

Wolf Creek Water and Sewer Improvement District

500,000 Gallon Tank

Contract Documents and Specifications

Only technical specification
Section 5, Drawings and
Geotechnical Report are included
in this submittal document. This
is not a bidding document. It is
for jurisdictional review only.

Prepared By



Last Saved:
December 20, 2016

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CONTRACT DOCUMENTS FOR CONSTRUCTION OF

CULINARY WATER PIPELINES

for

Wolf Creek Water and Sewer Improvement District

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SECTION 6. DRAWINGS (Bound Separately, Refer to Drawings for contents)

**SECTION 5.1
PIPELINE TRENCH EXCAVATION AND BACKFILL**

5.1.1 DESCRIPTION: The CONTRACTOR shall furnish all labor, materials, tools and equipment, and perform all work necessary to complete required excavations and backfills. Work shall also include required grading for completion of water lines and associated appurtenances all in accordance with the plans and these specifications.

The work shall include: clearing the site; loosening, loading, removing, transporting and disposing of materials, wet and dry, necessary for construction; sheeting and bracing; draining and dewatering; backfill of trenches, excavations, and pits; compaction, compaction testing, leveling, signing, detours, mobilization, and clean up.

5.1.2 MATERIALS:

5.1.2.1 PIPE STABILIZATION MATERIAL: Gravel for pipe stabilization material shall be clean crushed rock or pit run gravel conforming to the following gradation:

<u>Screen</u>	<u>Percent Passing</u>
3"	100
3/4"	5

The gravel material shall be deposited over the entire trench width and compacted by tamping, rolling, or other suitable methods. In addition, the material shall be graded to produce a uniform and continuous support for pipe bedding material or installed pipe as specified.

5.1.2.2 PIPE BEDDING MATERIAL: Pipe bedding is fill material in the pipe zone. The pipe zone is defined as the envelope area 6 inches below the bottom of the pipe to 12 inches above the top of the pipe, and any lateral area within 9 inches of any pipe, pipeline structure or appurtenance.

Pipe bedding material may be excavated or imported material consisting of loose earth, sand or gravel conforming to the following gradation specifications:

- DUCTILE IRON PIPE BEDDING MATERIAL

<u>Screen</u>	<u>Percent Passing</u>
2"	100
1/2"	5

- PVC or HDPE PIPE BEDDING MATERIAL

<u>Screen</u>	<u>Percent Passing</u>
3/4"	100
No. 4	5

5.1.2.3 TRENCH BACKFILL MATERIAL: Trench backfill material, backfill material placed above the pipe bedding material in 5.1.2.2, shall be readily compactable and shall be free from

alkali, salt, and petroleum products, roots, sod, limbs, and other vegetative matter, slag, cinders, ashes and rubbish, or other material that in the opinion of the ENGINEER may be objectionable.

Conforming to the following gradation specifications:

<u>Sieve Size</u>	<u>Percent Passing by Weight</u>
8 inch	100
No. 10	50 max.
No. 40	30 max.
No. 200	15 max.

Select material from excavation may be used if it will meet all requirements of granular backfill, including compaction requirements as specified for type of surface improvement above trench.

5.1.3 CONSTRUCTION:

5.1.3.1 TRENCH EXCAVATION: Trench excavation shall be described as the excavation of quicksand, sand, crushed slag, clay, loam, earth, hardpan, boulder-clay, boulders, bituminous or gravel roadway surface, together with removal of old timber, railroad ties, stone-filled or stone abutments and piers, boundaries, concrete and stone masonry, and every other class of material.

5.1.3.2 SOLID ROCK EXCAVATION AND BLASTING: Blasting will not be permitted, except by written permission from the ENGINEER on a case by case basis. If the CONTRACTOR seeks blasting permission, and is granted that permission by the ENGINEER, he must exercise great care and will be held responsible for and will assume all liability connected with the blasting and use of explosives. He will be liable for all damage to work on adjacent property, all injuries, lawsuits, complaints, and any other actual or alleged damages.

- **BLASTING EXPERTS:** Blasting shall be done only by experienced, qualified blasters. Blasting shall be done in accordance with the recommendations for best practice in Section 9 of AGC Manual of Accident Prevention in Construction and in accordance with the recommendations for best practice of the Institute of Makers of Explosives. Blasting shall comply with State and OSHA requirements.
- **COVERED BLASTING:** All blasting near dwellings must be covered with heavy mats to prevent flying rock fragments. No blasting shall be done within 15 feet of completed work.
- **SAFETY RULES:** The CONTRACTOR shall observe all safety rules for the handling of explosives, and in no case shall blasting caps be stored near the explosives. No blasting shall be done outside the regular working hours except with special approval.
- **BLASTING NOT BID ITEM:** Solid rock excavation is not a bid item. Should the CONTRACTOR choose to blast, the cost will be negotiated through a work directive and change order.

5.1.3.3 TRENCH WIDTH: The trench shall be excavated such that the pipe is always centered in the trench. The minimum trench width at the horizontal diameter of the pipe must not be less

than the outside diameter of the pipe plus enough room for mechanical compaction equipment such as a jumping jack or plate compactor, typically a total minimum of Pipe O.D. plus 24". The maximum width of trench at the top of the pipe shall be minimized based on the native material type and equipment used.

Trench width for pipeline structures, valves, or other accessories shall be sufficient to leave at least 12 inches clear between their outer surfaces and the trench. Backfill with earth under structures or valves will not be permitted. Any unauthorized excess excavation below the elevation indicated for foundation of any structures shall be backfilled in accordance with these specifications for "Granular Backfill Material", and "Pipe Foundation Material" at the CONTRACTOR's expense.

5.1.3.4 SHEETING, BRACING AND SHORING OF EXCAVATIONS: Excavations shall be sheeted, braced, and shored as required to support the walls of the excavations, to eliminate sliding and settling and as may be required to protect the workmen, the work in progress, and existing utilities, structures and improvements. All such sheeting, bracing, and shoring shall comply with the requirements of the Utah State Industrial Commission, Occupational Safety and Health Act (OSHA), and accident prevention and safety provisions of the contract.

The CONTRACTOR shall be fully responsible for the adequacy of methods and materials used in trench sheeting, bracing, shoring, and/or other systems provided to protect workmen. Injury to or death of workmen resulting from inadequate trench safety measures shall be the full and complete responsibility of the CONTRACTOR.

All damages resulting from lack of adequate sheeting, bracing and shoring shall be the responsibility of the CONTRACTOR, and the CONTRACTOR shall complete all necessary repairs or reconstruction at his own expense resulting from such damage.

Sheeting or shoring that does not extend below the centerline of the pipe may be removed at the discretion and responsibility of the CONTRACTOR after the trench backfill has been placed and compacted to a level 12 inches above the top of the pipe. Following removal of the sheeting or bracing, the trench shall be immediately backfilled and compacted.

5.1.3.5 PIPE STABILIZATION AND BEDDING MATERIAL INSTALLATION: Pipe stabilization and bedding material installation consists of preparing an acceptable pipe foundation – note that native, undisturbed, granular materials smaller than 3" in the trench bottom may provide an adequately firm foundation for the pipe installation, in which case installation of Pipe Stabilization material would not be warranted - excavating the pipe groove in the pipe foundation and backfilling from the pipe foundation to 12 inches above the top of the pipe. All piping shall be protected from lateral displacement and possible damage resulting from impact or unbalanced loading during backfilling operations by being adequately bedded.

- **PIPE STABILIZATION:** Wherever the trench subgrade material does not afford a sufficiently solid foundation to support the pipe and superimposed load, and/or where groundwater must be drained, or where solid rock intrudes into the trench bottom, the trench shall be excavated below the bottom of the pipe bedding approximately 8 inches, and filled with clean, compacted pipe stabilization material.
- **PIPE BEDDING:** Pipe Bedding material shall be installed from the top of the pipe foundation to 12 inches above top of pipe, with a minimum of 4 inches of pipe bedding material below the pipe - note that native material meeting the specifications for Pipe

Bedding Material may be used. Bedding material shall be deposited and compacted in layers not to exceed 8 inches in uncompacted depth, with a lift additionally being compacted when loose bedding materials are at the springline of the pipe to ensure proper compaction under the pipe haunches. This springline compaction may reduce the depth of the loose lift, depending on the size of the pipe, but shall not increase any loose lift above 8 inches. Deposition and compaction of bedding materials shall be done simultaneously and uniformly on both sides of the pipe. All bedding materials shall be placed in the trench with hand tools or other approved method in such a manner that they will be scattered alongside the pipe and not dropped into the trench in compact masses.

- **PIPE GROOVE:** A pipe groove shall be excavated in the Pipe Bedding material to receive the bottom quadrant of the pipe so that the installed pipe will be true to line and grade. Bell holes shall be dug after the trench bottom has been graded. Bell holes shall be excavated so that only the barrel of the pipe bears on the pipe foundation.

5.1.3.6 TRENCH BACKFILL: The trench shall be backfilled from 12 inches above the top of the pipe to the natural surface level or the finished grade section specified on the Drawings with materials meeting the specifications of 5.1.2.3.

5.1.3.7 EXCAVATED WASTE MATERIAL: Unless otherwise indicated on the specific plans for a given project, all excess material shall be hauled away from the construction site and disposed of in an area obtained by the CONTRACTOR and approved by the ENGINEER. The CONTRACTOR shall be responsible for all rights-of-way, easements, and access associated with the disposal of excess excavated material. He shall further be responsible to obtain permission from the property owner or person(s) controlling the property where the CONTRACTOR plans to dispose of excavated material. No compensation will be made to the CONTRACTOR for disposal of excess excavated material.

Excavated material shall be piled in a manner that will not endanger the work and will avoid obstructing sidewalks and driveways. Gutters and irrigation ditches shall be kept clear or other satisfactory provisions made for street drainage.

Grading of the area surrounding the trenches, including excavated materials, shall be performed as necessary to prevent surface water from flowing into trenches, or other excavations.

5.1.3.8 COMPACTION: Compaction shall be the responsibility of the CONTRACTOR. He shall select the methods to be used – except that consolidation by flooding the trench shall not be an acceptable method - and carefully perform the work of backfilling and compaction so as to prevent damage to new or existing piping. Any new or existing piping damaged during the CONTRACTOR's work shall be replaced as directed by the ENGINEER with new piping at no additional expense to the Owner.

5.1.3.9 COMPACTION TESTING: Compaction testing requirements called for herein are only minimum and are required for the purpose of indicating, during construction, the quality of materials and compaction. Dips or uneven surface caused by post settlement of any trenches, excavation, fill, or embankment that show up within the 1 year warranty period shall be repaired by the CONTRACTOR at no additional cost to the OWNER.

- **MAXIMUM DENSITY:** Maximum density as used in these specifications shall be defined as the maximum density obtained in the laboratory per ASTM D 1557. In place

density of compacted backfill will be determined by use of nuclear density determining equipment.

- **COMPACTION PERCENTAGE:** Unless otherwise specified, fills shall be compacted as indicated in the following tabulation:

<u>Location</u>	<u>Percent of Maximum Density</u>
Backfill adjacent to structure	90
Fill under structure	95
Fill areas for pipeline construction	95
Pipe bedding	90
Trench backfill (Outside traveled roadway)	90
Trench backfill (Inside traveled roadway)	95

- **COMPACTION CONFIRMATION:** It shall be the responsibility of the CONTRACTOR to accomplish the specified compaction for backfill, fill, etc., and to control all earthwork operations by tests or other means approved by the ENGINEER to verify and confirm that the CONTRACTOR is complying at all times with the requirements of the specifications.
- **INDEPENDENT TESTING:** Material tests are required and shall be made by an independent testing laboratory hired and paid for by the OWNER. It will be the responsibility of the CONTRACTOR to coordinate testing at the appropriate times. In areas where compacted backfill material is specified for pipeline trenches or around structures, the following amounts of satisfactory field density tests are required:
 - Street crossing less than 50 feet long:
2 Tests per crossing (18" above top of pipe and top of subbase).
 - Trenches running parallel to the roadway:
2 Tests per 500 feet (18" above top of pipe and top of subbase).
- **PROCTOR TESTS:** Earth material specified in this section having specific gradation requirements shall have a soil gradation and proctor analysis performed to verify compliance and used as a basis for compaction tests. The number of times each type of material shall be tested is as follows:
 - When material is being imported:
1 Test per borrow site.
1 Additional test per material change.
 - When native material is approved:
1 Test per geographical area where the composition and material gradation visually remains unchanged.

