

BRUCE E. SMITH LAW OFFICES, PLLC

201 SOUTH MAIN STREET
NICHOLASVILLE, KENTUCKY 40356
(859) 885-3393 + (859) 885-1152 FAX

BRUCE E. SMITH
bruce@smithlawoffice.net

HENRY E. SMITH
henry@smithlawoffice.net

August 20, 2014

VIA UPS

Mr. Jeff R. Derouen
Executive Director
Kentucky Public Service Commission
211 Sower Boulevard
P.O. Box 615
Frankfort, Kentucky 40602

RECEIVED

AUG 21 2014

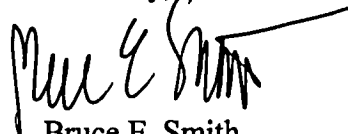
PUBLIC SERVICE
COMMISSION

Re: Case No. 2014-00084
Jessamine-South Elkhorn Water District
Notice of Filing – Deficiency Letter

Dear Mr. Derouen:

Delivered under cover of this letter is an original and ten (10) copies of **Applicant's Notice of Filing – Signed and Sealed Specifications** along with an original and one copy of the Technical Specifications.

Sincerely,



Bruce E. Smith

Enclosures

cc: Robert M. Watt, III, Esq.
Jennifer Black Hans, Esq.

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**COMMONWEALTH OF KENTUCKY
BEFORE THE PUBLIC SERVICE COMMISSION**

RECEIVED

In the Matter of:

AUG 21 2014

**APPLICATION OF JESSAMINE-SOUTH ELKHORN)
WATER DISTRICT FOR A CERTIFICATE OF)
PUBLIC CONVENIENCE AND NECESSITY TO)
CONSTRUCT AND FINANCE A WATERWORKS)
IMPROVEMENT PROJECT PURSUANT TO KRS)
278.020 AND 278.300**

PUBLIC SERVICE
COMMISSION

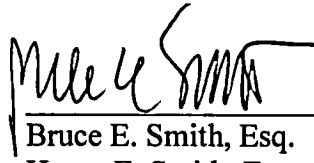
CASE NO 2014 -00084

APPLICANT'S NOTICE OF FILING – SIGNED AND SEALED SPECIFICATIONS

Pursuant to the Deficiency Letter from Commission staff, dated August 15, 2014, and based on the direction of Commission counsel as to the number of copies, the Applicant, Jessamine-South Elkhorn Water District (the "District"), by counsel, files under cover of this Notice an original and one copy of the Technical Specifications which have been signed and sealed by the engineer registered in Kentucky that prepared them. The only change to the Technical Specifications filed herewith as compared to those previously filed is that the Technical Specifications now reflect said engineer's seal and signature.

Accordingly, the Applicant respectfully requests that the Commission accept the foregoing as filed and proceed with Applicant's request for a Certificate of Public Convenience and Necessity to construct the subject tank.

Anthony G. Martin, Esq.
P.O. Box 1812
Lexington, Kentucky 40588
agmlaw@aol.com
(859)268-1451



Bruce E. Smith, Esq.

Henry E. Smith, Esq.

Bruce E. Smith Law Offices, PLLC

201 South Main Street

Nicholasville, Kentucky 40356

bruce@smithlawoffice.net

(859)885-3393

CO-COUNSEL FOR DISTRICT

CERTIFICATE OF SERVICE

The undersigned certifies that a true copy of the foregoing Notice with the cover page of the Technical Specifications attached was mailed to the following individuals, postage prepaid, on August 20, 2014:

Robert M. Watt, III, Esq.
Monica H. Braun, Esq.
300 West Vine Street, Suite 2100
Lexington, KY 40507

Jennifer Black Hans, Esq.
Gregory T. Dutton, Esq.
Assistant Attorneys General
1024 Capital Center Drive, Suite 200
Frankfort, KY 40601-8204



Bruce E. Smith

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AUG 21 2014

PUBLIC SERVICE
COMMISSION

TECHNICAL SPECIFICATIONS

Jessamine South Elkhorn Water District
802 South Main Street
Nicholasville, Kentucky 40356

CATNIP HILL PIKE 750,000 GALLON
ELEVATED STORAGE TANK
JESSAMINE COUNTY, KY

WX21113016
PROJECT # 4049

Prepared by:
HORNE ENGINEERING, INC.
216 South Main Street
Nicholasville, Kentucky 40356
(859) 885-9441
email@horneeng.com

June 2014

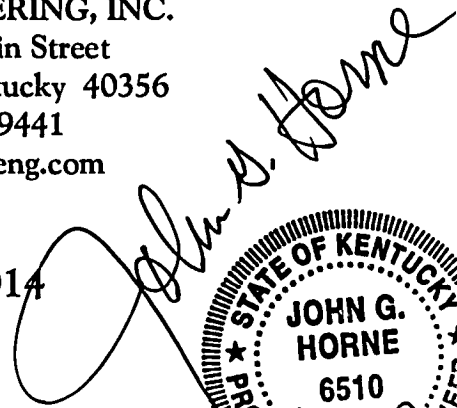


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**DIVISION 0
CONTRACTOR REQUIREMENTS**

SECTION 00700

GENERAL CONDITIONS

PART 1 - GENERAL

1.01 PURPOSE

- A. The purpose of this document is to provide information and guidance to developers, contractors, and design engineers in the construction of water facilities that shall be owned or connected to Jessamine-South Elkhorn Water District. This document shall be adhered to in its entirety.
- B. A separate document that outlines the fees and procedures to connect to the system can be obtained at the Jessamine-South Elkhorn Water District's office, 802 South Main Street, Nicholasville, KY 40356.
- C. See Division 1 for additional general requirements.

1.02 DEFINITIONS

OWNER: Jessamine-South Elkhorn Water District.

CONTRACTOR: Any developers, contractors, or other entity constructing water line extensions to be owned by Jessamine-South Elkhorn Water District.

ENGINEER : Horne Engineering, Inc.

1.03 OBLIGATION OF THE CONTRACTOR

The Contractor shall perform and complete the work to the satisfaction of the OWNER and in accordance with these specifications. The CONTRACTOR shall conduct his work to minimize interference with public and private business and traffic. The CONTRACTOR shall, at his own expense wherever necessary or required, provide barricades, flagmen, maintain lights, and take other precautions as may be necessary to protect life, property, adjacent building and structures. The CONTRACTOR shall be liable for all damages and injuries received or sustained by any person, persons or property in consequence of any neglect in safeguarding the work or by any act of neglect or misconduct by the CONTRACTOR or agents of the CONTRACTOR, subcontractors, employees or workmen.

The CONTRACTOR shall be responsible to contact all utilities to ascertain whether or not any utilities are present in the proposed pipeline area. Further, the CONTRACTOR shall be responsible to take all steps necessary to protect all utilities from damage. Should damage occur, the CONTRACTOR shall immediately take steps to minimize disruption and shall cause all necessary repairs to be made. Further, the CONTRACTOR shall indemnify the OWNER of any and all liabilities and legal action to so defend.

1.04 COOPERATION

Cooperation with the OWNER concerning construction activities is required.

1.05 DEFECTIVE MATERIAL AND WORKMANSHIP

Material not in accordance with this document or defective work may be rejected by the ENGINEER or OWNER. Failure by the OWNER to reject defective work shall not be construed as an acceptance of same.

1.06 NOTIFICATION

The CONTRACTOR shall give the OWNER or OWNER'S representative a minimum of 24 hours notice before starting construction.

1.07 INSPECTION

The OWNER or OWNER'S representative shall be present during construction. In addition to periodic inspection, a final inspection will be made by the OWNER or OWNER'S representative. A punchlist inspection shall be conducted and the final inspection will be made prior to acceptance of any facilities and only after all construction is complete. As part of the final inspection, the OWNER shall be provided a complete set of "As-built" plans. All vaults, valve boxes, meter pits and the like shall be cleaned of dirt, mud, and other foreign matter. The CONTRACTOR shall provide the labor as required to complete the punchlist prior to final inspection. Access to the construction site and construction records shall be provided at all times to inspectors.

1.08 EXISTING UTILITIES

Special precautions shall be taken by the CONTRACTOR to avoid damage to existing overhead and underground utilities.

Where existing utilities and appurtenant structures, either underground or aboveground, are encountered, they shall not be disturbed unless necessary. In such case, the utilities shall be replaced in as good or better condition than found and the utility company shall be notified prior to disturbance.

The CONTRACTOR or his representatives, shall bear the entire responsibility for locating, avoiding, and repairing damaged existing utilities.

1.09 CONFLICTING UTILITIES

All buried, potentially conflicting, utility lines or other facilities shall be exposed to determine requirements for maintaining required clearances prior to excavation. Where clearances cannot be obtained by minor vertical adjustments in planned grades, the CONTRACTOR shall notify the OWNER or OWNER'S representative prior to proceeding.

1.10 WATER MAIN, GRAVITY SEWER AND FORCE MAIN CLEARANCE

A. Water mains shall be separated by a minimum horizontal distance of ten feet when constructed parallel to gravity sewers or sewage force mains. For gravity sewers, approval may be granted on a case-by-case basis by the Kentucky

Division of Water where such a clearance is not practical. In this case, the waterline must be located a minimum of 18" above the top of the sewer pipe and on undisturbed trench bottom, or in a separate trench on either side of the gravity sewer. This deviation is not allowed for force mains.

- B. Water mains crossing sewers or force mains shall have an out-to-out vertical clearance of 18" and a full length of water pipe shall be located to maximize joint distance from the sewer or force main. Where it is impractical to obtain such clearance, approval may be granted on a case-by-case basis if the water main is encased for a distance of ten feet either side of the force line and has a minimum clearance of six inches. Encasement may be PVC pipe and shall be approved by the ENGINEER.

1.11 SAFETY AND SUPERVISION OF WORK

- A. The CONTRACTOR shall have total responsibility for safety on the construction site, including maintaining safe work procedures and methods. At no time will the ENGINEER or OWNER assume such responsibility, nor shall they direct or supervise the CONTRACTOR's personnel, subcontractors, or suppliers.
- B. Inspection services provided by the OWNER are to monitor if the work is completed in conformance with the drawing and specifications. The inspector's presence in no way relieves the CONTRACTOR of safety and supervision responsibilities; nor conformity with drawings and specifications; nor making the OWNER or ENGINEER as insurer of the CONTRACTOR'S performance.

1.12 PERMITS, EASEMENTS, AND RIGHTS-OF-WAY

The CONTRACTOR shall make application for, obtain, and pay fees for all licenses, permits, easements, and rights-of-way, including railroad permits (where applicable). The CONTRACTOR shall be required to comply with all State and municipal ordinances, laws and/or codes which may apply to same.

1.13 CONTRACTOR'S CERTIFICATION

- A. The CONTRACTOR shall certify, upon completion of project construction, that all work was completed in accordance with drawings and specifications, bearing OWNER'S approval.

1.14 WARRANTY

The CONTRACTOR shall warrant the material and workmanship for a period of one year from the date of acceptance by the OWNER.

- END OF SECTION -

**DIVISION 1
GENERAL REQUIREMENTS**

SECTION 01300

SUBMITTALS

PART 1 - GENERAL

1.01 WORK INCLUDED

Shop drawings, descriptive literature, product data and samples (when samples are specifically requested) for all manufactured or fabricated items shall be submitted by the CONTRACTOR to the ENGINEER for examination and review in the form and in the manner required by the ENGINEER. All submittals shall be furnished in at least six (6) copies and shall be checked and reviewed by the CONTRACTOR shall indicate his approval before submission to the ENGINEER. The review of such Drawings by the ENGINEER shall not be construed as a complete check, but will indicate only that the general method of construction and detailing is satisfactory. Review of such Drawings will not relieve the CONTRACTOR of the responsibility for any errors which may exist as the CONTRACTOR shall be responsible for the dimensions and design of adequate connections, details, and satisfactory construction of all Work.

1.02 RELATED SECTIONS

A. General Conditions

1.03 DEFINITIONS

A. The term "submittals" shall mean Shop Drawings, manufacturer's drawings, catalog sheets, brochures, descriptive literature, diagrams, schedules, calculations, material lists, performance charts, test reports, office and field samples, and items of similar nature which are normally submitted for the ENGINEER's review for conformance with the design concept and compliance with the Contract Documents.

1.04 GENERAL CONDITIONS

A. Review by the ENGINEER of Shop Drawings or submittals of material and equipment shall not relieve the CONTRACTOR from the responsibilities of furnishing same of proper dimension, size, quality, quantity, material and all performance characteristics to efficiently perform the requirements and intent of the Contract Documents. Review shall not relieve the CONTRACTOR from responsibility for errors of any kind of the Shop Drawings. Review is intended only to assure conformance with the design concept of the project and compliance with the information given in the Contract Documents.

B. Review of Shop Drawings shall not be construed as releasing the CONTRACTOR from the responsibility of complying with the Specifications.

1.05 GENERAL REQUIREMENTS FOR SUBMITTALS

A. Shop Drawings:

1. Shop drawings shall be prepared by a qualified detailer. Details shall be

identified by reference to sheet and detail numbers shown on Contract Drawings. Where applicable, show fabrication, layout, setting, and erection details.

2. Shop Drawings are defined as original Drawings prepared by the CONTRACTOR, subcontractors, suppliers, or distributors performing Work under this Contract. Shop Drawings illustrate some portion of the Work and show fabrication, layout, setting, or erection details of equipment, materials, and components. The CONTRACTOR shall, except as otherwise noted, have prepared the number of review copies required for his distribution plus three (3) which will be retained by the ENGINEER. Shop Drawings shall be folded to an approximate size of 8 ½ " x 11" and in such a manner that the title block will be located in the lower right-hand corner of the exposed surface.
3. Shop Drawing Submittals: Includes, but not limited to the following categories where applicable:

- PVC Pipe
- PE Tubing
- Gate Valves
- Gate Valve Box
- Fire Hydrant
- Copper Setter
- Corp Stop
- Meter box
- Meter Box Lid
- Compression Fitting
- Stainless Steel All-thread
- Duc-Lug
- Air Release Assembly
- 1" Ball Valve
- 1" Brass Nipple & Street ell
- Sensus SR Meter
- Meter Lock
- Pipe Saddles
- "U" Branch
- Valve Marker
- Ductile Iron Pipe
- Ductile Iron Fittings
- Ductile Iron Sleeve
- Meter Test Results
- Casing Pipe
- Casing Spacers
- Casing End Seals
- Special Equipment

- B. Product data shall include manufacturer's standard schematic drawings modified to delete information, which is not applicable to the project, and shall be supplemented to provide additional information applicable to the project. Each copy of descriptive literature shall be clearly marked to identify pertinent information as it applies to the project.
- C. Where samples are required, they shall be adequate to illustrate materials, equipment, or workmanship, and to establish standards by which completed

Work is judged. Provide sufficient size and quantity to clearly illustrate functional characteristics of product and material, with integrally related parts and attachment devices, along with a full range of color samples.

- D. All submittals shall be referenced to the applicable item, section and division of the Specifications, and to the applicable Drawing(s) or Drawing schedule(s).
- E. The CONTRACTOR shall review and check submittals, and shall indicate his review by initials and date.
- F. If the submittals deviate from the Contract Drawing and/or Specifications, the CONTRACTOR shall advise the ENGINEER, in letter of transmittals of the deviation and the reasons therefore. All changes shall be clearly marked on the submittal with a bold red mark. Any additional costs for modifications shall be borne by the CONTRACTOR.
- G. In the event the ENGINEER does not specifically reject the use of material or equipment at variance to that which is shown on the Drawings or specified, the CONTRACTOR shall, at no additional expense to the OWNER, and using methods reviewed by the ENGINEER, make any changes to structures, piping controls, electrical work, mechanical work, etc., that may be necessary to accommodate this equipment or material. Should equipment other than that on which Design Drawings are based be accepted by the ENGINEER, Shop Drawings shall be submitted detailing all modification Work and equipment changes made necessary by the substituted item.
- H. Additional information on particular items, such as Special Drawings, schedules, calculations, performance curves, and material details, shall be provided when specifically requested in the Technical Specifications.
- I. Submittals for all electrically operated items (including instrumentation and controls) shall include complete wiring diagrams showing leads, runs, number of wires, wire size, color coding, all terminations and connections, and coordination with related equipment.
- J. Equipment Shop Drawings shall indicate all factory or shop paint coatings applied by suppliers, manufacturers, and fabricators; the CONTRACTOR shall be responsible for insuring the compatibility of such coating with the field-applied paint products and systems.
- K. Fastener specifications of manufacturer shall be indicated on Equipment Shop Drawings.
- L. Where manufacturer's brand names are given in the Specifications for building and construction materials and products, such as grout, bonding compounds, curing compounds, masonry cleaners, waterproofing solutions, and similar products, the CONTRACTOR shall submit names and descriptive literature for such materials and products he proposes to use in the Contract.
- M. No material shall be fabricated or shipped unless the applicable Drawings or submittals have been reviewed by the ENGINEER and returned to the CONTRACTOR.
- N. All bulletins, brochures, instructions, parts lists, and warranties packaged with and accompanying material and products delivered to and installed in the project

shall be saved and transmitted to the OWNER through the ENGINEER.

1.06 CONTRACTOR RESPONSIBILITIES

- A. Verify field measurements, field construction criteria, catalog numbers and similar data.
- B. Coordinate each submittal with requirements of Work and of Contract Documents.
- C. Notify ENGINEER, in writing at time of submission, of deviation in submittal from requirements of Specifications and Drawings.
- D. Begin no work, and have no material or products fabricated or shipped which require submittal review until return of submittals with ENGINEER's stamp and initials or signature indicating review.

- END OF SECTION -

SECTION 01720
PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.01 RELATED SECTIONS

- A. Section 01300 - Submittals.

1.02 MAINTENANCE OF DOCUMENTS

- A. Maintain at jobsite, one copy of:
 - 1. Contract Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Reviewed Shop Drawings.
 - 5. Change Orders.
 - 6. Other modifications to Contract.
- B. Store documents in approved location, apart from documents used for construction.
- C. Provide files and racks for storage of documents.
- D. Maintain documents in clean, dry, legible condition.
- E. Do not use record documents for construction purposes.
- F. Make documents available at all time for inspection by ENGINEER and OWNER.

1.03 MARKING DEVICES

Provide colored pencil or felt-tip marking pen for all marking.

1.04 RECORDING

- A. Label each document "PROJECT RECORD" on 2-inch high printed letters.
- B. Keep record documents current.
- C. Do not permanently conceal any work until required information has been recorded.

- D. Contract Drawings: legibly mark to record actual construction:**
1. Horizontal and vertical location of underground utilities and appurtenances referenced to permanent surface improvements.
 2. Location of internal utilities and appurtenances concealed in construction referenced to visible and accessible features of structure.
 3. Field changes of dimension and detail.
 4. Changes made by Change Order or field order.
 5. Details not on original Contract Drawings.
- E. Specifications and Addenda: legibly mark up each section to record:**
1. Manufacturer, trade name, catalog number, and supplier of each product and item of equipment actual installed.
 2. Changes made by Change Order or field order.
 3. Other matters not originally specified.

1.05 SUBMITTAL

- A. At completion of project, deliver record documents to ENGINEER.**
- B. Accompanying submittal with transmittal letter, in duplicate, containing:**
1. Date.
 2. Project title and Contract number.
 3. CONTRACTOR's name and address.
 4. Title and sheet number of each record document.
 5. Certification that each document as submitted is complete and accurate.
 6. Signature of CONTRACTOR or his authorized representative.

- END OF SECTION -

SECTION 01725

VIDEO RECORDING

1.01 GENERAL DESCRIPTION

1.01.1 This Section covers the provision for the CONTRACTOR to provide all labor materials, equipment, services and perform all operations necessary to furnish to the OWNER and ENGINEER a complete, color audio-video record of the surface features within the proposed construction's zone of influence. This record shall include, but not be limited to, all audio-video storage, logs, and indexes. The purpose of this coverage shall be to accurately document the pre-construction condition of the features within the project area in sufficient detail and coverage to assess post-development conditions.

1.02 MATERIALS

1.02.1 General

The total audio-video recording system and the procedures employed in its use shall be such as to produce a finished product that will fulfill the technical requirements of the project, as well as those more subjective requirements of high quality audio and video production. The video portion of the recording shall reproduce bright, sharp, clear pictures with accurate colors and shall be free from distortion or any other form of picture imperfection. The audio portion of the recording shall reproduce the commentary of the camera operator with proper volume, clarity and be free from distortion.

The recording system shall utilize current standard video and NTSC compatible color (American TV Standard), and shall utilize digital technology.

1.02.2 Video

The video shall be furnished to both the OWNER and the ENGINEER. Each shall receive an original DVD, a copy on DVD, and a copy on a USB 2.0 Flash Drive (memory stick) which shall be new and thus shall not have been used for any previous recording.

1.02.3 Video Playback Compatibility

The recorded video shall be compatible for playback with any American TV Standard DVD or computer media player.

1.03 EXECUTION

1.03.1 Video Content

1.03.1.1 General

The recording shall contain coverage of all surface features located within the construction's zone of influence. The construction's zone of influence shall be defined (1) as the area within the permanent and

temporary easements, and areas adjacent to these easements which may be affected by routine construction operations; and (2) by the direction of the ENGINEER and/or OWNER. The surface features within the construction's zone of influence shall include, but not be limited to, all roadways, pavements, curbs, driveways, sidewalks, culverts, headwalls, retaining walls, buildings, landscaping, trees, shrubbery and fences. Of particular concern shall be the existence or non-existence of any faults, fractures or defects prior to construction.

1.03.1.2 Streets

Where construction will extend in or adjacent to a street, the full width of the construction's zone of influence including the street right-of-way shall be recorded, unless otherwise authorized by the ENGINEER. The term street shall be understood to mean a highway, road, street, avenue, boulevard, land, circle, alley, etc.

1.03.1.3 Easements

Where construction will extend through easement areas, the permanent and temporary easements and all other adjacent areas lying within the construction's zone of influence shall be recorded. The term easement shall be understood to mean all areas not defined as streets.

1.03.2 Alpha-Numeric Displays

All video must, by electronic means, display continuously and simultaneously generated, transparent, alpha-numeric information to include the following:

1.03.2.1 Video Index, Number, Project Title and General Project Location

Each video shall begin with a single, multi-line, alpha-numeric display indicating the video index number, project title and general location of the project.

1.03.2.2 Time and Date

During the entire duration of the recordings, the time (in hours, minutes and seconds separated by colons) and date (consisting of month, day and year separated by slashes) of recording must appear in the upper left-hand corner of the picture.

1.03.2.3 Name and Side of Street or Easement

During the entire duration of the recordings, the name and side of the street or easement being recorded must appear across the bottom of the picture.

1.03.2.4 Camera Position

During the entire duration of the recordings, the position of the camera, accurately referenced and displayed in terms of the construction's engineering stationing, shall be displayed (in standard

stationing format) in the lower left-hand corner of the picture. Where no stationing appears on the engineering plans, and appropriate stationing system acceptable to the ENGINEER and OWNER, shall be established and utilized.

1.03.3 Audio Content

Accompanying the video recording of each video shall be corresponding and simultaneously recorded audio. This audio recording, exclusively containing the commentary of the camera operator, shall assist in the maintenance of view orientation and in any needed identification, differentiation, clarification or objective description of the structures or features being shown in the video portion of the recording. The audio recording also shall be free from any conversations between the camera operator and the other production technicians.

1.03.4 Video Indexing

1.03.4.1 Video Identification

All videos shall be properly identified by video index number, project title, and general project location.

1.03.4.2 Video Logs

Displayed on the storage case of each video shall be a log of that video's contents. That log shall describe the various segments of coverage contained on that video in terms of the names and sides of the streets or easements, coverage beginning and endpoints, directions of coverage and video player counter numbers.

1.03.4.3 Cumulative Index

A cumulative alphabetical index correlating the various segments of coverage to their corresponding videos shall be supplied to the OWNER and ENGINEER.

1.03.5 Procedural Requirements

1.03.5.1 General

The following procedures shall be implemented in the production of preconstruction color audio-video documentation. Above all, the documentation shall be executed in a conscientious and professional manner to assure the end product's maximum usefulness to the OWNER and ENGINEER.

1.03.5.2 Time of Execution

- a. **Recording Schedule** - The recording schedule shall be performed prior to the placement of any construction materials or equipment on the proposed construction site.
- b. **Visibility** - All recordings shall be performed during times of good visibility. No recording shall be done during periods of significant precipitation, mist or fog. The recording shall only be done when sufficient sunlight is present to properly illuminate the subjects of recordings, and to produce bright, sharp video recordings of those subjects.

1.03.5.3 Coverage Continuity

The recording shall commence at Station 0+00 of each line, and run continuously interrupted to its end. If hand held walking is necessary, it shall be done to insure a complete uninterrupted record that is free from distortion, jiggle-free, and has clear audio.

1.03.5.4 Coverage Rates

The average rate of travel during a particular segment of coverage (e.g. coverage of one side of a street) shall be indirectly proportional to the number, size and value of the surface features within that construction area's zone of influence. The following table, which characterizes typical areas and sets the maximum average rates of travel in those areas, shall be used to establish approximate limits on actual average rates of travel:

	Area	Typically Characterized By	Avg. Rate Max
a.	High Density (e.g. developed subdivisions)	Hard Surface Streets, Curbs, Drives & Sidewalks; 50 Ft. Lots; Very Few Empty Lots	30 Ft./Min.
b.	Med. Density (e.g. Partially developed)	Gravel Roads, Hard & Soft Surface Drives, no Sidewalks, Culverts & Headwalls, 100 Ft. Lots; Few Empty Lots	60 Ft./Min.
c.	Low Density (e.g. suburban or woods house, fringe)	Gravel Roads, Small Fields	90 Ft./Min
d.	Extra Low Density (e.g. rural)	Gravel Roads, Large fields, Sparse Number of Houses	120 Ft/Min

1.03.6 Camera Positioning and Stability

- a. **Camera Height and Stability** - When conventional wheeled vehicles are used as conveyances for the recording system, the distance between the camera lens and the ground shall not be more than 12 feet. The camera shall be firmly mounted, such that transport of the camera during the recording process will not produce an unsteady picture.
- b. **Camera Control** - Camera pan, tilt, zoom-in, zoom-out rates shall be sufficiently controlled such that recorded objects will be clearly viewed during video playback. In addition, all other camera and recording system controls, such as lens focus and aperture, video level pedestal.

1.04 COORDINATION

- 1.04.1 The CONTRACTOR shall coordinate the video recording with the construction schedule so that portion of the construction that will be recorded first. Construction shall not begin in an area until acceptable video has been delivered to the OWNER and ENGINEER.

1.05 VIDEO DELIVERY

- 1.05.1 The CONTRACTOR shall deliver the video recordings to the OWNER and ENGINEER upon their completion as a whole, or upon request by the OWNER or ENGINEER, deliver specific video recordings to the OWNER and ENGINEER upon their completion. Upon delivery and acceptance of the videos, transfer of ownership of those videos shall be made to the OWNER.
- 1.05.2 Acceptance of a video by the ENGINEER will not relieve the CONTRACTOR of any liability he may incur by his failure to document a pre-work fault or defect that he may later be accused of causing

1.06 UNACCEPTABLE DOCUMENTATION

- 1.06.1 The OWNER or ENGINEER shall have the authority to reject all or any portion of the video. Those rejected portions shall be redone by the CONTRACTOR at no additional cost to the OWNER.

END OF SECTION -

SECTION 01730

OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Compile product data and related information appropriate for OWNER's maintenance and operation of equipment furnished under the Contract. Prepare operation and maintenance data as specified.
- B. Instruct OWNER's personnel in the maintenance and operation of equipment and systems as outlined herein.
- C. In addition to maintenance and operations data, the manufacturer's printed recommended installation practice shall also be included. If not part of the operations and maintenance manual, separate written installation instructions shall be provided, serving to assist the CONTRACTOR in equipment installation.

1.02 RELATED REQUIREMENTS

- A. Section 01300 - Submittals.
- B. General Conditions.

1.03 OPERATION AND MAINTENANCE MANUAL

- A. Every piece of equipment furnished and installed shall be provided with complete operation and maintenance manual. These shall be detailed in instructions to the OWNER'S personnel. They shall be attractively bound for the OWNER'S records.
- B. The manuals shall be submitted to the ENGINEER for review as to adequacy and completeness and upon acceptance, provide six (6) copies each.

1.04 FORMS OF SUBMITTALS

- A. Prepare data in the form of an instructional manual for use by OWNER'S personnel.
- B. Format:
 - 1. Paper size: 8 ½ " x 11".
 - 2. Data: Manufacturer's printed data, or neatly typewritten.
 - 3. Drawings:

- (a) Provide reinforced punched binder tab, bind with text.
 - (b) Fold large drawings to the size of the data pages where feasible.
 - (c) For flow or piping diagrams that cannot be detailed on the standard size drawings, a larger, appropriate size drawing may be submitted.
4. Provide tab sheet for each separate product, or each piece of operating equipment.
- (a) Provide typed description of product, and major component parts of equipment.
 - (b) Provide indexed tabs.
5. Cover: Identify each volume with types or printed title "OPERATIONS AN MAINTENANCE MANUAL". List:
- (a) Title of project.
 - (b) Identify separate equipment as applicable.
 - (c) Identify general subject matter covered in the manual.

C. Binders:

- 1. Commercial quality, durable and cleanable, 3-hole, post type binders with adequate capacity and with oil and moisture resistant hard covers.
- 2. When multiple binders are used, correlate that data into related consistent grouping.
- 3. Labeled on the front cover and spine of each binder shall be the name of the Plant, the CONTRACTOR, Number and Volume Number.

1.05 CONTENT OF MANUAL

- A. Neatly typewritten table of contents for each volume, arranged in systematic order.**
- 1. CONTRACTOR, name of responsible principal, address and telephone number.
 - 2. A list of each equipment required to be included, indexed to the content of the volume.
 - 3. List, with each equipment, the name, address and telephone number of:

- (a) Supplier of equipment.
 - (b) Subcontractor or installer.
 - (c) Maintenance contractor, as appropriate.
 - (d) Identify the area of responsibility of each.
 - (e) Local source of supply parts and replacement.
4. Identify each product by product name and other identifying symbols as set forth in Contract Documents.

B. Equipment Data:

- 1. Include only those sheets which are pertinent to the specific equipment; references to other sizes and type or models of similar equipment shall be deleted or lined out.
- 2. Annotate each sheet to:
 - (a) Clearly identify the specific equipment or part installed.
 - (b) Clearly identify the data applicable to the installation.
 - (c) Provide a parts list for all new equipment items, with catalog numbers and other data necessary for ordering replacement parts.
 - (d) Delete references to inapplicable information.

C. Drawings:

- 1. Supplement equipment data with drawings as necessary to clearly illustrate:
 - (a) Relations of component parts of equipment and systems.
 - (b) Control and flow diagrams.
- 2. Coordinate drawings with information in project record documents to assure correct illustrations of completed installation.
- 3. Do not use project record documents as maintenance drawings.

D. Written text, as required to supplement equipment data for th particular installation:

- 1. Organize in a consistent format under separate headings for different procedures.

2. Provide a logical sequence of instruction for each procedure.
- E. Copy of each warranty, bond, and service contract issued: Provide information sheet for OWNER'S personnel.
1. Proper procedures in the event of failure.
 2. Instances which might affect the validity of warranties or bonds.
- F. These manuals shall be delivered to the ENGINEER at the same time that the equipment to which it pertains is delivered to the site. The manuals must be approved by the ENGINEER before final payment on the equipment is made.

1.06 MAINTENANCE AND LUBRICATION SCHEDULES

- A. The CONTRACTOR'S attention is directed to the General Conditions and Section 01300 for all requirements relative to the submission of Shop Drawings for the mechanical equipment. For all mechanical and electrical equipment furnished, the CONTRACTOR shall provide a list including the equipment name, address and telephone number of the manufacturer's representative and service company so that service and/or spare parts can be readily obtained. In addition, a maintenance and lubrication schedule for each piece of equipment shall be submitted along with Shop Drawings. Submission shall be in six (6) copies. The lubrication schedule shall include the types of lubricant required for each scheduled item.

- END OF SECTION -

SECTION 01749

WARRANTIES AND BONDS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Compile specified warranties and bonds.
- B. Compile specified service and maintenance contracts.
- C. Co-execute submittals when required.
- D. Review submittals to verify compliance with Contract Documents.

1.02 RELATED REQUIREMENTS (AS APPLICABLE)

- A. Warranty bond.
- B. Performance and payment bonds.
- C. Guaranty.
- D. General warranty of construction.
- E. Warranties and bonds required for specific products: as listed in other Specification sections.

1.03 WARRANTY BOND

Warranty bond shall be issued upon acceptance by OWNER

1.04 WARRANTY BONDS OR CORPORATE GUARANTEES IN LIEU OF EXPERIENCE RECORD

- A. When specifically requested in the products and installation general provisions of a Specification section for a particular piece of equipment of product, a record of five (5) years of successful full-scale operation shall be from existing facilities utilizing the equipment or product specified, in an application similar to the application intended for this project.
- B. The manufacturer shall certify in writing to the CONTRACTOR that it has the required record of successful full-scale operation. This certification shall be submitted by the CONTRACTOR with his construction materials and/or equipment data list. In the event the manufacturer cannot provide the five (5)

year certification of experience to the CONTRACTOR, the CONTRACTOR shall furnish within thirty (30) days after the notice of award, a warranty bond of corporation guarantee from the equipment manufacturer written in the name of the CONTRACTOR and acceptable to the OWNER. The warranty bond or corporate guarantee shall be kept in fore for five (5) years from the date of substantial completion of the Contract, less the number of years of experience the manufacturer may be able to certify to the ENGINEER. As a minimum, the bond or guarantee shall be in force for one (1) year after the date of substantial completion of the Contract. The warranty bond shall be written in an amount equivalent to the manufacturer's quotation, the CONTRACTOR'S installation cost plus 100 per cent (100%). The warranty bond or corporate guarantee will assure the OWNER that, in the judgement of the ENGINEER, the equipment does not perform its specified function, the CONTRACTOR shall remove the equipment and install equipment that will perform the specified function and the work by the CONTRACTOR shall be paid for by the warranty bond or corporate guarantee.

1.05 SUBMITTALS REQUIREMENTS

- A. Assemble warranties, bonds, and service and maintenance contracts, executed by each of the respective manufacturers, suppliers, and subcontractors.
- B. Furnish two(2) original signed copies.
- C. Table of Contents: neatly typed, in orderly sequence. Provide complete information for each item:
 - 1. Product, equipment, or Work item.
 - 2. Manufacturer name, address and telephone number
 - 3. Supplier name, address and telephone number.
 - 4. CONTRACTOR name, address and telephone numb
 - 5. Scope.
 - 6. Date of beginning of warranty, bond, or service and maintenance contract.
 - 7. Duration of warranty, bond, or service and maintenance contract.
 - 8. Provide information for OWNER'S personnel:
 - (a) Proper procedure in case of failure.
 - (b) Instances that might affect the validity of warranty or bond.

1.06 FORM OF SUBMITTALS

- A. Prepare in duplicate packets.
- B. Format:
 - 1. Size 8 ½ " x 11", punch sheets for 3-ringed binder: fold larger sheets to fit into binders.
 - 2. Cover: identify each packet with typed or printed title "WARRANTIES AND BONDS". List:
 - (a) Title of the project.
 - (b) Date of project.
 - (c) CONTRACTOR name, address and telephone number.
- C. Binders: commercial quality, 3-ring, with durable and cleanable plastic covers.

1.07 TIME OF SUBMITTALS

- A. For equipment or component parts of equipment put into service during progress of construction: submit documents within ten (10) days after inspection and acceptance.
- B. Otherwise, make submittals within ten (100 days after date of substantial completion, prior to final request for payment.
- C. For items of work, where acceptance is delayed materially beyond the date of substantial completion, provide updated submittal within ten (10) days after acceptance, listing the date of acceptance as the start of the warranty period.

1.08 SUBMITTALS REQUIRED

Submit warranties, bonds, and service and maintenance contracts as specified in the respective sections of the Specifications. Additionally, the CONTRACTOR shall warrant the entire Contract, including all concrete, paving, building, plumbing, HVAC, mechanical and electrical equipment to be free from defects in design and installation for one (1) year from the date of startup. In the event a component fails to perform as specified or is proven defective in service during the warranty period, the CONTRACTOR shall repair the defect without cost to the OWNER.

- END OF SECTION -

SECTION 01750

SPARE PARTS AND MAINTENANCE MATERIALS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Spare parts and maintenance materials for routine maintenance and minor repairs shall be provided for indicated equipment items as specified in the respective technical sections of these Specifications.

PART 2 - PRODUCTS

2.01 SPARE PARTS

- B. Required spare parts to be provided are listed in the following equipment Specifications:

- 1. (Project specific and shall be determined by OWNER)
- 2. _____
- 3. _____
- 4. _____
- 5. _____
- 6. _____
- 7. _____
- 8. _____
- 9. _____
- 10. _____

- C. Parts shall be coated to protect them from a moist atmosphere. All spare parts shall be plainly tagged, marked for identification and reordering, and shall be delivered properly boxed. Required identification includes (but is not limited to):

- 1. Name, address and telephone number of the manufacturer of equipment.

2. Name of the unit for which the part is intended.
 3. Name of the spare part.
 4. Name address and telephone number of the supplier of the spare part.
 5. Manufacturer's catalogue and part number.
 6. Precautionary information.
 7. Any other identifying information deemed appropriate.
- D. All spare parts for a single equipment item shall be crated together in containers suitable for handling with hoisting equipment and designed for prolonged storage and stenciled to identify contents.
- E. Where oil or grease lubricated equipment is concerned, sufficient oil or grease of types recommended by the equipment manufacturer shall be supplied for one (1) years's operations.

PART 3 - EXECUTION

3.01 SPARE PARTS

- A. The CONTRACTOR shall furnish and deliver the spare parts to the OWNER at such time as the OWNER may direct but prior to Contract expiration date. Furnish to the ENGINEER for record purposes a list of spare parts delivered to the OWNER.

3.02 LUBRICATION

- A. THE CONTRACTOR shall make suitable provision for the proper lubrication of all equipment furnished under this Contract. Accessible grease fittings shall be provided where required. A supply of oil, grease, and other lubricants of proper quality, as recommended by the manufacturer of the equipment, shall be furnished. Lubricants shall be furnished in there original, unopened containers in sufficient quantity for initial fillings and for at least one (1) year of operation.

-END OF SECTION -

**DIVISION 2
SITE WORK**

SECTION 02225

EXCAVATING, BACKFILLING, AND COMPACTING FOR UTILITIES

PART I - GENERAL

1.01 SUMMARY

- A. Excavating of trenches.
- B. Bedding of pipe.
- C. Backfilling trenches.

1.02 RELATED SECTIONS

- A. Section 02610 - Pipe and Fillings. PART 2-PRODUCTS

PART 2 - PRODUCTS

2.01 BEDDING AND BACKFILLING STONE

- A. Crushed Stone material shall conform to the Kentucky Bureau of Highways Standard Specifications.
- B. Bedding Stone: No. 9 Crushed Stone or limestone sand.
- C. Backfill Stone: No. 9 Crushed Stone as specified hereinafter.

PART 3- EXECUTION

3.01 GENERAL REQUIREMENTS

- A. Trenching may be accomplished by means of a backhoe, trenching machine or by hand depending on the construction area. At the Contractor's option, trenching by a trenching machine or by backhoe is acceptable except as noted below:
 - 1. Where the pipe line parallels a state highway and is being installed within the limits of the shoulder, a trenching machine must be used whenever practicable.
 - 2. Where the pipe line is being constructed close to other utilities, structures, building, or large trees, and it is reasonable to anticipate possible damage from the use of a backhoe, then trenching shall be made by hand methods.
- B. Clearing - All trees, stumps, bushes, shrubbery, abandoned concrete or masonry structures and other obstacles within the limits of the trench shall be removed by the Contractor and disposed of in a manner satisfactory to the land owner or engineer and in accordance with federal, state, and local regulations.

