

**Imperial County
Workforce & Economic Development**

**County of Imperial
Palo Verde County Water District Water Well Replacement Project, Phase II
Project, No. ICCED-015
CDBG Grant #18-CDBG-12925**

ADDENDUM NO. 2

March 30, 2023

This ADDENDUM is hereby made part of the Contract Documents and specifications to the same extent as if originally included therein, and shall be signed by the Bidder and included with the proposal.

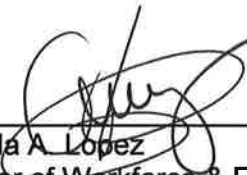
Revision No. 1: SPECIAL CONDITIONS and TECHNICAL SPECIFICATIONS

The Bid Manual advertised on March 8, 2023 did not include the project's Special Conditions and Technical Specifications. They have been attached to this Addendum.

County of Imperial
Palo Verde County Water District Water Well Replacement Project, Phase II
Project, No. ICCED-015
CDBG Grant #18-CDBG-12925

**ADDENDUM NO. 2
ACCEPTANCE OF NOTICE**

Please acknowledge receipt of this Addendum No. 2 consisting of two pages, by signing and returning this Acceptance of Notice. Each bidder must acknowledge receipt of this addendum in the noted space below and on the signature page of the Bid Form. Include a copy of this addendum with your Bid Proposal Package. It is the Contractor's responsibility to notify its sub-contractors about changes based all addendums.

By: 

Priscilla A. Lopez
Director of Workforce & Economic Development

Date: March 30, 2023

ACCEPTANCE OF NOTICE

Receipt of the ADDENDUM No. 2 is hereby acknowledged by

Company Name

Date

By: _____
Print Name & Title

Signature

26. SPECIAL CONDITIONS

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1. PROJECT DESCRIPTION

The Palo Verde County Water District's Water Treatment Plant is located two (2) miles south of the Palo Verde townsite, along State Highway 78. The Water Treatment Plant and Water Distribution System supplies services approximately 130 water customers. The average domestic demand (excluding fire flows) in the winter is 20,000 gallons per day, while the average demand (excluding fire flows) in the summer is 40,000 gallons per day. The estimated maximum demand is 70,000 gallons per day.

There are two (2) existing water wells at the Palo Verde Water Treatment Plant labeled North Well and South Well. The existing North Well as well as the existing South Well have a rated capacity of 250 Gallons Per Minute. Plan Sheet No. 2 illustrates the location of the existing and proposed water wells. The Wells are located approximately 30 feet from the Oxbow Lake Channel. The Oxbow Lake Channel is supplied with water from the Colorado River. The Existing North Well is 70 feet deep. The existing South Well is considered to be relatively new as it was constructed and placed into operation in 2020. The existing North Well was constructed in 1983 and has been out of operation since 2020, since the construction and operation of the new South Well. The existing North Well is aged and will be required to be repaired if used as a back up to the South Well. Therefore, it is critical that the North Well be replaced as soon as possible.

The purpose of this project is to replace the existing North Well with a new Well, which will also be referenced as the North Well. The installation of the new well and destruction of the existing well is to be accomplished in accordance with the State of California Department of Water Resources Bulletin 74-81 and 74-90, California Safe Drinking Water Act, requirements of the County of Imperial Public Health Department, and pertinent State of California Codes and Requirements such as Safe Drinking Water Act, California Code of Regulations, American Waterworks Association Standards, and other applicable Codes and Regulations.

Along with the replacement of the existing well, the contractor will be required to construct a concrete slab, shade structure, water piping, valves, water quality analyzing equipment, electrical and control equipment will be installed, as required for the new well.

It will be necessary to maintain the existing water treatment flow and operation through the Water Treatment Plant during the North Well replacement period. The sequence of construction for installation of the new well and destruction of the of the existing well shall be accomplished as per the specifications.

2. BUSINESS LICENSE

The Contractor and Subcontractors performing work on this project shall obtain a business license from the County of Imperial. The Contractor and Subcontractors shall contact the County Treasurer – Tax Collector’s office regarding the application process and fees. The Contractor and Subcontractor shall include the business license costs as part of mobilization.

3. INSPECTION OF WORK

All materials and equipment used in the construction of the project shall be subject to adequate inspection and testing in accordance with generally accepted standards, as required and defined in the Contract Documents.

The Contractor shall provide all inspection and testing services unless specified to be provided by the Owner’s Representative.

The Owner’s Representative shall provide at the Contractor’s expense the testing and inspection services required by the Contract Documents if the Contractor fails or refuses to provide the required testing and inspection services.

If the Contract documents, laws, ordinances, rules, regulations or orders of any public authority having jurisdiction require any work to specifically be inspected, tested, or approved by someone other than the Owner’s Representative, the Contractor will give the Owner’s Representative timely notice of readiness. The Contractor will then furnish the Owner’s Representative the required certificates of inspection, testing or approval.

Inspections, tests, or approvals by the Owner’s Representative or others shall not relieve the Contractor from the obligations to perform the work in accordance with the requirements of the Contract Documents.

If any work is covered prior to inspection by the Owner’s Representative it must, if requested by the Owner’s Representative, be uncovered for the Owner’s Representative’s observation and replaced at the Contractor’s expense.

The Owner and the Owner’s Representative will at all times have access to the work. In addition, authorized representatives and agents of any participating Federal or State agency shall be permitted to inspect all work, materials, payrolls, records, invoices of materials, and other relevant data and records. The Contractor will provide proper facilities for such access, observation of the work, and also for any inspection/testing thereof.

If the Owner's Representative considers it necessary or advisable that covered work be inspected or tested by others, the Contractor, at the Owner's Representative's request, will uncover, expose or otherwise make available for observation, inspection or testing as the Owner's Representative may require, that portion of the work in question, furnishing all necessary labor, materials, tools, and equipment. If it is found that such work is defective, the Contractor will bear all the expenses of such uncovering, exposure, observation, inspection and testing and of satisfactory reconstruction. If, however, such work is not found to be defective, the Contractor will be allowed an increase in the contract price or any extension of the contract time, or both, directly attributable to such uncovering, exposure, observation, inspection, testing and construction and an appropriate change order shall be issued.

4. SEQUENCE OF CONSTRUCTION

It will be necessary to maintain a water supply to the Palo Verde Water Treatment Plant during the Water Well Replacement Project construction period. The Sequence of Events for the construction of the project shall be accomplished in the order specified below. Any deviations or construction items not specifically mentioned below are to be noted and submitted by the contractor prior to the commencement of the construction.

The sequence of events for the installation of the new wells and destruction of the existing wells shall be accomplished in the following order:

1. Construct the class 2 base well access roads per demolition keynote 9 and construction keynote 7 as illustrated on plan sheet 2 prior to starting the destruction of the existing north well and construction of the new well. Place steel plates over the PCC sidewalk areas along the access roads to prevent damage to the PCC sidewalks.
2. Construct the native earth berm south of the northerly well per demolition keynote 4 and construction keynote 1 as illustrated on plan sheet 2 prior to or during the destruction of the existing north well.
3. Complete the destruction of the north well. The destruction of the north well shall be accomplished in accordance with demolition keynotes 1 and 2 on plan sheet 2, the technical specifications and the prior referenced codes and standards.

4. After the destruction of the north well is completed and approved the installation of the new north well shall commence. The construction of the north well shall include the following:
 - 4.1 Drill the new well to a depth of 160 feet below the existing grade per the technical conditions of the specifications. The well construction shall occur per the plans, specifications, and applicable state of California, Imperial County Department of Public Health, and AWWA standards. The well construction includes the installation of the electrical system for the well and the placement of the pcc slab centered at the top of the well casing.
 - 4.2 Performance testing of the well shall be completed after it is constructed.
 - 4.3 Disinfection of the water well is to be accomplished after the performance testing is satisfactorily accomplished.
 - 4.4 Water quality testing shall be accomplished after the disinfection of the well is satisfactorily accomplished.
 - 4.5 Construct piping downstream of the well according to the improvement plans after the performance testing, disinfection and water quality testing of the well have been accomplished. Pressure test and disinfect the piping in conformance with the plans and specifications. Install the flow metering system and associated electrical circuitry.
 - 4.6 The water well, piping and all other items associated with the well shall be approved by the County of Imperial Public Health Department prior to placing the well in service.
5. Complete the calibration and start-up of the magnetic flowmeter and associated flowmeter system. Complete the start-up of the flowmeter amplifier. Complete the circuitry connections and electrical instrumentation work for the compatible acceptance and integration of the amplifier output signal to the existing RTU unit
6. Calibrate, test, and start-up of the magnetic flowmeter and associated flowmeter system.
7. Install the turbidimeters.

8. Finalize the electrical and control instrumentation work for the monitoring, analyzing, and integration with the water treatment's plant's control system.
9. Construct new shade structure over the new north well.

5. ENVIRONMENTAL REPORT REQUIREMENTS

Environmental Documents have not been prepared for this Project. The Project was exempted by California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA).

The Contractor is responsible for exercising their Best Management Practices (BMPs) during the duration of construction on the Project Site.

The Contractor shall make a special effort to control dust during the execution of the work. Dust shall be maintained to a minimum by regular applications of water as necessary and as directed by the Owner's representative.

6. GEOTECHNICAL TESTING REQUIREMENTS

The following Geotechnical Testing shall be required for this project for Water Well Site Number 2:

- A total of two (2) compaction tests shall be obtained on the Class 2 base Access Roadway. The location of the tests shall be determined by the Resident Engineer. The contractor shall install the access road in its entirety prior to scheduling the compaction testing.
- Compaction tests for sand backfill and native soil backfill over underground pipe trench.
- Concrete testing shall be conducted for the concrete slab surrounding the Well.
- Concrete testing shall be conducted for the shade structure footing.

7. WATER TREATMENT PLANT REGULATORY AGENCY PERMIT

The County of Imperial Public Health Department, Division of Environmental Health is the Local Primary Agency (LPA) that oversees and regulates the Palo Verde County Water District Water Treatment Plant. The Palo Verde County Water Treatment Plant operates under Water System ID number 1300616.

The improvements for the Water Treatment Plant are being conducted via a Domestic Water Supply Permit Amendment submitted to the LPA. The LPA will monitor the construction and start-up phases of the project. The LPA will review the water well reports, water well decommissioning reports, review an updated Operations Plan, and conduct field observations at the construction site. All disinfection testing and water quality testing shall ultimately be approved by the LPA. The water wells shall only be placed in service after approval by the LPA. The LPA contact information is as follows:

Imperial County Public Health Department
Division of Environmental Health – Local Primary Agency
797 Main Street, Suite B
El Centro, CA, 92243
Phone: (442) 265-1888

Contact: Jorge A. Perez, Environmental Health Services Manager
Daniel Gutierrez, Environmental Health Compliance Specialist III

8. SPECIFIC SUBMITTAL LIST

Submittal Information shall be forward to the Engineer in electronic copy and hard copy form. The Contractor shall be required to forward the following submittal information to the Engineer within ten (10) calendar days after the issuance of the Notice to Proceed:

1. Construction Schedule
2. Letter Designating Project Superintendent
3. State required Contractor's Employee Notices, Wage Guidelines Postings
4. Project Sign
5. Granular Sand Gradation
6. Class 2 Base Mix Design
7. P.C.C. Concrete
8. Resilient Seated Gate Valve

9. Ductile Iron Pipe
10. PVC Pipe
11. Ductile Iron Fittings
12. Flanged Coupling Adapters
13. Pipe Support
14. Hardware for above and below grade piping
15. Silent Check Valve
16. Well Service Air Release Valve, shut off valve and drain valve
17. Pipe Support
18. Magnetic flowmeter
19. Per Magnetic Flow Meter Technical Specification.
20. Turbidimeter Assembly
21. Water Wells

See the Water Well Drilling, Installation and Testing Technical Specification for the listing of submittals.

22. Electrical
 1. Electrical Conduit – Above grade and below grade
 2. Pump Disconnect Switch
 3. Above grade pump junction box
 4. Traffic Rated Electrical Pull Box
 5. Electrical Conductors
 6. New Pump Starter Buckets including new starters, feeder breakers, elapsed time meters, HOA switches, run pilot lights, etc.
 7. Labels for Electrical Panels.
 8. Backing for mounting flowmeter transmitter
 9. Electrical and Control programming
23. Shade Structure Shop Drawings and Structural Calculations
 1. Shop Drawings including Design Loads, Structural Steel and Coating requirements, Fabric requirements, Aircraft Cable requirements and Steel Materials List

2. Shade Structure Structural Calculations prepared by a California Licensed Civil or Structural Engineer
3. Color Samples for Structural Steel and Fabric to be forwarded during submittal review for color selection

9. WELL DEMOLITION AND WELL CONSTRUCTION PERMIT

The Contractor shall be responsible to secure a Destruction Permit for the demolition of the existing north well, as well as secure a Construction Permit for the construction of the new North well. The Well Permits shall be attained from the County of Imperial Environmental Health Services Department. The telephone number for the County of Imperial Environmental Health Services Department is (442) 265-1888.

Well Destruction and Well Construction Permit – The contractor shall include \$8,000.00 for the existing Well Destruction and new Well Construction permits in the mobilization item of the bid form. If the Well Destruction and Well Construction permits cost is greater than \$8,000.00, the contractor shall be compensated for the additional costs between the permit fee and the \$8,000.00 included in the mobilization item with a positive change order. If the permit fee is less than \$8,000.00 then the owner shall be compensated by the contractor for the difference between the \$8,000.00 included in the mobilization item and the permit fee with a negative change order.

10. SHADE STRUCTURE PERMIT

The Contractor shall be responsible to secure a building permit for the construction of the shade structure from the County of Imperial Planning and Development Services Department prior to commencing work. The telephone number of the County of Imperial Planning and Development Services Department is (442) 265-1736.

The plans illustrate the shade structure in a diagrammatic fashion and note the shade structure material requirements. The shade structure is to be constructed according to the approved Shop Drawings and Structural Calculations approved during the submittal review process and permit review by the County of Imperial Planning and Development Services Department. The Submittal and Shop Drawing preparation, Structural Calculation preparation and County of Imperial Planning and Development Services Department permit process costs are to be included in Mobilization of the Bid Form.

Shade Structure Permit – The contractor shall include \$3,000.00 for the shade structure permit for new well number 2 in the mobilization item of the bid form. If the shade structure

permit is greater than \$3,000.00, the contractor shall be compensated for the additional costs between the shade structure permit fee and the \$3,000.00 included in the mobilization item with a positive change order. If the shade structure permit fee is less than \$3,000.00 then the owner shall be compensated by the contractor for the difference between the \$3,000.00 included in the mobilization item and the shade structure permit fee with a negative change order.

11. PROGRAMMING AND INTEGRATION OF FILTER CONTROL PANEL

The Contractor shall attain the services of the RTU (Remote Terminal Unit) SCADA Service provider and Filter Control Panel Service Provider/Manufacturer to integrate and program the Well pump operation, flowmeter system, and the two (2) turbidity meter systems.

The RTU unit's service supplier is Mission Communications and can be reached at telephone number (800)-795-5231 and website www.southlandwater.com or telephone number 877-993-1911 and website www.123mc.com.

The Filter Control Panel Service Provider/Manufacturer's is Kurita America, Inc. and can be reached at telephone number 800-530-1887, or website www.kuritaamerica.com for service.

28. TECHNICAL SPECIFICATIONS

01070	ABBREVIATIONS
01090	REFERENCE STANDARDS
01300	CONTRACTOR SUBMITTALS
01312	PROJECT MEETINGS
01505	MOBILIZATION
01520	TEMPORARY FACILITIES
01550	SITE ACCESS AND STORAGE
01660	MECHANICAL EQUIPMENT - INSTALLATION AND START-UP
01722	SURVEY AND CONSTRUCTION STAKING
02050	DEMOLITION AND SALVAGE
02200	EARTHWORK
02221	TRENCHING, BACKFILLING AND COMPACTING
02630	DUCTILE IRON PIPE
02640	PVC PIPE
02650	PIPE FITTINGS, TRANSITION COUPLINGS, AND HARDWARE
02666	PRESSURE PIPELINE WATER TESTING
02670	DISINFECTION OF POTABLE WATER PIPELINES
02733	WATER WELL DRILLING, INSTALLATION AND TESTING
03300	CAST-IN-PLACE CONCRETE
05220	CONCRETE BOLTS
05650	PRE-ENGINEERED SHADE STRUCTURE
11660	FINISH WATER TURBIDIMETER EQUIPMENT
15615	VALVES
15830	MISCELLANEOUS VALVES
17137	MAGNETIC FLOWMETER

SECTION 01070 - ABBREVIATIONS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Wherever in these Contract Documents the following abbreviations or acronyms are used, they shall have the meanings indicated as follows in this specification.

1.02 ABBREVIATIONS AND ACRONYMS

AA	Aluminum Association
AAMA	Architectural Aluminum Manufacturer's Association
AASHTO	American Association of the State Highway and Transportation Officials
A2LA	American Association of Laboratory Accreditation
A.C.	Asphalt Concrete
ACI	American Concrete Institute
ADWR	California Division of Water Resources
AGC	Associated General Contractors
AGMA	American Gear Manufacturer's Association
AI	The Asphalt Institute
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AMCA	Air Moving and Conditioning Association
ANSI	American National Standards Institute, Inc.
AOS	Apparent Opening Size
APA	American Plywood Association
API	American Petroleum Institute
APN	Assessor's Parcel Number
APWA	American Public Works Association
ASA	Acoustical Society of America
ASAE	American Society of Agriculture Engineers
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASLE	American Society of Lubricating Engineers
ASME	American Society of Mechanical Engineers
ASQC	American Society for Quality Control
ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials
AWPA	American Society for Preservers Association
AWPI	American Wood Preservers Institute

AWS	American Welding Society
AWWA	American Water Works Association
BHMA	Builders Hardware Manufacturer's Association
CBC	California Building Code
CBR	California Bearing Ratio
CDX	Apa Rated Plywood Sheathing Exposure
CGA	Compressed Gas Association
CLFMI	Chain Link Fence Manufacturer's Institute
CMA	Concrete Masonry Association
CRSI	Concrete Reinforcing Steel Institute
ETL	Electrical Test Laboratories
ETL	Extract, Transform Load
EPDM	Ethylene Propylene Diene M-Class
FHWA	Federal Highway Administration
GAI	Geosynthetic Accreditation Institute
GCP	Construction General Permit
GPM	Gallons per Minute
GRI	Geosynthetic Research Institute
HDPE	High Density Polyethylene
HPC	Heterotrophic Plate Count
ICBO	International Conference of Building Officials
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society
IID	Imperial Irrigation District
IPC	Institute of Printed Circuits
IPCEA	Insulated Power Cable Engineers Association
IPS	Iron Pipe Size
ISA	Instrument Society of America
LAP	Laboratory Accreditation Program
LLDPE	Linear Low Density Polyethylene
MARV	Minimum Average Roll Value
MD	Machine Direction
MGD	Million Gallons per Day
MPA	Mega Pascal
MBMA	Metal Building Manufacturer's Association
NACE	National Association of Corrosion Engineers
NBS	National Bureau of Standards
NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association
NFPA	National Forest Products Association
NGLI	National Lubricating Grease Institute
No.	Number
NOI	Notice of Intent
NOT	Notice of Termination
NSF	National Sanitation Foundation

NTPEP	National Transportation Product Evaluation Program
OD	Outside Diameter
OEM	Original Equipment Manufacturer
OIT	Oxidative Induction Time
OS&Y	Outside Stem and York
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PCC	Portland Concrete Cement
PSI	Pounds per Square Inch
PVC	Polyvinyl Chloride
SBR	Styrene Butadiene Rubber
SCH	Schedule
SDR	Standard Dimension Ratio
SMA	Screen Manufacturer's Association
SMACCNNA	Sheet Metal and Air Conditioning Contractors National Association
SPDT	Single Pole-Double Throw
SSPC	Steel Structures Painting Council
SSPWC	Standard Specifications for Public Works Construction
SWPPP	Storm Water Pollution Prevention Plan
TRS	Trihalomethane Removal System
UBC	Uniform Building Code
UL	Underwriters Laboratories, Inc.
USEPA	United States Environmental Protection Agency
UV	Ultra-Violet Disinfection
WCRSI	Western Concrete Reinforcing Steel Institute
WRI	Wire Reinforcement Institute, Inc.
WWPA	Western Wood Products Association
XMD	Cross Machine Direction