The term "test" shall mean a single test with acceptable results, i.e., equal to or greater than the specified minimums. In the event compaction tests results fall below the required minimum, the CONTRACTOR shall recompact and test the material until a test with acceptable results is obtained.

- **TEST RESULTS:** Copies of test results prepared by the independent testing laboratory will be transmitted to the CONTRACTOR at the same time they are transmitted to the ENGINEER.

Successful performance of field density tests by the independent testing laboratory shall not relieve the CONTRACTOR of his responsibility to meet the specified density requirements for the complete project.

Additional tests directed by the ENGINEER shall be made at locations selected by the ENGINEER.

5.1.3.10 RESTORATION OF CONSTRUCTION SITE: During the progress of the Work, the CONTRACTOR shall clean up all construction debris, excess excavation, and excess materials, and shall restore all fences, irrigation structures, ditches, culverts and similar items at no additional cost to the Owner. The CONTRACTOR shall stockpile the excavated trench material so as to do the least damage to adjacent grassed areas, or fences, regardless of whether these are on private property or public rights-of-way. All excavated materials shall be removed from grassed and planted areas and these surfaces shall be left in conditions equivalent to their original surface and free from all rocks, gravel, boulders, or other foreign materials.

The roadway including shoulders, slopes, ditches, and borrow pits shall be smoothly trimmed, and shaped by machinery, or other satisfactory methods, to the lines, grades and cross-sections, as established, and shall be so maintained until accepted. Any surplus material not suitable for spreading along the road to widen the existing shoulder or raise the grade shall be hauled away or otherwise disposed of in a manner acceptable to the Engineer and Owner.

5.1.3.12 CONTRACTOR'S RESPONSIBILITY: The CONTRACTOR will be responsible to see that the backfilling, consolidation and compaction are properly and adequately done. Settlement of trenches within a period of one year after final acceptance of the project, shall be considered incontrovertible evidence of inadequate compaction, and the CONTRACTOR shall be responsible for correcting the condition in accordance with the provisions of these Specifications, including the replacement of the surface materials at no additional cost to the Owner.

5.1.4 MEASUREMENT AND PAYMENT: Section 1.4.10, Bid Items, shall govern if there is a discrepancy with this Section 5.1.4.

5.1.4.1 PIPE STABILIZATION MATERIAL: When placement is required, as directed by the ENGINEER, payment will be per ton delivered to the site based upon certified weigh tickets delivered weekly to the site inspector. Payment shall be compensation for over excavation, disposal of excavated materials, placement and compaction costs.

5.1.4.2 PIPE BEDDING MATERIAL: Payment for pipe bedding material will be per ton delivered to the site based upon certified weigh tickets delivered weekly to the site inspector. Payment shall be compensation for placement and compaction costs.

5.1.4.3 IMPORTED TRENCH BACKFILL: When imported trench backfill material is required as directed by the ENGINEER, payment will be per ton delivered to the site based upon certified weigh tickets delivered weekly to the site inspector. Payment shall be compensation for placement and compaction costs. No additional compensation will be made for re-placement of

material excavated during construction of the trench. Compensation for re-placement of trench materials will be made with payment of the unit cost for pipe installation.

5.1.4.4 DEWATERING: No additional compensation will be made for dewatering or dewatering equipment. Compensation for dewatering efforts will be made with payment of the unit cost for pipe installation.

5.1.4.6 BACKFILLING AND COMPACTING: All work associated with excavation, backfilling, and compacting not previously addressed in Section 5.1.4 including but not limited to: sheeting, bracing, shoring, disposal of excess material, and clean up shall be included in the bid items for lineal foot cost of installed pipe lines.

END OF SECTION

**SECTION 5.2
PLACEMENT, REMOVAL & RESTORATION OF SURFACE IMPROVEMENTS**

5.2.1 DESCRIPTION: The CONTRACTOR shall be responsible for the protection and the restoration or replacement of any improvements existing on public or private property at the start of work or placed during the progress of the work. Surfacing material removed will be loaded, hauled and disposed of by the CONTRACTOR in approved disposal areas at no additional expense to the OWNER. Existing improvements shall include but not be limited to permanent surfacing, curbs, gutters, sidewalks, planted areas, ditches, driveways, culverts, fences, signing, and walls. All improvements shall be reconstructed to equal or better, in all respects than the existing improvements removed. Provide all signing, barricades, flagman or signals as necessary to provide safe travel to the public.

5.2.1.1 FIELD VERIFICATION OF IMPROVEMENTS: In submitting a bid, the CONTRACTOR will be deemed to have carefully examined the site of the work and to have acquainted himself with all conditions relating to the protection and restoration of existing improvements. The ENGINEER does not guarantee that all improvements are shown on the Drawings, and it shall be the CONTRACTOR's responsibility to provide in his bid for the protection and restoration of all existing improvements whether or not each is provided for specifically on the Drawings and/or Bid Form.

5.2.2 MATERIALS:

5.2.2.1 GRAVEL SURFACE: Material for use on gravel surfaces shall be obtained from sound, tough, durable gravel or rock meeting the following requirements for grading:

<u>Sieve Size</u>	<u>Percent Passing</u>
1-inch sieve	100
1/2-inch sieve	79 - 91
No. 4 sieve	49 - 61
No. 16 sieve	27 - 35
No. 200 sieve	7 - 11

5.2.2.2 UNTREATED BASE COURSE: Untreated base course shall be in accordance with Utah Department of Transportation Standard Specifications, 2012, Section 02721, Table 2:

Table 2

Gradation Limits		
Sieve Size	Job Mix Gradation Target Band	Job Mix Gradation Tolerance
1½ inch	100	
1 inch	90 - 100	±9.0
¾ inch	70 - 85	±9.0
½ inch	65 - 80	±9.0
⅜ inch	55 - 75	±9.0
No. 4	40 - 65	±7.0
No. 16	25 - 40	±5.0
No. 200	7 - 11	±3.0

5.2.2.3 BITUMINOUS SURFACE COURSE: Bituminous surface course gradation shall be in accordance with Utah Department of Transportation Standard Specifications, 2012, Section 02741, Table 6:. Actual gradation to be used shall be approved by the ENGINEER.

Table 6

Aggregate Gradations (Percent Passing by Dry Weight of Aggregate)					
Sieve Size		1 inch	¾ inch	½ inch	⅜ inch
Control Sieves	1½ inch	100.0			
	1 inch	90.0 - 100.0	100.0		
	¾ inch	<90	90.0 - 100.0	100.0	
	½ inch		<90	90.0 - 100.0	100.0
	⅜ inch			<90	90.0 - 100.0
	No. 4				< 90
	No. 8	19.0 - 45.0	23.0 - 49.0	28.0 - 58.0	32.0 - 67.0
	No. 200	1.0 - 7.0	2.0 - 8.0	2.0 - 10.0	2.0 - 10.0

5.2.2.4 TACK COAT: Tack coat shall be SS-1 Diluted with an equal amount of water.

5.2.2.5 CONCRETE: See Section 5.7.3 of these specifications.

5.2.2.6 SOD AND VEGETATION: All materials shall be from sources approved by the ENGINEER; however, such approval does not relieve the CONTRACTOR from responsibilities for growth, maintenance and replacement as specified herein.

5.2.2.7 TOPSOIL: Topsoil shall be fertile, friable, natural loam, surface soil, reasonably free of clay lumps, brush, weeds, and other litter, and free of rocks, stumps, stones larger than 2 inches in any dimension, and other extraneous or toxic matter harmful to plant growth. Obtain topsoil only from naturally, well-drained sites where topsoil occurs in a depth of not less than 4 inches. Do not obtain from bogs or marshes.

5.2.3 CONSTRUCTION:

5.2.3.1 REMOVAL OF CONCRETE OR ASPHALT SURFACES: The pavement, sidewalk, curb and gutter, driveway, etc. shall be cut vertically along the lines forming the trench, or nearest full joint, in such a manner as to not cause damage to adjoining pavement, sidewalk, curb and gutter, driveway, etc. An undercut level at the rate of 1 inch per foot of thickness or an underlap joint will be provided at the proposed junction between old and new surfaces. The portion to be removed shall be broken up in a manner that will not cause damage to the pavement or concrete outside the limits of the trench; however, any pavement damaged by operations outside the limits of the trench shall be replaced. Broken paving materials shall be removed immediately from the site of the work. The ENGINEER shall approve all saw cut locations.

5.2.3.2 GRAVEL SURFACE: Where trenches are excavated through gravel surfaced areas such as roads and shoulders, parking areas, unpaved driveways, etc., the gravel surface shall be restored to a minimum depth of 4 inches. The gravel shall be placed in the trench at the time it is backfilled. The surface shall be maintained by blading, sprinkling, rolling, adding gravel, etc., to maintain a safe, uniform surface satisfactory to the ENGINEER. Excess material shall be removed.

5.2.3.3 BASE COURSE AND TEMPORARY GRADED SURFACE: On paved areas, base course shall be placed in the top of the trench to a depth such that the final compacted thickness of the base course below the bottom of the pavement shall be equal to the existing base course but not less than 10 inches. This base course layer shall be brought flush with the paved surface and maintained in a smooth, rut free condition until time for the pavement to be placed.

5.2.3.4 TACK COAT: Tack coat shall be applied at the rate of 0.05 to 0.15 gal/SY. A hand sprayer or brush shall be used to apply tack coat to vertical faces of previously constructed bituminous pavement (over 1/2 hour hence) prior to placing an adjacent or parallel pass, curbs, gutters, slab edges, and all structures to be in actual contact with the bituminous pavement. Tack coat shall also be applied uniformly at the same rate to the horizontal top surface of each lift of bituminous pavement prior to placing the next lift of bituminous pavement to promote a bond between the two courses of pavement. None of the material shall penetrate into the pavement and for this reason the application should be limited.

Prior to applying the material, the surface to be treated shall be swept or flushed free of dust or other foreign material. Protect all surfaces not required to receive tack coat from any inadvertent application.

The temperature range of the tack coat at the time of application shall be such that the viscosity will be between 50 and 100 centistokes as determined in accordance with ASTM Designation D-2710.

Under no circumstances shall traffic be permitted to travel over the tacked surface. If detours cannot be provided, restrict operation to a width that will permit at least one-way traffic over the remaining portion of the roadbed. If one-way traffic is provided, the traffic shall be controlled in accordance with governing authority.

After application of tack coat, sufficient time shall be given to allow for complete separation of asphalt and water before paving operations begin. The tack coat shall be applied on only as many surfaces as will be paved against in the same day.

5.2.3.5 BITUMINOUS SURFACE: Trenches to be resurfaced shall be graded and rolled to provide a subgrade consisting of granular backfill and base course which is firm and un-yielded. Density of the subgrade materials shall be 95 percent of AASHTO T-99. Mud or other soft or spongy material shall be removed and the void filled with base course and rolled and tamped thoroughly in layers not exceeding 12 inches in thickness. The edges of trenches which are broken during subgrade preparation shall be removed and trimmed neatly before resurfacing.

Mixing, placing, spreading and compaction of a minimum 3-inch bituminous surface course shall conform to applicable parts of Section 402 of the State of Utah Standard Specifications for Road and Bridge Construction, excluding pay factor allowances.

