# WOODLAND SOUTH HILLS IRRIGATION COMPANY

# CULINARY WATER SYSTEM SPECIFICATIONS


***Woodland South Hills Irrigation Company***

*1 Woodland View Drive*
*Kamas, UT 84036*


A public water system providing services to a private community

## MARCH 2023

Specifications for water system construction

**WATER SYSTEM # 26052**


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## STANDARDS & TECHNICAL SPECIFICATIONS

## SECTION 1
## EARTHWORK

1.1 **GENERAL:** This section defines the requirements for excavation and backfill for structures, construction requirements for embankments and fills, and subgrade preparation for pavements and other surface improvements.

1.2 **CLEARING AND GRUBBING:** The ground within the right-of-way shall be cleared of all trees, stumps, brush, weeds, roots and other objectionable materials. All branches of trees close enough to the roadway surface to be considered an obstruction to traffic or sight distance shall be carefully removed. All trees, stumps, roots, etc., are to be removed to a depth of not less than 3 feet below the subgrade.

1.3 **EXCAVATION FOR STRUCTURES:** All structures shall be founded on undisturbed original subsoil. All unauthorized excavation below the specified structure subgrade shall be replaced with concrete monolithic with that of the slab above or with coarse gravel compacted to 95% of maximum dry density as measured by AASHTO T-180 in lifts not to exceed 10".

Subgrade soil for all concrete structures, regardless of type or location, shall be firm, dense, thoroughly compacted and consolidated; shall be free from mud and shall be compacted to 95% of AASHTO T-180. Coarse gravel or crushed stone may be used for subsoils reinforcement if satisfactory results can be obtained thereby. Such material shall be applied in thin layers not to exceed 4", each layer being embedded in the subsoil by thorough tamping. All excess soil shall be removed to compensate for the displacement of the gravel or crushed stone, and the finished elevation of any subsoil reinforced in this manner shall not be above the subgrade elevation.

1.4 **BACKFILL AROUND STRUCTURES:** Backfill around structures shall be placed to the lines shown on the approved drawings, or as directed. After completion of foundation footings and walls and other construction below the elevation of the final grades, and prior to backfilling, all forms shall be removed and the excavation shall be cleaned of all trash and debris. Material for backfilling shall consist of excavated material or borrow of sand, gravel, or other suitable material, and shall be placed in layers not exceeding ten (10) inches in uncompacted thickness. Each layer shall be compacted by hand or machine tampers or by other suitable equipment to a density equal to 95% of maximum dry density as measured by AASHTO T-180.

1.5 **CONSTRUCTION OF EMBANKMENTS AND FILLS:** Unsuitable materials that occur in the foundations for embankments and fills shall be removed by clearing, stripping, and/or grubbing. After stripping, the foundation shall be scarified to a depth of not less than six inches, and the loosened material shall be moistened and compacted as hereinafter specified for each layer. All materials in embankments and fills shall be placed, moistened, and compacted as provided in the following paragraphs.

When the embankment or fill exceeds the amount of excavation, sufficient additional material shall be obtained from borrow pits provided by the Contractor. All material proposed to be imported shall be subject to the review and approval of the Water System Engineer or his representative prior to start of hauling operations.

The materials used for embankment and fill construction shall be free from sod, grass, trash, rocks larger than four inches in diameter, and all other material unsuitable for construction of compacted fills.

Grading of completed embankments and fills shall bring the surfaces to a smooth, uniform condition with final grades being within 0.1 foot of the design grade. In no case shall embankment slopes be steeper than 3:1.

1.6 **COMPACTING EARTH MATERIALS:** The material shall be deposited in horizontal layers having a thickness of not more than 10 inches after being compacted as hereinafter specified; provided that, when mechanical equipment is used for placing and compacting the material on a sloping foundation, the layers may be placed parallel to the foundations. The distribution of materials shall be such that the compacted material will be homogeneous and free from lenses, pockets, or other imperfections.

During compaction operations the material shall have the optimum moisture content required for the purpose of compaction, and the moisture content shall be uniform throughout the layers, insofar as practicable. Moistening of the material shall be performed at the site of excavation, but such moistening shall be supplemented as required by sprinkling at the site of construction. If the moisture content is more than optimum for compaction, the compaction operations shall be delayed until such time as the material has dried to the optimum moisture content. When the material has been conditioned as hereinbefore specified, the backfill or embankment shall be compacted as follows:

Under Roadways and extending one foot beyond the proposed curb line the fill or embankment material shall be compacted to a density equal to not less than 95% of maximum dry density as measured by AASHTO T-180.

Under Sidewalk and Drive Approaches the fill or embankment material (to at least one foot each side of the edge of the slab) shall be compacted to a density equal to not less than 95% of maximum dry density as measured by AASHTO T-180.

Other Fills and Embankments not listed above shall be compacted to a density equal to not less than 85% of maximum dry density as measured by AASHTO T-180.

## SECTION 2
## PORTLAND CEMENT CONCRETE

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

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

A. Cement: Portland cement shall be Type II or as approved by the Water System Engineer and shall comply with the Standard Specification for Portland Cement, ASTM C-150.

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

C. 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.

D. 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.

E. Admixtures: No admixture (except calcium chloride) will be permitted to be used in portland cement concrete unless such use is specifically authorized by the Water System Engineer. Calcium chloride shall conform to ASTM Standard Specification D-98.

F. Fly Ash: No fly ash shall be added without mix design approved by the Water System Engineer. Fly Ash mixtures will be considered for structural concrete only.

G. Reinforced Steel: All bar material used for reinforcement of concrete shall be grade 60 steel conforming to the requirements of ASTM Designation A-615 and shall be deformed in accordance with ASTM Designation A-305.

H. Welded Wire Fabric: Welded wire fabric for concrete reinforcement shall conform to the requirements of ASTM A-185.

2.3 **CONCRETE MIX:** 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 as defined below:

| CLASS | Minimum Cement (sacks*/c.y.) | Minimum 28-day Compressive Strength (p.s.i) | Primary Use |
|---|---|---|---|
| A | 6 ½ | 4,000 | Reinforced Structural Concrete |
| B | 6 | 3,500 | Sidewalks, curb, gutters, cross gutters, pavements and unreinforced footings and foundations |
| C | 5 | 2,500 | Thrust Blocks, anchors, mass concrete |

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

All concrete shall also comply with the following requirements:

A. 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 unreinforced concrete slabs, the maximum size of aggregates shall not be larger than one-fourth the slab thickness.

B. 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.

C. Air-Entraining: Air content for air-entrained concrete shall comply with the following:

| Course Aggregate Size (in.) | Air Content % |
|---|---|
| 1 ½ to 2 ½ | 5 +/-1 |
| 3/4 or 1 | 6+/-1 |
| 3/8 or ½ | 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.

D. Calcium Chloride: Calcium chloride may be added as an accelerator with prior approval of the Water System Engineer during cold weather, with maximum amount being two pounds per sack of cement.

2.4 **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 curb and gutter work unless otherwise specified by the Water System 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.

Forms for curved sections shall be so constructed and placed that the finish surface of walls and edge of sidewalks, curbs and gutters will not deviate appreciable from the arc of the curve.

Exposed vertical and horizontal edges of the concrete in structures shall be chamfered by the placing of mouldings in the forms at those locations shown on the Drawings.

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

A. Sidewalks: Shall have scribed joints at intervals of 4 feet (4' width) or 6 feet (6' width) which joints shall be approximately 1/16" wide and be approximately 1/4 of the total slab thickness.

B. Curb and Gutter: Shall be cut into lengths of 10 feet by the use of 1/8 inch steel division plates of the exact cross section of the curb and gutter when constructed by hand methods. Curb and gutter constructed with a lay down machine shall be scribed with joints which shall be approximately 1/16" wide and be approximately 1/4 of the total curb thickness.

2.6 **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 2-inch concrete cover.

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.

2.7 **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 (except in freezing weather) or oiled, and masonry filler units that will be in contact with concrete shall be well drenched (except in freezing weather), and the reinforcements shall be well drenched (except in freezing weather), 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 Water System Engineer or Water System Inspector.

2.8 **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 separation of the

coarse aggregate from the mortar. 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 1. (b).

2.9 **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 which exceeds 90°F shall not be placed. Concrete cooling methods during hot weather will be approved by the Water System 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.

2.10 **PLACING CONCRETE IN COLD WEATHER:** No concrete shall be poured where the air temperature is lower than 40°F, at a location where the concrete cannot be covered or protected from the surrounding air. When concrete is poured below a temperature of 35°F the ingredients of the concrete shall be heated so that the temperature of the mixture shall not be less than 50°F or more than 100°F. Before mixing, the heated aggregates shall not exceed 125° F and the temperature of the heated water shall not exceed 175°F. Cement shall not be added while the temperature of the mixed aggregates and water is greater than 100°F. When there is likelihood of freezing during the curing period, the concrete shall be protected by means of an insulating covering and/or heating to prevent freezing of the concrete for a period of not less than 7 days after placing. 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 ensure that no part of the concrete becomes dried out or is heated to temperatures above 90°F. 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 which contain carbon dioxide.

2.11 **FINISHING:** All concrete finish work shall be carefully performed and shall produce a top-quality visual appearance as is common to the industry. After the concrete for slabs has been brought to the established grade and screened it shall be worked with a magnesium float and then given a light broom finish. In no case shall dry cement or a mixture of dry cement and sand be sprinkled on the surface to absorb moisture or hasten hardening. Surface edges of all slabs shall be rounded to a radius of ½ inch.

After concrete has been poured in curb and gutter forms it shall be puddled and spaded so as to ensure a thorough mixture, eliminate air pockets, and create uniform and smooth sides. Before the concrete has thoroughly set, and while the concrete is still green, the forms shall be removed and the front and top sides shall be finished with a flat or steel trowel to make a uniform finished surface. Wherever corners are to be rounded, special steel trowels shall be used while the concrete is workable and the corners constructed to the dimensions specified.

The top and face of the curb and also the top of the apron on combined curb and gutter must be finished true to line and grade and without any irregularities of surface noticeable to the eye. The gutter shall not hold water to a depth of more than one fourth (1/4) of an inch, nor shall any portion of the surface or face of the curb or gutter depart more than one-fourth (1/4) of an inch from a straight edge ten (10) feet in length, placed on the curb parallel to the center line of the street nor shall any part of the exposed surface present a wavy appearance.

2.12 **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:

A. Ponding of water on the surface or continuous sprinkling.

B. Application of absorptive mats such as 3-inch of cured hay, clean straw or fabric kept continuously wet.

C. Application of two inches of moist earth or sand uniformly distributed on the surface and kept saturated by spraying with water.

