Clean Water State Revolving Fund or the Drinking Water State Revolving Fund and that Federal law authorizing these Funds contains provisions commonly known as "American Iron and Steel" that requires all of the iron and steel products used in the project to be produced in the United States ("American Iron and Steel Requirement") including iron and steel products provided by the Contactor pursuant to this Agreement. The Contractor hereby represents and warrants to and for the benefit of the Owner and the state of Georgia that (a) the Contractor has reviewed and understands the American Iron and Steel Requirement, (b) all of the iron and steel products used in the project will be and/or have been produced in the United States in a manner that complies with the American Iron and Steel Requirement, unless a waiver of the requirement is approved, and (c) the Contractor will provide any further verified information, certification or assurance of compliance with this paragraph, or information necessary to support a waiver of the American Iron and Steel Requirement, as may be requested by the Owner or the state of Georgia. Notwithstanding any other provision of this Agreement, any failure to comply with this paragraph by the Contractor shall permit the Owner or the state of Georgia to recover as damages against the Contractor any loss, expense, or cost (including without limitation attorney's fees) incurred by the Owner or the state of Georgia resulting from any such failure (including without limitation any impairment or loss of funding, whether in whole or in part, from the state of Georgia or any damages owed to the state of Georgia by the Owner). The Owner and the Contractor agree that the state of Georgia, as a lender to the Owner for the funding of its project, is a third-party beneficiary and neither this paragraph (nor any other provision of this Agreement necessary to give this paragraph force or effect) shall be amended or waived without the prior written consent of the state of Georgia.

Appendix 1 – Definitions

For purposes of the Clean Water State Revolving Fund (CWSRF) and Drinking Water State Revolving Fund (DWSRF) projects that must comply with the AIS requirement, an iron or steel product is one of the following made primarily of iron or steel that is permanently incorporated into the project:

Lined or unlined pipes or fittings;
Manhole Covers;
Municipal Castings (defined in more detail below);
Hydrants;
Tanks;
Flanges;
Pipe clamps and restraints;
Valves;
Structural steel (defined in more detail below);
Reinforced precast concrete (defined in more detail below); and
Construction materials (defined in more detail below).

Product primarily of Iron or steel: The product must be made of greater than 50% iron or steel, measured by cost. If one of the listed products is not made primarily of iron or steel, United States (US) provenance is not required, except as required for reinforced precast concrete. If a product is composed of more than 50% iron or steel, but is not listed in Section 436 (a) (2) of the Act, it is not required to be produced in the US. Alternatively, the iron or steel in such a product can be sourced from outside the US.

Steel: An alloy that includes at least 50 percent iron and between 0.02 and 2 percent carbon and may include other elements. Other alloys of iron are not required to be produced in the US.

Produced in the United States: Production in the US of the iron or steel products used in the project requires that all manufacturing processes, including application of coatings, must take place in the United States, with the exception of metallurgical processes involving refinement of steel additives. All manufacturing processes includes processes such as melting, refining, forming, rolling, drawing, finishing, fabricating and coating. Further, if a domestic iron and steel product is taken out of the US for any part of the manufacturing process, it becomes foreign source material. However, raw materials such as iron ore, limestone and iron and steel scrap are not covered by the AIS requirement, and the material(s), if any, being applied as a coating are similarly not covered. Non-iron or steel components of an iron and steel product may come from non-US sources. For example, for products such as valves and hydrants, the individual non-iron and steel components do not have to be of domestic origin.

Municipal Castings: Municipal castings are cast iron or steel infrastructure products that are melted and cast. They typically provide access, protection, or housing for components incorporated into utility owned drinking water, storm water, wastewater, and surface infrastructure. They are typically made of grey or ductile iron, or steel. Examples of municipal castings include access hatches, ballast screen, benches, bollards, cast bases, cast iron hinged hatches, cast iron riser rings, catch basin inlets, cleanout/monument boxes, construction covers and frames, curb and corner guards, curb openings, detectable warning plates, downspout shoes, drainage grates, frames & curb inlets, inlets, junction boxes, lampposts, manhole covers, rings & frames, risers, meter boxes, steel hinged hatches, steel riser rings, trash receptacles, tree grates, tree guards, trench grates, and valve boxes.

Structural Steel: Structural steel is rolled flanged shapes, having at least one dimension of their cross-section 3 inches or greater, which are used in the construction of bridges, buildings, ships, railroad rolling stock, and for numerous other constructional purposes. Such shapes are designated as wide-flange shapes, standard I-beams, channels, angles, tees and zees. Other shapes include H-piles, sheet piling, tie plates, cross ties, and those for other special purposes.

Reinforced Precast Concrete: While reinforced precast concrete may not be at least 50% iron or steel, in this particular case, the reinforcing rebar must be produced in the US and meet the same standards as for any other iron or steel product. Additionally, the casting of the concrete product must take place in the US. The cement and other raw materials used in concrete production are not required to be of domestic origin. If the reinforced concrete is cast at the construction site, the reinforcing rebar is considered to be a construction material and must be produced in the US.

Construction Materials subject to AIS: Construction materials are those articles, materials, or supplies made primarily of iron and steel, that are permanently incorporated into the project, not including mechanical and/or electrical components, equipment and systems. Some of these products may overlap with what is also considered "structural steel". This includes, but is not limited to, the following products: welding rods, wire rod, bar, angles, concrete reinforcing bar, wire, wire cloth, wire rope and cables, tubing, framing, joists, trusses, fasteners (i.e., nuts and bolts), decking, grating, railings, stairs, access ramps, fire escapes, ladders, wall panels, dome structures, roofing, ductwork, surface drains, cable hanging systems, manhole steps, fencing and fence tubing, guardrails, doors, gates, and screens.

Construction Materials not subject to AIS: Mechanical and/or electrical components, equipment and systems are not considered construction materials. Mechanical equipment is typically that which has motorized parts and/or is powered by a motor. Electrical equipment is typically any machine powered by electricity and includes components that are part of the electrical distribution system.

The following examples, including their appurtenances necessary for their intended use and operation, are NOT considered construction materials: pumps, motors, gear reducers, drives, variable frequency drives (VFDs), mixers, blowers/aeration equipment, compressors, meters, electric/pneumatic/manual accessories used to operate valves (such as valve actuators), gates, motorized screens (such as traveling screens), sensors, controls, switches, supervisory control and data acquisition (SCADA), membrane bioreactor systems, membrane filtration systems, filters, clarifiers and clarifier mechanisms, rakes, grinders, disinfection systems, dewatering equipment, presses (including belt presses), conveyors, cranes, HVAC (excluding ductwork), water heaters, heat exchangers, generators, cabinetry and housings (such as electrical boxes/enclosures), lighting fixtures, electrical conduit, emergency life systems, metal office furniture, shelving, laboratory equipment, and analytical instrumentation.

Items temporarily used during construction, which are removed from the project site upon completion of the project, are not required to be made of U.S. Iron or Steel. For example, trench boxes or scaffolding are not considered construction materials subject to AIS requirements.

Incidental Components compliant with AIS under the De Minimis Waiver: This waiver permits the use of de minimis incidental components that may otherwise be prohibited under AIS. These de minimis items may cumulatively comprise no more than a total of 5 percent of the total cost of the materials used in and incorporated into the project. The cost of an individual item may not exceed 1 percent of the total cost of the materials used in and incorporated into the project.

These items are miscellaneous, generally low-cost components that are essential for, but incidental to, the construction and are permanently incorporated into the project. For many of these incidental components, the country of manufacture and the availability of alternatives are not always readily or reasonably identifiable prior to procurement in the normal course of business. For other incidental components, the country of manufacture may be known, but the miscellaneous character in conjunction with the low cost, individually and in total, as typically procured in bulk, mark them as properly incidental. Examples of incidental components include small washers, screws, fasteners (i.e., nuts and bolts), miscellaneous wire, corner bead, ancillary tube.

Examples of items that are not incidental and are not covered by the De Minimis Waiver include significant process fittings (i.e., tees, elbows, flanges, and brackets), distribution system fittings and valves, force main valves, pipes for sewer collection and/or water distribution, treatment and storage tanks, large structural support structures.

Items covered as compliant under this waiver must be documented in a report to the Owner to demonstrate that they are both incidental and that they fall within the cost allowances of this waiver. The costs of these items must be documented by invoices. The report must include a listing of types and categories of materials to which the waiver is applied, the total cost of incidental components covered by the Waiver for each category, and the calculations by which the total cost of materials incorporated into the project was determined.

Appendix 2 – Sample Certifications
Step Certification

The following information is provided as a sample letter of step certification for American Iron and Steel compliance. Documentation must be provided on company letterhead. This is to be provided by each handler (supplier, fabricator, manufacturer, processor, etc.). Each time a step in the manufacturing process takes place, the handler delivers its work along with a certification of its origin.

Date

Company Name
Company Address
City, State Zip

Subject: American Iron and Steel Step Certification for Project (Insert project name and SRF number)

I, (company representative), certify that the (melting, bending, coating, galvanizing, cutting, etc.) process for (manufacturing or fabricating) the following products and/or materials shipped or provided for the subject project is in full compliance with the American Iron and Steel requirement as mandated in EPA's State Revolving Fund Programs.

List of items, products and/or materials:

If any of the above compliance statements change while providing material to this project we will immediately notify the prime contractor and the engineer.

Signed by company representative

Appendix 2 – Sample Certifications
Final manufacturer certification

The following information is provided as a sample letter of the final manufacturer to certify American Iron and Steel compliance for the entire manufacturing process. Documentation must be provided on company letterhead.

Date

Company Name
Company Address
City, State Zip

Subject: American Iron and Steel Certification for Project (Insert project name and SRF number)

I, (company representative), certify that the following products and/or materials shipped/provided to the subject project are in full compliance with the American Iron and Steel requirement of P.L. 113-76 and as mandated in EPA's State Revolving Fund Programs.

List of items, products and/or materials:

If any of the above compliance statements change while providing material to this project we will immediately notify the prime contractor and the engineer.

Signed by company representative

Appendix 2 – Sample Certifications
Contractor De Minimis Report

Owner: (Owner Name)
SRF Project No: (SRF Number)
Project Description: (Contract title or brief description)
Date: (Date of report)
Submitted by (name & title): (Contractor representative)
Company Name

LIST OF MATERIALS OR CATEGORIES OF MATERIALS PERMANENTLY INCORPORATED INTO THE PROJECT	COST
Category or Item	$1,000.00
Category or Item	$1,000.00
Category or Item	$1,000.00
Category or Item	$1,000.00
Category or Item	$1,000.00
Category or Item	$1,000.00
Category or Item	$1,000.00
Category or Item	$1,000.00
Category or Item	$1,000.00
Category or Item	$1,000.00
Total Permanent Materials	**$10,000.00**

1 % of total material cost	**$100.00**	**Maximum cost for individual item waived**
5 % of total material cost	**$500.00**	**Maximum cumulative cost for category waived**

LIST OF MATERIALS OR CATEGORIES OF MATERIALS COVERED BY DE MINIMIS WAIVER	COST	COMPLIANT (Yes/No)
Category or Item	$100.00	Yes
Category or Item	$100.00	Yes
Category or Item	$100.00	Yes
Category or Item	$100.00	Yes
Category or Item	$100.00	Yes
Total De Minimis Items	**$500.00**	Yes

INVOICES ATTACHED FOR DE MINIMIS ITEMS.

Appendix 3 – P.L. 113-76, Consolidated Appropriations Act, 2014

The Act states:

Sec. 436 (a)(1) None of the funds made available by a State water pollution control revolving fund as authorized by title VI of the Federal Water Pollution Control Act (33 U.S.C. 1381 et seq.) or made available by a drinking water treatment revolving loan fund as authorized by section 1452 of the Safe Drinking Water Act (42 U.S.C. 300j–12) shall be used for a project for the construction, alteration, maintenance, or repair of a public water system or treatment works unless all of the iron and steel products used in the project are produced in the United States.

(2) In this section, the term "iron and steel products" means the following products made primarily of iron or steel: lined or unlined pipes and fittings, manhole covers and other municipal castings, hydrants, tanks, flanges, pipe clamps and restraints, valves, structural steel, reinforced precast concrete, and construction materials.

(b) Subsection (a) shall not apply in any case or category of cases in which the Administrator of the Environmental Protection Agency (in this section referred to as the "Administrator") finds that—

(1) applying subsection (a) would be inconsistent with the public interest;

(2) iron and steel products are not produced in the United States in sufficient and reasonably available quantities and of a satisfactory quality; or

(3) inclusion of iron and steel products produced in the United States will increase the cost of the overall project by more than 25 percent.

(c) If the Administrator receives a request for a waiver under this section, the Administrator shall make available to the public on an informal basis a copy of the request and information available to the Administrator concerning the request, and shall allow for informal public input on the request for at least 15 days prior to making a finding based on the request. The Administrator shall make the request and accompanying information available by electronic means, including on the official public Internet Web site of the Environmental Protection Agency.

(d) This section shall be applied in a manner consistent with United States obligations under international agreements.

(e) The Administrator may retain up to 0.25 percent of the funds appropriated in this Act for the Clean and Drinking Water State Revolving Funds for carrying out the provisions described in subsection (a)(1) for management and oversight of the requirements of this section.

(f) This section does not apply with respect to a project if a State agency approves the engineering plans and specifications for the project, in that agency's capacity to approve such plans and specifications prior to a project requesting bids, prior to the date of the enactment of this Act.

GENERAL CONDITIONS

1. DEFINITIONS

1.1 Wherever used in the CONTRACT DOCUMENTS, the following terms shall have the meanings indicated which shall be applicable to both the singular and plural thereof:

1.2 ADDENDA - Written or graphic instruments issued prior to the execution of the Agreement which modify or interpret the CONTRACT DOCUMENTS, DRAWINGS and SPECIFICATION, by additions, deletions, clarifications or corrections

1.3 BID - The offer or proposal of the BIDDER submitted on the prescribed form setting forth the prices for the WORK to be performed

1.4 BIDDER - Any person, firm or corporation submitting a BID for the WORK

1.5 BONDS - Bid, Performance and Payment Bonds and other instruments of security, furnished by the CONTRACTOR and his surety in accordance with the CONTRACT DOCUMENTS

1.6 CHANGE ORDER - A written order to the CONTRACTOR authorizing an addition, deletion or revision in the WORK within the general scope of the CONTRACT DOCUMENTS, or authorizing an adjustment in the CONTRACT PRICE or CONTRACT TIME

1.7 CONTRACT DOCUMENTS - The Contract, including Advertisement For Bidders, BID, Bid Bond, Agreement, Payment Bond, Performance Bond, NOTICE OF AWARD,

NOTICE TO PROCEED, CHANGE ORDER, DRAWINGS, SPECIFICATIONS and ADDENDA

1.8 CONTRACT PRICE - The total monies payable to the CONTRACTOR under the terms and conditions of the CONTRACT DOCUMENTS

1.9 CONTRACT TIME - The total number of calendar days stated in the CONTRACT DOCUMENTS for the completion of the WORK

1.10 CONTRACTOR - The person, firm or corporation (holder of a State of Georgia Utility Contractors License) with whom the OWNER has executed the Agreement

1.11 DRAWINGS - The part of the CONTRACT DOCUMENTS, which show the characteristics, and scope of the WORK to be performed and which have been prepared or approved by the ENGINEER

1.12 ENGINEER - The person, firm or corporation named as such in the CONTRACT DOCUMENTS

1.13 FIELD ORDER - A written order effecting a change in the WORK not involving an adjustment in the CONTRACT PRICE or an extension of the CONTRACT TIME, issued by the ENGINEER to the CONTRACTOR during construction

1.14 NOTICE OF AWARD - The written notice of the acceptance of the BID from the OWNER to the successful BIDDER.

1.15 NOTICE TO PROCEED - Written communication issued by the OWNER to the CONTRACTOR authorizing him to proceed with the WORK and establishing the date of commencement of the WORK.

1.16 OWNER - A public or quasi-public body or authority, corporation, association, partnership or individual for whom the WORK is to be performed.

1.17 PROJECT - The undertaking to be performed as provided in the CONTRACT DOCUMENTS

1.18 RESIDENT PROJECT REPRESENTATIVE - The authorized representative of the OWNER who is assigned to the PROJECT site or any part thereof

1.19 SHOP DRAWINGS - All drawings, diagrams, illustrations, brochures, schedules and other data which are prepared by the CONTRACTOR, a SUBCONTRACTOR, manufacturer, SUPPLIER or distributor, which illustrate how specific portions of the WORK shall be fabricated or installed

1.20 SPECIFICATIONS - A part of the CONTRACT DOCUMENTS consisting of written descriptions of a technical nature of materials, equipment, construction systems, standards and workmanship

1.21 SUBCONTRACTOR - An individual, firm or corporation having a direct contract with the CONTRACTOR or with any other SUBCONTRACTOR for the performance of a part of the WORK at the site

1.22 SUBSTANTIAL COMPLETION - That date as certified by the ENGINEER when the construction of the PROJECT or a specified part thereof is sufficiently completed, in

accordance with the CONTRACT DOCUMENTS, so the PROJECT or specified part can be utilized for the purposes for which it is intended

1.23 SUPPLEMENTAL GENERAL CONDITIONS - modifications to General Conditions required by a Federal agency for participation in the PROJECT and approved by the agency in writing prior to inclusion in the CONTRACT DOCUMENTS, or such requirements that may be imposed by applicable state laws

1.24 SUPPLIER - Any person or organization who supplies materials or equipment for the WORK, including that fabricated to a special design, but who does not perform labor at the site

1.25 WORK - All labor necessary to produce the construction required by the CONTRACT DOCUMENTS, and all materials and equipment incorporated or to be incorporated in the PROJECT

1.26 WRITTEN NOTICE - Any notice to any party of the Agreement relative to any part of this Agreement in writing and considered delivered and the service thereof completed, when posted by certified or registered mail to the said party or his authorized representative on the WORK

2. ADDITIONAL INSTRUCTIONS AND DETAIL DRAWINGS

2.1 The CONTRACTOR may be furnished additional instructions and detail drawings, by the ENGINEER, as necessary to carry out the WORK required by the CONTRACT DOCUMENTS

2.2 The additional drawings and instruction thus supplied will become a part of the CONTRACT DOCUMENTS. The CONTRACTOR shall carry out the WORK in accordance with the additional detail drawings and instructions.

3. SCHEDULES, REPORTS AND RECORDS

3.1 The CONTRACTOR shall submit to the OWNER such schedule of quantities and costs, progress schedules, payrolls, reports, estimates, records and other data where applicable as are required by the CONTRACT DOCUMENTS for the WORK to be performed.

3.2 Prior to the first partial payment estimate the CONTRACTOR shall submit construction progress schedules showing the order in which he proposes to carry on the WORK, including dates at which he will start the various parts of the WORK, estimated date of completion of each part and, as applicable:

3.2.1 The dates at which special detail drawings will be required; and

3.2.2 Respective dates for submission of SHOP DRAWINGS, the beginning of manufacture, the testing and the installation of materials, supplies and equipment

3.3 The CONTRACTOR shall also submit a schedule of payments that he anticipates he will earn during the course of the WORK.

4. DRAWINGS AND SPECIFICATIONS

4.1 The intent of the DRAWINGS and SPECIFICATIONS is that the CONTRACTOR shall furnish all labor, materials, tools, equipment and transportation necessary for the proper execution of the WORK in accordance with the CONTRACT DOCUMENTS and all

incidental work necessary to complete the PROJECT in an acceptable manner, ready for use, occupancy or operation by the OWNER.

4.2 In case of conflict between the DRAWINGS and SPECIFICATIONS, the SPECIFICATIONS shall govern. Figure dimensions on DRAWINGS shall govern over scale dimensions, and detailed DRAWINGS shall govern general DRAWINGS.

4.3 Any discrepancies found between the DRAWINGS and SPECIFICATIONS and site conditions or and inconsistencies or ambiguities in the DRAWINGS or SPECIFICATIONS shall be immediately reported to the ENGINEER, in writing, who shall promptly correct such inconsistencies or ambiguities in writing. WORK done by the CONTRACTOR after his discovery of such discrepancies, inconsistencies or ambiguities shall be done at the CONTRACTOR'S risk.

5. SHOP DRAWINGS

5.1 The CONTRACTOR shall provide SHOP DRAWINGS as may be necessary for the prosecution of the WORK as required by the CONTRACT DOCUMENTS. The ENGINEER shall promptly review all SHOP DRAWINGS. The ENGINEER'S approval of any SHOP DRAWING shall not release the CONTRACTOR from responsibility for deviations from the CONTRACT DOCUMENTS. The approval of any SHOP DRAWINGS, which substantially deviates from the requirement of the CONTRACT DOCUMENTS, shall be evidenced by a CHANGE ORDER.

5.2 When submitted for the ENGINEER'S review, SHOP DRAWINGS shall bear the CONTRACTOR'S certification that he has reviewed, checked and approved the SHOP DRAWINGS and that they are in conformance with the requirements of the CONTRACT DOCUMENTS.

5.3 Portions of the WORK requiring a SHOP DRAWING or submission shall not begin until the SHOP DRAWING has been approved by the ENGINEER. A copy of each approved SHOP DRAWING and each approved sample shall be kept in good order by the CONTRACTOR at the site and shall be available to the ENGINEER.

6. MATERIALS, SERVICES AND FACILITIES

6.1 It is understood that, except as otherwise specifically stated in the CONTRACT DOCUMENTS, the CONTRACTOR shall provide and pay for all materials, labor, tools, equipment, water, light, power, transportation, supervision, temporary construction of any nature, and all other services and facilities of any nature whatsoever necessary to execute, complete and deliver the WORK within the specified time.

6.2 Materials and equipment shall be so stored as to insure the preservation of their quality and fitness for the WORK. Stored materials and equipment to be incorporated in the WORK shall be located so as to facilitate prompt inspection.

6.3 Manufactured articles, materials and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned as directed by the manufacturer.

6.4 Materials, supplies and equipment shall be in accordance with samples submitted by the CONTRACTOR and approved by the ENGINEER.

6.5 Materials, supplies or equipment to be incorporated into the WORK shall not be purchased by the CONTRACTOR or the SUBCONTRACTOR subject to a chattel mortgage or under a conditional sales contract or other agreement by which an interest is retained by the seller.

7. INSPECTION AND TESTING

7.1 All materials and equipment used in the construction of the PROJECT shall be subject to adequate inspection and testing in accordance with generally accepted standards, as required and defined in the CONTRACT DOCUMENTS.

7.2 The OWNER shall provide all inspection and testing services not required by the CONTRACT DOCUMENTS.

7.3 The CONTRACTOR shall provide at his expense the testing and inspection services required by the CONTRACT DOCUMENTS.

7.4 If the CONTRACT DOCUMENTS, laws, ordinances, rules, regulations or orders of any public authority having jurisdiction require any WORK to specifically be inspected, tested, or approved by someone other than the CONTRACTOR, the CONTRACTOR will give the ENGINEER timely notice of readiness. The CONTRACTOR will then furnish the ENGINEER the required certificates of inspection, testing or approval.

7.5 Inspections, tests or approvals by the ENGINEER or others shall not relieve the CONTRACTOR from his obligations to perform the WORK in accordance with the requirements of the CONTRACT DOCUMENTS.

7.6 The ENGINEER and his representatives will at all times have access to the WORK. In addition, authorized representatives and agents of any participating federal or state agency shall be permitted to inspect all work, materials, payrolls, records of personnel, invoices of materials, and other relevant data and records. The CONTRACTOR will provide proper facilities for such access and observation of the WORK and also for any inspection, or testing thereof.

7.7 If any WORK is covered contrary to the written instruction of the ENGINEER it must, if requested by the ENGINEER, be uncovered for his observation and replaced at the CONTRACTOR'S expense.

7.8 If the ENGINEER considers it necessary or advisable that covered WORK be inspected or tested by others, the CONTRACTOR, at the ENGINEER'S request will uncover, expose or otherwise make available for observation, inspection or testing as the ENGINEER may require, that portion of the WORK in question, furnishing all necessary labor, materials, tools, and equipment. If it is found that such WORK is defective, the CONTRACTOR will bear all the expenses of such uncovering, exposure, observation, inspection and testing and of satisfactory reconstruction. If, however, such WORK is not found to be defective, the CONTRACTOR will be allowed an increase in the CONTRACT PRICE or an extension of the CONTRACT TIME, or both, directly attributable to such uncovering, exposure, observation, inspection, testing and reconstruction and an appropriate CHANGE ORDER shall be issued.

8. SUBSTITUTIONS

8.1 Whenever a material, article or piece of equipment is identified on the DRAWINGS or SPECIFICATIONS by reference to brand name or catalogue number, it shall be understood that this is referenced for the purpose of defining the performance or other salient requirements and that other products of equal capacities, quality and function shall be considered. The CONTRACTOR may recommend the substitution of a material, article, or piece of equipment of equal substance and function for those referred to in the CONTRACT DOCUMENTS by reference to brand name or catalogue number, and if, in the opinion of the ENGINEER, such material, article, or piece of equipment is of equal substance and function to that specified, the ENGINEER may approve its substitution and use by the CONTRACTOR. Any cost differential shall be deductible from the CONTRACT PRICE and the CONTRACT DOCUMENTS shall be appropriately modified by CHANGE ORDER. The CONTRACTOR warrants that if substitutes are approved, no major changes in the function or general design of the PROJECT will result. Incidental changes or extra component parts required to accommodate the substitute will be made by the CONTRACTOR without a change in the CONTRACT PRICE or CONTRACT TIME.

9. PATENTS

9.1 The CONTRACTOR shall pay all applicable royalties and license fees. He shall defend all suits or claims for infringement of any patent rights and save the OWNER harmless from loss on account thereof, except that the OWNER shall be responsible for any such loss when a particular process, design or the product of a particular manufacturer or manufacturers is specified, however if the CONTRACTOR has reason to believe that the design, process or product specified is an infringement of a patent, he shall be responsible for such loss unless he promptly gives such information to the ENGINEER.

10. SURVEYS, PERMITS, REGULATIONS

10.1 The OWNER shall furnish all boundary surveys and establish all base lines for locating the principal component parts of the WORK together with a suitable number of bench marks adjacent to the WORK as shown in the CONTRACT DOCUMENTS. From the information provided by the OWNER, unless otherwise specified in the CONTRACT DOCUMENTS, the CONTRACTOR, shall develop and make all detail surveys needed for construction such as slope stakes, batter boards, stakes for pile locations and other working points, lines, elevations and cut sheets

10.2 The CONTRACTOR shall carefully preserve bench marks, reference points and stakes and, in case of willful or careless destruction, he shall be charged with the resulting expense and shall be responsible for any mistakes that may be caused by their unnecessary loss or disturbance.

10.3 Permits and licenses of a temporary nature necessary for the prosecution of the WORK shall be secured and paid for the by CONTRACTOR unless otherwise stated in the SUPPLEMENTAL GENERAL CONDITIONS. Permits, licenses and easements for permanent structures or permanent changes in existing facilities shall be secured and paid for by the OWNER, unless otherwise specified. The CONTRACTOR shall give all notices and comply with all laws, ordinances, rules and regulations bearing on the

conduct of the WORK as drawn and specified. If the CONTRACTOR observes that the CONTRACT DOCUMENTS are at variance therewith, he shall promptly notify the ENGINEER in writing, and any necessary changes shall be adjusted as provided in **Section 13 CHANGES IN THE WORK.**

11. PROTECTION OF WORK, PROPERTY, AND PERSONS

11.1 The CONTRACTOR will be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the WORK. He will take all necessary precautions for the safety of, and will provide the necessary protection to prevent damage, injury or loss to all employees on the WORK and other persons who may be affected thereby, all the WORK and all materials or equipment to be incorporated therein, whether in storage on or off the site, and other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction.

11.2 The CONTRACTOR will comply with all applicable laws, ordinances, rules, regulations and orders of any public body having jurisdiction. He will erect and maintain, as required by the conditions and progress of the WORK, all necessary safeguards for safety and protection. He will notify owners of adjacent utilities when prosecution of the WORK may affect them. The CONTRACTOR will remedy all damage, injury or loss to any property caused, directly or indirectly, in whole or in part, by the CONTRACTOR, any SUBCONTRACTOR or anyone directly or indirectly employed by any of them or anyone for whose acts any of them be liable, except damage or loss attributable to the fault of the CONTRACT DOCUMENTS or to the acts or omissions of the OWNER or the ENGINEER or anyone employed by either of them or anyone for whose acts either of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of the CONTRACTOR.

11.3 In emergencies affecting the safety of persons or the WORK or property at the site or adjacent thereto, the CONTRACTOR, without special instruction or authorization from the ENGINEER or OWNER, shall act to prevent threatened damage, injury or loss. He will give the ENGINEER prompt WRITTEN NOTICE of any significant changes in the WORK or deviations from the CONTRACT DOCUMENTS caused thereby, and a CHANGE ORDER shall thereupon be issued covering the changes and deviations involved.

12. SUPERVISION BY CONTRACTOR

12.1 The CONTRACTOR will supervise and direct the WORK. He will be solely responsible for the means, methods, techniques, sequences and procedures of construction. The CONTRACTOR shall employ a state "UTILITY MANAGER" certificate holder to supervise his utility work. The "UTILITY MANAGER" will have oversight of and be in charge of all construction on the PROJECT. The CONTRACTOR will employ and maintain on the WORK a qualified supervisor or superintendent who shall have been designated in writing by the CONTRACTOR as the CONTRACTOR'S representative at the site. The supervisor shall have full authority to act on behalf of the CONTRACTOR and all communications given to the supervisor shall be as binding as if given to the

CONTRACTOR. The supervisor shall be present on the site at all times as required to perform adequate supervision and coordination of the WORK.

13. CHANGES IN THE WORK

13.1 The OWNER may at any time, as the need arises, order changes within the scope of the WORK without invalidating the Agreement. If such changes increase or decrease the amount due under the CONTRACT DOCUMENTS, or in the time required for performance of the WORK, an equitable adjustment shall be authorized by CHANGE ORDER.

13.2 The ENGINEER, also, may at any time, by issuing a FIELD ORDER, make changes in the details of the WORK. The CONTRACTOR shall proceed with the performance of any changes in the WORK so ordered by the ENGINEER unless the CONTRACTOR believes that such FIELD ORDER entitles him to a change in CONTRACT PRICE or TIME, or both, in which event he shall give the ENGINEER WRITTEN NOTICE thereof within seven (7) days after the receipt of the ordered change. Thereafter the CONTRACTOR shall document the basis for the change in CONTRACT PRICE or TIME within thirty (30) days. The CONTRACTOR shall not execute such changes pending the receipt of an executed CHANGE ORDER or further instruction from the OWNER.

14. CHANGES IN CONTRACT PRICE

14.1 The CONTRACT PRICE may be changed only by a CHANGE ORDER. The value of any WORK covered by a CHANGE ORDER or of any claim for increase or decrease in the CONTRACT PRICE shall be determined by one or more of the following methods in the order of precedence listed below:

a) Unit prices previously approved

b) An agreed lump sum

c) The actual cost for labor, direct overhead, materials, supplies, equipment, and other services necessary to complete the work. In addition there shall be added an amount to be agreed upon but not to exceed 15% of the actual cost of the WORK to cover the cost of general overhead and profit.

15. TIME FOR COMPLETION AND LIQUIDATED DAMAGES

15.1 The date of beginning and the time for completion of the WORK are essential conditions of the CONTRACT DOCUMENTS and the WORK embraced shall be commenced on a date specified in the NOTICE TO PROCEED.

15.2 The CONTRACTOR will proceed with the WORK at such rate of progress to insure full completion within the CONTRACT TIME. It is expressly understood and agreed, by and between the CONTRACTOR and the OWNER, that the CONTRACT TIME for the completion of the WORK described herein is a reasonable time, taking into consideration the average climatic and economic conditions and other factors prevailing in the locality of the WORK.

15.3 If the CONTRACTOR shall fail to complete the WORK within the CONTRACT TIME, or extension of time granted by the OWNER, then the CONTRACTOR will pay to the

OWNER the amount for liquidated damages as specified in the BID for each calendar day that the CONTRACTOR shall be in default after the time stipulated in the CONTRACT DOCUMENTS.

15.4 The CONTRACTOR shall not be charged with liquidated damages or any excess cost when the delay in completion of the WORK is due to the following, and the CONTRACTOR has promptly given WRITTEN NOTICE of such delay to the OWNER or ENGINEER.

15.4.1 To any preference, priority or allocation order duly issued by the OWNER

15.4.2 To unforeseeable causes beyond the control and without the fault or negligence of the CONTRACTOR, including but not restricted to, acts of God, or of the public enemy, acts of the OWNER, acts of another CONTRACTOR in the performance of a contract with the OWNER, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, and abnormal and unforeseeable weather; and

15.4.3 To any delay of SUBCONTRACTORS occasioned by any of the causes specified in paragraphs 15.4.1 and 15.4.2 of this article.

16. CORRECTION OF WORK

16.1 The CONTRACTOR shall promptly remove from the premises all WORK rejected by the ENGINEER for failure to comply with the CONTRACT DOCUMENTS, whether incorporated in the construction or not, and the CONTRACTOR shall promptly replace and re-execute the WORK in accordance with the CONTRACT DOCUMENTS and without expense to the OWNER and shall bear the expense of making good all WORK of other CONTRACTORS destroyed or damaged by such removal or replacement.

16.2 All removal and replacement WORK shall be done at the CONTRACTOR'S expense. If the CONTRACTOR does not take action to remove such rejected WORK within ten (10) days after receipt of WRITTEN NOTICE the OWNER may remove such WORK and store the materials at the expense of the CONTRACTOR.

17. SUBSURFACE CONDITIONS

17.1 The CONTRACTOR shall promptly, and before such conditions are disturbed, except in the event of an emergency, notify the OWNER by WRITTEN NOTICE of:

17.1.1 Subsurface or latent physical conditions at the site differing materially from those indicated in the CONTRACT DOCUMENTS; or

17.1.2 Unknown physical conditions at the site, of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in WORK of the character provided for in the CONTRACT DOCUMENTS.

17.2 The OWNER shall promptly investigate the conditions, and if he finds that such conditions do so materially differ and cause an increase or decrease in the cost of, or in the time required for, performance of the WORK an equitable adjustment shall be made and the CONTRACT DOCUMENTS shall be modified by a CHANGE ORDER. Any claim of the CONTRACTOR for adjustment hereunder shall not be allowed unless he has given the required WRITTEN NOTICE; provided that the OWNER may, if he

determines the facts so justify, consider and adjust any such claims asserted before the date of final payment.

18. SUSPENSION OF WORK, TERMINATION AND DELAY

18.1 The OWNER may suspend the WORK or any portion thereof for a period of not more than ninety days or such further time as agreed upon by the CONTRACTOR, by WRITTEN NOTICE to the CONTRACTOR and the ENGINEER which notice shall fix the date on which WORK shall be resumed. The CONTRACTOR will resume that WORK on the date so fixed. The CONTRACTOR will be allowed an increase in the CONTRACT PRICE or an extension of the CONTRACT TIME, or both, directly attributable to any suspension.

18.2 If the CONTRACTOR is adjudged a bankrupt or insolvent, or if he makes a general assignment for the benefit of his creditors, or if a trustee or receiver is appointed for the CONTRACTOR or for any of his property, or if he files a petition to take advantage of any debtor's act, or to reorganize under the bankruptcy or applicable laws, or if he repeatedly fails to supply sufficient skilled workmen or suitable materials or equipment, or if he repeatedly fails to make prompt payments to SUBCONTRACTORS or for labor, materials or equipment or if he disregards laws, ordinances, rules, regulations or orders of any public body having jurisdiction of the WORK or if he disregards the authority of the ENGINEER, or if he otherwise violates any provision of the CONTRACT DOCUMENTS, then the OWNER may, without prejudice to any other right or remedy and after giving the CONTRACTOR and his surety a minimum of ten (10) days from delivery of a WRITTEN NOTICE, terminate the services of the CONTRACTOR and take possession of the PROJECT and of all materials, equipment, tools, construction equipment and machinery thereon owned by the CONTRACTOR, and finish the WORK by whatever method he may deem expedient. In such case the CONTRACTOR shall not be entitled to receive any further payment until the WORK is finished. If the unpaid balance of the CONTRACT PRICE exceeds the direct and indirect costs of completing the PROJECT, including compensation for additional professional services, such excess SHALL BE PAID TO THE CONTRACTOR. If such costs exceed such unpaid balance, the CONTRACTOR will pay the difference to the OWNER. Such costs incurred by the OWNER will be determined by the ENGINEER and incorporated in a CHANGE ORDER.

18.3 Where the CONTRACTOR'S services have been so terminated by the OWNER, said termination shall not affect any right of the OWNER against the CONTRACTOR then existing or which may thereafter accrue. Any retention or payment of monies by the OWNER due the CONTRACTOR will not release the CONTRACTOR from compliance with the CONTRACT DOCUMENTS.

18.4 After ten (10) days from delivery of a WRITTEN NOTICE to the CONTRACTOR and the ENGINEER, the OWNER may, without cause and without prejudice to any other right or remedy, elect to abandon the PROJECT and terminate the Contract. In such case, the CONTRACTOR shall be paid for all WORK executed and any expense sustained plus reasonable profit.

18.5 If, through no act of fault of the CONTRACTOR, the WORK is suspended for a period of more than ninety (90) days by the OWNER or under an order of court or other public

authority, or the ENGINEER fails to act on any request for payment within thirty (30) days after it is submitted, or the OWNER fails to pay the CONTRACTOR substantially the sum approved by the ENGINEER or awarded by arbitrators within thirty (30) days of its approval and presentation, then the CONTRACTOR may, after ten (10) days from delivery of a WRITTEN NOTICE to the OWNER and the ENGINEER, terminate the CONTRACT and recover from the OWNER payment for all WORK executed and all expenses sustained. In addition and in lieu of terminating the CONTRACT, if the ENGINEER has failed to act on a request for payment or if the OWNER has failed to make any payment as aforesaid, the CONTRACTOR may upon ten (10) days written notice to the OWNER and the ENGINEER stop the WORK until he has been paid all amounts then due, in which event and upon resumption of the WORK, CHANGE ORDERS shall be issued for adjusting the CONTRACT PRICE or extending the CONTRACT TIME or both to compensate for the costs and delays attributable to the stoppage of the WORK.

18.6 If the performance of all or any portion of the WORK is suspended, delayed or interrupted as a result of a failure of the OWNER or ENGINEER to act within the time specified in the CONTRACT DOCUMENTS, or if no time is specified, within a reasonable time; an adjustment in the CONTRACT PRICE or an extension of the CONTRACT TIME or both shall be made by CHANGE ORDER to compensate the CONTRACTOR for the costs and delays necessarily caused by the failure of the OWNER or ENGINEER.

19. PAYMENTS TO CONTRACTOR

19.1 All payments to the CONTRACTOR will be made according to an approved partial payment estimate submitted as required, but not more than once per month. The CONTRACTOR will, on or before the 5th day of the month, submit to the ENGINEER a partial payment estimate filled out and signed by the CONTRACTOR covering the WORK performed during the period covered by the partial payment estimate and supported by such data as the ENGINEER may reasonably require. The period covered by the partial payment estimate will end on the 25th of the previous month. If payment is requested on the basis of materials and equipment not incorporated in the WORK but delivered and suitably stored at or near the site, the partial payment estimate shall also be accompanied by such supporting data, satisfactory to the OWNER, as will establish the OWNER'S title to the material and equipment and protect his interest therein, including applicable insurance. The ENGINEER will, within ten (10) days after receipt of each partial payment estimate, either indicate in writing his approval of payment and present the partial payment estimate to the OWNER, or return the partial payment estimate to the CONTRACTOR indicating in writing his reasons for refusing to approve payment. In the latter case, the CONTRACTOR may make the necessary corrections and resubmit the partial payment estimate. The OWNER will, within fifteen (15) days of presentation to him of an approved partial payment estimate, pay the CONTRACTOR a progress payment based on the approved partial payment estimate. The OWNER shall retain 10% of the amount of each payment until final completion and acceptance of all work covered by the CONTRACT DOCUMENTS. The OWNER at any time, however, after 50% of the WORK has been completed, if he finds that satisfactory progress is being made, shall reduce retainage to 5% of the contract amount on the current and remaining estimates.

When the WORK is substantially complete (operational or beneficial occupancy), the retained amount may be further reduced below 5% to only that amount necessary to assure completion. On completion and acceptance of a part of the WORK on which the price is stated separately in the CONTRACT DOCUMENTS, payment may be made in full, including retained percentages, less authorized deductions.

19.2 The request for payment may also include an allowance for the cost of such major materials and equipment, which are suitably stored either at or near the site.

19.3 Prior to SUBSTANTIAL COMPLETION, the OWNER, with the approval of the ENGINEER and with the concurrence of the CONTRACTOR, may use any completed or substantially completed portions of the WORK. Such use shall not constitute an acceptance of such portions of the WORK.

19.4 The OWNER shall have the right to enter the premises for the purpose of doing work not covered by the CONTRACT DOCUMENTS. This provision shall not be construed as relieving the CONTRACTOR of the sole responsibility for the care and protection of the WORK, or the restoration of any damaged WORK except such as may be caused by agents or employees of the OWNER.

19.5 Upon completion and acceptance of the WORK, the ENGINEER shall issue a certificate attached to the final payment request that the WORK has been accepted by him under the conditions of the CONTRACT DOCUMENTS. The entire balance found to be due the CONTRACTOR, including the retained percentages, but except such sums as may be lawfully retained by the OWNER, shall be paid to the CONTRACTOR within thirty (30) days of completion and acceptance of the WORK.

19.6 The CONTRACTOR will indemnify and save the OWNER or the OWNER'S agents harmless from all claims growing out of the lawful demands of SUBCONTRACTORS, laborers, workmen, mechanics, materialmen and furnishers of machinery and parts thereof, equipment, tools, and all supplies, incurred in the furtherance of the performance of the WORK. The CONTRACTOR shall, at the OWNER'S request, furnish satisfactory evidence that all obligations of the nature designated above have been paid, discharged, or waived. If the CONTRACTOR fails to do so the OWNER may, after having notified the CONTRACTOR, either pay unpaid bills or withhold from the CONTRACTOR'S unpaid compensation a sum of money deemed reasonably sufficient to pay any and all such lawful claims until satisfactory evidence is furnished that all liabilities have been fully discharged whereupon payment to the CONTRACTOR shall be resumed in accordance with the terms of the CONTRACT DOCUMENTS, but in no event shall the provisions of this sentence be construed to impose any obligations upon the OWNER to either the CONTRACTOR, his Surety, or any third party. In paying any unpaid bills of the CONTRACTOR, any payment so made by the OWNER shall be considered as a payment made under the CONTRACT DOCUMENTS by the OWNER to the CONTRACTOR and the OWNER shall not be liable to the CONTRACTOR for any such payments made in good faith.

19.7 If the OWNER fails to make payment thirty (30) days after approval by the ENGINEER, in addition to other remedies available to the CONTRACTOR, there shall be added to each such payment interest at the maximum legal rate commencing on the first day after said payment is due and continuing until the payment is received by the CONTRACTOR.

20. ACCEPTANCE OF FINAL PAYMENT AS RELEASE

20.1 The acceptance by the CONTRACTOR of final payment shall be and shall operate as a release to the OWNER of all claims and all liability to the CONTRACTOR other than claims in stated amounts as may be specifically excepted by the CONTRACTOR for all things done or furnished in connection with this WORK and for every act and neglect of the OWNER and others relating to or arising out of this WORK. Any payment, however, final or otherwise, shall not release the CONTRACTOR or his sureties from any obligations under the CONTRACT DOCUMENTS or the Performance BOND and Payment BONDS.

21. INSURANCE

21.1 The CONTRACTOR shall purchase and maintain such insurance as will protect him from claims set forth below which may arise out of or result from the CONTRACTOR'S execution of the WORK, whether such execution be by himself or by any SUBCONTRACTOR or by anyone directly or indirectly employed by any of them, or by anyone for whose acts of them may be liable:

21.1.1 Claims under workmen's compensation, disability benefit and other similar employee benefit acts

21.1.2 Claims for damages because of bodily injury, occupational sickness or disease, or death of his employees

21.1.3 Claims for damages because of bodily injury, sickness or disease, or death of any person other than his employees

21.1.4 Claims for damages insured by usual personal injury liability coverage which are sustained (1) by any person as a result of an offense directly or indirectly related to the employment of such person by the CONTRACTOR, or (2) by any other person

21.1.5 Claims for damages because of injury to or destruction of tangible property, including loss of use resulting therefrom

21.2 Coverages under the policies will not be canceled unless at least fifteen (15) days prior WRITTEN NOTICE has been given to the OWNER.

21.3 Certificates of Insurance acceptable to the OWNER shall be filed with the OWNER prior to commencement of the WORK.

21.4 The CONTRACTOR shall procure and maintain, at his own expense, during the CONTRACT TIME, liability insurance as hereinafter specified:

21.4.1 CONTRACTOR'S General Public Liability and Property Damage Insurance including vehicle coverage issued to the CONTRACTOR and protecting him from all claims for personal injury, including death, and all claims for destruction of or damage to property, arising out of or in connection with any operations under the CONTRACT DOCUMENTS, whether such operations be by himself or by any SUBCONTRACTOR under him, or anyone directly or indirectly employed by the CONTRACTOR or by a SUBCONTRACTOR under him. Insurance shall be written with a limit of liability of not less than $1,000,000 for all damages arising out of bodily injury, including death, at any time resulting therefrom, sustained by any one person in any one accident, and a limit

of liability of not less than $2,000,000 aggregate for any such damages sustained by two or more persons in any one accident. Insurance shall be written with a limit of liability of not less than $1,000,000 for all property damage sustained by any one person in any one accident; and a limit of liability of not less than $2,000,000 aggregate for any such damage sustained by two or more persons in any one accident.

21.4.2 The CONTRACTOR shall acquire and maintain, if applicable, Fire and Extended Coverage insurance upon the PROJECT to the full insurable value thereof for the benefit of the OWNER, the CONTRACTOR, and SUBCONTRACTORS as their interest may appear. This provision shall in no way release the CONTRACTOR or CONTRACTOR'S surety from obligations under the CONTRACT DOCUMENTS to fully complete the PROJECT.

21.5 The CONTRACTOR shall procure and maintain at his own expense, during the CONTRACT TIME, in accordance with the provisions of the laws of the state in which the work is performed, Workmen's Compensation Insurance, including occupational disease provisions, for all of his employees at the site of the PROJECT and in case any work is sublet, the CONTRACTOR shall require such SUBCONTRACTOR similarly to provide Workmen's Compensation Insurance, including occupational disease provisions for all of the latter's employees unless such employees are covered by the protection afforded by the CONTRACTOR. In case any class of employees engaged in hazardous work under this contract at the site of the PROJECT is not protected under Workmen's Compensation statute, the CONTRACTOR shall provide, and shall cause each SUBCONTRACTOR to provide adequate and suitable insurance for the protection of his employees not otherwise protected.

21.6 The CONTRACTOR shall secure, if applicable, "All Risk" type Builder's Risk Insurance for WORK to be performed. Unless specifically authorized by the OWNER, the amount of such insurance shall not be less than the CONTRACT PRICE totaled in the BID. The policy shall cover not less than the losses due to fire, explosion, hail, lightning, vandalism, malicious mischief, wind, collapse, riot, aircraft and smoke during the CONTRACT TIME, and until the WORK is accepted by the OWNER. The policy shall name as the insured the CONTRACTOR, the ENGINEER, and the OWNER.

22. CONTRACT SECURITY

22.1 The CONTRACTOR shall within 10 days after the receipt of the NOTICE OF AWARD furnish the OWNER with a Performance Bond and a Payment Bond in penal sums equal to the amount of the CONTRACT PRICE, conditioned upon the performance by the CONTRACTOR of all undertakings, covenants, terms, conditions and agreements of the CONTRACT DOCUMENTS, and upon the prompt payment by the CONTRACTOR to all persons supplying labor and materials in the prosecution of the WORK provided by the CONTRACT DOCUMENTS. Such BONDS shall be executed by the CONTRACTOR and a corporate bonding company licensed to transact such business in the state in which the WORK is to be performed and named on the current list of "Surety Companies Acceptable on Federal Bonds" as published in the Treasury Department Circular Number 570. The expense of these BONDS shall be borne by the CONTRACTOR. If at any time a surety on any such bond is declared a bankrupt or loses its right to do business in the state in which the WORK is to be performed or is removed

from the list of Surety Companies accepted on Federal BONDS, CONTRACTOR shall within ten (10) days after notice from the OWNER to do so, substitute an acceptable BOND (or BONDS) in such form and sum and signed by such other surety or sureties as may be satisfactory to the OWNER. The premiums on such BOND shall be paid by the CONTRACTOR. No further payments shall be deemed due nor shall be made until the new surety or sureties shall have furnished an acceptable BOND to the OWNER.

23. ASSIGNMENTS

23.1 Neither the CONTRACTOR nor the OWNER shall sell, transfer, assign or otherwise dispose of the Contract or any portion thereof, or of his right, title or interest therein, or his obligations thereunder, without written consent of the other party.

24. INDEMNIFICATION

24.1. The CONTRACTOR will indemnify and hold harmless the OWNER and the ENGINEER and their agents and employees from and against all claims, damages, losses and expenses including attorney's fees arising out of or resulting from the performance of the WORK, provided that any such claims, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property including the loss of use resulting therefrom; and is caused in whole or in part by any negligent or willful act or omission of the CONTRACTOR, and SUBCONTRACTOR, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable.

24.2 In any and all claims against the OWNER or the ENGINEER, or any of their agents or employees, by any employee of the CONTRACTOR, any SUBCONTRACTOR, anyone directly or indirectly employed by any of them, or anyone for whose acts any of them may be liable, the indemnification obligation shall not be limited in any way by any limitation on the amount or type of damages, compensation or benefits payable by or for the CONTRACTOR or any SUBCONTRACTOR under workmen's compensation acts, disability benefit acts or other employee benefits acts.

24.3 The obligation of the CONTRACTOR under this paragraph shall not extend to the liability of the ENGINEER, his agents or employees arising out of the preparation or approval of maps, DRAWINGS, opinions, reports, surveys, CHANGE ORDERS, designs or SPECIFICATIONS.

25. SEPARATE CONTRACTS

25.1 The OWNER reserves the right to let other contracts in connection with this PROJECT. The CONTRACTOR shall afford other CONTRACTORS reasonable opportunity for the introduction and storage of their materials and the execution of their WORK, and shall properly connect and coordinate his WORK with theirs. If the proper execution or results of any part of the CONTRACTOR'S WORK depends upon the WORK of any other CONTRACTOR, the CONTRACTOR shall inspect and promptly report to the ENGINEER any defects in such WORK that render it unsuitable for such proper execution and results.

25.2 The OWNER may perform additional WORK related to the PROJECT by himself, or he may let other contracts containing provisions similar to these. The CONTRACTOR will afford the other CONTRACTORS who are parties to such Contracts (or the OWNER, if

he is performing the additional WORK himself), reasonable opportunity for the introduction and storage of materials and equipment and the execution of WORK, and shall properly connect and coordinate his WORK with theirs.

25.3 If the performance of additional WORK by other CONTRACTORS or the OWNER is not noted in the CONTRACT DOCUMENTS prior to the execution of the CONTRACT, written notice thereof shall be given to the CONTRACTOR prior to starting any such additional WORK. If the CONTRACTOR believes that the performance of such additional WORK by the OWNER or others involves him in additional expense or entitles him to an extension of the CONTRACT TIME, he may make a claim therefore as provided in Sections 14 and 15.

26. SUBCONTRACTING

26.1 The CONTRACTOR may utilize the services of specialty SUBCONTRACTORS on those parts of the WORK which, under normal contracting practices, are performed by specialty SUBCONTRACTORS.

26.2 The CONTRACTOR shall not award WORK to SUBCONTRACTOR (S) in excess of 50% of the CONTRACT PRICE, without prior written approval of the OWNER.

26.3 The CONTRACTOR shall be fully responsible to the OWNER for the acts and omissions of his SUBCONTRACTORS, and of persons either directly or indirectly employed by them, as he is for the acts and omissions of persons directly employed by him.

26.4 The CONTRACTOR shall cause appropriate provisions to be inserted in all subcontracts relative to the WORK to bind SUBCONTRACTORS to the CONTRACTOR by the terms of the CONTRACT DOCUMENTS insofar as applicable to the WORK of SUBCONTRACTORS and to give the CONTRACTOR the same power as regards terminating any subcontract that the OWNER may exercise over the CONTRACTOR under any provision of the CONTRACT DOCUMENTS.

26.5 Nothing contained in this CONTRACT shall create any contractual relation between any SUBCONTRACTOR and the OWNER.

27. ENGINEER'S AUTHORITY

27.1 The ENGINEER shall act as the OWNER'S representative during the construction period. He shall decide questions, which may arise as to quality, and acceptability of materials furnished and WORK performed. He shall interpret the intent of the CONTRACT DOCUMENTS in a fair and unbiased manner. The ENGINEER will make visits to the site and determine if the WORK is proceeding in accordance with the CONTRACT DOCUMENTS.

27.2 The CONTRACTOR will be held strictly to the intent of the CONTRACT DOCUMENTS in regard to the quality of materials, workmanship and execution of the WORK. Inspection may be made at the factory or fabrication plant of the source of material supply.

27.3 The ENGINEER will not be responsible for the construction means, controls, techniques, sequences, procedures or construction safety.

27.4 The ENGINEER shall promptly make decisions relative to interpretation of the CONTRACT DOCUMENTS.

28. LANDS AND RIGHTS OF WAY

28.1 Prior to issuance of NOTICE TO PROCEED, the OWNER shall obtain all land and rights of way necessary for carrying out and for completion of the WORK to be performed pursuant to the CONTRACT DOCUMENTS, unless otherwise mutually agreed.

28.2 The OWNER shall provide to the CONTRACTOR information, which delineates and describes the lands owned and rights of way acquired.

28.3 The CONTRACTOR shall provide at his own expense and without liability to the OWNER any additional land and access thereto that the CONTRACTOR may desire for temporary construction facilities, or for storage of materials.

29. GUARANTY

29.1 The CONTRACTOR shall guarantee all materials and equipment furnished and WORK performed for a period of one (1) year from the date of SUBSTANTIAL COMPLETION. The CONTRACTOR warrants and guarantees for a period of one (1) year from the date of SUBSTANTIAL COMPLETION of the system that the completed system is free from all defects due to faulty materials or workmanship and the CONTRACTOR shall promptly make such corrections as may be necessary by reason of such defects including the repairs of any damage to other parts of the system resulting from such defects. The OWNER will give notice of observed defects with reasonable promptness. In the event that the CONTRACTOR should fail to make such repairs, adjustments, or other work that may be made necessary by such defects, the OWNER may do so and charge the CONTRACTOR the cost thereby incurred. The Performance BOND shall remain in full force and effect through the guarantee period.

30. ARBITRATION BY MUTUAL AGREEMENT

30.1 All claims, disputes, and other matters in question arising out of, or relating to, the CONTRACT DOCUMENTS or the breach thereof, except for claims which have been waived by making an acceptance of final payment as provided by Section 20, may be decided by arbitration if the parties mutually agree. Any agreement to arbitrate shall be specifically enforceable under the prevailing arbitration law. The award rendered by the arbitrators shall be final, and judgment may be entered upon it in any court having jurisdiction thereof.

30.2 Notice of the request for arbitration shall be filed in writing with the other party to the CONTRACT DOCUMENTS and a copy shall be filed with the ENGINEER. Request for arbitration shall in no event be made on any claim, dispute or other matter in question that would be barred by the applicable statute of limitations.

30.3 The CONTRACTOR will carry on the WORK and maintain the progress schedule during any arbitration proceedings, unless otherwise mutually agreed in writing.

31. TAXES

31.1 The CONTRACTOR will pay all sales, consumer, use and other similar taxes required by the law of the place where the WORK is performed.

SUPPLEMENTAL GENERAL CONDITIONS

1. These "Supplemental General Conditions" shall apply to work as whole and to each and all branches of the work. Subcontractors shall be supplied with a copy of the "Supplemental General Conditions", and no arrangement of contracts with the subcontractors is to be such as to conflict with same. They shall also apply to any modifications or extra work.

2. SPECIFICATIONS AND DRAWINGS - In addition to Sections 4.2 and 4.3 of the "General Conditions of these Specifications," if the Contractor fails to call any discrepancy to the attention of the Engineer, the subsequent decision of the Engineers regarding the Specifications and Drawings as to which is correct shall be binding and final.

3. SANITARY PROVISION - The Contractor shall provide and maintain in a neat and sanitary condition such accommodations for the use of his employees as may be necessary to comply with the regulation of the State Board of Health and all local ordinances. No nuisance will be permitted.

4. SOCIAL SECURITY TAX AND SALES TAX - The Contractor assumes and is liable specifically for all state and federal so-called payroll or Social Security taxes and for all state and federal sales and use taxes that may be in force at the time of the award of the Contract, and guarantees to hold the Owner harmless in every respect against same.

5. USE OF PREMISES - The Contractor shall not load nor permit any part of any structure to be loaded with a weight, which will endanger its safety. The Contractor shall confine his apparatus; the storage of materials and the operations of his workmen to the limits defined by laws, ordinance, permits or directions of the Engineer and shall not unduly encumber the premises with his material.

   The Contractor shall enforce the instructions of the Engineers regarding signs, advertisements, fire and smoking.

6. GUARDS, LIGHTS, ETC. - The Contractor shall provide all barricades, guards, lights or other such protection and walks around his work as are required by the regulation of state, county or federal laws and shall assume all responsibility of same, and keep them in repair. The necessary lighting, if required, to facilitate overtime work shall be provided. All barricades, etc. shall be promptly removed on completion of the work.

7. MOVING MATERIALS - If it becomes necessary at any time during the construction to move materials which are to enter into the construction, the materials having been temporarily placed, the Contractor or subcontractor shall, when so directed by the Engineer, move them or cause them to be moved without additional cost to the Owner.

8. CLEANING DURING CONSTRUCTION AND AT COMPLETION OF WORK- The General Contractor shall keep the premises clean at all times and shall remove all rubbish as often as directed by the Resident Inspector or Owner. If the Contractor does not at all times provide men to attend to the cleaning up, on request, in a manner satisfactory to the Resident Inspector, the Resident Inspector may employ such men to direct and charge the

cost of same to the account of the Contractor. Every effort shall be made to minimize siltation and bank erosion during construction.

Upon completion of the work, the Contractor shall leave the grounds in a neat and clean condition. Construction areas shall be replanted with grass and shrubs where they have been removed and where necessary, at the request of the Engineer, the ground shall be sprigged or sodded. All areas disturbed by construction shall be restored to present or better condition. Any existing structure, which is damaged during construction, shall be repaired or replaced to original condition at the Contractor's expense.

9. REMOVAL OF MATERIALS - All materials of unsound or otherwise unfit character and not in accordance with the terms of the Contract will be condemned by the Engineer.

The Contractor shall promptly remove from the premises all condemned materials whether incorporated in the work or not. The Contractor shall promptly replace the materials to the satisfaction of the Engineer. If the Contractor does not remove such condemned materials within a reasonable time fixed by written notice, the Owner may remove them and store at the expense of the Contractor. If the Contractor does not pay to the Owner the expense of such removal within 10 days' time thereafter, the Owner may upon 10 days written notice sell such materials at auction or private sale, and shall account for the net proceeds thereof, after deduction of all cost and expenses that rightfully should have been borne by the Contractor.

10. MAINTENANCE - The Contractor will be required to maintain all work done by him in a first class condition for 30 days after the same has been completed as a whole and the Engineers have notified the Contractor in writing that the work has been finished to their satisfaction. The retained percentage will not be due or payable to the Contractor until the 30 day maintenance period has expired.

Any damage to the site or surroundings, including paving, shoulders, culverts, drainage structures, grass, etc., shall be repaired by the Contractor and all parts of the site shall be left in as good repair as before the work started.

11. QUANTITIES OF ESTIMATE - The estimated quantities of work to be done and materials to be furnished under this Contract shown in any of the documents, including the Proposal, are given for use in comparing bids and to indicate approximately the total amount of the Contract; the right is especially reserved, except as herein otherwise specifically limited, to increase or diminish them as may be deemed reasonably necessary or desirable by the Owner to complete the work contemplated by this contract.

12. PUBLIC CONVENIENCE AND SAFETY - No street, alley or other roadway shall be closed to the public by the Contractor, except by written permission of the Engineer, and except while so closed, the Contractor shall maintain traffic over, through or around work with the maximum practical convenience for the full 24 hours of each day whether or not work has ceased temporarily. The Contractor shall notify the Engineer in writing, at the earliest practicable date and in any case before starting any construction that might in any way inconvenience or endanger traffic, regarding each proposed closure and proposed schedule of operations thereon, so all necessary arrangements may be made.

The convenience of the general public and of residents along the working area shall be provided for in a reasonably adequate and satisfactory manner. Where existing roadways

are not available for use as detours, traffic shall be permitted to pass through the work, except as otherwise specified or directed by the Engineer. The Contractor shall provide and maintain at his expense and in a manner approved and deemed practicable by the Engineer, such temporary roads as may be necessary to provide convenience access to driveways, houses, buildings, business establishments, and other property abutting the work as well as temporary approaches to and crossings of intersecting streets and other roadways. The Contractor shall provide at his expense temporary bridges for pedestrians, as required, at all street intersections over ditches, etc.

Materials and equipment stored along streets and other roadways shall be so placed and the work at all times shall be conducted as to insure minimum danger and obstruction to the traveling public.

Fire hydrants in operating condition shall be accessible at all times to the fire department. No material or other obstructions shall be placed closer to an operating fire hydrant than permitted by ordinances, rules or regulations. No operating fire hydrant shall be disconnected, removed or otherwise rendered inoperable without the written permission of the fire department.

The Contractor shall give the Chief of the fire department at least 24 hours' notice in writing before closure of each street and each street intersection.

13. PUBLIC UTILITIES - The Contractor will be held responsible for the protection of the property and services of public utilities within the limits of the work. Where such physical properties conflict with the performance of the work under the Contract, he shall anticipate such conflicts and give proper advance written notice thereof to the owners of the utilities involved. Until satisfactory arrangements are made for continuance of service, the Contractor shall not commence any operations which may interfere with or impair the efficiency of the existing physical properties.

    Unless otherwise specified or approved, utility lines shall be maintained in continuous service and shall be properly supported and protected by the Contractor.

    In no case shall interruption to water or sewer service be allowed to exist outside of working hours except as permitted by the Engineer on the pipe lines to be altered or replaced under this Contract. Operating fire hydrants shall be kept accessible to the fire department at all times, and shall be kept clear of excavated materials and other materials, as specified in these Supplemental General Conditions.

    In the event of interruption to water or other utility services as a result of accidental breakage, the Contractor shall promptly notify the proper authority and shall cooperate with the said authority in the restoration of service as promptly as practicable. In the event that such pipes or other facilities are broken or improperly supported, the Contractor will be held responsible for their complete and prompt restoration in substantial and workmanlike manner and for any claim for damage which may arise as a result of such interruption of service.

14. FUEL AND ELECTRIC CURRENT - The Contractor shall furnish fuel and electric current required for construction purposes, including any temporary incoming power connections, transformers, poles and metering equipment required therefore. The Contractor may use existing electrical systems while modifying existing facilities subject

to approval by the Engineer. The Owner will furnish without charge all electric current required for operating tests of permanent equipment installed under the Contract and for permanent operation.

15. MAINTENANCE DURING CONSTRUCTION - The Contractor shall maintain at his expense the work during construction and until final acceptance of all work under the Contract. Continuous and effective work shall be prosecuted day by day, with adequate equipment and forces as required to keep the backfill, pavement, structures, pipe lines and other features in satisfactory and acceptable condition at all times.

    In the event that the Contractor fails to remedy any unsatisfactory maintenance within 24 hours after receipt of written notice from Engineer describing the unsatisfactory conditions, the Owner may immediately proceed with adequate forces and equipment to maintain the project, and the entire cost of this maintenance will be deducted from the monies otherwise due the Contractor under the Contract. As an alternative to the above specified maintenance, all of the items which are not properly maintained may be deducted at the Contract prices from the current partial payment estimate even if such items have been paid for in previous estimates.

16. ERRORS AND OMISSIONS - The Contractor shall take no advantage of any apparent error or omission in the Drawings or Specifications; but if such error or omission does occur, the Engineer shall have the authority to make corrections and interpretations deemed necessary to fulfill the intent of the Drawings and Specifications; nor shall such corrections or interpretations, if any, be construed as a waiver of any Contract provision.

17. USE OF CHEMICALS - All chemicals used during project construction or furnished for project operation, whether herbicide, pesticide, disinfectant, polymer, reactant or of other classification, must show approval of either A.P.A. or U.S.D.A. Use of all such chemicals and disposal of residues shall be in strict conformance with instructions.

18. SCHEDULE OF WORK - The Contractor shall schedule his work to create minimal interruption of the treatment process of the existing facility and the work schedules and functions of the plant personnel. The schedule of work shall conform to that specified in Section 1 – General Requirements. The Contractor shall notify the Engineer and City personnel before starting any new phase of construction to verify that no unavoidable interruption of service will be encountered.

19. PROGRESS PAYMENT REQUESTS - The proposed format for use in monthly pay requests along with an estimated schedule of progress payment amounts for the full construction period must be submitted for approval before notice to proceed will be issued. Progress payment requests should include:

    a. Work in place

    b. Material and/or equipment which have been delivered to the construction site and when conditional or final acceptance is made by the Owner. It shall be the Contractor's responsibility to provide adequate insurance and appropriate security measures for the protection of the subject materials and/or equipment.

20. CONTRACTOR PROPOSED WORK SCHEDULE - A work schedule showing the proposed work schedule with the time required to complete each phase shall be submitted for approval prior to the notice to proceed. This work schedule shall be updated and

resubmitted with each monthly payment request. Engineer approval of the work schedule is required.

21. SHOP DRAWINGS - The Contractor shall submit 6 sets of shop drawings and details covering the required items of work and such other items which may be necessary for the successful completion of this Contract to the Engineer for checking and approval before any fabrication, erection or installation shall commence. An approved set of shop drawings with stamp of approval shall be kept on the job at all times.

    The Contractor shall notify the Engineer in writing about any information in the shop drawings which deviates from the Contract Document.

22. COORDINATION - The Contractor shall coordinate with the Engineer and Owner to insure the proper and successful completion of this contract.

23. RESIDENT INSPECTOR - The Resident Inspector, as the Engineer's representative on the project, shall assist and advise the Contractor as to interpretation of the Drawings and Specifications. He shall be authorized to inspect all work done and all materials furnished including preparation, fabrication and manufacture of the materials to be used. The Resident Inspector shall not be authorized to alter or waive any requirements of the Specifications without prior approval from the Engineer. He shall call the attention of the Contractor to any failure of the work or material to conform to the Specifications and Contract. He may reject material or suspend the work until any questions at issue can be referred to and decided by the Engineer.

    The presence of the Resident Inspector shall in no way lessen the responsibility of the Contractor. The Contractor in no way relieves himself of responsibility for adequacy of the work by following the directives of the Resident Inspector.

24. PRECONSTRUCTION CONFERENCE - A preconstruction conference shall be held prior to issuance of notice to proceed. The Contractor shall be represented by at least 1 principal of the firm, the job superintendent and, if applicable, the superintendent of the electrical subcontractor. The Contractor shall at that time present the construction schedule, progress payment format and estimates, any available subcontractor approval requirements, required insurance, and any other documents deemed necessary.

25. EXISTING PIPING AND STRUCTURES - The Contractor shall verify the location of existing piping and structures in an area prior to beginning new construction in that area.

26. INSURANCE - In addition to the requirements of Article 21 of the Standard General Conditions, the Owner and the Engineer shall be listed as Additional Insureds on the Contractor's General Liability Policy and Builders Risk in the same amounts as required for the Contractor. The certified endorsements for the Additional Insureds shall be in the same amounts as required for the Contractor, listed on the Certificate of Insurance and attached to the Certificate of Insurance. In addition to required policy endorsements, package shall include the following forms:

    - DS 70 27 01 08 – *Policy Change Endorsement*
    - CG 20 37 04 13 – *Additional Insured – Owners, Lessees or Contractors – Complete Operations*

- CG 20 10 04 13 – *Additional Insured – Owners, Lessees or Contractors – Scheduled Person or Organization*
- IL 02 62 02 15 – *Changes Cancellation and Nonrenewal*

27. SUBSURFACE INVESTIGATIONS – A subsurface investigation has been made by Geotechnical & Environmental Consultants, Inc. The prospective bidder must form his own opinion of the character of the subsurface materials to be encountered in excavating for and the construction of the various facilities. A copy of the report is available upon request from the Engineer at a nominal cost.

28. MODIFICATIONS - The Contractor and his subcontractors must submit in writing any requests for modifications to the Drawings and Specifications. Shop drawings that are submitted to the Engineer for his review do not constitute "in writing" unless it is brought to the attention of the Engineer that specific changes are being suggested. In any event, changes to the Drawings and Specifications by means of shop drawings become the responsibility of the person initiating such changes.

SECTION 1
GENERAL REQUIREMENTS

1.01 Location: The work described in these Specifications is located in the **CITY OF GROVETOWN, GEORGIA.**

1.02 Work to be Done: The work to be done consists of the furnishing of all materials, labor and equipment for the complete construction of **SEWERAGE SYSTEM IMPROVEMENTS, WATER POLLUTION CONTROL PLANT – PHASE II, JANUARY 2017 (REVISED MAY 2017) for the CITY OF GROVETOWN, GEORGIA** consisting of:

Sequencing batch reactors, tertiary filters, ultraviolet disinfection system, effluent pump station, plant pump station, digester, sludge dewatering building, blower / maintenance building, chemical feed structure, control building and standby generator, all complete with appurtenances.

1.03 Schedule of Work: The Contractor shall schedule the work to minimize interruptions or shutdowns of the existing sewerage system and to not have any sewage overflow during the work without prior approval of both the Owner and Engineer.

The Contractor shall notify the Engineer and the Owner before starting any new phase of construction to verify that no interruption of service will be encountered.

1.04 Drawings: The Drawings entitled "**SEWERAGE SYSTEM IMPROVEMENTS, WATER POLLUTION CONTROL PLANT – PHASE II** for the **CITY OF GROVETOWN, GEORGIA, JANUARY 2017 (REVISED MAY 2017)**" form a part of the Construction Agreement.

1.05 Specifications: The Specifications form a part of the Construction Agreement, and include this Section and Sections 2 through 15 as identified below:

Section Number	Title of Section
2	Control of Materials
3	Soil Erosion and Sediment Control
4	Concrete
5	Reinforcing Steel, Structural Steel, and Miscellaneous Metal
6	Site Preparation, Excavation, Backfilling and Grading
7	Sewers, Plant Piping and Storm Drainage
8	Piping, Fittings, Valves and Drains
9	Building and Building Service Equipment
10	Mechanical Equipment
11	Instrumentation and Control
12	Electrical
13	Generator Sets and Equipment
14	Painting

1.06 Protecting Existing Utilities and Structures: Prior to any excavation, the Contractor shall call the Utilities Protection Inc. "Call Before You Dig" number (811). Any damage done to existing utility lines, drains, power and telephone cable, poles, and structures of every nature, not indicated to be replaced and/or abandoned shall be repaired or replaced by the Contractor at his own expense. The approximate position of certain known underground lines and structures are shown on the Drawings according to the best available information. Existing small lines are not shown. The Contractor shall locate, excavate and expose all existing underground lines in advance of trenching and other construction operations. Where connections are to be made at underground structures and pipe lines, elevations and locations shall be verified prior to construction of the pertinent work. Where underground utilities or obstructions are encountered which conflict with the new work, the location and/or alignment of the new or existing lines may be changed to avoid interference upon written approval of the Engineer.

1.07 Working Drawings: The Contractor's attention is directed to the requirements of the "Instructions to Bidders and Special Provisions" with reference to working drawings. The Contractor shall submit 3 printed copies and 1 digital copy of drawings and details, covering Reinforcing Steel, Structural Steel, Miscellaneous Metals, and such other items of work as may be necessary for successful completion of the work of the Project, to the Engineer for review. . After review, the Engineer will return 1 digital copy and any excess printed copies to the Contractor.

A. Check by Contractor: The Contractor shall check all working drawings for accuracy of dimensions and details and for conformation with the Drawings and Specifications before submitting working drawings to the Engineer for approval. The Contractor shall indicate that working drawings have been checked by him by affixing an appropriate stamp or notation on the face of each of the working drawings.

B. Responsibility for Accuracy: Approval by the Engineer of the Contractor's working drawings shall not relieve the Contractor of the responsibility for accuracy of dimensions and details. The Contractor shall be responsible for agreement and conformity of working drawings with the Drawings and Specifications.

C. Working drawings for any structure shall consist of such detailed plans as may be required for the prosecution of the work but not included in the plans. All necessary-working drawings shall be furnished by the Contractor. They shall include shop details, erection plans, masonry layout diagrams, and bending diagrams for reinforcing steel, approval of which by the Engineer must be obtained before any work involving these plans may be performed. Plans for false work, centering, and form work may also be required and such cases shall be likewise subject to approval by the Engineer.

D. It is expressly understood, however, that approval by the Engineer of the Contractor's working drawings does not relieve the Contractor of any responsibility for accuracy of dimensions and details. The Contractor shall be responsible for agreement and conformity of his working drawings with the Drawings and Specifications.

E. The contract price shall include the cost of furnishing all working drawings and the Contractor will be allowed no extra compensation for such drawings.

1.08 As-Built Drawing: As the work progresses, the Contractor shall regularly record on 1 set of Drawings, all changes and deviations from the Contract Drawings and record the exact final locations of any deviation and original work. Upon completion, the Contractor shall have these drawings and records certified as to their completeness and correctness by the Resident Inspector and deliver them to the Engineer for incorporation in the tracings. Final as-built alignment, invert elevations and locations are to be supplied by the Contractor.

A. As-Built Requirements: All submitted as-builts must meet the following requirements:

1. Contractor must present as-builts on a clean set of Drawings. All as-builts must be neat and legible.

2. All new line appurtenances installed will have a minimum of two (2) distances from permanent points. (eg: manholes, fire hydrants, fittings, water and sewer taps, valves, plugs, etc.)

3. Detail of all piping is required.

4. Contractor must provide finish elevations and invert elevations of all structures.

5. A distance is required for all new water and sewer lines every 100 feet from centerline of road.

1.09 Submittals: Shop drawings, product data and engineering calculations covering all equipment, material, fabrications and similar items shall be submitted to the Engineer for review. Submittals shall verify compliance with the contract documents with any deviations noted by the Contractor. The Contractor shall submit 3 printed copies of drawings and details to adequately describe the function, performance characteristics, dimensions, arrangement, support, anchorage and other similar information to allow for installation, operation and maintenance. The Contractor shall provide 1 digital pdf file of the submittals for review. After review, the Engineer will return 1 digital copy and any excess printed copies to the Contractor.

1.10 Operation and Maintenance Manuals: Before the work is 50% complete, the Contractor shall submit 3 printed copies and 1 digital pdf file of operation and maintenance manuals for equipment as specified. The digital file shall be provided on a single drive or disk. Each component shall be labeled per the specification section referenced, for example:

"8.22 Aluminum Gates.pdf" or "11.13 Mechanical Bar Screen.pdf"

1.11 Easements: The Owner has obtained easements for all work on private property. The Contractor will be provided copies of all easement agreements to the Owner. The Contractor shall review any special conditions of any easement agreement and notify the Engineer of any condition which cannot be met under the Plans and Specifications without an increase in contract price.

1.12 Clean-up: Upon completion of the work, all excess material and rubbish shall be removed from the job site and disposed of as directed by the Engineer. The surrounding construction area shall be left in essentially as good a condition as existed prior to construction.

1.13 Payment: No separate payment will be made for the work of this Section. The cost of the work and all cost incidentals thereto shall be included in the price bid for the item to which the work pertains.

SECTION 2
CONTROL OF MATERIALS

2.01 Source of Supply and Quality of Materials: The source of supply for all materials and equipment shall be submitted to the Engineer for approval before orders are placed. Suppliers of reinforcing steel, fabricated metal work, and metal castings may be required to submit guarantees of conformity with Drawings and Specifications. Representative preliminary samples of the character and quantity prescribed shall be submitted by the Contractor or producer for examination and tested in accord with the methods referred to under the samples and testing materials section of these Specifications. Only materials conforming to the requirements of the Specifications and approved by the Engineer shall be used in the work. All materials proposed to be used may be inspected or tested at any time during their preparation and use. If, after trial, it is found that sources of supply which have been approved do not furnish a uniform product, or if the product from any source proves unacceptable at any time, the Contractor shall furnish materials from other approved sources. No material, which after approval has in any way become unfit for use, shall be used in the work.

2.02 Samples and Testing of Materials: Unless otherwise specified, standard tests of materials shall be made in accord with the Specifications and tests of the American Society for Testing Materials, by a commercial testing laboratory approved by the Engineer. Reports of the tests shall promptly be furnished to the Engineer. Tests shall be arranged by the Contractor. The cost of all tests will be paid for by the Contractor unless otherwise specified.

2.03 Schedule of Materials and Standard Tests: The following schedule of materials and the standard test to which each is to be subjected is given for the Contractor's guidance.

A. Cement (any quantity): Certificate of mill test to be furnished by producers of laboratory tests made as per ASTM C-1

B. Fly Ash: Independent laboratory test as per ASTM C 618

C. Sand (any quanitity for use in cement concrete): Tests to indicate conformity with ASTM C-33

D. Stone and Gravel (any quantity for use in cement): Coarse Aggregate, similar to sand

E. Concrete: Cylinder compression tests of concrete placed in the work from four (4) cylinders made for each day's placing of each class of concrete of each 50 cubic yards or fraction thereof. One (1) cylinder shall be broken at seven (7) days, two (2) cylinders shall be broken at 28 days, and one (1) cylinder shall be held in reserve.

F. Brick (1 to 5,000): Visual inspection for shape, color soundness, freedom from cracks, balls of clay, and particles of lime

G. Concrete Masonry Units: Visual inspection for shape, soundness and freedom from cracks and fractures. Laboratory tests are required on at least five (5) units as per ASTM C-140.

H. Structural Tile: Visual inspection for shape, soundness, color, texture and crazing. Laboratory tests are required on at least five (5) units as per ASTM C-126.

I. Building Stone:

1. 1 to 5 Tons: Visual inspection for shape and color

2. For Each Additional Five (5) Tons or Part Thereof: Visual inspection for shape and color and test for compression as per ASTM C-97 and C-170

J. Cast Iron Pipe and Ductile Cast Iron Pipe:

1. Field Inspection: Visual inspection for dimensions, coating, cement lining, holes, hammer test, weights

2. Laboratory Tests: Certified test reports by foundry

K. Steel Pipe: ASTM A-134 and A-139

L. Polyvinyl Chloride Pipe:

1. Visual Inspection: To insure that pipe is homogenous throughout, free from cracks, nicks, gouges, severe scratches, voids, inclusions and other defects, reasonably uniform in color density and other physical properties. Quality Control Certification Seal and markings to include manufacturer's name or trademark, nominal pipe size and size base, PVC Cell Classification or Material Code, Dimension Ratio or Standard Dimension Ratio Number, product type, pressure class or pressure rating standard specification designation, production records code.

2. Laboratory Tests: In amounts and character as per ASTM D-3034 for sewer pipe and AWWA C 900 for water pipe

M. Structural Steel:

1. Any Quantity: Field inspection for rust, shape, and dimensions

2. 25 to 200 Tons: Independent shop inspection and certified copies of mill tests

3. For Structures and Buildings: See ASTM A-36

N. Concrete Reinforcement Steel:

1. Up to 50,000 Pounds: Field inspection for rust, shape and dimensions

2. 50,000 Pounds and Up: Independent laboratory inspection as follows:

   a. Billet Steel - ASTM A-615

   b. Roll Steel - ASTM A-616

   c. Cold-Drawn Steel Wire - ASTM A-82

   d. Wire Fabric - ASTM A-185

O. Cast Iron Castings:

1. Field Inspection: For dimensions, coatings, holes, hammer test

2. Laboratory Tests: Certified test reports by foundry

2.04 Payment: No separate payment will be made for work under this Section of the Specifications. The cost of such work and all cost incidentals thereto shall be included in the price bid for the item to which the work pertains.

SECTION 3
SOIL EROSION AND SEDIMENT CONTROL (STAND ALONE)

3.01 Soil Erosion and Sediment Control Program: Siltation and soil erosion shall be prevented by the installation of erosion control measures and practices prior to or concurrent with land-disturbing activities. The Contractor shall utilize silt fence, hay bales, mulch, grass, slope drains and other erosion control devices or machines as necessary. All soil erosion and sedimentation control measures must be installed prior to initiation of construction activity. Siltation and erosion control shall be in compliance with the "Georgia Erosion and Sedimentation Act of 1975" as amended to date and these Specifications. Erosion, sedimentation and pollution control may include temporary construction work outside the right-of-way where necessary as a result of construction operations, such as haul roads and equipment storage sites. Any violations of the Act shall be subject to those penalties and fines as defined by the Act.

3.02 24-Hour Contact: Mr. Raymond Fulcher, Operations Manager, P.O. Box 120, Grovetown, Georgia 30813-0120, 706-863-4576

3.03 Erosion Control Program: Vegetation and mulch will be applied to applicable areas **immediately** after grading is completed. Best Management Practices (BMP(s)) will be employed to prevent erosion in areas of bare soils and concentrated water flows. Diversions and dikes will be installed to divert sediment-laden runoff into the sediment barriers and to protect cut and fill slopes from erosive water flows.

3.04 Standards and Specifications: All designs will conform to and all work will be performed in accordance with the standards and specifications of the publication entitled "Manual For Erosion and Sediment Control in Georgia" and in compliance with the "Georgia Erosion and Sedimentation Act of 1975" as amended to date. All materials shall be first-class quality to withstand a 25-year storm event.

3.05 Limit of Progress: The Engineer will limit the area of excavation commensurate with the Contractor's capability and progress in keeping the finish grading, mulching, seeding and other such pollution control measures current in accordance with an accepted schedule. Should seasonal limitations make such coordination unrealistic, special erosion control measures shall be taken immediately to the extent feasible and justified. Excavation shall not exceed 100' in advance of pipe laying.

3.06 Construction in Rivers, Streams and Impoundments: Unless otherwise approved in writing by the Engineer, construction operations in rivers, streams and impoundments shall be restricted to those areas which must be entered for the construction of temporary or permanent structures. As soon as conditions permit, rivers, streams and impoundments shall be promptly cleared of all false work, piling which are to be removed, debris, and other obstructions placed therein or caused by the construction operations. Frequent fording of live streams with construction equipment will not be permitted; therefore, temporary bridges or other structures shall be used wherever an appreciable number of stream crossings are necessary. Unless otherwise approved in writing by the Engineer, mechanized equipment shall not be operated in live streams except as may be required to construct channel changes and temporary or permanent structures, and to remove temporary structures.

3.07 Temporary Erosion Control: Temporary erosion control shall consist of planting temporary grass of a quick growing species such as millet, rye grass or cereal grasses suitable to the area. The Contractor shall use all means necessary to control dust on and near the work site and all offsite borrow areas. The Contractor should thoroughly moisten all surfaces as required to prevent dust from being a nuisance to the public, neighbors and concurrent performance of work on the site. Where the location of temporary erosion control structures are not indicated on the Drawings, the following guidelines shall be used: Install sedimentation structures at the toe of all disturbed earth slopes, around all drainage structure inlets, across constructed drainage ways at approximately 150' centers and at the tops of slopes and terraced slopes as indicated on the details. Siltation fences or hay bales only shall be used across constructed drainage ways. Hay bales only shall be used at drainage structure inlets. Perimeter barriers may be any of the types detailed. All areas left disturbed for a period greater than 14 days shall be stabilized with temporary seeding or straw mulch.

3.08 Silt Fence: Where shown on the Drawings and as directed by the Engineer, the Contractor shall furnish, install, maintain and remove water permeable self-supporting silt fencing to remove sediment laden run-off.

A. Fabric: Silt fencing shall be composed of strong rot-proof synthetic fibers formed into a fabric of either the woven or non-woven type. Either type of fabric shall be free of defects or flaws, coatings which may change its properties after installation, resist exposure to sunlight or heat and have finished edges to prevent fraying. Type fences shall be woven type.

In lieu of silt fence described above, the Contractor may use haybales. Haybales shall be placed as shown on the Drawings and secured with 2"× 4" wood post or No. 4 steel rebar.

1. Type "NS" Fence: Posts shall be a minimum of 4' long and either hardwood or steel may be used. If hardwood is used, the size may be 1.5" × 1.5" with a cross-section of 2.25-square inch. Steel posts shall be "U", "T" or "C" shaped with a minimum weight of 1.15-pounds per foot with props for fastening the fence. Maximum post spacing shall be 6'. Type "NS" sediment barriers shall have a P-factor no greater than 0.045.

2. Type "S" Fence: Posts shall be a minimum of 4' long and either hardwood or steel may be used. If hardwood is used, the size may be 1.5" × 1.5" with a cross-section of 2.25-square inch. Steel posts shall be "U", "T", or "C" shaped with a minimum weight of 1.15-pounds per foot with props for fastening the fence. Maximum post spacing shall be 4'. Type "S" sediment barriers shall have a P-factor no greater than 0.030.

B. Posts and Woven Wire Supports: Post installation shall start at the center of the low point (if applicable) with remaining posts spaced a maximum of 6' apart from Type "NS" fence and 4' apart for Type "S" fence. Post shall be driven in a minimum of 18". Fabric shall be secured to post with nails, staples, wire or string. Toe of fabric shall be buried 6" in the soil with 2" turned back upstream. If fence is erected in sections, a minimum of 18" overlap will be required.

C. Payment: Payment for silt fence will be in accordance with the unit price bid in the proposal as installed and/or other locations as directed by the Engineer. In the event repairing fence or removing silt deposit is required, the work shall be performed at no additional cost.

3.09 Check Dam: Stone or Haybale check dams may be installed as shown. For stone check dams, the drainage area shall not exceed two acres. For hay bales, the drainage area shall not exceed one acre. The center of the check dam must be at least 9" lower than the ends and 2' tall maximum with 2:1 side slopes. A geotextile should be used as a separator between the stone and the soil base. Stone check dams should be graded sizes 2" to 10". Hay bales should be staked with 2 × 2 wood post or No. 4 steel rebar and embedded a minimum of 4".

A. Payment: Payment for check dams will be in accordance with the unit price bid in the proposal as installed and / or other locations as directed by the Engineer. In the event repairing of the check dam or removing silt deposit is required, the work shall be performed at no additional cost.

3.10 Riprap: The Contractor shall furnish and place riprap as required and where shown. Riprap shall consist of stone or bagged sand-cement to a thickness of approximately 12". Stone shall be hard quarry or fieldstone of such quality that it will not disintegrate on exposure to water or weathering. Stone shall range in weight from a minimum of 25-pounds to a maximum of 150-pounds with at least 75% of the pieces weighing more than 50-pounds. Bagged sand-cement riprap shall consist of one part cement and five parts of sand in clean cloth bags approximately one cubic foot in size. Sand and cement shall be as specified for concrete work herein.

A. Payment: Riprap will be paid for based on the number of square yards measured in place to the thickness specified in the proposal at locations shown on the Drawings or other locations as directed by the Engineer.

3.11 Grassing of Disturbed Areas: The Contractor shall furnish and install all materials and provide all labor for grassing and sedimentation control as indicated on the Drawings and/or Specifications.

A. Preparation: The Contractor shall grass all areas that were disturbed by clearing or construction operations. Grassing shall be by conventional seeding or hydroseeding. Before seeding commences, the Contractor shall spread the stored stock piled top soil over the entire area, working the better top soil into the more rocky areas. The entire area shall be smoothed with a drag and all clods broken up. All deleterious material, large stones, roots, limbs and other debris shall be removed to leave a smooth area that would be suitable for mowing. Grassing (by seeding) shall be completed as soon as practical after finish grading is completed in order to minimize erosion from rainfall and run-off. Any erosion occurring in grassed areas shall be immediately repaired.

B. Grass Seed: Grass seed selection shall be in accordance with the "Manual for Erosion and Sediment Control in Georgia" as amended to date. Otherwise, the type of grass seed applied shall be determined by site and soil compatibility and Owner discretion.

C. Temporary and Permanent Seeding: Temporary seeding is required on any areas exposed longer than 14 days. Permanent seeding shall be done only if it can be completed between March 1st and April 15th or August 15th and November 15th. Use temporary seeding during remaining periods. The Contractor shall provide for later permanent seeding by obtaining a signed proposal to the Owner from an approved local landscaper for the work specified. The Owner shall deduct the amount of the proposal from the final payment. The work of spreading and compacting topsoil shall be performed by the Contractor, as specified, prior to planting rye grass. Replacing or repairing of eroded topsoil shall be done as necessary by the local landscaper at time of later grassing, and this work shall be included in his proposal.

D. Hydro-seeding: Mix the seed (inoculated if needed), fertilizer and wood cellulose or wood pulp fiber mulch with water and apply in slurry uniformly over the area to be treated. Apply within one hour after the mixture is made.

E. Grassing Along Highway Right-of-Way: Grassing along highway right-of-way shall be in accordance with Department of Transportation, State of Georgia, Standard Specifications, Construction of Roads and Bridges, 2013 Edition, Section 700.

F. Grassing through Established Pastures and Lawns: Grassing through established pastures and lawns shall be by seeding with the same type of grass as was disturbed or, if acceptable to the Owner, seeding may be as recommended by the local Soil Conservation Agent.

G. Grassing of Other Areas: Grassing of other areas shall be by planting grass of a quick growing species that will also give a permanent cover. Permanent seeding shall be a mixture of Bermuda and centipede.

H. Planting: Preparation of soil along highway right-of-way shall be as set out in highway specifications. The Contractor shall use recognized equipment and materials in preparation of the soils. Before planting, a fertilizer of 6-12-12 composition or approved equal shall be evenly applied at the rate of 1500-pounds per acre and disced or harrowed into the dampened soil.

I. Maintenance: Temporary grass may be intermixed with permanent grass. However, the Contractor shall cut and maintain the temporary grass such that the permanent grass will become established and not be choked out. The Contractor will be required to maintain the grass on the site until the job is accepted.

J. Payment: Grassing will be paid for on a lump sum basis and shall include all areas where the existing grass has been disturbed or destroyed by the Contractor's operation. Areas to be grassed shall be designated by the Engineer. Final acceptance and payment of grassing is defined as a full cover, over the seeded area of live and growing grass, when at least 98% of the total area has no bare spots exceeding 1 square foot, and the ground surface is fully stabilized against erosion. The cost of such work and all cost incidentals thereto shall be included in the unit prices bid for the item to which the work pertains.

3.12 Seed, Fertilizer, Mulch: Seed, fertilizer, mulch and periodic watering shall be applied in adequate quantities to assure a satisfactory ground cover over the entire disturbed area of construction operations. Water thoroughly as soon as completed and at least twice daily, or more often if necessary to provide continuous growth without setback until all growth from seed is thoroughly established.

The mulching material will consist of dry straw or hay of good quality, free of seeds of competing plants, and at the rate of two or two and a half tons per acre, respectively. Straw or hay mulch will be applied uniformly over the disturbed areas to achieve 75% coverage. It must be spread within 24-hours after seeding is done. The spreading must be done by blower-type or other mulch-spreading equipment or by hand and anchored by pressing the mulch into the soil. Anchoring must be done immediately after the mulch is spread. A disk harrow with the disk set straight or a special "packer disk" may be used. The disk may be smooth or aerated and should be 20" or more in diameter and 8" to 12" apart. The edges of the disk should be dull enough not to cut the mulch but sharp enough to press into the soil leaving much of it in an erect position.

A. Payment: No separate payment will be made for the above work. The cost of such work, and all cost incidentals thereto, shall be included in the unit prices bid for the item to which the work pertains.

3.13 Slope Stabilization: Sedimentation shall be controlled by the use of hay mulch on all slopes. On slopes greater than 3:1, the Contractor shall install blankets. Prior to placing the blanket, the grassing shall have been completed and the area left in a smooth, uniform condition, free from stones, lumps, roots, and other material which would prevent the blanket from making snug contact with the underlying soil.

A. Fiberglass Blanket: The fiberglass blanket shall be machine produced consisting of uniform layer of continuous, randomly-oriented glass fiber strands. The blanket shall be at least 48" wide and weighing a minimum of 0.2-pounds per square yard when used on slopes and 0.4 pounds per square yard when in waterways.

1. Securing and Stapling: All staples shall be driven flush with the ground. Staples for securing the blanket shall be made from cold drawn wire not less that 6" lengths of 14-gauge, to form a "U" of 1" in width. Longer staples may be required for loose soil.

   Each strip of the blanket shall be held firmly in place by means of three rows of staples; one row along each edge and one row along the middle. The staples shall be spaced no more than 3' apart in each row with the staples in the middle row spaced alternately with those at the edges. The edge staples shall be placed in the 2" overlap. At the end of each blanket, staples shall be placed in a row with spacing of approximately 12".

   An anchor slot or trench, 9" in depth, shall be dug across the upgrade end of the site. The first 12" of the blanket shall be placed in the trench and the backfill tamped solidly in place. Adjacent strip ends shall overlap 2" and adjoining ends shall overlap 6" with the upstream section on top.

B. Organic Fiber Blanket:

1. Straw Blanket: The straw blanket shall be a machine-produced blanket of clean, weed-free straw from agricultural crops with consistent thickness and the straw evenly distributed over the entire area of the blanket.

   a. Slopes: The top of each blanket shall be covered with a photodegradable plastic mesh having a maximum mesh size of 5/16" × 5/16" which is sewn to the straw using biodegradable thread. The blanket shall be at least 48" wide with a minimum thickness of ⅜" and a minimum dry weight of 0.5-pounds per square yard.

   b. Waterways: The blanket shall be the same as for slopes except having the photodegradable plastic mesh on the top and bottom.

2. Excelsior Blanket: A machine produced mat of curled wood excelsior of which 80% has 6" or longer fiber length with consistent thickness and the fiber evenly distributed over the entire area of the blanket. The blanket shall be smolder resistant. The top of the blanket shall be clearly labeled.

   a. Slopes: The top of each blanket shall be covered with a photodegradable plastic mesh having a maximum mesh size of 1½"× 3". The blanket shall be at least 48" wide with a minimum thickness of ¼" and a minimum dry weight of 0.8-pounds per square yard.

   b. Waterways: The blanket shall be the same as for slopes except having the photodegradable plastic mesh on the top and bottom.

3. Securing and Stapling: Staples shall be driven vertically into the ground to anchor the plastic mesh. Staples shall be spaced approximately 2-yards apart on each side of the blanket and one row in the center alternately spaced between each side staple. Where blankets are laid side to side, the staples shall be placed with half of the staple anchoring mesh from each blanket. At the beginning of a blanket, staples shall be placed in a row with spacing of approximately 12".

   In waterways, there shall be no longitudinal seams unless overlapped at least 6" with the upgrade section on top. The first 12" of the first row of blankets shall be placed in a 6" deep anchor slot stapled in the bottom, and the slot shall be backfilled and solidly tamped.

C. Payment: Slope stabilization will be paid for on a square yard basis as installed and approved by the Engineer. The cost of such work, and all cost incidentals thereto, shall be included in the unit prices bid for the item to which the work pertains. Laps will not be measured but considered as incidental to the work.