5.2.3.6 CONCRETE CURBS, GUTTER, SIDEWALKS AND DRIVEWAYS: Existing improvements shall be removed and replaced to the next joint or scoring line beyond the actually damaged or broken sections; or in the event that joints or scoring lines do not exist or are three or more feet from the removed or damaged section, the damaged portions shall be removed by saw cutting full-depth.

All new concrete shall match, as nearly as possible, the appearance of adjacent concrete improvements. Where necessary, lampblack or other pigments shall be added to the new concrete to obtain the desired results.

Concrete forms shall be true to line and of sufficient strength to ensure against bulging or displacement.

Contraction and expansion joints shall match original construction in placement and size, unless otherwise required by local jurisdiction having authority.

Reinforcement shall be replaced as in original construction, and dowelled into edges of existing concrete, unless otherwise required by local jurisdiction having authority, and shall be installed in accordance with applicable CRSI and ACI Standards.

Finishing and curing shall be in accordance with local jurisdiction having authority.

5.2.3.7 PLANTED AREAS: Prior to placing topsoil and/or sod, examine and repair the subgrade as necessary to assure a smooth and even surface which will match grade and contours of surrounding undisturbed ground. Finish grade construction areas to match grade prior to construction activities. Assure that a positive slope away from all building walls is maintained for at least 10 feet to prevent runoff from approaching walls.

5.2.3.8 SPRINKLING SYSTEMS: Restore all sprinkling systems disturbed, removed, or damaged by construction operations in a condition at least equal to that prior to construction.

5.2.3.9 MISCELLANEOUS IMPROVEMENTS: All other improvements interrupted or removed to permit the construction specified herein shall be restored. Miscellaneous improvements to be restored shall include, but shall not be limited to, the following:

- Traffic Signs
- Mail Boxes
- Drainage and Irrigation Ditches
- Culverts
- Canals and Canal Structures
- Bridges and Bridge Abutments
- Fences

5.2.3.10 PROTECTION: Protect all restored improvements from damage in accordance with these specifications, unless otherwise required by local jurisdiction having authority.

END OF SECTION

SECTION 5.3 CULINARY WATERLINE AND APPURTENANCES

5.3.1 DESCRIPTION: The CONTRACTOR shall furnish and install all pipe, valves, valve boxes, fire hydrants, service connections, meter boxes, check valves, air release valves, couplings, fittings, bolts, nuts, gaskets, jointing materials, and appurtenances as shown and specified, and as required for a complete and workable piping system.

5.3.2 MATERIALS:

NSF STANDARDS for HEALTH EFFECTS: All materials which may contact drinking water, including pipes, joints, lubricants, fittings, valves, and fire hydrants shall be ANSI-certified as meeting requirements of NSF Standards 61 and 372, Drinking Water System Components - Health Effects and applicable sections of ANSI/AWWA Standards C104 through C550 and C900 through C950. All such components shall be stamped with the NSF logo.

5.3.2.1 DUCTILE IRON PIPE: (Refer to Section 5.5, "Ductile Iron Pipe"). Ductile iron pipe is the standard pipe material in the Wolf Creek Water and Sewer Improvement District. If no pipe material is identified on the plans, assume ductile iron pipe.

5.3.2.2 PVC C-900/905 PIPE: (Refer to Section 5.6, "PVC AWWA C-900/905 WATER PIPE"). PVC pipe may be installed in limited instances and applications as shown on the plans for specific projects.

5.3.2.3 HDPE 4710 PIPING FOR POTABLE WATER: (Refer to Section 5.15, "HDPE 4710 PIPING FOR POTABLE WATER"). HDPE pipe may be installed as shown on the plans for specific projects.

5.3.2.4 FIRE HYDRANTS: Fire hydrants shall be of a "traffic model" type design conforming to AWWA C-502 Specifications. Hydrants shall be supplied with two 2-1/2-inch and one 4-1/2-inch nozzles. All nozzles shall have national standard threading. A one cubic yard gravel sump shall be provided at each hydrant for drainage. Fire hydrants shall be Mueller Centurion or system operator-approved equal with a minimum bury depth of 5 feet.

5.3.2.5 GATE VALVES: All gate valves shall conform to Standard AWWA C509 for Resilient-Seated Gate Valves. All gate valves shall be designed for 200 psi working pressure. The valves shall be mechanical joint unless otherwise designated on the plans.

5.3.2.6 CAST IRON FITTINGS: Fittings shall be of the short body design and shall meet ANSI Specification A 21.10 and shall have mechanical or push-on rubber gasket type joints unless noted otherwise on the project drawings or details. Fittings inside structures or where otherwise noted on the drawings shall be ASA Class 125 flanged design with full face rubber gaskets. All exterior surfaces of pipe and fittings shall be coated with hot coal tar as specified in the Proposed American Standard Specifications for Coal Tar Dip Coatings for Cast Iron Pipe and Fittings.

5.3.2.7 COUPLINGS: Couplings shall be equal to the product of Romac, JCM, Smith-Blair, or Dresser with cast iron couplings being used on all ductile iron pipe. Couplings shall be

of the straight, transition, or reducing style as required by the specific installation. All steel fittings and bolts shall be coated with a non-oxide coating.

5.3.2.8 CORPORATION STOPS: Connections to main lines shall be made through AWWA thread-type corporation stops with flared copper connection, shall be Mueller or system operator-approved equal.

5.3.2.9 PIPE FOR SERVICE CONNECTIONS: Pipe for water services shall be minimum 1" diameter 200 psi Copper pipe for potable water service, or as otherwise directed by the water provider and approved by the Engineer.

5.3.2.10 METER SETTER ASSEMBLY: A typical meter setter assembly (for a single family dwelling) shall consist of a copper setter, MUELLER, 18-inch riser with lockable valve on the inlet side and Utah State approved dual check valves on the outlet side. Connection to the copper service lines at the base of the setter shall be made with compression connections. All meter setter assemblies shall be no more than 24 inches and not less than 14 inches below the lid.

5.3.2.11 METER BOXES AND LIDS: Meter boxes shall be round 24 inches inside diameter HDPE boxes 36 inches deep. The lids for meter boxes shall be cast iron with a lifter worm lock, operated by a large pentagon head bolt with a 2" hole for meter reading, and shall be D&L supply model L-2244-2 or an approved equal. All meter boxes shall be installed and inspected in accordance with the approved drawings. The meter box shall be plastic if located on property corners out of the traveled way, and concrete if not located on property corners out of the traveled way.

5.3.2.12 THRUST BLOCKS: The material for thrust blocks shall be concrete which shall have a compressive strength of no less than 2,000 psi in 7 days.

5.3.2.13 UNDERGROUND WARNING TAPE AND LOCATION WIRE: The tape shall be a 2-inch metallic core with a polyethylene cover, blue in color, and have the words "Caution Water Line Buried Below" imprinted on it. The tape shall be installed 18"-24" below finished grade. The tape shall be Style No. 2WAT as manufactured by Seton Name Plate Company of New Haven, Connecticut, or approved equal. Copper location wire shall be at least #14 plastic coated solid copper wire.

5.3.2.14 CHECK VALVES: Check valves shall prevent reverse flow in the pipelines. The check valves shall have steel or ductile iron body with bronze trim, stainless steel spring, and resilient seat meeting AWWA Standard C508. The valves shall be rated for a working pressure of 150 PSI or greater. The check valve shall be a Val-Matic Swing Flex or approved equal.

5.3.2.15 AIR RELIEF VALVES: Air relief valves shall meet the AWWA Standard C512. APCO 140C, ARI D-040 or approved equal.

5.3.2.16 CONNECTION HARDWARE: Except where otherwise shown or specified, acceptable bolts and cap screws are:

- Carbon steel: Conforming to the requirements of ASTM A307 Grade A or higher yield and tensile strengths. The corresponding nuts shall conform to ASTM A563 Grade A or higher yield and tensile strengths.

- All bolts and nuts shall be coated with TRIPAC 2000 coating system. Anti-seize compound shall not be utilized with the blue nuts.
- Stainless steel: Conforming to the requirements of ASTM F593. The corresponding nuts shall conform to ASTM F594.
- Nuts shall be finished with TRIPAC 2000 coating system. Anti-seize compound shall not be utilized with the blue nuts.

5.3.2.17 OTHERS: Other materials as specified on the drawings.

5.3.3 CONSTRUCTION:

5.3.3.1 DELIVERY, STORAGE AND HANDLING: Load and unload pipe, fittings, specials, valves, and accessories by lifting with hoists or skidding so as to avoid shock or damage. Under no circumstances shall the pipe or accessories be dropped into the trench. Do not skid or roll pipe on against pipe already on the ground. Lifting of pipe during unloading and placing into the trench shall be done using two nylon slings placed at the quarter points of the pipe sections. The slings shall bear uniformly against the pipe. When not being handled, the pipe shall be supported on timber cradles or on properly prepared ground, graded to eliminate all point loading. The pipe shall be supported at all times in a manner which will not permit distortion or damage to the lining or coating. Any unit of pipe that, in the opinion of the ENGINEER, is damaged beyond repair by the CONTRACTOR shall be removed from the site of the work and replaced with another unit. No payment will be made for damaged pipe or for repairs to such damaged pipe. The use of chains or cables for handling the pipe is not permitted.

Each length of pipe shall be unloaded opposite or near the place where it is to be laid in the trench.

5.3.3.2 CONNECTIONS TO EXISTING MAINS: Connections to existing mains shall be made where indicated on the plans. New waterlines shall be tested and disinfected in accordance with Section 5.4 before connecting to existing mains. The CONTRACTOR shall determine the exact pipe size and material and provide applicable valves, fittings, and couplings to make properly aligned transition into the existing pipe line(s). All connections shall be made and visually inspected for leakage with the line under pressure prior to backfilling. Connections will normally be made with a coupling, tee, cross, or similar type connector.

The CONTRACTOR must uncover the connection area and determine the needs for the connection prior to turning off the water. The water may be turned off Monday through Friday between the hours of 9:00 am and 4:00 pm only. The OWNER must be given 24 hours notice prior to turning off the water to any portion of the system. The CONTRACTOR must make reasonable efforts to avoid disruption of water service.

5.3.3.3 PIPELINE INSTALLATION: Ductile iron pipe and PVC pipe shall be installed in accordance with the latest versions of AWWA C-600 and ASTM D2774, respectively. PVC pipe design and installation shall be in accordance with the latest version of AWWA Manual M23.

- The minimum standard mainline size in the Wolf Creek Water and Sewer Improvement District is 8 inches. Fire hydrant laterals are not considered main lines and may be 6 inches.

- Dead ends shall be minimized by making appropriate tie-ins whenever practical.
- Where dead-ends occur, they shall be provided with a fire hydrant if flow and pressure are sufficient to provide standard fire suppression flows, which will be assessed on a case-by-case basis by the Engineer, or a flushing hydrant or blowoff capable of flowing 3 fps in the main line.
- Flushing devices shall not be directly connected to a sewer.
- The minimum edge to edge horizontal separation between sewer and water lines shall be 10 ft. Where a water main must cross the sewer main, the water main shall be at least 18" above the sewer line.
- Mechanical and concrete thrust blocks shall be placed at all fittings and appurtenances shown in the standard details.

5.3.3.4 FIRE HYDRANTS: All fire hydrants shall be installed with a 1 cubic yard gravel sump and concrete thrust block. See Construction Drawings for thrust blocking. Concrete shall not be placed around joints, bolts, or drain holes. Cover all metal contact areas with a poly wrap material prior to concrete placement. All hydrants shall be installed with the upper safety flange at least 2-1/2 inches and not more than 6 inches above ground level. All hydrants shall be installed with the steamer nozzle facing the street unless otherwise approved by the OWNER.