1.03 PLAN SHEET ABBREVIATIONS

%	Percent
AASHTO	American Association of State Highway and Transportation Officials
A.C.	Asphalt Concrete
A.C.P.	Asbestos Cement Pipe
AC-FT	Acer Feet
Agg.	Aggregate
AOS	Apparent Opening Size
APP	Approximate
ASTM	American Society for Testing and Materials
AVE	Average
AWWA	American Water Works Association
BC	Beginning of Curve
BLDG.	Building

BTM	Bottom
B.V.	Butterfly Valve
C2B	Class 2 Base
CC	Cubic Centimeter
C.I.	Cast Iron
CIRC	Circumferential
CL	Centerline
CLR	Clear
C.M.C.	Cement Mortar Coated
C.M.L.	Cement Mortar Lined
CPVC	Chlorinated Polyvinyl Chloride
D.I.	Ductile Iron
DIA	Diameter
DWG	Drawing
D/W	Driveway
Δ	Delta
EC	End of Curve
EF	Each Face
EL.	Elevation
E.P.	Edge of Pavement
EPDM	Ethylene Propylene Diene M-Class
EW	Each Way
FF	Finish Floor Elevation
FG	Finished Grade
FL	Flowline
FL.	Flanged
F.M.	Flow Meter
FM	Force Main
FS	Finish Surface
GALV	Galvanized
GPH	Gallons per Hour
GPM	Gallons per Minute
GW	Ground Water
H.B.	Hose Bib
HDPE	High Density Polyethylene
HP	Horsepower
HW	High Water
I.D.	Inside Diameter
INV. EL.	Invert Elevation
INV.	Invert
IPS	Iron Pipe Size
L.	Length
LBS	Pounds
MAX.	Maximum
MG	Million Gallon
MGD	Million Gallons per Day

M.H.	Manhole
MIN.	Minimum
MISC.	Miscellaneous
M.J.	Mechanical Joint
MPH	Miles per Hour
N. RIM	North Rim
N.S.	Native Surface
N.T.S.	Not To Scale
O.C.	On Center
O.D.	Outside Diameter
OHC	Overhead Cable
OHE	Overhead Electric Line
OHT	Overhead Telephone Line
OS&Y	Outside Stem & York
P.C.C.	Portland Concrete Cement
P.E.	Plain End
PL	Property Line
P.P.	Power Pole
PP#	Power Pole Number
PPM	Parts per Million
PSI	Pounds per Square Inch
PT	Pressure Transmitter
PVC	Polyvinyl Chloride
P/S	Prestressing
R.C.	Reinforced Concrete
ROW	Right-of-Way
S.	Slope
SCH	Schedule
SCHED	Schedule
SD	Storm Drain
SDFM	Storm Drain Force Main
SDR	Standard Dimension Ratio
SM	Static Mixer
SQ	Square
SS	Sanitary Sewer
SST	Stainless Steel
STA	Station
S/W	Sidewalk
SWPPP	Storm Water Pollution Prevention Plan
TBD	To Be Determined
TBM	Temporary Benchmark
T.C.	Top of Curb or Top of Concrete
TDH	Total Dynamic Head
TF	Top of Footing
TMH	Top of Manhole
TOE	Top of Slope

TOF	Top of Floor
TOW	Top of Wall
T.P.	Top of Pavement
TRS	Trihalomethane Removal System
TV	Television
TYP.	Typical
UE	Underground Electricity
UNO	Unless Noted Otherwise
UT	Underground Telephone
VERT	Vertical

END OF SECTION 01070

SECTION 01090 - REFERENCE STANDARDS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. All work and materials shall be in accordance with applicable codes, ordinances and regulations of the County of Imperial, the State of California, American Water Works Association, and all other public authorities having jurisdiction. Codes governing this work include, but are not limited to, the latest approved edition of the following: Standard Specifications for Public Works Construction (Greenbook) latest edition; Occupational Safety and Health Act (OSHA); and the County of Imperial ordinances and regulations.
- B. Whenever in these Specifications references are made to published specifications, codes, standards or other requirements, it shall be understood that when no date is specified, only the latest published specifications, standards or requirements of the respective issuing agencies, as of the date that the Work is advertised for bids, shall apply; except to the extent that said standards or requirements may be in conflict with applicable laws, ordinances, or governing codes. No requirements set forth herein or shown on the drawings shall be waived because of any provision of, or omission from, said standards or requirements.

1.02 REFERENCE SPECIFICATIONS, CODE AND STANDARDS

- A. All work specified herein shall conform to or exceed the requirements of the referenced specifications, codes and standards to the extent that the provisions of such documents are not in conflict with the requirements of these Specifications.
- B. References herein to "Building Code" or UBC shall mean the Uniform Building Code of the International Conference of Building Officials (ICBO). The latest edition of the code, as of the date of award, as approved and adopted by the agency having jurisdiction, including all addenda, modifications, amendments or other lawful changes thereto, shall apply to the Work.
- C. References herein to American Water Works Association or AWWA shall comply with the latest edition of the code, as of the date of award.

- D. In case of conflict between codes, reference standards, drawings and other Contract Documents, the most stringent requirements shall govern. All conflicts shall be brought to the attention of the Engineer for clarification and directions prior to ordering or providing any materials or labor. The contractor shall bid the most stringent requirements.
- E. Applicable Standard Specifications: The Contractor shall construct the Work specified herein in accordance with the requirements of the Contract Documents and the referenced portions of those referenced codes, standards and specifications listed herein; except, that wherever references to “Standard Specifications” are made, the provisions therein for measurement and payment shall not apply.
- F. References herein to “OSHA Regulations for Construction” shall mean Title 29, Part 1926, Construction Safety and Health Regulations, Code of Federal Regulations (OSHA), including all changes and amendments thereto.
- G. References herein to “OSHA Standards” shall mean Title 29, Part 1910, Occupational Safety and Health Standards, Code of Federal Regulations (OSHA), including all changes and amendments thereto.
- H. All materials and equipment appurtenances that can contact potable water or water that will be treated to become potable shall be listed in NSF / ANSI Standard 61.
- I. References in the Contract Documents to “Standard Specifications” shall mean the Greenbook, formally known as the “Standard Specifications for Public Works Construction” as published by the American Public Works Association, including all current supplements, addenda and revisions thereof, latest edition.

END OF SECTION 01090

SECTION 01300 - CONTRACTOR SUBMITTALS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. All submittals by the Contractor shall be submitted to the Engineer at the Site.
- B. Within ten (10) days after the date of Notice to Proceed, the Contractor shall submit the following items to the Engineer:
 - 1. A Construction Schedule providing the starting and completion dates of the various stages of the Work. The Contractor shall be prepared to discuss its construction schedule at the pre-construction conference.
 - 2. Schedule of Values or lump sum price breakdown for progress payment purposes.
- C. Equipment submittals shall comply with Section 01660 – Mechanical Equipment – Installation and Start-Up

1.02 SUBMITTAL REQUIREMENTS AND PROCESS

- A. Wherever called for in the Contract Documents or when requested by the Engineer the Contractor shall furnish to the Resident Project Representative for review, two (2) copies of each submittal.
- B. All submittals shall be accompanied by a submittal transmittal form. This form may be obtained from the Engineer. A separate transmittal form shall be used for each specific item for which a submittal is required. Each submittal should be referenced to the specification section requiring the submittal. All Contractor submittals shall be carefully reviewed by an authorized representative of the Contractor, prior to submission to the Engineer. Each submittal shall be dated, signed and certified by the Contractor as being correct and in strict conformance with the Contract Documents. In the case of shop drawings, each sheet shall be so dated, signed and certified. No consideration for review by the Engineer of any Contractor submittals will be made for any items which have not been so certified by the Contractor. All non-certified submittals will be returned to the Contractor without action taken by the Engineer and any delays caused thereby shall be the sole responsibility of the Contractor.

- C. Multiple-page submittals shall be collated into sets with each set stapled or bound.
- D. The Engineer will return copies of each submittal to the Contractor with review comments within fifteen (15) calendar days following their receipt by the Resident Project Representative. There will be three (3) copies of a submittal returned to the Contractor when marked either "NO EXCEPTIONS TAKEN" or "APPROVED AS NOTED", and no formal revision and re-submission of said submittal will be required. However, if one or more copies of the submittal are returned to the Contractor marked 'REVISE AND RESUBMIT' or 'REJECTED', the Contractor shall revise said submittal and shall resubmit the required number of copies of said revised submittal to the Engineer.
- E. Fabrication of an item shall commence only after the Engineer has reviewed the submittal and returned copies to the Contractor marked either "NO EXCEPTIONS TAKEN" or "APPROVED AS NOTED". Corrections indicated on submittals shall be considered as changes necessary to meet the requirements of the Contract Documents and shall not be taken as the basis of claims for extra work.
- F. The Engineer's review of Contractor's submittals shall not relieve the Contractor of the entire responsibility for the correctness of details and dimensions. The Contractor shall assume all responsibility and risk for any misfits due to any errors in the Contractor submittals. The Contractor shall be responsible for the dimensions and the design of adequate connections and details.

1.03 CONTRACTOR'S SCHEDULE SUBMITTAL

- A. The Contractor shall submit to the Resident Project Representative a construction schedule for the Work showing a general plan for orderly progression of the Work including mobilization of plant and equipment and timing of procurement of major materials and equipment.
- B. The Engineer may request that the Contractor provide a revised or updated Construction Schedule if, at any time, the Engineer considers the completion date to be in jeopardy because of any portion of the Work falling behind schedule or the sequence of operations becomes different from the previous schedule.

1.04 PROPOSED SUBSTITUTES OR “OR EQUAL” ITEM SUBMITTAL

- A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the specification or description is intended to establish the type, function, appearance and quality required. Other items of material or equipment, or material or equipment of other Suppliers may be submitted to the Engineer for review under the circumstances described below subject to the *Instruction to Bidders* (Section 2, Article 11), *Standard General Conditions* (Article 6.05), and the following requirements:
 - 1. The Contractor shall be responsible for resultant changes and all additional costs or credit to the Owner which the accepted substitution requires in the Contractor’s work, the work of its subcontractors and of other contractors and shall effect such changes without cost to the Owner.
- B. The procedure for review by the Engineer will include the following:
 - 1. If proposed substitute material or equipment has been judged to be unacceptable by the Engineer, the Contractor shall provide the material or equipment named in the Contract Documents.

1.05 SAMPLES SUBMITTAL

- A. The Contractor shall submit not less than two (2) samples, unless noted otherwise in a material or equipment specification, to the Engineer for acceptance at no additional cost to the Owner. Samples shall be submitted for acceptance a minimum of ten (10) days prior to ordering such material for delivery to the job site. If accepted by the Engineer, one (1) set of samples will be returned to the Contractor and one (1) set of samples shall remain at the job site until completion of the Work.

1.06 OPERATION, MAINTENANCE AND TECHNICAL MANUAL SUBMITTAL

- A. The Contractor shall furnish operation, maintenance and technical manuals. Operation, maintenance, and technical manuals shall be in accordance with Section 01730 – Operation and Maintenance Manuals, as applicable.

- B. All technical manuals shall be submitted to the Engineer not later than the seventy-five percent (75%) of construction completion date or fourteen (14) days prior to start-up of equipment if started before seventy-five percent (75%) completion of project. All discrepancies found in the technical manuals shall be corrected by the Contractor within thirty (30) days from the date of written notification by the Engineer.

1.07 AS-BUILT SUBMITTAL

- A. The Contractor shall maintain, during the progress of the Work, one (1) set of As-Built Drawings and shall neatly mark on them all project changes from the details shown on the original Contract Drawings. Special attention shall be given to recording on the drawings the horizontal and vertical location of all buried utilities that differ from the locations indicated or which were revealed during the construction.
- B. As-Built drawings shall be accessible to the Engineer at all times during the construction period and shall be delivered to the Engineer upon completion of the Work.
- C. Upon substantial completion of the Work and prior to final acceptance the Contractor shall deliver a complete set of As-Built drawings to the Engineer.

1.08 SUPERINTENDENT SUBMITTAL

- A. A letter designating the Project Superintendent shall be forwarded to the Engineer for his review. The letter shall also include emergency contact information for the Project Superintendent and other Contractor Representative.

1.09 MATERIAL AND EQUIPMENT SUBMITTAL LIST

- A. At a minimum, the following material and equipment list shall be submitted for review and approval.
 - 1. General Requirements
 - 1.1 Construction Schedule

- 1.2 Schedule of Values
- 1.3 Letter Designation Project Superintendent
- 1.4 Emergency Contact Number
- 1.5 Operation and Maintenance Manuals
- 1.6 Project Sign

- B. A listing of submittals may be included in the Special Conditions section of the specifications. The Contractor shall review the Special Conditions for a list of specific submittals.

END OF SECTION 01300

SECTION 01312 - PROJECT MEETINGS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included:

1. Required to enable orderly review during pre-design phase and design phase and progress of the Work, and to provide for systematic discussion of installation problems and other construction problems arisen, the Owner and/or Representative will conduct project meetings throughout the construction period.

1.02 RELATED WORK SPECIFIED ELSEWHERE

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Division 1 – General Requirements.
2. The Contractor's relations with his Subcontractors and materials suppliers, and discussions relative thereto, are the Contractor's responsibility and normally are not part of project meetings content.

1.03 SUBMITTALS

A. Conform to provisions of Section 01330 – Submittals/Shop Drawings.

B. Agenda Items:

1. To the maximum extent practicable, advise the Owner and/or Representative at least twenty-four (24) hours in advance of project meetings regarding items to be added to the agenda or requesting the cancellation of any Meeting.

C. Minutes:

1. The Owner and/or Representative will compile minutes of each project meeting and will furnish one copy to the Contractor, Resident Project Representative, and all other involved parties.

2. Recipients of copies may make and distribute such other copies as they wish.

1.04 QUALITY ASSURANCE

- A. For those persons designated by the Contractor to attend and participate in project meetings, provide required authority to commit the Contractor to solutions agreed upon in the project meetings.

PART TWO - PRODUCTS (NOT APPLICABLE)

PART THREE - EXECUTION

3.01 MEETING SCHEDULE

- A. Except as noted below for Preconstruction Meeting, progress meetings are to be held every once every two weeks or as otherwise directed by the Owner and/or Representative.
- B. Coordinate as necessary to establish mutually acceptable schedule for additional meetings.

3.02 MEETING LOCATION

- A. The Owner and/or Representative will establish the meeting location. To the maximum extent practicable, meetings will be held in Contractor's office at the Site.

3.03 PRE- DESIGN AND CONSTRUCTION MEETING

- A. A Pre-Design and Construction Meeting will be scheduled to be held within twenty-one (21) working days after the Notice to Proceed has been issued.
 1. Provide attendance by authorized representatives of the Contractor and major Subcontractors.
 2. The Owner and/or Representative will advise other interested parties.
- B. Minimum Agenda: Data will be distributed and discussed on at least the following items.

1. Organizational arrangement of Contractor's forces and personnel, and those of the subcontractors, and materials suppliers.
2. Organizational arrangement of the Owner's forces and personnel and other authorized representatives.
3. Channels and procedures for communication.
4. Construction Schedule, including sequence of events and critical work.
5. Contract Documents, including distribution of required copies of original Documents and revisions.
6. Processing of Shop Drawings and other data submitted to the Owner and/or Representative for review.
7. Processing of bulletin, addenda, field decisions, Requests for Information and Change Orders.
8. Rules and regulations governing performance of the Work.
9. Procedures for site security, project quality control, housekeeping, and related matters.
10. It is the responsibility of the Contractor for Site Safety & First Aid; however, it shall be on the agenda.
11. Procedures for Contractor's request.
12. Emergency Information: The name, addresses, telephone and fax numbers of the Contractor, and Subcontractors, or their representatives, shall be filed with the Owner and/or Representative prior to start of the Work.

3.04 PROJECT MEETINGS

A. Attendance:

1. To the maximum extent practicable, the Project Superintendent and other representatives who have full knowledge of the project and full authority to act for the Contractor shall represent the Contractor at Project Meetings throughout the progress of the Work.

2. Subcontractors, materials suppliers, and others may be invited to attend these Project Meetings in which their aspect of the Work is involved.
3. The Contractor may not cancel or be absent from any meeting without advanced approval from the Owner and/or Representative. The Contractor must submit a written request with reason to the Owner and/or Representative twenty-four (24) hours before the scheduled meeting. If approved, the Contractor shall notify all parties of the cancellation.

B. Minimum Agenda:

1. Review progress of the Work since last meeting. Review actual starts and finish dates of activities. Review progress of design.
2. Review status (total complete and outstanding) of submittal for approval, Request for Information and Change Orders.
3. Identify old and new problems, which impede planned progress, identify responsible party for the follow-up actions. Mutually agree to a common solution and date of correction.
4. Develop corrective measures and procedures to regain lost time on the planned schedule.
5. Review Weekly Progress Reports including the forecasts.
6. Status of As-Builts.
7. Project site Walk-Through. Record all discussion and follow-up actions.
8. Any project site health and/or accident or safety issues.

3.05 SPECIFIC SITE MEETINGS

- A. Required when necessary to enable orderly review and discussion of site conditions and problems requiring solution during the progress of the contracted work. Notify the Owner and/or Representative of the need for additional site meetings as early as possible to resolve the problem without any impact to the Project Schedule.

- B. Provide necessary labor, tools, and equipment such as shoring, scaffolding, ladder, etc. to gain access to the specific sites.
- C. The Contractor and its authorized representative shall be present at all times.

All discussion and follow-up actions shall be recorded by the Owner and/or Representative, and the minutes shall be distributed at the next meeting or at earliest time

END OF SECTION 01312

SECTION 01505 - MOBILIZATION

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Mobilization shall include obtaining all of the contractor's administrative and construction management, including permits; moving plant equipment on-site; furnishing and erecting temporary buildings and other construction facilities; all as required for the proper performance and completion of the Work. Mobilization shall include, but not be limited to, the following principal items:
1. Moving on to the site, Contractor's and subcontractor's equipment and materials required for construction of the project. Removing equipment and materials from the project site.
 2. Install temporary construction power, wiring and lighting facilities.
 3. Providing potable water facilities as specified. This includes a means by which all on site Contractor, Subcontractor and supplier personnel can wash their hands with soap. It also includes providing potable drinking water to the construction personnel at the project site.
 4. Contractor to attain all Insurance and bonds required for project.
 5. Contractor's taxes and miscellaneous fees for the project.
 6. Providing on-site Contractor's restroom facilities.
 7. Have Contractor's superintendent dedicated to the construction project.
 8. Participation in construction meetings. Meetings to include the preconstruction conference, progress meetings, pre-final inspection, Final Inspection, and other miscellaneous meetings.
 9. Arranging and setting up the Contractor's work and storage yard.

10. Excavation and exposing (pothole) of underground and covered utilities.
11. All required project signs including but not limited to the project sign, contractor's identity sign, Contractor Employee Notice and Wage Guideline Signs.
12. Posting all OSHA required notices and establishment of safety programs. Implementing a Safety Program for the project construction.
13. Prepare and process all project submittal and shop drawing documents including the project construction schedule, contractor's price breakdown (Schedule of Values) and Submittal Schedule.
12. Comply with County of Imperial Departments, including the Air Pollution Control District, Environmental Health Department, Public Works Department, and Planning and Development Services (including Building Division) Department.
13. Preparation and submittal of the Operations and Maintenance Manuals.
14. Preparation and submittal of the As-Built Drawings.
15. Attain building and construction permits, as applicable.

1.02 PAYMENT FOR MOBILIZATION

- A. Payment for Mobilization, as noted in the Proposal Forms and approved Schedule of Values, shall not be released to the Contractor unless all items in Paragraph "A" above have been satisfied.

END OF SECTION 01505

SECTION 01520 - TEMPORARY FACILITIES

PART 1 - GENERAL

1.01 DESCRIPTION

The Owner shall bear no costs of temporary facilities, unless noted otherwise.