3.14 Final Stabilization: When monitoring is required, stabilized means at least 70% of the soil surface is uniformly covered in permanent vegetation unlike the NPDES Storm Water Discharges Associated with Construction Activities, General Permit (GAR 100001, 100002, 100003), which includes installation of equivalent permanent

stabilization measures (such as the use of riprap, gabions, permanent mulches or geotextiles). Permanent vegetation consists of planted trees, shrubs, perennial vines; a crop of perennial vegetation appropriate for the season and region; or a crop of annual vegetation and a seeding of target crop perennials appropriate for the region such that within the growing season a 70-percent coverage by the perennial crop is achieved. For linear construction projects on agricultural or silvicultural lands, stabilized means stabilizing it for its agricultural or silvicultural use.

Final acceptance of grassing for payment is defined as a full cover, over the seeded area of live and growing grass, when at least 98-percent of the total areas has no bare spots exceeding 1-square foot, and the ground surface is fully stabilized against erosion.

3.15 Maintenance Program: Best management practices will be inspected daily. Any damages will be repaired by the end of the day. Cleanout of sediment control structures will be accomplished in accordance with the publication entitled "*Manual for Erosion and Sediment Control in Georgia,*" latest edition and sediment disposal accomplished by spreading on the site. Sediment basins and barriers will remain in place until disturbed areas are stabilized. The sediment control barriers will then be removed and the areas by these structures grassed.

A. Payment: No separate payment will be paid for the above work, except silt fence, unless the work performed was in accordance with "Grassing of Disturbed Areas" paragraph, then payment would be made on a linear foot basis as specified. Otherwise, the cost of the above work and all cost incidental thereto shall be included in the unit prices bid for the item to which the work pertains. In case of failure on the part of the Contractor to adequately control erosion, pollution, and / or siltation, the Owner reserves the right to employ outside assistance or to use his own forces to provide the necessary corrective measures. Such incurred direct costs plus Project Engineering costs will be charged to the Contractor and appropriate deductions made from the Contractor's monthly progress estimate.

SECTION 4
CONCRETE

4.01 General: The work described by this Section consists of furnishing all materials and equipment and performing all labor for the complete construction of all concrete work, including all work and appurtenances thereto, as shown or specified or both. Work shall include the installation of all sleeves, inserts, piping, hangers, anchors, frames and other items to be built into the concrete work, and all other work and appurtenances specified or required or both for proper execution of the work. All products to be built into concrete work shall be correctly positioned in the formwork. Positioning must be inspected and approved by the Engineer before concrete is placed.

4.02 Applicable Specifications and Quality Assurance: Concrete work shall conform to all requirements of ACI-318 *Building Code Requirements for Structural Concrete,* ACI-350 *Code Requirements for Environmental Engineering Concrete Structures* and ACI301 *Specifications for Structural Concrete.*

4.03 Concrete: Concrete shall be composed of cement, Class F fly ash (if required) admixtures (if required), fine aggregate, coarse aggregate and water proportioned and mixed to produce a plastic workable mix in accordance with the requirements of this Section and shall be suitable for the specific conditions of placement. Concrete shall be classified as "A," "B" or "C," shall have normal setting characteristics (unless high early strength cement is specified); shall be used in the locations identified below and shall have 28-day compressive strengths not less than those listed below, except that concrete containing high early strength cement shall have 7-day compressive strengths not less than those listed below.

A. Class "A-1" concrete shall have a compressive strength of not less than 4,000-psi, and shall be used for reinforced concrete work and for unreinforced footings not thicker than 8".

B. Class "A-2" concrete shall be used for slabs and walls for all water containment structures. Class "A-2" concrete shall have a compressive strength of not less than 4,000-psi.

C. Class "B" concrete shall have a compressive strength of not less than 2,500-psi, and shall be used for blocking gravity type walls and for unreinforced footings and slabs thicker than 8".

D. Class "C" concrete shall have a compressive strength of not less than 1,500 psi, and shall be used for concrete sub foundations, pipe envelopes and concrete backfill where required.

4.04 Materials:

A. Admixture: Admixture may be added to Class "A-1", Class "A-2" and Class "B" concrete if its addition is approved by the Engineer. If approved, it shall be added in accordance with the admixture manufacturer's printed instructions. A standard dispenser shall be used to introduce the admixture into the mix, and the services

of the admixture manufacturer's representative to install and establish the operation of the dispenser shall be furnished by the Contractor.

B. Fine Aggregate: Fine aggregate shall be natural sand having fineness modulus of no less than 2.30 and no more than 3.00. Variation in fineness modulus shall be limited to +0.20 from the average of all tests.

Aggregate shall satisfy the requirements of ASTM C-33, amended to date, except that gradation shall be as follows:

Sieve Size	*Percent Passing, by Weight*
No. 4, Sieve	95 – 100
No. 8, Sieve	80 - 90
No. 16, Sieve	50 - 85
No. 30, Sieve	25 - 60
No. 50, Sieve	10 - 30
No. 100, Sieve	2 - 10

C. Coarse Aggregate: Coarse aggregate shall be washed gravel or crushed stone consisting of hard, strong, durable and uncoated particles and shall contain neither vegetable matter nor soft, friable, thin and elongated particles in quantities considered deleterious by the Engineer. Coarse aggregates shall satisfy the requirements of ASTM C-33, as amended to date, except that gradations shall be as follows:

Sieve Size	*Percent Passing, by Weight*
1-½" Sieve	100
1" Sieve	95 – 100
½" Sieve	25 - 60
No. 4, Sieve	0 - 10
No. 16, Sieve	0 - 5

D. Cement: The cement for concrete Class "A-1", Class "A-2", Class "B," or Class "C" shall be Portland Cement. Bland fineness shall be less than 2,000. Cement types shall be furnished in accordance with the following:

1. Portland Cement shall conform to ASTM D-150 Type II.
2. High Early Portland Cement shall conform to ASTM C- 150 Type III.
3. If Type II cement is not commercially available, subject to prior approval by the Engineer the Contractor may use an approved mix of Type I cement with fly ash. Fly ash, if used, shall satisfy the requirements of ASTM C-618, except that loss-on-ignition shall not be more than 6%.

4. ACI 318-11 exposure categories F, S, P and C, and exposure category classes F2, S3, P1 and C1. Additional requirements include a maximum W/C ratio of 0.45, minimum compressive strength of 4,500 psi and total air content of 6%.

5. Other provisions of these Specifications, except for cement, shall be applicable to such concrete.

E. Fly Ash: Fly ash, if used, shall satisfy the requirements of ASTM C-618, as amended to date, except that the loss-on-ignition shall not be more than 6%.

F. Admixtures:

1. Class "A-1" and Class "A-2" concrete shall be air entrained concrete. Air content shall be 5% + 1%.

2. Retarder shall be used when ambient air temperature of 75° F or higher is reached or expected during the day. Retarding admixtures shall conform to ASTM C-494.

3. Admixtures to be used shall be authorized and approved by the Engineer prior to inclusion into the mix.

G. Water: Water shall be fresh, clean and free from injurious amount of oil and acidic, alkaline and organic materials.

H. Forms: Forms shall be of plywood or of tongue-and-groove lumber and shall be of grade and type which will provide the concrete finish required. Forms constructed of tongue-and-groove lumber shall be lined when used to form exposed-to-view surfaces; form lining, where used, shall be tempered fiberboard not thinner than ⅛". Metal forms and other types of manufactured forms shall not be used unless their use has been approved by the Engineer. Form oil shall be non-staining mineral oil. Form ties shall be of the cone nut threaded rod or standard snap-tie type and designed so that when removed, no metal will be left closer than 1" from the finished concrete surface. The cavities left in faces of concrete work by removal of form ties shall be pointed-up with non-shrink mortar. Form ties shall have a working strength of not less than 3,000 pounds when fully assembled and must be approved by the Engineer.

I. Grout: Grout shall be composed of 1 part Portland Cement to 1 part sand to 2 parts of aggregate no larger than ⅜" and to those parts of water which will produce a grout having a consistency approved by the Engineer.

J. Water Stops: Water stops shall be of those configurations and types shown on the Drawings.

K. Nonshrink Cement Based Grout: The work covered in this Specification consists of furnishing all manufactured nonshrink cement-based grout where called for on the Drawings.

Nonshrink grout shall contain only premeasured, prepackaged materials supplied by the manufacturer.

Water to be used for mixing Portland Cement manufactured grout shall be potable.

1. Requirements for Nonshrink Cement-Based Grout: Manufacturer must submit certified information verifying:

   a. Plastic Volume Change: The grout shall show no shrinkage (0.0%) and a maximum of 4.0% expansion at any time before initial set when testing according to ASTM C-827.

   b. Hardened Volume Change: The grout shall show no shrinkage (0.0%) and a maximum of 0.2% expansion on the hardened state.

   c. Compressive Strength: All nonshrink cement-based grout shall show a minimum 28 day compressive strength of 5,000 psi at standard laboratory temperatures when tested according to ASTM C-109.

   d. Placeability: All nonshrink cement-based grouts shall be capable of a flowable consistency (124- 145 flow) when tested according to ASTM C-109. Standard nonshrink cement-based grout shall have a minimum initial set time of 60 minutes when tested according to ASTM C-191.

   e. Soundness: The grout shall contain no metallic substances, aluminum powder or other materials known to compromise long-term durability.

   f. Technical Service: Technical service shall be made available by the manufacturer upon request of the Contractor for purposes of advising on proper procedures dealing with grout installation.

2. Expansion Joint Filler: Expansion joint filler and sealer shall be as shown in the Drawings.

4.05 Storage:

A. Cement and fly ash shall be stored immediately upon receipt at the job site in a thoroughly dry, weather tight and properly ventilated building having adequate provisions for preventing cement from absorbing moisture. Storage shall permit ease of access for inspection and permit definite identification of each shipment.

B. Fine and coarse aggregate shall be stored separately in a manner which will avoid the inclusion of foreign material. Stockpiles of coarse aggregate shall be built in horizontal layers in a manner which will minimize or eliminate segregation.

4.06 Sampling and Testing: Sampling and testing of aggregate, cement and concrete cylinders shall be as specified in the "Control of Materials" section, and shall be made by an independent laboratory approved by the Engineer. Costs of all concrete testing shall be paid by the Engineer. The Owner shall have access to all places where concrete materials and concrete are manufactured, stored, proportioned, mixed, placed and tested. Modification 8.2, Standard Minimum Specification for Ready Mix Concrete shall apply.

A. Aggregate: The Contractor shall select the source of the concrete aggregates which he proposes to use in the work, and shall furnish suitable samples of those aggregates to the testing laboratory for testing and preparation of design mix not more than 60 days and no less than 30 days in advance of the time of proposed use.

B. Cement: Cement which has been stored for more than 4 months after being tested shall be re-tested before use.

C. Required Concrete Tests: Four (4) cylinders from the same batch of concrete shall be made for each day's placing of each class of concrete of each 50 cubic yards or fraction thereof. Each cylinder shall comprise a test under the definition of this Specification, with 1 cylinder being broken at the age of 7 days, 2 cylinders broken at the age of 28 days and 1 cylinder held in reserve.

D. Inspection Agency's Duties in Inspection: All sampling, molding, transportation, storing, curing, preparation for breaking and testing of cylinders shall be the responsibility of the inspection agency and shall be performed by qualified personnel observing all requirements of ASTM C31 and ASTM C39. The inspection agency shall make and record slump test in connection with each sampling of concrete. The inspection agency shall determine the air content of the concrete delivered to the job site. The Inspection Agency shall, in addition, cause its representative to visit the batching plant, observe and report on the compliance of procedures used therein with all provisions of this Specification and of applicable ASTM and ACI Standards, observe job conditions in the handling and placing of concrete and report any items of noncompliance with these Specifications to the Engineer.

E. Contractor's Duties in Inspection: The Contractor shall deliver to the laboratory and Owner all materials to be used in tests required by these Specifications. The Contractor shall supply test cylinders, wheelbarrows, shovels, mixing boards, shaded work space for molding cylinders and similar equipment required by the Owner's representative for molding test cylinders. Contractor shall provide stable, insulated storage boxes equipped with thermostatically controlled heat for storage of cylinders for the first 24 hours after molding in accordance with ASTM C31. He shall keep slump cone available for use on the job at all times.

F. Evaluation of Tests: Evaluation of test results shall be in accordance with ACI 318-11, Section 5.6 with the following exceptions:

1. Every cylinder must break at or above the design strength specified.
2. Concrete tests resulting in low compressive strength shall be cause to reject the concrete.

G. Faulty Concrete: Failure to measure up to any of the specified conditions constitutes faulty concrete. Unless otherwise directed by the Engineer, faulty concrete shall be removed and replaced with concrete as specified at no expense to the Owner.

H. Additional Tests: Additional tests, if permitted by the Engineer, shall be subject to the approval of the Engineer and at no expense to the Owner. Load test, if

permitted by the Engineer, shall be conducted in accordance with the loading criteria as required by the design of the structure as determined by the Engineer.

I. Slump Tests: Slump tests of each concrete placement shall be made in the field with an accurately made sheet iron test cone and shall be made by the Contractor in accordance with the procedure described in ASTM C-143. The slump of concrete to be placed in piers and wall shall not be less than 4" nor greater than 7". The slump for concrete to be placed in slabs on earth shall not be less than 1" nor greater than 4".

J. Leakage Tests: All water holding structures shall have a leakage test performed prior to acceptance. The test shall be performed in accordance with ACI 350.

4.07 Design Mix: Design mix for each classification of concrete to be used in the work shall be prepared and tested by the laboratory. The design mix shall be prepared, proportioned and mixed using samples of the cement, fly ash (if required), admixture (if required) and the aggregates to be used in the work. Not fewer than 4 cylinders shall be made from the design mix for each classification of concrete: 2 shall be tested at 7 days, and 2 shall be tested at 28 days. Cylinders shall be made and tested in accordance with ASTM C-31 and C-39. If an existing design mix that was recently prepared using the same source of proposed materials is demonstrated to conform to this specification, the Engineer may approve its use in the work.

4.08 Proportioning and Mixing: Proportioning and mixing shall be accomplished either at the job site or at a central mix plant. If proportioning and mixing is accomplished at the job site, the Contractor shall provide the equipment necessary to positively determine and control the actual amounts of ingredients entering the mix. If proportioning and mixing is accomplished at a central mix plant, the Contractor shall, through the testing laboratory, furnish a laboratory representative who shall control the proportioning and mixing of Class "A-1" or Class "A-2" concrete except as may be otherwise approved by the Engineer.

A. Proportioning of materials shall be accomplished in a manner which will produce a workable mixture having a slump within the required limits and having minimum water content.

1. The exact proportion of materials to be used in concrete shall be identical to that established by the design mix except that the proportions of materials shall be changed whenever, in the opinion of the Engineer, a change is necessary to obtain the required strength and the desired density for uniformity and workability. In structures intended to be water tight, good workability will be considered to be primary importance. The equipment necessary to positively determine and control the amounts of materials entering the concrete shall be furnished by the Contractor.

   All materials shall be measured by weight, except for water, which may be measured by volume. One (1) bag of Portland Cement shall be considered to weigh 94 pounds.

2. Cement and Fly Ash Content:

a. Each cubic yard of concrete containing Type I or Type III cement shall contain not less than the following quantities of cement and fly ash.

- Class "A-1" or Class "A-2" - 470 pounds (5 bags) of cement and 100 pounds of fly ash.
- Class "B" - 376 pounds (4 bags) of cement and 100 pounds of fly ash.
- Class "C" - 376 pounds (4 bags) of cement; no fly ash required.

b. Each cubic yard of concrete containing Type II cement shall contain not less than the following quantities of cement:

- Class "A-1" or Class "A-2" - 564 pounds (6 bags)
- Class "B" - 470 pounds (5 bags)
- Class "C" - 376 pounds (4 bags)

In calculating the total water content of mixes, the amount water borne on the surfaces of the aggregates shall, in all cases, be the least amount necessary to produce a plastic mix having the required strength and the desired density, uniformity, workability and characteristics, yet being within the limits of slump.

The total volume of aggregates to be used in each cubic yard of concrete and proportion of fine aggregate to coarse aggregate shall be that amount necessary to produce a dense mixture having the required workability.

B. Mixing, if accomplished at the job site, shall be accomplished with a batch mixer of approved design and of a type which will insure a uniform distribution of the ingredients. The entire contents of the drum shall be discharged before recharging. The volume of each batch shall not exceed the rated capacity of the mixer. The Contractor shall, during the mixing and placing of concrete, have no fewer than 2 mixers on the job site to maintain continuity of the placing in the event of mechanical failure of 1 of the mixers. The mixing of each batch shall continue not less than 1-½ minutes after all ingredients have been placed in the mixer. During mixing the mixer shall rotate at peripheral speed of no fewer than 200' per minute.

C. Mixing, if accomplished at a central mix plant, shall be accomplished by a plant which has had its layout, equipment and trucks approved by the Engineer. Concrete shall be mixed (and transported to the jobsite) in accordance with the requirements of ASTM C-94. Loading tickets for Class "A-1" or Class "A-2" concrete shall be initialed by the laboratory representative and shall bear the time of loading. Tickets shall be handed to the inspector when the trucks arrive at the job site and before the load is discharged.

4.09 Placing: Before concrete is placed, the depth and character of the foundations, the adequacy of forms and falsework and the placing of reinforcing steel and inserts must be inspected and approved by the Engineer. Approval, however, shall not relieve the

Contractor from the responsibility to produce the required work. Handling and placing of concrete and the preparation for placing concrete shall be as follows:

A. Accumulated water and debris must be removed from excavations and from forms into which concrete is to be placed. Flow of water into those places shall be diverted into side drains or sumps and be removed without disturbing newly placed concrete. Forms, unless lined, shall be thoroughly wetted with water before concrete is placed so as to tighten the joint. Runways for buggies and wheelbarrows, if used, shall not be supported by forms. Concrete shall be conveyed in a manner which will not disturb forms.

B. Concrete shall be placed in daylight. Placing of concrete in a portion of the work shall not be started if that portion of the work cannot be completed during daylight unless otherwise specifically approved by the Engineer. That approval, however, will not be given unless an adequate lighting system is provided and lighting system is approved by the Engineer.

C. Concrete shall not be placed when the atmospheric temperature is cooler than 35°F. If, after placing concrete, the atmospheric temperature becomes cooler than 35°F, the Contractor shall enclose, heat and protect the concrete in a manner which will keep the air surrounding the fresh concrete at a temperature not cooler than 45°F for a period of 5 days after concrete is placed. In addition, all requirements specified in ACI 306.1-90 *Standard Specification for Cold Weather Concreting* shall apply. The Contractor shall assume all risk of protecting the concrete. Unsatisfactory concrete shall be rejected.

D. When the ambient temperature is 90°F or above, special precautions shall be taken during mixing, placing and curing. In no case should the temperature of the concrete, when placed, be above 90°F. Attention shall be given to coordinating the dispatching of trucks with the rate of placement to avoid delays in delivery. When elapsed time from batching to placement is so long as to result in significant increases in mixing water demand or in slump loss, mixing in the trucks should be delayed until only sufficient time remains to accomplished mixing before the concrete is placed. On truck arrival at the job site, addition of water shall not be allowed other than that required to adjust the specified slump. The forms and reinforcing steel should be cooled to a temperature of not more than 90°F by spraying with fog nozzles. Admixtures or retardation shall conform to ASTM C494-15. Water curing is preferred but prompt application of curing compound, ASTM C309-11, may be used. In addition, all requirements specified in ACI 305.1-06 *Specification for Hot Weather Concreting* shall apply.

E. Concrete shall be transported from the mixer to the point of deposit with a crane-handled bottom-dump concrete bucket, concrete buggies or wheelbarrows. In the event the quality of the concrete as it reaches the forms and the method and placing thereof in the opinion of the Engineer is not satisfactory, the Contractor shall change his method of operation so as to place concrete in a manner approved by the Engineer.

F. Concrete shall be placed in a manner which will prevent the segregation of aggregates, displacing reinforcing and coating and splattering the concrete

reinforcing which is in place. Troughs, pipes, hoppers, chutes and canvas tremies shall be arranged and used in a manner which will insure the concrete is placed in the manner specified. The placing of concrete within formwork shall be regulated in a manner which will insure that the pressure within the formwork, caused by that placing shall not exceed the design pressure of the formwork. Concrete shall be placed in continuous horizontal layers, the thickness of which in general, shall not exceed 12". Each batch and each layer shall be placed immediately following the preceding batch and layer, so there will be no "cold joints" in the work. Care shall be used to fill each part of the forms. Concrete shall be deposited as near final position as possible. After the concrete has taken its initial set, care shall be used to avoid jarring the formwork and placing strain and vibration on the ends of projecting concrete reinforcements. If concrete must be dropped more than 5', it shall be deposited through a tremie.

1. Concrete when placed shall be compacted with mechanical internal-vibrating equipment. Compaction shall be supplemented with hand spading using a steel-splicing rod. Vibrating equipment shall not be used to transport concrete within forms. Vibrating equipment shall maintain an impulse rate of no less than 5,000 impulses per minute when submerged in concrete. No less than 1 spare vibrator shall be maintained on the job site as a relief. The duration of vibration shall be limited to that time necessary to satisfactorily consolidate the concrete without causing objectionable segregation. The vibrator shall not be inserted into lower layers which have begun to set.

2. Thin-section work shall be thoroughly worked with a steel rod. Faces of thin-section work shall be shaped and mortar flushed to the surface. Small diameter holes shall be drilled in formwork beneath large wall sleeves and inserts to prevent the entrapment of air beneath those sleeves and inserts when concrete is placed.

G. Concrete shall be placed and compacted in a manner which forms a dense, compact, impervious structure having smooth faces on exposed surfaces. Concrete work found to be porous, plastered and otherwise defective in the opinion of the Engineer shall be removed and replaced in whole or in part as directed by the Engineer at no additional expense to the Owner.

4.10 Joints:

A. Construction Joints: Construction joints shall be located where shown and where directed and approved by the Engineer. Placing of concrete, once started, shall continue without interruption so that the placement will be monolithic. No less than 72 hours shall elapse between casting of adjoining units unless otherwise approved by the Engineer. The Contractor shall submit to the Engineer for approval the detailed location of construction joints not shown on the Drawings but required for the execution of the work prior to the detailing of any reinforcing steel.

1. Construction joints in footings and walls required for proper execution of the work but not shown shall be located where directed by the Engineer

and across regions of low shearing stress so as to least impair the strength and appearance of the work. Special provisions shall be made for joining successive units as shown and as directed by the Engineer.

2. Construction joints in slabs, required for proper execution of the work but not shown, shall be located where directed by the Engineer. Special provisions, including concrete footing for construction joints in slabs on earth, shall be made for joining successive units as shown and as directed by the Engineer.

3. Keys shall be constructed in construction joints where shown and where directed by the Engineer. Keys and water stops shall be placed in those construction joints which will be subject to water pressure.

B. Expansion Joints: Expansion joints, when required, shall be located where and constructed as shown in the Drawings.

C. Bonding: Before placing new concrete work on and against concrete work which has recently set and that which has cured, the surfaces of recently set and cured concrete work shall be thoroughly roughened and made free from all foreign matter and laitance, the forms placed and tightened, and the surfaces of the recently set and cured concrete slushed with grout. New concrete shall be placed before the grout has attained its initial set. Bonding shall be accomplished in a manner which will insure complete bonding. Grout 2" to 4" shall be applied to construction joints.

1. Bonding of new concrete work to existing hardened concrete shall be accomplished with a multi-component epoxy adhesive complying with ACI 503R and construction procedures complying with ACI 503.2.

4.11 Forms: Forms shall be constructed, braced and removed in accordance with the following:

A. Forms shall be built to conform to the shape, lines and dimensions of the concrete work. Forms shall be set to line and grade and shall be braced, tied and secured in a manner which will withstand placing of the concrete and which will maintain shape and position. Forms shall be tight and be substantially assembled to prevent bulging and the leaking of concrete. Chamfer strips shall be placed in exterior corners of forms. Joints shall be arranged vertically or horizontally. Temporary openings shall be provided, where required, at the bottoms of wall forms and elsewhere to facilitate cleaning and inspecting. Lumber used once in forms shall have nails removed and surfaces in contact with concrete work thoroughly cleaned before reusing the lumber for forms. Wall sleeves, inserts and openings shall be properly set in forms.

B. Shores shall be used where necessary. If adequate foundations for shores cannot be obtained, trussed supports shall be provided. Structural members, another work which will be subject to additional loads during construction, shall be adequately shored to protect that work from distortion and damage.

C. Forms shall not be removed until the member supported thereby has acquired sufficient strength to safely support its own weight and the load imposed on it. Tie rod clamps shall be loosened 24-hours after concrete has been placed. Standard snap ties shall be removed when forms are stripped. Care shall be taken to avoid spoiling the concrete surface. Cutting ties back from the face of the wall will not be permitted. Under normal conditions, the time elapsing before the forms may be stripped shall not be less than that shown in the following schedule.

1.	Slabs:	14 days
2.	Columns and Pedestal:	7 days
3.	Walls and Vertical Faces Not Supporting Other Work:	2 days

The use of the schedule shall not relieve the Contractor from his responsibility for the safety of the structure. Wood forms shall be completely removed from all portions of the work so that no material will remain for termite infestation.

4.12 Finishing: Exterior concrete surfaces shall be finished to levels no less than 12" below finish grade levels. Interior concrete surfaces below grade and concrete surfaces exposed to view shall be finished. Interior of basins shall be finished to a level not less than 12" below overflow level. Concrete not exposed to view shall have rough edges tooled off. Irregularities shall be filled, pointed-up with non-shrink sand cement mortar and spot finished. All imperfect concrete shall be removed to dense solid concrete and repairs made as directed by the Engineer.

A. When concrete has set sufficiently to permit, forms and form ties shall be carefully removed. Depressions resulting from removal of form ties and other holes and rough places shall be thoroughly wetted with water and pointed-up.

B. After pointed surfaces have sufficiently set, surfaces specified to be finished shall be kept wet with water and shall be rubbed with a carborundum stone of medium fineness or with other equally as good abrasive to bring the surface to a smooth texture and to remove all form and other marks. The paste formed by the rubbing may be rubbed down by floating with a canvas float, carpet-faced float, cork float or with dry burlap. The maximum allowable time between concrete form removal and commencement of concrete rubbing shall be 14 days.

C. Slabs on Concrete: Before constructing concrete slabs on earth, all piping which will be under those slabs shall have been tested, approved and encased in Class "C" concrete. The sub-grade shall provide a solid bearing and shall be brought to a true and even plane. Where floor drains occur, floors shall be pitched thereto as shown on the Drawings. The concrete shall have comparatively dry consistency and shall be screeded level or to the proper grade. After compacting and vibrating the concrete, the surface shall be prepared to receive the specified finish.

D. Wood Float Finish: All floors, walks, platforms stairs and other slab work shall have a wood float finish. After screeding to the required grade while the concrete is still green but has hardened sufficiently to bear the finisher's weight, the concrete surface shall be floated with a wood float to a true and even plane, have no visible coarse aggregate and be sufficiently rough to prevent slipping.

E. Floor Topping: Floor topping shall be applied where shown. Sub-base shall be wire-brushed before sub-base has hardened, shall be swept clean, shall be thoroughly wetted and shall be slushed with bonding grout. Topping shall be floated and trowled twice in a manner which will prevent the fine material from being drawn up. Floor hardener shall be applied in strict accordance with the hardener manufacturer's printed instructions. Other type finishes shall be as shown on the Drawings.

4.13 Curing and Protecting: Freshly placed concrete shall be protected from rain and flowing water. Concrete shall not be allowed to dry out from the time it is placed until the expiration of the specified curing period. Methods of curing unless otherwise approved by the Engineer shall be as follows:

A. Concrete shall be kept wet with clean water for period of 7 days after placing. Each day forms are left in place shall suffice for wetting.

B. Curing may be accomplished by leaving forms sufficiently wet to prevent opening of joints.

C. After forms are removed, an approved membrane forming curing compound to seal water in the concrete shall be applied to all concrete except surfaces which are to receive future concrete or mortar. Compound shall be non-straining type which will retain 97% of the moisture within the concrete at a temperature of 135°F with a relative humidity of 30% in the first 24-hours. Curing compound shall be applied in accordance with the manufacturer's direction.

4.14 Imperfect and Damaged Work and Materials: Imperfect and damaged work and materials shall be satisfactorily removed. New work and new materials which are in accord with the requirements of the Drawings and Construction Specifications shall be furnished and installed at no additional expense to the Owner. Removal of imperfect and damaged work and materials and the installation of new work and materials shall be accomplished in a manner which will not impair the strength of the structure.

4.15 Cleaning: Upon completion of work, all forms, equipment, protective covering and rubbish resulting from the work shall be removed from the premises. Finished concrete surfaces shall be left in a condition satisfactory to the Engineer and Owner.

4.16 Payment: No separate payment will be made for the work under this Section except as may be specifically set forth in the Proposal. The cost of the work of this Section and all costs incidental thereto, except that work which may be specifically set forth in the Proposal, shall be included in the price bid for the items to which the work pertains.

SECTION 5
REINFORCING STEEL, STRUCTURAL STEEL AND MISCELLANEOUS METAL

5.01 Scope: The work covered by this section of Specifications consists of furnishing all materials and equipment and performing all labor necessary for furnishing and installing all reinforcing steel, structural steel, miscellaneous metal and appurtenances as indicated on the Drawings, as specified, and as required for completion of all work under this contract.

5.02 Drawings: The Contractor shall furnish to the Engineer for review 6 copies of bending and placing details for steel bar reinforcing which shall show bar size, spacing, bending and tagging identification and 6 copies of drawings covering structural steel work showing details of fabrication and erection of structural steel. No manufacturer or fabrication shall commence until such drawings have been reviewed. The Contractor shall submit to the Engineer for review the detailed location of construction joints not shown on the Drawings but required for the execution of the work prior to the detailing of any reinforcing steel.

5.03 Reinforcing Steel: Bar reinforcement and wire mesh reinforcement shall be furnished by domestic steel mills and shall conform to the applicable ASTM specifications and ACI Building Code, as amended to date, and in accordance with the following:

A. Bar Reinforcement: Materials, fabrication and placement of steel bar reinforcement shall be in accordance with the following:

1. Materials: Bar reinforcement shall be deformed bars and conform to the requirements of ASTM A- 615 Grade 60. The steel for bars shall be made by the open hearth, basic oxygen or electric furnace process, and the bars shall be rolled from billets or ingots of properly identified heats. The steel shall be made, and the bars rolled in the United States. The use of cold twisted bars will not be permitted.

2. Fabrication: Steel bar reinforcement shall be cold bent to shapes indicated on the Drawings. Bending shall be done in the shop before shipment unless otherwise specified. Bending details for steel bar reinforcement shall conform to the requirements of the ACI Building Code (ACI-318) unless otherwise indicated on the Drawings or specified. Steel bar reinforcement shall be bent, bundled and tagged in accordance with details furnished by the fabricator.

a. Splices: Steel bar reinforcement shall be furnished full length unless otherwise indicated on the Drawings. Splices, where permitted, shall be well distributed or located at points of low tensile stress. Splices and dowels, except when used in cantilever wall or slab construction shall lap not less than 30 times the diameter of the bar. Splices and dowels used in cantilever wall or slab construction shall lap 40 diameters. Splices in horizontal reinforcement shall be staggered. The minimum clear distance between spliced bars, except when bar clamps are specified, shall

be 1-½ bar diameters, but in no case less than 1", nor less than 1-½ times the maximum size of coarse aggregate.

1) Design is based upon "non-contact" type vertical splices lapped and specified above as required under the applicable sections of the ACI code. Tied "contact" lapped splices will be allowed for ease in establishing the basic framework for the vertical rebar mats. However, no more than 20% of the required vertical lap splices may be "contact" type splices. All other lap splices shall conform to the minimum and maximum clear distance requirements as specified above and in the applicable sections of the ACI code.

b. Hooks: Hooks of 180° shall have a radius of bend on the axis of the bar of not less than 3 bar diameters plus an extension of 4 bar diameters at the free end. Hooks of 90° shall have a radius of bend on the axis of the bar of not less than 4 bar diameters plus an extension of 12 bar diameters at the free end.

c. Openings: Openings 12" and larger through concrete walls and slabs shall have a minimum of 8 extra diagonal bars in each face of the wall or slab of the same size as the largest bar in the wall or slab. The length of extra diagonal bars at openings shall be as shown on the Drawings or diameter of opening plus 24 bar diameters each end of bar.

d. Minimum Reinforcing: Minor concrete walls, slabs and other Class "A" concrete sections, where no reinforcement is shown on the Drawings, shall have a minimum area of steel bar reinforcing equal to 0.0025 times the cross-sectional area of the concrete work.

3. Placing: Steel bar reinforcement shall be placed in the locations shown on the Drawings and held securely in place during the placing of concrete. The pushing of short bars into new concrete work will not be permitted. Bar reinforcing in walls shall be spaced the proper distance from the face of the wall by the use of approved precast concrete mortar blocks. Precast mortar blocks used for bar reinforcement spacing shall have a minimum compressive strength equal to the concrete being placed. Bar reinforcing in slabs or beams shall be spaced the proper distance from the bottom of the slab or beams by use of precast concrete mortar blocks, steel chairs with plastic coated legs or plastic tips, or stainless steel chairs. Vertical stirrups shall always pass around main tension members, and be securely attached thereto. Bar spacing, covering, minimum clearance, bond and anchorage shall conform to the requirements of the ACI Building Code (ACI-318), except as otherwise indicated on the Drawings or specified.

4. Fastening, Reinforcing and Placing Concrete: Steel bar reinforcing, when properly placed, shall be securely wired together at intersections with 18 gauge black annealed wire. Prior to the placing of concrete, all mortar and

other foreign matter which may reduce or destroy bond shall be removed from the reinforcement. No concrete shall be deposited until the placement of the reinforcing has been reviewed by the Engineer, or his representative.

B. Wire Mesh Reinforcement: Wire mesh reinforcement, when shown on the Drawings or specified to be required in the work to be done, shall be furnished and placed in accordance with the following:

1. Materials: Wire mesh reinforcement shall conform to the requirements of ASTM A-185 and unless otherwise indicated in the Drawings shall be 4" by 4" mesh of 6-gauge wire.

2. Placement: Wire mesh reinforcement shall be secured in position by spacer bars and chairs. Spacer bars shall be lapped not less than 5". Precast concrete mortar blocks may be used in lieu of metal chairs in slabs on ground. Mesh shall be checked for position during placing of concrete and any displacement corrected. Mesh shall overlap 1" at edges unless otherwise indicated on the Drawings and shall be securely tied at ends and overlap.

C. Reinforcement - Storage and Protection: Steel reinforcement shall be stored above the surface of the ground upon platforms, skids or other supports, and shall be protected as far as is practicable from mechanical injury and surface deterioration. When placed in the work, it shall be free from rust, dirt, scale, paint, oil or other foreign matter which may reduce or destroy bond.

5.04 Iron Castings: The Contractor shall furnish all miscellaneous iron castings, including catch basins, manhole frames and covers, steps, floor drains, bolt inserts, brackets, supports and such other iron castings as are shown on the Drawing in accordance with the applicable ASTM Specifications, as amended to date. All materials furnished shall be installed in a good workmanlike manner.

A. Castings: Castings, unless otherwise specified, shall be of gray-iron conforming to ASTM A-48. Manhole and step castings shall be the Owner's Standard unless otherwise specified.

B. Malleable Castings: Malleable castings shall conform to ASTM A-47.

C. Quality: All castings shall be tough, close-grained and smooth and free from blow holes, blisters, shrinkage stains, cracks, cold shots and like defects. No plugging of defective castings will be permitted.

D. Workmanship: All castings shall be made accurately to dimensions shown on the Drawings or ordered and shall be planned or ground where necessary whether marked or not to secure perfectly flat bearing surfaces. Allowance shall be in the patterns so that the specified thickness of metal will not be reduced.

E. Weights: No castings will be accepted, the weight of which is less than the theoretical weight, based on required dimensions, by more than 5%.

F. Cleaning and Painting: All castings shall be thoroughly cleaned and painted before rusting begins. All castings except those to be embedded in concrete shall be cleaned and given a priming coat of paint in the shop. Castings, which will be exposed in buildings, shall be painted in accordance with the section "Painting". Castings which are to be installed outdoors, such as manhole frames, covers and steps, shall be given one coat of an asphaltic or bituminous paint which results in a smooth and tough well-bonded coating.

5.05 Nosings for Concrete Treads: Nosings of all concrete steps, interior and exterior, shall be 3" in width and shall be Wooster Type 101 Alumogrit, American Abrasive Metal Company Style A or equal abrasive safety treads, securely anchored to concrete.

5.06 Stainless Steel: Unless otherwise specified, all fabricated work indicated on the Drawings and/or specified to be stainless steel shall be Type 316, in accordance with ASTM A-276 as amended to date.

5.07 Bolts, Nuts and Screws: Steel bolts and nuts for jointing miscellaneous steel shall conform to ASTM A-325 or A-490 and shall be American National Standard dimensions. Anchor bolts, in general, shall be placed in forms prior to placing concrete. When expansion bolts must be used, they shall be Rawl, National or equal. Anchor bolts and expansion bolts shall be Type 302, 304, or 316 stainless steel. Steel and aluminum weir plates, aluminum railing, miscellaneous aluminum, galvanized steel and stainless steel jointing shall be fastened with Type 302 or 304 stainless steel bolts, nuts, and screws as required.

5.08 Aluminum: Aluminum shall be of the following alloys:

- Sheet or plate 6061-T6
- Structural or rolled shapes 6061-T6
- Extruded shapes 6061-T6
- Tubing or pipe 6061-T6 or 6063-T6
- Nuts and bolts 2024-T4 with #205 aluminum finish

A. Aluminum Grating and Treads: All grating, except otherwise shown, shall be equal to Borden Aluminum Plank "Standard," or Liskey extruded aluminum grating, "Duro-Grip," with rectangular punch or equal. The grating shall be of the depth shown and shall be of aluminum alloy 6061-T6 or 6063-T6. Weld end plates to all bearing bars and band all cutouts. Exposed welds and welding beads on the exposed top surface of the grating and/or end plates and bands will not be acceptable. Samples, which represent the finished product, shall be submitted to the Engineer for review. Seat angles in concrete shall be ¼" thick aluminum angles of a size which will properly accommodate the depth of the grating bars. Stair treads shown as being of aluminum shall be of the same aluminum alloys as the grating. The types shall be as shown or approved equivalent. Field paint all aluminum surfaces which will be in contact with concrete or carbon steel with suitable asphaltic paint.

B. Aluminum Pipe Railing: All rails and posts shall be fabricated size 1½" Schedule 40 aluminum pipe of 6061-T6 or 6063-T6 alloy. Railing may be shop fabricated with continuous welded joints and mill finish or may be assembled from approved factory fabricated one piece extrusion machined fittings and pipe with 305 stainless steel blind rivets and self- tapping screws all with 7 mil anodized finish. Welding shall be by inert gas shielded arc method with all welds ground smooth.

C. Aluminum Gates and Frames: Aluminum gates and frames shall be built of structural or extruded shapes as shown on the Drawings and shall be given an anodizing finish.

5.09 Welding/Inspection and Testing: Welders working on job shall meet the following qualifications.

A. Experience of Welders and Welding Operators: Welders and Welding Operators, shop and field, shall be qualified by an independent laboratory using test procedures covered in AWS D1.1 and shall have been employed as a Welder/Welding Operator using the positions for which he/she is qualified during the previous 90 days. The Contractor shall provide the Engineer and laboratory inspector with the (a) names of Welders and/or Welding Operators to be employed in the shop and field, (b) certification of the position, (c) date of the last qualification test and (d) the name of the qualifying laboratory.

1. All welders employed in the field on the erection of the steel work shall be qualified for the most difficult welding position during field erection.

2. The Contractor shall require any welder to retake the test, when, in the opinion of the Engineer, the work of the welder creates a reasonable doubt as to the proficiency of the welder. Recertification of the welder shall be made to the Engineer only after the welder had taken and passed the specified test. The Engineer may require radiographic or ultrasonic testing or may require coupons to be cut from any location in any joint for testing.

3. All Section of welds found defective shall be chipped or cut out to base metal and rewelded before proceeding with the work.

4. Costs of all qualifications, tests and retests shall be borne by the Contractor.

5. Joint Qualification: All joints shall comply with AWS D1.1.

B. Inspection and Testing: Inspection and testing shall be as follows:

1. Inspections and Tests: Inspection and tests shall be performed by an independent laboratory complying with ASTM E-329. The testing laboratory shall be directed by the Engineer. All material to be furnished shall be subject to inspections and tests in the shop and field.

2. Shop Inspections: Shop inspections and tests shall include fit-up, preparation of surfaces and welding.

3. Field Inspections: Field inspections and tests shall include fit-up, preparations of surfaces, welding and bolting.

4. Reports: Reports of shop and field inspections and testing shall be made by the laboratory on a weekly basis. One copy of each shop and field inspection report shall be submitted directly to each of the following: Engineer, Inspector, Contractor, Fabricator and Erector.

5.10 Structural Steel:

A. Shop Drawings and Erection Procedures:

1. The Contractor shall prepare and submit shop and erection plans covering all structural steel and related items. All dimensions for checking of structural steel details shall be shown on the drawings.

2. The Contractor shall be responsible for the confirmation of all steel details to the typical and special details shown on the drawings and for all details, notes and schedules appearing on the drawings. The Contractor shall be responsible for giving information for the fabrication and erection of the structural steel. Related items shall be shown on the erection or shop drawings. Drawings shall include all shop and erection details including cuts, copes, connections, hole, bolts and welds. For bolted, the type, size and length of bolts including washers shall be shown. All welds, both shop and field, shall be indicated by standard welding symbols as noted by AWS D1.1. Drawings shall show the size, length and type of each weld.

3. The Contractor shall prepare and submit 2 copies of a detailed erection procedure with the shop and erection drawings. The procedure shall include the sequence of erection with temporary staying and bracing. No copies of such procedure will be returned.

B. Applicable Specifications and Codes: The following specifications and codes form a part of this section of these Specifications:

1. American Institute of Steel Construction Publications, Manual of Steel Construction, Eighth Edition:

a. Code of Standard Practice for Steel Buildings and Bridges.

b. Specification for the design, Fabrication and Erection of Structural Steel for Buildings with commentary.

2. American Society for Testing and Materials: As amended to date.

a. A *36, Specifications for Structural Steel.*

b. A 572, Specifications for High-Strength Low Alloy Columbium-Vanadium Steels for Structural Quality.

c. A 325, Specifications for High-Strength Steel Bolts for Structural Steel Joints, including Suitable Nuts and Bolts and Washers

d. A 490, Specifications for Quenched and Tempered Alloy Steel Bolts for Structural Steel Joints

e. E 329, Recommended Practice for Inspection and Testing Agencies for Concrete and Steel as Used in Construction

3. American Welding Society: Shall be D1.1 as amended to date, Structural Welding Code

4. Specifications for Structural Joints: Using ASTM A 325 or A 490 bolts

5. Fabrication and Erection of Structural Steel for Buildings: Unless otherwise indicated on the drawings or in the Specifications for the design, the publication, Fabrication and Erection of Structural Steel for Buildings of the American Institute of Steel Construction, hereafter designated AISC, shall govern structural steel work. Welding shall be in accordance with American Welding Society Standard Code D1.1.

C. Substitutions of Sections: Substitutions of sections or modifications of details, or both, and the reasons for such substitutions or modifications shall be submitted with the shop drawings for approval. Approved substitutions, modifications, and/or changes in related portions of the work shall be coordinated by the Contractor and shall be accomplished at no additional cost to the Owner.

D. Responsibility for Errors: The Contractor shall be responsible for all errors of detailing, fabrication and for the correct fitting of the structural members. The Contractor shall make all measurements in the field to verify or supplement dimensions shown on the Drawings and shall assume responsibility for fitting new work to existing work.

E. Templates: Templates with instructions for the setting of anchors, anchor bolts and bearing plates shall be furnished by the Fabricator to the job. The Contractor shall ascertain that the items are set during the progress of the work.

F. Qualifications:

1. Experience of Fabricator: Fabrication Shop and Erector shall have fabricated and erected projects of similar size and complexity for at least ten years.

2. Experience of Welders and Welding Operators: Welders and Welding Operators, shop and field, shall be qualified by an independent laboratory using test procedures covered in AWS D1.1, and shall have been employed as a Welder/Welding Operator using the positions for which he/she is qualified during the previous 90 days. The Contractor shall provide the Engineer and laboratory inspector with the (a) names of Welders and/or Welding Operators to be employed in the shop and field, (b) certification of the position, (c) date of the last qualification test and (d) the name of the qualifying laboratory.

   a. All welders employed in the shop on the fabrication of the steel work shall be qualified for the most difficult welding position during shop fabrication.

   b. All welders employed in the field on the erection of the steel work shall be qualified for the most difficult welding position during field erection.

c. The Contractor shall require any welder to retake the test, when, in the opinion of the Engineer, the work of the welder creates a reasonable doubt as to the proficiency of the welder. Recertification of the welder shall be made to the Engineer only after the welder had taken and passed the specified test. The Engineer may require radiographic or ultrasonic testing or may require coupons to be cut from any location in any joint for testing.

d. Should any two radiographic or ultrasonic tests or coupons cut from the work of any welder show strengths or undertests less than that of the base metal, it will be considered evidence of negligence or incompetence and such welder shall be removed from the work.

e. When coupons are removed from any part of a structure:

1) The members cut shall be repaired at no additional cost to the Owner in a neat and workmanlike manner.

2) Joints will be of a type to develop the full strength of the members.

f. Joints will be cut with peening to relieve residual stress.

g. All sections of welds found defective shall be chipped or cut out to base metal and re-welded before proceeding with the work.

h. Costs of all qualifications, tests and retests shall be borne by the Contractor.

3. Joint Qualification: All joints shall comply with AWS D1.1.

G. Inspection and Testing:

1. Inspections and Tests: Inspections and tests shall be performed by an independent laboratory complying with ASTM E-329. The testing laboratory shall be directed by the Engineer. All material to be furnished shall be subject to inspections and tests in the shop and field.

2. Shop Inspection: Shop inspections and tests shall include fit-up, preparation of surfaces and welding.

3. Field Inspections: Field inspections and tests shall include fit-up, preparations of surfaces, welding and bolting.

4. Reports of Inspections: Reports of shop and field inspections and testing shall be made by the laboratory on a weekly basis. One copy of each shop and field inspection report shall be submitted directly to each of the following: Engineer, Resident Engineer, Inspector, Contractor, Fabricator and Erector.

H. Materials: Materials shall be of domestic manufacture, within trade tolerances, new, undamaged and without splices. Structural material, plain or fabricated, shall be stored above the ground upon platforms, skids or supports. Materials shall be kept free of dirt, grease and foreign matter and shall be protected from corrosion.

1. Structural Steel:

   a. Structural steel shall comply with ASTM A-36 unless indicated otherwise on the Drawings.

   b. The Contractor shall furnish two copies of all mill reports covering the chemical and physical properties of the steel used.

2. Bolts, Nuts and Washers:

   a. All bolts, nuts and washers shall comply with ASTM A-325 or A-490.

   b. ASTM A-325 and A-490 bolts shall be used for connections as indicated on the Drawings.

3. Welding Electrodes and Flux:

   a. Electrodes and flux used for submerged arc welding shall be of the same manufacture. The flux shall be free of the contamination of dirt, mill scale and foreign material. Fused flux used in welding shall not be reused. Bare electrodes and flux used in combination shall conform to the requirements of AWS D1.1.

   b. Electrodes for manual shielded metal-arc welding shall conform to AWS D1.1.

4. Grout: Non-shrink grout beneath base and bearing plates shall be Embeco by the Master Builders Company, Five Star Grout by U.S. Grout Corp., or equal.

I. Welding Equipment: Welding equipment shall be capable of providing the welding required by the Drawings and/or Specifications and in compliance with the requirements of joint qualification in AWS D1.1.

J. Fabrication:

1. Structural Material: Structural material shall be fabricated and assembled in the shop. Assembled pieces shall be taken apart for the removal of burrs, and shavings produced by the reaming operation. Parts not connected in the shop shall be secured by bolts to prevent damage in shipment and handling.

2. Connections: Connections shall be as shown on the Drawings. Connections not indicated shall be made to conform with the AISC Specification. One-sided or other types of eccentric connections will not be permitted. Surfaces of joints for welded and bolted connections shall be clean bright metal. Fit up of the parts shall be inspected and approved by the laboratory inspector prior to making final connection.

   a. Holes shall be cut, drilled or punched at right angles to the surface of the metal and shall not be made or enlarged by burning. Holes in base or bearing plates shall be drilled. Holes shall be clean-cut without torn or ragged edges. Outside burrs resulting from drilling

or reaming operation shall be removed. Holes for bolts shall be 1/16" larger than the diameter of the bolt except as noted on the drawing.

b. Welded connections will be permitted only where indicated on the Drawings. Welded construction shall conform to the AISC and AWS Specifications.

c. Bolted connections using ASTM A-325 or A-490 bolts shall conform to the Specifications for Structural Joints using ASTM A-325 or A-490 bolts. Indicator washers shall be used to show that bolts are properly tightened. Both threads shall be excluded from the shear planes of the contact surfaces between the connected parts. Load indicator washers shall be Cornet Load Indicator by Cooper + Turner, Inc. or equal.

3. Milled Surfaces: Milled surfaces shall comply to the AISC Specification and the Drawings.

4. Allowance: Allowance shall be made for draw in all tension bracing.

K. Erection:

1. Splices: Splices and field connections shall be made as shown or noted on the Drawings. Errors in shop fabrication or deformation resulting from handling and transportation that prevent the assembly and fitting of parts shall be reported immediately to the Engineer for directions as to the method of correction. Corrections shall be made at no additional cost to the Owner.

2. Leveling Plates: Leveling plates shall not be used under base plates.

3. Anchor Bolts: Anchor bolts and anchors shall be located and built into connecting work. Bolts and anchors shall be preset by the use of templates to locate the anchors and anchor bolts.

4. Column Bases: Column bases and bearing plates may be attached or loose as approved on the shop drawings. Plates shall be supported and aligned on steel wedges or shim. After the supported members have been plumbed and positioned and the anchor nuts tightened, the entire bearing area under the plate shall be dry-packed solidly with non-shrink grout. Wedges and shims shall be cut off flush with the edge of the column base and bearing plates, and shall be left in place.

5. After Assembly: After assembly, the various members forming parts of a completed frame or structure shall be aligned and adjusted before being fastened. Tolerance shall conform to AISC. Fastening of splices of compression members shall be done after the abutting surfaces have been brought completely into contact. Bearing surfaces and surfaces that will be in permanent contact shall be cleaned before the members are assembled. As erection progresses, the work shall be fastened to take care of all dead load, wind and erection stresses. Splices will be permitted only

where indicated on the Drawings. Erection bolts used in welded construction shall be tightened and left in place. Welding for redrilling will not be permitted.

6. Driftpins: Driftpins may be used only to bring together the several parts, and shall not be used in such manner as to distort or damage the metal.

7. Gas Cutting Torch: The use of a gas cutting torch in the field for correcting fabrication errors is prohibited unless the Engineer has specifically approved such procedure for each case individually in writing.

L. Painting:

1. Cleaning: All steel work shall be cleaned of loose mill scale, loose rust, accessible weld slag or flux deposit, dirt, and foreign matter. Oil and grease deposits shall be removed by solvent. No paint shall be applied when steel temperature is below the dew point of the atmosphere.

2. After Cleaning: After cleaning and connections are approved by the laboratory inspector, all steel work except surfaces to be fireproofed, or surfaces to be welded shall be given a shop coat of primer. The primer shall be applied at a rate to provide a minimum dry film of 2.0 mils. The primer shall be applied without holidays or paint runs.

3. After Erection: After erection all field connections shall be cleaned. All connections, including welds and bolts, and all abraded surfaces on the shop primer shall be painted to give one complete coat of primer. Paint for field touch-up shall be the same paint used for the shop coat.

5.11 Payment: No separate payment will be made for the work of this Section. The cost of the work, and all costs incidental thereto, shall be included in the amount bid in the Proposal for every item to which the work pertains.

SECTION 6
SITE PREPARATION, EXCAVATION, BACKFILLING AND GRADING

6.01 Scope: The work covered by this Section of the Specifications consists of furnishing all materials and equipment, and performing all labor necessary for clearing, excavating, backfilling and grading for site development, and to permit construction of the structures and buildings in strict conformity with the contract Drawings, the Specifications and the directions of the Engineer.

6.02 Site Conditions and Soil Investigation: The Contractor's attention is directed to the paragraph of Instructions to Bidders and special provisions relating to Site Examination. Contours and existing topography shown on the Drawings are believed to be reasonably correct. It shall be the Bidder's responsibility to determine any major difference which would affect his bid and make allowance for such differences in his bid.

The Contractor shall visit the site and satisfy himself to the soil conditions anticipated. In addition, the bidder must form his own opinion of the character of the sub-surface materials to be encountered in excavating for and the construction of the various facilities

The Supplementary General Conditions identify any reports known to Owner of explorations and tests of subsurface conditions at or adjacent to the Site.

6.03 Clearing Site: The area shall be cleared of all existing structures, pavements and other obstructions interfering with or in the way of construction of new work. The area shall be cleared of trees, stumps, roots, brush, gravel, rubbish, vegetative, soft /loose and near-surface soils, utilities and cultivated sprayfield to a depth of 12" and to limits at least 10' outside of limits of tops of cuts and toes of fill. Trees and shrubs designated to be left in place and those outside of limits shall not be damaged. Top soil and vegetable matter shall be carefully stockpiled and preserved for surfacing completed slopes.

A. Disposal of Waste Material: All waste materials resulting from clearing operations shall be disposed of in accordance with applicable regulations of the Georgia Department of Natural Resources, Environmental Protection Division.

B. Damage to Existing Facilities: Any structure, pavement, fences or other such work removed for construction purposes or damaged by reason of construction operations; but not in the way of new work, shall be replaced or repaired.

6.04 Grading: Before the beginning of construction operations, the Contractor will grade the site to the proposed elevations above as indicated on the Drawings. The Drawings show both existing contour elevations and finished contour elevations.

A. Finish Grading: Upon completion of construction operations, the area shall be finish graded in accordance with finish contour elevations and grades shown on the Drawings. Graded areas shall be made to blend into conformation with remaining ground surfaces. All surfaces shall be left smooth and free to drain. The tops of all cuts shall have berm ditches.

B. Additional Material: If additional material, other than that to be obtained from excavation, is required for backfilling and grading, the Contractor shall obtain such additional material from borrow at his own expense.

C. Excess Material: Any excess earth excavation, and all rock excavation shall be placed on or near the site as directed by the Engineer. Surfaces on slopes of waste fills shall be left smooth and free to drain.

6.05 Excavations: The Contractor shall perform all excavating of every description, and of whatever substances encountered, to the dimensions and levels shown on the Drawings and/or as specified. Excavation may be accomplished by any customary method.

A. Earth Excavation: Earth excavation shall include all substances to be excavated other than rock.

B. Rock Excavation: Rock excavation shall comprise of solid rock, in the original bed or in well defined ledges; the removal of which, in the opinion of the Engineer, requires drilling, blasting or the use of jack hammers and bull points, and shall also include all boulders and detached pieces of rock 8-cubic feet or more in content.

C. Blasting: All blasting operations shall be conducted in accordance with existing ordinances and regulations, and as directed by the Engineer. Exposed structures shall be protected from the effects of blasts, and blasts shall be covered with suitable mats and shall be restricted to the extent that no appreciable shock will be transmitted to existing structures, pipe lines, sewers or other public or private facilities. No blasting shall be started without the Engineer's approval of method and quantity of explosive to be used.

D. Damage to Existing Facilities: Any damaged structures, pipe lines, sewers or other private or public facilities shall be immediately repaired or replaced at the expense of the Contractor. Any damage to such facilities which will impair or restrict the operation of the water supply system shall be immediately repaired or replaced with no stoppage of work until such repairs or replacements are complete.

6.06 Excavation for Structures: The limits of excavation for structures shall be in accordance with the following:

A. Earth Excavation: Earth excavation for structures shall be to limits not less than 2' outside wall lines, to allow for formwork and inspection; and further, as necessary, to permit the trades to install their work. Excavations for footings shall be to footing dimensions. Excavation for slabs shall be to near bottom slab level. Earth excavation for structures shall not be machine dug below a level 6" above bottom elevations of slabs or footings.

B. Rock Excavations: Rock excavations for structures shall be to limits not less than 2' outside of wall lines, with a vertical tolerance of 3" in or out, and further if necessary to allow for inspection and to permit trades to install their work. Excavation for footings shall be to a minimum depth and width not less than the footing dimensions. Excavation for slabs shall be not higher than bottom slab level.

1. Blasting: All blasting operations shall be conducted in strict accordance with existing ordinances and regulations and shall be done subject to the

Engineer's approval of the method and quantity of explosive to be used. Exposed structures shall be protected from the effects of blasts, and all blasts shall be covered with blasting mats, dirt, heavy timbers or other suitable material. They shall be restricted to the extent that no appreciable shock will be transmitted to existing structures, pipe lines, sewers or other public or private facilities. All blasting supplies shall be stored in a magazine which complies with all local, state and federal laws. In no case shall caps or other exploders be kept at the place where dynamite or other explosives are stored.

C. Foundation Subgrade Stabilization: If loose or soft soils are encountered in structural areas, the soils will need to be reworked or undercut to a point 10' outside the perimeters of the structural areas. Majority of these soils can be compacted in place, however very loose or soft soils were encountered near the surface at borings B-3 and B-6. Some undercutting of localized areas may be necessary. The extent of the reworking necessary will depend on the final grading plans and the climatic conditions at the time of construction. All undercut areas should be backfilled with structural fill.

6.07 Dewatering: The site shall be kept free of surface water at all times. Shallow groundwater was encountered at borings B-3 through B-13. The Contractor shall install drainage ditches and dikes and shall perform all pumping and other work necessary to divert or remove rainfall and all other accumulations of surface water from the excavations. The diversion and removal of surface water shall be performed in a manner that will prevent the accumulation of water behind temporary structures or at any other locations within the construction area where it may be detrimental. The Contractor shall provide, install and operate sufficient trenches, sumps, pumps, hose, piping, wellpoints, deep wells, etc., necessary to depress and maintain the ground water level at least 5' below the base of the excavation during all stages of construction operations. The ground water table shall be lowered in advance of excavation and maintained a minimum of 5' below the lowest excavation subgrade made until the structure has sufficient strength and weight to withstand horizontal and vertical soil and water pressures.

6.08 Underdrain System: Furnish and install underdrain systems where shown on the drawings. The underdrain system shall consist of clean uniform ¾" stone, perforated PVC pipe and non-woven fabric. A detail of construction is shown on the Drawings.

A. Placement: Material for the underdrain shall be placed uniformly in layers. No special compaction of the drain fill is required. The layers shall be 6" in depth.

B. Perforated Pipe: Perforated pipe shall be PVC, shall be bell and spigot, and shall be in lengths not exceeding 20'. The spigot end and bell shall be unperforated for a length equal to the socket or shoulder. Pipe shall be laid with perforations down and oriented symmetrically about a vertical centerline. Perforated PVC pipe and fittings shall conform to ASTM F 758 with a minimum stiffness of 46.

C. Filter Cloth/Fabric: Filter cloth/fabric shall be a non-woven fabric consisting of long chain polymeric filaments formed into a stable network. The fabric shall be inert to commonly encountered chemicals and non- biodegradable. The fabric shall have a pore size (EOS) equivalent to a 70-100 sieve, water permeability

coefficient of at least 0.1 cm/sec, grab tensile strength of 125 pounds, and trapezoidal tear strength of 65 pounds. The fabric shall be Miraffi 140S, Geotex 135ST or equal.

6.09 Structural Fill: After clearing and excavation operations have been completed, all structure locations shall be proof-rolled with a loaded pan or heavy pneumatic tired vehicle to densify upper soils and to locate possible areas which will require undercutting, removal and/or recompaction. This operation shall be conducted under the surveillance of an experienced soil inspector.

A. Fill Material: Fill shall be clean inorganic natural soil. Structural fill below building areas (and the upper 2' of fill beneath pavements) shall contain no rock fragments larger than 3" in longest dimension. Soils proposed for fill shall have a maximum density of 98 pounds per cubic foot or greater in Standard Proctor Compaction Test ASTM D698. Excavated materials which contain large quantities of rock or weathered rock fragments shall not be used in building areas. Fill below floors, foundations and paved areas shall be compacted at least 95% of the ASTM D698 maximum density.

B. Compaction: Fill shall be placed in loose layers 8" or less in thickness unless noted otherwise elsewhere in these Specifications. Each layer shall be compacted by sheeps foot or rubber tired roller operating independently of the dozer used to spread fill. If the fill soils are clayey or silty sands or sandy silts with Unified Classifications of SC, SM, SP, ML or CL, the compaction of each fill layer shall be completed by two coverages of rolling with a loaded earth moving scraper, dump truck or large rubber tired roller before more fill is placed.

C. Testing: Fill compaction shall be verified by field density testing conducted throughout the period of fill placement and compaction. Subgrade preparation shall be inspected by an experienced soil engineer. Field density tests shall be performed to verify that the specified degree of compaction is achieved. For building areas, a frequency of passing tests of at least 1 test per 1,500 square feet for each 18" of new fill thickness is required.

D. Construction Fabric: Contractor shall furnish and install, where indicated in these specifications, construction fabric to stabilize soil surfaces for structural fill placement. Construction fabric shall be a polyester continuous filament needle punched nonwoven engineering fabric such as Mirafi 500X, Geotex 200ST or equal.

6.10 Yard Fills: Yards shall be graded to widths, gradients and limits shown on the Drawings. The fill shall be thoroughly compacted. The Contractor shall place all sub- fills to approximately 8" lower than the finish elevations shown on the Drawings for areas to be surfaced. Areas outside the surfaced areas shall be graded to the elevations shown on the Drawings. Fill shall be of selected clay materials obtained from excavation suitable for compaction to form an unyielding sub-base. All fills shall be properly compacted by the use of sheeps foot or other approved roller. The fills shall be compacted and rolled until a solid sub-base is provided. If necessary, the fill shall be sprinkled and brought up to provide satisfactory compaction conditions. Yard fills shall be compacted to at least 90% of the ASTM D698 maximum density.

6.11 Storm Drainage Piping: The location, size and type of storm drainage piping shall be as shown on the drawings. All storm drainage shall be designed to provide adequate drainage of the areas so that no low spots holding water can develop. Corrugated steel drain pipe shall be used in storm drainage and shall be as follows:

A. Corrugated Steel Drain Pipe: Corrugated steel drain pipe shall be furnished and constructed in accordance with the Department of Transportation, State of Georgia, Standard Specifications Constructions of Roads and Bridges, 1983 Edition, and these Specifications. Pipe shall be galvanized and fully bituminous coated with a paved invert filling the corrugations for at least twenty-five (25%) percent of the circumference. The bituminous coating shall be a minimum thickness of 0.05", measured to the crest of corrugations. Pipe corrugations shall be 2 ⅔" x ½". Band shall be in accordance with WW-P-405-B 3.3.4.2. The projections of the bands shall conform substantially to the shape and depth of the pipe corrugations and shall be in circumferential rows with no less than seven projections per row. Required nuts and bolts shall be furnished with the band. Culvert pipe shall be 16-gauge through 24" diameter, 14 gauge for 30" and 36" diameter, 12 gauge for 42" through 54" diameter, 10 gauge for 50" through 72" diameter, and 8 gauge for 78" and 84" diameter.

The pipe shall have a duct tape (a type that will adhere and leave the heat number legible when removed) placed over one complete heat number before the bituminous coating is applied. This tape shall be located as close to the end of the pipe as the heat number will allow and from under the paved invert. All individual joints of pipe require this procedure.

Copies of certified mill test reports showing heat numbers, the chemical analysis and weight of spelter coated for each heat, lift of coil number, case, size and type of material used to fabricate this pipe will be mailed to the Engineer, Owner and Contractor within 5 calendar days of the delivery date of the pipe. Each copy will reference pipe size, number of sections, date of actual delivery to the job so that a positive identification can be made.

6.12 Earth Fills:

A. Materials: All fill materials shall be obtained from required excavations and designated borrow areas. The selection, blending, routing and disposition of materials in the various fills shall be subject to approval by the Engineer.

All fill material should be clean, soil, free of any organic and deletrious materials and rocks or stones over 3" in diameter. It should also have a Plasticity Index (PI) less than 30. The fill should be compacted to a minimum of 95% of the standard Proctor maximum dry density (ASTM D 698) with moisture contents being maintained between the soil's optimum moisture and 3% over optimum.

B. Foundation Preparation: Foundations for earth fill shall be stripped to remove vegetation and other unsuitable materials or shall be excavated as specified.

Except as otherwise specified, earth foundation surfaces shall be graded to remove surface irregularities and shall be scarified parallel to the axis of the fill or otherwise acceptable scored and loosened to a minimum depth of 2". The

moisture content of the loosened material shall be controlled as specified for the earth fill as specified for subsequent layers of earth fill.

Earth abutment surfaces shall be free of loose, uncompacted earth in excess of 2" in depth normal to the slope and shall be at such a moisture content that the earth fill can be compacted against them to effect a good bond between the fill and the abutments.

Foundation and abutment surfaces shall not be steeper than 1 horizontal to 1 vertical unless otherwise specified. Test pits or other cavities shall be filled with compacted earth fill conforming to the specifications for the earth fill to be placed upon the foundation.

C. Placement: Fill shall not be placed until the required excavation and foundation preparation have been completed and the foundation has been inspected and approved by the Engineer. Fill shall not be placed upon a frozen surface, nor shall snow, ice or frozen material be incorporated in the fill.

Fill shall be placed in approximate horizontal layers. The thickness of each layer before compaction shall not exceed 8" in thickness. Materials placed by dumping in piles or windows shall be spread uniformly to not more than an 8" thickness before being compacted. Hand compacted fill, including fill compacted by manually directed power tampers, shall be placed in layers whose thickness before compaction does not exceed 4". Fill must be adequately keyed into existing foundation materials. Benching and scarification of existing materials is required to provide adequate bonding.

Adjacent to structures, fill shall be placed in a manner which will prevent damage to the structures and will allow the structures to assume the loads from the fill gradually and uniformly. The height of the fill adjacent to a structure shall be increased at approximately the same rate on all sides of the structure.

Earth fill shall be placed so as to meet the following additional requirements:

1. The distribution of materials throughout each zone shall be essentially uniform, and the fill shall be free from lenses, pockets, streaks or layers of material differing substantially in texture or gradation from the surrounding material.

2. If the surface of any layer becomes too hard and smooth for proper bond with the succeeding layer, it shall be scarified parallel to the axis of the fill to a depth of not less than 2" before the next layer is placed.

3. The top surfaces of embankments shall be maintained approximately level during construction, except that a crown or cross-slope of not less than 2% shall be maintained to insure effective drainage, and except as otherwise specified for drain fill zones. If the drawings or specifications require or the Engineer directs that fill be placed at a higher level in one part of an embankment than another, the top surface of each part shall be maintained as specified above.

4. Dam embankments shall be constructed in continuous layers from abutment to abutment except where openings to facilitate construction or to allow the passage of stream flow during construction are required.

5. Embankments built at different levels as described under (3) or (4) above shall be constructed so that the slope of the bonding surfaces between embankment in place and embankment to be placed is not steeper than 3' horizontal to 1' vertical. The bonding surface of the embankment in place shall be scarified, moistened and recompacted when the new fill is placed against it is needed to insure a good bond with the new fill and to obtain the specified moisture content and density in the junction of the in place and new fill.

6. No fill should be placed on frozen or wet ground. Any placed fill that becomes frozen, saturated or excessively dry should be undercut and replaced. Any unsuitable or damaged fill should not be covered with additional fill. The surface of each fill lift should be left in an unsmooth condition to provide adequate bonding with subsequent fill lifts. All fill lifts should be graded to prevent surface water ponding. The fill pad should be sealed at the end of each day by proofrolling with rubber-tired rollers.

D. Control of Moisture Content: During placement and compaction of fill, the moisture content of the materials being placed shall be maintained within the specified range.

The application of water to the fill materials shall be accomplished at the borrow areas insofar as practicable. Water may be applied by sprinkling the materials after placement on the fill, if necessary. Uniform moisture distribution shall be obtained by discing, blading or other approved methods prior to compaction of the layer.

Material that is too wet when deposited on the fill shall either be removed or be dried to the specified moisture content prior to compaction.

If the top surface of the preceding layer of compacted fill or a foundation or abutment surface in the zone of contact with the fill becomes too dry to permit suitable bond it shall be scarified and moistened by sprinkling to an acceptable moisture content prior to placement of the next layer of fill.

A heavy duty harrow shall be on site while earth fill is being placed to provide the necessary discing for moisture control.

E. Compaction: Fill adjacent to structures shall be compacted to the required density by means of hand tamping or manually directed power tampers or plate vibrators. Heavy equipment shall not be operated within 2' of any structure. Vibrating rollers shall not be operated within 5' of any structure. Compaction by means of drop weights operating from a crane or hoist will not be permitted.

1. The passage of heavy equipment will not be allowed over the following:

a. Cast-in-place conduits prior to 14 days after placement of the concrete

b. Cradled precast conduits prior to 7 days after placement of the concrete cradle

c. Any type of conduit until the backfill has been placed above the top surface of the structure to a height equal to one- half the clear span width of the structure or pipe or 2', whichever is greater.

2. Compaction of fill adjacent to structures shall not be started until the following time intervals have elapsed after placement of the concrete.

Structure	Time Interval
Retaining walls and counterforts	14 days
Walls backfilled on both sides simultaneously	7 days
Conduit and spillway risers, cast-in-place (with inside forms in place)	7 days
Conduit and spillway risers, cast-in-place (inside forms removed)	14 days
Conduits, precast, cradled	2 days
Conduits, precast, bedded	1 day
Antiseep collars	3 days

F. Removal and Placement of Defective Fill: Fill placed at densities lower than the specified minimum density or at moisture contents outside the specified acceptable range of moisture content or otherwise not conforming to the requirements of the specifications shall be reworked to meet the requirements of the specifications shall be reworked to meet the requirements or removed and replaced by acceptable fill. The replacement fill and the foundation, abutment and fill surfaces upon which it is placed shall conform to all requirements of this specification for foundation preparation, approval, placement, moisture control and compaction.

6.13 Roadways and Walks: Excavation for roadways and walks shall be made to the lines, grades and typical sections shown. Proper allowances shall be made for specified thickness of roadbed and walkway below the finish grade shown. Should rock be encountered in the subgrade, the road shall be excavated to a depth of 6" below subgrade and the resulting space backfilled with suitable material.

A. Walks: Walks shall be constructed of Class "B" concrete, and shall be 4" deep. Transverse contraction joints shall be formed with a tool designed for forming a groove one-third the depth of the sidewalk, and on not more than 6'-0" centers. All edges shall be rounded with a 1¼" edger. Expansion joints shall be located on not more than 20'-0" centers and at all intersections.

B. Roadway Surfacing: All paved access roads and parking areas, where shown on the Drawings, shall have a crushed stone base course, binder course and asphaltic surface course. The compacted depth of crushed stone base course shall be 8", overlain by 2" of 19 mm Superpave binder course and 1" of 9.5 mm Superpave binder course. Materials and construction methods shall conform to the standard Specifications for highway construction of the Georgia Department of Transportation as follows:

1. Section 310: Base Course, except as specified
2. Section 412: Prime Coat
3. Section 400: Surface Course, Asphaltic Concrete Type "F"

A qualified soils technician shall observe placement and compaction of the base course material and perform field density tests to confirm material has been satisfactorily placed.

C. Shoulders: Shoulders shall be constructed of selected topsoil in accordance with typical sections shown and shall be grassed as specified elsewhere. Local quarry waste material may be used for base material meeting Section 310 of Highway Specifications, except for material passing No. 60 sieve which may be from 15 to 85%.

D. Embankment: Where roadways are constructed on fill, the embankment shall be placed in layers not over 6" deep as measured before compaction and be thoroughly rolled to a density of 98% of the Standard Proctor Dry Density with sheeps foot or pneumatic tired roller. The work shall be executed in a manner which will ensure that no places too steep to roll are left in the embankment. Portions inaccessible to the roller shall be rammed by hand. All materials shall be visibly damp. Water shall be applied as directed to obtain close adhesion between layers and all parts of the material.

1. Sheeps foot roller shall be of self-cleaning type, have feet projecting 7" from the shell and be of a weight so that the load of each tamper foot with the drum empty will be not less than 100 pounds per square inch of area in contact with a plane surface. Rolling shall be executed until the feet leave no appreciable imprint when the shell is filled to a maximum weight.
2. Pneumatic tired rollers shall be suitable for ballast loading which will give a compression, under working conditions, of not less than 325 pounds per inch width of tire tread. Forward and rear tires shall make separate tracks. Compaction shall be equivalent to that required for the sheeps foot roller.
3. Within the limits of the roadbed, the fill shall be constructed of selected clay materials from excavation and borrow, and be free from stones larger than 4" in diameter. Slopes of roadway outside the above limits may be constructed of alternate layers of rock and clay; in no case shall rock be allowed in nests. The stones shall be uniformly distributed over the preceding clay layers, and the voids shall be completely filled with clay so as to form a solid compaction embankment.

6.14 Unauthorized Excavation: Footings or slabs shall be set on undisturbed earth or rock to insure proper bearing; therefore care shall be taken that excavation does not extend below bottom levels of footings or slabs on earth or rock. Should the excavation, through carelessness or neglect, be carried below such levels, the Contractor shall fill in the resulting excess excavation with concrete under footings and with crushed stone, gravel or other approved materials under slabs. Should excavation be carried beyond outside lines of footings, such excess excavation should be filled with concrete, or formwork shall be provided, as directed by the Engineer. Additional costs of corrective work, made necessary by unauthorized excavation of earth or rock, shall be borne by the Contractor.

6.15 Water: The Contractor shall, by the use of well points, pumps, tile drains or approved methods, prevent the accumulation of water in excavated areas. Should water accumulate, the Contractor shall remove it promptly.

6.16 Preloading of Structures: All tanks shall be preloaded with water prior to making final pipe connections. Elevations of structures shall be monitored until settlement has virtually ceased.

6.17 Slabs on Earth Fill: Where slabs are to be constructed on earth fill, all loam, organic matter and other objectionable material shall be stripped from the area. In the event material excavated during construction operations from other locations is not suitable for use in compacted fill, the Contractor shall obtain select material from borrow on or near the site as directed by the Engineer. The fill shall be of select material, placed in layers of not more than 6" compacted thickness, and compacted by the use of heavy rolling or power tamping equipment to secure at least 95% of the Standard Proctor Dry Density. An experienced soil engineering technician shall take adequate density tests during placement of fill to verify that the specified degree of compaction is being achieved.

6.18 Backfilling Around Structures: Backfills around structures shall be properly placed and compacted. The fills shall be brought up in layers. The layers shall be thoroughly compacted to at least 95% of Standard Proctor Dry Density, each layer to be not deeper than 6" compacted thickness. Compaction around structures shall be by use of heavy power tamping equipment. Areas to be backfilled at structures shall be free from trash and wood.

6.19 Riprap: Riprap consisting of rock no less than ½ cubic floor in volume shall be placed on the areas shown on the Drawings. The riprap may be placed by dumping from trucks and hand spreading to a uniform surface and to a minimum depth of 12".

6.20 Grassing: The Contractor shall establish and maintain, until Engineer acceptance, grassing in all disturbed areas, grassing in all finish grade areas including cut and fill slopes and other areas as indicated on the Drawings. All pipe lanes and distribution pipe lanes shall be grassed.

A. Materials: (See Contract Drawings)

B. Preparation of Grade:

1. Grading: (See Contract Drawings)

2. Soil Improvement

a. The Contractor shall request the County Agent to check the pH, and if liming is recommended, shall apply line of the type and in prorations recommended by the County Agent.

b. The lime and fertilizer shall be uniformly mixed into the top 4" of soil. All surface areas distorted by ground preparation or mixing shall be restored to finish grade as shown on Drawings. On cut slopes steeper than 3:1, the mixing may be omitted.

C. Sowing of Seed: See Contract Drawings

D. Protection: All disturbed areas shall be covered with clean wheat or oat straw at a rate of one bale per 1,000 square feet. Adequate protection shall be provided for all areas against damage of any kind, until inspection and acceptance. Damaged areas shall be promptly repaired.

E. Grass Stabilization: See Contract Drawings

F. Temporary Grassing and Mulching: See Contract Drawings

6.21 Vegetation Cleanup, Maintenance and Inspection:

A. Cleanup: Any soil, mulch or similar material which has been brought onto paved areas by hauling operations or otherwise shall be removed promptly, keeping these areas clean at all times. Upon completion of the planting, all excess soil, stones and debris which have not previously been cleaned up shall be removed from the site or disposed of as directed by the Engineer. All grassed areas shall be prepared for final inspection.

B. Maintenance: Maintenance shall begin immediately after installation and continue until final inspection and acceptance by the Engineer. Grassing shall be protected and maintained by watering and mowing. Replanting may be necessary to produce a uniform stand of grass. Weeding, fertilizing, liming, disease and insect pest control, aerating and all other procedures consistent with good horticultural practice may be necessary to insure normal, vigorous and healthy grass.

6.22 Inspection for Acceptance: Upon the complete installation of grassing, the Contractor shall request an inspection by the Engineer to determine that all required areas have been satisfactorily grassed according to the plans and specifications. Grassing shall be noted as to condition and coverage and shall be free from erosion and other damage prior to being accepted. Upon acceptance, the Owner shall assume the responsibility for maintenance.

6.23 Fencing: Fencing shall be of the complete protection type. Provide gates with dimensions as shown on the Drawings. The fence shall be 7' high overall, consisting of 2" mesh x 9 gauge x 72" aluminum coated steel fabric, conforming to the latest revision of ASTM A 491, a 7 gauge aluminum coated steel coil spring tension wire along the bottom of the fence fabric and 3 strands of 12 ½ gauge aluminum coated steel barbed wire with 4 point aluminum barbs spaced 5" apart mounted on barbed wire support arms along the top of the fence fabric; galvanized lines posts, 2 ½" O.D. (3.65 pounds per foot); galvanized corner posts, 3" O.D. (5.79 pounds per foot); galvanized gate posts, 4" O.D. (9.11 pounds per foot); galvanized top rails, 1 ⅝" O.D. (2.27 pounds per foot) with

extra-long pressed steel sleeves. Corner and gate posts shall have necessary struts and tie bracing. Gates shall be equipped with heavy duty latches, keepers and heavy duty hardened bronze padlocks with duplicate master keys. Posts shall be set at not more than 10' centers, a full 3' deep in concrete poured to the full size of the excavated post holes. After setting the post the post holes shall be filled with grout to an elevation of 2" above the finished ground. Gate frames shall be galvanized, 2" O.D. (2.72 pounds per foot) with welded corners and necessary braces and trusses.

A. Gate Operators: Gate operator shall be manufactured by HySecurity, Liftmaster or approved equal.

1. Operation shall be by means of a brushed DC electric motor driving a single reduction gear reducer with an output sprocket driving #40 plated roller chain. When the gate is stopped, the motor applies a brake to the drive assembly which inhibits any forced, manual operation of the gate. Gate position is constantly monitored allowing for automatic reposition if motion is detected without the operator receiving a run command. The opening and closing speeds are user adjustable 0.75, 1.0 or 1.25 fps. The gear reducer shall be filled with synthetic lubricant capable of allowing operation down to -13°F without a heater. Operator shall be capable of handling gates up to 40' in length and weighing up to 1,500 pounds. Gate operator shall operate in the event of a power failure in an uninterruptible power supply mode to the extent the two 8Ah batteries can maintain adequate power.

2. Standard mechanical components shall include as a minimum:

   a. Two piece linear low density polyethylene cover with top locking latch. Cover protects bystanders from pinch hazards of roller chain traveling through idlers and drive sprocket.

   b. Frame to be constructed of 10ga or greater steel plate, welded.

   c. Frame to be zinc plated and other components zinc plated or non-corroding.

   d. Operator shall contain a position sensing device and a means of setting the limit position and maintaining this position in non-volatile memory. Operator must also contain a magnetic absolute position sensor to verify the gate position.

   e. Zinc or nickel plated #40 roller chain with chain mount brackets and connecting hardware.

3. Minimum standard electrical components shall be industrial grade and include as a minimum the following:

   a. Motor: ½ horsepower brushed DC motor with ball bearings

   b. Electronic circuit boards to be conformal coated to resist moisture induced failures.

   c. All components shall have overload protection.

d. Controls: Smart DC controller board with 512K memory containing:

- Adaptive inherent entrapment sensor
- Built in "warn before operate" system
- Built in timer to close
- 32 character LCD, 5 button user interface
- 24 programmable output relay options
- Anti-tailgate mode
- Built-in multi-level power surge and lightning strike protection using gas discharge and optoisolation technology
- Multi-stage intelligent battery charging under microprocessor control
- Capable of viewing EEPROM stored event logs for troubleshooting diagnostics
- RS232 and USB port for connection to laptop or other computer peripheral and RS485 connection of Master/Slave systems
- Pulse width modulated control of brushed DC motor using 110 Amp rated solid state switching devices

4. Transformer: 250 VAInput Power: 115V, 230V, Field selectable
5. Accessory Power: 12VDC, 24VDC, 24VAC
6. Stop switch, accessible from outside
7. Back Drivable: During AC and DC power loss, the gate can be pushed open.
8. Required External Sensors: Photo eyes to be installed such that the gate is capable of reversing in either direction upon sensing an obstruction
9. Control Devices: Vehicle detector and keypad
10. Optional Alert Devices: Rotating beacon or flashing lights
11. Extended battery backup using two 50 Amp hour batteries with base riser.

B. Tubular Barrier Gate: Provide one 4' by 20' galvanized tubular barrier gate. The gate shall have two 2" aluminum post caps, one 6⅝" O.D. Schedule 40 gate hinge post, one 4" aluminum post cap for gate post latch, two 6⅝" aluminum post cap for gate hinge post, and 1 fulcrum industrial gate latch.

6.24 Demolition: The work covered by this Section of the Specifications consists of furnishing all materials and equipment and performing all labor necessary for demolition and removal of existing structures and utilities as designated on the Drawings to be removed.

A. Site Conditions: The Contractor's attention is directed to Article 4 of Instructions to Bidders and Special Provisions relating to site examination.

B. Procedures: The Contractor shall submit proposed procedures for demolition work to the Engineer for review and approval. All demolition procedures shall be accomplished in strict compliance with all state and local laws and regulations as well as shall conform to NFPA Standard 241, *Safe Guarding Building Construction and Demolition Operations*. Submittals shall include a detailed description of the methods and equipment to be used for each operation and the sequence of operation, evidence of having successfully performed similar work on other projects; permits and notices authorizing demolition where required by local and/or state regulations, and permits for transport and disposal of debris where required by local and/or state regulations.

C. Site Work: The Contractor shall not use explosives without prior approval of the Owner and Engineer. The Contractor shall conduct operations to insure minimum interference with all roadways and adjacent businesses and facilities. The Contractor shall not obstruct roadways without obtaining permits and/or permission from governing authorities. The Contractor shall protect all existing underground and overhead utilities from damage or interruption of service from demolition activities.

D. Dust Control: Dust resulting from demolition shall be controlled to prevent the spread of dust to occupied portions of the site as well as avoid creation of nuisance to the surrounding area. Use of water will not be permitted when it results in, or creates hazardous or objectionable conditions such as ice, flooding and pollution.

E. Disconnection of Utility Service: Utilities shall be disconnected at points indicated on Drawings or as necessary for demolition of structures. The Contractor shall arrange for, and verify, termination of utility service including removal of meters and capping of lines by representatives of utilities that are involved.

F. Preparation: The Contractor shall remove all items to be salvaged for the Owner and place in designated storage area. The Contractor shall construct barriers, fences, guard rails, enclosures, shoring, etc. to deny public access to the demolition site and to protect utilities and structures that are to remain.

G. Structures: Structures shall be completely removed where noted on the plans. Holes resulting from removal structures shall be backfilled and compacted in accordance with these Specifications.

H. Cleanup: The Contractor shall remove debris and rubbish from the site as soon as practicable. Debris and rubbish will not be allowed to accumulate. Remove and transport debris in a manner as to prevent spillage on streets, public rights-of-ways or adjacent areas. The Contractor shall obtain all permits for transport and disposal of debris as required by all local, state and federal agencies. All disturbed areas from demolition activities shall be grassed in accordance with these Specifications.

6.25 Method of Payment: Payment for all excavation and fill work shown on the Drawings and herein specified and required to complete the clearing, grubbing, site excavation, trench excavation, borrow excavation, backfill, sheeting, shoring, topsoil, crushed stone or gravel, drainage, pumping, embankment fills and any other excavation and fills required to construct the project as shown on the Drawings shall be included in the lump sum price bid in the Proposal, and no measurement of the quantities will be made. The contours and elevations of the present ground are believed to be reasonably correct but are not guaranteed. The Contractor shall satisfy himself by actual examination of the site work as to the existing elevations and contours and the amount of work required under this Section.

A. If the quantities of common excavation required are increased or decreased as a result of changes made in the Drawings or by direction of the Engineer in writing during construction, the Engineer will determine the quantities of such changes, and the lump sum price will be adjusted upward or downward as applicable to compensate for such changes at the applicable adjustment unit price bid for common excavation in the Proposal.

B. No adjustment payment for trench excavation in earth will be made. Adjustment payment for such excavation shall be included in the applicable adjustment unit prices bid per linear foot of various sizes of pipe laid as listed in the applicable adjustment unit prices bid in the Proposal.

C. Additional payment will be made for any additional undercutting if required due to unsuitable soils. Additional undercutting will be any undercutting below the levels as shown on the Drawings, provided excavations have been made after the site has been properly dewatered. Additional payment shall include the cost of replacing and compacting unsuitable material. Undercutting due to improper dewatering and construction operations will be at no additional expense to the Owner.

D. The cost of all soils inspections and testing shall be paid by the Owner. If compaction tests do not meet required values, the cost of additional testing as required by the Engineer shall be paid by the Contractor.

E. Rock excavation is unclassified.

F. All landscaping planting, and erosion control structures, shown on the Drawings will be included in the lump sum bid in the Proposal.

SECTION 7
SEWERS, PLANT PIPING AND STORM DRAINAGE

7.01 Scope: The Contractor shall furnish all material and equipment and; construct the sewers, site piping and storm drainage shown, together with all clearing, grubbing, excavating, sheeting, backfilling, foundations, manholes, catch basins, and other appurtenances as shown and specified. The work shall include all ditching, diking, pumping, bailing, draining, flushing, and all provisions necessary to protect and maintain buildings, fences, water and gas pipes, drain culverts, power and telephone lines and cables, and other structures; the furnishing and maintenance of suitable crossings for roadways; the cleaning away of all rubbish and surplus materials; and the furnishing of all, materials, tools, implements and labor required to build and put in complete working order the specified sewers, piping and storm drainage, and all structures appertaining thereto. Unless otherwise specified or shown on Drawings, installation of sewers, piping and storm drainage in fill areas shall be after fills have been compacted and brought to approximate finished grade. Lines under structures shall be encased in 6" minimum Class 'C' concrete. All standard test designations refer to the revision of those standards in effect on the date of issue of the Contract Documents.

7.02 Sewer and Storm Drainage Pipe: Ductile iron pipe (see piping section of these Specifications for all sewer lines 36" and smaller unless shown or specified otherwise). Class III Reinforced Concrete Pipe shall be used for all storm drainage pipe, unless otherwise noted.

A. All pipe shall conform to the following ASTM Designations:

Designation	Material
C-76	Reinforced concrete, Table II as shown, Wall B, bell and spigot, Type 2 cement and crushed limestone coarse aggregate, in sizes 18" and larger, in lengths of at least 8'.

B. Pipe shall be tested in accord with the following ASTM Designations:

Designation	Material
C-497	Concrete pipe, for crushing strength absorption, hydrostatic and permeability. Absorption shall not exceed 9%.

C. Pipe joints shall conform to the following designations:

Designation	Type Joint
AWWA C-302	For round concrete pipe flexible watertight, "O" ring rubber gaskets, sole element for sealing joints

D. Quality and Inspection: Latitudes in, workmanship and finish allowed by the ASTM designations notwithstanding all pipe shall be first quality, have smooth exterior and interior surfaces, and be free from cracks, blisters and other imperfections, and true to theoretical shapes and forms throughout each length.

All pipe shall be subject to inspection by the Owner and by the Engineer at the pipe plant, trench and other point of delivery for the purpose of calling and rejecting pipe, independent of laboratory tests, which does not conform to the requirements of this section. Pipe which does not so conform shall be marked as such by the Engineer and shall not be delivered or used in the work. On-the-job repairing of rejected pipe will not be permitted.

E. Experience of Manufacturer: The manufacturer of the pipe shall submit evidence of having consistently produced pipe and joints of specified quality and satisfactory performance results in service over a period of at least two (2) years. Manufacturers who do not meet the two (2) year experience period will be considered if the manufacturer provides a bond or cash deposit which will guarantee replacement of the pipe in the event of failure or unsatisfactory service due to a deficiency in the pipe. The amount of bond or cash deposit shall be sufficient to cover all labor and equipment costs for replacement in addition to any costs incurred by the Owner because of failure or unsatisfactory service. The period of time for- which the bond or cash deposit is required shall be two (2) years.

All pipe shall be tested by an approved testing laboratory. It shall be stamped with the laboratory's special stamp. Each joint of pipe so stamped shall indicate the laboratory's certification that it was accepted in accordance with requirements of these specifications for pipe quality.

F. Repaired Pipe: Repaired and patched pipe will not be acceptable unless each individual pipe so repaired and patched shall have first been inspected and approved for repair and patching by the Engineer at the pipe plant. Repairs to, and patching of, gasket grooves and shoulders will not be permitted if damage thereto is of such nature, in the opinion of the Engineer, as to impair the water tightness of the completed joint.

G. Corrugated Steel Drain Pipe: Corrugated steel drain pipe shall be furnished and constructed in accordance with the Department of Transportation, State of Georgia, Standard Specifications Constructions of Roads and Bridges, 1983 Edition, and these Specifications. Pipe shall be galvanized and fully bitimunous coated with a paved invert filling the corrugations for at least 25% of the circumference. The bituminous coating shall be a minimum thickness of 0.05", measured to the crest of corrugations. Pipe corrugations shall be 2 ⅔" x ½". Band shall be in accordance with WW-P-405-B 3.3.4.2. The projections of the bands shall conform substantially to the shape and depth of the pipe corrugations and shall be in circumferential rows with no less than seven projections per row. Required nuts and bolts shall be furnished with the band. Culvert pipe shall be 16-gauge through 24" diameter, 14-gauge for 30" and 36" diameter, 12-gauge for 42" through 54" diameter, 10-gauge for 50" through 72" diameter, and 8-gauge for 78" and 84" diameter.

The pipe shall have a duct tape (a type that will adhere and leave the heat number legible when removed) placed over one complete hear number before the bituminous coating is applied. This tape shall be located as close to the end of the

pipe as the heat number will allow and from under the paved invert. All individual joints of pipe require this procedure.

Copies of certified mill test reports showing heat numbers, the chemical analysis and weight of spelter coated for each heat, lift of coil number, case, size and type of material used to fabricate this pipe will be mailed to the Engineer, Owner and Contractor within five (5) calendar days of the delivery date of the pipe. Each copy will reference pipe size, number of sections, date of actual delivery to the job so that a positive identification can be made.

7.03 Metal Pipe: Cast iron pipe and ductile iron pipe materials for sewers shall conform to provisions of the piping section of these Specifications.

7.04 Concrete and Cement Mortar: Concrete for collars, head walls, catch basins, drop inlets, manhole bottoms, bedding, encasement, etc., shall conform to all provisions of Section 4. Cement mortar for brick work and inverts of manholes shall be made of one part cement and two parts of clean, sharp masonry sand.

7.05 Reinforcing and Structural Steel: Materials, fabrication, and installation of reinforcing shall conform to all provisions of the steel section of these Specifications and to the details shown.

7.06 Iron Castings: Materials, fabrication, and installation of iron castings shall conform to all provisions of steel section of these Specifications and to the details shown.

7.07 Location and Grades: The line and grade of the sewer and drain, and the positions of all manholes and other structures, and other appurtenances, shall be laid out by the Contractor. The Contractor shall locate existing manholes to determine alignment and grade. Alignment and grade shall match the existing unless otherwise approved. All lines and grades shall be subject to checking by the Engineer, but that checking shall in no way relieve the Contractor from responsibility for the correctness. The Contractor shall provide such field men and assistance as the Engineer may request, and such hubs, stakes, spikes, nail, and other fastenings as may be required, in establishing and checking all controlling lines and grades.

The Contractor shall furnish the engineer with cut sheets for each line. Cut sheets shall show line number and in 50' increments invert, center line elevation and center line cut. Sample cut sheet will be provided by the Engineer. Existing sewer lines and service lines shall be replaced to match existing line and grade unless otherwise shown or approved by the Engineer.

7.08 Order of Work: The Owner reserves the right to accept and use portions of the work when it is considered to be in the public's best interest to do so; the Engineer shall have the authority to establish the order in which the lines shall be worked.

7.09 Inspection: All work done and materials furnished shall be subject to inspection by the Engineer; all improper work shall be reconstructed, and all materials, which do not conform to the requirements of the specifications, shall be removed from the work upon notice being received from the Engineer of the rejection of those materials. The Engineer shall have the right to mark rejected materials, and to distinguish them as such.

7.10 Organization of Work: The Contractor shall so organize his work that backfilling and cleanup shall closely follow pipe laying operations and manhole construction.

In general, not more than one block of a street or roadway shall be closed for construction at any one time. Before proceeding with trenching operations in a succeeding block, the preceding section shall be backfilled, cleanup completed and the street opened to traffic.

For work outside the streets and roadways, backfilling and windrowing, in accordance with the provisions of "General Backfilling" paragraph shall be performed in such manner that not more than 500' of trench shall remain open at any one time.

Failure on the part of the Contractor to comply with the above provisions in a reasonable manner, in the opinion of the Engineer, shall be sufficient cause for the Engineer to order a temporary shut-down of further trenching and pipe laying operations until the provisions have been met.

7.11 Clearing and Grubbing: The Contractor shall clear and grub only the areas for which a permanent sewer easement has been obtained which is a strip 10' on either side of the sewer centerline or as shown on the Drawings. Trees or loose objects between the permanent sewer easement and construction easement lines may be removed if necessary for construction purposes unless removal is specifically prohibited on the Drawings. Written approval by the Engineer for removal of such noted trees or objects will be required. In no case is the Contractor to go outside the construction easement 20' on each side of the sewer line or as shown on the Drawings) with men, machinery, or material.

All material and debris resulting from clearing and grubbing operations shall be disposed of in accordance with the rules and regulations of the Georgia Environmental Protection Division. Burning shall be in accordance with local regulations and as approved by the Engineer. The Contractor shall obtain any burning permits required and shall be responsible for any damage to surrounding property caused by his burning operation. All clearing debris hauled from the site must be disposed of in an EPD approved inert landfill or mulching operation.

7.12 Removing and Resetting Fences: At all locations where existing fences must be removed to permit construction of the sewer, the Contractor shall remove the fences and, as the sewer construction progresses, reset the fences in their original location and to their original condition. During construction, the Contractor shall provide temporary fencing, or employ other safeguards, which will prevent livestock from wandering to other property.

7.13 Protecting Trees, Shrubbery and Lawns: Trees and shrubbery along trench lines crossing developed private property shall not be disturbed unless absolutely necessary, subject to approval by the Engineer. Trees and shrubbery to be removed shall be properly heeled-in and replanted. Heeling-in and replanting shall be done under the direction of an experienced nurseryman.