- Fire hydrants shall be located as determined by the Weber Fire Marshal.
- Hydrant drains shall not be connected to, or located within 10 feet of, storm drains.

5.3.3.5 GATE VALVES: The CONTRACTOR shall furnish and install gate valves at the locations shown on the drawings. Isolation valves shall be located at intervals not to exceed 500 feet in commercial areas, 800 feet in residential areas and not more than one mile in areas where connections are scattered and not anticipated.

The valves shall include either 1) valve, valve box with lid, and 2" operating nut, or 2) valve, and hand wheel as indicated on the drawings. Unless shown otherwise on the project specific plans, the valves shall have mechanical joint ends, non-rising stem, O-ring, seals, operating nut and extension as required, or hand wheel, and iron body-bronze resilient seat. The valves shall meet or exceed AWWA Standard C-509.

Valves will be inspected, cleaned, set in line, and jointed to pipe with mechanical or flanged joints as indicated on the plans. All mainline valves shall have a concrete base poured in place onto which the valve is anchored against movement by straps on both sides of the valve housing. Steel anchor rods shall be rust-proofed.

5.3.3.6 VALVE BOXES: All buried valves shall be installed complete with two-piece, cast iron, 5-1/4-inch shaft valve box with locking lid. The lid shall have the work "WATER" cast in the metal.

Valves and valve boxes shall be installed where shown on the drawings. Valves and valve boxes shall be set plumb. Valve boxes shall be centered directly over the valve. Valves shall be aligned with property lines where possible. Earth fill shall be carefully tamped around the valve box to a distance of 4 feet on all sides of the box, or to the undisturbed trench face if less than 4 feet. Valve boxes shall have the interiors cleaned of all foreign matter before installation.

All valve boxes located in streets shall be installed as nearly to grade as possible. After the pavement is in place, the valve boxes shall be raised to grade, the surrounding asphalt shall be neatly cut to form a circular opening 2 feet and 6 inches in diameter with the valve box centered, and a concrete collar shall be cast around the box. Valve boxes in off-road areas shall extend 1 to 2 inches above grade before the requisite concrete collar is poured.

5.3.3.7 FITTINGS: Bends, tees, reducers, flange adapters, and adaptor couplings shall be inspected, cleaned, and jointed to pipe as specified by the manufacturer. Reaction or thrust blocking shall be applied at bends of 11-1/4 degrees and more, at plugs, caps, tees.

5.3.3.8 WATER SERVICE CONNECTIONS: Make service connections and install service lines as shown on the Construction Drawings, or as directed by the OWNER's representative. Use teflon tape on all taps. Locate service taps in the upper quadrant of the main line, approximately 45 degrees. The minimum distance between taps is 24 inches, with a 5 degree stagger. Do not make service taps within 24 inches of the end of the main line.

Excavate and backfill in accordance with Section 5.1, "Excavation and Backfill for Buried Pipelines". All work must be inspected by the OWNER prior to backfilling. Pressure test all services before backfilling. Make no service connections until main line is fully accepted by the OWNER. Extend service line to meter and 5 feet beyond meter and plug as indicated on the contract drawings. Coordinate service location with property owner and OWNER prior to beginning work.

Record station of service connection to main line and record location and depth of end of service line, tying distances to at least two surface landmarks. Sketch information on an 8-1/2 x 11 inch form and record any particular problems.

5.3.3.9 THRUST RESTRAINT: Thrust blocks shall be provided at reducers and valves, at all tees, plugs, and caps, and at bends deflecting 11-1/4 degrees or more. Mechanical joint restraints, equivalent to Mega lug by EBAA Iron or RomaGrip by Romac, shall also be installed according to manufacturer's recommendations at each location where a thrust block is called for.

Thrust blocks 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 on the drawings. The block shall, unless otherwise shown or directed, be so located as to contain the resultant thrust force and so that the pipe and fitting joints will be accessible for repair.

5.3.3.10 UNDERGROUND WARNING TAPE AND LOCATION WIRE: The CONTRACTOR shall furnish and install an underground warning tape as the trench is backfilled. The tape shall be placed directly over the waterline and to a depth of 18-24 inches below the finished ground surface. Location wire shall be accessible at the surface at least every 1,000 feet in a vault, manhole, valve box installed for facilities shown on the plans.

All mainline trace wires must be interconnected in intersections, at mainline tees and mainline crosses. At tees, the three wires shall be joined using a single 3-way lockable

connector. At crosses, the four wires shall be joined using a 4-way connector. Use of two 3-way connectors with a short jumper wire between them is an acceptable alternative. Direct bury wire connectors – shall include 3-way lockable connectors and mainline to lateral lug connectors specifically manufactured for use in underground trace wire installation. Connectors shall be dielectric silicon filled to seal out moisture and corrosion, and shall be installed in a manner so as to prevent any uninsulated wire exposure. Non locking friction fit, twist on or taped connectors are prohibited.

Location wire in valve boxes shall be installed outside the lower section and bolted inside the upper section of valve boxes and installed up fire hydrant barrel and wrapped twice above ground.

5.3.3.11 AIR RELIEF VALVES: At high points in the water mains where air can accumulate, provisions shall be made to remove air by means of air relief valves. Automatic air relief valve shall not be used in situations where flooding may occur. Vent from air relief valve shall be extended to at least one 1 foot above grade and provided with a #14 mesh screened downward elbow or protective shroud. System operator shall be contacted regarding valve model and information.

- Flushing devices shall not be directly connected to a sewer.

5.3.4 MEASUREMENT AND PAYMENT: Section 1.4.10, Bid Items, shall govern if there is a discrepancy with this Section 5.3.4.

5.3.4.1 CONNECTIONS TO EXISTING MAINS: Measurement for these items shall be on a per each basis for each connection made to existing waterlines. Payment shall be full compensation to complete the item including all required fittings, couplings, excavation, backfill, compaction, dewatering of excavated areas, dewatering of existing waterlines, and concrete thrust blocks as required.

5.3.4.2 PIPE: Refer to the pipe specification sections herein for the type of pipe installed.

5.3.4.3 FIRE HYDRANTS: Measurement and payment for fire hydrants shall be at the unit price bid amount for each fire hydrant installed. Payment shall be full compensation to complete the item including all excavation, backfilling, compaction, tee on the mainline, auxiliary valve and valve box at the main, lateral line, gravel drainage sump, furnishing and installing fire hydrant, adjusting the unit to finish grade. Payment shall include compensation for restoration of miscellaneous improvements damaged during construction.

5.3.4.4 MAIN LINE ISOLATION VALVES: Payment shall be at the unit price bid for each and shall be full compensation for furnishing and installing the isolation valve (butterfly or gate), mechanical restraints, valve box and thrust blocks in accordance with the Contract Drawings, if a specific bid item for the isolation valve is included in the Bid Schedule. Otherwise, payment for the valve and appurtenances shall be made as part of the bid item for which the valve installation is made.

5.3.4.5 FITTINGS: Payment for fittings shall be made as part of the unit cost for the pipe in which the fitting is installed, unless a specific bid item is included for each fitting. Payment shall be full compensation for furnishing and installing the fitting, mechanical restraints and thrust blocks in accordance with the Contract Drawings

5.3.4.6 WATER SERVICE CONNECTIONS: Payment for water service connections shall be at the unit price in the Bid Schedule. Payment shall include furnishing and installing saddle, corp. stop and piping as needed from the main line to the meter box, meter setter assembly, meter box and lid, excavation, asphalt cutting, compacted backfill, and all labor and equipment for a complete installation. Asphalt pavement and gravel surface repair are covered under Section 5.2, "Removal and Restoration of Surface Improvements".

5.3.4.7 THRUST RESTRAINT: Payment for both mechanical thrust restraints and concrete thrust blocks shall be made as part of the unit cost of the item on which it is being installed.

5.3.4.8 UNDERGROUND WARNING TAPE AND LOCATION WIRE: Payment for furnishing and installing underground warning tape and location wire shall be made as part of the unit cost for pipe.

5.3.4.9 AIR RELIEF VALVES: Payment for air relief valves shall be at the unit price in the Bid Schedule and shall be full compensation for all excavation, granular base, backfill and surface restoration, manhole and cover, vent piping and shrouded vent and other items required for a complete and operable installation.

5.3.4.10 MISCELLANEOUS: Fittings, minor piping, connections, and related construction not referenced above shall be included in the unit or lump sum cost of the bid item to which they are most closely related.

End of Section

**SECTION 5.4
DISINFECTION AND TESTING OF WATER LINES**

5.4.1 DESCRIPTION: Except as otherwise provided herein, the CONTRACTOR shall furnish all equipment, labor, and materials required for testing and disinfecting hydraulic structures and pipelines as specified. Water for testing and disinfecting will be furnished by the OWNER; however, the CONTRACTOR shall be responsible for coordinating with the OWNER the acquisition and use of the water for testing and disinfection procedures.

- Sections to be tested shall be no longer than 1,200 feet without prior approval from the Engineer.

- Disinfection shall be accomplished by chlorination in accordance with AWWA standard C-651.

- Each completed section shall be disinfected and tested prior to introduction into the drinking water system.

- Release of water from structures and pipelines, after testing and disinfecting have been completed, shall be in conformance with AWWA standard C-651.

5.4.2 PROCEDURES:

5.4.2.1 PRELIMINARY CLEANING AND FLUSHING: Prior to both testing and disinfecting, all pipelines shall be thoroughly washed, flushed or blown out, under the direction of the OWNER. Flushing shall be accomplished through hydrants, valves, blow-offs, or other means provided by the CONTRACTOR and approved by the OWNER sufficient to provide for a 3.0 foot per second flushing velocity in the pipeline.

5.4.2.2 HYDROSTATIC TESTS: Prior to testing, all piping shall be flushed or blown out as appropriate. The CONTRACTOR shall test all piping either in sections or as a unit. Mortar-lined piping shall not be tested before the mortar lining has attained an age of 14 days. The test shall be made by closing valves when available, or by placing temporary bulkheads in the pipe and filling the line slowly with water. Care shall be taken to see that all air vents are open during filling. After the piping or section thereof has been filled, it shall be allowed to stand under a slight pressure for a sufficient length of time to allow the mortar lining to absorb what water it will and to allow the escape of air from any air pockets. During this period, bulkheads, valves, and connections shall be examined for leaks. If any are found, corrective measures satisfactory to the OWNER shall be taken.

- The test shall consist of holding a minimum pressure of not less than 1.25 times the stated anticipated maximum sustained working pressure of the pipeline measured at the highest elevation along the test section and not less than 1.5 times the stated sustained working pressure at the lowest elevation of the test section. However, in no case shall the test pressure exceed the rated working pressure for any joint, thrust restraint, valve, fitting, or other connected appurtenance of the test section. A test pressure of 200 PSI at the lowest point in the section of line being tested will typically suffice in the Wolf Creek Water and Sewer Improvement District.

- The test pressure shall be maintained for a minimum period of 2 hours using either pneumatic or hydraulic means to maintain the pressure. Suitable means shall be provided by the CONTRACTOR for determining the quantity of water lost by leakage under the test pressure. All visible leaks shall be repaired as directed by the ENGINEER. Pressure and Leakage Testing shall be in accordance with AWWA Standard 600 or 605 for the type of pipe being tested. The maximum allowable leakage shall be as follows:

<u>Pipe Size (inches)</u>	<u>Allowable Leakage (gal/hr/1000 feet of pipe)</u>
6	0.57
8	0.76
10	0.96
12	1.15
14	1.34
16	1.53
18	1.72
20	1.91

In the case of pipelines that fail to pass the prescribed leakage test, the CONTRACTOR shall determine the cause of the excessive leakage, shall take corrective measures necessary to repair the leaks, and shall again test the pipelines, all at no additional cost to the OWNER.