- C. **Bracing and Sheeting** - In areas of unstable soils, bracing and sheeting shall be provided to adequately protect the workers during pipe line installation.
1. All requirements of the Occupational Safety and Health Act (OSHA) shall be met during trenching and backfill operations.
 2. When sheeting and bracing are required, the trench width shall not be less than specified herein. As backfill is placed, the sheeting shall be withdrawn in increments not exceeding one (1) foot and the void left by the withdrawn sheeting shall be filled and compacted.
 3. The Engineer will not be responsible for determining requirements for bracing or sheeting.
- D. Excavated materials shall be piled in a manner that will not endanger the Work and will avoid obstructing driveways and sidewalks. Gutters shall be kept clear or other satisfactory provisions made for street drainage.
- E. No trenching for water line installation shall take place until all final site regrade work for roads, driveways, storm water channels, etc., has been completed.

3.02 TRENCHING

A. **General:**

1. The Contractor shall perform all excavation of every description and of whatever substances encountered, including clearing over the pipe line route. All excavations for the pipe line shall be open-cut except at paved city and county roads, state and federal highways, railroads and blacktop or concrete driveways which shall be bored unless otherwise approved by Engineer. Banks of excavations shall be kept as nearly vertical as possible.
2. Trench widths at the top of the pipe shall not be less than or greater than that given in the following table:

ALLOWABLE TRENCH WIDTHS		
Pipe Diameter (inches)	Minimum Width (inches)	Maximum Width (inches)
4&less	16	28
6	18	30
8	20	32
10	22	34
12	24	36
14	26	38
16	28	40
18	30	42
20	32	44

B. Trench Depth:

- 1. The trench shall be excavated to a depth sufficient to provide 36 inches of cover over the pipe in non-traffic areas and 36 inches in traffic areas. In addition, excavation shall be carried to a minimum of six (6) inches below pipe grade in rock.**
 - 2. When it is necessary to install a pipe line below a roadway ditch, it shall be provided with a minimum of 36 inches of cover unless otherwise approved by Engineer.**
- C. All excavation will be unclassified. Unclassified excavation shall include all material encountered during excavation of trench to proper depth and width. It includes the removal of all shale, limestone, hardpan, soil, pavements, and solid rock and any other material which may be encountered in the trench.**
- D. Blasting for excavation will be permitted only when proper precautions are taken for the protection of persons and property. Any damage caused by the blasting shall be repaired by the Contractor at his expense. The Contractor's methods of blasting and procedure shall conform to federal, state, and local laws and municipal ordinances. The Engineer will not be responsible, nor direct in any way, blasting practices of the Contractor.**

3.03 WATER PIPE BEDDING

- A. The trench shall be excavated to a depth to allow a minimum of 36 inches cover over the top of the pipe.**
- B. Bedding material, in earth excavation areas, may be earth free from rocks, debris, or other foreign material may be used.**
- C. Bedding material, in rock excavation or vehicular traffic (including driveways) areas, shall be No. 9 Crushed Stone. The trench shall be overexcavated six (6) inches and filled with No. 9 Crushed Stone prior to laying pipe. In no case shall pipe be laid on solid or blasted rock.**
- D. Bedding material shall be placed from bottom of pipe in earth excavation, and from six (6) inches below bottom of pipe in rock excavation, to the centerline (springline) of the pipe. Bedding shall be compacted in layers not to exceed six (6) inches.**
- E. When the subgrade is found to be unstable or to include ashes, cinders, refuse, mud, organic material, or other unsuitable material, such material shall be removed to the depth ordered by the Engineer and replaced under the directions of the Engineer with clean, stable backfill material. When the bottom of the trench or the subgrade is found to consist of material that is unstable to such a degree that, in the judgement of the Engineer it cannot be removed, a foundation for the pipe and/or appurtenance shall be constructed using piling, timber, concrete, or other materials at the direction of the Engineer.**

3.04 WATER PIPE BACKFILLING

A. Initial backfill:

1. Initial backfill is defined as the material placed from the centerline (springline) of the pipe to 12 inches above the top of the pipe.
2. Initial backfill, in earth excavation areas, earth - free from rocks, debris, or other foreign materials may be used.
3. Initial backfill, in rock excavation or vehicular traffic (including driveways) areas shall be No. 9 Crushed Stone.

B. Final backfill:

1. Final backfill is defined as the material placed from a point 12 inches above the top of the pipe to the original surface.
2. Final backfill, in earth excavation areas, free from rocks, debris, or other foreign materials may be used.
3. Final backfill, in rock excavation shall be excavated material free of large stones or rock fragments. No stone or fragment shall exceed six (6") inches in any dimension..
4. Final backfill, in vehicular traffic (including driveways) areas shall be No. 9 Crushed Stone up to the subgrade of vehicular traffic surface courses.

-END OF SECTION -

SECTION 02507
CRUSHED STONE PAVING

PART 1 - GENERAL

1.01 SUMMARY

Crushed stone paving course, compacted.

1.02 REFERENCES

ASTM 033 - Aggregate for Concrete.

1.03 TESTS

Gradation of stone material will be performed in accordance with ASTM 033.

PART 2- PRODUCTS

2.01 MATERIALS

Crushed stone shall conform to ASTM C33, Type Dense Grade Aggregate (DGA), Type No. 57, Type No.2, and No. 610.

PART 3- EXECUTION

3.01 FIELD QUALITY CONTROL

- A. Verify compacted subgrade.
- B. Verify gradients and elevations of base are correct.
- C. Beginning of installation means acceptance of existing conditions.

3.02 PLACING AND COMPACTING STONE PAVING

- A. Spread stone material over prepared base to a total compacted thickness of 8 inches or as noted on the plans.
- B. Stone shall be placed in two 4-inch lifts. The bottom lift shall be No. 2 stone, graded and compacted. The top lift shall be DGA placed and compacted to a total thickness as indicated.
- C. Level surfaces to elevations and gradients indicated.
- D. Adequately compact placed stone materials.
- E. Add water to assist compaction. With an excess water condition, rework topping and aerate to reduce moisture content.
- F. DGA material shall be machine pugged at the quarry, meeting moisture and gradation requirement of the Department of Highways.

- END OF SECTION -

SECTION 02510

ASPHALTIC CONCRETE PAVING

PART 1 - GENERAL

1.01 SUMMARY

- A. Provide asphalt concrete paving for following applications and prepared subbase and compacted base.
 - 1. Roads.
 - 2. Parking areas.
 - 3. Driveways.
 - 4. Walkways.
 - 5. Curbs.
- B. Provide striping for parking, roadway, and handicapped markings.

1.02 SUBMITTALS

Submit to Engineer product data and test reports for approval.

1.03 QUALITY ASSURANCE

Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2- PRODUCTS

2.01 MATERIALS

- A. Prime coat: Cut-back asphalt.
- B. Tack coat: Emulsified asphalt.
- C. Asphalt cement: AASHTO M226 and as required by local authorities.
- D. Aggregate: Crushed stone.
- E. Traffic paint: Quick-drying chlorinated-rubber alkyd type, color as approved.
- F. Wheelstops: Precast concrete of uniform color and texture with steel stakes.

PART 3- EXECUTION

3.01 NEW PAVEMENT INSTALLATION

- A. Asphalt/aggregate Mixture: Comply with local Kentucky Department of Highways Standard Specifications for Highways and Bridges. Class as required by loading and use.

- B. Remove loose material from compacted subbase. Proof roll and check for areas requiring additional compaction. Report unsatisfactory conditions in writing.
- C. Apply prime coat to prepared subbase. Apply tack coat to previous laid work and adjacent in-place concrete surfaces.
- D. Place asphalt concrete at minimum temperature of 225° F in strips not less than 10 feet wide overlapping previous strips. Complete entire base course before beginning surface course.
- E. Construct curbs to dimensions indicated or if not indicated to standard shapes. Provide tack coat between curb and pavement.
- F. Begin rolling when pavement can withstand weight of roller. Roll while still hot to obtain maximum density and to eliminate roller marks.
- C. Provide four (4) inch lane and striping paint in uniform, straight lines. Provide wheelstops where indicated and securely dowel into pavement. Protect work from traffic and damage.
- H. Test in-place asphalt work for thickness and smoothness. Remove and replace defective work and patch to eliminate evidence of patching. Provide the following minimum thickness and smoothness unless otherwise greater thickness is required on the Drawings:
 - 1. Subbase course: 4-inch No. 2 stone and 4-inch DGA.
 - 2. Base course: 2-1/2-inch.
 - 3. Surface course: 1-1/2-inch
 - 4. Surface course smoothness: Plus or minus 1/8-inch in 10 feet.
No ponding of water is acceptable.

3.02 REPLACEMENT PAVEMENT FOR UTILITIES

- A. Sections of pavement shall be replaced as required to install the pipelines. Disturbed pavement shall be constructed to original lines and grades as detailed on the Drawings and in such manner as to leave all surfaces in fully as good or better condition than that which existed prior to these operations.
- B. Prior to trenching, the pavement shall be scored or cut to straight edges along each side of the proposed trench to avoid unnecessary damage to the remainder of the paving. Edges of the existing pavement shall be recut and trimmed as necessary to square, straight edges after the pipe has been installed and prior to placement of the concrete trench cap.
- C. Trenches shall be backfilled with No. 9 Crushed Stone up to the concrete cap.
- D. Asphalt surface course shall be one course construction in accordance with applicable provisions of the Kentucky Department of Highways Standard Specifications, Section 402.

1. Placement and compaction of surface course shall be in accordance with Section 402 of the Kentucky Department of Highways Standard Specifications. Minimum surface course thickness after compaction shall be two (2) inches.

- END OF SECTION -

SECTION 02520

PORTLAND CEMENT CONCRETE PAVING

PART I - GENERAL

1.01 SUMMARY

- A. Provide Portland cement concrete paving at following locations and prepared subbase and compacted base.
 - 1. Driveways and vehicular entrances.
 - 2. Walkways.
 - 3. Curbs.

1.02 SUBMITTALS

Submit to Engineer product data, mix design, mock-ups, and test reports for approval.

1.03 QUALITY ASSURANCE

Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2- PRODUCTS

2.01 MATERIALS

- A. Concrete mix design: Conform to specific mixes in Section 03300 as required for sidewalks, curbs, and vehicular ways.
- B. Exposed aggregate paving:
 - 1. Aggregate to match approved sample.
 - 2. Retarder.
- C. Reinforcing: 6 x 6, 1.9 x 1.9 welded flat wire mesh and ASTM A36 deformed steel bars.
- D. Joints: Preformed joint fillers/sealers.
- E. Finish:
 - 1. Paving: Fine bristled stiff broom.
 - 2. Exposed aggregate finish: Match approved sample.
 - 3. Imprinting: Tools and hardeners by Bomanite Corp.
 - 4. Curbs: Steel form finish, sponge float.

- F. Minimum Thickness - Replacement to match existing or minimum, whichever is greater.
 - 1. Driveways - 6 inches.
 - 2. Vehicular entrances - 8 inches.
 - 3. Roads - 12 inches.
 - 4. Walkways - 4 inches.
 - 5. Curbs - 6 inches.

PART 3- EXECUTION

3.01 INSTALLATION

- A. Proof roll subbase and check for unstable areas. Report unsatisfactory conditions in writing. Correct any soft or unstable areas.
- B. Comply with concrete section for concrete mix, testing, placement, joints, tolerances, curing, repairs, and protection.

-END OF SECTION -

**SECTION 02525
FLOWABLE FILL**

PART 1 - GENERAL

1.01 SUMMARY

Provide flowable fill at location and placement as per note and detail of construction plan.

1.02 SUBMITTALS

Submit to Engineer product data, mix design and test report as per applicable requirement of Standard Specifications for Road and Bridge Construction, Kentucky Transportation Cabinet, Department of Highways, current edition

1.03 QUALITY ASSURANCE

Comply with testing and reporting procedures of the specification standards stated in 1.02. Use experienced installers, deliver, handle and store materials in accordance with Section 1.02 specification requirements.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Mix design: conform to Section 601 - Concrete and paragraph 601.03.03.B.5(a) of Standard Specifications for Road and Bridge Construction, Kentucky Transportation Cabinet, Department of Highways, current edition.
- B. Fly Ash meeting requirements of said specification.
- C. Depth - place material at location and depth as indicated on plans that is to comply with the following requirement.

Embankment area - The surface of the placed flowable fill shall be at original ground surface, less depth of anticipated stripping.

Excavated area - The surface of the placed flowable fill shall be at subgrade level.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Placement of flowable fill shall be in accord with Section 601.03.09(c) of the Standard Specifications for Road and Bridge Construction, Kentucky Transportation Cabinet, Department of Highways, current edition.
- B. Prior to placement of flowable fill, contractor shall level #9 stone bedding and conduct placement in such manner as to prevent surging or displacement of bedding material.
- C. Contractor shall take any and all necessary steps to remove bleed water from trench, such as: excavating bleed ditches, sump pit and pumping, controlled placement, etc.
- D. Payment will be based on volume of job delivered tickets of material in place and accepted. Waste, overfilling, unacceptable material and other situations resulting in unacceptable placement will not be paid.

- END OF SECTION -

SECTION 02607
PRECAST CONCRETE VAULT

PART 1 - GENERAL

1.01 SUMMARY

Contractor shall furnish all materials, labor, and equipment to install precast concrete vault as shown on drawings or specified herein.

1.02 RELATED SECTIONS

- A. Section 02225 - Excavating, Backfilling, and Compacting for Utilities.
- B. Section 02610 - Pipe and Fittings.
- C. Section 02642 - Water Valves and Accessories.

PART 2 - PRODUCTS

2.01 PRECAST CONCRETE VALVE VAULT

- A. Dimensions: Inside dimensions as shown on drawings.
- B. Concrete Strength: Type I, 4000 psi at 28 days (85% strength prior to handling).
- C. Wall Slabs: Minimum six (6) inches thick, minimum square inches of steel per vertical foot of wall shall be 0.0025 times the longest vault wall dimension, in inches, with strength to support H20 traffic loading.
- D. Top and Bottom Slabs:
 - 1. H20 traffic loading - per vault manufacturer; but in no case shall top and bottom slabs be less than eight (8) inches thick and have minimum #4 rebar placed on 6-inch centers, each way.
 - 2. Non-traffic loading - Minimum top and bottom slab thickness of eight (8) inches with #4 rebar placed on 12-inch centers, each way.
- E. Steel Reinforcement: Minimum steel reinforcement shall be as noted in Articles C and D of this paragraph (2.01). Minimum yield strength of reinforcement shall be 60,000 psi. Steel reinforcement shall have two (2) inch clearance to slab edge.
- F. Conformance: Concrete shall conform to ACI 301. Reinforcement shall conform to ASTM A615, A616, or A617.
- C. Manufacturer: Cloud Precast or approved equal.

2.02 ACCESS HATCH

Access hatch shall be the size indicated and installed in the top slab of the valve vault at the locations shown on the drawings. Frames and covers shall be fabricated of aluminum. Fasteners shall be stainless steel. Covers shall be provided with lifting handle and safety latch to hold the cover in the 90° open position with safety grate. Locking hasps shall be provided. Covers shall be of the checkered plate design. Access frame and cover shall be Model KD as manufactured by the Bilco Company, New Haven, CT, or approved equal. Frame and cover shall be located at sidewall centered over steps.

2.03 STEPS

Polypropylene (rebar reinforced) steps shall be cast-in-place in the vault wall beneath the hatch. Rebar reinforcement shall extend a minimum of 1-3/8 inches beyond slab's steel mat.

2.04 DRAIN

The vault shall be manufactured with a four inch diameter floor drain located in the low corner fitted with a metal grate cover. Vault shall be installed to drain to low corner at a maximum pitch of 1/8 inch/foot. The drain shall be piped to daylight or dry well. Drains piped to daylight shall be equipped with rodent screen and flap closure.

Where location makes drain installation impracticable a sump pit and pump shall be utilized.

2.05 PIPES AND VALVES

Pipe is specified in Section 02610. Valves are specified in Section 02642.

PART 3- EXECUTION

3.01 INSTALLATION

Vault shall be handled and installed in accordance with manufacturer's recommendations.

-END OF SECTION -

SECTION 02608

MANHOLES

PART 1 - GENERAL

1.01 SUMMARY

The Contractor shall furnish all labor, material, and equipment necessary to construct manholes for sanitary and/or storm sewers, including steps, frames, and covers, together with all appurtenances as shown and detailed on the Drawings and specified herein. Manhole materials shall be precast concrete as noted on the Drawings.

1.02 RELATED SECTIONS

- A. Section 02225 - Excavating, Backfilling, and Compacting for Utilities.
- B. Section 03300 - Cast-in-Place Concrete.

1.03 DEFINITIONS

- A. **Standard Manhole:** A standard manhole is defined as any manhole that is greater than 4 feet in depth, as measured from the invert of the manhole base at its center to the top (rim) of the manhole cover.
- B. **Shallow Manhole:** A shallow manhole is defined as any manhole that is 4 feet or less in depth, as measured in the preceding sentence.

PART 2- PRODUCTS

2.01 CONCRETE MANHOLES - GENERAL

- A. Manholes shall conform in shape, size, dimensions, materials, and other respects as shown on the Drawings or specified herein.
- B. All concrete manholes shall have precast reinforced concrete developed bases. No other type of base will be allowed. Invert channels shall be factory constructed when the base is made. Sloping invert channels shall be constructed whenever the difference between the inlet and outlet elevation is 2 feet or less.
- C. The concrete manhole walls (barrels and cones) shall be precast concrete sections. The top of the cone shall be built of reinforced concrete adjustment rings to permit adjustment of the frame to meet the finished surface. Minimum strength of the concrete for the precast sections shall be 4,000 psi at the time of shipment.
- D. For concrete manholes, the inverts of the developed bases shall conform accurately to the size of the adjoining pipes. Side inverts shall be curved and main inverts (where direction changes) shall be laid out in smooth curves of the longest possible radius which is tangent, within the manhole, to the centerlines of adjoining pipelines.
- E. For concrete manholes, the cast-iron frames and covers shall be the standard

frame and cover as indicated on the Drawings and specified herein.

- F. Manholes shall be manufactured by Cloud Precast, or approved equal.

2.02 PRECAST CONCRETE SECTIONS

- A. Precast concrete sections and appurtenances shall conform to the ASTM Standard Specifications for Precast Reinforced Concrete Manhole Sections, Designation C478, latest revision, with the following exceptions and additional requirements.
- B. The base section shall be monolithic for 4-foot diameter manholes. Manholes with diameter of 5 feet or larger shall have base slab.
- C. The wall sections shall be not less than 5 inches thick.
- D. Type II cement shall be used except as otherwise permitted.
- E. Joints between sections shall be made watertight through the use of rubber O-ring gaskets or rubber profile gaskets such as Forsheda 138. Gaskets shall conform to the ASTM Standard C-443, latest revision. Rope mastic or butyl mastic sealant shall be installed per manufacturer's direction.
- F. Butyl mastic sealant shall be installed between the concrete cone section, any cast iron adjusting sections or rings, and cast iron frame.

2.03 CONCRETE MANHOLE - FRAMES AND COVERS

- A. The Contractor shall furnish all cast iron manhole frames and covers conforming to the Drawings or as specified herein.
- B. The castings shall be of good quality, strong, tough, evengrained cast iron, smooth, free from scale, lumps, blisters, sandholes, and defects of every nature which would render them unfit for the service for which they are intended. Contact surfaces of covers and frame seats shall be machined to prevent rocking of covers.
- C. All casting shall be thoroughly cleaned and subject to a careful hammer inspection.
- D. Castings shall be at least Class 25 conforming to the ASTM Standard Specifications for Gray Iron Casting, Designation A48, latest revision.
- E. Unless otherwise specified, manhole covers shall be 22-3/4 inches in diameter, weighing not less than 350 pounds per frame and cover. Manhole covers shall set neatly in the rings, with contact edges machined for even bearings and tops flush with ring edge. They shall have sufficient corrugations to prevent slipperiness. The covers shall have two (2) pick holes about 1-1/4 inches wide and 1/2 inches deep with 3/8-inch undercut all around. Covers shall not be perforated. Frames and

covers shall be J.R. Hoe and Sons, Mc-350, or approved equal.

- F. All covers shall be marked, in the center in large letters "SANITARY SEWER" or "STORM SEWER", as applicable.

2.04 MANHOLE STEPS (CONCRETE MANHOLES)

Manholes steps shall be the polypropylene plastic type reinforced with a 1/2" diameter deformed steel rod. The step shall be 10-3/4" wide and extend 5-3/4" from the manhole wall. Steps shall line up over the downstream invert of the manhole. The steps shall be embedded into the manhole wall a minimum of 3-3/8 inches. Steps shall be uniformly spaced at 12-inch to 16-inch intervals.

PART 3- EXECUTION

3.01 FABRICATION - PRECAST SECTIONS

- A. Manhole sections shall contain manhole steps accurately positioned and embedded in the concrete when the section is cast.
- B. Sections shall be cured in an enclosed curing area and shall attain a strength of 4,000 psi prior to shipment.
- C. No more than two (2) lift holes or inserts may be cast or drilled in each section.
- D. Flat slab tops shall have a minimum thickness of 6 inches and reinforcement in accordance with ASTM C478.
- E. The date of manufacture and the name or trademark of the manufacturer shall be clearly marked on the precast sections.
- F. Acceptance of the sections will be on the basis of material tests and inspection of the completed product and test cylinders if requested by the Engineer.
- C. Cones shall be precast sections of similar construction.

3.02 SETTING PRECAST MANHOLE SECTIONS

- A. Precast-reinforced concrete manhole sections shall be set so as to be vertical and with sections and steps in true alignment.
- B. Rubber gaskets, rope mastic or butyl mastic sealant shall be installed in all manhole joints in accordance with the manufacturer's recommendations.
- C. All holes in sections used for their handling shall be thoroughly plugged with rubber plugs made specifically for this purpose or concrete grout.

3.03 ADJUSTING MANHOLE FRAMES AND COVERS TO GRADE

- A. Except where shown on the Drawings, the top of the precast concrete eccentric cone of a standard manhole or the top of the flat slab of a shallow manhole shall

terminate 4 inches below existing grade in an unpaved non-traffic area except in a residential yard and 13 inches below existing grade in a paved or unpaved traffic area and in a residential yard. The remainder of the manhole shall be adjusted to the required grade as described hereinafter in paragraphs B and C of this article.

- B. When a manhole is located in an unpaved non-traffic area other than in a residential yard, the frame and cover shall be adjusted to an elevation 3 inches to 5 inches above the existing grade at the center of the cover. If field changes have resulted in the installed manhole invert elevation to be lower than the invert elevation shown on the Drawings, the adjustment to an elevation of 3 inches to 5 inches above existing grade shall be accomplished by the use of precast concrete or cast iron adjusting rings. If field changes have resulted in the completed manhole invert to be greater than the invert shown on the Drawings and the cover higher than 5 inches above existing grade, then the top of the eccentric cone, when used, or the top of the barrel section, when used, shall be trimmed down so that the manhole cover, after installation, is no greater than 5 inches above existing grade at the center of the cover. The area around the adjusted frame and cover shall be filled with the required material, sloping it away from the cover at a grade of 1 inch per foot.
- C. When a manhole is located in a bituminous, concrete, or crushed stone traffic area, or in a residential yard, the frame and cover shall be adjusted to the grade of the surrounding area by the use of precast concrete or cast iron adjusting rings. The adjusted cover shall conform to the elevation and slope of the surrounding area. If field changes have resulted in the installed manhole invert elevation to be so much higher than the invert elevation shown on the Drawings that the top of the eccentric cone, when used, or the top of the flat slab, when used, is less than the thickness of the frame and cover 7 inches from the grade of the surrounding area, then the top of the cone or barrel section shall be trimmed down enough to permit the cover, after installation, to conform to the elevation and slope of the surrounding area. After installation, the inside and outside surfaces of the precast concrete adjusting rings shall receive a waterproofing bitumastic coating.
1. The Contractor shall coordinate elevations of manhole covers in paved streets with the Owner. If resurfacing of the street in which sewers are laid is expected within two (2) months, covers shall be set 1-1/2 inches above the existing pavement surface in anticipation of the resurfacing operations.

3.04 ADJUSTING SECTIONS

Only clean adjusting sections shall be used. Each adjusting section shall be laid in a bead of butyl mastic sealant and shall be thoroughly bonded. Adjustment shall be restricted to two rings or 12".

3.05 SETTING MANHOLE FRAMES AND COVERS

- A. Manhole frames shall be set with the tops conforming to the required elevations set forth hereinbefore. Frames shall be set concentric with the top of the concrete and in a full bead of butyl mastic sealant so that the space between the top of the masonry and the bottom flange of the frame shall be completely watertight.
- B. Manhole covers shall be left in place in the frames at all times, except when personnel is actually in the manhole.

- END OF SECTION -

SECTION 02610
PIPE AND FITTINGS

PART 1 - GENERAL

1.01 SUMMARY

- A. The Contractor shall furnish all labor, material, and equipment necessary to install water piping and appurtenances as shown on the drawings and specified herein.
- B. This section describes several types of pipe which may or may not apply to the current project. Selected pipe materials will be identified on the drawings.

1.02 RELATED SECTIONS

- A. Section 02225 - Excavating, Backfilling, and Compacting for Utilities.
- B. Section 02642 - Water Valves and Accessories.
- C. Section 02630 - Casing Pipe.
- D. Section 02675 - Disinfection of Water Distribution Systems.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Pipe and accessories shall be unloaded at the point of delivery, hauled to, and distributed at the site of the project by Contractor in such a manner to avoid damage to the materials. Whether moved by hand, skidways, or hoists, materials shall not be dropped or bumped against pipe or accessories already on the ground or against any other object.
- B. In distributing material at the construction site, each piece shall be unloaded as near the installation point as possible.
- C. Pipe shall be handled in such a manner as to avoid damage to the ends. When such damaged pipe cannot be repaired to the Engineer's satisfaction, it shall be replaced at the Contractor's expense. The interior of all pipe and accessories shall be kept free from dirt and foreign matter at all times. The interior of all pipe and accessories shall be checked for dirt and debris and, if necessary, thoroughly cleaned before use in the project.

PART 2- PRODUCTS

2.01 DUCTILE IRON PIPE AND FITTINGS

- A. Scope: This article covers the design and manufacture of ductile iron centrifugally cast in metal molds and ductile iron fittings.
- B. Specific Requirements: Ductile iron pipe shall be furnished cement lined unless otherwise noted on the drawings or in other sections of these specifications. Ductile iron pipe shall be furnished with rubber gasket push-on joints except as may otherwise be noted on the drawings or in difficult working areas and approval of the Engineer.

1. Pressure class shall be 350 psi for pipe sizes 20 inches or smaller and pressure class 250 psi for pipe sizes larger than 20 inches for mechanical and push-on joint pipe.
2. Thickness design of ductile iron shall conform in all aspects to the requirements of ANSI/AWWA C150/A 21.50 latest revision.
3. Manufacture and testing of ductile iron pipe shall conform in all aspects to the requirements of ANSI/AWWA C151/A 21.51 latest revisions.
4. Cement mortar lining with bituminous seal coat shall conform to the requirements of ANSI/AWWA C104/A 21.4, latest revision for cement-mortar lining for ductile iron pipe, gray iron pipe, and fittings for water. Bituminous outside coating shall be in accordance with ANSI/AWWA C151/A 21.51 for pipe and ANSI/AWWA CI 10/A 21.10 for fittings.
5. Fittings and gaskets for mechanical and push-on joint ductile and cast iron pipe shall conform to the latest revisions of ANSI/AWWA 0110/A 21.10 for mechanical and push-on joint fittings, ANSI/AWWA C111/A 21.11 for gaskets, and ANSI/AWWA CI 53/A 21.53 for mechanical and push-on joint compact fittings. Mechanical and push-on joint fittings shall have pressure class rating of 350 psi for sizes 20 inches and smaller and 250 psi for sizes larger than 20 inches.
6. All ductile and cast iron fittings shall be ductile iron grade 80-60-03 in accordance with ASTM A339-55.
7. Flanged ductile iron pipe shall conform to the latest revisions of ANSI/AWWA C115/A 21.15. Bolt pattern of flange shall be in accordance with ANSI/AWWA C115/A 21.15 (which is equivalent to ASME/ANSI B16.1, Class 125 flange bolt pattern). Pipe shall have pressure class 250 rating. Gaskets shall be synthetic rubber ring gaskets with a thickness of 1/8 inch. Nuts and bolts shall be in accordance with ASME/ANSI B18.2.1, ASME/ANSI B18.2.2, ASME/ANSI B1.1, and ASTM A307.
8. Flanged fittings shall conform to the latest revisions of ANSI/AWWA C110/A 21.10 or ANSI/AWWA CI 53/A 21.53 (compact fittings). Gaskets shall be in accordance with ANSI/AWWA 0111/A 21.11. Fittings shall have pressure class rating of 250 psi. Bolt pattern of flange shall be in accordance with ANSI/AWWA 0115/A 21.15 (which is equivalent to ASME/ANSI B16.1, class 125 flange bolt pattern).
9. Restrained joint pipe and fittings shall be a boltless system equal to "Field-Lok" restraining gaskets or "TRFLEX Joint" as manufactured by U.S. Pipe & Foundry Company.
10. Ball and socket restrained joint pipe and fittings shall be a boltless system equal to USIFLEX manufactured by U.S. Pipe & Foundry Company or FLEX-LOK manufactured by American Pipe Company. Pipe shall have a working pressure rating of 250 psi and have a maximum joint deflection of 15°. Nominal laying lengths shall be in range of 18 feet 6 inches to 20 feet

11. 6 inches.
Manufacturers: Pipe shall be as manufactured by U.S. Pipe & Foundry Company, Clow, American Cast Iron Pipe Company, or equal.
12. Marking: Pipe or fitting shall have the ANSI/AWWA standard, pressure (or thickness) class, diameter, DI or ductile noted, manufacturer, and country and year where cast on the outside of the body.

2.02 CAST AND DUCTILE IRON PIPE AND FITTINGS

- A. Scope: This article covers the design and manufacture of cast iron pipe centrifugally cast in metal molds and cast iron fittings for pipe sizes two inch (2") through sixty inch (60").
- B. Specific Requirements: Cast iron pipe shall be centrifugally cast in metal molds and shall be furnished cement lined unless otherwise noted on the drawings or in other sections of the specifications. Cast iron pipe shall be furnished with rubber-gasket push-on joints except as may otherwise be noted on the drawings or in difficult working areas and approval of the Engineer.
 1. Thickness class shall be class 50 for all pipe sizes.
 2. Thickness design of cast iron shall conform in all aspects to the requirements of ANSI-AWWA 0101 latest revision.
 3. Manufacture and testing of cast iron pipe centrifugally cast in metal molds shall comply with the requirements of the National Standard Institute and American Waterworks Association designation A21.6/AWWA 0106 latest revisions.
 4. Cement mortar lining with bituminous seal coat shall conform to the requirements of ANSI/AWWA 0104/A 21.4, latest revision for cement-mortar lining for ductile iron pipe, gray iron pipe, and fittings for water. Bituminous outside coating shall be in accordance with ANSI/AWWA 0151/A 21.51 for pipe and ANSI/AWWA 0110/A 21.10 for fittings.
 5. Fittings and gaskets for mechanical and push-on joint ductile and cast iron pipe shall conform to the latest revisions of ANSI/AWWA 0110/A 21.10 for mechanical and push-on joint fittings, ANSI/AWWA 0111/A 21.11 for gaskets, and ANSI/AWWA 0153/A 21.53 for mechanical and push-on joint compact fittings. Mechanical and push-on joint fittings shall have pressure class rating of 350 psi for sizes 20 inches and smaller and 250 psi for sizes larger than 20 inches.
 6. All ductile and cast iron fittings shall be ductile iron grade 80-60-03 in accordance with ASTM A339-55.
 7. Cast iron pipe and fittings should only be used when specifically noted on the drawings or ductile iron is not available in certain sizes.

2.03 PVC (POLYVINYL CHLORIDE) PIPE

- A. **Scope:** This article covers the design and manufacture of PVC 1120 manufactured of CLASS 12454-B or CLASS 12454-C (cell classification) resin material with a hydrostatic-design-basis (HDB) rating of 4,000psi at 73.4 degree F (23 degree C).
- B. **Specific Requirements:** PVC pressure pipe shall be furnished, constructed of materials and to the specifications of this section. The types of PVC pipe permitted for use on the project will be as noted on the drawings. The selected pipe will be designated either as PVC (ASTM) or PVC (AWWA) followed by an appropriate pressure rating or dimension ratio (DR or SDR).
 - 1. **PVC (ASTM) Pipe:**
 - a. PVC (ASTM) pipe shall be designed, manufactured, and tested to conform with the latest revision of ASTM D-2241, ASTM D-1784, and ASTM D-2672.
 - b. Rubber gasketed joints shall conform to ASTM D-3139. The gaskets for the PVC pipe joint shall conform to ASTM F-477 and D-1869. Gaskets shall be integral bell joints with rubber O-ring seals.
 - c. PVC (ASTM) pipe shall be furnished as SDR 17 for 250 psi or SDR 21 for 200 psi.
 - 2. **PVC (AWWA) Pipe:**
 - a. PVC (AWWA) pipe shall be designed, manufactured, and tested to conform with the latest revision of AWWA 0900 for pipes sizes 12 inches and smaller and AWWA 0905 for pipes sizes 14 inches and larger.
 - b. Pipe shall have cast iron pipe equivalent ODs.
 - c. Rubber gasketed joints shall conform to ASTM D-3139. The gaskets for the PVC pipe joint shall conform to ASTM F-477 and D-1869.
 - d. PVC (AWWA) pipe shall be furnished as SDR 18 and 14 for Class 150 psi and 200 psi, respectively.
- C. Rubber gasket joints shall provide adequate expansion to allow for a 50° change in temperature on one length of pipe. Lubrication for rubber connected couplings shall be water soluble, non-toxic, be non-objectionable in taste and odor and have no deteriorating affect on the PVC or rubber gaskets and shall be as supplied by the pipe manufacturer.
- D. Standard laying lengths shall be 20 feet ± for all sizes. At least 95 percent of the total footage of pipe of any class and size shall be furnished in standard lengths, the remaining 5 percent in random lengths. Random lengths shall not be less than 10 feet long. Each standard and random length of pipe shall be tested to four times the class pressure of the pipe for a minimum of five (5) seconds. The integral bell shall be tested with the pipe.

- E. PVC Pipe shall be NSF approved for potable water service and manufactured in accordance with ASTM standards.
- F. All pipe and couplings shall bear identification markings that will remain legible during normal handling, storage, and installation, which have been applied in a manner what will not reduce the strength of the pipe or the coupling or otherwise damage them. Pipe and coupling markings shall include the nominal size and OD base, material code designation, dimension ratio number, ASTM or AWWA Pressure Class, ASTM or AWWA designation number for this standard, manufacturer's name or trademark seal (mark) of the testing agency that verified the suitability of the pipe material for potable-water service. Each marking shall be applied at intervals of not more than five (5) feet for the pipe and shall be marked on each coupling.
- G. Fittings shall be ductile iron in accordance with Article 2.01 of this section. No PVC fittings are allowed.

PART 3- EXECUTION

3.01 LAYING DEPTHS

Water pipe shall be laid with a minimum cover of 36 inches unless otherwise noted on drawings.

3.02 PIPE SPACING

Water mains shall be laid at least 10 feet horizontally from any existing or proposed sewer. A sewer is defined as any conduit conveying fluids other than potable water. The distance shall be measured edge to edge. In cases where it is not practical to maintain a 10 foot separation, this office may allow deviation on a case-by-case basis, if supported by data from the design engineer. Such deviation may allow installation of the water main closer to a sewer, provided that the water main is laid in a separate trench or on an undisturbed shelf located on one side of the sewer at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer. This deviation will not be allowed for force mains.

Water mains crossing sewers shall be laid to provide a minimum vertical distance of 18 inches between the outside of the water main and the outside of the sewer. This shall be the case where the water main is either above or below the sewer. At crossings, one full length of the water pipe shall be located so both joints will be as far from the sewer as possible. Special structural support for the water and sewer pipes may be required.

3.03 THRUST BLOCKING

- A. Concrete: Concrete thrust blocking shall be installed as shown on drawings.
- B. Hydrants:

The bowl of each hydrant shall be well braced against a sufficient area of unexcavated earth at the end of the trench with concrete blocking, and it shall be tied to the pipe as shown on drawings.

1. Thrust restraint design pressure shall be equal to the test pressure.

C. Fittings:

All plugs, caps, tees, and bends shall be restrained and shall also be provided with thrust blocking and shall be rodded to each other.

D. Restraint Materials:

Thrust Blocking: Vertical and horizontal blocking shall be made of concrete having a compressive strength of not less than 3,500 psi after 28 days. Blocking shall be placed between solid ground and the fitting to be anchored; the area of bearing on the pipe and on the ground in each instance shall be that shown or directed by the Engineer. The blocking shall, unless otherwise shown or directed, be located to contain the resultant thrust force and allow the pipe and fitting joints to be accessible for repair.

E. Rod Materials:

All thread rod shall be commercial grade stainless steel Grade 304SS, using stainless steel nuts and flat washers. All thread rod shall be affixed to fitting via ductile lug such as manufactured by Central Castings Corporation.

3.04 PIPE INSTALLATION

A. Proper implements, tools, and facilities shall be provided and used for the safe and convenient performance of the work. All pipe, fittings, valves, and hydrants shall be lowered carefully into the trench by means of a derrick, ropes, or other suitable tools or equipment, in such a manner as to prevent damage to water line materials and protective coatings and linings. Under no circumstances shall water line materials be dropped or dumped into the trench. The trench should be dewatered prior to installation of the pipe.

B. The Contractor shall secure from the manufacturer an installation guide for the pipe being used. The Contractor shall in all cases adhere to the recommended installation procedures of the manufacturer except where those given herein are more stringent. The more stringent requirements shall be met.

- 1. Examination of Material** - All pipe fittings, valves, hydrants, and other appurtenances shall be examined carefully for damage and other defects immediately before installation. Defective materials shall be marked and held for inspection by the Engineer who may prescribe corrective repairs or reject the materials.
- 2. Pipe Ends** - All lumps, blisters, and excess coating shall be removed from the socket and plain ends of each pipe, and the outside of the plain end and the inside of the bell shall be wiped clean and dry and be free from dirt, sand, grit, or any foreign material before the pipe is laid.
- 3. Pipe Cleanliness** - Foreign material shall be prevented from entering the pipe while it is being placed in the trench. During laying operations, no debris, tools, clothing, or other materials shall be placed in the pipe.

4. Pipe Placement - As each length of pipe is placed in the trench, the joint shall be assembled and the pipe brought to correct line and grade. The pipe shall be secured in place with approved backfill material. All jointing of pipe shall occur in the trench. In no case shall the pipe be jointed on the ground and lowered into the trench.
 5. Pipe Plugs - At times when pipe laying is not in progress, the open ends of pipe shall be closed by a water tight plug or other means approved by the Engineer. The plug shall remain in place until the trench is pumped completely dry. Care must be taken to prevent pipe floatation should the trench fill with water.
- C. All dead-end lines must be provided with a fire hydrant or a blow-off assembly per plan and/or detail.
- D. At high points in water mains where air can accumulate, provisions shall be made to remove the air by means of automatic air relief valves.
- E. Water lines within a 200 foot radius of oil or gasoline lines, underground storage tanks, petroleum storage tanks or pumping stations shall be constructed of ductile iron pipe. Pipe joint materials which are resistant to permeation of the petroleum products shall be used within the 200 foot radius.
- F. Underwater crossing:
- For underwater crossings for water surface greater than 15 feet in width, the following shall be provided:
1. The pipe shall be of special construction, per stream encasement detail.
 2. Valves shall be provided at both ends of water crossings so that the section can be isolated for testing or repair; the valves shall be easily accessible, and not subject to flooding.
 3. Stream meter assembly shall be installed at indicated gate valve as shown per detail.

3.05 JOINT ASSEMBLY

A. Push-On Joints:

Push-on joints are to be assembled as follows:

1. Thoroughly clean the groove and bell socket and insert the gasket, making sure that it faces the proper direction and that it is correctly seated.
2. After cleaning dirt or foreign material from the plain end, apply lubricant in accordance with the pipe manufacturer's recommendations.
3. Be sure that the plain end is beveled; square or sharp edges may damage or dislodge the gasket and cause a leak. When pipe is cut in the field, bevel the plain end with a heavy file or grinder to remove all sharp edges.

Push the plain end into the bell of the pipe. Keep the joint straight while pushing. Make deflection after the joint is assembled.