Where sewer trenches cross private property through established lawns, sod shall be cut, removed, stacked and maintained in suitable condition until replacement is approved by the Engineer. Topsoil underlying lawn areas shall likewise be removed and kept separate from general excavated materials and shall be replaced at the surface of the trench in backfilling. In lieu of removing and replacing sod, the Contractor may, if approved by

the Engineer, regrass lawns by seeding or sprigging with grass of the same type as the established lawn. Before planting, a fertilizer of 16:4:8 composition, or approved equal, shall be evenly applied at the rate of 20 pounds per 1,000 square feet and disked or harrowed into the dampened soil. An acceptable date for seeding shall be as recommended by the local Soil Conservation Agent. Areas sown with grass seed shall be mulched and kept watered until all growth is thoroughly established.

7.14 Protection of Other Utilities and Structures: Damage to existing utility lines, services, poles, and structures shall be repaired or replaced by the Contractor at his own expense. The approximate positions of certain known underground lines are shown for information. A minimum clearance of 10' horizontal and 18" vertical must be maintained between new sewer lines and existing water mains. Existing small lines are not shown. The Contractor shall locate existing small lines, and other possible unknown existing utility lines, with an electronic pipe finder and shall excavate and expose all existing underground lines in advance of trenching operations. Removing and relaying of those lines and appurtenances which constitute an obstruction to the completed line and grade of the new work, in the opinion of the Engineer, will be made at the expense of the Owner, unless otherwise shown on Drawings to be altered by the Contractor.

7.15 Excavation: Excavation for sewer lines shall be by open- cut, unless otherwise shown or specified. No tunneling shall be done without approval by the Engineer to tunnel cross section and details of construction. The top portion of trenches may have sloping or vertical sides to any width, which will not cause damage to adjoining structures, roadways, pavements, utilities, and private property. For untimbered trenches and trenches held by stay bracing only, the width of the lower portion of the trench, to a height of 2' above the top of the pipe, shall not exceed the trench widths specified for the respective pipe size in the trench width section of these Specifications. The width of trenches where skeleton or solid sheeting is used may be increased to dimensions approved by the Engineer but shall be not greater than that necessary to clear the walers when lowering pipe into the trench. If trenches are excavated to widths in excess of the above limitations or if trenches collapse because of insufficient bracing and sheeting, the Contractor shall use special methods of constructing pipe foundations, as specified in the section on bedding of pipe at his own expense. Excavation in excess of the depths required for manhole and other structures shall be corrected by pouring a subfoundation of Class 'C' concrete, at the Contractor's expense.

7.16 Excavation in Solid Rock: Solid rock is defined as those materials in the original bed and in well-defined ledges which, in the opinion of the Engineer, cannot be removed with pick, shovel, ditching machine, ⅝ cubic yard backhoe and other similar devices, and which requires jack hammering with bull point, or drilling and blasting. Concrete and masonry structures to be removed, which require drilling and blasting for removal, shall be considered rock unless otherwise provided for herein. Boulders, and detached pieces of rock, having volumes of more than 8 cubic feet, shall be considered as rock.

Where excavation of rock, boulders or large stones is required, a clearance of not less than 6" in every direction from all parts of pipe and appurtenances shall be provided.

Where rock is encountered at grade in trenches, the trench shall be excavated not less than 6" below the bottom of the pipe bell, refilled with crushed stone thoroughly tamped

in-place, and shaped to the pipe. No additional payment will be made for crushed stone bedding in rock excavation, the cost shall be included in the unit price stated for rock excavation.

Excavated rock shall not be mixed with material selected for tamped backfilling under and around the pipe up to a level at least 2' above the pipe.

Where sewers are constructed across streets, pastures, and cultivated fields, excavated rock shall not be mixed with backfill material used to complete the final 12" layer of backfill at the original ground surface. Surplus rock shall be removed and wasted at locations approved by the Owner.

A. Payment: Rock excavation is unclassified.

7.17 Blasting: Blasting operations shall be conducted in strict accord with these Specifications.

7.18 Bracing and Sheeting: The sides of all trenches and excavations for sewer shall be securely held by stay bracing, or by skeleton or solid sheeting and bracing, as required by the soil conditions encountered, unless otherwise permitted by the Engineer.

A. Timber: No timber for shoring, bracing, and sheeting exceeding that size customarily used, will be paid for unless the use of larger sizes shall have been ordered, in writing by the Engineer. Timber sheeting near the bottom of trenches over 10' deep, for pipe 15" size and larger, shall remain in place and shall be cut off no less than 2' above the top of the completed line. When in the opinion of the Engineer sheeting and bracing cannot be safely removed above this level, it shall be left in place. Sheeting left in place shall be cut off at least 2' below the surface. Bracing and sheeting may be removed in units when the level of the backfilling has reached the point necessary to protect the pipe and adjacent property.

1. Payment: No extra payment will be made for timber sheeting required to be left in place to a point 2' above the top of the pipe, the cost thereof shall be included in the lump sum bid for sewers. Timber ordered to be left in place in excess of 2' above the top of the pipe will be paid for in accord with the unit price bid for the item under "Extra Work."

B. Steel Sheeting: Continuous interlocking steel sheeting may be substituted for timber sheeting, when approved by the Engineer. Steel sheeting may be removed without cutting, provided the rate of removal is in pace with tamping and backfilling operations to assure complete filling of the void created by the withdrawal of the sheeting. Complete withdrawal of the sheeting in advance of tamping and backfilling will not be permitted.

7.19 Dewatering Trenches: Where groundwater is encountered, the Contractor shall make the effort necessary to secure a dry trench bottom before laying pipe. In sandy and in other suitable type soils, dewatering shall be done by well pointing. If, in the opinion of the Engineer, the Contractor has failed to obtain an absolutely dry trench bottom by insufficient use of all known methods of trench dewatering, the Engineer may order the Contractor to excavate below grade and place not less than 6" of graded crushed stone fill material over the trench bottom to form trench drains to suitable located sumps and the

water removed by bailing or pumping. The graded crushed stone fill material shall be placed at the Contractor's own expense and shall be of such depth that there shall be no water in bell holes at the time of coupling pipe. Water removed by bailing or pumping shall not be discharged into state waters. Sediment shall be removed from water using BMPs described in these Specifications at no additional cost to the Owner.

7.20 Crushed Stone Stabilization: Wherever the subgrade is by nature too soft or mucky, in the opinion of the Engineer, for the proper installation of the pipe, he may order the Contractor to undercut the trench and backfill with crusher run stone or crushed stone ¾" in size and less. The stone shall be brought to the subgrade required by the class of bedding for the particular location and compacted.

A. Payment: Payment for crushed stone stabilization, only where ordered by the Engineer, will be made in accord with the unit price bid for the item under "Extra Work," measured before placing, and shall include the removal of unsuitable subgrade materials.

7.21 Bedding of PVC and Ductile Iron Pipe: All pipe shall be laid on foundations prepared in accordance with the following specifications.

A. PVC Pipe: PVC pipe shall be laid as specified using the following classes of bedding required for the various type of soils and conditions encountered. Bedding for PVC pipe shall be in accordance with ASTM D 2321, as amended to date, the manufacturer's recommendations, and these Specifications.

1. Bedding Material: Class I materials shall be used for bedding and haunching in all conditions. Class II, III, IV and V materials will not be permitted for bedding and haunching under any condition.

2. Depth of Bedding: Bedding material shall be used to provide uniform longitudinal support for the pipe. Trench shall be undercut to allow for a minimum of 6" of bedding material. Bell holes shall be excavated in the bedding material to allow for unobstructed assembly of the joint, but care shall be taken to assure that bell hole is no larger than necessary to accomplish proper joint assembly. After joint assembly, material shall be placed underground around the entire length of pipe and compacted. Compaction to the springline of the pipe shall be of the same material used in the bedding. Backfill with Class I, II, III or IV material shall then be carried to a point 6" above the top of pipe, using hand tools for tamping, Class IV material will not be allowed in a wet ditch. If the remaining backfill material contains large particles, which could damage the pipe from impact during placement, the initial backfill shall be increased to 12" above the top of the pipe. Puddling will not be allowed as a method of compaction. The remaining backfill shall be as specified in "Selected Backfill" and "General Backfill" paragraphs of these specifications. Pipe shall have at least 30" of cover before wheel loading and at least 48" of cover before using heavy-duty tamping equipment such as a hydrohammer.

3. Definition of Bedding Material: Class I, II, III, IV and V materials are defined as follows:

Class I	Angular ¼" to ¾" graded stone. Latest revision of ASTM C 33 - Gradation #67 (ASTM #67) or #57 (ASTM #57) are acceptable.
Class II	Coarse sands and gravels with maximum particle size of ¾" including variously graded sands and gravels containing small percentages of fines, generally granular and non-cohesive, either wet or dry.
Class III	Fine sand and clayey (clay filled) gravels, including fine sands, sand-clay mixtures and gravel-clay mixtures.
Class IV	Silt, silty clays and clays, including inorganic clays and silts of medium to high plasticity and liquid limits.
Class V	This class includes organic soils as well as soils containing frozen earth, debris, rocks larger than 1½" in diameter, and other foreign materials.

B. Ductile Iron Pipe: Ductile iron pipe for gravity sewers and force mains shall be laid as specified using the following type of bedding required for the depth of cover for the various sizes of pipe to be installed. Type 4 and 5 Bedding as shown and described in Ductile/Cast Iron Handbook - Fourth Addition Page 182-208 may be used for additional depths if approved by the Engineer.

1. Type 1-Flat Bottom Trench. Flat bottom trench on undisturbed earth with excavation for Bells. Loose backfill shall be as specified in the "Selected Backfilling" and "General Backfilling" paragraphs.

2. Type 2-Flat Bottom Trench. Flat Bottom Trench on undisturbed earth with excavation for Bells. Lightly consolidated backfill to centerline of pipe, additional backfill shall be as specified in the "Select Backfilling" and "General Backfilling" Paragraphs.

3. Type 3-Loose Soil Bedding. Pipe bedded in 4" minimum Loose Soil. Backfill lightly consolidated to top of pipe. Additional Backfill shall be as specified in the "Select Backfill" and "General Backfill" Paragraphs.

4. Cover: Maximum depth of cover for ductile iron pipe of the various classes and sizes to be installed are as shown on the following page:

Laying Condition - Maximum Depth of Cover (Feet)

Pipe Size	Pressure Class (PSI)	Nominal Thickness	Type1	Type2	Type3
4"	350	0.25"	53	61	69
6"	350	0.25"	26	31	37
8"	350	0.25"	16	20	25
10"	350	0.26"	11	15	19
12"	350	0.28"	10	15	19

7.22 Trench Widths: Trench widths and depths (where applicable) for PVC pipe.

A. PVC Pipe: The maximum trench widths and depths with the various classes of bedding and required compaction shall be as follows:

1. Trench Width: The maximum clear trench width at the top of the pipe shall not exceed a width equal to the nominal pipe diameter plus 18". If this width is exceeded or the pipe is installed in a compacted embankment, pipe embedment shall be compacted to a point at least 2.5 pipe diameters from the pipe on both sides of the pipe or to the trench walls, whichever is less.

2. Trench Depths: Minimum pipe stiffness of 46-pounds / inch

Class of Bedding	*% of Proctor Density Range*	*Maximum Height of Cover*
I	95	50

3. Compaction: If the proper compaction cannot be obtained with materials from trench excavation, the Contractor will be required to obtain them elsewhere.

4. Payment: The cost of any extra work to obtain required compaction shall be included in the prices bid for sewers at various depths.

B. Reinforced Concrete Pipe: See Table One for reinforced concrete pipe trench widths.

Table One – Maximum Trench Widths and Maximum Depths for Reinforced Concrete Pipe with Various Bedding Methods

			Class of Bedding		
			C	*B*	*A*
Pipe Size	*Maximum Trench Width*	*Class of Pipe*	*Shaped Bottom Trench*	*Special Earth Bedding*	*Special Concrete Bedding*
15"	2' - 10"	3	8'	10'	20'
15"	2' - 10"	4	14'	19'	30'
15"	2' - 10"	5	30'	30'	30'
18"	3' - 2"	3	8'	10'	20'
18"	3' - 2"	4	14'	19'	30'
18"	3' - 2"	5	30'	30'	30'
21"	3' - 6"	3	12'	21'	30'
21"	3' - 6"	4	20"	28'	30'
21"	3' - 6"	5	30'	30'	30'
24"	3' - 10"	3	12'	21'	30'
24"	3' - 10"	4	20'	28'	30'
30"	4' - 7"	3	13'	16'	30'
30"	4' - 7"	4	20'	28'	30'
30"	4' - 7"	5	30'	30'	30'
36"	5' - 5"	3	13'	16'	28'
36"	5' - 5"	4	20'	28'	30'
36"	5' - 5"	5	30'	30'	30'

7.23 Manholes: Manholes shall be constructed of specified materials to the sizes, shapes and dimensions and at the locations shown on the Drawings or as otherwise directed by the Engineer. The height or depth of the manhole will vary with the location, but unless shown otherwise on the Drawings, shall be such that the top of the manhole frame will be level with the finished grade of the pavement or ground surface and the invert will be at the designed elevations. Wall thickness of precast concrete and brick manholes shall be as shown on the Drawings.

A. Concrete: Concrete, cement, sand and water in manhole construction shall conform to the applicable requirements of these Specifications. All concrete shall be Class A. Steel reinforcement shall conform to the applicable requirements of these Specifications.

B. Brick: Brick used in manhole construction shall be either solid or cored, medium hard or better, Grade MA brick conforming to requirements of latest ASTM C-32 for sewer brick.

C. Construction of Precast Concrete Manholes: Precast concrete manholes shall consist of precast reinforced concrete sections, a conical or flat slab top section

and a base section conforming with the typical manhole details as shown on the Drawings.

D. Precast Concrete Manholes: Precast concrete manholes shall consist of precast reinforced concrete riser sections, concentric top section, and a base section conforming to Typical Details shown on Detail Drawings. Precast manhole sections shall be manufactured in accordance with ASTM C 478, as amended to date, and these specifications. Concrete shall have a minimum compressive strength of 4,000 psi when tested in accordance with ASTM C 478, as amended to date. Wall and bottom section shall have a minimum thickness of 5".

1. Base Sections: Base sections for precast concrete manholes shall have a bottom poured monolithically with the walls. Base sections shall be furnished with inside diameters of 4', 5', and 6' as required. Base sections shall be furnished with a minimum height of 24" for pipes having a diameter of 8", 10", or 12" and a minimum height of 36" for pipes having a diameter of 15" or 18". Minimum height for 5' or 6' diameter base sections shall be 48" regardless of pipe size. Base sections with 5' or 6' inside diameters shall be reduced to 4' inside diameter by means of an adapter ring or transition top.

   The opening in the base section for the accommodation of the pipe shall be cast to closely conform to job conditions and shall provide a minimum clearance of 3" between the inside bottom of the base and outside bottom of the pipe barrel.

2. Riser Sections: The riser sections shall be furnished in a minimum of 6" increments and shall be 4' in diameter with: (a) tongue and groove joint to be sealed with approved butyl rubber or bitumastic material, similar to "E-Z Stik" as manufactured by Concrete Supply Company or (b) O-ring gasket type joint conforming to ASTM C 443, as amended to date. The gasket joint shall be thoroughly cleaned of all loose materials and brushed with an approved epoxy to give a smooth surface free of any honeycomb. Manhole joints shall be externally sealed with approved butyl rubber or bitumastic manhole joint wrap similar to seal-wrap as manufactured by InFi-Shield, MultiSeal, Inc. or equal. The joint shall be thoroughly cleaned of all loose materials and primed with the aid of an aerosol primer. The seal shall be designed and installed to prevent leakage of water through the joint sections of the manhole.

3. Alteration to Manholes: In the event that the manhole has to be altered after delivery to job site the Contractor may, core a new or additional hole in the side of the manhole. A rubber boot shall be installed to provide a watertight seal between the base section and pipe. All unused wall penetrations shall be sealed with a rubber boot and PVC plug.

4. Repaired and Patched Sections: Repaired and patched sections will not be acceptable unless each individual section so repaired or patched shall have first been inspected and approved by the Engineer, for repair and patching

at the manhole plant. Repairs to and patching of "O"- ring grooves and shoulders **will not be** permitted.

5. Absorption: Absorption shall not exceed 9% when determined in accordance with ASTM C 497, as amended to date.

6. Testing and Stamping: An inspection, by an independent testing laboratory approved by the Engineer, of the manufacturer's plant and product will be required to assure conformity of the precast manholes to these Specifications, and the minimum requirements of ASTM C 478, as amended to date. Each section of precast concrete manhole shall be stamped with the laboratory's stamp. Each stamped section shall indicate the laboratory's configuration that it was accepted in accordance with applicable ASTM Specifications. A copy of such report will be furnished the Engineer with submittal of shop drawings for approval. Job site inspection shall be visual for shape, uniformity, and density.

E. Construction of Brick Manholes: Brickwork shall be constructed using one (1) part Portland Cement to 2 parts clean sand, meeting ASTM C-144, thouroughly mixed to workable plastic mixture.

Twenty pounds of hydrated lime per sack of cement may be added. No retempered mortar shall be used. Brick shall be laid radially with mortar joints not more than ⅜" thick horizontally and not less than ⅜" wide vertically at the the inside face of the manhole. Each sixth brick course shall be a "stretcher" course. Inside joints shall be trowel struck flush joints to provide smooth, clean surfaces. Joints shall be broken in successive layers.

1. Outside and inside walls of all manholes shall be covered with cement mortar plaster as shown on the Drawings. Manholes shall be completely waterproof.

2. After the foundation has been prepared and has been approved by the Engineer, the bottom shall be constructed to the required line and grade. After the bottom has been allowed to set for a period of not less than 24 hours, the manhole shall be constructed, care being exercised to form the incoming and outgoing sewer pipes into the wall of the manhole at the required elevations.

3. The steps shall be inserted into the wall of the manhole at the proper locations and elevations as the work progresses and shall be securely embedded in the masonry.

4. The cast iron frame for the manhole cover shall be set at the required elevation and properly anchored to the masonry. Where manholes are constructed in paved areas, the top surface of the frame and cover shall be tilted to conform to the exact slope, crown and grade of the existing adjacent pavement.

5. Manhole inverts shall be constructed of 1:2 grout and shall have the same cross section as the invert of the sewers which they connect. The manhole

invert shall be carefully formed to the required size and grade by gradual and even changes in sections. Changes in direction of flow through the sewer shall be made to a true curve with as large a radius as the size of the manhole will permit.

6. Masonry work shall be allowed to set for a period of not less than 24 hours. Outside forms, if any, then shall be removed and the manhole backfilled and compacted in the manner provided in these Specifications. All loose or waste material shall be removed from the interior of the manhole. The manhole cover then shall be placed and the surface in the vicinity of the work cleaned off and left in a neat and orderly condition.

7. After backfilling has been completed, the excavated area, if located in a street, alley or sidewalk, shall be provided with a temporary surface.

7.24 Frames and Covers: Manhole rims, toe pockets and covers shall be cast iron conforming to the minimum requirements of Federal Specification WW-1-652 or to the latest ASTM A-48, for Class 30 Gray Iron Castings. All castings shall be made accurately to the required dimensions, fully interchangeable, sound, smooth, clean and free from blisters and/or other defects. Defective castings which have been plugged or otherwise treated shall not be used. All castings shall be thoroughly cleaned and painted or coated with a bituminous paint. Each casting shall have its actual weight in pounds stenciled or painted on it in white paint.

Manhole frames and covers shall be of the size and weights shown on the Drawings and as manufactured by the Griffin Foundry Co., Russell Pipe & Foundry Co., Neenah Foundry Co., or equal.

7.25 Laying Gravity Sewer Pipe: All sewer pipe shall be laid upgrade; the spigots shall point downgrade. Minimum cover shall be 4'-0. Where cover is less than 4'-0, ductile iron pipe must be used. The pipe and specials shall be laid in the trench so that, after the line is completed, the interior surface shall conform on the bottom accurately to the grades and alignment fixed or given by the Engineer and laid out by the Contractor. The interior of all pipes shall be carefully freed of all dirt and superfluous material of every description, as pipe laying proceeds. Defective joints discovered after laying shall be repaired and made tight. Defective pipe shall be removed and proper replacement made.

A. PVC Pipe with Elastomeric Joints: Proper implements, tools and equipment shall be used for placement of the pipe in the trench to prevent damage. Under no circumstances may the pipe be dropped into the trench. In subfreezing temperatures, caution shall be exercised in handling pipe to prevent impact damage. All pipe shall be carefully examined for cracks, nicks, gouges, severe scratches, voids, inclusions and other defects before laying. If any pipe is discovered to be defective after having been laid, it shall be removed and replaced with sound material at the expense of the Contractor.

1. Assembly of Gasketed Joint: The assembly of the gasketed joint shall be performed as recommended by the pipe manufacturer. The elastomeric gaskets may be supplied separately in cartons or pre-positioned in the bell joint or coupling at the factory. When gaskets are color coded, the

Contractor shall consult the pipe manufacturer or his literature for the significance. In all cases, the gasket, the bell or coupling interior, especially the groove area (except when gasket is permanently installed) and the spigot area shall be cleaned with a rag, brush or paper towel to remove any dirt or foreign material before the assembling. The gasket pipe spigot bevel, gasket groove, and sealing surfaces shall be inspected for damage or deformation. When gaskets are separate, only gaskets, which are designed for and supplied with the pipe, shall be used. They shall be inserted as recommended by the manufacturer.

Lubricant used shall be supplied by the pipe manufacturer and shall be applied as specified by the pipe manufacturer.

2. Assembly of Pipe Joints: After lubrication, the pipe is ready to be joined. Good alignment of the pipe is essential for ease of assembly. Align the spigot to the bell and insert the spigot into the bell until it contacts the gasket uniformly. Do not swing or "stab" the joint; that is, do not suspend the pipe and swing it into the bell. The spigot end of the pipe is marked by the manufacturer to indicate the proper depth of insertion. The pipe should be inserted up to this line.

   If undue resistance to insertion of the pipe end is encountered, or the reference mark does not position properly, the joint shall be disassembled and the position of the gasket checked. If it is twisted or pushed out of its seat ("fishmouthed"), the Contractor shall inspect components, repair or replace damaged items, clean the components, and repeat the assembly steps. Both pipe lengths must be concentric alignment. If the gasket was not out of position, the Contractor shall verify proper location of the reference mark. The reference mark shall be relocated if it is out of position.

3. Field Cut: Field cut pipe to be joined shall be square cut using a hacksaw, handsaw or power saw with a steel blade or abrasive disc. The pipe shall be marked around its entire circumference prior to cutting to assure a square cut. A factory-finished beveled end shall be used as a guide for proper bevel angle, and depth of bevel plus the distance to the insertion reference mark. The end may be beveled using a pipe beveling tool or a wood rasp to cut the correct taper. A portable sander or abrasive disc may be used to bevel the pipe end. Any sharp edges on the leading edge of the bevel must be rounded off with a pocketknife or a file.

4. Deflection Testing: The maximum deflection in the installed PVC pipeline shall not exceed 5% of the pipes original internal diameter. The sewer alignment shall be checked by a visual inspection including either laser or lamping alignment. Deflection testing will be required using either a deflectometer or a "GO-NO-GO" mandrel. The Engineer shall randomly select portions of the project to be deflection tested after a period of 30 days has elapsed after backfilling has occurred. Such portions shall consist of not less than 5% of the total reaches (reach being

length of pipe between two manholes) in the project (excluding house leads).

The Contractor when using a mandrel shall use a pull line and a retrieve line. The pull line shall be blown in the line by means of air or water. The mandrel shall be placed in the pipe and be pulled up or down the pipe to the next manhole or defect. Testing shall be done in accordance with ASTMD 3034 Standards.

Where deflection is found to be in excess of 5% of the original pipe diameter, the Contractor shall excavate to the point of excess deflection and carefully compact around the point where excess deflection was found. The line shall then be retested for deflection. However, should after the initial testing the deflection pipe fail to return to the original size (inside diameter) the line shall be replaced.

In the event that deflection occurs beyond the 5% limit in any section of 5% or more of the reaches tested, the entire system shall be tested.

5. Payment: Measurement for payment of sewer lines shall be made along the top of the pipe from center to center of manholes and from center of main to end of pipe for house service lines. The unit price stated in the Proposal shall include all costs of constructing the sewer line unless otherwise specified for payment in the Proposal or these Specifications.

B. Ductile Iron Pipe with Mechanical or Push-on Joints: Proper and suitable tools and equipment shall be used for the safe and convenient handling and lying of ductile iron pipe. Care shall be taken to prevent damage to the exterior coating and interior cement lining. All pipe shall be carefully examined for cracks and other defects before laying. If any pipe or fitting is discovered to be defective after having been laid, it shall be removed and replaced with sound material at the expense of the Contractor. Whenever pipe is required to be cut, the cutting shall be done by skilled workmen using an abrasive wheel cutter. Use of a cold chisel or oxyacetylene torch will not be permitted.

1. Mechanical Joints: Mechanical joints shall be made only by experienced mechanics. Sockets and spigots shall be washed with soapy water before slipping the gland and gasket over the spigot end of the pipe.

The spigot shall be inserted into the socket full depth, then backed off ¼" to provide clearance for expansion. The gasket shall be brushed with soapy water and shall be pushed into position making sure that it is evenly seated in the socket. The gland shall then be moved into position for compressing the gasket. All bolts and nuts shall be made "finger-tight."

For joints made in trenches, the bolts shall be tightened to a uniform permanent tightness, using a torque wrench for tightening. Bolts shall be tightened alternately 180° apart.

2. Push-On Joints: The groove and bell socket shall be thoroughly cleaned and lubricated before the gasket is inserted. Before inserting the gasket, it

shall be thoroughly lubricated and manufacturer's instructions shall be followed for proper facing and seating of gasket. After the gasket is in place and just prior to joint assembly, a generous coating of lubricant shall be applied to the exposed gasket surface. The lubricant used shall be a lubricant supplied by the pipe manufacturer.

The plain end shall be inspected and any sharp edges, which might damage the gasket, shall be removed by means of a file or power grinder. Pipe that is cut in the field must be ground and beveled before assembly. Prior to inserting the plain end of the pipe into bell socket lubricant shall be applied to the beveled nose of the pipe.

Small pipe may be pushed home with a long bar but large pipe may require additional power such as a jack, lever or backhoe. A timber header shall be used between the bell and bar or other power to avoid damage to the pipe.

During assembly of the pipe, the joint must be kept straight while pushing. Pipe may be deflected if desired but only after the assembly is completed.

3. Mechanical Joint or Push-On Joint Pipe on Piers: Mechanical or push-on joint pipe may be used on piers in gravity sewer lines. Pipe shall be laid with ¼" clearance in each joint to provide for expansion. Jointing of pipe shall be as described above. On mechanical joint pipe, the bolts shall be tightened alternately 180° apart but be left "finger-tight" until the sewage is diverted into the sewers; then bolts shall be further tightened a sufficient amount which will prevent leakage of the joint, but which will not prevent slippage, which may occur because of temperature stresses.

4. Payment: Measurement for payment of ductile iron pipe constructed on piers, in trenches, in casings or in tunnels will be from end to end or inside wall to inside wall of manhole unless lump sum payment is provided for herein.

7.26 Assembling, Jointing, and Laying Pipe and Fittings for Force Main: The Contractor shall assemble, joint and lay all pipe and fittings to accurately conform to the lines and grades established by the Engineer and as follows:

A. Handling: Proper and suitable tools and equipment, for the safe and convenient handling and laying of pipe shall be used. Care shall be taken to prevent ductile iron pipe or fittings coating from being damaged, particularly the cement lining on the interior of the ductile iron pipe. All pipe shall be carefully examined for cracks, broken lining or other defects. PVC pipe shall be carefully examined for cracks, nicks, gouges, severe scratches, voids, inclusions, and other defects before laying. No pipe or fitting shall be laid which is known to be defective. If any pipe or fitting is discovered to be defective, after being laid, it shall be removed and replaced with sound material, without further charge.

B. Alignment and Gradient: In general, pipe line alignment and gradient shall be straight; however, pipe line may be laid on a curve but must be within the limits of curvature as recommended by the pipe manufacturer. All force mains shall be

laid on a minimum rising grade of 0.10% unless otherwise shown on the Drawings. Minimum cover shall be 4'-0. Where cover is less than 4'-0, ductile iron pipe must be used.

C. Dewatering Trenches: All excavation shall be dewatered properly before laying pipe. Where running sand is encountered, dewatering shall be done by well pointing whenever possible. Where soil conditions are not favorable for use of well point, french drains of graded stone shall be constructed to suitably located sumps and the water removed by bailing or pumping. All costs of equipment, labor, and materials required for dewatering shall be included in the prices bid for pipelines.

D. Sequence of Work: Excavation, laying, jointing and backfilling shall be kept up as closely as is possible to progress in a uniform, workmanlike manner. The Contractor will be required to backfill and compact the trench as soon as is possible after lying and jointing is completed.

E. Laying Pipe in Trenches: When laying pipe in trenches, care shall be taken to give the pipe solid bearing throughout its entire length. Bell holes shall be excavated in a manner, which will relieve pipe bells of all load.

F. Assembling and Installing Ductile Iron Pipe and Fittings: Proper care shall be exercised in the assembly and installation of ductile iron pipe and fittings.

1. Pipe Lines in Earth Trenches: Where pipes are laid in earth excavated trenches, the bottom of such trenches shall be fine graded by skilled workmen to a true line and shall not be laid on loose rock or other hard materials, but be bedded on fine, clean undisturbed earth. Over excavation in the bottom of trenches shall be filled to grade with granular material and compacted. Backfill shall be performed as specified herein.

2. Pipe Line in Rock Trenches: Where pipe is laid in rock trenches the bottom of such trenches shall be undercut and the pipe shall be bedded in at least 6" of crushed stone conforming to ASTM C 33, as amended to date, gradation #67 and the trench shall be backfilled with earth, rock dust, clay or sand as specified herein.

3. Installing Ductile Iron Pipe with Mechanical Joints: Pipe and fittings with mechanical joints shall be installed by experienced mechanics. Sockets and spigots shall be washed with soapy water before slipping gland and gasket over spigot. The spigot shall be inserted in the socket full depth. The gasket shall be brushed with soapy water and shall be pushed into position, making sure the gasket is evenly seated in the socket. The gland shall be slid into position for compressive gasket. All bolts and nuts shall be tightened "fingertight," after which bolts shall be tightened to a uniform permanent tightness, using a torque wrench for tightening. Bolts shall be tightened alternately 180° apart. Sockets, spigots, glands, and bolts shall be kept wet with soapy water until each joint is completed. Any joints, which leak, shall be remade.

4. Installing Ductile Iron Pipe with "Push-On" Type Joints: The groove and bell socket shall be thoroughly cleaned and lubricated before the gasket is inserted. Before inserting the gasket, it shall be thoroughly lubricated and manufacturer's instructions shall be followed for proper facing and seating of gasket. After the gasket is in place and just prior to joint assembly, a generous coating of lubricant shall be applied to the exposed gasket surface. The lubricant used shall be a lubricant supplied by the pipe manufacturer.

   The plain end shall be beveled and inspected, any sharp edges, which might damage the gasket, shall be removed by means of a file or power grinder. Pipe that is cut in the field must be ground and beveled before assembly. Prior to inserting the plain end of the pipe into bell socket, lubricant shall be applied to the beveled nose of the pipe.

   Small pipe may be pushed home with a long bar but large pipe will require additional power such as a jack, lever or backhoe. A timber header shall be used between the bell and bar or other power to avoid damage to the pipe.

   During assembly of the pipe, the joint must be kept straight while pushing. Pipe may be deflected if necessary but only after the assembly is completed.

7.27 Placing Precast Concrete Manholes: Precast concrete manholes or a combination of precast concrete and brick manholes shall be placed or constructed where shown and/or directed by the Engineer. Manholes shall be 4', 5' and 6' in diameter as determined from the schedule of pipe sizes and line deflections, or as shown.

The top of manholes outside of roads, streets highways, and pastures and yards shall be built to grades 2' above ground surface unless otherwise shown on the Drawings. Manholes in roads, etc. shall be built to grade designated by the Engineer. Vented manholes shall be constructed to elevations as shown on the Drawings.

Manholes shall be placed and/or constructed as follows:

A. Precast Concrete Manholes: Precast concrete manholes shall be bedded on not less than 6" of compacted crushed stone at Contractor's expense. The crushed stone shall extend not less than 6" outside the walls of the manhole, and shall be compacted under the entire length of pipe within manhole excavation.

   1. Connection of Pipe to Manhole: Connections of pipe to manhole for 4" through 15" pipe shall be made with a flexible joint system. The joint system shall be a neoprene or synthetic rubber boot or sleeve, either cast or core drilled into the wall of manhole. The boot or sleeve shall be clamped and seated to the pipe with a stainless steel band. The boot or sleeve system shall be "LOCK JOINT FLEXIBLE MANHOLE SLEEVE" as manufactured by Interpace Corporation, Parsippany, New Jersey or "KOR-N-SEAL" as manufactured by National Pollution Control Systems, Inc., Nashua, New Hampshire or equal. Connections of pipe to manhole for 18" pipe and above shall be made with a collar of mortar. The opening

between the pipe and the manhole shall have a minimum clearance of 1" and shall be filled from the inside of the manhole with a non-shrink grout.

2. Adjustment: The top of the concentric top section shall have a minimum wall thickness of 8". Grade adjustment shall be performed using concrete grade rings and steel riser rings only. The maximum adjustment for setting the frame and cover to grade shall be 8". Brick will not be allowed to adjust manhole grade.

B. Drop Connections: Drop connections will be required, where called for on the Drawings, or as determined by the dimensions shown in "Drop Manhole Schedule," shown on the Drawings. Drop pipe shall not be smaller than 8". Generally, drop pipe shall be one size smaller than the sewer, which they serve. Openings in walls of precast concrete manholes for drop connections shall not be made at joints. Drop connection fittings and riser pipe shall be encased in brick and mortar or formed Class 'C' concrete. Drop connections for both brick and precast concrete manholes shall conform with typical details as shown on the Drawings. Drop connections shall be carefully backfilled to prevent dangerous side pressures.

C. Manhole Inverts: Manhole inverts shall be carefully constructed with cement grout, Class 'B' concrete, or cement mortar brickwork; special care shall be taken to lay the channel and adjacent pipes to grade. Cement mortar shall be made of one (1) part cement and two (2) parts clean sharp sand. Channels shall be properly formed, rounded, and troweled smooth. The connections of the sewer with the wall and channel of the manhole shall be tight and smooth.

D. Manhole Steps: Manhole steps shall conform to the details shown. Steps for precast concrete manholes shall be installed along a vertical centerline, on approximately 14" to 16" centers.

E. Manhole Vacuum Testing: All manholes shall be vacuum tested in accordance with ASTM C1244, "Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test" as amended to date. All pipes entering the manhole should be plugged, taking care to securely place the plug from being drawn into the manhole. The test head shall be placed near the top of the manhole frame and cover and the seal inflated in accordance with the manufacturer's recommendations. A vacuum pump of 10" of mercury shall be drawn and the vacuum pump shut off. With the valves closed, the time shall be measured for the vacuum to drop to 9". Following in Table Two are minimum allowable test times for manhole acceptance at the specified vacuum drop:

Table Two – Test Times

Depth	*Time (Seconds)*		
	48" Diameter	*60" Diameter*	*72" Diameter*
4'	10	13	16
8'	20	26	33
12'	30	39	49
16'	40	52	67
20'	50	65	81
24'	59	78	97
Add 2-ft. more depth	5	6.66	8

Note: These numbers have been taken from ASTM C 1244-93 (reapproved 2000).

1. If the manhole fails the initial test, repairs and adjustments necessary due to extenuating circumstances (i.e. pipe joint, plug sealing) should be made. Retesting shall proceed until a satisfactory test is obtained.
2. A final visual inspection shall be made by the Inspector and contractor. Any deficiencies noticed shall be repaired accordingly.
3. The cost for testing each manhole shall be included in the cost per vertical foot to install the pre-cast concrete manhole. Retest cost required due to defects in the Contractor's work, shall be paid by the Contract.
4. Testing shall be performed on all new or refurbished manholes.

7.28 Selected Backfilling: All trenches shall be backfilled immediately after pipes are laid therein, and joints have been inspected by the Engineer, unless other protection of the pipeline is directed. Selected backfill material shall consist of finely divided earth, stone dust, sand, crushed stone, or other approved material carefully placed about the pipe and up to a height of at least 12" above the top of the pipe barrel, and in uniform layers not exceeding 6" in thickness, each layer thoroughly compacted with proper hand tools in a manner which will not disturb and/or injure the pipe. Backfilling shall be carried on simultaneously on both sides of the pipe and in a manner, which will prevent injurious side pressures. If suitable select materials are not available from the trench excavation, the Contractor will be required to obtain the select materials elsewhere.

No extra payment will be made for selected backfill, unless on-site material is not acceptable. If borrow material is required for road cut backfill, the cost of furnishing, installing and wasting bad material shall be paid per cubic yard as bid under extra work items.

7.29 General Backfilling: After selected backfill material has been placed and tamped, the remainder of the trench may be backfilled with general excavated material, except that no rock, unless in small shattered fragments, will be permitted to be mixed with other backfill material.

A. Street and Road Right-of-Way, Yards and Other Traveled Areas: In streets and road right-of-ways, yards and other traveled areas open to vehicular or pedestrian travel the ditch shall be backfilled and each layer shall be tamped to a density equivalent to at least 95% of the Standard Proctor maximum dry density in accordance with ASTM D 698, as amended to date.

Backfill material shall be placed in uniform layers not exceeding 6" in thickness, with each layer thoroughly compacted with heavy duty tampers to a height of at least 36" or 48" above the top of the pipe barrel.

The remainder of the ditch may be backfilled and tamped in the same manner or if the Contractor so elects he may place backfill in layers not exceeding 12" and use wheel loading or heavy duty power tamping equipment. Pipe shall have at least 36" of cover before wheel loading and at least 48" of cover before using heavy duty tamping equipment.

1. Areas Requiring Pavement Replacement: Mechanical tamping will be required of all backfilling of excavated portions. After backfilling and tamping as described above is completed the top 6" of the ditch shall be backfilled with compacted crushed stone, ASTM C 33, as amended to date, gradation #67 or #57, with sufficient fines for compaction. Further compaction shall be accomplished by leaving the backfilled trench open to traffic while maintaining the surface with stone. Settlement in trenches shall be refilled with stone and such maintenance shall continue until replacement of pavement is authorized by the Engineer.

   The cost of the 6" of stone and any additional stone used shall be included in unit price bid for replacing pavement.

2. Other Areas: Other areas, including woodland, fields, pastures and areas not open to vehicular travel, the remainder of the ditch may be backfilled by placing fill in ditch and "walking-in" with wheel loaded equipment. Backfill material may be windrowed and maintained in a suitable manner so as to concentrate and pond rainfall runoff over the trench. After sufficient settlement has been obtained, the Contractor shall complete surface dressing, remove surplus material and clean up in accordance with these Specifications. Wherever trenches have not been properly filled, or if settlement occurs, they shall be refilled, smoothed off and finally made to conform to the surface of the ground. Backfilling shall be carefully performed and the original surface restored as specified herein. Surplus material shall be disposed of by the Contractor.

7.30 Concrete Encasement of Pipe: Where shown, and where otherwise directed by the Engineer, the pipe shall be completely encased with Class 'C' concrete. The trench shall first be excavated not less than 6" below the bell of the pipe and the pipe laid to line and grade on concrete blocking. Concrete shall then be poured to the full width of the trench, but in no case less than 6" from the pipe bell on either side of the pipe, and to a height of not less than 6" above the top of the pipe bell. No backfill material shall be placed in the trench for a period of at least 24 hours after the concrete encasement has been poured.

7.31 Jointing Dissimilar Pipe: Dissimilar pipes shall be joined together using flexible couplings as manufactured by "Fernco" or "Mission" or equal. Concrete collars will be permitted only if flexible couplings are not available in sizes needed. Concrete collar shall be constructed of Class "A" concrete and shall be poured to completely and securely encase the entire joint. The collar shall be formed as shown on the Drawings or, if no detail is shown, the collar shall be constructed as directed by the Engineer. The inside of the pipe shall be free of foreign material to the satisfaction of the Engineer.

A. Assembling and Installing PVC Pipe with Elastomeric - Gasket Bell Ends Ductile Iron Fittings: All dirt or foreign material must be removed from the groove of pipe. If necessary, groove shall be wiped with a clean, dry cloth. Care shall be taken to insure that the proper ring is used. The rubber ring shall be wiped clean before it is inserted into the groove. The GROOVE OR RUBBER RING MUST NOT BE LUBRICATED. Apply lubricant to beveled spigot and push lubricated end past the gasket into the bell housing. Manufacturer's recommendations must be strictly adhered to in assembling rubber ring in groove and installing pipe into the bell.

The assembling of ductile iron mechanical joint fittings must be done by experienced mechanics. The gasket shall be brushed with soapy water before slipping the gasket and gland into place. Bolts shall be tightened fingertight and then tightened alternately 180° apart to a uniform tightness, using a torque wrench.

1. Cutting PVC Pipe: Wherever pipe or special castings are required to be cut, the cutting shall be done by skilled workmen, using hacksaw, handsaw or a power saw with a steel blade or abrasive disc. The end may be beveled using a beveling tool or wood rasp, which will cut the correct taper.

2. PVC Pipe, Trench, and Bedding: The trench bottom must be free of large stones, large dirt clods or frozen earth. Place 4" of select material on trench bottom to provide smooth cushion for pipe. Excavation for pipe bells shall be provided so that the pipe is uniformly supported along its length. When an unstable trench bottom is encountered and, in the opinion of the Engineer, will not support the pipe, the Contractor shall remove the bad material and replace with a minimum depth of 12" of No. 67 stone.

3. Depth of Bedding and Marking Tape: Minimum depth of bedding shall be 4". Compaction to the centerline of the pipe shall be of the same material used in the bedding. Backfill shall then be carried to a point 18" above the top of pipe, using hand tools for tamping. Puddling will not be allowed as a method of compaction. Before replacing the remaining backfill, **DETECTABLE** marking tape shall be placed in the ditch for the entire length of force main. Tape shall be 3" in width, imprinted with the words "BURIED SEWER," and shall be as manufactured by Black Burn, Allen Systems, Inc. or equal. The remaining backfill shall be as specified in the "Selected Backfill" and "General Backfill" paragraphs of these

specifications. Pipe shall have at least 36" of cover before wheel loading and at least 48" of cover before using heavy-duty tamping equipment such as a hydrohammer.

7.32 Construction Along Highways, Streets and Roadways: The Contractor shall install pipe lines and appurtenances along highways, streets, and roadways in accordance with the applicable regulations of the State Department of Transportation and the Owner with reference to construction operations, safety, traffic control, road maintenance and repair.

A. Protection of Traffic: The Contractor shall provide suitable signs, barricades, and lights for protection of traffic in locations where traffic may be endangered by construction operations. All signs removed because of construction shall be replaced as soon as the condition, which necessitated their removal, has been cleared. No highway, street, or roadway shall be closed without first obtaining permission from the proper authorities.

B. Construction Operations: The Contractor shall construct all work along highways, streets, and roadways using the following sequence of construction operations so as to least interfere with traffic.

1. Stripping: Where the pipe line is laid along road shoulders, all sod, topsoil, and other material suitable for shoulder restoration shall be stripped and stockpiled for replacement.

2. Trenching, Laying, and Backfilling: The Contractor shall open trenches, install pipe line, and backfill. The trench shall not be opened ahead of pipe laying operations any further than is necessary for proper laying operations. Trenches shall be progressively backfilled and consolidated; excess material shall be removed immediately behind laying operations.

3. Shaping: The Contractor, immediately after completing backfilling operations, shall re- shape damaged cut and fill slopes, side ditches and ditch lines, and shall replace topsoil, sod, and other materials removed from shoulders in accordance with the requirements, and to the full and complete satisfaction, of the proper highway personnel and the Owner. The Contractor, when installing pipe lines and appurtenances, shall provide sufficient personnel and equipment to simultaneously carry out all of the above operations.

C. Excavated Material: Excavated material shall not be placed along highways, streets, and roadways in a manner, which would cut off traffic. No scattered excavated material shall be allowed to remain on the pavement; all such material shall be kept swept away.

D. Drainage Structures: All pipe, side ditches, culverts, cross drains, and other drainage structures shall be kept clear of excavated material and be free to drain at all times. Any drainage structure that must be temporarily removed during construction operations must be replaced immediately after construction has been completed in the vicinity. All structures damaged must be replaced at no additional cost to the owner.

E. Maintaining Highways, Streets, Roadways and Driveways: The Contractor shall furnish proper construction equipment, which shall be available for use at all times, for maintaining highways, streets, and roadways upon which work is being performed. All such highways, streets, and roadways shall be maintained in suitable condition for movement of traffic until completion and final acceptance of the work.

F. Payment: No separate payment will be made for the above work. The cost of such work, and all cost incidental thereto, shall be included in the unit prices bid for the item to which the work pertains. The Contractor shall be responsible for fully informing himself with regard to all regulations relating to pipe line installation along roadways.

7.33 Connections to Existing Manholes: At locations where new sewers are shown to be connected to existing manholes the Contractor may temporarily block and/or divert sewage flows to facilitate construction operations. The work shall consist of coring the opening in the manhole wall, installing a flexible rubber boot, inserting the new pipe to the elevation shown, filling the space in the wall around the pipe with mortar and constructing and remodeling manhole inverts.

High-early strength cement shall be used for mortar in order that proper channels may be formed in manhole bottoms with a minimum interruption of service to the existing sewer.

This work shall include all costs of labor, material, and equipment required to complete each connection and shall include the costs involved in blocking and/or diverting sewage flows, and shall include all cost of delays, temporary works, and maintaining existing sewers in service.

7.34 Connections to Existing Sewers: At locations where new sewers are shown to be connected to existing sewers at a new manhole, the Contractor shall first expose the existing sewer and remove all soil to a minimum of 6" below the existing pipe. Support shall be provided as required to prevent the existing sewer from sagging. The new precast doghouse manhole section should be placed over the existing sewer and the invert and bench subsequently poured with Class 'A' concrete. The ends of the manhole should be sealed watertight with concrete or hydraulic cement. Under special conditions, and with approval by the Engineer, the Contractor may temporarily block and/or divert sewage flows to facilitate construction operations. Actual physical connection of the sewers will be made at a later date, as directed by the Engineer.

This work shall include all costs of labor, material, and equipment required to expose and support the existing sewer, block and/or divert sewage flows, make future physical connections, as well as all costs of delays, temporary works, and maintenance of existing sewers in service.

7.35 Highway Crossing: The Contractor shall install pipe lines across highways in accordance with the applicable regulations of the State Department of Transportation and as shown on the Drawings. All work shall conform to the "Construction Along Highways, Streets and Roadways" section of these Specifications. Permits for highway crossings will be obtained by the Owner.

A. The work is herein defined as the operations in which both the boring auger and the jacking of the casing or carrier pipe are done mechanically, and in which the diameter of the casing pipe is too small to permit hand working at the heading of the casing pipe. Two basic methods are (1) pushing the casing into the fill or earth simultaneously as the boring auger drills out the ground; and (2) drilling the hole through the fill or earth and pushing the casing into the hole after the drill auger has completed the bore.

B. A suitable boring pit shall be opened adjacent to the slope of the embankment, or adjacent to point of bored and jacked section as shown on the Drawings. The boring pit shall be long enough to accommodate the selected working room. The boring pit shall be solid sheeted, braced and shored as necessary to provide a safe operation. The Contractor shall take all precautions, and shall comply with all requirements as may be necessary to protect private or public property. Guide timbers or rails for keeping the casing pipe on line and grade shall be accurately set and maintained in the bottom of the pit, and with heavy timber back-stop supports installed at the rear of the pit to adequately take thrust of the jacks without any movement or distortion. It is paramount to the securing of acceptable tolerance limits of workmanship in the boring and jacking operation that extreme care be taken in the setting of all guides, rails and jacks to the end that the casing pipe in final position be within the limits of acceptability for the placing and laying of the carrier pipe. Except as otherwise limited on the plans, variations in grade elevation not exceeding 4" from the established line and grade will be considered as acceptable within these Specifications, subject to the Engineer's approval.

C. In general, the diameter, thickness, style, joints and materials selected for casing pipe shall be as shown on the Drawings and shall be considered as "minimum" requirements, all subject to prior approval of the Engineer. In all cases, the approval for construction by agreement with the private company and/or construction permit issued by the State, County or municipal agency will be required before construction starts.

D. In general, carrier pipe will be P.V.C. or cast iron/ductile iron with mechanical or push-on joints. Joints shall be assembled adjacent to the casing pipe and the assembly pushed through the casing pipe so that the carrier pipe will be on a uniform grade as shown on the Drawings. For 12" or smaller carrier pipe a minimum of four (4) skids places at 90° will be required. For carrier pipe larger than 12" a minimum of six (6) skids placed at 60° will be required. Skids shall be pressure treated lumber strapped to pipe. Thickness of skids must prevent bell of pipe from touching casing. Skids for ductile iron pipe shall be a minimum of 12" long, strapped behind the bell. Skids for PVC shall be full length of pipe with sufficient straps to prevent skids from moving during placement. Where necessary to maintain the grades as shown, adequate blocking shall be placed as required. Sand backfilling of the annular space between the carrier pipe and the casing shall be mechanically placed by an acceptable method approved by the Engineer.

Installation of the steel casing shall include all necessary excavation and sheeting for pit, protective service, and all other miscellaneous materials and work required for a complete installation. All excavation for pit and bore shall be unclassified.

E. Installation by Boring and Jacking: Where called for on the Drawings, casing, sewer line or force mains shall be installed by the boring and jacking method.

This section pertains to the boring and jacking of casing for short lengths of sewers or force mains under railroads and private right-of-way, highway, streets and similar features to the limits shown on the Drawings and as herein specified, including the installation of sewers (carrier pipes) generally 24" or less in diameter inside said casing pipe.

The work is herein defined as the operations in which both the boring auger and the jacking of the casing or carrier pipe are done mechanically, and in which the diameter of the casing pipe is too small to permit hand working at the heading of the casing pipe. Two basic methods are (1) pushing the casing into the fill or earth simultaneously as the boring auger drills out the ground; and (2) drilling the hole through the fill or earth and pushing the casing into the hole after the drill auger has completed the bore.

A suitable boring pit shall be opened adjacent to the slope of the embankment, or adjacent to point of bored and jacked section as shown on the Drawings. The boring pit shall be long enough to accommodate the selected working room. The boring pit shall be solid sheeted, braced and shored as necessary to provide a safe operation. The Contractor shall take all precautions, and shall comply with all requirements as may be necessary to protect private or public property. Guide timbers or rails for keeping the casing pipe on line and grade shall be accurately set and maintained in the bottom of the pit, and with heavy timber back-stop supports installed at the rear of the pit to adequately take thrust of the jacks without any movement or distortion. It is paramount to the securing of acceptable tolerance limits of workmanship in the boring and jacking operation that extreme care be taken in the setting of all guides, rails and jacks to the end that the casing pipe in final position be within the limits of acceptability for the placing and laying of the carrier pipe. Except as otherwise limited on the Drawings, variations in grade elevation not exceeding 4" from the established line and grade will be considered as acceptable within these Specifications, subject to the Engineer's approval.

In general, the diameter, thickness, style, joints and materials selected for casing pipe shall be as shown on the Drawings and shall be considered as "minimum" requirements, all subject to prior approval of the Engineer. In all cases, the approval for construction by agreement with the private company and/or construction permit issued by the State, County or municipal agency will be required before construction starts.

In general, carrier pipe will be PVC or cast iron/ductile iron with mechanical or push-on joints. Joints shall be assembled adjacent to the casing pipe and the assembly pushed through the casing pipe so that the carrier pipe will be on a uniform grade as shown on the Drawings. For 12" or smaller carrier pipe a

minimum of four (4) skids places at 90° will be required. For carrier pipe larger than 12" a minimum of six (6) skids placed at 60° will be required. Skids shall be pressure treated lumber strapped to pipe. Thickness of skids must prevent bell of pipe from touching casing. Skids for ductile iron pipe shall be a minimum of 12" long, strapped behind the bell. Skids for PVC shall be full length of pipe with sufficient straps to prevent skids from moving during placement. Where necessary to maintain the grades as shown, adequate blocking shall be placed as required. Sand backfilling of the annular space between the carrier pipe and the casing shall be mechanically placed by an acceptable method approved by the engineer.

Installation of the steel casing shall include all necessary excavation and sheeting for pit, protective service, and all other miscellaneous materials and work required for a complete installation. All excavation for pit and bore shall be unclassified.

7.36 Location and Protection of Existing Underground Utilities: Underground utilities shown on the Drawings are for the Contractor's information only and it is not the intention of the Engineer to convey the opinion that all utilities are shown. It is the responsibility of the Contractor to locate the underground utilities and to protect same. Utility lines or services damaged by the construction shall be the Contractor's own expense.

7.37 Benching for Sewers: All excavation required for benching shall be unclassified. Where called for on the Drawings, the Contractor shall construct a bench, prior to sewer construction.

A. Payment: Payment for benching will be on a lump sum basis as provided in the Proposal. Where payment is allowed for bench excavation, the measurement of trench depths for payment for sewers will be from the invert of the sewer to the finish grade of the bench.

7.38 Riprap: The Contractor shall furnish and place riprap as required and where shown on the Drawings. Riprap shall consist of stone or bagged sand-cement to a thickness of approximately 12". Stone shall be hard quarry or field stone of such quality that it will not disintegrate on exposure to water or weathering. Stone shall range in weight from a minimum of 25 pounds to a maximum of 150 pounds with at least 50% of the pieces weighing more than 30 pounds. Bagged sand-cement riprap shall consist of one part cement and five parts of sand in clean cloth bags, approximately one cubic foot in size. Sand and cement shall be as specified for concrete work herein.

A. Payment: Riprap will be paid for based on the number of square yards measured in place to the thickness specified in the proposal at locations shown on the Drawings or other locations as directed by the Engineer.

7.39 Closing Pipe: When the work of pipe-laying is suspended for the night, and at other times, the end of the sewer shall be closed with a tight cover. The Contractor shall be responsible for keeping the sewer free from obstructions.

7.40 Street Maintenance: Wherever feasible, all street and roads on which the Contractor is performing work shall be maintained for traffic as directed by the Engineer. Proper construction equipment shall be available for this maintenance.

No more than one block of a street shall be closed for construction at any one time. Before proceeding with trenching operations in a succeeding block the preceding section shall be completely backfilled, cleanup completed, and the street opened to traffic. When work is halted for the day, the Contractor shall completely backfill all excavations and remove all equipment to allow an uninterrupted flow of traffic.

7.41 Surfacing of Trenches in Dirt Streets and Driveways: Where trenches are along dirt streets and across dirt driveways open to vehicular traffic, the top 2" of backfill up to the traveled surface shall be of crusher run or of a good grade, all-weather soil approved by the Engineer.

7.42 Surfacing of Trenches in Paved Streets and Driveways: Where trenches are in paved streets and driveways, the remaining 6" of backfill up to the traveled surface shall be made with crushed stone, ASTM C 33, as amended to date, Gradation #67 or #57, with sufficient fines for compaction. Trenches shall be compacted and maintained until pavement is replaced.

7.43 Grassing of Disturbed Areas: After completion of pipe laying operations, the Contractor shall grass disturbed areas.

A. Grassing Along Highway Right-of-Way: Grassing along highway right-of-way shall be in accordance with Department of Transportation, State of Georgia, Standard Specifications.

B. Grassing through Established Pastures: Grassing through established pastures shall be by seeding with the same type of grass as was disturbed or, if acceptable to the property owner, seeding may be as recommended by the local Soil Conservation Agent.

C. Grassing of Other Areas: Grassing of other areas shall be by planting grass of a quick growing species that will also give a permanent cover. Seeding may be as recommended by the local Soil Conservation Agent.

7.44 Planting: Preparation of soil along highway right-of-way shall be as set out in Highway Specifications. Preparation of soil in (B) and (C) above shall be performed by the Contractor using recognized type equipment and materials for this type operation. Before planting, a fertilizer of 16:4:8 composition, or approved equal, shall be evenly applied at the rate of 20 pounds per 1,000 square feet and disced or harrowed into the dampened soil. Seeding shall be as stated above. Seed, fertilizer, mulch, and periodic watering shall be applied in adequate quantities to assure a satisfactory ground cover over the entire disturbed area of construction operations. A satisfactory stand of grass is defined as a full cover, over the seeded area of live and growing grass, when at least 98% of the total area has no bare spots exceeding one square foot and the ground surface is fully stabilized against erosion. After completion of pipe laying operations, the Contractor shall grass disturbed areas.

A. Grassing Along Highway Right-of-Way: Grassing along highway right-of-way shall be in accordance with Department of Transportation, State of Georgia, Standard Specifications.

B. Grassing through Established Pastures: Grassing through established pastures shall be by seeding with the same type of grass as was disturbed or, if acceptable to the property owner, seeding may be as recommended by the local Soil Conservation Agent.

C. Grassing of Other Areas: Grassing of other areas shall be by planting grass of a quick growing species that will also give a permanent cover. Seeding may be as recommended by the local Soil Conservation Agent.

7.45 Testing and Cleaning: Before acceptance of any sewer or systems of sewers, lines shall be cleaned and tested in accordance with these Specifications. Where any obstruction is met, the Contractor will be required to clean the sewers by means of rods, swabs, or other instruments. Lines and manholes shall be clean before final inspection. Pipe lines shall be straight and shown a uniform grade between manholes. The Contractor shall be required to correct any variations therefrom which may be disclosed during the inspection.

7.46 Cleaning Up: Before the work is considered complete, all material not used and rubbish of every character must be removed from the project. All streets, sidewalks, curbs, fences and other private or public facilities and structures disturbed must be in essentially as good condition as existed before the work was done. Any subsequent settlement of backfill or pavement over trenches shall be replaced by the Contractor and the surfaces brought to grade.

7.47 Acceptance of Work: Sewer lines and appurtenances will not be considered ready for acceptance until all provisions of the Specifications have been complied with, until all tests have been satisfactorily completed, and until inspection of the work has been made. Sewage flows shall not be diverted into new sewers until after such time as final inspection of the lines has been made by the Engineer, and permission granted.

7.48 Payment: Payment for all items in this section will be included in the lump sum price provided in the Proposal.

SECTION 8
PIPING, FITTINGS, VALVES AND DRAINS

8.01 Scope: The work described by this Section consists of furnishing all materials and equipment and performing all labor necessary to install all interior and exterior piping systems and valves, complete, as shown on the Drawings or specified, and as required for proper operation of all equipment installed under this Contract. All standard test designations refer to the revision of those standards in effect on the date of issue of the Contract Documents, except when a specific revision is specified.

8.02 Drawings: The Contractor shall furnish 6 copies of pipe fabrication details and dimensional layouts for all piping systems for checking and approval by the Engineer. Each joint of pipe and fittings shall be marked and dimensioned to insure installation shall commence until those drawings have been approved.

8.03 Sewer Pipe: Pipe for sewers shall be furnished in accordance with the following requirements:

A. Quality and Inspection: Latitudes in workmanship and finish allowed by ASTM notwithstanding, all pipe shall have smooth exterior and interior surfaces; be first quality; be free from cracks, blisters, and other imperfections; and be true to theoretical shapes and forms throughout each length. Pipe shall be subject to inspection by the Engineer at the pipe plant, trench, and other points of delivery for the purpose of culling and rejecting pipe, independent of laboratory tests, which does not conform to the requirements of this Section. Pipe, which does not conform, will be so marked by the Engineer and shall not be used in the work. On-the-job repairing of rejected pipe will not be permitted.

B. Experience of Manufacturer: The pipe manufacturer shall submit evidence, if requested by the Engineer, of having consistently produced pipe and joints of the quality specified herein, and which have exhibited satisfactory performance results in service over a period of not fewer than two years. The pipe manufacturer and the pipe manufacturing process shall be subject to approval by the Engineer.

C. Polyvinyl Chloride (PVC) Sewer Pipe and Fittings: Polyvinyl chloride (PVC) sewer pipe shall be bell and spigot pipe, shall be in lengths not exceeding 12½' laying lengths and shall have minimum wall thickness conforming to ASTM D 3034 under the classification for DR 26 pipe, as amended to date.

Polyvinyl chloride (PVC) sewer pipe fittings shall be bell and spigot or bell and plain end and shall conform to ASTM D 3034, as amended to date.

1. Markings: PVC pipe shall be marked at intervals of 5' or less with the following information, manufacturer's name or trademark, plant code, date of manufacturer, nominal pipe size, PVC cell classification, the legend "Type PSM DR 26 PVC Sewer Pipe," and ASTM designation D 3034.

Fittings shall be marked with the following information: manufacturer's name or trademark, nominal size, designations PVC and PSM and ASTM designation D 3034.

All markings shall remain legible during normal handling, storage, and installation.

2. Certification: The Contractor shall furnish the Engineer with a written statement from the manufacturer that all pipe and fittings furnished have been sampled, tested, and inspected in accordance with ASTM D 3034, as amended to date. Each certification so furnished shall be signed by an authorized agent of the manufacturer.

3. Joints: All pipe shall have elastomeric joints with an integral belled gasket coupler. Rubber gaskets shall comply with the physical requirements specified in the latest revision of ASTM F 477, as amended to date. Joints shall meet the requirements specified in ASTM D 3212, as amended to date.

4. All existing PVC, concrete, and clay pipe to be replaced shall be replaced with PVC pipe unless otherwise indicated on the drawings or required by these specifications. Refer to the "Iron Pipe and Fitting" section of these Specifications.

5. Locating Wire and Detector Tape: The Contractor shall install mylar marking tape and detection wire 1' above all non-ferrous pipe and properly connect to fittings.

8.04 Iron Pipe and Fittings: Cast iron or ductile iron pipe shall be used in sizes 3" through 8"and ductile iron pipe shall be used in sizes 10" through 64" where shown or indicated on the Drawings. All cast iron and ductile iron pipe shall be designed for a minimum 150-psi working pressure, 100-psi surge allowance, a 2 to 1 factor of safety on the sum of working pressure plus surge pressure, single AASHO H-20 truck loading, laying condition 2, and cover required. Each pipe shall be subjected to a hydrostatic pressure test of at least 500-psi at the point of manufacture. Cast iron pipe shall be of the thickness according to ANSI A21.1. Cast iron pipe shall conform to ANSI A21.6 or ANSI A21.8. Ductile iron pipe shall conform to ANSI A21.51. The class or nominal thickness, net weight without lining, and casting period shall be clearly marked on each length of pipe. Additionally, the manufacturer's mark, year in which the pipe was produced, and the letters "D.I./C.I." or "Ductile/Gray Iron" shall be cast or stamped on the pipe. Fittings shall be cast from gray or ductile iron. Ductile iron fittings shall conform to AWWA C 110 (ANSI A 21.10), or ANSI/AWWA C153/A21.53, gray iron fittings shall conform to ANSI/AWWA C110/A21.10, or latest revision. All fittings shall have standard mechanical joints. Exterior joints for cast iron and ductile iron shall be push-on type unless otherwise shown. Interior joints shall be flanged in accordance with ANSI A21.15 and ANSI A21.10. All pipe and fittings shall be coated inside and out with an approved coal tar coating. Ductile iron air piping shall be provided unlined with viton gaskets.

A. Lining: The lining for all gravity sewer pipe shall be AWWA C104 cement

lining. Lining shall be applied according to the manufacturer's recommendations.

B. Certification: The manufacturer of iron pipe and fittings shall furnish both the Engineer and the Owner with certified reports stating that inspection and specified tests have been made and that the results thereof comply with the applicable ANSI Specifications for each.

1. Ductile Iron Pipe: Ductile iron pipe shall be used for sanitary sewer at all aerial crossings, road crossings, shallow cuts, and all locations directed by the plans or Engineer.

C. Polyvinyl Chloride Pipe: The contractor shall furnish polyvinyl chloride pipe in accordance with the following requirement:

1. Polyvinyl Chloride Pipe: Polyvinyl chloride pipe shall conform to requirements of AWWA C C900, as amended to date, with standard dimension ration DR 18 (Class 150) for PVC 1120 pipe with cast iron pipe equivalent Ods. Integral wall-thickened and sleeve-reinforced bell-type pipe ends designed for joint assembly using elastomeric seals shall be measured in accordance to ASTM D 2122 as amended to date. Pipe shall be furnished in standard 20' laying lengths.

2. Markings: Pipe and couplings shall bear identification markings in accordance with AWWA C900, as amended to date, that will remain legible during normal handling, storage and installation and which have been applied in a manner that will not reduce the strength of the pipe or coupling or otherwise damage them.

3. Certification: The manufacturer shall furnish both the Engineer and the Owner with certified reports stating that inspection and specified tests have been made and that the results thereof comply with the applicable AWWA and ANSI Specifications.

4. Locating Wire and Detector Tape: The Contractor shall install locator wire along the entire section of pipe line. The locator wire shall be installed simultaneously with the polyethylene piping.

8.05 Copper and Brass Pipe: Copper pipe shall be as specified in Article 7.11 and shall be used for small water pipe and fittings. Brass used for air lines shall be of commercial iron pipe sizes conforming to ASTM B43 "Standard Red Brass Pipe, Standard Sizes".

8.06 Steel Casing Pipe: Casing shall be Grade B steel pipe minimum yield strength 35,000 psi and shall conform to ASTM A252 Grade 2. The diameter and wall thickness shall be as shown on the Drawings. Joints where required shall be electric fusion (arc) proper installation. No fabrication, manufacture, and welding by operators qualified in accordance with American Welding Society Standard Procedure.

8.07 Polyvinyl Chloride Pipe:

A. Water Lines: Except where noted on the drawings, the Contractor can provide in the Proposal a price for installing polyvinyl chloride pipe outside of structures. PVC pipe for water lines shall meet the requirements of AWWA C-900, "Standard for Polyvinyl Chloride (PVC) Pressure Pipe 4" through 12" for Water".

PVC pipe shall be class 200 (DR 14) and shall have iron outside diameters and must be Underwriters Laboratories, Inc. listed. Pipe less than 4" shall be SDR21 (PR200) conforming to ASTM D-2241. All pipe shall be jointed with integral thickened bell and elastomeric gaskets. Lubricant used with PVC pipe must be non-toxic and supplied or approved for use by the pipe manufacturer.

1. Testing and Inspection: All pipe shall be tested and inspected at the place of manufacture for all requirements of the AWWA C-900 standards. Certified copies of the test reports covering each shipment shall be submitted to the Engineer prior to laying.

2. Detectable Tape: Where PVC pipe is installed, the Contractor shall place in the pipe trench 1' above the top of pipe a metallic detectable tape. The tape shall have a 2" minimum width, imprinted with "Caution Buried Water Line", and shall be made of polyethylene film laminated to aluminum film with a total thickness of not less than 4 mils.

B. Chemical Feed Lines: Polyvinyl chloride pipe shown on the Drawings to be installed inside of structures, or for gaseous chlorine, acid, or other chemicals shall have solvent weld joints except as noted. Sufficient unions shall be provided to facilitate maintenance of all lines. PVC yard pipe shall be SDR21 (PR200) conforming to ASTM D-2241. PVC pipe shall be Schedule 80, Type 1, Grade 1, National Sanitation Foundation approved and shall conform to Commercial Standard, CS 207, latest revision, ASTM D-1734 and ASTM D-1785, latest revision, as applicable to Type 1, Grade I polyvinyl chloride plastic pipe, Schedule 80 water pressure ratings. Fittings shall comply with ASTM D-2467.

1. Valves: Valve material shall meet requirements of Type 1, Grade I polyvinyl chloride as outlined in ASTM D-1784, with seats and seals as required by usage. Ball valves shall carry a pressure rating of 150 psi, W.O.G. at 75° F. All wetted surfaces shall be of a material not affected by chemicals to be transported.

2. Testing and Inspection: Pipe shall be all tested and inspected at the place of manufacture for all requirements of the latest ASTM and Commercial Standard tests and certified copies of the test reports covering each shipment shall be submitted to the Engineer prior to laying.

   All pipe used for liquid or gaseous chlorine shall be tested with ammonia solution as recommended by the manufacturer of the chlorination equipment.

8.08 Unloading, Hauling, Distributing and Storing Pipe and Related Materials: The Contractor shall unload, haul, distribute, and store pipe and related materials as follows.

A. Unloading: Equipment and facilities for unloading, hauling, distributing and storing materials shall be furnished by the Contractor and shall at all times be available for use in unloading materials. Delays in unloading railroad cars, unloading trucks, or hauling from freight terminal, which incur demurrage, truck waiting charges or terminal charges shall be at the expense of the Contractor.

B. Handling: Pipe, fittings, and other material shall be carefully handled so as to prevent breaking and/or damage. Pipe may be unloaded individually by hand but shall not be unloaded by rolling or dropping off of trucks or cars. Preferred unloading is in units using mechanical equipment, such as forklifts, cherry pickers or front-end loaders with forks. If forklift equipment is not available, units may be unloaded with use of spreader bar on top and nylon strips or cables (cushioned with rubber hose sleeve) looped under the unit.

C. Distributing: Materials shall be distributed and placed so as to least interfere with traffic. No street or roadway may be closed without first obtaining permission of the proper authorities. The Contractor shall furnish and maintain proper warning signs and obstruction lights for the protection of traffic along highways, street and roadways upon which material is distributed. No distributed materials shall be placed in drainage ditches.

D. Storage: All pipe, fittings, and other materials, which cannot be distributed along the route of the work, shall be stored for subsequent use when needed. The Contractor shall make his own arrangements for the use of storage areas; except that, with permission, he may make reasonable use of the Owner's storage yards.

1. Ductile Iron Pipe: Ductile iron pipe must be stockpiled on level ground. Timbers must be placed under the pipe for a base and to prevent dirt and debris from washing into the pipe.

2. PVC Pipe: PVC pipe must be stockpiled on level ground. If pipe is unloaded individually by hand, timbers must be used under the pipe for a base, spaced the same as factory load, with stop blocks nailed at either end. Stockpile must be built up the same manner as it was stocked for shipment, transferring dunnage and chock-blocks from load to stockpile. Individual lengths of pipe shall not be stacked in piles any higher than 5'.

   If pipe is unloaded in units, the units must be placed on level ground and shall not be stacked more than 2 units high. Units must be protected by dunnage in the same way they were protected while loaded on the truck or car. The dunnage must support the weight of all units so that pipe lengths do not carry the weight of the unit loaded above.

   If pipe is to be stored outside and exposed to sunlight for a number of months, the pipe must be protected by covering with canvas or other opaque material. The cover shall be loose enough to allow for air circulation around the pipe. The use of clear plastic sheets will not be permitted.

8.09 General Provisions for Laying Exterior Metal Pipe Lines: The Contractor shall lay all pipe and fittings to accurately conform to the lines and grades established by the Engineer as follows:

A. Handling: Proper and suitable tools and equipment, for the safe and convenient handling and laying of pipe, shall be used; great care shall be taken to prevent the pipe and coatings from being damaged. All pipe shall be carefully examined for cracks and other defects, and no pipe and other castings shall be laid which are

known to be defective. If pipe and other castings are discovered to be cracked, broken and defective after being laid, it shall be removed and replaced with sound material, at no additional expense to the Owner. All pipe and fittings shall be thoroughly cleaned before being laid, and shall be kept clean until accepted in the complete work.

B. Alignment and Gradient: Pipe line alignment and gradient shall be straight, or shall follow true curves as near as is practicable. Curvature in pipe lines, where required, shall be well within the allowable horizontal or vertical laying radius.

C. Schedule of Work: Excavation, cleaning, laying, jointing, and backfilling shall be kept up as closely as is possible so as to progress the work in a uniform workmanlike manner. In no case shall pipe be left in the trench overnight without completing the jointing.

The completed pipe line shall not be left exposed in the trench unnecessarily; the Contractor shall backfill and compact the trench as soon as is possible after laying and jointing is completed. Each day at the close of work, and at all times when laying is not in progress, the exposed end of the pipe line in the trench shall be closed with an approved head or barrier of wood or metal. If at any time it becomes necessary to cover the end of an incomplete pipe line with backfill, the end of that pipe shall be closed with a mechanical joint plug.

D. Cleaning: The Contractor shall clean each joint of pipe while it is suspended before it is lowered into the trench. The Contractor shall keep exposed ends of the pipe properly plugged during laying to prevent dirt and other materials from entering the line, and shall, before the system is accepted, thoroughly clean all lines.

E. Laying Pipe in Trenches: When laying pipe in trenches, care shall be taken to give the pipe solid bearing throughout its entire length. The earth used in refilling trenches, from the bottom of the trench, under and up to 2' over the top of the pipe line, shall be of selected material, carefully packed, and tamped and rammed with proper tools for the purpose. Pipe in rock trenches shall be carefully bedded in 4" minimum fine selected material. Extreme care should be exercised to prevent contact with the rock. All tees and bends in pipe lines shall be firmly blocked with Class "B" concrete to the dimensions shown on the Drawings or as directed by the Engineer, placed between fittings and the vertical face of the trench; all exposed pipes, valves, hydrants, etc., shall be securely strapped, and all ends and bends shall be properly blocked.

F. Mechanical Jointing: Mechanical joints shall be made only by experienced mechanics. Sockets and spigots shall be washed with soapy water before slipping gland and gasket over spigot. The spigot shall be inserted in the socket full depth. The gasket shall be brushed with soapy water and shall be pushed into position, making sure the gasket is evenly seated in the socket. The gland shall be laid into position for compressing gasket. All bolts and nuts shall be tightened "fingertight", after which bolts shall be tightened to a uniform permanent tightness using a torque wrench for tightening. Bolts shall be tightened alternately 180° apart. Sockets, spigots, gaskets, glands, and bolts shall be kept

clean and wet with soapy water until each joint is completed. Suitable bell holes shall be cut in the bottom of the trench at the location of joints in order to secure a uniform bearing of the pipe in the trench. Gaskets of high quality EPDM meeting the requirements of ASTM D200 shall be used for air piping.

G. Flanged Connections: Flanges shall have 125# AN91 drillings. Gaskets of rainbow rubber, or equal, with cloth inserts shall be used. Flanges shall be firmly bolted with machine bolts of the proper size and threaded. The bolts and nuts shall be of the best quality refined bar iron, with good, true threads, and shall be tightened in a manner which will evenly distribute the stress in the bolts and bring the pipe into uniform alignment.

H. Jointing Bell-Spigot Connections: All bell-spigot connections shall be jointed with a molded rubber gasket. The inside of the bell, and the outside of the pipe, shall be thoroughly cleaned. Only joint runners in good condition shall be used in the work.

1. Gasket: All joints shall be made with best quality molded rubber gasket, properly installed in accord with manufacturer's printed recommendations.

2. Defective Joints: All defective joints shall be replaced to the satisfaction of the Engineer.

I. Push-On Joints: Joints shall be made in accord with the manufacturer's printed instructions.

J. Cutting: Whenever pipe and special castings are required to be cut, the cutting shall be done by skilled workmen; cutting torches shall not be used.

8.10 General Provisions for Laying Exterior PVC Pipe Lines: Installation of PVC pipe shall meet the provisions of the installation section of these Specifications and shall be in accordance with UNI-BELL STANDARD UNI-B-3, "Installation of Polyvinyl Chloride PVC Pressure Pipe". The provision of for laying the pipe in trenches section of these Specifications shall be followed. The select material used in filling the ditch around the pipe must be free of rocks, clods, and frozen material larger than 1-½" in the largest dimension. Extreme care must be taken not to damage the PVC pipe with mechanical compactors.

8.11 Heavy Interior Piping Systems: The Contractor shall furnish and install all heavy interior piping systems, complete, as indicated on the Drawings, as specified, and as required for proper operation of equipment. Those piping systems shall be jointed as specified in these Specifications and shall be properly supported by a system of hangers, pipe stanchions, brackets, concrete piers, and saddles as required. Inserts, bolts, and anchors, required for proper support, shall be set into form work or concrete work by the Contractor before concrete is placed. Pressure lines shall be secured with struts or reaction blocking to prevent slippage.

8.12 Operating Piping Systems: The Contractor shall furnish and install all small operating and control piping systems, and other small piping systems indicated on the Drawings and as required for operation of all equipment.

A. Materials: Piping for all operations and control piping systems shall be PVC, except as otherwise specified. Pipe, fittings, and valves shall be as follows:

1. Pipe and Fittings:

a. Above ground/exposed piping shall be PVC Schedule 80 pipe and be manufactured from a Type I, Grade I Polyvinyl Chloride (PVC) compound with a Cell Classification of 12454 per ASTM D1784. The pipe shall be manufactured in strict compliance to ASTM D1785.

b. Hot water piping shall be CPVC schedule 80 pipe and be manufactured from a Type IV, Grade I Chlorinated Polyvinyl Chloride (CPVC) compound with a minimum Cell Classification of 23447 per ASTM D1784. The pipe shall be manufactured in strict compliance to ASTM F441. The pipe shall have a Flame Spread rating < 25 and a Smoke Development rating < 50 when tested and listed for Surface Burning Characteristics in accordance with CAN/ULC-S102-2-M88 or equivalent.

c. All small yard pipes shall be PVC SDR 21 PR 200 (½" shall be SDR 13.5 PR315) and shall be manufactured from a Type I, Grade I Polyvinyl Chloride (PVC) compound with a Cell Classification of 12454 per ASTM D1784. The pipe shall be manufactured in strict compliance to ASTM D2241.

d. All piping shall be stored indoors after production at the manufacturing site until shipped from factory. This pipe shall carry the National Sanitation Foundation (NSF) seal of approval for potable water applications.

2. Valves: Valves shall be check, gate or globe pattern as indicated on the Drawings or specified, and shall have soler ends. Air, globe and check valves shall have composition disc for tight shut-off. All valves shall be designed for 125 psi working pressure. Valves for gauges shall be union gauge cocks having pipe thread-to-copper adapters. Valves shall be located inside at all water supply entrances to buildings.

a. PVC ball valves shall be full port, true union type designed for easy service with reversible PRFE seats, fine pitch seal retainer threads and double O-ring stem seals. Ball valves shall be manufactured by Heyward, Parker or equal.

B. Installation and Arrangement: All pipe runs shall be parallel with, or at right angles to, walls, ceilings equipment etc. 45° fittings and angle runs shall be avoided as far as possible. Piping shall be arranged and installed neatly, and so that it satisfies the service requirements and leaves the machine and equipment it is service accessible. Insofar as possible, all valves shall be accessible for operation by a person standing on the floor.

1. Pipe Drainage: All piping, whose service requires drainage of moisture, shall be installed with the required slope in the proper direction for gravity drainage and in such a manner to least interfere with foot traffic.

2. Parallel Runs: All parallel runs of piping shall be installed with equi-distant spaces between the piping and shall be neatly grouped. Grouping shall be such that crossovers, except as branches, are avoided.

C. Hangers and Supports:

1. The maximum distance between hangers and supports shall be:

¼" and ⅜" diameter -	4' - 0"
½" diameter -	6' - 0"
¾" and 1" diameter -	8' - 0"
1-¼" to 2" diameter -	10' - 0"
2-½" diameter and larger -	12' -0"

2. Maximum distance between hangers and supports for plumbing piping shall be:

Cast Iron -	5' - 0"
Screwed Pipe -	12' - 0"
Copper, 1-½"and smaller -	6' - 0"
Copper, 2 "and larger -	10' - 0"

3. Piping 1" and smaller, shall not be hung from rod hangers. Rod hangers, where used for pipe 1-¼" and larger, shall be split pattern. No pipe shall be clamped directly to a masonry surface. Steel brackets shall be used so that there will be a space not less than ¾" between the pipe and the masonry. Piping 1" and smaller and, preferably, piping 1-¼" and larger, shall be clamped to brackets and other steel members with clamps which will allow no axial movement. Clamps and clamping arrangements shall be of the "Unistrut" type, properly supported for the required arrangement.

8.13 Standard Gate Valves: The Contractor shall furnish and install all gate valves as indicated on the Drawings, listed in the Proposal, and specified herein. Gate valves size 4" and larger, (equipped with "O" ring packing) shall conform, in general, with the latest Specifications of the American Water Works Association, Designation C-500 and shall be as follows:

A. General Construction: Gate valves shall be mechanical joint end, double disc, parallel seat, iron body, bronze mounted, non-rising stem with 0-ring stem seals, open left. Valves 2" through 12" shall be designed for installing in a vertical position. Valves larger than 14" shall be designed for a horizontal installation and equipped with bevel gearing, gear case, tracks, rollers, scrapers and by-pass valves. Gate valves shall conform to AWWA standard specification C-500, latest revision for "Ordinary Water Works Service".

B. Working Pressure: Gate valves 2" thru 12" shall be designed for 200 psi, water working pressure. Valves 14" and larger shall be designed for a water working pressure of 150 psi.

C. Operation: All valves shall open left. Valves shall be operated by nut. Operating nuts shall conform to the present standard of the Owner, and shall have an arrow cast on them, indicating the direction for opening the valve.

D. Marking: Each valve shall be plainly marked with the manufacturers name or particular mark, the year of manufacture, the size of the valve, and designation indicating working pressure, all cast on the bonnet or body.

E. Installation: Gate valves size 12" and smaller shall be for vertical installation, N.R.S., with operating nut. Exterior gate valves, in general, shall be installed and jointed as specified in Article 7.08. The installation of exterior gate valves shall include the installation of valve boxes.

F. Testing: All gate valves shall be tested in accordance with American Water Works Association Standards. Internal test is required in field.

G. Jointing: All exterior gate valves shall be furnished with mechanical joints, and necessary bolts, glands and gaskets.

H. Valve Boxes: All exterior gate valves shall be equipped with valve boxes. Valve boxes shall be heavy roadway type. The valve boxes shall be cast iron two-piece slide type with drop covers. The word "water" shall be cast in raised letters on the covers. The valve boxes shall be adjustable to 6" up or down from the nominal required cover over the pipe. A concrete protecting slab shall be required when valve box is not located on a paved area. Installation shall be so that the top is flush with the protecting slab. Concrete protecting slabs shall not be smaller than 18" square by 6" thick.

8.14 Eccentric Plug Valves: Plug valves shall be used on all sewage, sludge and gas lines, and as indicated, and shall be furnished complete with operators and accessories shown on the Drawings or specified. Valves shall be of the eccentric, non- lubricated resilient seat type, designed for sewage at 125 psi working pressure and shall have mechanical joint or flanged ends. Drilling for flanged ends shall be in accordance with ANSI B 16.1, Class 125. The valve body shall be semi-steel conforming to ASTM A 126, Class B. Seats shall have a welded-in or cast overlay of not less than 90% pure nickel on all surfaces which will contact the rubber seating area. Upper and lower plug stem bushings shall be of stainless steel and permanently lubricated. Valves shall be manufactured by DeZurik, or equal.

A. Valve Operators and Accessories: Valves shall be furnished with operators and accessories as shown and/or required for the intended service and shall include the following.

1. All valves 6" and larger, and all 4" and larger underground valves, and valves submerged in sewage shall be gear operated.

2. Below floor/grating valves operated from floor above shall have bushed extension stem with valve stand or floor box. Valves which are more than

6' above operating levels shall be geared for chainwheel operation. Chains shall be cadmium plated.

3. One operating wrench shall be furnished for each wrench-operable valve. Valve stands shall be furnished as shown on the Drawings.

4. Gear actuators shall be submersible, and have a seal provided on all shafts which will prevent entry of water into the actuator. The enclosed gearing, with heavy duty corrosion resistant bearings, shall run in oil or grease. Packing shall be adjustable without disassembling the actuator. Actuator shall clearly indicate valve position; closing torque shall be set by an adjustable stop.

B. Valve operators shall be manual or electric operated as shown. Valve shall be designed for open LEFT operation. Valves operators shall be pretested at rated operating pressure using the specified valve operator to perform the opening and closing cycle."

8.15 Check Valves: Check valves shall be constructed of heavy cast iron with bronze and stainless steel fittings. It shall prevent reverse flow back through the valve when the inlet pressure decreases below the delivery pressure. The valve must be tight seating, and must operate without hammer or shock. The seat ring must be renewable and shall be securely held in place by a threaded joint. The valve disc shall be of cast iron and shall be hinged above its seat so that perfect closure is always attained. Check valves for all pump discharge lines shall have outside spring and lever. The high point of the valve shall be tapped and provided with a stopcock for bleeding of air.

8.16 Rubber Flapper Check Valves:

A. General:

1. The check valve shall be of the full body type, with a domed access cover and only one moving parts, the flexible disc.

2. The valves shall be designed, manufactured and tested in accordance with American Water Works Association Standards ANSI/AWWA C508.

3. Valves shall be provided with flanges in accordance with ANSI B16.1, Class 125.

4. The valve body shall be full flow equal to nominal pipe diameter at all points through the valve.

5. A threaded port with pipe plug shall be provided on the bottom of the valve to allow for field installation of a backflow actuator, without special tools or removing the valve from the line.

6. The top access port shall be full size, allowing removal of the disc without removing the valve from the line. The access cover shall be domed in shape to provide flushing action over the disc for operating in lines containing high solids content. A threaded port with pipe plug shall be provided in the access cover to allow for field installation of a mechanical, disc position indicator.

7. The test results shall be independently certified.

B. Materials:

1. The valve body and cover shall be constructed of ASTM A536 Grade 65-45-12 ductile iron.

2. The disc shall be precision molded Buna-N (NBR), ASTM D2000-BG.

3. The exterior and interior of the valve shall be coated with an ANSI/NSF 61 approved fusion bonded epoxy.

C. Accessories:

1. A screw-type backflow actuator shall be provided to allow opening of the valve during no-flow conditions. Buna-N seals shall be used to seal the stainless steel stem in a bronze bushing. The backflow device shall be of the rising-stem type to indicate position. A stainless steel T-handle shall be provided for ease of operation.

2. A mechanical indicator shall be provided to provide disc position indication on valves 4" and larger. The indicator shall have continuous contact with the disc under all operating conditions to assure accurate disc position indication.

D. Manufacturer:

1. The manufacturer shall demonstrate a minimum of 5 years experience in the manufacture of resilient, flexible disc check valves with air and hydraulic cushions.

2. Valves shall be Val-Matic Series 500 Swing-Flex as manufactured by Val-Matic®, GA Industries Figure 200 or equal.

8.17 Vacuum and Air Relief Valves: Vacuum and air relief valves shall be of the sizes shown in the Drawings and shall be a type that will release air and prevent the formation of a vacuum. The valves shall automatically release air from the lines when the lines are being filled with water, and shall admit air into the lines when water is being withdrawn in excess of the inflow. Valves shall be cast iron body, stainless steel float and stainless steel for all other interior metal parts. Valves shall be equipped with an inlet valve and drain valve. Valves shall be Model S20A (2" x 2") as manufactured by Crispin, DeZurik, GA Industries or equal.

Location	*Size*	*Model (Type)*
Influent Force Main	3"	S30AB/SL20B (Comb. Air &Vac. and A.R.V.)
Effluent Pump Station	2"	SL20B (Air release valve)
Reuse Pump Station	2"	SL20B (Air release valve)

8.18 Solenoid Valves: Solenoid valves shall be normally closed and shall open wide to permit full pipe opening when the solenoid is energized and closed tight when the solenoid is de-energized. All parts in contact with the fluid being handled shall be of corrosion resistant

construction. Coils shall be rated for continuous duty and shall be completely encapsulated in epoxy resin.

8.19 Butterfly Valves: All butterfly valves shall be of the tight closing rubber seat type with rubber seats that are securely fastened to the valve disc or valve body. No metal-to-metal seating surfaces shall be permitted. Valves shall be bubble-tight as rated pressures with flow in either direction, and shall be satisfactory for applications involving throttling service and/or frequent operation and for applications involving valve operation after long period of inactivity. Valve discs shall rotate 90° from the full open position to the tight shut position. Valves 20" and smaller shall meet the full requirements of AWWA Standard C-504.

A. Valve Bodies and Flanges: Valve bodies shall be constructed of cast iron ASTM A-126, Class B. Flange drilling shall be in accordance with ANSI B16.1 standard for cast iron flanges. Two trunnions for shaft bearings shall be integral with each valve body. Body thickness shall be in strict accordance with AWWR Standard C-504.

B. Valve Discs: Valve discs shall be constructed of ductile iron or alloy cast iron ASTM A-436, Type I (Ni-Resist).

C. Valve -Shafts: Shafts of all valves shall be turned, ground and polished. Valve shafts shall be constructed of 18-8 Type 304 or Type 316 stainless steel. Shaft diameters must meet minimum requirements established by AWWA Standard C-504. Shafts shall extend into gear reducers with diameters not less than the AWWA minimums.

D. Valve Seats: Valve seats shall be of a synthetic compound. Valves shall have seats that are mechanically retained on the valve disc or simultaneously molded in, vulcanized and bonded to the body. Seat bond must withstand 75 pounds peel strength under test procedure ASTM D-429, Method B.

E. Valve Bearings: Valves shall be fitted with sleeve type bearings. Bearings shall be corrosion resistant and self-lubricating. Bearing load shall not exceed1/5 of the compressive strength of the bearings or shaft material.

F. Valve Packing: Packing shall be self-adjusting Chevron type.

G. Valve Operators: Valve operators shall conform to AWWA C-504. Manual operators shall be of the traveling nut, self-locking type and shall be designed to hold the valve in any intermediate position between fully open and fully closed without creeping or fluttering. Operators shall be equipped with field adjustable mechanical stop-limiting devices independent of the operator case to prevent over-travel of the disc in the open and closed positions. Valves shall close with a clockwise rotation. Operators shall be fully enclosed and designed to produce the specified torque with a maximum pull of 60 pounds on the handwheel or chainwheel. Operator components shall withstand an input of 450 ft. lbs. at extreme operator position without damage.

H. Painting: All surfaces of the valve shall be clean, dry and free from grease before painting. The valve surfaces except for disc, seating and finished portions shall

be evenly coated with a suitable primer to inhibit rust or with asphalt varnish in accordance with Federal Specification TT-V-51c and AWWA Standard C-504.

I. Testing: Hydrostatic and seat leakage tests shall be conducted in strict accordance with AWWA Standard C-504, Section 12.

8.20 Knife Gate Valves: Knife gate valves shall be of the bonnetless type with wafer face-to-face flanged connections. Flanges shall be drilled to the ANSI 125/150 pound standard. Valve ratings shall be 150 psi in sizes 2" through 24" and 125 psi in sizes 30" through 72". Valve bodies shall have wetted parts of Type 304 stainless steel. Valves shall be metal seated with a round port. Valve packing shall be multiple layers of square, braided flax and shall be impregnated with marine or petroleum base lubricants. The packing gland shall be plastic coated. The gate shall have a knife edge with both sides being finish ground. The steni shall be stainless steel and shall have double pitch threads. The valve super-structure shall be fabricated of hot rolled angular steel. The yoke sleeve shall be acid resisting bronzed. Valves 2" to 24" shall have a raised face seat with a relieved area around the seat to prevent jamming. Valves shall be furnished with bevel gear actuators to provide vertical mounting on the handwheel. Yoke height and stern lengths to be as necessary to provide handwheel locations as shown on the Drawings.

8.21 Swivel Joint: Swivel joint for sludge supernatant decant line shall be a low pressure swivel joint capable of 360° rotation in one plane. The joint shall be fabricated of standard schedule 40 steel pipe with two rows of ball bearings in ground, flame hardened ball races. Bearing and races shall be sized to adequately handle all movement, thrust and radial loads. Joint seals and materials shall be selected by the manufacturer to suit the intended use conditions. Joint shall be a greaseless connection, and accepting remote lubrication line shall not be required. Swivel joint shall be the Style No. 40 Chicksan Standard Low Pressure Swivel Joint as manufactured by FMC Corporation, Fluid Control Division, Union Swivel or equal.

8.22 Aluminum Gates:

A. Slide Gates: The fabricated aluminum slide gates will be self-contained, rising stem with the guides designed to embed in the concrete or to mount to the face of the concrete. Gates will be manufactured by Rodney Hunt Company, Waterman Industries or equal.

1. The guides will be of extruded aluminum incorporating a dual slot design. The primary slot will accept the plate of the disc and the secondary slot will be sufficiently wide to accept the reinforcing ribs of the disc. The guides shall be designed for maximum rigidity, and will be provided with keyways to lock it into the concrete. The invert of the frame will be an angle welded to the lower ends of the guides to form a seating surface for the resilient seal mounted on the disc.

2. Where the guides extend above the operating floor, they shall be sufficiently strong so that no further reinforcing will be required. The yoke to support the operating bench-starid will be formed by two angles or channels welded at the top of the guides to provide a one-piece rigid frame. The arrangement of the yolk will be such that the disc and stem

can be removed without disconnecting the yoke. The design of the yoke will be such to limit its deflection to 1/360 of its span under full operating load.

3. The disc or sliding member will be of aluminum plate reinforced with "U" shaped aluminum extrusions welded to the plate. The disc will not deflect more than 1/360 of the span of the gate under the design head. Reinforcing ribs will extend into the guides so that they overlap the seating surface of the guide.

4. A specially molded resilient seal will be mounted on the bottom of the disc to provide flush-bottom closure. The shape of the seal will produce a seating surface having a minimum width of ¾" and the seal will extend into the secondary slot of the guide. The vertical face of the seal will be in contact with the seating surface of the guide to provide a proper seal at the corners.

5. Operating of the gate will be by means of a wheel or crank operated bench stand mounted on the yoke of the gate. The operating stems will be Type 303 or 304 stainless steel designed to have L/r of less than 200 and to withstand in compression at least twice the rated output by means of a cast aluminum stem connector bolted to the stem and welded to the disc.

6. All necessary attaching bolts and anchor bolts will be stainless steel and will be furnished by the slide gate manufacturer.

B. Weir Gate: The fabricated aluminum weir will be self-contained, rising stem with the guides designed to mount to the face of the concrete, and extend below the invert of the opening. The gate will be designed to lower to open and will be manufactured by Rodney Hunt Company, Waterman Industries or equal. Construction of the weir gate will be as specified for the slide gate, with the following exceptions:

1. The invert angle and invert seal are not required.

2. A specially molded resilient J-seal will be placed along the invert and up the sides so that the gate will be tight in the fully raised position and all of the flow will be over the disc in partially opened positions. The seal will be mounted on an embedded aluminum frame.

8.23 Flap Valves: Flap valves shall be flat back type for mounting with anchor bolts in the wall. The body and flap shall be of cast iron, ASTM A126-B, with 2 cast iron pivot links. Each link shall have two pivot points; an adjustable lower flap valve sensitivity. Valve shall have dovetailed bronze seating faces, bronze bushings and stainless steel fasteners.

8.24 Shear Gates: All shear gates shall have iron bodies with standard frames and shall be mounted on wall pipes. Furnish extension handle with lugs and wall loop.

8.25 Sluice Gates: Sluice gates shall be cast iron, bronze mounted, rising stem, flat back, and flush bottom sealing. All gates shall be equipped with necessary wedges and wedge

blocks and shall be reinforced to safely withstand 20' of seating head and 5' of unseating head. Gates shall be as manufactured by Rodney Hunt, Waterman Industries or equal.

A. Frame: Frame shall be of cast iron, one piece construction, with rectangular opening as indicated. The frame shall have machined dove-tail grooves on the front face into which bronze seat facings shall be driven and then machined. The back of the frame shall be machined and drilled to bolt directly to the machined face of a wall thimble. The number of bolt holes and bolts required in the gate for attachment to thimbles shall be as required by design head conditions.

B. Disc: The disc shall be cast iron, one-piece construction, rectangular with integrally cast vertical and horizontal ribs. A reinforcing rib along each side shall be provided to insure rigidity between the side wedges. The disc shall have machine dove-tailed grooves on the seating face into which bronze seat facings shall be driven and then machined. Wedges pads, when required, shall be cast integrally on the disc and then machined to receive the adjustable bronze wedges. A heavily reinforced nut pocket shall be cast integrally on the vertical centerline and above the horizontal center to receive the thrust nut.