5.4.2.3 DISINFECTING PIPELINES: AWWA 651-14 Sec. 4.4 is incorporated herein. Other methods of chlorination are acceptable, if preapproved by the Engineer and if done in accordance with the latest revision of AWWA standard C651.

- **CHLORINATION:** A chlorine-water mixture shall be applied by means of a solution-feed chlorinating device. The chlorine solution shall be applied at one end of the piping or pipeline through a tap in such manner that as the pipeline is filled with water, the dosage applied to the water entering the pipe shall be sufficient to establish a free chlorine residual of 25 ppm. Care shall be taken to prevent the strong chlorine solution in the line being treated from flowing back into the line supplying the water through the use of backflow prevention devices (double check or reduced-pressure principle).
- **RETENTION PERIOD:** Chlorinated water shall be retained in the pipeline long enough to destroy all non-spore-forming bacteria. This period shall be at least 24 hours. After the chlorine-treated water has been retained for the required time, the chlorine residual at the pipe extremities and at other representative points shall be at least 10 ppm.
- **CHLORINATING VALVES:** During the process of chlorinating the piping and pipelines, all valves and other appurtenances where possible shall be operated while the pipeline is filled with the heavily-chlorinated water.

5.4.2.4 FLUSHING: After both pressure testing and chlorination, all pipelines shall be flushed. Flushing shall be accomplished through fire hydrants, end of line blow offs with a

minimum of 2-inch diameter or, the CONTRACTOR shall install a tap sufficient in size to provide for a 3.0-foot per second flushing velocity in the pipeline.

The following is the flow quantity required to provide a 3.0-foot per second flushing velocity, along with the approximate number of 2" blowoff or 2 ½" hydrant outlet openings needed at a 40 PSI residual pressure to obtain the required flow.

Pipe Size (inches)	Flow (GPM)	2" blowoffs (Quantity)	#2 ½" FH Nozzles (Quantity)
6	270	1	1
8	470	1	1
10	740	2	1
12	1,060	3	2
14	1,440	4	2
16	1,880	5	2
18	2,380	-	3
20	2,940	-	3

5.4.2.5 BACTERIOLOGICAL TESTS: Bacteriological testing shall be in accordance with AWWA Standards C651. After final flushing and before the new water main is connected to the distribution system, two consecutive sets of acceptable samples, taken no less than 16 hours apart, shall be collected from the new main. At least one set of samples shall be collected from every 1,200 ft of new water main, plus one set from the end of the line and at least one set from each branch.

End of Section

SECTION 5.5 DUCTILE IRON PIPE

5.5.1 DESCRIPTION: This section covers the requirements for ductile iron pressure pipe materials, installation and inspection.

5.5.2 MATERIALS:

5.5.2.1 DUCTILE IRON PIPE: Ductile iron pipe shall conform to all requirements of AWWA C-151 and ANSI A-21.51 "Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand Lined Molds, For Water or Other Liquids." Minimum thickness shall be Class 52. Pipe shall meet the requirements of NSF Standard 61 and be so stamped.

5.5.2.2 JOINTS:

- **MECHANICAL JOINTS:** All mechanical joints shall meet requirements of ANSI A21.6 and ANSI 21.11. All gaskets surfaces shall be smooth and free from imperfections. All mechanical joint gaskets shall be armor tipped type gaskets and shall conform to tests in accordance with construction specifications and shall be less than one year old. Bolts shall meet all requirements of the above specifications, honoring all characteristics, tolerances, and tests. All bolts shall be of the proper size and length to match the size of pipe fitting as per drawings.
- **PUSH-ON JOINTS:** Push-on joints will be used for main line 6-inch, 8-inch and 10-inch ductile iron pipe for this project. All push-on joints shall meet the requirements of ANSI 21.11. Gaskets shall be free from defects and not over one year old.

Lubricants shall be non-toxic and have no deteriorating effects on gasket materials. It shall not impart taste, odor or flavor to water in a pipe. It shall conform in every way to ANSI 21.11.

- **FLANGED JOINTS:** Flanged joints shall be bolted firmly with machine, stud or cap bolts of proper size. Flanges may be cast integrally with the pipe or may be screwed or threaded pipe. Flanges shall be faced and drilled and of proper dimensions and class, for size and pressure required. All flanges shall meet requirements of ANSI A21.10, "American Standard for Cast Iron Fittings."

Bolts and nuts shall meet the requirements of 5.3.2.16 above, and have clean, well-fitting threads. Bolts will be provided with standard hexagonal nuts and standard hexagonal heads. Bolts shall be of the diameter required for each flange and, when installed, shall be of length so that no more than 3/8 inch or less than 1/8 inch extends past face of nut. Gaskets shall be 1/16 inch thick, made of best quality sheet gasket material or equal. A full face gasket for each flange joint of proper size shall be installed.

5.5.2.3 FITTINGS:

- **MECHANICAL JOINT FITTINGS:** Mechanical Joint Fittings shall conform to ANSI A21.10, "American Standard For Cast Iron Fittings."
- **PUSH-ON FITTINGS:** Push-on fittings shall conform to ANSI A21.10 with bells, sockets, and plain ends per ANSI A21.11.
- **FLANGED FITTINGS:** Flanged fittings shall conform to ANSI A21.10, "American Standard For Cast Iron Fittings."

All flanges shall be faced and drilled. Where cap screws or stud bolts are needed, flanges shall be tapped to support cap screws or stud bolts as per approved drawings.

5.5.2.4 CEMENT MORTAR LINING: Ductile iron pipe and fittings shall be lined with cement mortar in accordance with the requirements of the "American National Standard for Cement Mortar Lining for Ductile-Iron Pipe and Fittings" (ANSI A21.4/AWWA C104).

5.5.2.5 COAL TAR COATING: Pipe and fittings installed above-grade shall be bare (no coal-tar coating applied) so that a two-part epoxy paint may be applied without the necessity of removing the coal tar coating. Pipe and fittings that are below-grade shall be coated to resist corrosion with a coal tar coating.

5.5.3 CONSTRUCTION:

5.5.3.1 INSTALLATION: Ductile iron pipe shall be installed in accordance with the "AWWA Standard for Installation of Ductile-Iron Water Mains and Appurtenances" (ANSI/AWWA C600).

Tees, elbows, crosses, and reducers shall be used for changes in direction and outlets, unless otherwise specified on the drawings.

Anchors, thrust bolts and thrust blocks shall be placed at valves, elbows, tees, etc., as shown on the approved drawings or as directed by the ENGINEER.

All ductile iron pipe installation shall proceed on a stable foundation, with joints closely and accurately fitted. Joints shall be clean and dry, and a non-toxic joint lubricant, as recommended by the pipe supplier, shall be applied uniformly to the mating joint and gasket surfaces to facilitate easy, positive joint closure. All push-on joints shall have brass wedges as supplied by the pipe manufacturer, and installed as per standard push-on joint specifications unless otherwise directed by the ENGINEER.

All pipe shall be installed with uniform bearing under the full length of the barrel, with suitable excavations being made to receive pipe bells and fittings.

Bedding material shall be compacted around the pipe to firmly bed the pipe in position. If adjustment of position of a pipe length is required after being laid, it shall be removed and rejoined as for new pipe installation. In addition to the above requirements, all pipe installation shall comply with the specific requirements of the pipe manufacturer.

Each pipe shall be laid true to line and grade and in such a manner as to form a close concentric joint with adjoining pipe and to prevent sudden offsets to the flow line. All joint offsets shall be made as specified in AWWA Standard for "Installation of Water Mains" C-600. As work progresses, the interior of the pipe shall be cleared of dirt and superfluous materials. Where cleaning after laying is difficult because of small pipe size, a suitable swab or drag shall be kept in the pipe and pulled forward past each joint immediately after jointing as set, and pipe shall not be laid when conditions of the trench or weather is unsuitable for such work. At all times when work is in progress, all open ends of the pipe and fittings shall be securely closed to the satisfaction of the ENGINEER, so that no water, earth, or other substance will enter the pipe or fittings.

5.5.3.2 PIPE STABILIZATION MATERIAL: See Section 5.1.3.5.

5.5.3.3 PIPE BEDDING: See Section 5.1.3.5.

5.5.3.4 CLEANING AND FLUSHING: See Section 5.4, "Disinfection and Testing of Water Lines").

5.5.4 MEASUREMENT AND PAYMENT: Ductile iron pipe measurement shall be per lineal foot installed of the type, size and class shown on the drawings and in the bidding schedule. Measurement shall be along the centerline of the pipe as measured in the field following construction. No deduct in length for payment will be made for valve fittings, manholes or structures.

Payment will be made per Bid Item only after the surface restoration, including gravel and asphalt restoration, has been completed and accepted.

Payment to install pipelines shall be at the unit price in the Bid Schedule. Payment shall be full compensation for mobilization, traffic control signs, devices and flag persons; cutting asphalt pavement; unclassified excavation; trench backfill; location tape; storing and installing the pipe, fittings, elbows and couplings; removal and disposal of excess or rejected excavated materials; compaction; thrust blocks; pressure testing and disinfecting, flushing and placing the line into service. Payment shall also include compensation for restoration of miscellaneous improvements damaged during construction.

No classification of excavated materials shall be made other than solid rock requiring blasting (refer to Section 5.2, "Pipeline Trench Excavation and Backfill"). Excavation shall include the removal and subsequent handling of all water, earth, shale, loose or cemented gravel, loose rock, and other materials of whatsoever nature excavated or otherwise removed in the performance of contract work.

End of Section

SECTION 5.6
PVC AWWA C-900/905 WATER PIPE

5.6.1 DESCRIPTION: The work includes providing and installing PVC AWWA C-900/905 water pipe with integral bell and spigot joints.

5.6.2 MATERIALS:

5.6.2.1 PIPE: Pipe shall be AWWA C-900 or C-905, depending on the nominal diameter of the pipe, with material compound being 12454, per ASTM D1784. Pipe shall be of the dimension ratio shown on the plans.

5.6.2.2 JOINTS: The Elastomeric Seal (gasket) shall conform to ASTM F477. The gasketed joint assembly shall conform to ASTM D3139, and the installation of the pipe shall conform with Uni-Bell-3, AWWA M23 installation guide.

5.6.2.3 FITTINGS: Fittings shall be short body cast iron or ductile iron, iron pipe size for PVC application, and in accordance with AWWA C-110. They shall be capable of withstanding, without bursting, hydrostatic tests of three times the rated water working pressure. The fittings shall be furnished with mechanical, or flange joints and shall conform to the dimensions and weights given in AWWA C-110 and AWWA C-111.

5.6.2.4 SERVICE CONNECTIONS: Service connection to PVC plastic pressure pipe shall be by painted cast iron "Romac" double stainless steel strap service saddles or approved equal specifically designed for plastic pipe.

5.6.2.5 QUALITY ASSURANCE: Each standard and random length of pipe is to be tested to four times the class pressure of the pipe for a minimum of 5 seconds. The integral bell is to be tested with the pipe. Randomly selected samples shall be tested in accordance with ASTM D1599 to withstand, without failure, pressures listed below when applied in 60 to 70 seconds. Class 150, a minimum burst pressure of 775 PSI; Class 200, a minimum burst pressure of 985 PSI.

5.6.3 CONSTRUCTION:

5.6.3.1 INSTALLATION: The trench bottom shall be stable, smooth and free of frozen material, clodded dirt, and stones over 1/2 inch in diameter. Bell holes should be provided at each joint for easier assembly and uniform support. Large rocks must be removed to provide 6 inches clearance in all directions from pipe and accessories. The pipe shall be installed with proper bedding providing uniform support under the pipe. Bedding materials shall be worked under the pipe to provide adequate haunching. Bedding material should be placed to a minimum of 12 inches over the pipe. All pipe bedding material shall be selected and placed carefully, avoiding stones over 3/4-inch, frozen lumps, and debris.