4. Small pipe can be pushed into the bell socket with a long bar. Large pipe requires additional power, such as a jack or lever puller. The supplier may provide a jack or lever pullers. A timber header shall be used between the pipe and jack to prevent damage to the pipe. Homing by backhoe bucket shall not be used unless approved by Engineer.

B. Mechanical Joints:

Mechanical joints are to be assembled as follows:

1. Wipe clean the socket and plain end. The plain end, socket, and gasket should be washed with a soap solution to improve gasket seating.
2. Place the gland on the plain end with the lip extension toward the plain end, followed by the gasket with the narrow edge of the gasket toward the plain end of the pipe.
3. Insert the pipe into the socket and press the gasket firmly and evenly into the gasket recess. Keep the joint straight during assembly.
4. Push the gland toward the bell and center it around the pipe with the gland lip against the gasket.
5. Align bolt holes and insert bolts with bolt heads behind the bell flange, and tighten opposite nuts to keep the gland square with the socket. Make deflection after joint assembly but before tightening the bolts.
6. Tighten the nuts in accordance with the manufacturer's recommendation and the following table:

MECHANICAL JOINTS - BOLT TORQUES	
Bolt Diameter (inches)	Torque (feet - pound)
5/8	45-60
3/4	75-90
1	86-100
1-1/4	105-120

3.06 PIPE CUTTING

Cutting of pipe for the insertion of valves, fittings or closure pieces shall be done in a neat workmanlike manner without creating damage to the pipe, linings, or coatings and in strict accordance to manufacturer's recommendation.

3.07 ASBESTOS CONCRETE MAIN TAPPING

During the process of tapping the asbestos concrete main, the contractor shall conform to OSHA regulations governing the handling of hazardous waste. Pieces of asbestos concrete resulting from the tap shall be double bagged, placed in a rigid container, and disposed of in an approved landfill.

3.08 TESTING

- A. After the pipe has been laid, all newly laid pipe or any valved section thereof shall be subjected to a hydrostatic pressure test. In addition, a leakage test shall be conducted and may be concurrent with the pressure test.
- B. Pressure Test:
1. Test pressure shall be equal to the pipe classification, i.e; class 200 equals a test pressure of 200 psi. The testing shall be conducted for an uninterrupted continuous period of twenty (24) four hours.
 2. Each valved section of pipe shall be filled with water slowly and the specified test pressure, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Engineer.
 3. Before applying the specified test pressure, air shall be expelled completely from the pipe, valves, and hydrants. If permanent air vents are not located at all high points, the Contractor shall install corporation cocks at such points so that the air can be expelled as the line is filled with water. After all the air has been expelled, the corporation cocks shall be closed and the test pressure applied. At the conclusion of the pressure test, the corporation cocks shall be removed and plugged, or left in place at the discretion of the Engineer.
 4. All exposed pipe, fittings, valves, hydrants, and joints shall be examined carefully during the test. Any damage or defective pipe, fittings, or valves that are discovered following the pressure test shall be repaired or replaced with sound material and the test shall be repeated until it is satisfactory to the Engineer.
 5. The watermain as constructed shall be tested between valved sections, but in no case shall the length of test section exceed 3500 feet. If so, the contractor at no additional to the Owner, shall install an inline valve in order to reduce the test section to 3500' or less.
 6. The Contractor shall furnish for the pressure testing a battery operated chart pressure gauge fitted with a continuous 24-hour, 4" diameter pressure recording chart. Such recording device shall be attached to the test section at a place and method approved by Engineer and shall remain in place and protected throughout the test period.
 7. Pressure and leakage test shall not be commenced until all installations, (i.e; fire hydrants, meter services, air-release assemblies, etc.) have been completed. All appurtenances shall be active and subject to the pressure/leakages tests.

C. Leakage Test:

1. Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe, or any valved section thereof, to re-establish the specified test pressure at the end of a twenty (24) four hour period after the air in the pipeline has been expelled and the pipe has been filled with water.
2. The pipe may be tested concurrently with the disinfection. No pipe installation will be accepted if the leakage is greater than that allowed in the following formula:

$$L = [S + 5280] \times D \times 10$$

Where:

L = the allowable leakage (gallons)

S = length of pipe tested (feet)

D = nominal diameter of the pipe (inches)

3. When hydrants are in the test section, the test shall be made against the closed hydrant, with the hydrant gate-valve open.
4. Acceptance shall be determined on the basis of allowable leakage. If any pipe has leakage greater than allowed, the Contractor shall, at his own expense, locate and repair the defective material until the leakage is within the specified allowance.
5. All visible leaks are to be repaired regardless of the amount of leakage.
6. All appurtenances, such as meter services, air-release assemblies, stream meters, PRV vaults, etc. shall be opened and subjected to the pressure/leakage test.

- END OF SECTION -

**SECTION 02630
CASING PIPE**

PART 1 - GENERAL

1.01 GENERAL

Contractor shall provide all labor, materials, and equipment to construct, complete and in place, the casing pipe at the locations shown on the drawings.

1.02 RELATED SECTIONS

- A. Section 02225 - Excavating, Backfilling, and Compacting for Utilities.
- B. Section 02610 - Pipe and Fittings.

PART 2- PRODUCTS

2.01 STEEL CASING PIPE

- A. Casing pipe shall be steel (unless otherwise shown on the drawings), plain end, conforming to AWWA Specification C-200, latest revision. Steel for casing pipe shall have a minimum yield strength of 35,000 psi. Casing pipe shall neither be coated or wrapped. The inside diameter of the casing pipe shall be a minimum of 4 inches greater than the outside diameter of the carrier pipe joint or coupling. Used petroleum pipe will not be acceptable.

- B. The minimum wall thickness shall be in accordance with the following table:

STEEL CASING PIPE WALL THICKNESS		
Casing Diameter (inches)	Minimum Wall Thickness Under Railroads (inches)	Minimum Wall Thickness All Other Uses (inches)
16 and under	0.250	0.250
18	0.281	0.281
20 and 22	0.312	0.281
24	0.344	0.312
26	0.375	0.344
28	0.406	0.375
30	0.438	0.406
32	0.469	0.438

34and36	0.500	0.469
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2.02 PIPELINE SPACERS

- A. Pipeline spacers and accessories such as nuts and bolts shall be constructed of polyethylene and/or stainless steel. Other materials will not be accepted.

- B. Carrier pipes installed inside casing pipes shall be centered throughout the length of casing pipe. Centering shall be accomplished by the installation of polyethylene pipeline spacers attached to the carrier pipe in such a manner as to prevent the dislodgement of the spacers as the carrier pipe is pulled or pushed through the casing pipe. Spacers shall be of such dimensions to provide: full supportive load capacity of the pipe and contents; of such thickness to allow installation and/or removal of the pipe; and to allow no greater than 1/2 inch movement of the carrier pipe within the cover pipe after carrier pipe is installed.

- C. Spacers shall be located immediately behind each bell and at a maximum spacing distance as follow:

Carrier Pipe Diameter (inches)	Maximum Spacing (feet)
2-2-1/2	4
3-8	6
10-26	8
28	9
30	8

- D. The materials and spacing to be used shall be accepted by the Engineer prior to installation. The polyethylene pipeline spacers shall be manufactured by Pipeline Seal and Insulator, Inc. (PSI), Raci Spacers, Inc., Advanced Products & Systems, Inc., or approved equal. Installation shall be in accordance with manufacturer's recommendations.

2.03 SEALING

After installation of the carrier pipe within the casing pipe, the ends of the casing shall be sealed in the following manner. An Ethylene Propylene Diene Monomer (EPDM) elastomeric membrane shall be wrapped around the end of the casing pipe in three layers and securely bound to the casing and the carrier pipe barrel with stainless steel bands. The EPDM membrane shall be 0.045 inches thick and have a tear resistance of 125 pounds/inches. The membrane shall be manufactured by Carlisle Tire & Rubber Company,

Firestone Industrial Products Company, or an approved equal.

PART 3- EXECUTION

3.01 BORE AND JACK

- A. Where designated on the drawings, crossings beneath state maintained roads, railroads, or other surfaces shall not be disturbed and are to be installed by boring and jacking of steel casing pipe followed by installation of the carrier pipe within the casing pipe. The Contractor shall provide a jacking pit, bore through the earth, and/or rock, jack the casing pipe into proper line and grade and then install the carrier pipe within the casing pipe.
- B. The approach trench shall be large enough to accommodate one section of casing pipe, the jacks and blocking. The Contractor shall furnish and use adequate equipment to maintain the line and grade.
- C. In no case shall the bore pit or exit ditch face be closer than six (6') feet from any pavement surface.

3.02 OPEN CUT

Where designated on drawings, the Contractor shall open the trench under the direction of the Engineer and install the casing pipe and complete the bedding, backfilling, and paved surface restoration as specified elsewhere herein, or as shown by details.

3.03 DAMAGE

The cost of repairing damage which is caused by boring or open cutting the trench under a highway or railroad shall be borne by the Contractor.

- END OF SECTION -

SECTION 02642
WATER VALVES AND ACCESSORIES

PART 1 — GENERAL

1.01 SUMMARY

The Contractor shall furnish all labor, material, and equipment necessary to install valves together with all appurtenances as shown and detailed on the drawings and specified herein.

1.02 RELATED SECTIONS

- A. Section 02225 - Excavating, Backfilling, and Compacting for Utilities.
- B. Section 02610- Pipe and Fittings.

1.03 SUBMITTALS

- A. Complete shop drawings of all valves and appurtenances shall be submitted to the Engineer in accordance with the requirements of Section 01300.
- B. The manufacturer shall furnish the Engineer two (2) copies of an affidavit stating that the valve and all materials used in its construction conform to the applicable requirements of the latest revision of the applicable AWWA Standard, and that all tests specified therein have been performed and that all test requirements have been met.
- C. The Engineer shall be furnished two (2) copies of affidavit that the "Valve Protection Testing" has been done and that all test requirements have been met.
- D. The Engineer shall be furnished with two (2) copies of affidavit that inspection, testing, and rejection are in accordance with the latest revision of the applicable AWWA Standard.

PART 2— PRODUCTS

2.01 GATE VALVES

- A. All gate valves shall be of the resilient seat type in accordance with the latest revision of AWWA C509 Standard. The valve body, bonnet, and gate castings shall be ductile iron. The valve shall have a non-rising stem (NRS), fully bronze mounted with O-ring seals. Valve body and bonnet, inside and out, shall be fully coated with fusion bonded epoxy coating in accordance with AWWA C550 Standard. Valves shall have a rated working pressure of 200 psi.
- B. Gate valves for buried service shall be furnished with mechanical joint end connections, unless otherwise shown on the drawings or specified herein. The end

- connection shall be suitable to receive ductile iron or PVC pipe.
- C. Gate valves for meter pits, pump stations, stream crossing meters or other installations as shown on the drawings shall be furnished with flanged joint and connections, outside screw and yoke and handwheel operator. The gate valve shall have the direction of opening cast on the rim of the handwheel and provided with chain and lock.
 - D. All gate valves shall have the name or monogram of the manufacturer, the year the valve casting was made, the size of the valve, and the working pressure cast on the body of the valve.
 - E. Buried service gate valves shall be provided with a 2-inch square operating nut and shall be opened by turning to the left (counterclockwise). For valves having a burial depth in excess of 48", the valve shall be equipped with an extension such that the operating nut is 24" below the lid of the gate-valve box.
 - F. Buried service gate valves shall be installed in a vertical position with valve box as detailed on the drawings. They shall be set vertically and properly adjusted so that the cover will be in the same plane as the finished surface of the ground or street.
 - G. Valves shall be those manufactured by Mueller, M & H Valve Company, American, or approved equal.

2.02 CHECK VALVES

- A. **General:** Check valves shall be all iron body bronze mounted, full opening swing type. Valve clapper shall swing completely clear of the waterway when valve is full open, permitting a "full flow" through the valve equal to the nominal pipe diameter. They shall comply with AWWA Standard O-508 latest revision. The valves shall be M & H Valve Company, Anniston, AL, Valve Type 159-Lever Weight, or approved equal.
- B. **Rating:** Check valves shall be rated at 200 psi water working pressure, 350 psi hydrostatic test for structural soundness (2-inch through 12-inch) and 150 psi water working pressure and 300 psi hydrostatic test (sizes 14-inch through 30-inch). Seat tightness at rated working pressure shall be in accordance with valves shown in AWWA Standard O509 for gate valves and fully conform to AWWA C508.
- C. **End Configurations:** Check valves shall be furnished with 125-pound ANSI flanges ends with accessories.
- D. **Materials:** All cast iron shall conform to ASTM A126 Class B. Castings shall be clean and sound without defects that will impair their service. No plugging or welding of such defects will be allowed. Clappers shall be all bronze for sizes through 4-inch and cast iron, neoprene faced for sizes 6-inch and larger. Hinge pins shall be 18-8 stainless steel rotating in bronze plugs. Bolts shall be electro-zinc plated steel with hex heads and hex nuts in accordance with ASTM A307 and A563, respectively.
- E. **Design:** Check valves shall be constructed to permit top entry for complete removal of internal components without removing the valve from the line. Glands

shall be O-rings, 2-inch to 12-inch sizes and conventional in 14-inch to 30-inch sizes. Check valves shall be equipped with adjustable outside lever and weight to accomplish faster closing and to minimize slamming effect. All valves 14-inch and larger shall have extended hinge pins for future addition of levers and springs required. Valves shall be suitable for installation in either horizontal or vertical position.

- F. **Painting:** The inside and outside of all valves, together with the working parts except bronze and machined surfaces, shall be coated in accordance with the latest revision of AWWA 0550 Standard.
- G. **Marking:** Marking shall be in accordance with AWWA 0508 and shall include size, working pressure, and cast arrow to indicate direction of flow, name of manufacturer, and year of manufacture.

2.03 SILENT CHECK VALVES

- A. Silent check valves 3 inches and larger shall be iron body, bronze mounted with a stainless steel spring and Buna-N-Resilient seating. The valves shall be APCO Series 600 globe style or approved equal. The valve plug shall be brass and center guided at both ends with a through integral shaft and spring loaded.
- B. Valves shall be designed for a water working pressure of 200 psi.
- C. The seat and plug shall be replaceable manually in the field.
- D. The flow area through the valve body shall be equal to or greater than the cross-sectional area of the equivalent pipe length.
- E. Valves shall be capable of operating in either a horizontal or vertical position.

2.04 ELECTRIC CHECK VALVE

- A. **Operation:** The pump control valve shall minimize pump starting and stopping surges by placing the pump "on line" and taking it "off line" slowly. The controls shall consist of adjustable independent opening and closing speed control valves, a cam operated limit switch, a three-way solenoid valve with a manual operator, and a two-way solenoid valve for power failure quick closure.
- B. **Design:**
 - 1. The pump control valve shall be flanged globe body, fully bronze mounted, external pilot operated, with free floating piston (operated without springs diaphragm, or levers), single seat with seat bore equal to size of valve.
 - 2. The minimum travel of the piston shall be equal to 25 percent of the diameter of the seat and for true alignment (to correct lateral thrust and stem binding) the piston shall be guided above and below the seat a distance equal to no less than 75 percent of the diameter of the seat. The piston shall be cushioned and so designed as to insure positive closure.

3. The piston shall carry a contoured cushion device that will cause a gradual change in flow area as the valve approaches the seat. This cushion device must move with the piston to minimize head loss when the valve is fully opened.
4. The valve shall be packed with resilient seating to insure tight closure and prevent metal to metal friction and seating; furnished with indicator rod, to show position of opening of the piston, and pet-cocks for attachment to valve body for receiving gauges for testing purposes.
5. The design shall be such that repairs and dismantling internally of main valve may be made without its removal from the line.
6. The installation shall incorporate the emergency close (or power-failure quick close) feature. This uses a second solenoid pilot valve to bypass the normal slow closing speed control valve on power outage to close the valve quickly (but still at a controlled rate).

C. Physical and Chemical Properties:

1. The 125-pound and 250-pound flanged assemblies shall conform to A.S.A. standards for flange thickness and drilling and wall thickness of body and caps. The valve shall be constructed of first class grey iron free from cold shuts, defective or spongy spots, and conforming to ASTM Specification A-126 Class B.
2. The bronze parts shall conform to ASTM specification B-62.

D. Test: The test before shipment may be witnessed by a representative of the Engineer for simulated field conditions and a cold hydrostatic test of at least 100 percent above the maximum pressure for which the valve is to operate.

E. Painting: All iron castings shall be coated on all sides with fusion bonded epoxy coating in accordance with AWWA 0550 Standard.

F. Manufacturer: The valve shall be Model 42 WARS Pump Control Valve as manufactured by the Ross Valve Mfg. Co., Inc., or approved equal.

2.05 BUTTERFLY VALVES (NON-BURIED)

- A. For Valves 4-inch or Larger: The butterfly valves shall be DeZurik AWWA C504 series (or approvable equal), lug style, resilient seat, cast iron body and disk, stainless steel seating edge (ring) and shaft, Chloroprene seat, class 150B, and furnished with a manual handwheel actuator.
- B. For Valves 3-inch or Smaller: The butterfly valves shall be DeZurik BGS series (or approvable equal), lug style, resilient seat, cast iron body and EPDM seat, stainless steel seat ring and shaft, ductile iron nickel plated disc, class 150, and furnished with a manual lever actuator.
- C. Valves shall be fully coated, inside and out, with fusion bonded epoxy in

accordance with the latest revision of AWWA 0550 Standard.

2.06 BUTTERFLY VALVES (BURIED)

For Valves 4-inch through 24-inch: The butterfly valve shall be DeZurik or M&H Valve Company AWWA C504 series (or approvable equal), mechanical joint, resilient seat, cast iron body and disk, stainless steel shaft and seating edge (ring), Chloroprene seat, Class 150B, cast iron housing with 2-inch operator nut in vertical position for use with a valve box. The valve shall be fully coated, inside and out, with fusion bonded epoxy in accordance with the latest revision of AWWA C550 Standard.

2.07 TAPPING VALVES

- A. All tapping valves shall be of the resilient seat, gate valve type in accordance with the latest revision of AWWA C509 Standard. The valve body, bonnet, and gate castings shall be cast iron. The valve shall have a non-rising stem (NRS), fully bronze mounted with O-ring seals. Valve body and bonnet, inside and out, shall be fully coated with fusion bonded epoxy coating in accordance with AWWA C550 Standard. Valves shall have a rated working pressure of 200 psi.
- B. Valve shall be furnished with ANSI B16.1 flanged end with centering ring on tapping side. Outlet side shall be mechanical joint. All valves through 12 inches shall mate all sleeves through 12-inch outlet regardless of manufacturer.
- C. All cast iron shall conform to ASTM A126, Class B. Castings shall be clean and sound without defects that will impair their service. No plugging or welding of such defects will be allowed. Bolts shall be electric-zinc plated steel with hex heads and hex nuts in accordance with ASTM A-307 and A-563.
- D. Stems shall be manganese bronze having a minimum tensile strength of 60,000 psi, a minimum yield of 20,000 psi. NRS stem collars shall be cast integral with them and machined to size. The housing for the valve stem collar shall be machined. All thrust bearing shall be incorporated as required, to optimize operating torques. NRS valves shall be furnished with two (2) o-ring stem seals located above the thrust collar and one (1) below. O-rings shall be set in grooves in the stem. The o-ring grooves shall not be less than the root diameter of the stem threads.

Gates for valve shall be totally encapsulated in rubber, be field replaceable and provide a dual seal on the mating body seat. Valve shall be capable of installation in any position with rated sealing in both directions. Rubber sets of specially compounded SBR materials shall be utilized and be capable of sealing even under conditions of normal wear. The valve body shall have integral guide engaging lugs in the gate in a tongue-and-groove manner, supporting the gate throughout the entire open/close travel.

- E. Tapping valves shall be capable of making taps by using any cutter not less than 1/4-inch smaller than nominal pipe size.
- F. All tapping valves shall have the name or monogram of the manufacturer, the year the valve casting was made, the size of the valve, and the working pressure cast on the body of the valve.

- G. Tapping valves shall be provided with a 2-inch square operating nut and shall be opened by turning to the left counterclockwise.
- H. Tapping valves shall be installed in a vertical position with valve box as detailed on the drawings. They shall be set vertically and properly adjusted so that the cover will be in the same plane as the finished surface of the ground or street.
- I. Valves shall be those manufactured by Mueller, M & H Valve Company, American, or approved equal.

2.08 AIR RELEASE VALVES

- A. The air release valves shall be the size noted on the drawings and equal to Valmatic Model 38.5 as manufactured by Valmatic Valve and Manufacturing Corp.
- B. The valves shall be in accordance with ANSI/AWWA C512.
- C. The valves shall be of the type that automatically exhausts large quantities of air during the filling of a system and allows air to re-enter during draining or when a vacuum occurs. Valves shall be constructed of cast iron body and cover, stainless trim, and float with a Buna-N seat for positive seating.
- D. The baffle shall be ductile iron and shall protect float from direct impact of air and water. The seat shall slip fit into the baffle or cover and lock in place without any distortion. The float and baffle assembly shall be shrouded with a water diffuser. The float shall be stainless steel center guided for positive seating and be rated at 1,000 psi non-shock service.
- E. The discharge orifice shall be fitted with a double-acting throttle device to regulate and restrict air venting.
- F. All parts of the valves and the operating mechanisms shall be made of non-corrodible materials.

2.09 COMBINATION PRESSURE REDUCING/PRESSURE SUSTAINING VALVE (PRV/PSV)

- A. The valve shall maintain a constant downstream pressure regardless of fluctuations in demand. When the upstream pressure lowers to a pre-set minimum the valve shall throttle to maintain a constant inlet pressure.
- B. The valve shall be a hydraulically operated, diaphragm-actuated, globe pattern valve. It shall contain a resilient, synthetic rubber disc, having a rectangular cross-section, contained on three and one-half sides by a disc retainer and forming a tight seal against a single renewable seat. The diaphragm assembly containing a valve stem shall be fully guided at both ends by a bearing in the valve cover and an integral bearing in the valve seat. This diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve, separating operating pressure from line pressure. The diaphragm shall consist of nylon fabric bonded with synthetic rubber and shall not be used as a seating surface. Packing glands and/or stuffing boxes are not permitted, and there shall be no pistons operating the valve or pilot controls. All necessary repairs shall be possible without removing valve from the line.

- C. The pressure reducing pilot control shall be a direct-acting, adjustable, spring-loaded, normally open diaphragm valve, which closes when downstream pressure exceeds the spring setting. The pressure sustaining pilot control shall be a direct-acting, adjustable, spring-loaded, normally closed diaphragm valve which opens when upstream pressure exceeds the spring setting.
- D. Valve shall have a cast iron body with bronze trim.
- E. Pressure reducing range shall be 30 psi to 300 psi and pressure sustaining range shall be 20 psi to 200 psi.
- F. Valve shall be fully coated with fusion bonded epoxy in accordance with AWWA C550 Standard.
- G. The valve shall be similar to a Model 92G-01 Combination Pressure Reducing, Pressure Sustaining Valve (globe style) as manufactured by Cla-Val Co.

2.10 PRESSURE SUSTAINING VALVE (PSV)

- A. The valve shall maintain a constant downstream pressure regardless of fluctuations in demand. When the upstream pressure lowers to a pre-set minimum the valve shall throttle to maintain a constant inlet pressure.
- B. The valve shall be a hydraulically operated, diaphragm-actuated, globe pattern valve. It shall contain a resilient, synthetic rubber disc, having a rectangular cross-section, contained on three and one-half sides by a disc retainer and forming a tight seal against a single renewable seat. The diaphragm assembly containing a valve stem shall be fully guided at both ends by a bearing in the valve cover and an integral bearing in the valve seat. This diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve, separating operating pressure from line pressure. The diaphragm shall consist of nylon fabric bonded with synthetic rubber and shall not be used as a seating surface. Packing glands and/or stuffing boxes are not permitted, and there shall be no pistons operating the valve or pilot controls. All necessary repairs shall be possible without removing valve from the line.
- C. The pressure sustaining pilot control shall be a direct-acting, adjustable, spring-loaded, normally closed diaphragm valve which opens when upstream pressure exceeds the spring setting.
- D. Valve shall have a cast iron body with bronze trim.
- E. Pressure sustaining range shall be 20 psi to 200 psi.
- F. Valve shall be fully coated with fusion bonded epoxy in accordance with AWWA C550 Standard.
- G. The valve shall be similar to a Model 730 Pressure Sustaining Valve (globe style) as manufactured by Bernad.

2.11 PRESSURE REDUCING VALVE (PRV)

- A. The valve shall automatically reduce a higher inlet pressure to a steady lower downstream pressure regardless of changing flow rate and/or varying inlet pressure. The main valve and pilot valve shall close drip-tight when downstream pressure exceeds the pressure setting of the control pilot.
- B. The valve shall include a check feature that will close the valve when pressure reversal occurs. The closing of valve shall be accomplished by transmitting downstream pressure to the main valve cover chamber.
- C. The valve shall be a hydraulically operated, diaphragm-actuated, globe pattern valve. It shall contain a resilient, synthetic rubber disc, having a rectangular cross-section, contained on three and one-half sides by a disc retainer and forming a tight seal against a single renewable seat. The diaphragm assembly containing a valve stem shall be fully guided at both ends by a bearing in the valve cover and an integral bearing in the valve seat. This diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve, separating operating pressure from line pressure. The diaphragm shall consist of nylon fabric bonded with synthetic rubber and shall not be used as a seating surface. Packing glands and/or stuffing boxes are not permitted, and there shall be no pistons operating the valve or pilot controls. All necessary repairs shall be possible without removing valve from the line.
- D. The pressure reducing pilot control shall be a direct-acting, adjustable, spring-loaded, normally open diaphragm valve, which closes when downstream pressure exceeds the spring setting.
- E. Valve shall have a cast iron body with bronze trim.
- F. Upstream adjustment range shall be 20 psi to 300 psi and downstream adjustment range 30 psi to 300 psi.
- G. Valve shall be fully coated with fusion bonded epoxy in accordance with AWWA C550 Standard.
- H. The valve shall be similar to a Model 90G-01 Pressure Reducing Valve (globe style) as manufactured by Cla-Val Co.

2.12 ELECTRIC CONTROL VALVE

- A. Operation: The electric control valve shall operate independent of valve differential pressure. The double-chambered diaphragm actuator always has full differential pressure to develop maximum power and immediate reaction. Upper control chamber operates on 3-way control principle. A 3-way solenoid valve alternately applies upstream pressure to tightly close the main valve and vent pressure to the atmosphere to open widely the main valve. Main valve shall be normally open. Solenoid valve shall close main valve when energized.

- B. **Design:** The main valve shall consist of a wide, Y-pattern body, hydrodynamically designed with semi-straight flow; a double-chambered diaphragm actuator, hydraulically operated. The body shall have a single removable seat with full-flow opening, free of bottom stem guide, and a resilient seat for drip-tight closing. The valve diaphragm actuator contains two defined control chambers that can be removed as one distinct assembly. The actuator includes the separating partition. Valve shall be rated for 175 psi working pressure.
- C. **Materials:** Main valve and actuator shall be cast iron in accordance with ASTM A126, Class B. Main valve trim and pilot control system shall be cast bronze or brass in accordance with ASTM B62 or ASTM B21, respectively. Diaphragm shall be nylon reinforced neoprene and seals shall be Buna-N.
- D. **Electrical:** Solenoid valve shall be 120 volt, single phase, NEMA 4 enclosed with heavy duty coil with class H insulation.
- E. **Accessories:** Electric control valve shall be equipped with a large control filter, a v-port throttling plug, a valve position indicator, and a mechanical closure and flow adjuster.
- F. **Painting:** Main valve shall be fully coated on all sides with fusion bonded epoxy in accordance with AWWA C550 Standard.
- G. **Marking:** Main valve marking shall include size, working pressure, flow direction, name of manufacturer, and year of manufacture.
- H. **Manufacturer:** The electric control valve shall be Model 710 as manufactured by Bermad, or approved equal.

2.13 SURGE ARRESTOR VALVES

- A. **Function:**
 - 1. The surge arrestor valve shall open quickly at a predetermined over-pressure to dissipate surge and close slowly after restoration of normal pressure. Plus, open quickly at a pre-determined under-pressure setting, remain open for a suitable time period to dissipate surge, and then slowly close. Plus, open quickly on electrical power failure, remain open for a suitable time period to dissipate surge and then slowly close.
 - 2. Needle valves shall be furnished to provide independent and adjustable control of the main valve opening and closing speed.
 - 3. The valve shall be completely piped ready for installation.

B. Description:

1. The main valve shall operate on the differential piston principle such that the area on the underside of the piston is no less than the pipe area, and the area on the upper surface of the piston is of a greater area than the underside of the piston.
2. The valve piston shall be guided on its outside diameter by long stroke stationary Vee ports which shall be downstream of the seating surface to minimize the consequences of throttling. Throttling shall be done by the valve Vee ports and not the valve seating surfaces.
3. The valve shall be capable of operating in any position and shall incorporate only one flanged cover at the valve top from which all internal parts shall be accessible. There shall be no stems, stem guides, or spokes within the waterway. There shall be no springs to assist the valve operation.

C. Construction:

1. The valve body shall be of cast iron ASTM A-126 with flanges conforming to the latest ANSI Standards. The valve shall be extra heavy construction throughout. The valve interior trim shall be bronze B-62 as well as the main valve operation.
2. The valve seals shall be easily renewable while no diaphragm shall be permitted within the main valve body.
3. All controls and piping shall be of non-corrosive construction.
4. A visual valve position indicator shall be provided for observing the valve position at any time.

D. Manufacturer: The valve shall be Model 735 as manufactured by Bermad, Model 6700-D (globe) or 6600-D (angle) as Manufactured by Golden Anderson, or approvable equal.

2.14 ALTITUDE VALVES

A. Single Acting (one direction):

1. **Function:** The single acting altitude valve shall be a one-way valve of the delayed opening, non-throttling type that controls the high and low water level in a standpipe as shown on the drawings. The valve shall assume either a fully open or fully closed position and shall be able to control a water level change of a minimum of five (5) feet and a maximum of 50 feet between closing and opening points. Opening and closing points shall be adjustable.
2. **Description:** The altitude valve shall be a hydraulically operated, pilot controlled, diaphragm type globe valve. The valve shall be single seated and shall have a resilient disc for tight closure. Small changes in storage tank level shall cause an immediate action of the pilot control. The control

system shall consist of a main valve and pilot valve to control the reservoir level. The opening and closing rates of the valve shall be adjustable to prevent surges and line shock. The valve shall be provided complete with all piping and appurtenances necessary for operation, including a valve position indicator, a pilot valve strainer, and a 3/4-inch minimum brass or copper pressure sensing line. The entire valve and control assembly shall be readily accessible and easily removable, and its design shall be such that repairs to the main valve can be made without its removal from the line.

3. Construction: Valve body and trim shall be bronze or cast-iron conforming to ASTM B62, ASTM B61, or ASTM A126 Class B, respectively. Ends shall be Class 125 according to ANSI B16.1 and flanged. The valve shall be Class 125 with a pressure rating of 175 psi. All iron castings shall be fully coated on all sides with fusion bonded epoxy in accordance with AWWA 0550 Standard.
4. Manufacturer: Altitude valve shall be model 30R-AWR, figure 29A, as manufactured by Ross Valve Manufacturing Company; Model 210-3 as manufactured by CLA-VAL Company; or equal

B. Double Acting (two directions):

1. Function: The double acting altitude valve shall be a two-way valve of the delayed opening, non-throttling type that controls the high water level in a tank as shown on the drawings. The valve shall assume either a fully open or fully closed position and shall be able to control a water level change of a minimum of five (5) feet and a maximum of 50 feet between closing and opening points. The closing point shall be adjustable and the opening point shall be non-adjustable and activates when the distribution pressure drops one (1) to four (4) feet below the closing point.
2. Description: The altitude valve shall be a hydraulically operated, pilot controlled, diaphragm type globe valve. The valve shall be single seated and shall have a resilient disc for tight closure. Small changes in storage tank level shall cause an immediate action of the pilot control. The control system shall consist of a main valve and pilot valve to control the reservoir level. The opening and closing rates of the valve shall be adjustable to prevent surges and line shock. The valve shall be provided complete with all piping and appurtenances necessary for operation, including a valve position indicator, a pilot valve strainer, and a 3/4-inch minimum brass or copper pressure sensing line. The valve shall have a factory installed "vacuum break" line on the control circuit. The entire valve and control assembly shall be readily accessible and easily removable, and its design shall be such that repairs to the main valve can be made without its removal from the line.
3. Construction: Valve body and trim shall be bronze or cast-iron conforming to ASTM B62, ASTM B61, or ASTM A126 Class B, respectively. Ends shall be Class 125, according to ANSI B16.1 and flanged. The valve shall be Class 125 with a pressure rating of 175 psi. All iron castings shall be fully coated on all sides with fusion bonded epoxy in accordance with AWWA C550 Standard.

4. **Manufacturer:** Altitude valve shall be model 40R-DAWR, figure 33A, as manufactured by Ross Valve Manufacturing Company; Model 210-02 as manufactured by CLA-VAL Company; or equal.

2.15 VALVE BOXES

- A. Each buried stop and valve shall be provided with a suitable valve box. Boxes shall be of the adjustable, telescoping, heavy-pattern type with the lower and upper parts of cast iron. They shall be so designed and constructed as to prevent the direct transmission of traffic loads to the pipe or valve.
- B. The upper or sliding section of the box shall be provided with a flange having sufficient bearing area to prevent undue settlement. The lower section of the box shall be designed to enclose the operating nut and stuffing box of the valve and rest on the valve bonnet.
- C. The boxes shall be adjustable through at least six (6) inches vertically without reduction of the lap between sections to less than four (4) inches.
- D. The inside diameter of boxes for valves shall be at least 4-1/2 inches, and the lengths shall be as necessary for the depths of the valves or stops with which the boxes are to be used.
- E. Covers for valves shall be close fitting and substantially dirt-tight and marked "WATER."
- F. The top of the cover shall be flush with the top of the box rim.
- G. Valve boxes shall be manufactured by Muller, Accer Cast, Inc., or approved equal.

2.16 TAPPING SLEEVES

- A. Tapping sleeves shall be cast iron and capable of containing pressure within the full volume of the sleeve. Sleeve shall be mechanical joint suitable for use with ductile iron or PVC pipe.
- B. Sleeve shall be rated at 200 psi working pressure through 12-inch size and 150 psi for sleeves 14-inch through 24-inch.
- C. Flanged throat section of mechanical joint sleeves through 12-inch size shall conform to MSS SP60 Standard. For throat sections larger than 12 inches, flanged section shall mate valves of same manufacture as sleeves.
- D. All cast iron shall conform to ASTM A126, Class B. Castings shall be cleaned and sound without defects that will impair their service. No plugging or welding of such defects will be allowed. Bolts, nuts, and gaskets shall be in accordance with mechanical joint requirements of AWWA 0111.
- E. Tapping sleeves shall be capable of withstanding their rated pressure without leakage past the side gaskets and end gaskets of the sleeve. Sleeves shall be

supplied with split end gaskets and two-piece glands. Side flange rubber gaskets shall butt against the rubber end gaskets to make a watertight seal. Side and end bolts shall be of a T-head design. The throat flange shall be designed to center the tapping valve to the sleeve. Tapping sleeve shall be equipped with a test plug.

- F. Tapping sleeves shall be fully coated with fusion bonded epoxy coating in accordance with AWWA 0550 Standard.
- G. Sleeves shall be marked with the name of the manufacturer and size (run x branch).
- H. Tapping sleeve shall be manufactured by Mueller, M & H Valve Company, or approved equal.

2.17 COMPOUND WATER METER

- A. Master meter shall be a compound meter in the size noted on the drawings.
- B. Meter shall be in accordance with AWWA 0702.
- C. Meter shall meet the following specifications:

Typical Operating Range	1-700 GPM
(100%±1.5%)	
Low Flow Registration	1/2 GPM
Maximum Continuous Flow	500 GPM
Pressure Loss at Maximum Continuous Flow	6 PSI at 500 GPM
Pressure Loss at Crossover	6 PSI
Minimum Crossover Accuracy	95%
Maximum Operating Pressure	150 PSI
Maximum Operating Temperature	120°F
Meter Flanges	Round flanges, Class 150
Register	Straight reading, single register, sealed magnetic drive standard. Remote reading units optional.
Total Flow	100,000,000 gallons
Registration	100 gallons/sweep hand revolution

Low Flow	10,000,000 gallons
Registration	10 gallons/sweep hand revolution
Housing	Cast bronze
Nose Cone and Straightening Vanes	Thermoplastic
Rotor	Thermoplastic
Rotor and Valve Casing	Thermoplastic
Rotor Spindle, Bearing, and Endstone	Ceramic
Measuring Chamber and Disc	Thermoplastic
High Flow Valve	Thermoplastic
High Flow Swing Weight	Cast bronze
Triggers	Stainless steel
Magnets	Ceramic and alnico
Register Lens	Glass/thermoplastic
Register Housing and Cover	Thermoplastic
Trim	Stainless steel

- D. Meter shall be equal to the Recordall as manufactured by Badger Meter or Neptune Tru/Flo as manufactured by Schlumberger Industries.

2.18 TURBINE WATER METER

A. General:

1. The turbine type water meters provided for the project shall be of single manufacturer. The meter manufacturer shall have a minimum of five (5) years of experience in the design and manufacture of turbine water meters of equal size and quality to those specified.
2. Water meter shall meet or exceed the latest requirements of AWWA 0701 for Class II turbine type, magnetic drive, flanged meter tube with 150 psi working pressure.
3. Water meters provided for this project shall be Neptune as manufactured by Schlumberger Industries or approved equal.

B. Components:

1. Meter tube shall be flanged cast bronze. The internal and external of the meter tube and meter head shall be free of any casting flaws or sharp corners or burrs. The meter tube shall have manufacturer's name, meter size, AWWA Class II, and flow arrow cast into both sides. Meter tubes shall offer minimum obstruction to the flow. Four-inch and 6-inch meters shall be furnished with 1-inch NPT coupling on outlet side.
2. Meter head shall be connected to the tube by means of gasket sealed connection with stainless steel bolts. The meter shall be designed for easy removal of water wetted parts from the tube for inspection or repair without having to remove the complete tube. Water wetted meter components that are permanently attached to the tube or meter head will not be accepted. The meter head shall incorporate a sealed stainless steel flow adjusting vane for recalibration. The vane shall be set at the factory, capped, and sealed to prevent unauthorized adjustment.
3. Measuring chamber shall be removable from the meter head. The drive mechanism shall be directly coupled to the rotor by mean of gears. The gearbox shall be integral with the outlet housing and shall be designed to facilitate easy replacement of gears.
4. Rotor shall be permanently attached to the rotor shaft and shall rotate on an axis that is parallel to the direction of the water flow through the pipe. The rotor shall be resistant to normal corrosion and deformity due to high flow velocities, and shall be directly coupled to the gear train.
5. Bearings for the rotor shaft dual out-board graphite bearings, position to provide uniform loading of the rotor. Dual thrust bearings shall handle flows in both forward and reverse directions. All bearings must be field replaceable.
6. Totalizer shall be a six-digit, straight reading type with a 3-inch diameter, 100 division dial, and center sweep test hand to permit timing for an accurate determination of flow rate. The totalizer shall be equipped with a leak detector hand to indicate very low flow. The totalizer shall read in units of gallons per day and shall be magnetically driven and equipped with change gears to facilitate easy change of registration without removing pressure from the line. The totalizer shall be encased in an o-ring sealed bonnet made of cast bronze.

- C. Quality Control: Volumetric testing of all meters must be performed and approved prior to shipment. The complete head assembly must be accurately tested in the same pipe size and same tube that the meter will be mounted in. The test shall be minimum, intermediate, and maximum AWWA flow ranges of the meter. The amount of water used to conduct the test must be left on the totalizer. Prior to shipping, a tag shall be attached to the meter showing the totalizer reading after the test. A copy of the certified accuracy test record must be furnished to the Owner at no charge.

2.19 ULTRASONIC FLOW METER (FOR POTABLE WATER)

- A. The flowmeter shall be of the ultrasonic clamp on, transit-time and provide indicating, totalizing, and transmitting of liquid flow rate in full pipes.