C. Guides: The guides shall be of cast iron, one-piece, designed to withstand the total thrust due to the water pressure and the wedging action. The guides shall be machined on all contact surfaces. The guides shall be of such length as to retain and support at least ½ of the disc in the full open position.

D. Wedges: The wedges shall be solid cast bronze, machined on all contact surfaces and keyed to the cast iron pads to maintain adjustment by preventing undersirable rotation or lateral motion. They shall be attached to the disc with silicon bronze studs and nuts.

E. Seat Facings: All seat facings shall be malleable extruded bronze of a composition which will resist dezincification and shall increase in wearing ability with cold working.

F. Stems: Operating stems shall be of stainless steel. The stem shall be designed to safely transmit in compression at least twice the forces created during gate operation under the unbalanced heads specified. The threaded portion of the stem shall have machined cut or rolled threads of the Acme type. Stems of more than one section shall be joined by stainless steel couplings threaded and keyed, or bored and pinned to the sterns. All threaded and keyed couplings of the same size shall be interchangeable. Gates shall be provided with an adjustable stop collar on the stem above the floor stand lift nut.

G. Stem Guides: Stem guides shall be cast iron, bronze bushed, mounted on cast iron brackets. They shall be adjustable in two directions and shall be spaced at sufficient intervals to adequately support the stem. Stem guide spacing shall not exceed 7', or an L/r ratio of 120.

H. The flush bottom closure type of gate shall have a compressible resilient seal attached to the bottom of the disc (sliding member) or to the gate frame in the invert with a bronze or stainless steel bar and bronze or stainless steel fasteners.

The seal shall be shaped to produce a wide sealing area on a machined surface on the frame invert or on a rounded projection on the bottom of the disc.

I. Wall thimbles shall be of 'IF" type section and of depth not less than the thickness of the wall in which they are installed. They shall be cast iron, one-piece construction, of adequate section to withstand all operational and reasonable installation stresses. Wall thimbles shall be internally braced during concrete placement. A center ring or water stop shall be cast around the periphery of the thimble. The front flange shall be machined and have tapped holes for the sluice gate attaching studs and metal-stamped vertical centerlines with the word "top" for correct alignment. The opposite end of the wall thimbles shall be machined to provide the exact depth specified. A permanent gasket of uniform thickness shall be provided between the sluice gate and the wall thimble.

J. Crank operated floorstand operator shall have 2 to 1 gear reduction. Operator shall be provided with a threaded lift nut to engage the operating stem. All components shall be totally enclosed in a cast iron case and cover. Fittings shall be provided for the lubrication of all gears and bearings. Floorstands shall include a cast iron pedestal to position the crank shaft approximately 36" above the operating floor. An arrow with the word "Open" shall be permanently attached or cast on the floorstand indicating the direction of rotation to open the gate. Each floor stand shall be provided with a clear plastic stem cover for visual indicating of gate position.

8.26 Floor Stands and Extensions Stems: Floor stands, unless otherwise specified or directed, shall be of the non-rising stem type equipped with a suitable indicator to show at all times the position of the valve and shall be fitted with handwheels of proper size for easy operation. In no case shall more than a 40-pound pull on the crank of the handwheel be required for valve operation. Extension stems shall be designed for non-rising stem valves and shall be equipped with stem guides and handwheel. Suitable anchor bolts shall be furnished with all stem guides. All floor stands shall be set plumb with the operating stem and shall bear evenly on the base plate and masonry. The floor stand or base plate shall be grouted in place as required for a proper installation.

8.27 Wall Sleeves: Where piping connects with, or passes through, concrete walls, furnish and install wall sleeves of cast iron, as specified in these Specifications. Pipe shall run continuous through walls. Formed openings in concrete walls for inserting cast iron piping will not be allowed. Wall sleeves shall be accurately located and securely fastened in place before concrete is placed. In a similar manner, wall sleeves shall be used in locations where small piping and electric wiring connects to, and passes through, concrete walls. Wall sleeves shall be furnished with water stops.

8.28 Pipe Couplings: Pipe couplings for cast iron pipe shall be of gasketed, sleeve type, with diameter to properly fit the pipe. Each coupling shall consist of 1 steel middle ring, 2 steel followers, 2 rubber-compounded wedge section gaskets, and sufficient track-head steel bolts to properly compress the gaskets. Couplings shall be Dresser Style 38, Rockwell Series 411 or equal.

A. The middle ring and followers of the coupling shall be true circular sections free from irregularities, flat spots, or surface defects. They shall be formed from mill

sections with the follower-ring section of such design as to provide confinement of the gasket.

B. Coupling bolts shall be of the elliptic-neck track-head design with rolled threads. All bolt holes in the followers shall be oval for greater strength.

C. Baskets shall be composed of crude or synthetic rubber base compounded with other products to produce a material which will not deteriorate with age, from heat, or exposure to air under normal storage conditions. It shall also possess the quality of resilience and ability to resist cold flow of the material so that the joint will remain sealed and tight indefinitely when subjected to shock, vibration pulsation, and temperature or other adjustments of the pipe line.

8.29 Flanged Adaptor: Contractor shall furnish and install cast iron flange adapters to joint plain-end pipe to flanged pipe where shown on the Drawings. Adapters shall be manufactured to meet ASTM A-126, Class B, cast-iron. Flange end of adapter shall mate with ASA 16.1 and B16.5 flanges of the same nominal size. Adapters shall be locking type with special high-strength steel pins. Adapters shall be Style 128 as manufactured by Dresser Manufacturer Division, Mega Flange Series 2100 or equal.

8.30 Backflow Preventer: A double check valve assembly shall be installed at each noted location. The assembly shall consist of 2 positive seating check modules with captured springs and rubber seat discs. The check module seats and seat discs shall be replaceable. Service of all internal components shall be through a single bronze or stainless steel access cover secured with stainless steel bolts. The assembly shall also include 2 resilient seated isolation valves; four top mounted, resilient seated test cocks. The assembly shall meet the requirements of ASSE Std. 1015 and AWWA Std. C510. Assembly shall be a Watts Series 007. Heated enclosures shall be insulated aluminum. The enclosure shall be WattsBox by Watts or equal sized to suit backflow preventer.

8.31 Hose Bibs: Hose bibs shall be furnished and installed where shown on the Drawings and shall be ¾", non-freeze type with brass casings and T-handle. Furnish one quick female coupling hose fitting for each hose bib.

8.32 Wall Hydrants: Wall hydrants-shall be cast brass, non-freeze with 1" HPT outlet, T-handle, polished face, brass wall casing, renewable nylon seat, and brass operating parts. Wall hydrants shall be Josam Model 71000-8, Wade Model W8600L6+2 or equal.

8.33 Yard Hydrants: Yard hydrants shall be 1" post hydrant with galvanized casings ¾" inlet and discharge hose connections, non-freeze with vacuum breaker and sanitary siphon drain system. Yard hydrants shall be Josam Model 71400, Wade Model 8610 or equal.

8.34 Clearing: The Contractor shall perform all clearing work required for the installation of the complete work. Clearing shall consist of the removal and disposal of all trees, stumps, roots, brush or debris in the way of the work.

A. Any private or public facilities, including fences, removed for construction purposes shall be promptly replaced. Trees or shrubbery along highways, roadways, and streets shall not be disturbed unless absolutely necessary, subject to the approval of the Engineer. Any such trees or shrubbery which may be

necessary to be removed shall be heeled in and replanted. Heeling in and replanting shall be done under the direction of an experienced nurseryman.

8.35 Excavation for Trenches: Excavation of pipe trenches shall include all excavation of every description and whatever substance encountered and shall include disposal of all rock excavation and shall include disposal of excess earth excavation not required for backfilling of trenches.

A. Depth of Trenches: The minimum cover over the top of the pipe shall be 4' unless otherwise directed by the Engineer. Where obstructions are encountered, minimum depth may be changed to avoid interference.

B. Width of Trenches: Trenches shall be excavated sufficiently wide to allow proper installation of pipe, fittings and other materials, and to not less than 6" clear of the outside barrel of the pipe on any side at any point.

C. Bell Holes: Bell holes of ample depth and width shall be excavated in pipe trenches at the location of each joint to permit the joint to be properly made.

D. Earth Excavation: Earth excavation shall include all excavation of whatever substance encountered, except rock excavation, as further provided for in these Specifications. In locations where pipe is to be bedded in earth excavated trenches, the bottom of such trenches shall be fine graded to allow firm bearing for the bottom of the pipe on undisturbed earth. Where any part of the trench has been excavated below the grade of the trench, the part excavated below such grade shall be filled in with bank sand and compacted at the Contractor's expense.

E. Rock Excavation: Rock excavation shall comprise solid rock in the original bed, or in well defined ledges, the removal of which in the opinion of the Engineer requires drilling, blasting, or the use of jack hammers or bottle points, and shall also include boulders or detached pieces of rock 8 cubic feet or more in content.

1. Blasting operations shall be conducted in strict accordance with all blasting ordinances and regulations and all blasting shall be done as directed by the Engineer. All exposed structures shall be carefully protected from the effects of blast and all blasts shall be covered with heavy timbers, mats or suitable protection. The blasting shall be done only by experienced men. Very light charges must be used to prevent damages to adjacent structures.

2. No blasting operations shall be started without the Engineer's approval of method and quantity of explosive to be used. Any damage done shall be promptly repaired by the Contractor at his own expense. Where there are no local ordinances governing blasting and the storage of explosives, all blasting supplies shall be stored in a manner approved by the Engineer and a watchman shall be stationed at all times at the place of storage. In no case shall caps or other explosives be kept at the place where dynamite or other explosives are stored.

8.36 Existing Pipe Lines: Where new pipe line parallels or crosses existing pipe lines, the Contractor shall take precautions as necessary to insure that such existing pipe lines are

not disturbed. Any damage to existing pipe lines shall be promptly repaired at the Contractor's expense.

8.37 Connections to Existing Pipe Lines: Connections to existing pipe lines shall be made with the necessary fittings and valves as indicated on the drawings.

A. Location: The Contractor shall, before opening pipe line trenches, locate the various points of connections to be made into existing pipe lines and shall uncover as necessary for the Engineer to prescribe the type of connections and fittings to be installed.

B. Interruption of Service: Connections to existing pipe lines shall be made only at such times and in such manner as will meet operating requirements. No cut shall be made in existing lines until the permission of the Owner's Superintendent of Utilities has been obtained as to time and manner of making the cuts and connections. All existing vales shall be operated only by authorized representatives of the Owner.

8.38 Existing Underground Utilities and Obstructions: Certain existing water lines, culverts and cross drains are shown on the Drawings, according to the best information available to the Engineer. The Drawings indicate the pipe lines to be laid over, under or around underground utilities or obstructions where such utilities or obstructions are known to exist. Where these or unforeseen underground utilities or obstructions are encountered, minimum depth of cover, or the location and alignment, may be changed, upon written approval of the Engineer, to avoid interference. The location of the existing utilities are approximate only. The Contractor is responsible for determining the exact location of all utilities before beginning construction.

A. The Contractor shall furnish and have available at all times an Electronic Pipe and Cable Finder in working order, for the purpose of locating existing pipe lines or other obstructions in the way or are along the route of the new work.

8.39 Additional Trench Depth: Where necessary to increase the minimum depth of cover to avoid interference with underground utilities, obstructions and utilities services, the Contractor shall furnish all construction equipment and shall perform all labor required for additional trench depth, as authorized by the Engineer.

A. Authorization: All authorization for performing work for additional trench depth shall be issued in writing.

B. Delay: Any delay or extra cost due to encountering underground utilities mains, obstructions and utilities services not shown on the Drawings or found in locations different from those shown on the Drawings shall not constitute a claim for additional payment, except as provided for payment for authorized additional trench depths.

8.40 Removing Pavement: The Contractor shall remove pavement as necessary for installing the new pipe lines and appurtenances and for making connections to existing pipe lines.

A. Marking: Before removing any pavement, the pavement shall be marked for cuts nearly paralleling pipe lines and existing street lines. Pavement shall be cut back from the top edges of trenches for a distance of at last 12" on each side of the

trench to provide solid bearing for the edges of pavement to be replaced. Tunneling will be permitted under existing sidewalks, curbs and gutters, but not under pavement.

1. Power saws shall be used to cut all types of pavement along marked lines. The pavement shall be sawed to a depth of at least 2" or deeper if the Engineer so directs. "Sawing" is not a separate pay item and the cost thereof shall be included in the overall bid submitted.

B. Machine Pulling: No pavement shall be machine pulled until completely separated along the marked cuts.

C. Damage to Adjacent Pavement: The pavement adjacent to pipe line trenches must not be disturbed or damaged. If the adjacent pavement is disturbed or damaged due to any cause, such as caving ditch banks, indiscriminate use of construction machinery, etc., the Contractor shall remove the damaged pavement and shall replace at his own expense.

D. Stone or Pre-Cast Concrete Curb: The Contractor shall remove and replace or tunnel under any stone or pre-cast concrete curb encountered. No additional payment will be made for removing, replacing or tunneling under said curb.

8.41 Concrete Blocking: The Contractor shall furnish all materials and perform all labor as necessary for installing concrete blocking for fittings, including elbows, tees, and other fittings as shown on the drawings and/or as specified herein.

A. Concrete blocking shall be formed and poured at the backs of fittings, including elbows, tees, and other fittings as shown on the Drawings and as directed by the Engineer. Concrete mix shall be 1:2-1/2:3-1/3, and have a compressive strength of not less than 2500 psi after 28 days. Blocking shall be poured against undisturbed earth.

8.42 Backfilling: The Contractor shall furnish all equipment and labor, and when necessary, the material required for backfilling the pipe line trenches as follows:

A. Backfill shall be placed in two stages. First, sidefill to the level 1' over the top of pipe; and second, overfill to former surface grade. Sidefill should consist of granular material laid in 6" layers, each consolidated by mechanical tamping and controlled addition of moisture, to a density of 95% as determined by AASHO Method T-99 or GHD-7. Overfill should be layered and consolidated to match the entrenches material in cohesion and compaction. The top 12" shall be compacted to 100% of specified density. Consolidation by saturation or ponding will not be permitted. For backfill of entrenched pavement, materials and methods of compaction should be adapted to achieve prompt restoration of traffic service. There shall be additional cutback of base and surfacing and transitioning of trench shoulders to minimize later development of sag in the grade of pavement of the trench.

B. When testing for leaks in open trenches, backfilling shall not be done until after all testing has been completed and all leaks eliminated.

8.43 Testing and Cleaning Sewer and Drain Lines: Before acceptance of any sewer or systems of sewers, lines shall be cleaned and tested in accordance with these Specifications. Where any obstruction is met, the Contractor will be required to clean the sewers by means of rods, swabs, or other instruments. Lines and manholes shall be clean before final inspection. Pipe lines shall be straight and shown a uniform grade between manholes. The Contractor shall be required to correct any variations therefrom which may be disclosed during the inspection.

No extra payment will be made for testing and cleaning.

8.44 Leakage Tests: All sewer lines, including house service lines, shall be tested for leakage, in the presence of the Engineer or his representative, before being placed into service. Tests shall be conducted by the low pressure air test method:

A. Low-Pressure Air Test: Low pressure air testing shall be performed in accordance with ASTM F1417 or UNI-B-6-90, as amended to date. Prior to air testing, the section of sewer between manholes shall be thoroughly cleaned and wetted. Immediately after cleaning or while the pipe is water soaked, the sewer shall be tested with low-pressure air. At the Contractor's option, sewers may be tested in lengths between manholes or in short sections (25' or less) using air-lock balls pulled through the line from manhole to manhole. Air shall be slowly supplies to the plugged sewer section until internal air pressure reaches approximately 4.0-psi. After this pressure is reached and the pressure allowed to stabilize (approximately 2 to 5 minutes), the pressure may be reduced to 3.5-psi before starting the tests. If a 1.0 psi drop does not occur within the test time, then the line has passed the test. If the pressure drops more than 1.0 psi during the test time, the line is presumed to have failed the test, and the contractor will be required to locate the failure, make necessary repairs and retest the line. Minimum test time for various pipe sizes, in accordance with Uni-Bell PVC Pipe Assoc. UNI-B-6-90, as amended to date, is as follows:

1. Specification Time required for a 1.0 PSIG Pressure Drop for Size and Length of Pipe Indicated for Q = 0.0015

Pipe Diameter	Minimum Time (minutes:second)	Length for Minimum Time	Time for Longer Length (second)
4"	3:46	597'	0.380
6"	5:40	398'	0.854
8"	7:34	298'	1.520
10"	9:26	239'	2.374
12"	11:20	199'	3.418
15"	14:10	159'	5.342
18"	17:00	133'	7.692
21"	19:50	114'	10.470
24"	22:40	99'	13.674

Required test equipment includes air-lock balls, braces, air hose, air source, timer, rotometer as applicable, cut-off valves, pressure reducing valve, 0-15 pressure gauge, 0-5 pressure gauge with gradations in 0.1 psi and accuracy of ± 2%.

The Contractor shall keep records of all test made. Copy of such records will be given to the Engineer or the Owner. Such records shall show date, line number and stations, operator and such other pertinent information as required by the Engineer.

The Contractor is cautioned to observe proper safety precautions in performance of the air testing. It is imperative that plugs be properly secured and that care be exercised in their removal. Every precaution shall be taken to avoid the possibility of overpressurizing the sewer line.

B. Repairs: All visible leaks shall be repaired regardless of whether the air test is within allowable limits. No sewer will be accepted until leakage tests demonstrate compliance with the leakage test method.

C. Payment: The Contractor shall furnish all materials, labor and equipment and necessary for testing and retesting as required and shall make all necessary repairs. No extra payment will be made for testing and repairs, the cost thereof to be included in the unit prices bid for sewers.

8.45 Testing Force Main: When a section of force main of a length deemed adequate by the Engineer is ready for testing, the line shall be filled with water, air completely exhausted and a leakage test made. The Contractor shall furnish all labor, materials and equipment for carrying out these tests. Wherever conditions will permit, in the opinion of the Engineer, pipe lines shall be tested before the trench is backfilled. All joints then shall be examined during open trench test and all leaks entirely stopped. The Contractor shall furnish a test pump, and means for accurate measurement of water introduced into a line during testing, and shall furnish and install corporation stops in the line as required for blowing lines free from air and at the test pump location.

A. The Contractor shall furnish, install and remove all temporary bulkheads, flanges or plugs, to permit the required pressure tests, and shall furnish all equipment and labor to properly carry out such tests and to replace defective material.

B. Force main shall be tested in accordance to AWWA C600 for ductile iron mains and AWWA C605 for PVC mains, except as specified otherwise herein. Test pressures shall be 100 pounds per square inch. Allowable leakage in gallons per hour per 1,000' of pipe line shall not exceed 0.045 D (D is the nominal pipe diameter in inches). Minimum test period shall be 2 hours; however, if in the opinion of the Engineer, additional testing is required, such additional testing shall be performed by the Contractor at no additional expense to the Owner.

C. Any cracked or broken material shall be removed and replaced with sound pieces, at the expense of the Contractor. Joints which leak shall be carefully remade. Remade joints and replace material shall be carefully re- tested under the same conditions of operation. If joints or materials are then found to be defective, they shall be remade and replace until the line passes the required test.

D. Payment: No separate payment will be made for the above work.

8.46 Testing Potable Water Lines and Chemical Lines: When a section of pipe of a length deemed adequate by the Engineer is ready for testing, the line shall be throughly blown free from air and a leakage test made, and the Contractor shall furnish all labor, materials and equipment for carrying out these tests. Wherever conditions will permit, in the opinion of the Engineer pipe lines shall be tested before the trench is backfilled. All joints then shall be examined during open trench test and all leaks entirely stopped. The Contractor shall furnish a test pump and means for accurate measurement of water introduced into a line during testing, and shall furnish and install corporation stops at all high points in the line as required for blowing lines free from air and at the test pump location.

A. Temporary Bulkheads: The Contractor shall furnish, install and remove all temporary bulkheads, flanges or plugs, to permit the required pressure tests, and shall furnish all equipment and labor to properly carry out such tests and to replace defective material.

B. Test Pressure and Leakage: Test pressures shall be 200 pounds per square inch. Leakage allowed during the test per thousand feet of pipe shall be:

- 4" - .43 gallons / hour
- 6" - .64 gallons / hour
- 8" - .85 gallons / hour
- 10" - 1.06 gallons / hour

C. Minimum test period shall be 2 hours. However, if, in the opinion of the Engineer, additional testing is required, such additional testing shall be performed by the Contractor at no additional expense to the Owner.

8.47 Sterilizing Potable Water Lines: All pipe lines and all appurtenances which have been exposed to contamination by reason of this construction shall be sterilized by the Contractor before being placed in service subject to the approval and direct supervision of the Engineer.

A. Sterilization: Pipe lines shall remain filled for a 24-hour period with a solution of water and chlorine in amounts to provide a free chlorine residual of not less than 25 mg/l. Disinfection of the new main and the disposal of the heavily chlorinated water following disinfection shall be accomplished in accordance with the latest edition of AWWA Standard C651. The quality of the water used during the disinfection procedures shall meet the required drinking water standards. The heavily chlorinated water shall be retained in the main for at least 24 hours during which time all valves and hydrants shall be operated to ensure disinfection of the appurtenances. At the end of the 24-hour period the treated water in all portions of the main shall have a residual of not less than 10 mg/l free chlorine.

1. The Contractor shall obtain bacteriological analysis of samples of water taken from the distribution system which are satisfactory to the Engineer before the line will be accepted by the Owner. The Contractor shall

furnish all liquid chlorine required for sterilization and shall furnish all equipment and labor required for the work and shall provide for the bacteriological test which will be paid for by the Owner.

B. Flushing: Upon completion of the sterilization, all mains and piping shall be thoroughly flushed before placing in service. All chlorinated water shall be disposed of in a procedure acceptable to the Georgia Environmental Protection Division. The heavily chlorinated water must not be disposed in a manner that will harm the environment. Neutralizing chemicals such as sulfur dioxide, sodium bisulfite, sodium sulfite or sodium thiosulfate can be used to neutralize the chlorine residual remaining in the water to be wasted. Flush all lines until residual is equal to existing system. After final flushing and before the water main is placed into service, water samples shall be collected from the main and tested for microbiological quality in accordance with Georgia Rules for Safe Drinking Water, Chapter 391-3-5. The laboratory results must show the absence of coliform organisms in the water. Reflux and redisinfect the lines as necessary until satisfactory bacteriological results are obtained.

8.48 Connections to Structures: At all structures, including manholes, provide a flexible joint no more than 24" from the face of the structure. It shall be the responsibility of the Contractor to submit details of the proposed connection to the Engineer for approval. Connections not approved will be subject to removal and replacement by an approved flexible joint.

8.49 Pipe Insulation and Heat Tracing: Exterior pipe and fittings, where indicated on the Drawings, shall be insulated and heat traced as follows:

A. Pipe insulation shall be 1" thick formed cellular glass insulation weighing 8 to 10 pounds per cubic foot. The insulation shall be specifically shaped for use with pipes, shall be formed true to shape and roundness, shall exhibit negligible water absorption and shall have a "k" value of not less than 0.3813 tu/hr/sf at 50 degrees F. The insulation shall be installed and jacketed with dry aluminum foil 4 mils thick in accordance with directions of the manufacturer.

B. Heating cable shall be rated at a constant 4 watts per foot at 120 V and shall be P.V.C. sheathed. Cable shall be U.L. listed and shall be installed with thermostat in complete accordance with manufacturer's instructions. Heating cable shall be Emerson Model NC4 or Chromolox Model CWM 4-1CT or equal.

8.50 Cleaning Up: Before the work shall be considered complete, all material not used, and rubbish of every character, must be removed from the streets and placed at some point to be designated by the Owner; and all streets, sidewalks, curbs, fences and other private or public facilities and structures disturbed must be essentially in as good condition as existed before the work was done. Any subsequent settlement of backfill or pavement over trenches -shall be replaced by the Contractor and the surfaces brought to grade.

8.51 Payment: No separate payment will be made for the work of this Section. The cost of the work and all cost incidental thereto shall be included in the bid in the Proposal. Rock excavation is unclassified for all work. Payment for the complete work shall be made

upon the basis of measured or completed quantities actually installed at the unit prices bid in the Proposal.

A. Fittings for extra work shall be paid for on the basis of the published weights of the fittings itself exclusive of followers rings and gaskets.

B. Lump sum items will be paid at the price bid in the Proposal or as specified.

SECTION 9
BUILDING AND BUILDING SERVICE EQUIPMENT

9.01 General Requirements:

A. Scope: The Contractor shall furnish under this section all labor, material, tools and equipment for, and erect all building structures complete as herein specified and as shown on the Drawings.

B. Materials and Workmanship:

1. All materials furnished and used under this section shall be specified, or if not particularly designated, shall be of the best of their respective kinds.

2. Workmanship shall be first class in all respects. Neat and workmanlike appearances in the finished work will be required.

3. All work shall be done in accordance with all pertinent codes, laws, and regulations. Where gauges are shown, these shall be U.S. Standard for all metals except aluminum, which shall be "B and S."

4. Where Contractor's or manufacturer's detail drawings are called for herein, these shall be from measurement of structures as built and to which the several materials may apply.

C. Color Requirement: Within 60 days of the "Notice to Proceed," the Contractor shall submit a complete set of color samples for each product in these Specifications, requiring color selection, to the Engineer for selection.

9.02 Concrete Work and Steel Reinforcement:

A. All concrete work and steel reinforcement required as part of the work to be performed under this item shall be in accordance with the applicable provisions of "Concrete Work" and "Reinforcing Steel, Structure Steel, and Miscellaneous Metal" Sections of these Specifications. The Contractor shall grout all column bases, beams, and other structural members, to their correct elevation.

B. Sleeves for all waste and water lines and all other plumbing and pipelines, all electrical lines, floor drains, etc., passing through concrete floors and roofs shall be provided and set in accordance with applicable items specified elsewhere in these Specifications.

C. All metal wheel guards, angle guards, etc. which are anchored or embedded in concrete shall be installed properly before the concrete is poured.

9.03 Concrete Block Masonry: The Contractor shall furnish and place all blockwork required as shown on the Drawings or as required for the proper completion of this item inclusive of common blockwork and exterior architectural blockwork together will all ties and all pointing and cleaning.

A. Products:

1. Concrete masonry construction shall conform to all requirements of "Specification for Concrete Masonry Construction (ACI-531.1-76)" as

published by ACI except as modified by supplemental requirements below.

2. Concrete block masonry shall be furnished and installed at the places and in the manner shown on the Drawings and as required for the proper completion of this item of the work.

3. Concrete masonry shall be made of hollow loadbearing units meeting the requirements of the latest ASTM Standard Specification C 90 for Grade A units. Cinder blocks will not be accepted. Exterior face of perimeter walls shall be architectural or split face standard gray color. Optional color samples shall be submitted for selection by the Owner. If the Owner chooses an optional color, the Owner will pay for the difference in cost between standard gray and optional color selected. All interior block shall be standard smooth face block. All masonry units shall be obtained from one supplier whose manufacturing and curing facilities must be approved by the Engineer.

4. Masonry units shall be 8" × 16" nominal face size, and of nominal thickness as indicated on the Drawings.

5. Masonry cement for all blockwork shall conform to ASTM Specifications C-144 and sand shall be white in color. If Owner chooses an optional color, pigment shall be added to the mortar to match block color.

B. Wall Reinforcement:

1. Wall reinforcement shall be standard reinforcement truss design for block wall construction with No. 9 gauge, deformed galvanized side rods and No. 9 gauge galvanized continuous cross rods. Out to out spacing of side rods shall be approximately 2" less than the nominal thickness of the wall or wythe. Wall reinforcement shall be as manufactured by Dur-O-Wal, AA Wire Products Co., Wire-Bond or equal. Reinforcement shall be placed in first and second bed joint (8" c. to c.) above and below openings, as specified above, and in every second bed joint (16" c. to c.) throughout the remainder of the wall.

2. Reinforcement in the first bed joint immediately above and below openings shall be continuous. In the second bed joint, it shall extend 2' beyond each side of the opening. Reinforcing shall be lapped a minimum of 6" at splices. Corner and abutting wall reinforcement shall be prefabricated corner and tee sections. Wall ties of at least 16-gauge galvanized metal and of quality known as "Dovetail" masonry anchors or equal shall be used in all cases where blocks are laid against concrete and where proper bonding of courses cannot otherwise be obtained as elsewhere required by the Engineer.

C. Execution:

1. Prior to starting blockwork if optional color block is to be selected, Contractor shall lay up sample panels of block using various shades of

mortar as directed by the Engineer. Mortar color shall be of an approved type that is compatible with the brand of masonry cement used.

2. Block shall be laid in all cases from scaffolds erected on the exterior side of the wall. No overhand work will be permitted. All exposed joints shall be ⅜", finished brick shall be delivered thoroughly protected against chipping, and in no case will chipped brick be permitted to remain installed in walls.

3. Blocks shall be laid in running bond with ⅜" joints horizontal and vertical. The masonry units shall be struck flush with the block face. It shall then be firmly compacted with a tooling joint. Full mortar bedding shall be used on the first course on the concrete base. Interior walls shall be of the thickness shown on the Drawings and laid as specified above. Provide "bull-nose" units at exterior corners where partitions intersect at right angles and at other locations where edge of block is exposed.

4. Walls shall be reinforced as detailed on the Drawings. Where vertical bars are required cells shall be completely filled with 3,000 pounds of concrete.

5. All metal doorframes, exterior and interior, shall be set plumb, square and braced before masonry wall construction is started. Masonry anchors shall be placed as specified by doorframe manufacturer, during masonry wall construction, to properly anchor doorframes. All metal doorframes shall be filled with grout.

6. Reglets shall be left in blockwork where required for the installation of sheet metal work or expansion joints where shown or specified.

7. The Contractor shall build in all flashing and lintels as shown, specified or required.

8. The Contractor shall lay out his own blockwork. All anchor bolts and wood blocks shall be built in and chases, slots, sleeves or openings shall be built into the walls as the work is performed, where required for wall plates, beams or other ironwork, piping, electric wiring, heating or ventilating pipes, ducts or equipment. A neat finish shall be made around all slots or openings. Whenever block masonry is left for the night or is left unfinished for any reason, the masonry must be raked off or toothed, as directed, and all mortar removed from the exposed surface of the block. All work shall be covered with tarred felt or polyethylene after each day's work.

9. Upon completion, the Contractor shall clean down all exposed surfaces of blockwork removing all dirt and mortar stains, raking out all loose joints and repointing the same to give the appearance of the original joint, also pointing in against work of other items that has not been completed, and making the completed installation free from defects, thoroughly watertight and satisfactory to the Engineer. The use of sapolio or wire brushes in cleaning down of blockwork is positively forbidden. Dilute muriatic acid

and a fiber brush shall be used for cleaning down masonry walls. Walls shall be thoroughly rinsed off during cleaning operations.

9.04 Miscellaneous Metals: Contractor shall furnish all bolts, nuts, anchor bolts, plates, anchors, ties, clamps, hangers, nails, spikes, screws, straps, toggle and expansion bolts and other items of rough hardware of sufficient size and number to tie together the various parts of the building and secure all of its parts in place. Such miscellaneous items shall be of same material as metals they contact.

A. Materials:

1. Bronze and Aluminum: All bronze and aluminum shall be close-grained, tough metal, with planes, angles and corners true and out of wind. The work shall be free of blowholes, flaws, and other defects.

2. Cast Iron: All castings shall be tough gray iron, of uniform thickness and free from blowholes and other defects, cast true to pattern and finished in a workmanlike manner.

3. Steel: All structural shapes and plates shall conform to Standard Specifications for Structural Steel for Buildings as adopted by the American Society for Testing Materials,

4. Wrought Iron: Wrought iron shall be tough, fibrous and have uniform quality.

B. Fabrication:

1. All work shall be laid out, cut and assembled by mechanics skilled in the fabrication of the different metals required so that the work will present a neat, satisfactory appearance in the building. Measurements shall be accurate, cutting true in line, joints tight and secure, all in accordance with the best practice in modern fabricating shops.

2. When the cutting torch is used, the burned edges of the metal shall be milled to dimension. All exposed edges of metal shall be milled smooth and straight.

3. All required holes shall be drilled or punched, not cut with the torch. Punching or drilling shall be accurately done and any holes not matching shall be reamed and not drifted.

4. Welding shall be done with electric arc equipment and executed in accordance with the "Code for Fusion Welding in Building Construction" of the American Welding Society. The welding electrode shall conform to American Welding Society Specifications Class E-40. Welding joints in metal cut with torch shall have the scale and burned metal ground or stripped back to bright metal before welding. All welded joints that will be exposed to view shall have the welds formed so the joint can be and shall be ground smooth. Unless otherwise specifically noted for items specified hereinafter, exposed welds shall be ground smooth so that connected surfaces are true to place, of same texture and generally imperceptible.

5. Should it be necessary to use cutting torch or welding arc on the inside of the building, the Contractor shall provide adequate fire extinguishers and other protective devices at the location of the work before any cutting or welding is started.

C. Joints in Metal Work: All jointing of metal members shall be designed to develop the full strength of the members at the connection. Where members are bolted together, not less than two (2) bolts are to be used for each connection, unless otherwise noted.

D. Galvanizing: Any items specified under this Section to be hot-dip galvanized shall conform to the following:

1. Rolled, pressed, or forged steel shapes, or steel plates, bars, or strips, ⅛" thick and heavier shall meet the requirements of ASTM Designation A 123-59.

2. Bolts and other fasteners shall meet the requirements of ASTM Designation A 153.

3. Iron or steel sheets lighter than 1/8" thickness shall meet the requirements of ASTM Designation A 93- 59T.

4. If the Engineer requires verification of weight of coating on any item delivered to the job site, he shall select sample and the Contractor shall effect test by the stripping method in accordance with ASTM Designation A 90. If the tested item conforms to coating requirements, the Owner will pay cost of test.

   If the items fail to meet coating requirements, the Contractor shall pay cost of test. In event of failure, at the Contractor's option and expense, second and third specimens may be similarly selected and tested. Failure of tested item or items to meet coating requirements shall cause the entire lot to be rejected. All rejected items shall be replaced with items meeting the requirements at no additional cost to the Owner.

9.05 Carpentry and Millwork:

A. Shop Drawings: Furnish shop drawings for all fabricated items in this Section in accordance with the General Requirements section of these Specifications.

B. Products:

1. Blocking, nailers, rough bucks, furring, and all timber and framing shall be Southern Pine Grade #1.

2. Treated Wood:

   a. Chemical Treatment: All lumber as hereinafter specified to be "Treated Wood" shall be impregnated with Fluor-Chrome-Arsenate-Phenol type wood preservatives (Osmosalts, Wolmanized or equal) in accordance with Fed. Spec. No. TT-W-535. Preservatives shall be applied in a closed cylinder by vacuum-pressure process in accordance with Fed. Spec. No. TT-W-571 f.

The retention of dry salts shall be .35 pounds per cubic foot of wood.

b. Drying: After treatment, all lumber shall be kiln dried to a 15% to 19% moisture content.

c. Color: Treated lumber shall have a pale green appearance, which shall be apparent throughout the full section of the member when cut.

d. Job Treatment: Job cut surfaces and boltholes shall be brushed with a 1-1 mixture of preservatives and water before being anchored or nailed in place.

e. Schedule of Treated Wood: Lumber used in the following locations shall be chemically treated:

(1) Wood in contact with concrete or steel

(2) Wood in contact with masonry

(3) Wood built into concrete or masonry and wood members concealed by other materials or finish

(4) Wood which is not within a temperature controlled environment

C. Execution:

1. General: Work shall be installed straight, plumb, in line, in neat fashion. Lay out work carefully to produce results intended by Drawings and to accommodate work of other trades.

2. Nailers on roof shall be applied only when they can be immediately covered by roofing and sheet metal materials. Should it be necessary to leave them exposed, cover with felt or plastic film to prevent wetting.

9.06 Moisture and Thermal Protection:

A. Membrane Waterproofing:

1. Membrane below floor slabs shall be "Nervastral" Seal-Pruf H-D as manufactured by Rubber and Plastics Compound Company, Inc., or 20 mil Vinyl as manufactured by B.F. Goodrich, "Wasco Seal No. 20" as manufactured by Wasco, or equal.

2. Plastic for setting and sealing membrane shall be as furnished by the membrane manufacturer.

B. Execution:

1. Under concrete floor slabs on grade, provide continuous membrane of Material noted in preceding paragraph entitled "Membrane Waterproofing." Membrane shall be laid at right angles to the direction of concrete pour with joints lapped 9" and sealed with 4" wide application of mastic.

2. Exercise care in installation so as to minimize punctures. Holes shall be patched with plastic lapping the puncture a minimum of 4" and sealed with mastic.

3. Where underslab membranes intersect wall bituminous waterproofing, the two shall overlap 4" and be sealed together so-as-to provide continuous barrier.

4. The membrane shall be carried up intersecting vertical walls behind finish wall material at least 4".

5. Roll the entire horizontal area with not less than a 50 pound roller, and the corners and vertical sections with a rubber roller to ensure solid anchorage.

6. Membrane shall be turned up and sealed to all projecting items through floors to receive membrane.

9.07 Fabricated Wood Trusses: Fabricate, supply and erect wood trusses as shown on the Drawings and as specified. Work to include anchorage, blocking, curbing, miscellaneous framing and bracing.

A. Design:

1. Trusses shall be designed in accordance with these Specifications and where any applicable design feature is not specified herein, design shall be in accordance with applicable provisions of latest edition of *National Design Specifications for Wood Construction*, American Forest and Paper Association, *National Design Standard for Metal Plate Connected Wood Truss Construction*, Truss Plate Institute and code of jurisdiction.

2. Fabricator shall furnish design drawings bearing seal and registration number of a civil or structural engineer licensed in state where trusses are to be installed. Drawings shall be approved by Engineer prior to fabrication.

3. Truss design drawings shall include as minimum:

a. Span, depth or slope and spacing of trusses

b. Required bearing width

c. Design loads as applicable

(1) Top chord live load

(2) Top chord dead load

(3) Bottom chord live load

(4) Bottom chord dead load

(5) Concentrated loads and their points of application

(6) Wind and seismic criteria

d. Adjustment to lumber and plate design values for condition of use

e. Reactive forces, points of occurrence and direction

f. Lumber size, species and grade for each member

g. Location of any required continuous lateral bracing

h. Calculated deflection ratio and/or maximum deflection for live

i. Maximum axial forces in truss members

j. Location of joints

k. Connection requirements for

(1) Truss to truss girders

(2) Truss ply to ply

(3) Field splices

B. Materials

1. Lumber

a. Lumber used for truss members shall be in accordance with published values of lumber rules writing agencies approved by board of review of American Lumber Standards Committee. Lumber shall be identified by grade mark of a lumber inspection bureau or agency approved by that board and shall be as shown on design drawings.

b. Moisture content of lumber shall be no less than 7% or greater than 19% at time of fabrication.

c. Adjustment of values for duration of load or conditions of use shall be in accordance with *National Design Specification for Wood Construction.*

d. Fire retardant treated lumber, if applicable, shall meet specifications of AWPA Standard C20. Allowable values par 6.4.9.1 and shall be redried after treatment in accordance with AWPA Standard C20. Allowable values must be adjusted in accordance with NDS par 2.3.4. Lumber treater shall supply certificate of compliance.

2. Metal Connector Plates

a. Metal connector plates shall be no less than 0.36" in thickness (20 gage) and shall meet or exceed ASTM A653 grade 40, shall be hot dipped galvanized according to AST< A653 coating designation G60. Working stresses in steel are to be applied to effective ratios for plates as determined by test in accordance with Chapter 5 of ANSI/TPI 1-2002.

b. In highly corrosive environments, special applied coatings or stainless steel may be required.

C. Fabrication: Trusses shall be fabricated in a properly equipped facility of a permanent nature. Trusses shall be fabricated by experienced workmen, using precision cutting, jigging and pressing equipment meeting requirements of ANSI/TPI 1-2002, Chapter 3. Truss members shall be accurately cut to length, angle and true to line to assure proper fitting joints within tolerances set forth in ANSI/TPI 1-2002, Chapter 3 and proper fit with other work.

D. Handling, Installation and Bracing

1. Trusses shall be handled during fabrication, delivery and at job site so as not to be subjected to excessive bending.

2. Trusses shall be unloaded on smooth ground to avoid lateral strain. Trusses shall be protected from damage that might result from on-site activities and environmental conditions. Prevent toppling when banding is removed.

3. Handle during installation in accordance with *Handling, Installing and Bracing Wood Trusses (HIB-91)*, TPI and ANSI/TPI 1-2002. Installation shall be consistent with good workmanship and good building practices and shall be responsibility of the Contractor.

4. Apparent damage to trusses, if any, shall be reported to manufacturer prior to installation.

5. Trusses shall be set and secured level and plumb and in correct location. Trusses shall be held in correct alignment until specified permanent bracing is installed.

6. Cutting and altering of trusses is not permitted.

7. Concentrated loads shall not be placed atop trusses until all specified bracing has been installed and decking is permanently nailed in place. Specifically avoid stacking full bundles of decking or other materials onto unsheathed trusses.

8. Erection bracing is always required. Professional advice should always be sought to prevent toppling or dominoing of trusses during installation.

9. The Contractor is responsible for obtaining and furnishing the materials used for installation and permanent bracing.

9.08 Metal Roofing: Furnish and install metal roofing and accessories in accordance with these Specifications and Drawings.

A. Submittals:

1. Submit manufacturer's current specifications and related literature

2. Provide samples in accordance with section

3. Submit shop drawings outlining roof plans, profiles, and trim flashing in accordance with the General Requirements section of these Specifications. Show details at all edges.

B. Products:

1. Standing Seam Metal Roof: Metal roof pans shall have 1 ¾" tall by ⅜" wide integral snap together seam. Panels shall have factory applied striations with factory applied notch at panel ends and factory applied sealant at side joints.

   a. Base metal shall be 24 Ga., Grade 50 with ASTM AZ55 galvanized coating.

   b. Finish shall be 70% Kynar 500 Premium Fluorocarbon or equivalent.

   c. Texture shall be striated.

   d. Width of panel shall be 12-inches.

   e. Flashing and trim shall be fabricated from same material and finish as panels.

   f. Installation:

      (1) Installer must field verify all necessary dimension prior to fabrication of metal panels.

      (2) All panels and related trim shall be installed plumb and true to line.

      (3) All panels shall be installed in continuous length unless there is a change of direction or slope.

      (4) Standard for workmanship shall be the Architectural Sheet Metal Manual as published by SMACNA.

      (5) Only minor blemishes shall be touched up. Any other damage shall be replaced.

      (6) Installer shall examine all surfaces where panels are to be applied. If surfaces are not suitable to apply the metal panel system, he shall notify the Engineer in writing. Installation is not to proceed until the surface is acceptable to all parties.

   g. Delivery and Storage: Store material out of weather in a clean dry place. One end of container should be slightly higher to allow moisture to drain.

      (1) Panels and/or flushing with strippable film must not be stored in areas exposed to sunlight. Care should be taken to prevent contact with any substance which might cause discoloration of finish.

2. Flush Panels:

   a. Base metal shall be 24 Ga., Grade 50, with ASTM AZ55 galvanized coating.

b. Finish shall be 70% Kynar 500 Premium Fluorocarbon or equivalent.

c. Panels shall be twelve (12") inches wide with stiffening ribs.

d. Installer must field verify all necessary dimension prior to fabrication of metal panels.

e. All panels and related trim shall be installed plumb and true to line.

f. All panels shall be installed in continuous length unless there is a change of direction or slope.

g. Standard for workmanship shall be the Architectural Sheet Metal Manual as published by SMACNA.

h. Only minor blemishes shall be touched up. Any other damage shall be replaced.

9.09 Sealants and Caulking:

A. Products:

1. Sealant for exterior work shall be a one (1) part silicone rubber meeting the requirements of Federal Specification TTS-001543, without primer. Prior to use of this material, the Contractor shall submit two (2) copies of tests made by recognized testing laboratory certifying that sealants meet this specification. Color shall match color of adjacent material.

2. Primers shall be furnished by the sealant manufacturer.

3. Caulking for interior work shall be gun consistency, "Tremco Caulking and Pointing Compound" as manufactured by Tremco Manufacturing Company, P.R.C. "Architectural Grade," Pecora "Architectural Grade," or equal. Compound shall be a non-staining gray.

4. Joint Back-up Strips shall be closed cell structure extruded rod as manufactured by Tremco Manufacturing Company, P.R.C., or equal. Width of material shall be 1-½ times the width of joint. Depth of rod shall be same as width of joint, but in no case less than ¼".

9.10 Fiber Cement Board:

A. General:

1. Provide and install fiber cement lap siding, panels, single trim, fascia, soffit, molding and accessories as shown on the Drawings or specified herein. Cement board lap siding shall be warranted for a period of 30 years. Cement board trim and vented soffit shall be warranted for a period of 15 years.

2. Fiber cement lap siding requirement for shall comply with ASTM C 1186 Type A Grade II and ASTM E 136 as a noncombustible material.

B. Preparation:

1. Clean surfaces thoroughly prior to installation.

2. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3. Install a water-resistive barrier as required in accordance with local building code requirements.

C. Installation – Lap Siding:

1. Install materials in strict accordance with manufacturer's installation instructions.

2. Starting: Install a minimum ¼" thick lath starter strip at the bottom course of the wall. Apply planks horizontally with minimum 1-¼" wide laps at the top. The bottom edge of the first plank overlaps the starter strip.

3. Allow minimum vertical clearance between the edge of siding and any other material in strict accordance with the manufacturer's installation instructions.

4. Align vertical joints of the planks over framing members.

5. Locate splices at least one stud cavity away from window and door openings.

D. Installation – Trim:

1. Install materials in strict accordance with manufacturer's installation instructions. Install flashing around all wall openings.

2. Seal gap with high quality, paintable caulk.

3. Install trim fascia boards to rafter tails or to subfascia.

9.11 Flashing and Sheet Metal:

A. Submittals: Contractor shall submit shop drawings which shall indicate thicknesses, dimensions, fastenings and anchoring methods, expansion joints and other provisions necessary for thermal expansion and contraction in accordance with the General Requirements section of these Specifications. Scaled manufacturer's catalog data may be submitted for factory fabricated items.

B. Materials: Contractor shall furnish sheet metal items in 8' to 10' length. Single pieces less than 8' long may be used to connect to factory-fabricated inside and outside corners and at ends of runs. Factory fabricate corner pieces with minimum 36" legs. Provide accessories and other items essential to complete the sheet metal installation. These accessories shall be made of the same materials as the items to which they are applied. Fabricate sheet metal items of the materials specified below and to the gauge, thickness or weight shown in Table 1 at the end of this section.

C. Finish: Exposed exterior aluminum sheet metal items shall have a baked-on, factory-applied color coating of polyvinylidene fluoride (PVF2) or other equivalent fluorocarbon coating applied after metal substrates have been cleaned and pretreated. Finish coating dry-film thickness shall be 0.8 to 1.3 mils, and color shall match adjacent materials.

D. Installation:

1. Requirements: Contractor shall make surfaces to receive sheet metal plumb and true, clean, even, smooth, dry and free of defects and projections which might affect the application. For installation of items not shown in detail or not covered by specifications conform to the applicable requirements of SMACNA ASMM, Architectural Sheet Metal Manual. Sheet metal flashing in the angles formed where roof decks about walls, curbs, ventilators, pipes or other vertical surfaces and wherever indicated and necessary to make the work watertight shall be. Join sheet metal items together as shown in Table II.

2. Nailing: Contractor shall confine nailing of sheet metal generally to sheet metal having a maximum width of 18". Confine nailing of flashing to one edge only. Space nails evenly not over 3" on centers and approximately ½" from edge unless otherwise specified or indicated. Face nailing will not be permitted.

3. Flat Lock Seams: The finish shall not be less than ¾" wide.

4. Lap Seams: The overlap seams not less than 3".

5. Loose Lock Expansion Seams: Seams shall be not less than 3" wide and provide a minimum 1" movement within the joint. Contractor shall completely fill the joints with the manufacturer specified sealant applied at not less than ⅛" thick bed.

6. Mechanical Fastening of Aluminum: Contractor shall use No. 12 aluminum alloy, sheet metal screws or other suitable aluminum alloy or stainless steel fasteners. Drive fasteners in holes made with a No. 26 drill in securing side laps, end laps and flashings. Space fasteners 12" maximum on centers. Where end lap fasteners are required to improve closure, locate the end lap fasteners not more than 2" from the end of the overlapping sheet.

7. Metal Surfaces: Contractor shall paint surfaces in contact with mortar, concrete or other masonry materials with alkali-resistant coatings such as heavy-bodied bituminous paint.

8. Wood or Other Absorptive Materials: Paint surfaces that may become repeatedly wet and in contact with metal with two coats of aluminum paint or a coat of heavy-bodied bituminous paint.

9. Aluminum: Aluminum surfaces shall not directly contact other metals stainless steel, zinc or zinc coating. Where aluminum contacts another metal, paint the dissimilar metal with a primer flowed by two (2) coats of aluminum paint. Where drainage from a dissimilar metal passes over aluminum, paint the dissimilar metal with a non-lead pigmented paint.

10. Expansion and Contraction: Contractor shall provide expansion and contraction joints at not more than 32' intervals for aluminum and at not

more than 40' intervals for other metals. Where the distance between the last expansion joint and the end of the continuous run is more than half the required interval, an additional joint shall be provided. Space joints evenly. Join extruded aluminum flashing stops and fascias by expansion and contraction joints evenly. Join extruded aluminum flashing stops and fascias by expansion and contraction joints spaced not more than 12' apart.

11. Counterflashing: Except where indicated or specified otherwise, insert counterflashing in reglets located from 9" to 10" above roof decks, extend down vertical surfaces over upturned vertical leg of base flashings not less than 3". Fold the exposed edges of counterflashings ½". Where stepped counterflashings are required, they may be installed in short lengths or may be of the preformed one-piece type. Provide end laps in counterflashings not less than 3" and make it weathertight with plastic cement. Do not make lengths of metal counterflashings exceed 10'. Form the flashings to the required shapes before installation. Factory-form the corners not less than 12" from the angle. Secure the flashings in the reglets with lead wedges and space not more than 18" apart; on short runs, place wedges closer together. Fill calked-type reglets or raked joints which receive counterflashing with calking compound. Turn up the concealed edge of counterflashings built into masonry or concrete walls not less than ¼" and extend not less than 2" into the walls. Install counterflashing to provide a spring action against base flashing.

12. Fascias: Contractor shall prefabricate in the shapes and sizes indicated and in lengths not less than 8'. Extend flange at least 4" onto roofing. Provide prefabricated, mitered corners internal and external corners.

13. Edge Strip: Contractor shall hook the lower edge of fascias at least ¾" over a continuous strip of the same material bent outward at an angle not more than 45° to form a drip. Nail hook strip to a wood nailer at 6" maximum on centers. Where fastening is made to concrete or masonry, use screws spaced 12" on centers driven in expansion shields set in concrete or masonry. Where necessary, install strips over 1/16" thick compatible spacer or washers.

14. Joints: Contractor shall leave open the section ends of flashing stops and fascias ¼" and backed with a formed flashing plate, mechanically fastened in place and lapping each section end a minimum of 4" set laps in plastic cement. Face nailing will not be permitted. Install prefabricated aluminum fascias in accordance with the manufacturer's printed instructions and details.

15. Metal Drip Edge: Contractor shall provide a metal drip, designed to allow run-off to drip free of underlying construction at overhangs. Extend back from the edge not more than 3" and secure with compatible spaced not more than 10" on center along upper edge.

TABLE ONE SHEET METAL WEIGHTS, THICKNESSES AND GAUGES	
Sheet Metal Items	***Aluminum Inch***
Covering on minor flat, pitched or curved surfaces	.40
Scupper lining	.32
Strainers, wire diameter or gauge	.144
Flashings:	
▪ Cap (Counterflashing)	.32
▪ Overhang	--
▪ Valley	.32
Fascias:	
▪ Extrusions	.075
▪ Sheets, corrugated	.032
▪ Sheets, smooth	.050
▪ Edge strip	.050
Joint cover plates (See Table Two)	.032

TABLE TWO SHEET METAL JOINTS TYPE OF JOINT		
	Type of Joint	
Item Designation	***Steel, Zinc-Coated***	***Aluminum***
Overhang flashing	1" flat	1" flat
	Locked, cleated 1" loose locked, expansion joint cleated	Locked, locked, cleated one inch loose locked, sealed expansion joints, cleated.
Edge strip	Butt	Butt
Sheet, smooth	Butt with ¼" space	Butt with ¼" space

9.12 Fiberglass Reinforced Polymer Doors (Doors A, B, C): Fiberglass doors shall be manufactured by Chem-Pruf Fiberglass Door Co., Curries, Inc., Cline Aluminum Doors, Inc., Edgewater FRP Door, Inc., or equal.

A. General:

1. Doors shall be made of fiberglass reinforced polymer (FRP) using chemically proven resins resistant to contaminants typically found in the project environment. Doors shall be 1 ¾" thick and of flush construction having no seams or cracks. All doors up to 4'-0" x 8'-0" shall have equal diagonal measurements with a maximum tolerance of ±1/32".

2. Door plates shall be ⅛" thick, molded in one continuous piece, starting with a 25 mil gelcoat of the color specified, integrally molded with at least 2 layers of 1.5 ounce per square foot fiberglass mat, 1 layer of 16 ounce per square foot fiberglass mat, and 1 layer of 16 ounce per square yard

unidirectional roving, yielding a plate weight of 0.97 pounds per square foot at a ratio of 30/70 glass to resin.

3. Stiles and rails shall be constructed starting from the outside toward the inside of a 25 mil gel coat of the color specified followed by a matrix of at least 3 layers of 1.5 ounce per square foot of fiberglass mat. The stile and rail shall be molded in one continuous piece to a U-shaped configuration and to the exact dimensions of the door. There shall be no miter joints or disparate materials used to form the one piece stile and rail.

4. Core material shall be polypropylene plastic honeycomb core with a non-woven polyester veil for unparalleled plate bonding, 180 psi typical compression range unless otherwise specified.

5. Internal reinforcement shall be SPF #2 of sufficient amount to adequately support required hardware and function of same.

6. Finish of door and frame shall be identical in color and texture. At time of manufacture, 25 mil of resin-rich gelcoat must be integrally molded into both the door and frame. Secondary painting to achieve color is not acceptable.

7. Louver openings shall be completely sealed, so the interior of the door is not exposed to the environment. Louvers shall be solid fiberglass inverted "V" vanes and shall match the color, texture and finish of the door plates.

8. Transoms shall be identical to the doors in construction, materials thickness and reinforcement.

B. Door Hardware: Contractor shall furnish and deliver to the jobsite all items of finish hardware not specified in other Sections. Hardware shall be a perfect fit, uniform in color, free from imperfections affecting serviceability or marring appearance. Locks shall be keyed to Owner's master. Hardware shall be stainless steel corrosion resistant unless noted otherwise. Hardware shall be equal in quality, design and function to the hardware listed below. Hardware manufacturers' names are given as a standard only and equal hardware will be acceptable from Corbin Russwin, Sargent Manufacturing Company, Von Duprin, or equal. Hardware finish shall be US32D Standard.

1. Door A:

	Item	*Quantity*	*Manufacturer Item No.*
a.	1½ pr butts	3	Hager BB 1199, Stanley FBB199, or equal stainless steel, 4 ½ x 4 ½, US 32D
b.	Silencers	3	Hager 307D, Ives SR64, or equal
c.	Closer	1	Dorma STA 8600, Norton 7500SS, or equal stainless steel corrosion resistant exposed components
d.	Weatherstripping	3	Hager 891SS, Reese 825, or equal
e.	Exit Device	1	Sargent 8700, Corbin Russwin

	Item	*Quantity*	*Manufacturer Item No.*
			ED5000, or equal stainless steel
f.	Lockset	1	Sargent 8200 mortise, 626 CPC trim, Corbin Russwin ML2000 mortise, 626C trim, or equal stainless steel with lever trim
g.	Kickplate	1	ASSA Abloy K1050, Ives 8400 or equal

2. Door B:

	Item	*Quantity*	*Manufacturer Item No.*
a.	1½ pr butts	3	Hager BB 1199, Stanley FBB199, or equal stainless steel, 4 ½ x 4 ½, US 32D
b.	Silencers	3	Hager 307D, Ives SR64, or equal
c.	Closer	1	Dorma STA 8600, Norton 7500 SS, or equal stainless steel corrosion resistant exposed components
e.	Weatherstripping	3	Hager 891SS, Reese 825, or equal
f.	Lockset	1	Sargent 8200 mortise, 626 CPC trim, Corbin Russwin ML2000 mortise, 626C trim, or equal stainless steel with lever trim
g.	Kickplate	1	ASSA Abloy K1050, Ives 8400 or equal

3. Door C:

	Item	*Quantity*	*Manufacturer Item No.*
a.	1½ pr butts	6	Hager BB 1199, Stanley FBB199, or equal stainless steel, 4 ½ x 4 ½, US 32D
b.	Silencers	6	Hager 307D, Ives SR64, or equal
c.	Closer	2	Dorma STA 8600, Norton 7500SS, or equal stainless steel corrosion resistant exposed components
d.	Threshold	1	Hager 520SN, Reese S483, or equal aluminum with insert
e.	Weatherstripping	3	Hager 891SN, Reese 825, or equal
f.	Exit Device	1	Sargent 8700, Corbin Russwin ED5000, or equal stainless steel

	Item	*Quantity*	*Manufacturer Item No.*
g.	Lockset	1	Sargent 8200 mortise, 626 CPC trim, Corbin Russwin ML2000 mortise, 626C trim, or equal stainless steel with lever trim
h.	Kickplate	2	ASSA Abloy K1050, Ives 8400 or equal
i.	Outside Astragal	2	Hager 802S, Reese 959 or Equal

C. Fiberglass Door Frames:

1. Frames shall be fiberglass and manufactured using the resin transfer method in closed rigid molds to ensure uniformity in color and size. Beginning with a minimum 25 mil gel coat and a minimum of 2 layers continuous strand fiberglass mat saturated with resin, the frame shall be of one piece construction with molded stop. All frame profiles up to ¾" shall be solid fiberglass. All frame profiles greater than ¾" shall have a core material of 2 psf polyurethane foam. Metal frames or pultruded fiberglass frames will not be accepted.

2. Finish of frame shall be identical in color and texture to the door; 25 mil resin rich gel coat will be integrally molded into the frame at time of manufacture. Secondary painting to achieve color is not acceptable.

3. Jamb/header connection shall be coped by CNC for tight fit.

4. Internal reinforcement shall be continuous within the structure to allow for mounting of specified hardware. Reinforcing material shall be a dense matrix of cloth glass fibers and premium resin with a minimum hinge screw holding value of 1,000 pounds per screw. All reinforcing materials shall be completely encapsulated. Documented strength of frame screw holding value after 3rd insert must be submitted. Dissimilar materials such as steel will be deemed unacceptable as reinforcement for hardware attachment.

5. Mortises for hardware shall be accurately machined by manufacturer to hold dimensions to ± 0.010' in all 3 axes.

6. Hinge pockets shall be accurately machined by manufacturer to facilitate heavy-duty hinges at all hinge locations using spacers when standard weight hinges are used.

9.13 Metal Door Frames:

A. Shop Drawings: Submit shop drawings for work fabricated under this Section in accordance with the General Requirements section of these Specifications. Drawings shall show elevations, gauges of materials, and sections through frames indicating adjacent materials and anchorage.

B. Products: Unit type full welded door frames shall be fabricated to details and profiles shown of cold rolled buck steel.

1. Manufacturer: Hollow metal door frames shall be as manufactured by Amweld Metal Door and Frame Company, Habersham Metal Products Company, or equal.

2. Gauges: Frames shall be 16 USS gauge.

3. Sizes: Frame sizes shall be as shown on the Drawings.

4. Construction:

   a. Head and jamb intersections including angles, molds, returns and miters, shall be continuously welded and ground off smooth and flush.

   b. Steel reinforcements, minimum ⅛" × 1 ½" × 9", shall be provided for hardware cutouts to ensure rigid construction, and shall be spot welded to the inside surface of the jambs over which weld 26 gauge galvanized plaster guards.

   c. Removable steel angle spreaders shall be welded to the bottom to ensure parallel alignment.

   d. Provide minimum of three, 16 gauge × 2" × 10" adjustable corrugated steel anchors per jamb except as required for labeled frames. Jambs at columns shall be provided for transoms at a maximum spacing of 24" O.C.

   e. Removable stops of 14-gauge steel shall be provided where indicated on Drawings for securing glass and grilles. Stops shall be secured to frames with countersunk oval head Phillip's head sheet metal screws at 9" O.C.

   f. Each jamb shall be provided with sill clips welded to the frame and punched with two ⅜" holes for anchoring. Unless specifically indicated otherwise on the Drawings, frames shall extend down to structural slabs.

   g. Holes shall be drilled and tapped from template to receive butts, closers, and lock strikes. Templates for this purpose shall be furnished to the frame manufacturer by the hardware manufacturer.

   h. Painting: Frames shall be thoroughly cleaned of oil, grease, dirt, and filled to ensure a smooth finish, and shall be given factory baked-on prime coat of rust inhibitive paint.

C. Execution: Doorframes shall be stored on jobsite in an upright position, under cover, on wooden sills so-as-to protect frames from rust, stain, and damage prior to installation. Attach sill clips on frames to concrete slabs with 5/16" expansion bolts operating in expansion shields. Secure jambs to steel studs. Where frames are installed in masonry walls, the space between masonry and frame shall be filled with mortar. Erect frames plumb and in perfect alignment.

9.14 Metal Doors (Doors D, E, F):

A. Shop Drawings: Submit shop drawings for work fabricated under this Section in accordance with the General Requirements section of these Specifications. Drawings shall show elevations, gauges of materials, and sections.

B. Products: Hollow metal doors shall be as manufactured by Amweld Metal Door and Frame Company, Habersham Metal Products Co., or equal.

1. Flush type doors shall be equal to Amweld "Extra Heavy Duty Core Door" seamless door with face sheets of No. 16 U.S. gauge cold rolled, leveled sheet metal. Doors shall be covered by a 10 year performance warranty.

2. Doors shall be mortised reinforced for hardware and shall be drilled and tapped at the factory from templates to receive items of mortised hardware. Templates shall be provided by hardware manufacturer. Surface applied items shall be reinforced, but drilling and tapping shall be done in the field.

3. Tops and bottoms of doors shall be closed with not less than 18 gauge channels. Tops of doors shall be completely closed.

4. Doors shall be given one factory baked-on prime coat of rust inhibitive paint. Prior to painting, all materials shall be thoroughly cleaned of oil, grease, dirt, and filled to assure a smooth finish.

C. Door Hardware: Contractor shall furnish and deliver to the jobsite all items of finish hardware not specified in other Sections. Hardware shall be a perfect fit, uniform in color, free from imperfections affecting serviceability or marring appearance. Locks shall be keyed to Owner's master. Hardware shall be equal in quality, design and function to the hardware listed below. Hardware manufacturers' names are given as a standard only and equal hardware will be acceptable from Corbin, Sargent, Von Duprin or equal. Hardware finish shall be US32D Standard.

1. Door D:

	Item	*Quantity*	*Manufacturer Item No.*
a.	1½ pr butts	3	Hager BB 1199, Stanley FBB199, or equal, 4 ½ x 4 ½, US 32D
b.	Silencers	3	Hager 307D, Ives SR64, or equal
c.	Closer	1	Dorma 8618, Hager 5100, or equal
d.	Threshold	1	Hager 431S, Reese S245, or equal aluminum with insert
e.	Weatherstripping	3	Hager 891SS, Reese 825, or equal
f.	Exit Device	1	Sargent 8700, Corbin Russwin ED5000, or equal
g.	Lockset	1	Sargent 8200 mortise, 626 CPC trim, Corbin Russwin ML2000 mortise,

	Item	*Quantity*	*Manufacturer Item No.*
			626C trim, or equal with lever trim, doors marked with asterisk (*) to have keypad door locks
h.	Kickplate	1	ASSA Abloy K1050, Ives 8400 or equal

2. Door E:

	Item	*Quantity*	*Manufacturer Item No.*
a.	1½ pr butts	3	Hager BB 1199, Stanley FBB199, or equal, 4 ½ x 4 ½, US 32D
b.	Silencers	3	Hager 307D, Ives SR64, or equal
c.	Closer	1	Dorma 8618, Hager 5100, or equal
d.	Threshold	1	Hager 431S, Reese S245, or equal aluminum with insert
e.	Weatherstripping	3	Hager 891SS, Reese 825, or equal
f.	Lockset	1	Sargent 8200 mortise, 626 CPC trim, Corbin Russwin ML2000 mortise, 626C trim, or equal with lever trim, doors marked with asterisk (*) to have keypad door locks Corbin M800 or equal
g.	Kickplate	1	ASSA Abloy K1050, Ives 8400 or equal

3. Door F:

	Item	*Quantity*	*Manufacturer Item No.*
a.	1½ pr butts	3	Hager BB 1199, Stanley FBB199, or equal, 4 ½ x 4 ½, US 32D
b.	Silencers	3	Hager 307D, Ives SR64, or equal
c.	Closer	1	Dorma 8618, Hager 5100, or equal
d.	Lockset	1	Sargent 8200 mortise, 626 CPC trim, Corbin Russwin ML2000 mortise, 626C trim, or equal with lever trim
e.	Kickplate	1	ASSA Abloy K1050, Ives 8400 or equal

D. Execution: Doors shall be stored indoors, in a horizontal position, on wooden sills and covered to protect from damage prior to installation. Installation shall be plumb and true and doors shall be adjusted to operate free and easily. Locks shall be keyed to City master. Provide wall stops for all doors opening to a wall, Hager model 255W, Ives WS11X, or equal.

9.15 Interior Wood Doors (Doors G, H, I): Doors shall be MDF construction as described herein, manufactured by TruStile, Bartels, or equal. Dimensions shall be as shown on the Drawings.

A. Manufacturer: Door C to be TruStile TS1000 Series MDF, Bartels model C29, or equal. Door B to be TruStile PL100 series MDF, Bartels model C14, or equal.

B. Stile: Interior core material to be constructed of 2 pieces of 48 pound density MDF laminated with PVC adhesive or ⅛" MDF over LVL. For exterior doors MDF shall be exterior grade MDF manufactured with phenolic resins to resist moisture.

1. Thickness: 1⅜"

2. Stile and Rail (Sticking) Type: Quarter round

3. Panel Type: Raised panels constructed of 48 pound density MDF routed to profile specified. Panels shall float inside the sticking in true stile and rail construction. Panels shall be held in place by the sticking, and flexible bumper shall be installed inside sticking to keep panel centered.

C. Finish: Factory primed, finish coat in field

D. Door Hardware: Contractor shall furnish and deliver to the jobsite all items of finish hardware not specified in other Sections. Hardware shall be a perfect fit, uniform in color, and free from imperfections affecting serviceability or marring appearance. Hardware shall be equal in quality, design and function to the hardware listed below. Hardware manufacturers' names are given as a standard only and equal hardware will be acceptable from Corbin, Sargent, Von Duprin or equal. Hardware finish shall be US32D Standard.

1. Doors G, H, I:

	Item	*Quantity*	*Manufacturer Item No.*
a.	1½ pr butts	3	Hager BB 1199, Stanley FBB199, or equal, 4 ½ x 4 ½, US 32D
b.	Silencers	3	Hager 307D, Ives SR64, or equal
c.	Closer	1	Dorma 8618, Hager 5100, or equal
d.	Lockset	1	Sargent 8200 mortise, 626 CPC trim, Corbin Russwin ML2000 mortise, 626C trim, or equal with lever trim, door marked with dagger (†) shall be security access door Corbin M804 or equal
e.	Kickplate	1	ASSA Abloy K1050, Ives 8400 or equal

2. Wall Stops: Provide wall stops for all doors opening to a wall, Hager model 255W, Ives model WS11X or equal. Provide all software and configuration for operation or remote access keypad.

9.16 Overhead Door: Contractor shall furnish and install the overhead doors as shown and specified. Doors shall be Overhead Door Co. model 627, Wayne Dalton model 800C, or approved equal. Doors shall be fabricated for installation as shown on the Drawings. Shop drawings shall be submitted in accordance with the General Requirements section of these Specifications for approval before fabrication. Doors shall be furnished complete with hardware and accessories.

A. Performance Requirements:

1. Wind Loads: Design door assembly to withstand wind/suction load of 20 psf (958 Pa) without damage to door or assembly components in conformance with ASTM E 330.

2. Operation: Design door assembly, including operator, to operate for not less than 20,000 cycles.

3. Through Curtain Sound Rating:

a. Sound Rating: STC-28 (STC-30+ with HZ noise generator) as per ASTM E 90

b. Installed System Sound Rating: STC-21 as per ASTM E 90

4. Air Infiltration: Meets ASHRAE 90.1 and IECC 2012/2015 C402.4.3 Air leakage <1.00 cfm/ft$^{2.}$

B. Construction:

1. Curtain: Interlocking roll-formed slats as specified:

a. Endlocks shall be attached to each end of alternate slats to prevent lateral movement.

b. Shall be flat profile type F-265i for doors up to 40' wide

c. Shall be front slat fabricated of 24 gauge galvanized steel and back slat fabricated of 24 gauge galvanized steel

d. Slat cavity shall be filled with CFC-free foamed-in-place, polyurethane insulation with:

(1) R-Value: 10.9

(2) U-Value: 0.09

(3) Sound Rating: STC-21

2. Finish:

a. Slats and hood shall be galvanized in accordance with ASTM A 653 and receive rust-inhibitive, roll coaling process, including 0.2 mils thick baked-on prime paint and 0.6 mils thick baked-on polyester top coat. Contractor shall submit color samples to Engineer for Owner's selection

b. Non-galvanized exposed ferrous surfaces shall receive one coat of rust-inhibitive primer.

3. Weatherseals: Vinyl bottom seal and internal hood seals, interior and exterior EPDM triple-seal finned guide, Lintel weatherseal shall be provided.

4. Bottom Bar: Two galvanized steel angles minimum thickness ⅛" bolted back to back to reinforce curtain in the guides shall be provided.

5. Guides: Three structural steel angles with PowderGuard Weathered finish with iron/black powder

6. Brackets: Galvanized steel to support counterbalance, curtain and hood

7. Counterbalance: Helical torsion spring type housed in a steel tube or pipe barrel, supporting the curtain with deflection limited to 0.03" per foot of span shall be provided. Counterbalance is adjustable by means of an adjusting tension wheel.

8. Hood: Provide with internal hood baffle weatherseal and 24 gauge galvanized steel with intermediate supports as required

9. Manual Operation: Chain hoist

10. Locking: Chain keeper locks for chain hoist operation

11. Wall Mounting Condition: Face-of-wall mounting

C. Execution:

1. Doors shall be stored indoors, in a horizontal position, on wooden sills and covered to protect from damage prior to installation.

2. Install in accordance with manufacturer's instructions

3. Installation shall be plumb and true and doors shall be adjusted to operate free and easily.

4. Contractor shall install perimeter trim and closures.

5. Contractor shall instruct Owner's personnel in proper operating procedures and maintenance schedule.

6. Contractor shall test for proper operation and adjust as necessary to provide proper operation without binding or distortion.

7. Contractor shall adjust hardware and operating assemblies for smooth and noiseless operation.

D. Warranty: Manufacturer's limited door warranty for 2 years for all parts and components shall be provided.

9.17 Aluminum Windows: All windows shall be outward opening, side-hung casement windows as fabricated by Hope's Windows, Winco Ventilator Co., or approved equal. Submit shop drawings for all work fabricated under this section in accordance with the General Requirements section of these Specifications.

A. Material:

1. Frame, ventilator and weathering sections shall be solid extruded aluminum shapes specifically designed for the purpose.

2. All frame sections shall not be less than 2" deep front to back and not less than ⅛" thick.

3. All vertical meeting rails between double side-hung- out, and horizontal meeting rails in windows greater than 4'-0 ⅞" in width, shall be tubular aluminum extrusions with webs not less than 3/32" thick and flanges not less than 1/8" thick.

4. Ventilator sections shall be not less than 2-3/16" deep front to back with minimum ⅛" thick web flanges.

B. Construction:

1. The corners of all window frames shall be mortised, tenoned, riveted and securely heli-arc welded watertight across webs and up abutting flanges on unexposed areas. All principal horizontal and vertical frame members shall be mortised, tenoned, riveted, and securely heli-arc welded at ends and intersection. Butyl rubber joint sealing compound shall be applied on the interior of all principal frame intersections.

2. All four corners of ventilators shall be miter cut and electronic fusion welded throughout the entire section profile, with weld dressed smooth on exposed and contact surfaces.

C. Weatherstripping: Ventilator sections shall be designed to receive polypropylene or neoprene weather-stripping securely interlocked into the inside and outside weathering contacts.

D. Glazing: Windows shall be arranged for inside glazing with aluminum extruded snap-in glazing beads designed to accommodate glass up to and including 1" thick double insulating glass. Snap-in glazing beads shall securely interlock into the extruded window sections without extending underneath the glass. Glazing rebate legs shall be a full ¾" in height dimensioned from the top of the bead retention lip to the top of rebate leg. Glass, glazing compound, and glazing shall be by the glazing contractor.

E. Hardware: Projected ventilators shall be balanced on heavy-duty stainless steel and aluminum assemblies securely fastened to both frame and ventilator with stainless steel screws and fitted with nylon slides with suitable set screws to provide friction adjustment. Stainless steel riveted pins shall be used at all pivoted points. Project-out ventilators shall be fitted with case white bronze cam type locking handle.

F. Anchors and Clips: Anchors, clips, bolts and screws necessary to secure windows shall be provided and shall be at manufacturer's option either aluminum, non-magnetic stainless steel, or zinc coated steel.

G. Finish: All windows shall be chemically cleaned and given the following finish:

Duranodic, 312, Medium Bronze, No. AAC 12 C22 A42

H. Cleaning and Protection: The Contractor shall protect all windows from misuse or damage after installation, and shall clean all plaster, mortar, or other foreign materials from the windows immediately prior to the completion of his Contract.

9.18 Glass and Glazing: Glazing system shall be produced, fabricated, and installed to withstand normal thermal movement, wind loading, and impact loading (where applicable), without failure including loss or glass breakage attributable to the following:

- Defective manufacture
- Defective fabrication and installation
- Failure of sealants or gaskets to remain watertight and airtight
- Deterioration of glazing materials
- Other defects in construction

A. Glass Design: Glass thicknesses indicated on Drawings are for detailing only. Confirm glass thicknesses by analyzing project loads and in-service conditions. Provide glass lites for the various size openings in the thicknesses and strengths (annealed or heat-treated) to meet or exceed a minimum glass thickness, nominally, of lites in exterior walls of 0.23".

1. Normal thermal movement results from the following maximum change (range) in ambient and surface temperatures acting on glass-framing members and glazing components.

   a. Engineering calculation shall be based on materials' actual surface temperatures due to both solar heat gain and nighttime sky heat loss.

   b. Temperature Change (Range): 120°F ambient; 180°F material surfaces

B. Flat Glass Materials:

1. Float Glass (Type FG-A): ASTM C1036, Type 1 transparent flat, Class 1 clear, Quality q3 glazing select; ¼" minimum thick

2. Safety Glass (Type FG-B): ASTM C1048, fully tempered, Condition A uncoated, Type 1 transparent flat, Class 1 clear, Quality q3 glazing select; conforming to ANSI Z97.1; ¼" minimum thick

3. Wired Glass (Type FG-H): ASTM C1036, Type II patterned and wired flat, Class 1 translucent, Quality q8 glazing; ½" square mesh, ¼" minimum thick

4. Tinted Glass: PPG Industries, Inc. Solarbronze, meeting requirements of float glass and safety glass at locations indicated

C. Insulating Glass Products:

1. Sealed Insulating Glass Units: Provide preassembled units consisting of organically sealed lites of glass separated by dehydrated air spaces complying with ASTM E 774 and with other requirements indicated.

a. For properties of individual glass lites making up units, refer to requirements specified elsewhere in this Section applicable to types, classes, kinds, and conditions of glass products comprising lites of insulating glass units.

b. Provide heat-treated, where recommended by manufacturer, to comply with system performance requirements specified and Kind FT (fully tempered) where safety glass is designated or required.

c. Performance characteristics designated for insulating glass are nominal values based on manufacturer's published test data for units with lites 0.23" thick and nominal ½" dehydrated space between lites, unless otherwise indicated.

d. U-values are expressed as Btu/hour x square feet x °F.

2. Insulated Glass Units: ASTM E774 and E773; double pane with glass elastomer edge seal; outer pane of ¼" tinted glass, inner pane of ¼" clear low-e glass, purge interpane space and fill with argon; total unit thickness of 1"

3. Edge Seal Material: Black color

D. Elastomeric Glazing Sealants:

1. General: Provide products of type indicated, complying with the following requirements:

a. Compatibility: Select glazing sealants and tapes of proven compatibility with other materials they will contact, including glass products, seals of insulating glass units, and glazing channel substrates, under conditions of installation and service, as demonstrated by testing and field experience

b. Suitability: Comply with sealant and glass manufacturer's recommendations for selecting glazing sealants and tapes that are suitable for applications indicated and conditions existing at time of installation

c. Colors: The Contractor shall submit a complete set of standard color samples for the exposed joint sealants to the Engineer for Owner's selection.

2. Elastomeric Glazing Sealant Standard: Provide manufacturer's standard chemically curing, elastomeric sealants.

3. Glazing Sealant for Fire-Resistant Glazing Products: Identical to product used in test assembly to obtain fire-resistive rating

E. Back-Bedding Mastic Glazing Tape: Preformed, butyl-based elastomeric tape with a solids content of 100%, non-staining and non-migrating in contact with nonporous surfaces, with or without spacer rod as recommended by tape and glass manufacturers for application indicated, packaged on rolls with a release paper backing, and complying with AAMA 800

F. Miscellaneous Glazing Materials: Provide products of material, size and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials involved for glazing application indicated, and with a proven record of compatibility with surfaces contacted in installation.

1. Cleaners, Primers and Sealers: Type recommended by sealant or gasket manufacturer

2. Setting Blocks: Elastomeric material with a Shore A durometer hardness of 85 plus or minus 5

3. Spacers: Elastomeric blocks or continuous extrusions with a Shore A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated

4. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side-walking)

9.19 Fabrication of Glass and Other Glazing Products: Fabricate glass and other glazing products in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with recommendations of product manufacturer and referenced glazing standard as required to comply with system performance requirements.

9.20 Heating, Ventilating and Air Conditioning: Provide a complete, functional heating, ventilation and air conditioning system as shown on the Drawings or specified herein.

A. Reference to Other Sections: The following work is specified under other sections unless otherwise noted on Drawings or specified hereinafter:

1. Electrical Wiring

2. Painting

B. Codes and Reference Specifications: Comply with the following publications:

1. Refrigeration Equipment: ASHRAE "Safety Code for Mechanical Refrigeration" ANSI B9.1

2. Local heating, ventilation and air conditioning and electrical codes

3. All electrical equipment field of factory installed shall be UL listed.

C. Noise: When in operation, system shall be free from objectionable noise and vibration.

D. Guarantee: Guarantee shall include prompt repair of leaks and refrigerant and oil lost through leaks.

E. Shop Drawings: Shop drawings shall be submitted in accordance with the General Requirements section of these Specifications

1. Submit for approval complete performance data and drawings on the following items:

a. Packaged air conditioning unit with electric heat

b. Electric unit heaters

c. Exhaust fans

d. Louvers

2. Information on submittal data pertaining to specific equipment features, performance, arrangement, accessories, and space limitations specified or shown on drawings shall be underlined or encircled. Such information, which does not appear on manufacturer's standard literature shall be added in preparing submittal data.

F. Operating and Maintenance Instructions: Before the work is 50% complete, the Contractor shall submit 3 printed copies and 1 digital pdf file of operation and maintenance manuals for equipment as specified. The digital file shall be provided on a single drive or disk. Each component shall be labeled per the specification section referenced, for example:

"9.21 HVAC.pdf"

1. Instruct the Owner's representative in operation and maintenance of the system.

2. Start-up and adjustment of heating units shall be done during cold weather, of cooling units during hot weather.

G. Space Conditions:

1. All material shall fit the space available. Verify dimensions and clearances at building before commencing work.

2. Maintain maximum headroom and accessibility to equipment consistent with requirement of the drawings and specifications.

3. Minor deviations from drawings, required by space limitations shall be made at no additional cost, subject to Engineer's approval.

H. Equipment and Materials:

1. Split System Air Conditioning Unit with Electric Heat: One split-system air conditioning system consisting primarily of an outdoor mounted, air-cooled, condensing unit suitable for ground installation and a properly matched indoor packaged fan coil unit shall be provided by the Contractor and installed as shown on the Drawings. Heating capacity shall be 5.0-kW, factory installed, electric strip heat and a minimum of two-stage design. The system shall have a SEER of 16.0 Btuh/watt or greater at DOE conditions.

The fan coil unit shall be designed for horizontal installation and physically sized to accommodate installation between ceiling joists. The unit shall be installed with vibration isolation at each point of support and feature canvas duct connectors for both supply and return ducts. The return air filter grille shall be provided as an accessory to the fan coil unit, properly sized for the air volumes handled and suited for installation in the

gypsum board ceiling. The contractor shall also provide and install an auxiliary drain pan with a 1" drain line piped to daylight.

The system shall be provided with a wall-mounted, programmable thermostat. The condensing unit shall be Model 25HCD342 and the fan coil unit Model FX4CNF024 as manufactured by the Carrier Corporation or XR13 condensing unit and the Hyperion XR fan coil unit by the Trane Corporation or equal.

a. Supply and return air plenums shall be galvanized sheet metal wrapped with 1.5" vapor tight fiberglass insulation or 1" thick fiberglass ductboard.

b. Individual supply ducts shall be installed, flexible duct rated to 1" s.p. minimum. Each diffuser shall be installed with spin-in collar and damper.

c. Supply air diffusers shall be steel construction perforated face, and suited for installation in 2' × 2' T-bar grid ceiling system. Finish of diffuser shall be off-white baked enamel. Diffusers shall be Titus Model PAS-3, Krueger 1240 D or approved equal.

d. Return air grille/filter shall be the type and size recommended and supplied by the package air conditioning unit manufacturer. The grille/filter shall be suited for installation in 2' × 2' T-Bar grid ceiling system, unless noted otherwise.

2. Exhaust Fans: Exhaust fans shall be furnished and installed by the Contractor as shown on the Drawings.

3. Louvers: Intake louvers shall be weatherproof, have automatic inlet and be of the size shown on the Drawings. Free area of the louvers shall be 40% minimum. Louvers shall be provided with insect/bird screens. Louvers shall be Ruskin Manufacturing Model ELC6375DAX, United Enertech CFL-D-6, or equal.

4. Electric Unit Heaters: Electric unit heaters shall be furnished and installed by the Contractor as shown on the Drawings.

I. Foundations and Supports: Provide foundations, supports, and means of attachment to structure for all equipment furnished under this section unless otherwise noted or specified.

J. Installation and Functions:

1. Manufacturer's Recommendations: Install materials and equipment specified in this section in compliance with current recommendations of the manufacture.

2. Installation Details: Install equipment complete with all components, services, and connections for safe operation and compliance with requirements of the drawings and specifications.

3. Starters: Overload elements shall be of the proper size to protect motors in accordance with the N.E.C.

9.21 Laboratory Furniture and Equipment:

A. General: Furnish and install the following laboratory furniture equipment and supplies. All items shall be procured from a recognized dealer of scientific products with national standing, such as Fisher Scientific, Burrell Corp., Cherne Scientific, Inc., and Laboratory Design & Supply, Inc. The Contractor shall furnish, for approval, listings of each item catalog numbers and sizes. Catalog numbers are for identification as to type and quality. Chemicals shall not be delivered to the job site until two weeks before plant start-up, thereby insuring adequate shelf-life.

B. Laboratory Furniture:

1. General: Furnish and install the laboratory furniture in accordance with the schedule shown on the Drawings. Catalog numbers are for identification as to type and quality. All materials used shall be the best of its kind and all construction details are in conformity with the best practices in the industry. Casework shall be as manufactured by Cherne Scientific, Fisher Scientific, Laboratory Design & Supply, Inc., Duralab, VWR International or equal.

2. Materials: All material used in construction of laboratory furniture shall be industrial grade free from defects. Cabinets shall be constructed from medium-density fiber board or particle board and covered with a high pressure plastic laminate. Phenolic cabinet liner and thermo fused melamine. PVC edge banding shall be l-mm thick, black in color.

a. All high pressure plastic laminate, vertical grade, is melamine impregnated decorative surface papers, superimposed over kraft phenolic core sheets, then bonded at pressures exceeding ½-ton per square inch while maintaining temperatures in excess of 280 degrees, F. After pressing, edges and ends are trimmed and the backside is sanded to facilitate bonding. Vertical grade, high pressure, plastic laminate has a nominal thickness of .030".

b. Phenolic cabinet liner, is composed of layers of paper saturated with synthetic resins and bonded together under heat and a pressure of ½ ton per square inch. The decorative side is of alpha papers and melamine resin. NEMA type designation is CL20 and nominal thickness is .020".

c. Thermo-fused melamine is melamine resin impregnated decorative paper, thermally fused to industrial grade particleboard or to medium density fiberboard (MDF). Thermal fusion under heat and pressure, permanently bonds the resin impregnated paper to the substrate, and produces a permanent bond between the melamine surface and the substrate.

d. Medium Density Fiberboard (MDF): MDF is ¼" thick, highly compressed wood fibers in a homogeneous sheet, using the fiber's natural resins and other added binders. Physical properties: Average modulus of rupture is 4,500 pounds per square inch; elasticity is 450,000 pounds per square inch; density is 46 pounds per square inch. MDF meets or exceeds ANSI standard A208.2-1994; meets the regulation (24CFR3280.308) when tested in accordance with ASTM E1333-90 for low formaldehyde emissions: 0.20-ppm when tested at a 0.08 $ft.^2/ft.^1$ loading ration, which is 50% lower than normally acceptable commercial levels. MDF has a flame spread rating of Class C or Class III.

e. Particleboard is industrial grade, with the following physical properties: Density, 46 to 50 pounds per cubic feet; modulus of rupture, minimum, 2,200-psi; modulus of elasticity, minimum, 450,000-psi.

f. PVC edgebanding on casework components is 1mm thick, black. Edgebanding applied to door and drawer face edges is 3-mm, black PVC. If specified, edgebanding can be color coordinated with specified high pressure laminate selection.

g. Glass:

(1) DSB glass is double strength, grade "B" and ⅛" thick.

(2) Float glass is poured, clear glass, ¼" thick, with a minimum of 88% clarity.

(3) Laminated safety glass consists of 2 outer plies of glass with a vinyl interlayer, and is either 7/32" or ¼" thick.

(4) Tempered safety glass is specially heat treated glass, ¼" thick with a minimum of 88% clarity.

3. Construction:

a. Drawers:

(1) Drawer Front: Particle board core, overlayed with a .030" vertical grade, high pressure, plastic laminate face, and a cabinet liner back

(2) Drawer Front Edges: Black 3-mm PVC edging

(3) Drawer box: Front, sides and back; ½-", thermo-fused melamine

(4) Drawer Bottom: ¼", thermo-fused melamine

b. Doors, Hinged:

(1) Hinged solid doors, 48" or less in height

(2) Core Ply: Particleboard with squared edges

(3) Plastic Laminate: Two face plys: one applied to each face of the core ply. Face plys are .030" thick, vertical grade, high pressure, plastic laminate.

(4) Edges: Black 3-mm PVC edging applied to squared edges of core ply.

c. Hinged Glazed Doors:

(1) Hinged glazed doors, 48" or less in height

(2) Frame: Particleboard with squared edges

(3) Plastic Laminate: Two (2) face plys: one applied to each face of the core ply. Face plys are 0.030" thick, vertical grade, high pressure, plastic laminate.

(4) Edges: Black 3-mm PVC edging applied to squared edges of core ply

(5) Glass: ⅛" thick DSB glass

d. Sliding Glazed Doors:

(1) Sliding glazed doors, 48"or less in height

(2) Frame: Particleboard with squared edges

(3) Plastic laminate: Two (2) face plys: one applied to each face of the core ply. Face plys are 0.030" thick, vertical grade, high pressure, plastic laminate.

(4) Edges: Black 3-mm PVC edging applied to squared edges of core ply

(5) Glass: ⅛" thick DSB glass

e. Base Cabinets:

(1) Rails:

(a) Horizontal Front Top Rail: 1" by 4", thermo-fused melamine on particleboard

(b) Horizontal Rear Top Rail: 1" by 4", thermo-fused melamine, particleboard

(c) Front Intermediate Rails: ¾" by 4", thermo-fused melamine, particleboard

(d) Back Intermediate Rails as Required: ¾" by 4", thermo-fused melamine on particleboard

(2) Backs:

(a) Exposed Exterior: Exterior surface is high pressure plastic laminate, ¾" particleboard, and interior surface is phenolic cabinet liner.

(b) Cabinets with unexposed exteriors: ¼" thermo-fused melamine on MDF

(3) End Panels:

(a) Cabinets with Exposed Exterior End Panel: ¾" particleboard with exterior surface high pressure plastic laminate, and interior surface of phenolic cabinet liner

(b) Cabinets with Unexposed End Panel: Interior and exterior surfaces of ¾" particleboard are thermo-fused melamine.

(4) Bottom and Shelves: Thermo-fused melamine on ¾" particleboard.

(5) Exposed edges are edged with 1-mm black PVC, applied after lamination. 1-mm PVC, color coordinated to specified exterior high pressure plastic laminate, is available at an additional charge.

(6) Drawer separators, furnished only when specified, are ¼", thermo-fused melamine on MDF.

f. Wall and Upper Cases:

(1) Top Panel, Bottom Panel: 1" particleboard both surfaces are thermo-fused melamine.

(2) Adjustable Shelves: ¾" thermo-fused melamine on particleboard

(3) Backs:

(a) Exposed Exterior: ¾" particleboard. Exterior surface is high pressure plastic laminate, and interior surface is phenolic cabinet liner.

(b) Unexposed Exterior: ¼", thermo-fused Melamine on MDF

(4) End Panels:

(a) Exposed Exterior: ¾" particleboard. Exterior surface high pressure plastic laminate, and interior surface phenolic cabinet liner.

(b) Unexposed End Panel Surfaces: ¾" particleboard with both surfaces thermo-fused melamine. Exposed edges have 1mm black PVC, applied after lamination. 1-mm PVC, color coordinated to specified exterior high pressure plastic laminate, is available at an additional charge.

(c) Exterior Hanger Rails: 3" by ¾" hardwood veneer core plywood

4. Hardware and Accessories:

a. Pulls are powder coated black, extruded aluminum rod, ⅜" in diameter. Pull is mounted with two screws, 4" on center and projects 1-5/16" from the surface.

b. Handles are die cast zinc alloy, 4¼" long, streamline in design, and has a black finish. Handle operates with ¼-turn. Double door cases have latching handles on the right door and dummy handles on the left door. A three point latching system provides a positive engagement at the top and bottom of the door with tapered aluminum rods which pull the door snug when they engage plastic strikes. The rods are 5/16" in diameter and move in nylon guides attached to the back of the door. The middle of the door is secured by a latch plate, which engages the side of the case, or latches behind the left door on cases with double doors.

c. Locks are laboratory grade with 5-disc tumbler mechanism, and a dull chrome plated face. Tumblers and keys are brass, while plug and cylinder are die cast steel. Pushing in on the lock while turning the key, engages a lock bolt into the strike plate; a turn of the key, unlocks the bolt. There are 200 key changes standard. Locks are keyed differently, master keyed and furnished with 2 keys per lock. Locks and corresponding keys are alpha-numerically coded for a quick match. Locks are furnished only when indicated.

d. Hinges are heavy duty, institutional type, 5-knuckle hospital tipped, and made from .095" thick, black powder coated mild steel. Hinge is wrap around style, and 2¾" high.

e. Friction roller catches are a zinc plated steel catch with a positive action, spring cushioned, polyethylene roller, and a metal strike plate. The catch and steel strike plate mount with screws. Catch screw holes are slotted for adjustability.

f. Drawer slides are electrostatically epoxy powder coated, cold rolled steel, heavy-duty, side mounted, and have a 150 pound load capacity. They are equipped with heavy-duty, ball bearing nylon rollers for smooth effortless operation. Slides have automatic positive stop levers to prevent accidental drawer removal but allow quick removal without tools.

File drawer slides are zinc plated, cold rolled steel, heavy-duty, side mounted and have a 100 pound load capacity. They are equipped with heavy-duty, ball bearing nylon rollers for smooth

effortless operation. Slides are full extension with a positive stop and a lift out disconnect.

g. Sliding door track assembly has an overhead aluminum track and adjustable, nylon roller hangers. The lipped edge of the upper aluminum track prevents rollers from jumping track. Two hard plastic guides are mounted on the bottom interior of the door and operate in recessed aluminum channels.

Sliding glass door track assembly has an aluminum bottom track and an aluminum channel mounted at the top of the cabinet. The glass rests in aluminum shoes with nylon rollers, which operate in the bottom track. The top swiped edge of the glass is fitted with plastic glide clips to assure smooth movement in the channel.

h. Shelf clips are made from steel, then brass plated after fabrication. Clips are angle type with a ¼" diameter, ⅜" long stud which fits into holes drilled 32-mm on centers. The ¾-inch long ledge is dipped in a non-slip plastic coating and has a predrilled hole to anchor shelf to the clip, if desired.

i. Leg shoes are closed-bottom style, 2¼" square and molded of ⅛" black polyethylene.

j. Crossbars and Greenlaw Arms are ¾" diameter, anodized aluminum rods, with ends rounded.

k. Upright rods are ¾" diameter, anodized aluminum, 36" long with a rounded top and a tapered bottom to fit rod sockets.

l. Clamps are 1" square aluminum stock, with two ¾" diameter openings at right angles to each other, bored through sides. Openings are for upright rods and crossbars or Greenlaw Arms. Thumb screws into each end of the clamp, tighten against the rods to hold positions.

m. Burette rods are ½" diameter, anodized aluminum, and either 18" or 24" long. Rods are furnished with a tapered aluminum adapter to fit rod socket.

n. Rod sockets are mushroom type, machined from a solid aluminum road. Sockets are secured to the top by heavy aluminum lock nut and washer.

5. Sinks and Sink Outlets: Epoxy resin sinks are non-glaring black, specially modified epoxy resins, molded in one solid piece for optimum physical and chemical resistance. Inside corners are coved and the bottom is dished to the outlet. Outlets are epoxy resin, specially compounded and cured for optimum physical and chemical resistance, and 1½" in diameter, unless otherwise specified.

6. Laboratory Tops: Top is 1" thick, molded from a modified epoxy resin and has optimum physical and chemical resistance. The specially compounded and cured uniform mixture throughout the thickness of the top is not dependent on a surface coating for chemical or stain, resistance. Standard color is non-glaring black. However, other colors are available. Exposed edges and corners are radiused, and a drip groove is provided on under surface, when specified. The curb is 4" high.

7. Casework Finish: High pressure, phenolic cabinet liner and thermo-fused melamine laminates meet or exceed the NEMA LD3-1991-GP28 and ALA minimum requirements for applications used. Laminates conform to relevant sections of standards set by Woodworkers Institute of California (WIC) for exposed, semi-exposed and unexposed surfaces. Laminates meet the ASTM-E-84 and ULC burn test standards; and, in accordance with FTM-2 show formaldehyde emissions of less than 0.3-ppm.