5.6.3.2 INSTALLATION OF LOCATOR TAPE AND LOCATION WIRE: PVC pipelines shall be furnished with metallic locating tape laid along the centerline of the pipe trench at a depth of 24 inches below finish grade. The CONTRACTOR shall furnish manufacturer's literature, completely describing the tape proposed to be installed. No tape shall be installed prior to approval of the Engineer. Copper location wire shall be placed in the

bottom of the trench with the installation of pipe. The ends of the wire shall be coiled and terminated inside valve boxes to permit connection to pipeline locating devices.

5.6.3.3 GRAVEL FOUNDATION FOR PIPE: Wherever the subgrade material does not afford a sufficiently solid foundation to support the pipe and superimposed load, and where groundwater must be drained, the subgrade shall be excavated to such depth as may be necessary and replaced with crushed rock or gravel compacted into place.

5.6.4 MEASUREMENT AND PAYMENT

PVC AWWA C-900/C-905 WATER PIPE: PVC pipe measurement shall be per lineal foot installed piping of the type, size and class shown on the drawings and in the bidding schedule. Measurement shall be along the centerline of the pipe as measured in the field following construction. No deduct in length for payment will be made for valve & fittings.

Payment will be made per Bid Item only after the surface restoration, including gravel and asphalt restoration, has been completed and accepted.

Payment to install pipelines shall be at the unit price in the Bid Schedule. Payment shall be full compensation for mobilization, cutting asphalt pavement; unclassified excavation; imported material for pipe bedding; trench backfill; location tape; storing and installing the pipe, fittings, elbows and couplings; removal and disposal of excess or rejected excavated materials; compaction; thrust blocks; pressure testing; disinfecting, flushing and placing the line into service. Payment shall also include compensation for restoration of miscellaneous improvements damaged during construction.

End of Section

**SECTION 5.7
PORTLAND CEMENT CONCRETE**

5.7.1 DESCRIPTION: This section of the specifications defines materials to be used in all portland cement concrete work and requirements for mixing, placing, finishing, and curing.

5.7.2 MATERIALS: Materials used in portland cement concrete and reinforcing of portland cement concrete shall meet the following requirements:

5.7.2.1 CEMENT: Portland cement shall be Type II or as approved by the Engineer and shall comply with the Standard Specification for Portland Cement, ASTM C-150. POZZOLANS, FLY ASH AND/OR SILICA FUME SHALL NOT BE USED.

5.7.2.2 AGGREGATES: Concrete aggregates shall conform to Tentative Specifications for Concrete Aggregates, ASTM C-33.

5.7.2.3 WATER: Water used in mixing concrete shall be clean and free from oil, acid, salt, injurious amounts of alkali, organic matter or other deleterious substances.

5.7.2.4 ENTRAINING AGENT: An air-entraining agent shall be used in all concrete exposed to the weather. The agent shall conform to ASTM Designation C-175 and C-260.

5.7.2.5 ADMIXTURES: No admixtures unless directed by the Engineer. Calcium chloride shall not be used in reinforced concrete.

5.7.2.6 FLY ASH: No fly ash shall be added without mix design approved by the Engineer.

5.7.2.7 REINFORCED STEEL: All bar material used for reinforcement of concrete shall be intermediate grade steel free of rust conforming to the requirements of ASTM Designation A-615 GR-60 and shall be deformed in accordance with ASTM Designation A-305.

5.7.2.8 WELDED WIRE FABRIC: Welded wire fabric for concrete reinforcement shall conform to the requirements of ASTM A-185.

5.7.3 CONSTRUCTION: For the purpose of practical identification, concrete has been divided into three classes: Class A, B, and C. Basic requirements and use for each class are defined as follows:

Class	Minimum Cement (sacks/c.y.)	Minimum 28-day Comp. Strength (psi)	Primary Use
A	6	4000	Reinforced Structural Concrete
B	6	3500	Sidewalks, curbs, and gutters, cross gutters, pavements, and non-reinforced footings and foundations
C	5	2500	Thrust blocks, anchors, mass concrete

Note: Above specifications contain 94 pound sacks of Portland Cement.

All concrete shall also comply with the following requirements.

AGGREGATES: The maximum size of the aggregate shall be not larger than one-fifth of the narrowest dimension between forms within which the concrete is to be cast, nor larger than three-fourths of the minimum clear spacing between reinforcing bars or between reinforcing bars and forms. For non-reinforced concrete slabs, the maximum size of aggregates shall not be larger than one-fourth the slab thickness.

WATER: Sufficient water shall be added to the mix to produce concrete with the minimum practicable slump. The slump of mechanically vibrated concrete shall not exceed four inches. **NO** concrete shall be placed with a slump in excess of five inches. The maximum permissible water-cement ratio (including free moisture on aggregates) shall be 5 and 5-3/4 gallons per bag of cement respectively for Class A and B air entrained concrete.

AIR-ENTRAINING: Air content for air-entrained concrete shall comply with the following:

Course Aggregate Size (in.)	Air Content %
1-1/2 to 2-1/2	5 ± 1
3/4 or 1	6 ± 1
3/8 or 1/2	7 ± 1

The air-entraining agent shall be added as liquid to the mixing water by means of mechanical equipment capable of accurate measurement and control.

5.7.3.1 FORMS: Forms shall be substantially built and adequately braced so as to withstand the liquid weight of concrete. All linings, studding, walling and bracing shall be such as to prevent bulging, spreading, or loss of true alignment while pouring and displacement of concrete while setting. Metal forms shall be used for sidewalk work unless otherwise specified by the City Engineer. All edge forms for sidewalk pavements, curbs, and gutters shall be of sufficient rigidity and adequately braced to accurately maintain line and grade. Prior to concrete placement, all forms shall be lightly coated with oil to prevent concrete adhesion to form materials.

Exposed vertical and horizontal edges of the concrete in structures shall be chamfered by the placing of molding in the forms or as directed by the Engineer and as indicated in the plans.

FORM STRIPPING: Forms shall remain in-place for at least the following time periods after completion of a concrete pour in a given section of forms:

Walls and columns:	24 hours
Roof deck:	10 days

5.7.3.2 JOINTS: Joints shall be provided for sidewalk and curb and gutter as follows:

SIDEWALKS: Shall have scribed joints at intervals of 4 feet which joints shall be approximately 3/16" wide and be approximately 1/4 of the total slab thickness. In addition, 1/2-inch expansion joints shall be provided at 50-foot intervals and at locations where sidewalks adjoin curbs or existing sidewalks, driveways, building walls or aprons. Expansion joints shall be provided at 4-foot intervals where manholes, valve boxes or meter boxes are located.

5.7.3.3 REINFORCEMENT AND EMBEDDED ITEMS: Reinforcing steel shall be clean and free from rust, scale, paint, grease or other foreign matter which might impair the bond. It shall be accurately bent and shall be tied to prevent displacement when concrete is poured. Reinforcing steel shall be held in place by only metal or concrete ties, braces and supports. No steel shall extend from or be visible on any finished surface and shall have a minimum of 1 1/2" concrete cover. Bars shall be grade 60.

The Contractor shall use concrete chairs for holding the steel away from the subgrade, and spreader or other type bars for securing the steel in place. The spreader bars shall be not less than 3/8-inch in diameter.

5.7.3.4 PREPARATIONS: Before batching and placing concrete, all equipment for mixing and transporting the concrete shall be cleaned, all debris and ice shall be removed from the places to be occupied by the concrete, forms shall be thoroughly wetted or oiled, and masonry filler units that will be in contact with concrete shall be well drenched and the reinforcements shall be thoroughly cleaned of ice or other coatings. Water shall be removed from spaces to receive concrete. When placing concrete on earth surfaces, the surfaces shall be free from frost, ice, mud, and water. When the subgrade surface is dry soil or pervious material, it shall be sprayed with water immediately before placing of concrete or shall be covered with waterproof sheathing paper or a plastic membrane. No concrete shall be placed until the surfaces have been inspected and approved by the Engineer or Inspector.

COMPACTION: All subgrade and backfill materials shall be compacted in accordance with Section 5.1.3.10.

5.7.3.5 CONCRETE MIXING: All concrete shall be ready-mixed and delivered in accordance with ASTM C-94. The concrete shall be mixed until there is a uniform distribution of the materials. Sufficient water shall be used in mixing concrete to produce a mixture which will flatten and quake when deposited in place, but not enough to cause it to flow. Sufficient water shall be used in concrete in which reinforcement is to be embedded, to produce a mixture which will flow sluggishly when worked and which, at the same time, can be conveyed from the mixer to the forms without segregation of aggregate. In no case shall the quantity of water used be sufficient to cause the collection of a surplus in the forms or exceed the maximum allowable slump as specified in 5.7.3.

5.7.3.6 DEPOSITING: Concrete shall be deposited as nearly as practical in its final position to avoid segregation due to rehandling or flowing. The concrete placing shall be carried on at such a rate that the concrete is at all times plastic and flows readily into the corners of forms and reinforcing bars. No concrete that has partially hardened or been contaminated by foreign material shall be deposited in the work, nor shall retempered concrete be used. No concrete shall be dropped more than 3 feet. Concrete delivered to the job site having a temperature that exceeds 90 degrees Fahrenheit shall not be placed. Concrete cooling methods during hot weather will be approved by the Engineer.

All concrete in structures shall be vibrator compacted during the operation of placing, and shall be thoroughly worked around reinforcement and embedded fixtures and into the corners of the forms.

CONSTRUCTION JOINTS: All construction joints shall be located and prepared as shown on the drawings or otherwise approved in writing by the Engineer. Unanticipated cold joints may be cause for rejection of the entire poured section in which the cold joint is located, at the sole discretion of the Engineer, in consultation with others. Rejected sections shall be demolished and re-poured by the Contractor as specified at no additional cost to the Owner.

5.7.3.7 PLACING CONCRETE IN COLD WEATHER: No concrete shall be poured where the air temperature is lower than 40 degrees Fahrenheit, at a location where the concrete cannot be covered or protected from the surrounding air. Where concrete is poured below a temperature of 35 degrees Fahrenheit the ingredients of the concrete shall be heated so that the temperature of the mixture shall not be less than 50 degrees or more than 100 degrees Fahrenheit. Before mixing, the heated aggregates shall not exceed 125 degrees Fahrenheit and the temperature of the heated water shall not exceed 175 degrees Fahrenheit. Cement shall not be added while the temperature of the mixed aggregates and water is greater than 100 degrees Fahrenheit. When there is likelihood of freezing during the curing period, the concrete shall be protected by means of an insulating covering and/or heating the concrete for a period of not less than 7 days after placing. The temperature must be maintained at a minimum of 40 degrees Fahrenheit. Concrete shall not be placed on frozen soil. Equipment for protecting concrete from freezing shall be available at the job site prior to placing concrete. Particular care shall be exercised to protect edges and exposed corners from freezing. In the event heating is employed, care shall be taken to insure that no part of the concrete becomes dried out or is heated to temperatures above 90 degrees Fahrenheit. The housing, covering, or other protection used shall remain in place and intact at least 24 hours after the artificial heating is discontinued. Combustion heaters shall not be used during the first 24 hours unless precautions are taken to prevent exposure of the concrete to exhaust gases that contain carbon dioxide.

5.7.3.8 FINISHING:

FORMED SURFACE FINISHES - Provide the following finishes unless indicated or shown otherwise on the drawings.

ROUGH FORM FINISH - Applies to all surfaces not exposed to view such as surfaces in contact with earth backfill. Repair defects and patch tie holes. Remove fins exceeding 1/4 inch in height. Otherwise leave surfaces with the texture imparted by the forms.