1. The operational specifications shall be accuracy +/- 0.5 percent of velocity or +/- 0.05 FPS.
- B. The meter shall operate on the following pipe materials: carbon steel, stainless steel, mortar-lined ductile iron, copper, aluminum, cast iron, FRP, ASB, and PVC.
1. The meter shall be programmable for use on all pipe schedules and diameters one (1) inch through 90 inches using the same hardware and electronics.
 2. The instrument shall be of the Auto Zero type. There will be no requirement to stop or alter flow during installation.
 3. The ultrasonic flowmeter shall measure flow rates in clean liquids with a velocity span of +/- 0 to 50 feet per second in pipe sizes of one (1) to 90 inches.
- C. The meter shall have four (4) outputs which can be programmed for signal loss, reverse flow, totalizer pulses, or over scale functions.
- D. The electronics shall be provided in a NEMA-4X enclosure with viewing window for reading indicators with door closed.
- E. The 4-20 mA output shall be proportional to flow rate. The maximum, resistive load shall be 600 OHMS and current limited.
- F. The meter shall have a 4-20 mA input for display locally in scalable units of measure.
- C. Unit to have a built-in microprocessor to provide capability for:
1. Adapting instrument hardware to existing piping and flow conditions.
 2. Automatically calculating transducer spacing.
 3. Programming the scale factor.
 4. Programming the low flow cut-off.
 5. Selecting English or Metric units.
 6. Automatic speed of sound calculation of measured fluid.
 7. Bi-directional totalization with selectable resolution.
 8. Displaying, in percent, 4-20 mA inputs from external sources.
 9. Flow output selection in GPM, GPH, MOD, and FPS (or metric equivalent).
 10. Adjustable damping from 1 to 99 seconds.
 11. LCD indication or flow diagnostics to include a "fault" status.
 12. Section of zero functions:
 - a. Auto zero under flow conditions.
 - b. Set zero when flow can be stopped.
 - c. Zero operate for fast response.
 13. Storage of data for up to eight pipes with recall capability.
- H. The transmitter shall be wall mounted in meter vault.

- I. A remote flow rate indicator/totalizer terminal shall be provided. It shall be panel mounted in the MTU located in the laboratory. (The MTU is provided as part of Specification Section 13400). A 4-20 mA analog output signal proportional to the flow rate shall be included for connection to the remote flow indicator/totalizer.
- J. The flowmeter shall be equal to TYME-FLYTE ISTT by POLYSONICS.

2.20 STRAINER FOR METERS

Strainer for meters shall be installed upstream of meter at location shown on the drawings. In no case shall there be less than a minimum of five (5) pipe diameters of straight unobstructed pipe upstream of strainer. Strainer body and cover shall be bronze in sizes 2-inch through 6-inch and cast iron in sizes 8-inch and 10-inch. Strainer plate and cover bolts shall be stainless steel. Strainer shall be rated for 150 psi working pressure and be equal to the Neptune Turbine Strainer manufactured by Schlumberger Industries.

2.21 FLEXIBLE JOINT

Flexible joint shall be in size as shown on the drawings and equal to the Standard Spool Type Expansion Joint manufactured by Metraflex Company. Flexible joint carcass shall be 2 arch and constructed by Chlorobutyl and polyester with bias-ply tire cord reinforcement and rated for working pressure shown in table. Flexible joint shall have integral rubber flange with ductile iron retaining ring. Flexible joint shall have 3 control rods. Flanges shall be 150-pound strength.

Joint Size (Inches)	Joint Length (inches)		Pressure Rating (psi)		Gusset Plate Thickness (inches)	Rod Diameter (inches)
	1-Arch	2-Arch	2-Rods	3-Rods		
2	6	10	200	200	3/8	5/8
2 1/2	6	10	200	200	3/8	5/8
3	6	10	200	200	3/8	5/8
4	6	10	200	200	3/8	5/8
5	6	10	200	200	3/8	5/8
6	6	10	140	200	1/2	5/8
8	6	10	140	190	1/2	3/4
10	8	12	140	190	3/4	7/8
12	8	12	140	190	3/4	1
14	8	12	85	130	3/4	1
16	8	12	65	110	3/4	1 1/8
18	8	12	65	110	3/4	1 1/8
20	8	12	65	110	3/4	1 1/8
24	10	14	65	100	1	1 1/4

2.22 COUPLING ADAPTER

- A. The pipe couplings shall be of a gasketed, sleeve-type with diameter to properly fit the pipe. Each coupling shall consist of one (1) steel middle ring of thickness and length specified, two (2) steel followers, two (2) rubber-compounded wedge section gaskets and sufficient track-head steel bolts to properly compress the gaskets. Field joints shall be made with this type of coupling. 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. After welding, they shall be tested by cold expanding a minimum of one (1) percent beyond the yield point. The coupling bolts shall be of the elliptic-neck, track-head design with rolled threads. Couplings shall have longitudinal restraint with locking pins. The manufacturer shall supply information as to the recommended torque to which the bolts shall be tightened. All bolt holes in the followers shall be oval for greater strength. The gaskets of the coupling shall be composed of a crude or synthetic rubber base compounded with other products to produce a material which will not deteriorate from 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. The couplings shall be assembled on the job in a manner to insure permanently tight joints under all reasonable conditions of expansion, contraction, shifting and settlement, unavoidable variations in trench gradient, etc.
- B. Nuts and bolts shall be in accordance with AWWA C111.
- C. Couplings shall be shop primed and field painted in accordance with Division 9 (or one coat of coal tar epoxy if not specified in Division 9).
- D. Compression couplings shall be equal to Style 38 manufactured by Dresser. Flanged couplings shall have flanges in accordance with AWWA C207 and be equal to Style 128 manufactured by Dresser.

2.23 PRESSURE GAUGES

- A. Pressure gauges shall have cast brass cases with bourdon tubes and precision rotary movements of bronze, nickel, or other material suitable to the environment in which they will be located. Dials shall be 4-1/2 inches in diameter with a pressure range of 0 to 300 psi. Provide female quick coupler for connection to corporation stop. Each gauge shall be provided with snuffer.
- B. Corporation stops shall be similar to Ford Products and shall have iron pipe threads with pack joint connection outlets. Provide male quick coupler for attachment of pressure gauge.

2.24 FIBERGLASS LINE MARKER

A. General:

1. **Design:** The continuous fiberglass reinforced composite line marker (CUM375) shall be a single piece marker capable of simple, permanent installation by one person using a manual driving tool. The CUM-375 upon proper installation shall resist displacement from wind and vehicle impact forces. The CUM-375 shall be of a constant flat "T" cross-sectional design with reinforcing support ribs incorporated longitudinally along each edge to provide sheeting protection and structural rigidity. The bottom end of the marker shall be pointed for ease of ground penetration.
2. **Material:** The CUM-375 marker shall be constructed of a durable, UV resistant, continuous glass fiber and marble reinforced, thermosetting composite material which is resistant to impact, ozone, and hydrocarbons within a service temperature range of -40° F to +140° F.
3. **Workmanship:** The CUM-375 marker shall exhibit good workmanship and shall be free of burns, discoloration, cracks, bulges, or other objectionable marks which would adversely affect the marker's performance or serviceability.
4. **Marking:** Each CUM-375 shall be permanently marked "Water Valve Below" or "Water Main Below" and include "Before Digging Call 859-881-0589". The letters shall be a minimum of two (2) inches in height. A black line shall be stamped horizontally across the front of the marker near the bottom to indicate proper burial depth as shown in the standard detail.

B. Physical and Mechanical Requirements:

1. **Dimensions:** The CUM-375 marker shall conform to the shape and overall dimensions shown in the standard detail.
2. **Mechanical Properties:** The CUM-375 shall have the minimum mechanical properties as follows:

Property	ASTM Test Method	Minimum Value
Ultimate Tensile Strength	D-638	50,000 psi
Ultimate Compressive Strength	D-638	45,000 psi
Specific Gravity	D-792	1.7
Weight % Glass Reinforcement	D-2584	50%
Barcol Hardness	D-2583	47

3. **Color Fastness:** The CUM-375 shall be pigmented throughout the entire cross-section so as to produce a uniform color which is an integral part of the material. Ultraviolet resistant materials shall be incorporated in the construction to inhibit fading or cracking of the delineator upon field exposure.
4. **Vehicle Impact Resistance:** The Carsonite CUM-375 marker shall be capable of self-erecting and remain functional after being subjected to a series of ten head on impacts by a typical passenger sedan at 35 miles per hour. The CUM-375 shall retain a minimum of 60 percent of its sheeting.

C. Reflectors:

1. The reflector shall be of impact resistant, pressure sensitive retro-reflective sheeting which shall be subject to approval by the Engineer. The sheeting shall be grade "High Intensity" and of appropriate color to meet MUTCD requirements.
2. **Mounting:** The retro-reflective sheeting shall consist of a minimum of a 3-inch wide strip placed a maximum of two (2) inches from the top of the post unless otherwise specified.

2.25 FIRE HYDRANTS

- A. The fire hydrant shall be Mueller Super Centurion 250, Model A-423, 5 1/4" main valve opening, with two (2) hose nozzles and one (1) pumper nozzle. (No Substitutions)
- B. Specified burial depth for the fire hydrant assembly shall be 3' - 6', resulting in a cover of 36" over pipe.
- C. Hydrant shall be rodded to gate valve and mainline tee as per detail.
- D. Contractor shall take care to provide adequate weep sump and ensure that weep holes are not plugged. Any hydrant not exhibiting rapid barrel water draw down, shall be removed and properly installed.
- E. After installation is complete, contractor shall check oil level in bonnet and adjust as necessary, using manufacturer supplied oil.
- F. Upon completion of testing and flushing, the hydrant assembly that is exposed above ground shall receive two (2) coats of Sherwin-William KEM-400 Urethane Enamel, Fire Hydrant Red F75KY-R008 12252, applied as per manufacturer.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Valves shall be installed as staked out, with the approval of the Engineer in the positions indicated on the drawings consistent with conveniences of operating the handwheel or wrench. All valves shall be carefully erected and supported in their respective positions free from all distortion and strain on appurtenances during handling and installation.

- B. All material shall be carefully inspected for defects in workmanship and material, all debris and foreign material cleaned out of valve openings and seats, all operating mechanisms operated to check their proper functioning, and all nuts and bolts checked for tightness.
- C. Valves and other equipment which do not operate easily or are otherwise defective shall be repaired or replaced at the Contractor's expense.
- D. Valves shall not be installed with stems below the horizontal.
- E. Valves shall be set plumb and supported adequately in conformance with the instructions of the manufacturer. Valves mounted on the face of concrete shall be shimmed vertically and grouted in place. Valves in the control piping shall be installed so as to be easily accessible.
- F. Where chain wheels are provided for remote operation of valves, two (2) S-shaped hooks shall be provided for each valve to enable the chains to be hooked so as not to interfere with personnel traffic.
- G. Valves shall be provided with extension stems where required for convenience of operation. Extension stems shall be provided for valves installed underground and elsewhere so that the operating wrench does not exceed six (5") feet in length and the operating nut is not greater than 24" below the gate-valve box lid.
- H. A permanent type gasket of uniform thickness shall be provided between flanges of valves and sluice gates and their wall thimble.

Wall thimbles shall be accurately set in the concrete walls so that the gates can be mounted in their respective positions without distortion or strain.
- J. Floorstand operators and stem guides shall be set so that the stems shall run smoothly in true alignment. Guides shall be anchored firmly to the walls. Distances from the centerlines of gates to the operating level or base of floorstand shall be checked by the Contractor and adjusted if necessary to suit the actual conditions of installation.

3.02 PAINTING

- A. Valves shall be factory primed and fully coated, inside and out, with fusion bonded epoxy in accordance with the latest revision of AWWA 0550 Standard, if valve is available in this coating.
- B. Other painting as specified.

- END OF SECTION -

SECTION 02665

DOMESTIC WATER SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

Contractor shall furnish all labor, materials, and equipment to install water service piping and appurtenances, including tapping saddle, corporation stop, meter, meter setter, meter box with lid, pressure reducing valve (PRV) (if required), and service line as shown on drawings and specified herein.

1.02 RELATED SECTIONS

- A. Section 02225 - Excavating, Backfilling, and Compacting for Utilities.
- B. Section 02610 - Pipe and Fittings.
- C. Section 02675 - Disinfection of Water Distribution Systems.

PART 2- PRODUCTS

2.01 METERS

- A. Meters shall be 5/8 inch by 3/4 inch unless noted otherwise on the drawings. Meters shall be first-line quality of the manufacturer. The latest requirements of the AWWA Specifications 0-700 shall be complied with, except in cases of conflict with these Specifications. Make of meter offered must have been manufactured and marketed in the U.S. for at least five (5) years or more.
- B. Main Cases - The main case shall be high grade waterworks bronze, with hinged, single lid cover and raised characters cast on them to indicated the direction of flow. Each meter must have the manufacturer's serial number stamped on the lid. They must have a working pressure of 150 psi. Standard cast iron frost bottom meters shall be furnished. Non-ferrous strainers shall be provided which fit tightly against the main case.
- C. Measuring Chambers - The measuring chamber shall be of 85-5-5-5 bronze alloy composition and stainless steel or monel trimmed. The chamber shall be of the two piece design, equipped with a disc made of hard rubber and as near to the specific gravity of water as possible. Discs shall be of the three piece design of the thrust roller type.
- D. Registers - The register shall be straight reading U.S. gallon type. The register unit shall be completely encased and hermetically sealed, and driven by permanent magnets. There shall be a test index circle, divided into 100 equal parts, and shall have a red center sweep test hand. Registers shall be guaranteed by the manufacturer for a period of at least fifteen (15) years.
- E. Manufacturers - Meters shall be, Sensus SR. (No substitution)

2.02 METER COPPER SETTERS

Meter setters shall be copper setter, riser type, horizontal inlet and outlet multipurpose coupling for copper pipe. They shall be 5/8-inch by 3/4-inch single or tandem or size as indicated, Ford or Mueller with ASSE dual check and brace eye, or equal.

2.03 PRESSURE REDUCING VALVE (IF REQUIRED)

- A. Pressure reducing valves for water service shall be single seated for dead-end or continuous service. Size 3/4-inch shall have bronze bodies with screwed ends. The cup packing and valve seat shall be of high grade leather; the diaphragm of nylon-inserted neoprene. Valve shall have bronze strainer. The valves shall be Mueller H-900b, Wilkins #600, Watts Regulator Series US #35130, or approved equal.
- B. Each valve shall have an adjustable pressure range of 60-125 psi and is to be set at 90 psi. These regulators shall be installed on the inlet side of the service meter using tandem coppersetter. Burying of the PRV or installing in separate meter box will not be permitted.

2.04 POLYETHYLENE SERVICE LINE

- A. Polyethylene flexible pipe for sizes 3/4-inch through 1-inch water service piping shall be PE 3408, SDR-9, OD Base for 200 psi working pressure at 73.4° F, meeting latest edition of ASTM Specification D 2737 for material. Pipe shall be copper tubing sizes (CTS).
- B. Pipe shall meet all applicable provisions of the Commercial Standards and shall bear the National Sanitation Foundation (NSF) seal of approval.
- C. Fittings shall be standard bronze fittings in copper tubing sizes and manufactured by Ford or Mueller.

2.05 COPPER SERVICE LINE

- A. Copper service pipe shall be seamless copper tubing for water service, Type K meeting the latest edition of ASTM Specification B88.
- B. Fittings shall be standard bronze fittings in copper tubing sizes and manufactured by Ford or Mueller.

2.06 METER BOX

- A. Meter box shall be a polyvinyl chloride (PVC) or polyethylene (PE) box 18 inches in diameter x 30 inches deep (inside dimensions) and include a cast iron meter pit cover. The box shall be able to withstand 1,200 pounds compression. The box shall be used for both single and tandem setters. The meter box shall be equal to the MS Meter Box by Mid-States Plastics.
- B. The cast iron meter pit cover shall be equal to the 18-inch meter box cover, Model 32-H, as manufactured by Ford, or approved equal.

2.07 SADDLES

Saddles shall be brass equal to the Ford S70 Series or Mueller H13000 Series.

2.08 CORPORATION STOP

- A. Corporation stops shall be used with copper pipe (or polyethylene service pipe in copper pipe sizes) with flare type connections to connect to saddle around pipe. Stops shall be Mueller Model H-1500, Ford F-1000 or approved equal.
- B. Corporation stops shall be factory tested to 200 psi to be compatible with the pipes in which they are installed.

2.09 CURB STOP (IF REQUIRED)

- A. Ball Curb Valve: Ball curb valve shall be used with copper service pipe with compression type connections. Ball curb valve shall be installed at location shown on customer service connection detail in the drawings. Ball curb valve shall be equal to Mueller 300, Model B-25209.
- B. Curb Box: Curb box shall be cast iron with lid (including locking nut) marked "water." Curb box shall be slide type and installed over the ball curb valve. Curb box shall be equal to Tyler 6505 Series, Item 92-D.

PART 3- EXECUTION

3.01 TESTING OF METERS

Contractor shall provide copies of certified tests by manufacturer of all meters provided in project.

3.02 INSTALLATION OF METER SETTINGS

Meter settings shall include meter box and lid, meter, coppersetter, corporation stop, plus service line and adapter on the customer's side of meter. (This latter item is to prevent the customer or his plumber from disarranging or loosening the meter after the Contractor has already set the meter in its proper position.) Meter shall be set as close to the right-of-way fence as practicable inside the right-of way. No meter shall be set outside the right-of-way unless prior approval has been obtained from the Engineer or his representative. Meters shall be set in a workmanlike manner with backfill neatly compacted in place. In yards, pastures and other grassed areas, top of meter box will be 1/2 inch above grade. Upon completion of successful testing, contractor shall install meter and lock service with lock seal studs part no. 93210140.

3.03 INSTALLATION OF PRESSURE REDUCING VALVES

Pressure reducing valves will be installed for individual meter settings where shown on drawings. Installation shall be by tandem setter per detail drawing.

3.04 INSTALLATION OF SERVICE LINES

A. Service Lines Not Crossing a Road:

Service line shall be installed at locations shown on drawings and at a minimum depth of 30 inches.

B. Service Lines Crossing a Road:

Service line shall be jacked or pushed under paved roads and driveways. Open-cut may be used on all unpaved roads and driveways. In all cases the service line shall have a minimum cover of 30 inches. All backfill in paved areas shall be full depth crushed stone.

C. When noted on the drawings, the service line crossings shall be threaded through a steel or PVC casing pipe which shall be jacked or pushed under paved surfaces.

3.05 RECONNECTION OF EXISTING METERS

Where indicated on the plans, existing meters shall be disconnected from the existing water main and reconnected to the new water main. In the event that the water main from which meters are to be disconnected is to remain in service, corporation stops on the original service taps of the disconnected meters shall be located, excavated, and turned off to complete the disconnection.

3.06 RELOCATION OF EXISTING METERS

Where indicated on the plans, existing meter settings shall be disconnected from existing service lines, relocated where indicated and reconnected to the new service line. This work shall include matching type/diameter service line, new meter, meter box and lid, copper setter and reconnecting to existing service line. Compression couplings with inserts shall be used to reconnect flexible (plastic) service line and sweat joints used for copper service line.

3.07 INSPECTION AND TESTING

All service connection shall be pressure tested simultaneously with the watermain to demonstrate their conformance with the specified operational capabilities and any deficiencies shall be corrected, device replaced or otherwise made acceptable to the Engineer.

- END OF SECTION -

SECTION 02675

DISINFECTION OF WATER DISTRIBUTION SYSTEMS

PART 1 - GENERAL

1.01 STERILIZATION

A. General:

It is the intent of this section to present essential procedures for disinfecting new and repaired water mains. The section is simultaneously patterned after AWWA C651. The basic procedure comprises:

1. Preventing contaminating materials from entering the water mains during construction or repair and removing by flushing materials that may have entered the water main.
2. Disinfecting any residual contamination that may remain.
3. Determining the bacteriologic quality by laboratory test after disinfection.

B. Preventive Measures During Construction:

1. Precautions shall be taken to protect pipe interiors, fittings, and valves against contamination. Pipe delivered for construction shall be strung so as to minimize entrance of foreign material. When pipe laying is not in progress, as for example, at the close of the day's WORK, all openings in the pipeline shall be closed by water tight plugs. Joints of all pipe in the trench shall be completed before WORK is stopped. If water accumulates in the trench, the plugs shall remain in place until the trench is dry.

If dirt, that, in the opinion of the ENGINEER, will not be removed by the flushing operation (Article 1.01-C.) enters the pipe, the interior of the pipe shall be cleaned and swabbed as necessary, with a five percent (5%) hypochlorite disinfecting solution.

2. Packing Materials and Joints - No contaminated material or any material capable of supporting prolific growth of micro-organisms shall be used for sealing joints. Packing material shall be handled in such a manner as to avoid contamination. Where applicable, packing materials must conform to AWWA standards. Packing material for cast iron pipe must conform to AWWA C600. Yarning or packing material shall consist of molded or tubular rubber rings, or treated paper. Materials such as jute or hemp shall not be used. The lubricant used in the installation of sealing gaskets shall be suitable for use in potable water. It shall be delivered to the job in enclosed containers and shall be kept clean.

C. Preliminary Flushing:

No site for flushing should be chosen unless it has been determined that drainage is adequate at the site. The main shall be flushed prior to disinfection, except when the tablet or granular methods are used (Articles 1.01 -E.3. and 1.01 -E.4.). It

is required that the flushing velocity be 2.5 ft/sec. or greater. The rate of flow required to produce this velocity in various diameters is shown in the following table:

REQUIRED OPENINGS TO FLUSH PIPELINES (40-psi Residual Pressure)				
Flow Required to Produce 2.5 ft/sec.		Minimum Outlet Size		
Pipe Size (in)	Flow Rate (gpm)	Flushing Pipe Size (in)	Hydrant Nozzle	
			Number	Size (in)
4	100	1	1	2½
6	220	1½	1	2½
8	390	2	1	2½
10	610	3	1	2½
12	880	3	2	2½
14	1,200	4	2	2½
16	1,565	4	2	2½
18	1,980	6	2	2½

D. Form of Chlorine for Disinfection:

The most common forms of chlorine used in the disinfecting solutions are liquid chlorine (gas at atmospheric pressure), calcium hypochlorite tablets, calcium hypochlorite granules, and sodium hypochlorite solutions.

1. **Liquid Chlorine Use** - Liquid chlorine shall be used only when suitable equipment is available and only under the direct supervision of a person familiar with the physiological, chemical, and physical properties of this element and who is properly trained and equipped to handle any emergency that may arise. Introduction of chlorine gas directly from the supply cylinder is unsafe and shall not be permitted.

Note: The preferred equipment consists of a solution fed chlorinator in combination with a booster pump for injecting the chlorine gas water mixture into the main to be disinfected. Direct feed chlorinators are not recommended because their use is limited to situations where the water pressure is lower than the chlorine cylinder pressure.

2. **Hypochlorites**
 - a. **Calcium Hypochlorite** - Calcium hypochlorite contains seventy percent (70%) available chlorine by weight. It is either tabular or granular in form. The tablets, 6-8 to the ounce, are designed to dissolve slowly in water. Calcium hypochlorite is packaged in

containers of various types and sizes ranging from small plastic bottles to 100 pound drums.

A chlorine-water solution is prepared by dissolving the granules in water in the proportion requisite for the desired concentration.

- b. Sodium Hypochlorite - Sodium hypochlorite is supplied in strengths from five and one-quarter percent (5.25%) to sixteen percent (16%) available chlorine. It is packaged in liquid form in glass, rubber, or plastic containers ranging in size from one (1) quart bottles to five (5) gallon carboys. It may also be purchased in bulk for delivery by tank truck.

The chlorine water solution is prepared by adding hypochlorite to water. Product deterioration must be reckoned with in computing the quantity of sodium hypochlorite required for the desired concentration.

E. Methods of Chlorine Application:

Upon completion of construction, disinfection shall be strictly in accordance with the procedure designated in the State Regulations, which reads as follows:

“A water distribution system, including storage distribution tanks, repaired portions of existing systems, or all extensions to existing systems, shall be thoroughly disinfected before being placed into service. A water distribution system shall disinfect with chlorine or chlorine compounds, in amounts as to produce a concentration of at least fifty (50) ppm and a residual of at least twenty-five (25) ppm at the end of twenty-four (24) hours and the disinfection shall be followed by a thorough flushing.”

1. Continuous Feed Method - This method is suitable for general application.
 - a. Water from the existing distribution system or other approved sources of supply shall be made to flow at a constant, measured rate into the newly laid pipe line. The water shall receive a dose of chlorine, also fed at a constant, measured rate. The two rates shall be proportioned so that the chlorine concentration in the water in the pipe is maintained at a minimum of 50 mg/L available chlorine. To assure that this concentration is maintained, the chlorine residual should be measured at regular intervals in accordance with the procedures described in the current edition of Standard Methods and AWWA M12--Simplified Procedures for Water Examination.

Note: In the absence of a meter, the rate may be determined either by placing a pitot gauge at the discharge or by measuring the time to fill a container of known volume.

Solutions of one percent (1%) chlorine may be prepared with sodium hypochlorite or calcium hypochlorite. The latter solution requires approximately one (1) pound of calcium hypochlorite in

eight and five-tenths (8.5) gallons of water. The following table gives the amount of chlorine residual required for each 100 feet of pipe of various diameters:

CHLORINE REQUIRED TO PRODUCE 50 mg/L CONCENTRATION IN 100 FT. OF PIPE (By Diameter)		
Pipe Size (in)	100 Percent Chlorine (lb)	1 Percent Chlorine Solutions (gal)
4	0.027	0.33
6	0.061	0.73
8	0.108	1.3
10	0.170	2.04
12	0.240	2.88

- b. During the application of the chlorine, valves shall be manipulated to prevent the treatment dosage from flowing back into the line supplying the water. Chlorine application shall not cease until the entire main is filled with the chlorine solution. The chlorinated water shall be retained in the main for at least twenty-four (24) hours during which time all valves and hydrants in the section treated shall be operated in order to disinfect the appurtenances. At the end of this twenty-four (24) hour period, the treated water shall contain no less than 25 mg/L chlorine throughout the length of the main.
2. Slug Method - This method is suitable for use with mains of large diameter (greater than 12" diameter) for which, because of the volumes of water involved, the continuous feed method is not practical.

 - a. Water from the existing distribution system or other approved source of supply shall be made to flow at a constant, measured rate (see Article 1.01-E.1.a.) into the newly laid pipe line. The water shall receive a dose of chlorine also fed at a constant, measured rate. The two rates shall be proportioned so that the concentration in the water entering the pipe line is maintained at no less than 300 mg/L. The chlorine shall be applied continuously and for a sufficient period to develop a solid column or "slug" of chlorinated water that will, as it passes along the line, expose all interior surfaces to a concentration of at least 300 mg/L for at least three (3) hours. The application shall be checked at a tap near the upstream end of the line by chlorine residual measurements.
 - b. As the chlorinated water flows past tees and crosses, related valves and hydrants shall be operated as to disinfect appurtenances.

3. **Tablet Method** - Tablet disinfection is best suited to short extension (up to 500 feet) and smaller diameter mains (up to 12 inches). Because the preliminary flushing step must be eliminated, this method shall be used only when scrupulous cleanliness has been exercised. It shall not be used if trench water or foreign material has entered the main or if the water is below 5 degrees C (41 degrees Fahrenheit). This method may only be used at the express written consent of the Engineer, prior to the beginning of construction.

a. **Placement of Tablets** - Tablets are placed in each section of pipe and also in hydrants, hydrant branches, and other appurtenances. They shall be attached by an adhesive, except for the tablets placed in hydrants and in the joints between the pipe sections. All the tablets within the main must be at the top of the main. If the tablets are fastened before the pipe section is placed in the trench, their position should be marked on the section to assure that there will be no rotation. When placing tablets in joints, they are either crushed and placed on the inside annular space, or, if the type of assembly does not permit, they are rubbed like chalk on the butt ends of the sections to coat them with calcium hypochlorite.

The adhesive may be Permatex No. 1 or any alternative approved by the ENGINEER of the purchaser. There shall be no adhesive on the tablet except on the broad side next to the surface to which the tablet is attached. The following table gives the number of hypochlorite tablets required for various pipe diameters and lengths:

NUMBER OF 5G HYPOCHLORITE TABLETS REQUIRED FOR DOSE OF 50 mg/L						
Length of Pipe (ft)	Pipe Diameter					
	2	4	6	8	10	12
13 or less	1	1	2	2	3	5
18	1	1	2	3	5	6
20	1	2	3	5	7	10
30	1	2	4	6	9	14
40						

b. **Filling and Contact** - When installation has been completed, the main shall be filled with water at a velocity of less than 1 foot per second. This water shall remain in the pipe for at least twenty-four (24) hours.

Valves shall be manipulated so that the strong chlorine solution in the line being treated will not flow back into the line supplying the water.

4. **Granule Method** - Granular disinfection may only be used in the same instances when tablets disinfection can be used; that is, it may be used if the pipes and appurtenances are kept clean and dry during construction.

- a. Placement of Granules - Granules of calcium hypochlorite shall be placed during construction at the upstream end of the first section of pipe, at the upstream end of each branch main, and at 500-ft intervals.

Note: These granules cannot be used on solvent-welded plastic or on screwed-joint pipe because of the danger of fire or explosion from the reaction of the joint compounds with the calcium hypochlorite.

The following table gives the ounces of hypochlorite granules required for various pipe diameters:

OUNCES OF CALCIUM HYPOCHLORITE GRANULES TO BE PLACED AT BEGINNINGS OF MAIN AND AT 500-ft INTERVALS	
Pipe Diameter (in.)	Calcium Hypochlorite Granules (oz.)
4	0.5
6	1.0
8	2.0
12	4.0

- b. Filling and Contact - When installation has been completed, the main shall be filled with water at a velocity of less than 1 foot per second. This water shall remain in the pipe for at least twenty-four (24) hours. If the water temperature is less than 41° F (5° C) the water shall remain in the pipe for at least forty-eight (48) hours.

Valves shall be manipulated so that the strong chlorine solution in the line being treated will not flow back into the line supplying the water.

F. Final Flushing:

After the applicable retention period, the heavily chlorinated water shall be flushed from the main until the chlorine concentration in the water is no higher than that generally prevailing in the system, or less than 1 mg/L. Chlorine residual determination shall be made to ascertain that the heavily chlorinated water has been removed from the pipe line.

F. Bacteriologic Tests:

New or repaired water distribution lines shall not be placed into service until bacteriological samples taken at the points specified in 401 KAR 8:150 section 4(2) are examined and are shown to be negative following disinfection. Bacteriologic test sampling and testing to be conducted by the District with cost borne by the contractor.

1. After final flushing, and before the water main is placed in service, a sample or samples shall be collected from the end of the line and tested for bacteriologic quality and shall show the absence of coliform organisms. If the number and frequency of samples is not prescribed by the public health authority having jurisdiction, at least one sample shall be collected from chlorinated supplies where a chlorine residual is maintained throughout the new main. From unchlorinated supplies at least two samples shall be collected at least twenty-four (24) hours apart.
2. Samples for bacteriologic analysis shall be collected in sterile bottles treated with sodium thiosulphate. No hose or fire hydrant shall be used in collection of samples. A suggested sampling tap consists of a standard corporation cock installed in the main with a copper tube gooseneck assembly. After samples have been collected, the gooseneck assembly may be removed, and retained for future use.

- H. Repetition of Procedure -** If the initial disinfection fails to produce satisfactory samples, disinfection shall be repeated until satisfactory samples have been obtained. The tablet method cannot be used in these subsequent disinfections. When the bacteriological sample tests indicate that disinfection has been effective, the main may be placed in service.

Procedure After Cutting Into or Repairing Existing Mains - The procedures outlined in the Article apply primarily when mains are wholly or partially dewatered. Leaks or breaks that are repaired with clamping devices while the mains remain full of water under pressure present little danger of contamination and require no disinfection.

1. **Trench "Treatment" -** When an old line is opened, either by accident or by design, the excavation will likely be wet and may be badly contaminated from nearby sewers. Liberal quantities of hypochlorite applied to open trench areas will lessen the danger from such pollution. Tablets have the advantage in such a situation because they dissolve slowly and continue to release hypochlorite as water is pumped from the excavation.
2. **Main Disinfection -** The following procedure is considered as a minimum that may be used.
 - a. **Swabbing with Hypochlorite Solution -** The interior of all pipe and fittings used in making the repair (particularly couplings and tapping sleeves) shall be swabbed with five percent (5%) hypochlorite solution before they are installed.
 - b. **Flushing -** Thorough flushing is the most practical means of removing contamination introduced during repairs. If valving and hydrant locations permit, flushing from both directions is

recommended. Flushing shall be started as soon as the repairs are completed and continued until discolored water is eliminated.

- c. **Slug Method** - Where practicable, in addition to the above procedures, a section main in which the break is located shall be isolated, all service connections shut off, and the section flushed and chlorinated as described in Article 2.5.2, except that the dose may be increased to as much as 500 mg/L, and the contact time reduced to as little as one-half (1/2) hour. After chlorination, flushing shall be resumed and continued until discolored water is eliminated.
3. **Sampling - Bacteriologic samples** shall be taken after repairs to provide a record by which the effectiveness of the procedures used can be determined. If the direction of flow is unknown, samples shall be taken on each side of the main break.
- J. **Residual Disinfection** — A minimum free chlorine residual of 0.2 ppm must be maintained throughout the distribution system. If this residual cannot be maintained, booster chlorination facilities must be provided. If chloramination is used, a minimum combined residual of 0.5 ppm must be maintained throughout the distribution system.
 - K. **Chlorine Storage** — The chlorine storage room shall be provided with separate switches for the fan and lights located outside. The ventilating fan is to be installed near floor level, with a capacity of one complete air change per minute. Panic hardware shall also be provided on chlorine room doors.

1.02 NOTIFICATION AND REPORTING

- A. Contractor shall notify OWNER so they can contact radio station to announce boil water advisory for affected service area until lab results show safe water.
- B. Contractor shall prepare report within 48 hours of break that includes time, location, chlorine residuals, lab results, etc. OWNER shall maintain reports in file.
- C. If repairs cause water to be off more than 8 hours, Contractor must notify the OWNER so they can contact Division of Water.
- D. Contractor shall notify OWNER if loss of service exceeds 4 hours, and/or affects 10% of OWNER's customers, or 500 customers, whichever is less, so that OWNER can contact the Public Service Commission.

- END OF SECTION -

SECTION 02835
CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.01 SUMMARY

- A. The Contractor shall furnish and erect the chain link fence and gates as indicated on the drawings and as herein specified.
- B. The chain link fence shall have a top rail and bottom tension wire, and three (3) strands of barbed wire projecting outward at the top.
- C. The chain link fence materials and installation shall meet or exceed the standards of the Chain Link Fence Manufacturers Institute, New York, NY, except as otherwise specified in this Section. Fence materials shall meet or exceed Federal Specification RR-F-191H/GEN for fencing, wire, and post metal (gates, chain link fence fabric, and accessories), and shall conform to the ASTM Standard Specifications hereinafter noted.
- D. Fence framework, fabric, and accessories.
- E. Excavation for post bases.
- F. Concrete anchorage for posts and center drop for gates.
- C. Manual gates and related hardware.

1.02 RELATED SECTIONS

Section 03300 - Cast-in-Place Concrete.

1.03 REFERENCES

- A. ANSI/ASTM A123: Zinc (hot galvanized) coating of products fabricated from rolled, pressed, and forged steel shapes, plates, bars, and strips.
- B. ANSI/ASTM F567: Installation of chain link fence.
- C. ASTM A120: Pipe, steel, black and hot-dipped zinc-coated (galvanized) welded and seamless, for ordinary uses.
- D. ASTM C94: Ready-mix concrete.
- E. FS RR-F-191: Fencing, wire, post, and metal.

1.04 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in commercial quality chain link fencing with two (2) years of experience.

- B. Installation: ANSI/ASTM F567.

1.05 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 01300.
- B. Include plan layout, grid, spacing of components, gates, accessories, fittings, hardware, anchorages, and schedule of components.
- C. Submit manufacturer's installation instructions under provisions of Section 01300.

PART 2-PRODUCTS

2.01 MATERIALS

- A. All ferrous metal fittings, posts, fence, and gate framework, and all accessories shall be galvanized with a heavy coating of 2.0 ounces pure zinc spelter per square foot of surface area to be coated using the hot-dip process. Thinner zinc coatings and electro-galvanizing will not be used as a substitute for the specified hot-dip galvanized finish.
- B. All fabrication and welding shall be done before hot-dip galvanizing. All welding shall conform to the American Welding Society standards.
- C. The chain link fence fabric shall be galvanized steel chain link fabric conforming to ASTM Standard Specification for zinc-coated steel chain link fence fabric, Designation A392-74, with Class 2 zinc coating (2.0 ounces of zinc per square foot of uncoated wire surface). The fabric shall be woven in 2-inch mesh from No. 9 gage wire in a 7-foot width with barbed salvages top and bottom.
- D. The barbed wire shall be galvanized steel barbed wire consisting of two (2) strands of twisted No. 12 1/2-gage wires with 4-point barbs spaced 3 inches apart and conforming to ASTM Standard Specification of zinc-coated (galvanized) steel barbed wire, Designation A121-77, with Class 3 zinc coating (minimum of 0.80 ounces of zinc per square foot of uncoated wire surface for No. 12 1/2-gage wire).
- E. The tension wire shall be No. 7 gage coil spring steel wire with galvanized finish having minimum of 0.80 ounces of zinc coating per square foot of uncoated wire surface.
- F. Tie wires for fastening fence fabric to line posts and rails shall be not less than No. 6 gage aluminum wire.
- G. Line posts shall be 2-3/8 inches outside diameter steel pipe weighing not less than 3.65 pounds per foot, or 1-7/8 inches high carbon steel H-beams weighing not less than 2.70 pounds per foot.
- H. End, corner, and pull posts shall be 2-7/8 inches outside diameter steel pipe weighing not less than 5.79 pounds per foot, or 2-1/2 inches square steel tube weighing not less than 5.14 pounds per foot, or 3-1/2 inches roll-formed, steel corner section weighing not less than 5.14 pounds per foot.

- I. Gate posts for gate leaves up to and including 6-foot wide, shall be 2-7/8 inches outside diameter steel pipe weighing not less than 5.79 pounds per foot or 3-1/2 inches by 3-1/2 inches roll-formed, steel corner section weighing not less than 5.14 pounds per foot.
- J. Gate posts for gate leaves over 6 feet wide, including 13 feet wide, shall be 4 inches outside diameter steel pipe weighing not less than 9.10 pounds per foot.
- K. Top railings and railing for top, middle, and bottom braces between terminal posts and adjacent line posts shall be 1-5/8 inch outside diameter steel pipe weighing not less than 2.27 pounds per foot, or 1-5/8 inches by 1-1/4 inches, 14 gage roll-form section.
- L. Diagonal truss braces between terminal and adjacent line posts and for gate framework shall be 3/8-inch diameter steel rod.
- M. Barbed wire support arms shall project outward from the top of the posts at 45 degrees and shall be capable of withstanding a 200-pound downward pull on the outermost end of arm, without failure. The arms shall have provision for the attachment of three (3) strands of evenly spaced barbed wire. Arms shall be integral with post top weather caps having holes for the passage of the top rail at intermediate posts.
- N. Fittings shall be heavy duty malleable iron or pressed steel of suitable size to produce strong construction.
- O. Stretcher bars for attaching fabric to terminal posts such as end, corner, pull, or gate posts and gate frames shall be flat bars with minimum cross-section dimensions of not less than 1/4-inch by 3/4-inch. The stretcher bars shall be the full height of the fabric and shall be secured with bar bands of not less than 11 gage sheet steel, spaced approximately 15 inches on centers and bolted with 3/8-inch diameter bolts.
- P. Gate framework shall be 1-7/8 inches outside diameter steel pipe weighing not less than 2.72 pounds per foot.
- Q. If bolted or riveted corner fittings are not used, the gate frame shall be hot-dip galvanized after welding.
- R. Gate hinges shall be of heavy pattern of adequate strength for the gate size, with large bearing surfaces for clamping or bolting in position.
- S. The gates shall be provided with a suitable latch accessible from both sides and with provision for padlocking.
- T. Double leaf swing gates shall have a center bolt, center stop, and automatic backstops to hold leaves in open position.
- U. Gate padlocks shall have laminated plate cases, hardened steel shackles, and keyed cylinders. Padlocks shall be No. 5 manufactured by Master Lock Company. The padlocks shall be furnished with two (2) keys each and keyed on the project master key system.