It shall be the Contractor's responsibility to provide equipment that is adequate for the performance of the Work under this Contract within the time specified. All equipment shall be kept in satisfactory operating condition, shall be capable of safely and efficiently performing the required Work and shall be subject to inspection and approval by the Owner's representative at any time within the duration of the Contract. All work hereunder shall conform to the applicable requirements of the OSHA Standards for Construction.

1.02 POWER AND LIGHTING

The Contractor shall provide temporary electric power as necessary for the execution of the Work, including that required by all Subcontractors. Contractor shall make the necessary arrangements with utility purveyor to include all permits, applications and fees, and shall bear all costs for these temporary services and shall furnish and install all necessary transformers, metering facilities and distribution centers from branch circuits as may be required.

The Contractor shall provide lighting and outlets in temporary structures throughout the Project as may be required for safety, proper performance and inspection of the Work. If operations are performed during hours of darkness, or if natural lighting is deemed insufficient by the Owner, the Contractor shall provide adequate floodlights, clusters and spot illumination. The use of permanently installed lighting fixtures, lamps and tubes for work shall not be permitted except by special permission of the Owner. The Contractor shall make arrangements with Subcontractors for electrical services and lighting as may be necessary in the performance of their work.

1.03 WATER SUPPLY

- A. General: The Contractor shall provide an adequate supply of water of a quality suitable for all domestic and construction purposes. Utility or plant effluent water may be used for hydraulic structures and pipeline testing as approved, in writing, by the Owner. Potable water shall be furnished by the Owner without charge.

- B. Drinking Water: All drinking water on the site during construction shall be furnished by the Contractor and shall be bottled water or water furnished in approved dispensers. Notices shall be posted conspicuously throughout the site warning the Contractor's personnel that piped water for construction purposes may be contaminated and is not for human consumption.
- C. Water Connections: The Contractor shall not make connection to, or draw water from, any fire hydrant or pipeline without first obtaining permission, in writing, of the authority having jurisdiction over the use of said fire hydrant or pipeline and from the agency owning the water system. For each such connection made the Contractor shall first attach to the fire hydrant or pipeline a valve, backflow preventer and a meter, if required by the said authority, of a size and type acceptable to said authority and agency.
- D. Removal of Water Connections: Before final acceptance of the Work all temporary water connections and piping installed by the Contractor shall be entirely removed, and all affected improvements shall be restored to their original condition, or better, to the satisfaction of the Owner and to the agency owning the affected utility.
- E. Fire Protection: The Contractor shall provide fire extinguishers and other fire protection equipment to adequately protect new and existing facilities and temporary facilities against damage by fire. Hose connections and hose, water casks, chemical equipment or other sufficient means shall be provided for fighting fires in the new, existing and temporary structures and other portions of the Work and responsible persons shall be designated and instructed in the operation of such fire apparatus so as to prevent or minimize the hazard of fire. The Contractor's fire protection program shall conform to the requirements of the OSHA Standards for Construction. The Contractor shall employ every reasonable means to prevent the hazard of fire.

1.04 CONSTRUCTION OFFICE TRAILER

If called out in the Special Conditions, the Contractor shall install and maintain a Construction Office Trailer at the Project Site. The Trailer shall have a floor area of at least 500 square feet with a minimum of 150 square feet designated for the sole use of the Resident Project Representative. The Trailer shall be provided with lighting, hot/cold water dispenser, heating, air conditioning, two (2) file cabinets, three (3) desks, six (6) chairs and one (1) telephone line. The Contractor shall provide a power

service, wiring, conduit and electrical service pole in accordance with the standards of the power division of the Imperial Irrigation District. All costs related to the Construction Office Trailer shall be borne by the Contractor. The Construction Trailer shall be moved on the Site within **ten (10) days** of the Notice to Proceed. Drinking water shall be supplied by the Contractor.

1.05 SANITATION

- A. Toilet Facilities: Portable chemical toilet facilities shall be provided wherever needed for the use of employees. Toilets at Site(s) shall conform to the requirements of Subpart "D", Section 1926.51 of the OSHA Standards for Construction. The Owner's toilet facilities shall not be used by the Contractor or subcontractors. Two (2) toilet facilities shall be positioned at the project site. One (1) toilet facility shall be for men. The other toilet facility shall be for women. Toilet facilities shall be relocated as required and be maintained close to daily work activities. The toilet facilities shall be cleaned and serviced on a weekly basis.
- B. Sanitary and Other Organic Wastes: The Contractor shall establish adequate and regular collection of all sanitary and organic wastes. All wastes and refuse from sanitary facilities provided by the Contractor or organic material wastes from any other source related to the Contractor's operations shall be disposed of in a manner satisfactory to the Owner and in accordance with all laws and regulations pertaining thereto. Contractor may install temporary piping for toilet facilities to discharge into the incoming sewer.

1.06 COMMUNICATIONS

- A. Telephone Services: The Contractor shall provide and maintain a phone line.

1.07 FENCE AND BARRICADES

The Contractor shall provide such protective fences and barricades as deemed necessary for public safety and to protect storage areas and the Work in place. The location and appearance of all fences shall be subject to the approval of the Owner.

1.08 CONTRACTOR PARKING

The Contractor shall not park his equipment, nor allow his personnel to park, in any area except those specifically designated by the Owner.

1.09 TEMPORARY LIVING QUARTERS

Temporary living quarters shall not be allowed on the Site or on publicly owned properties. In addition, all local zoning codes for the area in question shall be strictly adhered to.

1.10 REMOVAL OF TEMPORARY CONSTRUCTION

The Contractor shall remove temporary office facilities, toilets, storage sheds and other temporary construction from the site as soon as, in Owner's opinion, the progress of Work permits. Contractor shall recondition and restore those portions of the site occupied by the same to a condition equal to or better than it was prior to construction.

END OF SECTION 01520

SECTION 01550 - SITE ACCESS AND STORAGE

PART 1 - GENERAL

1.01 HIGHWAY AND STREET LIMITATIONS TO PROJECT SITE

- A. The Contractor shall make its own investigation of the condition of available public and private roads and of clearances, restrictions, bridge load limits and other limitations affecting transportation and ingress and egress to the Site. It shall be the Contractor's responsibility to construct and maintain any haul roads required for its construction operations or define any alternate routes to the Site due to roadway or bridge restrictions.
- B. Nothing herein shall be construed to entitle the Contractor to the exclusive use of any public street, utility right-of-way or the Site during the performance of the Work hereunder. The Contractor shall conduct its operations so as not to interfere unnecessarily with the authorized work of utility companies, other agencies, or the Owner's plant personnel. No street or access shall be closed without first obtaining permission of the Owner or proper governmental authority. Where excavation is being performed in primary streets or highways one (1) lane in each direction shall be kept open to traffic at all times unless otherwise provided or shown by the Contract Documents. Fire hydrants on or adjacent to the Work shall be kept accessible to fire-fighting equipment at all times. Temporary provisions shall be made by the Contractor to assure the use of sidewalks, access routes and the proper functioning of all gutters, sewer inlets and other drainage facilities.
- C. Traffic Control: For the protection of traffic in public streets and plant operating personnel at the Site, the Contractor shall provide, place and maintain all necessary barricades, traffic cones, warning signs, lights and other approved safety devices. All barricades, traffic cones, warning signs, lights and other approved safety devices shall be placed according to the agency requirements maintaining jurisdiction, as applicable. The Contractor shall take all necessary precautions for the protection of the Work and the safety of the Owner's personnel and the public. All barricades and obstructions shall be illuminated at night.

1.02 CONTRACTOR'S WORK AND STAGING AREA

- A. The Owner will designate and arrange, for the Contractor's use, a portion(s) of the property on or adjacent to the Site for its exclusive use during the term of the Contract. The area is designated for an

office, storage and shop area for construction operations relative to this Contract. Contractor shall be solely responsible for the security of its tools, supplies and equipment at the site. The staging area(s) for this project will be located within the Water Treatment Plant site.

- B. The Contractor will only be allowed to gain access and work at the Water Treatment Plant site on Monday through Friday during the hours of 7:00 AM to 3:00 PM.
- C. The Contractor shall coordinate with the Owner and Construction Manager to set up a locking system for gaining access into the Water Treatment Plant site's gate.

END OF SECTION 01550

**SECTION 01660 - MECHANICAL EQUIPMENT -
INSTALLATION AND START-UP**

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section contains general information required for the installation of mechanical equipment as specified within the various individual specifications. The plans and/or performance specifications describe equipment and general layout based on certain commercially available equipment. It shall be the responsibility of the Contractor to ascertain the compatibility of all equipment and utilization of available space based on the Contractor's approved design and/or shop drawings and intent of these Contract Documents.
- B. Included shall be all supervision, labor, materials, tools, equipment and services as required for the furnishing, installation, testing and operation of equipment including the services of manufacturer service engineers, receiving, unloading, storage, protection, installation and complete erection of all mechanical equipment required in these Contract Documents.
- C. Installation shall include, but not be limited to placing, core drilling, shimming, anchoring, grouting, cleaning, painting, lubricating, assembling, testing and adjusting of all mechanical equipment. Installation shall also include providing all required miscellaneous parts and appurtenances.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 15380 – Motors

1.03 DESCRIPTION

- A. General:
 - 1. The Contractor shall be liable for all damage to the equipment which is to be furnished and installed under this Contract, as well as for any damage to the building structures, existing equipment or other property, real or personal, resulting from the movement of equipment or installation work. This liability shall continue until the installed equipment is accepted by the Owner.

2. The Contractor shall cause the equipment to be furnished under this division to be the product of firms regularly engaged in the design and manufacture of the type of item specified, possessing the required technical competence, skill, resources and ability to complete the work specified herein with the requisite degree of quality and in a timely and efficient manner. The Contractor shall be prepared to adequately document the qualification of the manufacturers nominated to provide equipment specified under this division. All documentation shall be submitted to the Owner or representative for review and acceptance prior to design, fabrication and shipment of any component specified herein. Nothing contained within these provisions shall be construed as relieving the Contractor of his responsibility for any portion of the work covered by this division.

B. Arrangement:

1. This arrangement of equipment as described by the specifications is based upon the best information available to the Owner at the time of the preparation of the concept drawings and specifications and is not intended to show exact dimensions peculiar to any specific manufacturer unless otherwise shown or specified. The Conceptual Drawings are, in part, diagrammatic, and, therefore, it is to be expected that the illustrated equipment, if any, be installed be per the Contractor's design and conform adequately to actual equipment installation requirements. The Owner or representative will review all equipment shape drawings, and installations to assure compliance with these requirements. It is to be anticipated that structural supports, equipment pads, foundations, connected piping and valves shown, in part or in whole, may have to be altered in order to accommodate the equipment furnished. Equipment pads shall be increased or reduced in size to properly suit the actual equipment. No additional payment will be made for such changes. All necessary calculations and drawings shall be submitted to the Owner or representative prior to beginning of the construction phase.

1.04 QUALITY ASSURANCE

- A. Equipment and appurtenances shall be designed in conformity with the conceptual documents and performance specifications.

Equipment shall be constructed of materials for the conditions of exposure and of such strength to withstand all stress which may occur during testing, installation, all conditions of operation, including start-up, shut-down and power failure.

- B. All equipment shall be installed true and level and to the locations shown on the Plans. All work shall be performed to the satisfaction of the Owner. Precision gauges and levels shall be used in setting all equipment.
- C. The Contractor shall be responsible for installation of the equipment in a manner consistent with the requirements of performance warranties and equipment workmanship of the manufacturer.
- D. Machinery parts shall conform exactly to the dimensions shown on the Shop Drawings. The corresponding parts of identical machines shall be made interchangeable. Clearance shall be provided for repairs, inspection and adjustment.
- E. Exposed surfaces shall be finished in appearance. All exposed welds shall be ground smooth at the corners for personnel protection.
- F. All machinery and equipment shall comply in all respects with the provisions of the Occupational Safety and Health Act of 1970, and other applicable Federal, State and local laws and regulations.
- G. Conformance to Design Criteria and Performance Guarantee.
 - 1. In submitting a bid, the Contractor shall formally acknowledge receipt of and understanding of the design criteria presented in the Conceptual Drawings and Performance Specifications and guarantees that the equipment to be supplied shall be designed and performs in compliance with the design criteria.
 - 2. Contractor shall guarantee all equipment provided under this Contract in accordance with the Contract Documents.

1.05 SUBMITTALS AND MISCELLANEOUS REQUIREMENTS

- A. General:

1. All mechanical equipment provided under this division shall be submitted for review by the Owner or Representative. The submittal package for each individual equipment or groups of related equipment shall be complete and in accordance with Section 01300 – Submittals/Shop Drawings.

PART 2 - PRODUCTS

2.01 ANCHORS AND SUPPORTS

- A. The Contractor shall furnish, install and protect all guides, bearing plates, anchor and attachment bolts, and all other appurtenances required for the installation of equipment. Anchors and supports shall be of ample size and strength for the purpose intended and shall be approved by the Owner or Representative.
- B. Anchor bolts shall be furnished and set in concrete foundations where required. All anchor bolts, studs and fasteners shall be Class 316 stainless steel.
- C. Anchor bolts, flange bolts, and other fasteners using nuts and threaded bolts shall have no more than 1 ½ to 2 threads extending beyond the nut when fully tightened.
- D. The Contractor shall obtain and use shop drawings and suitable templates when required for installation of equipment.

2.02 LUBRICATION

- A. The Contractor shall thoroughly lubricate all equipment in accordance with the equipment manufacturer's instructions. Lubricating oils and greases shall be of the type and viscosity recommended by the equipment manufacturer.
- B. All lubricants shall be furnished with flushing oils as recommended by the manufacturer. This includes, but is not limited to, all gearing and bearings, regardless of whether they have been shipped with or without oil soluble protective coatings.
- C. Following flushing, oil lubricating systems shall be filled with "run-in" oil as recommended by the equipment manufacturer. The equipment shall be "run-in" at the no load condition for a minimum of two (2) hours. Following "run-in" and inspection, the equipment

is to be drained and flushed again with flushing oil and refilled with lubricant as recommended by the manufacturer.

- D. The grease fittings on all mechanical equipment shall be such that they can be serviced with a single type of grease gun. Grease fittings shall be standard zirt type.
- E. Where locally mounted grease fittings would be difficult to service, the fitting shall be extended by adequately sized 316 stainless steel tubing to a point that shall provide accessibility for normal maintenance. Such points shall be located and installed as per the Owner or Representative's directive.

2.03 PROTECTIVE COATING AND PAINTING

- A. All equipment and materials shall be shop painted. Particular attention shall be directed to wetted surfaces and other areas exposed to corrosive, extreme temperature or other hazardous environments.
- B. Painting shall be in strict accordance with Section 09800 unless otherwise indicated in the detailed equipment specifications. If there is no Section 09800, coating shall be as follows:
 - 1. Ferrous Metals: Exterior Exposure (Non-submerged and non-buried)
 - a. Surface preparation: SSPC-SP 6.
 - b. Product: Devoe:
 - (1) Primer: Bar Rust 231 - 2 coats (3-5 mils DFT)
 - (2) Intermediate: Devran 224 HS (4-5 mils DFT)
 - (3) Finish: Devthane 378H - 1 coat (3-5 mils DFT) or approved equal.
 - c. Color to be selected by the Owner.
 - 2. All Piping and Valves that have a factory epoxy coating shall receive a final coating in the field with a product compatible with the existing coating.
 - a. Color to be selected by the Owner.

- C. All machined surfaces and shafting shall be cleaned and protected from corrosion by the proper type and amount of coating necessary to assure a minimum protection for two (2) years after shipment.
- D. Oil lubricated gearing, bearings, and other lubricated components shall be shipped with an oil soluble protective coating as recommended by the manufacturer. The coating shall be selected to provide protection for two (2) years.
- E. Motors, reducers and electric controls shall have the standard factory finish prior to delivery except where specific exception is noted in the individual equipment specifications.
- F. Provide two (2) gallons of paint compatible with the equipment finish coat for field touch-up and provide blend numbers for primer coat and finish coat paints.

2.04 COUPLINGS

- A. Unless otherwise specified, mechanical equipment with a driver greater than ½ horsepower, and where the input shaft of a driven unit is directly connected to the output shaft of the drive, shall have its two shafts connected by a flexible coupling which can accommodate angular misalignment, parallel misalignment and end float, and which cushions shock loads and dampens torsional vibrations. The flexible member shall consist of a tire with synthetic tension members bonded together in rubber. The flexible member shall be attached to flanges by means of clamping rings and cap screws, and the flanges shall be attached to the sub shaft by means of taperlock bushings which shall give the equivalent of a shrunk-on fit. There shall be no metal-to-metal contact between the driver and the driven unit.
- B. Coupling sizes shall be as recommended by the manufacturer for the specific application, considering horsepower, speed of rotation, and type of service, and shall be installed as recommended by the manufacturer.

2.05 GUARDS

- A. All exposed moving parts shall be provided with guards in accordance with the requirements of CAL/OSHA. Guards shall be fabricated of 14 gage steel, ½-13-15 expanded metal screen to provide visual inspection of moving parts without removal of the guard. Guards shall be galvanized after fabrication and shall be

designed to be readily removable to facilitate maintenance of moving parts. Reinforced holes shall be provided.

2.06 NAMEPLATES

- A. A nameplate shall be provided on all items of equipment and shall contain approved equipment name or abbreviation and equipment number. Equipment nameplates shall be engraved or stamped on stainless steel and fastened to the equipment in an accessible location with No. 4 or larger oval head stainless steel screws or drive pins. Nameplates for motor-driven equipment shall include capacity, head, horsepower, bearing data, model number and serial number of pump, blower, compressor and motor. The main sewage pump nameplates shall also include the impeller diameter.

2.07 TOOLS AND ACCESSORIES

- A. The Contractor shall supply one (1) complete set of any special wrenches or other special tools necessary for the assembly, adjustment, and dismantling of the equipment. Special tools shall include any type of tool that has been specifically made for use on an item of equipment for assembly, disassembly, repair, and maintenance or is not available in current Snap-On Catalogue or Proto Professional Tools Full-Line Catalogue. When special tools are provided, they shall be marked or tagged, and a list of such tools shall be included with the maintenance and operation manuals describing the use of each marked tool. All wrenches and spanners shall be of best quality, hardened steel forgings with bright, finished heads and with work faces dressed to fit nuts. Each set of tools shall be neatly mounted in a toolbox of suitable design provided with a hinged cover.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. The Contractor shall cause each item of equipment provided as a part of the Contract Documents to be installed, aligned and tested by skilled workmen to the tolerances recommended by the equipment manufacturer. In addition, the equipment shall be installed, aligned and tested under the direction of installation engineers who have been factory trained by the equipment manufacturer. Upon completion of the Work and as a condition precedent to final acceptance, the Contractor shall furnish written certification from each equipment manufacturer that each item has

been installed, aligned and tested correctly and that the installation meets all the manufacturer's requirements for efficient, trouble-free operation. This provision, however, shall not be construed as relieving the Contractor of his overall responsibility for the Work.

3.02 NOISE REQUIREMENTS

- A. All equipment specified shall be tested for noise generation after installation. When tested, equipment shall include the complete driver and driven equipment. Three (3) certified copies of the test shall be submitted to the Owner for approval prior to final acceptance.

3.03 SHOP INSPECTION AND SHOP TESTING

- A. The Owner shall be granted reasonable access to the production and shop test areas of the equipment manufacturer's facility during manufacturing and testing.
- B. The Contractor shall notify the Owner in writing, at least ten (10) working days prior to commencement of shop tests, of the time and place of all shop tests.
- C. Inspection by the Owner will not relieve the Contractor of his responsibility for workmanship, materials and Conceptual Drawings and Specification requirements.
- D. Manufacturer's standard test procedures shall be required and the manufacturer shall demonstrate that equipment meets all the requirements of these Conceptual Drawings and Specifications.