SMOOTH FORM FINISH - Applies to all exposed surfaces and interior surfaces of vaults and pits. Use form facing material to produce a smooth, hard, uniform surface. Support with backing capable of preventing specified deflection. Do not use material with raised grain, torn surfaces, worn edges, patches, dents, or other defects which will impair the texture of the concrete surface. Keep the number of seams to a minimum. Repair and patch all tie holes and defects. Remove all fins.

GROUT CLEANED FINISH - Smooth rubbed finish shall be produced by "brush-off" sandblasting or grinding with a stone wheel or grinder on all exposed wall surfaces prior to filling holes to expose all holes near the surface of the concrete. The wall surface shall then be rubbed with a mortar consisting of one part portland cement and 1-1/2 parts of fine sand passing the 100 screen with enough water and an emulsified bonding agent to have the consistency of thick creme. The wall surface shall be thoroughly wetted. Apply the grout by rubbing it over the entire area with clean burlap, sponge rubber floats, or trowels. Surface shall be wiped clean and most cured.

SLAB FINISHES - Unless specified or otherwise shown on the drawings, apply finishes to slabs as follows:

FLOATED FINISH - Use for surfaces to be trowel finished or to be broom finished. After the concrete has been placed, consolidated, struck off, and leveled, do not work further until water sheen has disappeared and the surface has been stiffened. When water sheen has disappeared and surface has stiffened, float with a hand float or with a bladed power trowel equipped with float shoes, or with a powered disc float. During or after the first floating, planeness of surface shall be checked with a 10-ft. straightedge applied at not less than two differed angles. Cut down all high spots and fill all low spots to produce a surface level tolerance of 1/4 inch in 10 feet throughout. Then refloat immediately to a uniform sandy texture.

TROWELED FINISH - Use for interior floors intended as walking surfaces. The surface shall first be float-finished as specified above. Next, power trowel followed by hand troweling. The first troweling after power floating shall produce smooth surface which is free of defects but which may still show some trowel marks. Additional trowelings shall be done by hand after the surface has hardened. Accomplish final troweling when a ringing sound is produced as the trowel is moved over the surface. Thoroughly consolidate surface by the hand troweling until the finished surface is free of trowel marks, uniform in texture and appearance and level within a tolerance of 1/4 inch in 10 feet in all directions. On surfaces intended to support floor coverings, defects which show through the floor covering shall be removed by grinding.

BROOM OR BELT FINISH - Use for exterior horizontal walks and slabs. Immediately after the concrete has received a float finish as specified above, provide a coarse transverse scored texture by drawing a broom or burlap belt across the surface.

5.7.3.9 CURING AND PROTECTION: As soon as the concrete has hardened sufficiently to prevent damage, the finished surface shall be protected for curing one of the following ways:

Application of a curing compound, conforming to "Specifications for Liquid Membrane-Forming Compounds for Curing Concrete" ASTM C-309. The compound shall be light in color and shall be applied in accordance with the manufacturers recommendations immediately after any water sheen, which may develop after finishing has disappeared from the concrete surface.

Ponding of water on the surface or continuous sprinkling. Application of light colored waterproof plastic materials, conforming to "Specifications for Waterproof Sheet Materials for Curing Concrete" ASTM C-171, placed and maintained in contact with the surface of the concrete. The freshly finished surface shall be protected from hot sun and drying winds until it can be sprinkled or covered as above specified. The concrete surface must not be damaged or pitted by rain. The contractor shall provide and use, when necessary, sufficient tarpaulins to completely cover all sections that have been placed within the preceding twelve (12) hours.

The Contractor shall erect and maintain suitable barriers to protect the finished surface. Any section damaged from traffic or other causes occurring prior to its official acceptance, shall be repaired or replaced by the Contractor at his own expense in accordance with these specifications.

Defective concrete conditions or surfaces shall be removed, replaced, or repaired, without further cost to the OWNER, in accordance with these specifications.

5.7.3.10 CONCRETE TESTING: The Engineer may order the taking of concrete test cylinders to check the required compressive strengths. If taken, samples will be made in accordance with ASTM C172 and tested as follows:

- a. Air Content: Test for air content shall be performed in accordance with ASTM C 173 or ASTM C 231. A minimum of 1 test shall be conducted each time a slump test is made.
- b. Slump: At least 1 slump test shall be made on randomly selected batches of each mixture of concrete for every 50 cubic yards of ready-mixed concrete delivered to the job site. Also note the time batched at the plant and the starting time when unloading began at the site. Tests shall be performed in accordance with ASTM C 143.
- c. Temperature: Concrete and air temperatures shall be measured and recorded with each set of cylinders and the air temperature shall also be recorded when the air temperature at the site is 40 degrees F or below and/or 90 degrees F or above.

EVALUATION AND ACCEPTANCE OF CONCRETE

- a. Frequency of Testing: Samples for strength tests of each class of concrete placed each day shall be taken not less than once a day, nor less than once for each 50 cubic yards of concrete, nor less than once for each 3000 square feet of surface area for slabs or walls. If this sampling frequency results in less than 5 strength tests for a given class of concrete, tests shall be made from at least 5 randomly selected trucks or from each truck if fewer than 5 truck loads are used. Field cured specimens for determining form removal time or when a structure may be put in service shall be made in numbers directed to check the adequacy of curing and protection of concrete in the structure. The specimens shall be removed from the molds at the age of 24 hours and shall be cured and protected, insofar as practicable, in the same manner as that given to the portion of the structure the samples represent.
- b. Testing Procedures: Cylinders for acceptance tests shall be molded and cured in accordance with ASTM C 31. Cylinders shall be tested in accordance with ASTM C 39. A strength test shall be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days or at another specified test age.

- c. Evaluation of Results: Concrete specified on the basis of compressive strength will be considered satisfactory if the averages of all sets of three consecutive strength test results equal or exceed the specified strength and no individual strength test result falls below the required strength by more than 500 pounds per square inch.
- d. Unless noted otherwise, make a minimum of four (4) concrete cylinders each time a test is required. When concrete is being placed in suspended slabs, beams and retaining walls make two (2) extra cylinders that must be cured on site. The extra cylinders will be used to determine when to remove forms and/or when to backfill.

In-place concrete may be cored for testing. Cost of all laboratory testing shall be the responsibility of the Owner. Any retesting required because of test failures shall be the responsibility of the Contractor. All concrete delivered to the job site shall be accompanied by a ticket specifying: bag mix, air content, etc. Said ticket shall be given to the Engineer's Inspector who may field check slump and air entrainment compliance.

5.7.3.11 Miscellaneous: All other items, including, but not limited to, waterstops and joint sealant, shall be as shown on the Plans.

End of Section

SECTION 5.8 EARTHWORK

5.8.1 DESCRIPTION: Extent of earthwork is indicated on drawings. Preparation of bedding of pipe and trenching is included in Section 5.1 "Trench Excavation and Backfill".

"Excavation" consists of removal of material encountered to subgrade elevations indicated and subsequent relocation of materials removed. Perform excavation work in compliance with applicable requirements of governing authorities having jurisdiction. "Embankment" includes compacted backfill in specified lifts and densities.

A copy of the geotechnical report prepared for this project is appended to this specification book for the information of the CONTRACTOR.

5.8.2 MATERIALS:

5.8.2.1 SATISFACTORY MATERIALS: Materials are defined as those complying with ASTM D2487 soil classification groups GW, GP, GM, SM, SW and SP.

5.8.2.2 UNSATISFACTORY SOIL MATERIALS: Unsatisfactory soil materials are defined as those complying with ASTM D2487 soil classifications groups GC, SC, ML, CL, CH, OL, OH and PT.

5.8.2.3 STRUCTURAL FILL: Imported structural fill shall meet the following requirements:

<u>Fill to Support</u>	<u>Requirements</u>
Footings and Slabs	Non-expansive granular soil Passing No. 200 Sieve < 35% Liquid Limit < 30% Maximum size 4 inches
Floor Slab (Upper 4 inches)	Sand and/or Gravel Passing No. 200 Sieve < 5% Maximum size 2 inches

The moisture of the soil shall be adjusted to within 2 percent of optimum to facilitate compaction. This may require wetting or drying of the soil depending on the soil moisture at the time of construction.

5.8.2.4 BACKFILL AND FILL MATERIALS: Satisfactory soil materials free of clay, rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetable and other deleterious matter.

5.8.2.5 COMPACTION TESTING: Owner may employ at Owners Expense, testing laboratory to perform soil testing and inspection service for quality control testing during earthwork operations.

5.8.2.6 SITE CONDITIONS: Data on indicated subsurface conditions at the end of this section are not intended as representations or warranties of accuracy or continuity between soil borings. It is expressly understood that Owner will not be responsible for interpretations or conclusions drawn therefrom by Contractor. Data is made available for convenience of Contractor.

Contractor may make additional test borings and other exploratory operations at no cost to Owner.

5.8.3 CONSTRUCTION: Locate existing underground utilities in areas of work. If utilities are to remain in place, provide adequate means of support and protection during earthwork operations. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility owner immediately for directions. Cooperate with owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to the satisfaction of utility owner.

Do not interrupt existing utilities serving facilities occupied and used by Owner or others during occupied hours, except when permitted in writing by Engineer and then only after acceptable temporary utility services have been provided.

Provide minimum of 48-hour notice to Engineer, and receive written notice to proceed before interrupting any utility.

Demolish and completely remove from site any and all existing underground utilities identified for removal. Coordinate with utility companies for shut-off of services if lines are active.

5.8.3.1 EXPLOSIVES: The use of explosives is not permitted without written approval of ENGINEER and OWNER and any and all Authorities Having Jurisdiction over the use of explosives.

Procedures and liabilities as outlined in Section 5.1.3.3, Solid Rock Excavation And Blasting, shall be followed if the use of explosives is necessary.

5.8.3.2 PROTECTIONS OF PERSONS AND PROPERTY: Barricade open excavations occurring as part of this work. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations.

5.8.3.3 EXCAVATION CLASSIFICATIONS: The following classifications of excavation will be made when rock excavation is encountered in work:

Earth Excavation - Includes excavation of pavements and other obstructions visible on ground surface; underground structures, utilities and other items indicated to be demolished and removed; together with earth and other materials encountered that are not classified as rock or unauthorized excavation.

Rock Excavation in Trenches and Pits - Includes removal and disposal of materials and obstructions encountered which cannot be excavated with a 1.0 cubic yard (heaped) capacity, 42 inch wide bucket on track-mounted power excavator equivalent to Caterpillar Model 215, rated at not less than 90 HP flywheel power and 30,000 lb. drawbar pull. Trenches in excess of 10' - 0" in width and pits in excess of 30' - 0" in length or width are classified as open excavation.

Rock Excavation in Open Excavations - Includes removal and disposal of materials and obstructions encountered, which cannot be dislodged and excavated with modern track-mounted heavy-duty excavation equipment without drilling, blasting or ripping. Rock excavation equipment is defined as Caterpillar Model No. 973 or No. 977K, or equivalent track-mounted

loader, rated at not less than 170 HP flywheel power and developing 40,000 lb. break-out force (measured in accordance with SAE J732C).

Typical of materials classified as rock are boulders 1/2 cu. yd. or more in volume, solid rock, rock in ledges, and rock-hard cementitious aggregate deposits.

Intermittent drilling, blasting or ripping performed to increase production and not necessary to permit excavation of material encountered will be classified as earth excavation.

Do not perform rock excavation work until material to be excavated has been cross-sectioned and classified by the Engineer. Such excavation will be paid on basis of contract conditions relative to changes in work.

Rock Payment Lines are limited to the following:

Two feet outside of concrete work for which forms are required, except footings. One foot outside perimeter of footings. In pipe trenches, 6 inches below invert elevation of pipe and 2 feet wider than inside diameter of pipe, but not less than 3 feet minimum trench width. Neat outside dimensions of concrete work where no forms are required. Under slabs on grade, 6 inches below bottom of concrete slab.

Unauthorized Excavation - Consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be at Contractor's expense.