D. 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.

E. 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 manufactures recommendations immediately after any water sheen, which may develop after finishing has disappeared from the concrete surface.

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 a manner satisfactory to the Water System Engineer.

Defective concrete conditions or surfaces shall be removed, replaced or repaired as directed to meet the approval of the Water System Engineer.

2.13 **CONCRETE TESTING:** In the event that the concrete placed or delivered to the job site appears to have questionable quality, the Water System Engineer may order the taking of concrete test cylinders to check required compressive strengths. In place concrete may be cored for testing. Cost of all required laboratory testing shall be the responsibility of the Subdivider/Developer, Contractor or ready-mix supplier. All concrete delivered to the job site shall be accompanied by a ticket specifying bag mix, air content, etc., said tickets shall be given to the Water System Inspector who may field check slump and air entrainment compliance.

## SECTION 3
## EXCAVATION AND BACKFILL FOR PIPELINES

3.1 **GENERAL:** The work covered by this specification consists of furnishing all labor, tools, materials, equipment, and in performing all operations in connection with the excavation, trenching, and backfilling for underground pipelines and appurtenances.

3.2 **CONTROL OF GROUNDWATER:** Trenches shall be kept free from water during excavation, fine grading, pipe laying and jointing, and pipe embedment operations in an adequate and acceptable manner. Where the trench bottom is mucky or otherwise unstable because of the presence of groundwater, and in all cases where the static groundwater elevation is above the bottom of any trench or bell hole excavation, such groundwater shall be lowered to the extent necessary to keep the trench free from water and the trench bottom stable when the work within the trench is in progress. The discharge from trench dewatering shall be conducted to natural drainage channels, gutters, or drains. Surface water shall be prevented from entering trenches.

3.3 **EXCAVATION FOR PIPELINES:** Excavation for pipelines shall follow lines parallel to and equidistant from the location of the pipe centerline. Trenches shall be excavated to the depths and widths required to accommodate the construction of the pipelines, as follows:

A. Except in ledge rock, cobblerock, stones, or water-saturated earth, mechanical excavation of trenches shall not extend below an elevation four inches above the bottom of the pipe after placement in its final position. All additional excavation necessary for preparation of the trench bottom shall be made manually. Excavation shall not be carried below the grade shown on the drawings. Any unauthorized excavation made below grade for any reason shall be backfilled in accordance with these specifications.

B. Excavation for trenches in ledge rock, cobblerock, stones, mud, or other material unsatisfactory for pipe foundation shall extend to a depth of at least four inches below the bottom of the pipe. A bedding of special material shall be placed and thoroughly compacted with pneumatic tampers in four-inch lifts to provide a smooth, stable foundation. Special foundation material shall consist of suitable earth materials free from roots, sod, or organic matter. Trench bottoms shall be hand-shaped as specified in paragraph (A) above.

Where unstable earth or muck is encountered in the excavation at the grade of the pipe, a minimum of twelve inches below grade will be removed and backfilled with crushed rock or gravel to provide a stable subgrade.

C. The maximum width of trench, measured at the top of the pipe, shall be as narrow as possible but not wider than twelve inches on each side of sewer pipe or drainage pipe and fifteen inches on each side of water pipe.

D. Excavation for pipelines under existing curb and gutter, concrete slabs or sidewalks, shall be open cut. In no case shall tunneling be allowed. At the option of the Water System Engineer, jacking under permanent facilities may be allowed based on his direction. Backfill of open cut areas shall be restored as specified in Section 3.7.

3.4 **GRAVEL FOUNDATION FOR PIPE:** Wherever the subgrade material does not afford a sufficiently solid foundation to support the pipe and superimposed load, where water must be drained to

maintain a dry trench bottom for pipe installation, and at other locations as previously defined, the subgrade shall be excavated to the specified depth and replaced with crushed rock or gravel. Gravel for pipe foundation shall be clean, crushed rock or gravel conforming to the following gradation:

| Screen | % Passing |
|---|---|
| 3/4" | 100 |
| No. 4 | 5 |

Gradation may vary under the direction of the Water System Engineer.

The gravel material shall be deposited over the entire trench width in six-inch maximum layers; each layer shall be compacted by tamping, rolling, vibrating, spading, slicing, rodding, or by a combination of two or more of these methods. In addition, the material shall be graded to produce a uniform and continuous support for the installed pipe.

3.5 **BLASTING:** Blasting will not be allowed except by special permission of the Water System Engineer. When the use of blasting is necessary, the Contractor shall use utmost care not to endanger life or property. The Contractor shall comply with all laws, ordinances, and applicable safety code requirements and regulations relative to the handling, storage, and use of explosives and protection of life and property, and he shall be fully responsible for all damage attributable to his blasting operations. Signals warning persons of danger shall be given before any blast. Suitable weighted plank coverings of timber mats shall be provided to confine all materials lifted by blasting within the limits of the excavation or trench.

Excessive blasting or overshooting will not be permitted, and any material outside the authorized cross section which may be shattered or loosened by blasting shall be removed at the Contractor's expense. The Water System Engineer shall have authority to order any method of blasting discontinued which leads to overshooting or is dangerous to the public or destructive to property or to natural features.

3.6 **SHEETING, BRACING, AND SHORING OF EXCAVATIONS:** Excavation shall be sheeted, braced, and shored as required to support the walls of the excavations to eliminate sliding and settling and as may be otherwise required to protect the workmen and existing utilities, structures, and improvements. All such sheeting, bracing, and shoring and side slopes shall comply with the requirements of the Utah State Industrial Commission and OSHA.

All damage resulting from lack of adequate sheeting, bracing and shoring shall be the responsibility of the Contractor, and the Contractor shall accomplish all necessary repairs or reconstruction resulting from such damage.

3.7 **BACKFILLING:** Backfill shall be carefully placed around and over pipes and shall not be permitted to fall directly on a pipe from such a height or in such a manner as to cause damage. In these specifications the process of preparing the trench bottom to receive the pipe and the backfilling on each side of the pipe to a level 12” over the top of the pipe is defined as bedding. Bedding requirements are as defined on the Drawings and in the Specifications for each pipe type. Bedding material shall conform to the following:

A. Ductile-iron pipe - One hundred percent (100%) less than two-inch (2") and maximum of five percent (5%) passing a No. 200 sieve.

B. PVC or polyethylene pipe - One hundred percent (100%) less than three-quarter inch (3/4") and maximum five percent (5%) passing a No. 200 sieve.

Backfill around the pipe to the level indicated in the Standard Drawings shall be free from sod, vegetation, and other organic or deleterious materials

Trench backfilling above the level of the pipe bedding shall normally be accomplished with native excavated materials and shall be free from rocks larger than eight inches in diameter.

3.8 **COMPACTION OF BACKFILL:** Compacted backfill shall be placed by means of pneumatic tire rollers, hoe packs or other mechanical tampers of a size and type approved by the Water System Engineer.

The backfill in all utility trenches shall be compacted according to the requirements of the materials being placed. Under pavements or other surface improvements the in-place density shall be a minimum of 95% of laboratory standard maximum dry density, as determined by AASHTO T-180. In shoulders and other areas the in-place density shall be a minimum of 90% of laboratory standard maximum dry density, as determined by the same laboratory method. A Water System approved testing laboratory shall provide in-place density tests at various depths throughout the trench backfill. In-place density tests shall be taken every 200 feet of trench section (mainline and service laterals) unless otherwise directed by the Water System Engineer. A copy of all in-place density tests shall be delivered to the Water System Department and the Water System Engineer for review and approval. Any portion of the trench backfill which does not meet the minimum compaction requirements of this section, shall be removed, recompacted and retested at the cost of the contractor until passing tests are obtained.

The material shall be placed at a moisture content such that after compaction the required relative densities will be produced; also, the material shall be placed in lifts which, prior to compaction, shall not exceed two feet (10" maximum lifts in the pipe bedding section) or as recommended by the project soils engineer. Prior to compaction, each layer shall be evenly spread and moistened, if required, as approved by the project soils engineer.

Approval of equipment, thickness of layers, moisture content, and compactive effort shall not be deemed to relieve the Contractor of the responsibility for attaining the specified minimum relative densities. The Contractor, in planning his work, shall allow sufficient time to make tests for relative densities for the approval of the Water System Engineer.

3.9 **IMPORTED BACKFILL MATERIAL:** In the event the native excavated materials appear to be very difficult to compact or are unacceptable as backfill in the opinion of the Water System Engineer, the Contractor shall furnish and install imported granular material. This granular material shall pass a 3 inch square sieve and shall not contain more than 15% of material passing a 200 mesh sieve, and shall be free from sod, vegetation, and other organic or deleterious materials.

# SECTION 4
# CULINARY WATER SYSTEM

## PART 1 GENERAL

### 4.1.01 WORK INCLUDED

A. Inspection

B. Preparation

C. Water pipe installation

D. Valve and fitting installation

E. Thrust block installation

E. Corrosion protection

F. Field quality control

H. Combination Air/Vacuum Valves

I. Inspections

J. General

1. The work to be done consists of furnishing all necessary labor, materials and equipment to provide complete installation and testing of water system facilities. Modifications to existing facilities shall conform to the Water System specifications.

2. The construction of water mains shall include: excavation, backfill and compaction, construction of concrete structures, anchors, thrust blocks, supports, encasements; furnishing, installing, flushing, testing and disinfecting water pipelines, fittings, valves, blow offs, air valves, services, fire hydrants, and all appurtenances; removal and restoration of existing improvements and all work in accordance with the project plans and specifications.

K. Unacceptable Work

1. Unacceptable work as determined by the Water System whether the result of poor workmanship, use of defective materials, damage through carelessness or any other cause, found to exist prior to the final acceptance of the work, shall be removed immediately and replaced in an acceptable manner at the contractor's expense.

### 4.1.02 RELATED WORK

A. Excavation and Backfill for Pipelines – See Section 3 of the Water System Standard Specifications.

B. Disinfection of Water Distribution Systems – See Section 5 of the Water System Standard Specifications.

**4.1.03 QUALITY ASSURANCE**

A. Comply with federal, state, and local codes and regulations. Underground piping pressure testing shall be witnessed by the Water System Engineer or a designated Water System representative.

B. Pipe, valve, and appurtenance materials and workmanship shall be in accordance with AWWA Standards or other standards as specified herein.

