SECTION 02511
RECYCLED WATER SYSTEM

PART 1 GENERAL

1.1 RELATED WORK
A. Section 02321: Trenching, Backfilling and Compacting.
B. Section 02950: Site Restoration and Rehabilitation
C. Section 02740: Asphalt Concrete Paving

1.2 REFERENCES
A. American Water Works Association (AWWA):
   C. C105 Polyethylene Encasement for Gray and Ductile Cast-Iron Piping for Water and Other Liquid.
   E. C115 Flanged Ductile-Iron and Gray-Iron Pipe with Threaded Flanges.
   F. C151 Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water and Other Liquids.
   G. C153 Ductile Iron Compact Fittings 4" through 12" for Water and Other Liquids.
   H. C219 AWWA C219 Bolted, Sleeve-Type Couplings for Plain-End Pipe.
   I. C509 Resilient-Seated Gate Valves, 3" through 12", for Water and Sewage Systems.
   J. C600 Installation of Ductile-Iron Water Mains and their Appurtenances.
   K. C601 Disinfecting Water Mains.
   L. C605 Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings.
   M. C800 Underground Service Line Valves and Fittings
   N. C900 Polyvinyl Chloride (PVC) Pressure Pipe, 4" through 12", for Water.
   O. California Department of Transportation - Section 90 Portland cement concrete
P. Uniform Plumbing Code, Appendix J

1.3 SUBMITTALS

A. Provide manufacturers specification and literature for all materials furnished.

B. Contractor shall submit manufacturers' Certificates of Compliance for all materials furnished from suppliers not specifically listed in this specification or as shown on the contract drawings.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Handling: Pipe, fittings, valves, and accessories shall be handled carefully at all times. Only suitable equipment and appliances shall be used for the safe loading, hauling, unloading, handling, and placing of materials. Special care shall be exercised so that the preformed resilient joints on pipe and fittings are not damaged.

PART 2 PRODUCTS

1.5 WATER LINES 3-inch to 12-inch DIAMETER

A. Ductile iron pipe (DIP): Pipe shall conform to AWWA C151, minimum pressure class 250. All ductile iron pipes shall be cement mortar lined in conformance with AWWA C104 and shall have a 1-mil thick exterior petroleum asphaltic coating. Pipe shall be of domestic manufacture: U.S. Pipe, American Ductile Iron pipe, or Pacific States. No substitutions.


1.6 WATER LINES 2-inch AND SMALLER DIAMETER

A. Domestic Water Service: Pipe shall be annealed (soft) Type "K" copper (Cu). No hard copper tubing is permitted.

B. Irrigation Lines: Pipe shall be polyvinyl chloride Schedule 40, or Class 315, whichever has the highest pressure rating for the size required. Pipe shall be National Sanitation Foundation approved.

1.7 POLYETHYLENE ENCASEMENT

A. Where shown on plans buried ductile iron pipe and fittings shall be encased in colored “purple” polyethylene in accordance with AWWA C105.

1.8 COUPLINGS AND SLEEVES
A. General: All couplings and sleeves for plain end pipe, and accessories shall be of domestic manufacture; U.S. Pipe, Tyler/Union Foundry, Smith-Blair; no substitutions.

B. FOR DIP AND PVC PIPE: - 4-inch thru 12-inch diameter:

1. Solid sleeves shall be mechanical joint type conforming to AWWA C153 as manufactured by Tyler/Union Foundry, or US Pipe. No substitutions.

2. Couplings: Quantum Couplings as manufactured by Smith-Blair, Inc. No substitutions.

3. Unless otherwise noted, flanges on all DIP spools shall conform to AWWA C115.

Pipe: 14-inch diameter and larger:

4. Solid sleeves shall be mechanical joint type conforming to AWWA C153 as manufactured by Tyler/Union Foundry, or US Pipe. No substitutions.

5. PVC PIPE: 2-INCH AND SMALLER: PVC pipe 2-INCH in diameter and smaller shall have Schedule 40, solvent-weld PVC socket couplings.

C. COPPER TUBING:

1. Couplings and pipe thread adaptors for copper tubing shall be Mueller 110 Compression Connection, no substitutions. Soldered joints are not permitted.