3.04 SHIPPING AND IDENTIFICATION

- A. All shipments shall be "tagged" by the Contractor with "wired-on" metal or plastic tag clearly stenciled or lettered with paint or waterproof ink. The information on the tags and cartons shall include Contractor's order number, purchase order number, manufacturer's number, and equipment number. Any expense incurred by the Owner due to the Contractor's failure to do so will be backcharged or deducted from his Contract.
- B. Each piece of equipment shall be provided with a substantial stainless steel nameplate, securely fastened in a conspicuous location and clearly inscribed with the manufacturer's name, year of manufacturer, serial number, principal rating data and equipment item number.

- C. The equipment covered in these Specifications shall be fabricated in the minimum number of sub-assemblies necessary for transportation. Small components or assemblies shall be adequately boxed or crated to prevent damage during shipment.
- D. Each assembly or package shall be identified with a durable shipping tag securely attached and plainly marked with the Contractor's order number, manufacturer's purchase order number and equipment number.
- E. All openings shall be covered with plywood, plastic or wood plugs or shields to prevent debris from entering the assemblies. Each assembly or sub-assembly shall have lifting lugs to facilitate erection and subsequent removal when necessary.

3.05 OPERATION AND MAINTENANCE MANUALS

- A. Operation and Maintenance manuals shall be furnished in accordance with Section 01730.

3.06 OPERATION AND MAINTENANCE INSTRUCTION

- A. The Contractor shall provide instruction time in accordance with the detailed equipment specifications, after the equipment has been accepted by the Owner. The time shall be used to instruct the Owner's personnel in the proper operation and maintenance of the equipment. The manufacturer shall provide technical personnel familiar with the operation and maintenance of the equipment in making this presentation.
- B. Training shall consist of on-site operation training, classroom training, operational, safety and emergency drills.

3.07 INSTALLATION OF EQUIPMENT

- A. The Contractor's work procedure shall conform to the manufacturer's installation instructions unless expressly directed otherwise by the Owner.
- B. Equipment shall be erected level and plumb on the existing foundations and supports at the locations and elevations shown on the Plans, unless otherwise directed, in writing, by the Owner and Resident Project Representative during installation. Any additional

pads, plates and other appurtenances necessary for the installation shall be provided by the Contractor.

- C. The equipment shall be brought to proper level with leveling nuts. After the machine has been leveled and aligned, the nuts on the anchor bolts shall be tightened to anchor the machine firmly into place against the leveling nuts.
- D. The grout shall be installed in accordance with the manufacturer's instructions.
- E. All equipment shall be installed in such a manner as to provide access for routine maintenance and lubrication as specified in Section 2.02 of this specification.
- F. Equipment of a portable nature which requires no installation shall be delivered to a location designated by the Owner.

3.08 MECHANICAL START-UP

- A. Once the equipment has been installed, complete with all auxiliary and support systems, and is ready for operation, the Contractor shall mechanically check out the equipment to verify that the equipment functions correctly under "non-process" conditions. The equipment shall be fine-tuned, adjusted, water tested, where applicable, and completely checked out before the equipment and support systems are considered ready for process start-up.
- B. The Contractor will be responsible for coordinating this effort and providing all support services and facilities necessary for this work effort.
- C. The equipment will not be considered ready for process start-up until the Owner is satisfied that the equipment has been satisfactorily checked out and successfully passed leakage and non-process test runs and appropriate training has been completed per the detailed equipment specifications.

3.09 FIELD SERVICE

It is understood that the Contractor and manufacturer share a joint responsibility in this Work. The Contractor shall provide the Manufacturer's qualified field representative and supporting personnel as required for the equipment furnished and installed under this Contract to perform the following:

- A. Assistance during equipment installation shall be provided to align the equipment or check the alignment of pre-aligned equipment prior to making connections to or anchoring of the equipment.
- B. Inspection during equipment installation work shall be provided to determine compliance with equipment erection methods and procedures recommended by the manufacturer.
- C. Conduct the process start-up necessary to operate, adjust, calibrate and tune the equipment and systems into operating service in accordance with the design criteria described in each detailed equipment specification.
- D. Conduct performance tests to demonstrate compliance with design criteria and performance guarantee set forth in the Specifications.

3.10 PROCESS START-UP

- A. Once the equipment has been considered ready for process start-up and the support system can deliver the process material, the Contractor shall start up the equipment under process conditions and conduct performance tests to verify compliance with the Specifications. The Contractor shall give the Owner forty-eight (48) hours written notice of his intent to start up equipment under process conditions and conduct performance testing.
- B. The Contractor shall provide the necessary supervision and technical personnel and services required to perform the work. The Owner shall coordinate this phase of the work with the Contractor and provide all necessary support services and facilities to assist the Contractor in performing the work.
- C. The equipment shall be considered ready for a performance test only after the Contractor has demonstrated to the Owner that the equipment can operate continuously, without mechanical interruption under the process flow conditions for up to three (3) days, or such time as may be mutually agreeable to the Owner and Contractor.
- D. After it has been determined that the equipment will operate satisfactorily under process conditions, the performance test shall be made by the Contractor to verify that the equipment can meet the requirements outlined in the Specifications. The performance test shall be based on maintaining the design requirements for a time period mutually agreeable to the Owner and the Contractor, or such period as is stipulated in the General Provisions.

3.11 OWNER FURNISHED EQUIPMENT

- A. The Contractor shall notify the Owner when Owner furnished equipment is completely installed in accordance with the Owner furnished manufacturer's instruction and requirements of the Contract Documents and ready for operation testing. The Owner or Representative will schedule the manufacturer's representative to visit the site of the Work and inspect, check adjust if necessary and approve the equipment installation. If the manufacturer's representative cannot complete the testing and startup services due to the Contractor's negligence in installing the equipment, the Contractor shall be responsible for the costs of the service representatives' revisit to the site of the Work.

3.12 PERFORMANCE TESTS

- A. Performance test procedures shall be prepared by the Contractor and approved (in writing) by the Owner a minimum of fourteen (14) days before performance tests are conducted.
- B. Costs of all inspections, field service, mechanical start-up, run-in work, process start-up and performance tests shall be borne by the Contractor and shall be included in the total price bid for the Work.
- C. The Contractor shall also agree to repay the Owner installation costs for any rejected equipment. The installation costs will be derived by the Owner based on actual costs charged for the installation of the equipment.

3.13 ACCEPTANCE OF EQUIPMENT BY THE OWNER

After all the conditions of the Performance Specifications have been satisfied, the Owner will designate in writing that the equipment is accepted, and at such time the Owner will be responsible for all further maintenance and operation of same. The warranty period for all equipment shall start on the date of final acceptance by the Owner.

END OF SECTION 01660

SECTION 01722 – SURVEYING AND CONSTRUCTION STAKING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Permanent Survey Marker:

1. The Contractor shall be responsible for the preservation of survey monuments and benchmarks except as noted herein. At least two (2) working days before the start of construction, the Contractor shall submit acceptable preconstruction survey tie notes to the Engineer's office. These tie notes shall be prepared by a California-licensed Land Surveyor or Registered Civil Engineer authorized to practice land surveying. These survey tie notes will be for all survey markers or benchmarks that may be lost or disturbed due to construction. Lost or disturbed monuments shall be replaced at the Contractor's expense by a California Licensed Land Surveyor or Registered Civil Engineer authorized to practice land surveying. Post-construction survey monument ties acceptable to the Engineer shall be submitted to the Engineer's office before the completion of the Work (see "Monuments", Section 8771, Land Surveyors Act, Division 3, Chapter 15 of the Business and Professions Code). The Engineer will re-establish the monuments and benchmarks where survey services are provided by the Engineer, providing the Contractor protects the preconstruction reference points. In this case, where the monuments are to be removed or damaged by the Contractor, the Contractor shall notify the Engineer in writing seven (7) calendar days before starting the Work.

B. Lot Stakes:

1. The Contractor shall preserve property line and corner survey markers, except where their destruction is unavoidable. The lot stakes shall be replaced per Specification Section 01722, 1.01, A, 1 (noted above). Markers that otherwise are lost or disturbed by its operations shall be replaced at the Contractor's expense by the Engineer.

C. Survey Services:

1. The Engineer will perform and be responsible for the survey work at the Site unless otherwise noted on the Plans or Specifications. The Contractor shall preserve construction survey stakes and marks for the duration of their usefulness. If any construction survey stakes are lost or disturbed and need to be replaced, such replacement shall be accomplished by the Engineer at the expense of the Contractor.
2. The Engineer shall establish horizontal and vertical control points for construction. The Contractor shall notify the Engineer in writing at least five (5) full working days before survey services are required in connection with the laying out of any portion of the work. The Contractor shall dig all holes necessary for line and grade stakes when requested by the Engineer.
3. The Contractor shall be responsible for their own layout based on the Engineer's survey stakes and cut sheets. The Contractor shall allow sufficient time for checking and issuance of cut sheets by the Engineer.
4. Unless otherwise specified, stakes will be set and stationed by the Engineer for curbs, ribbon gutters, headers, sewer pipelines, water pipelines, storm drains, structures, and rough grade. A corresponding cut or fill to finished grade (or flowline) will be indicated on the cut sheet.

D. Line and Grade:

1. The Engineer shall set alignment and grade stakes only for all on-site pipelines that are four-inches (4") in diameter or larger. The Contractor shall furnish all other lines and grades required for proper execution of the work.
2. After exterior walls have been located, the Contractor shall be responsible for the location of all interior construction including interior piping.
3. All work shall conform to the lines, elevations, and grades illustrated on the Plans.
4. Three consecutive points set on the same slope shall be used together so that any variation from a straight grade can be detected. Any such variation shall be reported to the Engineer in writing. In the absence of such written

notification, the Contractor shall be responsible for any error in the grade of the finished work.

5. Grades for underground pipelines will be established by the offset hubs at the surface of the ground. The Contractor shall be responsible for transferring the grades to the bottom of the trench and pipeline.

E. Benchmarks:

1. The Contractor shall use the benchmarks illustrated on the Plans to conduct grading work at the project site. The Contractor shall be allowed to establish temporary benchmarks; however, the Contractor shall establish the temporary benchmarks from the benchmarks illustrated on the Plans. The Contractor shall provide the Engineer with fully prepared Level Notes substantiating the correct elevation of the temporary benchmark.

- F. The Contractor shall provide grade checkers to verify subbase, subgrade and final grade elevations prior to those grades being checked, verified and approved by the Engineer. The Contractor shall provide grade checkers to place bluetop staking in parking lots, basins, roadways or other specified locations as required by Improvement Plans. Bluetop stakes are stakes set to grade. The Engineer will verify the grading work after the bluetop stakes have been placed by the grade checkers. The Contractor shall review Section 02200 - Earthwork; Section 02221 - Trenching, Backfilling and Compacting and Section 02510 - Asphalt Concrete and Paving, required for any required bluetop staking for this project.

- G. The Engineer shall provide three (3) sets of cut sheets to the Contractor within 24 hours after completing a staking activity.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 02200 – Earthwork
- B. Section 02221 – Trenching, Backfilling and Compacting

PART 2 - EXECUTION

2.01 SURVEY REQUIREMENTS

The Engineer shall provide the Survey and Staking for the following listed items for this project.

A. Water Well:

1. Two (2) in-line offset stakes for the well point. The hubs shall be placed at a distance of 10-feet from the well.
2. Four (4) offset stakes for the structure shall be set at a diagonal from the corners of the slab for initial excavation purposes. The hubs shall be placed at a distance of 5-feet from the exterior edges of the slab unless a different horizontal distance is requested by the Contractor.

B. Pipelines:

1. Hubs shall be provided at 20 feet on center along the length of the pipelines at an offset determined by the Contractor. Hubs shall also be placed at vertical or horizontal angle points, valve locations, fittings, beginning points and termination points. Vertical cut distances as referenced from the offset hubs to the invert (flowline) elevations of the pipelines shall be provided.

C. Roadway Edges:

1. Offset hubs shall be placed along the exterior edges of roadways 20 feet on center at an offset determined by the Contractor. Offset hubs shall be placed at angle points, beginning of curb radius points, end of curb radius points, beginning and termination points. Cut and fill vertical distances to the top of the exterior roadway edge finish grade surface shall be provided.

END OF SECTION 01722

SECTION 02050 - DEMOLITION AND SALVAGE

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The Contractor shall provide demolition and removal of existing structural materials, piping, fencing, electrical gear, equipment and structures in accordance with the requirements of the Contract Documents. The Contractor shall conduct demolition operations so that existing facilities to remain and new work to be completed will not be damaged or disturbed.
- B. It is vital that the existing treatment plant system remain in operation at all times. Any proposed shut-down of any one of the systems facilities shall be coordinated and approved by the Owner and the Owners Representative.
- C. If during demolition operations the Contractor becomes aware of any asbestos, hazardous waste or toxic material at the Site to which the Contractor or any subcontractor, supplier or Owner's personnel may be exposed, the Contractor follow procedures as noted in Articles 4 and 8 of the Standard General Conditions.
- D. The Contractor shall repair or replace, without cost to the Owner and to the satisfaction of the Owners Representative, existing facilities disturbed or damaged during demolition and removal operations.
- E. Immediately upon removal of demolition items, the Contractor shall legally dispose of demolished items not to be salvaged. Demolished items not to be salvaged shall be removed from the Site within ten (10) calendar days of the commencement of demolition activities. ***Unless noted in the Plans, the Owner reserves the right to salvage any of the existing material or equipment. The Contractor, upon being notified by the Owners Representative, shall salvage and relocate to an Owner-designated, on-site storage area any materials or equipment the Owner desires to keep. The cost of the removal and relocation of the items shall be included in the contract price.*** No demolished items shall be sold while on the Owner's property.
- F. The Contractor shall patch and seal abandoned openings and holes left as a result of removal and demolition to match the existing surrounding structure. Openings in concrete shall be

patched with a non-shrink grout and if necessary grouted openings in floors shall be supported in a manner approved by the Owners Representative. Large openings shall be supported by $\frac{3}{4}$ -inch minimum treated plywood bolted to the structure underneath the opening prior to the placement of the non-shrink grout.

- G. Existing concrete structures exhibiting spalls or holes not related to previously installed mechanical equipment shall be patched with a non-shrink grout.

END OF SECTION 02050

SECTION 02200 - EARTHWORK

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The Work of this Section includes all earthwork required for construction of the Work. Earthwork shall include, but not be limited to the loosening, removing, loading, transporting, depositing and compacting in its final location of all materials wet and dry, as required for the purposes of completing the work specified in the Contract Documents which shall include, but not be limited to: P.C.C. concrete and underlying material to a subbase design grade, the installation of subbase material to a subbase grade beneath concrete infrastructure, the excavation of pipeline trenches, the installation of backfill material within pipeline trenches, excavations for above-grade and below-grade structures, backfill requirements for material to be placed beneath above-grade and below-grade structures, backfill requirements for the areas surrounding above-grade and below-grade structures, backfilling of depressed areas resultant from demolition, the disposal of excess excavated materials, borrow of materials to make up deficiencies for fills; and all other incidental earthwork, all in accordance with the requirements of the Contract Documents.

Principal work items included in this Section are:

1. Structural excavation and backfills.
2. Trench excavation and backfills.
3. Disposal of surplus and/or unsuitable materials.
4. Clean-up.

1.02 REFERENCE STANDARDS

ASTM C 131	Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM D 75	Practice for Sampling Aggregates
ASTM D 422	Method for Particle-Size Analysis of Soils

ASTM D 698	Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5-lb (2.49-kg) Rammer and 12-in (304.8-mm) Drop
ASTM D 1556	Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	Test Method for Moisture-Density Relations of Soils Using Rammer and Drop
ASTM D 2419	Test method for Sand Equivalent Values of Soil and Fine Aggregate
ASTM D 2487	Classification of Soils for Engineering Purposes
ASTM D 2922	Test Method for Density of Soil in Places by Nuclear Methods (Shallow Depth)
ASTM D 3017	Test method for Water Content of Soil and Rock in Place by Nuclear Methods
ASTM D 4253	Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Plate
ASTM D 4254	Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
CAL-OSHA	Title 8 General Industry Safety Orders

1.03 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 02150 - Sheeting, Shoring and Bracing
- B. Section 02221 - Trenching, Backfilling and Compacting
- C. Section 02630 - Ductile Iron Pipe
- D. Section 02640 - PVC Pipe

1.04 DEFINITIONS

- A. Site: The property owned by the Palo Verde County Water District. The site includes the Water Treatment Plant site.
- B. Controlled Fill: Compacted suitable fill material in all areas of the site requiring filling to grade as shown on the Plans.

- C. Structural Fill: Compacted suitable fill material which will support a structure or some part of a structure. This includes support material for P.C.C. structures and pads
- D. Structural Backfill: Compacted suitable material placed between the wall of a structure and construction excavation slope up to finished grade.
- E. Suitable Material: As specified herein shall be any material imported or excavated from the cut areas that is, in the opinion of the Owner's Representative, suitable for use in constructing fills.
- F. Waste Excavation: Also Surplus Material. Material from project excavations which is not suitable for use in backfill or compacted fills or is in excess of that required to be used for backfill or to construct fills.
- G. Pipe Zone Backfill: Material suitable for placement below or surrounding the pipe to a given vertical distance above the pipe as required by the pipe section.
- H. Pipe Trench Backfill: Material suitable for placement from the pipe zone to finish grade or to pavement subbase material.

1.05 SITE INVESTIGATION

- A. Soil Investigation Report: If required, a Geotechnical Report shall be prepared by a Geotechnical Engineer and be acquired by the Contractor. Soil requirements provided by the Geotechnical Report, shall be adhered to.
- B. Contractor's Responsibility: The Contractor shall carefully examine the site and make all inspections necessary in order to determine the full extent of the work required to make the completed Work conform to the Drawings and Specifications. The Contractor shall satisfy himself/herself as to the nature and location of the Work, conditions, the conditions of the existing ground surface, and the character of equipment and facilities needed prior to and during prosecution of the Work. The Contractor shall satisfy himself/herself as to the character, quality and quantity of surface and subsurface materials or obstacles to be encountered. Any inaccuracies or discrepancies between the actual field conditions and the Plans, or between the Plans and Specifications must be brought to the Owner's Representative's attention in order to clarify the exact nature of the Work to be performed.

- C. Existing Elevations: All existing elevations illustrated on the Plans are approximate. The Contractor shall recognize and acknowledge the condition that the bid lump sum price shall include all earthwork activities irrespective of the possible localized difference in contour elevations and actual ground; and that there will be no additional compensation from the Owner for earthwork changes, engineering, or field staking in this regard.

1.06 SAFETY

The Contractor shall familiarize himself/herself with, and shall at all times conform to, the regulations of the “OSHA General Industry Occupational Safety and Health Standards”, and “OSHA Safety and Health Regulations for Construction Safety Orders” and “Trench Construction Safety Orders” of the State of California, Department of Industrial Relations, Division of Occupational Health and Safety. A copy of these documents shall be kept on the job site.

1.07 ENVIRONMENTAL SAFEGUARDS AND REGULATIONS

The Contractor shall comply with regulations in force at all times to prevent pollution of air and water. The Contractor shall be responsible for the construction of Project Environmental Control facilities in accordance with Section 01560 of the Technical Specifications, as applicable.

1.08 GEOTECHNICAL TESTING

The Contractor shall provide the services of a qualified Geotechnical Consultant to perform the required earthwork geotechnical testing specified within the contents of the Plans and Specifications. The cost for the Geotechnical Testing shall be borne by the Contractor. A copy of all tests shall be forwarded to the Owner’s Representative within two (2) days after the testing is complete. Geotechnical Earthwork Testing shall include in-situ native soil compaction testing, moisture-density soils testing, compaction testing, gradation testing, sand equivalent testing and similar testing. The Contractor shall bear the cost of retest and re-inspection of re-worked material due to faulty work.