**4.1.04 REFERENCES**

A. American Water Works Association (AWWA)

1. C104, “Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water”

2. C105, "Polyethylene Encasement for Gray and Ductile Cast-Iron Piping for Water and Other Liquids".

3. C110, “Ductile-Iron and Gray-Iron Fittings for Water”.

4. C111, "Rubber-Gasket Joints for Ductile-Iron and Gray-iron pressure Pipe and Fittings".

5. C151, "Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids".

6. C504, "Rubber-Seated Butterfly Valves".

7. C509, "Resilient-Seated Gate Valves for Water and Sewer Systems".

8. C600, "Installation of Gray and Ductile Cast-Iron Water Mains and Appurtenances".

B. American Society for Testing and Materials (ASTM):

1. A-126: For valve bodies.

These above-mentioned references, or the most current version, apply to all work within this section.

**4.1.05 SUBMITTALS**

A. Submit manufacturer's specifications for all products to the Water System for approval.

### 4.1.06 DELIVERY, STORAGE AND HANDLING

A. Load and unload pipe, fittings valves, and accessories by lifting with hoists or skidding so as to avoid shock or damage. Do not skid or roll pipe on skid ways against pipe already on the ground.

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

C. At times when pipe laying is not in progress, the open ends of the pipe shall be closed by a watertight plug or other means approved by the Water System.

## PART 2 PRODUCTS

All material that may come in contact with the culinary water supply shall conform to NSF/ANSI 61 standards.

### 4.2.01 POLYVINYL CHLORIDE (PVC) PRESSURE PIPE

A. Buried Applications

1. Pipe Diameter 4"-12": Standard ANSI/AWWA - C900 PVC Pipe, DR-14
2. Pipe Diameter 14" - 24": Standard ANSI/AWWA - C905 PVC Pipe, DR-14
3. National Sanitation Foundation: NSF Standard 61
4. Locator Wire: AWG THHN 12 ga. Solid Copper plastic coated wire
5. Locator Tape: Place 2” wide locator tape 24” above PVC Pipe
6. Joints:
   a. Bell and spigot with flexible elastomeric seals, ASTM D 3139. Use non-toxic lubricant.
   b. Solvent weld, ASTM D 2564.
7. Pipe color: Blue. Color shall be uniform throughout material.

### 4.2.02 DUCTILE IRON PIPE

A. Buried Applications

1. Standard: AWWA C600.
2. Pressure Rating (class) - Pipe Diameters 4" to 12" shall be thickness Class 51, Pipe Diameters 14" and larger shall be pressure Class 250 p.s.i.
3. Cement lined and bituminous coated in accordance with AWWA C104.
4. Rubber gasketed slip-on pipe joints in accordance with AWWA C111.

5. Class 250 psi mechanical joint fittings in accordance with AWWA C110.

6. Standard: NSF 61 - Drinking Water System Components - Health Effects.

B. Above Ground Applications

1. Same as below ground except joints and fittings to be flanged in accordance with AWWA C115.

2. Gaskets to be full faced, 1/16th inch thick rubber.

**4.2.03 ACCESSORIES**

A. Nuts and Bolts as required (includes food grade grease).

B. Gaskets to be 1/16th inch full face rubber.

C. 8 mil. polyethylene wrap in accordance with AWWA C105.

**4.2.04 CORROSION PROTECTION**

A. Bolts: Apply food grade grease to all exposed surfaces of bolts and to all bolt threads after installation of piping, fittings, valves, and couplings.

B. Encase all buried ductile iron valves, fittings, connections and specialties in minimum 8 mil. polyethylene sheets in accordance with AWWA C105. Duct tape shall be used to secure polyethylene sheets to the pipe.

C. Encase buried ductile iron pipe in minimum 8 mil. polyethylene sheets in accordance with AWWA C105 in selected areas and soil types which required corrosion protection as approved and directed by the Water System Engineer.

**4.2.05 VALVES**

A. Gate valves (10" and smaller) shall be Mueller Series 2300:

1. Cast Iron Body, Bronze Mounted: Furnish resilient-seated gate valves 3 inches through 10 inches that conform to the requirements of AWWA C509-01, non-rising stem design with "O" ring seals.

2. Operating Direction: Open counterclockwise.

3. Buried Valves: Flanged, mechanical joint, restrained joint or as indicated.

B. Tapping valves and sleeves:

1. Tapping valves shall have large diameter seat rings to permit entry of tapping machine cutters. Inlet shall be flanged. Outlet shall suit branch piping and shall include the required flange for tapping machine adapter connection. In other

details, tapping valves shall conform to the requirements outlined for gate valves in Paragraph 13.2.06 A.

2. Tapping sleeves shall be suitable for assembly around the existing main. Body shall be high strength ribbed construction. End gaskets shall be sized to suit the existing main, and the seals between the pipe and the gaskets shall be formed around the perimeter of the pipe.

3. Tapping valves and sleeves shall be split cast iron or stainless steel fully gasketed.

C. Butterfly valves (12" and Larger) shall be Mueller Lineseal III:

1. Shall comply with the requirements of AWWA C504, Class 150 B.

2. Valve bodies shall be cast in conforming to ASTM A126, Class B. Ends shall be flanged unless otherwise specified.

3. Valve discs shall be streamlined and shall have a continuous 360 sealing surface of stainless steel, ASTM A276, type 304.

4. Valve shafts shall be stainless steel ASTM A276, type 304, of stub construction with at least 1-1/2 shaft diameter engagement into the disc and shall be fastened to the disc with upset pins.

5. Valve seats shall be of Buna N material bonded to the valve body.

6. Valve bearings shall be self-lubricating and non-corrosive and shall have a significant difference in hardness from the valve shaft.

7. Valve actuators shall be designed as an integral part of the valve and shall meet all the requirements of AWWA C504. All actuators shall be hermetically sealed and permanently lubricated with no exposed moving parts. All manual actuators will meet the requirements of AWWA C504 for nut input.

**4.2.06 VALVE BOXES**

A. Shall be suitable for HS-20 traffic loading.

B. Shall be furnished and installed over each line valve and over each auxiliary hydrant valve. All buried valves shall be installed complete with a Tyler 564A slip valve box or approved equivalent. Valves over 5' in depth shall have a valve nut extension stem installed.

**4.2.07 FITTINGS**

A. Mechanical joint:

1. Mechanical joint fittings shall be cast iron class 250 and shall conform to AWWA C110 and C111. Mechanical joint fittings shall be coated with a petroleum asphaltic coating 1 mil thick.

B. Flanged fittings:

1. Flanged fittings shall conform to AWWA C110 and C111 Cast Iron Fittings. Flanges shall be faced and drilled and shall be Class 250. Flanged fittings shall be coated with a petroleum asphaltic coating 1 mil thick.

### 4.2.08 COMBINATION AIR/VACUUM RELIEF VALVES (See Standard Details)

A. Combination air/vacuum relief valves shall be ”APCO” model 144 or equivalent as specified or as approved by the Water System.

B. Combination air/vacuum relief valve locations and vent piping shall be approved by the water system operator.

C. Combination air/vacuum relief valves shall be housed in a 5-foot diameter precast concrete manhole section with cast iron ring and cover unless otherwise specified.

D. Vent piping shall be galvanized steel and shall have an open air protected discharge terminal as approved for drinking water systems. The location of the discharge terminal shall be determined by the Water System.

## PART 3 EXECUTION

### 4.3.01 INSPECTION

A. All pipe fittings, valves and other appurtenances shall be examined by Contractor carefully for damage and other defects immediately before installation.

B. Defective materials shall be marked and held for inspection by the Water System Engineer, who may prescribe corrective repairs or reject the materials.

C. Prior to installation, valves shall be inspected for direction of opening, freedom of operation, tightness of pressure-containing bolting, cleanliness of valve ports and seating surfaces, handling damage, and cracks. Defective valves shall be corrected or held for inspection by the Water System Engineer.

### 4.3.02 PREPARATION

A. Furnish temporary support, adequate protection, and maintenance of all underground and surface structures, drains, sewers, and other obstructions encountered in the progress of the work.

B. The trench bottom and pipe bedding surface shall be prepared in accordance with the approved plans, the excavation and backfill specifications in the Water System Standards prior to pipe installation.

C. All lumps, blisters, and excess coating shall be removed from the socket and plain ends of each pipe, and the outside of the plain end and the inside of the bell shall be wiped clean

and dry and be free from dirt, sand, grit, or any foreign material before the pipe is laid. Bevel and file plain end of pipe to prevent gasket damage during joint assembly.

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

### 4.3.03 WATER PIPE INSTALLATION

A. The water pipe shall be laid and maintained to lines and grades established by the drawings and specifications with fittings and valves at the required locations unless otherwise approved by the Water System. Unless otherwise shown, all water lines shall have 4.0' minimum cover to final finish grade. All main lines are to be located 10' off the street centerline as shown on Water System approved drawings unless otherwise specified. All valves and fire hydrants are to be installed as noted on the approved plans.

B. When crossing existing pipelines or other structures, alignment and grade shall be adjusted as necessary, with the approval of the Water System Engineer to provide clearance as required by federal, state, or local regulations or as deemed necessary by The Water System to prevent future damage or contamination of either structure.

C. Lay all water lines on a continuous grade to avoid high points except as shown on the plans.

D. Prevent foreign material from entering the pipe while it is being placed in the trench. During laying operations, no debris, tools, clothing, or other materials shall be placed in the pipe. If the pipe-laying crew cannot put the pipe into the trench and in place without getting earth into it, the Engineer may require that, before lowering the pipe into the trench, a heavy, tightly woven canvas bag of suitable size shall be placed over each end and left there until the connection is to be made to the adjacent pipe.

E. As each length of pipe is placed in the trench, the joint shall be assembled in accordance with manufacturer's recommendations.

F. The pipe shall be brought to correct line and grade and shall be secured in place with approved backfill material in accordance with the Water System Standards.

G. Wherever it is necessary to deflect pipe from a straight line, either in the vertical or horizontal plane, to avoid obstructions or plumb stems or where long-radius curves are permitted, the amount of deflection allowed shall not exceed that recommended by pipe manufacturer and shall be approved by the Water System Engineer.

H. At times when pipe laying is not in progress, the open ends of pipe shall be closed by a watertight plug or other means approved by The Water System. When practical, the plug shall remain in place until the trench is pumped completely dry. Care must be taken to prevent pipe flotation should the trench fill with water.

I. Cutting pipe for the insertion of valves, fittings, or closure pieces shall be done in a neat, workmanlike manner without creating damage to the pipe or lining.

J. Cut ends and rough edges shall be ground smooth. For push-on joint connections, the cut end shall be beveled.

K. Whenever possible, all tie-ins will be made dry and not on a day proceeding a weekend or holiday. The Water System shall turn off the water upon 48 hours minimum advance notice by the contractor. It shall be the contractor's responsibility to advise all affected water users of the interrupted service a minimum of 24 hours prior to any service interruption. In large areas where there is heavy use, where shutting down the line is not feasible in the opinion of the Water System Engineer, the contractor shall be required to tie onto the main by using a wet tap. Mega-lugs are required in addition to thrust blocking on all tie-ins.