Under footings, foundation bases, or retaining walls, fill unauthorized excavation by extending indicated bottom elevation of footing or base to excavation bottom, without altering required top elevation. Lean concrete fill may be used to bring elevations to proper position, when acceptable to Engineer.

Elsewhere, backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed by Engineer.

Additional Excavation: When excavation has reached required subgrade elevations, notify Engineer who will make an inspection of conditions.

If unsuitable bearing materials are encountered at required subgrade elevation, carry excavations deeper and replace excavated material as directed by Engineer. Removal of unsuitable material and its replacement as directed will be paid on basis of contract conditions relative to changes in work.

5.8.3.4 STABILITY OF EXCAVATIONS: Slope sides of excavations to comply with local codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated.

Maintain sides and slopes of excavations in safe condition until completion of backfilling.

5.8.3.5 SHORING AND BRACING: Provide materials for shoring and bracing, such as sheet piling, uprights, stringers and cross-braces, in good serviceable condition.

Establish requirements for trench shoring and bracing to comply with local codes and authorities having jurisdiction.

Maintain shoring and bracing in excavations regardless of time period excavations will be open. Carry down shoring and bracing as excavation progresses.

5.8.3.6 DEWATERING: Prevent surface water and subsurface or groundwater from flowing into excavations and from flooding project site and surrounding area.

Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottoms, undercutting footings, and soil changes detrimental to stability of subgrades and foundations. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.

Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey rain water and water removed from excavations to collecting or run-off areas. Do not use trench excavations as temporary drainage ditches.

5.8.3.7 MATERIAL STORAGE Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade and shape stockpiles for proper drainage. Locate and retain soil materials away from edge of excavations. Do not store within drip line of trees indicated to remain. Dispose of excess soil material and waste materials as herein specified.

5.8.3.8 COLD WEATHER PROTECTION: Protect excavation bottoms against freezing when atmospheric temperature is less than 35°F. (1°C).

5.8.3.9 COMPACTION: Control soil compaction during construction providing minimum percentage of density specified for each area classification indicated below.

Structural Fill and Sub-Ballast: Compact top 8 inches of subgrade and each layer of structural fill material or sub-ballast at 95% maximum modified proctor density (ASTM D 1557). Maximum compacted thickness of any one lift shall not exceed 6-inches.

Sub-Grade: Compact top 6 inches of subgrade and each layer of backfill or fill material at 90% maximum modified proctor density (ASTM D 1557).

Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade, or layer of soil material. Apply water in manner to prevent free water appearing on surface during or subsequent to compaction operations.

Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.

Soil material that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by dicing, harrowing or pulverizing until moisture content is reduced to a satisfactory value.

5.8.3.10 BACKFILL AND FILL: Place acceptable soil material in layers not exceeding 8 inches (uncompacted depth) and compact each layer prior to placement of next layer to required subgrade elevations, for each area classification listed below.

Sub-ballast, use structural fill material, or satisfactory excavated or borrow material, or combination of both.

Under Ballast, use sub-ballast material.

Backfill excavations as promptly as work permits, but not until completion of the following:

- Acceptances of construction below finish grade including, where applicable, dampproofing, waterproofing, and perimeter insulation.
- Inspection, testing, approval, and recording locations of underground utilities.

5.8.3.11 GROUND SURFACE PREPARATION: Remove vegetation, debris, unsatisfactory materials, obstructions, and deleterious materials from ground surface prior to placement of fills. Plow, strip, or break-up sloped surfaces steeper than 1 vertical to 4 horizontal so that fill material will bond with existing surface.

When existing ground surface has a density less than that specified under "Compaction" for particular area classification, break up ground surface, pulverize, moisture-condition to optimum moisture content, and compact to required depth and percentage of maximum density.

5.8.3.12 PLACEMENT AND COMPACTION: Place backfill and fill materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

Place backfill and fill materials evenly adjacent to structures, piping or conduit to required elevations. Take care to prevent wedging action of backfill against structures or displacement of piping or conduit by carrying material uniformly around structure, piping or conduit to approximately same elevation in each lift.

5.8.3.13 GRADING: Uniformly grade areas within limits of grading under this section including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are indicated, or between such points and existing grades.

Finish surfaces free from irregular surface changes, and as follows:

Ballast and Sub-Ballast: Shape surface of areas under Ballast and Sub-Ballast to line, grade and cross-section, with finish surface not more than 2 inches above or below required subgrade elevation.

Compaction: After grading, compact subgrade surfaces to the depth and indicated percentage of maximum dry or relative density for each area classification.

5.8.3.14 MAINTENANCE:

Protection of Graded Areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris. Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.

Reconditioning Compacted Areas: Where subsequent construction operations or adverse weather disturbs completed compacted areas, scarify surface, re-shape, and compact to required density prior to further construction.

Settling: Where settling is measurable or observable at excavated areas during general project warranty period, remove surface (pavement, lawn or other finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

5.8.3.15 DISPOSAL OF EXCESS AND WASTE MATERIALS

Removal to Designated Areas on Owner's Property: Transport acceptable excess excavated material to designated soil storage areas on Owner's property. Stockpile soil or spread as directed by Engineer.

Removal from Owner's Property: Remove waste materials, including unacceptable excavated material, trash and debris, and dispose of it off Owner's property, in a legal manner.

End of Section

SECTION 5.9 CONCRETE TANK SPECIAL CONDITIONS

5.9.1 DESCRIPTION: The Contractor shall furnish all labor, materials and equipment necessary or required to complete construction of a concrete reservoir in all aspects, as shown on the plans and required in the Specifications and as hereinafter specified. Once actual tank construction has begun, construction shall be continuous and shall not exceed 120 days.

5.9.2 MATERIALS

5.9.2.1 REINFORCING STEEL: See Sheet S0.1 of the drawings.

5.9.2.2 CONCRETE: See Section 5.7 of these specifications and Sheet S0.1 of the Drawings. In the event of a conflict, Sheet S0.1 shall take precedence.

5.9.2.3 LADDER: The access ladder shall be fabricated in accordance with construction drawing and hot dip galvanized. All anchor bolts shall be stainless steel. Rungs shall be fabricated with a non-slip profile.

5.9.2.4 AIR VENT: Fabricated from standard wall thickness steel and hot dipped galvanized as detailed on the construction drawings.

5.9.2.5 DUCTILE IRON PIPE: See Section 5.5

5.9.2.6 ACCESS HATCH: The access hatch shall be "FTWT" by EJ, "FPS 625" by U.S.F., or approved equal 4'X4' roof hatch with stainless steel hardware, fully enclosed curb with concealed padlock lug to the dimensions shown on the plans. The frame of any access opening shall be provided with a close-fitting, solid shoebox type cover that extends down around the frame at least 2 inches and is furnished with a gasket(s) between the lid and frame. The horizontal surface of the tank lid shall not have any openings, cracks, or penetrations, such as a lock, key hole, or bolted handle that would allow contaminants to enter the tank. The access hatch shall be provided with a locking device and two sets of keys.

5.9.3 CONSTRUCTION

5.9.3.3 EXCAVATION: Excavation shall be through whatever materials are encountered to the depth and extent shown on the plans to permit construction of the storage facilities. Excavated banks shall be sloped consistent with safety requirements and to prevent slipping and caving.

5.9.3.4 SUBGRADE FOR CONCRETE RESERVOIR: CONTRACTOR shall notify the Engineer after subgrade excavation is complete and prior to placement of forms - so that the Engineer or the Engineer's representative can review the tank foundation soils to determine if they meet design assumptions and are suitable for the tank foundation.

Earth subgrade upon which concrete is placed shall be firm and free from water. Ground water shall be kept below subgrade until the concrete has set. When the subgrade is in dry earth it shall be thoroughly dampened with water immediately prior

to placing concrete to ensure that no moisture will be absorbed from the fresh concrete.

The Contractor shall compact under footings and slabs to achieve a minimum density of 95 percent of ultimate density at optimum moisture content as determined by AASTHO T-180 Method A.

5.9.3.5 LEAK TEST: After the surface finishing has been completed and prior to backfilling, the interior of the tank shall be thoroughly cleaned removing all loose material, burrs, form ties, dirt, excess concrete spill, etc. The interior shall then be washed with a water hose under pressure until clean. The CONTRACTOR will be responsible for pressurizing the potable wash-down water. Only equipment dedicated to potable-water use and thoroughly disinfected will be allowed in the wash-down process. The OWNER will provide the wash-down water free of charge to the CONTRACTOR at the OWNER's nearest fire hydrant. The Contractor shall be responsible to transport the water to the new tank site at no additional cost to the Owner. The reservoir shall then be filled with potable water, inlet and outlet lines plugged, and the water level observed for 72 hours. The Contractor shall repair all visible leaks or "sweat" spots and in no case shall the leakage exceed 1/10 of one percent of the tank volume in a 24-hour period. Leaks shall be repaired at the Contractor's expense to the satisfaction of the OWNER.

5.9.3.6 DISINFECTION OF RESERVOIR: Disinfection shall be in accordance with AWWA C652-latest edition procedures and requirements, modified as specified herein. Upon satisfactory completion of the leak test, the Contractor shall disinfect the interior of the tank and appurtenances by adding sufficient chlorine (50 ppm minimum) to provide a residual of 25 ppm chlorine after 24 hours. Care shall be exercised to insure thorough mixing of chlorine.

Upon approval of the Engineer, the tank interior may be disinfected by spraying liberally with a solution of 250 ppm chlorine, followed by clean water after a minimum waiting period of 30 minutes. Proper safety precautions shall be taken to protect workmen from inhalation of the chlorine gases or bodily contact with the solution.

After disinfection is completed, by either method, the interior shall be thoroughly flushed with potable water. Effluent created shall be conducted to drainage designated by the Engineer. Two negative post-construction bacteriological samples shall be obtained from the water stored in the tank, retrieved no less than 24 hours apart, before the tank disinfection will be considered complete.

5.9.3.7 INTERIOR SEALANT: If excessive (greater than 2% of interior wall surface area) honeycombing occurs, the Contractor shall be required to coat inside surfaces with one coat Amercoat 86 Primer (1 mil total dry film thickness) and two coats Amercoat 33 Vinyl Copolymer tank liner (1.5 mil total dry film thickness per coat) or other approved lining system at no additional cost to owner. Coating must meet NSF 61 standards.

5.9.3.8 BACKFILL: Backfill of the reservoir shall be to the line and grade shown on the drawings. Backfill operation shall be done after concrete in the structure has reached its design strength and approval is given by the Engineer.

The depth of backfill at any location adjacent to the reservoir shall never exceed the depth of backfill at any other location adjacent to the reservoir by more than two (2) feet.

Before commencing backfill all foreign material, wood scraps, forms, excess concrete spills, etc. shall be removed to the bottom of the footings. Satisfactory excavated material may be used for backfill. Any rocks larger than 6 inches in any dimension shall not be suitable for backfill. All unsuitable or excess material shall be removed from the area and disposed of by the Contractor in a manner approved by the Engineer.

Backfill shall be placed in uniform horizontal layers not exceeding 12 inches in thickness, moisture added if necessary for optimum moisture content and compacted to at least 90% ultimate density at optimum moisture content as determined by AASTHO T-180 Method A. Backfill shall be graded to the uniform neat line and grade satisfactory to the Engineer.

5.9.3.9 CLEANUP: Upon completion of construction all scraps of lumber, forms, steel, excess concrete spills, rocks, debris, etc. shall be removed from the area and disposed of by the Contractor.

5.9.3.10 MISCELLANEOUS METAL: (See site plan for locations) The ladder, inlet, outlet, drain pipes and air vent shall be fabricated of the material, gauge thickness and to the dimensions shown on the drawings. All fabricated metal fittings shall be hot dipped galvanized after fabrication.

End of Section

Appendix