8. Counter Tops: All countertops, backsplashes and reagent shelves shall be ¾" molded modified epoxy resin mixture, cured to provide optimum physical and chemical resistance, with the 1" molded marine edge to contain spills. Backsplashes shall be molded into counter tops.

9. Sink Assembly: Sink assembly shall base unit, work top with basin cutout, basin hangers, trap, overflow, gooseneck faucet with hot and cold water supply and molded epoxy resin sink.

10. Submittals: Shop drawings shall be submitted in accordance with the General Requirements section of these Specifications and shall show detailed plan and elevation views of the laboratory furniture and accessories. Quantity, specified part number and description shall be listed on the Drawings.

C. Laboratory Equipment Allowance: The Contractor shall include in his bid allowance amount of $25,000 for laboratory equipment. The Owner will provide the Contractor with a list of equipment to purchase using this allowance amount as construction nears completion.

9.22 Specialties:

A. Base Bid:

1. Hose Reel: Armstrong Model 047-82, Strahman Model RS-X or equal hose reel with 75' of ¾" wash down hose with bumper stop and stainless steel spray nozzle

2. Dock Bumpers: Contractor shall furnish and install where shown on the Drawings molded cored rubber dock bumper. Bumpers shall be fabricated of new rubber with nylon, rayon or tyrex cord. Number and spacing of units shall be as indicated on the Drawings, and installation shall be as recommended by the manufacturer. Bumper shall be type XHD-12/24 by Geo. W. Lumm & Co., LB424-11 BT by Durable Corp or equal

3. Utility Sink: Contractor shall furnish and install where shown on the Drawings one (1) stainless steel utility style scullery sink 16-gauge steel, 27" W x 27½" D x 42" H by Griffin Products Model T60-144, Advance Tabco 400 Series 1 or equal with American Standard Model 7298.152.002, Kohler Model K-7308-5A-CP or equal faucet. Provide and install all necessary appurtenances.

4. Lockers: Provide 17 sections of single tier lockers (2 in women's restroom and 15 in men's restroom), 12" W x 18" D x 72" H of steel construction with baked-on enamel finish, Model 5042 by Lyon Metal Products, Inc. or equal.

5. Shower Room Bench: One (1) bench, 9 ½" wide x 8' long. Seat to be selected hardwood with clear sealer.

6. Map Rack: One (1) map rack, 24"W x 36"D x 48"H of welded steel construction with twelve (12) plan set capacity on equally spaced, pivoting arms

7. Fire Extinguishers:

   a. General: Brochures showing details of extinguishers shall be submitted for approval of the Engineer. Provide extinguishers where shown on the Drawings.

   b. Dry Chemical Extinguishers: Dry chemical extinguishers shall be 10% capacity rated for Class A, B, C fires. Shell material shall be enameled steel. Extinguishers shall be wall mounted in cabinet as shown on the Drawings.

   c. Execution: Installation shall be in strict accordance with approved shop drawings.

8. Water Heater: Contractor shall furnish and install where shown on the Drawings:

Location	*Description*	*Model*
• Control Building	Two (2) 4,500 W, 240V, single phase elements 80 gallon storage	State Statesman SSE-80, Ruud Rue Pro 80-2
• Sludge Dewatering Building	One (1) 18,000 W, 480V, three phase element 80 gallon storage	State Statesman SSE-80, Ruud Rue Pro 80-2
• Blower Building	One (1) 3,000 W, 240V, single phase element 30 gallon	State Statesman SSE-30, Ruud Rue Pro 30-2

9. Safety Shower: Contractor shall furnish and install where shown on the Drawings safety shower with eye wash.

   a. Indoor Unit: Haws Model 8300-8309, Guardian G1909 or equal

   b. Outdoor, Self-Draining Unit: Haws Model, 8300.158, Guardian G1941 or equal

10. Hoist Equipment: The Contractor shall furnish and install all hoists, trolleys, festoons, control panels and appurtenances shown on the Drawings and specified herein including all hangers, brackets, clamps, anchors, anchor bolts and other necessary equipment required for a complete installation. All equipment shall be suitable for outdoor service with stainless steel drums and wire rope. Festoons shall have C-track with 12/4 power cable and stainless steel brackets and trolleys. Equipment shall be as manufactured by Shaw-Box or equal . Hoist and trolley shall be provided as per the following schedule:

Location	***Effluent Pump Station***
Lift Capacity	2 ton
Lift Height	35'
Lift Speed	20/5 fpm
Trolley Speed	50/17 fpm
Treadline > Hook Dim. (max)	40"
Voltage	460

   a. Trolley: Contractor shall provide trolley of steel construction, suitable for outdoor service and shall be adjustable for a variety of monorails sizes. Side plates shall act as bumpers to protect wheel flanges from damage. Trolley wheels shall be equipped with ball bearings.

   b. Contractor shall provide certified load test in accordance with OSHA 1910.179.

11. Tool Chest: Contractor shall provide 42" W x 18 ⅛" D x 38 ¾" H 11-drawer, rolling tool cabinet with 41"W x 17 ¾" D x 21 ½" H 8-drawer top tool chest by Homak Pro Series, WEN or equal.

12. Utility Shelf: Contractor shall furnish and install where shown on the Drawings one 72" H x 48" W x 24" D, 5-tier steel free standing unit utility shelf by Edsal, Tennsco or equal.

13. Desk: Contractor shall furnish 3 double pedestal metal desk, 5'-0 W × 2'-0 D with plastic laminate flakeboard top, lockable center drawer, three standard box drawers on the left and box over file drawer on the right. Baked-on enamel finish to be black with cherry colored laminate top. Desk to be "Metro Series" by Hon, Elevation Series by High Point Furniture Industries or equal.

14. Desk Chair: Contractor shall furnish 3 multi task, swivel desk chairs with fully welded, one-piece frame and base construction, foam back and arm

rests, lumbar support and pneumatic height adjustment. Chair color to be navy with black base and frame. Chairs to be Hon Model HVL601, 1007 by High Point Furniture Industries or equal.

15. Guest Chair: Contractor shall furnish 4 guest chairs HON Model HVL 653, High Point Furniture, or equal and two (2) HON Model H2403, High Point Furniture or equal. Chair color to be selected by Owner.

16. Coffee Table: Contractor shall furnish one 20" D x 42" W x 16" H laminate coffee table, Hon Model HBLH3160, Highpoint Furniture Industries or equal.

17. Conference Table: Contractor shall furnish one 72" x 36" table top. Tabletop color shall be cherry and steel base color shall be black. Tabletop and base shall be manufactured by Hon, Highpoint Furniture Industries or equal.

18. Conference Chairs: Contractor shall furnish 8 upholstered stack chairs with 1" dome seat pad. Vinyl color shall be black on black frame. Chairs shall be Hon Model 1081, High Point Furniture Industries Model 712 or equal.

19. File Cabinets: Contractor shall furnish four 4- drawer, letter size file cabinets. Cabinets to be full suspension of steel construction and have a baked-on enamel finished in black color. Cabinets to be "210 Series" by Hon, Elevation Series by High Point Furniture Industries or equal.

20. Bookcase: Contractor shall furnish five 36" width × 60" height square edge abrasion resistant thermal fused laminate bookcase. Color is to be cherry. Bookcase to be "Value Series" by Hon, Elevation Series by High Point Furniture Industries or equal.

21. Television and Wall Mount: Contractor shall furnish 60" LED Smart TV, Samsung 6200 Series, Model UN60J6200 with tilt and swivel articulating arm wall mount bracket full motion model DCB15204 or equal.

22. Mounted Posters: Contractor shall provide the following posters, mounted separately in Studio Décor Trendsetter Black 24" x 36" poster frame or equal:

    a. Chart of Active Sludge Microorganisms, USABlueBook number 70241

    b. Activated Sludge Troubleshooting Chart, USABlueBook number 70245

    c. Biological Nutrient Removal Troubleshooting Chart for Suspended Growth Systems, USABlueBook number 70246

9.23 Toilet Accessories: Contractor shall furnish and install all toilet room accessories specified herein.

A. Submittals: Contractor shall submit shop drawings for all manufactured or fabricated items in this Section in accordance with Section 1 – General

Requirements of these Specifications. Submittal shall indicate method of anchoring each type of accessory to each type of wall.

B. Products:

1. Toilet Paper Dispenser: Provide 1 toilet paper dispenser for each water closet by Bobrick model B-273, American Standards model 0710, or equal.

2. Paper Towel Dispenser: Provide 1 paper towel dispenser for each restroom and laboratory by Bobrick model B-262, American Standards model 705431, or equal.

3. Waste Receptacle: Provide 1 waste receptacle for each restroom by Bobrick model B-279, American Standards model 20826, or equal.

4. Soap Dispenser: Provide 1 soap dispenser for each restroom and laboratory by Bobrick model B-2111, American Standards model 20363, or equal.

5. Mirror: Provide a 16 " x 24 " mirror for each restroom by Bobrick model B-165, American Standards model 0620, or equal.

6. Coat Hook: Provide 1 coat hook for each water closet by Bobrick model B-682, American Standards model 7382, or equal.

9.24 Plaque: The Contractor shall furnish and install on the building as directed by the Engineer, 1 anodized aluminum plaque sized as indicated on the Drawings. The plaque shall be a simple design and shall bear inscriptions in raised letters as shown on the Drawings. The Contractor shall submit detailed full scale drawings showing the inspection as directed and indicating clearly the means for attaching the plaque to the wall. No work shall be done until the detailed drawing and rubbing have been approved.

9.25 Payment: No separate payment will be made for the work of this section. The cost of the work, and all costs incidental thereto, shall be included in the price bid for the item to which the work pertains.

SECTION 10
MECHANICAL EQUIPMENT

10.01 Scope: The Contractor shall furnish all materials, labor and equipment necessary for complete installation of mechanical equipment as shown on the Drawings and/or specified and the furnishing of the services of a competent factory representative to supervise and/or inspect the installation and initial operation of the equipment. The duration of the service to be furnished during the periods of installation and initial operation is estimated as specified below:

Article Number	Equipment	Days of Service
10.13	Sequencing Batch Reactor System	12
10.14	Tertiary Filter System	2
10.15	Ultraviolet Disinfection Equipment	3
10.16	Sludge Dewatering Equipment	2
10.17	Submersible Pumps	1
10.18	Vertical Turbine Pumps	1
10.19	Chemical Feed Equipment	4
10.20	Floating Aerators	1
10.21	Floating Mixers	1
10.22	Post Aeration Equipment	1

A. The Contractor shall furnish, install, test, adjust and paint in accurate, satisfactory, workmanlike manner, all machinery, equipment, apparatus, accessories, and fittings required for the completion of the work in accord with the Drawings, Specifications and equipment manufacturer.

B. The Contractor shall furnish and install all materials including electric wiring, conduits, and controls not furnished by the equipment manufacturers. The Contractor's attention is directed to the General Requirements with reference to requirements for furnishing working drawings.

C. The Contractor shall refer to electrical drawings for all voltage requirements for mechanical equipment.

10.02 Supervisory Services: The periods of installation and initial operation shall be assumed to occur on successive days, unless otherwise stated herein. If the Contractor fails to arrange his work so that all services may be performed on successive days, he will be required to furnish such services at a later date, at no additional expense to the Owner. Periods of service on more than 1 item furnished by the same manufacturer may run

concurrently, if so approved and permitted by the Engineer. Manufacturers, who are required to furnish supervisory and/or inspection services, shall extend those services to include all equipment furnished by them for the Project, whether listed or not.

10.03 Equipment Bids:

A. Manufacturer: Any reference to an item of equipment or material by a specific manufacturer's trade name in these Specifications is intended merely as a standard. Even though named in the Specifications, equipment offered with smaller or lightweight mechanism or devices compared to that specified will not be approved for the project. Each bidder is required to state in his bid the name of at least 1 manufacturer or supplier named in these Specifications for each major item of equipment and his bid price for that item as required in the Proposal. This requirement is to prevent rejection of the bid should a piece of substitute equipment be rejected. Other equipment shall be considered as specified in the "General Condition," if offered by the bidder under "Substitute Equipment," in the Proposal: provided, it is equal in functional design, mechanical and structural details, to the one specified.

If no named manufacturers are specified, the Contractor shall include the name of the manufacturer to be used in the Proposal.

B. Substitute Equipment: Equipment offered under "Substitute Equipment" of the Proposal shall comply with requirements of these Specifications. It shall be the responsibility of the Bidder to determine that equipment offered in the Proposal is in accordance with the Specifications. Substitute equipment offered at a lower price by reason of smaller or lightweight members, inferior to or inefficient mechanism or devices will not be considered.

C. Substitute Equipment Bid: The price for substitute equipment shall include the cost of all changes in the structure, mechanical, electrical work, and in other appurtenances for the accommodation of such equipment as determined by the Engineer, at the expense of the Contractor.

1. Information Required: It shall be the responsibility of the Bidder to ascertain that each manufacturer named in his Proposal has submitted to the Engineer at least 2 weeks in advance of the letting date complete information in regard to the equipment offered. For makes of equipment named in the Specifications this may be a statement that the equipment offered is in strict accordance with the Engineer's Specifications, listing any and all exceptions. To all substitute items of equipment, complete drawings, specifications, thickness and weights of principle parts shall be furnished to the Engineer 2 weeks prior to the letting date. A list of all substitute equipment which has been submitted in accordance with the above will be provided to all bidders 1 week prior to the receipt of bids.

   For makes of equipment with no named manufacturers, the manufacturer must either submit a statement that equipment is in strict accordance with the Specifications or list any exceptions.

2. Experience and Manufacturer: It is desired that only equipment which has undergone thorough development as provided by successful service in similar installations for at least 2 years shall be accepted for installation unless specified elsewhere in these Specifications. Manufacturers and/or equipment which does not meet the 2 year experience period will be considered if the manufacturer or supplier provides a bond or cash deposit which will guarantee replacement of the equipment or process in the event of failure or unsatisfactory service. The amount of bond or cash deposit shall be sufficient to cover all labor and equipment costs for replacement in addition to any costs incurred by the Owner because of failure or unsatisfactory service. The period of time for which the bond or cash deposit is required shall be 2 years.

D. Standardization: To avoid a division of responsibility among several manufacturers for items of equipment having functions related to each other or to the same portion of the treatment process, and to avoid unnecessary duplication of replacement parts and service calls by the Owner, unless otherwise permitted herein, the equipment supplied under any numbered paragraph shall be the product of, or furnished and guaranteed by, 1 manufacturer.

10.04 Equipment Obtained from Equipment Manufacturer:

A. The Contractor shall obtain all equipment specified, and that required for the safe operation and use of that equipment from the manufacturer or the equipment, unless excluded by provisions in this paragraph or Specifications for the item.

B. Unless otherwise stated in the Specifications, the following type of materials shall not be considered to be a part of the equipment:

1. Connecting piping and valves
2. Railing set in the tank or structure
3. Motor starters and wiring
4. Steps and manholes installed separately from equipment
5. Finish painting, etc.

10.05 Equipment Approval: Each manufacturer furnishing equipment shall submit the following information to the Engineer for approval:

A. Shop drawings, guaranteed performance curves, wiring diagrams, specifications, and lists of electrical controls, including manufacturer's name and catalog number; furnish horsepower, normal full load maximum load ampere rating of each motor shall be submitted to the Engineer for approval. Submittals shall verify compliance with the contract documents with any deviations noted by the Contractor. Prior to shipment, Contractor shall submit 3 printed copies of certified test curves for each pump with capacity of greater than 100 gpm, certified drawings and details to adequately describe the function, performance characteristics, dimensions, arrangement, support, anchorage and other similar information to allow for installation, operation and maintenance. The Contractor shall provide 1 digital pdf file of the submittals for review. After review, the

Engineer will return 1 digital copy and any excess printed copies to the Contractor. Submittals shall also include the estimated weight of each unit.

B. Spare Parts List: Contractor shall list spare parts and tools furnished with equipment. Unless otherwise specified herein, tools shall be only such special tools required by the particular equipment.

10.06 Mechanical Testing: After each unit has been installed and is ready for operation, it shall be operated continuously for a period of 24 hours. During that period, the equipment will be inspected for defects and weakness. Parts of the unit, which show a defect or weakness, or both, shall at once be removed and be replaced with new parts or be made good in a satisfactory manner, at no additional expense to the Owner.

A. Continuous 24-hour test shall be made after all defects have been remedied, at no additional expense to the Owner.

B. After installation and final testing, each equipment manufacturer furnishing supervision and/or inspection services shall make written certification to the Engineer and the Owner that the equipment and controls have been properly installed in accord with the Drawings, Specifications and manufacturer's requirements, and that the required operating and maintenance instructions have been furnished to the Engineer.

10.07 Piping for Equipment: The Contractor shall furnish completely dimensioned layouts for all piping, fittings, valves, specialties, and other equipment. Deviations from the dimensions shown on the drawings caused by equipment dimensions shall be taken into consideration by the Contractor and changes in piping, electrical conduit, and other similar items shall be done at no additional expense to the Owner.

A. All piping and appurtenances shall be properly supported by a system of hangers, pipe stands, saddles, base ells, and concrete piers as required. Concrete insets, bolts, anchors, etc., shall be placed in the forms before placing concrete.

B. Drip piping, ¾" in size, shall be provided for all pumps; use crosses and plugs at all changes of direction. Piping shall be run to nearest drain in a manner, which will not constitute a hazard to floor traffic. Furnish plug valve, or stop cock, bleeds for high points in piping for all pumping units.

10.08 Shop Painting: All shop painting of equipment shall be as specified in "Painting" Section, unless otherwise specified.

10.09 Operation and Maintenance Manuals: Before the work is 50% complete, the Contractor shall submit 3 printed copies and 1 digital pdf file of operation and maintenance manuals for equipment as specified. The digital file shall be provided on a single drive or disk. Each component shall be labeled per the specification section referenced, for example:

"8.22 Aluminum Gates.pdf" or "11.13 Mechanical Bar Screen.pdf"

10.10 Guarantees: The Contractor shall guarantee the equipment to be free from defects in workmanship, design, and material for a period of 1 year after initial operation begins; the Contractor shall replace at no additional expense to the Owner, every defective part, and every part showing undue wear during that guarantee period. The date of initial

operation shall be only after approval by the Engineer and shall be furnished in writing to the Contractor.

10.11 Spare Parts and Allowance: The Contractor shall allow $10,000.00 in his bid for spare parts in addition to those specified for individual pieces of equipment. The Contractor shall submit a list of spare parts recommended by the manufacturers along with a price list for the Engineer's approval.

10.12 Motors: Motors for operating mechanical equipment shall satisfy the latest requirements of the Institute of Electrical and Electronic Engineers, American National Standards Institute, and the National Electrical Manufacturer's Association. Motors shall be manufactured by Weg, Baldor, NIDEC or approved equivalent. All single and three-phase motors (except fan motors which may be of an approved manufacturer standard) shall be ball bearing, and have either sealed-in lubricant or be designed for external oil or grease lubrication. The equipment manufacturer shall supply motors having sufficient torque to start equipment under load and to accelerate the equipment smoothly and quickly to full speed without exceeding the motor nameplate ratings, including service factor. Motors shall have 1.15 service factor, except totally enclosed and inverter duty rated motors unless otherwise specified.

A. Motors 25 horsepower and larger shall be equipped with embedded stator thermostats (normally closed) connected internally in series and brought out through motor junction box for connection to starter pilot relay 115V control circuit. Large motor protection will be covered under the paragraph applying to the individual motor.

B. Motors ½ horsepower and larger shall be 3-phase, 60 hertz, induction type and be designed for full voltage starting. Motors shall have either 40° C rise Class insulation or 60° C rise Class B insulation, be open drip-proof for indoor installation, be vertical splash-proof and drip-proof for outdoor installation or have 70° C Class B rating rise for totally enclosed, non-ventilated, outdoor, horizontal installation.

C. Motors smaller than ½ horsepower shall be single phase, induction, capacitor-run type, unless otherwise specified. Very small motors, and those for special purposes, may be shaded pole type; their use shall be subject to approval by the Engineer.

10.13 Sequencing Batch Reactor System: The Contractor shall furnish all labor, material, tools and equipment necessary to install a complete sequencing batch reactor system (SBR) as shown on the Drawings and in accordance with these Specifications.

A. Manufacturers: The SBR system shall be supplied by a company of good reputation that is regularly engaged in the manufacture and fabrication of SBR wastewater treatment systems. The manufacturer's experience shall include a minimum of 10 installations where equipment of similar size and design has been in operation successfully in a similar process for a minimum of 5 years. As a minimum, the supplier shall be the manufacturer of the following components: mixers, decanters, retrievable diffusers, aerator and controls. The system shall be manufactured by Aqua-Aerobic Systems, Inc., or equal.

The Contractor shall assign full responsibility for the functional operation of all SBR system components to a single source supplier. This supplier shall be responsible for all engineering necessary in order to select, furnish, inspect the Contractor's equipment installation and connections, calibrate and place into operation the SBR system along with all other equipment and accessories as specified herein.

B. Service: The equipment manufacturer shall furnish the services of a factory trained representative for a maximum of 3 trips and twelve 8-hour days at the jobsite to inspect the Contractor's equipment installation, supervise the initial operation of the equipment, instruct the plant operating personnel in proper operation and maintenance and provide process assistance.

C. SBR Function Requirement: The manufacturer of the SBR system shall be completely responsible for the proper design of their system including but not limited to: diffused aeration equipment, transfer pumps, mixers, aerator, decanters and controls. All equipment shall perform as specified and the completed installation shall operate in accordance with the requirements of Drawings and Specifications.

The aeration system is defined as the aeration device working in conjunction with a mixer. The aeration system shall be designed to provide oxygen distribution to the entire basin. It shall also ensure mixing to promote suspension of all biological solids in the basin without the introduction of air. No change in the basin geometry shall be allowed. The velocity and mixing in the basin shall be sufficient to ensure complete biological solids suspension and dispersion.

The aeration system for the aeration basins shall be capable of providing mixing such that when operated under any combination of the specified design conditions, it shall suspend all biological floc and mixed liquor suspended solids throughout the liquid mass in each basin. The aeration system shall further be capable of maintaining complete aerobic conditions and suspension of all biological floc and suspended solids throughout the liquid mass in each basin.

The aeration system shall be designed to operate within a minimum of 13.3' and a maximum of 21' side water depth and shall be capable of transferring a minimum of 419.6 pounds / hour of process oxygen (AOR) into the wastewater.

1. Warranty:

   a. The floating mixer shall be warranted for 3 years for defects in materials and workmanship and 5 years as a no maintenance unit.

   b. The SBR system shall be warranted against defects in materials and workmanship. Manufacturer shall warrant the goods provided by the manufacturer to be free from defects in materials and workmanship under normal conditions and use for a period of 1 year from the date the goods are put into service, or 18 months from shipment of equipment, whichever first shall occur. This warranty shall not apply to any goods or part which has been altered, applied, operated or installed contrary to the

manufacturer's instructions or subject to misuse, chemical attack/degradation, negligence or accident.

D. Design Conditions: The Contractor shall furnish and install the SBR system as shown and / or specified.

1. Average Daily Flow: 3.0 MGD

2. Peak Daily Flow: 7.5 MGD

3. Design Loadings:

		Influent	Effluent (after filtration)
a.	BOD (mg/l):	300	5
b.	TSS (mg/l):	300	20
c.	TKN (mg/l):	40	
d.	NH_3-N (mg/l):		0.5
e.	Total Phosphorus (mg/l):	8	0.5

4. Wastewater Temperature: 54° F to 72° F

5. Jobsite Elevation: 450 MSL

a. Alpha (maximum value allowed): 0.85

b. Beta (maximum value allowed): 0.95

c. F/M Ratio: 0.083 lb BOD_5 / Pound MLSS / Day

d. MLSS at Low Water Level: 4,500 mg/l

e. Cycles: 5 per day per basin

f. Oxygen Requirements:

- BOD_5 Applied: 1.25 lbs O_2/ lb
- TKN Applied: 4.6 lbs O_2/lb

g. Aeration Time: 1.7 hours/cycle @ MDF

h. Mixing Time: 2.85 hours/cycle @ MDF

i. Settling Time: 0.75 hours/cycle @ MDF

j. Maximum Oxygen Transfer Efficient (per foot of diffuser submergence standard conditions): 1.25%

k. Average Diffuser Submergence: 15.6'

E. SBR Structure:

1. The SBR system shall be field erected in 4 basins as shown on the Drawings with the following:

a. Inside Dimension: 88' diameter

b. Side Water Depth (minimum): 13.3' SWD

c. Maximum Operating Level: 21' SWD

d. Top of Wall: 23.5'

2. Influent Plug Valve: Contractor shall furnish one 20" diameter electrically operated flanged plug valve for each basin to control the influent flow.

Valves shall be a 125# flanged end connection, ASTM A-126 Class B cast iron body with welded in nickel seat, neoprene coated cast iron plug, assembled and tested with a 460 volt, three phase, 60 cycle open/close service electric actuator. The valve shall be a non-lubricated type with a port area of at least 80% of full pipe size. Valve actuator shall include a compartment heater. Each valve shall include a manual override with limit switch feedback to the micro-processor in both the open and closed positions. Field wiring and junction box disconnect shall be provided by the Contractor.

3. Floating Mixer: Contractor shall provide 1 mechanical floating mixer and related equipment accessories as described herein for each basin. Each mixer shall consist of a motor, direct drive impeller driven at a constant speed, an integral flotation unit and impeller volute. The mixer shall provide for 3 years without routine maintenance.

a. Performance: Each mixer shall have a zone of complete mix of 88' diameter at 21' water depth and a direct pumping rate of 16,540 gallons per minute with a recirculation rate of 546,000 gallons per minute and a basin turnover of 1.75 minutes at maximum water level. Complete mix shall be defined as maintaining biological suspension of all mixed liquor suspended solids with an MLSS of 4,500 mg/l or less without the introduction of air.

b. Mixer Drive Motor: The motor shall be rated for 25 horsepower at 900 RPM and wired for 460 volt, 60 hertz, 3-phase service. The motor shall be premium efficiency, vertical P base design, totally enclosed fan cooled TEFC and generally rated for severe duty. The motor shall in all cases equal or exceed standard NEMA specifications. A minimum service factor of 1.15 shall be furnished.

The motor winding shall be nonhygroscopic, and insulation shall equal or exceed NEMA Class 'F'. A labyrinth seal shall be provided below the bottom bearing to prevent moisture from penetrating around the motor shaft. A condensate drain shall be located at the lowest point in the lower-end bell housing. Unit shall have a one-piece motor shaft, continuous from the top motor bearing through the lower bearing and down to and through the propeller. The shaft will be manufactured from 17-4 PH stainless steel.

Motor bearings shall be regreasable. Sealed bearings are not acceptable. Top bearing shall be shielded on the bottom side only. Bottom bearing shall be open. The top and bottom motor bearings

shall be of combined radial and axial thrust type. The lower motor bearing inner race shall be locked to the motor shaft via a special washer and locking nut arrangement. The shaft shall be threaded just below the lower bearing and shall have a keyway cut into the motor shaft. This key shall accept a tab from the inner diameter of the locking washer, and the locking nut shall have recesses to accept a tab from the outer diameter of the locking washer to prevent the nut from backing off. Snap ring type bearing retainers will not be acceptable.

Submerged motors, jet pumps, submerged gear motors or gearboxes shall not be acceptable.

Each motor shall include one 115V, single phase, 60 Hz normally closed motor winding thermostat.

c. Motor Mounting Base: The motor shall be securely mounted onto a solid 304 stainless steel base which is integral with the motor base expansion. All submersed wetted motor mounting base components shall be constructed of 304 stainless steel.

The upper portion of the motor mounting base immediately below the lower motor bearing shall include 2 independent acting air seals. The 2 seals shall be capable of sealing off the flow of air from the suction action of the pumped flow and prevent backflow of liquid during impeller reversal. The lower end of the motor base extension shall be provided with a rotating backflow seal that will prevent grit from being introduced into the anti-deflection insert reservoir but shall allow liquid to contact the shaft. The backflow seal shall not require scheduled lubrication or maintenance.

d. Flotation: Each unit shall be equipped with a modular float constructed of fiber reinforced polyester skin (FRP) with a central float passage of a size to allow installation and removal of the pump impeller. The minimum diameter of the float shall be 114 ½", and the minimum thickness shall be 13 ¼". The float shall be foamed full of polyurethane foam of the closed cell type and shall be totally sealed to prevent the foam from being in contact with the external environment. The minimum reserve buoyancy shall be 2,885 pounds.

e. Impeller: The impeller shall be designed to pump the liquid from near the surface and direct it down toward the basin bottom. The impeller shall be a two blade, marine type precision casting of 316 stainless steel and shall be specifically designed for the application intended. It shall be dynamically and hydraulically balanced. The propeller must be attached to the motor shaft with a hardened stainless steel pin and set screw. Impeller shall be capable of being reversed to cause backflow liquid movement without causing

damage to the mixer chassis and without causing upflow liquid damage to the motor bearing and windings. No liquid spray or other liquid leakage upward onto the surface of the motor support surface or flotation chassis will be allowed.

f. Intake Volute Assembly: The impeller shall operate in a volute made of 304 stainless steel plate with a minimum 3/16" thick.

g. Vibration: The impeller and rotor unit shall be dynamically balanced as a completed assembly and as an integral unit with the motor mounting base to a vibrational level not to exceed two mils at the motor RPM.

h. Cable Mooring System: A cable mooring system shall be supplied consisting of 3 stainless steel mooring cables which extend from the basin sidewall to the unit. In addition, cables shall be provided complete with clips, thimbles and quick disconnects as shown on the Drawings to ensure a consistent location within the basin.

i. Pivotal Mooring Electrical Power Cable: Each unit shall include #6-four conductor power and #12-3 thermostat cable wired into the motor conduit box and terminating at the basin wall. Electrical cable shall be supplied with Kellems cable grips at the motor and basin wall terminations. Electrical cable shall be attached to the mooring arm with cable ties provided by the equipment supplier. Attachment of cable and supply of junction box/disconnect at the basin wall shall be the responsibility of the Contractor.

4. Decant Assembly: Contractor shall furnish one 10 x 9 mechanical floating decanter and related equipment accessories as described herein for each basin. Each decanter shall consist of an integral flotation unit, a stainless steel moveable weir assembly and an electric motor-driven actuator to open and close the weir.

a. Performance: Each decanter shall be capable of withdrawing decant fluid from 4" to 6" beneath the liquid surface, regardless of liquid depth, down to the minimum allowable water level specified below. The decant liquid shall be drawn through an adjustable weir opening of 2" to 6". The weir shall be circular in shape and permit liquid to enter the decanter from the entire 360° without obstruction.

1) Maximum allowable water level in the basin is 21'.

2) Minimum allowable water level in the basin is 13.3'.

3) The centerline of each decant pipe must be located 3.8' below the low water level by the Contractor.

4) Each decanter shall be rated for an average flow of 5,208 gallons per minute.

b. Weir Actuator: The weir actuator shall include a reversible electric motor operated linear actuator. The actuator shall be capable of operating with a closing force of 1,500 pounds and shall operate from a 115 volt, single phase, 60 hertz source. Adjustable limit switches shall be included to permit adjustment of the weir opening. A coil spring shall be included to provide for travel after the weir has closed and provide desired closure pressure. A corrosion resistant removable cover shall be included to provide protection to the actuator and motor during normal operation. The power section is 304 stainless steel. #14 AWG ten-conductor power cable shall be provided from the NEMA 4X junction box of the unit to the basin wall. Supply of junction box disconnect at the basin wall shall be the responsibility of the Contractor.

c. Weir: The weir shall be constructed of 304 stainless steel, be circular in shape and shall include vortex control baffles permanently affixed to the weir. The weir shall be attached to the actuator through a removable single shaft which shall also function as the torque restraint.

d. Flotation: Each unit shall be equipped with a modular float constructed of 304 stainless steel filled with closed cell polyurethane foam having a minimum of 2.0 pounds/cubic feet density. Float shall be completely sealed to prevent the foam from being in contact with the external environment. Float shall have 1,833 pounds reserve buoyancy to ensure stability and to provide support flotation required during decanter servicing. A urethane type seal shall be molded onto the bottom of the float assembly to receive the decanter weir.

e. Decanter Discharge Pipe: Each decanter shall include a 304 stainless steel elbow with 18" diameter stainless steel. The Contractor shall provide a ¾" valve with hose bib connection on the decant line between the decanter and the decant valve.

Each decanter shall include two 18" diameter stainless steel flex joints. Flex joints shall be constructed of 304L stainless steel flanges and 321 stainless steel bellows. Flex joints shall utilize heavy duty 304L stainless steel hinges with over-travel stops and full perimeter welds. Flex joints shall carry a minimum rating of 50,000 cycles per EJMA calculations, the Elastic Joint Manufacturer's Association. Flex joints shall be full port diameter, and not reduce flow area of the nominal pipe size. Flex joints shall be fully crated and provided with shipping bars that immobilize and protect the flex joint prior to final installation. Flex joints constructed of plastic or rubber material are not acceptable.

Each decanter assembly shall terminate in a flanged 304 stainless steel elbow at the basin wall. All piping, pipe supports, gaskets

and hardware beyond the terminating flange of the elbow shall be supplied by the Contractor.

f. Decanter Restrained Mooring System: Each decanter shall include a 304 stainless steel mooring frame attached to the float. One 4" diameter Schedule 40 304 stainless steel mooring post assembly with base plate shall be provided to assure consistent location of the decanter in the basin. Mooring post shall be filled with concrete by the Contractor.

304 stainless steel dewatering support posts consisting of two 4" diameter Schedule 40 vertical pylons with base plates shall be provided. Each support with base plate shall be affixed to the basin floor with 304 stainless steel adhesive anchors.

Top and bottom mooring post supports constructed of 304 stainless steel shall be provided for attachment to the basin wall by the Contractor.

g. Decant Flow Control Valve: Contractor shall furnish one 20" diameter electrically operated butterfly valve for each basin to control the decant rate.

Valves shall be an AWWA C-504 Class 150B electrically operated butterfly valve with ANSI Class 125# flanged end ASTM A-536 ductile iron body, ductile iron disk with a 316 stainless steel edge, fully lined EPDM seat vulcanized in the body, 304 stainless steel shaft assembled and tested with a 460 volt, three phase, 60 cycle open/close service electric actuator. Valve actuator shall include a compartment heater. Each valve shall include a manual override with limit switch feedback to the microprocessor in both the open and closed positions. Field wiring and junction box disconnect shall be provided by the Contractor.

h. Sludge Pump: Contractor shall furnish 1 submersible non-clog sludge pump for each basin. Each pump shall be equipped with 3 horsepower, submersible electrical motor connected for 460 volt, three phase, 60 hertz operation. Pump housing shall be painted cast iron. Pump shall include an adequate length of multi-conductor hypalon jacketed type SPC cable suitable for submersible pump applications. The power cable shall also be sized according to NEC and ICEA standards. The pump shall be supplied with a mating cast iron discharge elbow and be capable of delivering 50 gallons per minute at 33' TDH and 225 gallons per minute at 25" TDH. Each unit shall be fitted with an adequate length of 304 stainless steel lifting chain of adequate strength to permit raising and lowering the pump.

1) Discharge Connection: The 3" diameter discharge connection elbow shall be permanently installed with the

discharge piping. The pump shall be automatically connected to the discharge connection elbow when lowered into place and shall be easily removed for inspection or service. There shall be no need for personnel to enter the basin or pump well. Sealing of the pumping unit to the discharge connection elbow shall be accomplished by a simple linear downward motion of the pump.

2) Guide Bar Bracket: A 304 stainless steel guide bar bracket shall be provided with each pump. The entire weight of the pumping unit shall be guided by 304 stainless steel guide bars and pressed tightly against the discharge connection elbow with metal-to-metal contact. NO sealing of the discharge interface by means of a diaphragm, O-ring or other devices shall be acceptable. The pump, with its appurtenances and cable, shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65'.

3) Discharge Piping: Supply of all discharge piping, supports, gaskets and hardware beyond the flanged connection of the pump discharge connection elbow shall be the responsibility of the Contractor.

4) Discharge Valve: Each pump shall include a manually operated discharge valve to control the design transfer flow rate.

Valve shall be 3" diameter flanged end connection, ASTM A-126 Class B cast iron body with welded in nickel seat, neoprene resilient plug facing. The valve shall be a non-lubricated type with a port area of at least 80% of full pipe size.

A sewage service air vacuum valve shall be provided loose for installation in the piping by the Contractor. Valve shall be 2" by 1" NPT. Each pump shall include a 3" diameter check valve with cast iron body and bronze disk to prevent backflow.

Valves shall be provided loose for installation within the discharge piping by the Contractor. Valve gaskets and hardware shall be supplied by the Contractor.

Adhesive anchors of 304 stainless steel shall be provided for anchoring the pump.

5. Retrievable Fine Bubble Diffuser with Electric Winch: The aeration system shall be a fine bubble diffused air system and shall be a retrievable configuration as shown on the Drawings. The aeration system shall be capable of delivering 2,656 SCFM per basin.

a. Diffuser Assembly: The Contractor shall furnish 9 retrievable air diffuser assemblies for each basin. Each assembly shall consist of membrane diffusers, frame assembly, manifold weldment, vertical air column, track beam, flexible airline, isolation valve and lifting mechanism. A total of 25 diffuser tubes shall be provided for each diffuser rack. The 4" diffuser manifold weldment shall be constructed of 304 stainless steel. The entire assembly shall be located such that each diffuser centerline is 12" above the basin floor.

Air diffuser assemblies shall be of the tubular, non-clog, fine bubble type with a flexible perforated air release membrane. Disc and panel diffuser designs are not acceptable. The diffuser membrane shall be constructed from EPDM rubber and be suitable for continuous or intermittent aeration. Each membrane shall be held in place by two 304 stainless steel band clamps. The membrane shall include UV inhibitor and compounds designed for resistance to chemical attack, weathering, fatigue and aging. The diffuser assemblies shall have double backflow prevention to prevent liquid from passing into the aeration header. Backflow prevention shall consist of self-sealing slits and membrane clamping over the circumference of the diffuser support pipe. The membrane exterior surface shall be smooth as to inhibit biological film growth. The membrane shall inflate during aeration and deflate when the airflow is discontinued, further restricting biological film growth. The membrane shall be cleanable in place with water from a high pressure wash. Each diffuser membrane shall be supported over its full length and circumference by a support tube. Tube diffuser shall be of non-buoyant design. Diffusers which are of buoyant design are not acceptable

1) Vertical Air Column: The vertical air column shall be constructed of 304 stainless steel. Each diffuser assembly shall include a 3" diameter wire reinforced EPDM flexible air line with quick disconnect end fittings and a 304 stainless steel threaded flange, elbow and polypropylene quick disconnect adapters. All air distribution piping, gaskets and hardware beyond the threaded flange shall be supplied by the Contractor. The vertical track beam assembly shall be 304 stainless steel. The vertical track beam shall support the manual lifting mechanism assembly during operation and servicing.

2) Diffuser Hoist: Each assembly shall include a 304 galvanized steel diffuser hoist assembly with base socket to receive a portable electric winch. A total of 1 portable electric winch shall be provided for the diffuser assemblies. The winch mechanism shall be of sufficient design capacity

to raise the diffuser rack assembly to the servicing position. The portable electric winch shall operate from a 115 volt, single phase, 60 hertz electrical supply rated for 12.6 full load amps and 19.0 locked rotor amps. The winch shall be provided with a total of 8' of electrical cable. Supply of electrical power supply, wiring and junction box shall be the responsibility of the Contractor.

3) Isolation Butterfly Valve: Each diffuser assembly shall include a 3" manually operated isolation butterfly valve for connection to the main air distribution piping by the Contractor. Valve gaskets and hardware is to be provided by the Contractor. Valve shall be a wafer style butterfly valve with cast iron body, EPDM seat, aluminum bronze disk and one piece stainless steel shaft.

4) Anchors: Adhesive anchors of 304 stainless steel shall be provided for anchoring the diffuser assemblies to the basin.

6. Blowers: There shall be furnished five 125 horsepower, 460 volt, 60 cycle, three lobe type, positive displacement blowers with TEFC premium efficiency U.S. Electric, Teco or equal motor. Each blower shall be capable of delivering 1,328 SCFM of air at a discharge gauge pressure of 10.88 psig. The blowers shall be manifolded for individual and / or combined operation.

Each blower assembly shall be complete and mounted on a base weldment with four-corner and anti-vibration mountings, designed for direct application on a concrete slab or other solid foundation. Each assembly shall be suitable for shipment as a complete unit, factory assembled (less discharge pipe fittings) as much as possible to facilitate shipping and handling.

Equipment shall include a blower, electric motor, belts and sheaves, inlet filter, inlet silencer, discharge silencer, discharge check valve, rubber inlet sleeve and discharge connection, pressure relief valve, 6" butterfly discharge isolation valve and rubber expansion joint. A personnel protection guard shall be included over the belts and sheaves.

a. The blower shall be provided in a 73 dBa sound attenuating enclosure.

b. Provide a stainless steel, liquid filled discharge pressure gauge, 0 to 15 psi range.

7. Air Control Valves: Furnish a total of four 12" diameter and two 8" diameter electrically operated butterfly valves to control the air flow.

Valves shall be electrically operated butterfly valve with lug style end cast iron body, stainless steel iron disk, viton seat, 416 stainless steel ring and cap screws, valve body seat of 304 stainless steel, 304 stainless steel shaft

assembled and tested with a 115 volt, single phase, 60 cycle open / close service electric actuator. Valve actuator shall include a compartment heater. Each valve shall include a manual override with limit switch feedback to the microprocessor in both the open and closed positions. Field wiring and junction box disconnect shall be provided by the Contractor.

8. Pressure Transducer: Furnish one submersible pressure transducer unit constructed of stainless steel for each basin. Transducer shall utilize a diffused silicone semiconductor sensor protected by an integral stainless steel diaphragm with seal fluid. Transducer output shall be a 4-20 mA signal. Electrical connection shall be to an attached 2 wire loop, powered through a shielded integral cable, comprised of 22 AWG conductors and separate drain wire. Transducers shall be suspended on a removable mounting pipe assembly. 304 stainless steel pipe, 304 stainless supports and 304 stainless steel anchors shall be provided. Field attachment of the pipe and supports to the basin shall be the responsibility of the Contractor. A moisture excluding aneroid bellows shall be supplied loose for installation in the junction box / disconnect. Attachment and supply of the junction box / disconnect at the basin wall shall be the responsibility of the Contractor.

   a. Adhesive anchors of 304 stainless steel shall be provided for anchoring.

9. Level Sensors: Furnish one level sensor assembly consisting of a chemical resistant, polypropylene cased liquid level sensor with a smooth, chemical resistant polypropylene casing and 316 stainless steel mounting bracket for each basin. Each float switch shall be provided with a three conductor electrical cable. Electrical cable shall terminate at a junction box disconnect located at the basin wall. Field wiring and junction box disconnect shall be provided by the Contractor. Adhesive anchors of 304 stainless steel shall be provided for anchoring the level sensor mounting bracket.

10. Controller: Furnish one AV38 controller per basin. The AV38 shall receive the digital input from a maximum of two devices. The controller will communicate with the main PLC via 4-20 mA signals. The AV38 will have a NEMA 4X with corrosion-resistant finish and shall be AC powered from a 100-240VAC, 50/60Hz power source. Each probe module shall include a sun shield.

11. Dissolved Oxygen Sensor: Furnish 1 dissolved oxygen sensor per basin. A handrail bracket and 304 stainless steel pipe shall be provided for each sensor for installation to the side of the basin. Field wiring, conduit, and installation of cable shall be the responsibility of the Contractor.

12. Solenoid Valves: Provide 1 solenoid valve per SBR basin to control the flow of Alum. Solenoid valves have one inlet and one outlet, and are used to permit and shut off fluid flow. Valve shall be direct acting construction

when the solenoid is energized, the core directly opens the orifice of a Normally Closed valve or closes the orifice in a Normally Open Valve. The valve will operate at pressures from 0 psi to its rated maximum. Valve shall be RedHat by ASCO or Equal.

F. SBR Control Panel Without Motor Starters: The control system shall be designed to optimize the SBR process while minimizing operator attention and to accommodate the continuous maximum daily flow without adjusting cycle structures. The control software program shall be factory tested prior to installation at the jobsite.

The control system shall be a timer based system with level overrides and shall provide control, sequence, monitoring and alarm annunciation capabilities. The operator shall be able to access the timer values and set points through the operator interface panel to allow for adjustment of cycle times and system flexibility. The control system shall be designed to automatically accommodate the plant's full range of loads and flows.

A complete control system shall be provided as described in the following paragraph and as shown on the Drawings. The control system shall include 115 volt control circuit breaker, microprocessor control, operator interface display, indicator lights and HAND-OFF-AUTOMATIC selector switches.

The incoming service of the control system shall be 115 volt, 60 hertz, single-phase. Controls for the equipment listed below shall be provided within the SBR control panel. Elapsed time indication shall be provided through the operator interface of the SBR control panel for equipment indicated by an asterisk.

1. SBR Equipment:

	Description	Quantity
a.	25 Horsepower Mixers*	4
b.	3 Horsepower Sludge Pumps*	4
c.	125 Horsepower Blowers*	5
d.	Influent Valves	4
e.	Decanter Actuators	4
f.	Decanter Valves	4
g.	Air Control Valves	7
h.	Level Sensors	4
i.	4-20 mA Pressure Transducer Signals	4
j.	4-20 mA DO Signals	4
k.	Common Alarm	1

2. Control Panel Wiring and Assembly: All control enclosures shall be custom assembled and wired in an Underwriters Laboratories (UL) certified cabinet shop using quality materials and labor. Short circuit

rating of control enclosure shall be 5 kA RMS symmetrical @ 120 VAC maximum. All control panel single conductor wire shall be 16 AWG multi-strand machine tool wire (MTW) minimum with PVC insulation.

a. Wire colors are as follows:

1)	208 VAC or higher	Black
2)	120 VAC control power	Red
3)	Neutral	White
4)	Ground	Green
5)	AC Power from remote source	Yellow
6)	Neutral from remote source	White with Yellow Stripe
7)	24 VDC (+)	Blue
8)	24 VDC (-)	White with Blue Stripe
9)	VDC (+) from remote source	Orange
10)	VDC (-) from remote source	White with Orange Stripe
11)	Intrinsically Safe	Light Blue

b. All wires shall be clearly marked with an identification number consistent with the wiring schematic drawing. Wire markers shall be a thermal transfer printable type. The material shall be a self-laminating vinyl. Wiring inside the control panel shall be run in PVC wiring duct rated for continuous temperatures up to 122° F. Devices mounted in the enclosure door shall have wires run in spiral wrap to avoid pinch points when opening and closing the door. Control components mounted internal and external to the enclosure shall be mounted with stainless steel hardware and clearly labeled with a plastic identification nametag. The tag shall be white with black lettering.

c. Control Enclosure: The automatic controls shall be provided in a UL listed, NEMA Type 12 mild steel, 12 gauge, floor mount enclosure that provides a degree of protection for electrical controls and components from dust, dripping water and external condensation of non-corrosive liquids. The enclosure is intended for indoor installation. Enclosure shall include gasketed overlapping doors with a 3-point latch mechanism operated by an oil tight key-lock handle. The enclosure shall have white polyester powder paint inside with ANSI 61 gray polyester powder paint outside over phosphatized surfaces. The enclosure shall include a painted white, 10 gauge, mild steel sub-panel mounted with collar studs. The control enclosure shall be mounted remotely.

d. Corrosion Inhibitor: Each control enclosure assembly shall be provided with corrosion inhibitors to protect interior electrical

components from damage caused by high humidity. The corrosion inhibitors shall be installed prior to shipment to provide protection during shipment and storage of the enclosure.

e. Circuit Breaker: All single phase branch or supplementary circuits shall be protected with a single-pole, C-Curve rated circuit breaker. Circuit breakers shall be rated for 240 VAC maximum, 50/60 Hz and UL 489 listed

f. Fuse: Properly rated fuses and fuse holders shall be provided for protection of individual control devices (discrete and analog signals) mounted outside of the enclosure. Each fuse shall be housed in a hinged type fuse block to protect against contact with the fuse. Fuse holders for discrete devices shall be rated to 600 VAC and 30 Amps. Fuse holders for analog devices shall be rated to 300 VAC and 15 Amps.

g. Operator Devices: Operator devices (pushbuttons and selector switches) shall be mounted through the control enclosure door for all automatic controlled equipment. Transformer type pilot lights and illuminated pushbuttons shall be provided for indication of an operation status. Lights shall be a 6 VAC incandescent type lamp. Color coding shall be applied as required and is as follows:

1)	Amber:	Alarm active, caution
2)	Green:	Valve open, motor running
3)	Red:	Valve closed
4)	White:	Information

All operator devices shall be UL Listed, 30.5mm style, NEMA Type 4X rated, oil and water tight with finger safe guards located on the contact blocks to prevent accidental contact with wire connections. Operator device function shall be identified with an engraved white nameplate with black letters. Operator devices shall be Allen-Bradley 800H, Square D 9001 or equal.

h. High Frequency Noise Filter: A UL listed active tracking filter shall be provided to protect the PLC and HMI power feeds from high-frequency noise and low-energy transients. It shall be designed for a single phase input voltage of 120/240VAC operating at 47 to 63 Hz. The unit shall reduce normal mode transients to plus or minus 2 volts, provide surge capacity of 45,000 amps and protect in all modes (line to neutral, line to ground and neutral to ground).

i. Ground Fault Duplex Receptacle: A UL listed ground fault circuit interrupter (GFCI) duplex receptacle shall be provided within the panel for instrument (e.g. programming terminal, modem, etc.) use only. The receptacle shall be protected with a 5 Amp circuit

breaker. The receptacle shall carry a 20A / 120VAC rating. The electro-mechanical circuit interrupter shall be double-pole and trip free (GFCI protection and shall not be overridden by holding reset button). Built-in transient suppression shall protect GFCI's internal circuitry from voltage transients.

j. 24 Volt DC Power Supply: A UL listed, industrial grade, compact power supply shall be supplied to provide 24 VDC power to such rated components. The power supply shall be DIN rail mounted and functional with input voltage of 100 to 240 VAC (single-phase) incoming control power. The power supply shall have a green LED which shall be illuminated when output voltage is "OK".

k. Control Relay: UL listed control relays for general control purposes shall be supplied with a pilot light to indicate when the coil is in an energized state. The relay socket shall be panel or DIN rail mounted inside the enclosure. The relays shall provide the following ratings: 120VAC coil, 10A contact rating (thermal), 250 VAC insulation rating and 5 million mechanical life cycles. Relays shall be Allen Bradley 700-HK, Square D or equal.

l. Terminal Block: Standard feed-through screw terminal blocks, DIN rail mounted, shall be supplied for all point to point wiring connections. All terminals shall be numbered per the wiring schematic with printed markers. Terminals shall carry a 600V AC/DC voltage rating.

m. Programmable Logic Controller: Automatic operation of the SBR shall be controlled through a programmable logic controller (PLC) mounted inside the main control panel. The PLC components shall consist of a power supply, CPU, discrete input and output modules and analog input and output modules. The processor unit shall include built-in USB and 2 Ethernet IP communication ports. All input and output points supplied (including unused) shall be wired to terminal blocks. Processor design characteristics shall include: 1.0MB user memory size, real-time clock and calendar, battery backed RAM and an operating temperature range between 32° F and 140° F. The PLC processor shall be an Allen-Bradley CompactLogix 1769-L30ER, Emerson Controlwave Micro or equal. Modular equipment shall be provided to as required complete the PLC system. Provide all connections and programming as required for communication of Modbus TCP/IP over Ethernet to plant SCADA.

n. PLC Power Supply: Input voltage range of 85-265 / 170-265 VAC, 47-63 Hz, maximum inrush current of 30 amps, backplane output current of 4 amps @ 5V or 2 amps @ 24V, internal fuse

protection, ambient operating temperature of 32°F to 140°F, Class I, Division 2 hazardous location certified, UL Listed

o. I / O Modules: Discrete input module, operating voltage of 79 to 132 VAC at 47 to 63 Hz, backplane current draw at 5VDC = 115mA , off-state current 2.5mA maximum, maximum inrush current 250mA, LED status indication of each point, ambient operating temperature of 32°F to 140°F, UL Listed. Discrete output module, operating voltage of 5 to 265 VAC at 47 to 63 Hz / 5 to 125 VDC, backplane current draw at 5 VDC = 205mA , at 24VDC = 180mA, off-state current leakage is 1.0mA, LED status indication of each point, ambient operating temperature of 32°F to 140°F, UL Listed. Analog input module, backplane current draw at 5 VDC = 120mA, at 24VDC = 70mA, LED status indication of each point, ambient operating temperature of 32°F to 140°F, UL Listed. Analog output module, backplane current draw at 5 VDC = 120mA, at 24VDC = 170mA, LED status indication of each point, ambient operating temperature of 32°F to 140°F, UL Listed.

p. Remote Access Ethernet Modem: A UL listed, remote access Ethernet modem shall be supplied to provide connection capability between the Ethernet PLC network to a standard analog phone line. The device shall be complete with 4 RJ-45 10/100 full/half duplex network ports with on RJ-12 modem port capable of line rates (V90) of 56K thru 28K bps. The unit shall meet compliance with FCC Part 68, Part 15-Class b, UL/CSA Certified, CTR 21, CE. Mounting shall be on 35 mm-din rail with an operating input of 8 to 48V DC.

q. Human Machine Interface: The operator interface shall be a NEMA Type 12, 13, 4X rated, 10.4" diagonal, color touchscreen display with Ethernet and serial communications. The interface shall be a liquid crystal display (LCD). The display type shall be color active matrix thin-film transistor (TFT) with 640 x 480 pixel resolution. The rated operating temperature shall be 32° to 131° F.

G. SCADA Monitoring System: A SCADA (Supervisory Control And Data Acquisition) system shall be provided by the wastewater equipment manufacturer as described herein and as shown on the Drawings.

1. Scope: The SCADA functionality shall include custom designed software with the following distinct features:

a. Detailed, dynamic graphics depicting regions of the facility and specific equipment within each area

b. Drill-down feature to provide detailed pop-up windows for pieces of equipment

c. Simple, intuitive navigation

d. System setpoint and preset adjustments

e. Consolidated alarm summary for all monitored areas, plus an alarm log

f. Event log to capture operator commands as well as process/equipment functions

g. Historical data logging, providing long term storage of data to assist with plant optimization

h. Historical trending of analog and/or discrete variables including providing real time values, zoom/pan and pause features

i. Both the operating system and graphical package shall have multiple levels of logins.

j. Picture/video screen captures – allows screen captures to be saved to a file or sent to a printer

k. Remote Access: The SCADA system shall include remote access capabilities using a broadband internet communication. The remote access facilitates support from the SCADA supplier to address concerns or future upgrades and provides the option to allow remote access by the operations personnel to help assess a situation when away from the site.

l. The SCADA system shall be designed, programmed and functionally tested by the SCADA manufacturer prior to shipment. All software packages shall be provided with licenses that can be transferred to the end user.

m. The SCADA system shall be provided loose for installation, interconnection, and field wiring by the Contractor.

H. Monitored Equipment: The SCADA system shall provide monitoring and control of remote functions and processes for the bar screen, grit separator, raw sewage pump station, sequencing batch reactor, tertiary filters, UV System, effluent pump station, plant pump station, chemical feed and sludge dewatering press. The manufacturer for the aforementioned equipment shall provide a final list of Modbus Registers for incorporation into the plant SCADA system.

I. SCADA Screens: The following list of parameters are preliminary. The final list shall be provided by the equipment manufacturer for the equipment listed. The manufacturer for each equipment shall provide a final list of Modbus TCP/IP Registers and scales for use in programming the screens. At a minimum, the following screens shall be provided:

1. Headworks:

a.	DI1	Bar Screen Fault
b.	DI2	Bar Screen Running Forward
c.	DI3	Bar Screen Running Reverse

d.	DI4	Spiral Conveyor Fault
e.	DI5	Spiral Conveyor Running Forward
f.	DI6	Spiral Conveyor Running Reverse
g.	DI7	Grit Pump Status
h.	DI8	Grit Pump Low Vacuum
i.	DI9	Grit Pump Overload
j.	DI10	Paddle Drive Status
k.	DI11	Paddle Drive Fault
l.	DI12	Grit Screw Status
m.	DI13	Grit Screw Fault
n.	DI14	Solenoid Valve Status
o.	DI15	Emergency Stop
p.	DI16	Raw Sewage Pump No. 1 Run
q.	DI17	Raw Sewage Pump No. 1 Fault
r.	DI18	Raw Sewage Pump No. 2 Run
s.	DI19	Raw Sewage Pump No. 2 Fault
t.	DI20	Raw Sewage Pump No. 3 Run
u.	DI21	Raw Sewage Pump No. 3 Fault
v.	DI22	Raw Sewage Pump No. 4 Run
w.	DI23	Raw Sewage Pump No. 4 Fault
x.	DI24	Raw Sewage High Level Float
y.	DI25	Raw Sewage Low Level Float
z.	AI1	Raw Sewage Pump Station Wetwell Level
aa.	AI2	Raw Sewage Pump No. 3 Speed
bb.	AI3	Raw Sewage Pump No. 4 Speed

2. SBR: Per manufacturer's recommendation
3. Tertiary Filters: Per manufacturer's recommendation
4. UV Disinfection:

a.	DI01	UV Bank 1A Status
b.	DI02	UV Bank 1B Status
c.	DI03	UV System Minor Alarm
d.	DI04	UV System Major Alarm
e.	DI05	Post Air Blower Status

f.	DI06	Post Air Blower Fault
g.	DO01	UV System Call to Run
h.	DO01	Post Air Blower Call to Run
i.	AI01	UV Channel Level
j.	AI02	UV Bank 1A Intensity
k.	AI03	UV Bank 1B Intensity
l.	AI04	Effluent Flow

5. Effluent and Plant Pump Stations:

a.	DI01	Effluent Pump No. 1 Status
b.	DI02	Effluent Pump No. 1 Fault
c.	DI03	Effluent Pump No. 2 Status
d.	DI04	Effluent Pump No. 2 Fault
e.	DI05	Effluent Pump No. 3 Status
f.	DI06	Effluent Pump No. 3 Fault
g.	DI07	Effluent Pump Chamber No. 1 Low Level Float
h.	DI08	Effluent Pump Chamber No. 2 Low Level Float
i.	DI09	Plant Pump No. 1 Status
j.	DI10	Plant Pump No. 1 Fault
k.	DI11	Plant Pump No. 2 Status
l.	DI12	Plant Pump No. 2 Fault
m.	DI13	Plant Pump Station High Level Float
n.	DI14	Plant Pump Station Low Level Float
o.	AI01	Effluent Pump Station Wetwell Level
p.	AI02	Plant Pump Station Wetwell Level
q.	AI03	Pumped Flow

6. Digester and Sludge Dewatering Press:

a.	DI01	Belt Drive Status
b.	DI02	Belt Drive Fault
c.	DI03	Washwater Pump Status
d.	DI04	Washwater Pump Fault
e.	DI05	Sludge Pump Status
f.	DI06	Sludge Pump Fault
g.	DI07	Cross Conveyor Status

h.	DI08	Cross Conveyor Fault
i.	DI09	Discharge Conveyor Status
j.	DI10	Discharge Conveyor Fault
k.	DI11	Low Air Pressure
l.	DI12	Belt overtravel
m.	DI13	Belt Broken
n.	DI14	Polymer System Status
o.	DI15	Polymer System Fault
p.	DI16	Low Polymer
q.	DI17	Floating Aerator No. 1 Status
r.	DI18	Floating Aerator No. 1 Fault
s.	DI19	Floating Aerator No. 2 Status
t.	DI20	Floating Aerator No. 2 Fault
u.	DI21	Floating Aerator No. 3 Status
v.	DI22	Floating Aerator No. 3 Fault
w.	DI23	Floating Mixer No. 1 Status
x.	DI24	Floating Mixer No. 1 Fault
y.	DO01	Floating Aerator No. 1 Call to Run
z.	DO02	Floating Aerator No. 2 Call to Run
aa.	DO03	Floating Aerator No. 3 Call to Run
bb.	AI01	WAS Flow
cc.	AI01	DO Digester

7. Chemical Feed:

a.	DI01	Lime Mixer Status
b.	DI02	Lime Mixer Fault
c.	DI03	Lime Pump No. 1 Status
d.	DI04	Lime Pump No. 1 Fault
e.	DI05	Lime Pump No. 2 Status
f.	DI06	Lime Pump No. 2 Fault
g.	DI07	Lime Pump No. 3 Status
h.	DI08	Lime Pump No. 3 Fault
i.	DI09	Alum Pump No. 1 Status
j.	DI10	Alum Pump No. 1 Fault

k.	DI11	Alum Pump No. 2 Status
l.	DI12	Alum Pump No. 2 Fault
m.	DI13	Alum Pump No. 3 Status
n.	DO01	Lime Pump No. 1 Start
o.	DO02	Lime Pump No. 2 Start
p.	DO03	Lime Pump No. 3 Start
q.	DO04	Alum Pump No. 1 Start
r.	DO05	Alum Pump No. 2 Start
s.	DO06	Alum Pump No. 3 Start
t.	AI01	Lime Tank Level
u.	AI02	Alum Tank Level
v.	AO01	Lime Pump No. 1 speed reference
w.	AO02	Lime Pump No. 2 speed reference
x.	AO03	Lime Pump No. 3 speed reference

J. SCADA System Hardware: The SCADA system provided shall meet or exceed the following hardware specifications. At the time of manufacture, components specified below shall be subject to "or equal" or "upgrade" status to provide for the most current model available.

1. Personal Computer (PC): A personal computer, Dell OptiPlex 9010 MiniTower, with 5-Year ProSupport, shall be provided with the following parameters:

a.	Processor:	Intel® Core™ i7 2600 Quad Core, 3.4GHz
b.	Memory:	4.0GB DDR3, 1333MHz Dual Channel SDRAM
c.	Monitor:	Dell UltraSharp™ 21" widescreen
d.	Video:	512MB, DVI
e.	Boot Hard Drive:	320GB SATA, 16MB DataBurst Cache™
f.	Second Hard Drive:	Identical to boot hard drive
g.	Hard Drive Operating Mode:	RAID 1
h.	Removable Media Storage:	16X DVD+/-RW With read/write support software
i.	Keyboard:	USB Quiet Keyboard
j.	Mouse:	USB Optical mouse with scroll
k.	NIC:	10/100/1000 Ethernet

2. Printer: Color inkjet printer with printer cable

3. Uninterruptable Power Supply (UPS): APC battery backup UPS, 1000 VA minimum

K. PC Operating System and Productivity Software: Operating system shall be provided with the following parameters:

1. Operating System: Microsoft® Windows 7 Professional, with XP Mode, 32-bit
2. Productivity Software: Microsoft® Office Professional 2013
3. Hard Drive Backup / Imaging Software: Symantec Norton Ghost
4. Anti-virus / Anti-spam / Firewall software: McAfee® Total Protection
5. Screen Capture/Edit Software: TechSmith® SnagIt®

L. Graphical Software: Rockwell Software RSView 32 Works, Development/Runtime, 1500 Tag Count with RSLinx Classic Gateway

M. Programming Software for PLC: Rockwell Software RSLogix 5000 (IEC-61131-3 compliant)

N. Programming Software for HMI: Rockwell Software FactoryTalk View Studio ME

O. Ethernet Communication:

1. Less than 323' maximum distance between Ethernet switches
2. The PLC shall communicate to a dedicated PC network interface card (NIC) which shall provide the SCADA connectivity to the plant control network.
3. Ethernet shall be a local area network that provides communication between various devices at 10/100 MBaud. The protocol utilized for message transport between devices shall be TCP/IP. The processor connector shall conform to ISO/IEC 8802-3 STD 802.3 and utilize 10/100Base-T media. Connections shall be made directly from the processor to an industrial Ethernet switch. The SCADA computer NIC shall also be of the type 10/100Base-T and shall connect directly to an Ethernet switch. Twisted-pair 10/100Base-T cables with RJ-45 connectors shall be used to make connections between switches and devices. Twisted-pair cabling between all switches and devices shall be a maximum of 323' in length; and kept to a minimum whenever possible. If a distance greater than 323' or runs through high noise environments are required, the SCADA supplier must be contacted.
4. The PC shall have a separate network interface card to connect the PC to the internet.
5. Conduit and routings for the communication cables shall be provided by the installing contractor. Communication cables shall not be installed within conduit which contains AC control or power cables.

6. Additional hardware (repeaters or switches) to accommodate longer Ethernet cable runs shall be supplied by the Contractor.

10.14 Tertiary Filter System: The Contractor shall furnish all labor, material, tools and equipment necessary to install a complete tertiary filter system as shown on the Drawings and in accordance with these Specifications. Through the wall spool piping, external piping and effluent weir shall be provided by the Contractor.

A. Manufacturers:

1. There shall be 2 disk filters as manufactured by Aqua-Aerobic Systems, Inc. or equal.

2. The disk filter supplier shall have experience in the design and manufacture of the specified technology for a minimum of 5 years and shall be able to demonstrate a minimum of 10 installations within the United States in municipal wastewater applications similar to that herein specified.

3. The equipment manufacturer shall furnish the services of a factory trained representative for a minimum of 2 trips and eight 8-hour days at the jobsite to inspect the Contractor's equipment installation, supervise the initial operation of the equipment, instruct the plant operating personnel in proper operation and maintenance and provide process assistance.

B. Design Conditions:

1. The disk shall be capable of filtering effluent from a SBR process. Design shall be for:

   a. 3.0 MGD Average Daily Flow

   b. 7.5 MGD Peak Daily Flow

2. Filter influent suspended solids concentration shall be at 10 mg/l average and 10 mg/l peak at average daily flow rate.

3. Disk system shall be designed at a hydraulic loading rate of 3.25 GPM per square feet of submerged disk area at average daily flow and 6.5 GPM per square feet of submerged disk area at peak daily flow. Solids load shall not exceed 3.25 pounds per square feet per day. Performance data shall be included in the submittal package to demonstrate the cloth media is capable of operating at the above stated solids load.

C. Equipment: Each unit will include:

1. Basin mounting brackets and hardware

2. Centertube installation with cloth media discs

3. Drive installation

4. Backwash / sludge discharge installation

5. Automatic valves

6. Electrical controls with internal components as specified

7. Pressure transducer

8. All motors, pumps, and bearings shall be designed for continuous duty and long operating life in a high humidity atmosphere. All motors and pumps shall be 460 volt, 60 hertz, 3 phase.

9. The valves, equipment, materials of construction and controls specified under this section supersedes valves, equipment, materials of construction and controls specified elsewhere in the contract documents.

D. Installation:

1. Drive Assembly: Each filter shall include an adjustable drive installation with a gearbox, nylon drive sprocket, acetal drive chain with 304 stainless steel chain guards. The gearbox shall be parallel in-line helical type, AGMA Class 1 with a ¾ horsepower drive motor rated for 460 volt, 3 phase, 60 Hz.

2. Mounting Brackets and Hardware: Each filter basin shall be fitted with 304 stainless steel mounting brackets to accommodate attachment of the filter components to the basin. All mounting brackets shall be attached to the basin wall with 304 stainless steel wedge anchors and hardware. Through the wall spool piping and all filter external piping shall be provided by the Contractor.

3. Center Tube Assembly: Each center tube assembly shall include a 3/16" thick, 304 stainless steel center tube weldment, driven sprocket, wheel assemblies and frame and cloth assemblies. Each center tube assembly shall also include a Viton V-Ring effluent port seal. The driven sprocket shall be multi segment made of U.H.M.W. polyethylene. All fasteners shall be 316 stainless steel.

4. Filter Cloth Assemblies: Each filter shall include 12 cloth disk assemblies. Each cloth disk assembly shall be comprised of 6 individual segments, each consisting of a cloth media sock supported by an injection molded polypropylene co-polymer frame. Cloth/frame assemblies shall be constructed such that each segment is easily removable from the center tube, without special tools, to allow for removal and replacement of the cloth at the point of installation.

   Cloths shall be of fiber pile construction with polyester backing material having a nominal filtration rating of 10 microns. Granular media and screens having structured identical openings shall not be allowed. The pile cloth shall be free chlorine resistant cloth. The cloth media shall have an active filter depth of 3 to 5 mm to provide additional collisions between solids particles and the media within the media depth, resulting in capture of solids across a broader particle range. The cloth depth shall also provide storage of captured solids, reducing backwash volumes while maintaining an operational headloss. Woven mesh or microscreen type disk with no filtration depth are not acceptable.

Each cloth disk assembly shall have a total of 53.8 square feet of effective submerged filtration area. Effluent filtration area is defined as only the portion of the disk that is submerged during filtration. Any disk area that is not submerged shall not be considered as effective area. Each disk shall be divided into no more than 6 segments and shall be easily removable for service.

During filtration, the filter unit shall operate in a static condition with no moving parts. The filter system shall provide for the collection of filtered solids on the outside of the cloth media surface to allow for the direct contact of cleaning systems. Filtered effluent shall be used for backwashing. The filter flow path shall be from the outside of the disk to the inside.

5. Backwash / Sludge Discharge Installation: The backwash function shall incorporate a pump that draws filter effluent through the cloth thereby removing accumulated solids from the cloth surface. Heavy duty springs shall be used to maintain proper tensioning of the backwash shoe against the media surface.

   a. Each backwash / sludge discharge assembly shall include an external piping assembly, backwash system assembly and 2 backwash pumps, valves and gauges. The installing Contractor shall install external piping including backwash valves, 3" manually operated gate valve for flow control, vacuum gauge, vacuum transducer and a pressure gauge. The backwash assembly shall include 304 stainless steel backwash shoe supports with end springs, UHMW backwash shoes, PVC reinforced flexible hose and 304 backwash manifold with stainless steel hose clamps and a PVC sludge collection manifold.

   b. The backwash system shall include 304 stainless steel backwash shoe supports with 316 stainless steel springs, UHMW backwash shoes, polypropylene quick couplers, wire reinforced reinforced PVC flexible hose and 304 stainless steel backwash manifold with stainless steel hose clamps and PVC sludge collection manifold .

   c. The backwash pumps shall be an externally mounted centrifugal pump. Pump shall be provided with a 2 horsepower, 460 volt, 3 phase, 60 Hz motor and operate at 1,750 nominal RPM. Pump shall be rated for 130 gpm at 23' TDH. Contractor shall supply unions or flanges for service, wiring and conduit between pumps and control panel.

   d. Pump manually operated threaded gate valve shall be class 125 bronze with screw in bonnet, non-rising stem, and solid wedge. Valve shall conform to MSS SP-80.

   e. The 3" threaded ball valves shall be a two-piece, full port with a brass body. Valves shall conform to MSS SP-110.

f. The vacuum gauges shall have a minimum 2.5" dial with all stainless steel welded construction, 0-30" vacuum range, liquid filled, ¼" back or bottom connection, 316 stainless steel bourbon tube and tip material, and bronze socket material.

g. The pressure gauges shall have a 2½" dial with a black painted steel case, 0-15 psi, heat resistant polycarbonate window, ¼" lower connection, "C" shaped bronze bourbon tube and brass socket material.

h. Filtering shall not be interrupted during normal backwashing and solids waste discharge.

i. Each filter shall be supplied with three 2" backwash valves, with the capacity to add 2 additional backwash valves in the future. Valves shall be 3 piece, flanged end, ASTM A351 Grad CF8M stainless steel body, 316 stainless steel ball and stem, fullport with a 115 volt, 1 phase, 60 cycle open / close service electric actuator. Valve / actuator combination shall be manufactured by TCI / RCI, Nibco or equal. Valve actuator shall include a compartment heater and thermostat with limit switch feedback to the microprocessor in both the open and closed positions.

j. Each filter shall include 1 sludge valve. Valve shall be 2 piece, flanged end, ASTM A351 Grade CF8M stainless steel body, 316 stainless steel ball and stem, fullport, with a 115 volt, single phase, 60 Hz, open / close service electric actuator. Valve / actuator combination shall be manufactured by TCI / RCI, Nibco or equal. Valve actuator shall include a compartment heater and thermostat with limit switch feedback to the microprocessor in both the open and closed positions.

k. Each filter shall include a sludge removal system consisting of perforated manifold, mounted on the floor of the filter tank. The manifold shall be designed to siphon settled sludge for discharge through the backwash pump. The operation of the sludge discharge system shall be automatic with user adjustable intervals and duration through the operator interface.

6. Influent Valve: One influent valve shall be provided by the Contractor for each filter. Valve shall be 18" lugged style influent butterfly valve with a cast iron body, aluminum bronze disk, stainless steel shaft and EPDM seat. Valve shall include a gear operator and hand wheel. Each valve shall include a valve stem extension to raise the actuator approximately 42" above the top of the wall. The extension shall be constructed of painted steel. Intermediate valve supports and hardware required from mounting of the extension shall be provided by the Contractor.

7. Influent Weir Box: Each filter shall include a 304 stainless steel influent weir box. The weir box shall be mounted to the filter basin interior using

304 stainless steel wedge anchor and hardware. The basin wall must be smooth and plumb to facilitate a quality installation.

8. Pressure Transducer: Contractor shall furnish 1 submersible pressure transducer unit constructed of stainless steel for each filter to monitor and report liquid level. Unit shall monitor the water level in the filter tank. Transducer shall use a diffused silicone semiconductor sensor protected by an integral stainless steel diaphragm with seal fluid. Transducer output shall be a 4-20 mA signal over a 0-5 psi range. Electrical connection shall be a two wire, loop powered through a shielded integral cable comprised of 22 AWG conductors and separate drain wire. Pressure transducer shall be provided with a stainless steel mounting bracket and hardware.

9. High Level Float Switch: A float switch shall be furnished to indicate emerging overflow level. The float shall contain a non-mercury switch, chemical resistant polypropylene casing hermetically sealed and a PVC #18 AWG three conductor cable. Switch rating shall be 4.5 amps non-inductive at 120 Vac.

10. Vacuum Transmitter: The vacuum transmitter shall have stainless steel wetted parts and provide a 4-20 mA signal over a range of 1 standard atmosphere to full vacuum.

11. Spare Parts:

    a. 2 frame and cloth assemblies

    b. 1 backwash/solids waste valve and actuator

    c. 1 Viton V-ring effluent port/centertube seal

12. Control Enclosure: The automatic controls shall be provided in a UL listed, NEMA Type 4X 304, 14 gauge stainless steel wall mounted enclosure that provides insulation and protection for electrical controls and components from highly corrosive environments indoors and outdoors. Enclosure shall include a seamless foam-in-place gasket to assure watertight and dust-tight seal. An internal 3-point latch and 316 stainless steel padlocking handle shall be provided. Enclosures shall be unpainted, with a smooth #4 brushed finish. Enclosure shall include a painted white, 12 gauge mild steel sub-panel mounted with collar studs.

    a. Corrosion Inhibitor: Each control enclosure assembly shall be provided with corrosion inhibitors to protect interior electrical components from damage caused by high humidity. The corrosion inhibitors shall be installed prior to shipment to provide protection during shipment and storage of the enclosure.

    b. Main Disconnect Circuit Breaker: A UL listed, automatic molded case 3-pole disconnect breaker shall be provided in the control enclosure. The primary function of the disconnect switch shall be to provide a means to manually open a circuit and automatically open a circuit under overload or short circuit conditions. The

disconnect breaker shall have a door mounted operating mechanism with trip indication. Power distribution connectors shall be mounted integrally to the circuit breaker for multiple load connections. Integral connectors shall be provided.

c. Motor Starter: A full voltage non-reversing integrated motor starter-controller shall be provided for motor applications up to 15 kW. Each starter shall provide control, protection and monitoring functions for the motor. The starter shall be IEC rated and shall have certifications according to UL and CSA standards and shall bear the CE marking. The starter shall have a maximum rated operational voltage of 690V and provide a 42kA @ 480 VAC rated breaking capacity on short circuit. The starter shall have a mechanical durability of 15 million operations. The starter shall provide short circuit trip, thermal overload trip with selectable tripping class, under current trip and phase imbalance trip.

A full voltage non-reversing IEC Style motor starter shall be provided for motor applications over 15 kW. Each starter shall consist of a circuit breaker, contactor and overload relay. The starter shall be IEC rated and shall have certifications according to UL and CSA standards and shall bear the CE marking. The starter shall have a maximum rated operational voltage of 690V and provide a minimum 18 kA @ 480VAC and 25 kA @ 240 VAC interrupt rating on short circuit when used in combination with a circuit breaker. The starter shall have a mechanical durability of 15 million operations. The solid state overload relay shall have class 10 tripping characteristics with trip current adjustment, phase loss and unbalance protection.

d. Transformer: A step-down multi-tap transformer shall be supplied when there is a necessity to reduce incoming 3-phase power to 120 VAC single-phase. The transformer power wire connections (incoming and outgoing) shall be protected with a finger-safe cover to protect against accidental contact. Primary and secondary fuse protection shall be provided. Transformer shall be UL listed and of continuous wound construction with vacuum impregnated with non-hygroscopic thermosetting varnish.

e. Transformer Primary and Secondary Fuse: Properly rated fuses and fuse blocks shall be provided for primary and secondary protection of the transformer. Each fuse shall be equipped with a thermoplastic cover to protect against accidental contact. Clip style fuse block shall be rated up to 600 VAC and 100 amps, dual element, time delay fuses shall be rated up to 600 VAC. Fuse blocks and fuses shall be UL listed.

f. Circuit Breaker: All single phase branch or supplementary circuits shall be protected with a single-pole, C-Curve rated circuit

breaker. Circuit breakers shall be rated for 240 VAC maximum, 50/60 Hz and UL 489 listed.

g. Fuse: Properly rated fuses and fuse holders shall be provided for protection of individual control devices (discrete and analog signals) mounted outside of the enclosure. Each fuse shall be housed in a hinged type fuse block to protect against contact with the fuse. Fuses shall be rated up to 250 VAC. Fuse holders for discrete devices shall be rated to 600 VAC and 30 Amps. Fuse holders for analog devices shall be rated to 300 VAC and 15 Amps.

h. Operator Device: Operator devices (pushbuttons and selector switches) shall be mounted through the control enclosure door for manual operation of the filter. Transformer type pilot lights and illuminated pushbuttons shall be provided for indication of an operation status. Lights shall be a 6 VAC incandescent type lamp. Color coding shall be applied as required and is as follows:

1)	Amber:	Alarm active, caution
2)	Green:	Valve open, motor running
3)	Red:	Valve closed
4)	White:	Information

All operator devices shall be UL Listed, 30.5 mm style, NEMA Type 4X rated, oil and water tight with finger safe guards located on the contact blocks to prevent accidental contact with wire connections. Operator device function shall be identified with an engraved white Gravoply nameplate with black letters. Operator devices shall be Allen-Bradley 800H, Square D 9001 or equal.

i. High Frequency Noise Filter: A UL listed active tracking filter shall be provided to protect the PLC and HMI power feeds from high-frequency noise and low-energy transients. It shall be designed for a single phase input voltage of 120/240VAC operating at 47 to 63 Hz. The unit shall reduce normal mode transients to plus or minus 2 volts, provide surge capacity of 45,000 amps and protect in all modes (line to neutral, line to ground and neutral to ground).

j. Ground Fault Duplex Receptacle: A UL listed ground fault circuit interrupter (GFCI) duplex receptacle shall be provided within the panel for instrument (e.g. programming terminal, modem, etc.) use only. The receptacle shall be protected with a 5 amp circuit breaker. The receptacle shall carry a 20A / 120VAC rating. The electro-mechanical circuit interrupter shall be double-pole and trip free (GFCI protection and shall not be overridden by holding reset button). Built-in transient suppression shall protect GFCI's internal circuitry from voltage transients.

k. 24 Volt DC Power Supply: A UL listed, industrial grade, compact power supply shall be supplied to provide 24 VDC power to such rated components. The power supply shall be DIN rail mounted and functional with input voltage of 100 to 240 VAC (single-phase) incoming control power. The power supply shall have a green LED which shall be illuminated when output voltage is "OK".

l. Control Relay: UL listed control relays for general control purposes shall be supplied with a pilot light to indicate when the coil is in an energized state. The relay socket shall be panel or DIN rail mounted inside the enclosure. The relays shall provide the following ratings: 120VAC coil, 10A contact rating (thermal), 250 VAC insulation rating and 5 million mechanical life cycles. Relays shall be Allen Bradley 700-HK, Square D or equal.

m. Terminal Block: Standard feed-through screw terminal blocks, DIN rail mounted, shall be supplied for all point to point wiring connections. All terminals shall be numbered per the wiring schematic with printed markers. Terminals shall carry a 600V AC/DC voltage rating.

n. Programmable Logic Controller: Automatic operation of the filter shall be controlled through a Allen Bradley MicroLogix 1400, Emerson Controlwave Micro or equal programmable logic controller (PLC) mounted inside the main control panel. The PLC components shall consist of a base unit, expansion I/O modules, and memory module. All input and output points supplied (including unused) shall be wired to terminal blocks. The PLC user memory shall consist of a minimum of 20K words of program and data. All PLC hardware shall be UL listed and operate at an ambient temperature of -4° to 140° F. Provide all connections and programming as required for communication of Modbus TCP/IP over Ethernet to plant SCADA. Ethernet connection shall be made via an optical isolator protection circuit.

o. Base Unit: The base unit shall house embedded inputs, outputs, power supply and communication (Ethernet, RS-232, RS-485) ports. The base unit shall also provide the interface to expansion I/O when required by an application. The power supply input range shall be 100 to 240V AC at 47 to 63 Hz with a maximum power consumption of 100 VA. The embedded discrete inputs shall be rated for 120V AC and the discrete (relay) outputs shall be rated for 265V AC/125V DC. Embedded analog I/O shall be voltage (±10 V) inputs and outputs. Each I/O point shall have LED status indication. The base unit shall have one (1) RS-232-C serial port, one (1) RS-485 serial port and one (1) RJ-45 port which supports 10/100 Mbps EtherNet/IP. These ports shall be capable

of local and remote programming, troubleshooting and data manipulation.

p. Digital Expansion Input Module: The expansion digital input module shall have an operating voltage of 79 to 132V AC at 47 to 63 Hz. The module shall have an LED status indication of each point.

q. Memory Module: The controller shall be shipped with a memory module for user program and data backup

r. Ethernet Switch: An Ethernet switch shall be provided inside the control enclosure to provide connectivity between the PLC, operator interface and plant networking. The switch shall support both 10 and 100 Mbit/s operation and provide for store and forward switching mode. The switch shall have 5 10/100Base-T ports with RJ-45 sockets and shall support auto-crossing, auto-negotiation and auto-polarity. Maximum distance for twisted pair cable shall be 100m. The unit shall be DIN rail mounted and require 24VDC/100mA power. Diagnostic LEDs for power, link status, data and data rate shall be provided.

s. Human Machine Interface Overview: The control system shall be equipped with a UL listed operator interface that provides control display screens. These screens shall be used by the operator to monitor and control filter status, setpoint, and alarm information.

1) The interface shall allow the Operator access to adjust the following operating parameters:

- Backwash interval
- Backwash duration
- Solids waste interval
- Solids waste duration
- Number of backwashes between solids waste interval

2) The operator interface shall provide information to assist the Operator in assessing the status of the filter system. The interface screen shall display, at minimum, the following parameters:

- Water level in the filter
- Time since last backwash
- Time since last solids waste withdrawal
- Elapsed time on the drive motor
- Elapsed time on the backwash/waste pumps
- Total backwash time and cycles
- Total solids waste withdrawal time and cycles

3) The operator interface shall allow the Operator to:

- Initiate backwash
- Control all electric actuated valves

The interface shall display the alarm history. The alarm history shall include the time and date of the most recent 25 alarms along with the description of the alarm.

The interface shall also display current alarms, including the date, time and a description of the alarm.

As a diagnostic aid to the Operator, the interface shall display the time between backwashes for the most recent 40 backwashes.

t. Human Machine Interface: The operator interface shall be a NEMA Type 12, 13, 4X rated, 6.5" diagonal, color touchscreen display with Ethernet and serial communications. The interface shall be a liquid crystal display (LCD). The display type shall be color active matrix thin-film transistor (TFT) with 640 x 480 pixel resolution. The rated operating temperature shall be 32° to 131° F.

10.15 Ultraviolet Disinfection System: The Contractor shall furnish all labor, materials, equipment and appurtenances required to provide an open channel, gravity flow, low pressure high intensity ultraviolet lamp (UV) disinfection system complete with an automatic chemical/mechanical cleaning system and variable output lamp drivers. The UV system shall be complete and operational with all control equipment and accessories as shown and specified herein. This system will be capable of disinfecting effluent to meet the water quality standards listed in this section.

A. Manufacturers: The ultraviolet disinfection system UV Signa will be by Trojan Technologies Inc. or equal.

1. Design Criteria: Contractor shall provide equipment that will disinfect effluent with the following characteristics:

a.	Current Peak Flow:	7.5 MGD
b.	Average Flow:	3.75 MGD
c.	Future Peak Flow:	15 MGD
d.	Total Suspended Solids:	30 mg/L 30 day average of grab samples
e.	Effluent Temperature Range:	33°F to 85°F
f.	Ultraviolet Transmittance @ 253.7 nm:	65%, minimum

g. Effluent standards to be achieved:

200 fecal coliform/100ml based on 30 day geometric mean of daily samples for the effluent standard as specified in a. through f. Effluent standards will be guaranteed regardless of influent count to UV system.

2. The UV system is to be installed in 1 open channel having the following dimensions (not including the water level controller):

a.	Length (minimum):	26'
b.	Width:	3'-4"
c.	Depth:	7'-8"

3. The maximum effluent depth in the channel will be

4. System Configuration:

   a. The UV system must fit within the UV channel as stated without modification.

   b. The UV system configuration will be as follows:

1)	Number of Channels:	1
2)	Number of Banks per Channel:	2
3)	Number of Lamps per Bank:	12
4)	Total Number of Lamps in the UV System:	24
5)	Number of System Control Centers:	1
6)	Number of UV Sensors:	1 per bank
7)	Number of Power Distribution Centers:	2
8)	Number of Level Controllers:	1

   c. Channel dimensions and configuration will accommodate two (2) additional UV banks for future peak flow capacity of 15 MGD as shown in the related UV system contract drawings.

B. Performance Requirements:

1. Provide a UV disinfection system complete with UV Banks and lifting mechanism system control center, power distribution centers, and water level controller as shown on the Drawings and as herein specified.

2. The ultraviolet disinfection system will produce an effluent conforming to the following discharge permit: 200 fecal coliform/100 ml, based on a 30 day geometric mean. Grab samples will be taken in accordance with the Microbiology Sampling Techniques found in *Standard Methods for the Examination of Water and Wastewater, 21st Ed.*

3. To ensure thorough characterization and disinfection performance of the UV reactor, 2 challenge organisms will be used in the validation testing. One challenge organism with low UV resistance (e.g. T1 with resistance of ~5 mJ/cm^2 per log inactivation) and a second challenge organism with higher UV resistance (e.g. MS2 with resistance of ~20 mJ/cm^2 per log inactivation. The use of at least 2 organisms will allow a "bracketing" methodology (as described in the USEPA UVDGM) to be used for accurate sizing.

4. The UV system will be designed to deliver a minimum MS2 RED of 30 mJ/cm^2 at peak flow, in effluent with a UV Transmission of 65% at end of lamp life (EOLL) after reductions for quartz sleeve fouling. The basis for evaluating the RED will be the independent third party bioassay without exception. Bioassay validation methodology to follow applicable protocols described in NWRI *Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse* (May 2003, 2012) and 2006 USEPA UVDGM.

5. The RED will be adjusted using an end of lamp life factor of 0.5 to compensate for lamp output reduction over the time period corresponding to the manufacturer's lamp warranty. The use of a higher lamp aging factor will be considered only upon review and approval of independent third party verified data that has been collected and analysed in accordance with protocols described in the NWRI *Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse* (May 2003, 2012).

6. The RED will be adjusted using a quartz sleeve fouling factor of 0.8 to compensate for quartz sleeve transmission reduction due to wastewater effluent fouling. The use of a higher quartz sleeve fouling factor will be considered only upon review and approval of independently verified data that has been collected and analysed in accordance with protocols described in the NWRI *Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse* (May 2003, 2012). The data recorded for the determination of the validated fouling factor must be obtained by testing in secondary wastewater effluent utilizing the same lamp, quartz sleeve and cleaning system proposed by the UV manufacturer.

7. Independent validation for use of higher factors (lamp aging and sleeve fouling) must be submitted to the Engineer for consideration a minimum of fifteen (15) days prior to bid. The independent validation shall have oversight by a qualified registered professional engineer with knowledge and experience in testing and evaluation of UV systems as defined in the EPA UVDGM (Appendix C, Section C.3.3)

8. The system will be designed for complete outdoor installation.

C. Warrantees:

1. Equipment: The equipment furnished under this section will be free of defects in material and workmanship, including damages that may be incurred during shipping for a period of 12 months from date of start-up or 18 months after shipment, whichever comes first.

2. UV Lamps: The UV lamps will be warranted for a minimum of 15,000 hours when operated in automatic mode, prorated after 9,000 hours. On/off cycles are limited to an average of 4 per day accumulated over the guaranteed life of the lamp.

3. Lamp Drivers: Lamp drivers will be warranted for 10 years, prorated after 1 year.

4. UV Intensity Sensors: UV Intensity Sensors will be warranted for 10 years.

D. Design, Construction and Materials: All UV Bank metal components in contact with effluent will be Type 316 stainless steel. All wiring exposed to UV light will be Teflon™ coated.

1. Lamp Array Configuration:

a. The lamp array configuration will be in a staggered inclined arrangement.

b. The system will be designed for complete submersion of the UV lamps under all flow conditions including both electrodes and the full length of the lamp arc.

c. To maximize performance and ensure safety, bank light locks will be used in each bank to prevent potential short circuiting over the top of the lamps.

d. For any UV inclined system that does not contain UV bank light locks to prevent short circuiting, the sytem shall be supplied with 1 additional UV bank to compensate for short-circuiting over the top of the lamps.

2. UV Bank:

a. Each UV bank will consist of UV lamps, quartz sleeves and an automatic chemical/mechanical cleaning system mounted in a Type 316 stainless steel frame.

b. Each lamp will be enclosed in its individual quartz sleeve, one end of which will be closed and the other end sealed by a lamp end seal. To be considered as an alternate, lamp quartz sleeves that are open at both ends will be supplied with twice the amount of specified spare seals and lamps.

c. The closed end of the quartz sleeve will be held in place by a retaining o-ring. The quartz sleeve will not come in contact with any steel in the frame.

d. Each UV bank will contain a pre-formed Type 316 stainless steel wall on each side to prevent possible short-circuiting at the side walls of the reactor.

e. Each UV bank will contain light locks at the top of the bank to prevent short circuiting over the top of the lamps and maximize disinfection efficiency.

f. Each UV bank will be rated Type 6P. UV banks that are not Type 6P rated are not acceptable.

g. To minimize maintenance, equipment must be provided by the UV manufacturer to enable lifting a complete bank of lamps from the channel at once for inspection and/or servicing.

3. UV Lamps:

a. Lamps will be high intensity low pressure amalgam design. Lamps that are not amalgam will not be allowed.

b. The filament shall be significantly rugged to withstand shock and vibration.

c. Electrical connections for the lamp will consist of 4 pins at one end of the lamp only. Lamp wiring shall be Teflon insulated stranded wire.

d. Lamps without maintenance coating or that do not have 4 pins are considered instant-start and are not acceptable due to reduced reliability and increased maintenance and operating costs.

e. Lamps will be rated to produce zero levels of ozone.

f. The lamp shall withstand an average of 4 on/off cycles per day without reducing lamp life, warranty or causing any damage to the lamp.

g. Lamps will be operated by electronic lamp drivers with variable output capabilities ranging from 30% to 100% of nominal power. The lamp assembly shall incorporate active filament heating to maintain a minimum lamp efficiency of 35% across varying water temperatures and between the minimum and maximum stated lamp power levels.

4. Lamp Plugs:

a. Each lamp plug will be accessible from the top of the UV bank to facilitate lamp removal without moving the UV banks or any other components.

b. Each lamp plug shall have provisions for a light emitting diode (LED) visual indicator that indicates on/off status for each lamp.

c. An integral safety interlock in the lamp plug will prevent removal of energized lamps.

d. The lamp plug shall be rated Type 6P.

5. Lamp Drivers:

a. Each lamp driver will independently power 2 UV lamps. Failure of one lamp will not affect operation of the other lamp.

b. The lamp driver will have a power factor correction circuit to ensure minimum 99% power factor and less than 5% total harmonic distortion (THD) current at the maximum power level and nominal input voltage.

c. The lamp driver electrical efficiency will be minimum 95% at the maximum power level.

d. The lamp driver will be programmed-start type utilizing filament preheat followed by a high voltage pulse to ignite the lamp.

e. During lamp operation, variable filament heating current shall be provided according to a predetermined curve to maintain optimum filament temperature and amalgam temperature to ensure maximum lamp life and maintain a minimum lamp efficiency of 35% across varying water temperatures and between the minimum and maximum stated lamp power levels.

f. A ground fault in the output circuit shall be detected and communicated as a warning to the external controls system while the corresponding lamp operates undisturbed.

g. The communication protocol shall be Modbus implemented on an RS485 electrical interface.

h. Local visual diagnostic will be provided with LEDs for lamp driver status, lamp status (on, idle, preheat, fault), power and communication status.

i. For reliability and to facilitate trouble shooting, at a minimum, the following external indicators (protections, status, warnings and alarms) shall be provided: lamp status, driver status, ground fault, and communication time-out.

The lamp driver shall be UL, CE, and RoHS compliant.

6. Quartz Sleeves:

a. Quartz sleeves will be clear fused quartz circular tubing containing 99.9% silicon dioxide.

b. Sleeves will have minimum UV transmittance at 254nm of 87% (1mm wall thickness).

c. Sleeves will be open at one end only and domed at the other end.

7. Cleaning System:

a. An automatic in-situ cleaning system will be provided to clean the quartz sleeves using both chemical and mechanical methods. Wiping sequence will be automatically initiated with capability for manual override.

b. The cleaning system shall also incorporate an integrated debris removal device to clear the quartz sleeves of any large solids or debris to maximize the life of the chemical/mechanical cleaning system.

c. The wiper on the cleaning system shall be parked out of the effluent when not in use.

d. Cleaning systems that utilize a screw drive, or park the wiper in the effluent while not in use shall not be acceptable due to collection of debris in and around the wetted parts of the wiper.

e. The cleaning system will be fully operational while UV lamps and modules are submerged in the effluent channel and energized.

f. To minimize maintenance, UV System will be designed such that cleaning solution replacement can be performed while the UV Bank and lamps are in place and operational in the channel.

g. Cleaning sequence frequency will be field adjustable to enable optimization with effluent characteristics.

h. Cleaning system operation will be remote auto (default) or remote manual.

i. The cleaning system will be provided with the required solutions necessary for initial equipment testing and for equipment start-up.

j. The wipers shall travel the full length of the UV lamp arc. Designs in which the wipers only travel part way along the sleeves will not be acceptable.

k. The UV intensity sensor shall be cleaned utilizing the same chemical/mechanical cleaning method as that of the lamp quartz sleeves. UV intensity sensors that only utilize a mechanical means shall not be acceptable.

To be considered as an alternate, systems that use only mechanical wiping must have the ability to periodically be cleaned out of channel using a chemical bath. Out of channel cleaning will include lifting slings, removable banks, cleaning tanks, agitation system and air compressors, as required. The UV manufacturer will be responsible for supplying all equipment including any equipment not specifically listed required to perform out of channel chemical cleaning. Contactor will be responsible for installation.