1.09 STANDARDS FOR SOIL CLASSIFICATION, PROPERTIES AND TESTS

A. Backfill for Trench:

1. Classification - ASTM D 2487.
2. Compaction - Modified Proctor ASTM D 1557-91.

3. Field Density Test - ASTM 1556-82; D 2937-83, D 2922-81 (as approved by Geotechnical Engineer).
- B. Structural Fill and Backfill:
1. Classification - ASTM D 2487.
 2. Attenberg Limits - PlastiOwner Index and Liquid Limit ASTM D 4318.
 3. Compaction - Modified Proctor ASTM D 1557-91.
 4. Physical Properties - ASTM D 854, D 2216.
 5. Field Density Test - ASTM D 1556-82, D 2937-83, D 2922-81 (as approved by Geotechnical Engineer).
- C. Controlled Fills:
1. Classification - ASTM D 2487.
 2. Physical Properties - ASTM D 854, D 2216.
 3. Compaction - Modified Proctor ASTM D 1557-91.
 4. CBR - ASTM D 1883 (R-Value - ASTM 2844).
 5. Field Density Test - ASTM D 1556-82, D 2937-83, D 2922-81 (as approved by Geotechnical Engineer).
- D. Borrow:
1. Classification - ASTM D 2487.
 2. Other properties - as determined by requirements at point of use.
- E. Pipe Trenches:
1. Classification - ASTM D 2487.
 2. Physical Properties - ASTM D 854, D 2216.
 3. Compaction - Modified Proctor ASTM D 1557-91.
 4. CBR - ASTM D 1883.

5. Field Density Test - ASTM D 1556-82, D 2937-83, D 2922-81 (as approved by Geotechnical Engineer).

1.10 COMPACTION

The maximum dry density, optimum moisture content and field density of each soil type used in the controlled compacted fill shall be determined as stated in Section 1.09 above.

1.11 INSPECTION

Observation and compaction tests shall be obtained by the Geotechnical Consultant engaged by the Contractor during the filling and compacting operations.

The Geotechnical Consultant shall be required to be present at the site on a full-time basis for several work activities and conduct intermittent testing for other work activities. The following chart indicates the earthwork items which will require full time or intermittent geotechnical testing.

<u>NO.</u>	<u>ITEM</u>	<u>GEOTECHNICAL TESTING</u>
1.	Installation of Class 2 Base and Granular Sand Fill material beneath Pipe Support foundations.	Intermittent Testing
2.	Installation of Class 2 Base and Granular Sand Fill material beneath the Shade Structure footings.	Intermittent Testing
3.	Installation of Class 2 Base beneath the any Concrete Pads.	Intermittent Testing
4.	Backfill for Water Pipe Trenches. The Specification requires that the backfill be compacted in lifts. Additional lifts shall not be allowed to be placed until previous lifts have been satisfactorily tested for compaction.	Intermittent Testing
5.	Backfill for Electrical Conduit Trenches, if applicable. The specification requires that the backfill be compacted in lifts. Additional lifts shall not be allowed to be placed until	Intermittent Testing

previous lifts have been satisfactorily tested for compaction. This requirement shall be strictly enforced and the Contractor shall be required to remove all backfill from the electrical conduit trench if this specification is violation.

5. Installation of Granular Sand for Water Pipelines.

Intermittent
Testing

1.12 GUARANTEE

Work required by this Section shall be subject to the guarantee requirements stated in the Conditions of the Contract and included in the Performance/Maintenance Bond.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Structural Fill Material: Materials shall consist of crushed rocks, Class 2 Base, granular sand, decomposed granite (crusher fines) or fine gravel either imported or manufactured from excavated onsite rocky material.

The crushed aggregate, granular sand, decomposed granite (crusher fines) or fine gravel shall be uniformly graded. The following gradations shall apply:

1. Granular Sand:

Clean granular sand free of clay, shale and deleterious material. Sand shall be compacted to 95 percent of maximum density at optimum water content per ASTM D 1557 unless otherwise noted on the Plans.

The material shall conform to a sand equivalent of 30 or greater.

The maximum amount of material passing the Number 200 sieve shall be 5 percent.

The sand shall conform to the following gradation percentages:

<u>SIEVE SIZE</u>	<u>GRANULAR SAND</u> <u>% PASSING</u>
3/8"	100
No. 4	98-90
No. 8	90-75
No. 10	75-60
No. 16	60-50
No. 30	50-38
No. 40	38-29
No. 50	29-19
No. 100	19-7
No. 200	5-0

The Contractor shall supply a 5-gallon sample of sand material to the material testing laboratory within five (5) days after the Notice to Proceed is issued. The gradation, sand equivalent and maximum density of the sand material shall be determined. The test results shall be forwarded to the Owner's Representative. The cost of testing shall be incurred by the Contractor. The gradation of the granular sand shall be determined and the test results forwarded to the Owner's Representative prior to the delivery of the granular sand material to the Site. Prior to the placement of sand the native subbase grade shall be checked and approved by the Owner's Representative.

Crusher fines shall be allowed to be utilized in lieu of sand if approved by the Owner's Representative.

2. Crusher Fines:

Crusher fines shall consist of decomposed granite indigenous to the Imperial Valley. Crusher fines utilized for this project shall conform to the following gradation requirements:

<u>SIEVE SIZE</u>	<u>PERCENT PASSING</u>
5/8"	100
No. 4	80-100
No. 8	50-85
No. 30	30-50
No. 200	4-15

The sand equivalent shall be 20 or greater.

The Contractor shall supply a five-gallon sample of crusher fines material to the material testing laboratory within five (5) days after the Notice to Proceed is issued. The Gradation and Maximum Density of the crusher fines material shall be determined. The test results shall be forwarded to the Owner's Representative for approval prior to the delivery of the material to the Site. The cost of the testing shall be incurred by the Contractor.

3. Fine Gravel:

Clean fine gravel free of clay, shale and deleterious material. Fine gravel shall be compacted with a plate compactor with one pass in maximum 1 foot lifts. Additional lifts shall not be added until previous lifts shall have been passed over by the plate compactor.

The maximum amount of material passing the 1/4" Sieve shall be 2 percent.

The fine gravel shall conform to the following gradation percentages:

<u>SIEVE SIZE</u>	<u>PERCENT PASSING</u>
3/8"	100
1/4"	0-2

The Contractor shall supply a five-gallon sample of fine gravel material to the material testing laboratory within five (5) days after the Notice to Proceed is issued. The Gradation and Maximum Density of the fine gravel material shall be determined. The test results shall be forwarded to the Owner's Representative for approval prior to the delivery of the material to the Site. The cost of the testing shall be incurred by the Contractor.

4. Class 2 Base:

The Class 2 Base material shall conform to Caltrans Section 26, Latest Edition, for 25mm maximum base material.

The gradation requirements are as follows:

<u>SIEVE SIZE</u>	<u>CLASS 2 BASE % PASSING</u>
1"	100
3/4"	87-100
No. 4	30-65
No. 30	5-35
No. 200	0-12

The sand equivalent shall be 25 or greater. An angular aggregate is to be used. Class 2 Base material shall be compacted to 95 percent of maximum density according to ASTM D 1557, unless otherwise noted on the Plans or Details. The tolerance for the Class 2 Base between design subgrade elevation and actual subgrade elevation as constructed in the field shall be plus or minus 0.02 feet as referenced from the design subgrade. Prior to the placement of Class 2 Base, the native subbase grade shall be checked and approved by the Owner's Representative. The native subbase grade shall be within plus or minus 0.05 feet of native subbase design grade prior to the placement of Class 2 Base.

The Contractor shall supply a 5-gallon sample of the Class 2 Base to the material testing laboratory within four (4) days of the Notice to Proceed. The material shall be delivered to the testing laboratory to determine the maximum density, gradation, R-value, sand equivalent and durability index of the Class 2 Base. A copy of the test results shall be forwarded to the Owner's Representative by the Geotechnical Consultant for review. The gradation of the Class 2 Base shall be determined and the test results forwarded to the Owner's Representative for approval prior to the delivery of the Class 2 Base material to the Site. *Class 2 Base utilizing recycled materials shall not be allowed.*

- C. Structural Backfill Material: Structural Backfill Material shall consist of the same material listed with the Structural Fill Material item above.
- D. Special Crushed Rock Bedding and Structure Foundation: When groundwater is encountered in the excavation and/or where indicated on the Plans, the material in the bottom of the trench or excavation shall be removed to a depth directed by the Geotechnical Engineer and replaced with 3/4-inch maximum

crushed rock bedding or 1" round rock bedding. The rock beddings shall be installed and compacted per these Specifications. The 3/4-inch maximum crushed rock and 1" round rock materials shall be approved by the Geotechnical Engineer before use.

The bottom and sidewalls of the trench shall be covered with a geotextile. The geotextile fabric shall extend to the top of the pipe zone material on both sides of the trench excavation, and cover the top of the crushed rock and or 1-inch round rock.

1. 3/4-Inch Maximum Crushed Rock

Crushed rock shall be the product of crushing rock or gravel. Fifty percent (50%) of the particles by weight retained on a 3/8-inch sieve shall have their entire surface area composed of faces resulting from fracture due to mechanical crushing. Not over 5% shall be particles that show no faces resulting from crushing.

Less than 10% of the particles that pass the 3/8-inch sieve and are retained on the No. 4 sieve shall be waterworn particles. Gravel shall not be added to the crushed rock.

Crushed rock (3/4") shall have the following gradation:

<u>SIEVE SIZES</u>	<u>3/4-INCH MAX. CRUSHED ROCK % PASSING</u>
1"	100
3/4"	90-100
1/2"	30-60
3/8"	0-20
No. 4	0-5
No. 8	-

The 3/4-inch maximum crushed rock shall be compacted with a plate compactor in one pass in maximum 1 foot lifts. Additional lifts shall not be added until previous lifts shall have been passed over by the plate compactor.

The Contractor shall supply a five-gallon sample of the 3/4-inch maximum crushed rock material to the material testing laboratory within four (4) days of the Notice to Proceed. The Gradation and Sand Equivalent of the

crushed rock shall be determined. The tests results shall be forwarded to the Owner's Representative for approval prior to the delivery of the material to the Site. The cost of the testing shall be incurred by the Contractor.

2. 1" Round Rock

The 1-inch round rock material shall conform to the following gradation requirements:

<u>SIEVE SIZES</u>	<u>1-INCH ROUND ROCK % PASSING</u>
1-1/2"	100
1"	96
3/4"	79
1/2"	25
3/8"	1

The 1-inch round rock shall be compacted with a plate compactor in one pass in maximum 1 foot lifts. Additional lifts shall not be added until previous lifts shall have been passed over by the plate compactor.

The Contractor shall supply a five-gallon sample of the 1-inch round rock material to the material testing laboratory within four (4) days of the Notice to Proceed. The Gradation of the round rock shall be determined. The tests results shall be forwarded to the Owner's Representative for approval prior to the delivery of the material to the Site. The cost of the testing shall be incurred by the Contractor.

PART 3 - EXECUTION

3.01 GENERAL

The Work performed under this Specification shall be constructed to the lines, grades, elevations, slopes and cross-sections indicated on the Plans, specified herein, and/or directed by the Owner. Slopes, graded surfaces, and drainage features shall present a neat uniform appearance upon completion of the Work.

It shall be the Contractor's responsibility (1) to maintain adequate safety measures and working conditions; and (2) to take all measures necessary during the performance of the Work to protect the entire project area and

adjacent properties which would be affected by this Work from storm damage, flood hazard, caving of trenches and embankments, and sloughing of material, until final acceptance by the Owner. It shall be the Contractor's responsibility to maintain completed areas until the entire project area is in satisfactory compliance with the job specification.

Utility lines and structures indicated on the Plans which are to remain in service shall be protected by the Contractor from any damage as a result of his/her operation. Where utility lines or structures not shown on the Plans are encountered, the Contractor shall report them to the Owner before proceeding with the Work. The Contractor shall bear the cost of repair or replacement of any utility lines or structures which are broken or damaged by his/her operations.

3.02 REMOVALS, CLEARING AND GRUBBING

- A. Clearing: Clearing consists of the complete removal of objectionable materials and obstructions above and below the ground surface including tree stumps, brush, grass, vegetative matter and other objectionable materials within the project limits. All brush and organic material shall be removed before placing any earth fills. It shall be the Contractor's responsibility to save and protect all trees that lie outside the construction area.
- B. Grubbing: Grubbing consists of the complete removal of stumps, including tap roots or lateral roots 1-1/2 inches or more in diameter, and the removal of brush, grass or weeds to depths below the natural ground as specified herein. Stumps shall be grubbed to a depth of 3 feet and grass or weeds shall be grubbed to a depth of 6 inches below the natural ground surface, or to the depths as determined in the field by the Owner's Representative at the time of construction.
- C. Protection: Existing items not designated to be demolished or removed shall be protected from damage. Any such item damaged by the Contractor shall be restored or replaced immediately at the Contractor's expense.
- D. Debris and Waste Material: All debris and waste material resulting from demolition, clearing and grubbing shall be removed from the site and disposed of by the Contractor.

3.03 DUST CONTROL

The Contractor shall take all steps possible to prevent and reduce dust arising from the construction activity. Section 01560 Project Environmental Controls elaborates on dust control requirements.

3.04 CARE OF DRAINAGE WATER

Contractor shall take care of drainage water from the construction operations, and of stormwater and/or wastewater reaching the construction area from any source, so that damage is not incurred to the excavation, pipe or structures. The Contractor shall be responsible for any damages to persons or property on or off the Site due to such drainage water or to the interruption or diversion of such stormwater or wastewater on account of his/her operation.

Such grading shall be accomplished as may be necessary to prevent surface water from flowing into excavations, and any water accumulating therein shall be removed by pumping or by other reviewed methods.

Protection of the site during construction shall be the responsibility of the Contractor. Completion of a portion of the project shall not preclude that portion or adjacent areas from the requirements for site protection until such time as the entire project is complete.

3.05 EXCAVATION

- A. General: The Contractor shall perform all excavation necessary or required as illustrated on the Plans. The excavation shall include the removal and disposal of all earth materials of whatever nature encountered, which shall include both rock excavation and common excavation when both are present, and shall include the furnishing, placing and maintaining of shoring and bracing necessary to safely support the sides of the excavations. The Work shall also include all pumping, ditching and other required methods for the removal or exclusion of water. See Technical Specifications Section 02150 - Sheeting, Shoring and Bracing, respectively.
- B. Excavation for Structures: Structure excavation shall include the removal of all materials of whatever nature encountered, including all obstructions of any nature that would interfere with the proper execution and completion of the Work. The removal of such materials shall conform to the lines and grades shown on the Plans and/or herein specified. Temporary structure excavations shall at all times conform to the Requirements of the State of California, Division of Occupational Health and Safety, and pertinent requirements contained in referenced Geotechnical Investigation

Report and Specification Section 02150 - Sheeting, Shoring and Bracing.

Continuous wall and isolated footings shall be underlain by a minimum compacted controlled fill thickness to a minimum 1.5 times the footing width or greater if indicated in the referenced Geotechnical Investigation Report or as required by the Plans. This zone of over-excavation, scarification and recompaction shall extend a minimum of five feet (5') beyond the footing lines unless otherwise illustrated on the Plans. Exposed native surface shall be scarified and brought to optimum moisture content and compacted to a minimum of 90 percent relative compaction if required by the Geotechnical Investigation Report or the Plans.

All surfaces to receive concrete slabs-on-grade shall be underlain by a minimum compacted controlled fill thickness of 18 inches or greater if indicated in the referenced Geotechnical Investigation Report or as required by the Plans. This shall be accomplished by combination of over-excavation and compaction of native material to 90% of relative compaction or as required by the Geotechnical Investigation Report or as required by the Plans.

Contingent upon locations, all surfaces to receive compacted fill shall be scarified, brought to near optimum moisture content and compacted to required percentage of relative compaction as specified herein unless otherwise indicated on the Plans.

Rough grade excavations for structures and footings will be inspected by the Geotechnical Engineer to verify that the excavations extend into satisfactory soils and are free of loose and disturbed materials.

Foundation for tanks, pump vaults or subsurface chambers shall have structural fill material extending 12 inches, minimum, below the structural base slab to native material, which has been scarified and compacted to 90% relative compaction unless otherwise indicated on the Plans.

3.06 STRUCTURE FILL AND STRUCTURE BACKFILL MATERIAL

- A. Placement of Structure Backfill: Before beginning backfilling, all foreign material, including water, shall be removed from the space to be backfilled and the area to be backfilled shall be inspected and approved by the Geotechnical Engineer. Sloping sides of the excavated space shall be stepped to prevent wedging action of the backfill against the structure. No backfill shall be placed around or

upon any structure until it is proven that the concrete has attained satisfactory strength in accordance with the Division 3 of Technical Specifications and that the structure as a whole is adequate to receive backfill. The compressive strength shall be determined by tests on representative cylinders cured under conditions similar to those prevailing at the site.

- B. General: Structure fill and structure backfill shall consist of granular sand, Class 2 Base, crusher fines or other material as indicated on the Plans. The subbase grade shall be excavated to within plus or minus 0.05 feet of design grade prior to the placement of structure fill and structure backfill. The design subbase grade shall be field verified and approved by the Owner's Representative prior to the placement of the structure fill or structure backfill material. The Owner's Representative shall determine the number and location of points to check for the subbase grade elevation compliance. Prior to the Owner's Representative's inspection of the subbase grade the Contractor shall establish bluetop stakes on a 20-foot by 20-foot grid across the area which structure backfill is to be placed.

Granular sand, Class 2 Base and crusher fine structure fill and structure backfill material shall be placed in maximum 8-inch lifts and compacted to 95 percent of maximum density at optimum water content per ASTM D 1557. Additional granular sand, Class 2 Base or crusher fine lifts shall not be placed until previous lifts have attained the specified compaction requirement and are approved by both the on-site geotechnical representative and the Owner's Representative.

- C. Placing, Spreading and Compacting Fill Material: The structural fill and structural backfill material shall be placed by the Contractor in thin layers that when compacted shall not exceed 8 inches. Each layer shall be spread evenly and shall be thoroughly mixed during the spreading to obtain uniformity of material in each layer.

When the moisture content of the fill material is below that required by the Geotechnical Engineer, water shall be added by the Contractor until the moisture content is as required for the specified compaction.

When the moisture content of the fill material is above that required by the Geotechnical Engineer, the fill material shall be aerated by the Contractor by blading, mixing, or other satisfactory methods until the moisture content is as required for the specified compaction.

After each layer has been placed, mixed and spread evenly, it shall be thoroughly compacted by the Contractor to the specified density. Compaction shall be accomplished by sheepsfoot rollers, vibratory rollers, multiple-wheel pneumatic-tired rollers or other types of acceptable compacting equipment. Equipment shall be of such design that it shall be able to compact the fill to the specified density. Compaction shall be continuous over the entire area and the equipment shall make sufficient passes over the material to ensure that the desired density has been obtained.

Compacted fill slopes shall be overbuilt and cut back to grade, exposing the firm, compacted inner core. The slopes shall be overbuilt a minimum of five feet (5'). If the desired compaction is not achieved, the existing slope shall be overexcavated and reconstructed. The amount of overbuilding shall be increased until the desired compaction is achieved on the slope. The Contractor shall provide thorough mechanical compaction to the outer edge of the overbuilt slope surface. There shall be no excessive loose soil on the slopes.

The Contractor shall provide and maintain adequate erosion control facilities during the construction of the fill areas. The erosion control facilities shall be maintained in optimum condition until the permanent drainage system and vegetation is complete. The facilities shall be inspected following significant rainfall, repairs made, and excess sediment removed. It shall be the Contractor's responsibility to prevent the discharge of sediment off-site or to adjacent watercourses.

3.07 SUITABLE MATERIAL AND WASTE EXCAVATION

- A. General: Suitable material or waste excavation consists of native material. The subbase grade shall be excavated to within plus or minus 0.05 feet of design grade prior to the placement of suitable material or waste excavation material. The design subbase grade shall be field verified and approved by the Owner's Representative prior to the placement of the suitable material or waste excavation material. The Owner's Representative shall determine the number and location of points to check for the subbase grade elevation compliance. Prior to the Owner's Representative's inspection of the subbase grade the Contractor shall establish bluetop stakes on a 20-foot by 20-foot grid across the area suitable material or waste excavation material is to be placed.

The suitable material or waste excavation material shall be placed in maximum 1-foot lifts and compacted to 90 percent of maximum density at optimum water content per ASTM D 1557. Additional suitable material or waste excavation material lifts shall not be placed until previous lifts have attained the specified compaction requirement and are approved by both the on-site geotechnical representative and the Owner's Representative.