L. All dead ends shall be plugged complete with a 2" blow-off assembly (see Standard Details).

**4.3.04 VALVE AND FITTING INSTALLATION**

A. Valves shall be as located on The Water System Standard Details.

B. Valve-operating stems shall be oriented in a manner to allow proper operation.

C. A valve box shall be provided for every valve that has no gearing or operating mechanism or in which the gearing or operating mechanism is fully protected with a gear case. The valve box shall not transmit shock or stress to the valve and shall be centered over the operating nut of the valve, with the box cover flush with the surface of the finished area or such other level as may be directed by the owner. In all areas, a concrete collar around the valve box is required.

D. In no case shall valves be used to bring misaligned pipe into alignment during installation. Pipe shall be supported in such a manner as to prevent stress on the valve.

**4.3.05 THRUST BLOCK INSTALLATION**

A. Thrust blocks shall be provided at reducers, valves, tees, plugs, and caps, and at bends deflecting 22-1/2 degrees or more. 11-1/4 degree pipe bends shall be installed with approved ductile iron retainer glands.

B. Thrust block 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. Concrete shall not be located within 1-1/2" of the joints and bolts.

C. Concrete for thrust blocks shall have a compressive strength of not less than 2500 psi in 28 days.

D. Care shall be taken to not pour concrete around bolts.

E. Refer to Standard Details for thrust block details.

### 4.3.06 CORROSION PROTECTION

A. Bolts: Apply food grade grease to all exposed surfaces of bolts and to all bolt threads after installation of piping, fittings, valves, and couplings.

B. Encase all buried ductile iron valves, fittings, connections, and specialties in minimum 8 mil. polyethylene sheets in accordance with AWWA C105.

C. In areas where corrosive soils may be present, all buried ductile iron pipe is to be poly-wrapped in accordance with AWWA C105. The Water System Engineer will designate areas where an appropriate soils analysis is required to determine soil characteristics. Contractor shall bare the expense for soils analysis.

### 4.3.07 SERVICE LATERALS

A. The contractor shall be responsible to have sufficient elevation controls at the construction site to set water meter boxes at the Water System approved finish grades.

B. Corporation stops shall be tapped at 45° degree angles unless approved otherwise by the Water System Engineer. The installer should firmly compact dirt around and under the corporation stop and copper loop.

C. Type K soft drawn copper shall be connected to the top of the water main at a 45° angle by using a brass nut and a compression fitting on the end of the copper. All tubing shall be cut straight.

D. A small loop (goose neck) of excess copper must be put in the copper tubing to accommodate for settlement that may occur (see Standard Details).

E. All laterals must be of one continuous copper tube between the corp stop and the meter box. No joints or copper to copper connectors will be allowed.

F. All laterals shall have a minimum of 48" cover from top of copper tubing to finished grade.

G. All yokes shall be 18" Mueller H-1434-2W-01018 or approved equivalent and are to be connected to the service line by use of Mueller compression fittings or equivalent.

H. From the top of the lid (cast iron) to shut off valve on the yoke, there must be a distance of not less than 18" or more than 24". No meter will be set if this or any other specification is not met.

I. All meter boxes shall be centered squarely over the yoke to provide access to the connection nuts on the bottom of the yoke. Meter box interior shall be kept clear of dirt so that connecting nuts are visible.

J. All meter boxes will be installed so the lid of the meter box will be level with the adjacent grade after any settlement has occurred.

K. See Standard Details for typical installation detail.

L. Precautions should be used to prevent any foreign materials from entering the pipe. Service lines shall be temporarily capped on the end when stubbed into the property. Contractor will make every effort to ensure that no kinks or restrictions occur in the copper service.

The Water System may require the compression fitting on the cold side of the yoke to be tested by inserting a jumper in between the yoke. Jumper shall be complete with gaskets and will be installed and ready for inspection prior to calling the Water System inspector.

M. Copper laterals may, at the discretion of the Water System Engineer, be required to be bedded in sand. If sand bedding is required, a minimum of 6" below and 6" above the pipe shall be placed.

**4.3.08 FIELD QUALITY CONTROL**

A. Temporary connections for pressure testing shall be made by the Contractor at his expense and removed by him after the satisfactory completion of the testing work.

B. Pressure Test:

1. After completion of the installation of the system, (including water mains and all service laterals) or any reasonable length thereof, prior to backfilling and after thorough flushing of the portion to be tested, pressure tests shall be made. The system to be tested shall be subjected to a hydrostatic pressure of 225 pounds per square inch, following AWWA C600 procedures, unless otherwise noted on the drawings, for a period of not less than 2 hours duration. The test pressure shall not vary by more than ±5 psi for the duration of the test. Test pressure shall be maintained within this tolerance by adding makeup water through the pressure test pump into the pipeline. The amount of makeup water added shall be accurately measured by suitable methods and shall not exceed the applicable testing allowance as specified in the following table.

**Hydrostatic testing allowance per 1,000 ft of pipeline – gph ***

| Avg. Test pressure psi | Nominal Pipe Diameter – in. | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **4** | **6** | **8** | **10** | **12** | **14** | **16** | **18** | **20** | **24** | **30** | **36** |
| 225 | 0.41 | 0.61 | 0.81 | 1.01 | 1.22 | 1.42 | 1.62 | 1.82 | 2.03 | 2.43 | 3.04 | 3.65 |

* If the pipeline under test contains sections of various diameters, the testing allowance will be the sum of the testing allowance for each size. (This table adapted from AWWA Standards).

2. The portion to be tested shall be filled with water slowly and the specified test pressure shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Water System Engineer. The Contractor shall make the temporary connection for pressure testing.

3. Before applying the specified test pressure, air shall be expelled completely from the pipeline section under test. If permanent air vents are not located at all high

points, corporation cocks shall be installed at these points to expel any air as the line is filled with water. Use of corporation cocks above rated pressure must be at the risk of the user and authorized specifically by the manufacturer. Following removal of any air, the corporation cocks shall be closed and the test pressure applied. At the conclusion of the pressure test, the corporation cocks shall be removed and plugged by the Contractor with a brass plug.

4. The pipeline shall be allowed to stabilize at the test pressure before conducting the hydrostatic test. This may require several cycles of pressurizing and bleeding trapped air prior to beginning the test.

5. All exposed pipe, fittings, valves, hydrants, and joints shall be examined carefully during the test. Any damage or defective pipe, fittings, valves, or hydrants that are discovered following the pressure test shall be repaired or replaced with sound material and the test shall be repeated until it is satisfactory to the Water System Engineer, at no cost to the Owner.

6. Acceptance of installation shall be determined on the basis of allowable leakage. If any test of pipe laid discloses leakage greater than that specified above, the contractor shall, at his own expense, locate and repair the defective material until the leakage is within the specified allowance.

7. All visible leaks, other than a minor amount of sweating, shall require immediate stoppage of the test and tightening of the joints so that, when pressure is again put on the system, there will be no leakage.

C. Disinfection of Water Distribution Systems:

1. Refer to Section 5 of The Water System Standards.

### 4.3.13 CROSS CONNECTION CONTROL AND BACKFLOW PREVENTION

A. It shall be unlawful at any place supplied with water from the water distribution system to do any of the following:

1. To install after written notification from the Water System Operator or use any physical connection or arrangement of piping or fixtures which may allow any fluid or substance not suitable for human consumption to come in contact with potable water in the Water Distribution System.

2. To install any connection, arrangement, or fixtures without using a backflow prevention device or assembly designed to prevent a violation of Title 309-550-9 of the State of Utah Administrative Rules for Public Drinking Water Systems. Any such device or assembly must be approved for installation by the Water System Operator with respect to each application.

3. To install any backflow prevention device or assembly which is not installed as required in the Utah Plumbing Code.

B. Backflow prevention devices or assemblies required by this section shall be tested not less than once each year by a technician certified by the Safe Drinking Water Committee of the State of Utah. Test results shall be furnished to the Water System Operator.

**4.3.14 COMBINATION AIR/VACUUM RELIEF VALVE INSTALLATION**

A. Combination air/vacuum relief valves shall be provided to automatically exhaust large quantities of air during the filling of the pipeline and allow air to re-enter during the draining or when negative pressure occurs. All air relief valves shall comply with Title 309-550-6(6) of the State of Utah Administrative Rules for Public Drinking Water Systems

B. Combination air/vacuum relief valves shall be installed directly to the main line using an approved double strap service saddle. An isolation valve shall be installed between the air/vacuum relief valve and saddle for servicing purposes.

C. A manhole cone section with a cast iron ring and cover raised to grade with concrete collar (in all areas) shall provide access to the air/vacuum relief valve. The main line and the area around the air/vacuum relief valve shall be over-excavated 12-inches and backfilled with clean gravel for a drainage sump at the bottom of the manhole section.

D. Discharge from the valve shall be piped underground directly to the above ground vent.

**4.3.15 INSPECTIONS:** All construction shall be subject to inspection by authorized Water System personnel or their representatives, state and county health departments and their representatives.

**4.3.16 WATER QUALITY:** All materials that may come into contact with drinking water, including pipes, gaskets, lubricants, and O-rings, shall be ANSI-certified.

The use of asbestos cement pipe shall not be allowed. Pipes and fittings installed after January 4, 2014 shall be lead free in accordance with Section 1417 of the Federal Safe Drinking Water Act. They shall be certified as meeting ANSI/NSF 372 or Annex G of ANSI/NSF 61.

Only materials that have been used previously for conveying drinking water may be reused. Used materials shall meet the above standards, be thoroughly cleaned, and be restored to their original condition.

Hydrant drains shall not be connected to, or located within, 10 feet of sanitary sewers. Where possible, hydrant drains shall not be located within 10 feet of storm drains.

# SECTION 5
# DISINFECTION OF WATER DISTRIBUTION SYSTEMS

## PART 1 GENERAL

All new and repaired water mains or appurtenances shall be disinfected in accordance with AWWA Standard C651. The chlorine solution shall be flushed from the water main with potable water prior to the main being placed in use.

### 5.1.01 WORK INCLUDED

A. Flushing of water distribution system and supply lines

1. Chlorine disinfection

2. Final flushing

### 5.1.02 QUALITY ASSURANCE

A. All disinfection and testing procedures shall be in accordance with applicable Federal, State, and local standards, and in accordance with applicable provisions of AWWA C651.