1.9 ASSEMBLY BOLTS AND NUTS

A. Bolts and nuts for above ground flanges shall be standard hex-head, cadmium plated machine bolts with American Standard Heavy, hot-pressed, cadmium plated hexagonal nuts. Buried flange nuts and bolts shall be as above except they shall be of Type 316 stainless steel.

B. Bolts and nuts for mechanical joints shall be high-strength, low-alloy corrosion resistant steel conforming to ASTM A 325 (type 3).

1.10 FITTINGS

A. Fittings for pipe sizes 4-inches thru 12-inches shall be mechanical joint, AWWA CI53, 350 psi working pressure-rated, ductile-iron for use with the type of pipe specified. Fittings shall be cement-mortar lined per AWWA C104 and shall have a 1-mil thick exterior petroleum asphaltic coating. T-bolts shall be AWWA C111, high strength, low alloy steel. Fittings and all accessories shall be of domestic manufacture; U.S. Pipe TrimTyte, Union Foundry, Tyler; no substitutions.

B. Fittings used at intersections of water mains where valves are required shall be cement-lined, flanged fittings. Valves at these locations shall have flange by mechanical joint ends. Flange bolts and nuts at these locations shall be stainless steel.
C. Fittings for PVC pipe 2-inches in diameter and smaller shall be Schedule 40 PVC. Fittings shall be solvent-weld socket fittings except where there is a change in pipe material.

1.11 MECHANICAL JOINT FITTING & PUSH-ON JOINT RESTRAINTS

A. Mechanical joint fitting restraints for Ductile Iron pipe and PVC pipe sizes 4-inches thru 24-inches shall be shall be rated in accordance with the performance requirements of ANSI/AWWA C111/A21.11 Rubber Gasket Joints for Ductile-Iron Pressure Pipe and Fittings and meet or exceed the requirements of ASTM F1674 of the latest revision for PVC pipe.

1. Mega-Lug® type as manufactured by EBAA, Inc. Series 1100 for Ductile Iron pipe and series 2000PV for PVC pipe, OR:

2. MJ FIELD LOK® Gasket as manufactured by US Pipe and Foundry.

B. Push-on joint restraint as specified on the drawings:

1. FIELD-LOK 350 gaskets as manufactured by US Pipe & Foundry, no substitutions.

1.12 GATE VALVE

A. Buried gate valves 3-inches thru 12-inches diameter shall be Mueller resilient wedge gate valve model A-2360 series, 250 psi working pressure, non-rising stem with square operating nut (turned counterclockwise to open), and –“O” ring packing; no substitutions. 3-inches size shall be by an approved manufacturer.

B. Gate valves 2-inches and smaller shall be Milwaukee model 1140 gate valve with hand wheel, no substitutions.

C. For above ground gate valves in domestic and fire service systems, including backflow prevention assemblies and other locations with hand wheel.

1.13 TAPPING SLEEVE AND VALVE

A. Tapping sleeves for 4-inches thru 12-inches mains shall be cast iron, 200 psi working pressure; Mueller H-615/H-619; no substitutions.

B. Tapping valves shall be Mueller resilient wedge gate valve model A-2360-16, 250 psi working pressure, non-rising stem with 2-inches square operating nut (turned counterclockwise to open), and "O" ring packing; no substitutions, with flanged or mechanical joint ends.

1.14 SERVICE SADDLES

A. Service saddles for pipes 4-inches thru 12-inches diameter shall be Mueller BR2B
Double strap bronze with AWWA I.P. thread. Tap diameter to match service connection size. No substitutions.

1.15 AIR RELEASE VALVES

A. Air release and combination air release / vacuum relief valves shall conform AWWA C512-92 and have NSF/ANSI Standard 61 certification.

B. Combination air release / vacuum relief valves shall be cast-iron body, threaded inlets, stainless steel trim, floats, seats, and linkage. Air release valves shall be universal air-vacuum type, Val-Matic 200 series, no substitutions.