- B. Placing, Spreading and Compacting Suitable Material and Waste Excavation Material: The suitable material and waste excavation material shall be placed by the Contractor in 1-foot lifts. Each layer shall be spread evenly and shall be thoroughly mixed during the spreading to obtain uniformity of material in each layer.

When the moisture content of the fill material is below that required by the Geotechnical Engineer, water shall be added by the Contractor until the moisture content is as required for the specified compaction.

When the moisture content of the fill material is above that required by the Geotechnical Engineer, the fill material shall be aerated by the Contractor by blading, mixing, or other satisfactory methods until the moisture content is as required for the specified compaction.

After each layer has been placed, mixed and spread evenly, it shall be thoroughly compacted by the Contractor to the specified density. Compaction shall be accomplished by sheepsfoot rollers, vibratory rollers, multiple-wheel pneumatic-tired rollers or other types of acceptable compacting equipment. Equipment shall be of such design that it shall be able to compact the fill to the specified density. Compaction shall be continuous over the entire area and the equipment shall make sufficient passes over the material to ensure that the desired density has been obtained.

Compacted fill slopes shall be overbuilt and cut back to grade, exposing the firm, compacted inner core. The slopes shall be overbuilt a minimum of five feet (5'). If the desired compaction is not achieved, the existing slope shall be overexcavated and reconstructed. The amount of overbuilding shall be increased until the desired compaction is achieved on the slope. The Contractor shall provide thorough mechanical compaction to the outer edge of the overbuilt slope surface. There shall be no excessive loose soil on the slopes.

The Contractor shall provide and maintain adequate erosion control facilities during the construction of the fill areas. The erosion control facilities shall be maintained in optimum condition until the permanent drainage system and vegetation is complete. The facilities shall be inspected following significant rainfall, repairs made and excess sediment removed. It shall be the Contractor's responsibility to prevent the discharge of sediment off-site or to adjacent watercourses.

3.08 ESTABLISHMENT OF SUBBASE GRADE, SUBGRADE OR FINISH GRADE

Finish Grade is defined as the finish surface grade. For instance, the top of an A.C. or P.C.C. paved surface is referred to as finish grade.

Subgrade is defined as the grade of the material beneath the finish surface. For instance, the top of Class 2 Base grade beneath an A.C. or P.C.C. paved surface is referred to as subgrade.

Subbase is defined as the grade of the material beneath the base material. For instance, the top of native material beneath the Class 2 Base subgrade material of an A.C. or P.C.C. paved roadway is the subbase grade.

Finish grade surfaces are to be graded to within plus or minus 0.02 feet from design grade as illustrated on the Grading Plans. The Contractor shall place bluetop stakes on a 20-foot x 20-foot grid across the top of the finish grade surface during final grading. A bluetop stake is defined as a stake placed at the finish grade elevation within the tolerance of plus or minus 0.02 feet of finish grade. The Owner's Representative shall obtain elevations across finish grade surfaces at locations determined by the Owner's Representative prior to accepting and approving the finish grade surfaces. The Contractor shall rework areas not conforming to the finish surface grade tolerance as required. Work items to occur after the establishment of finish grade shall not occur until the Owner's Representative has approved the finish grade.

Subgrade surfaces are to be graded to within plus or minus 0.02 feet from design grade as illustrated on the Grading Plans. Bluetop stakes shall be placed on a 20-foot x 20-foot grid pattern across rectangular or square facilities such as parking lots and access roads. The Owner's Representative shall obtain elevations across the subgrade surfaces at locations determined by the Owner's Representative prior to accepting and approving the subgrade surfaces. The Contractor shall rework areas

not conforming to the subgrade tolerance as required. Work items to occur after the establishment of subgrade shall not occur until the Owner's Representative has approved the finish subgrade.

Subbase surfaces are to be graded to within plus or minus 0.05 feet of subbase design grade as illustrated on the Grading Plans. Bluetop stakes shall be placed on a 20-foot x 20-foot grid pattern across rectangular or square facilities such as parking lots, access roads, sludge beds, structures, building pads, etc. The Owner's Representative shall obtain elevations across the subbase surfaces at locations determined by the Owner's Representative prior to accepting and approving the subbase surfaces. The Contractor shall rework areas not conforming to the subbase design grade tolerance as required. Work items to occur after the establishment of subbase grade shall not occur until the Owner's Representative has approved the subbase grade.

3.09. CLEAN-UP

Upon completion of Work in this Section, all rubbish and debris shall be removed from the site. All construction equipment and implements of service shall be removed and the entire area involved shall be left in a clean, neat and acceptable condition.

END OF SECTION 02200

SECTION 02221 - TRENCHING, BACKFILLING AND COMPACTING

PART 1 - GENERAL

1.01 DESCRIPTION

Requirements specified in the Technical and Special Conditions form a part of this Section. The Work of this Section includes all labor, machinery, construction equipment and appliances to perform in a professional manner all trench excavation and backfill work illustrated on the Plans and herein specified.

A. Principal items included:

1. Trench excavation, backfill and compaction.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02150 – Sheeting, Shoring and Bracing

B. Section 02200 – Earthwork

C. Piping & Conduit Work specified in other Sections

1.03 SAFETY

The Contractor shall be familiarized with, and shall at all times conform to all applicable regulations of “Excavations, Trenching, and Shoring” of OSHA Safety and Health Regulations for Construction, “General Construction Safety Orders” and “Trench Construction Safety Orders” of the State of California, Department of Industrial Relations, Division of Occupational Health and Safety.

1.04 INSPECTION AND CONTROL

The Contractor shall provide inspection and testing by a Geotechnical Engineer. The Geotechnical Engineer shall be engaged by the Contractor, to perform inspection of the removal and replacement of unsuitable materials, all excavations, and the placement and compaction of all fills and backfills within the limits of earthwork on this Project. Costs for all such inspections and tests will be paid by the Contractor, and Contractor shall bear the cost of retest and re-inspection of reworked fills and backfills due to compaction test failure.

1.05 REQUIREMENTS

A. General:

1. The Work performed under this Specification shall be constructed to the lines, grades, elevations, slopes and cross-sections indicated on the Plans, specified herein, and/or directed by the Owner's Representative in writing. Slopes, graded surfaces, and drainage features shall present a neat, uniform appearance upon completion of the Work.
2. It shall be the Contractor's responsibility (1) to maintain adequate safety measures and working conditions; and (2) to take all measures necessary during the performance of the Work to protect the entire project area and adjacent properties which would be affected by this Work from storm damage, flood hazard, caving of trenches, cavings of excavations, and embankments, and sloughing of material, until final acceptance by the Owner. It shall be the Contractor's responsibility to maintain completed areas in good condition until the entire project area is in satisfactory compliance with the Project Specifications.
3. Contractor shall be responsible for the excavation and disposition of unsuitable or surplus material by approved means of conveyance away from the working area.

B. Protection of Existing Utilities:

1. Utilities: Unless otherwise illustrated on the Plans or stated in the Specifications, all utilities, either underground or overhead, shall be maintained in continuous service throughout the entire contract period. The Contractor shall be responsible and liable for any damages to or interruption of service caused by the construction.

If the Contractor desires to simplify his operation by temporarily or permanently relocating or shutting down any utility or appurtenance, he shall make the necessary arrangements, agreements and approvals with the utility purveyor, Owner and the Owner's Representative and shall be completely responsible for all costs concerned with the relocation or shutdown and reconstruction. All property shall

be reconstructed in its original or new location as soon as possible and to a condition at least as good as its previous condition. This cycle of relocation or shutdown and reconstruction shall be subject to inspection and approval by the Owner's Representative, Owner and the utility purveyor.

The Contractor shall be entirely responsible for safeguarding and maintaining all conflicting utilities that are illustrated on the Plans. This includes overhead wires and cables and their supporting poles whether they are inside or outside of the open trench. If, in the course of work, a conflicting utility line that was not illustrated on the Plans is discovered, it shall be brought to the immediate attention of the Owner's Representative for a determination regarding alternatives to the conflict.

2. Building, Foundations and Structures: Where trenches are located adjacent to buildings, foundations and structures, the Contractor shall take all necessary precaution against damage to them. The Contractor shall be liable for any damage caused by the construction except where authorized in the Special Conditions or in writing by the Owner's Representative. Water settling of backfill material in trenches adjacent to structures will not be permitted.
3. Electronic, Telephonic, Telegraphic, Electrical, Oil and Gas Lines: These underground facilities shall be adequately supported by the Contractor. Support for plastic pipe shall be continuous along the bottom of the pipe. Support for metal pipe and electrical conduit may be continuous or nylon webbing may be used for suspension at no greater than ten foot (10') intervals. The Contractor shall avoid damaging the plastic pipe, pipe ways or conduits during trench backfilling and during foundation and bedding placement.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Granular Sand Material: Granular sand material shall consist of imported granular sand complying with Section 02200, of the specifications.

- B. Crusher Fines: Crusher fines material shall consist of imported decomposed granite complying with Section 02200, of the specifications.
- C. Class 2 Base Material: Class 2 Base material shall consist of imported virgin (not recycled) Class 2 Base complying with Section 02200, of the Specifications.
- D. Crushed Rock Bedding: Crushed rock bedding shall consist of imported rock complying with Section 02200, of the Specifications.
- E. 1-inch Round Rock: 1-inch Round Rock material shall consist of import rock material complying with Section 02200, of the Specifications.
- F. Concrete: 5,000 PSI compressive strength, minimum, as specified in Division 3, Concrete, of the Specifications.
- G. Pipelines: Use materials shown on the Plans and as specified in other pertinent Sections of the Specifications.

PART 3 - EXECUTION

3.01 TRENCH EXCAVATION

- A. Excavation for Trenches: Shall include the removal of all material of any nature for the installation of the pipe or facility and shall include the construction of trench shoring and stabilization measures, timbering and all necessary installations for dewatering.
- B. Minimum Width of Trench: The minimum width of pipe trenches, measured at the crown of the pipe, shall not be less than 12 inches greater than the exterior diameter of the pipe, exclusive of bells and the minimum base width of such trench shall be not less than 12 inches greater than the exterior diameter of the pipe, exclusive of special structures or connections, and such minimum width shall be exclusive of all trench supports.
- C. Maximum Width of Trench: The maximum allowable width of trench for all pipelines measured at the top of the pipe shall be the outside diameter of the pipe (exclusive of bells or collars) plus 16 inches, and such maximum shall be inclusive of all timbers. A trench wider than the outside diameter plus 16 inches may be used without special bedding if the Contractor, at his expense, furnishes pipe of the required strength to carry the additional trench load.

Such modifications shall be submitted for the Owner's Representative's review. Whenever such maximum allowable width of trench is exceeded for any reason, except as provided for on the Plans or in the Specifications, or by the written direction of the Owner's Representative, the Owner's Representative may, at its discretion, require that the Contractor, at his own expense for all labor and materials, cradle the pipe in 5,000 PSI compressive strength concrete, or other approved pipe bedding.

- D. Maximum Length of Open Trench: Except by special permission by the Owner's Representative only that amount of open trench shall be permitted, which shall allow for that amount of pipeline construction, including excavation, construction of pipeline, and backfill in any one location, which can be completed in one day; however, maximum length of open trench shall never exceed 500 feet. This length includes open excavation, pipe laying and appurtenant construction and backfill which has not been temporarily resurfaced.
- E. Trench Side Slopes:
1. Temporary trench excavations shall at all times conform to the safety requirements hereinbefore specified in Section entitled "Safety".
 2. Loose cobbles or boulders shall be removed from the sides of the trenches before allowing workmen into the excavation, or the trench slopes must be protected with screening or other methods. Trench side slopes shall be kept moist during construction to prevent local sloughing and raveling. Surcharge loads due to construction equipment shall not be permitted within 10 feet of the top of any excavated slope.
 3. If the Contractor elects to shore or otherwise stabilize the trench sides, he shall file with the Owner's Representative copies of drawings for same prepared, signed and stamped by a Civil Engineer duly registered in the State of California before commencing excavation.
- F. Excess Trench Excavation: If any trench, through the neglect of the Contractor, is excavated below the bottom grade required, it shall be refilled to the bottom grade, at the Contractor's expense for all labor and material, with granular sand material compacted to a firm stable foundation.

3.02 BRACING TRENCHES

The sides of the trenches shall be supported with plank sheeting and bracing in such a manner as to prevent caving of the sides of the trench. Space left by withdrawal of sheeting or shoring shall be filled completely with dry granular material blown or rammed in place. Trench shoring shall be completed per the recommendations of the Geotechnical Report and OSHA Standards.

3.03 PIPING BEDDING

The Contractor shall excavate to four inches (4") below the bells or couplings for the full width of the trench and shall place four inches (4") of granular material upon which the pipe is to be laid, unless indicated otherwise on the Plans. Construct pipe bedding as indicated on the Plans.

At pipe subgrade, if foundation soil in trench is soft, wet, spongy, and unstable or does not afford solid foundation for pipe, the Contractor shall excavate as directed by the Owner's Representative and provide stable base by excavating any unsuitable material 18" minimum below the subgrade base or as the Owner's Representative determines is necessary for placement of pipe bedding. A filter fabric shall be placed in the trench bottom and along the trench sidewalls in the pipe zone to the top of the pipe zone material. A crushed rock material shall be placed at the bottom of the trench and sidewalls of the pipe to a point 1 foot above the pipe. The crushed rock material shall be hand tamped in 16-inch lifts along the sidewalls. The crushed rock shall be compacted with a plate compactor in minimum 6 inch lifts beneath the pipe and over the top of the pipe.

Where rock is encountered in the trench, the Contractor shall excavate to a minimum 18 inch depth below subgrade or as the Owner's Representative determines is necessary, and shall construct a base by placing crushed rock bedding upon which a subgrade can be prepared.

Before any pipe is lowered in place, the trench bottom shall be prepared so that each pipe shall be supported for the full length of the barrel with full bearing on the bottom segment of the pipe equal to a minimum of one-half (1/2) of the pipe OD, and a width equal to the trench width. All adjustments in line and grade shall be made by scraping away or filling and tamping in under the barrel of the pipe. Wedging or blocking is not permitted.

The pipe bedding shall be compacted to a minimum of 90 or 95 percent relative compaction as hereinafter specified or as required by the Plans.

3.04 BACKFILLING PIPE TRENCHES

- A. Backfilling Pipe Zone: Backfill material for the pipe zone shall consist of imported granular material or two sack cement/sand slurry as required by the Plans. Place material in the trench simultaneously on each side of the pipe for the full width of the trench and the depth of the pipe zone in layers 6 inches in depth. Each layer shall be thoroughly compacted by tamping. In all cases, backfilling of the pipe zone must be accomplished by hand. Particular attention shall be given to underside of the pipe and fittings to provide a firm support along the full length of the pipe. The pipe zone shall be considered to extend 12 inches above the top of the pipe unless otherwise illustrated on the Plans, and shall be compacted in the trench to a relative compaction of not less than 90 or 95 percent of maximum density per ASTM D 1557 as illustrated on the Plans. Care shall be taken not to damage pipe and fittings or special coatings on the pipe and fittings.
1. Use of material other than those specified shall be reviewed by the Owner's Representative prior to use. The Contractor shall bear all cost of removal of rejected material, it's hauling to an authorized disposal site, and cost of providing required material to complete the bedding and backfilling.
- B. Backfilling Pipe Trench: After the pipe has been laid in the trench and has been inspected and approved, and backfilling in the pipe zone is complete and compacted, the remainder of the trench may be backfilled. The backfill material shall be granular sand or Class 2 Base as specified in Paragraph 2.01 and illustrated on the Plans. Care shall be taken to ensure that no voids remain under, around or near the pipe.
1. The Contractor shall incur the expense to remove and dispose of the excess trench excavation material displaced by the trench import material and include the costs in the bid.
- C. Compaction: The maximum dry density and optimum moisture content of each soil type used in the controlled compacted fill shall be determined by ASTM D 1557-91. Field density tests shall be determined in accordance with ASTM D 1556-82, ASTM D 2937-83 and ASTM D 2922-81.
- D. Placement and Compaction of Trench Backfill: The placement and compaction of all trench backfill shall be as follows:

1. Mechanically Compacted Backfill: With approval of the Owner's Representative, backfill shall be mechanically compacted by means of tamping rollers, sheepfoot rollers, pneumatic tire rollers, vibrating rollers, or other mechanical tampers to 90 or 95 percent relative compaction as illustrated by the Plans. Impact-type pavement breakers (stompers or hydro-hammers) shall not be permitted over any pipe. Permission to use specific compaction equipment shall not be construed as guaranteeing or implying that the use of such equipment will not result in damage to adjacent ground, existing improvements or improvements installed under the Contract. The Contractor shall make his own determination in this regard. Backfill shall be placed in horizontal layers not exceeding eight inches (8"). Each layer shall be evenly spread, the moisture content brought to near optimum condition and then tamped or rolled until the specific relative compaction has been attained. Additional backfill lifts shall not be placed until previous lifts have been satisfactorily compacted and tested and approved by the Owner's Representative.

3.05 CENTRAL PIPELINE INSTALLATION REQUIREMENTS

- A. Depth of Pipe: Unless otherwise illustrated on the Plans, all pipelines shall have coverage of at least 36 inches between the top of the pipe and the finished surface. All gravity line invert elevations and locations illustrated on the Plans are intended to be exact and any change in alignment and grade shall be reviewed in accordance with the Contract Documents to the satisfaction of the geotechnical testing representative and the Owner's Representative. All force and gravity mains shall have 1-foot vertical clearance between themselves and all other utilities. At all water main, sewer and stormwater crossings, both gravity and force mains shall have 20 linear feet of concrete encasement centered at the crossing as required by the State of California Department of Health.
- B. Changes in Line and Grade: In the event obstructions not shown on the Plans, are encountered during the progress of the Work, which will require alterations to the Plans, the Owner's Representative shall issue the necessary revisions to the Plans and order the necessary deviation from the line or grade. The Contractor shall not make any deviation from the specified line and grade without prior review and approval by the Owner's Representative. Should any deviations in line and grade be permitted by the Owner's Representative in order to reduce the

amount of rock excavation or for other similar convenience to the Contractor, any additional costs for thrust blocks, valves, air and vacuum valve assemblies, blow-off assemblies, extra pipe footage, concrete, sewer structures, or other additional costs shall be borne by the Contractor.

1. Contractor shall include in his Bid provisions to cover any deviation from the invert grade shown on the Plans to facilitate the extra depth required to avoid possible conflicts between existing gravity pipelines and other utilities with new water, stormwater or sewer forcemains.

C. Pipe Installation:

All pipe and fittings, and accessories furnished by the Contractor shall be new material free from rust or corrosion. All piping and fittings shall be cleaned on the inside when installed and the Contractor shall take all necessary precautions to insure that the lines are kept free of any foreign matter and dirt until the work is completed. All pipes shall be carefully placed and supported at the proper lines and grades as shown on the Plans. Piping runs shown on the Plans shall be followed as closely as possible, except for minor adjustments as approved by the Owner's Representative to avoid other piping or structural features. Bedding material shall first be placed so that the pipe is supported for the full length of the barrel with full bearing on the bottom segment of the pipe. Hunching of the pipe shall not be allowed. Pipe will be carefully inspected in the field before and after laying. If any cause for rejection is discovered in a pipe after it has been laid, it shall be subject to rejection by the Owner's Representative. Any corrective work shall be approved by the Owner's Representative. Pipe shall be laid true to line and grade with uniform bearing under the full length of the barrel of the pipe. Suitable excavation shall be made to receive the bell or collar which shall not bear upon the subgrade or bedding. Any pipe which is not in true alignment or shows any undue settlement after laying shall be taken up and relaid at the Contractor's expense. Pipe shall be laid upgrade with the socket ends of the pipe upgrade unless otherwise authorized by the Owner's Representative. Pipe sections shall be laid and joined in such a manner that the offset of the inside of the pipe at any joint will be held to a minimum at the invert. The maximum horizontal offset at the invert of the pipe shall be 1% of the inside diameter of the pipe or 0.02 feet, whichever is smaller. The vertical grade shall be ± 0.02 feet of the design invert. In joining socket pipe, the spigot

of each pipe shall be so seated in the socket of the adjacent pipe as to give a uniform annular space all around the pipe in the socket.