### 5.1.03 REFERENCES

A. American Water Works Association (AWWA).

1. C651, “Disinfecting Water Mains”.

2. B300, “Hypochlorite”.

3. B301, “Liquid Chlorine”.

B. "Standard Methods for Examination of Water and Wastewater", American Public Health Association, AWWA, and Water Pollution Control Federation.

C. "Utah Administrative Code" Title R309-550-8(10).

### 5.1.04 SUBMITTALS

A. Results of chlorine residual tests.

B. Results of bacteriological quality tests.

## PART 2 PRODUCTS

### 5.2.01 CHLORINE

A. Sodium Hypochlorite:

1. Shall be in accordance with AWWA B300.

2. Shall be stored as recommended by manufacturer.

B. Calcium Hypochlorite:

1. Shall be in accordance with AWWA B300, “Hypochlorites”.

2. Shall be in granular or tablet (5 gram) form.

3. Shall be stored in a cool, dry, and dark environment or as recommended by manufacturer.

C. Liquid chlorine shall conform to AWWA B301.

## PART 3 EXECUTION

### 5.3.01 PREPARATION

A. Notify the Water System at least 72 hours prior to any flushing or disinfecting.

B. Contractor shall install temporary connections for flushing water lines after disinfection. After the satisfactory completion of the flushing work, the Contractor shall remove and plug the temporary connection.

### 5.3.02 TABLET METHOD

A. Tablet Method PG AWWA C651, Section 4.4.2

B. The tablet method consists of placing calcium hypochlorite granules or tablets in the water main as it is being installed and then filling the main with potable water when installation is completed.

C. This method may be used only if the pipes and appurtenances are kept clean and dry during construction.

D. Placing of calcium hypochlorite granules. During construction, calcium hypochlorite granules shall be placed at the upstream end of the first section of pipe, at the upstream end of each branch main, and at 500-ft intervals. The quantity of granules shall be as shown in Table 1.

Warning: This procedure must not be used on solvent-welded plastic or on screwed-joint steel pipe because of the danger of fire or explosion from the reaction of the joint compounds with the calcium hypochlorite.

**Table 1 Ounces of calcium hypochlorite granules to be placed at beginning of main and at each 500-ft interval**

| Pipe Diameter *(d) in.* | Calcium Hypochlorite Granules *oz* |
|---|---|
| 4 | 1.7 |
| 6 | 3.8 |
| 8 | 6.7 |
| 10 | 10.5 |
| 12 | 15.1 |
| 14 and larger | $D^2$ x 15.1 |

Where D is the inside pipe diameter in feet *D* = d/12
(This table adapted from AWWA Standards).

E. Placing of calcium hypochlorite tablets: During construction, 5 gram calcium hypochlorite tablets shall be placed in each section of pipe. Also one such tablet shall be placed in each hydrant, hydrant branch, and other appurtenances. The number of 5 gram tablets required for each pipe section shall be 0.0012 d2 L rounded to the next higher integer, where d is the inside pipe diameter, in inches, and L is the length of the pipe section, in feet.

Table 2 shows the number of tablets required for commonly used sizes of pipe. The tablets shall be attached by a food-grade adhesive. There shall be adhesive only on the broad side of the tablet attached to the surface of the pipe. Attach all the tablets inside and at the top of the main, with approximately equal numbers of tablets at each end of a given pipe length. If the tablets are attached before the pipe section is placed in the trench, their position shall be marked on the section to indicate that the pipe has been installed with the tablets at the top.

**Table 2 Number of 5-g calcium hypochlorite tablets required for dose of 25 mg/L***

| Pipe Diameter | Length of Pipe Section, *(ft)* | | | | |
|---|---|---|---|---|---|
| | 13 | 18 | 20 | 30 | 40 |
| *in.* | Number of 5-g Calcium Hypochlorite Tablets | | | | |
| 4 | 1 | 1 | 1 | 1 | 1 |
| 6 | 1 | 1 | 1 | 2 | 2 |
| 8 | 1 | 2 | 2 | 3 | 4 |
| 10 | 2 | 3 | 3 | 4 | 5 |
| 12 | 3 | 4 | 4 | 6 | 7 |
| 16 | 4 | 6 | 7 | 10 | 13 |

* Based on 3.25 g available chlorine per tablet (65% available chlorine per 5 gram tablet); any portion of tablet rounded to next higher number. Dose of 25 mg/l required.

(This table adapted from AWWA Standards).

F. When installation has been completed, the main shall be filled with water at a rate to ensure that water within the main will flow at a velocity no greater than 1 ft/s. Precautions shall be taken to assure that air pockets are eliminated. This water shall remain in the pipe for at least 24 hours. If the water temperature is less than 41° F, the water shall remain in the pipe for at least 48 hours. Valves shall be positioned so that the strong chlorine solution in the treated main will not flow into water mains in active service.

G. Chlorination of the completed culinary water distribution system shall be provided with a disinfection dosage of 25 mg/l. The dosage shall be of sufficient strength to provide a minimum of 10 ppm residual after a 24-hour contact in the pipeline.

H. If directed by the Water System, the completed piping system, or specified sections, shall be "super chlorinated." "Super chlorination" shall provide dosage of 100 mg/l of chlorine for a period of at least 3 hours. The chlorine residual shall be a minimum of 50 mg/l after the 3-hour contact time.

### 5.3.03 ALTERNATIVE METHODS

A. Alternative disinfection methods:

1. Continuous-Feed Method PG AWWA C651, Section 4.1.

2. Slug Method PG AWWA C651, Section 4.4.4

### 5.3.04 FINAL FLUSHING

A. Clearing the main of heavily chlorinated water:

1. After the applicable retention period, heavily chlorinated water should not remain in prolonged contact with pipe.

2. In order to prevent damage to the pipe lining or to prevent corrosion damage to the pipe itself, the heavily chlorinated water shall be flushed from the main, fittings, valves, and branches until chlorine measurements show that the concentration in the water leaving the main is no higher than that generally prevailing the distribution system or that is acceptable for domestic use.

B. Disposing of heavily chlorinated water:

1. The environment to which the chlorinated water is to be discharged shall be inspected. If there is any possibility that the chlorinated discharge will cause damage to the environment, a neutralizing chemical shall be applied to the water to be wasted to thoroughly neutralize the residual chlorine (see Appendix C of the AWWA standard C651).

2. Where necessary, federal, state, local, or provincial regulatory agencies should be contacted to determine special provisions for the disposal of heavily chlorinated water.

3. Contractor to comply with Federal Clean Water Act. If necessary, secure permission from Utah Division of Water Quality or the local County Health Department for disposal of heavily chlorinated water.

### 5.3.05 BACTERIOLOGICAL SAMPLING AND TESTING

A. Samples for bacteriologic analysis shall be collected in sterile bottles treated with sodium thiosulfate, as required by Standard Methods for the Examination of Water and Wastewater. A minimum of two (2) consecutive samples must be taken at least 24 hours apart. A sampling tap shall be provided by the Contractor. The Water System shall be responsible for sampling and bacteriologic analysis by a certified testing laboratory. Contractor to give minimum 48 hours' notice to the Water System prior to required sampling.

B. Water line:

1. After final flushing and before the new water main is connected to the distribution system, two consecutive sets of acceptable samples, taken at least 24 hours apart, shall be collected from the new main. (NOTE: The pipe, the water loaded into the pipe, and any debris exert a chlorine demand that can interfere with disinfection.)

2. At least one set of samples shall be collected from every 1,200 ft of the new water main, plus one set from the end of the line and at least one set from each branch. Additional samples may be taken at the system operator's direction to test for turbidity or other forms of contamination that he may deem necessary.

3. Samples shall be tested for bacteriological (chemical and physical) quality in accordance with Standard Methods for the Examination of Water and Wastewater; and shall show the absence of coliform organisms; and, if required, the presence of a chlorine residual. Turbidity, pH, and a standard heterotrophic plate count (HPC) test may be required at the option of the owner because new material does not typically contain coliforms but does typically contain HPC bacteria.

4. If sample results from the lab indicate a measured HPC greater than 500 colony-forming units (cfu) per mL, flushing should be resumed and another coliform and HPC set of samples should be taken until no coliforms are present and the HPC is less than 500 cfu/mL.

5. If the initial disinfection fails to produce satisfactory bacteriological results or if other water quality is affected, the new main may be reflushed and shall be resampled. If check samples also fail to produce acceptable results, the main shall be re-chlorinated by the continuous-feed or slug method of chlorination until satisfactory results are obtained – that being two consecutive sets of acceptable samples taken 24 hours apart.

6. High velocities in the existing system, resulting from flushing the new main, may disturb sediment that has accumulated in the existing mains. When check samples are taken, it is advisable to sample water entering the new main to determine the source of turbidity.

7. When the samples are satisfactory, the water line may be placed in service upon receiving notification from the Water System Engineer to do so.

### 5.3.06 DISINFECTION PROCEDURES WHEN CUTTING INTO OR REPAIRING EXISTING MAINS

A. The following procedures apply primarily when mains are wholly or partially dewatered. After the appropriate procedures have been completed, the existing main may be returned to service prior to the completion of bacteriological testing in order to minimize the time customers are without water. Leaks or breaks that are repaired with clamping devices while the mains remain full of pressurized water may present little danger of contamination and therefore may not require disinfection.

1. Trench treatment: When an existing main is opened, either by accident or by design, the excavation will likely be wet and may be badly contaminated from

nearby sewers. Liberal quantities of hypochlorite applied to open trench areas will lessen the danger from this pollution. Tablets have the advantage in this situation, because they dissolve slowly and continue to release hypochlorite as water is pumped from the excavation.

2. Swabbing with hypochlorite solution: The interiors of pipe and fittings (particularly couplings and sleeves) used in making the repair shall be swabbed or sprayed with a 1 percent hypochlorite solution before they are installed.

3. Flushing: Thorough flushing is the most practical means of removing contamination introduced during repairs. If valve and hydrant locations permit, flushing toward the work location from both directions is recommended. Flushing shall be started as soon as the repairs are completed and shall be continued until discolored water is eliminated.

### 5.3.07 SPECIAL PROCEDURE FOR CAULKED TAPPING SLEEVES

A. Before a tapping sleeve is installed, the exterior of the main to be tapped shall be thoroughly cleaned, and the interior surface of the sleeve shall be lightly dusted with calcium hypochlorite powder, at a rate of 100 mg per square foot.

Tapping sleeves are used to avoid shutting down the main. After the tap is made, it is impossible to disinfect the annulus without shutting down the main and removing the sleeve. The space between the tapping sleeve and the tapped pipe is approximately ½ in., so that as little as 100 mg/ft2 of calcium hypochlorite powder will provide a chlorine concentration of more than 50 mg/L.