8. Effluent Level Controller:

a. Level control weir shall be located at the discharge end of the UV channel.

b. Weir will be designed to maintain the minimum channel effluent level required to keep lamps submerged at all times.

c. Weir to be constructed of Type 304 stainless steel.

9. Light Locks:

a. Light locks, 2 per bank, will be provided to force effluent through the UV treatment zone maximizing disinfection performance.

b. The entire length of the lamp arc will remain submerged to maximize UV dose delivered to the effluent and to prevent any UV exposure above the water free surface.

10. Electrical:

a. All applicable electrical components will be UL-listed to ensure safety standards are met.

b. Each UV lamp within a bank will be powered from a power distribution center.

c. UV manufacturer shall supply all cabling between lamps and drivers.

d. Each electronic lamp driver will power 2 lamps.

e. Power factor will not be less than 99% leading or lagging.

f. Electrical supply to each power distribution center will be 480/277V, 60 Hz, 3 Phase, 4 Wire + GND, 27.0 kVA.

g. Electrical supply to the hydraulic system center will be 480V, 60 Hz, 3 Phase, 3 Wire + GND, 2.5 kVA

h. Electrical supply for the water level sensor will be provided by the PDC and be 12 Volt DC.

i. Electrical supply to the system control center will be 120V, 60 Hz, 1 Phase, 2 Wire + GND, 1.8 kVA

11. Power Distribution Center (PDC):

a. The configuration of power distribution centers shall be lamps per PDC.

b. PDC enclosure material will be 304 stainless steel, Type 4X.

c. All internal components will be sealed from the environment.

d. All power distribution centers shall be UL approved or equivalent.

e. An internal heater will be provided in the PDC to prevent condensation when the external temperature drops below the dew point.

f. Each PDC shall be able to electrically isolate each bank of lamp drivers and safely replace a lamp driver without de-energizing any other operating banks.

12. Hydraulic System Center:

a. The hydraulic system center (HSC) houses the components required to operate the automatic cleaning system and bank automatic raising mechanism (ARM).

b. HSC enclosure material will be 304 Stainless Steel (Type 4X).

c. The HSC will contain hydraulic power unit complete with pump, fluid reservoir, manifolds, valves and filter.

13. Control and Instrumentation:

a. System Control Center (SCC): The monitoring, operation and control of the TrojanUVSigna is managed at the System Control Center (SCC) by a Allen Bradley Compact Logix with a Beijer 15 inch A15 HMI screen.

1) If the SCC is installed outdoors, the operator interface shall be positioned out of or away from direct sunlight and shall include a sunshade. The operator interface screen will be desiged for a rugged outdoor environment capable of operating at ambient temperatures between -30 Deg C and +70 Deg C with a high brightess display (minimum 1000 Nit). HMI screen shall be certified for outdoor use (UL50E Type 4X Outdoor)

2) Alarms will be provided to indicate to plant operators that maintenance attention is required or to indicate an extreme alarm condition in which the disinfection performance may be jeopardized. The alarms will include, but not be limited to:

- Individual Lamp Failure
- Multiple Lamp Failure
- Low UV Intensity
- Bank Communication Alarm

3) The 100 most recent alarms will be recorded in an alarm history register and will be displayed when prompted.

4) Mode of operation for UV Banks can be manual, automatic or remote.

5) Elapsed time of each bank will be recorded and displayed on the display screen when prompted.

6) Monitoring points shall be available to the SCADA system via MODBUS TCP/IP over Ethernet. The manufacturer shall provide a complete list of all Modbus digital and analog I/O registers including scales as shown on the Drawings to provide all information as required to coordinate communications with the SCADA integrator.

b. Low Water Level Sensor: The UV manufacturer will provide 1 low water level sensor for each UV channel. During all modes of system operation (manual, automatic and remote), the water level sensor will ensure that lamps extinguish automatically if the water level in the channel drops below an acceptable level.

c. UV Intensity Sensors:

1) A UV sensor will continuously monitor the UV intensity produced within each UV Bank. The sensors will measure only the germicidal portion of light emitted by the lamps.

2) The UV sensor shall be factory-calibrated to US National Institute for Standards and Technology (NIST). Sensors requiring field-calibration are not acceptable.

3) The sensor shall be digitally calibrated to ensure calibration accuracy.

4) To ensure continuous disinfection, the sensor shall be accessible without shutting down the system, lifting a bank/module or removing lamps.

5) Sensors will be designed to provide UV intensity data for dose monitoring and control functions. Dose pacing program will enable use of measured UV intensity along with flow rate and UVT to determine the delivered dose during operation.

6) Sensors will be designed such that reference sensor readings can be taken without interrupting disinfection and without removing UV lamps, banks/modules or sleeves.

d. Dose-Pacing:

1) A dose-pacing system will be supplied to modulate the lamp UV output in relationship to a 4-20 mA DC signal from an effluent flow meter (supplied and installed by others) and UV intensity sensors.

2) The system to be dose-paced such that as the flow and effluent quality change, the design UV dose is delivered while conserving power.

3) The dose-pacing system will allow the operator to vary the design dose setting. Logic and time delays will be provided to regulate UV Bank ON/OFF cycling.

14. UV Bank Lifting Device:

a. The lifting device for UV Banks will be supplied by the UV manufacturer.

b. An ARM will be designed and supplied to facilitate lifting a UV bank from the channel without use of ancillary equipment.

c. The ARM will be integrated into the UV Bank for simple and seamless operation.

d. The UV Bank will be raised from the channel for easier access and maintenance.

e. The ARM design will provide access to components without having to break electrical connections thus reducing wear on connectors.

15. Spare Parts: The following spare parts and safety equipment shall be supplied:

a. 4 UV Lamps

b. 4 Quartz Sleeves

c. 4 Lamp Wiper Seals

d. 1 Operators Kit that includes UV-resistant face shield, gloves and cleaning solution.

To be considered as an alternate, systems that require more lamps than specified, the UV manufacturer will provide spares in the amount equal to the quantities listed plus an additional quantity equal to the percentage of lamps required over and above the number of lamps specified.

E. Installation: UV equipment shall be installed in accordance with Drawings, manufacturers' shop drawings and instructions.

F. Manufacturer's Services:

1. Installation Assistance and Certification: As required for proper installation prior to start up

2. Start-up and Field Testing: 5 full 8-hour days on site, including all travel expenses.

a. Follow-up inspection and retraining at 6 months and 1 year after initial startup

3. Operator Training: 1 full 8-hour day on site

4. Warranty Service: As required during the warranty period

10.16 Sludge Dewatering Equipment: The Contractor shall furnish all labor, materials, tools and equipment necessary to install a complete belt filter press system as shown on the Drawings and as specified.

A. Combination Gravity Belt Thickener / Belt Filter Press: The sludge dewatering equipment shall be a 3-belt design with 3 distinct dewatering zones: independent gravity-dewatering zone, wedge zone and a shear/pressure zone. The gravity zone shall be independent of the wedge zone and shear/pressure zone making it possible to select different dewatering belts and vary the speed of each area independently of the other for dual use purposes. Each machine shall be designed to serve both as a belt press and also as an independent gravity belt thickener.

1. The combination 3-belt unit shall be designed, fabricated, assembled and tested by the belt filter press manufacturer in their own facility. The belt filter press manufacturer shall maintain a suitable spare parts inventory.

2. The equipment shall be guaranteed against defects in material and workmanship under normal use and service for a period of one year after start-up not to exceed 18 months after shipment during which time repairs or replacements shall be made without charge.

3. All equipment, which deviates from these Specifications, will be acceptable only on the basis that all costs associated with any revisions in the engineering or construction will be the responsibility of the Contractor.

B. Design Data:

1.	3-Belt Combination Units:	1
2.	Manufacturer / Model:	Charter / 3BTP17.93S BDP Industries / 3DP
3.	Minimum Belt Width:	1.7 meters
4.	Maximum Filter Press Dimensions:	8'-4" W x 23'-11" L x 9' x 7" H

5. Each gravity belt thickener / belt filter press shall be capable of operating satisfactorily under the following performance conditions:

Description	
a. Sludge Type	Aerobically Digested
b. Effective width of filter belt, meters	1.5
c. Average infeed solids, %	1.5%
d. Minimum hydraulic loading rate, gpm	220
e. Minimum solids loading rate lbs. ds / hour	1,650
f. Minimum cake solids, %	16%

C. Gravity Belt Thickener Main Frame:

1. The main frame shall be constructed of welded and bolted MC10 X 22 channels conforming to ASTM Specification A36 and sized such that, during installation and under conditions of operational loading, the deflection of any frame member shall exceed 0.03". The frame safety factor is greater than 19.8.

2. Main frame coating is crucial to the protection of the gravity belt thickener section. All frame members shall be prepared and coated according to ASTM A123, hot dip galvanized to a minimum 5-mil thickness. All frame members shall be drilled and machined prior to galvanizing and all bolted connections shall be disassembled prior to galvanizing.

3. All hardware used in assembly shall be type 304 stainless steel.

D. Flocculator:

1. The gravity belt thickener shall be furnished with an upstream sludge-conditioning device consisting of an inline adjustable orifice venturi type

mixer complete with polymer injection device. The mixer shall be designed to condition the sludge with polymer to result in a degree of flocculation that will produce the greatest amount of dewatering while maintaining the highest quality filtrate.

2. The inline mixer will have flanged connections and be constructed of 304 stainless steel, complete with a UHMW polyethylene injection ring, providing one complete unit.

3. Location of the inline mixer will vary with the application. Contractor shall provide spool pieces if indicated

E. Gravity Dewatering Zone:

1. The gravity-dewatering zone shall consist of a 12' section of the horizontal filter belt. The minimum dewatering area shall be, 66.67 square feet. The gravity dewatering zone shall be independent of the belt filter press section and be capable of operating in a thickening mode only, utilizing its own drive, tensioning and tracking systems.

2. A type 304 stainless steel head-box shall distribute sludge onto the horizontal dewatering belt and be equipped with a sludge-leveling bar for even distribution across the entire width of the dewatering belt.

3. The sludge shall be contained on the belt by type 304 stainless steel side channels with neoprene seals.

F. Cake Discharge Zone:

1. A counterweighted doctor blade shall be mounted at the discharge roller for removing sludge cake from the belt. The doctor blade shall be constructed of UHMW polyethylene. The blade shall be rigidly reinforced to provide even, gentle pressure on the belt with a minimal amount of abrasiveness and shall be capable of providing passage clearance for the belt seam without injuring that seam.

2. The thickener shall be capable of discharging thickened sludge into a screw conveyor for transfer or direct the thickened sludge into the pressure zone of the combination unit.

G. Thickener Rollers:

1. All rollers shall be designed for a deflection of less than 0.057" at mid span under conditions of maximum operational loading. Maximum operational loading shall be defined as the sum of the belt tension load, friction loads, equipment and sludge loads, any loads induced by the elasticity of the belt, and any loads induced by the torque of the drive. Maximum roll deflection shall be 0.0062", which is calculated using the belt tension of 50 PLI, and the drive torque of 1,960" pounds.

2. All rollers shall be of stub shaft design with each stub secured by an end plate and an internal bulkhead. Assembly of rollers, shafts, end plates, and

bulkheads shall be of machined concentricity and by means of continuous weld.

3. The drive and tracking roller shall be coated with a minimum ⅜" thick synthetic rubber of 60 durometer to provide the friction required for efficient belt drive and tracking. The tensioning roller shall be coated to the point of insertion of the bearing with Rilsan Nylon II to a thickness of 25 mil by the electrostatic, fusion bonded powder dispersion process..

4. Minimum roll safety factor shall be 20 63.

H. Thickener Roller Bearings and Seals:

1. Roller bearings shall have an L-10 rating greater than 15,000,000 hours per AFBMA test procedure under maximum loading conditions and calculated at a belt speed of 20 meters per minute. All bearings shall be double row spherical roller type with all grease fittings located for servicing from the machine exterior. Bearings shall have quadruple lip contact seals.

2. All bearing housings shall be class 30 cast iron one-piece pillow block type with gasketed end plate as manufactured by Charter Machine Company. Bearing housings shall be coated with Rislan Nylon II to a thickness of 12 mils by electro static fusion bonding.

3. All bearing pads and bearing housings shall be machined at the factory to guarantee proper alignment.

4. All roller bearings located on the thickening portion of the combination 3-belt unit shall be guaranteed for the life of the unit.

I. Thickener Belt Tensioning:

1. Belt tensioning shall be maintained pneumatically and controlled from the thickener mounted pneumatic control center.

2. The dewatering belt shall be tensioned by a pair of corrosion resistant pneumatic cylinders attached to a rigid tensioning assembly. The tensioning assembly shall be attached to each tensioning cylinder in such a way as to assure parallel movement of the tensioning roller.

3. Belt tension adjustment shall be possible while the machine is in operation. Tensioning pressure shall be gauged at the pneumatic control center. Tensioning cylinders shall be power retractable for belt replacement and emergency detensioning.

J. Thickener Belt Tracking:

1. Belt tracking shall be totally pneumatic and shall function as a continuous automatic belt guidance system. The belt shall be tracked by a type 304 stainless steel paddle arm and analog system sensor that monitors one edge of the belt and pneumatically signals a corrosion resistant pneumatic cylinder for corrective positioning when required. That corrective motion shall be smooth, minimal, and adjustable.

2. The belt tracking assembly shall be center pivoting complete with bearings to minimize dewatering belt stretch and wear.

K. Pneumatic Control System:

1. All belt thickener pneumatic system controls, belt tensioning, tracking, and sludge plow grid control shall be frame mounted on the thickener in a type 304 stainless steel NEMA 4X enclosure. Low air alarm switch, tensioning and plow grid lift valves shall be mounted inside the enclosure. Tensioning on/off and plow grid lift levers, tension gauges, and adjustment controls shall extend through the enclosure wall for easy access. The enclosed controls shall be preceded by a 3 micron air filter/regulator with gauge and a 0.1-micron oil coalescing filter. One ¼" female NPT supply air connection shall be required to the total pneumatic system. Lubrication of the pneumatic system is not required.

2. All pneumatic cylinders shall be rated for 200 PSI and constructed of anodized aluminum tube with stainless steel tie rods, Teflon seals and graphite bearings. Lubrication shall not be required.

L. Belt Wash Station: The filter belt shall be equipped with a belt wash station for constant belt washing. The belt wash station shall include a manifold with removable stainless steel nozzles, internal hand wheel operated brush, hand wheel operated flush valve, and stainless steel neoprene skirted enclosure for containing spray mist. Belt spray water shall be collected in the stainless steel enclosure and plumbed to the base sump. Spray nozzles shall be suitable for use with non-potable water with a maximum solids concentration of 200 mg/l without clogging. The press shall be designed to allow the operator to close the wash water supply solenoid valve to the pressure belts to reduce the belt wash water requirements when utilizing the thickening operation only.

M. Filter Belt:

1. The filter belt shall be of polyester monofilament woven-ware with minimum tensile strength of 890 pounds per lineal inch. Belt edges shall be chamfered and sealed. The belt seams shall be type 316 stainless steel clipper type. Mesh shall be selected for optimal gravity dewatering of the pertinent sludge.

2. Replacement of filter belt shall be accomplished without any disassembly of any part of the gravity belt thickener except the belt seam.

3. Belt life will be warranted for 4,000 hours.

N. Thickener Drive and Motor:

1. The drive shall be Variable Frequency Drive (VFD) using AC motor and quadruple gear speed reducer. The inverter along with start/stop and speed control of the drive shall be located in the master control panel.

2. The drive motor shall be a severe duty, TEFC, type motor of ample power for starting and operating under normal conditions without exceeding the

nameplate horsepower. The drive motor shall have a service factor of 1.15.

3. All electrical controls for the gravity thickener shall be in the master control panel.

O. Factory Wiring: All equipment and components shall be factory wired using non-metallic, flexible liquid-tight conduit and fittings wired to numbered terminal blocks in a frame mounted NEMA 4X junction box. All conduit shall be run and secured inside the MC channel frame wherever possible.

P. Safety Features:

1. Each gravity belt thickener section of the combination unit shall be equipped with a lanyard type safety switch with cable encircling the thickener at an easily accessible height.

2. The belt tracking system shall have a limit switch on each side of the thickener that shall shut down the system in the event of belt tracking failure.

3. The belt tensioning system shall have a limit switch that shall shut down the system in the event of total belt failure.

4. Each pneumatic control center shall have a pressure switch that shall shut down the system in the event of low air pressure.

Q. Tower Belt Filter Press Main Frame:

1. The main frame shall be a box frame of welded and bolted MC channels conforming to ASTM Specification A36. Pressure roll bearings will be installed on MC 8 x 22.8 channels, and remaining mainframe members shall be MC 6 x 18 to accommodate all operating and static loads without significant deflection, deformation or vibration. Maximum operational loading shall be defined as the sum of the belt tension load based on a belt tension of 50 pli, friction loads, roller, equipment and sludge loads; any loads induced by the belts, and any loads induced by the torque of the drive. The pressure zone main beams shall have a moment of inertia of at least 60" to the fourth power. The frame safety factor shall be greater than 5.12 with a maximum frame deflection of 0.018.

2. Main frame coating shall protect the press main frame, and all frame members shall be prepared and coated according to ASTM A123, hot dip galvanized to a minimum 5-mil thickness. All frame members shall be drilled and machined, and all bolted connections shall be disassembled prior to galvanizing

R. Wedge Zone:

1. The wedge zone shall be provided to transition the thickened sludge to the shear/pressure zone from the gravity zone. The wedge zone initiates the pressure on the sludge by converging the 2 belts to form the cloth/cake sandwich.

2. The wedge zone shall be provided with a leveling bar and stainless steel containment sides for even distribution along the entire width of the belt.

S. High Pressure / Shear Zone: The high pressure/shear zone shall consist of a minimum of 8 rollers. The first shall be a ¼" thick perforated drum of 26" diameter with perforations of minimum ⅞" diameter and minimum 34% open area. The succeeding rollers shall be solid faced decreasing in diameter from 20" to 14" to 11" and arranged in a vertical configuration with belt to roller contact exceeding 205°. The total high pressure dewatering area shall be a minimum of; 101.92 square feet as measured along the length of a single belt in contact with the pressure rolls.

T. Cake Discharge Zone:

1. Adjustable pneumatically loaded doctor blades shall be mounted at the discharge rollers for removing sludge cake from both belts. The doctor blades shall be power retractable and can be held away from the filter belts for cleaning and maintenance. The amount of pressure the doctor blades exert equally against both belts can be varied while the machine is operating. The adjustment of the doctor blades can be regulated from a pneumatic control panel located on the press.

2. The doctor blades shall be made from UHMW polyethylene. The blades shall be rigidly reinforced to provide even gentle pressure on the belts with a minimal amount of abrasiveness and shall be capable of providing passage clearance for the belt seam without injuring the seam.

3. A 14-gauge type 304 stainless steel chute shall be provided to accommodate the method of removal.

U. Rollers:

1. All rollers shall be designed for a maximum deflection of 0.011" at mid span under maximum loading conditions. Maximum loading shall be defined as the sum of the belt tension load at 50 pli, friction loads, equipment and sludge loads, any loads induced by the elasticity of the belts, and any loads induced by the torque of the drive. Minimum roll safety factor shall be 6.89 at mid span. Minimum safety factor shall be 11.19 at shaft.

2. The perforated drum shall be of through shaft design with internal bulkhead and matched deflection of shaft and end plates. All other rollers shall be of stub shaft design with each stub secured by an end plate and an internal bulkhead. Assembly of rollers, shafts, end plates, and bulkheads shall be of machined concentricity and by means of continuous weld. The shaft inserted into the bearing shall be machined and polished to a diameter of 2.953". In addition each stub shaft shall be held in place with a lock ring to guarantee alignment and eliminate any slippage or misalignment that can occur with tapered sleeves and tightening ring arrangements.

3. Drive rollers and tracking rollers shall be coated with a minimum ⅜" thick synthetic rubber of 60 durometer to provide the friction required for efficient belt drive and tracking. All other solid rollers shall be coated to the point of insertion of the bearing with Rilsan Nylon II to a thickness of 25 mil by the electrostatic, fusion bonded powder dispersion process.

4. The perforated drum shall be hot dip galvanized to a minimum thickness of 5 mil and shall be totally free of projections that may shorten belt life.

5. The pressure rollers shall be arranged vertically on alternating sides of the main pressure channel. The diameters of the rollers starting with the perforated roll shall decrease in size up through the vertical stack to the 1st of five 10 ¾" diameter rolls, with each roller separately pan drained to prevent rewetting of the sludge on the preceding rollers.

V. Roller Bearings and Seals:

1. Roller bearings shall have an L-10 rating greater than, 500,000 hours per AFBMA test procedure under maximum loading conditions as the sum of the belt tension load at 50 pli and calculated at a belt speed of 5 meters per minute. All bearings and grease fittings shall be located on the machine exterior for servicing and maintenance. All roller bearings shall be double row spherical. All bearings shall have quadruple lip contact seals.

2. All bearing housings shall be class 30 cast iron one-piece pillow block type with end plate as manufactured by Charter Machine. Bearing housings shall be coated the electrostatic, fusion bonded powder dispersion process.

3. All tower press roller bearings shall be guaranteed for 5 years.

W. Belt Tensioning:

1. Belt tensioning shall be maintained pneumatically and controlled from the press mounted pneumatic control center.

2. Each filter belt shall be tensioned by a pair of corrosion resistant pneumatic cylinders attached to a rigid tensioning assembly. The tensioning assembly shall be attached to each tensioning cylinder in such a way as to assure parallel movement of the tensioning roller.

3. Each belt shall be tensioned individually and capable of changes during operation. Tensioning pressure shall be gauged at the pneumatic control center. Tensioning cylinders shall be power retractable for belt replacement and emergency detensioning

X. Belt Tracking:

1. Belt tracking shall be totally pneumatic and shall function as a continuous automatic belt guidance system. Each belt shall be tracked individually by a type 304 stainless steel paddle arm and analog system sensor that monitors one edge of the belt and pneumatically signals a corrosion

resistant pneumatic cylinder for corrective positioning when required. That corrective motion shall be smooth, minimal, and adjustable.

2. Each belt tracking assembly shall be center pivoting complete with bearings to minimize dewatering belt stretch and wear.

3. Belt life will be warranted for 4,000 hours.

Y. Pneumatic Control System:

1. All belt press pneumatic system controls, belt tensioning, tracking and doctor blades shall be frame mounted on the belt press in a type 304 stainless steel NEMA 4X enclosure. Belt and doctor blade tensioning adjustments, low air alarm switch and tensioning valves for on/off control shall be mounted inside the enclosure. Belt and doctor blade tensioning on/off levers, tension gauges and adjustment controls shall extend through the enclosure for easy access. The enclosed controls shall be preceded by an oil coalescing filter and a 3 micron air filter regulator with gauge. One ½" female NPT supply air connection shall only be required to the total pneumatic system. Lubrication of the pneumatic system shall not be required.

2. All pneumatic cylinders shall be rated for 200 PSI and constructed of anodized aluminum tube with stainless steel tie rods, Teflon seals and graphite bearings. Lubrication shall not be required.

3. Each combination belt press and thickener shall be furnished with a receiver mounted single stage air compressor. The unit shall be complete with 17 gallon ASME code receiver rated for 200 psi, pressure gauge, automatic overload protector, intake air filter-muffler, pressure switch, safety valve, tank drain, outlet valve, and constant speed regulator. The motor shall be 1.5 horsepower, TEFC with 1.15 service factor.

Z. Belt Wash Stations:

1. Each filter belt shall be equipped with a belt wash station for constant belt washing. Each station shall include a manifold with removable stainless steel nozzles, internal hand wheel operated brush, hand wheel operated flush valve, and stainless steel neoprene skirted enclosure for containing spray mist. Belt spray water and flush water shall be collected in stainless steel pans and plumbed to the base sump to prevent rewatering of sludge process. Spray nozzles shall be suitable for use with non-potable plant effluent water with a maximum solids concentration of 200 mg/l without clogging.

2. One wash water booster pump G&L Model SSH-C will be provided to be utilized for both the gravity belt thickener and the high pressure section. The pump shall be centrifugal type with replaceable wear rings and shall be plumbed into the belt wash system by the Contractor.

AA. Filter Belts:

1. Filter belts shall be of polyester monofilament wovenware with minimum tensile strength of 890 pounds per lineal inch. Edges shall be chamfered and belt seams shall be type 316 stainless steel clipper type. Mesh shall be selected for optimal pressure dewatering of the pertinent sludge. Belts shall be self-threading under power for replacement.

2. Replacement of filter belts shall be accomplished without any disassembly of any part of the belt filter press except the belt joints.

BB. Drive Motor:

1. The belt drive shall be variable speed, shaft mounted on one drive roller shaft. Drive shall transfer to the second drive roller by means of a gear combination. The gears shall be enclosed by a solid, stainless steel enclosure. The drive motor shall be severe duty TEFC of ample power for starting and operating under normal conditions without exceeding the nameplate horsepower and shall have a service factor of 1.15.

2. The drive shall be VFD using AC motor and quadruple gear speed reducer. Speed control of the drive shall be in the master control panel. The inverter, start/stop and speed control of the drive shall be in the master control panel.

CC. Factory Wiring: All equipment and components shall be factory wired using non-metallic, flexible liquid-tight conduit and fittings wired to numbered terminal blocks in a frame mounted NEMA 4X junction box. All conduit shall be run and secured inside the MC channel frame wherever possible.

DD. Safety Features:

1. Each belt filter press shall be equipped with a lanyard type safety switch with cable encircling three sides of the press at an easily accessible height.

2. Each belt tensioning system shall have a limit switch that shall shut down the system in the event of total belt failure.

3. The belt tracking system shall have a limit switch on each side of the press that shall shut down the system in the event of belt tracking failure.

4. Each pneumatic control center shall have a pressure switch that shall shut down the system in the event of low air pressure.

5. Each gear drive shall have a solid stainless steel enclosure.

EE. Design Requirements:

1. Electrical: 460 volt, 3 phase, 60 Hz

2. Power:

a.	Gravity Belt Drive:	1.5
b.	Belt Filter Press Drive:	2.0
c.	Air Compressor	1.5

d. Wash Water Booster Pump: 7.5

e. Thickened Sludge Cross Screw Conveyor: 1.5

3. Belt Wash Water @ 85 psi (minimum):

a. Thickening Mode (thickener only): 27 gpm

b. Dewatering Mode (thickener and press): 80 gpm

4. Pneumatics: 3 cfm at 80-psi min., 250 psi max.

FF. Electrical Control Panel: Each belt filter press shall be provided with a control panel that will contain the necessary control devices and equipment for controlling the dewatering process as described herein. The control panel shall meet the following general requirements:

1. The control panel shall accept a 460 volts, 60 hertz, 3-phase AC power input. A main disconnect circuit breaker and operator mechanism shall be included. When the disconnect is in the open position, all power shall be removed from the control system.

2. IEC rated motor starters shall be provided for the air compressor, belt wash water booster pump, cross conveyor, and the discharge conveyor.

3. VFD shall be provided for the pressure belt drive and gravity belt drive. VFD for sludge feed pump and polymer pump can be supplied if specified.

4. Short circuit protection for each motor shall be accomplished utilizing fuses. Individual thermal overload protection shall be provided (except for the belt drive and sludge feed pump).

5. A control power transformer shall be included that will provide 120 volts, AC control power to the system.

6. An industrial programmable logic controller (PLC) located in the control panel shall perform all logic functions for the system.

7. A CONTROL POWER ON/OFF switch shall be located on the front of the control panel. When in the ON position, the CONTROL POWER ON pilot light will be illuminated, and control power shall be distributed to the control system. When in the OFF position, the control system shall be held de-energized.

8. An EMERGENCY STOP pushbutton shall be located on the control panel. It shall be a mushroom head style pushbutton that when depressed shall immediately de-energize all moving equipment in the system.

9. An alarm horn shall be included with the control panel for audible alarm annunciation along with a horn silencing button in the front of the panel.

10. Controls and drives for ancillary equipment will be provided and installed in the master control panel as specified.

11. Control and Pilot Devices: As a minimum, the following control and pilot devices shall be located on the front of the control panel with nameplates as worded below in UPPERCASE LETTERS:

a. Pushbuttons:

1) AUTO STOP
2) SYSTEM RESET
3) ALARM SILENCE
4) WASHWATER PUMP START
5) WASHWATER PUMP STOP
6) BELT DRIVE START
7) BELT DRIVE STOP
8) GRAVITY BELT DRIVE START
9) GRAVITY BELT DRIVE STOP
10) SLUDGE PUMP START
11) SLUDGE PUMP STOP
12) POLYMER PUMP START
13) POLYMER PUMP START
14) CROSS CONVEYOR START
15) CROSS CONVEYOR STOP

b. Selector Switches:

1) PRESS HAND/OFF/AUTO MODE
2) CONTROL POWER ON/OFF
3) AIR COMPRESSOR ON/OFF
4) DEWATERING MODE THICKENER/PRESS

c. Indicator Lights:

1) PREWET CYCLE ON
2) POSTWASH CYCLE ON
3) AIR COMPRESSOR RUNNING
4) WASHWATER PUMP RUNNING
5) BELT DRIVE RUNNING
6) GRAVITY BELT DRIVE RUNNING
7) SLUDGE PUMP RUNNING
8) POLYMER SYSTEM RUNNING

9) CROSS CONVEYOR RUNNING

10) LOW AIR PRESSURE

11) BELT OVERTRAVEL

12) BELT BROKEN

d. Speed Potentiometers:

1) SLUDGE FEED PUMP SPEED (If required)

2) BELT DRIVE SPEED

3) GRAVITY BELT SPEED

4) POLYMER PUMP SPEED (If required)

12. Signal Input and Output Devices:

a. Discrete Input Signals: The control panel shall receive the following discrete input signals from normally open dry contacts in external devices (contacts close when the equipment runs or a fault occurs):

1) POLYMER PUMP RUNNING

2) POLYMER PUMP FAIL

3) SLUDGE FEED PUMP RUNNING

4) SLUDGE FEED PUMP FAIL

5) DISCHARGE CONVEYOR RUNNING

6) DISCHARGE CONVEYOR FAIL

b. Discrete Output Signals: The control panel shall provide the following discrete signals for transmission using normally open dry contacts (contacts close when the equipment is called to run or a fault occurs):

1) SYSTEM RUNNING

2) SYSTEM FAULT

13. Sequence of Operation (Thickening Mode):

a. Automatic Mode of Operation:

1) Turn operation selector switch to the thickening position.

2) The thickener may be operated in the automatic mode by placing the HAND/OFF/AUTO selector switch in the AUTO position. The operator will next turn the AIR COMPRESSOR SELECTOR SWITCH to the ON position and allow the pressure to reach normal operating level.

3) After the air pressure has reached operating level, the operator will press the AUTO START pushbutton to

energize the wash water booster pump and GRAVITY belt drive, illuminate the PREWET CYCLE ON pilot light and start the pre-wet time delay. After the pre-wet timer times out, the sludge pump, polymer system, cross conveyor and the discharge conveyor will be energized.

4) Pressing the AUTO STOP pushbutton will de-energize the sludge pump and polymer pump, illuminate the WASHDOWN CYCLE ON pilot light, and start a wash down time delay. After the wash down timer has timed out, the gravity belt drive, washwater pump, cross conveyor and discharge conveyor will be de-energized.

b. Manual Mode of Operation:

1) To operate the press in the manual mode, the operator will place the HAND/OFF/AUTO selector switch in the HAND position. The operator will next turn the air compressor selector switch to the on position. After the air pressure has reached operating level, all components or drives can be started individually.

2) The system will be stopped by pressing the respective STOP pushbutton for each drive or component.

14. Sequence of Operation: (PRESS MODE):

a. Automatic Mode of Operation:

1) Turn operation selector switch to the Press position.

2) The press may be operated in the automatic mode by placing the HAND/OFF/AUTO selector switch in the AUTO position. The operator will next turn the air compressor selector switch to the on position and allow the pressure to reach normal operating level.

3) After the air pressure has reached operating level, the operator will press the AUTO START pushbutton, this will energize the washwater booster pump belt drive and gravity belt drive, illuminate the PREWET CYCLE ON pilot light and start the pre-wet time delay. After the pre-wet timer times out, the sludge pump and polymer pump will be energized. (The cross conveyor remains off.)

4) Pressing the AUTO STOP pushbutton will de-energize the sludge pump and polymer pump, illuminate the WASHDOWN CYCLE ON pilot light and start a washdown time delay. After the washdown timer has timed out, the gravity belt drive, washwater pump and cross conveyor will be de-energized.

b. Manual Press Mode of Operation:

1) To operate the press in the manual mode, the operator will place the HAND/OFF/AUTO selector switch in the HAND position. The operator will next turn the air compressor selector switch to the ON position. After the air pressure has reached operating level, all components or drives can be started individually.

2) The system will be stopped by pressing the respective STOP pushbutton for each drive or component.

15. Faults: When any of the following fault conditions occur, in automatic or manual mode, the appropriate fault indicator will be illuminated, the alarm horn will sound and the belt filter press and associated equipment will be de-energized.

a. LOW AIR PRESSURE (amber light)

b. BELT OVERTRAVEL (amber light)

c. BELT BROKEN (amber light)

d. LOW POLYMER (amber light) if specified

e. BOOSTER PUMP FAULT (flashing run light)

f. GRAVITY BELT DRIVE FAULT (flashing run light)

g. GRAVITY BELT DRIVE (flashing run light)

h. SLUDGE PUMP FAULT (flashing run light)

i. CROSS CONVEYOR FAULT (flashing run light)

16. Components:

a. Enclosures: Control panel enclosures shall be free-standing, fabricated of type 304 stainless steel and shall be suitable for NEMA 4X service. Enclosures shall be manufactured by Saginaw Manufacturing.

b. Wiring: All power and control wiring shall be 600 volt, type MTW insulation stranded copper, and sized for the required load, 18 AWG minimum.

c. Circuit Breakers: Circuit breakers for the main disconnect shall be thermal magnetic molded case units. Circuit breakers shall be ABB type.

d. Motor Starters: Motor starters shall be full voltage, non-reversing, IEC style across the line units. Coils shall be 120 volts AC, Siemens type Sirius 3RT10.

e. Selector Switches: All selector switches shall be heavy duty, corrosion resistant units rated for NEMA 4X service. Contact

blocks shall be rated for 10-ampere continuous service. Selector switches shall be Idec Series TWTD.

f. Pushbuttons: All pushbuttons shall be heavy duty, corrosion resistant units rated for NEMA 4X service. Contact blocks shall be rated for 10-ampere continuous service. Pushbuttons shall be Idec Series TWTD.

g. Pilot Lights: Pilot lights shall be heavy duty, corrosion resistant units rated for NEMA 4X service. Units shall be 120 VAC full voltage incandescent type. Pilot lights shall be Idec Series TWTD.

h. Terminal Blocks: Terminal blocks shall be high density, solderless box lug style, with 600-volt rating. Terminal blocks shall be Allen Bradley type 1492.

i. Control Relays: Control relays shall be general purpose type with a 10 amp contact rating, miniature square base and internal on status pilot light. Relays shall be IDEC RY series.

j. Programmable Logic Controller (PLC): The PLC shall be a modular type with discrete and analog capabilities. The CPU shall have 6K minimum RAM for user instructions. The unit shall have battery backed RAM and EEPROM backup. The PLC shall be an Allen Bradley Micrologix Type.

k. Variable Frequency Drive (VFD): The VFD shall be UL listed and shall be manufactured by Control Techniques.

GG. Accessories: The belt filter press manufacturer shall furnish the following sludge dewatering equipment accessories for installation by the Contractor:

1. Dewatered Sludge Conveyor: A sludge conveyor shall be supplied as shown on the Drawings. The conveyor shall receive dewatered sludge cake from the belt filter press and convey the material to the sludge storage area.

a. The belt conveyor system shall include the following: conveyor frame, supports, belt, drive, head pulley with shaft and bearings, tail pulley with shaft and bearings, take-ups, drip pan, skirting, scraper device, and safety lanyard.

b. The conveyor shall be a troughing slider type conveyor approximately 28' long by 18" wide and have a minimum belt width of 14". The conveyor shall be inclined to meet the discharge elevation shown on the Drawings.

c. The conveyor frame and supports shall be constructed of carbon steel channel sufficiently cross braced so as to form a rigid structure. Conveyor support base pads shall be drilled for anchor bolt installation by the Contractor. The frame and supports shall be painted in accordance with the painting section of these Specifications.

d. The "troughing" section of the conveyor shall be formed from UHMW polyethylene and supported along the entire troughing length of the conveyor. UHMW return idlers shall be supplied and spaced at a maximum of 10'.

e. The conveyor belt shall be a "free slide" belt constructed of a durable PVC top cover and a bare polyester bottom specifically designed for slider bed applications. The belt thickness shall be 3/16" thick with a tension rating of 150 pounds per inch of belt width. The ends of the belt shall be joined together by #25, stainless steel alligator lacing.

f. The head pulley shall be constructed of 6" diameter face crowned carbon steel with ⅜" thick rubber lagging, machine crowned with a diamond grooved patter. The tail pulley shall be constructed in the same manner, but without lagging. Both pulleys shall be fastened to their shafts with keyed, tapered bushings. The head pulley shall be mounted to the conveyor frame in fixed pillow block bearings. The tail pulley shaft shall be mounted in 12" long adjustable screw type ball bearing take-ups attached to the conveyor frame.

g. A 3.0 horsepower, 3 phase, 60 cycle, TEFC induction motor and speed reducer shall be supplied to drive the conveyor belt at a constant speed of 60' per minute. The conveyor drive shall be directly mounted to the head pulley shaft.

h. A counter weighted belt scraper with replaceable blade shall be installed just after the head pulley to remove material from the conveyor belt. The manufacturer shall provide 2 replacement blades.

i. The conveyor shall be supplied with a minimum 14 gauge type 304 stainless steel skirting with rubber seal in the sludge loading area.

j. A minimum 14 gauge type 304 stainless steel drip pan shall be supplied beneath the conveyor frame to collect and convey all material to a common discharge point.

k. An emergency stop switch with safety lanyard cable shall be provided on both sides of the conveyor. All controls, interlocks and motor starters for the conveyor shall be contained in the belt press control panel.

2. Adjustable Back Pressure Valve: Back pressure valve shall be constructed of heavy cast iron with bronze and stainless steel fittings. It shall prevent reverse flow back through the valve when the inlet pressure decreases below the delivery pressure. The valve must be tight seating and must operate without hammer or shock. The seat ring must be renewable and shall be securely held in place by a threaded joint. The valve disc shall be of cast iron and shall be hinged above its seat so that perfect closure is always attained. The back pressure valve shall have an outside adjustable

weighted lever. The valve shall be capable of operation in the vertical position with an upward flow direction.

3. Reciprocating Positive Displacement Pump: Contractor shall furnish and install sludge pumps as specified in this section and shown on the Drawings. Pumps shall be complete pump unit consisting of pump, v-belt drive arrangement, and motor all completely assembled on fabricated stainless steel base and shall conform to the pump requirement described herein. Pumps shall be manufactured by Penn Valley Pump Company, Inc., or equal..

   a. Experience and Quality Assurance:

      1) The equipment manufacturer shall be experienced in manufacturing pumping equipment of this technology as specified and have a record of successful in-service performance. Manufacturer must have a history of manufacturing this equipment for at least 10 years' and able to submit evidence of manufacturing experience and installations upon request.

      2) The manufacturer shall maintain a fully equipped shop facility to perform all operations including welding, fabrication, assembly and testing. These integrated operations provide the level of quality necessary for the equipment specified. All materials shall be designed to withstand the stresses encountered in fabrication, erection and operation. All equipment shall be of corrosion resistant materials or shall be suitably protected by the supplier with corrosion resistant industrial coatings approved by the Engineer.

      3) Warranty: The equipment shall be warranted for a period of 2 years against defects in workmanship and materials under normal use, operation and service. If the equipment should fail during the warranty period due to a defective part, it shall be replaced and the units restored at no expense to the Owner.

   b. Design Parameters:

1)	Number of Units:	1
2)	Material Being Pumped:	WAS Sludge
3)	Maximum Percent Solids:	1%
4)	Capacity:	350 gallons per minute
5)	Rated Discharge Head:	10'
6)	Maximum Discharge Head (TDH):	140'
7)	Suction and Discharge Port Size:	6", 150 pounds, flanged

8)	Drive Type:	V-belt and pulley arrangement
9)	Maximum Pump Speed:	140 rpm
10)	Minimum Motor Horsepower:	7.5
11)	Maximum Motor Speed (RPM):	1,200 rpm
12)	Service Factor:	1.15 minimum
13)	Motor Enclosure:	TEFC
14)	Motor Electrical:	208 V/3 Ph/60 Htz

c. Description: Each pump shall be a simplex heavy duty, free disc style positive displacement type. Duplex arranged pumping units shall not be considered. The pumping action shall be achieved by 2 free floating, non-captive free floating reciprocating discs attached to high tensile aluminum connecting rods driven by a rotating eccentric shaft. The reciprocating action of the discs shall also perform the duty of valves. Each disc shall be mounted to the connecting rod by a stub shaft constructed of hardened high tensile constructed of high tensile neoprene with multiple layers of fabric for longevity and strength. Pump designs that use a captive diaphragm with external metal plate and that require internal check valves for operation shall not be acceptable. The suction and discharge discs shall be universal and interchangeable with each other to increase the commonality of spare parts and eliminate confusion.

1) The pump housings shall be Class 30 cast iron. The pump shall consist of 3 housings horizontally split to allow access to the internal components. The pump shall incorporate a Maintain-in-Place hinged housing design that allows the pump to be serviced and internal components replaced without removal of the pump or disturbing the suction and discharge piping. The discharge housing shall contain the mounting lugs and be bolted directly to the mounting frame. The discharge, intermediate and suction housings shall incorporate an integral hinge arrangement that allows the suction and intermediate housings to be lowered and removed. The hinges shall be connected to each other with a quick release ball detent pin allowing for easy pin removal.

2) The pump shall be capable of providing 0.30 gallons per revolution when operating at 60' TDH. The pumps shall be capable of operating dry for an indefinite period of time without damage. The pumps shall be capable of self-priming up to 14" Hg and 25" Hg when fully primed.

3) Sealing of the pump fluid chamber shall be achieved by

flexible trunnions. The trunnion seal shall not be designed to provide any pumping action. The trunnion construction shall be of fabric-reinforced neoprene and shall be capable of withstanding pressures from 0 to 110 psi on an intermittent basis. Maximum operating pressure is 140' TDH. Pump designs utilizing packing glands, mechanical seals or water seal systems will not be acceptable.

4) The swan neck entry port to the suction housing shall be a 2 piece design allowing for mounting of the suction connection in 90° increments and provide easy access for clack replacement. The upper swan neck shall be provided with a 2" NPT connection to allow mounting of the suction pulsation dampener if required. The entry port shall be a full 4" diameter with a minimum opening of 12.56 square inches to minimize debris buildup and blockages. The seating surface for the clack valve shall be machined on the mounting face of the swan neck. Designs that require an individual plate with smaller diameter opening shall not be acceptable. The clack valve shall be integrally mounted to the swan neck to facilitate access and replacement. The clack valve shall be manufactured of neoprene construction with multiple layers of fabric encapsulating a rigid core. The clack valve shall incorporate an integral O-ring seal for positive sealing.

5) The bearing drive assembly shall consist of 2 aluminum modular pedestals designed to provide accurate bearing alignment, superior bearing loading and ease of assembly. The drive shaft shall be a minimum 1 ⅜" diameter and capable of withstanding a dead head situation. The shaft shall be constructed of hardened high-tensile stainless steel and shall be mounted on 4 self-aligning, sealed bearings. The eccentric cams shall be constructed of high tensile, cast bronze alloy and shall be pinned to the shaft by spirol drive pins to allow for the absorption of reciprocating loads generated by the pumping action. Pump drive assemblies that utilize keyways and setscrews will not be acceptable. All drive bearings must be completely sealed with no provisions for scheduled grease lubrication. No grease fittings shall be supplied for the bearings.

6) The pump shall be driven through a V-belt and drive assembly consisting of a 2 groove Type B arrangement. The pulley ratios shall be sized to provide the maximum pump speed listed in the pump schedule in this section and to provide the required torque generated between the pump and motor.

7) Pump shall be provided with OSHA approved guards and covers. The V-belt drive cover and pump drive assembly cover shall be manufactured from stainless steel 304 material.

8) Each pump and V-Belt assembly shall be mounted on a common stainless steel 304 sub base. Base design shall have raised cross-members on the suction and discharge end to allow for complete wash-out and draining without trapping liquid. Each sub base shall be manufactured from 2" stainless steel 304 square tubing. Base shall be sufficient gusseted, reinforced and braced to withstand all shock loads and resist all wearing and buckling during pump operation. Tubing ends shall be capped with black plastic plugs for neat appearance.

9) Pulsation dampeners shall be provided on the suction and discharge lines. The dampeners shall be 6" diameter schedule 40 carbon steel pipe with fully welded end caps. The suction dampener shall mount directly to the suction swan neck through the 2" NPT connection. The discharge dampener shall be a separate piece with 4" ASA 150# flanged connections. The dampeners shall be pressure tested to 60 psi for leaks. Each dampener shall be provided with a 1" half coupling located at the top. This connection shall be suitable for the vacuum and pressure switch assembly or the ball valve/quick disconnect assembly should a switch not be specified. The discharge dampener shall be supplied with a 1 ½" NPT coupling and plug in the bottom to act as a drain/sample port. Bladder type and 3-piece assemblies using connecting rods and gasket shall not be acceptable.

10) Motor: The motor shall be adequately sized to withstand the loads during starting and pump operation. The power, the horsepower, and the motor speeds shall conform to the Specifications as outlined in the pump schedule in this section. Motor shall be severe duty, premium efficient, inverter ready per NEMA STD MG1 Part 31.4.4.2 with epoxy coated cast iron frame or equal.

11) Suction Vacuum Protection: The pump manufacturer shall provide a suction vacuum sensor and switch assembly to mount on the suction pulsation dampener. The sensor shall be a PVP420, Red Valve 42/742 or equal 1" NPT isolation pressure sensor with SS316 body and EPDM elastomeric sensing tube. The process pressure is sensed through the 360° elastomeric tube and glycerin transfers pressure to the gauge and switch. The gauge and switch shall be attached

to the sensor with stainless steel 316 fittings. The vacuum assembly shall be fitted with 4" stainless steel 30" Hg to 30 psi gauge and Ashcroft, Barksdale, or equal adjustable vacuum switch set at 10" Hg. The units shall be capable of being cleaned in place by simply using the process pressure through a stainless steel 316 isolation valve mounted to the top of the sensor. The opposite end of the valve shall be fitted with a universal, quick acting coupling, suitable for compressed air. This valve connection will be suitable to charge the dampener with compressed air.

12) Discharge Pressure Protection: The pump manufacturer shall provide a discharge pressure sensor and switch assembly to mount on the discharge pulsation dampener. The sensor shall be a PVP420, Red Valve 42/742 or equal 1" NPT isolation pressure sensor with SS316 body and EPDM elastomeric sensing tube. The process pressure is sensed through the 360° elastomeric tube and glycerin transfers pressure to the gauge and switch. The gauge and switch shall be attached to the sensor with stainless steel 316 fittings. The discharge assembly shall be fitted with a 4" stainless steel 0-100 psi pressure gauge and shall be fitted with adjustable switch preset at 30 psi manufactured by Ashcroft, Barksdale or equal. The units shall be capable of being cleaned in place by simply using the process pressure through a stainless steel 316 isolation valve mounted to the top of the sensor. The opposite end of the valve shall be fitted with a universal, quick acting coupling, suitable for compressed air. This valve connection will be suitable to charge the dampener with compressed air.

13) Special Tools and Spare Parts: Contractor shall provide 1 set total of the following factory recommended spare parts consisting of:

- Two (2) Discs
- Two (2) Trunnions
- One (2) Complete set of gaskets
- One (1) Clack valve
- No special tools shall be required for disassembly, maintenance or repair.

d. Finishes: All cast iron and carbon steel components shall be finished with manufacturer's standard industrial grade primer 2 to 3 mils DFT and industrial enamel top-coat 2 to 3 mils DFT. All stainless steel and aluminum surfaces will remain unpainted. All

weld splatter shall be removed and all welds ground smooth for a neat appearance.

4. Sludge Conditioner: A sludge conditioner shall be furnished and installed as shown on the Drawings. The conditioner shall be a complete unit with motor and cutter assembly completely assembled on a fabricated steel base. Unit shall be capable of flowing 300 gallons per minute of 3.5% sludge. A 15-mm shearplate hole size shall be provided to reject potentially damaging materials. Electrical motor shall at a minimum be 5 horsepower, 230 to 460V, 3 phase, 60Hz

HH. Field Services: The manufacturer shall include the services of a factory-trained representative for the purposes of installation inspection, equipment start-up and training of plant personnel regarding proper operation and maintenance of the equipment for a period of two 8-hour days.

The Contractor will coordinate date for the initial start-up and field test. The Contractor shall ensure that all electrical, instrumentation and controls necessary to operate and document performance of the pumping units is functional at the time of startup.

II. Filtrate Recycle:

1. The belt press shall be plumbed to enable use of clear filtrate from the filtrate pan as well as external supply. This system functions to reduce water consumption and hydraulic loading on the treatment plant processes. Accordingly, plant water may be required only for start-up and shutdown. The washwater system shall also be valved to allow use of plant water for the belt washing functions.

2. A level sensor shall be furnished in the filtrate pan for maintenance of adequate supply for the washwater booster pump and a solenoid valve shall be plumbed into the belt washwater system to control the flow of externally supplied washwater.

JJ. Polymer System:

1. Description of Work: The polymer preparation/feed unit shall be capable of automatically metering, diluting, activating and feeding an emulsion polymer with water.

   a. The system shall be capable of controlling separately the water flow and the polymer injection dosage.

   b. The polymer equipment shall be furnished as a complete assembled unit to the Contractor, complete with 304 stainless steel stand.

   c. The polymer unit shall be furnished and supplied as an integrated component of the sludge processing equipment.

2. Quality Assurance:

   a. All equipment furnished under this section shall be the product of a

manufacturer who has a minimum of 10 years' experience in the design and manufacture of polymer systems. The equipment shall be designed, constructed and installed in accordance with the best practices and methods.

b. All equipment and controls specified in this section shall be furnished by a single supplier who shall assume full responsibility for the proper operation of the complete polymer system.

c. Any alternate equipment offered that differs from these Specifications and Drawings shall be acceptable only on the basis that any revisions in the design and/or construction of the structure, piping, appurtenant equipment, electrical work, etc., required to accommodate the equipment shall be made at no additional cost to the Owner, be the responsibility of the contractor and shall be approved by the Engineer.

3. Submittals: Contractor shall submit copies of material required to establish compliance with this section. Submittals shall include the following as a minimum:

   a. Drawings showing all details of construction, dimensions, weights and anchor bolt locations

   b. Descriptive literature, catalogs or bulletins of the equipment

   c. Bill of materials

   d. Complete piping and wiring diagrams, control schematics and suitable control panel outline drawings

   e. Manufacturer's warranty for the polymer system including all associated auxiliary equipment that is incorporated to provide the complete operating system

   f. Operation and maintenance manuals shall be provided. The manuals shall be prepared as regarding this installation and shall include all required cut sheets, drawings, equipment lists and descriptions that are required to properly operate and maintain the system.

4. Warranties: All equipment provided in this specification shall be warranted against defects in material and workmanship for 18 months after delivery or 12 months after acceptance whichever comes first. Damages due to makeup water particulates will not be considered as a warranty defect and will be the responsibility of the owner.

5. System Description:

   a. Water Control:

      1) Make up water flow shall be variable and measurable by means of a control valve and a sight glass rotometer.

2) Make up water flow capacity shall be 0-10 gpm (RB1), (2-20 gpm RB2) provided at 30 psi minimum.

b. Polymer Make-up Pump:

1) A polymer make-up pump shall be integrated in the system. The pump shall be a diaphragm electrical pulsation type with separate speed and stroke controls.

2) Digital keypad and large LCD display, select feed rate display in strokes/min or gph, flow monitor input, interface with profibus, and/or 4-20ma output signal shall be provided.

c. Multi-Zone Mixing Chamber (High Energy):

1) Polymer shall be injected in the water stream by the feed pump to a kinetic mixing chamber to create a thorough mixing energy. The design shall include a motor driven impeller to create a high impact energy and low fluid shear. Solution shall undergo a tapered mixing intensity slope as it passes through a second recovery zone. Polymer activation efficiency shall be consistent over the entire dilution water range.

2) A portion of the mixed polymer is then re-circulated through the mixing chamber ensuring optimum mixing has occurred.

3) A transparent section after the mixing chamber shall be provided to observe the solution consistency.

d. Multi-Zone Acrylic Polymer Blending Chamber (Low Energy): The mixed polymer solution is then transferred to an exclusive acrylic blending chamber allowing the pre-mixed polymer solution to be gently mixed and provide additional retention time to achieve the highest performance.

e. Post Dilution System: Dilution water shall be split into two streams. Primary water flow shall supply the mixing chamber. Secondary water flow shall be used to post dilute the activated polymer stream. These two streams shall be completely blended by a static mixer prior to exiting the unit.

1) Each stream shall have an electronic flow sensor with immersed in-line element capable of transmitting a signal to the unit micro controller for display of flow rate. Element shall be removable without plumbing disassembly.

2) Each stream shall have a rate control valve for isolation or throttling of water flow.

3) Unit shall have an electric solenoid valve for on/off control

of total dilution water flow

f. Assembly and Frame Work:

1) All components and parts shall be of corrosion resistant construction.

2) All sheet metal work and frame assemblies shall be of type 304 stainless steel.

g. Controls:

1) A local-off-remote switch for the mixing chamber shall be provided.

2) A hand-off-auto switch for the polymer injection pump shall be provided.

3) The system shall be provided with positive flow logic to signal an alarm in the event of low dilution water flow. This alarm will disable the polymer injection pump from operating when the injection pump is run in the automatic mode.

4) The polymer preparation system shall be capable of remote start/stop operation.

5) A speed potentiometer for the polymer make-up pump speed rate shall be provided.

6) All controls are to be mounted in a NEMA 4X FRP enclosure and wired directly to its components. A common power feed cord with a standard male plug for a 120V, 20-amp receptacle shall be furnished. Receptacle shall be provided by Contractor.

10.17 Submersible Pumps: The Contractor shall furnish and install submersible pumps as manufactured by Flygt Pump Company or equal. Pumps shall be as shown on the Drawings and in accordance with the following:

	Plant Pump Station
• Quantity	2
• Discharge Size	6
• Capacity (gallons per minute)	694
• TDH	48'
• Shutoff Head	75'
• RPM (maximum)	1,755
• Horsepower	15 horsepower

A. Discharge Connection: A sliding bracket shall be an integral part of the pump unit. The volute casing shall have a machined discharge flange to automatically and firmly connect with the cast iron discharge connection, which when bolted to the floor of the sump and discharge line, will receive the pump discharge connecting flange without the need of adjustment, fasteners, clamps or similar devices. Installation of the pump discharge connecting flange without the need of adjustment, fasteners, clamps or similar discharge connection shall be the result of a simple linear downward motion of the pump unit guided by at least 1 guide bar.

B. Guide Bars: Lower guide bar holders shall be integral with the discharge connection. The guide bars shall be installed for each pump, to permit raising and lowering the pump. Guide bars shall be of 2" Schedule 40 stainless steel pipe or one or two 2" x 2" x ¼" stainless steel T-bar of sufficient length to extend from the lower guide holders on the pump discharge connection to the upper guide holders, as shown on the Drawings. The existing guide bars and discharge connections will be replaced to accommodate the new pumps.

C. Motor: The pump motor shall be housed in an air- filled, or Glycol watertight casing and shall have moisture resistant Class H 180° C insulation. The motor shall be NEMA Design B and designed for continuous duty with a minimum service factor of 1.25.

D. Motor Cable: The pump motor cable shall be suitable for submersible pump applications. Cable sizing shall conform to NEC Specifications for pump motors and shall be of adequate size to allow motor conversion without replacing the cable. The cable entry water seal design shall be such that preludes specific torque requirements to insure a watertight and submersible seal. The cable entry junction box and motor shall be separated by a stator lead sealing gland or terminal board which shall isolate the motor interior from foreign materials gaining access through the pump top.

E. Pump Design: The pumps shall be capable of handling raw, unscreened sewage and return activated sludge. The design shall be such that the pump unit will be automatically and firmly connected to discharge piping when lowered into place on its mating discharge connection, permanently installed in the wetwell. The pump shall be easily removable for inspection or service, requiring no bolts, nuts, or other fastenings to be disconnected. For this purpose, they shall be fitted with a stainless chain of adequate strength and length to permit raising and lowering the pump for inspection or removal. A safety chain hook shall be provided for attachment of the chain to the access door frame. The pump, with its appurtenances and cable, shall be capable of continuous submergence under water without loss of watertight integrity to a depth of 65'. All major parts, such as the stator casing, oil casing, sliding bracket, volute and impeller shall be of gray iron.

F. Impeller: The impeller shall be of gray cast iron, Class 35B, balanced, semi-open, multi-vane, back-swept, non-clog design. The impeller vane leading edges shall be mechanically self-cleaned upon each rotation as they pass across a spiral groove located on the volute suction which shall keep them clear of debris, maintaining an unobstructed leading edge. The impeller vanes shall have screw-

shaped leading edges that are hardened to Rc 45 and shall be capable of handling solids, fibrous materials and other matter found in wastewater and sludge with up to 7% solids. Impellers shall be locked to the shaft and held by an impeller bolt.

G. Volute Bottom/Insert Ring: The pump volute shall be gray cast iron and shall have integral spiral shaped cast groove at the suction of the volute. The internal volute bottom or insert ring shall provide effective sealing between the pump volute and the multi-vane, semi-open impeller. The sharp spiral groove shall provide the shearing edge across which each impeller vane leading edge shall cross during its rotation in order to remain unobstructed. The clearance between the internal volute bottom and the impeller leading edges shall be adjustable.

H. Seals: Each pump shall be provided with a mechanical rotating shaft seal system running in an oil reservoir having a separate, constantly hydro- dynamically lubricated lapped seal faces. The seal unit between the pump and oil chamber shall contain 1 stationary and 1 positively driven rotating tungsten carbide, silicon carbide or ceramic and carbon ring. The seal unit between the oil sump and motor housing shall contain 1 stationary tungsten-carbide ring or silicon carbide and 1 positively driven rotating carbon or ceramic or silicon carbide ring. Each interface shall be held in contact by its own spring system supplemented by external liquid pressures. The seal shall require neither maintenance nor adjustment, but shall be easily inspected and replaceable. No seal damage shall result from operating the pumping unit out of its liquid environment. The seal system shall not rely upon pumped media for lubrication.

I. Control Panel: An automatic control center equipped for the voltage and service required complete with main circuit breaker, circuit breaker combination, NEMA rated across-the-line magnetic starters, 3 phase, overload protection, phase failure relay, electrical alternator, automatic transfer to non-operating pump in event of overload in the operating pump, overload switch, run indication lights, elapsed time meters, control circuit transformer, separate high-water alarm light, all components housed in a corrosion resistant NEMA 4X stainless steel enclosure. A cable holder shall be installed inside the wetwell. The starting level and stopping level for each pump shall be independently adjustable. Contractor shall provide and install 4 mercury float switches. The pump controller shall relay pump status over Modbus Etherne TCP/IP. Each float/transducer shall be provided with adequate length of electric cable

J. Control System: Pump starts and discharge shall be controlled by a submersible transducer provided by the pump manufacturer. The controller shall be Motor Protection Electronics SC1000-SE or equal. The submersible transducer shall be Motor Protection Electronics model LM-A-B or equal with cable length and pressure range to suite installation. The submersible transducer shall be supplied with a transducer vent bellows to prevent moisture from entering the vent tube. Provide a 2-stage surge suppressor circuit using both an MOV and TVS provide high voltage transient protection for the transducer circuitry. A stainless steel diaphragm and silicone oil fill shall be provided. Provide and install a backup float based control system to control pump start / stop levels.

A float control type system shall be installed as a backup to the pressure transducer system. The float system shall take over operation of the pumps in the event the pressure transducer system fails. Floats shall incorporate simple relay circuit, 24 volts.

K. Monitoring: Monitoring points shall be available to the SCADA system via MODBUS TCP/IP over Ethernet. The points shall include:

1. Plant Pump No. 1 – On
2. Plant Pump No. 1 – Alarm Status
3. Plant Pump No. 2 – On
4. Plant Pump No. 2 – Alarm Status
5. Wetwell level
6. The manufacturer shall provide a complete list of all Modbus digital and analog I/O registers including scales as shown on the Drawings to provide all information as required to coordinate communications with the SCADA integrator.
7. Ethernet connection shall be made via an optical isolator protection circuit.

L. Control Enclosure: The enclosures shall be a NEMA 4x rated enclosure. The enclosure shall be free standing type with a minimum depth of 12" sized to adequately house all the components. The door gasket shall be rubber composition with a retainer to ensure a positive weatherproof seal, the door shall open a minimum of 180°. Adequate ventilation and a sunshield on the front and sides shall be provided to reduce the internal temperature.

The dead front aluminum door shall be mounted on a continuous aircraft type hinge, shall contain cutouts for mounted equipment and provide protection of personnel from live internal wiring. A breaker handles shall be provided on the main breaker and cutout shall be provided on all other breakers to allow operation of breakers without entering the compartment. All control switches, indicator pilot lights, elapsed time meters, controller and other operational devices shall be mounted on the external surface of the front door.

The back plate shall be manufactured of 12-gauge sheet steel and be finished with a primer coat and 2 coats of baked on white enamel. All hardware mounted to the subpanel shall be accomplished with machine thread tapped holes. Sheet metal screws are not acceptable. All devices shall be permanently identified with engraved nameplates. Use of DYMO tape for identification is not acceptable.

M. Testing: After installation, the Contractor shall furnish the services of a competent factory representative of the pump manufacturer for the purpose of inspecting the installation and initial operation of the station. The equipment will be inspected for defects or weakness, or both, and if found, the equipment shall at once be removed and be replaced with new parts or be made good in a satisfactory manner, at no additional expense to the Owner.

N. Guarantee: The Contractor shall guarantee the equipment to be free from defects in workmanship, design, and material for a period of 1 year after initial operation begins. The Contractor shall replace at no additional expense to the Owner, every defective part, and every part showing undue wear during the guarantee period.

10.18 Vertical Turbine Pumps: Contractor shall provide and install a vertical turbine pumping system as shown and specified. Vertical turbine pumps shall be water lubricated type and shall conform to the requirements of AWWA Specification E101-71, except as otherwise specified. Guaranteed performance curves and certified test curves shall be submitted to the manufacturer. Information from manufacturer shall include performance curve showing head capacity curves, speeds, efficiencies and brake horsepower at both design points and stating maximum BHP required by the pump at maximum allowable RPM, which shall correspond with the following conditions:

	Effluent Pumps	***Reuse Pump***
• Number Required	3	1
• Capacity (gallons per minute)	2,604	120
• Total Dynamic Head	172'	160'
• Shutoff Head (minimum)	241'	229'
• Horsepower (minimum)	150	7.5
• Minimum Efficiency @ Design ± 0.5%	81%	74%
• RPM (maximum)	1,770	3,600
• Discharge Column	12"	4"
• Number of Stages (maximum)	2	4
• Type Motor	WPII	WPI
• Inverter Duty Rated	N	Y

A. Pump bowls and suction bell shall be A48, Class 30 cast iron designed for easy removal of impellers and bearings. Upper and lower connections on the bowls shall be bolted, flanged, rabbited machine fit. Threaded bowls are acceptable for reuse pump only. Bowls shall be enamel lined for high efficiency and wear. The suction bell shall have a flared inlet to reduce entrance losses.

Bowls shall have B144-3B or B584 bronze, bearings above and below each stage. Suction bowl shall have lower grease packed bronze bearing with sand collar. The upper stage bearing shall also be protected by a sand collar. Bowls shall be furnished with 400 Series stainless steel or B148-97 aluminum bronze wear rings.

B. Impellers shall be ASTM B148 aluminum bronze or ASTM B584 silicon bronze enclosed type accurately machined and finished to fit the contour of the bowls. Impellers shall be handfitted in the water passages for high efficiency. Impellers shall be statically and dynamically balanced for vibration operation. Impellers shall be fastened to the pump shaft with 416 stainless steel lock collets. Impellers

shall be protected from wear at the suction inlets with renewable B144-3B, bronze wearing rings.

C. Pump bowl shaft shall be A582, grade 416 stainless steel ground and polished over its entire length. Shaft shall be of sufficient size to transmit the horsepower and torque of the pump from shut-off to minimum head.

1. Pump column pipe shall be flanged A53B schedule 40 steel with A36 steel flanges welded to the column. Column sections shall not be greater than 5'. Flanges shall be machined square with the column centerline after fabrication. Flanges shall have rabbited machine fit for holding B144-3B bronze bearing retainers.

2. Line shaft bearings shall be cutlass neoprene rubber type, held in place in the bronze bearing retainers with A582, grade 416 stainless steel lock rings or push in type.

3. Line shafting shall be A582, grade 416 stainless steel with stainless steel couplings. Shafting shall be of sufficient size to transmit the horsepower and torque of the pump and motor over the entire operating range.

D. A stainless steel strainer shall be provided to prevent foreign material entering the pump.

E. The discharge head and motor base shall be A48, class 30 cast iron of sufficient strength to support the pump motor, column pipe and bowl assembly. Discharge head shall have rabbited machine fit to align the vertical hollow shaft motor to the column shafting.

1. Discharge head shall have flat faced, sized per Drawings, flanged discharge drilled 125# standard (250# reuse pump).

2. A heavy duty cast iron packing gland housing shall be bolted to the discharge head and have neoprene "O" ring seal. It shall hold a minimum of 6 rings of packing and have solid type bronze or 300 Series stainless steel packing gland, lantern ring for lubrication and bronze head shaft bearing drilled for lubrication.

3. A two piece stainless steel headshaft with solid coupling shall be provided to facilitate installation of motor and maintenance.

4. The whole pump assembly shall be mounted on a fabricated steel soleplate securely anchor bolted to the concrete structure.

F. Pumps shall be manufactured by Peerless Pump Company, Layne Vertiline or equal.

G. Pump motors shall be vertical hollow shaft shielded drip proof, weather protected WP-1 or totally enclosed fan cooled (TEFC) from coded as shown or specified. Motor shall be non-overloading beyond the nameplate full load amp rating at any point from shut-off to minimum operating head.

1. Motors shall be of ball bearing construction with angular contact oil lubricated thrust bearing at the top with oil level gage and sight glass and

grease lubricated lower radial bearing with system for purging old grease. Lower bearing is to be protected at the shaft outlet with neoprene seal slinger.

2. Motors shall have large oversized diagonally split conduit boxes and ballomatic type non-reverse ratchet assemblies.

3. Inverter duty rated motors shall meet the requirements for variable speed service in accordance with NEMA MG-1 Part 31.

H. Effluent Pump Station Control Panel: An automatic control center equipped for the voltage and service required complete with main circuit breaker, hand-off-automatic switch, electrical alternator, automatic transfer to non-operating pump in event of overload in the operating pump, overload switch, run indication lights, elapsed time meters, 24 volt control circuit transformer, and all components shall be housed in a corrosion resistant NEMA 4X enclosure. The starting level and stopping level for each pump shall be independently adjustable. Provide an adjustable time delay relay (0 to 30 seconds) for control of the lag pumps. Upon activation of the lag pump "on" regulator, the lag pump shall have a delay prior to start-up to prevent pumps from starting simultaneously.

All conduits from control panel to wetwell shall be sealed at both ends with "FST Duct Seal" closed cell foam or approved equal to prevent sewer gases from entering the control panel.

1. General: The control system shall be designed to operate the required number of pumps specified on the Drawings at the power characteristics shown.

   The control function shall provide for the operation of the pumps under normal conditions and shall alternate the pumps on each pump down cycle to equalize the run time. In the event the incoming flow exceeds the capacity of the lead pump, subsequent pumps shall automatically start-up to handle the increased flow. As the flow decreases the pump shall cut-off at the elevations as shown on the Drawings.

   The control shall function as described below. The following listed equipment is a guide and does not relieve the supplier from supplying a system that will function as required.

2. Enclosure: The enclosure shall be a NEMA 4X Stainless steel enclosure. The enclosure shall be a wall mount type with a minimum depth of 10" sized to adequately house all the components. Enclosures larger than 60" high x 36" wide shall be provided with 12" high leg stands. The enclosure door gaskets shall be rubber composition with a retainer or seamless foamed in place to assure a positive weatherproof seal. The gasket material shall not retain memory. The door shall open a minimum of 180°. Doors shall close via a ¼-turn locking handle, with a 3-point latch. Electrical schematics of the panel shall be affixed to the inside of the door.

   a. Inner Dead Front Door: A polished, aluminum dead front shall be mounted on a continuous aircraft type hinge. It shall contain

cutouts for mounted equipment and provide protection of personnel from live, internal wiring. Cutouts for breaker handles shall be provided to allow operation of breakers without entering the compartment. All control switches, indicator pilot lights, elapsed time meters, duplex receptacle, and other operational devices shall be mounted on the external surface of the dead front. The dead front shall open a minimum of 150° to allow access to equipment for maintenance. A ¾" break shall be formed around the perimeter of the dead front to provide rigidity.

b. Back Plate: The back plate shall be manufactured of 12 gauge steel and be finished with a primer coat and 2 coats of baked on, white enamel. All hardware mounted to the subpanel shall be attached with machine thread, tapped holes. Sheet metal screws are not acceptable. All devices shall be permanently identified.

c. Access Doors and Frames: Access doors and frames shall be to dimensions as shown, of standard aluminum, Bilco Type J-AL or equal. Doors shall have a 3 point latch with one turn latch locking and have a safety handle to maintain the door in open position.

d. Panel Markings: All component parts in the control panel shall be permanently marked and identified as they are indicated on the drawing. Marking shall be on the back plate adjacent to the component. All control conductors shall be identified with wire markers at each end, as close as practical to the end of the conductor. Laminated electrical schematics shall be displayed on the inner face of the outer door.

3. Electrical: The panel power distribution shall include necessary components and be completely wired stranded copper conductors rated at 90° C. All conductor terminations shall be as recommended by the device manufacturer.

a. Circuit Breakers: All circuit breakers shall be heavy-duty thermal magnetic or motor circuit protectors similar and equal to Square D Type HDL. Each motor breaker shall be adequately sized to meet the pump motor operating characteristics and shall have a minimum of 18,000 amps interrupting capacity at 480 VAC. Heavy-duty breakers shall control the control circuit. Provide an 250A/3P main circuit breaker to feed entire control panel.

Circuit breakers shall be indicating type, providing "on-off-trip" positions of the operating handle. When the breaker is tripped automatically, the handle shall assume a middle position indicating "trip."

Thermal magnetic breakers shall be quick-make and quick-break on manual and automatic operation and have inverse time

characteristics secured through the use of bimetallic tripping elements supplemented by a magnetic trip.

Breakers shall be designed so that an overload on one pole automatically trips and opens all legs. Field installed handle ties shall not be acceptable.

b. Reduced Voltage Soft Starters (RVSS): Motor starters shall be provided in the blower building motor control center. The manufacturer shall verify all coordinating communications with controls described herein and drives as provided.

c. Transformers: Control transformers shall be provided to produce the 120 VAC and/or 24 VAC for control circuits. Transformers shall be fused on the primary and secondary circuits

d. Control Wiring: Control wiring shall be copper, tinned, UL1015, 18ga. Minimum.

4. Level Control System: Pump starts and discharge shall be controlled by a submersible transducer provided by the pump manufacturer. The controller shall be SC2000-SE as manufactured by MPE Electronics or equal. The level transducer shall be provided to control the operation of the pumps under normal operation. A high and low level float control type system shall be installed as a backup to the level probe system. The float system shall take over operation of the pumps in the event the transducer system fails. Floats shall incorporate simple relay circuit, 24 volts.

a. A controller shall be provided to control up to 4 pumps. The controller shall be capable of alternating the pumps, and must provide lag pump delays and high and low level alarms.

b. The controller shall be standard "off the shelf" equipment with published literature and fully tested hardware and operating program. The controller must be field configurable from the front of the unit, and require no special tools or software to set-up or operate.

c. The controller shall be a microprocessor-based device and not require a battery to maintain the operating program. All set-up values shall be stored in non-volatile memory. The controller shall be UL listed as Industrial Control Equipment, UL 508. A numerical 3 digit, 7 segment LED level display shall be provided on the front of the unit showing levels in feet and tenths of feet.

d. The controller shall not require an external power supply or any external I/O modules to be a fully functioning unit. An analog input (4-20mA) with zero and span adjustments, shall be provided. Relays with 10 amps rated contacts shall be provided as standard for control functions.

e. All electrical connections, for power or I/O, shall be by quick disconnect phoenix style connectors.

f. The controller shall have 12 discrete inputs. The inputs shall be optically isolated, transient protected and be programmable for the following functions:

1) Pump disable with HOA in OFF, or pump fault

2) External alternator selector switch

3) All pump disable for connection to phase monitor

4) Limit number of pumps called to run while on emergency power

5) Alternation by external time clock

6) Freeze wetwell level during a bubbler tube purge

7) Pump disable upon low level for connection to low level float switch

8) Float switch backup

g. Troubleshooting features shall include a fault indicator on the front of the unit and retrievable fault codes that aid in diagnosing most 8 common problems. Status of the discrete inputs shall also be viewable from the front of the unit. A level simulation feature shall be available from the front of the unit. The controller shall automatically return to monitoring wetwell level after sixty seconds, if left in simulation mode.

h. Menu selectable First-On/First-Off or First-On/Last-Off alternation sequences shall be available. Menu selectable alternation modes shall include:

1) Standard alternation

2) Fixed sequence (Pump No. 1 always lead)

3) Stepped on/off (only 1 pump runs at a time)

i. Pump disable discrete inputs shall cause the alternator to skip over disabled pumps. The controller shall remember which pump was in the lead position during a power outage.

j. An RS232 serial port with the Modbus TCP/IP protocol shall be provided for SCADA. Modbus RTU or ASCII modes shall be menu selectable. RTS and CTS hardware connections along with all necessary programming shall be in place to fully interface with commonly used radio or telephone modems. Programming shall be in place to collect and transmit the station status, and to allow for the remote control of the pumps.

k. The pump On/Off levels, high level alarm, and low level alarm setup values shall be viewable and changeable from a remote location. Pump elapsed time meters shall be viewable and resettable from a remote location, and shall be stored in non-volatile memory during a power outage.

l. The controller shall contain a discrete input for connection to an external time clock to force pump alternation. The controller shall have a parameter setting to allow the analog input level to be a 4-20ma signal from a transducer, or an input from a conductance level probe with ten sensor points or both using probe as a backup. The controller shall have a parameter to select the level probe type by the distance between the electrodes, impedance settings and shall have a level offset parameter to enable the transducer or conductance level probe to be placed off the bottom of the wetwell, while maintaining an accurate representation of the wetwell depth. The controller shall be able to perform float back-up with 2 to 6 floats.

m. Ancillary Equipment: The control system shall include, but not be limited to, the ancillary equipment listed below.

1) HOA (Hand/Off/SC2000) Switches: A 3-position HOA switch shall be provided for each motor. The switch shall be NEMA 4X rated with 10 amp contacts. A position indicating legend plate shall be provided. The HOA switches shall be mounted on the inner dead front door. The HOA in the hand position will allow the pump to run and bypass all safety shutdowns except for the overloads. In the SC2000 position, the SC2000 will control the pumps while monitoring all shutdowns and stop the pump.

2) Run Indicators: A green run pilot indicator shall be mounted on the dead front door. All pilot lights shall be push to test LED type. Fluorescent lighting shall be provided inside the panel.

3) Elapsed Time Meter: An elapsed time meter shall be mounted on the dead front door. The meter shall operate on 120 VAC, shall indicate in hours and tenths (6 digits) and shall not be re-settable.

4) Heater: An internal 100-watt heater shall be provided to maintain temperature above the dew point. The unit shall be thermostatically controlled.

5) Drawings: A final, "as-built" drawing encapsulated in mylar shall be attached to the inside of the front door. A list of all legends shall be included.

6) RTD temperature sensor protection shall be provided.

7) Monitoring points shall be available to the SCADA system via MODBUS TCP/IP over Ethernet. The points shall include:

- Effluent Pump No. 1 – On
- Effluent Pump No. 1 – Alarm Status
- Effluent Pump No. 2 – On
- Effluent Pump No. 2 – Alarm Status
- Effluent Pump No. 3 – On
- Effluent Pump No. 3 – Alarm Status
- Wetwell level

8) Provide dry contacts for the wetwell float switches to forward a discrete low wetwell signal to plant SCADA.

9) The manufacturer shall provide a complete list of all Modbus digital and analog I/O registers including scales as shown on the Drawings to provide all information as required to coordinate communications with the SCADA integrator. Ethernet connection shall be made via an optical isolator protection circuit.

5. Level Transducer: The submersible transducer shall be MPE model LM with cable length and pressure range to suit installation. The submersible transducer shall be supplied with a transducer vent bellows (TVB1) to prevent moisture from entering the vent tube. Provide a two-stage surge suppressor circuit using both an MOV and TVS to provide high voltage transient protection for the transducer circuitry. A stainless steel diaphragm and silicone oil fill shall be provided.

6. Float Switch: Two (2) mechanical float switches shall be supplied for level control and be suspended at the desired height from its own cable. The float switch case shall be made of polypropylene and the cable sheathed with a special PVC compound. The float switch cables shall be supplied with 40' of cable. Two (2) float switches shall be provided to indicate low level in each of the wetwell chambers.

7. Testing: All panels shall be tested to the power requirements as shown on the Drawings to ensure proper operation of all components. Each control function shall be activated to check for proper indication.

8. Guarantee: All equipment shall be guaranteed for a period of 1 year from the date of installation. The guarantee is effective against all defects in workmanship and/or defective components. The warranty is limited to replacement or repair of the defective equipment.

9. Manufacturer: The manufacturer shall be a UL listed shop for industrial control systems and shall serialization evidence of such on the control panel enclosure.

I. Complete Constant Pressure Control System (Reuse Pump):

1. Complete constant pressure control system shall include the following: Simplex variable speed controller with remote monitoring, Constant pressure with automatic reset.

2. System shall be HC Plus manufactured by Peerless, Layne Vertiline with Danfoss VLT Packaged Drive or equal.

3. Accessories:

a. Pressure Transducer

b. In-line minimum 12-gallon capacity bladder tank with isolation ball valve and pressure relief valve

J. Services: Provide a manufacturer's representative for initial start-up, testing and training for a minimum of one 8-hour day

10.19 Chemical Feed Equipment: Provide and install chemical feed systems as shown on the Drawings and as described herein. Provide complete lime slurry and alum feed systems as outlined below.

A. Scope: A multiple pump floor mounted chemical feed system shall be completely self-contained and designed to safely feed metered amounts lime and alum. The metering pumps shall be capable of both manual and automatic modes of operation utilizing a 4-20 mA signal or a pulse contact input. The chemical feed system will be completely assembled and tested prior to delivery to the jobsite.

1. Lime Feed System: The lime feed system shall have 2 feed points. Lime Pumps No. One and No. Two will operate lead/lag flow proportioned to the raw sewage pump station wetwell level. Plant SCADA will provide wetwell level to the lime pump controller over MODBUS Ethernet. During normal operation Lime Pump No. Three shall be valved to provide lime to the digester. Lime Pump No. Three will remain in the "OFF" position and shall be switched to "HAND" to supply lime to the digester. Should Lime Pumps No. One or No. Two be down for maintenance Lime Pump No. Three shall be put in "AUTO" mode by the operator and operate in lead/lag mode.

2. Alum Feed System: The alum feed system shall have 4 feed points. Alum Feed Pump No. One will provide alum to the SBR basins. Alum Feed Pump No. One will receive call to run signal from the plant SCADA. Alum Feed Pump No. Two will provide alum to the plant pump station in "AUTO" mode. The plant SCADA will provide a run signal to Alum Feed Pump No. Two when the plant pump station is operating. Alum Feed Pump No. Two shall provide alum to the Digester by placing the pump in "MANUAL" mode and opening the valve to the digester and closing the valve to the plant pump station. Alum Feed Pump No. Three shall provide alum to the filter influent chamber. The plant SCADA will provide a run signal to Alum Feed Pump No. Three when the SBRs are operating in decant mode.

3. Quality Control: Complete chemical feed system shall be provided by a single system vendor who shall provide all of the equipment and appurtenances, regardless of manufacturer, and be responsible for the satisfactory operation of the entire system. Chemical feed system shall be provided by Hugo Jahnz Systems, Inc., Carl Eric Johnson, Inc., Burnett Lime, or equal.

B. Liquid Alum Feed System: Contractor shall provide a liquid alum feed system including tank and pumps. The alum storage tank shall be a 6,000 gallon FRP or HDLPE tank with outside level indication on the tank.

1. Alum Tank: The minimum required wall thickness of the cylindrical shell at any fluid shell be determined by the following equation but shall not be less than 0.187" thick.

T = P x O.D./2 SD = 0.433 x S.G. x H x 0.D./2 SD

T = wall thickness

SD = hydrostatic design stress, PSI

P = pressure (.433 x S.G. x H), PSI

H = fluid head, ft.

S.G. = specific gravity, g/cm^3

O.D. = outside diameter, inches

The hydrostatic design stress shall be determined by multiplying the hydrostatic design basis, determined by ASTM D2837 using rotationally molded samples with a service factor selected for the application. The hydrostatic design stress is 600 PSI at 73° F for Type 1 and Type II materials. The tank shall have a stratiform (tapered wall thickness) wall.

The hydrostatic design stress shall be derated for service above 100° F and for mechanical loading of the tank. The standard design specific gravity for the alum tank shall be 1.5.

The minimum required wall thickness for the cylinder straight shell must be sufficient to support its own weight in an upright position without any external support. Flat areas shall be provided to allow locating large fittings on the cylinder straight shell.

The top head must be integrally molded with the cylinder shell. The minimum thickness of the top head shall be equal to the top of the straight wall. The top head of tanks with 2,000 or more gallons of capacity shall be designed to provide a minimum of 1,300 square inches of flat area for fitting locations.

Tanks with 2,000 or more gallons of capacity shall have a minimum of 3 lifting lugs integrally molded into the top head. The lifting lugs shall be designed to allow erection of an empty tank.

The tank shall be designed to provide a minimum of 4 tie-down lugs

integrally molded into the top head and to allow tank retention in wind and seismic loading situations without tank damage.

Heating systems for use with polyethylene tanks shall be designed to meet specific requirements such as tank material type, tank size, low ambient temperature and desired maintenance temperature. All heating system components shall be NEMA 4 rated and factory pre-wired for 110 or 220 VAC. Each control box shall contain 2 temperature controls. One control shall regulate the maintenance temperature setting, and the other control shall regulate the high temperature setting. The maintenance temperature setting should be set at the desired maintenance temperature. The high temperature setting shall be adjusted to 10° above the desired maintenance temperature to a maximum of 130° F. All control systems must be designed with a power off failure mode. The heating panels shall be designed to wrap around and lie flat against the surface of the tanks. The heating panels shall have a maximum heating density of 0.022 watts per square centimeter. All heating panels and sensor bulbs shall be attached to the tank with 2" wide duct tape. Under no circumstances shall cable type heaters be used with polyethylene tanks. Insulation used shall be polyurethane foam with a density of 2.0 – 3.0 pound/ft^3 with an "R" value of 8.33/in. The foam shall be applied with a nominal thickness of 2" to all external tank surfaces except the tank bottom shell. Upon completion of application and curing of the insulation, two full coverage coats of latex mastic coating shall be applied to the surface of the insulation in such manner as to seal the insulation from the outside environment.

2. Size: The tank shall be vertical, flat bottom, dish top, 10'- 0" I.D. with a nominal capacity of 6,000 gallons.

3. Quality Assurance: Acceptable manufacturer shall be Polyprocessing, Inc., Snyder Industries, Inc. or equal.

   a. Tanks shall meet all appropriate standards for polyethylene tanks and piping as described by ASTM, ARM and ANSI.

   b. Chemical compatibility shall be according to the following chemical resistance guides: Pruett, Kenneth M., "Chemical Resistance Guide for Elastomers", Compass Publications.

4. Loading Calculations: Tank shall meet the following design criteria:

   a. Wind load limit when anchored: 100 mph

   b. Concentrated top load limit: 1,000 pounds at 10 psi

   c. Snow load-limit: 25 psf

C. Chemical Storage Requirements: 50% liquid alum, maintain 70° F at ambient temperature of 0° F and 1.3 specific gravity. Tank shall also be suitable for storage of ferric chloride solution (38% solution and 1.42 specific gravity) and aluminum chloride solution (28% solution and 1.3 specific gravity).

1. Accessories:

   a. Flanged Nozzles: Conically gusseted, flanged diameter and drilling, ANSI B6.5, 150 pounds, 40-50 durameter ⅛" thickness full-faced gaskets

   b. Tie Down Lugs: Number and location standard with manufacturer

   c. Tank Lifting Lugs: Provide 3 lifting lugs spaced 120° apart at top portion of straight shell with one aligned with a hold down lug

   d. Certification label stating:

      1) Resin Used

      2) Serial Number

      3) Chemical to be stored including concentration and specific gravity

      4) Tank capacity

      5) Date of manufacture

   e. Level Indicator:

      1) Alum level control shall be the Milltronics MultiRanger level transmitter and tank level indicator. The level indicator shall produce an audible high level alarm located on the exterior of the pump enclosure and a re-order indicator light located on the exterior of the system control panel. Level signal will be obtained through the lime system PLC 1761-NET-ENI module via ethernet cable provided by others.

      2) Panel enclosure shall be a polycarbonate enclosure rated NEMA 4X and shall be located perpendicular to the control panel.

   f. Thermometer and Thermowell: Bi-metal 3" dial thermometer, range -40° F to 160° F, both case and ½" NPT connection, thermowell (separable socket) for 4-½" insertion length with ¾" male thread. Thermowell wetted parts and connectors shall be made of applicable corrosion resistant material, Hastelloy C-276, or equal. Thermowells shall be corrosion resistant for each of the following chemicals: alum, caustic and ferric chloride. Thermowell to be similar to those as manufactured by Trerice or equal.

2. Instrumentation:

   a. Transducer/transmitter shall be a 6" flange mounted transducer as manufactured by Milltronics model XPS15. The level display Milltronics MultiRanger shall be mounted perpendicular to the control panel.

b. A pressure transducer/transmitter indicator shall be as manufactured by Endress Hauser and provided for each pump discharge line. Red line indicators shall mount in the door of the control panel.

3. Schedule (See Drawings for location of fittings):

a. 1 – 24" top hinged manway with cover or manufacturer's standard cover with air surge device

b. 1 – 2" flanged nozzle for liquid level float

c. 1 – 2" flanged nozzle, inlet, outlet and drain

d. 1 – ¾" FPR threaded coupling for thermometer and thermal well

e. 1 – 24" top hinged manway with cover

f. 1 – Carbon steel ladder

g. 1 – 3" Overflow outlet at top of shell portion of tank

4. Installation: Install in accordance with manufacturer's instructions.

5. Hydrostatic Test: After tank has been installed and before piping connections are made and equipment attached, block outlets and fill straight shell portion with water and check for leakage

D. Multiple Pump Floor Mount Alum Feed System:

1. One alum metering pump shall have a capacity of 3 gallons per hour @ 150 psi.

2. Two peristaltic pumps shall have the capacity of 4.2 to 24 gallons per hour, each @ 60 psi. Pumps shall be Flomotion Systems, Inc., ALH10, Graco, Inc., Grundfos Pumps, or approved equal.

3. The chemical feed system floor mount panel shall be constructed from solid black high density polyethylene having a minimum thickness of ½. The floor mount panel shall be assembled using thermal welding technology. Bolted construction is not acceptable.

4. Each chemical feed metering pump must include 1 diaphragm protected pressure gauge and all required piping, ball valves and supports. The feed system shall include 1 calibration column. Provide 1 pulsation dampener per injection point. Piping shall include isolation valves and unions for all serviceable components. Accessories shall be constructed of materials suitable for use with alum.

5. All piping shall be schedule 80 PVC. The skid manufacturer shall perform assembly in a controlled shop environment. All pipes shall be squarely cut with precision equipment. All socket-welded connections shall follow the guidelines set by the pipe/fitting manufacturer for proper cleaning, priming and gluing procedures. A medium bodies solvent suitable for use with alum or caustic, respectively shall be used. All

threaded connections will utilize Teflon tape, a suitable thread sealant or a combination of both.

6. The piping will be attached to the floor mounted skid with non-metallic corrosion resistant support systems. All supports shall be welded to the floor mount panel. Bolted or screwed supports are not acceptable. The straps shall be removable and reusable for servicing. All inlet/outlet connections shall be marked clearly for installation. The chemical feed system shall be tested at the factory on a computerized calibrated test stand to insure rated flow, pressure and hydrostatic conditions are met.

7. Diaphragm metering pump will be manufactured by Prominent, Pulsifeeder, Grundfos or equal.

8. Digital dosing pump shall be Grundfos DDA 12-10, ProMinent, Inc., Pulsafeeder Engineered Products, or equal.

9. Accessories:

   a. Calibration Column: The top of the calibration column shall be vented back to the supply container for overflow protection.

   b. Three pulsation dampeners shall be provided and sized for a minimum of 90% dampening. Pulsation dampeners must be of the inline design with PVC housings and EPDM or chemically compatible diaphragms. The dampener must include a 2½" pressure gauge and gas changing valve.

   c. Piping and valves shall be solvent welded schedule 80 PVC with EPDM or chemically compatible O-rings and diaphragms. Diaphragm valves must be true union style.

   d. Four diaphragm protected pressure gauges shall be provided for indication of system pressure. PVC gauges shall be utilized and the isolators shall have a PVC body with Teflon sealing diaphragm

10. Services: Provide a manufacturer's representative for initial start-up, testing and training for a minimum of two 8-hour days.

E. Lime Feed System: The manufacturer shall furnish and install one complete bulk slurry storage system and feed system as specified herein and as shown on the Drawings. The equipment shall be fabricated, erected, assembled and placed in proper operating condition in full conformity with the Drawings, Specifications, instructions and recommendations of the equipment manufacturer.

1. Project Description:

   a. System shall include one 10,000-gallon storage tank and metering pumps as described herein. The pump and control system is pre-assembled and factory tested at manufacturing facility prior to shipping.

   b. The tank will be shipped directly from the manufacturer, in coordination with the pump and control enclosure and set on the

concrete pad provided by the Contractor.

c. The pump and control enclosure will be transported to the site and set into place in conjunction with the 10,000-gallon storage tank.

d. Manufacturer's installation and startup technicians will provide all final terminations and system extensions.

e. Manufacturer will provide both startup and technical training for the operators. Specific operational procedures, reporting and safety training will be the responsibility of the Owner.

2. System Description:

a. Lime Slurry Tank:

1) Tank shall be single compartment, welded steel reinforced top, having a nominal capacity of 10,000 gallons and a maximum diameter of 12'.

2) Tank shall be fabricated using steel as specified by ASTM A36.

3) Tank design shall be in accordance with AWWA D100 with minimum top and bottom plate thickness of ¼" and minimum wall plate thickness of 3/16".

4) Tank appurtenances shall be as follows: (Reference to Drawings for preliminary orientation)

- 12" mixer mounting nozzle (top)
- 24" atmospheric manhole / inspection port (top)
- 24" manhole (3-½' above bottom)
- 6" nozzle (pump suction, 9" above bottom)
- 6" nozzle (pump suction, 9" above bottom)
- 3" nozzle (drain, 2" above bottom)
- 4" threaded connection (overflow, 6" below top)
- 2" nozzle (spare, top)
- 6" nozzle (level sensor – 18" off wall, top)
- 2" nozzle (water fill, top)
- 2" nozzle (slurry fill, top)
- 3" nozzle (re-circulation)
- Four 10" wide by 23' long gusseted baffles fabricated from ¼" plate positioned 1" off the wall
- Anchor lugs (6)

- Ladder, ladder cage and full tank perimeter handrail shall be of carbon steel
- Standoff pipe supports and clamps (maximum 8' on center for overflow, slurry and water lines)
- Lift lugs (2)
- Fill pipe (2"), with quick-connect
- Overflow pipe (4")
- Six ¾" x 16" stainless anchors furnished and installed by Burnett Lime Company

5) Surface Preparation and Painting: The exterior of the tank dome, wall and appurtenances shall be prepared by commercial sandblast followed by one coat of time-Lock Mopoxy IR High Solids Epoxy Coating of #41 Series. Field Painting of exterior of the tank dome and wall shall be by Contractor. The bottom exterior of the tank shall be coated with coal tar epoxy.

3. Controls:

a. Lime Control Panel:

1) All motor starters, relays, timers and devices for the control and operation of the equipment shall be housed in a control panel. A PLC within the control panel shall provide remote signal/equipment interface with the plant system via Contractor supplied Ethernet cable.

2) The lime slurry system with PLC is designed to be a stand-alone manually operated self-contained lime delivery system or may be remotely operated from a plant SCADA system via Ethernet cable provided by the Contractor to the Burnett Lime supplied with Ethernet module. A list of addresses shall be provided to the plant HMI programmer for status display. Remote inputs to the lime system are necessary for the stroke adjustment (0-100%). This stroke adjustment is generally calculated by the plant's own HMI system, based on flow rates, pH, anticipated lime needs, etc. as a 0-100% value of stroke adjustment. The lime slurry system PLC shall be CompactLogix manufactured by Allen-Bradley or equal.

3) Monitoring points shall be available to the SCADA system via MODBUS TCP/IP over Ethernet. The manufacturer shall provide a complete list of all Modbus digital and analog I/O registers including scales as shown on the Drawings to provide all information as required to

coordinate communications with the plant SCADA. Ethernet connection shall be made via an optical isolator protection circuit. The points shall include:

- Lime Mixer Status
- Lime Mixer Fault
- Lime Pump No. 1 Start
- Lime Pump No. 1 Status
- Lime Pump No. 1 Fault
- Lime Pump No. 1 4/20mA reference
- Lime Pump No. 2 Start
- Lime Pump No. 2 Status
- Lime Pump No. 2 Fault
- Lime Pump No. 2 4/20mA reference
- Lime Pump No. 3 Start
- Lime Pump No. 3 Status
- Lime Pump No. 3 Fault
- Lime Pump No. 3 4/20mA reference
- Alum Pump No. 1 Start
- Alum Pump No. 1 Status
- Alum Pump No. 1 Fault
- Alum Pump No. 2 Start
- Alum Pump No. 2 Status
- Alum Pump No. 2 Fault
- Alum Pump No. 3 Start
- Alum Pump No. 3 Status
- Alum Pump No. 3 Fault
- Lime Tank Level
- Alum Tank Level

b. Power Supply: The Contractor shall provide a 480 VAC, 3-phase power feed to the flange-mounted circuit breaker located in the lime system control panel. All controls shall operate on 120 VAC maximum. A 3,000 VA control power transformer with primary and secondary over current protection will be provided.

c. Enclosure: NEMA 4X 304 stainless steel, bottom entry, flange-mounted disconnect. A grounding lug is provided within the panel to assure positive system ground.

d. Components:

1) Circuit Breaker: Isolation breaker for the panel shall be a 60 Amp Type M breaker /ITED 43B060L or equal

2) Starters and Motor Protection: Pump motor will controlled and protected by Allan Bradley Model AB100C and AB140MC2, Type E self-protected manual starter with adjustable amperage breaker. Motor protection shall conform to IEC Circuit Breaker requirements as defined by IEC 947-2 and UL/CSA listed.