The following pipe installation items shall be required:

1. No pipe shall be laid which is damaged, cracked, checked or spalled or has any other defect deemed by the Owner's Representative to make it unacceptable, and all such sections shall be permanently removed from the Work.
2. At all times when the Work of installing pipe is not in progress, all openings into the ends of the pipelines shall be kept tightly closed with suitable plywood or sheet metal bulkheads to prevent the entrance of animals and foreign materials and to prevent water from entering the pipe.
3. Keep the pipe trench free from water at all times and take all necessary precautions to prevent the pipe from floating due to water entering the trench from any sources. Any damage is the Contractor's full responsibility. Restore and replace the pipe to its specified conditions and grade if it is displaced due to floating.
4. All pipelines adjoining concrete structures (including manholes) shall have a flexible joint, such as sleeve transition couplings, within 36 inches from the face of such concrete structures. Flexible joints shall be installed on all pipe 4" and larger whether or not a flexible joint is illustrated on the Plans. Where the flexible joint is illustrated on the Plans, install the joint at the location indicated.

3.06 COMPACTION OF PIPE BEDDING AND BACKFILL

Unless specified in the Plans or Earthwork Specification (Section 02200), the following compaction test for piping shall be required.

- A. One (1) compaction test for the granular sand fill pipe bedding along each 100 lineal foot of water, sewer or stormwater pipe placed for each 1 foot lift of material installed.
- B. One (1) compaction test shall be obtained for each 1 foot lift of Class 2 Base material along each 100 foot section of water, sewer or stormwater pipeline installed.

- C. One (1) compaction test shall be required for each 1 foot of vertical sand fill material placed along each 100 feet of water, sewer or stormwater pipeline installed.
- D. One (1) compaction test shall be obtained for each 1 foot lift of native material along each 100 foot section of water, sewer or stormwater pipeline installed.

3.07 CLEAN-UP

Immediately upon completion of Work for this Section, all rubbish and debris shall be removed from the Site. All pipe trench areas shall be finish graded with a "blade" or "motor patrol". All construction equipment and implements of service shall be removed and the entire area involved shall be left in a neat, clean and acceptable condition.

END OF SECTION 02221

SECTION 02630 - DUCTILE IRON PIPE

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The Contractor shall furnish and install all ductile iron pipe, fittings, transitions, connections and appurtenant work, complete and in accordance with the requirements of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 02200 - Earthwork
- B. Section 02221 - Trenching, Backfilling and Compacting
- C. Section 02650 – Pipe Fittings
- D. Section 02666 – Pressure Pipeline Water Testing
- E. Section 02670 – Disinfection of Potable Water Pipelines
- F. Section 09800 – Protective Coatings

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Commercial Standards:

ANSI/AWWA C 104/A 21.4	Cement-mortar lining for Ductile Iron and Gray Iron Pipe and Fittings for Water.
ANSI/AWWA C 105/A 21.5	Polyethylene Encasement for Gray and Ductile Cast Iron Piping for Water and Other Liquids.
ANSI/AWWA C 110/A 21.10	Fittings, 3-inch through 48-inch for Water and Other Liquids, Gray Iron and Ductile Iron.
ANSI/AWWA C 111/A 21.11	Rubber Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings
ANSI/AWWA C 115/A 21.15	Flanged Ductile Iron and Gray Iron Pipe with Threaded Flanges.

ANSI/AWWA C 150/A 21.50	Thickness Design of Ductile Iron Pipe.
ANSI/AWWA C 151/A 21.51	Ductile Iron Pipe, Centrifugally Cast, in Metal Molds or Sand-Lined Molds for Water and Other Liquids.
ANSI/AWWA C 209	Cold Applied Coatings for the Exterior of Special Sections, Connections and Fittings for Steel Water Pipelines.
ANSI/AWWA C 214	Tape Coating Systems for the Exterior of Steel Water Pipelines.
ANSI/AWWA C 600	Water Mains and Appurtenances, Installation of Ductile Iron.
ANSI/ASTM D 1248	Polyethylene Lining Material for Ductile Iron Pipe and Fittings.
ASTM C 150	Specification for Portland Cement.
ASTM A 746	Installation of Ductile Iron Pipe for Gravity Sewers.

1.04 CONTRACTOR SUBMITTALS

- A. The Contractor shall furnish a certified affidavit of compliance for all pipe and other products or materials furnished under this Section of the Specifications and as specified in the referenced standards. Certification shall include physical and chemical properties of pipe materials and hydrostatic test reports.
- B. All expenses incurred in sampling and testing for certifications shall be borne by the Contractor.

1.05 QUALITY ASSURANCE

- A. Ductile iron pipe shall be manufactured with the material, have the dimensions, be within the tolerances and meet the testing requirements set forth in ASTM A 746 and ANSI A 21.51. Ductile

iron pipe shall be manufactured in nominal 18 foot or 20 foot laying lengths and shall have the lining called for in the Contract Documents.

- B. All pipe shall be subject to inspection at the place of manufacture in accordance with the provisions of the referenced standards, as supplemented by the requirements herein.
- C. In addition to those tests specifically required, the Owner's Representative may request additional samples of any material including lining and coating samples for testing by the Owner. The additional samples shall be furnished at no additional cost to the Owner.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Mortar lined and polyethylene encased ductile iron pipe shall conform to ANSI/AWWA C 151, C 104, C 105, C 214 and D 1248, subject to the following supplemental requirements. The pipe shall be of the diameter and class shown, shall be furnished complete with rubber gaskets as indicated in the Contract Documents and all specials and fittings shall be provided as required under the Contract Documents. Any ductile iron pipes used as air lines and connected after the blowers shall have EPDM gaskets.
- B. The pipe shall be handled by use of wide slings, padded cradles or other devices acceptable to the Owner's Representative, designed and constructed to prevent damage to the pipe lining and/or coating. The use of chains, hooks or other equipment which might injure the pipe lining and coating will not be permitted. Stockpiled pipe shall be safely and properly supported to prevent accidental rolling. The Contractor shall be fully liable for the cost of replacement or repair of pipe which is damaged.
- C. Maximum pipe laying lengths shall be 20 foot with shorter lengths provided as required by the Design.
- D. The pipe shall have a smooth dense interior surface and shall be free from fractures, defects and roughness.

2.02 MATERIALS

- A. Ductile iron pipe materials shall conform to the requirements of ANSI/AWWA C 151/A 21.51.
- B. Fittings for ductile iron pipe shall conform to the requirements of ANSI/AWWA C 110/A 21.10 for diameters 3 inch through 48 inch. Ductile iron fittings larger than 48 inch shall conform to the above-referenced standard with the necessary modifications for the larger size.
- C. Cement for mortar lining shall conform to the requirements of ANSI/AWWA C 104/A 21.4; provided, that cement for mortar lining shall be Type V. A fly ash or pozzolan shall not be used as a cement replacement.
- D. Material for the polyethylene encasement shall conform to the requirements of ANSI/AWWA C 105/A 21.5.
- E. All elastomer gaskets used for ductile iron pipe shall be of neoprene material.
- F. All buried bolts and nuts used in the assembly of ductile iron pipe and fittings shall be 316 stainless steel bolts.

2.03 DESIGN OF PIPE

- A. Ductile iron pipe shall be designed in accordance with the requirements of ANSI/AWWA C 150/A 21.50, as applicable and as modified in this Section. The pipe furnished shall be cement-mortar lined. Buried ductile iron pipe shall be polyethylene encased.
- B. The pipe shall be designed, manufactured, tested, inspected and marked according to applicable requirements previously stated and except as hereinafter modified, shall conform to ANSI/AWWA C 151.
- C. The pipe and fittings shall be of the diameter shown and shall be of pressure Class 350 for pipe sizes twelve inches and below and pressure Class 250 for pipe fourteen inches to twenty inches and pressure Class 200 for twenty-four inch pipe and pressure Class 150 for thirty inch and above, except that where mechanical couplings are used and the pipe is grooved, the ductile iron pipe shall be of special thickness Class 53.
- D. Ductile iron pipe and fittings shall be furnished with mechanical joints, push-on joints, flanged joints and restrained joints as required.

1. Mechanical and push-on joints shall conform to ANSI/AWWA C 111/A 21.11.
 2. Flanged joints shall conform to ANSI/AWWA C 115/A 21.15.
 3. Restrained joints shall be “Lok-Ring” Restrained Joint by American Ductile Iron Pipe, “TR FLEX” Restrained Joint by U.S. Pipe, “Mechanical/Lock Joint” by Pacific States Cast Iron Pipe Company, or equal.
- E. For bell-and-spigot ends with rubber gaskets, the clearance between the bells and spigots shall be such that when combined with the gasket groove configuration and the gasket itself will provide watertight joints under all operating conditions when properly installed. The Contractor shall require the pipe manufacturer to submit details complete with significant dimensions and tolerances and also to submit performance data indicating that the proposed joint has performed satisfactorily under similar conditions. In the absence of a history of field performance, the results of a test program shall be submitted.

2.04 CEMENT-MORTAR LINING

- A. Except as otherwise provided herein, interior surfaces of ductile iron pipe, fittings and specials to be furnished with cement-mortar lining shall be cleaned and lined in the shop with cement-mortar lining applied centrifugally in conformity with ANSI/AWWA C 104. If lining is damaged or found faulty at delivery site, the damaged or unsatisfactory portions shall be replaced with lining conforming to these Specifications.
- B. The minimum lining thickness shall be as follows:

Nominal Pipe Diameter (inches)	Minimum Lining Thickness (inches)
3-12	1/8
14-24	3/16
30-54	1/4

- C. For all pipe and fittings with plant-applied cement-mortar linings, the Contractor shall provide a polyethylene or other suitable bulkhead on the ends of the pipe and on all special openings. All bulkheads shall be substantial enough to remain intact during shipping and storage until the pipe is installed.

2.06 EXTERIOR COATING OF PIPE

- A. The exterior surfaces of ductile iron pipe which will be exposed to the atmosphere inside structures or above ground shall be thoroughly cleaned and then given a shop coat of rust-inhibitive primer conforming to the requirements of Division 9. This exposed piping shall not be coated with the bituminous coating by the manufacturer prior to delivery.
- B. Buried ductile iron pipe shall be polyethylene encased in accordance with the requirements of ANSI/AWWA C 105/A 21.5.

PART 3 - EXECUTION

3.01 INSTALLATION OF PIPE

- A. All pipe, fittings, etc. shall be carefully handled and protected against damage, impact shocks and free fall. All pipe handling equipment shall be acceptable to the Owner's Representative. Pipe shall not be placed directly on rough ground, but shall be supported in a manner which will protect the pipe against damage whenever stored at the trench site in accordance with Paragraph 2.01, herein. All pipe damaged prior to Substantial Completion shall be repaired or replaced by the Contractor.
- B. The Contractor shall inspect each pipe and fitting prior to installation to ensure that there are no damaged portions of the pipe. No pipe shall be installed where the lining or coating exhibit defects that may be harmful as determined by the Owner's Representative. Such damaged lining or coating shall be repaired, or a new undamaged pipe shall be furnished and installed.
- C. The pipe shall be installed in accordance with ANSI/AWWA C 600. Before placement of the pipe in the trench, each pipe or fitting shall be thoroughly cleaned of any foreign substance which may have collected thereon and shall be kept clean at all times thereafter. For this purpose, the openings of all pipes and fittings in the trench shall be closed during any interruption to the Work. As pipe laying progresses, the Contractor shall keep the pipe interior free of all debris. The Contractor shall completely clean the interior of the pipe of all sand, dirt, rocks and any other debris following completion of pipe laying prior to testing and disinfecting the completed pipeline.

- D. Pipe shall be laid directly on the imported bedding material. No blocking will be permitted and the bedding shall be such that it forms a continuous, solid bearing for the full length of the pipe. Excavations shall be made as needed to facilitate removal of handling devices after the pipe is laid. Bell holes shall be formed at the ends of the pipe to prevent joint loading at the bells or couplings. Excavation shall be made as needed outside the normal trench section at field joints to permit adequate access to the joints for field connection operations and for application of coating on field joints.
- E. Where necessary to raise or lower the pipe due to unforeseen obstructions or other cause, the Owner's Representative may change the alignment and/or the grades. Such change shall be made by the deflection of joints, by the use of bevel adapters or by the use of additional fittings. However, in no case shall the deflection in the joint exceed the maximum deflection recommended by the pipe manufacturer.
- F. No pipe shall be installed upon a foundation into which frost has penetrated or at any time that there is a danger of the formation of ice or penetration of frost at the bottom of the excavation. No pipe shall be laid unless it can be established that the trench will be backfilled before the formation of ice and frost occurs.
- G. The openings of all pipe and specials where the pipe and specials have been cement-mortar lined in the shop shall be protected with suitable bulkheads to prevent unauthorized access by persons, animals, water or any undesirable substance. At all times, means shall be provided to prevent the pipe from floating.
- H. Immediately before jointing pipe, the bell end of the pipe shall be thoroughly cleaned and a clean rubber gasket lubricated with an approved vegetable-based lubricant shall be placed in the bell groove. The spigot end of the pipe shall be carefully cleaned and lubricated with a vegetable-based lubricant. The spigot end of the pipe section shall then be inserted into the bell of previously laid joint and telescoped into its proper position. Tilting of the pipe to insert the spigot into the bell will not be permitted.

END OF SECTION 02630

SECTION 02640 - PVC PIPE

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The Contractor shall furnish and install all Polyvinyl Chloride (PVC) plastic pipe, fittings, transitions, connections and appurtenant work, complete and in accordance with the requirements of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 02200 - Earthwork
- B. Section 02221 - Trenching, Backfilling and Compacting
- C. Section 02666 – Pressure Pipeline Water Testing
- D. Section 02670 – Disinfect Potable Water Pipelines

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Commercial Standards:

ASTM D 1784 and ASTM D 1785	Specifications for Polyvinyl Chloride (PVC) Plastic Pressure Pipe
ASTM D 3034	Specifications for Polyvinyl Chloride (PVC) Plastic Gravity Sewer Pipe
AWWA C 900	Specifications for Polyvinyl Chloride (PVC) Plastic Water Pressure Pipe
ASTM D 2321	Standard Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe

1.04 CONTRACTOR SUBMITTALS

- A. Contractor shall submit copies of the manufacturer's product specifications according to the requirements of Section 01330 - Contractor Submittals.

PART 2 - PRODUCTS

2.01 PVC (POLYVINYL CHLORIDE) PRESSURE PIPE, 4 INCHES AND SMALLER SOLVENT-WELDED

- A. All PVC pressure pipe 4 inches and smaller shall be made from all new rigid unplasticized polyvinyl chloride and shall be Normal Impact Class 12454-B, Schedule 80, to conform to ASTM D 1785, unless otherwise shown. Elbows and tees shall be of the same material and schedule as the pipe. Unless otherwise shown, joint design shall be for solvent-welded construction.

2.02 AWWA C 900 AND AWWA C 905 WATER PIPELINE WITH BELL AND SPIGOT JOINTS

This Specification designates general requirements for unplasticized polyvinyl chloride (PVC) plastic class water pipe with integral bell and spigot joints for the conveyance of water. Pipe shall meet the requirements of AWWA C 900 or AWWA C 905 "Polyvinyl Chloride (PVC) Water Distribution".

All pipe shall be suitable for use as pressure conduit, provisions must be made for expansion and contraction at each joint with an elastomeric ring. The bell shall consist of an integral wall section with a factory installed, solid cross-section elastomeric ring which meets the requirements of ASTM F 477. The bell section shall be designed to be at least as hydrostatically strong as the pipe wall and meet the requirements of AWWA C 900. Sizes and dimensions shall be as shown in this Specification. Joint design shall meet qualification requirements of ASTM F 3139. Each pipe shall be tested to four times the pressure class of the pipe for a maximum of 5 seconds. The integral bell shall be tested with the pipe. Standard laying lengths shall be 20 feet (± 1 ") for all sizes.

The pipe stiffness using $F/\Delta Y$ for PVC class water pipe is contained in the table below:

<u>CLASS</u>	<u>DR</u>	<u>$F/\Delta y$ (PSI)</u>
100	25	129
150	18	364
200	14	815

Pipe shall withstand, without failure at 73°F, an impact of a falling missile, TUP C, at the following levels (per ASTM D 2444):

<u>Pipe Size (IN.)</u>	<u>Impact (FT./LBS.)</u>
4	100
6	100
8	100
10	120
12	120

There shall be no visible evidence of shattering or splitting when the energy is imposed.

Randomly selected samples tested in accordance with ASTM D 1599 shall withstand, without failure, pressures listed below when applied in 60-70 seconds.

<u>Class</u>	<u>Minimum Burst Pressure At 73°F (PSI)</u>
100	535
150	755
200	985

Pipe for this Project shall conform with the specifications for AWWA C 900, DR 18 PVC pipe material for diameter sizes 4-inches through 12 inches and AWWA C 905, DR 25 PVC pipe material for diameter sizes 14 inches through 36-inches unless otherwise indicated on the Plans.

2.03 PVC (POLYVINYL CHLORIDE) GRAVITY PIPE

- A. Pipe shall conform to the requirements of ASTM D 3034 for SDR 35 gravity pipe, unless otherwise indicated on the Plans.
- B. All pipe joints shall be of the bell and spigot type with electrometric seals and conform to the requirements of ASTM D 3212. Gaskets shall be factory installed and chemically bonded to the bell end of the pipe. Gasket material shall conform to the requirements of ASTM F 477.
- C. All fittings shall be fabricated from pipe meeting the requirements of these standards. Fabricated miter joints shall be reinforced by fusion heat welding. All fittings shall be approved for use by the pipe manufacturer and shall be capable of accepting bell and spigot connections.

1. There shall be no sign of flaking or disintegration when immersed in anhydrous acetone for 20 minutes as described in ASTM D 2152.
- D. All pipe shall be from quality PVC resin, compounded to provide physical and mechanical properties that equal or exceed cell class 12454 as defined in ASTM 1784.
- E. Minimum pipe stiffness at 5 percent deflection shall be 46 PSI for all sizes when tested in accordance with ASTM D 2412, External Loading Properties of Plastic Pipe by Parallel-Plate Loading”.
- F. Each pipe shall be identified with the name of manufacturer, nominal size, cell classification, ASTM designation F 1803, the pipe stiffness designation “PS-46” and manufacturer’s date code.

PART 3 - EXECUTION

3.01 INSTALLATION OF PIPE

- A. All pipe, fittings, etc., shall be carefully handling and protected against damage, impact shocks and free fall. All pipe handling equipment shall be acceptable to the Owner’s Representative. Pipe shall not be placed directly on rough ground, but shall be supported in a manner which will protect the pipe against injury whenever stored at the Site. All pipe damaged prior to Substantial Completion shall be repaired or replaced by the Contractor.
- B. The Contractor shall inspect each pipe and fitting prior to installation to ensure that there are no damaged portions of the pipe. Damaged pipe shall be replaced with new undamaged sections of pipe.
- C. Before placement of the pipe in the trench, each pipe or fitting shall be thoroughly cleaned of any foreign substance which may have collected thereon and shall be kept clean at all times thereafter. For this purpose, the openings of all pipes and fittings in the trench shall be closed during any interruption to the Work. As pipe laying progresses, the Contractor shall keep the pipe interior free of all debris. The Contractor shall completely clean the interior of the pipe of all sand, dirt, rocks and any other debris following completion of pipe laying prior to testing, disinfecting and placing the completed pipeline in service.