2.02 CONCRETE MIX

Concrete shall be in accordance with Division 3.

2.03 FINISHES

- A. Galvanized: ANSI/ASTM A123; 1.8 ounce per square foot coating.
- B. Accessories: Same finishing as framing and fabric.

PART 3- EXECUTION

3.01 INSTALLATION

- A. The fence and gates shall be erected by skilled mechanics.
- B. Post spacing shall be uniform with maximum spacing of 10 feet in fences erected along straight lines. All posts shall be placed plumb and centered in the concrete foundation.
- C. Post foundations in earth shall be concrete cylinders with a minimum diameter of 12 inches, crowned two (2") inches at grade to shed water, and shall not be less than 36 inches deep in the ground. Posts shall be set in the full depth of the concrete foundations except for last 3 inches of concrete under the posts.
- D. If foundation holes are excavated in peat or other unstable soil, the Engineer shall be notified for determination of suitable construction precautions.
- E. If solid rock is encountered without overburden of soil, posts shall be set into the rock a minimum depth of 12 inches for line posts and 18 inches for terminal posts. Post holes shall be at least one (1) inch greater in diameter than the post, and the grout shall be thoroughly worked into the hole so as not to leave voids, and shall be crowned at the top to shed water. Where solid rock is covered by an overburden, the total setting depths shall not exceed the depths required for setting in earth, and the posts shall be grouted into the rock as described.
- F. Any change in direction of the fence line of 20 degrees or more shall be considered corners. Pull posts shall be used at any abrupt change in grade.
- G. Maximum area of unbraced fence shall not exceed 1,500 square feet.
- H. Terminal posts shall be braced to adjacent posts with horizontal brace rails and diagonal truss rods brought to proper tension so that posts are plumb. Diagonal truss rods shall be affixed to post by bands and "J" fitting. Bending of truss rod into end of horizontal pipe will not be permitted.

There shall be no loose connections or sloppy fits in the fence framework. The fence framework shall withstand all wind and other forces due to the weather.
- J. Fabric shall be stretched taut and tied to posts, rails, and tension wires with the bottom edge following the finished grade not more than two (2) inches above the grade. The fabric shall be installed on the security side (outside) of the fence and shall be anchored to the framework so that the fabric remains in tension after pulling

force is released. The fabric shall be attached to line posts with ties spaced at not more than 15-inch intervals and to rails and braces at no more than 24-inch intervals.

The fabric shall be attached to the tension wire with hog ring ties on 24-inch centers.

- K. Three (3) strands of barbed wire shall be installed on each extension arm of the line fence at the top of each gate. The wires shall be pulled taut and fastened at each support.
- L. Gates shall be installed plumb, level, and secure for the full width of the opening and the hardware adjusted for smooth operation. Provide concrete center drop to foundation depth and drop rod retainers at center of double gate openings.

- END OF SECTION -

SECTION 02935
SEEDING AND SODDING

PART 1 —GENERAL

1.01 GENERAL

The Contractor shall furnish all labor, materials, and equipment to regrade construction areas to original contours or regrade contours shown on drawings, fertilize and lime, seed or sod, and return all disturbed areas to their original or regrade contour and condition.

PART 2— PRODUCTS

2.01 LIME AND FERTILIZER

Four (4) tons of agricultural limestone per acre and 2 tons per acre of fertilizer with a 10-10-10 analysis shall be uniformly applied and incorporated into soil.

2.02 SEED

A mixture of fifty percent (50%) bluegrass, forty percent (40%) perennial rye and ten percent (10%) turf fescue shall be sowed at the rate of three hundred (300) pounds per acre. The seed shall have a minimum of ninety percent (90%) germination and a maximum of one percent (1%) weeds.

2.03 SOD

Sod shall be thirty percent (30%) to fifty percent (50%) bluegrass and fifty percent (50%) to seventy percent (70%) Falcon Fescue.

PART 3— EXECUTION

3.01 FINAL GRADING

- A. Upon completion of backfill, the construction area shall be regraded roughly to original or regrade contours. The top six (6) inches of the regrade must be free from rocks and other deleterious material. All rock shall be picked up and disposed of at a designated place approved by Owner.
- B. Any and all settled areas must be brought to grade and restored to as near original conditions as possible prior to final acceptance of the project by the Owner.

3.02 SEEDING AND SODDING

- A. Preparation of Seed Bed - Where the area to be seeded is not sufficiently pulverized to provide a good seedbed, the seedbed will be prepared by pulverizing the soil to a depth of four (4) inches with a disk harrow, drag harrow, spike toothed harrow or similar tool immediately prior to seeding. The area to be seeded shall be graded to a uniform surface and all rock and debris removed. Lime and fertilizer shall be applied prior to preparing seed bed and incorporated into the soil.

- B. Seeding - The seed shall be raked or cultipacted into the ground to a depth of no greater than 1/4-inch.
- C. Mulching - All seeded areas shall be covered with a straw mulch placed to a uniform depth of 1-1/2 inches loose.
- D. Sodding - The sod bed shall be prepared, fertilized and limed similar to those areas to be seeded. Then the sod shall be placed in accordance with Section 528.3.4 of the Standard Specifications for Road and Bridge Construction of the Kentucky Department of Transportation.
- E. Maintenance - Contractor is to take all necessary steps as required to maintain the seed and/or sodded areas so as to ensure an acceptable stand of grass at the conclusion of one full growing season. Any areas not meeting acceptability, shall be redone.

- END OF SECTION -

**DIVISION 3
CONCRETE**

SECTION 03300
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Cast-in-place concrete.
- B. Floors and slabs on grade.
- C. Control, expansion, and contraction joint devices associated with concrete work, including joint sealants.
- D. Equipment pads, thrust blocks, and miscellaneous.

1.02 RELATED SECTIONS

- A. Section 02520 - Portland Cement Concrete Paving.

1.03 REFERENCES

- A. ACI 301 - Structural Concrete for Buildings.
- E. ACI 302 - Guide for Concrete Floor and Slab Construction.
- C. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete.
- D. ACI 305R - Hot Weather Concreting.
- E. ACI 306R - Cold Weather Concreting.
- F. ACI 308 - Standard Practice for Curing Concrete.
- G. ACI 318 - Building Code Requirements for Reinforced Concrete.
- H. ASTM C33 - Concrete Aggregates.
- I. ASTM C94 - Ready-Mixed Concrete.
- J. ASTM C150 - Portland Cement.
- K. ASTM C260 - Air Entraining Admixtures for Concrete.
- L. ASTM C494 - Chemical Admixtures for Concrete.
- M. ASTM C618 - Fly Ash and Raw or Calcinated Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.

- N. ASTM 0948 - Test Method for Dry and Wet Bulk Density, Water Absorption and Apparent Porosity of Thin Sections of Glass-Fiber-Reinforced Concrete.
- O. ASTM D994 - Preformed Expansion Joint Filler for Concrete (Bituminous Type).
- P. ASTM D11 90 - Concrete Joint Sealer, Hot-Poured Elastic Type.
- Q. ASTM D1751 - Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
- P. ASTM DI 752 - Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

1.04 DEFINITIONS

- A. **BEAM:** A horizontal structural member, usually set between columns or other vertical components.
- B. **COLUMN:** A vertical structural member, transferring loads from beams and other horizontal components to the building foundations.
- C. **CONSTRUCTION JOINT:** A joint where two successive placements of concrete meet; where reinforcement is not interrupted.
- D. **CONTRACTION (CONTROL) JOINT:** A formed, sawed, or tooled groove in concrete to create a weakened plane to encourage shrinkage or movement cracking to occur at the joint.
- E. **EXPANSION JOINT:** A separation joint between two concrete components of the structure, to allow differential movement where expansion is likely to exceed contraction. This joint continues through the building structure.
- F. **FORMWORK:** Temporary wood, steel, or prefabricated glass fiber falsework used to contain wet concrete until final set commences.
- C. **FORM TIES:** Metal tension anchors to space formwork and maintain dimensional stability during placement of wet concrete.
- H. **GRADE BEAM:** A horizontal structural member, usually spanning between vertical pile or caisson foundations or spread footings.
- I. **GROUT (NON SHRINK GROUT):** A cementious or epoxy based mix used to fill the gap created between bearing components or baseplates and the building foundation or other supporting element.
- U. **JOINT FILLER:** A compressible material placed in concrete control joints, usually at the perimeter of slabs on grade. This material is compressible and expandable to fill the joint space under joint movement conditions.
- K. **ONE WAY SLAB:** A floor or roof slab that transfers loads in one direction only and requires structural support only at opposing bearing edges.

- L. **PILE CAP:** A concrete pad, usually square or rectangular in shape, placed over the top of a pile or caisson foundation, to transfer loads from the building structural frame to the foundation.
- M. **REINFORCEMENT:** Usually deformed steel bars or wire mesh placed within wet concrete to increase tensile strength of the structural concrete member and to assist in resisting shrinkage cracking.
- N. **RETAINING WALL:** A structural vertical exterior concrete wall, unrestrained at the top, used to retain soil or other material of dissimilar elevation.
- O. **STIRRUP:** A formed device of reinforcing steel bar, shaped to a square or rectangular hoop, used to tie bar reinforcement into a cage configuration, for purposes of resisting buckling of the concrete member.
- P. **STRUT:** A structural member used to restrict other structural components from movement.
- Q. **TIES:** A soft annealed steel wire used to bind bar reinforcement, placed perpendicular to each other.
- R. **THRUST BLOCK:** A subgrade concrete structure placed surrounding large water main elbows and tees to resist movement of the pipe caused by water hammer.
- S. **VAPOR RETARDER:** A sheet material placed under interior slabs on grade to arrest the movement of moisture within a building enclosure assembly.

1.05 SUBMITTALS FOR REVIEW

- A. Section 01300 - Submittals: Procedures for submittals.
- B. **Product Data:** Provide data for proprietary materials and items, including forming accessories, admixtures, patching compounds, preformed joints, curing compounds, and others if requested by Engineer.
- C. Shop drawings for reinforcing detailing and fabrication.
- D. Laboratory test reports for concrete materials and mix design test.
- E. Material certificates in lieu of material laboratory test reports when permitted by Engineer.

1.06 QUALITY ASSURANCE

- A. Perform work in accordance with ACI 301.
- B. Place concrete in accordance with ACI 304.
- C. Acquire cement and aggregate from same source for all work.

- D. Conform to ACI 305R when concreting during hot weather.
- E. Conform to ACI 306R when concreting during cold weather.

PART 2- PRODUCTS

2.01 CONCRETE MATERIALS

- A. Cement: ASTM C150, Type I - Normal.
- B. Fine and Coarse Aggregates: ASTM C33.
- C. Water: Clean and not detrimental to concrete.

2.02 ADMIXTURES

- A. Air Entrainment: ASTM C260.
- B. Chemical: ASTM C494; Type A - Water Reducing, Type D - Water Reducing and Retarding, Type E - Water Reducing and Accelerating, Type F - Water Reducing, High Range, and Type C - Water Reducing, High Range, and Retarding.
- C. Fly Ash: ASTM C618, Type F.

2.03 ACCESSORIES

- A. Bonding Agent: Polymer resin emulsion, Polyvinyl Acetate, Latex emulsion, or two-component modified epoxy resin.
- B. Vapor Retarder: 8 mil thick clear polyethylene film.
- O. Non-Shrink Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 2,400 psi in 48 hours and 7,000 psi in 28 days.

2.04 JOINT DEVICES AND FILLER MATERIALS

- A. Joint Filler: ASTM D1752; Closed cell polyvinyl chloride or molded vinyl foam, resiliency recovery of 95 percent if not compressed more than 50 percent of original thickness. Asphalt impregnated fiberboard may be used with Engineer's approval.
- B. Construction Joint Devices: Integral galvanized steel, formed to tongue and groove profile, with removable top strip exposing sealant trough, knockout holes spaced at six (6) inches, ribbed steel spikes with tongue to fit top screed edge.
- C. Sealant: Cold applied two part liquid neoprene. Use concrete color.

2.05 CONCRETE PROPORTIONING AND DESIGNING MIXES

- A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. For the trial batch

method, use an independent testing agency acceptable to Engineer for preparing and reporting proposed mix designs.

1. Do not use the same testing agency for field quality control testing.
 2. Limit use of fly ash to not exceed 25 percent of cement content by weight.
- B. Submit written reports to Engineer of each proposed mix for each class of concrete at least 15 days prior to start of work. Do not begin concrete production until proposed mix designs have been reviewed by Engineer.
- C. Design mixes to provide normal weight concrete with the following properties as indicated on drawings and schedules:
1. 4000 psi, 28-day compressive strength; water-cement ratio, 0.44 maximum (non air-entrained), 0.35 maximum (air-entrained).
 2. 3500 psi, 28-day compressive strength; water-cement ratio, 0.58 maximum (non air-entrained), 0.46 maximum (air-entrained).
 3. 2500 psi, (Lean concrete, if used) 28-day compressive strength; water-cement ratio, 0.67 maximum.
- D. Water-Cement Ratio: Provide concrete for following conditions with maximum water-cement (W/C) ratios as follows:
1. Subjected to freezing and thawing: W/C 0.45.
 2. Subjected to deicers/watertight: W/C 0.40.
 3. Subjected to brackish water, salt spray, or deicers: W/C 0.40.
- E. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as follows:
1. Ramps, slabs, and sloping surfaces: Not more than three (3) inches.
 2. Reinforced foundation system: Not less than one (1) inch and not more than three (3) inches.
 3. Concrete containing high-range water-reducing admixture (superplasticizer): Not more than eight (8) inches after adding admixture to site-verified 2-to-3-inch slump concrete.
 4. Other concrete: Not more than four(4) inches.
- F. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, as accepted by Engineer. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Engineer before using in work.

2.06 ADMIXTURES

- A. Use water-reducing admixture or high-range water-reducing admixture (superplasticized) in concrete, as required, for placement and workability.
- B. Use accelerating admixture in concrete slabs placed at ambient temperatures below 50°F (10°C).

- C. Use high-range water-reducing admixture in pumped concrete, architectural concrete, concrete required to be watertight, and concrete with water-cement ratios below 0.50.
- D. Use air-entraining admixture in exterior exposed concrete unless otherwise indicated. Add air-entraining admixture at manufacturer's prescribed rate to result in a concrete at point of placement having total air content with a tolerance of plus or minus 1½ percent within the following limits:
 - 1. Concrete structures and slabs exposed to freezing and thawing; deicers, chemicals, or hydraulic pressure:
 - a. 4.5 percent (moderate exposure); 5.5 percent (severe exposure) for 1 ½ inch maximum aggregate.
 - b. 4.5 percent (moderate exposure); 6.0 percent (severe exposure) for 1-inch maximum aggregate.
 - c. 5.0 percent (moderate exposure); 6.0 percent (severe exposure) for ¾-inch maximum aggregate.
 - d. 5.5 percent (moderate exposure); 7.0 percent (severe exposure) for ½ -inch maximum aggregate.
 - 2. Other concrete not exposed to freezing, thawing, or hydraulic pressure, or to receive a surface hardener: 2 to 4 percent.
- E. Use admixtures for water reduction and set accelerating or retarding in strict compliance with manufacturer's directions.

PART 3- EXECUTION

3.01 EXAMINATION

- A. Verify site conditions.
- B. Verify requirements for concrete cover over reinforcement. Where not shown, use minimum as specified in ACI 318.
- C. Verify that anchors, plates, reinforcements, and other items to be cast into concrete are accurately placed, positioned securely, and will not cause hardship in placing concrete.

3.02 PREPARATION

- A. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent in accordance with manufacturer's instructions.
- B. In locations where new concrete is dowelled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.
- C. Coordinate the placement of joint devices with erection of concrete formwork and placement of form accessories.

3.03 PLACING CONCRETE

- A. Place concrete in accordance with ACI 304.
- B. Notify Engineer minimum 24 hours prior to commencement of operations.
- C. Ensure reinforcement, inserts, embedded parts, and formed construction and contraction joints are not disturbed during concrete placement.
- D. Install vapor retarder under interior slabs on grade only where space is inhabited. Lap joints minimum six (6) inches and seal watertight by taping edges and ends.
- E. Repair vapor retarder damaged during placement of concrete reinforcing. Repair with vapor retarder material; lap over damaged areas minimum six (6) inches and seal watertight.
- F. Separate slabs on grade from vertical surfaces with 1/4 to 3/8 inch joint filler.
- G. Extend joint filler from bottom of slab to within about 1/4 inch of finished slab surface. Conform to Section 07900 for finish joint sealer requirements.
- H. Install preformed metal tongue and groove joint devices, if used, in accordance with manufacturer's instructions.
- I. Apply sealants in joint devices in accordance with Section 07900.
- J. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
- K. Place concrete continuously between predetermined expansion, control, and construction joints.
- L. Do not interrupt successive placement; do not permit cold joints to occur.
- M: Saw cut control joints within 24 hours after placing. Use 3/16 inch thick blade, cut into 1/4 depth of slab thickness.
- N. Screed floors and slabs on grade level, maintaining surface flatness of maximum 1/4 inch in 10 feet.

3.04 CONCRETE FINISHING

- A. Provide formed concrete surfaces to be left exposed with smooth rubbed finish as scheduled in this Section. Other formed concrete surfaces to be left exposed to get rough form finish (see ACI 301).
- B. Finish concrete floor surfaces in accordance with ACI 301.
- C. Steel trowel surfaces of building slabs which are to be exposed.
- D. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains at 1:100 minimum, but not less than indicated on drawings.

3.05 CURING AND PROTECTION

- A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
- C. Cure concrete in accordance with ACI 301 and ACI 308. Cure concrete for seven (7) days minimum after placement.

3.06 FIELD QUALITY CONTROL

- A. Provide free access to work and cooperate with appointed firm.
- B. Submit proposed mix design of each class of concrete to testing firm and Engineer for review prior to commencement of work.
- C. Tests of cement and aggregates may be performed to ensure conformance with specified requirements.
- D. Four concrete test cylinders will be taken for every 75 or less cubic yards of each class of concrete placed.
- E. One additional test cylinder will be taken during cold weather concreting, cured on job site under same conditions as concrete it represents.
- F. One slump test will be taken for each set of test cylinders taken.

3.07 PATCHING

- A. Allow Engineer to inspect concrete surfaces immediately upon removal of forms.
- B. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify Engineer upon discovery.
- C. Patch imperfections in accordance with ACI 301.

3.08 DEFECTIVE CONCRETE

- A. Defective Concrete: Concrete not conforming to required lines, details dimensions, tolerances, or specified requirements.
- B. Repair or replacement of defective concrete will be determined by the Engineer.
- C. Do not patch, fill, tough-up, repair or replace exposed concrete except upon express direction of Engineer for each individual area.

3.09 SCHEDULE - CONCRETE TYPES AND FINISHES

- A. Below grade footings: 3500 psi.

- B. Thrust blocks: 3500 psi.
- C. All other concretes: 4000 psi
- D. Finishes:
 - 1. Formed surfaces:
 - a. Not exposed: Remove fins and repair obvious defects.
 - b. Exposed to view: Patch tie holes and defects, and remove fins. Give smooth rubbed finish.
 - 2. Unformed surfaces:
 - a. All surfaces to have floated finish unless noted.
 - b. Troweled finish: Building floor slabs and similar structures.
 - c. Broom finish: All exposed floor areas, sidewalks, and steps subject to foot traffic and likely to be wet should have a broom finish,

- END OF SECTION -

DIVISION 04

MULTI-COLUMN ELEVATED WATER STORAGE TANK

SECTION 04000

MULTI-COLUMN ELEVATED WATER STORAGE TANK

PART 1. GENERAL

1.01. Description

The contractor shall furnish, erect, paint and sterilize a new 1,000,000 gallon capacity, torus bottom style welded steel elevated water storage tank. The tank is to be complete with all accessories specified herein, and is to be erected on a foundation to be designed and constructed by the tank contractor. The tank site is located off of Catnip Hill Pike in northwestern Jessamine County.

1.02. Scope

The Contractor shall be responsible for all labor, materials and equipment necessary for the design, fabrication, construction, painting, disinfection and testing of an elevated, welded carbon steel water storage tank supported by a series of supporting columns and cross bracing. This style of tank is commonly referred to as a "Multi-Column" Tank. Design and construction of the Elevated Tank shall conform to all requirements of AWWA D100 Standard for Welded Carbon Steel Tanks for Water Storage, except as modified by the requirements of these contract documents.

1.03. Experience

The design and construction of the "Multi-Column" elevated water storage tank shall only be undertaken by a Contractor with a minimum of ten (10) years experience with elevated tank construction. The Contractor must be able to demonstrate experience through the design and construction of at least ten (10) "Multi-Column" elevated water tanks. The Contractor shall not subcontract the design or erection of the steel tank and supporting tower.

1.04. Standard Specifications

All work on the water storage tank shall fully conform to the requirements of the latest published editions of the following Standard Specifications:

- A. AWWA (American Water Works Association) D100 Standard for Welded Carbon Steel Tanks for Water Storage.
- B. AWWA D102 - Standard for Painting Steel Water Storage Tanks.
- C. AWWA C652 - Standard for Disinfection of Water Storage Facilities.
- D. AWS (American Welding Society) D1.1
- E. NSF (National Sanitation Foundation) 61 - Materials in contact with Potable Water.
- F. Steel Structures Painting Council Manual - Volume 1 - Good Painting Practice.

- G. Steel Structures Painting Council Manual - Volume 2 - Systems and Specifications.
- H. ACI 318 - Building Code Requirements for Reinforced Concrete
- I. ACI 301 – Standard Specification for Structural Concrete

1.05. Tank Details

The elevated tank shall be all-welded construction of the most economical design. All members of structural steel or of reinforced concrete shall be designed to safely withstand the maximum stresses to which they may be subjected during erection and operation.

- A. The minimum operating capacity of the storage tank will be 1,000,000 US gallons.
- B. The capacity of the tank, low water level to high water level, shall be contained within a maximum operating head range of 38'9" .
- C. The height of the tank, top of foundation to high water level, shall be 148.68 feet.
- D. Top of foundation elevation shall be 1,023.00 feet

1.06. Working Drawings

After contract award and prior to construction, the Contractor shall provide engineering drawings and design calculations for the elevated steel tank and the foundation. Drawings shall show the size and location of all structural components and the foundations along with reinforcement details, the required strength and grade of all materials, and the size and arrangement of principle piping and equipment. The design coefficients and resultant loads for snow, wind and seismic forces, and the methods of analysis shall be documented. All submitted plans shall be stamped by a Professional Engineer registered in Kentucky.

PART 2. DESIGN

2.01. General

The structural design of the elevated storage tank shall conform to the following design standards (latest edition) except as modified or clarified as follows:

- A. Foundations – AWWA D100 and ACI 318 – Building Code Requirements for reinforced concrete.
- B. Steel Tank – AWWA D100
- C. Steel Tank Painting – AWWA D102

2.02. LOADS

- A. Seismic Load

Seismic Design shall be performed in accordance with Section 13 of AWWA D100-05.

B. Wind Load

Wind pressure shall be determined in accordance with AWWA D100-05, Section 3.1.4.

C. Snow Load

Snow load shall be determined in accordance with AWWA D100-05.

2.03. Foundation

A Geotechnical investigation has been carried out at the site and a copy of the report is included with the Contract Documents.

2.04. Steel Tank

A. General

The materials, design, fabrication, erection, welding, testing and inspection of the steel tank shall be in accordance with the applicable sections of AWWA D100 except as modified in this document.

B. Minimum Plate Thickness

The minimum thickness for any part of the structure shall be 3/16 inch for parts not in contact with water and 1/4 inch for parts in contact with water. All portions of the tank including the roof shall be of watertight construction.

PART 3. CONSTRUCTION

3.01. Concrete Foundation

The foundation shall be designed and constructed to safely and permanently support the structure. The concrete foundation shall be constructed in accordance with ACI 301.

3.02. Steel Tank Construction

A. General

The erection of the steel tank shall comply with the requirements of Section 10 of AWWA D100 except as modified by these documents.

B. Welding

All shop and field welding shall conform to AWS and AWWA D100, Section 10. The contractor shall ensure welders or welding operators are qualified in accordance with ASME Section IX or ANSI/AWS B2.1.

C. Fabrication

All fabrication and shop assembly shall conform to the requirements of AWWA D100, Section 9, Shop Fabrication.

D. Erection

Plates subjected to stress by the weight or pressure of the contained liquid shall be assembled and welded in such a manner that the proper curvature of the plates in both directions is maintained. Plates shall be assembled and welded together by a procedure that will result in a minimum of distortion from weld shrinkage.

E. Inspection and Testing

Inspection of shop and field welds shall be in accordance with AWWA D100, Section 11, Inspection and Testing. All inspection shall be performed prior to interior and exterior field painting. Radiographic inspection shall be performed by an independent testing agency with all costs included in the Contractor's bid and paid by the Contractor.

F. Roof Lap Joints

All interior lap joints shall be sealed by means of caulking or continuous seal welding. This shall include penetrations of roof accessories.

G. Painting and Disinfection

Surface preparation and coating of all steel surfaces shall be in accordance with Section 0500 "Coating System for Steel Water Storage Tanks".

PART 4. ACCESSORIES

4.01. General

The following accessories shall be provided in accordance with these specifications. All items shall be in full conformity with the current applicable OSHA safety regulations and the operating requirements of the structure.

4.02. Ladders

Access ladders shall be provided at the following locations:

- A.** The tower ladder, which shall be caged, shall extend up one column from near the base connecting with the balcony. The first rung shall be located approximately 8 feet above top of foundation, with a locking ladder guard in this location.

- B. An outside tank ladder from the balcony to the roof hatch.
- C. An inside tank ladder from the roof hatch to the inside bottom of the tank.
- D. An inside riser ladder from the base of the riser to the bottom of the tank. Ladder side rails shall be a minimum 3/8 inch by 2 inches with a 16 inch clear spacing. Rungs shall be not less than 3/4 inch, round or square, spaced at 12 inch centers. The surface of the rungs shall be knurled, dimpled or otherwise treated to minimize slipping. Ladders shall be secured to adjacent structures by brackets located at intervals not exceeding 10 feet. Brackets shall be of sufficient length to provide a minimum distance of 7 inches from the center of the rung to the nearest permanent object behind the ladder.

4.03. Fall Protection

Ladders shall be equipped with a fall arrest system meeting OSHA regulations. The system shall be supplied complete with safety harnesses, locking mechanisms, and accessories for two persons. The tank Contractor shall also furnish a full body safety harness with a shock cord to the Engineer at start of project.

4.04. Balcony

The tank shall be equipped with a balcony not less than 36" wide with a handrail not less than 42" high. The floor shall be perforated for drainage.

4.05. OPENINGS

A. Roof Hatches

Provide two access hatches on the roof of the tank. One hatch shall be 30 inch diameter and allow access from the roof to the interior of the tank. The hatch will be hinged and equipped with a hasp for locking. The hatch cover shall have a 2 inch downward edge. The second hatch will be 24 inch diameter and flanged with a removable cover so constructed that an exhaust fan may be connected for ventilation during painting operations. The openings shall have a minimum 4 inch curb.

B. Tank Vent

The tank vent should be centrally located on the tank roof above the maximum weir crest elevation. The tank vent shall have an intake and relief capacity sufficiently large that excessive pressure or vacuum will not develop during maximum flow rate. The vent shall be designed, constructed and screened so as to prevent the ingress of wind driven debris, insects, birds and animals. The vent shall be designed to operate when frosted over or otherwise clogged. The screens or relief material shall not be damaged by the occurrence and shall return automatically to operating position after the blockage is cleared.

C. Riser Manhole

A minimum 18 x 24 inch elliptical access manhole shall be provided

approximately 3 feet above the base of the wet riser. The hatch shall open inward.

4.06. Riser

The diameter of the wet riser shall be not less than 6 feet.

4.07. Piping

A. Inlet/Outlet Piping

The vertical combined inlet/outlet pipe connection to the bottom of the riser shall be a 12 inch standard weight carbon steel pipe with appropriate transition to a ductile iron base elbow of the same diameter. The vertical pipe shall extend up into the riser one foot above the riser base.

B. Overflow

The 12 inch steel overflow pipe shall have a minimum wall thickness of 1/4". A suitable weir shall be provided inside the tank with the crest located at High Water Level. The overflow shall be routed from the weir to closely match the roof contour and extend down.

4.08. Identification Plate

A tank identification plate shall be mounted on the tank riser pipe above the access manhole. The identification plate shall be corrosion resistant and contain the following information.

A. Tank Contractor

B. Contractor's Project Or File Number

C. Tank Capacity

D. Tank Diameter

E. Height To High Water Level

F. Overflow Elevation

G. Date Erected

PART 5. Guarantee

5.01. General

The tank Contractor shall guarantee all work for a period of one year from the contract closeout date. Performance and payment bond shall remain in effect, until released by owner, to ensure compliance with warranty.

-END OF SECTION-

DIVISION 05

TANK PAINTING SPECIFICATIONS

SECTION 05000

TANK PAINTING SPECIFICATIONS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Coat the new steel potable water storage tank constructed as part of this contract.

1.02 QUALITY ASSURANCE

- A. All materials specified herein are manufactured by the Tnemec Co., Inc., North Kansas City, Missouri, or equal. These products are specified to establish standards of quality and are approved for use on this project.
- B. Equivalent materials of other manufacturers may be substituted on approval of the Engineer. Requests for substitution shall include manufacturer's literature for each product, giving the name, generic type, descriptive information and evidence of satisfactory past performance. Submittals shall include the performance data as certified by a qualified testing laboratory.
- C. Bidders desiring to use coatings other than those specified shall submit their proposal in writing to the Engineer prior to surface preparation or application. Substitutions which decrease the dry film thickness, the number of coats applied, change the generic type of coating or fail to meet the performance criteria of the specified materials will not be approved. Prime and finish coats of all surfaces shall be furnished by the same manufacturer.
- D. All materials shall be compatible with the service intended. No products shall be used that may have ingredients which might react detrimentally with adjacent fluids or gases. All materials intended for use on the interior of the tank shall be included on the National Sanitation Foundation list of drinking water system components and be approved by the Kentucky Division of Water for such use.
- E. All field applied primers and intermediate coats shall be provided to insure compatibility of total coating systems and of the same manufacturer as the finish coats for each system as specified. Provide barrier coats over incompatible primers or remove and reprime as required. No thinner or solvents other than those approved by the coating manufacturer shall be used.

1.03 COATINGS

- A. Epoxy-Polyamide - The coating shall meet or exceed all of the following test results, Federal and/or ASTM standards using the associated test:

Test:	Abrasion
Method:	Federal Test Method Standard No. 141, Method 6192 CS-17 Wheel 1,000 grams load
Requirement:	No more than 130mg.loss after1,000 cycles

Test: Adhesion
Method: Elcometer Adhesion Tester (0-1000 psi)
Requirement: Not less than 800 psi pull, average 3 trials

Test: Fresh Water
Method: Coating system applied to sandblasted steel panels, cured for seven (7) days at 77° F and immersed tap water 77°F
Requirement: No blistering, cracking softening or delamination of film after eighteen (18) months

Test: Hardness
Method: ASTM3363-74(pencil)
Requirement: Must pass 6H

Test: Impact
Method: ASTM G-14-72
Requirement: No less than 140 in./lb. average

- B. Aliphatic Polyurethane - The coating shall meet or exceed all of the following test results, Federal and/or ASTM Standards using the associated test:

Test: Abrasion
Method: ASTM D 4060; CS-17 Wheel 1,000 grams load
Requirement: No more than 95 mg. loss after 1,000 cycles

Test: Adhesion
Method: Elcometer Adhesion Tester (0-1000 psi) Coating system applied to sandblasted steel panels and cured a minimum of thirty (30) days at 77° F
Requirement: Not less than a rating of 5, average of 3 tests

- C. Urethane Zinc-Rich Primer - The coating shall meet or exceed all of the following test results, Federal and/or ASTM standards using the associated test:

Test: Abrasion
Method: ASTM D 4541; Coating applied to sandblasted steel panels and cured fourteen(14) days at 77° F/50% R.H.
System: 90-8 One-coat 90-97 Tnemec-Zinc
Requirement: Not less than 800 psi pull, average 3 trials

1.04 SUBMITTALS

- A. Submittals shall be as specified in the General Conditions.
- B. Submit the following:
1. Coating manufacturer's certificate for each coating proposed for use attesting that the coatings meet the specifications in this section and are proper for the proposed application.
 2. Coating manufacturer's specifications and data sheets and application instructions for each coating proposed for use on the interior and exterior of the tank including the coating for the logo.
 3. Color chart for Engineer's selection of colors.

4. Certificate of compliance to each product performance requirement.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. The Contractor shall be responsible for the delivery, storage and handling of coating products.
- B. Deliver all materials to the job site in original, new and unopened packages and containers bearing manufacturer's name and label.
- C. Provide labels on each container with the following information:
 1. Name or title of material;
 2. Manufacturer's stock number;
 3. Manufacturer's name;
 4. Contents by volume, for major pigment and vehicle constituents;
 5. Expiration date after which the material should not be used;
 6. Thinning instructions; and
 7. Application instructions.
- D. Store coating products in sealed and labeled containers. Properly store coatings to prevent degradation of the coating products. Do not use coating products which have been damaged during storage, which have not been applied prior to the applicable expiration date, or which do not otherwise comply with the specifications. Promptly remove damaged coating products from the job site.
- E. Restrict storage to coating materials and related equipment. Store materials in an area protected in accordance with NFPA Bulletin No. 101.
- F. Product delivery, storage and handling shall meet the requirements of safety, health and fire regulations. Remove used rags from the job site and take all necessary steps to prevent spontaneous combustion.

1.06 JOB CONDITIONS

- A. The contractor shall ascertain that job conditions are suitable for the application of coatings.
- B. Do not apply coatings when the surrounding air temperature, measured in the shade, is below 50° F. Do not apply coatings when the temperature of the surface to be coated is below 50°F. Do not apply coatings when the relative humidity exceeds 85%. Do not apply coatings in extreme heat. Do not apply coatings in dust or smoke-laden air.
- C. Take all precautions necessary to prevent damage of adjoining properties due to coating work. The Contractor shall be solely liable for such damage.
- D. Conduct all operations in a clean and sanitary manner. No nuisance shall be committed in a tank; the workmen shall either use proper waste receptacles or leave the tank whenever necessity arises.

- E. The Contractor shall not operate valves or controls in the existing waterworks. The Owner will operate all existing valves, hydrants, blowoffs and controls.

PART 2 - PRODUCTS

2.01 INTERIOR COATINGS

The interior coatings shall be as follows:

COAT	COATING TYPE	TNEMEC SERIES	DFT
Primer	Zinc-Rich Moisture Cured Urethane Primer	94H20 Hydro-Zinc	2.5-3.5 mils
Intermediate	Polyamidamine Epoxy	N140-1225 Pota-Pox Plus	4.0-6.0 mils
Finish	Polyamidamine Epoxy	N140-15BL Pota-Pox Plus	4.0-6.0 mils

2.02 EXTERIOR COATINGS

The exterior coatings shall be as follows:

COAT	COATING TYPE	TNEMEC SERIES	DFT
Primer	Zinc-Rich Moisture Cured Urethane Primer	94H20 Hydro-Zinc	2.5-3.5 mils
Intermediate	Polyamidamine Epoxy	N69	2.0-3.0 mils
Finish	Polyfunctional Hybrid Urethane	740 Endura-Shield UVX	2.5-4.0 mils

2.03 SIGN

The legend "JESSAMINE SOUTH ELKHORN WATER DISTRICT" shall be painted on two sides of the tank, in lettering size and style appropriate for visibility, and as approved by Engineer. Tnemec Series 700 HydroFlon or equivalent applied at 2.0 – 3.0 dry mils per coat

2.04 COLORS

- A. Vary the color of alternate coats to provide a contrast.
- B. Finish color of tank exterior and tank signs shall be per direction of the Engineer.

PART 3 - EXECUTION

3.01 INSPECTION

- A. The Engineer or an outside inspection service representing the Engineer will make inspections shown in this Article. Additional inspections will be made if required. It shall be the responsibility of the Contractor to request an inspection by at least the end of the second day preceding the inspection day. Should the Engineer be summoned to inspect a complete phase of construction and find the work incomplete and, therefore, not ready for inspection, the contractor shall bear the cost of inspection. It is not the intent to charge the contractor for an inspection if discrepancies are found in the complete phase of construction as long as the discrepancies do not necessitate additional inspection trips.

B. The following inspections will be made:

1. After uncoated surfaces in the interior of a tank have been blasted and before coatings are applied, the coated surface on the exterior of a tank, tower, and appurtenances shall be blasted and primed immediately; however, if the inspector

removes field primed, over blasted or shop primed areas and finds evidence of improper blasting and cleaning, the inspector may order all questionable coatings removed by blasting and the cleaned areas reprimed at no cost to the Owner;

2. After all coating work has been completed; at this time, the total required mil thickness, lack of holidays", and aesthetic acceptability will be checked by the Engineer.
3. A first anniversary inspection shall be made at approximately one year's time after the painting has been completed to determine whether any repair work is necessary. The owner shall establish the date for the inspection and shall notify the Contractor at least 30 days in advance. If an inspection has not been established within 13 months after final acceptance of the painting work by the owner, the first anniversary inspection shall be considered to be waived. The Owner shall drain the tank, and the Contractor shall provide all lighting, ventilation and other equipment necessary to complete the inspection.

Any location where coats of paint have peeled off, bubbled or cracked and any location where rusting is evident shall be considered to be a failure of the paint system. The Contractor shall make repairs at no cost to the Owner at all points where failures are observed by removing the deteriorated coating, cleaning the surface and recoating with the same paint system. If the areas of failures exceeds 25 percent of the area of a portion of the tank surface, then for that portion, the entire paint system shall be removed and repainted. For purposes of determining the need for complete repainting, the inside roof, shell and floor and the outside roof, shell, floor, legs, ladders, and catwalk shall be considered separately.

The Contractor shall prepare and deliver to the owner an inspection report covering the first anniversary inspection, setting forth the number and type of failure observed, the percentage of the surface area where failure has occurred, and the names of the persons making the inspection. Color photographs illustrating each type of failure shall be included in the report.

C. The contractor shall furnish the following for purpose of inspection by the engineer:

1. Pictorial surface preparation standards as provided by the steel structures Paint Council (SSPC - Vis 1) or the American society for Testing and Materials (ASTM D2200);
2. Wet film thickness measurement gauge;
3. Dry film thickness measurement gauge;
4. certified thickness calibration standards;
5. Steel temperature gauges;
6. Wet bulb and dry bulb temperature-measuring equipment and psychometric tables;
7. Low-voltage wet sponge instrument; and
8. "Tooke" gauge.

Additionally, the Contractor shall provide any necessary rigging to facilitate the inspection of all tank areas. Proper coordination with the Engineer is intended to prevent extensive re-rigging by the Contractor. Therefore, it is the responsibility of the Contractor to keep the Engineer fully informed on the status of the painting operation.

3.02 EXTERIOR COATING SYSTEM

A. Shop Coating

1. Abrasive blast clean all surfaces in accordance with Steel structures Painting council Specification SSPC-SP 6 Commercial Blast. Commercial Blast is defined as the removal of at least two-thirds of all visible rust, mill scale, paint and other foreign matter from each square inch of surface.
2. Apply one coat Tnemec Series 94H20 Hydro Zinc to a dry film thickness between 2.5 - 3.5 mils.

B. Field Coating

1. Following erection, spot clean all rusted abraded areas in accordance with SSPC-SP 6 Commercial Blast. Feather all edges of existing primer or remove any loose or lifted primer. Clean all exterior metal surfaces before applying subsequent field coats.
2. Apply Tnemec Series 94H20 Hydro Zinc on the blasted areas to a dry film thickness of 2.5 - 3.5 mils.
3. Apply one intermediate Coat of Tnemec Series N69 to a dry film thickness 2.0 - 3.0 mils.
4. Apply one finish coat of Tnemec Series 740 - Endura Shield UVX to a dry film thickness of 2.5 - 4.0 mils.

C. The total dry film thickness of the exterior coating system shall not be less than 7.0 mils.

3.03 INTERIOR COATING SYSTEM

A. Shop Coating

1. Abrasive blast clean all surfaces in accordance with steel structures Painting Council Specifications SSPC-SP 10 Near White Metal Blast. Near White Metal Blast is defined as the removal of 95% of all visible rust, mill scale, paint and other foreign matter from each square inch of surface by compressed air nozzle blasting.
2. Apply one coat Tnemec Series 94H20 Hydro Zinc Primer to a dry film thickness between 3.0 - 5.0 mils.