C. Air release valve shall be Val-Matic model as specified on drawings.

D. Corporation stops (for use with air release valve connections): Corporation stops shall be two inches (2-inches) size, cast bronze body, plugs, and trim, and IP threaded for saddles, Mueller H-15023, no substitutions.

1.16 WATER VALVE BOX

A. A valve box shall be provided for each buried valve. Water valve boxes shall be pre-cast concrete box with steel or cast iron traffic cover marked "RECYCLED WATER" as detailed on the Plans; Christy Box G04 box and G04C lid; no substitutions.

1.17 VALVE STEM EXTENSIONS

A. Valve stem extensions shall be Fiberplas valve extensions as manufactured by Pipeline Products. Valve stem extension shall consist of Fiberplas upper operating nut (FPU-210), 2-inches square Fiberplas extension tubing (FPT-200), and Fiberplas lower operating nut (FPL-220).

1.18 RECYCLED WATER SERVICES

A. General: - Water services shall be sized as shown on the plans and shall be 1-inch minimum in size.

B. Water Services 2-inches and smaller: -- Water services 2-inches and smaller shall be Type K soft copper. Service clamps, corporation stop valves, meter stops, and ball valves (on meter outlets) shall be installed for all services 2-inches and less unless otherwise shown. Service clamps shall be bronze, double strap, tapped for iron pipe size, Mueller H-16102/116 for DIP or Mueller H-13490/94 for PVC; no substitutions. Fittings shall be as below; no substitutions:

<table>
<thead>
<tr>
<th>SERVICE SIZE</th>
<th>CORPORATION STOP</th>
<th>ANGLE METER STOP</th>
<th>BALL VALVE</th>
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</thead>
<tbody>
<tr>
<td>1-INCH</td>
<td>MUELLER</td>
<td>MUELLER</td>
<td>NOT REQUIRED</td>
</tr>
</tbody>
</table>
C. Water Services 3-inches and larger: Water services 3-inches and larger shall be constructed using pipe, valves, and fittings as herein specified for water mains and as shown on the plans.

1.19 WATER METER ASSEMBLY

A. Water meters shall be of the size indicated on the drawings with bronze flanges, red brass nipples and bronze meter spuds (where applicable), and registers reading directly in cubic feet. Meter assemblies, including bypass piping, shall be adjusted to finish grade using approved pipe and fittings, as follows:

B. 2-inches and smaller meters: -- For 2-inches and smaller meters, meter assemblies shall be adjusted such that the meter registers are 6-inches below bottom of meter box lid.

C. For 4-inches and larger meters, meter assemblies shall be adjusted such that the top of valve handwheels are 3-inches below the bottom of the meter enclosure lid.

D. Recycled Water Meters:
   1. 1-inch: Badger Meter 70 (bronze body and bottom)
   2. 1-1/2 inch: Badger Turbo 160
   3. 2-inch: Badger Turbo 200
   4. 3-inch: Badger Turbo 450
   5. 4-inch: Badger Turbo 1000
   6. Larger than 4-inch: As approved by Stanford Utilities.

E. Automatic meter reading system.
   1. Badger Recordall Transmitter Register (RTR) with ITRON 100WP End Point ERT and factory calibrated for Stanford University.
   2. Recycled Water: Non-potable Identification Clearly marked, including: a lavender colored lid, shroud and register face; the word “RECYCLED WATER” incorporated on the meter housing and chamber, and the non-potable water symbol on the register lid.

F. An approved pre-cast reinforced concrete water meter enclosure shall be provided for

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<tr>
<th></th>
<th>H-15028</th>
<th>H-14258</th>
<th>H-14277</th>
<th>FORD</th>
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</thead>
<tbody>
<tr>
<td>1-1/2-INCH</td>
<td>MUELLER</td>
<td>MUELLER</td>
<td>FORD</td>
<td></td>
</tr>
<tr>
<td></td>
<td>H-15023</td>
<td>H-14277</td>
<td>BF 13-666W</td>
<td></td>
</tr>
<tr>
<td>2-INCH</td>
<td>MUELLER</td>
<td>FORD</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>H-15023</td>
<td>BF 13-777W</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
each water meter assembly. The words "RECYCLED WATER" shall be cast in each concrete lid and welded in 2-inches high letters on each steel lid.