## SECTION 6
## WATER STOP

**6.1** **WATER STOP:** Water stop for the reservoir shall be Greenstreak, No. 732 (6") or approved equal. Rubber Water Stop shall be equal in quality, but not restricted to molded rubber water stop as manufactured by Greenstreak Water Seal, Inc. or equivalent.

## SECTION 7
## CRYSTALLINE CONCRETE WATERPROOFING: XYPEX ADMIX C-500

**PART 1 GENERAL**

**7.1.01 SUMMARY:** This section covers the requirements for waterproofing of concrete structures for below grade walls and slabs, decks and water or chemical storage areas that require enhanced chemical resistance.

**7.1.02 REFERENCES**

A. American Society for Testing and Materials (ASTM)

B. Army Corp. of Engineers (CRD)

C. American Concrete Institute Reference 308

**7.1.03 SYSTEM DESCRIPTION**

A. The concrete waterproofing admixture shall be of the cementitious crystalline type that chemically controls and permanently fixes a non-soluble crystalline structure throughout the capillary voids of the concrete.

B. The design shall include the use of the crystalline waterproofing repair materials that generate a non-soluble crystalline formation in the concrete.

**7.1.04 STORAGE, DELIVERY AND HANDLING:** Store manufacturer's sealed and labeled material containers in dry, protected environment off the ground.

**7.1.05 SCHEDULING:** Coordinate with Section 2 Portland Cement Concrete.

**7.1.06 QUALITY ASSURANCE**

A. Manufacturer: Provide products of manufacturer with no less than 10 years' experience in manufacturing the cementitious crystalline waterproofing materials for the required work. Manufacturer's that cannot provide the performance data specified herein will not be considered for the project.

B. Applicator: A factory certified representative is to be present during the time of batching at the batch plant to ensure quality control and proper mix ratios.

**7.1.07 WARRANTY**: Manufacturer's warranty: Manufacturer shall provide standard product warranty executed by authorized company official. Term of warranty shall be 10 years from Date of Substantial completion.

## PART 2 PRODUCTS

### 7.2.01 MANUFACTURERS

A. Xypex Chemical Corporation, Richmond, B.C., Canada.

B. Equivalent materials as approved by the engineer 10 days prior to acceptance of bids.

**7.2.02 MATERIALS:** Xypex Admix C-1000 / C-2000.

### 7.2.10 MIXES

A. For waterproofing concrete the recommended addition rate for Admix C-1000 / C-2000 is 2% by weight of cement.

B. For enhanced chemical protection, consult with the manufacturer or an authorized Xypex representative to determine appropriate addition rate.

## PART 3 APPLICATION

### 7.3.01 MATERIALS PREPARATION

A. Xypex Admix must be added to the concrete at the time of batching.

B. Blend total concrete mix using normal practices to ensure formation of homogeneous mixture.

C. For precast concrete manufacturers this usually means adding the Xypex into their pan type mixers.

D. A factory certified technician must supervise the admix at the batch plant to insure quality control and approve warranties.

### 7.3.02 APPLICATION

A. Placement of concrete shall be in accordance with the Section 2 of this specification.

B. Retardation of set may occur when using Xypex Admix. The amount of retardation will depend upon the concrete mix design and the dosage rate of the Admix. Consult with the manufacturer regarding proper dosage rate.

C. Concrete that contains Xypex Admix C-500 must be cured as per "Standard for Curing Concrete" (ACI 308).

D. Normal backfilling procedures may be used after concrete has cured for at least 7 days.

# SECTION 8
# CULINARY WATER RESERVOIRS

## 8.1 DISINFECTION OF RESERVOIRS

Reservoirs shall be disinfected following all applicable state drinking water rules including AWWA standards. See R309-545-20 of the State of Utah Administrative Rules for Public Drinking Water Systems.

Drinking water storage structures shall be disinfected before being put into service for the first time, and after being entered for cleaning, repair, or painting. The reservoir shall be cleaned of all refuse and shall then be washed with potable water prior to adding the disinfectant. AWWA Standard C652 shall be followed for reservoir disinfection, with the exception there shall be no delivery of waters used in the disinfection process to the distribution system.

Upon completion of tank chlorination, as outlined in AWWA C652, the contractor must properly dispose of residual super-chlorinated waters in the outlet pipes. Other super-chlorinated waters, which are not to be ultimately diluted and delivered into the distribution system, shall also be properly disposed. Disposal of super-chlorinated waters may be accomplished using de-chlorination equipment or other methods approved by the Water System's Operator. Chlorinated water will not be allowed to flow into any receiving waters supporting aquatic life.

Disinfection shall be accomplished by swabbing or spraying all interior surfaces with a chlorine solution containing 200 ppm of available chlorine. The surface of the reservoir must be kept wet for a minimum of 30 minutes before the structure is filled. Care must be taken to assure that inlet and outlet piping are adequately disinfected. The spray operator shall be protected with suitable protective clothing and breathing apparatus. The safety equipment shall be appropriate for the environment within the tank and shall meet all OSHA requirements.

At least two satisfactory bacteriological samples including a heterotrophic plate count of not greater than 50 must be achieved from the reservoir after the disinfection procedure has been accomplished and the reservoir has been filled with potable water. Analysis of volatile organic compounds shall also be performed with satisfactory results prior to placing the facility into service. If the samples fail, the disinfection procedure must be repeated.

## 8.2 RESERVOIR CONSTRUCTION - COATINGS, ADMIXTURES, SEALERS, ETC.

Reservoir construction shall follow the state administrative rules for drinking water systems rule 309-545. ANSI/NSF 61 certification must be followed for all materials that come in contact with drinking water including paints, coatings, concrete admixtures, concrete release agents, concrete sealers, joining and sealing materials, adhesives, caulks, gaskets, primers sealants and mechanical devices such as sensors, valves electrical wire, pumps and switches.

Concrete shall be allowed to cure according to ACI recommendations prior to filling and leak testing the reservoir. Liners and coatings shall also be allowed to cure according to manufacturer's recommendations prior to filling and leak testing the reservoir. Application of any admixture, liner, or coating shall not permit the introduction of any substance into the drinking water that exceeds the maximum contaminant level under the Safe Drinking Water Act.

## 8.3 RESERVOIR LEAK TESTING AND REPAIR

After curing is complete, the reservoir shall be filled and tested for leaks before backfilling.

A. Leak Testing Procedure: The reservoir shall be filled in eight-foot increments and allowed to sit for a period of eight hours during which time frame the reservoir is to be closely observed for possible leaks through walls and footings. As leaks are detected, they are to be repaired to the satisfaction of the Water System Engineer. Once the reservoir has been filled to the overflow elevation and no further visible leaking is detected, it shall be allowed to remain for an additional 24 hours during which time frame the reservoir will again be closely observed for possible leaks.

B. Leakage Repair: Leakage through joints, which may have resulted from bent over water-stops or honeycomb under or around water-stops may require the removal of concrete around the joints in suspected areas.

Chipped out concrete areas shall be properly dry packed with a mix of 1 part cement to 2 parts coarse sand, after coating the existing concrete surface with an approved epoxy bonding agent.

C. Acceptance: The acceptable drop in water level of covered water reservoirs shall not exceed 1/10 inch per 24 hours in the second week after the reservoir has been filled. There shall be no visible running leaks or water puddles. Any cracks, voids, honeycomb or cold joints showing or causing running leaks of water, shall be epoxy pumped by qualified operators until such cracks and voids have been completely sealed.

The reservoir shall not be backfilled until and unless the Engineer has accepted the tests.

## 8.4 TANK STANDARDS

The following standards, or current standards, shall be incorporated and adhered to:

A. AWWA Standards.
   1. C652, Disinfection of Water-Storage Facilities.
   2. D110, Wire- and Strand-Wound, Circular, Prestressed Concrete Water Tanks.
   3. D130, Geomembrane Materials for Potable Water Applications.

B. NSF International Standards.
   1. NSF 60, Drinking Water Treatment Chemicals - Health Effects.
   2. NSF 61, Drinking Water System Components - Health Effects.

C. Utah OSHA.

Applicable standards of the Utah Occupational Safety and Health Division shall be adhered to. These above-mentioned references, or the most current version, apply to all work within this section.

# SECTION 9
# WELL DRILLING

## PART 1 GENERAL

### 9.1.01 DESCRIPTION

A. This section covers drilling of the well, installation of well casing, and grouting the annular space between the borehole and well casing.

### 9.1.02 REFERENCE

A. The latest edition of the following publications form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

1. American Petroleum Institute R. P. 13-B, "Procedures for Testing Drilling Fluids."

2. American Water Works Association (AWWA) AWWA A-100 – Well.

3. Public Drinking Water Rules as found in R309 of the Utah Administrative Code.

4. Journal of American Water Works Association, Volume 45, No. 2, February 1984.

5. Administrative Rules for Water Well Drillers as found in R655 of the Utah Administrative Code.

6. American Society for Testing and Materials (ASTM)

7. American Welding Society.

## PART 2 MATERIALS

### 9.2.01 GENERAL

A. The following list of materials may not be complete and other materials may be listed in other areas of this section. Unless otherwise stated, all materials and equipment are assumed to be provided by the CONTRACTOR.

### 9.2.02 CLEANING AND DECONTAMINATION

A. Prior to setting up on hole and/or between holes, all equipment that may contact the interior of a hole, or that may contact other equipment that will enter the hole (including, but not limited to, drill rods, bits, subs, sampling equipment, and tools) shall be thoroughly steam cleaned or otherwise disinfected. Any tools, drilling equipment, or sampling equipment that will be used down-hole and that is found lying on the ground after cleaning or is otherwise deemed by the ENGINEER to be contaminated shall again be steam cleaned or otherwise disinfected prior to reuse. At the drill site, cleaned equipment shall be kept off the ground.

### 9.2.03 DRILLING FLUID

A. No use of drilling fluid is anticipated to be required on the well. If needed foam may used if agreed to by the CONTRACTOR and the OWNER or project representative. Upon OWNER's request, the CONTRACTOR shall furnish a chemical breakdown or chemical analysis of the drilling fluid proposed for use.

B. Toxic and/or dangerous substances shall not be added to the drilling fluid. No drilling fluids, chemicals, additives or conditioners that may be believed to become a food source for bacteria growth in the well or in the aquifer, including phosphates, will be allowed. If the CONTRACTOR introduces any such materials into the well, the CONTRACTOR shall immediately notify the OWNER and initiate removal of such materials at no additional cost to the OWNER. CONTRACTOR will then meet with OWNER and ENGINEER to discuss the conditions related to the violation and at that time be prepared to propose methods and procedures to thoroughly clean the well from all such materials to the satisfaction of the OWNER and ENGINEER at no additional cost to the OWNER. If CONTRACTOR cannot demonstrate to the satisfaction of the OWNER and ENGINEER that all such materials have been removed, the OWNER shall have no further obligation to pay any invoices for services performed by CONTRACTOR.