B. Field Coating

1. Following erection, spot clean all rusted abraded areas in accordance with SSPC-SP 10 Near white Metal Blast. Feather all edged of existing primer to remove any loose of lifted primer. Clean all interior surfaces before applying subsequent field finish coat.
2. Apply Tnemec Series 94H20 Hydro Zinc Primer on the blasted areas to a dry thickness of 2.5 – 3.5 mils.
3. Apply intermediate coat Tnemec Series 140-1255 Pota-Pox to a dry film thickness of 4.0-6.0 mils.

4. Apply one finish coat of Tnemec Series 20-AA90 Pota Pox White to a dry film thickness of 4.0 - 6.0 mils.
- C. The total dry film thickness of the interior coating system shall not be less than 11.0 mils.

3.04 COATING PROCEDURES

- A. All coating work shall meet the requirements of the coating manufacturer.
- B. All surfaces to be coated shall be in the proper condition to receive the specified coatings before any coatings are applied. Do not sandblast any more surface than can be primed within the same working day that the sandblasting is done. Round off all sharp edges and rough welds. Remove all burrs and weld spatter. remove oil, grease and heavy deposits of surface contaminates by solvent or detergent Cleaning. All surfaces shall be clean, dry and free of any dirt, dust, grease, oils, salts, and other deleterious substances before coatings are applied.
- C. Whatever metal is cleaned during a working day shall be coated with primer on the same working day.
- D. Coat all interior and exterior weld seams surfaces by the brush method on field prime coat field intermediate coats.
- E. Coatings shall be applied in such a manner to produce as uniform a thickness of coat and as complete a coverage as possible, free of lap marks.
- F. Each coat shall have air drying period of at least 24 hours.
- G. The dry film thickness specified shall be obtained. Additional coats shall be applied at the Contractor's expense, if required to achieve the specified dry film thickness.
- H. Only good, clean brushed and equipment shall be used. Clean all brushes, rollers, buckets and spray equipment at the end of each coating period.
- I. Do not start filling the coated tank with water before the coatings have properly dried or cured. The minimum drying or curing time allowed shall be not less than seven days at 75°

-END OF SECTION-

DIVISION 06

**SCADA
SUPERVISORY CONTROL AND DATA ACQUISITION SYSTEM**

SECTION 06000

SCADA-SUPERVISORY CONTROL AND DATA ACQUISITION SYSTEM

PART 1 - GENERAL

1.01 PROJECT DESCRIPTION

A. Description of Work

The work to be accomplished under this section shall consist of furnishing the equipment necessary for a complete automatic control and monitoring system to function as specified herein and as shown on the drawings. The system integrator's shall furnish a completely integrated all solid-state radio telemetry base Supervisory Control and Data Acquisition (SCADA) system. It shall be the system integrator's responsibility to supply a system that is compatible with existing equipment, new equipment supplied by others as part of this contract, and equipment supplied in other contracts. The complete system shall be designed, fabricated, programmed, tested, started up, and warranted by a single supplier to insure a single source of responsibility.

B. Scope of Work

This section covers a radio telemetry based SCADA and Instrumentation System to include:

(1) 750,000 Gallon Elevated Tower Remote Unit (RTU), and upgrades to the existing Central Terminal Unit with software upgrades to the existing Operator Display Console HMI software.

C. Contractor Shall Supply

1. All equipment required in other sections of the specifications.
2. All labor for installation and start-up of the system.

D. System Integrator Shall Supply:

1. Engineering submittal and shop drawings prior to installation.
2. All the paper work and fees necessary to obtain a FCC radio license in the name of the Owner.
3. All ancillary equipment, hardware, software, and appurtenances needed for proper installation and operation of equipment.
4. All user licenses and fees for software supplied in this system with licenses in the name of the owner.

5. Provide spare parts and maintenance tools as described below.
6. Operation and maintenance manuals as detailed below.
7. All start-up labor and services.
8. All operator training.

E. Owner Shall Supply:

1. Access and easements as needed for all sites.
2. 120VAC power at all sites.

F. Tank Contractor Shall Supply:

1. Pressure sensing taps for all sensing points in the system.
2. Meter pits for sensing tank levels or line pressures in the system.

1.02 QUALITY ASSURANCE

A. Manufacturer's Qualifications

The system specified herein shall be the product of a manufacturer who can demonstrate at least ten (10) years of satisfactory experience in furnishing and installing comparable radio based telemetry/control systems for water and wastewater installations. The manufacturer of this system shall maintain a 24-hour available inventory of all replaceable modules to assure the Owner of prompt maintenance service and a single source of responsibility. The manufacturer shall certify this to the Engineer in writing at the time of bidder pre-qualification.

B. Pre-bid Approval

The Base Bid approved systems integrator for this project is:

Micro-Comm, Inc.	Tel	913-390-4500
15895 S. Plfumm Rd	Fax	913-390-4550
Olathe, KS 66066		
Local Representative: Delaney and Associates, Inc., 859-342-4944		

Other integrators desiring to bid this project as "alternate" integrators must seek pre-bid approval by providing a submittal (14) days prior to the bid date. Submissions that fail to include a complete submittal as detailed shall be deemed unresponsive. The Consulting Engineer and the Owner shall be the sole judge as to whether the alternate equipment is considered an approved equal. Approval of an alternate system by the Engineer will not relieve the alternate system of strict adherence to these specifications. The pre-bid submittal shall include the following:

1. An installation list with the names and phone numbers of both the Owner and Consulting Engineer for at least ten projects of similar size and complexity.
2. A "statement of compliance" detailing paragraph by paragraph the bidders compliance to these specifications.
3. Block diagrams for the various sites in the proposed system showing the selected pieces of hardware equipment to be used.
4. Sample electrical drawings for typical sites proposed in this contract.
5. A product performance data sheet shall be included for each hardware component in the system (i.e. antennas, radios, coaxial cables & arrestors, programmable controllers, power supplies, time delays and relays, and the various sensors required) and each software component (programming & configuration software and operator display console software).
6. Radio path study for each radio path in the system. Bidders shall satisfy themselves that the necessary radio frequency(s) can be obtained. The radio path study provided by each bidder shall utilize either:
 - a. Computer generated techniques utilizing a USGS 3 second terrain database to plot the path profiles for each radio path with elevation samples at not more that 200 foot increments.
 - b. Actual field measurements to showing the necessary antenna heights, transmitter power, and antenna gains required to insure a 20db fade margin as detailed in Section 2.02 of these specifications. The a physical path analysis shall be made using temporary equipment installations and a radio communications analyzer to measure actual path margins. The bidder shall include in his bid, all the calculations used to extrapolate the measured data. The bidder is expected to obtain the necessary temporary FCC license for the study.
7. Communications diagram for the entire system showing normal CTU-RTU communications paths and Peer-to-Peer back-up communications paths.

C. Approval Agencies

The control system and its components shall comply will all applicable requirements of the following:

1. Electrical Code Compliance (National & Local)
2. UL 508A
3. NEMA Compliance

4. IEEE Compliance
5. EIA Compliance
6. FCC Compliance

1.03 SUBMITTALS:

- A. Complete submittal shall be provided to the engineer for approval prior to equipment fabrication. The submittal data shall include the following:
 1. Product Data - Provide product data sheets for each instrument and component supplied in the system. The data sheets shall show the component name as used on reference drawings, manufacturer's model number or other product designator, input and output characteristics, scale or ranges selected, electrical or mechanical requirements, and materials compatibility.
 2. Shop Drawings - Provide drawings for each panel showing the wiring diagrams for control circuits and interconnections of all components. The drawings shall include wiring diagrams for all remote devices connected to the panel.
 3. Panel Layout Drawings - A front panel and sub-panel layout shall be included as part of each control panel drawing. Components shall be clearly labeled on the drawing.
 4. Installation Drawings - Typical installation drawings applicable to each site in the system shall be included.
 5. Operator Interface Software - The submittal shall include a generic but detailed technical description of the Operator's Interface Software as proposed for this system including:
 - a. Sample text screens and menus
 - b. Sample graphics screens
 - c. Sample report logs and printed graph

1.04 MAINTENANCE INFORMATION

A. Maintenance Data Manuals

Submit maintenance manuals and "as built" drawings on all items supplied with the system. The manuals and drawings are to be bound into one or more books as needed. In addition to "as built" engineering submittal data and drawings, the manual shall include trouble shooting guides and maintenance and calibration data for all adjustable items.

1.05 JOB CONDITIONS

- A. All instruments and equipment shall be designed to operate under the environmental

conditions where they are to perform their service. The equipment shall be designed to handle lightning and transient voltages as normal environmental hazards. The environmental conditions are as follows:

1. Outdoor - The equipment will be exposed to direct sunlight, dust, rain, snow, ambient temperatures from -20 to +120 degrees F, relative humidity of 10 to 100 percent, and other natural outdoor conditions. The installations shall be hardened to withstand normal vandalism.
2. Indoor - The equipment will be capable of operating in ambient temperatures of +32 to +130 degrees F and relative humidity of 20 to 100 percent.

1.06 DELIVERY, STORAGE, & HANDLING

- A. All items shall be stored in a dry sheltered place, not exposed to the outside elements, until ready for installation. All items shall be handled with appropriate care to avoid damage during transport and installation.

1.07 SEQUENCING & SCHEDULING

A. Coordination

The Systems Integrator shall coordinate with other electrical and mechanical work including wires/cables, raceways, electrical boxes and fittings, controls supplied by others, and existing controls, to properly interface installation and commissioning of the control system.

B. Sequence

Sequence installation and start-up work with other trades to minimize downtime and to minimize the possibility of damage and soiling during the remainder of the construction period.

1.08 DISTRIBUTED CONTROL OPERATION

A. General

The control system shall use "Programmable Logic Controllers" (PLCs) at all locations in the system as detailed later in these specifications. Each site in the system shall have a unique digital address. The Central Processing Units (CPUs) and Input/Output (I/O) cards used in each of the PLCs shall all be identical, fully interchangeable without reprogramming by the operator. The PLCs shall be "self-initializing" and "self-restoring" so that operator intervention is not required after power interruptions, transients from lightning storms, or component changes.

The system shall be composed of a Central Terminal Unit (CTU) that monitors and controls the operation of multiple Remote Terminal Units (RTUs). The CTU shall be composed of a PLC (as described above) and one or more Operator Display Consoles (ODCs) with Human-Machine-Interface (HMI) software to display, alarm, record, all

data received and for operator input for changes to the system.

The control system shall be capable of implementing multiple modes of communications in a single system to include: radio, leased phone-line, dial-up phone-line, high speed data highway, fiber optic, and Ethernet communications as details in these specifications. The individual sites in the system shall simultaneously support both Master-Slave and Peer-to-Peer communications as needed implement the distributed control features listed in these specifications.

B. Distributed Control Software Features

The system shall be a "distributed control" type system that simultaneously provides for the features of both "supervisory control" (i.e. centralize control of RTUs from the CTU) and "distributed control" (i.e. RTU self initiated control using local inputs and peer-to-peer communications with other RTUs) in to a single unified control system. The control system shall simultaneously support both Master-Slave (ie CTU to RTU) and Peer-to-Peer (i.e. RTU to RTU) communications to provide completely automatic control with no single point of system wide failure in either the PLC system or the communications system. The systems integrator shall implement redundant communications paths between RTUs to maintain automatic control in the event of CTU or system wide communications failure.

The control algorithms shall have the ability to integrate both hardware and software operator inputs (i.e. ODC setpoints and selector switch inputs) along with hardware inputs at the remote sites (i.e. remote Hand/Off/Auto selector switches, etc.) in to a unified cohesive automatic control system. As data is received, changes, or lost (i.e. a loss of signal from a RTU or CTU), the Central Unit control logic shall automatically adjust the controlling algorithm to the new situation.

In general the RTUs shall receive and store control parameter commands as inputted by the operator from both the CTU or the RTU. These inputs shall be displayed at both the CTU and RTU. Distributed control shall provide for fully automatic by the RTU based on the pre-programmed control algorithm, operator inputs received from the CTU, operator inputs received from the RTU front panel display, data received from other RTUs, and local inputs monitored at the RTU. For example, the RTU shall based on operator inputs automatically control the operation of pumps or valves based on level data received from other RTUs and local pressure, flow, and discrete inputs monitored at the RTU. Pump call/run/fail status shall be reported to the CTU for centralize display, alarming, and recording. The RTU distributed control algorithm shall handle the daily pump call/run/fail, automatic alternation, automatic transfer on fail, high discharge cut-off, low suction cut-off, low & high flow cut-ff and basic tank fill or demand supply operations at the pump station for RTUs as detailed for each RTU.

Supervisory control shall automatically or manually provide for the CTU to be able to override or modify the automatic operation of RTUs based on a pre-programmed control algorithm. For example, the CTU shall be able to automatically turn on or off pumps at RTUs or change RTU operational parameters as needed to satisfy "system" wide requirements such as peak load shedding for power or water distribution management during peak demand periods.

The control system shall provide for multiple levels of control such that a single point of failure shall not render the control system in-operative:

1. In the event of a ODC failure, the PLC at the shall continue to poll all of the RTUs to collect data and provide supervisory control.
2. In the event of PLC failure at the CTU, the individual RTUs shall continue to provide fully automatic control using last stored operator inputs and peer-to-peer communications with other RTUs for control data as needed.
3. In the event of peer-to-peer communications failure between RTUs, the controlling RTUs (ie sites with pumps, valves, etc) shall continue to provide automatic control based on locally sensed pressures and flows.
4. In the event of complete failure of local RTU at a booster station (or similar site), the failure shall cause a "system normal" lamp and relay to be de-energized to automatically re-engage any existing back-up control system (such as pressure switches, float switches, etc.) to maintain automatic control.

The system shall automatically revert to the next higher level of control as communications or equipment failures are repaired.

C. Standard Control Software Features

The supplied software shall not be a one-of-a-kind system, but rather a comprehensively designed software platform that provides a number of built in features that monitor local & remote inputs combined with standard software algorithms to provide an integrated system as follows:

1. Monitor local Hand/Off/Automatic (HOA) selector switch positions (i.e. on existing pump control panels) and integrate the switch position in to the control logic such that a HOA in HAND or OFF shall be considered by the control system as 'un-available'.
2. Provide for High Discharge Cut-off and Low Suction Cut-off control of pumps from locally entered setpoints at RTUs equipped with suction and discharge pressure transmitters and/or from existing pressure switches.
3. Provide automatic Pressure/Flow pump staging operation of pumps of different sizes (including variable speed pumps) from local discharge pressure and discharge flow inputs in a closed-loop system. The pumps shall be up-staged on decreasing discharge pressure and down-staged on decreasing flow rate. The control shall include PID (Proportional Integral Derivative) loop control of variable speed pumps mixed with constant speed pumps for the various stages required.
4. Provide "Compound Loop" PID control of final devices (i.e. chemical feeders) from multiple inputs (i.e. flow rate and a chemical process analyzer, such as chlorine residual).

1.09 RADIO CHANNEL DATA OPERATION

A. General

The control system shall be specifically designed for radio channel data communications. The core of the system shall be over FCC licensed radio frequency spectrum intended for SCADA and remote control purposes. The systems integrator shall be responsible of obtaining the necessary FCC licenses for one or more frequencies as needed to establish both supervisory and distributed control.

All of the equipment required for operation of the system shall be directly owned by the Owner and included as part of this contract. Systems using third party repeaters, trunking masters, or leased equipment will not be allowed. The Systems Integrator shall select radio equipment as detailed below to insure reliable operation and be able to implement all software features listed in this specification whether currently required or described as a "shall be capable" feature.

The overall system design and operation shall provide a 20db pad over the minimum required for operation on all primary data paths (primary paths may include data relays) to insure a 98% reliability of communications. Remote site communications for distributed peer-to-peer communications shall provide 30db of pad to insure operation under all weather conditions and provide a 99.9% communications reliability. The 20db and 30db pad requirements and FCC rule compliance shall be demonstrated (at no additional cost) to the Engineer at his request. The testing shall be accomplished using an IFR AM/FM 1000S communications analyzer or equal equipment.

B. Communications

The CTU-RTU supervisory communications and RTU-RTU distributed control communications system shall operate in a half-duplex mode over a single "licensed" radio frequency using "point-to-point" communication techniques. The RTUs shall monitor for the channel to avoid data collisions with other RTUs during peer-to-peer communications. The system shall be capable of sharing the radio channel with other radio telemetry system.

To facilitate system layout and future expansion all RTUs shall under the direction of the CTU be able to implement store-and-forward communications to relay data and commands to and from other RTUs as required to establish the desired path. Should the assigned relay site for a distant remote be inoperative, the Central Unit shall automatically choose another remote site to access the distant remote. Any RTU shall be able to provide automatic antenna switching as part of their relaying operations.

All data transmitted shall be in digital word form using FSK (frequency shift keying) transmission. All transmissions shall include the address of the sender and the receiver, and be subject to check sum, parity, and framing error checks, to insure a minimum data reliability of 1 error in 1,000,000,000 bits. Any transmissions that fail the data checking will be retried until correct. No data correction methods will be allowed. A plug-in RS232C data port shall be provided at all locations in the system to allow the use of a standard data terminal to view data exchanges between the sites and to provide a means of extensive de-bugging.

The system shall provide a complete data update at least once every (2) minutes with some functions updating faster as required by local system conditions.

C. Radio Channel Operation

The system shall be capable of operation on the narrow band splinter frequencies of the Private Land Mobile Radio Services within the Federal Communications Commissions (FCC) rules and regulations regarding these telemetry channels. The manufacture shall guarantee operation under co-channel conditions with other radio systems without interference to this system. FSK tones, data baud rates, transmitter output power, transmitter deviation, antenna gain, and antenna height shall be chosen to comply with the FCC requirements Part 90 - Subpart 90.35 and 90.238 for the Industrial/Business frequency pools. The radio system shall specifically meet the operating requirement that the sum of the highest FSK frequency and the amount of deviation shall not exceed 1.7 kHz for 3F2 emission (or 2.8 kHz for 6F2 emission) as detailed by the FCC for the specific frequency assigned.

CTUs and RTUs shall be capable of automatically switching antennas and/or radios (including radios on different frequencies) during CTU-RTU, RTU-RTU, and store & forward communications. The antenna/radio switching at remote units shall automatically default back to RTU-CTU paths if communications are lost with the CTU.

D. FCC Licensing

The system manufacturer/supplier shall be responsible for collecting all information, generating all paper work, and paying all fees required obtaining a license on behalf of the Owner.

PART 2 - PRODUCTS

2.01 PROGRAMMABLE LOGIC CONTROLLERS & LOCAL I/O EQUIPMENT

A. General

Industrial Programmable Logic Controllers (PLCs) shall be used at all locations. The PLCs shall have an operational range of 0-60degC and 5-95% relative humidity. The PLCs shall all be from the same family of controllers, scalable from very small to very large applications, and programmed from identical programming software used for all processors. The PLCs shall be readily available on and directly purchasable online from the manufacture's WEB page. The PLCs shall be Allen-Bradley CompactLogix or Micro-Comm M1550 Series controllers.

The software at all locations shall be stored in a user removable non-volatile CompactFlash or similar type ROM memory that can be exchanged under power, used to upgrade sites in the field, and store historical data (local trends, accumulators, etc) for retrieval locally or by the central unit. The memory modules shall store all site specific logic and configurations including communication parameters, control algorithms, analog input/output scaling, PID control parameters. The module shall be programmed via the CPU and without the use of external adapters. The PLCs shall

include "watch-dog" circuitry and be "self-initializing" without operator intervention. In the event that the program or configuration data is corrupted, the CPU shall reload the program and configuration data from the EEPROM memory module.

The PLCs shall be fully online programmable while the PLC continues to communicate with the rest of the system and performs its assigned control tasks. The PLCs shall support "fill-in-the-blank" type configuration for basic operation and to set-up common features such as COM port set-up, peer-to-peer data collections, local back-up control set points, input and output setup, output on/off time delay settings, front panel display setup, etc. The PLC shall also support a process script language or ladder logic type programming for site-specific customizations including special input and output manipulations, local sequential control, math functions, and PID control as follows:

1. Relay (Bit) Type - Examine if ON, Examine if OFF
2. Timer & Counter - Timer ON, Timer OFF, Timer DONE
3. Compare Functions - Equal, Not Equal, Greater Than, Less Than, etc
4. Math Functions - Add, Subtract, Multiply, Divide, Square Root
5. Scaling Functions - Scale & Scale with Parameters
6. Logical Functions - AND, OR, & NOT
7. Program Control - Jump & Skip Next functions
8. PID - PID with compound loop input

The PLC programming software shall be written for the 32 bit interface of Windows XP. The supplier shall provide a licensed copy of the PLC configuration and programming software along with the necessary communications cables to the owner. Training on the use of the software shall be provided as part of the system training.

B. Construction

The PLC shall use modular construction. The base unit shall be composed of the power supply, CPU, communications modules, and basic inputs and outputs (I/O). The unit shall have expandable inputs and outputs using a "rack-less" DIN rail mount design and capable of supporting local I/O (via an integrated high-performance serial I/O bus) and remote I/O via a industrial serial bus. All terminations shall use removable, NEMA-style "finger-safe" terminal blocks so that individual modules may be removed without disturbing adjacent modules.

The PLC shall be capable of being powered from AC, DC, or solar sources. DC and solar powered PLCs shall have an integral battery charging circuit that protects the external battery from over and under voltage conditions and provides automatic charging of the battery after power failures. The back-up power supply shall be either 12VDC with 24VDC DC/DC converter or 24VDC with a 12VDC DC/DC converter to run the 12VDC radio and 24VDC to power external sensors from a single battery source. Series tapped 24VDC batteries for 12VDC will not be allowed. Back-up batteries shall

be rechargeable sealed lead-acid type batteries as manufactured by PowerSonic or equal. The back-up battery shall provide for 24 hours of back-up operation at water tower remote units and 3 hours at all other sites.

The PLC shall have a minimum of two (2) communications ports. The first shall be used primarily for CTU-RTU and RTU-RTU communications. It shall support baud rates of 110-19,200 baud and have a plug-in standard 25pin or 9pin sub-D connector that provides a full RS232 interface and radio modem interface. The second communications port shall provide programming, operator front panel interface, multiple PLC interconnect and other local communications. It shall support baud rates of 110-19,200 baud and have a 9-pin sub-D interface. The communications ports shall include LED's to show the status of all control lines. The PLC shall also optionally support Ethernet communications as detailed in the specifications.

The PLC shall utilize a rack-less design and provide for sufficient installed and configured spare inputs and outputs (I/O) to meet the site requirements as detailed and provide for 25% spares of each type. The unit shall have a minimum of (4) discrete (relay) outputs, (8) discrete inputs (DI), (4) analog inputs (AI), and (2) analog outputs (AO). The analog inputs shall provide for sensor excitation with separate fuses for each input. The fuses may be the self-resetting type. All input and output connections to the PLC shall be via Nema "finger-safe" plug-in terminal blocks.

The PLC shall support both local and remote I/O. Input/Output cards shall be mounted on a DIN rail channel. The PLC inputs, outputs, and operator interface shall be as follows:

1. **DISCRETE OUTPUTS** - The discrete outputs shall be isolated relay outputs rated at 5.0A continuous @ 240VAC. LEDs on the front of the PLC base unit or expansion module shall indicate the status of each output point. Interposing relays shall be provided if the voltage or current of the external load on a contact exceed the 5.0A 240VAC ratings. Each output shall be provided with operator settable software ON and OFF time delays.
2. **DISCRETE INPUTS** - The discrete inputs shall be optically isolated and provide for 24VDC excitation to remote sensors and switches. Each input shall be separately fused or current limited such that accidental grounding shall not render the other inputs non-functional. LEDs on the front of the input module shall indicate the status of each input point.
3. **ANALOG INPUTS** - The analog inputs shall provide filtered and scalable analog to digital conversion of input signals. The analog inputs shall be switch selectable from 0-5VDC to 0-20mADC and provide a minimum of 0.3% resolution and 0.5% accuracy over the temperature range of 0-70degrees C. The PLC shall provide separately fused 24VDC excitations to the remote sensors.
4. **ANALOG OUTPUTS** - The analog outputs shall provide a 4-20mA isolated signal to other panels and devices as specified.
5. **PULSE INPUTS** - The high-speed counter/pulse inputs shall provide for pulse rates up to 1 KHz direct from flow meter transmitter heads without interposing equipment. The pulse input shall include fused 12VDC excitation to the meter transmitters.

6. **POWER SUPPLY** - Each PLC assembly shall include an integral power supply. Power supplies shall be designed for 12VDC or 24VDC input power and suitable for use in battery back-up operations. DC/DC converters shall be required to insure that both the 12VDC and 24VDC are regulated separately from the common source.
7. **KEYPAD & DISPLAY UNIT** - The optional keypad & display unit shall have a 4x20 back-lighted LCD display to display the status of all local inputs and the tank level of the associated control water tower level. The 5x5 keypad shall provide for operator input of set points and timer settings. The operator interface shall be menu driven and provide for dedicated keys for cursor position and input functions. The operator interface shall provide for up to 50 screens of data display. The keypad & display unit shall be supplied and mounted on the front of the PLC enclosure if detailed in the specific PLC I/O requirement list. The keypad & display unit shall maintain the Nema 4 rating of the PLC enclosure.
8. **GRAPHICAL TOUCH-SCREEN DISPLAY UNIT** - The optional Graphical Touch-Screen display unit shall have an 6" diagonal (3.5" x 4.5") back-lighted 256-color TFT LCD display with resolution of at least VGA (640x480 pixels) resolution. The display shall have a resistive touch-screen with a touch accuracy of 2mm. The operator interface shall be graphical and provide for display of all data monitored and operator input of setpoints and operating commands. The Graphical Touch-screen unit shall be supplied and mounted on the front of the PLC enclosure if detailed in the specific PLC I/O requirement list. The unit shall maintain the Nema 4 rating of the PLC enclosure.

C. Enclosures

The remote unit enclosures for indoor mounting shall meet all the requirements for NEMA Type 12 enclosures. The enclosures body shall be made of a minimum 14 gauge steel with continuously welded seems and be furnished with external mounting feet. The enclosure door shall be made of a minimum 16 gauge steel with have a 14 gauge steel hinge. Enclosures larger than 16x14 shall have a rolled lip on 3 sides of the door for added strength. The door opening shall have a rolled edge on 4 sides to protect the door gasket. The door gasket shall be heavy neoprene and attached to the door with oil resistant adhesive. Sub-panels shall be 14-gauge steel for 16x14 enclosures and 12 gauge for larger enclosures. The enclosure finish shall be gray polyester powder coating inside and out over phosphatized surfaces. The subpanels shall be finished in white. Nema 12 enclosures shall be Hoffman "CH" or "CONCEPT" wall mount enclosures.

Remote site installations requiring equipment to be mounted outside shall have a double box enclosure with the remote unit enclosure mounted inside a lockable NEMA 3R enclosure. The double enclosure shall be required to control vandalism, provide complete weather protection, reduce the heating effects of the sun, and prolong the life of the equipment. The NEMA 3R enclosure shall be constructed of 14 gauge galvanized steel, with a drip shield top and seems free sides front and back, and a stainless steel hinge pin. The enclosure finish shall be gray polyester powder coating inside and out over phosphatized surfaces. The NEMA 3R enclosure shall be Hoffman Bulletin A-3.

The remote unit enclosures mounted in damp corrosive areas (such as concrete meter vaults) shall be NEMA Type 4X rated enclosures. The enclosures shall be made of molded fiberglass polyester and be furnished with external mounting feet. The door shall have a seamless foam-in-place gasket and corrosion-resistant hinge pin and bails. Sub-panels shall be 14-gauge steel for 16x14 enclosures and 12 gauge for larger enclosures. The enclosure finish shall be a light gray inside and out. The subpanels shall be finished in white. Nema 4X enclosures shall be Hoffman "Fiberglass Hinged Cover".

Refer to Appendix for specific enclosure requirements.

D. Front Panel Hardware Displays

As detailed in the appendix, the PLC units may include front panel displays of the specified inputs and outputs. The indicator lamps, pushbuttons, and selector switches used in the system shall be IP65 oiltight/waterproof/corrosion resistant rated. The indicators use slide or bayonet based colored LED light sources. The lenses shall be acrylic and color matched to the LED color. The lamps shall have translucent marking plates for legends and be constructed such that the acrylic lens covers the legends for dust and water protection. The pushbutton and selector switch operators shall be Nema 600V rated with contacts rated for 6A @ 120VAC inductive. The contact blocks shall be stackable and snap-fit with screw terminals for termination.

Refer to Appendix for specific front panel display requirements.

E. Local Control Functions

In general the PLC shall be programmed to provide generic control functions as detailed earlier and to work in concert with the CTU. The integrator shall be responsible to meet with the owner and the engineer to develop the automatic control strategy required for the system.

Refer to Appendix for special input and output control requirements.

2.02 RADIO TRANSCEIVERS & ACCESSORIES

A. General

The radio transceivers shall be standard "un-modified" radios that can be tuned, aligned, and repaired at any two-way radio shop. Interface to external data modems shall be through the front panel microphone jack. The radios shall be synthesized and fully field programmable and include a built-in time-out timer to disable the transmitter after 0-60seconds. The units shall be tuned to FCC specifications for the specific frequency assigned. The radio equipment shall be FCC type approved and the system capable of operation on the 3KHz or 6KHz narrow band splinter frequencies (154 or 173MHz) in the Industrial/Business radio service, or UHF.

B. VHF Radio Transceiver (154 MHz or 173 MHz)

The system manufacturer shall supply a 5-watt VHF radio transceiver to insure a high level of quality and reliability. The radios shall be adjustable to 4 watts output power as may be required by the FCC for ERP (Effective Radiated Power) restrictions. All connections to the radio shall be plug-in. The VHF radio transceiver shall have the following specifications:

Transmitter:

RF output power	25 watts minimum (adjustable to 4)
Spurs & Harmonics	16 dBm (25uW) (or -50dBc)
Frequency stability	$\pm 0.00025\%$ (-30 to +60 degrees C)
Emission	6F2 (2.5 kHz DEV max) or 3F2 (1.2 kHz DEV max)
FM hum and noise	-40 dB

Receiver:

Sensitivity	0.35uV @ 12 dB SINAD (.5uV @ 20db quieting)
Selectivity	-65 dB
Spurious image rejection	-50 dB
Inter-modulation	-65 dB
Frequency stability	$\pm 0.00025\%$ (-30 to +60 degrees C)
Receive bandwidth	*6 kHz (or 3kHz) as required to match the transmitter

* The receiver bandwidth shall be reduced to match the transmit bandwidth of the transmitter and provide a minimum adjacent channel rejection of -50db.

The radio transceivers shall be a Motorola Radius CM200 or a Microwave Data Systems 1710.

C. UHF Radio Transceiver (450 MHz)

If the system supplier can demonstrate to the satisfaction of the Engineer that no VHF (154-173 MHz) frequency can be obtained, an UHF (450-470 MHz) frequency may be used. The UHF shall operate under Part 90.35 and 90.238 for secondary fixed operations. The system will still be required to operate with point-to-point operation within the FCC rules and regulations and provide the same RF path margins as detailed in these specifications. Existing Frequency is 456.250MHz.

The UHF radios must meet or exceed the requirements set forth in these specifications for VHF radios, except that the radio output power must be adjustable to 2 watts as needed to meet FCC requirements. The radios shall be tuned to operate in 6KHz of bandwidth to meet the proposed FCC standards for 2005. Antennas shall provide a minimum 10db of gain.

The radio transceivers shall be Motorola Radius CM200 or Microwave Data Systems 4710. No changes to the contract amount will be made for a change to UHF operation.

D. Antenna & Coaxial Cable

The radio antennas at all locations shall be a five element Yagi, constructed with 3/8" diameter solid aluminum rod elements and 1-1/16" diameter aluminum pipe element support with a type N coaxial connector. The antenna shall have a minimum 8.0db forward gain with a 20.0db front-to-back ratio. The antenna shall be wind rated for a 100-MPH wind speed. The VHF antennas shall be MC-Yagi, Decibel Products DB292, or Celwave PD390S. The UHF antennas shall be MC-Yagi or Celwave PD688S.

Antennas shall be cabled to the transmitter enclosure connection by a RG/8U type low loss (less than 1.8db per 100ft @ 100MHz) coaxial cable with cellular polyethylene (foam) dielectric. The coaxial cable shall have a braided copper shield coverage of 97% and a long life weather resistant polyvinyl chloride jacket. The antenna coaxial cable connection shall be a constant impedance weatherproof Type N connector, taped with a weather resistant electrical tape to insure a lifetime watertight assembly. The coaxial cable shall be Belden 8214 or 9913 cable.

E. Antenna Lightning Protection

Coaxial connection to remote and central unit enclosures shall be by means of a coaxial type bulkhead lightning arrestor. The units shall be rated at 1 kilowatt with a minimum 500V and maximum 2000V-breakdown voltage. Coaxial lightning arrestors shall be a PD-593 or PolyPhaser IS-B50LN-C1.

F. Antenna Mounting Systems

Antennas shall be mounted at a height above ground that is consistent with FCC rules and regulations and provides adequate signal fade margin as described earlier. Antennas must be a minimum of 15 feet above ground and mounted as follows:

1. Water Towers: The antenna shall be mounted on the ladder or the water tower catwalk railing at a height consistent with FCC requirements. The coaxial cable shall be secured to the ladder or obstruction lighting conduit. A 3/4" rigid conduit with a weather-head shall be provided from the transmitter to the ladder on the tower.

2.03 INSTRUMENTATION & ACCESSORIES

A. General

All items in the control system (electronic cards, power supplies, radios, time delays, relays, etc.) shall be of plug-in construction, make use of a plug-in wiring harness, use plug-in terminal blocks, and be interchangeable without recalibration. To insure field repair-ability by non-technical personnel, equipment that must be un-wired for replacement will not be accepted.

The following instrumentation devices and techniques shall be used as specifically called for in the RTU and CTU input/output sections of this specification.

B. Power Supplies

The DC power supplies shall provide $\pm 0.1\%$ line and load regulation with $\pm 10\%$ input variations. They shall have a temperature coefficient of $\pm 0.02\%$ per degree C. The input/output isolation shall be 100 Mohms DC (900Volts AC) with output transient response of 50 microseconds maximum. The power supplies shall be sized to operate the remote unit equipment with or without the back-up battery in place. Power Supplies shall be a Power One Series MAP130, Sola SLS, or approved equal.

C. Battery Back-up Operation

The remote units indicated shall be supplied with battery back-up operation. The rechargeable batteries shall be the sealed solid gelled electrolyte types, designed for float or standby service. Unless noted otherwise in the RTU descriptions, batteries shall be sized to maintain 24-hour service at water tower remotes and 8 hour service at pump stations and other remotes. The remote shall include a charging module to recharge the battery when power is resumed, maintain the charge between outages, and provide a low voltage cut-off to protect the battery from excessive discharge during prolonged outages. All discrete, analog, and pulse inputs (i.e. switch closures, pressure, level, flows, etc.) shall continue to function on battery back up. Batteries shall be Globe Gel/Cell or approved equal.

D. Single Phase 120VAC Power Line Lightning Protection

Every site in the system shall be equipped with AC line filtering and lightning protection. The equipment shall provide 2-stage lightning/transient protection including inductive and capacitive filtering and MOV over-voltage protection.

E. Time Delays & Relays

All hardware time delays used in the system shall be of plug-in construction with DIN rail mounted sockets and have pilot duty contacts rated for 3 amps resistive @ 240VAC (or 0.8 amps inductive) loads. The time delays shall have switch selectable ranges from .1-1c, .2-10, 1.2-60, and 12-600 seconds. The time delays shall provide a $\pm 0.2\%$ repeat accuracy. The time delays shall have both "timing" and "timed" LED indicators. Time delays and relays shall be IDEC series GT5Y and RY4S or approved equal.

F. Level & Pressure Transducers

Level & pressure transducers shall be of the all solid-state two-wire transmitter type with a 4-20mA output from a 10.5-24VDC excitation. The units shall be powered from the RTU power supply. The transducers shall have a combined error (linearity and hysteresis) of $\pm 0.25\%$ full scale and be temperature compensated to $\pm 2.5\%$ per 100 degrees Fahrenheit. Zero and span adjustments shall be standardized so that transducers are interchangeable without recalibration. All exposed or wetted parts shall be series 316 stainless steel, PVC, or Buna-N. The units shall be capable of a three times full scale over pressure with out damage or change of calibration.

The transducers shall be mounted at the sensing point and wired to the enclosure. The transducers shall have a 1/4" or 1/2" NPT process pressure connection.

Transducers for above ground mounting shall have a 1/2" conduit connection for cable entry. Transducers at water towers (and other outside locations) shall be mounted below grade and below frost line to prevent freezing. Below grade mounted units shall have factory signal cabling and be suitable for a minimum of 100' submerged duty.

Level transducers for clear-wells and wetwells shall be suspended in the clearwell or wetwell and supplied with sufficient factory installed cable to access a "clean/dry area" junction box. The suspension cable shall have a polyethylene jacket and internal venting to provide for atmospheric sensing of the non-process side of the diaphragm. The sensors shall have a multi-ported pressure-sensing end that protects the diaphragm while sensing the level of viscous liquids or slurries. The cable connection in wet-well applications shall have a non-fouling guard to prevent build up of foreign materials.

Pressure/Level transducers shall be Micro-Comm L5N series, Consolidated A300 Model 221GEE, or Ametek Model 57S.

2.04 EXISTING CENTRAL UNIT EQUIPMENT

A. General

The existing "Central Unit" is composed of two separate CPUs communicating over a high-speed serial data links. The existing CTU software will be modified to support monitoring and control of the added RTU's.

2.05 MAIN OPERATOR DISPLAY CONSOLE SOFTWARE

A. General

The software shall be 32bit compatible and capable of operating in the ODC hardware described above as well as in customer supplied Windows XP Professional/Vista Business compatible hardware similar to the unit specified above. The contractor shall supply a fully functional "developmental" version of the SCADA software (including any required software protection keys) for the first ODC as well as a separate configured "runtime" version for installation and use in a customer supplied back-up computer. The software may be modular; however the operator interface shall provide an integrated interface to all areas of the program. Demo program copies will not be allowed. The existing HMI software will be updated to the latest SCADAview 32 software as described below.

The software shall operate in the 32-bit Windows XP Professional/Vista Business environment. The software shall be the latest "full developmental" version of SCADAview 32 (Optional SC), Wonderware InTouch, GE-Fanuc iFIX, or Allen-Bradley RSVIEW 32 (Optional SE). The software shall be licensed to the owner.

B. System Back-up & Installation

The contractor shall provide a back-up copy of the installed software on a CD-ROM disk. Back-up copies of any setup or graphic files shall be on a CD-ROM. The copies shall be kept by the Owner for emergency reloading in the event of a catastrophic

failure. The contractor shall provide an easy to use installation (or re-installation) program that will automatically setup the hard drive operating system and automatically load (or reload) the software.

C. System Capacity

At a minimum, the operating software shall be capable of accommodating 32,000 tag points as follows:

1. Discrete status & alarm points
2. Measured variables
3. Accumulated variables
4. Calculated status & alarm points
5. Calculated control points

D. Communications

The HMI shall have several methods for exchanging data from programmable controllers and other software programs.