1. 1-inches: Christy B9 and extensions with 9FLD lid with 4-inches pea gravel bed.

2. 2-inches: Christy B36 and extensions with B36-61G checker plate lid with 6-inches pea gravel bed.

3. 4-inches and 6-inches: Christy B48 box and extensions with one-half 62D cover and one-half 62G cover (checker plate with reading lid over meter) with a 6-inches thick pea gravel bed providing 3-inches clearance below the bottom of the meter assembly. Shop drawings for meter vault/pits and lids including meter assembly, piping layout, and required clearances shall be submitted for approval.

G. All fittings used in 4-inches and larger water meter assembly shall be flanged ductile iron.

1.20 THRUST BLOCKS

A. Thrust blocks shall be constructed of Caltrans designated Class A concrete, and be mixed and delivered to the jobsite by an approved ready-mix concrete supplier, unless otherwise approved by the Stanford Utilities.

1.21 TRACER WIRE

A. A tracer wire shall be installed to facilitate the detection of all mains 4-inches and larger. Tracer wire shall be positioned and installed as shown on standard details. Tracer wire shall be THNN, 8 gauge copper wire, and solid blue in color. All wire shall be joined by use of a wire clamp. These connections shall be sealed and taped to create a watertight connection.

1.22 PIPE MARKING

A. New Buried pipe: The use of purple colored pipe with continuous wording “RECYCLED WATER—DO NOT DRINK” printed on opposite sides of the pipe is the preferred method for identification of new buried recycled water piping (constant-pressure mainlines/intermittent-pressure laterals). Pipe must be laid with wording facing upwards.

B. New Buried Pipe: An acceptable alternative: all new buried recycled water lines (constant-pressure mainlines/intermittent-pressure laterals) must be identified by continuous lettering on three inch (3”) minimum width, purple marking tape with one inch black or white contrasting lettering bearing the continuous wording “RECYCLED WATER—DO NOT DRINK.” This tape must run continuously on top of all piping (mainlines and laterals) and must be attached to piping with plastic tape banded around the marking tape and the pipe every five feet on center. Marking tape must extend to all valve boxes and/or vaults and exposed piping.
C. Existing buried piping which will be converted to recycled water use need not be marked unless the piping becomes exposed, such as during installation of new pipeline or maintenance of existing pipe. The exposed section must be marked as indicated above for new piping.

D. Inside Structures: Exposed (not buried) constant-pressure recycled water irrigation pipelines, such as copper or galvanized pipelines, that might be used in a structure such as a parking garage to route recycled water, must be identified per UPC Appendix J, with the exception that the labeling on the piping must read “CAUTION: RECYCLED WATER—DO NOT DRINK.” Intermittent-pressure lines inside a structure must be identified by affixing decals to the piping at ten-foot intervals and wherever the piping changes directions. These decals must be purple in color and must be imprinted in nominal one-inch-high, black, uppercase letters, with the words “RECYCLED WATER—DO NOT DRINK,” and must be adhesive, permanent, and resistant to environmental conditions.

PART 3 EXECUTION

3.1 STRUCTURES AND APPURTENANCES

A. Except as noted herein or on the plans, all water system structures, components, and appurtenances shall be constructed and installed in accordance with the applicable AWWA specifications.

3.2 MINIMUM COVER FOR UNDERGROUND LINES

A. Water lines 4-inch and greater diameter: 42-inches minimum cover.

B. Water lines less than 4-inch diameter:
   1. Paved areas: 42-inches minimum cover.
   2. Landscaped and unimproved areas: 36-inches minimum cover.

3.3 MINIMUM SEPARATION

A. A minimum horizontal separation of ten feet between parallel, buried recycled and potable domestic water pipelines should be maintained. If a ten-foot horizontal separation is not practical, a separation of at least four feet may be allowed subject to special construction conditions contact the Water Shop for more information. In no case is horizontal separation of less than four feet or construction in the same trench as potable facilities allowed.