C. No lost circulation materials (LCMs) may be brought to the job site unless specifically authorized in writing by the ENGINEER or the OWNER prior to use. If LCMs are approved for use, the LCMs, acid treatment chemicals (for LCM removal), labor and other associated expenses shall be provided by the CONTRACTOR at no additional expense to the OWNER. If LCMs are approved for use, the CONTRACTOR shall submit a complete LCM program proposal including the proposed LCMs, amounts to be used, where to be used, by what method they will be applied, and the professional mud engineer that will be in charge of their use, followed by a complete acid treatment removal program including the proposed acid chemicals, amounts to be used, where to be used, by what method they will be applied, and by what method they will be removed, neutralized and disposed of. The ENGINEER will notify the CONTRACTOR in writing whether the proposal is accepted or rejected within 3 working days of receipt of the CONTRACTOR's proposal.

D. Water used by the CONTRACTOR to prepare the drilling fluid shall be composed of fresh water from a municipal supply. If municipal water is not available, the CONTRACTOR shall contact the ENGINEER to determine a suitable source with permission of the OWNER.

### 9.2.04 WELL CASING

A. All well casing shall be new. The casing shall be made of carbon steel material which conforms to the requirements of ASTM A53. The casings shall be of the diameters and minimum wall thicknesses as specified in Table 1.

**TABLE 1**

**MINIMUM WALL THICKNESS FOR STEEL WELL CASING**

| Depth | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Nominal Casing Diameter (in)** | **0 to 200 (ft)** | **200 to 300 (ft)** | **300 to 400 (ft)** | **400 to 500 (ft)** | **600 to 800 (ft)** | **800 to 1000 (ft)** | **1000 to 1500 (ft)** | **1500 to 2000 (ft)** |
| 2 | .154 | .154 | .154 | .154 | .154 | .154 | ... | ... |
| 3 | .216 | .216 | .216 | .216 | .216 | .216 | ... | ... |
| 4 | .237 | .237 | .237 | .237 | .237 | .237 | .237 | .237 |
| 5 | .250 | .250 | .250 | .250 | .250 | .250 | .250 | .250 |
| 6 | .250 | .250 | .250 | .250 | .250 | .250 | .250 | .250 |
| 8 | .250 | .250 | .250 | .250 | .250 | .250 | .250 | .250 |
| 10 | .250 | .250 | .250 | .250 | .250 | .250 | .313 | .313 |
| 12 | .250 | .250 | .250 | .250 | .250 | .250 | .313 | .313 |
| 14 | .250 | .250 | .250 | .250 | .313 | .313 | .313 | .313 |
| 16 | .250 | .250 | .313 | .313 | .313 | .313 | .375 | .375 |
| 18 | .250 | .313 | .313 | .313 | .375 | .375 | .375 | .438 |
| 20 | .250 | .313 | .313 | .313 | .375 | .375 | .375 | .438 |
| 22 | .313 | .313 | .313 | .375 | .375 | .375 | .375 | .438 |
| 24 | .313 | .313 | .375 | .375 | .375 | .438 | ... | ... |
| 30 | .313 | .375 | .375 | .438 | .438 | .500 | ... | ... |

**Note: Minimum wall thickness in inches.**

B. All casing shall bear mill markings that will identify the material as that which is specified. If necessary, the CONTRACTOR shall furnish the ENGINEER with a copy of the mill certificate for approval before delivery of the casing to the well site.

### 9.2.05 NEAT CEMENT GROUT

A. A mixture of Portland Cement Type II (ASTM C150) and not more than five (5) gallons of clean water per bag of cement (one cubic foot or 94 pounds) shall be used. A maximum of 8 percent, by weight, pozzolan (fly ash) and 2 percent, by weight, calcium chloride may be added if approved by the ENGINEER.

B. The use of special cements or other admixtures (ASTM C494) to reduce permeability, increase fluidity, and/or control time of set, and the composition of the resultant slurry must be approved by the ENGINEER.

**PART 3 EXECUTION**

**9.3.01 DRILLING OF WELL**

A. Location

1. The CONTRACTOR shall construct the well at the location indicated on the drawings and staked in the field.

B. Depth & Diameter

1. The well is to be drilled to the estimated depths and diameters as shown in the Bid Schedule. Estimated bedrock depth is 540 feet.

C. Methods

1. The CONTRACTOR shall be responsible for designing and controlling a drilling program that conforms to sampling method requirements in accordance with this section. The work shall be performed with equipment which is adequate to complete all phases of well construction. If in the opinion of the ENGINEER, the CONTRACTOR's equipment is not capable of satisfactorily performing the work provided for in these specifications, the CONTRACTOR at his own expense shall substitute equipment satisfactory to the ENGINEER.

2. The CONTRACTOR shall provide a sufficient water supply from a source approved by the OWNER and a pump or pumps to properly operate the equipment. The CONTRACTOR shall secure a supply for such quantities and quality of construction water as may be required. Costs for facilities to convey the water to the point of use shall be borne by the CONTRACTOR. The cost of the water shall be borne solely by the CONTRACTOR unless other arrangements are made with the OWNER.

3. The CONTRACTOR shall take all measures necessary to protect the borehole from caving or raveling. If the borehole becomes unstable, caves in or sloughs to the point that tools are lost, casings become stuck or it becomes impractical or impossible to complete the well in accordance with these specifications, the CONTRACTOR shall re-drill and construct a new well at no additional cost to the OWNER.

**9.3.02 DRILLER'S LOGS AND REPORTS**

The CONTACTOR shall prepare a driller's log of the production well, daily reports, and a penetration log. These shall conform to the following requirements:

A. Driller's Log:

1. During drilling the CONTRACTOR shall prepare a complete log setting forth the following where applicable:

a. The reference point for all depth measurements.

b. The depth at which each change of formation occurs.

c. The depth at which the first water was encountered.

d. The depth at which each stratum was encountered.

e. The thickness of each stratum.

f. The identification of the material of which each stratum is composed, such as:

i) Clay
ii) Sand or Silt
iii) Sand and Gravel – Indicate whether gravel is loose, tight, angular or smooth; color.
iv) Cemented formation – indicate whether grains have natural cementing material between them; e.g., silica, calcite, etc.
v) Bedrock – Indicate whether sedimentary bedrock or igneous (granite-like, basalt-like, etc.)

g. Samples will be taken every 5 feet

h. The depth at which hole diameters (bit sizes) change.

i. The depth to the static water level (SWL) and changes in SWL with hole depth.

j. Any fractures encountered beneath the water table.

k. Depth or location of any lost drilling fluid, drilling materials or tools.

l. Total depth of completed well.

m. Any and all other pertinent information for a complete and accurate log; e.g., temperature, pH, and appearance (color) of any water samples taken.

n. The depth of the surface seal, if applicable.

o. The nominal diameter of the borehole above and below casing seal.

p. The amount of cement (number of sacks) installed for the seal, if applicable.

q. The depth and description of the well casing.

r. The description (to include length, diameter, slot size, material, and manufacturer) and location of slotted casing, or number, and size and location of perforations.

s. The sealing off of water-bearing strata, if any, and the exact location thereof.

B. Penetration Rate Logs

1. A time log shall be kept showing the actual penetration time required to drill each twenty-foot section of hole. The types of bits used in each portion of the hole shall be noted in this log (i.e. drag, roller, button, or percussion type) and whether designed for soft, medium or hard formations, together with approximate weight on

the bits during the drilling of the various types of formations in the various sections of the hole.

C. Daily Driller's Report

1. A daily, detailed driller's report shall be maintained and delivered upon request to the OWNER or his representative at the well site. The report shall give a complete description of all formations encountered, number of feet drilled, number of hours on the job, shutdown due to breakdown, the water level in the well at the beginning and end of each shift, the water level at each change of formation if readily measurable with the drilling method used, feet of casing set, and such other pertinent data as requested by the OWNER or his representative.

**9.3.03 DRILLING FLUID CONTROL PROGRAM**

A. The CONTRACTOR shall be responsible for maintaining the qualities of the drilling fluid which affect 1) successful completion of well drilling and construction, 2) protection of water bearing and potential water bearing formations exposed in the borehole, and 3) the collection of representative samples of the formation materials. Drilling fluid properties including density, viscosity, filtration, solids content and water loss shall be designed, prepared, controlled and monitored by the CONTRACTOR in order to successfully suspend and remove cuttings, stabilize the borehole, cool and lubricate the drilling tools, control fluid loss, drop cuttings in the settling chamber and facilitate well construction.

B. All drilling fluids and well additives shall be NSF approved. No drilling fluids, chemicals, additives or conditioners that may be believed to become a food source for bacteria growth in the well or in the aquifer, including phosphates, will be allowed.

C. Tests shall be conducted on the drilling fluid samples whenever conditions appear to have changed or problems arise.

D. The CONTRACTOR is responsible for the removal of all drilling fluids from the well. The CONTRACTOR shall design his drilling fluids program and well development methods such that the well is developed to its maximum water yielding capacity.

**9.3.04 CLEANING UP**

A. Upon completion of work, all drilling equipment shall be removed, and all holes shall be backfilled and compacted. All drill cuttings and drilling fluid additives shall be removed from the site to the satisfaction of the ENGINEER prior to backfilling any excavations. The site shall be left level and free and clear of any material, equipment, or debris, to the satisfaction of the ENGINEER.

**9.3.05 CASING PERFORATIONS**

A. Well perforations shall be placed at the locations to be determined by the ENGINEER after the well designs are finalized based on the geophysical logs and the sieve analyses of the pilot boreholes.

### 9.3.06 JOINING CASING

A. The casing shall be joined by welding or by using threaded and coupled joints in accordance with the requirements of AWWA C206. Joining shall be completed to produce a permanent well casing that is continuous and watertight from top to bottom of the casing except for the well screen. If the casing is welded, the standards of the American Welding Society shall apply. If threaded and coupled joints are used, couplings shall be API or equivalent, made up so that when tight, all threads will be buried in the lip of the coupling.

### 9.3.07 SANITARY PROTECTION OF WELL

A. At all times during the progress of the work the CONTRACTOR shall use reasonable precautions to prevent either tampering with the well or the entrance of foreign material into it.

B. Upon completion of the work the CONTRACTOR shall cap the well using a steel plate welded onto the casing with a full bead weld.