1. Direct
2. DDE Client/Server
3. OPC Client
4. ODBC
5. SQL Database (MySQL, MS-SQL, PostgreSQL)

E. HMI Operational Characteristics:

In general, the HMI software shall display all received data in engineering units with appropriate generated labels, generate and print alarms, print logs, store manually entered data, update displays, and perform operator commands as required by the database. The system shall automatically generate the following system displays:

1. Main Menu page (with direct access to all screens and other program modules)
2. System Summary page listing key data points for all RTUs in the system
3. RTU specific display pages showing all data for each RTU in the system

Beyond the basic operating software required for SCADA operations, the software package shall accommodate the following:

1. **Status Point Operations:**
 - a. **Display ODC, CTU, and RTU status functions**
 - b. **Input/Display control database**
2. **Analog Data:**
 - a. **Display value directly in engineering units**
 - b. **Accept operator High & Low alarm limits and generate alarms**
 - c. **Accept operator rate of change alarm limit and generate alarm**
 - d. **Store data for trending displays**
3. **Flow Rate Data:**
 - a. **Display value directly in engineering units**
 - b. **Accept operator High & Low rate alarm limits and generate alarms**
 - c. **Totalize flow total and display in engineering units**
 - d. **Accept operator High/Low 24 hour total limits and alarms**
 - e. **Store data for trending displays**
4. **Pump Control Operations:**
 - a. **Display ODC, CTU, and RTU HAND/OFF/AUTO functions**
 - b. **Display Pump CALL/RUN/FAIL status for each pump**
 - c. **Input/Display control database**
5. **Alarm Point Operations:**
 - a. **Display ODC, CTU, and RTU alarm functions**
 - b. **Enter new alarm in data log archive and send alarm to printer**
 - c. **Sound alarm horn until alarm is acknowledge by the operator**
 - d. **Log alarm acknowledgment to data log and printer**
 - e. **Log alarm clearing and send alarm clear to printer**
 - f. **Input/Display control database**
6. **Event Point Operations:**

- a. Display ODC, CTU, and RTU alarm functions
 - b. Display ODC, CTU, and RTU event functions
 - c. Enter new event in data log archive and send alarm to printer
 - d. Log event clearing and send alarm clear to printer
 - e. Input/Display control database
7. Historical Trending Operations:
- a. Real-time and historical trending functions
 - b. Create a multi-pen trend.
 - c. Ability to be shaded to compare two or more different trends
 - d. Create a trend that is part of a graphic display
 - e. The trends shall have a marker displaying the pen's date, time, and value

F. Graphical Screen Display Editor

The HMI shall provide a graphics display editor for creating displays using graphic objects. The graphics display editor shall have the ability to drag and drop objects from a pre-configured graphics library, paste objects that are copied to the clipboard from another Windows application, and insert objects created by another Windows application using OLE. True OLE support is required in that it shall be possible to call up the native application that created the object being inserted and use the naïve object editing tools from within the HMI. The graphics display editor shall have tear-away toolbars and color palettes. It shall be possible to customize the color pallet. Graphics drawn with a customized color pallet shall not require the customized color pallet to be present on all runtime computers. Colors must be stored internal to the graphic files as Red, Green, Blue numbers, not pallet indexes. The graphics display editor shall have:

1. Context sensitive "right-mouse" support on all objects.
2. As a minimum the following drawing tools:
Rectangle, line, ellipse, wedge, and text
3. As a minimum the following editing tools:
Tag substitute, flip, rotate, resize, reshape, align, cut, paste, copy, duplicate, bring to front, send to back, space, fill, undo, redo, line, and color.
4. As a minimum the following viewing tools:
Zoom in, zoom out, pan, and view entire graphic.

5. The ability to use tag placeholders to provide a way to use one graphic display to represent a number of similar operations.
6. Provide tools for each of the following as a minimum:
Numeric input, numeric display, string input, string display, label, arrow, recipe, alarm summary, tag monitor, input command line, trend, button, OLE object, and ActiveX object.
7. The ability to create a screen background by converting objects to wallpaper. These wallpaper objects cannot be selected or edited.
8. Allow the user to create libraries of graphic objects.
9. Allow the user to assign control to any object or grouping of objects. It shall also allow the user to drill down in a group to modify any object or object attribute without losing any object control property.
10. Allow control to be copied from any object to another object.
11. Permit the user to specify screen placement anywhere on the display.

PART 3 - EXECUTION

3.01 EQUIPMENT EXAMINATION

The control system shall be completely tested prior to shipment. The entire control system shall be "Burned In" at the factory for a period of at least 20 days. The component equipment shall be computer tested and temperature cycled at zero degrees and at fifty degrees centigrade.

3.02 SYSTEM START-UP

The manufacturer shall supply "Factory" personnel for start-up service as needed to insure satisfactory operation. Subsequent trips to the job site to correct defects shall be made at no charge to the Owner during the warranty period.

3.03 TRAINING

The system manufacturer shall supply "factory" personnel to conduct two separate on-site training sessions, totaling a minimum of three days of training.

The initial training session shall be conducted during start-up as needed until the Owner and Engineer are satisfied that the operators are comfortable with the operation and maintenance of the system. Training shall be done on site with the owner's personnel.

Three to six months after the Owner commencing system operation, the system

manufacturer shall supply "factory" personnel to conduct follow-up training of the Owner's personnel. The follow-up training shall be conducted on-site and consist of reviewing the operation and maintenance of the system. The Owner shall be contacted a minimum of two weeks in advance, prior to scheduling the training session to allow proper coordination.

3.04 SUBSTANTIAL COMPLETION

The Engineer will grant substantial completion only after completion of the start-up and initial training phase of the project. The Engineer shall make an inspection of the system to determine the status of completion. Substantial completion will be awarded only when the system is providing usable service to the Owner. If the system is commissioned in phases, the Contractor may request substantial completion for the completed phases.

3.05 WARRANTY/SUPPORT PROGRAM

The control system manufacturer shall supply a five (5) year parts and labor warranty and comprehensive support program for all items and software supplied under this section (except as noted below). Power surges and lightning damage shall be included as part of the warranty.

The warranty shall begin from the time of "substantial completion" as issued by the engineer. The manufacturer shall provide a 24-hour response to calls from the Owner. The manufacturer, at his discretion, may dispatch replacement parts to the Owner by next-day delivery service for field replacement by the Owner. Any damage to the control system caused by the actions of the Owner in attempting these field replacements shall be the sole responsibility of the manufacturer. If, during the warranty period, satisfactory field repair can not be attained by field replacement of parts by the Owner, the manufacturer shall dispatch "factory" personnel to the job site to complete repairs at no cost to the Owner.

The support program shall begin from the time of "substantial completion" as issued by the engineer. The support program shall include free updating of all software as needed and providing free phone support from the integrator throughout the warranty period.

PART 4 - APPENDIX: DETAILED EQUIPMENT DESCRIPTION

4.01 WATER TOWER REMOTE UNIT REQUIREMENTS:

A. Installation Requirements:

The tower transceiver shall be mounted inside a lockable, NEMA 3R enclosure as specified.

The level transducer shall be a two-wire transmitter suitable for below ground mounting as specified earlier. The level transducer shall be installed at a point below freezing in the altitude vault (if available) or in a 24" fiber meter vault with a freeze proof lid. The pressure connection shall be equipped with a corporation stop

providing a 1/4" NPT female connection for the transducer. The contractor shall run 3/4" rigid conduit from the vault or meter box to the transceiver enclosure for the transducer signal cable.

The antenna shall be as specified and mounted on the water tower at a height consistent with FCC requirements. The contractor shall provide a 3/4" rigid conduit with a weather-head from the transmitter to the ladder on the tower.

B. Front Panel Display Requirements:

1. Keypad & Display assembly to display all inputs and output status

C. Discrete Outputs:

1. (1) System Normal (displayed on front of RTU assembly)
2. (spare)

D. Discrete Inputs:

1. Power Failure
2. (spare) Unauthorized Entry

E. Analog Inputs:

1. Water Tower Level (suppressed head data from new transducer)
2. (spare) RTU Temp

F. Pulse Inputs:

1. (spare) Battery Voltage

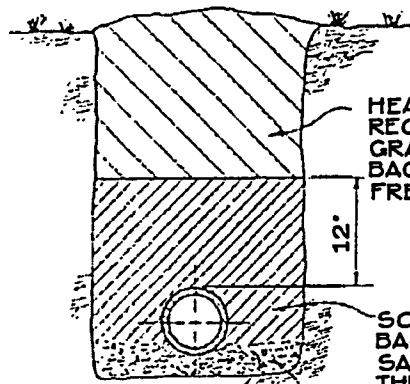
G. Specific Control Requirements:

The existing central control group for the Clays Mill Booster Pump Station will be modified to allow the new 750,000 gallon elevated tank level to also be used as an operator selected level control in the control group.

-END OF SECTION-

STANDARD DETAILS

SD-1 thru SD-21

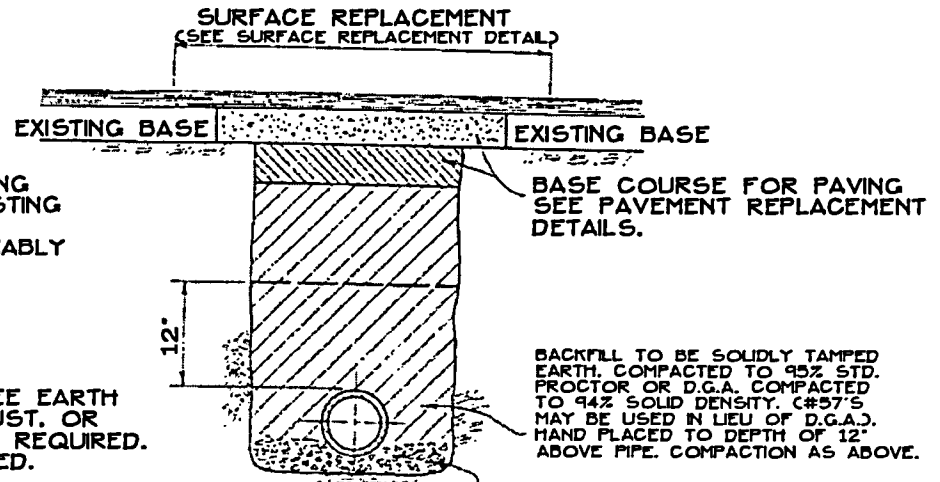


HEAPED BACKFILL. NO TAMPING REQUIRED. REGRADE TO EXISTING GRADE AFTER SETTLEMENT BACKFILL SHALL BE REASONABLY FREE OF ROCK.

SOLIDLY TAMPED, ROCK FREE EARTH BACKFILL. IF LIMESTONE DUST, OR SAND USED, NO TAMPING IS REQUIRED. THIS ZONE SHALL BE PLACED.

SEE STANDARD EXCAVATION + BEDDING METHOD DETAIL

METHOD "A"



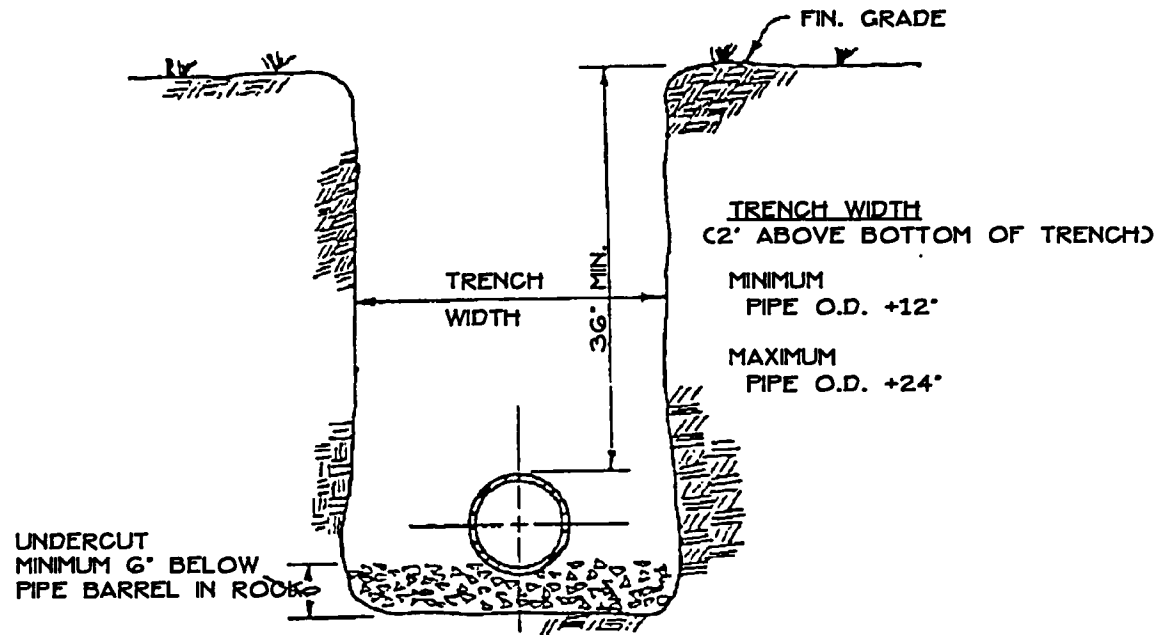
BASE COURSE FOR PAVING SEE PAVEMENT REPLACEMENT DETAILS.

BACKFILL TO BE SOLIDLY TAMPED EARTH, COMPACTED TO 95% STD. PROCTOR OR D.G.A. COMPACTED TO 94% SOLID DENSITY, (#57'S MAY BE USED IN LIEU OF D.G.A.) HAND PLACED TO DEPTH OF 12" ABOVE PIPE. COMPACTION AS ABOVE.

SEE STANDARD EXCAVATION + BEDDING METHOD DETAIL.

METHOD "C"

Backfilling



TRENCH BOTTOM SHALL PROVIDE A MINIMUM OF 6" OF UNDISTURBED SOIL. IF SOLID ROCK OCCURS LESS THAN SIX INCHES THEN UNDERCUT TO 6" AND USE SOLID ROCK BEDDING PROCEDURE.

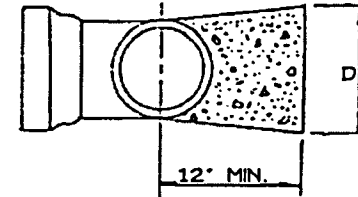
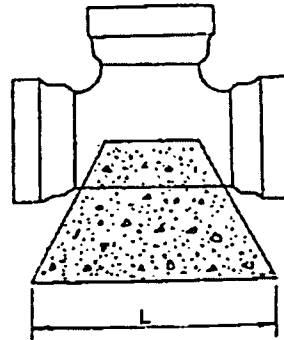
Standard Excavation & Bedding Method

NOT TO SCALE

SD-2

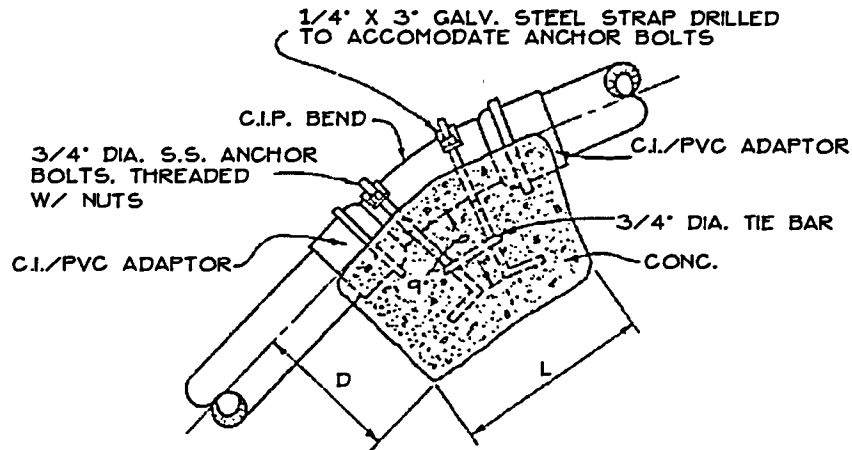
VERTICAL BENDS + STRAIGHT PIPES							
SIZE	2'	3'	4'	6'	8'	10'	12'
D	10"	12"	12"	18"	18"	24"	24"
L	12"	18"	18"	30"	30"	36"	36"

TEES							
SIZE	2'	3'	4'	6'	8'	10'	12'
D	12"	12"	12"	24"	24"	36"	36"
L	12"	12"	20"	36"	36"	48"	48"

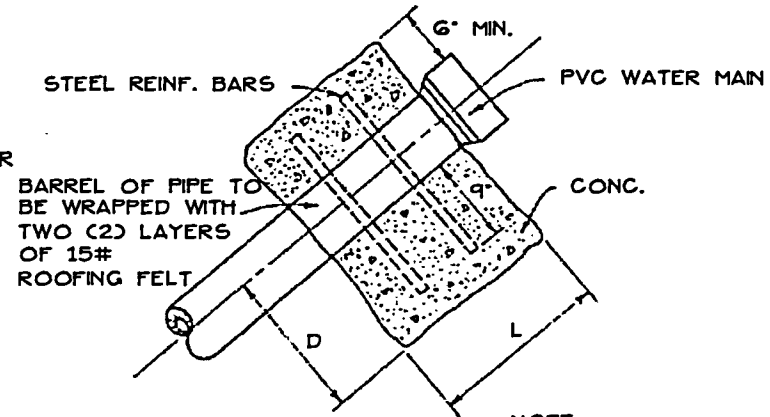


SECTION

TEE



VERTICAL BEND



STRAIGHT PIPE

NOTE:
 DEPTH 'D' MAY BE GREATER THAN SPECIFIED TO ALLOW WORKING SPACE. PIERS MUST BE PLACED AGAINST UNDISTURBED EARTH. TO BE USED ON GRADES EXCEEDING 15% FOR 50 FEET OR MORE. ALL METAL IN CONTACT WITH SOIL TO BE STAINLESS OR NON CORROSIVE. ONE ANCHOR REQUIRED FOR EACH JOINT OF PIPE.

Concrete Anchor Blocks

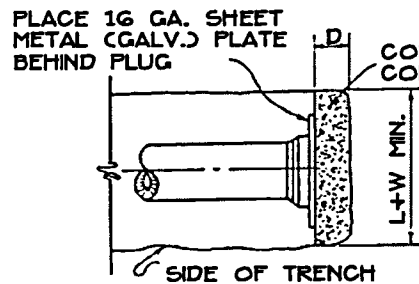
NOT TO SCALE

PLUGS							
SIZE	2'	3'	4'	6'	8'	10'	12'
D	6"	6"	6"	6"	6"	6"	6"
L+W	14'	16'	18'	24'	30'	36'	42'

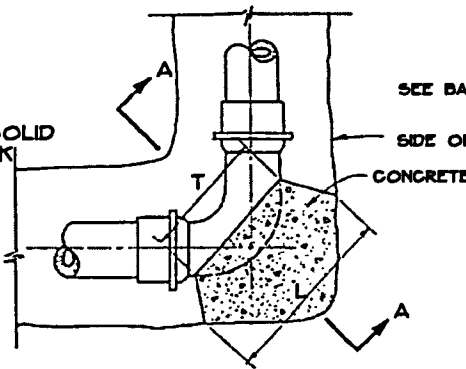
(45°) EIGHTH BENDS							
SIZE	2'	3'	4'	6'	8'	10'	12'
D	6"	6"	6"	6"	6"	6"	6"
L	12'	14'	16'	24'	30'	30'	36'
T	10'	12'	14'	16'	16'	18'	18'

(90°) QUARTER BENDS							
SIZE	2'	3'	4'	6'	8'	10'	12'
D	6"	6"	6"	12"	12"	18"	18"
L	21'	24'	27'	36'	36'	42'	48'
T	10'	12'	14'	16'	20'	24'	24'

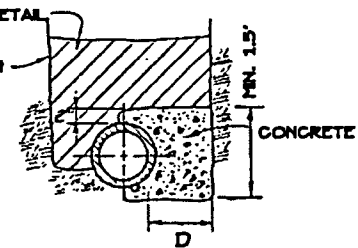
NOTE:
 DEPTH 'D' MAY BE GREATER THAN SPECIFIED TO ALLOW WORKING SPACE. PIERS MUST BE PLACED AGAINST UNDISTURBED EARTH. TO BE USED ON GRADES EXCEEDING 15% FOR 50 FEET OR MORE. ALL METAL IN CONTACT WITH SOIL TO BE STAINLESS OR NON CORROSIVE. ONE ANCHOR REQUIRED FOR EACH JOINT OF PIPE.



PLUGS



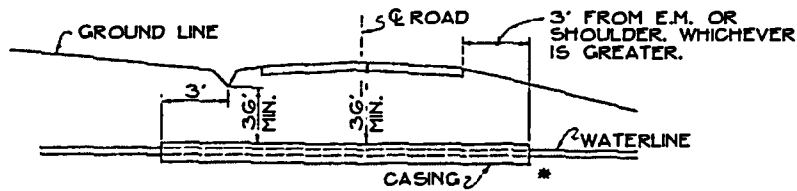
45° & 90° BENDS



SECTION A-A

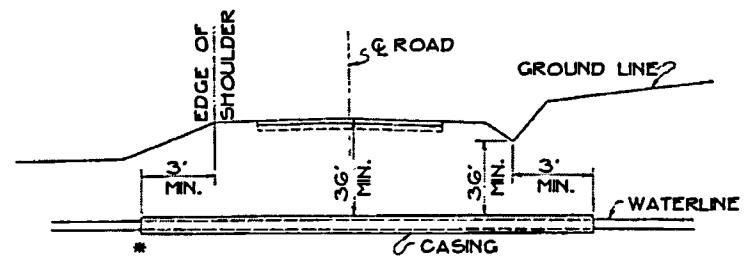
Concrete Thrust Blocks

NOT TO SCALE



BORE + CASE OR TRENCH WITH SLEEVE W/ BACKFILL METHOD 'C'. PAVEMENT AS PER DETAIL.

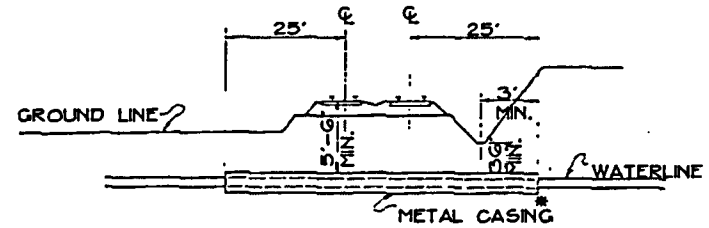
TYPICAL COUNTY ROAD CROSSING



TYPICAL STATE + FEDERAL ROAD CROSSING

NOTE: ALL PIPES INSTALLED IN CASINGS REQUIRE CASING INSULATORS TO BE INSTALLED AT A MINIMUM OF 3 PER PIPE JOINT.

*CASING PIPE ENDS TO BE SEALED WITH NEOPRENE GASKET WITH STAINLESS STEEL BANDS.



NOTE: CASING PIPE TO BE INSTALLED AS PER SECTION 5.2. SPECIFICATIONS FOR PIPE LINES CONVEYING NON-FLAMMABLE SUBSTANCES OF THE A.R.E.A. MANUAL FOR RAILROAD ENGINEERING REGARDING METHOD OF INSTALLATION + MATERIALS

TYPICAL RAILROAD CROSSING

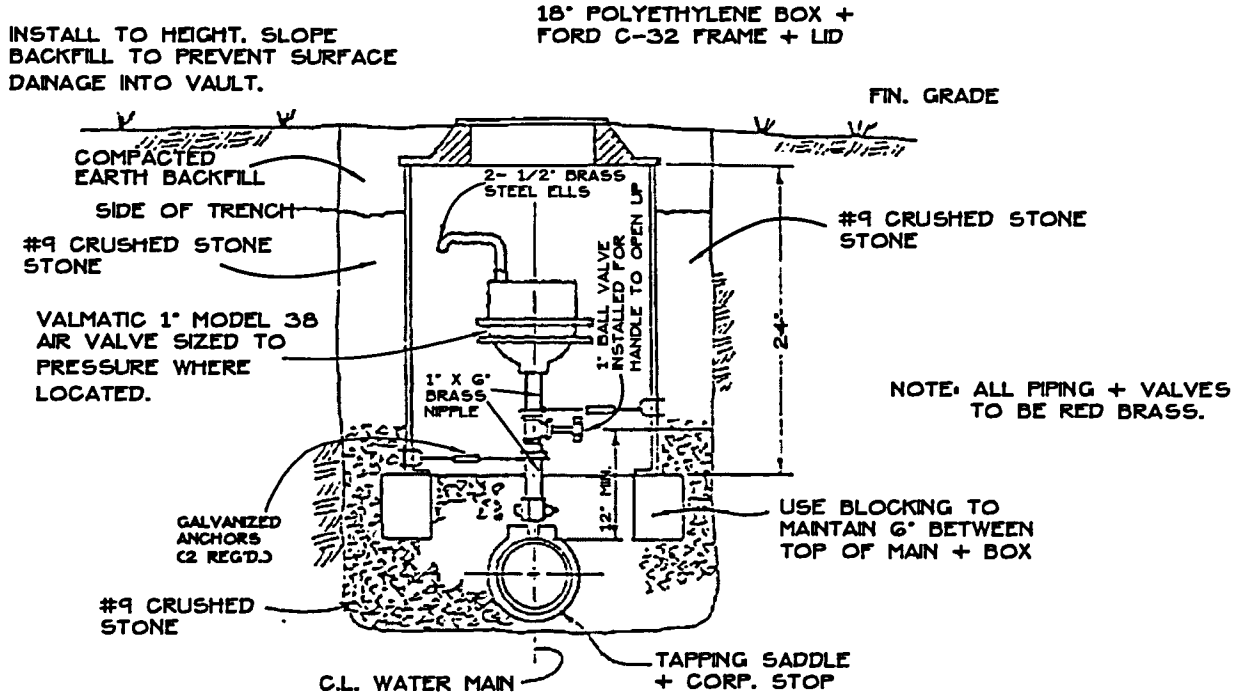
CASING PIPE SIZES		
CARRIER PIPE SIZE	CASING PIPE SIZE	WALL THICKNESS #METAL
2"	4"	0.250
4"	10"	0.250
6"	12"	0.250
8"	14"	0.250
10"	16"	0.250

*MINIMUM YIELD STRENGTH OF 35,000 P.S.I. NO ALTERNATE ALLOWED FOR RAILROAD CROSSING.

Road Casing Details
NOT TO SCALE

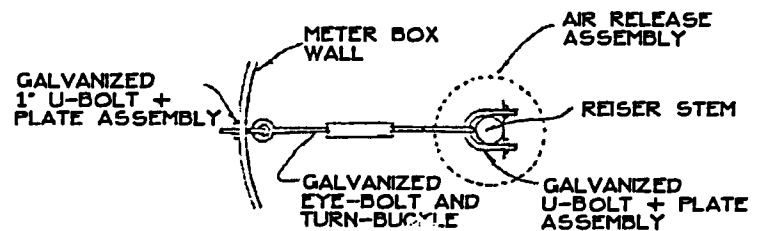
NOTE: AIR VALVE TO BE ANCHORED AS PER DETAIL HEREON.

NOTE: ALL AIR RELEASE ASSEMBLIES WHICH FALL WITHIN PASTURE OR CULTIVATED FIELDS SHALL BE LOCATED UNDER OR NEAR A FENCE LINE. MAIN LINE TAP SHALL BE MADE AT HIGH POINT AND IF NECESSARY POLY TUBING LAID AT POSITIVE GRADE TO AIR RELEASE ASSEMBLY.



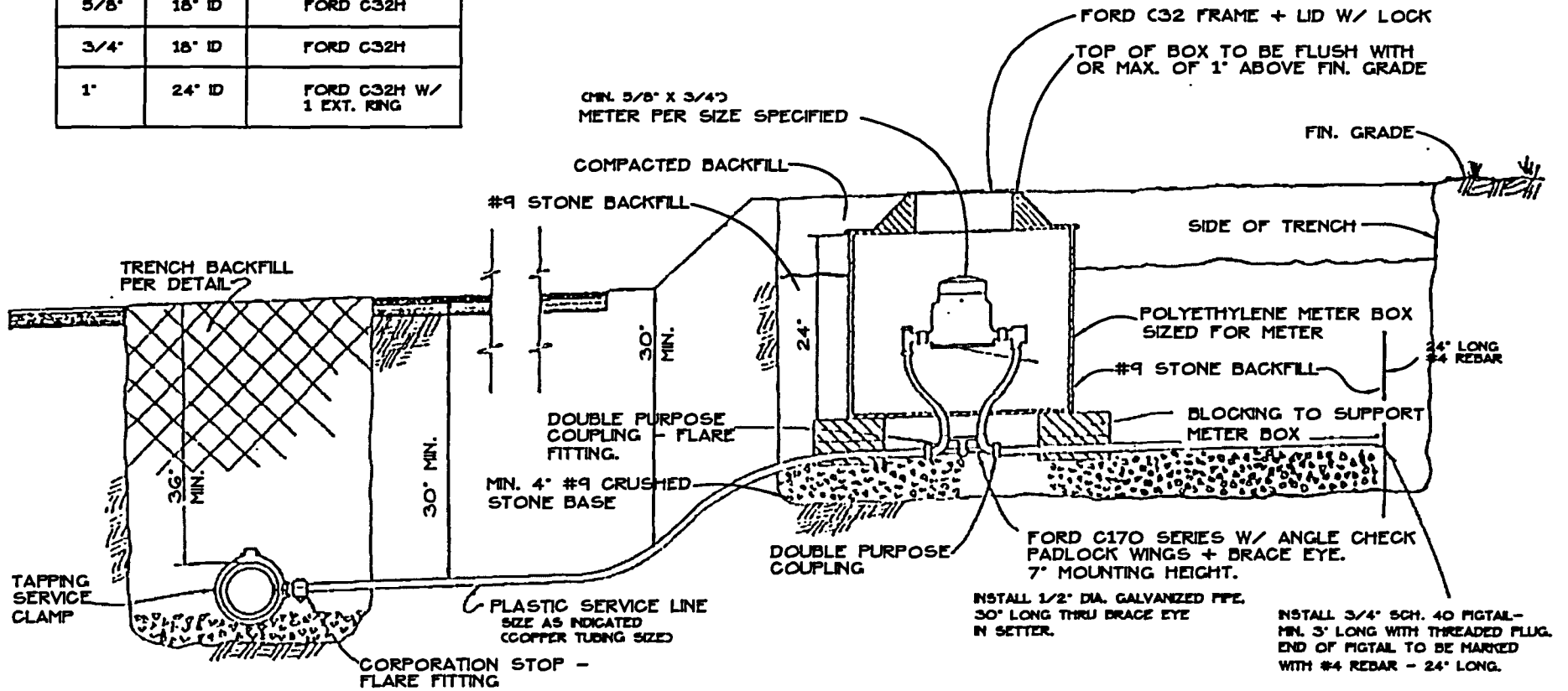
TYPICAL AIR VALVE SETTING

NOT TO SCALE



Air Valve Setting
Galvanized Anchor Detail
 (2 Required each installation)
 Not to scale

METER SIZE	BOX DIA.	METER LID
5/8"	18" ID	FORD C32H
3/4"	18" ID	FORD C32H
1"	24" ID	FORD C32H W/ 1 EXT. RING

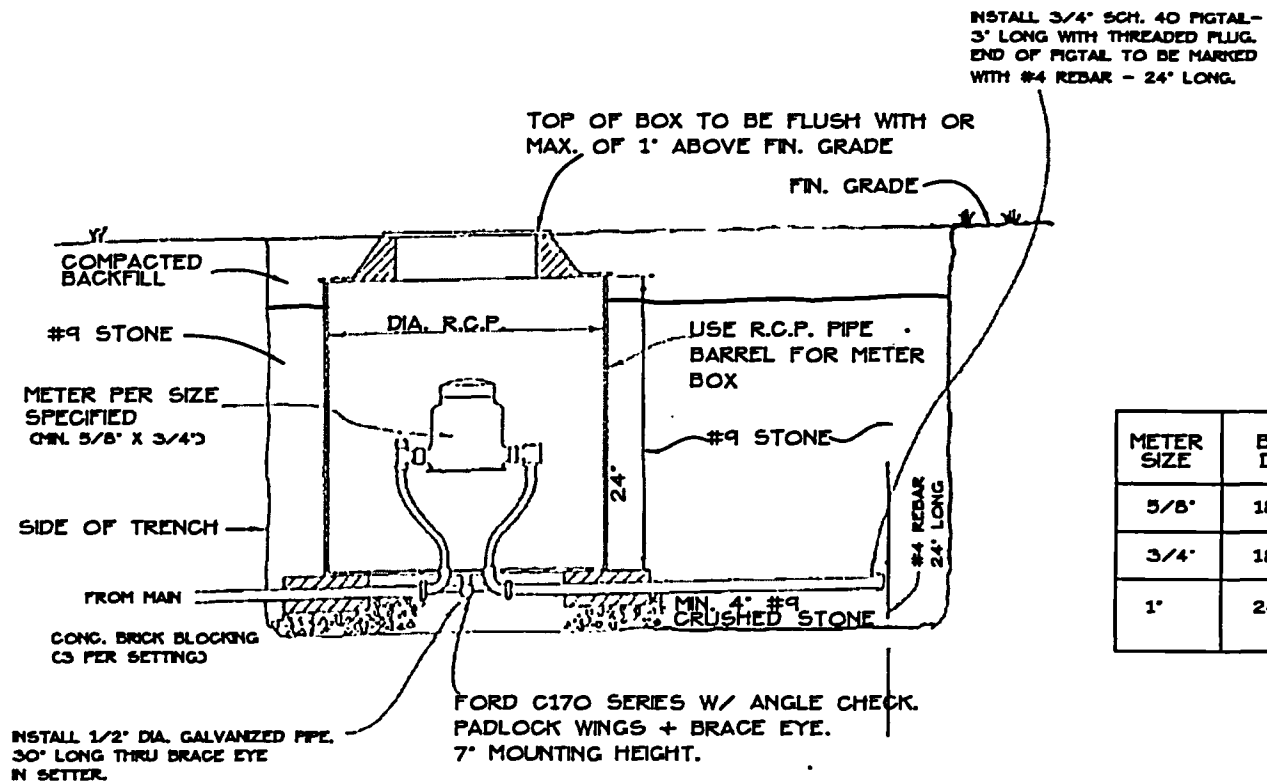


TYPICAL SERVICE CONNECTION

5/8" THRU 1" - NON-TRAFFIC BEARING

NOT TO SCALE

SD-7



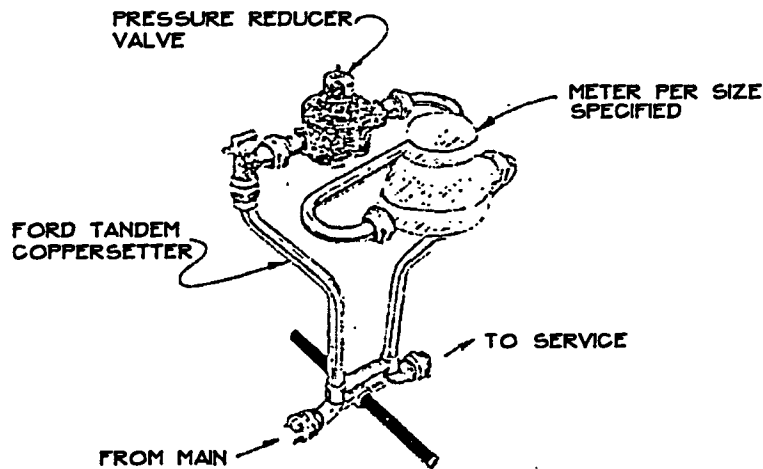
METER SIZE	BOX DIA.	METER LID
5/8"	18" ID	FORD C32H
3/4"	18" ID	FORD C32H
1"	24" ID	FORD C32H W/ 1 EXT. RING

TYPICAL METER INSTALLATION

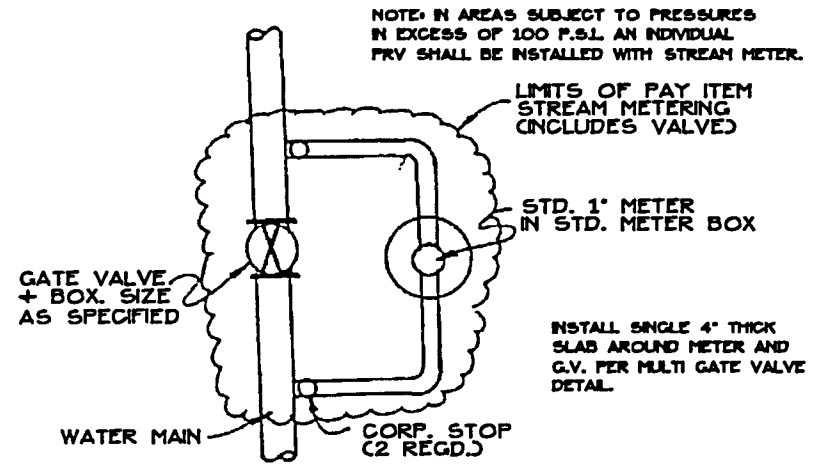
5/8" THRU 1" - TRAFFIC BEARING

NOT TO SCALE

NOTE: COPPERSETTER SHALL HAVE BALL VALVE ON BOTH INLET AND OUTLET SIDE.

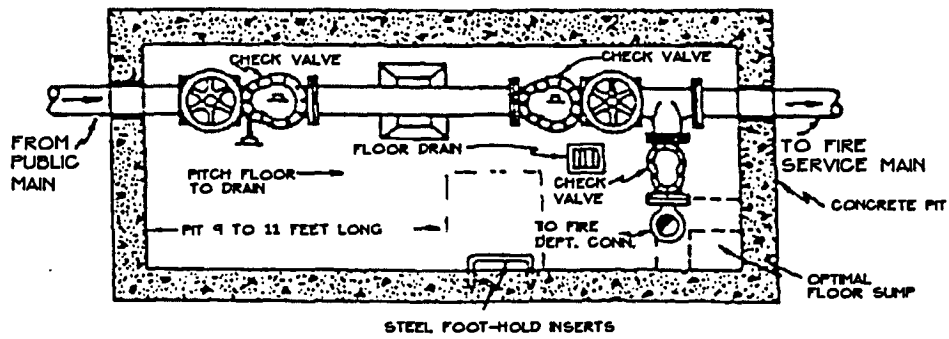


Typical Meter Installation.
with Pressure Reducer Valve

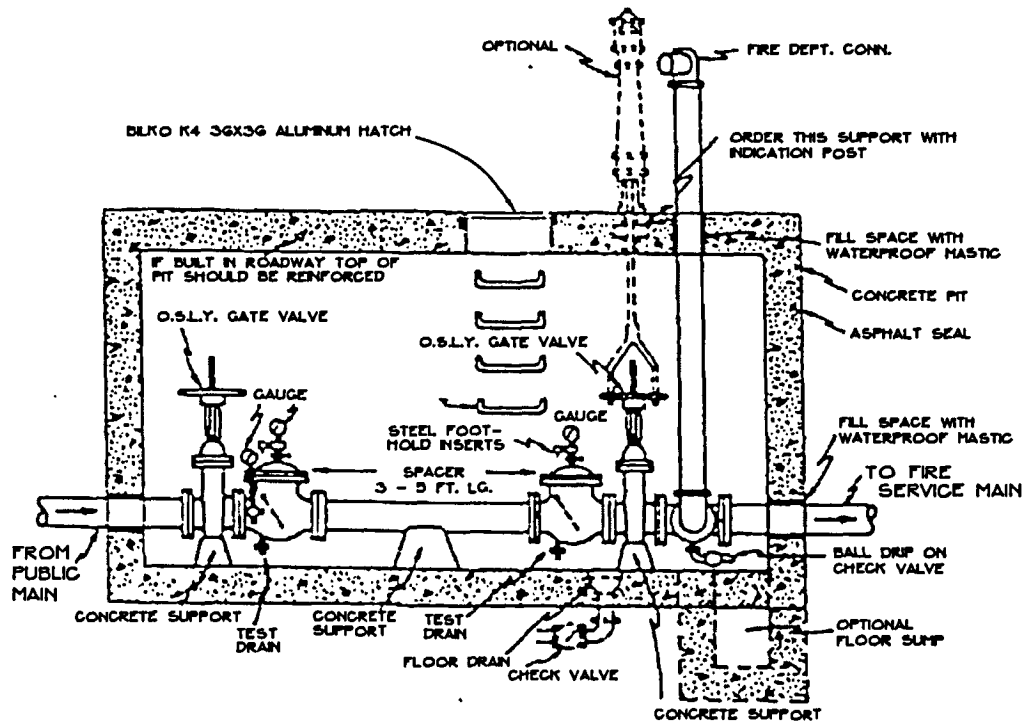


NOTE: IN AREAS SUBJECT TO PRESSURES IN EXCESS OF 100 P.S.I. AN INDIVIDUAL PRV SHALL BE INSTALLED WITH STREAM METER.