B. Vertical separation at crossings where a buried constant pressure recycled water pipeline crosses a buried potable water pipeline, it must be located a minimum of 12 inches below the potable water pipeline. Constant pressure recycled water pipelines are allowed over potable water pipelines with a minimum of 12 inches vertical separation if a full standard pipe length is centered over the crossing, or the recycled water pipeline is
installed in a pipe sleeve which extends a minimum of 10 feet on either side of the potable water piping.

3.4 THRUST BLOCKS

A. Thrust block locations may not be shown on the drawings, but blocks shall be provided for all pressure pipe fittings, changes in pipe alignment/direction, and at all other points where there is a possibility of joint separation under pressure. Provide anchors and supports where necessary for fastening work into place. Make proper provisions for expansion or contraction of pipelines. Thrust blocks shall be placed between solid ground and the pipe or fittings to be anchored as detailed. Thrust blocks shall be as detailed on the drawings, or where not detailed, in accordance with AWWA C600 and pipe manufacturer's recommendations.

B. Where concrete thrust blocking is not possible due to space limitations or unstable soil conditions, the Contractor shall provide an alternate means of thrust restraint. Thrust restraint methods shall conform to NFPA 24 requirements. Acceptable methods include mechanical joint ductile iron retainer glands, restrained mechanical joints, and restrained push-on joints. Tie rods shall not be used unless tie rod materials, tie rod arrangement, and corrosion protection methods have been specifically submitted and approved by the Stanford Utilities Department for the actual field conditions encountered.

C. Backfilling operations at thrust blocks may begin as soon as the concrete has set sufficiently to remain in position and withstand the weight of the earth. Concrete shall not be disturbed or pressure loaded for at least five (5) days after placing unless otherwise permitted by the Owner.

3.5 HYDROSTATIC PIPELINE TESTING

A. After the pipe has been laid and backfilled it shall be subjected to hydrostatic pressure tests. Tests shall not be conducted until at least 12 hours have elapsed since pipe laying and at least five (5) days have elapsed since placing of concrete thrust blocks. The pipe shall be filled with water, which shall remain without external application of pressure for 24 hours before tests are conducted.

B. Prior to hydrostatic testing, flush pipe system with fresh water until piping is free of dirt and foreign matter.

C. Pressure shall be applied by a pump and measured by a test gage. The Contractor shall furnish all necessary apparatus and labor for conducting the pressure and leakage tests.

D. The Contractor is responsible to ensure the release of air from the line during filling, as well as the prevention of collapse due to vacuum when dewatering the line.

E. For pressure test, use a hydrostatic pressure not less than 200 psi. The duration of the test shall not be less than 4 hours. The pressure shall not vary by more than 5 psi for the duration of the test.
F. For portions of new mains with butterfly valves, use a hydrostatic test pressure of not less than 150-psi. The duration of the test shall not be less than 4 hours. The pressure shall not vary by more than 5-psi for the duration of the test.

G. Leakage Defined.

1. Leakage shall be defined as the quantity of water that must be supplied into a newly laid pipe or any valved section to maintain pressure within 5-psi of the specified test pressure after the pipe has been filled with water and the air expelled. A drop in pressure in the test section shall not measure leakage over a period of time.

2. Allowable Leakage: No pipe installation will accepted if the leakage is greater than that determined by the following formula per AWWA C600-93:

\[ L = \frac{(S \cdot D \cdot \sqrt{P})}{133,200} \]

Where:

- \( L \) = allowable leakage, in gallons per hour
- \( S \) = length of pipe, feet
- \( D \) = pipe diameter, inches
- \( P \) = test pressure, psi

H. Acceptance. Acceptance shall be determined on the basis of allowable leakage. If any test of laid pipe discloses leakage greater than specified in section 3.05.H, repairs or replacements shall be made by the contractor’s at his own expense.

3.6 DISINFECTION

A. General: Supply all equipment and chemicals required to perform disinfection, flushing and dechlorination including hoses, diffuser, chlorine, de-chlorination chemical, and testing equipment.

B. All domestic water lines, mains, and branches shall be disinfected by chlorination in accordance with AWWA C601 and as herein specified. Chlorine shall be a 1 percent solution (containing 10,000 parts per million available chlorine) or shall be obtained by use of dry chlorine in tablet form firmly attached to inside top of the pipe.