### 9.3.08 GROUT LOCATION

A. Grout shall be installed in the annular space between the borehole and the surface conductor casing and in the annular space between the well casing and the surface conductor casing by the method specified. The annular space to be grouted shall not be less than a nominal 2 inches or as shown or specified on drawing details. The length of the surface seal shall not be less than the minimum specified in the state or locally applicable construction code, (i.e. the “State of Utah Administrative Rules for Water Well Drillers”).

B. In addition to the grouting associated with the surface conductor casing, selective grouting will be required at other locations and lengths to be determined by the ENGINEER based on information from the test and/or production hole(s).

C. The entire space to be grouted must be open and available to receive the grout at the time the grouting operation is performed. If a section of larger pipe (conductor pipe) is installed to keep the entire space open (in caving materials), this larger pipe must be removed, as the grout is installed, from the zone where the seal is required. If the conductor pipe cannot be removed, DDW approval for allowing the extra conductor pipe to remain shall be obtained by the CONTRACTOR. If DDW approval cannot be obtained, the well shall be re-drilled at a location suitable to the OWNER at no additional cost to the OWNER.

### 9.3.09 METHOD OF GROUT INSTALLATION

A. Grout material shall be placed by a positive displacement method such as pumping or forced injection by air pressure (after water or other drilling fluid has been circulated in the annular space sufficient to clear obstructions). Grout shall be injected in the annular space between the inner casing and either the outer casing or the borehole. The annular space must be a minimum of 2 inches for sand-and–cement or neat cement grout. The grout pipe shall extend from the surface to the bottom of the zone to be grouted. The grout pipe shall have a minimum inside diameter of one inch. The grout pipe may be slowly raised as the grout is placed, but the discharge end of the grout pipe must be submerged in the emplaced grout at all times until grouting is completed. The grout pipe shall be maintained full, to the surface, at all times until the completion of the grouting of the entire specified zone. In the

event of interruption in the grouting operations, the bottom of the pipe should be raised above the grout level and should not be re-submerged until all air and water have been displaced form the grout pipe and the pipe flushed clean with clear water.

B. If the depth of grout around the surface conductor casing exceeds 100 feet and/or the depth of grout around the well casing exceeds 300 feet, then the grout shall be placed in stages around the well casing and the surface conductor casing in order to not exceed the collapse strength of the casing. The required curing time for Portland Cement Type II cement is a minimum of 36 hours which shall be allowed prior to the placement of each additional stage. The maximum depth of grout per stage around the well casing is 300 feet. The maximum depth of grout per stage around the surface conductor casing is 100 feet.

C. After cement grouting is applied, work on the well shall be discontinued until the cement or concrete grout has properly set as per Division of Drinking Water inspector's recommendation.

### 9.3.10 GROUT WITNESS

A. The CONTRACTOR shall arrange to have the grouting operations properly witnessed by a representative of the State in accordance with the requirements of the Utah State Division of Drinking Water. It shall be the responsibility of the CONTRACTOR to satisfy the State requirements for this item. A certified copy of the grout witness report shall be furnished to the OWNER.

# SECTION 10
# SUBMERSIBLE WELL PUMP INSTALLATION

## PART 1 GENERAL

### 10.1.01 DESCRIPTION

A. Scope. This section covers the work necessary to furnish and install, complete, the submersible well pump and motor specified herein.

B. Submittals. Shop drawings shall be submitted and shall include descriptive information as required to fully describe the pump, controls (if required), and overall operating performance. The shop drawings shall clearly state any deviations from the specified requirements. The following shall also be furnished with the shop drawings. Performance requirements specified hereinafter shall be defined in the Hydraulic Institute Standards and ANSI/AWWA E101-88.

1. Performance data curves (adjusted for operating speed) showing head, capacity, horsepower demand, and pump efficiency over the entire operating range of the pump, from shutoff to maximum capacity. The equipment manufactured shall indicate separately the head, capacity, horsepower demand, overall efficiency, and minimum submergence required at the specified design point.

2. Equipment manufactured shall provide complete and detailed information regarding the installation of the pumps. Any installation requirements or operating conditions which the supplier or manufacturer feels to be critical to the safe and reliable operation of the pumps should be identified and described in detail.

3. All components in contact with water shall be certified lead free. Pump shall be certified to be compliant with NSF 61, Annex 6. Submittals shall include certifications.

4. Operating and Maintenance manuals and Maintenance Summary Sheets for the equipment specified herein shall be furnished to the owner.

### 10.1.02 DESIGN CRITERIA

A. General. Pumps shall be capable of continuous operation while pumping untreated groundwater

B. Operating Capacity

| | |
|---|---|
| Pump Setting Depth (top of pump) | 220 Feet Below Ground Surface |
| Capacity | 30 US GPM |
| Total Dynamic Head | 640 Feet TDH |
| Nominal Operating Speed | up to 3,600 RPM |
| Minimum Efficiency | 74% |
| Minimum Motor Horsepower | 7.5 |

| | |
|---|---|
| Motor Size | 6” Nema |
| Column Size | 2” |

The submersible pump and motor shall be capable of operating within specified parameters without permanent damage.

## PART 2 PRODUCTS

### 10.2.01 PUMP DESIGN

A. General. Pump shall include an integral check valve designed into the discharge of the pump.

Pump shall include and integral carbon graphite bearing or Nitrile Rubber to handle momentary upthrust loads. An upthrust bumper bolt in the discharge of the pump will not be acceptable. The motor thrust bearing shall absorb pump downthrust. Each impeller shall be fitted with a seal ring around its eye or skirt to prevent hydraulic loss. A filter screen shall be included as part of the suction inlet assembly. All metallic components of the pump shall be stainless steel. All elastomeric components shall be Nitrile Rubber. The pump and motor shall be of the same manufacturer.

### 10.2.02 MOTOR DESIGN

A. General. The motor shall be a squirrel cage induction motor designed for continuous underwater operation in conformance with NEMA standards. A Kingsbury type thrust bearing shall be used to carry the pump downthrust load. The bearing shall be rated for a minimum of 130% of the maximum pump down thrust load. Motor shall be filled with a water & propylene glycol solution for cooling and lubrication. No oils or grease lubrication shall be used. A flexible diaphragm shall be provided to permit expansion of internal motor fluid. The shaft seal shall be Nitrile Rubber lip seal or a Nitrile, Carbon, Carbide and/or Ceramic face seal. A mercury type shaft seal will not be acceptable.

B. The nameplate horsepower shall not be exceeded at the primary design point. The maximum allowable horsepower at any point on the pump curve shall be 100% of the nameplate horsepower.

C. The pump and motor shall be of the same manufacturer. Private labeled motors are not considered to be the same manufacturer.

### 10.2.03 ELECTRICAL CABLE

A. General. The motor lead to electrical cable splice shall conform to IEEE and NEC standards. The electrical wire shall be annealed bare 19 stranded copper conductors insulated with PVC. All power conductors plus a ground conductor shall be jacketed in a flat heavy-duty PVC jacketing. All cable shall be UL listed per UL83 Type TvfcW Construction A, as Deep Well Submersible Cable. Power conductors shall be sized to allow no more than 5% of voltage loss in the entire length. Grounding conductor shall be sized per Table 24.3 of UL83. The electrical cable shall be strapped to the discharge column with stainless steel bands. The electrical cable shall be firmly attached to the riser pipe at 20-foot intervals or less.

**10.2.04 DISCHARGE COLUMN**

A. General. The discharge column shall be of a black steel pipe conforming to ASTM A53 Grade A. Thread shall be a .75” taper National Pipe Thread.

**10.2.05 SOUNDER TUBE**

A. General. A PVC sounder tube shall be installed with the column. The sounder tube shall be a minimum of 1" schedule 80 flush thread PVC pipe. Threads shall conform to ASTM F480. The sounder tube shall extend from the top of the pump assembly to the surface. The bottom of the sounder tube shall be capped. The bottom 10 feet and the top 10 feet of the sounder tube shall be slotted, in accordance with ASTM F-480. The slot size shall be 0.050”. The sounder tube shall be strapped to the discharge column with stainless steel bands.

**10.2.06 DISCHARGE HEAD**

A. General. The discharge body shall be constructed from ductile iron or fabricated steel. O-ring seats shall be designed to seal full circumference and be of a non-corrosive material. The spool shall include a threaded inlet of the size indicated on the drawings. The spool shall have o-rings set into the body for sealing to the discharge body. The riser shall be of adequate size to pass the spool. The length shall be as required to allow 5 feet of bury depth plus 2 feet above the surface as shown on the drawings. A discharge port shall be of a size indicated on the drawings. The discharge outlet shall be as shown in the drawings. Acceptable manufacturers are Baker Mfg. and Maass Midwest.

All State of Utah Rules regarding the use of pitless units shall apply, including, but not limited to, Rule R309-515-6(12)(c), *Pitless Well Units and Adapters*, and Rule R655-4-11.7.5, *Pitless Adapters/Units*.

**10.2.07 WATER LEVEL INDICATION**

A. General. A complete water level indication system for the water well shall be provided. The system shall consist of two components. A submersible analog transmitter and a digital indicator.

B. The level transmitter shall be a two-wire type, .80 inches in diameter. The transmitter shall produce a 4 to 20 milliamp signal proportionate to the span range of the transmitter. The span range shall exceed the static water level of the water well. An integral electrical cable shall suspend the transmitter. The cable shall include a Kevlar standing capable of supporting 200 pounds. The transmitter shall be approved by the Engineer.

C. The digital indicator shall receive the analog signal, display the level, provide local alarm to the pump controls, and retransmit the analog signal to a telemetry system provided by others. The indicator shall be housed in a fiberglass enclosure. The indicator shall be approved by the Engineer.

## PART 3 EXECUTION

### 10.3.01 INSTALLATION

A. The installation shall be in accordance with manufacturers written recommendations. The installation shall be as shown in the drawings. Installation shall be done by a State of Utah licensed pump installer. Installation shall be overseen by the supplier.

### 10.3.02 PAINTING

A. Surfaces subject to weathering shall be painted to protect against corrosion or deterioration.

### 10.3.03 FUNCTIONAL TEST

A. Prior to owner acceptance and formal pump station start-up, all equipment shall be inspected for proper alignment, quiet operation, proper connection, and satisfactory performance by means of a function test. A start up report showing function testing, motor voltages, running amperages and well water levels shall be provided to the engineer after pump station start-up.

### 10.3.04 SUPPLIER

A. The supplier of the submersible well pump, motor and appurtenances shall have been in business for not less than 10 years. The primary function of the supplier shall be water well pumps and motors. This supplier shall have sole responsibility for all materials contained within this specification section.

B. The supplier shall be, manufacturer certified as: Authorized Factory Service Center for pump and motor. Authorized Warranty Center for pump and motor.