3) Relays: Relays shall be general purpose control type, 10 amps, 600-volt reversible contacts. Relays shall be equal to Allen-Bradley, Pump 700, and Type H.

4) Selectors: 30.5 mm, NEMA 4X rated; contacts shall be rated 10 amps continuous, 6 amps breakers at 120 VAC, manufactured by Allen-Bradley, Type 800H.

5) Weatherproof Horn: Horn shall generate a loud audible alarm when activated by 115 VAC power. The horn shall surface mount with sealable side conduit entry and shall be rated for NEMA 4X. Horn shall be equal to Federal, Model 350W.

6) Indicator Lights: Provide green run 30.5 mm transformer type LED indicator lights as equal to Allen-Bradley type 800H for each motor.

7) High Level Indicator Light and Reorder Indicator Light: Provide Red 30.5 mm transformer type LED indicator lights as equal to Allen-Bradley type 800H.

8) Panel Construction: All wiring across panel hinges shall be protected by a plastic enclosure. Terminal strips will be numbered for all field-wiring terminations.

9) Engraved Nameplates: Engraved nameplates with white background and black letters on all front panel-mounted devices.

10) External Interface:

- Surge Protection: All AC power wiring shall be protected against lightning spikes and other transient surges at all control panel termination points. Protection shall be as manufactured by Siemens TPS series.

- Cater pump control panel shall be provided for managing the high and low pressure status of the lime slurry pumps MP-1 and MP-2. A red indicator light for both high and low pressure alarm and the Red Lion digital readout are located on the door the panel. Pressure shall be read through the system PLC.

4. Lime Tank – Level Indicator Transmitter:

   a. Lime level control shall be the Milltronics MultiRanger level transmitter and tank level indicator. The level indicator shall produce an audible high level alarm located on the exterior of the pump enclosure and a re-order indicator light located on the exterior of the system control panel. Level signal will be obtained through the lime system PLC 1761-NET-ENI module via ethernet cable provided by others.

   b. Panel enclosure shall be a polycarbonate enclosure rated NEMA 4X and shall be located perpendicular to the control panel.

5. Tank Mixer:

   a. The tank mixer shall be vertical, flange mounted with two axial flow, and one radial flow impeller sized and positioned to maintain a homogenous mixture of up to 30% lime slurry at ambient temperature. Mixer shall be suitable for operation in supplied tank.

   b. The motor shall be furnished by SEW-Euro drive, Inc. specifically for direct mounting to gear reducer. Motor shall be a TEFC, Frame DRE132MC4 with a severe duty canopy with the following characteristics:

      1) Horsepower (maximum): 10
      2) Maximum Speed: 1,750 rpm
      3) 460 volt, 3-phase, 60 Hz
      4) Continuous duty
      5) TEFC

   c. A local mixer disconnect switch is located within visible sight of the mixer motor and the top entrance manway to the tank. All tank-mounted conduit shall be PVC schedule 80.

   d. The speed reducer shall be designated for mixing service and operation in an outdoor environment. The rating of the speed reducer shall adhere to appropriate AGMA standards and the reducer shall bear an AGMA nameplate.

   e. The speed reducer shall be constructed and supported so that the shaft deflection, caused by operation loads, does not affect alignment of the antifriction bearings or cause misalignment of

gearing during mixer operation. The reducer output shaft bearings shall have minimum rated B-10 life of 100,000 hours.

f. All reducer bearings shall be severe duty, anti-friction type, oil or grease lubricated. The speed reducer shall be splash lubricated, by means of gears or a slinger rotating on a horizontal shaft in an oil bath, to ensure positive displacement of the oil upward for lubrication of critical bearings. A single oil drain shall be provided at the low point of the speed reducer to allow oil drainage and leave a maximum residual of oil of no more than ¼" in the drive housing.

g. The shaft and impellers shall be carbon steel. The maximum operating speed of the unit shall be 0.5 times the natural frequency of the shaft and impeller assembly. The shaft diameter shall be determined by an analysis of torque and bending moment as well as critical speed. Minimum shaft diameter shall be 3". The shaft supporting the turbine shall be removable from the speed reducer without disturbing the gears of the speed reducer using a rigid flange coupling on the impeller shaft.

h. The mixer shall be Tesco Model LSM-20-30 with motor and Eurodrive F series gear reducer.

6. Slurry Feed Pumps:

a. Three feed pumps shall be a tubular diaphragm type, maximum rated delivery capacity of 2.6 to 15.9 gallons per hour while operating at a service speed of 60 rpm. Pump shall have a minimum turndown ratio of 10 to 1 by variation of the stroke of the pump.

b. For lime slurry systems with a system PLC, the pump selector switch is placed in Auto, ready to receive a remote input signal (0-100%) from the remote plant integrations system to the lime system PLC 1761-NET-ENI Ethernet card via Ethernet interface provided by the Contractor. The system PLC shall send the 4-20mA corresponding input to the metering pump to adjust the stroke length 0 to 100% and provide an output signal back to the system PLC for monitoring. Remote connection via ethernet cable shall be provided by Contractor.

c. The motor shall be Baldor as required by pump size and shall have the following characteristics:

1)	Horsepower:	¾
2)	460 volt, 3-phase, 60 Hz	
3)	TEFC:	Continuous Duty
4)	Service Factor:	1.15

d. The chemical feed system floor mount panel shall be constructed from solid black high density polyethylene having a minimum thickness of ½. The floor mount panel shall be assembled using thermal welding technology. Bolted construction is not acceptable.

7. Chemical Feed Lines: The slurry feed lines shall be accessible in a PVC conduit provided by the Contractor. The feed tubing to the feed point shall be either ¼", ⅜", ½", ⅝" or ¾" ID clear flexible reinforced PVC or HDPE hose and shall be equal to Kuri Tec Series #K3150.

8. Valves and Appurtenances:

a. Water isolation valves shall be true union PVC ball valves.

b. Automatic flush valves shall be true union, 3-way actuated stainless steel ball valves.

c. Provide one ¾" hose bibb on water supply header.

d. Isolation valves for liquid lime service shall be 2" flanged, pinch valves, ONYX Controls or equal. There are 2 limit switches on all pinch valves. One limit switch is interlocked in the pump run circuit to assure positive position of the valve for pump protection. The second limit switch is to provide a water flush on system shutdown.

e. Water meter shall be 2", BadgerMeter Recordall Disk Meter positive displacement AWWA approved water meter with BadgerMeter Recordall Transmitter Register (RTR). The water meter shall have maximum range of 170 gpm.

9. Instrumentation:

a. Transducer/transmitter shall be a 6" flange mounted transducer as manufactured by Milltronics model XPS15. The level display Milltronics MultiRanger shall be mounted perpendicular to the control panel.

b. A pressure transducer /transmitter indicator shall be as manufactured by Endress Hauser and provided for each pump discharge line. Red line indicators shall mount in the door of the control panel.

c. A dilution water control panel shall be mounted near the water meter consisting of a NEMA 4X enclosure housing a Red Lion PAXI digital readout and a start/pause pushbutton Allen Bradley Model 800H. Connection shall be made to the Badger Meter Recordall water meter with Recordall transmitter register (RTR).

F. Execution:

1. Installation: All installation shall be in strict compliance with the manufacturer's written instructions. All anchor bolts placed in the concrete structure shall be located, drilled and installed in place with

epoxy according to the manufacturer, as approved by the Engineer. All electrical connections shall be made in accordance with the National Electric Code (NEC).

2. Manufacturer's Service:

   a. Furnish the services of a factory representative for one 8-hour day during the installation phase of the equipment. The factory representative shall have full knowledge and experience in the installation of the type of equipment being installed.

   b. Furnish the services of a factory representative, having complete knowledge of proper operation start-up procedure and maintenance requirements for one 8-hour day to inspect the final installation, supervise a test run of the equipment and instruct the Owner's personnel in the proper operation of the system.

3. Manufacturer's System Warranty:

   a. The manufacturer shall warrant that all supported materials and components will function as specified and be free from defects in manufacturing, design and fabrication for a period of one year after the system is placed in operation.

   b. Equipment components and accessories manufactured by others but purchased through Burnett Lime Company, Inc., such as electric motors, valves and other controls, are guaranteed only to the extent of coverage offered by their original manufacturer.

   c. Expressly excluded from the warranty are defects caused by misuse, abuse or improper applications, employment or operation of the unit. The warranty does not cover acts of God, such as, lightning, explosion, fire, flood or terrorist acts.

      This warranty does not extend to damage caused by day-to-day operation considered normal wear items, such as tubes, seats, diaphragm etc. Equipment, such as tank, mixer, pumps and associated electrical equipment are covered under this warranty, and if the equipment requires repair or replacement as a result of ordinary wear and tear under normal conditions, Burnett Lime Company will repair or replace such equipment as required without cost to the Owner.

      Alterations or changes to the Burnett Lime Company CAL~FLO® system without approval from Burnett Lime could void the warranty.

   d. Slurry: The delivered slurry concentration will be 30%, and the system will feed an established dilution of the delivered concentrate. Strict quality control from the manufacturer is important to the smooth operation of the system. Consequently,

carbide limes and generic slurries may have coarse inert particles that could interrupt chemical feeding.

1) Slurry Specifications: Calcium hydroxide shall be a stabilized 30% aqueous suspension, microparticulated under high intensity rotary fusion, and processed by HWTG quality control requirements. The mean particle size shall be 22 microns and the maximum particle size shall not exceed 96 microns. Slurry product must be ANSI/NSF standard 60 certified. Delivery tankers shall be equipped with a system to avoid spillage during offloading. Supplier shall be responsible for proper dilution, and guarantee the function of the feed system from storage tank sediment and line stoppage as a result of the slurry product. System performance guarantees will be honored with the prior listed specifications.

e. The above warranty is in lieu of any other guarantee, either expressed or implied. Burnett Lime's total liability under any circumstance shall not exceed the original purchase price of the equipment component in question and does not extend to any consequential damages or attorney fees that may result in the need for the replacement of nonconformity components.

G. Cleaning: All reactors will be cleaned of all debris prior to factory test. Burnett Lime Company will clean and remove from site all excess construction material utilized in the installation of the system.

1. Startup: The manufacturer will conduct a site acceptance test upon the completion of the installation. Tests will be conducted using water as the testing media. Contractor shall be responsible for providing and disposal of the water and providing the power from either the permanent or temporary source.

H. Work by Contractor:

1. Foundations, floor slabs, trenching, grating and electrical conduit in slab
2. Grounding for the pump enclosure and tank
3. All drainage from floor drains
4. Curbs and containment structures
5. 480V, 3ph, 60A power to the power panel and terminating in the power panel
6. All communication cable /wiring from the Plant SCADA to the Lime System PLC
7. 2" valve service water connection including backflow preventer (if required) and customer service connection to the pump enclosure building

8. All trenching, feed line conduit, open trenching, wall sleeves coring, and tapping

9. Final painting of tank

10. Service water pressure not to exceed 70 pounds to the CAL~FLO® system

10.20 Floating Aerators: The Contractor shall furnish and install 3 floating aerators complete as shown on the Drawings and specified.

A. Aerator: 40 horsepower direct-drive, floating mechanical surface aerators as manufactured by Aqua Aerobics, Inc. or equal shall be provided. The aerator shall consist of a motor, direct drive and impeller drive at a constant speed. The motor shall deliver 40 horsepower and shall be wired for 460 volts, 60 cycle, 3-phase service. The motor shall be totally enclosed, fan cooled and generally rated for severe chemical duty with a 1.15 service factor. The motor windings shall be nonhygroscopic and insulation shall equal or exceed NEMA Class "F". A condensate drain shall be located at the lowest point in the lower endbell housing.

All motor frame parting surfaces shall be deep registered and Permate or equal sealed.

All through bolts, nuts and screws shall be type 18-8 stainless steel.

Each motor will have a rain cup constructed of cast iron or non-corrosive 304 stainless steel. Painted or plated carbon steel rain caps will not be acceptable.

A stainless steel nameplate shall be provided with each motor and shall securely fastened thereto. The voltage, speed, insulation class, amperage, service factor, wiring diagram, motor serial number and the manufacturer's name and address shall be steel stamped or otherwise permanently marked. The motor shall be an Aqua-Aerobic Systems, Inc., "Centaur" model supplied by Reliance Electric or "Endura" model supplied by USEM or Teco-Westinghouse.

B. Motor Drive Shaft: Unit shall have a one piece motor shaft continuous from the top motor bearing, through the lower bearing and down to and through the propeller. This shaft will have a minimum diameter of 2.125" and be manufactured from 17-4 PH stainless steel or comparable stainless steel having a minimum yield strength of 100,000 psi. Units shall operate a nominal maximum speed of 1,200 RPM.

C. Motor Bearings: Motor bearings shall be regreasable. Sealed bearings are not acceptable. Top bearing shall be shielded on the bottom side only. Bottom bearing shall be open.

The top and bottom motor bearings shall be of the combined radial and axial thrust type and shall be packed at the factory with "high performance" grease.

The lower motor bearing inner race shall be locked to the motor shaft via a special washer and locking nut arrangement. The shaft shall be threaded just below the lower bearing and shall have a keyway cut into the motor shaft. This key shall accept a tab from the I.D. of the locking washer, and the locking nut shall have

recesses to accept a tab from the O.D. of the locking washer to prevent the nut from backing off.

D. Diffuser Head:

1. The design of the diffuser head shall be such that the liquid spray will discharge at an angle of 90° to the motor shaft and over a 360° pattern in the horizontal plane and shall be a stainless steel monolithic casting.

2. The diffuser head casting shall act as a base for the aerator motor and alignment of the motor to this base shall be controlled by machined index fittings that engage the P-base of the motor. Diffuser head/motor arrangements that are dependent upon boltholes only for alignment will not be acceptable. All diffusion head hardware will be 304 stainless steel and safety wired.

3. The diffuser head casting shall act as a thrust block to deflect the high velocity, pumped volume of the aerator from the vertical to the horizontal direction. In order to minimize vibration and to provide adequate strength, the diffuser head casting shall weigh no less than 182 pounds. The bottom side of this casting shall have a 90° radius transition to effect the hydraulic change in direction with a minimum of head loss.

4. The diffuser head shall absorb all normal and shock loads encountered by the propeller and transmitted to the diffuser head via the motor shaft and lower motor end-bell. The diffuser head shall distribute these forces into the float via webs that terminate in a flange or ring that is an integral part of the diffuser head. This flange shall mate with a similar flange that is an integral part of the float/volute to spread the stresses generated by the propeller uniformly around the float so that no point loading of the float is allowed. These flanges shall be machined flat to provide proper bearing surfaces. The alignment of the diffuser head flange to the float/volute shall be by use of 360° index pilot.

5. The diffuser head shall contain an anti-deflection journal insert to limit the radial deflection of the motor shaft.

6. This anti-deflection journal insert shall be located in the lower extremity of the diffusion head, approximately ½ the distance between the motor base and the lower end of the shaft.

7. The journal insert shall be machined from Delrin or molded from moly-filled urethane and shall be a minimum of 0.060" larger through the bore than the diameter of the motor shaft.

8. There shall be a fluid deflector located on the motor shaft immediately below the anti-deflection journal which shall cover completely the anti-deflection journal and the lower portion of the diffusion head.

9. This fluid deflector shall be molded from black neoprene and shall be press fit onto the motor shaft.

10. Each unit shall be furnished with a low trajectory diffuser of high density polyethylene. This assembly shall be attached to the top of the diffusion head and shall be used to lower the aerator spray pattern and reduce windblown spray.

E. Flotation: Each aerator shall have 2,125 pounds reserve buoyancy to ensure stability and to provide support flotation required during aerator servicing. Floats shall be one piece.

1. Under no circumstances will unstable floatation designs requiring counterbalancing, ballast of liquid, solid mass or submerged major fabricated assemblies to stabilize the operation of the aerator be allowed. Only aerators demonstrating stable operational characteristics, without rocking or oscillating, will be acceptable.

2. The float shall be a minimum of 94.5" in diameter and 14.875" thick and shall be fabricated of a minimum of 14 gauge, 304 stainless steel.

a. All floats shall be constructed so that the internal void can be filled full of closed cell polyurethane foam having a minimum of 2.0 pounds per cubic feet density and shall be completely sealed water tight.

b. The float construction shall be such that the volute will distribute the load of the entire motor, drive, diffusion head and volute static load plus the entire dynamic load from the propeller thrust and radial forces by spreading these forces uniformly around the full 360° circumference of the float's central core. Point connected joints or point stressed connections will not be accepted.

F. Propeller: The propeller shall be a two-blade, left-handed, marine type precision casting of 316 stainless steel, 16.5" in diameter and shall be specifically designed for the application intended. It shall be a self-cleaning type that will not accumulate fibers, rags, stringy materials, etc. The propeller will have a diameter not allowing a greater clearance with the volute of ¼".

1. Each propeller blade shall be pitched so that the pitch angle and rank angle are within ± 2% of the other blades

2. The propeller shall be pitched so that the drive motor is loaded between 88% and 95% of full load nameplate horsepower.

3. The propeller must be attached to the motor shaft with a hardened stainless steel pin and set screw.

G. Volute: The propeller shall operate in a volute made of 304 stainless steel and shall be a minimum of 17" in diameter. It shall be round and true so that propeller blade tip clearance is uniform within the volute as it rotates. The volute shall have a minimum of 3/16" wall thickness, and a minimum of 4 full length stainless steel gussets shall be welded on a 90° spacing around the circumference of the volute between the top and bottom flanges.

1. The volute shall have a large machined flange at its top extremity that completely encircles the volute, and this flange shall match a similar flange on the bottom of the diffuser head to provide for a bolted, machined flange to flange fit to provide uniform distribution of the dynamic loads generated by the propeller and the static weight of the motor and drive. A 360° machined index in the upper flange shall provide concentric alignment of the propeller in the volute by engaging the inside diameter of the mating flange on the diffusion head. Bolt holes alone will not be acceptable to locate the important alignment of the propeller.

2. Fiberglass volutes or carbon steel volutes that are fiberglass, steel or stainless steel lined are not acceptable.

H. Intake Cone: The intake cone shall be fabricated from .105" 304 stainless steel having a gradually expanding opening outward to the intake end. The length and inlet diameter shall be sufficient to provide uniform inlet hydraulics so that no increase in vibration is caused due to its shape or size. The minimum acceptable length is 14" and minimum inlet diameter is 24.5".

1. The material used to fabricate the intake cone shall be structurally sufficient to support the weight of the entire aerator assembly when the aerator is freestanding on dry ground.

2. For maximum in-depth mixing efficiency, the intake cone shall be designed so that the suction lift from the aerator propeller is vertical from the liquid depth below the aerator. Unless specifically required for anti-erosion requirements, side or angle entry suction inlets will not be approved. All aerators 20 horsepower and larger must provide anti-vortex crosses welded inside the cones. Anti-erosion devices, if required, must be welded to the crosses.

I. Balancing: The entire rotating assembly including the motor rotor, shaft, shaft accessories and impeller shall be dynamically balanced to within 0.12"/second velocity measured at the upper and lower motor bearing. Measurements shall be taken with the motor in a vertical, shaft down position with the entire power section mounted on resilient pads. Measurements shall be taken at a frequency equivalent to the motor RPM.

Measurements shall be taken with the motor in a vertical, shaft down position with the entire power section mounted on resilient pads.

J. Mooring: A pivotal mooring system shall be supplied consisting of a stainless steel mooring arm which extends from the basin sidewall to the unit. In addition two mooring cables complete with clips, thimbles and quick disconnects shall be supplied as shown on the drawings to assure a consistent location within the basin.

Outer jacket shall be high quality CPE, PVC, TPE or equal and shall be resistant to oil, sunlight, ozone, grease, acids, water, abrasion and impact.

K. Electrical Service Cable: Each cable unit shall be furnished with required feet of #4-4 AWG electrical service cable, continuous length (non-spliced). The cable shall have 3 power conductors and a ground conductor.

1. Conductors shall be flexible type annealed copper stranded. Each conductor, including the ground conductor, shall be insulated. Cables containing an uninsulated ground conductor will not be acceptable.

2. The insulated conductors shall be assembled together with a non-hygroscopic filler material.

3. Outer jacket shall be high quality CPE, PVC, TPE or equal and shall be rated at a conductor operating temperature of not less than 90° C.

4. The cable shall be rated for hard usage, outdoor service and shall be resistant to oil, sunlight, ozone, grease, acids, water, abrasion and impact.

L. Flex Conduit: Flex conduit shall be provided for all power cables suspended above the digester.

M. Dissolved Oxygen Sensor: Furnish 1 dissolved oxygen sensor per basin. A handrail bracket and 304 stainless steel pipe shall be provided for each sensor for installation to the side of the basin. Field wiring, conduit, and installation of cable shall be the responsibility of the Contractor.

N. Warranty: The aerator shall be warranted for three years for defects in materials and workmanship and five years as a no maintenance unit.

10.21 Floating Mixer: The Contractor shall furnish and install a mechanical floating mixer, complete as shown on the Drawings and as specified below. Equipment shall be manufactured by Aqua-Aerobic Systems, Inc., Evoqua or equal.

A. Mixer: There shall be supplied one 25 horsepower mixer complete with accessories. The mixer shall consist of a motor, direct drive impeller driven at a constant speed and integral flotation unit and impeller volute.

B. Motor: The motor shall deliver horsepower as indicated at 900 RPM and shall have the electrical requirements indicated on the Drawings.

1. The motor shall be vertical P base design, totally enclosed, fan cooled and generally rated for sever duty and have a 1.15 service factor.

2. The motor winding insulation shall in all cases equal or exceed NEMA class F design and shall be nonhygroscopic.

3. All motor end bells shall be deep registered and Permatex sealed.

4. All through bolts, nuts and screws shall be of type 18-8 stainless steel.

5. Each motor will have a rain cap constructed of cast iron or non-corrosive 304 stainless steel. Painted or plated carbon steel rain caps will not be acceptable.

6. A stainless steel nameplate shall be provided with each motor and shall be securely fastened thereto. The voltage, speed, phase, insulation class, amperage, service factor, wiring diagram, motor serial number and

manufacturer's name and address shall be stamped thereon or otherwise permanently marked.

C. Motor Bearings: Motor bearings shall be regreasable. Sealed bearings are not acceptable. Top bearing shall be shielded on the bottom side only. Bottom bearing shall be open.

1. The top and bottom motor bearings shall be of the combined radial and axial thrust type.

2. The lower motor bearing inner race shall be locked to the motor shaft via a special washer and locking nut arrangement. The shaft shall be threaded just below the lower bearing and shall have a keyway cut into the motor shaft. This key shall accept a tab from the I.D. of the locking washer and the locking nut shall have recesses to accept a tab from the O.D. of the locking washer to prevent the nut from backing off.

D. Motor Shaft: The mixer motor shall have a one-piece motor shaft continuous from the top motor bearing through the lower bearing and down to and through the impeller.

1. The mixer motor shaft shall be 2.25" in diameter and manufactured from 17-4PH stainless steel. The maximum allowable full length shaft run out shall be limited to 0.006" T. I.R.

2. The mixer motor shaft shall operate freely without contacting any bearings or bushings other than the motor bearings.

E. Motor Base Assembly: The motor shall be securely mounted onto a solid 304 stainless steel base that is integral with the motor base extension. All submersed wetted motor mounting base components to be constructed of 304 stainless steel.

1. The motor base shall contain a machined recess to permit the use of a free running, anti-deflection insert. The anti-deflection insert shall not require lubrication. The provision for this insert shall be located in the lower extremity of the motor base extension immediately above the impeller.

2. The journal insert shall be machined from Delrin or molded from moly-filled urethane and shall be a minimum of .060" diameter or larger through the bore than the diameter of the motor shaft.

3. The motor end bell alignment pilot on the motor base shall be machined concentric with the machined recess that houses the free running, anti-deflection insert.

4. The upper portion of the motor mounting base, immediately below the lower motor bearing shall include two independent acting air seals. These two seals shall be capable of sealing off the flow of air from the suction action of the pumped flow and prevent back flow of liquid during impeller reversal. The lower end of the motor base extension shall be provided with a rotating backflow seal that will prevent grit from being introduced into the ant-deflection insert reservoir but shall allow liquid to contact the

shaft. The backflow seal shall not require scheduled lubrication or maintenance.

F. Flotation: Each unit shall be equipped with a modular float constructed of heavy duty 14 gauge, 304 stainless steel, foamed full of polyurethane foam of the enclosed cell type and shall be totally sealed to prevent the foam from being in contact with the external environment. The minimum float diameter of the mixers shall be 83", and the minimum float thickness shall be 12".

1. The center structure of the float shall be integral to the float cover and shall transmit all mooring stress from one mooring line to another.
2. The center structure shall also contain rigid vertical support gussets that connect the top and bottom alignment flanges that support and connect the motor support base and the submerged impeller volute assembly.
3. All connecting bolts shall be 316 stainless steel and have drilled heads and shall be safety wired in place with stainless steel safety wire.

G. Impeller: The impeller shall be a two-blade marine type, 14.5" in diameter and be a precision casting of 316 stainless steel.

1. The impeller shall be designed to pump the liquid from near the surface and direct it down toward the vessel/basin bottom.
2. The impeller shall be streamlined to prevent cavitation and reduce drag and shall have 180° trailback blades to insure non-clog operation.
3. The impeller shall be capable of being reversed to cause back flow liquid movement without causing damage to the mixer chassis and without causing upflow liquid damage to the motor bearings and windings.
4. The impeller shall be securely attached to the motor shaft in such a manner so that reversal operation for liquid backflushing will not loosen its connection; therefore, impellers requiring the threading of the shaft for attachment will not be allowed.
5. The impeller shall be "pitch balanced" to insure equalization of load under full flow operation. Each blade's pitch and rake shall not vary more than 2% from the other.
6. No liquid spray or other liquid leakage upward onto the surface of the motor support surface or flotation chassis will be allowed at any time.

H. Intake Volute Assembly: The impeller shall operate in a volute made of 304 stainless steel plate with a minimum volute diameter of 15". No plastic, fiberglass, carbon steel or cast iron materials shall be acceptable. The volute shall be welded to and aligned concentrically with the motor base and float without shims or external adjustment.

I. Balancing: The entire rotating assembly including the motor rotor, shaft and impeller shall be dynamically balanced with 2.0 mils peak-to-peak horizontal displacement measured at the upper and lower motor bearing.

J. Mooring: A cable mooring system shall be supplied consisting of three stainless steel mooring cables which extend from the basin sidewall to the unit. In addition, cables shall be provided complete with clips, thimbles and quick disconnects as shown on the Drawings to ensure a consistent location within the basin.

K. Warranty: The mixer shall be warranted for three years for defects in materials and workmanship and 3 years as a non-maintenance unit.

L. Electrical Service Cables: Each unit shall be furnished with required feet of AWG electrical service cable (size as shown on the Drawings), continuous length (non-spliced) to safely disconnect switches. The cable shall have 3 power conductors and a ground conductor. Contractor shall field verify length before ordering.

1. Conductors shall be flexible type annealed copper stranded. Each conductor, including the ground conductor, shall be insulated. Cables containing an un-insulated ground conductor will not be acceptable.

2. The insulated conductors shall be assembled together with a non-hygroscopic filler material.

10.22 Post Air Equipment: The Contractor shall furnish all labor, materials, tools and equipment necessary to install a complete coarse bubble aeration system in the post aeration tank, as shown on the Drawings and as specified.

A. Blowers: There shall be furnished one 15 horsepower, 460 volt, 60 cycle, rotary lobe type, positive displacement blowers with TEFC premium efficiency U.S. Electric, Teco, WEG, or equal motor. Each blower shall be capable of delivering 459 SCFM of air at a discharge gauge pressure of 3.5 psig. Blowers shall be Aerzen Generation 5 Delta Blower Package, Gardner Denver 408 Hewliflow, or equal.

Each blower assembly shall be complete and mounted on a base weldment with four-corner and anti-vibration mountings, designed for direct application on a concrete slab or other solid foundation. Each assembly shall be suitable for shipment as a complete unit, factory assembled (less discharge pipe fittings) as much as possible to facilitate shipping and handling.

1. Equipment shall include a blower, electric motor, belts and sheaves, inlet filter, inlet silencer, discharge silencer, discharge check valve and discharge connection, pressure relief valve, 4" butterfly discharge isolation valve and rubber expansion joint. A personnel protection guard shall be included over the belts and sheaves.

2. Enclosure: The blower enclosure shall be provided in a 71 dBa sound attenuating enclosure.

3. Blower Casing: The blower casing shall be of one-piece construction with separate sideplates that are bolted and pinned to the housing. Materials shall be close-grained cast iron ASTM A48 suitably ribbed to prevent distortion under the specified operating conditions. Minimum blower

casing pressure rating shall be 36 psig. The casing shall incorporate a proven means of pulsation cancellation. Rotor/shaft shall be drop forged in one single piece of AISI 1043 or equivalent. Cast, hollow rotors shall be capped, dust tight.

4. Factory Tests: Each blower stage shall be factory tested in accordance with ISO 1217 performance test to verify flow and brake horsepower at blower maximum conditions. The acceptance criteria are +5% tolerance on power and -5% tolerance on flow regardless of the size of the machine. Bearings shall have a minimum life time of 100,000 hours. Timing gears shall be helical AGMA 12 quality gears with hardened and ground teeth, minimum AGMA service factor of 1.70.

5. Accessories: Blower accessories shall include:

   a. Inlet filter / silencer with filter media meeting ASHRAE 52.2 MERV7 50-70% @ 3-10 microns corresponding to EN 799 G4

   b. Base frame with chamber style discharge silencer

   c. EPDM single arch style, flexible connection

   d. V-belt drive with belt guard compliant with OSHA regulations

   e. Pressure safety valve sized to pass 100% of design flow

   f. Check valve, flapper type design

   g. Instrumentation consisting of inlet vacuum gauge, discharge pressure gauge, and discharge temperature gauge/switch with 4" dials

   h. Acoustic enclosure made of galvanized sheet steel. Acoustic material shall comply with UL 94-HF1 for fire-retardant, self-extinguishing, non-dripping materials.

   i. One spare air filter

   j. One spare set of v-belts

B. Materials, Fabrication and Finishing:

1. Stainless Steel – Pipe, Fittings and Supports:

   a. Fabricate all welded parts and assemblies from sheets and plates of 304L stainless steel with a 2D finish conforming to ASTM A240, 554, 774, 778.

   b. Fabricate non-welded parts and flanges from sheets, plates or bars of 304 stainless steel conforming to ASTM A240 or ASTM A276.

   c. Welds and Welding Procedure

      1) Weld in the factory with ER 316L filler wire using MIG, TIG or plasma-arc inert gas welding processes. Provide a cross section equal to or greater than the parent metal.

2) Provide full penetration butt welds to the interior surface with gas shielding of interior and exterior to joint.

3) Continuously weld both sides of face rings and flanges to eliminate potential for crevice corrosion.

d. Corrosion Protection and Finishing: Clean all welded stainless steel surfaces and welds after fabrication by using the following procedure:

1) Pre-clean all outside weld areas to remove weld splatter with stainless steel brushes and/or deburring and finish grinding wheels.

2) Finish clean all interior and exterior welds and piping by full immersion pickling and rinse with water to remove all carbon deposits and contaminants to regenerate a uniform corrosion resistant chromium oxide film per ASTM A380 Section 6.2.11, Table A2.1 Annex A-2 and Section 8.3.

3) Corrosion protection techniques not utilizing full immersion methods are unacceptable and will be cause for rejection of the equipment.

2. Natural Rubber: Furnish all fixed and expansion joint O-ring gaskets of natural rubber/SBR with a Shore A durometer of 45± 5.

C. Coarse Bubble Aeration System Components:

1. Drop Legs: Provide a 4" stainless steel drop leg from the air main connection to the drop leg connection to the manifold.

a. Provide a stainless steel Van Stone style flange with a 150-pound drill pattern for the top connection.

b. Provide a stainless steel band clamp coupling with gasket for the lower dropleg to manifold connection.

2. Manifolds: Provide a stainless steel manifold for connection to the air distribution headers.

a. Fabricate manifolds with 4" diameter fixed threaded union or flanged joints for connection to the air distributors.

b. Design manifold, distributor connections and supports to resist thrust generated by expansion/contraction of the air distributors over a temperature range of 125° F.

c. Support manifold with a minimum of 2 supports.

d. Correct manifolds with fixed threaded union or flanged joints to prevent rotation or blow apart.

3. Coarse Bubble Diffusers: Diffusers shall be 24" 316 stainless steel with deflector bottom and ¾" male NPT connection. The end cap should be

welded to the diffuser body. The diffusers shall be EDI MaxAir 24-C, Sanitaire D-24 or equal.

4. Supports: Provide each section of manifold with a minimum of 2 supports.

   a. Limit maximum support spacing to 8'.

   b. Design all supports to allow for thermal expansion and contraction forces over a temperature range of 125° F and to minimize stress build up in the piping system.

   c. Design supports to be adjustable without removing the air distributor from the support.

   d. Design supports to allow for complete removal from the tank to facilitate installation of additional headers and in-tank maintenance.

5. Anchor Bolts:

   a. Design anchor bolts for embedment in 4000 psi concrete with a pullout safety factor of 4.

   b. Provide a mechanical stainless steel expansion type anchor bolt system.

D. Services: Provide a manufacturer's representative for initial start-up, testing and training for a minimum of one 8-hour day

10.23 Prestressed Concrete Tank (Deduct 1): The Contractor shall furnish all materials, labor and equipment necessary to construct circular prestressed concrete tanks in accordance with ACI 350, AWWA Standard D110-04, *Wire and Strand Wound, Circular Prestressed Concrete Water Tanks,* and all applicable state and local standards. Manufacturer shall provide complete design calculations and construction details prepared by a professional engineer licensed in the State of Georgia. The tanks shall be manufactured by Crom, LLC, Precon Corporation, or equal. The circular, prestressed concrete tanks shall be designed and constructed by a manufacturer regularly engaged in the design and construction of circular, prestressed concrete tanks.

10.24 Payment: No separate payment will be made for the work of this Section. The cost of the work, and all costs incidental thereto, shall be included in the amount bid in the Proposal for the item to which the work pertains. Items herein not listed under Item No. 2 in the Proposal shall be included in the lump sum amount under Item No. 1 in the Proposal.

SECTION 11
INSTRUMENTATION AND CONTROL

11.01 Scope: The Contractor shall furnish all materials, labor and equipment necessary for the complete installation of instrumentation and control systems as shown on the Drawings and/or specified.

A. The Contractor shall furnish, install, test, adjust and paint in accurate, satisfactory, workmanlike manner, all machinery, equipment, apparatus, accessories and fittings required by the completion of the work in accord with the Drawings and these Specifications and in accord with the drawings, specifications and directions for erection furnished by each equipment manufacturer.

B. The Contractor shall furnish and install all materials including electric wiring, conduits and controls not furnished by the equipment manufacturers. The Contractor's attention is directed to the General Requirements with reference to requirements for furnishing working drawings.

11.02 Work to be Done: All requirements concerning supervisory services, equipment bids, equipment obtained from manufacturer, equipment approved, mechanical testing, piping for equipment, shop painting, operation and maintenance manuals, guarantees and motors specified in Section 10.02 through Section 10.12 shall apply to this Section of the Specification unless otherwise specified.

11.03 Standards: All work shall conform to applicable standards of ANSI, IEEE, ISA, NEMA, UL and NEC.

11.04 Submittals: Complete shop drawings showing the panel outline dimensions, instruments and control configurations, wiring schematics, field termination types of devices and description of operation for review prior to fabrication.

11.05 Qualifications: Attention is directed to the fact that instrumentation is an integrated system; and as such, shall be furnished by a single system vendor who shall provide all of the equipment and appurtenances, regardless of manufacturer, and be responsible for the satisfactory operation of the entire system.

A. Instruments and instrumentation shall be furnished by J.K. Duren Co., Southern Flow, Inc., or equal.

11.06 Supervisory Control and Data Acquisition Equipment (SCADA): The Contractor shall provide an Ethernet and fiber optic network to transmit MODBUS TCP/IP communications from the bar screen control panel, grit separator control panel, raw sewage pump station control panel, SBR control panel, tertiary filter control panel, UV System control center, effluent pump station control panel, plant pump station control panel, chemical feed, and sludge dewatering press control panel. The Contractor may offer substitute equipment for consideration in accordance with these specifications.

The SCADA system shall be the product of one system integrator having at least 5 years' experience in furnishing similar systems. Complete electrical diagrams, dimensional drawings, and functional description shall be provided for approval by the Engineer.

A. Remote Terminal Units: The Contractor shall connect new devises to these units where shown on the Drawings or described herein.

1. RTU-1 (Control Building): The RTU panel shall consist of a; Best Power Ferrups UPS, redundant power supply, duplex receptacle, surge protector, fiber patch panel, a DIN mounted fiber optic Ethernet switch and connections to communicate MODBUS TCP/IP over the plant network in a Hoffman NEMA 12 enclosure. One (1) Ethernet 4 channel analog output DIN mounted module shall be supplied. A label plate shall be mounted on the outside of the RTU cabinet with the RTU number and site name on a black background with white lettering. Complete wiring schematics shall be mounted inside the cabinet. All wiring terminals shall be numbered to correspond with the wiring diagram.

   a. Analog Outputs:

      AO1 Effluent Flow

      AO2 WAS Flow

      AO3-4 Spares

2. RTU-2 (Blower Building): The RTU panel shall consist of a; Best Power Ferrups UPS, redundant power supply, duplex receptacle, surge protector, fiber patch panel, a DIN mounted fiber optic Ethernet switch and connections to communicate MODBUS TCP/IP over the plant network in a Hoffman NEMA 12 enclosure. One (1) Ethernet 8 channel analog input Modbus TCP/IP DIN mounted module shall be supplied. Two Isolated 18 channel Digital I/O Modbus TCP/IP DIN mounted modules shall be supplied. A label plate shall be mounted on the outside of the RTU cabinet with the RTU number and site name on a black background with white lettering. Complete wiring schematics shall be mounted inside the cabinet. All wiring terminals shall be numbered to correspond with the wiring diagram.

   a. Analog Inputs:

      - AI1 Effluent Flow
      - AI2 WAS Flow
      - AI3 Pumped Flow
      - AI4 8 Spares

   b. Digital I/O Module One:

      - DI1 Reuse Pump Running
      - DI2 Digester Mixer Running
      - DI3 Digester Aerator No. 1 Running
      - DI4 Digester Aerator No. 2 Running
      - DI5 Digester Aerator No. 3 Running

- DI6 — Wetwell Chamber No. 1 Low Level
- DI7 — Wetwell Chamber No. 2 Low Level
- DI8 — 12 Spares
- DO1 — Digester Aerator No. 1 Call to Run
- DO2 — Digester Aerator No. 1 Call to Run
- DO3 — Digester Aerator No. 1 Call to Run
- DO4 — 6 Spares

c. Digital I/O Module Two:

- DI1 — Pump No. 1 Running
- DI2 — Pump No. 1 MCC Fault
- DI3 — Pump No. 2 Running
- DI4 — Pump No. 2 MCC Fault
- DI5 — Pump No. 3 Running
- DI6 — Pump No. 3 MCC Fault
- DI7 — 12 Spares
- DO1 — Pump No. 1 Call to Run
- DO2 — Pump No. 2 Call to Run
- DO3 — Pump No. 3 Call to Run
- DO4 — 6 Spares

d. The RTU shall have a relay(s) to forward generator running signal from the generator to each of the 5 blower passive filters.

3. RTU-3 (Raw Sewage Pump Station): The RTU panel shall consist of a; Best Power Ferrups UPS, redundant power supply, duplex receptacle, surge protector, fiber patch panel, a DIN mounted fiber optic Ethernet switch and connections to communicate MODBUS TCP/IP over the plant network in a Hoffman NEMA 4X enclosure. Two isolated 18 channel digital I/O MODBUS TCP/IP DIN mounted modules shall be supplied. A label plate shall be mounted on the outside of the RTU cabinet with the RTU number and site name on a black background with white lettering. Complete wiring schematics shall be mounted inside the cabinet. All wiring terminals shall be numbered to correspond with the wiring diagram.

a. DI1 — Bar Screen Fault

b. DI2 — Bar Screen Running Forward

c. DI3 — Bar Screen Running Reverse

d.	DI4	Spiral Conveyor Fault
e.	DI5	Spiral Conveyor Running Forward
f.	DI6	Spiral Conveyor Running Reverse
g.	DI7	Grit Pump Status
h.	DI8	Grit Pump Low Vacuum
i.	DI9	Grit Pump Overload
j.	DI10	Paddle Drive Status
k.	DI11	Paddle Drive Fault
l.	DI12	Grit Screw Status
m.	DI13	Grit Screw Fault
n.	DI14	Solenoid Valve Status
o.	DI15	Emergency Stop
p.	DI	16-24 Spares
q.	DO	1-12 Spares

4. RTU-4 (Sludge Dewatering Building): The RTU panel shall consist of a; Best Power Ferrups UPS, redundant power supply, duplex receptacle, surge protector, fiber patch panel, a DIN mounted fiber optic Ethernet switch and connections to communicate MODBUS TCP/IP over the plant network in a Hoffman NEMA 12 enclosure. A label plate shall be mounted on the outside of the RTU cabinet with the RTU number and site name on a black background with white lettering. Complete wiring schematics shall be mounted inside the cabinet. All wiring terminals shall be numbered to correspond with the wiring diagram.

5. Communications Cable: Premium grade, shielded 100BaseT cable shall be used to connect all Ethernet capable devices over cable runs of 200 feet or less. Longer runs shall utilize premium grade fiber optic cable with appropriate signal converters. Fiber optic cable shall be OM1, OFNP rated, distribution cable with 6 multi-mode (62.5 μm/125 μm) fibers, having 900μm tight buffers, and Aramid yarn strength members. The Cable shall have an orange jacket. The cable manufacturer shall use Corning® optical fibers exclusively. Individual fibers will be color coded. Acceptable fiber optic cable manufacturer is TLC (The Light Connection) or Equal. Two of the six fibers will be used to complete the Ethernet link to each panel. The remaining four will be spare. All spare fibers will be terminated and tested. Fiber cable lengths will be measured and verified by the supplier on-site before ordering the fiber. Each cable run shall be of continuous length of cable without splices of any kind. Suitable end connectors and lightning arrestors shall be provided.

6. Field Installed Fiber Optic Connectors: If fiber cable connectors are not factory installed, all field installed fiber connectors will be Corning Cable

fiber terminations are made and fiber fan out kits are used, the accepted fan out kit is Corning Cable Systems Buffer Tube Fan-Out Kit, FAN-BT25-06.

7. Fiber Optic/Ethernet Switches: Shall be managed Ethernet switches with minimum of 3 10/100BaseT(X) ports, and 2 100BaseFX multi-mode ports with ST connectors, 0 to 60°C operating temperature. They will be DIN rail mountable. And support the following protocols: Plug-n-play Turbo Ring (recovery time < 20 ms), RSTP/STP (IEEE 802.1w/D) for Ethernet redundancy, QoS, IGMP snooping/GMRP, VLAN, LACP, SNMPv1/v2c/v3, and RMON. Acceptable switches are Moxa EDS-405A/408A Series or equal.

8. Fiber Patch Panel: Panels shall be installed inside each RTU, or Cabinet location where a fiber cable terminates. Each patch panel will be DIN rail mountable and provide strain relief and a dry, clean environment for the exposed fibers. Each will have 6 or 12 multimode ST/ST duplex fiber adapters. Patch panel shall be SNAP-12ST-MM or equal.

9. Ethernet Analog Output Module: Analog output module shall be DIN mounted with 4 analog current outputs 4-20mA DC and four discrete voltage I/O channels 0-32V DC. Ethernet communication shall be over the Modbus TCP/IP network. Module shall be Acromag XT1530 or equal.

10. Ethernet Analog Input Module: Analog intput module shall be DIN mounted with 8 analog current inputs 4-20mA. Ethernet communication shall be over the Modbus TCP/IP network. System integrator shall define Modbus registers and scales and coordinate communication with the Plant SCADA. Module shall be Acromag XT1210 or equal.

11. Isolated Digital I/O Ethernet Module: Eighteen channel digital intput/ouput module shall be DIN mounted with 12 discrete 0-30V inputs and 6 discrete 0-30V inputs. Ethernet communication shall be over the Modbus TCP/IP network. System integrator shall define Modbus registers and coordinate communication with the Plant SCADA. Module shall be Advantec ADAM-6050 or equal.

B. Start-up and Service: The SCADA equipment supplier shall provide the services of a factory-trained representative to check the completed installation, place the equipment in operation and instruct the Owner's personnel in the proper use and maintenance of the equipment. All equipment shall be guaranteed against defects of material and workmanship for a period of 2 years from date of acceptance.

11.07 Parshall Flume Liner (FEI): One (1) flume shall be developed by installation of a full length Parshall Flume liner into the structure as indicated on the Drawings. The liner shall be fabricated in one piece from polyester resin reinforced with not less than 30% fiberglass by weight. Locking devices for engagement with the grout around the liner and reinforcing ribs shall be an integral part of the liner. Removable bracing shall be provided to insure proper maintenance of liner dimensions during shipment and

installation. The wall thickness of the liner shall be not less than ¼". The flume waterway dimensions shall conform to the U.S. Department of Agriculture, Soil Conservation Circular No. 843, latest edition. The liner shall be furnished with a staff gauge molded in the side of the flume.

11.08 Ultrasonic Flow Meter:

A. General: One (1) ultrasonic flow meter shall be installed to measure flow in the Parshall flume at the locations shown on the Drawings in accordance with the manufacturer's recommendations. The flow meter shall have microprocessor-based electronics, a front panel menu driven keyboard and shall produce an isolated 4-20 ma DC signal proportional to the flow, over a measurement range of 0 to 10 mgd. The flow meter shall be self-compensation for ambient temperature conditions. The flow meter shall also have as standard, four (4) relay outputs available for alarm conditions, sampling or pulsing external totalizers. The unit shall be capable of simulating flow without any external devices for verifying outputs and calibrations. The unit shall be a Control Electronics, Teledyne ISCO or equal.

B. Acoustic and Mounting Equipment: One (1) acoustic sensor shall be permanently mounted at the measuring site and positioned according to the manufacturer's approved method. Sensor mounting adaptors shall be supplied by the manufacturer. The sensors shall transmit and receive and acoustic signal to accurately measure fluid depth at the monitoring site. The sensors shall have built-in temperature compensation to maintain accuracy. The transmitted beam angle shall not be greater than 3°. The sensors shall be capable of an indefinite submergence of 30' without degradation. The sensor shall function over an ambient temperature of 20° F to 160° F.

C. Flow Indicating Transmitter: One (1) transmitter shall contain all necessary circuitry to utilize the signal from the acoustic sensor, area flow meter and shall produce an accurate 4-20 maDA signal. An RS-232 serial port connection shall be provided for computer interface for real-time communications. The transmitters shall be supplied with an LCD indicator to display flow rate and flow total and their respective flow units and multipliers. The display shall indicate if there is a fault or an alarm condition. The transmitter shall also produce four (4) relay output connections for external alarms, sampling or pulse output to drive a remote flow indication/totalizer.

The flow indicating transmitter shall be mounted in a NEMA-4X fiberglass enclosure with see through acrylic door. Surge protection shall be provided for the 120 VAC and the 4 to 20 mA output.

D. Operating Parameters: Accuracy of the unit shall be unaffected by temperature changes within the specified ambient temperature range. Flow sampling shall be a minimum of 15 samples per second and the unit shall be able to operate with as few as 2% of the samples taken successfully. In the event of the prolonged loss of acoustic signal, the unit shall indicate the condition by a flashing status indication on the front display panel. The flow signal shall be an isolated 4-20 maDC operating into a maximum of 1000 ohms. The accuracy shall be ±0.1% of target

distance or ±.08", whichever is greater. Repeatability shall be within ±0.2%. The unit shall operate using 117 VAC, 60 Hz electrical service. Power consumption shall be less than 10 watts indoor/210 watts outdoor. All user wiring connections shall be made via well-marked terminal blocks.

E. Transducer Cable: The electrical signaling cable, supplied by the flow meter manufacturer, shall be connected from the sensor to the transmitter housing. The cable shall be installed in an exclusive ¾" to 1" rigid or flexible, continuous, watertight, metallic conduit.

F. Service: It shall be the responsibility of the manufacturer of the flow meter to have a trained representative place the equipment in operation, demonstrate the operation to the Owner and the Engineer and train the Owner's personnel in the proper use of the equipment.

11.09 Electronic Flow Meter: There shall be furnished electromagnetic flow meters suitable for fixed-site measurement of bi-directional flow in a full pipe. The flow meters shall consist of a flow tube and a flow transmitter which shall indicate totalize and transmit flow. The flow tubes shall use a spool piece configuration with field-interchangeable sensors containing coils and electrodes.

A. Spool Piece Flow Tube and Sensors:

1. The nominal diameter of the flow tubes shall be

   a. 4" at the waste sludge

   b. 4" at the digested sludge

2. The spool piece flow tube shall be made of carbon steel and shall be a fusion bonded polyethylene finish inside and outside. O ring seals shall be made of Viton, and standpipe gaskets shall be made of nitrile rubber.

   a. The flow tube shall not require an insulating liner. The flow tube liner shall be polyethylene that conforms to National Sanitation Foundation Standard 61 for use with potable water. Accuracy shall be not be affected by cuts or scratches in the flow tube liner.

   b. The flow tube shall be supplied with raised face carbon steel flanges to ANSI 150rf Table D.

3. Each flow sensor shall contain a coil, a pair of sensing electrodes and an integral grounding electrode. The sensors shall use solid state design with the coils, electrodes and other sensor components encapsulated in polyurethane that conforms to National Sanitation Foundation Standard 61 for use with potable water.

   a. The electrodes shall be made of Type 316 stainless steel.

   b. The flow tube shall use unipolar pulsed AC electromagnetic excitation with typical magnetizing current of not less than 1A base to peak and frequency of not less than ⅔ of power supply frequency (40 Hz for a 60 Hz power supply frequency) to ensure a high signal-to-media noise ration.

4. The minimum media conductivity shall be 0.5 microS/cm.

5. The maximum media temperature shall be 175 ° F (80 ° C).

6. The flow meter shall include multiple sensors to measure mean velocity in full pipes.

   a. The mean velocity measurement range shall be from 0.1' per second to 40' per second.

   b. The minimum detectable mean velocity shall be 0.02' per second.

   c. The mean velocity shall be measured with a maximum error of ± 0.005' per second over a range of less than 1' per second and ±0.5% of flow rate over a range of 1' to 40' per second. A mean velocity of 0.1' per second shall be measured with a maximum error of ±5% of reading. Accuracy shall be traceable to the US National Institute of Standards and Technology (NIST) and shall be guaranteed on-site for applications such as drinking water, raw sewage and similar media, even with a permanent coating of raw sewage or similar on the electrodes provided that specification parameters and installation recommendations are met. A NIST traceable calibration certificate shall be provided with each flow meter.

   d. The temperature coefficient shall be less than 0.05% per 10° F.

   e. A non-full pipe condition shall be indicated by a user-supplied signal into one of the contact inputs on the flow transmitter.

   f. Maximum pressure shall be 150 psi (10 bar).

7. The wiring from the flow transmitter to the sensors shall be one 8-conductor cable, 18 gauge (0.75 mm^2), twisted and shielded. The wiring from the flow transmitter to the sensors shall be as shown on the Drawings.

8. The flow tube and sensors shall exceed the NEMA 6P (IP68) submersibility standard and shall be submersible to 33'.

9. The flow tube shall have a 10-year warranty and the sensors a 5-year warranty.

B. Flow Transmitter:

1. The flow transmitter shall be microprocessor-based, and shall contain a keypad and a 2 line, 32 character, backlit alphanumeric liquid crystal display (LCD) with characters 0.3" high and 0.2" wide. The LCD shall visually prompt the user through the programming sequence, and the flow transmitter shall include a built-in help system. The LCD shall display flow rate and/or total flow in user-selectable units of measure. The flow transmitter shall be capable of displaying forward, reverse, net and grand total flows, and the totalizers shall be resettable or non-resettable.

2. The flow transmitter shall include two (2) isolated contact inputs, activated by contact closure or transistor, programmable to acknowledge alarms, reset totalizers, select the current flow rate range in forward flow/multi range mode, or indicate non-full pipe condition.

3. The flow transmitter shall include an isolated, internally powered 4 to 20 mA output into a maximum of 500 ohms. The 4 to 20 mA output shall be programmable to operate in either forward flow rate, forward flow rate/multi range, bidirectional flow rate or bidirectional flow rate/split range mode.

   a. In forward flow rate mode, 4 mA shall represent zero flow rate, and 20 mA shall represent the programmable maximum forward flow rate.

   b. In bidirectional flow rate mode, independent maximum forward and reverse flow rates shall be programmable with flow direction indicated by a relay output.

   c. In bidirectional flow rate/split range mode, 4 mA shall represent the programmable minimum reverse flow rate, and 20 mA shall represent the programmable maximum forward flow rate.

4. The flow transmitter shall include a two (2) wire solid state pulse output, internally powered, rated 25 volts DC, 80 mA. The pulse output shall be programmable to operate in either scaled or frequency mode.

   a. Scaled mode shall be used for totalizing, with a programmable maximum frequency of 5, 10 or 100 Hz and a corresponding pulse width of 100, 50 or 5 ms, respectively.

   b. Frequency mode shall be used for rate indication, with a square wave output programmable from 0 to 1,000 Hz to 0 to 10,000 Hz.

5. The flow transmitter shall include two (2) isolated, normally open relay contacts, activated based on reverse flow, high or low flow rate, total flow, or diagnostic errors, rated 60 volts DC, 30 volts AC RMS, 3 A resistive.

6. The flow transmitter shall be Factory Mutual (FM) Approved for use in ordinary locations.

7. The flow transmitter shall operate on 120 VAC, 50/60 Hz, line power. Typical power consumption shall be 10 W, including the sensors.

8. The flow transmitter shall be housed in a rugged, watertight, dust-tight, corrosion resistant (NEMA 4X and IP65) cast aluminum, epoxy painted enclosure suitable for conduit connections. The enclosure shall include a polycarbonate window for viewing the LCD without opening the enclosure.

9. The flow transmitter shall have a 2-year warranty.

11.10 Permanent Clamp-On Flow Meter:

A. General: The furnished flow meter shall be a Flexim 7407 or approved equal. Approval for an equivalent flow meter will be given if the proposed flow meter meets the specifications as established by these Specifications and upon an actual successful demonstration of the equipment on the intended or similar application. The meter must be a clamp-on design with no liquid contact that mounts externally on the pipe.

B. Scope:

1. The meter must utilize the transit-time flow measurement technique and employ the use of TWO microprocessors and have the ability to monitor TWO independent flow channels simultaneously (second channel optional).

2. The metering electronics must have the ability to operate HIGH TEMPERATURE flow sensors capable of monitoring liquids at temperatures in excess of 750°F.

3. The meter must also have the ability to employ an alternate Doppler measurement technique for liquids with high air or solid content.

4. The meter must have a multi-point (7 points minimum) wet flow calibration certificate accredited from an international standards agency with an accuracy of better than 1%.

5. The meter must have a transducer encased in stainless steel with an integral armored stainless steel jacketed TRIAX cable. The use of COAX cable and BNC cable connections will not be acceptable.

6. The transducers are to be mounted in a fully sealed (water tight) stainless steel mounting track and have the ability to be coupled using permanent coupling pads (grease is NOT acceptable).

7. All transducer markings and identification must be laser scribed and solvent resistant. The use of adhesive labels for transducer identification will not be acceptable.

8. All transducers supplied must have a multi-point (7 points minimum) wet flow calibration certificate accredited from an international standards agency with an accuracy of better than 1%. All calibration and transducer data must reside in a non-volatile memory chip located in the transducer junction box or flow meter.

9. The meter must have the ability to automatically recognize the transducers when connected. Programming of the transducer type into the meter will not be acceptable.

10. The meter must be of a type that requires NO zero calibration. The zero calibration must be factory pre-set automatic without the need for zero check/calibration after installation. There must not be any zero drift

mechanisms (i.e. temperature change related drift) as the meters can NOT be installed with any low-flow cutoff or "deadband".

11. The meter must also provide automatic Reynolds number, liquid sonic velocity compensation, and have built in liquid tables for automatic sound velocity, viscosity, and density settings.

12. The flow meter electronics shall be housed in a NEMA 4X enclosure and have the ability to indicate flow rate, flow velocity, mass flow, total flow, signal strength, signal quality, liquid sonic velocity, Reynolds regime (laminar/turbulent/transition).

13. The meter must have the ability to have dynamic (automatic) compensation for changes in viscosity and density.

14. The meter must be able to have inputs for Pt100 4 wire temperature RTD, 4-20ma input for temperature, 4-20ma for pressure, 4-20ma for density.

15. The meter shall be capable of outputting multiple 4-20ma, Voltage 0-1v or 0-10v, high precision frequency 0-1kHz or 0-10kHz galvanically isolated, RS-232, RS-484, binary output pulse or alarm for relay total and meter status.

16. The meter shall have the ability to status alarm for conditions of fault, flow direction, sound velocity limit, flow velocity limit.

17. The meter shall have the ability to set the 4-20ma to a settable status condition (i.e. 2ma for an alarm condition).

18. The meter shall have RS-232 output and internal memory with a minimum storage of 100K data points.

19. The flow transmitter shall be housed in a rugged, watertight, dust-tight, corrosion resistant (NEMA 4X and IP65) cast aluminum, epoxy painted enclosure suitable for conduit connections. The enclosure shall include a polycarbonate window for viewing the LCD without opening the enclosure.

11.11 Automatic Sampler: The Contractor shall furnish and install as shown and specified 1 refrigerated automatic sampler.

A. General:

1. Instrument: There shall be furnished an automatic refrigerated wastewater sampler for sequential and composite sampling applications, suitable for indoor or outdoor installation without the requirements for additional enclosures for weather protection. The sampler shall be capable of collecting samples from a variety of liquid sources including open channels, sewers, and storm water conduits. The sampler shall route samples to storage containers for collection and off-site analysis. The sampler shall be suited to collect priority pollutant or general purpose samples in multiple bottles or a single bottle. The unit shall be line (AC)

powered 115 volt 60Hz. The automatic sampler shall be Teledyne Isco model 5800, Hach / Sigma Model 900AWRS or equal.

2. Refrigerator: The shell of the refrigerator shall be constructed of rotationally molded UV-resistant polyethylene with molded-in-place thermal insulation, providing exceptional resistance to corrosion and weathering. The top of the refrigerator door shall be recessed for ease of access from above. For 24 bottle configurations, the bottle rack shall slide out for ease of sample recovery. The copper refrigeration lines, condenser coil and evaporator plate shall be powder-coated with heat-treated polyester for additional corrosion resistance. The refrigerant used shall be a non-CFC refrigerant with an ozone depletion potential of zero.

   a. The refrigerator's door shall have hasps capable of accepting a padlock to prevent unauthorized tampering with the sample compartment contents. A compression gasket shall be used to seal the refrigerator door. The refrigerator power supply and solid-state thermostat shall be contained in an epoxy-potted enclosure housed in a separate pocket of the sampler's molded frame. All exposed metal components used in the construction of the refrigeration system shall be either plated aluminum or stainless steel.

   b. The unit shall include long-life electronic temperature sensing devices that shall measure the refrigeration compartment and evaporator plate temperatures. A microprocessor shall utilize this sensor to control operation of the compressor, built-in heaters and the self-defrosting cycle of the evaporator plate. The built-in heaters shall prevent collected samples from freezing if the ambient air temperature drops below freezing. The sampler shall not require a separate heater for the controller. The sampler shall use a condensing coil with forced-air cooling. The current refrigeration temperature shall appear on the sampler's display, and temperature readings shall be stored in a report.

   c. The refrigerator shall use a compressor rated at 1/5 horsepower for 110V. The compressor shall be equipped with a temperature safety cutout that will disengage the compressor if a temperature of 221°F (105°C) is reached. The refrigeration system shall contain HFC-134a as the refrigerant. The refrigerator shall have a 5 minute typical recovery time to return to 39°F (4°C) after the door has been opened for 1 minute in 75° F (24°C) ambient conditions. The collected samples shall be stored in an enclosure capable of operating in ambient temperatures from -20° to 120°F (-29° to 49°C).

   d. The refrigerator shall, upon program initiation, drop the temperature within the sample compartment by 2.5°C below the set temperature for the first 24 hours of operation before resuming normal operation.

e. The top section housing the control panel, pump, distributor electronics, and power supply box shall be NEMA rated at 4X, 6, and IP 67.

B. Controller:

1. The controller shall be housed in a separate pocket of the sampler's molded frame beneath a flip cover. The controller shall use a 2 row, 20 column, 40 total character display to show sampler status and program information. This display shall be angled for easy viewing and backlit for easy use in all light conditions. An 18 position keypad shall be used for all program entries and manual control of the sampler.

2. The sampler's memory shall maintain the program settings, stored programs, and the results of the last sampling sequence when the sampler is turned off or an external power interruption occurs. A user-initiated diagnostics routine shall determine the operational status of the sampler. Any error conditions detected by the diagnostic routines shall be displayed to the user.

3. The user can define specific program operational parameters. The user can program the sampler to collect sequential or composite samples at user-definable intervals and volumes. A delay to first sample collection shall be programmable by the real-time clock, if desired.

4. Time Pacing: The sampler shall use an internal real-time clock to provide time and date information. Uniform time-paced samples shall be collected at regular time intervals from 1 to 9,999 minutes. Sample volumes may be equal or variable in proportion to flow.

5. Flow Pacing – DC Pulse: The sampler shall accept a 5 to 15 VDC flow proportional pulse or isolated dry contact closure from an external flow meter for flow pacing. The pulse or contact closure shall be at least 25 ms in duration. Samples shall be equal in volume and shall be taken at variable times proportional to flow. The user shall select the number of flow pulses as the flow interval for each sample collection, from 1 to 9,999 pulses.

6. Flow Pacing – Analog Input: The sampler shall have a standard 4-20mA flow proportional input compatible with most flow meters without additional interfacing. Samples shall be equal in volume and shall be taken at variable times proportional to flow.

7. Flow-Weighted Volumes – DC Pulse: The sampler shall accept a 5 to 15 VDC flow proportional pulse or isolated dry contact closure from an external flow meter. The pulse or contact closure shall be at least 25 ms in duration. Samples shall be taken at equal time intervals, and variable sample volumes shall be proportional to cumulative flow.

8. Flow-Weighted Volumes – Analog Input: The sampler shall have a standard 4-20 mA flow proportional input compatible with most flow meters without additional interfacing. Samples shall be taken at equal

time intervals, and variable sample volumes shall be proportional to cumulative flow.

C. Sampler Outputs:

1. The sampler shall have four (4) standard digital alarm outputs capable of direct wiring to a Programmable Logic Controller (PLC) or data logger (5 volt, 100 mA).

2. The sampler shall output an event mark of 12VDC for the duration of the sample fill, from the flow meter connector.

3. The sampler shall store a one-minute temperature data report retrievable by an IBM-compatible computer using a program such as Hyper Terminal. The program shall include failsafe loading with site ID codes to prevent field errors due to multiple files

D. Sample Delivery: The sampler program shall allow the user to select from 3 types of sample distribution: samples per bottle, bottles per sample and multiple bottle compositing. In the samples per bottle mode, a minimum of 15 samples shall be capable of being deposited in each sample container. In the bottles per sample mode all sample bottles shall be capable of being filled with a single initiation. Multiple bottle compositing shall allow the user to simultaneously create a pair or set of bottles containing multiple samples. The sampler shall switch bottles after a period of time has elapsed or a predetermined number of samples has been collected.

1. Pump: Samples shall be collected using a peristaltic pump. This pump shall produce typical line velocities of 3.0' per second in a ⅜" ID suction line at 3' of head. At 25' of head, the pump shall typically produce a line velocity of 2.2' per second. The pump shall be capable of lifting a sample a maximum of 28'. The body of the peristaltic pump shall be housed in a separate pocket of the sampler's molded frame. The pump shall be constructed of high strength Noryl plastic and designed for corrosion resistance. Before and after each sample is collected, the pump shall air-purge the suction line. Pre-purges and post-purges shall be automatically controlled, and no pre-calibration adjustments are required. The sample stream shall be a direct path from sample source to sample bottle. Samples shall not pass through metering chambers or other diversions. The pump shall include a latched cover and thumbscrew opening for the replacement of pump tubing. The pump shall include a built-in magnetic safety interlock. With the opening of the pump's latch and band, all power shall be removed from the sampler's pump motor to eliminate the possibility of a pump activation injuring personnel.

2. Sampler: The sampler shall typically deliver sample volumes with an accuracy of ±10 ml or ±10%, whichever is greater, of the programmed value. The sample volume repeatability shall be ±5 ml or ±5%, whichever is greater, of the average of the maximum and minimum sample volume in the sample set. The user can select sample volumes from 10 to 9,990 ml

in 1 ml increments. Additionally, the sampler shall be capable of being programmed to rinse the suction line with the source liquid up to three times.

3. Liquid Detector: The sampler shall utilize a non-wetted, non-conductive detector to sense the presence of the liquid. The sensor shall not be dependent on, or affected by, any chemical or physical property of the liquid or its contents. The sensor shall not require routine maintenance or cleaning. The liquid detection system shall minimize the effects of changing head, intermittent flow in the suction line or variable battery conditions on sample volume. After initial detection of liquid, the sensor shall monitor for the presence of liquid during the sample collection sequence. The liquid detector also monitors for anomalies in the sample collection process. If no liquid is detected, the sampler shall be capable of retrying the sampling sequence up to three times.

4. Pump Revolution Counter: After liquid detection, the pump revolution counter shall count actual pump revolutions to determine sample volume delivery to the storage containers. If liquid flow is interrupted during the sample collection sequence, the detector shall inhibit the pump revolution counter from incrementing until liquid flow is restored. Automatic compensations for air slugs in the sample shall be made by the delivery system. Additionally, the pump revolution counter shall monitor the total number of pump revolutions and alert the user when a pre-selected number of counts has been reached. This tubing life indicator shall alert the user to the need for pump tubing replacement. This indicator shall be on the sampler's display screen. The pump tubing used shall be specially treated to minimize water extractable pollutants. Specially designed bands shall indicate the correct placement of the tubing inside the pump. The tubing shall typically last for a minimum of 1,000,000 pump counts. One pump revolution is equivalent to 12 pump counts.

5. Distributor: The distributor shall be housed in a separate pocket of the refrigerator's molded frame. Sample distribution shall be belt-driven by a stepper motor. An optical sensor shall be used for positive location of the distributor arm. A single adjustable distributor arm shall be used for all bottle configurations and sampler mounting possibilities. The distributor arm may be moved by hand for ease of sample recovery and will relocate itself before the next sample is taken.

6. Suction Lines and Strainers: Each sampler shall require 25' suction line and strainer. The suction line shall be made of ⅜" (.95 cm) ID vinyl. The suction line shall have a factory-installed standard ⅜" weighted polypropylene strainer.

7. Sample Collection Containers: Each sampler shall be supplied with sample collection containers. The containers shall be two (2) round 10L polyethylene containers with caps.

8. Service: The sampler supplier shall provide equipment startup and training in accordance with the contract documents.

11.12 Float Switch: Two (2) float switches to be installed as high level cut off in each aerobic digester basin shall be provided.

11.13 Totalizing-Indicating-Recorder: Contractor shall provide two (2) microprocessor based circular chart recorders shall be capable of indicating, totalizing and recording (Return Sludge, Waste Sludge, and Effluent Flow). The pen mechanism has a linear motion marking on a 10" uniform chart.

A. The unit must be fully programmable with a built-in keypad mounted on the chart plate. Rate and totals shall be in engineering units and be displayed on a two line LCD display. The unit shall have the capabilities for contact integration, alarm set points, linearization, summation and 4-20 maDC retransmission.

B. The transmitter shall be mounted in the recorder housing. The recorder shall be enclosed in a NEMA-12 housing suitable for wall mounting.

11.14 Payment: No separate payment will be made for the work of this Section. The cost of the work and all costs incidental thereto, shall be included in the amount bid in the Proposal for the item to which the work pertains.

SECTION 12
ELECTRICAL

12.01 General:

A. Work Included:

1. This section covers the complete interior and exterior electrical system for all work shown on the Drawings as specified herein providing all material, labor and equipment required for the installation of the electrical systems complete and in operating condition.

2. Contractor shall include in the electrical work all the necessary supervision and the issuing of all coordinating information to any other trades who are supplying work to accommodate the electrical installations.

3. All electrical work must be coordinated with the utility company, Owner's representatives, Contractor and electrical subcontractor to minimize delays, outages, work area conflicts, etc. Coordination shall be done at no additional cost to the Owner.

B. Drawings:

1. The Drawings for electrical work utilize symbols and schematic diagrams that have no dimensional significance. The work shall therefore be installed to fulfill the diagrammatic intent expressed on the electrical drawings.

2. Review drawings for door swings, cabinets, counters, moldings and built-in equipment, conditions indicated on Drawings shall govern. Prior to rough-in of receptacles and systems' outlets, refer to casework drawings for rough-in coordination.

3. Coordinate electrical work with the details, floor plans, elevations, structural and mechanical drawings. Provide fittings, junction boxes and accessories to meet conditions.

4. Do not scale Drawings. Dimensions for layout of equipment, or spaces shall be obtained from structural or mechanical drawings unless specifically indicated on the electrical drawings.

5. Discrepancies shown on different drawings, between Drawings and Specifications or between Drawings and field conditions shall be promptly brought to the attention of the Engineer.

6. Provide as used on the Drawings and in the Specifications shall mean furnish, install, connect, adjust and test.

7. The Drawings and Specifications are complimentary and any work or material shown in one and omitted in the other, or described in the one and not shown in the other, or which may be implied by both or either, shall be furnished as though shown on both, in order to give a complete and first class installation.

C. Site Investigation: Potential Contractors shall visit the project site prior to bid date to satisfy themselves as to the existing conditions and distances that may affect the cost of the project. Where work under this project requires extension, relocation, reconnecting or modifications to existing equipment or systems, the existing equipment or systems shall be restored to their original condition with the exception of the work under this Contract before the completion of this project.

D. Shop Drawings:

1. Submit for approval by the Engineer all materials and equipment to be incorporated in the electrical work.

2. Submit only shop drawings that comply with the contract documents. Shop drawings shall be checked and corrected by the Contractor before they are submitted to the Engineer. Shop drawings that are not corrected by the Contractor shall be returned for correction without detailed notations by the Engineer as to the necessary corrections.

3. Mark each individual submittal item to show Specification section that pertains to the item.

4. Submit information as required under SUBMITTALS, for each of the individual electrical sections of the Specifications.

5. Data submitted shall contain all information required to indicate compliance with equipment specified.

6. Submit field information drawings to explain fully all procedures involved in erecting, mounting and connecting all items of equipment that differ from that specified.

7. The Engineer's approval of any shop drawing submittals does not release the Contractor from responsibility for deviations from Contract Documents. See General Conditions for details.

E. Record Drawings:

1. One complete set of electrical drawings shall be reserved for as-built drawings. Any approved deviation from the contract drawings shall be recorded on these drawings. Drawings shall be checked monthly for completeness.

2. Completed as-built drawings shall be presented to the Engineer prior to final inspection.

F. Maintenance and Operating Instructions:

1. Contractor shall provide at the time of final inspection 6 sets of maintenance and operating instruction for:

   a. Switch Gear

   b. Automatic Transfer Covered Schematic

   c. Motor Control Center

d. Lighting and Power Panelboards

e. Fuses

f. Floor Boxes

g. Wiring Devices

h. Lighting Fixtures and Lamps

i. Disconnect Switches

j. Transformers

k. Photo Control and Contactors

l. Engine Generator

m. Surge Protection System

2. Contractor shall furnish a qualified and accredited factory trained technician to train personnel designated by the Owner in the proper operation and maintenance of specialized equipment.

3. The issuing of operating instructions shall include the submission of the name, address and telephone number of the manufacturer's representative and service company for each item of equipment so that service and spare parts can be readily obtained.

G. Codes and Permits:

1. All electrical work shall meet or exceed the latest requirements of the following codes and/or other authorities exercising jurisdiction over the electrical construction work and the project.

a. The National Electrical Code (NFPA 70) - 2011 Edition

b. The National Electrical Safety Code (ANSI C-2)

c. The Life Safety Code (NFPA 101) - 2012 Edition

d. The Standard Building Code - Latest Edition

e. Regulations of the local utility company with respect to metering and service entrance

f. Municipal and State ordinances governing electrical work

2. All required permits and inspection certificates shall be obtained and made available at the completion of the work. Permits, inspections and certification fees shall be paid for as a part of the electrical work.

H. Deviations:

1. No deviations from the plans and specifications shall be made without the full knowledge and consent of the Engineer or his authorized representative.

2. Should the Contractor find at any time during progress of the work that, in his judgment, existing conditions make desirable a modification in requirements covering any particular item or items, he shall report such items promptly to the Engineer for his decision and instruction.

I. Cooperation:

1. This Contractor shall schedule his work and in every way possible cooperate with all other Contractors on the job to avoid delays, interferences, and unnecessary work. He shall notify them of all openings, hangers, excavations, etc., so that proper provisions shall be made for his work. This shall not relieve him of the cost of cutting when such is required.

2. This Contractor shall do all cutting and excavating necessary for the complete installation of his work, but he shall not cut the work of any other Contractor without first consulting the Engineer. He shall repair any work damaged by him or his workmen, employing the services of the Contractor whose work is damaged.

3. This Contractor shall by all means coordinate the location of ceiling lighting fixtures, both recessed and surface mounted, with the ceiling Contractor so that proper hangers and supports shall be provided.

4. Any conflict between electrical and other trades shall be reported before construction starts. No extra charges will be approved for work resulting from failure to coordinate with other trades.

J. Installation:

1. Raceways, fixtures, devices and other electrical equipment shall be installed in a neat and workmanlike manner and in accordance with recognized good practice for a first class installation.

2. The Engineer or his representative shall have the authority to reject any workmanship not complying with the contract documents.

3. The electrical contractor shall personally or through an authorized licensed and competent electrician, constantly supervise the work from beginning to complete and final inspection.

4. Electrical equipment shall be installed in accordance with manufacturer's recommendations.

5. Locations of proposed raceway, riser, location of structural elements, location and size of chases method and type of construction of floors, walls, partitions, etc., shall be verified before construction starts.

6. Consult Owner and utility companies for underground lines before any underground work is started. Contractors shall be responsible for any damage.

K. Adjusting and Cleaning: Contractor shall:

1. Clean and lamp all lighting fixtures after installation and wiring
2. Install all fuses. All lighting fixtures shall be clean at time of final acceptance.
3. Provide all wiring for testing and trials, for all required corrections, changes, additions, completions and adjustments until final acceptance of the work
4. Coordinate numbers and label all field wiring between equipment of the various electrical equipment suppliers
5. ANY DAMAGE TO WORK ALREADY IN PLACE AS A RESULT OF ELECTRICAL WORK SHALL BE REPAIRED AND MADE GOOD AT NO EXPENSE TO THE OWNER.

L. Testing and Acceptance: Prior to acceptance by the Owner, all control systems shall function as required; all motors shall be connected to protective devices and control devices associated with a machine or a group of machines to produce the correct operating, timing and sequencing necessary for the proper functioning of the mechanical equipment.

M. Excavation, Trenching and Backfilling:

1. General: The Contractor shall perform all excavation to install conduit structures and equipment specified in this Section of the Specifications. During excavation, materials for backfilling shall be piled back from the banks of the trench to avoid over-loading and to prevent slides and cave-ins. All excavated materials not to be used for backfill shall be removed and disposed of by the Contractor. Grading shall be done to prevent surface water from flowing into trenches and other excavations and water accumulating therein shall be removed by pumping. All excavations shall be made by open cut. No tunneling shall be done. All requirements of OSHA shall be complied with.
2. Trench Excavation: The bottom of the trenches shall be graded to provide uniform bearing and support for each section of the conduit on undisturbed soil at every point along its entire length. Over depths shall be backfilled with loose, granular, moist earth, tamped. Removed unstable soil that is not capable of supporting the conduit and replace with specified material.
3. Backfilling: The trenches shall not be backfilled until it is reviewed by the Engineer or his representative. The trenches shall be backfilled with the excavated materials approved for backfilling, consisting of earth, loam, sandy clay and gravel, or soft shale, free from large clods of earth or stones, deposited in 6" layers and tamped until the conduit has a cover of not less than the adjacent existing ground but not greater than 2" above existing ground. The backfilling shall be carried on simultaneously on both sides of the trench so that conduit is not displaced. The compaction

of the filled trench shall be at least equal to that of the surrounding undisturbed material, except that trenches occurring under paved areas or in areas to be filled shall be backfilled in 6" maximum layers and each layer compacted to 95% maximum density. Settling the backfill with water will not be permitted. Any trenches not meeting compaction requirements or where settlement occurs shall have backfill removed down to the top of the conduit then backfill with approved materials as specified hereinbefore.

4. Positively no tree roots are to be damaged; hand dig where required. Damaged trees or shrubbery shall be replaced in kind and must be approved by Engineer.

N. Materials:

1. Materials specified by manufacturer's name shall be used unless approval of other manufacturers are listed in addenda to these Specifications.

2. Drawings indicating proposed layout of space, all equipment to be installed therein and clearance between equipment shall be submitted, where substitution of materials alter space requirements on the Drawings.

3. Material Standards: All materials shall be new and shall conform to the standards where such have been established for the particular material in question. Publications and standards of the organization listed below are applicable to materials specified herein.

   a. American Society for Testing and Materials (ASTM)

   b. Underwriter's Laboratories, Inc. (UL)

   c. National Electrical Manufacturer Association (NEMA)

   d. Insulated Cable Engineers Association (ICEA)

   e. Institute of Electrical and Electronic Engineers (IEEE)

   f. National Fire Protection Association (NFPA)

   g. American National Standards Institute (ANSI)

4. Material of the same type shall be the product of one manufacturer.

5. Materials not readily available from local sources shall be ordered immediately upon approval.

6. The Engineer shall have authority to reject any materials, or equipment not complying with these Specifications and have the Contractor replace materials so rejected immediately upon notification of rejection.

7. Any material or equipment, so rejected, shall be removed from the job within 24 hours of such rejection. Otherwise the Engineer may have same removed at the Contractor's expense.

O. Equipment Connections:

1. All equipment requiring electrical power connections shall be connected under this Section of these Specifications.

2. Where electrical connections to equipment require specific locations, such locations shall be obtained from shop drawings and mechanical trades involved.

3. Drawings for location of conduit stub-up boxes mounted in wall or floor to serve specific equipment, shall not be scaled.

4. Electrical circuits to equipment furnished under other sections of these specifications are based on design loads. If actual equipment furnished has loads other than design loads electrical circuits and protective devices shall be revised to be compatible with equipment furnished at no additional cost to the Owner. Any revisions must have prior approval by the Engineer. Before submitting shop drawings, electrical subcontractor shall, along with the Contractor, review voltage and load requirements for mechanical and plumbing equipment to determine the compatibility between what is being furnished and what is shown in the Contract Drawings. The electrical subcontractor shall along with his submittals submit a statement that he has reviewed all shop drawings including review with the Contractor and any other appropriate subcontractors.

5. Where equipment is indicated to be served through conduit stub-up, conduit shall be stubbed up not less than 4" above floor where transition shall be made to sealtite flexible conduit for connection to equipment. Flexible conduit shall be secured in a neat and workman like manner.

6. The Contractor's attention is called to other sections of these Specifications, where equipment requiring electrical service or electrically related work is specified to become fully aware of the scope of work required for electrical service or related work. Electrically operated valves, particle counters, transmitters and receivers, filter consoles, and pump control panel are furnished under other sections of these Specifications. Specifications, wiring diagrams and descriptive information provided for the system shall be consulted to determine location, conductor type and number, method of conductor termination and flexible connection to the device.

7. Where electricity utilizing equipment is supplied separate from the electrical work and is energized, controlled or otherwise made operative by electrical work, the testing to provide the proper functional performance of such wiring systems shall be conducted by the trade responsible for the equipment. The electrical work shall, however, include cooperation in such testing and the making available of any necessary testing or adjustments to the electrical equipment.

8. Heating, air conditioning and ventilating equipment is specified to be furnished and installed under other sections of these Specifications. The

controls likewise are specified to be furnished thereunder. All necessary wiring, wiring troughs and circuit breakers for power for this equipment shall be furnished and installed under this section of the Specifications, in accordance with the plans and/or diagrams furnished with the equipment, or shown on the Drawings. Starters furnished by the mechanical contractor shall be installed under this division of the Specifications. Power wiring to auxiliary equipment on a piece of equipment remote from its main terminal box and interlocking of apparatus shall be accomplished under HVAC equipment section of the Specifications. Conduit and outlets for control wiring shall be furnished and installed under HVAC section of these Specifications. Control conductors for mechanical equipment shall not be installed in same conduit with power conductors.

9. Contractor is to note that location of disconnect switches shown are schematic in nature. Exact location of disconnect switch and mounting height shall be coordinated with field conditions and equipment shop drawings. Locate disconnect as required to maintain clearances required by National Electrical Code.

P. Product Delivery, Storage, Handling and Protection:

1. Inspect materials upon arrival at project and verify conformance to Specifications and Drawings. Prevent unloading of unsatisfactory material. Handle materials in accordance with manufacturer's applicable standards and suppliers recommendations, and in a manner to prevent damage to materials. Store packaged materials in original undamaged condition with manufacturer's labels and seals intact. Containers which are broken, opened, damaged or watermarked are unacceptable and shall be removed from the premises and replaced.

2. All material, except items specifically designed to be installed outdoors such as pad mounted transformers or stand-by generators, shall be stored in an enclosed, dry building or trailer. Areas for general storage shall be provided by the Contractor. Provide temperature and/or humidity control where applicable. No material for interior installation, including conductors, shall be stored other than in an enclosed weather tight structure. Equipment stored other than as specified above shall be removed from the premises and replaced.

3. Equipment and materials shall not be installed until such time as the environmental conditions of the job site are suitable to protect the equipment or materials. Conditions shall be those for which the equipment or materials are designed to be installed. Equipment and materials shall be protected from water, direct sunlight, cold or heat. Equipment or materials damaged or which are subjected to these elements are unacceptable and shall be removed from the premises and replaced.

Q. Cleaning and Painting:

1. Remove oil, dirt, grease and foreign materials from all raceways, fittings,

boxes, panel board trims and cabinets to provide a clean surface for painting. Touch-up scratched or marred surfaces of lighting fixtures, panel board and cabinet trims, motor control center, switchboard or equipment enclosures with paint furnished by the equipment manufacturers specifically for that purpose.

2. Do not paint trim covers for flush mounted panel boards, telephone cabinets, pull boxes, junction boxes and control cabinet unless required by the Engineer. Remove trim covers before painting. Under no conditions shall locks, latches or exposed trim clamps be painted.

3. Unless indicated on the Drawings or specified herein to the contrary, all painting shall be done under the PAINTING section of these Specifications.

4. Where plywood backboards are used to mount equipment provided under Division 16, paint backboards with two coats of light gray semi-gloss paint. Plywood shall be ¾" fire rated plywood. Paint shall be fire retardant paint.

R. Guarantee:

1. Defective lamps shall be replaced up to the date of acceptance and shall be guaranteed for one year.

2. All systems and component parts shall be guaranteed for one year from the date of final acceptance of the complete project. Defects found during this period shall be promptly corrected at no additional cost to the Owner.

S. Service: Contractor shall contact Utility Company and verify voltage, location and type of service. Prior to rough-in, coordinate an on-site meeting with each utility company to review exact requirements. Submit letter of coordination to Engineer for review.

T. Scheduling of Outages:

1. Electrical work requiring interruption of electrical power that would adversely affect the normal operation of the other portions of the Owner's property shall be done at time other than normal working hours. Normal working hours shall be considered 8:00 a.m. until 5:00 p.m., Monday through Friday.

2. Schedule all work requiring interruption of electrical power two weeks prior to actual shutdown. Submit schedule in writing to Engineer indicating extent of system to be de-energized, date and time when power is intended to be interrupted, and date and time power will be restored. Schedule shall be subject to the review of the Engineer and the Owner.

12.02 Switchboard: The Contractor shall furnish and install, where indicated, a free-standing, dead-front type low voltage distribution switchboard, utilizing group mounted circuit protective devices as specified herein, and as shown on the Drawings.

A. Ratings:

1. The assembly shall be rated to withstand mechanical forces exerted during short-circuit conditions when connected directly to a power source having available fault current as shown on the Drawings.

2. Voltage rating to be as indicated on the Drawings.

B. Construction:

1. Switchboard shall consist of the required number of vertical sections bolted together to form a rigid assembly. The sides and rear shall be covered with removable bolt-on covers. All edges of front covers or hinged front panels shall be formed. Provide adequate ventilation within the enclosure.

2. All sections of the switchboard shall be front and rear aligned with depth as shown on the Drawings. All protective devices shall be group mounted. Devices shall be front removable and load connections front accessible enabling switchboard to be mounted against a wall.

3. The assembly shall be provided with adequate lifting means.

4. The switchboard shall be equal to Eaton type Pow-R-Line C utilizing the components herein specified and as shown on the Drawings.

5. The switchboard shall be suitable for use as service entrance equipment and be labeled in accordance with UL requirements.

C. Bus:

1. All bus bars shall be silver-plated copper. Main horizontal bus bars shall be mounted with all three phases arranged in the same vertical plane. Bus sizing shall be based on NEMA standard temperature rise criteria of 65°C over a 40°C ambient (outside the enclosure).

2. Provide a full capacity neutral bus where a neutral bus is indicated on the Drawings.

3. A copper ground bus (minimum ¼" x 2") shall be furnished firmly secured to each vertical section structure and shall extend the entire length of the switchboard.

4. All hardware used on conductors shall be high-tensile strength and zinc-plated. All bus joints shall be provided with conical spring-type washers.

D. Wiring / Terminations:

1. Small wiring, necessary fuse blocks and terminal blocks within the switchboard shall be furnished as required. Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's wiring diagrams.

2. Mechanical-type terminals shall be provided for all line and load terminations suitable for copper or aluminum cable rated for 75°C of the size as indicated on the Drawings.

3. Lugs shall be provided in the incoming line section for connection of the main grounding conductor. Additional lugs for connection of other grounding conductors shall be provided as indicated on the Drawings.

4. All control wire shall be type SIS, bundled and secured with nylon ties. Insulated locking spade terminals shall be provided for all control connections, except where saddle type terminals are provided integral to a device. All current transformer secondary leads shall first be connected to conveniently accessible short-circuit terminal blocks before connecting to any other device. All groups of control wires leaving the switchboard shall be provided with terminal blocks with suitable numbering strips. Provide wire markers at each end of all control wiring.

E. Main Protective Devices:

1. Protective devices shall be fixed switchboard class insulated case low-voltage power circuit breakers, Eaton type Magnum SB or approved equal. Breaker shall be UL listed for application in its intended enclosures for 100% of its continuous ampere rating.

2. Breaker shall be manually operated as indicated on the Drawings.

3. All insulated case circuit breakers shall have a minimum symmetrical interrupting capacity of 65,000 amperes. To ensure a selective system, all circuit breakers shall have 30-cycle short-time withstand ratings equal to 18 times their frame ratings. Insulated case circuit breakers without an instantaneous trip element adjustment shall be equipped with a fixed internal instantaneous override set at that level.

4. All insulated case circuit breakers shall be constructed and tested in accordance with UL 1066. The circuit breakers shall carry a UL label.

5. Provide all trip units 1200A frame and higher with arc flash reduction maintenance switch accessory. The arc flash reduction maintenance switch shall allow the operator to enable a maintenance mode with a preset accelerated instantaneous override trip to reduce arc flash energy.

6. The breaker control interface shall have color-coded visual indicators to indicate contact open or closed positions as well as mechanism charged and discharged positions. Manual control pushbuttons on the breaker face shall be provided for opening and closing the breaker. The power circuit breaker shall have a "Positive On" feature. The breaker flag will read "Closed" if the contacts are welded and the breaker is attempted to be tripped or opened.

F. Insulated Case Breaker Trip Units:

1. Each low-voltage power circuit breaker and insulated case circuit breaker shall be equipped with a solid-state tripping system consisting of three

current sensors, microprocessor-based trip device and flux-transfer shunt trip. Current sensors shall provide operation and signal function. The trip unit shall use microprocessor-based technology to provide the basic adjustable time-current protection functions. True rms sensing circuit protection shall be achieved by analyzing the secondary current signals received from the circuit breaker current sensors and initiating trip signals to the circuit breaker trip actuators when predetermined trip levels and time delay settings are reached. Interchangeable current sensors with their associated rating plug shall establish the continuous trip rating of each circuit breaker. The trip unit shall be equal to Eaton type Digitrip RMS 520MC.

2. The trip unit shall have an information system that provides LEDs to indicate mode of trip following an automatic trip operation. The indication of the mode of trip shall be retained after an automatic trip. A reset button shall be provided to turn off the LED indication after an automatic trip.

3. The trip unit shall be provided with a display panel, including a representation of the time/current curve that will indicate the protection functions. The unit shall be continuously self-checking and provide a visual indication that the internal circuitry is being monitored and is fully operational.

4. The trip unit shall be provided with a making-current release circuit. The circuit shall be armed for approximately two cycles after breaker closing and shall operate for all peak fault levels above 25 times the ampere value of the rating plug.

5. Trip unit shall have selectable thermal memory for enhanced circuit protection.

6. Protective device coordination shall be provided by the addition of the following individually adjustable time/current curve shaping solid-state elements:

   a. All circuit breakers shall have adjustments for long delay pickup and time.

   b. All circuit breakers shall have individual adjustments for short delay pickup and time, and include I^2t settings.

   c. All circuit breakers shall have an adjustable instantaneous pickup.

   d. All circuit breakers shall have individually adjustable ground fault current pickup and time, and include I^2t settings or ground alarm only.

7. The trip unit shall have provisions for a single test kit to test each of the trip functions.

8. The trip unit shall have an information system that utilizes battery backup LEDs to indicate mode of trip following an automatic trip operation. The

indication of the mode of trip shall be retained after an automatic trip operation. The indication of the mode of trip shall be retained after an automatic trip. A test pushbutton shall energize a LED to indicate the battery status.

9. The trip unit shall have a 4-character LCD display showing phase, neutral, and ground current. The accuracy of these readings shall be +/- 2% of full scale.

10. The trip unit shall be provided with an arcflash reduction maintenance System technology capability for compliance with NEC Article 240.87. The maintenance system shall allow the operator to enable a maintenance mode using a 5 position switch which enables a preset accelerated instantaneous override trip to reduce arc flash energy. A blue LED on the trip unit shall indicate the trip unit is in the maintenance mode.

G. Feeder Protection Devices:

1. Protective devices shall be group-mounted molded case circuit breakers with inverse time and instantaneous tripping characteristics and shall be Eaton or approved equal.

2. Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip-free. Automatic tripping of the breaker shall be clearly indicated by the handle position. Contacts shall be nonwelding silver alloy and arc extinction shall be accomplished by means of DE-ION arc chutes. A push-to-trip button on the front of the circuit breaker shall provide a local manual means to exercise the trip mechanism.

3. Circuit breakers shall have a minimum symmetrical interrupting capacity as indicated on the Drawings.

4. Circuit breakers 600-ampere frame and below shall have thermal-magnetic trip units and inverse time-current characteristics.

5. Circuit breakers 800-ampere through 1,200-ampere frame shall have microprocessor-based rms sensing trip units.

6. Ground fault protection shall be provided where indicated.

7. Where indicated provide UL listed circuit breakers for applications at 100% of their continuous ampere rating in their intended enclosure.

H. Molded Case Breaker Electronic Trip Units:

1. Each molded case circuit breaker microprocessor-based tripping system shall consist of three (3) current sensors, a trip unit and a flux-transfer shunt trip. The trip unit shall use microprocessor-based technology to provide the adjustable time-current protection functions. True rms sensing circuit protection shall be achieved by analyzing the secondary current signals received from the circuit breaker current sensors, and initiating trip signals to the circuit breaker trip actuators when predetermined trip levels

and time-delay settings are reached. The trip unit shall be equal to Eaton type Digitrip 310+ or approved equal.

2. An adjustable trip setting dial mounted on the front of the trip unit, or interchangeable ratings plugs shall establish the continuous trip ratings of each circuit breaker. Rating plugs shall be fixed or adjustable as indicated. Rating plugs shall be interlocked, so they are not interchangeable between frames, and interlocked such that a breaker cannot be closed and latched with the rating plug removed.

3. System coordination shall be provided by the following microprocessor-based time-current curve shaping adjustments:

   a. Adjustable long-time setting (set by adjusting the trip setting dial or rating plug)

   b. Adjustable short-time setting and delay with selective curve shaping

   c. Adjustable instantaneous setting

   d. Adjustable ground fault setting and delay where shone on the Drawings

4. The microprocessor-based trip unit shall have both powered and unpowered thermal memory to provide protection against cumulative overheating should a number of overload conditions occur in quick succession

5. When the adjustable instantaneous setting is omitted, the trip unit shall be provided with an instantaneous override.

6. Where internal ground fault protection is specified, adjustable settings shall not exceed 1,200 amperes. Provide neutral ground fault sensor for four-wire loads.

7. Breakers shall have built-in test points for testing the long-time delay, instantaneous, and ground fault functions of the breaker by means of a test set

8. Trip units for breakers 1200A frame and greater shall be equipped with arcflash reduction maintenance system technology capability to meet NEC Article 240.87. The maintenance system shall allow the operator to enable a maintenance mode which enables a preset accelerated instantaneous override trip to reduce arc flash energy. A blue LED on the trip unit shall indicate the trip unit is in the maintenance mode.

I. Accessories: Provide shunt trips, bell alarms and auxiliary switches as shown on the Drawings

J. Miscellaneous Devices:

1. Key interlocks shall be provided as indicated on the Drawings.

2. Control power transformers with primary and secondary protection shall be provided, as indicated on the Drawings, or as required for proper operation of the equipment.

K. Customer Metering:

1. Where indicated on the Drawings, provide a separate customer metering compartment with a front facing hinged door and include the following:

2. Current Transformers for Each Meter: Current transformers shall be wired to shorting-type terminal blocks.

3. Microprocessor-based metering system shall be equal to Eaton Power Xpert 2260 meter with Modbus TCP communications and embedded web server.

L. Enclosures: NEMA 1 Enclosure

M. Nameplates:

1. Engraved nameplates, mounted on the face of the assembly, shall be furnished for all main and feeder circuits as indicated on the Drawings. Nameplates shall be laminated plastic, black characters on white background. Characters shall be 3/16" high, minimum. Nameplates shall give item designation and circuit number as well as frame ampere size and appropriate trip rating. Furnish master nameplate giving switchboard designation, voltage ampere rating, short-circuit rating, manufacturer's name, general order number and item number.

2. Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's wiring diagrams.

N. Finish: All exterior and interior steel surfaces of the switchboard shall be properly cleaned and provided with a rust-inhibiting phosphatized coating. Color and finish of the switchboard shall be ANSI 61 light gray.

O. Installation:

1. The Contractors shall install all equipment per the manufacturer's instructions, Drawings and National Electrical Code.

2. The assembly shall be provided with adequate lifting means and shall be capable of being moved into installation position and bolted. All necessary hardware to secure the assembly in place shall be provided by the Contractor.

P. Field Adjustments:

1. The Contractor shall perform field adjustments of the protective devices as required to place the equipment in final operating condition. The settings shall be in accordance with the approved short-circuit study, protective device evaluation study and protective device coordination study.

2. Necessary field settings of devices, adjustments and minor modifications to equipment to accomplish conformance with an approved short circuit and protective device coordination study shall be carried out by the Contractor at no additional cost to the Owner.