C. The weight of chlorine or chlorine compound required to make a 1 percent chlorine solution is as follows:
1% CHLORINE SOLUTION TABLE

<table>
<thead>
<tr>
<th>PRODUCT</th>
<th>AMOUNT OF PRODUCT</th>
<th>QUANTITY OF WATER (GALLONS)</th>
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</thead>
<tbody>
<tr>
<td>High-Test Calcium Hypochlorite (65-70% Cl)</td>
<td>1.0 LBS</td>
<td>7.50</td>
</tr>
<tr>
<td>Chlorinated Lime (32-35% Cl)</td>
<td>2.0 LBS</td>
<td>7.50</td>
</tr>
<tr>
<td>Liquid Laundry Bleach (5.25% Cl)</td>
<td>1.0 GALLONS</td>
<td>4.25</td>
</tr>
<tr>
<td>Liquid Chlorine (100% available chlorine)</td>
<td>0.62 LBS</td>
<td>7.50</td>
</tr>
</tbody>
</table>

B. The required concentration of chlorine in the pipe is 50 parts per million. This concentration may be attained by adding 5 gallons of the chlorine solution to 1,000 gallons of water.

C. The required concentration of chlorine in the mains may be obtained by the use of HTH tablets as produced by Olin Mathieson in the following quantities:

1. HTH TABLET (70%) DOSAGE
2. Number of Tablets Per Length of Pipe

<table>
<thead>
<tr>
<th>Length of Section</th>
<th>DIAMETER OF PIPE</th>
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<tbody>
<tr>
<td></td>
<td>4&quot;</td>
</tr>
<tr>
<td>13'</td>
<td>1</td>
</tr>
<tr>
<td>18'</td>
<td>1</td>
</tr>
<tr>
<td>20'</td>
<td>1</td>
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<tr>
<td>30'</td>
<td>2</td>
</tr>
<tr>
<td>36'</td>
<td>2</td>
</tr>
<tr>
<td>40'</td>
<td>2</td>
</tr>
<tr>
<td>100'</td>
<td>4</td>
</tr>
</tbody>
</table>

D. Liquid Chlorine Solution Method: All foreign matter shall be flushed from mains, branch runs, hydrant runs, and installed services. Liquid chlorine solution shall be introduced at appropriate locations to assure uniform distribution through the facilities at the proper concentration. Installed copper service lines shall not be used to convey the concentrated solution to the mains. The sanitizing solution shall be retained in the facilities for a period of 24 hours after which each service, hydrant run, branch run and dead end shall be flushed until the residual chlorine is less than one part per million or is no greater than the concentration of chlorine in the water supplied for flushing.
E. HTH Tablet Method: Tablets are to be fastened to the inside top surface of each length of pipe using "Permatex No.1" no earlier than the day pipe is laid. Tablets shall not be installed in the pipe and left overnight before laying and shall not be accessible at any time for casual pilferage by the general public or by children. Tablets shall be stored in a hermetically sealed container. The new facilities are to be slowly filled with water. Air is to be exhausted from each dead end, branch run, hydrant run, and installed service. Water shall be retained for a period of 24 hours, after which each service, hydrant run, branch run and dead end shall be thoroughly flushed to clear foreign matter and until the residual chlorine concentration is less than one part per million or is no greater than the concentration of chlorine in the water supplied for flushing. Stanford Utilities shall approve the method of dechlorination prior to flushing and disposing of heavily chlorinated water.

3.7 Bacteriological Testing:

A. Samples shall be gathered and tests conducted at the expense of the Contractor by a laboratory approved by the Owner. Samples are to be taken at representative points as required by the Owner.

B. The new facilities shall remain isolated and out of service until satisfactory test results have been obtained which meet the requirement of the California Department of Public Health and until the Owner has accepted the results as indicative of the bacteriological condition of the facilities. If unsatisfactory or doubtful results are obtained from the initial sampling, the chlorination process shall be repeated until acceptable test results are reported.

END OF SECTION