Stream Metering
Installation



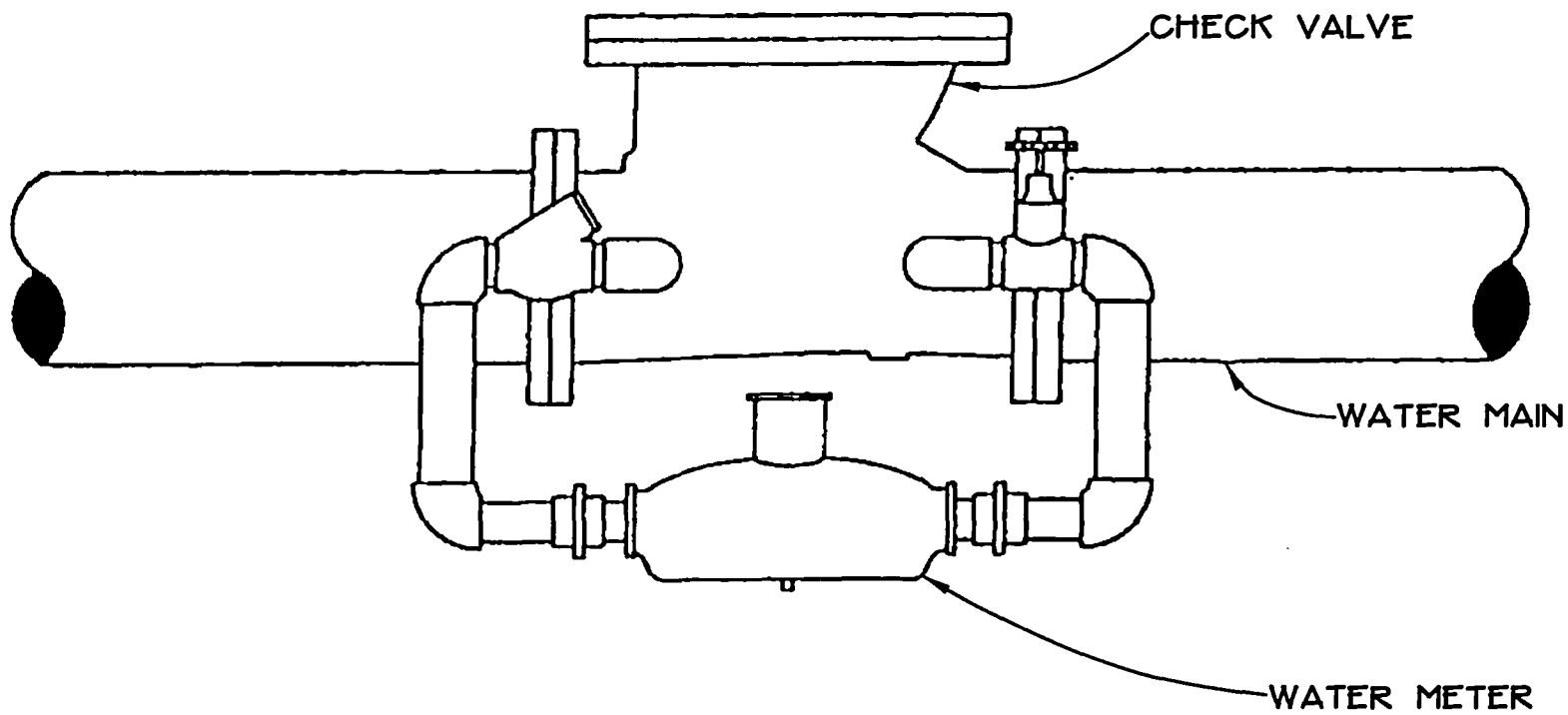
PLAN
NO SCALE



SECTION
NO SCALE

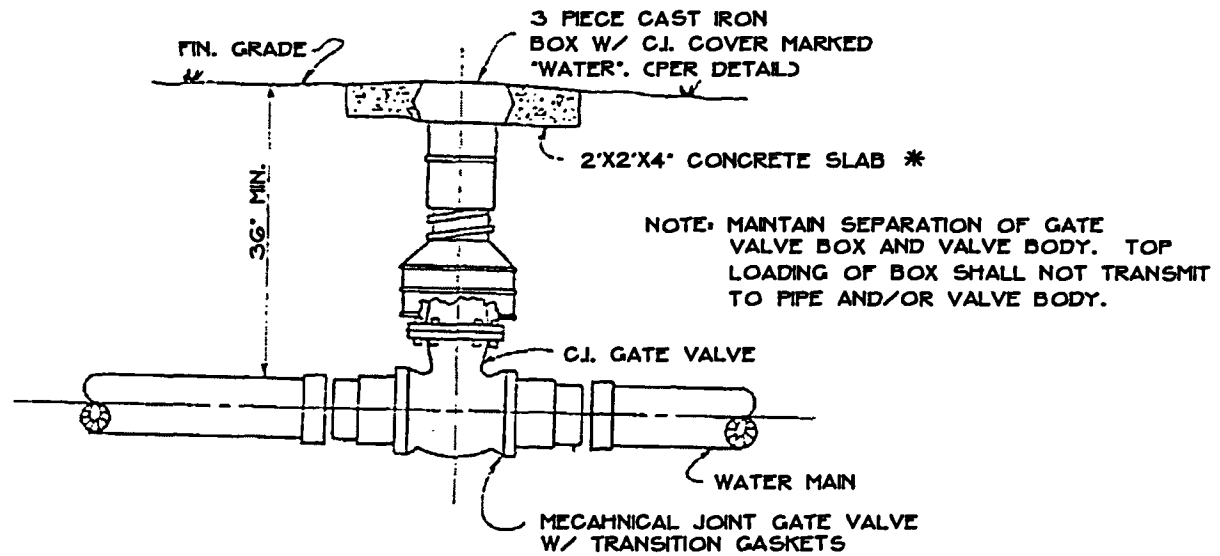
DETECTION CHECK VALVE
DOUBLE

SD-10



DETAIL OF DETECTION CHECK
METER

SD-11

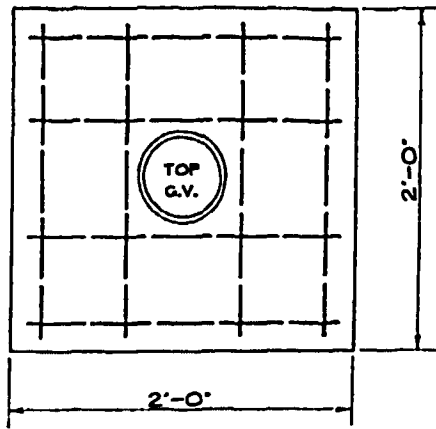


Typical Gate Valve Setting

NOT TO SCALE

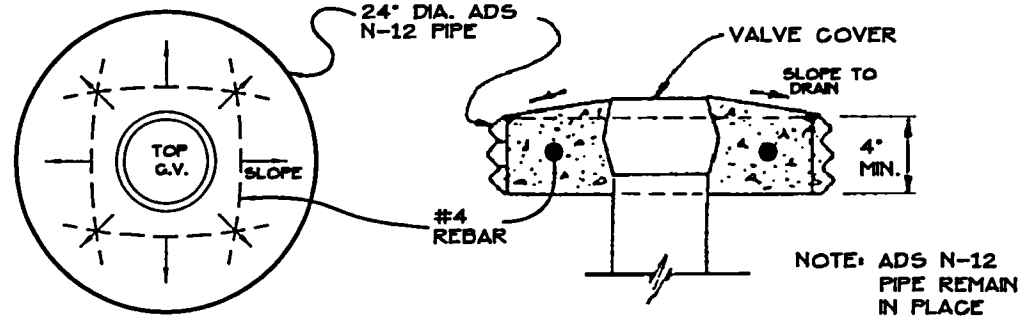
* **ALTERNATE:**

GATE VALVE SLAB MAY BE FORMED BY 4" SEGMENT
OF 24" DIAMETER ABS N-12 PIPE.

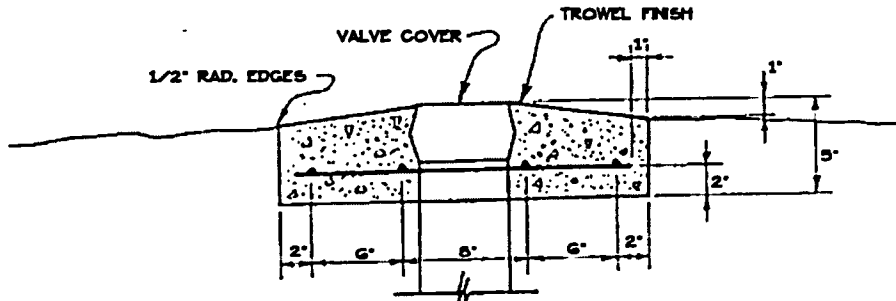


PLAN

ALL SLABS IN TRAFFIC AREAS SHALL HAVE 1/2" REBARS AT 6" O/C E/W.

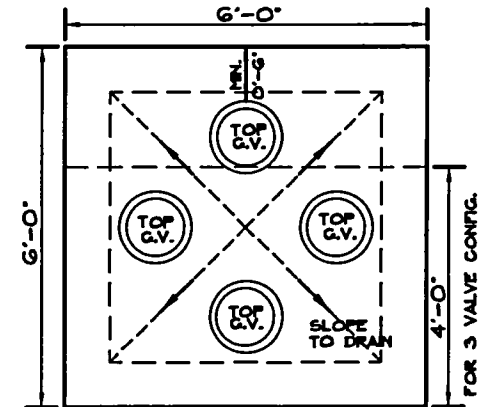


**ALTERNATE CONSTRUCTION
NON TRAFFIC AREA**



NOTE: USE 4 - #4 X22" REBARS EACH WAY

**SECTION
TRAFFIC AREA**

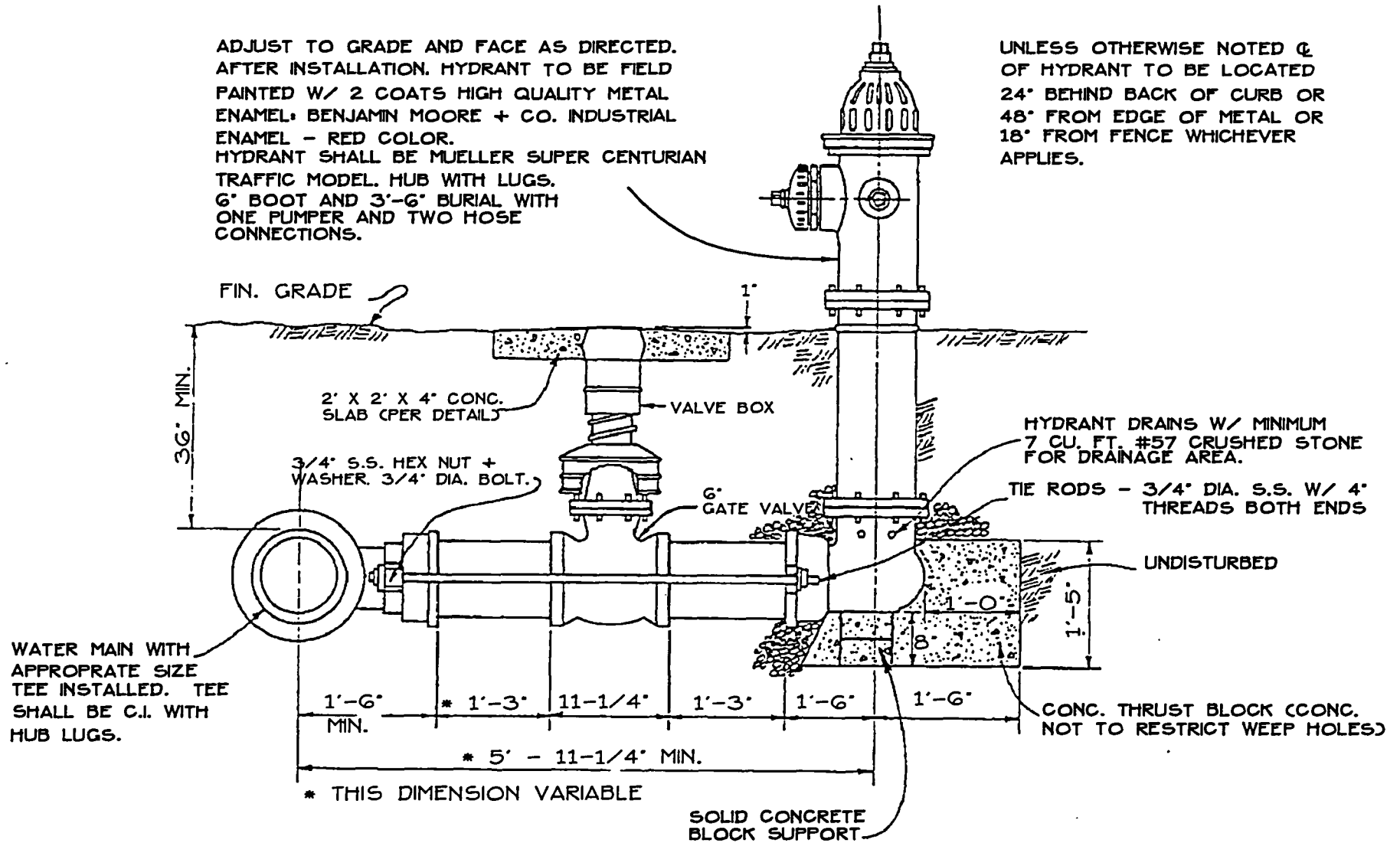


**TYPICAL 4(3) VALVE
ARRANGEMENT AT
CROSS-CONNECTIONS
(+ TEES)
NOT TO SCALE**

NOTE: ANY VALVE LOCATED WITHIN 10" OF A FITTING IS TO BE RODDED TO THE FITTING.

ADJUST TO GRADE AND FACE AS DIRECTED.
 AFTER INSTALLATION. HYDRANT TO BE FIELD
 PAINTED W/ 2 COATS HIGH QUALITY METAL
 ENAMEL: BENJAMIN MOORE + CO. INDUSTRIAL
 ENAMEL - RED COLOR.
 HYDRANT SHALL BE MUELLER SUPER CENTURIAN
 TRAFFIC MODEL. HUB WITH LUGS.
 6" BOOT AND 3'-6" BURIAL WITH
 ONE PUMPER AND TWO HOSE
 CONNECTIONS.

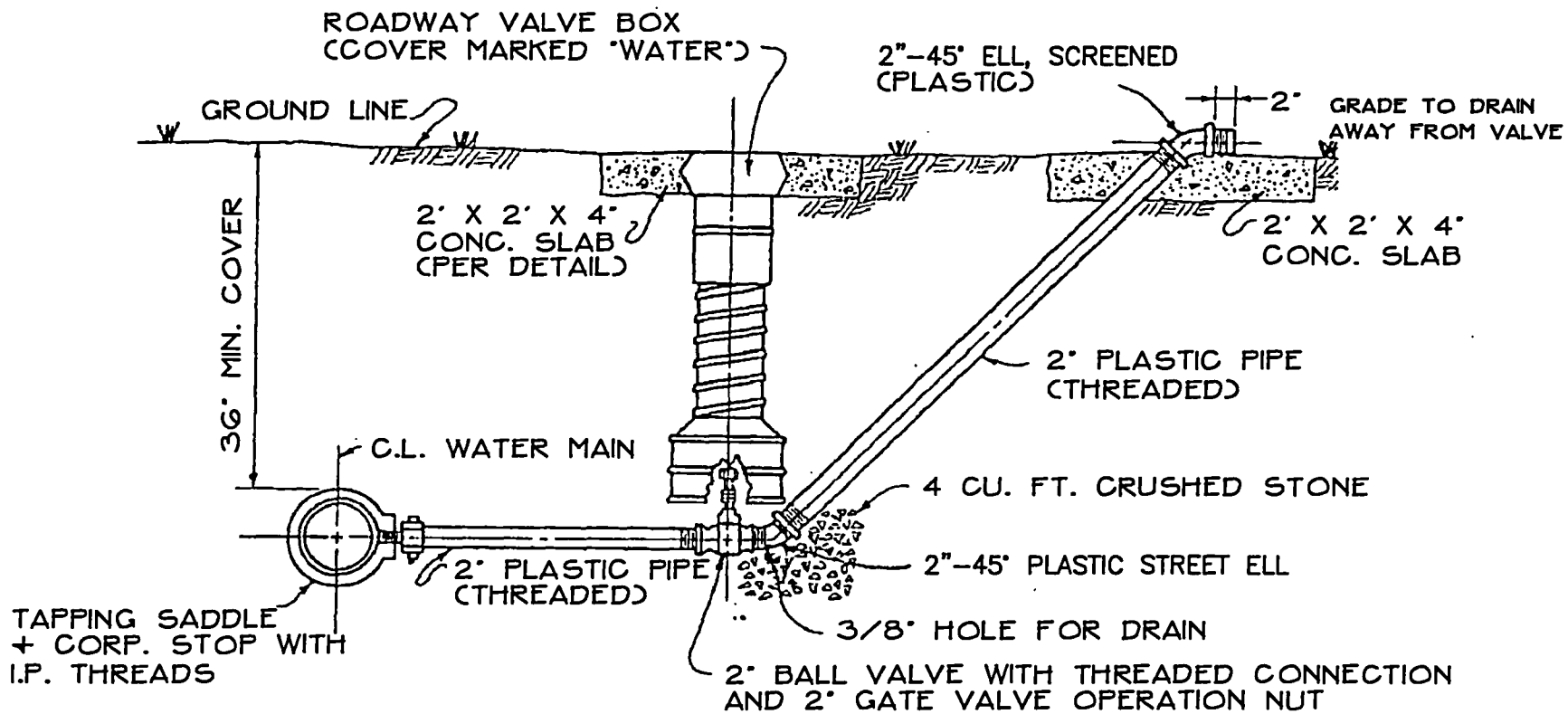
UNLESS OTHERWISE NOTED @
 OF HYDRANT TO BE LOCATED
 24" BEHIND BACK OF CURB OR
 48" FROM EDGE OF METAL OR
 18" FROM FENCE WHICHEVER
 APPLIES.



FIRE HYDRANT VALVE + VALVE BOX

NOT TO SCALE

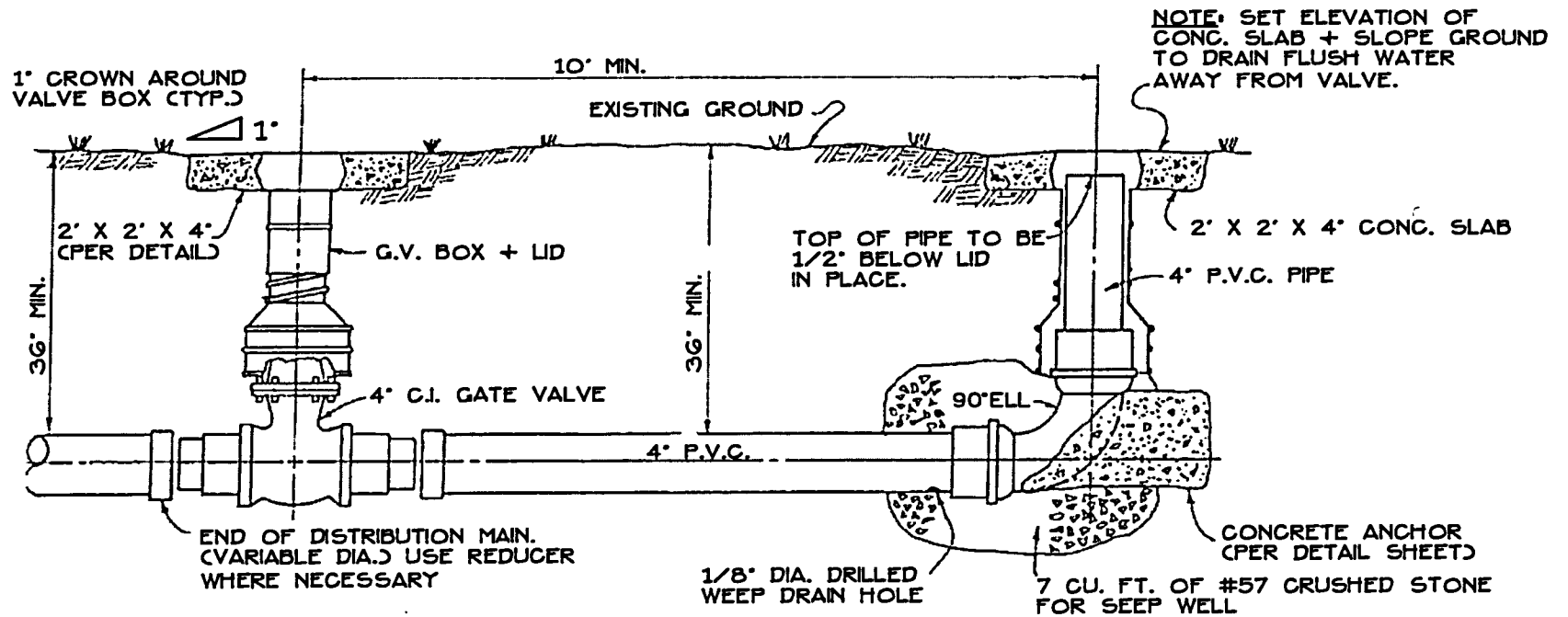
SD-14



NOTE: ALL 2" PIPE BENDS, VALVES
AND CONNECTIONS TO BE
I.P. THREADS.

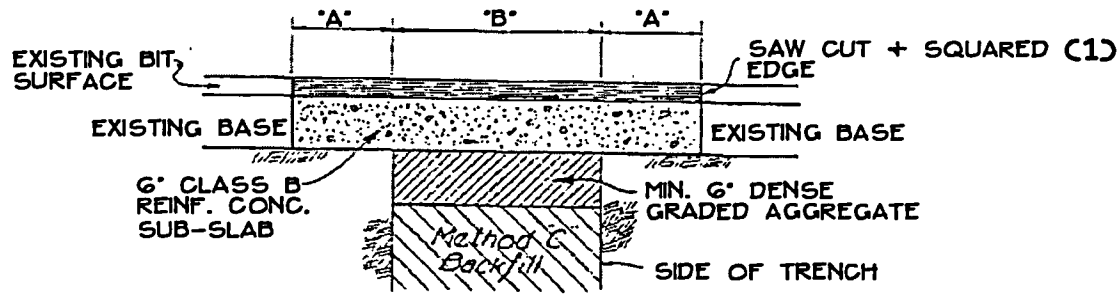
Typical Blow-off

NOT TO SCALE

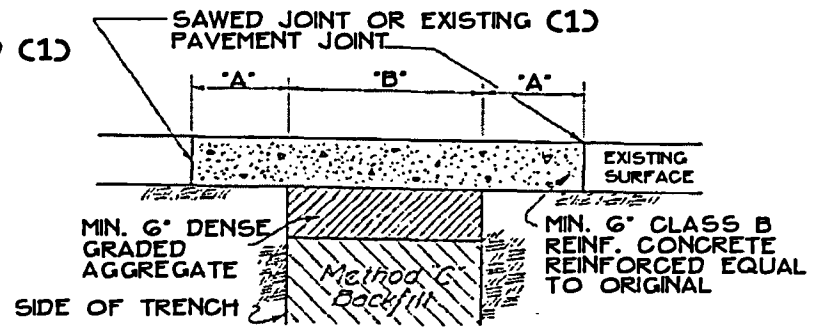


Line Termination Blow-off
NOT TO SCALE

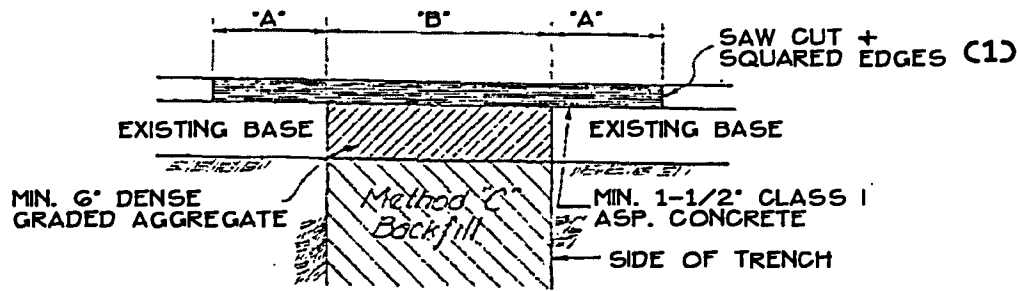
HEAVY DUTY SURFACE REPLACEMENT



BITUMINOUS



CONCRETE



LIGHT DUTY BITUMINOUS

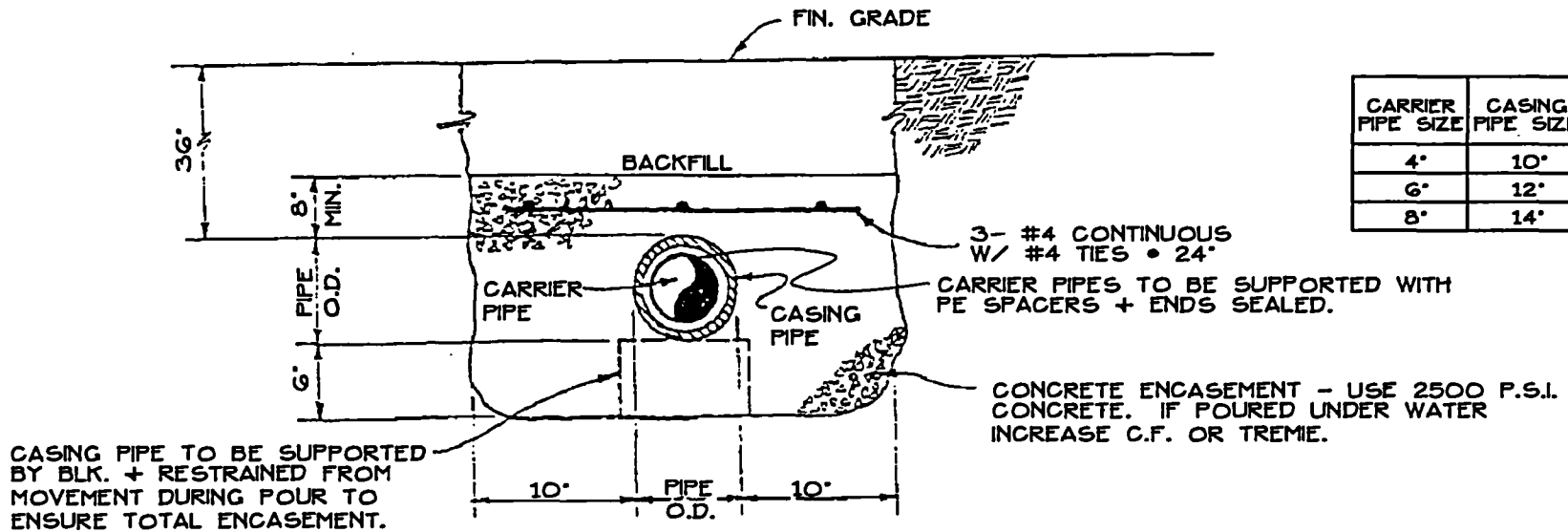
(1) DIMENSIONS SHOWN ARE MINIMUM. IF SURFACE EDGES ARE BROKEN WIDTH SHALL BE INCREASED AND EACH SIDE MAINTAINED PARALLEL.

ROADWAY	PAVEMENT REPLACEMENT TYPE
FEDERAL HIGHWAY	HEAVY DUTY
STATE HIGHWAY	HEAVY DUTY
COUNTY (PAVED)	HEAVY DUTY
COUNTY (UNPAVED)	LIGHT DUTY
DRIVEWAYS + ACCESS	LIGHT DUTY

MINIMUM REPLACEMENT WIDTH SCHEDULE			
PIPE SIZE	MIN. "A"	MIN. "B"	MIN. PAVEMENT REPLACEMENT
4" THRU 12"	12"	24"	4'-0"
14" THRU 18"	12"	30"	4'-6"
20" THRU 24"	12"	36"	5'-0"
26" THRU 36"	12"	48"	6'-0"

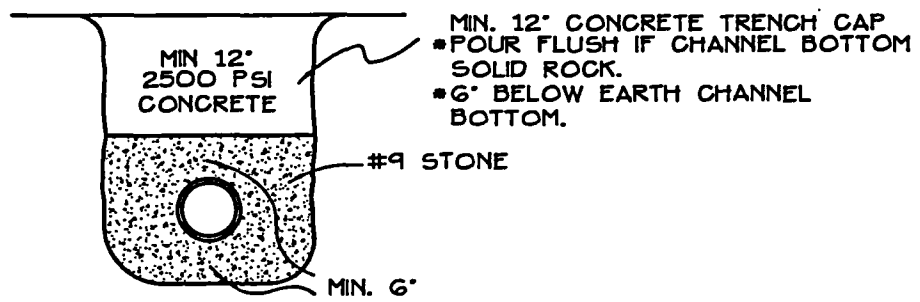
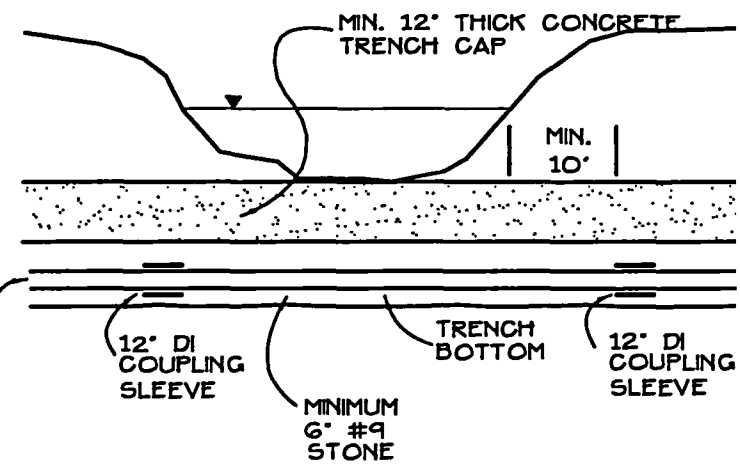
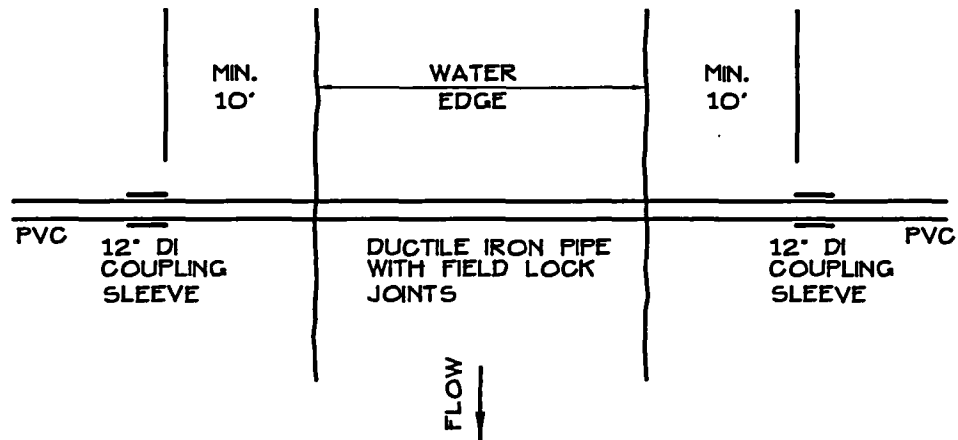
PAVEMENT REPLACEMENT

NOT TO SCALE



Typical Concrete Encasement

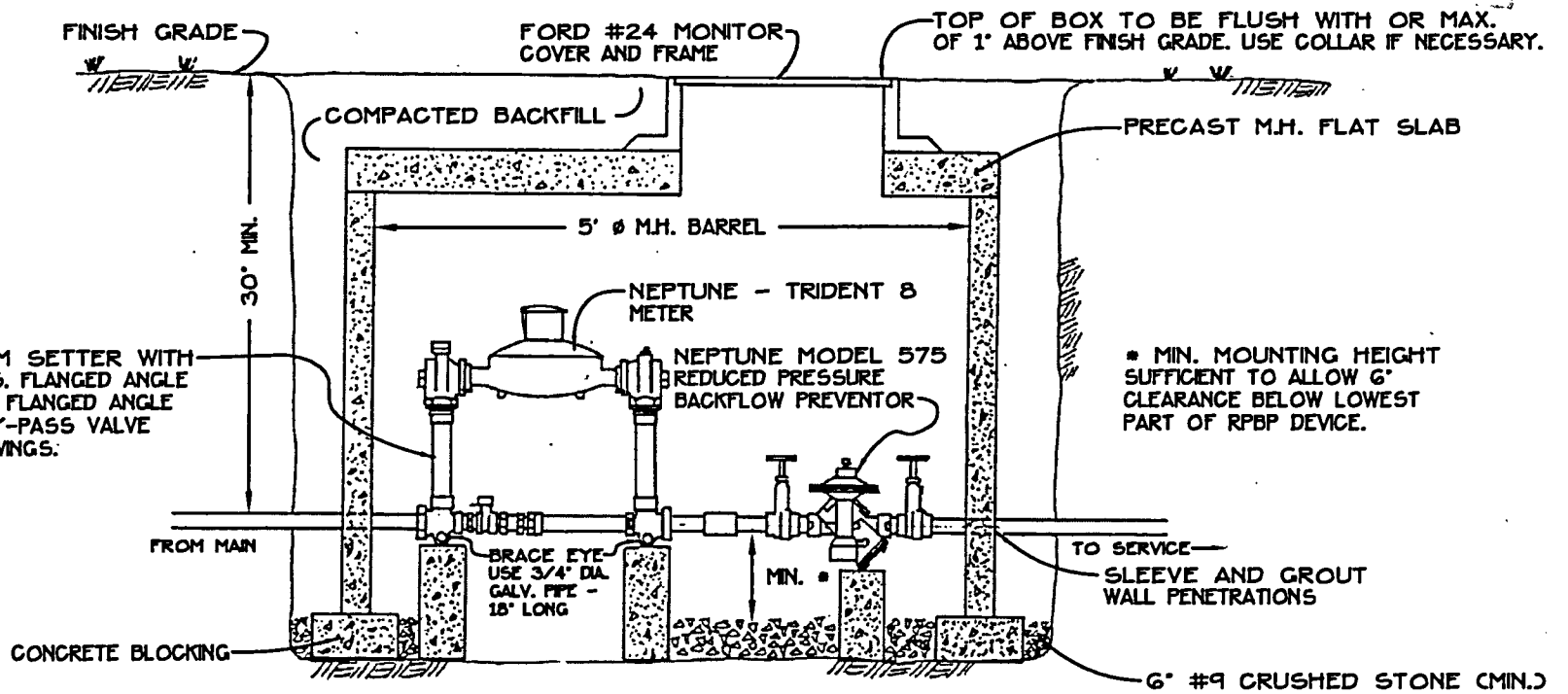
NOT TO SCALE



TYPICAL STREAM CROSSING

NOT TO SCALE

SD-19



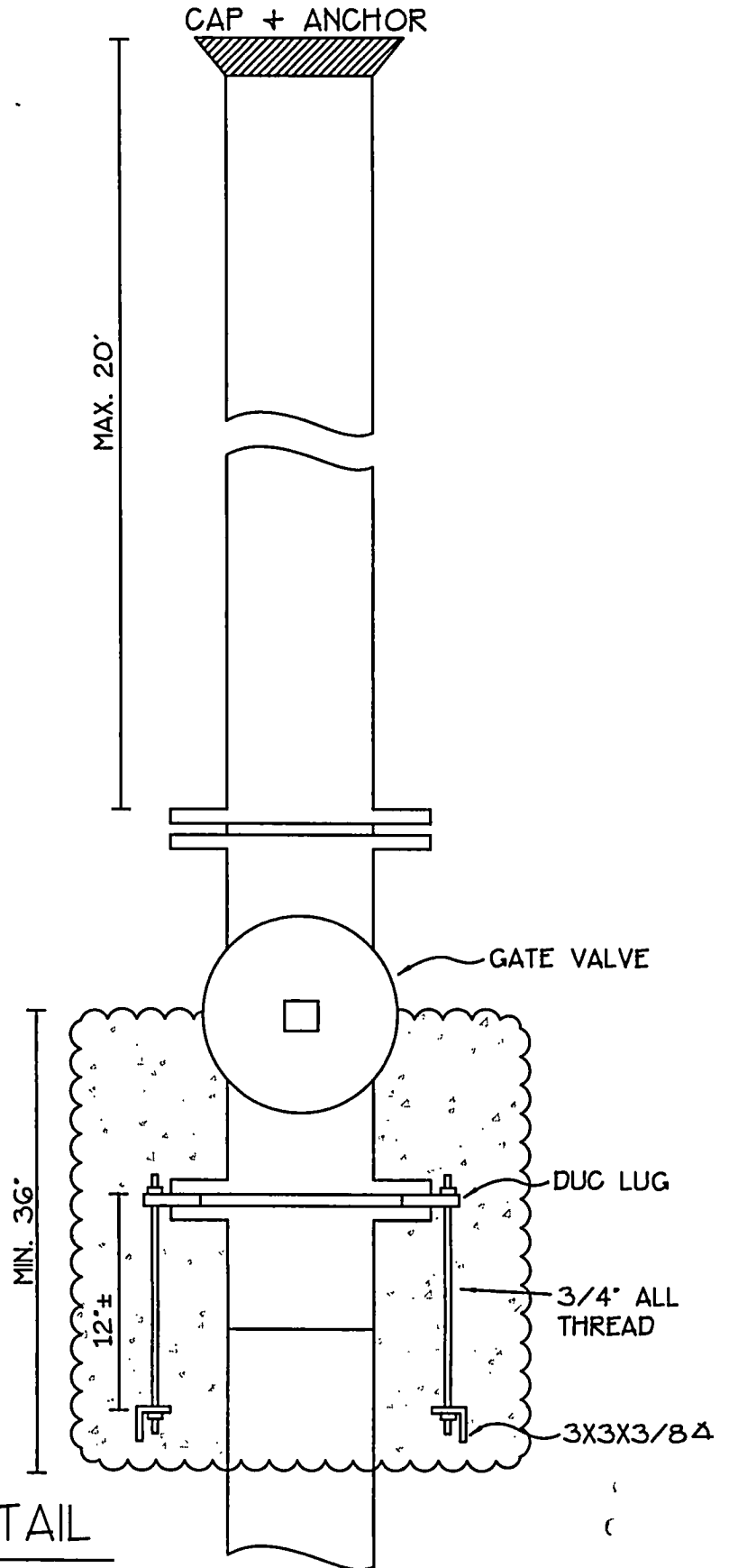
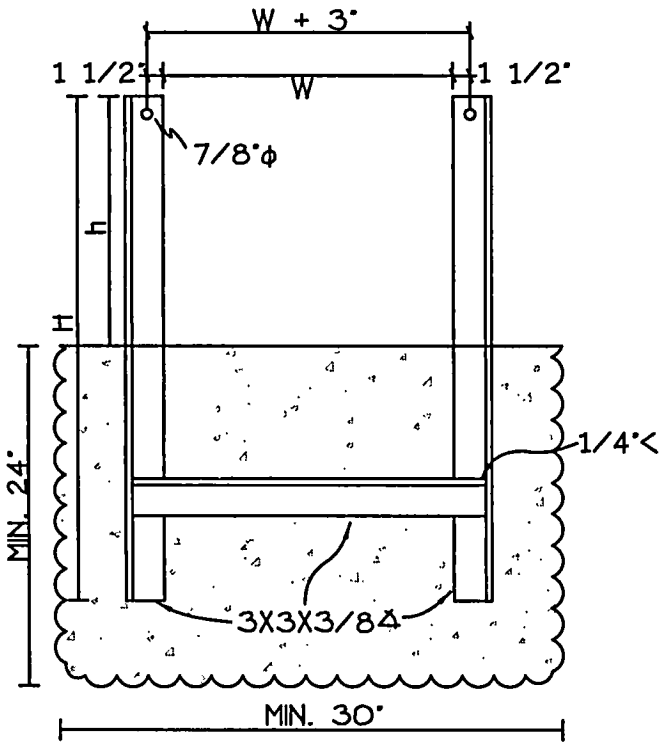
TYPICAL METER INSTALLATION

>1" THRU 2" - WITHOUT FIRE PROTECTION

NOT TO SCALE

SD-20

VALVE SIZE	W	H	h
12"	18"	24"	9"
10"	16"	23"	8"
8"	14"	22"	7"
6"	12"	21"	6"
4"	10"	20"	5"
3"	8"	19"	4"



DEADMAN ANCHOR DETAIL

SD-21