12.03 Motor Control Centers:

A. Description: Shall be dead front, free standing assemblies consisting of enclosure, bussing, combination starters, circuit breakers, switches and other such items as may be shown or specified herein.

B. Quality Assurance:

1. The motor control center design shall be in accordance with the latest applicable standards of NEMA and Underwriters Laboratories.

2. The motor control center design shall have been tested in a recognized high power laboratory to prove adequate mechanical and electrical capabilities.

C. Manufacturers: The following manufacturers meeting these Specifications are acceptable: ABB, Rockwell Automation, Cutler Hammer, G.E., Siemens, Square "D" Company, or equal.

D. Submittals:

1. Shop drawings shall show separate views of the elevation, profile and conduit openings. The elevation shall show the section, identification and the unit identification. The Drawings shall give dimensions of size and location of the following:

a. Vertical section height, width and depth

b. Mounting channels

c. Conduit openings top and bottom

d. Wireway openings in sides

e. Horizontal bus

f. Ground Bus

2. The Drawings shall contain a summary of the design Specifications containing but not limited to the following:

a. NEMA type enclosure and class of wiring

b. Rated bus voltage

c. Current ratings for horizontal bus, vertical busses and ground bus

d. Bus material and plating

e. Bus bracing and short circuit rating

3. The Drawings shall contain a listing of each unit containing but not limited to the following:

a. Unit location

b. Nameplate

c. Major contents of unit (fuse starter, C.B. switch, M.C.P) complete with NEMA size and heater rating or current rating

d. Size of load served (H.P. KVA, KW)

4. Shop drawings shall be complete and shall clearly list all accessories. The control contractor shall review and approve all accessories required for control wiring prior to submittal.

E. Enclosures:

1. Each section shall be 90" high and not less than 20" wide and 15" deep.

2. Each section shall contain 12 to 13 space factors and shall accept a maximum of 6 front mounted unit starters per side.

3. Each section shall be physically independent free standing completely separated from adjacent section except for wireways and busses. End section shall have removable plates and wireways and busses for future additions.

4. A vertical wireway with a minimum of 19 square inches of cross sectional area shall be adjacent to each vertical wireway and shall contain steel rod cable supports with plastic cable ties. All wireway hardware to be captive.

5. Each section shall have a minimum of 6" vertical conduit and wiring space at the bottom.

6. Each section shall contain a horizontal wireway at the top isolated from the horizontal bus and shall be readily accessible through a hinged cover.

7. Enclosure shall be furnished in baked enamel on cleaned phosphatized steel in ASA #410. Enclosure shall be NEMA 1 gasketed; unless shown NEMA 2, drip-proof, NEMA 3R, walk-in, or NEMA 12 on plans

F. Bus:

1. Each section shall contain a horizontal bus located at center or near the top of the control center which has been tested for the capacity as shown. Bus shall be sized as shown on Drawings but in no case shall main bus have a rating less than 600 amperes based on UL requirements.

2. The horizontal bus shall be of the same size for the entire length of the control center, without reduction and shall have provisions for adding future sections as shown.

3. Vertical bus in each section shall be rated as required by equipment feed, but in no case shall it be less than 300 amperes, front mount only or 600 amperes back to back mounting, based on UL standards.

4. The vertical bus shall be completely isolated and insulated by barriers to effectively isolate the vertical busses from unit spaces except for stab

openings that accept unit bus stabs. Where space only is specified, bus stab openings shall have snap in plastic covers installed. Bus barriers shall be removable at joints, splices, etc., to allow bus maintenance.

5. A horizontal ground bus rated 25% of main bus shall be run continuous through each section for the entire length of each motor control center.

6. A neutral bus and/or neutral lugs shall be provided for all 4 wire motor control centers.

7. All buses shall be tin plated aluminum or copper. All connections between horizontal and vertical aluminum bus shall be made with bolts with spring washers.

8. All buses shall be braced as shown except no bus shall be braced as shown for less than 22,000 amperes RMS symmetrical. Where current limiters are employed in units, bus rating shall be a minimum of 42,000 amperes RMS symmetrical.

G. Units:

1. All units protected 225-amp and less shall be drawout type. Bus stabs shall be tin plated and of such design that high currents tighten their grip on the bus. Stabs shall be free-floating and self-aligning.

2. Unit shall be of modular dimensions and supported on steel pans. It shall be possible to remove and relocate pans without the use of tools. Units shall have covers mounted to the fixed enclosure. Doors shall be removable, but the door must open wide enough to allow unit equipment to be removed or replaced without removing door. Doors shall be held shut by captive hardware. Pilot devices and starter overload reset buttons shall be door mounted. Interior of units shall be painted white.

3. Units shall be furnished with NEMA Class 1, type B wiring. Terminals shall be pull-apart type for all control wiring. Terminals shall be mounted in the unit not the vertical wireway.

4. Circuit breakers, MCP or fusible switches shall be externally operated and shall be interlocked to prevent closing the circuit breaker, MCP or switch with the door open and to prevent opening the door with the breaker or switch on. It shall be possible to defeat the interlocks for maintenance or inspection. Door mounted handles that must engage the circuit breaker or switch handle while the door is being closed are not acceptable. Each unit shall have an engraved black and white bakelite nameplate riveted or glued in place.

5. Padlock facilities shall be provided to positively lock the disconnect in the off position with from 1 to 3 padlocks, with the door open or closed.

6. All breakers 1,200A and larger shall be connected to an arc flash energy reduction maintenance switch with integral status indication as required by NEC Article 240.87.

H. Starters:

1. Combination starter units shall utilize the motor circuit protector (MCP) or fusible switches as shown on the Schedule on the Drawings. The MCP shall provide adjustable magnetic protection and be provided with pin insert to stop the magnetic adjustment at 1,300% of motor full load nameplate. The MCP and starter shall have a combined fault current rating of 22,000 amps RMS Symmetrical.

2. Starters shall be electrically operated, electrically held, three pole assemblies with extinguishing characteristics and be NEMA size 1 minimum. They shall have provisions for adding a minimum of 6 normally open or normally closed electrical interlocks.

3. The overload relay assembly shall be of the solid state type. Single speed starters shall have 3 overloads, and 2 speed shall have 6 overloads.

4. Each starter shall be for 120 volt control power obtained from an integral 1 fuse control transformer. A control circuit disconnect shall be installed in the protective device of each starter unit to disconnect control power from starter when the protective device is opened. An individual control circuit fuse shall be provided for each starter.

5. Each starter shall be equipped with the following control devices: Reset button, 2 N.O. Auxiliary contacts. Reversing and two speed starters shall have 2 N.O. and 2 N.C. contacts. Additional control devices shall be furnished as shown on Drawings.

I. Circuit Breakers: All separate circuit breakers shall be thermal magnetic common trip, FA frame and larger. All circuit breakers shall have the following minimum RMS symmetrical interrupting capacity unless shown larger on Drawings.

480 Volts

100A	225A	400A	600A	800A	1,200A
25KA	25KA	30KA	35KA	35KA	35KA

J. Control Devices:

1. All pushbuttons, pilot lights, selector switches and other control devices shall be separate, standard size (full) and shape, heavy duty oil- tight units.

2. All pilot lights to be LED type with push to test

3. Each control device to be equipped with nameplates

4. All control relays shall be 600-volt minimum 10-amp rated convertible contacts.

K. Variable Frequency Drives:

1. Drive panels shall be 6 pulse type with fault withstand ratings of 65k AIC with breaker disconnect.

2. Provide input line reactors on all VFDs rated 3 horsepower or larger. The integrated DC Link reactors shall be the equivalent to 3% AC impedance.

3. Provide dv/dt output filters, load filters as indicated on the Drawings.

4. All drives shall be UL listed and meet the requirements of UL 508A.

5. Drive shall include a drive output contactor and drive bypass starter with motor overload relay. The output and bypass contactors will be mechanically and electrically interlocked to prevent operating at the same time.

6. Drive shall contain a backlit graphic liquid crystal display (LCD) and shall display 6 alphanumeric lines providing display for programming, diagnostics, I/O check, operation status and copy functions. The LCD display shall function independently of the programming mode to allow programming and monitoring of the drive simultaneously. The LCD display shall be mounted remotely on the outside of the motor control center.

7. Drives shall include MODBUS RTU, Ethernet IP communication protocols.

L. Special Requirements: Where the schedules and diagrams show deviations from these Specifications, the schedules and diagrams shall take precedence, but only for the particular feature.

M. Installation:

1. Motor control centers shall be installed on 4" thick concrete pads unless specifically shown otherwise. Pad shall extend a minimum of 2" to all sides and shall have chamfered edges.

2. Orientation of motor control centers shall be as shown on the Drawings.

3. Motor control centers shall be grounded as shown on Drawings.

4. Verify all accessories as shown on Drawings. Perform all necessary additions and modifications to make the motor control center conform to the Drawings.

N. Information Furnished to Owner:

1. Equipment brochures showing equipment type and model

2. Six (6) sets of shop drawings

3. Three (3) sets of installation instructions

4. The nearest and most convenient source of replacement parts and service

12.04 Lighting and Power Panelboards:

A. Submittals:

1. Complete panelboard shop drawings shall be submitted, listing as a minimum the following items:

a. Voltage rating

b. Bus assembly rating

c. Main breaker rating by capacity, number of poles and interrupting rating in RMS symmetrical amperes

d. Surface or flush mounting

e. Listing of branch breakers by capacity number of poles and interrupting rating in RMS symmetrical amperes

f. Top or bottom feed

g. A schedule similar to that shown on the Drawings, depicting branch breaker arrangement and breaker sizes and giving full explanation for any difference between the two

B. Manufacturers: For the purpose of selecting quality and types of panels, equipment as manufactured by: G.E., Square D, Siemens, Cutler Hammer or equal.

C. Equipment:

1. Furnish and install circuit breaker lighting and power panelboards as indicated in the panelboard schedule and where shown on the plans. Panelboards shall be of the dead front safety type, equipped with thermal magnetic molded case circuit breakers with frame and trip rating as shown in the schedule.

2. Circuit breakers shall be HACR rated, quick-make, quick-break, thermal-magnetic, trip-indicating, and have common trip on all multi-pole breakers. Trip indication shall be clearly shown by the breaker handle taking position between ON and OFF, when the breaker is tripped. Branch circuit breakers feeding convenience outlets shall have sensitive instantaneous trip setting of not more than 10 times the trip rating of the breakers. Connection to bus in all panels shall be bolted. All breakers shall be 20-ampere trip, unless otherwise shown. All breakers shall be minimum for 120/208 volts (22,000) A.I.C. sym. unless otherwise noted.

3. Bus bar connections to the branch circuit breakers shall be the distributed phase type. Three-phase, four-wire bussing shall be such that any 3 adjacent single-pole breakers are individually connected to each of the 3 different phases in such a manner that 2 or 3-pole breakers can be installed at any location. All current-carrying parts of the bus assembly shall be copper. Main ratings shall be as shown in the panelboard schedule on the Drawings.

4. Panel front shall be provided with a continuous piano hinge on one side.

5. A steel circuit directory frame permanently attached (spot welded) at factory and card with a clear plastic covering shall be provided on the inside of the door. The directory card shall provide a space at least ¼" high × 3" long for each circuit.

6. All panels shall be equipped with a copper equipment-grounding bar. The bar shall have lugs of sufficient size to handle all grounding conductors.

7. Sub-feed circuit breakers are not permitted in panels unless specifically called for.

8. Provide mounting hardware for all spaces shown on panelboard schedule.

9. Panelboard circuit numbering shall be such that starting at the top, odd numbering shall be used in sequence down the left hand side and even numbers down the right hand side.

10. Except where otherwise indicated on the Drawings or required to avoid conflicts, mount the panelboards so the tops of the cabinets will be 6' above the finished floors. For panel boards that are too high, mount them so the bottoms of the cabinets will be not less than 6" above the finished floors.

11. Locate the cabinets so that present and future conduits can be connected to them conveniently. Coordinate the dimensions of the cabinets with the dimensions of the spaces designated for installation prior to fabrication of the cabinets. Cabinet shall be minimum 20" wide.

12. Wiring in panelboards shall be neatly grouped and secured with ty-wraps.

13. Electrical panels shall not be used as wire-ways or junction boxes for control conductors.

14. Where spaces are called for in a panel, all mounting hardware shall be provided for the frame size indicated.

15. Splices in panelboards are not permitted.

12.05 Fuses:

A. Submittals: Shop drawings shall be submitted and shall consist of manufacturer's published literature and technical data sufficient for the Engineer to determine whether system function will be adversely affected, whether proposed fuses meet this Specification and whether they are equal in quality.

B. Manufacturers: Acceptable manufacturers are: Littelfuse, Bussman, Gould – Shawmut or equal.

C. Equipment/Material:

1. All fuses rated 600 volts or less and used for main, feeder, or branch circuit protection with 200,000 ampere interrupting rating and shall be so labeled. Fuse classes and sizes indicated on the Drawings have been selected to provide a fully coordinated selective protection system. To maintain this design, all fuses provided shall be furnished by the same manufacturer. Should equipment provided require a different U.L. Class or fuse size, the Engineer shall be furnished with sufficient data to ascertain that system function will not be adversely affected.

2. Current-Limiting Fuses 601 to 6,000 Amperes: Fuses rated over 600 amperes shall be U.L. Class "RK-1" fuses, and shall have a minimum time delay of 10 seconds at 500% rating.

3. Current-Limiting Fuses 600 Amperes or Less: All fuses 600 amperes and below shall be true dual-element time delay fuses with separate spring-loaded thermal overload elements in all ampere ratings. All ampere ratings shall be designed to open at 400° F or less when subjected to a non-load oven test. To eliminate induction heating, all fuse ferrules and end caps shall be non-ferrous and shall be bronze or another alloy not subject to stress cracking.

4. Spare Fuses: At the time of final acceptance, the Contractor shall furnish the Owner's representative, not less than 3 spare fuses of each size and type installed. Spare fuses at main switchgear are not required.

12.06 Raceways:

A. Submittals: Submit manufacturer's literature for each type of conduit or tubing and fittings used in the project

B. Manufacturers:

1. Acceptable manufacturers of rigid aluminum and electrical metallic tubing conduit are: Allied Tube and Conduit Co., Wheatland Tube Co., Triangle, L.T.V., American Brass, E.T.P., Robroy or equal.

2. Acceptable manufacturers of polyvinyl chloride (PVC) conduit are: Certainteed, Georgia Pipe, Carlon, Can-Tex, Queen City or equal.

3. Acceptable manufacturers of PVC coated rigid galvanized conduit and fittings are: Plasti-bond Red H_2OT or equal.

4. Acceptable manufacturers of conduit fittings, bushings, and locknuts are: O-Z/Gedney, Thomas and Belts, Raco or equal.

C. Materials:

1. All metallic conduit and electric metallic tubing shall be aluminum 6063 alloy, T1, of standard pipe dimensions, smooth inside and out, and shall be painted where exposed. Where the word "conduit" is used hereinafter it shall mean rigid aluminum conduit, 6005 alloy aluminum electric metallic tubing, flexible aluminum conduit, liquid tight flexible aluminum conduit or schedule 40 plastic conduit. Intermediate grade conduit is not acceptable. Where aluminum conduit is embedded in concrete or comes in contact with earth, it shall have supplementary corrosion protection, such as aluminum bitumastic paint or tape wraps approved for the purpose.

2. Rigid conduit shall be used in all areas where it will be exposed to physical damage. Schedule 40 plastic conduit shall be used underground and in slab-on-grade. In no case shall plastic conduit be exposed; switch to rigid aluminum conduit when turning up exposed. All other conduit,

unless otherwise specified or called for on the plans, may be aluminum electric metallic tubing. Any exposed conduit on exterior of the structures shall be painted rigid aluminum to match surface attached.

3. Plastic conduit shall be made from virgin polyvinyl chloride C-300 compound. Conduit and fittings shall carry a UL label. Fitting and cement shall be produced by the same manufacturer as the conduit to assure system integrity.

4. All conduit shall be concealed in building construction except as noted or shown otherwise. In areas with no finished ceiling and where conduit is run exposed all runs down to switches, receptacles, etc. shall when possible be concealed in wall. It is the intent of these Specifications that all conduit will be concealed whenever possible.

5. EMT fittings shall be compression or and made of aluminum for sizes 2" or smaller, steel set screw type fittings may be used on sizes 2½" or larger. Connectors and couplings shall be rain tight and shall have a nylon insulated throat. All fittings shall be "UL" approved. Die cast, and indenter type fittings are not acceptable. Fittings for flexible aluminum conduits and liquid tight flexible conduit shall be aluminum and have nylon insulated throat.

6. Rigid aluminum conduit and EMT shall be not less than ¾" trade size, schedule 40 plastic conduit shall not be less than ¾" trade size and not less than required by the NEC or indicated.

7. Conduit and EMT systems indicated on the Drawings for communication and signaling systems are for typical systems. Install conduit and EMT systems for the system being installed.

8. Connect individual recessed lighting fixtures to the conduit or EMT system with maximum 6'-0" flexible, galvanized steel conduit. Use flexible aluminum for final connection to all rotating equipment and transformers. The flexible conduits shall be long enough to permit the full range of required movements without strain and to prevent the transmission of vibration. Do not utilize flexible conduit to loop between fixtures and devices.

9. Rigid Aluminum Conduit Couplings and Connections:

   a. Install standard, conduit-threaded fittings

   b. Ream the ends of conduits after cutting and threading them

   c. For connection to cast aluminum boxes, cabinets and other metal enclosures, install locknuts on the inside and outside of the enclosure for each connection

10. EMT Couplings and Connectors:

    a. Ream the ends of EMT after cutting them

    b. Install the following threadless type fittings:

1) Connectors: aluminum compression type with insulated throat or aluminum tap-on type with insulated throat

2) Couplings: aluminum compression or tap-on type

11. Installation of Plastic Conduit:

a. Shall be installed in complete accordance with manufacturer's recommendations

b. Shall be a minimum of 2'-0" below finished grade when not covered by concrete

c. Shall have properly sized bond wire installed with all circuits

d. Bends and turns shall be kept to a bare minimum.

e. Extreme care shall be taken to avoid crushing or cracking conduit. **DO NOT** run vehicles over exposed conduit under any conditions.

f. All conduit and fittings shall be solvent welded.

g. Plastic conduit maybe turned up in masonry walls only. PVC conduit shall be allowed to be routed concealed in masonry walls to a maximum height of 48" A.F.F.

h. Plastic conduit shall not be bent with a propane torch or open flame. Contractor shall utilize a heat gun, heat blanket or hot box. Plastic conduit bent with such shall not be scorched or marred.

12. Insulated Bushings:

a. Install nylon insulated bushings on the end of all rigid conduit

b. The insulating material shall be designed for rugged, long service.

c. Bushings which consist of only insulating material will not be accepted.

d. Fittings which incorporate insulated bushings will be considered for approval in lieu of fittings with separate bushings.

13. All couplings and connections in location where water or other liquid or vapor might contact the conduit and EMT shall also be watertight.

14. Close empty conduit and EMT as complete runs before pulling in the cables and wires.

15. Install exposed conduit and EMT parallel to or at right angles with the lines of the building. Locate them so they will not obstruct headroom or walkways or cause tripping.

16. Avoid bends or offsets where practicable:

a. Do not install more bends, offsets or equivalent in any conduit or EMT run than permitted by the NEC.

b. Make bends with standard conduit bending machines.

c. Conduit hickeys may be used for making slight offsets and for straightening conduits tubbed out of concrete.

d. Conduit or EMT bent with a pipe tee or vise will not be accepted.

e. Do not install crushed or deformed conduits or EMT.

17. Install Conduit or EMT Clamps:

a. At intervals as required by the NEC

b. Above suspended ceilings, metal supports may be installed as permitted by the NEC, except that conduit cannot be supported or secured to the T-bar grid or from the wire supporting the T-bar grid

c. Trapeze, split ring, band or clevis hanger may be installed as permitted by the NEC. Trapeze hangers shall be structural metal channels, angle irons or preformed metal channel shapes with the conduit and EMT runs held on specific center by U-bolts, clips or clamps. Do not support conduit from ceiling suspension wire or from other conduit.

d. Chain, wire or perforated strap supports will not be acceptable. Nor are they acceptable as a means of securing the conduit.

e. Fasten the clamps and other supports as follows:

1) For new masonry or concrete structures, install threaded metal inserts prior to pouring the concrete.

2) For existing solid masonry or reinforced concrete structures:

- Install expansion anchors and bolts or approved power-set fasteners
- Expansion anchors and bolts shall be not less than ¼" diameter and shall extend not less than 3" into the concrete or masonry.
- Power-set fasteners shall be not less than ¼" diameter and shall extend not less than 1¼" into the concrete.

3) For hollow masonry install toggle bolts: Bolts supported only by plaster will not be accepted.

4) For metal structures, install machine screws.

5) Attachments to wood plug, rawl plug, soft metal insert or wood-blocking will not be permitted.

18. For Vertical Runs of Conduit of EMT:

a. Install supports for conduit, EMT, cables and wires at intervals as required by the NEC and as indicated on the Drawings

b. Conduit and EMT supports shall be supported by framing for the floors.

19. Conduits and EMT shall be kept 6" away from parallel runs of steam or hot water pipes.

20. Clogged raceways shall be entirely free of obstructions or shall be replaced.

21. Rigid aluminum conduit installed underground and in concrete shall be wrapped with Scotchwrap #50 corrosion protection tape or painted with bitumastic approved for the purpose.

22. All empty conduit shall have nylon pull cord installed to provide for installation of cables, conductors or wiring.

23. Do not combine conduit homeruns. Each homerun shall be separately routed directly to panel unless specifically noted otherwise.

24. Install service conduit (TV, electrical and telephone) as follows:

a. All underground entrances shall have metallic sleeves through building foundation walls and extend to undisturbed ground to avoid shear, and shall be full weight, threaded rigid aluminum conduit.

b. All 90° bends to be rigid metallic conduit, with a radius of not less than 10 times the diameter of the conduit.

c. Maintain a minimum cover of 24" below final grade for conduits.

25. Telephone conduits: Where telephone conduit runs are longer than 100' or have more than two 90° bends (or equivalent) or have a reverse bend, pull boxes shall be provided.

26. Do not install conduit in cavity between concrete block and brick. Conduit shall not be stubbed up into this cavity or routed horizontally in cavity.

12.07 Conductors:

A. Submittals: Shop drawings shall be submitted and shall consist of manufacturer's published literature.

B. Materials:

1. Ratings and Sizes:

a. Shall be not less than indicated on the Drawings and not less than required by the NEC

b. Minimum size shall be No. 12 AWG copper provided the maximum voltage drops in the control circuits will not adversely affect the operation of the controls.

c. Conductor sizes indicated on the Drawings are for copper conductors.

2. Conductors and Ground Wires:

   a. Shall be copper

   b. Size No. 8 AWG and larger shall be stranded

   c. Size No. 10 AWG and smaller shall be solid

3. Conductor Insulation: Conductor insulation shall be the NEC type THHN.

4. Wire shall be factory color coded in size No. 10 and smaller. Color shall be by integral pigmentation with a separate color for each phase, neutral and grounding conductor. Color code per phase shall be continuous throughout the project.

5. Manufacturer's name and other pertinent information shall be marked or molded clearly on the overall jacket's outside surface or incorporated on marker tapes within the cables and wires at reasonable intervals along the cables and wires.

6. Cables and wires indicated on the Drawings for communication and signaling systems are for typical systems. Install cables and wires for the system being installed.

7. All wiring shall be in conduit unless specifically noted otherwise.

8. Every coil of wire shall be in the original wrapping and shall bear the Underwriters Label of approval.

9. Where wires are left for connection to any fixture or an apparatus, spare wire or cables shall be provided at the ends for connections. Fixture connections at the outlet box shall be made with insulated wire connectors.

10. Outer jackets shall be color coded as follows:

    a. Three phase or single phase circuits, 120/208 volts:

       1) Phase A - Black

       2) Phase B - Red

       3) Phase C - Blue

       4) Neutral - White

       5) Insulated ground wire - Green

       6) Isolated ground wire - Green with Yellow tracer.

       Note: Where dedicated neutrals are used for receptacle circuits, outer jacket shall be white with appropriate colored tracer (i.e. white with red tracer, white with blue tracer, white with black tracer).

    b. Three phase or single phase circuits, 480/277 volts:

1) Phase A - Brown

2) Phase B - Orange

3) Phase C - Yellow

4) Neutral - Gray

5) Insulated ground wire - Green

c. Large power cables and wires which do not have color coded jackets: No. 8 and larger only:

1) Install bands of adhesive non-fading colored tape or slip-on bands of colored plastic tubing over the cables and wires at their originating and terminations points and at all outlets of junction boxes.

2) Color shall be permanent and shall withstand cleanings.

11. Wiring for telemetering and signal circuits shall conform to the recommendations of manufacturers of the signal system being installed, so the system shall have optimum performance and maximum service continuity. Communication and signaling circuit wiring where run in conduit below grade or in a damp location shall be listed for use in a damp or wet location.

12. No circuit wiring shall be smaller than number 12. Where the homerun exceeds 100' in length, number 10 (minimum) wire shall be used even though all such circuits are not indicated on the Drawings. All wiring for emergency branch circuits shall be number 10 (minimum) unless noted otherwise.

13. When installing THHN extra care must be exercised so as not to damage nylon jacket. When nylon jacket is damaged wiring shall be removed from service, and replaced with new conductors.

12.08 Outlets:

A. Submittals: Shop drawings shall be submitted and shall consist of manufacturer's published literature.

B. Manufacturers: Acceptable manufacturers are: Raco, Steel City, Appleton, Hubbell or equal.

C. Materials:

1. Boxes shall be galvanized pressed sheet steel for all concealed work.

2. Where conduit runs are exposed, outlet shall be of the cast metal type.

3. For concealed work each box shall be provided with a square cornered plaster ring.

4. Each surface lighting fixture, receptacle and switch shall be provided with flush mounted outlet box. All outlets installed in panels and other architectural features shall be centered. The location of any outlet may be

moved as much as 10'-0" by the Engineer before the outlet is placed without incurring any extra cost. All dimensions refer to the finished floor line. Outlet boxes shall be pressed sheet steel and shall be galvanized for all concealed work. Where conduit runs are exposed, outlets shall be of the cast metal type.

5. Boxes shall be for the service and the type of outlet and shall not be less than 4" square and 1½" deep except where otherwise specified. Boxes installed in walls shall be provided with a square cornered 1½" plaster ring installed flush with surface of wall. Coordinate depth of plaster ring required for particular wall construction. Each outlet box above ceiling shall be supported from a structural member of the building either directly or by using a substantial and approved metal support. Conduit is not an approved means of support. Boxes installed in wall shall be supported either directly to a stud or between studs utilizing an approved bar hanger. In no case shall switch box support and clips used for mounting boxes in old work be used unless specifically called for. Top of outlet box shall be level.

6. All ceiling or wall recessed outlet boxes or their associated plaster rings shall be flush with the finished surface. Using cover plate to secure wiring devices or shimming the device is not acceptable. Contractor shall exercise due care when cutting opening in walls or ceilings for outlet boxes so that opening size will permit the proper installation of boxes and devices. Fixture studs in ceilings and bracket outlets shall be bolted with stove bolts or shall be locking type of stud mounting.

7. In addition to boxes indicated, install enough boxes to prevent damage to cables and wires during pulling-in operations.

8. Remove only knockouts as required and plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.

9. There shall be no outlets installed back to back. A minimum of 4" shall separate each outlet.

10. Where the volume allowed per conductor exceeds that allowed in Table 370-6(b) of the NEC for the minimum size outlet specified, a larger size outlet box shall be used and shall be sized in accordance with the table noted above.

11. Outlet boxes shall be clean and free from dust, paint, dirt, plaster ready mix joint compound and any other debris.

12. Floor boxes shall be:

    a. Steel City 665 Series or Walker RFB-4 concealed service floor box and hinged service top, 126 cubic inch total capacity.

    b. Each box shall be equipped with 2-duplex receptacles, and provision for 2 low voltage devices. Coordinate low voltage

device brackets with low voltage systems contractor and provide brackets accordingly to coordinate with devices installed.

c. Color of service top shall be as selected by the Engineer.

d. Coordinate installation of floor covering with General Contractor.

12.09 Wiring Devices and Device Plate:

A. Submittals:

1. Submit product data under provisions of these Specifications.

2. Provide product data showing configurations, finishes, dimensions and manufacturer's instructions.

B. References:

1. FS W-C-596 - Electrical Power Connector, Plug, Receptacle and Cable Outlet

2. FS W-S-896 - Switch, Toggle

3. NEMA WD 1 - General-Purpose Wiring Devices

4. NEMA WD 5 - Specific-Purpose Wiring Devices

C. Manufacturers: For the purpose of selecting quality and type of device, equipment manufactured by Arrow Hart has been specified. The following manufacturers meeting this Specification are acceptable: Bryant, Pass and Seymour, Hubbell, Eagle, Leviton or equal.

D. Products:

1. Switches: All wall switches shall be rated 20 ampere, 120/277 volts, have self grounding provisions, side wiring only and shall be of the silent type. Color shall be gray.

a. Single pole: Arrow Hart 1221

b. Double pole single throw: Arrow Hart 1222

c. Three way: Arrow Hart 1223

d. Four way: Arrow Hart 1994

e. Key switch single pole and three-way: Arrow-Hart 1191 and 1193 with 1187 cover plate, or Pass and Seymour equal. Three way and four way key switches shall be keyed alike.

f. Single pole illuminated handle light switch lit in (on) position: Arrow Hart 1991 ILC, clear handle.

g. Despard single pole switches installed in mullions. Arrow Hart QS791.

2. Receptacle: All receptacles shall be of the grounding type, of the configuration shown on the Drawings and shall be flush wall mounting type. Color shall be gray.

a. Standard Duplex Receptacle: 20 ampere, 125 volt, NEMA type 5-20 R, 2 pole, 3 wire, straight blade, U-grounding slot, specification grade. Arrow Hart 5342

b. Isolated Grounding Duplex Receptacle: 20 ampere, 125 volt, NEMA type 5-20 R, straight blade type, 2 pole, 3 wire, U-grounding slot, specification grade. Arrow Hart IG 5362 GRY

c. Power, Receptacle with Matching Plug: 20 ampere, 125/250 volt, NEMA type 14-20, 3 pole 4 wire grounded, straight blade type. Arrow Hart 5759

d. Power Receptacle with Matching Plug: 20 ampere, 250 volt, NEMA type 6-20R 2-pole, 3 wire grounded, and straight blade type. Arrow Hart 5461 GRY

e. Power Receptacle with Matching Plug: 30 ampere, 250 volt, NEMA type 6-30R 2-pole, 3 wire, u-grounded slot, straight blade type. Arrow Hart 5700 N

f. Power Receptacle with Matching Plug: 50 ampere, 125/250 volt, NEMA type 14-50R, 3-pole, 4 wire grounded, and straight blade type. Arrow Hart 5754 N

g. Ground Fault Interrupter Receptacle: 20 ampere, 125 volts, NEMA type 5-20R, 2-pole, 3-wire with grounded U slot. Arrow Hart AHGF 5342

3. Device Plates: Plates shall be furnished for all devices and outlets indicated on the Drawings (telephone, computer, TV, etc.). All plates on masonry walls shall be oversized jumbo type.

a. Flush Mounted Plates: Beveled type with smooth rolled outer edge, stainless steel type 302 with brushed finish

b. Surface box plates, beveled, galvanized steel, pressure formed for smooth edge to fit box

c. Die Cast Weatherproof Cover. Lockable hasp vertical mounting. Intermatic #WP1010MC.

E. Installation:

1. Switches:

a. Switches shall be connected to the live side of the circuit and shall control only the outlets indicated.

b. Conductors shall be looped around the terminal screw.

c. Where more than one switch is indicated in the same location switches shall be gang mounted under a common plate.

d. Where multi-wire, 277 volt switching (480 volt potential) occurs, a barrier shall be provided between switches.

e. Center line of switches in general, shall be set 3'-6" above the floor (off position down) and shall clear the door trim or corner by 4" or center the space occupied.

f. Plans shall be consulted before placing switches so they will in every case be located on the strike side of the door and clear door, chair, window, and baseboard moldings.

g. Switches shall be screwed tight to the boxes and shall not depend on the cover plate to pull them tight.

2. Receptacles:

a. Conductors shall be looped around the terminal screws. DO NOT BACKWIRE DEVICES.

b. Receptacles shall be grounded by the green wire bond and shall be pigtailed as shown on the Drawings.

c. Receptacles shall be screwed tight to the plaster ring or outlet box and shall not depend on the device plate to pull them tight.

d. Center line of general use receptacles shall be in general, set 18" above the floor with receptacle mounted in the vertical position and with grounding pole at the top.

e. Coordinate receptacle height with Drawings and locate so that bottom of receptacle plate shall be 1" above counter or back splash and clear all moldings.

f. Center line of receptacles located adjacent to lavatories in toilets shall be set 3'-6" above floor.

g. Receptacles serving water coolers shall be located within cooler housing or as close to bottom of housing as possible. Cord serving unit shall be as short as possible. In no case shall cord or receptacle be seen from normal viewing angle.

h. All receptacles installed in bathrooms, toilets, within 4' of lavatories or sinks, or on building exterior shall be ground fault circuit interrupter type.

3. Plates:

a. Plates shall be level and all edges shall be in full contact with wall.

b. Plates shall be furnished for all devices and other outlets indicated on the Drawings.

c. Install plates on outlet boxes and junction boxes in unfinished areas above ceilings and on surface mounted outlets.

d. Plates shall not be used to keep devices secure.

e. Plates shall be clean and free from dust, plaster or paint and spots.

f. Plate shall cover openings around outlets.

12.10 Lighting Fixtures and Lamps:

A. Submittals:

1. Lighting fixture submittals shall consist of manufacturer's literature including photometric data and shall note on the submittals any special requirements that have been specified.

2. The Engineer reserves the right to require sample fixtures for approval.

3. Manufacturer's literature for all lamps

B. Manufacturers:

1. Lighting fixtures shall be selected from those fixtures included in the fixture schedule as noted on the Drawings or in the Specifications. Lighting fixtures submitted as equal to those in the Drawings without accompanying photometric data will be rejected.

2. Lamps:

a. Sylvania

b. Phillips

c. General Electric

d. E.Y.E.

C. Equipment:

1. Review plans and specifications and provide lighting fixtures compatible with ceiling suspension system specified.

2. Fixtures shall be selected from the fixture schedule not only by catalog number but with consideration to mounting, number and types of lamps, and reference notes as contained in the fixture schedule and as noted on the Drawings and in the Specifications. Manufacturers not listed on fixture schedule will not be accepted.

3. Fluorescent ballast shall be electronic type as manufactured by Motorola, Advance, General Electric, Magnetek or equal. Ballast shall have five-year warranty, total harmonic distortion of less than 20%. Where fixtures are shown with inboard/outboard lamps switched separately provide 2 ballasts per fixture. Ballast shall be instant start and parallel lamp operation.

4. Support of lighting fixtures shall be the responsibility of the fixture installer and shall be as follows:

a. Fluorescent fixture flush mounted in exposed tee, suspended acoustical tile ceilings shall be of the lay-in type and shall be supported at diagonal corners of the fixture, utilizing two (2) #14 gauge steel wires attached to the bar joist or overhead structure. Flexible conduit and wiring from outlet box to fixture shall be

minimum ⅜" C., and minimum #14 THHN conductors. Factory supplied whips of smaller ratings are not acceptable.

b. Surface mounted fluorescent fixtures shall be supported by light weight channel to 2 members of the ceiling suspension system. Two support channels are required. Surface mounted fixtures mounted on sheet rock or plaster ceilings or low density acoustical tile ceilings shall be mounted with two ¼" × ¼" × 4" metal spacers between fixture and ceiling. Spacers shall be located to provide air gap between fixture and ceiling. Do not place spacers directly over ballast.

c. Recessed incandescent, mercury vapor, high pressure sodium, and metal halide fixtures shall be installed using standard manufacturer's mounting hardware.

d. Exit lights shall be mounted directly to the outlet box and in case of ceiling mounted units the outlet box shall be flush with the ceiling and shall be supported by a 1½" channel spanning between main structural members of the suspension system. Secure channel with metal fasteners.

e. Provide 2 exit lights in addition to those shown in the event the fire department requires additional units. Turn over to the Owner any exits not used.

5. Align, mount and level the lighting fixtures uniformly.

6. Avoid interference with and provide clearance for equipment.

7. Lighting fixtures shall be located as shown on the lighting plan. If for any reason this is impossible or impractical, the Engineer shall be notified immediately for a decision as to the best direction for the shift.

8. Upon completion of installation, lighting fixtures and equipment shall be in first class operating order, in perfect condition as to finish, free from defects. At final inspection, fixtures shall be completely lamped, be complete with required diffusers, reflectors, side panels, louvers or the other components necessary to complete fixtures. All fixtures and equipment shall be clean and free from dust, insects, plaster or paint spots. Any reflectors, diffusers, side panels or other parts broken prior to final inspection shall be replaced by Contractor.

9. Lamps shall be provided for all fixtures:

   a. Incandescent lamps shall be medium base, inside frost extended service (minimum 2500 hours).

   b. 48" fluorescent lamps shall be 32 watt T8 3500° K.

   c. U-shaped lamps shall be F 32 T8 SP35.

d. Mercury vapor lamps shall be mogul base, of the wattage called for in the fixture schedule and shall be style tone as manufactured by Phillips (no substitute accepted).

e. Metal halide lamps shall be mogul base, of the wattage called for in the fixture schedule and shall be of the coated type.

f. High pressure sodium lamps shall be mogul base, of the wattage called for in the fixture schedule and shall be of the diffuse type.

g. LED modules provided by fixture manufacturer as required.

12.11 Disconnect Switches:

A. Submittals: Shop drawings shall be submitted and shall consist of manufacturer's published literature.

B. Manufacturers: Acceptable manufacturers are: Square "D" Company, G. E., Siemens, Cutler Hammer or equal.

C. Equipment:

1. Disconnect switches shall be provided for all motors and heaters located out of sight of motor controller, and where specifically indicated on the drawings. Disconnect switches shall disconnect all ungrounded conductors. When exposed to weather, enclosure shall be NEMA-3R. Switches shall be installed to be fully accessible in accordance with Article 110-26 of the National Electrical Code. Where indicated on Drawings, disconnect switches shall be NEMA 4X.

2. All disconnects shall be heavy duty type and shall be equipped with factory installed equipment ground kit bonded to the can for grounding purposes.

3. For single phase motors, a single or double pole toggle switch, rated only for alternating current, will be acceptable for capacities less than 30 amperes, provided the ampere rating of the switch is at least 125% of the motor rating. Enclosed safety switches shall be horsepower rated in conformance with Table III of Fed. Spec. W. D. 865. Switches shall disconnect all ungrounded conductors.

4. Each disconnect ground mounted serving exterior A/C units shall be equipped with a padlock (Master 3206) all keyed alike.

5. All disconnects shall be equipped with provisions to lock the handle in the OFF position.

6. All disconnects shall be fusible type, fused in accordance with the name plate data on the unit. Disconnects serving water heaters or resistance heat strips shall be fused at 125% of the full load amps of the unit.

7. Install fuses so that ampere rating can be read without having to remove fuses.

8. All fuses shall be as specified.

9. Disconnects shall be identified as specified.

10. Maintain 3'-0" clearance in front of disconnect having voltage rating of 250 volts and 4'-0" clearance in front of disconnect having voltage rating of 480 volts. Do not locate disconnect over other electrical equipment (i.e.: transformers).

12.12 Dry Type Transformers:

A. Submittals: Shop drawings shall be submitted and shall include as a minimum the following information:

1. Voltage, phase and KVA ratings
2. ANSI, NEMA and UL listings
3. Sound rating
4. Temperature rise - insulation system data
5. Taps
6. Neutral terminal sizing
7. Electrostatic shield
8. K Factor rating
9. Physical dimensions and weight

B. Manufacturers: For the purpose of selecting quality and type of transformers, equipment as manufactured by Square D Company has been specified. Where called for on Drawings, transformers shall be designed for high harmonic, non-linear loads and equal to NL/NLP Dry Type Transformers as manufactured by Square D Company. The following manufacturers meeting these Specifications shall be acceptable: General Electric, Cutler-Hammer, Siemens, Sola HD or equal.

C. Equipment:

1. Dry type transformers shall be provided where shown to provide 3 phase, 4 wire, 120/208 volt grounded wye service to specific panelboards. Primary rating shall be 480 volts. KVA ratings shall be as shown on the Drawings.

2. Transformer shall be provided with 6 full capacity taps, 2½% full capacity taps: 2 above and 4 below are standard NEMA taps for the specific KVA rating. Sound rating shall not exceed 50-db for those specified above 75 KVA. Temperature rise shall not exceed 115° C. under full load in an ambient of 40° C. Overload capacity shall not be less than 10% at rated voltage. Minimum B.I.L. shall be 10 KV. Vibration dampers shall be provided as a standard feature on all transformers.

3. Primary and secondary connections to dry type transformers shall be made with flexible galvanized steel conduit.

4. Transformers shall be located a minimum of 6" from wall.

5. Lug kits shall be provided with each transformer.

D. Installation:

1. Primary and secondary connections to dry type transformers shall be made with flexible galvanized aluminum conduit.

2. Transformers shall be located a minimum of 6" from wall.

12.13 Photo Control and Contactor:

A. Submittals: Submittal shall be manufacturers published literature.

B. Manufacturers:

1. Photo Controls: Tork, Paragon, General Electric Company, Siemens, Intermatic or equal

2. Contactors: Square "D" Company,Cutler-Hammer, ASCO, G. E., Intermatic or equal

C. Equipment:

1. Photo control shall be rated at 1,800 V.A., 90% power factor on 120 volt system. Switching mechanism shall be hermetically sealed and shall be calibrated to close circuit when illumination falls below 5' candles. Switching mechanism shall contain delay feature to prevent circuit opening in transient illumination such as headlights from passing vehicles. (Photo Control shall contain manually adjustable light level slide.) Orient photo control light sensing element north.

2. Contactor shall be electrically held, 120 or 277 volt operating coil and in NEMA 1 enclosure. The number and rating of poles shall be as noted on the drawings.

3. Time clock shall be 24-hour type with astro dial and general purpose indoor case. Time clock shall be digital type with battery backup.

12.14 Pull Boxes and Junction Boxes and Fittings:

A. Boxes shall be provided in the raceway systems wherever required for the pulling of wires and the making of connections.

B. Pull boxes of not less than the minimum size required by the National Electrical Code Article 370 shall be constructed of cast aluminum. Boxes shall be furnished with screw fastened covers. Boxes located on the exterior of the structures shall be watertight. Covers shall be secured with tamper proof screws.

C. Boxes shall be securely and rigidly fastened to the surface of which they are mounted or shall be supported from structural member of the structure either directly or by using a substantial and approved metal rod or brace.

D. All boxes shall be so installed that the wiring contained in them can be rendered accessible without removing part of the structure.

E. Where several circuits pass through a common pull box, the circuits shall be tagged to indicate clearly their electrical characteristics, circuit number and designation.

F. All junction boxes larger than 4" × 4" flush mounted in wall shall have overlapping cover plate to cover rough-in openings.

12.15 Grounding:

A. Summary: The work required under this section consists of furnishing, installation and connections of the building secondary grounding systems. Exterior branch circuit wiring and feeder conductors extended beyond the building are included. The building electrical system shall be a 3 phase, 4 wire grounded wye delta system supplemented with equipment grounding system. Equipment grounding system shall be established with equipment grounding conductors; the use of metallic raceways for equipment grounding is not acceptable.

B. Quality Assurance:

1. Industry Referenced Standards: The following specifications and standards are incorporated into and become a part of this Specification by Reference.

a. Underwriters' Laboratories, Inc. (UL) Publications:

No.44	Rubber-Insulated Wire & Cables
No.83	Thermoplastic-Insulated Wires
No.467	Electrical Grounding & Bonding Equipment
No.493	Thermoplastic-Insulated Underground Feeder & Branch Circuit Cables
No.486	Wire Connectors and Soldering Lugs

b. National Electrical Manufacturers' Standards (NEMA):

WC-5	Thermoplastic Insulated Wire & Cable
WC-7	Cross-Linked-Thermosetting Polyethylene Insulated Wire

c. National Fire Protection Association Publication (NFPA):

No.70	National Electrical Code (NEC)

2. Acceptable Manufacturers: Products produced by the following manufacturer which conform to this specification are acceptable.

a. Hydraulically applied conductor terminations: Square D, Burndy, Ilsco, Scotch (3M), Thomas and Betts (T&B), Anderson or equal

b. Mechanically applied (crimp) conductor terminations: Scotch (3M), Ideal, Thomas and Betts (T&B), Burndy or equal

C. Grounding Conductors:

1. Grounding electrode conductor shall be bare or green insulated copper conductor sized as indicated on the Drawings.

2. Equipment grounding conductors shall be green insulated type THHN conductors sized as indicated on the Drawings. Where size is not indicated on the Drawings, conductor size shall be determined from the National Electrical Code table of sizes of equipment grounding conductors.

3. Bonding jumpers shall be flexible copper bonding jumpers sized in accordance with the National Electrical Code table on sizes of equipment grounding electrode conductors.

D. Transformers and Motor Controllers:

1. Provide a conductor termination grounding lug bonded to the enclosure of each transformer and motor controller.

2. Provide an equipment ground bar with bonding screw in each disconnect for grounding purposes.

E. Devices: Each receptacle and switch device shall be furnished with a grounding screw connected to the metallic device frame. Bond equipment grounding conductor to each outlet box. For isolated ground receptacles, bond equipment grounding conductor to box, and isolated ground conductor to device grounding screw.

F. Ground Rods: Ground rods shall be ¾" × 10'-0" copper clad steel. Connection to all ground rods shall be by exothermic weld.

G. Installation:

1. Ground all non-current carrying parts of the electrical system, i.e., wireways, equipment enclosures and frames, junction and outlet boxes, machine frames and other conductive items in close proximity with electrical circuits, to provide a low impedance path for potential grounded faults.

2. Service Entrance and Separately Derived Electrical Systems Grounding Electrode System:

a. The neutral conductor of the electrical service serving the premises wiring system shall be grounded to the ground bus bar in the service equipment which shall be grounded to the cold water system, the ground rod system, and other grounding electrodes specified herein or indicated on the Drawings. Grounding electrode conductors shall be installed in rigid, non-metallic conduit to point of ground connection, unless subject to physical damage in which case they shall be installed in rigid aluminum. Where metallic conduit is permitted, bond conduit at both ends to grounding electrode conductor with a UL bonding bushing.

b. Make connection to main water line entering the building. Make connections ahead of any valve or fittings whose removal may interrupt ground continuity. Install a bonding jumper of the same size as the grounding conductor around the water meter.

c. Bond together the following systems to form the grounding electrode system. All system connections shall be made as close as possible to the service entrance equipment and each connected at the service entrance equipment ground bus. Do not connect electrode systems together except at ground bus.

1) Cold water piping system

2) Ground rod system

3) Structural steel metal building frame

4) Main rebar in a foundation footing for a concrete structure

d. Ground the neutral of all dry type transformers

e. Grounding electrode connections to structural steel, reinforcing bars, ground rods or where indicated on the Drawings shall be with chemical exothermic weld connection devices recommended for the particular connection type. Connections to piping shall be with UL listed mechanical ground clamps.

f. Bonding shall be in accordance with the National Electrical Code.

g. Install ground rods where indicated on the Drawings with the top of the ground rods 12" below finished grade.

3. Equipment Grounding Conductor:

a. Grounding conductors shall be provided in all branch circuit raceways and cables. Grounding conductors shall be the same AWG size as branch circuit conductors.

b. Grounding conductors for feeders are typically indicated on the Drawings and the raceway is sized to accommodate grounding conductor shown. Where grounding conductor size is not indicated on the Drawings, conductor shall be in accordance with the equipment grounding conductor table of the National Electrical Code.

c. A grounding conductor shall be installed in all flexible conduit installations. For branch circuits, grounding conductor shall be sized to match branch circuit conductors.

d. A feeder serving several panelboards shall have a continuous grounding conductor which shall be connected to each related cabinet grounding bar.

e. The equipment grounding conductor shall be attached to equipment with bolt or sheet metal screw used for no other

purpose. Where grounding conductor is stranded, attachment shall be made with lug attached to grounding conductor with crimping tools.

f. Ground all motors by drilling and tapping the bottom of the motor junction box with a round head bolt used for no other purpose. Conductor attachment shall be through the use of a lug attached to conductor with a crimping tool.

g. Equipment grounding conductors shall terminate on panelboard, switchboard, or motor control center grounding bus only. Do not terminate on neutral bus. Provide a single terminals lug for each conductor. Conductor shall terminate the same section as the phase conductors originate. Do not terminate neutral conductors on the ground bus.

4. Other Grounding Requirements:

a. Each telephone backboard shall be provided with a No.6 grounding conductor. Ground conductor shall be routed to ground bar in nearest panel. Terminate conductor by stapling to backboard. Provide 6' slack conductor.

b. Lighting fixtures shall be grounded with a green insulated ground wire secured to the fixture with a UL listed bond lug, screw, or clip specifically made for such use.

H. Testing: Upon completion of the ground rod installation, grounding resistance reading shall be taken before connection is made to the building cold water piping system. Ground resistance readings shall not be taken within 48 hours of rainfall. Results of ground resistance readings shall immediately be forwarded in writing to the Owner.

12.16 Equipment Identification:

A. Submittals: Contractor shall submit sample of laminated plastic identification plate with lettering.

B. Materials:

1. Laminated plastic plates with 3/16" high white letter etched on black background

2. Plates shall be permanently mounted utilizing pop rivets or a permanent mastic/epoxy.

3. Painted, stenciled or indented tape identification is not acceptable.

C. Item Identification:

1. All electrical apparatus such as wiring troughs, panelboards, individual circuit breakers, transformers and disconnect switches shall have laminated plastic identification plates. Identification shall match labeling shown on Drawings.

2. A "steel" circuit directory frame permanently attached at factory (not glued) and a directory card with a plastic covering shall be provided on the inside of each panel door. The directory shall be typed to identify the load fed by each circuit and the areas served. Spaces or room numbers shown on the Drawings are not necessarily the final numbers to be assigned to these areas. The Contractor shall before completion of the project obtain from the Engineer final space or room numbers so that it can be typed onto directory.

3. Circuit breakers and disconnects shall identify the equipment served and circuit and panel from which it is served.

4. On all panelboards the exterior identification plate shall match that on the drawings and the panel and circuit number serving the panel shall be designated within the panel.

12.17 Surge Protective Devices (SPD) – Low Voltage AC Surge Protection for Electrical Distribution Systems:

A. General:

1. Scope: The Contractor shall furnish and install the surge protective device equipment having the electrical characteristics, ratings and modifications as specified herein and as shown on the contract Drawings. To maximize performance and reliability and to obtain the lowest possible let-through voltages, the ac surge protection shall be integrated into electrical distribution equipment such as switchgear, switchboards, panelboards, busway (integrated within bus plug) or motor control centers.

2. SPD units and all components shall be designed, manufactured and tested in accordance with the latest applicable UL standard (ANSI/UL 1449 3rd Edition).

B. Manufacturers: The following manufacturers meeting these Specifications are acceptable: Rockwell Automation, Cutler Hammer, General Electric, Siemens, Square "D", Current Technology, Intermatic or equal.

C. Voltage Surge Suppression:

1. Electrical Requirements:

a. Unit Operating Voltage: Refer to Drawings for operating voltage and unit configuration

b. Maximum Continuous Operating Voltage (MCOV): The MCOV shall not be less than 115% of the nominal system operating voltage.

c. The suppression system shall incorporate thermally protected metal-oxide varistors (MOVs) as the core surge suppression component for the service entrance and all other distribution levels. The system shall not utilize silicon avalanche diodes, selenium cells, air gaps or other components that may crowbar the system

voltage leading to system upset or create any environmental hazards.

d. Protection Modes: The SPD must protect all modes of the electrical system being utilized. The required protection modes are indicated by bullets in the following table:

	Protection Modes			
Configuration	***L-N***	***L-G***	***L-L***	***N-G***
Wye	●	●	●	●
Delta	N/A	●	●	N/A
Single Split Phase	●	●	●	●
High Leg Delta	●	●	●	●

e. Nominal Discharge Current (In): All SPDs applied to the distribution system shall have a 20kA In rating regardless of their SPD Type (includes Types 1 and 2) or operating voltage. SPDs having an In less than 20kA shall be rejected.

f. ANSI/UL 1449 3rd Edition Voltage Protection Rating (VPR): The maximum ANSI/UL 1449 3rd Edition VPR for the device shall not exceed the following:

Modes	***208Y/120***	***480Y/277***	***600Y/347***
L-N; L-G; N-G	700	1200	1500
L-L	1200	2000	3000

2. Maintenance Free Design: The SPD shall be maintenance free and shall not require any user intervention throughout its life. SPDs containing items such as replaceable modules, replaceable fuses or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.

3. Balanced Suppression Platform: The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating replaceable SPD modules shall not be accepted.

4. Electrical Noise Filter: Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method. Products unable able to meet this Specification shall not be accepted.

5. Internal Connections: No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be soldered, hardwired with connections utilizing low impedance conductors.

6. Monitoring Diagnostics: Each SPD shall provide the following integral monitoring options:

a. Protection Status Indicators: Each unit shall have a green / red solid-state indicator light that reports the status of the protection on each phase.

1) For wye configured units, the indicator lights must report the status of all protection elements and circuitry in the L-N and L-G modes. Wye configured units shall also contain an additional green / red solid-state indicator light that reports the status of the protection elements and circuitry in the N-G mode. SPDs that indicate only the status of the L-N and L-G modes shall not be accepted.

2) For delta configured units, the indicator lights must report the status of all protection elements and circuitry in the L-G and L-L modes.

3) The absence of a green light and the presence of a red light shall indicate that damage has occurred on the respective phase or mode. All protection status indicators must indicate the actual status of the protection on each phase or mode. If power is removed from any one phase, the indicator lights must continue to indicate the status of the protection on all other phases and protection modes. Diagnostics packages that simply indicate whether power is present on a particular phase shall not be accepted.

b. Remote Status Monitor: The SPD must include Form C dry contacts (one NO and one NC) for remote annunciation of its status. Both the NO and NC contacts shall change state under any fault condition.

c. Audible Alarm and Silence Button: The SPD shall contain an audible alarm that will be activated under any fault condition. There shall also be an audible alarm silence button used to silence the audible alarm after it has been activated.

d. Surge Counter: The SPD shall be equipped with an LCD display that indicates to the user how many surges have occurred at the location. The surge counter shall trigger each time a surge event with a peak current magnitude of a minimum of 50 ± 20A occurs. A reset pushbutton shall also be standard allowing the surge counter to be zeroed. The reset button shall contain a mechanism to prevent accidental resetting of the counter via a single, short-duration button press. In order to prevent accidental resetting, the surge counter reset button shall be depressed for a minimum of 2 seconds in order to clear the surge count total.

1) The ongoing surge count shall be stored in non-volatile

memory. If power to the SPD is completely interrupted, the ongoing count indicated on the surge counter's display prior to the interruption shall be stored in non-volatile memory and displayed after power is restored. The surge counter's memory shall not require a backup battery in order to achieve this functionality.

7. Overcurrent Protection: The unit shall contain thermally protected MOVs. These thermally protected MOVs shall have a thermal protection element packaged together with the MOV in order to achieve overcurrent protection of the MOV. The thermal protection element shall disconnect the MOV(s) from the system in a fail-safe manner should a condition occur that would cause them to enter a thermal runaway condition.

8. Fully Integrated Component Design: All of the SPD's components and diagnostics shall be contained within one discrete assembly. SPDs or individual SPD modules that must be ganged together in order to achieve higher surge current ratings or other functionality shall not be accepted.

9. Safety Requirements:

   a. The SPD shall minimize potential arc flash hazards by containing no user serviceable / replaceable parts and shall be maintenance free. SPDs containing items such as replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.

   b. SPDs designed to interface with the electrical assembly via conductors shall require no user contact with the inside of the unit. Such units shall have any required conductors be factory installed.

   c. Sidemount SPDs shall be factory sealed in order to prevent access to the inside of the unit. Sidemount SPDs shall have factory installed phase, neutral, ground and remote status contact conductors factory installed and shall have a pigtail of conductors protruding outside of the enclosure for field installation.

D. System Application:

1. The SPD applications covered under this section include distribution and branch panel locations, busway, motor control centers (MCC), switchgear, and switchboard assemblies. All SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C, B and A environments.

2. Surge Current Capacity: The minimum surge current capacity the device is capable of withstanding shall be as shown in the following table:

Minimum surge current capacity based on ANSI / IEEE C62.41 location category			
Category	***Application***	***Per Phase***	***Per Mode***
C	Service Entrance Locations (Switchboards, Switchgear, MCC, Main Entrance)	250 kA	125 kA
B	High Exposure Roof Top Locations (Distribution Panelboards)	160 kA	80 kA
A	Branch Locations (Panelboards, MCCs, Busway)	120 kA	60 kA

3. SPD Type: All SPDs installed on the line side of the service entrance disconnect shall be Type 1 SPDs. All SPDs installed on the load side of the service entrance disconnect shall be Type 1 or Type 2 SPDs.

E. Lighting and Distribution Panelboard Requirements:

1. The SPD application covered under this section includes lighting and distribution panelboards. The SPD units shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category B environments.

   a. The SPD shall not limit the use of through-feed lugs, sub-feed lugs and sub-feed breaker options.

   b. SPDs shall be installed immediately following the load side of the main breaker. SPDs installed in main lug only panelboards shall be installed immediately following the incoming main lugs.

   c. The panelboard shall be capable of re-energizing upon removal of the SPD.

   d. The SPD shall be interfaced to the panelboard via a direct bus bar connection. Alternately, an SPD connected to a 30A circuit breaker for disconnecting purposes may be installed using short lengths of conductors as long as the conductors originate integrally to the SPD. The SPD shall be located directly adjacent to the 30A circuit breaker.

2. Switchgear, Switchboard, MCC and Busway Requirements:

   a. The SPD application covered under this section is for switchgear, switchboard, MCC and busway locations. Service entrance located SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C environments.

   b. The SPD shall be of the same manufacturer as the switchgear, switchboard, MCC and busway

   c. The SPD shall be factory installed inside the switchgear, switchboard, MCC and/or bus plug at the assembly point by the original equipment manufacturer

d. Locate the SPD on the load side of the main disconnect device, as close as possible to the phase conductors and the ground/neutral bar.

e. The SPD shall be connected through a disconnect (30A circuit breaker). The disconnect shall be located in immediate proximity to the SPD. Connection shall be made via bus, conductors, or other connections originating in the SPD and shall be kept as short as possible.

f. The SPD shall be integral to switchgear, switchboard, MCC, and/or bus plug as a factory standardized design.

g. All monitoring and diagnostic features shall be visible from the front of the equipment.

12.18 Passive Filter: The passive harmonic filter (hereafter called the filter) shall be designed to filter all characteristic low frequency harmonics (5th, 7th, 11th, 13th, etc.), generated from 3-phase diode rectifier loads such as variable frequency drives (VFD), while improving the system power factor. The filter shall be UL-Listed under UL 508A. The filter shall be sized as required for the load. The filter shall ensure compliance with IEEE519, and the THD of the circuit shall be less than 5% with loads greater than 50%.

A. High Endurance Capacitor Cells: High-endurance capacitor cells shall have a voltage rating capable of handling continuously the nominal system voltage plus 10% of the over voltage tolerance. These capacitor cells shall also operate under the worst case voltage gain due to the leading nature of the capacitive current. Dielectric material shall be low-loss (less than 0.25 watts per kVAR). High-endurance capacitor cells themselves shall be rated to operate at a temperature of 65° C on the capacitor case.

B. Inductors: Both shunt circuit inductors and series line reactors shall be designed for harmonic filtering service and for slowing the rate of rapid current changes. The inductors shall be UL component-recognized or listed and shall be built to comply to UL 508. Construction shall be of copper wire-wound on magnetic steel cores. Inductors shall be 3-phase. Series line reactors shall be sized appropriately for the total connected load. Design maximum temperature rise for inductors shall be 115° C on bobbin wound and 155° C on form wound devices at rated current.

C. Enclosure: The filter shall be offered in an open panel arrangement, a stand-alone UL Type 3R enclosure.

D. Contactor: The filter shall have a contactor option to control the insertion of the shunt capacitor in the circuit and control the capacitive VARS on the power system. The contactor shall be controlled by an external 120V dry contact. 120V power shall be provided internal to the filter.

E. Warranty: The harmonic filter shall be warranted free from defects both in materials and in workmanship for a period of 3 years from the date of shipment, when applied in accordance with the manufacturer's recommended procedures.

The filter shall be HarmonicGuard Passive Filter as manufactured by TCI, LLC or equal.

12.19 Construction Reviews, Inspection and Testing:

A. Construction Reviews: Before covering or concealing any conduit below grade or slab, the Contractor shall notify the Engineer so that he can review the installation.

B. Contractor's Final Inspection:

1. At the time of the final inspection, all systems shall be checked and tested for proper installation and operation by the Contractor in the presence of the Engineer or his representative.

2. The Contractor shall furnish the personnel, tools and equipment required to inspect and test all systems.

3. Following is a list of items that the Contractor must demonstrate to the Engineer or his representative as complying with the Drawings and Specifications. Please note that this list does not necessarily represent all items to be covered in the final inspection, but should give the Contractor an idea of what is to be reviewed.

a. Service ground, show connection to ground rod and cold water main

b. Demonstrate that main service equipment is properly bonded

c. Demonstrate that all panels have breakers as specified, ground bar, copper bus, typed directory for circuit identification and that they are free of trash

d. Demonstrate that all conduits are supported as required by the National Electrical Code

e. Demonstrate that all outlet boxes above or on the ceiling are supported as required by the National Electrical Code

f. Demonstrate that outlet boxes in wall or ceilings of combustible materials are flush with surface of wall or ceiling, and that outlet boxes in walls or ceilings of noncombustible materials are so installed that the front edge of the box or plaster ring is not set back more than ¼"

g. Demonstrate that outlet boxes in wall are secure

h. Demonstrate that all devices are properly secured to boxes, that device plates are properly aligned and are not being used to secure device

i. Utilizing a Woodhead No. 1750 testing device, demonstrate that all 125 volt receptacles are properly connected

j. Demonstrate that all fixtures have specified lamps, ballast and lens, and that they are supported as required by the National Electrical Code or as called for on the Drawings or in the Specifications

k. Demonstrate that all disconnects requiring fuses are fused with the proper size and type, and that all disconnects are properly identified and supported

12.20 Payment: No separate payment will be made for the work of this Section. The cost of the work and all costs incidental thereto, shall be included in the amount bid in the Proposal for the item to which the work pertains.

SECTION 13
GENERATOR SETS AND EQUIPMENT

13.01 Work Included:

A. Diesel Engine Driven Standby Generator Sets

B. Fuel System

C. Exhaust System

D. Weatherproof Enclosure

E. Base Mounted Fuel Tank

F. Installation and Start Up

13.02 Quality Assurance:

A. The selling agency shall maintain a permanent parts and service facility no more than 100 miles from the job site from which parts and service may be obtained in necessary quantities at any time during the day or night, and any day of the week. The selling agency shall be required to prove that he continuously maintains in stock at the above specified location and at the bid date at least one piston-rod-liner set, fuel injector nozzle and pump set, air fuel, and oil filter set, and starter for each unit supplied. In addition, the selling agency shall have established and documented some means of parts procurement from an accessible depot which shall result in 95% or greater parts availability within 24 hours from order.

B. The performance of the engine-generator unit shall be tested as a unit and the factory performance characteristics shall be supplied to the Engineer indicating the results as to the sets full load ratings, voltage and frequency regulation.

C. Shall comply with all applicable codes

D. The units offered under these specifications shall be covered by the manufacturer's standard warranty or guarantee on new machines. But in no event shall it be for a period of less than two (2) years from date of initial start-up of the system.

E. Acceptable manufacturer's shall have in operation at time of bid, engine generator sets of similar size and design at least 3 years previous to bid opening, operating in a weather exposed, exterior environment.

13.03 Submittals:

A. General: All requirements concerning supervisory services, equipment bids, equipment obtained from manufacturer, equipment approved, mechanical testing, piping for equipment, shop painting, operation and maintenance manuals, guarantees, and motors specified in Section 10.02 through Section 10.12 shall apply to this section of the Specification unless otherwise specified.

B. Complete shop drawings shall be submitted for review and shall include detailed specification data and information on the specific engine-generator proposed as

specified in the General Requirements section of these Specifications. General manufacturer's product bulletins alone shall not be considered sufficient for review. Options and accessories to be furnished shall be clearly noted and drawings and/or literature provided.

C. The Contractor shall also include as a portion of the submittal the following job drawings:

1. Generator plan layout showing the engine generator set, accessories, and pertinent conditions. Plan shall be ¼" scale minimum.

13.04 General Requirements:

A. Furnish and install a diesel engine driven emergency generator, complete with all accessories as required for a complete emergency generator system. The generator shall be rated as specified.

B. All materials and parts comprising the units herein specified shall be new and unused, of current manufacture, and of the highest grade, free from all defects or imperfections affecting performance. Workmanship shall be of the highest grade, in accordance with modern practice. All major components shall be manufactured in the United States.

13.05 Testing: The performance of the generator sets shall be tested, as to the sets full power rating, voltage and frequency regulation. A copy of the above performance chart shall be supplied to Engineer.

13.06 Job Conditions:

A. Treatment Plant Generator:

2. 1,000 KW standby, 1,250 kVA-Minimum. See Drawings for load requirements.

3. 277Y 480V, 3 Ph., 4 W. WYE

B. Accessories:

1. Water jacket heater, complete with thermostat

2. Muffler, critical silencing type

3. Weather proof, sound attenuating enclosure

4. Base Mounted

13.07 Acceptable Manufacturers:

A. Caterpillar

B. Cummins

C. Kohler

13.08 Generator:

A. The diesel electric generator set shall be the product of a firm regularly engaged in the manufacture of this product. The components of the plant other than the

diesel electric generator set shall be the products of a firm regularly engaged in the manufacture of the products of this type.

B. Electric set rating shall be based on operation at 1800 rpm when equipped with all necessary operating accessories. Electric set shall be capable of producing the required KW at 0.8 PF for continuous standby electric set applications. All ratings shall be readily accessible in public literature; no factory special ratings are acceptable. Ratings shall be based on SAE standard ambient conditions of 29.38" of mercury and 85° F. Engine shall be rated with jacket cooling water pump radiator fan and other required appurtenances; no two core radiators or separate after cooler water circuits shall be allowed.

C. Generator shall be 3 phase, 4 wire, 60 cycle, 1,800 RPM, rated as shown. It shall be single bearing of heavy-duty ball bearing construction connected to engine flywheel through a suitable flexible coupling. Regulator shall have adjustments for gain, level and droop.

D. Exciter shall have sufficient capacity to produce ample excitation under all normal load conditions. Exciter shall be brushless type. The alternator shall be rated for 125° temperature rise at full load.

E. The generator mounted control panel shall be vibration isolated 14 gauge with the following equipment:

1. Voltmeter, 2% accuracy
2. Ammeter, 2% accuracy
3. Frequency meter, Dial type
4. Voltmeter-ammeter transfer switch
5. Voltage adjustment level rheostat
6. 4 fault indicator lights (low oil pressure, high coolant temperature, overspeed, overcrank)
7. Panel illumination lights

F. A main line molded case circuit breaker rated at 600 volts shall be provided as a load circuit interrupting and protection device and be mounted on the generator. It shall operate both manually for normal switching functions and automatically during overload and short circuit conditions. Generator/Exciter field circuit breakers do not meet the above electrical standards and are unacceptable for line protection. The circuit breaker shall meet standards established by Underwriters Laboratories, NEMA, and the National Electrical Code.

13.09 Engine:

A. The engine shall be a full compression ignition four-cycle, single-acting, solid-injection unit.

B. Engine output capacity shall not be less than the required horsepower to drive the specified generator 1800 RPM under the rating conditions specified.

C. Engine speed shall not exceed 1,800 RPM at normal full load operation.

D. Governor shall be of the hydro-mechanical type and shall maintain frequency regulation within 3% from no load rated load.

E. Satisfactory performance on No. 2 domestic burner oil is a requirement. Diesel engines requiring premium fuel will not be considered.

F. Injection pumps and injection valves shall not require adjustment in service. The engine shall have an individual mechanical injection valve for each cylinder, any one of which may be removed and replaced from parts stock.

G. A gear-type lubricating oil pump with lube oil cooler will supply oil under pressure to main bearings, crank pin bearings, camshaft bearings, and valve mechanism. Pistons shall be spray cooled. Effective full flow lubricating oil filters of the replaceable resin impregnated cellulose type shall be provided and so located that lubricating oil is continuously filtered. Filter system shall be equipped with a spring-loaded bypass valve as an insurance against stoppage of lubricating oil circulation in event the filters become clogged. All lubricating oil piping and lube oil temperature controls shall be factory fabricated. Generator manufacturer shall pipe a valved oil drain pipe to the edge of the skid with flexible hose to facilitate oil removal. Engine shall be filled with SAE 10W oil.

H. One or more engine mounted dry-type air cleaners of sufficient capacity to protect engine working parts from dust and grit shall be provided.

I. Provide suitable engine-mounted instrument panel including the following instruments:

1. Lubricating Oil Pressure Gauge
2. Water Temperature Gauge
3. Engine Hour Meter

J. Shutdown devices shall be provided which automatically shut down the engine in the event of low oil pressure, high coolant temperature, overcrank or overspeed.

K. The engine shall be equipped with a steel sheathed immersion type electric jacket water heater for maintaining the engine jacket water at approximately 100° F. The heater shall be equipped with an adjustable thermostat and mounted on the engine, circulating the water by means of natural convection. Heater shall operate from the 240 volt, 1 phase electric system.

L. A 12 or 24 volt battery charging alternator with D.C. Ammeter shall be provided to provide a quick charge of battery during operation of Engine-Generator set.

M. A battery charger with at least 10A fast charge rate and trickle charge rate with ammeter and voltmeter and low/high rate indicator lamps shall be furnished for remote mounting for maintaining the battery charge while the engine is idle.

13.10 Fuel System:

A. The fuel system shall be in accordance with the engine manufacturer's recommendations and shall include all piping, pumps, filters, storage tanks, etc.

All fuel lines shall be sized and type as recommended by the manufacturer. A flexible section of tubing shall be used between the engine and the fuel supply line. A replaceable element fuel filter shall be conveniently located for servicing. The engine shall be equipped with a built-in fuel transfer pump.

B. All main fuel lines shall be copper or black iron pipe as recommended by the manufacturer. Do not use galvanized pipe, fittings, or tank in system. Fuel system shall be complete with return lines.

C. Base mounted, double walled fuel storage tanks with 1,500 gallon capacity shall be furnished and installed. The fuel storage tank shall be sized to provide a minimum of 24 hours run time at 100% load. The tank shall be equipped with all openings required, including fill, drain & vent.

13.11 Cooling System:

A. The engine shall be equipped with an engine mounted radiator, fan, fan drive, and water pump for circulation of coolant through the water jackets of the cylinder block, cylinder head, exhaust manifold and lube oil cooler. The water pump shall be engine mounted and gear driven. Water temperature shall be thermostatically controlled.

B. Radiator shall be equipped with a capped filler opening, overflow line and drain cock. The radiator fan shall blow cooling air through the radiator. All engine cooling water piping shall be factory fabricated requiring only main supply and return connection to radiator. Cooling system shall be designed to operate in 125° F ambient rated output and shall be filled with a 50% emylene glycol solution.

13.12 Starting System:

A. System shall include 12 or 24 volt automatic starting motor, sufficient Amp/H capacity batter set with rack and cables, and other wiring, controls, and equipment as required for heavy duty, long life operation.

B. Batteries shall be mounted in suitable battery rack 2" off floor. Rack shall be made of non-corrosive materials (but not wood). However, a wood base plate shall be provided to isolate battery from floor. Coat terminals with grease. Batteries shall be of size recommended in manufacturers published literature. Batteries shall be Delco, Willard, Exide or equal.

13.13 Mounting System: The engine generator shall be mounted on corfund vibration isolators, the complete engine-generator and all auxiliary devices shall be housed within a WP enclosure with hinged side doors and hinged door over the instrument panel.

13.14 Installation:

A. All equipment shall be properly supported and additional support provided where necessary.

B. Installation shall be according to the manufacturer's recommendations, shall be done in a neat workmanlike manner and shall be installed under the supervision of a manufacturer's representative.

C. The manufacturer's representative shall be present during start-up and testing and shall provide certification of the system.

13.15 Wiring:

A. Two (2) 20A, 120V, single phase circuit with plug and cord shall be provided and wired to a receptacle on the engine generator for the crankcase heater and battery charger.

B. All wiring shall conform to manufacturers wiring diagrams and shall be installed in a neat manner and in accordance with all other sections of the specification. Wiring shall be stranded and terminated in the box type terminals.

13.16 Exhaust System:

A. Avoid sharp bends, use sweeping long radius elbows, and use a section of seamless stainless steel flexible exhaust pipe between the engine manifold and the rigid piping.

B. Exhaust piping shall be sized according to the engine manufacturer's recommendations. Exhaust piping shall be wrought iron with adequate support to stand severe service and allow for expansion as required by operating temperatures. No weight shall be supported by the engine manifold.

13.17 Generator Enclosure:

A. A weatherproof, enclosure shall be provided to house the engine/generator and accessories. The enclosure is to be in compliance with the National Electrical Code (NEC) and the National Fire Protection Association (NPPA) with regard to clearance around electrical equipment as specified.

B. Housing shall consist of a weather proof enclosure to completely enclose the engine generator and accessories. Housing shall protect the engine generator from the environment yet be conductive to easy maintenance. Housing shall have removable swing out doors on each side and lockable rear door for access to meters and controls. Side doors shall have a means to pad lock. Construction of housing shall be a minimum 14-gauge sheet steel and painted manufacturer's standard color.

13.18 Automatic Transfer Switch:

A. Automatic transfer switch shall be furnished and installed as shown on the plans. Automatic transfer switch shall be provided with contacts and logic to allow start/stop of the generator. Terminal strips shall be provided in the automatic transfer switch, clearly marked for each control or status point.

B. The rating shall be as shown on the plans for use on 277 Y 480V, 3 phase, 4 wire system.

C. The automatic transfer switch shall be U L 1008 as listed and be ASCO Series 7000SE as described in the Drawings. Accessories to be included are time delay on start (30 sec.) to ignore momentary outages, adjustable time delay transfer to normal (2 to 30 min), cool down timer, test switch to simulate outages and to load the plant, pilot contacts to initiate starting of the engine, insulated neutral pad,

three (3) sets of auxiliary contacts for remote indication of switch position on normal and emergency, weekly exercise timer, charger, described previously may be housed in the switch enclosure. The transfer switch shall be housed in a NEMA 3R type enclosure as shown on the Drawings. For allowing motor and transformer voltage decay prior to transfer, the transfer switch shall have either a timed programmed neutral or timed contacts that may be wired into the motor starter circuits that will drop out selected motor starters then re-energize them after the transfer is made. The time shall be adjustable up to 10 seconds.

D. Breaker in the treatment plant transfer switch shall be connected to an arc flash energy reduction maintenance switch with integral status indication per NEC Article 240.87.

13.19 Information Furnished to the Owner:

A. A factory authorized technician shall instruct the Owner's representative in the proper operation and maintenance of the equipment installed and shall furnish at least 2 copies of operating and maintenance instruction manual covering the engine-generator and such auxiliary equipment as may require published instructions or periodic maintenance.

B. The nearest and most convenient source of replacement parts and service shall also be furnished.

SECTION 14
PAINTING

14.01 Scope: Contractor shall furnish all materials and equipment and perform all labor necessary for painting all surfaces constructed under this Contract, and specified to require painting, gas proofing or coating as indicated on the Drawings.

14.02 Material: Materials for use in this work shall be delivered in unbroken original containers, bearing the manufacturer's name and shall be mixed and applied in conformance with the manufacturer's specifications and directions.

14.03 General: Painting shall be done in a first-class, workmanlike manner, and no paint shall be applied upon damp or frosty surfaces or in wet, foggy or freezing weather. All surfaces shall be brushed free of dust, and all foreign matter removed before any paint is applied. All surfaces shall be completely dry before any paint is applied. All iron and steel and other steel work which is shop primed shall have all abrasions in the priming coat cleaned by wire brushing, sandpaper or an approved method to bright metal, so as to remove all scale, ridges, rust or faults in the prime coat. All welding splatter shall be removed and this area reprimed. All voids, open or hollow places shall be repaired with a material suitable to the surface to be repaired. Paint shall be evenly spread and well brushed out, so there shall be no drops, runs or sagging of the coating. Where runs and drops do occur, they shall be removed and the surface recoated to the satisfaction of the Engineer. Sufficient time, as directed by the manufacturer shall be allowed for the paint to dry before the application of succeeding coats. Drop cloths shall be used to protect other surfaces of the structure or equipment in place, and upon completion of work all paint spots shall be removed from surfaces as directed by the Engineer, and any defaced surfaces shall be refinished as directed by the Engineer. Any painting work found to be defective or applied under adverse conditions shall be removed and replaced at the direction of the Engineer.

14.04 Surfaces Requiring Painting: Surfaces requiring painting shall include all new surfaces specified under this Section of the Specifications and constructed on this project. Exterior building surfaces requiring painting shall include doors, concrete block, wood, miscellaneous iron and steel. Surfaces requiring painting in basins and structures shall consist of equipment, piping and miscellaneous iron and steel.

14.05 Preparation of Painting Surfaces: All surfaces to be painted shall be prepared in accordance with the best practices with particular attention to the following:

A. Non-submerged ferrous metal surfaces of small miscellaneous items such as handrails, metal doors, cast iron piping, pumps and motors, etc.. shall be prepared in accordance with SSPS Surface Preparation Specification No. 2 "Hand Tool Cleaning."

B. Submerged ferrous metal surfaces shall be prepared in accordance with SSPS Surface Preparation Specification No. 10 "Near-White Blast Cleaning".

C. All concrete or masonry surfaces must be free of dust, from oils, curing compounds or any foreign matter that would interfere with the bond of the coating.

14.06 Manufacturer: Paint manufacturers specified are Tnemec, Carboline and Induron. Contractor shall submit for approval proposed paint manufacturer, coatings and color charts.

14.07 Painting Miscellaneous Iron and Steel Work: Miscellaneous iron and steel work and structural steel work before leaving the shop of the fabricator and before being exposed to weather, shall be thoroughly cleaned of all foreign matter, loose black scale and rust to a SSPC-SP 2 or SP3 standard and shall receive a pretreatment of one (1) coat of Carboline Rustbond or Tnemec pretreatment if applicable. Allow 24 hours to dry then apply one (1) coat of Tnemec Series 1 or equal at 2.0-3.0 mils dry or one (1) coat of Carbocoat 115. Whenever the priming coat has been damaged in transit or during construction or has become deteriorated due to long exposure to the elements, the metal shall be cleaned, touched up, or re-primed to the satisfaction of the Engineer. Valves, gates and appurtenances, if not tar dipped, shall be primed and painted as specified for miscellaneous iron and steel. PLEASE NOTE ANY IMMERSION GRADE STEEL WILL RECEIVE A NEAR WHITE METAL BLAST SSPC-SP10 AS ITS SURFACE PREPARATION METHOD.

A. Existing Treatment Unit: Repair/repaint all structural steel surfaces following surface preparation and corrosion protection as follows:

1. Immersion Grade Steel:

a. Surface Preparation: Pressure wash all substrates to be abrasive blasted. Abrasive blast the steel to a Near White Blast SSPC-SP10 standard. Prior to paint the substrate must be clean, dry and free of all contaminants. Acceptable paint manufacturers are Tnemec, Induron and Carboline.

b. Paint coats as follows:

1) 1st Coat – Polyurethane primer applied at 2 to 3 mils dry

2) 2nd Coat – Hydrophobic aromatic polyurethane applied at 6 to 8 mils dry

3) 3rd Coat – Hydrophobic aromatic polyurethane applied at 6 to 8 mils dry

c. Minimum dry film thickness is 14 mils.

2. Exposed Exterior Steel:

a. Surface Preparation: Pressure wash all substrates to be abrasive blasted. Abrasive blast the steel to a Commercial Blast SSPC-SP-6 standard. Prior to paint the substrate must be clean, dry and free of all contaminants.

b. Paint coats as follows:

1) 1st Coat – Polyurethane primer applied at 2 to 3 mils dry

2) 2nd Coat – Polyamidoamine epoxy applied at 2 to 3 mils dry (Color must be lighter shade than the topcoat field

applied color.)

3) 3rd Coat – Polyfunctional hybrid urethane applied at 2 to 3 mils dry

c. Minimum dry film thickness is 6 mils.

3. Miscellaneous Steel:

a. Surface Preparation: Pressure wash all substrates to be abrasive blasted. Abrasive blast the steel to a Commercial Blast SSPC-SP-6 standard. Prior to paint the substrate must be clean, dry and free of all contaminants.

b. Paint coats as follows:

1) 1st Coat – Polyurethane primer applied at 2 to 3 mils dry

2) 2nd Coat – Cycloaliphatic amine epoxy applied at 3 to 4 mils dry

3) 3rd Coat – Cycloaliphatic amine epoxy applied at 3 to 4 mils dry

c. Minimum dry film thickness is 8 mils.

14.08 Painting Galvanized Iron Work:

A. Interior Painting Galvanized Iron Work: Surface shall be prepared by solvent cleaning the entire substrate to be painted using xylol or xylene. The substrate should be clean dry and free of all contaminants prior to painting. The first field coat should be painted with Tnemec Series 66, Carboline Galoseal WB or equal applied at 2.0 to 3.0 mils dry. The second field coat should be painted with Tnemec Series N69, Carboline Carbocoat 45 or equal applied at 2.0 to 3.0 mils dry.

B. Exterior Painting Galvanized Iron Work: Surface shall be prepared by abrading the surface to a SSPC-SP3 standard. The substrate should be clean dry and free of all contaminants prior to painting. The first field coat should be painted with Tnemec Series 66, Carboline Galoseal WB or equal applied at 2.0 to 3.0 mils dry. The second field coat shall be painted with Tnemec Series 73/1074, Carboline Carbocoat 45 or equal applied at 2.0 to 3.0 mils dry.

14.09 Painting Cast Iron or Ductile Iron Piping:

A. Submerged Cast Iron and Ductile Piping: The substrate should be blasted to a SSPC-SP10 "Near White Blast Standard." The substrate should be clean dry and free of all contaminants prior to painting. The shop coat or first field coat shall be painted with Tnemec Series N140-1211, Carboline Carboguard 891HS or equal applied at 3.0 to 4.0 mils dry. The second and third field coat shall be painted with Tnemec Series N69 (non-potable), Carboline Carboguard 890 (non-potable) or equal applied at 4.0 to 6.0 mils dry. If piping is potable water, apply two (2) coats of Tnemec Series N140, Carboline Carboguard 891HS or equal applied at 4.0 to 6.0 mils dry.

B. Buried Cast Iron and Ductile Piping: The substrate should be clean dry and free of all contaminants prior to painting. The first field coat shall be painted with Tnemec Series 135 or equal applied at 3.0 to 4.0 mils dry. The second field coat shall be painted with Tnemec Series N69 or equal applied at 4.0 to 6.0 mils dry.

C. Exterior Exposed Cast Iron and Ductile Piping: Surface shall be prepared by applying SSPC-SP6 "Commercial Blast Cleaning." The substrate should be clean dry and free of all contaminants prior to painting. The shop coat or first field coat shall be painted with Tnemec Series N140-1211, Carboline Bitumastic 300M or equal applied at 3.0 to 4.0 mils dry. The second field coat shall be painted with Tnemec Series N69 or equal applied at 3.0 to 4.0 mils dry. The third coat shall be Tnemec Series 73/1074, Carboline Carbothane 133 HB or equal applied at 2.0 to 3.0 mils dry.

14.10 Painting Interior Electrical Conduit: Surface shall be prepared by solvent cleaning the entire substrate to be painted using xylol or xylene. The substrate should be clean dry and free of all contaminants prior to painting. The first field coat shall be painted with Tnemec Series 66, Carboline Sanitile 120 or equal applied at 2.0 to 3.0 mils dry. The second field coat shall be painted with Tnemec Series N69, Carboline Carbocoat 45 or equal applied at 2.0 to 3.0 mils dry.

14.11 Painting Structural Surfaces:

A. Surface Preparation: Structural surfaces to be painted, including concrete and masonry surfaces, shall be thoroughly dry and clean. Concrete work shall be rubbed and finished in accordance with provisions of "Concrete" Section. Concrete and masonry surfaces shall be further cleaned using stiff scrubbing brushes. Using scrubbing brush, scrub and neutralize with 10% muriatic acid solution thoroughly and wash down completely with fresh, clear water.

Flushing shall be performed before the acid solution dries and forms acid salts. All traces of dust, form oil, curing compound or other foreign matter shall be carefully removed. Allow two to four days for complete and thorough drying, or longer if necessary, depending upon humidity and temperature. Space heaters shall be used if due to condensation or temperature conditions painting may not otherwise be accomplished. No painting shall be started unless surfaces are thoroughly dry and they shall be kept dry during all painting operations.

B. Painting: Prime surface with Carboline Sanitile 120 at 1.0 to 2.0 mils dry. Painting structural surfaces shall be accomplished by applying two (2) coats of Tnemec Series 180 (self-priming), Carboline Carbocrylic 3359 DTM or equal at the rate of 150 square feet per gallon and allowing 4 hours drying time at 75° F between coats.

C. Repair of Concrete Structural Surfaces: Concrete structural surfaces to be repaired shall receive either a coat of epoxy, cementitious resurface applied at 1/16" to ½" to repair/restore existing surfaces in the influent structure. The material shall be epoxy modified mortar.

14.12 Painting Doors and Windows: Interior and exterior ferrous metal doors and windows shall receive a priming coat of Tnemec Series 1, Carbocoat 115 or equal applied at 2.0 to

3.0 dry mils in the shop. The substrate should be clean, dry and free of all contaminants prior to painting. The first field coat shall be painted with Tnemec Series 73/1074, Carboline Carbocoat 145 or equal applied at 2.0 to 3.0 mils dry. The second field coat shall be painted with Tnemec Series 73/1074, Carboline Carbocrylic 3359 or equal applied at 2.0 to 3.0 mils dry.

Doors and windows of non-ferrous metal shall not be painted, unless otherwise specified.

14.13 Painting Equipment: Special care shall be used to leave all nameplates and non-ferrous metal trim unpainted unless otherwise directed by the Engineer. The substrate should be clean dry and free of all contaminants from shop applied coat of Tnemec Series 1, Carboline Carbocoat 115 or equal. The first field coat shall be painted with Tnemec Series 135, Carboline Carbocoat 45 or equal applied at 3.0 to 4.0 mils dry. The second field coat shall be painted with Tnemec Series 73/1074 or equal applied at 2.0 to 3.0 mils dry.

14.14 Equipment and Metal Submerged in Sewage, Sludge or Water Subject to Splash or Buried in Ground:

A. Surface preparation and special coatings shall be done only by crews experienced in this work and approved by the Engineer. A representative of the paint company shall be present when work begins to instruct personnel in sandblasting and application techniques in the presence of the Engineer.

B. Surfaces to be coated shall be sandblasted to the equivalent of SSPC-SP 5-63, "White Metal Blast Cleaning" of the Steel Structures Painting Council. The Contractor shall furnish the Engineer a Sample No. 5 blast cleaning plate suitably sealed in plastic and purchased from the Steel Structures Painting Council to be used as a field guide. Under no circumstances shall sandblasted surfaces be permitted to rust or have condensation to form thereon prior to coating. Surfaces sandblasted shall be coated the same day. If surfaces are allowed to remain uncoated overnight or longer, they shall be resandblasted before coating. All cleaning and coating application shall be performed only during daylight hours.

No coating shall be applied when temperature is below 50° F., nor when the relative humidity is greater than 85%, nor when condensation is present on base and coated surfaces, nor when ambient air temperature is falling.

C. Equipment and metal shall be shop primed with one (1) coat Tnemec Series 1, Carboline Carboguard 891HS or equal applied at 2.0 to 3.0 dry mil thickness. Field prime shall be "Touch-Up" with same. Finish shall be:

1. **NON-POTABLE**: The substrate should be clean dry and free of all contaminants from shop applied coat of Tnemec Series 1, Carboline Carboguard 891HS or equal. The first field coat shall be Tnemec Series 66, Carboguard 891HS or equal applied at 4.0 to 6.0 mils dry. The second field coat shall be Tnemec Series 104, Carboguard 891HS or equal applied at 6.0 to 8.0 mils dry.

2. **POTABLE**: The substrate should be clean dry and free of all contaminants from shop applied coat of Tnemec Series 1, Carboline Carboguard 891HS or equal. The first field coat shall be Tnemec Series

20-1255, Carboline Carboguard 891HS or equal applied at 4.0 to 6.0 mils dry. The second field coat shall be Tnemec Series N140, Carboline Carboguard 891HS or equal applied at 6.0 to 8.0 mils dry.

D. Items to be included are bar screen, grit removal equipment, sludge collector equipment and interior housings of drive units for same, including all metal and equipment in wet wells, grit removal tanks, settling tanks, operating stands and all shafting and miscellaneous meta.

E. These items do not include cast iron or ductile iron piping in sewage, sludge and ground, collector chains, and wearing surface of sprocket teeth and guides.

14.15 Miscellaneous Painting:

A. Exterior Woodwork: Exterior woodwork shall receive one (1) priming coat of Tnemec Series 36-603, Carboline Sanitile 120 or equal applied at 2 to 3 mils dry film thickness Apply two (2) finish coats of Tnemec Series 28/29, Carboline Carbocoat 45, or equal, applied at 2 to 3 mils dry film thickness. Allow 4 hours drying time at 75° F between coats.

B. Interior Wood: Interior woodwork shall receive one (1) priming coat of Tnemec Series 10-99W, Carboline Sanitile 120 or equal applied at 2 to 3 mils dry film thickness Apply two (2) finish coats of Tnemec Series 1028/1029, Carboline Carbocoat 45, applied at 2 to 3 mils dry film thickness. Allow 4 hours drying time at 75° F between coats.

C. Interior Concrete Block, Concrete Walls and Concrete Ceilings: Concrete block - Apply 1 coat of waterborne cementitious acrylic applied at the rate of 90 square feet per gallon; 2 coats of polyamidoamine epoxy applied at 275 square feet gallon. Concrete walls and concrete ceilings - Apply 2 coats of polyamidoamine epoxy applied at the rate of 275 square feet per gallon.

1. Interior Concrete Block, Concrete Walls and Concrete Ceilings: Concrete Block: The prime field coat shall be 1 coat of Tnemec Series 130, Carboline Sanitile 100 or equal applied at the rate of 75 to 90 square feet per gallon. The second field coat shall be 2 coats of Tnemec Series N69, Carboline Carboguard 890 or equal applied at 320 square feet gallon (3 to 4 dry mils per coat).

2. Concrete Walls and Concrete Ceilings: The prime field coat shall be 2 coats of Tnemec Series N69, Carboline Carboguard 890 or equal applied at the rate of 320 square feet per gallon (3 to 4 dry mils per coat).

D. Interior Concrete Floors: Surface shall be prepared by acid etching the entire surface to be painted to a CSP 1 standard. The substrate should be clean dry and free of all contaminants prior to painting. The prime field coat shall be Tnemec Series 201, Carboline Sanitile 100 or equal applied at 4.0 to 6.0 mils dry. The second field coat shall be Tnemec Series 281, Carboline Carboguard 890 or equal applied at 6.0 to 8.0 mils dry. The third field coat shall be Tnemec Series 281, Carboline Carboguard 890 or equal applied at 6.0 to 8.0 mils dry.
***For a non-slip surface broadcast 50/70 mesh sand into 2nd field coat*

E. Interior Drywall: The substrate should be clean, dry and free of all contaminants prior to painting. The prime field coat shall be Tnemec Series 51-792, Carboline Sanitile 100 or equal applied at 1.0 to 2.0 mils dry. The second field coat shall be Tnemec Series 113/114, Carboline Carbocoat 45 or equal applied at 2.0 to 3.0 mils dry. The third field coat shall be Tnemec Series 113/114, Carboline Carbocoat 45 or equal applied at 2.0 to 3.0 mils dry.

F. All surfaces to be painted that have an existing coating shall be patch tested.

14.16 Colors: Where more than one coat of paint is required, paint for each undercoat shall be job tinted off shade, sufficient to show complete coverage for each coat. The colors of paints for the various parts of the work shall be selected by the Engineer. The lower 4' of walls and partitions shall have dado stripe and color darker than the upper walls and ceilings, unless otherwise specified or directed by the Engineer.

14.17 Piping Color Codes: The Contractor shall paint all exposed metallic pipe lines with the colors specified. Small diameter non-metallic lines should not be painted but should be color-coded with the colors specified using labels according to the "Signs and Labels" section.

Line	*Tnemec Color*	*Tnemec No.*	*Carboline Color*	*Carboline No.*
Water Lines:	Safety Blue	11SF	Safety Blue	5150
Chemical Lines:	Safety Yellow	02SF	Safety Yellow	6666
Waste Lines:	Weathered Bark	84BR	Walnut Grove	2248
Sewage:	Gray	33GR	Machine Gray	0754
Air Line:	Balsam	91GN	Vernal Green	0388
Gas Line:	Monterrey Tile	28RD	Tile Red	0156

14.18 Signs and Labels: After other painting of pipe work has been completed as provided for herein, the Contractor shall label the pipe work by stenciled legends, all as ordered by the Engineer.

A. In addition to the color coding of piping, two legends descriptive of the function of the pipe, such as "Sludge" shall be stenciled. One legend shall be stenciled on each side of the pipe on the pipe lines, and on the side of the bands away from the valve or fittings. The legend shall be located on the pipe so that it will be in direct line of vision. Legend may be omitted from one side if view is obstructed from that side. Where the flow in a pipe shall be at all times in one direction only, then a flow arrow shall be placed in front of each legend on the pipe. The lettering and arrows shall be cut neatly into stencils, the arrows being the same height as the letters. The size of lettering shall be:

	Outside Diameter of Pipe or Covering	**Size of Letters**
1.	¾" to 1¼"	½"
2.	1½" to 3"	¾"
3.	3¼" to 4¼"	1"

	Outside Diameter of Pipe or Covering	Size of Letters
4.	4½" to 6¾"	1½"
5.	7" to 7¾"	2"
6.	8" to 9¾"	2-10"
7.	10" to 11¾"	3"
8.	12" and over	3½"

B. For pipes smaller than ¾" in outside diameter, use laminated plastic or aluminum tag with the lettering etched or stamped and filled in with black or contrasting enamel.

C. The legends and flow arrows shall be stenciled with approved black or contrasting stencil paint. The above outline of intent designates the general extent of the identification work and is not exclusive of other similar work such as identification and other equipment as may be directed by the Engineer. Following the completion of the work under this item, the Contractor shall deliver to the Owner two (2) sets of all stencils used.

D. In addition to the above labeling of pipe work, the Contractor shall paint stencil lengths in the same manner as a pipe of appropriate size on the individual units of equipment such as blowers, pumps, collector drives, compressors, silencers, etc. All push buttons, starters, switches, etc. when remote from the equipment controlled and/or power packs shall have labels of the engraved plastic type fixed to or adjacent to the remote switch, push button, starter, etc.

14.19 Payment: No separate payment will be made for the work of this Section. The cost of the work, and all cost incidentals thereto, shall be included in the price bid for the item to which the work pertains.