- D. Pipe shall be laid directly on the imported bedding material. No blocking will be permitted and the bedding shall be such that it forms a continuous, solid bearing for the full length of the pipe. Bell holes shall be formed at the ends of the pipe to prevent joint loading at the bells or couplings.
- E. Where necessary to raise or lower the pipe grade due to unforeseen obstructions or other causes, the Owner's Representative may change the alignment and/or the grades. Such change shall be made by the deflection of joints or by the use of additional fittings. However, in no case shall the deflection in the joint exceed the maximum deflection recommended by the pipe manufacturer.
- F. No pipe shall be installed upon a foundation into which frost has penetrated or any time that there is a danger of the formation of ice or penetration of frost at the bottom of the excavation. No pipe shall be laid unless it can be established that the trench will be backfilled before the formation of ice and frost occurs.
- G. Immediately before jointing bell and spigot pipe, both the bell and spigot end of the pipe shall be thoroughly cleaned and lubricated with an approved vegetable-based lubricant. The spigot end of the pipe section shall then be inserted into the bell of the previously laid joint and telescoped into its proper alignment. Tilting of the pipe to insert the spigot into the bell will not be permitted.
- H. Solvent-welded and heat-fused joints shall be carefully and thoroughly cleaned immediately before jointing the pipe. Particular care shall be taken in making solvent-welded joints to ensure a uniform, homogeneous and complete bond.
- I. Pipe installation shall conform with Technical Specification Section 02221 - Trenching, Backfilling and Compacting. If this installation of pipe section and Section 02221 conflict, the most stringent specification shall apply.

END OF SECTION 02640

**SECTION 02650 –
PIPE FITTINGS, TRANSITION COUPLINGS, AND HARDWARE**

PART 1 - GENERAL

1.01 DESCRIPTION

The Contractor shall provide and install pipe fittings, transition couplings, and hardware for the connection of PVC, ductile iron and other pipeline material. Other connecting items may also be required. This section includes the specifications and requirements for the prior listed pipe connection items. The hardware for this specification section shall include the hardware for pipe or any other fittings or items located along a pipeline. Material shall be new and free from defects.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 02630 - Ductile Iron Pipe
- B. Section 02640 - PVC Pipe

1.03 REFERENCE DOCUMENTS

Unless otherwise indicated, the current editions of the following reference standards and specifications apply to the Work described herein, and are considered part of this Specification.

C 104/A 21.4-03	American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
C 105/A 21.5-99	American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems
C 110/A 21.10-03	American National Standard for Ductile-Iron and Gray-Iron Fittings, 3-In. through 48-In. (76 mm through 1,219 mm), for Water
C 111/A 21.11-00	American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
C 115/A 21.15-99	American National Standard for Flanged Ductile Iron Pipe with Ductile-Iron or Gray-

Iron Threaded Flanges

C 116/A 21.16-03	American National Standard for Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Service
C 153/A 21.53-00	American National Standard for Ductile-Iron Compact Fittings, 3-In. (76 mm) through 64-In. (1,600 mm), for Water Service
ASTM A 536	American Standards for Testing and Materials - High Strength Ductile Iron for Sleeve and Flanges of Transition Coupling and Flanged Coupling Adapter
ASTM A 536-80, Grade 65-45-12	American Standard Testing and Material - Ductile Iron Mechanical Joint Restraint Fitting
UNI-B-13-92	As listed Underwriters Laboratories - Restraining Glands for Mechanical Restrained Joint Fittings
ASTM B 117	American Standard Testing Materials - Salt Spray Testing for Bolts

1.04 CONTRACTOR SUBMITTALS

- A. The Contractor shall furnish a certified affidavit of compliance for all pipe and other products or materials furnished under this Section of the Specifications and as specified in the referenced standards. Certification shall include physical and chemical properties of pipe materials and hydrostatic test reports.
- B. All expenses incurred in sampling and testing for certifications shall be borne by the Contractor.

1.05 QUALITY ASSURANCE

- A. Ductile iron fittings shall be manufactured with the material, have the dimensions, be within the tolerances and meet the testing requirements set forth in ANSI A 21.53-00 and ANSI A 21.10-03.

- B. All fittings shall be subject to inspection at the place of manufacture in accordance with the provisions of the referenced standards, as supplemented by the requirements herein.
- C. In addition to those tests specifically required, the Owner's Representative may request additional samples of any material including lining and coating samples for testing by the Owner. The additional samples shall be furnished at no additional cost to the Owner.

PART 2 - PRODUCTS

The Technical Requirements for Ductile Iron Fittings, Transition Couplings, and Hardware follow:

2.01 DUCTILE IRON FITTINGS

Fittings and reducers for the water mains shall be composed of ductile iron. The ductile iron fittings shall conform to ASTM A 536. Mechanical joint fittings shall conform with AWWA C 153 C 350 PSI. Flanged fittings shall conform with AWWA C 110 C 250 PSI. Flange fittings shall have standard wall thickness not compact thickness. The fittings shall be cement-mortar lined in accordance with ANSI/AWWA C 104/A 21.4, Standard for Cement-Mortar Lining for Ductile Iron and Gray Iron Pipe Fittings for Water, latest revision. Asphaltic seal coating shall be applied to the interior and exterior of the below-grade fittings in accordance with ANSI/AWWA C 104/A 21.4, asphaltic seal coating shall be applied to the interior of the above-grade fittings. The exterior surfaces of above-grade ductile iron fittings shall be thoroughly cleaned and then given a shop coat of rust inhibitive primer conforming to the requirements of Division 9. This exposed piping shall not be coated with the bituminous coating by the manufacturer prior to delivery.

2.02 TRANSITION COUPLING

The transition couplings shall be installed as required. The center rings shall be constructed of ductile iron conforming to ASTM A 536-80, Grade 65-45-12. the end rings shall be constructed of ductile iron conforming to ASTM A 536, Grade 65-45-12. Gaskets shall be composed of virgin styrene butadiene rubber (SBR) compounded for water and sewer service in accordance with ASTM D 2000 MBA 810. The coating for the ductile iron transition coupling shall be fusion bonded epoxy. The transition coupling shall be capable of sustaining a working pressure of 250 PSI.

2.03 RESTRAINED JOINT FITTINGS

Mechanical joint restraint shall be incorporated into the design for the follower gland. The gripping or restraining mechanism shall transmit uniform restraining pressure around the circumference of the pipe, thus avoiding point loading or pipe distortion. This restraining process shall be kept separate from the mechanical joint sealing process and **not** a part of the sealing function. All components shall be manufactured of ductile iron conforming to ASTM A 536-80, Grade 65-45-12.

The restrained twist-off nut bolt system shall have a torque limiting feature designed to break off at 75 to 90 FT-LBS of torque to insure proper actuating of restraining devices. Both the twist-off nut and the removal nut shall be the same size as tee-bolt nut. Hardware shall be composed of 316 stainless steel.

The gland shall be such that it can replace the standardized mechanical joint gland and can be used with the standardized mechanical joint bell conforming to ANSI/AWWA C 111/A 21.11, C 110/A 21.10 and C 153/A 21.53 of the latest revision.

The device shall restrain all classes of ductile iron, C 900 PVC, C 905 PVC and high-density polyethylene (HDPE) with the use of a standard mechanical joint gasket. The same device without any field modification shall additionally restrain IPS PVC, IPS steel and IPS HDPE with the use of a transition gasket.

The restraining glands shall have a pressure rating equal to twice (2:1) that of the pipe on which it is used. The restraining glands shall have been tested to UNI-B-13-92, be listed by Underwriters Laboratories and be approved by factory mutual. The mechanical joint restraint device shall be UNI-Bell, EBBA Series 2000, Sigma One-Lock or equal.

Restrained joint fittings shall be placed at all termination points, tees, bends, and angle points. Restrained joint fittings shall be placed for connection points of existing to new pipelines, unless noted in the plans. New pipeline-to-pipeline connections shall not be required to have restrained harness assemblies unless noted in the Plans.

2.04 HARDWARE

Hardware for ductile iron fittings shall conform with ANSI/AWWA C 111/A 21.11-07, Appendix "C", Section C.1 entitled "Bolts and Nuts". The size, length and number of bolts are illustrated in Tables 2 and 3 of ANSI/AWWA C 115/A 21.15.

Hardware for transition couplings and mechanical restrained joint fittings shall comply with the manufacturer's recommendation for steel or ductile iron bolts and nuts.

For above ground and underground, all steel or ductile iron nuts and bolts shall be coated with a fluoropolymer using Xylan/014 as a primary coating. The coating shall be electrostatically applied to the hardware after all surfaces are chemically cleaned, abrasive blasted and primed with a nickel phosphate primer. Multiple coats of the Xylan/014 shall be applied to the steel or ductile iron hardware and baked at 425°F for one (1) hour. Hardware protected with this coating system shall exhibit no signs of corrosion after salt spray testing up to 3,000 hours. The coating system shall be a Tripac 2000 Blue or an approved equal.

316 stainless steel hardware shall be used if specified for a given pipe, valve, fitting or other component on the Plans or within the contents of this document.

2.05 POLYETHYLENE ENCASEMENT

All ductile iron or gray iron fittings, transition couplings and coupling adapters shall be polyethylene encased at the time of installation. Polyethylene encasement and installation shall be in accordance with ANSI/AWWA C 105.

PART 3 - EXECUTION

3.01 INSTALLATION OF FITTINGS, TRANSITION COUPLINGS, AND HARDWARE

- A. All fittings, etc. shall be carefully handled and protected against damage, impact shocks and free fall. All fittings, etc. handling equipment shall be acceptable to the Owner's Representative. Fittings, etc. shall not be placed directly on rough ground, but shall be supported in a manner which will protect the fittings, etc. against damage whenever stored at the trench site. All fittings, etc. damaged prior to Substantial Completion shall be repaired or replaced by the Contractor.
- B. If during the course of fastening and securing the hardware (nuts and bolts) for the fittings, etc., the fluoropolymer coated is scratched, chipped or otherwise removed from the hardware surface, then a coating system supplied by the manufacturer shall be applied to the damaged hardware surface. The repair coating

system shall be applied prior to the backfilling or covering of the fittings, etc. hardware.

END OF SECTION 02650

SECTION 02666 – PRESSURE PIPELINE WATER TESTING

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The Contractor shall perform flushing and testing of all pipelines and appurtenant piping complete, including conveyance of test water from Engineer-designated source to point of use and disposal thereof after testing, in accordance with the requirements of the Contract Documents. The disposal method of the water shall be reviewed and approved by the Owner's Representative prior to the commencement of the test.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 02221 - Trenching, Backfilling and Compaction
- B. Section 02630 - Ductile Iron Pipeline
- C. Section 02640 - PVC Pipe

PART 2 – PRODUCTS

2.01 MATERIAL REQUIREMENTS

- A. All test equipment, fuel, electrical connections, temporary valves, bulkheads, compressors, water pumps, water gauges and other water control equipment support systems and required materials for hydrostatic or pneumatic air testing shall be furnished by the Contractor subject to the Owner's Representative's review.

PART 3 – EXECUTION

3.01 GENERAL

- A. The Contractor shall notify the Owner's Representative at least four (4) days in advance of any planned testing and shall review the testing procedures with the Owner's Representative. The source of testing water and disposal of the testing water shall be reviewed.
- B. Unless otherwise provided herein, water for testing pipelines shall be furnished by the Owner; however, the Contractor shall make all necessary provisions for conveying the water from the Owner-

designated source to the points of use. The Contractor shall provide inlet hoses, fittings, pressure gauges pumping equipment, meters, backflow preventers and other required items.

- C. The Contractor shall provide a double bronze service saddle, brass corporation stop, inlet pipeline and outlet pipeline at the beginning and end of the pipeline section to be tested to allow water to be directed into the pipeline and air to be purged from the pipeline while the pipeline is filling with water. The fittings and pipe shall be used during the chlorination and disinfection of the pipeline. After the hydrostatic pipe testing and disinfection of the pipeline are satisfactorily completed remove the corporation stop from the brass service saddle. Place a brass plug in the service saddle inlet.
- D. All pipelines shall be tested. All testing operations shall be performed in the presence of the Owner's Representative.
- E. The disposal or release of test water from pipelines, after testing, shall be acceptable to the Owner's Representative. The conveyance items to dispose of the testing water shall be provided by the Contractor.

3.02 HYDROSTATIC TESTING OF PIPELINES

- A. Prior to hydrostatic testing, all pipelines shall be thoroughly flushed of all sand, dirt and material to the satisfaction of the Owner's Representative. The Contractor shall test all pipelines either in sections or as a unit. The Contractor shall be responsible to ensure all test bulkheads are suitably restrained to resist the thrust of the test pressure without damage to, or movement of, adjacent pipe or structures. Care shall be exercised to ensure that all air vents are open during filling.
- B. The pipeline shall be filled at a rate which will not result in surges or exceed the rate at which the air can be released through the air valves at a reasonable velocity and all the air within the pipeline shall be properly purged. After the pipeline or section thereof has been filled it shall be allowed to stand under a slight pressure for at least 24 hours to allow the concrete or mortar lining, if applicable, to absorb water and allow the escape of air from the pipeline. During this period, bulkheads, valves and connections shall be examined for leaks. If leaks are found, corrective measures shall be initiated and completed to the satisfaction of the Owner's Representative.

- C. The hydrostatic test shall consist of holding the test pressure within the pipeline for a period of 4 hours. The test pressure for pipelines shall be 150 PSI or 1.5 times the rated pipe pressure class which ever is greater. All leaks shall be repaired. The hydrostatic pressure shall be relieved from the pipeline prior to initiating leak repair.
- D. Pipe leaks, as evidenced by water loss from the basin from which water is pumped into the pipeline, shall not be allowed after the test begins. Test pressures shall be held for at least two (2) hours after the test commences without additional pumping and observed for not less than four (4) hours. Approved gauges shall be provided by the Contractor. Gauge range shall not exceed 50 PSI above test pressure. In the event leaks occur after the hydrostatic test commences, the Contractor shall determine the cause of the leakage and take corrective measures necessary to repair the leaks. After the leaks are satisfactorily repaired the pipeline shall be re-tested.

3.03 AIR TESTING OF WATER PIPELINE

In lieu of hydrostatic testing of water pipeline sections within the water treatment plant area, air testing shall be allowed.

- A. The Contractor shall leak test 100% of the pipeline installed. The leak testing shall be accomplished after any required deflection testing of the pipeline is completed.
- B. Pipelines shall be subject to acceptance testing after backfilling has been completed but prior to the placement of the finish surface material (i.e. Class 2 Base, A.C. pavement and P.C.C. concrete).
- C. The cost of repairs or corrections necessary to conform to the testing requirements will be borne by the Contractor at no cost to the Owner.
- D. Air testing will be accomplished by the means of "Low Pressure Air Testing". Tests may be conducted by the Contractor or an independent testing firm. However, acceptance tests shall be made only in the presence of the Owner's Representative.
- E. Test Procedure:
 - 1. Before testing, the pipe shall be thoroughly cleaned.

2. The Contractor shall seal off the section of pipe to be tested at each pipe beginning and termination point. Test plugs must be securely braced at the beginning and termination points of the pipeline.
3. A minimum of two (2) connection hoses to link the air inlet test plug with an aboveground test-monitoring panel must be provided.
 - a) One (1) hose is to induce air through the test plug and into the test chamber.
 - b) The second hose is for the purpose of monitoring the test pressure from within the enclosed pipe.
4. Under no circumstances are workers to be allowed in the area of the braced pipeline beginning and termination points while pressure testing is being conducted.
5. Add air slowly into the test section. After an internal pressure of 4.0 PSI is obtained, allow internal air temperature to stabilize for a minimum of 2 minutes.
6. After the stabilization period, adjust the internal air pressure to 3.5 PSI, disconnect the air supply and begin timing the test.
7. Refer to the following pipeline air test table to determine the length of time (minutes) the pipeline section being tested must sustain air pressure while not losing in excess of 1 PSI as monitored by the test gauge. If the section of pipeline to be tested includes more than one pipe size, calculate the test time for each size and add the test times to arrive at the total test time for the section.
8. Sections so determined to have lost 1 PSI or less during the test period will have passed the leakage test. Those sections losing in excess of 1 PSI during the test period will have failed the leakage test.
9. Appropriate repairs must then be completed and the line re-tested for acceptance.

PIPELINE AIR TEST TABLE

Minimum Test Time for Various Pipe Sizes*

Nominal Pipe Size, In.	T (Time), Min/100 FT.	Nominal Pipe Size, In.	T (Time), Min/100 FT.
3	0.2	21	3.0
4	0.3	24	3.6
6	0.7	27	4.2
8	1.2	30	4.8
10	1.5	33	5.4
12	1.8	36	6.0
15	2.1	39	6.6
18	2.4	42	7.3

*The time has been established using the formulas contained in
ASTM C 828, Appendix.

END OF SECTION 02666

SECTION 02670 - DISINFECTION OF POTABLE WATER PIPELINES

PART 1 - GENERAL

1.01 DESCRIPTION

Potable pipelines within the water distribution system, Water Treatment Plant, and other areas are to be disinfected prior to being connected to other existing active pipelines and placed in service. The new pipelines are to be isolated from the existing active pipelines (usually by means of a closed valve) until the pipeline has been satisfactorily hydrostatically tested, leak tested (if required) and disinfected. The pipelines shall be hydrostatically and leak tested as a separate procedure from the pipeline disinfection.

1.02 PURPOSE

The purpose of this standard is to define the minimum requirements for the disinfection of water mains, including the preparation of water mains, application of chlorine, and sampling and testing for the presence of coliform bacteria.

1.03 REFERENCE SECTIONS

Reference sections pertaining to the disinfection testing are as follows:

Section 02630	Ductile Iron Pipe
Section 02640	PVC Pipe
Section 02666	Pressure Pipeline Water Testing
ANSI/AWWA C 651-05	American National Standards Institute/ American Water Works Association
ANSI/AWWA B 300	Hypochlorites
ANSI/AWWA B 301	Liquid Chlorine
AWWA Manual M 12	<i>Simplified Procedures for Water Examination,</i> AWWA: Denver, Colorado

SECTION 2 - PRODUCTS

2.01 GENERAL

A. Construction of Pipeline, Associated Fittings, Valves and Components:

The Contractor shall train pipe crews to be aware of the need to maintain clean pipes, fittings, etc and avoid contamination. While bacteriological testing is used to verify the absence of coliform organisms and is generally accepted as verification that disinfection of the pipeline has been accomplished, following sanitary practices for handling and installation of pipe, valves, fittings, and accessories, coupled with adequate flushing of the line before disinfection, is necessary to ensure that the disinfected pipeline will be ready for connection to the water system. Failure to pass the bacteriological test shall require that the flushing or disinfection process be repeated. The final water quality test is not the primary means for certifying the sanitary condition of a main. The sanitary handling of materials, the practices during construction, and the continual inspection of the work are the primary means for ensuring the sanitary condition of the water main.

B. Methods of Disinfecting Newly Constructed Water Pipelines and the Acceptable Method of Disinfecting Pipelines:

The three methods of disinfecting newly constructed water mains are the tablet method, the continuous-feed method and the slug method. Factors considered when selecting a method include the length and diameter of the main, type of joints present, availability of materials, equipment required for disinfection, training of the personnel who will perform the disinfection, and safety concerns. This Project shall allow chlorination of pipelines by the continuous feed method. The tablet method and slug method shall not be allowed.

The tablet method shall not be used unless the main can be kept clean and dry. It shall not be used in large-diameter mains if it is necessary for a worker to enter the main to grout joints or perform inspection, because the tablets may release toxic fumes after exposure to moist air. When using the tablet method, the chlorine concentration is not uniform throughout the main, because the hypochlorite solution is dense and tends to concentrate at the bottom of the pipe. The use of the tablet method precludes preliminary flushing. The tablet method is convenient to use in mains having diameters up to 24 inches, and it requires no special equipment.

The continuous-feed method is suitable for general application. Preliminary flushing removes light particulates from the main but not from the pipe-joint spaces. The chlorine concentration is uniform throughout the main.

The slug method is suitable for use in large-diameter mains where the volume of water makes the continuous-feed method impractical and difficult to achieve for short attachments. The slug method results in appreciable savings of chemicals used to disinfect long, large-diameter mains. Also, this method reduces the volume of heavily chlorinated water to be flushed to waste.

C. Forms of Chlorine for Disinfection:

The forms of chlorine that may be used in the disinfection operations are liquid chlorine, sodium hypochlorite solution, and calcium hypochlorite granules or tablets. For this Project, liquid chlorine shall be used unless otherwise approved by the Owner's Representative.

1. **LIQUID CHLORINE:** Liquid chlorine conforming to ANSI/AWWA B301 contains 100 percent available chlorine and is packaged in steel containers usually of 100-lb., 150-lb., or 1-ton net chlorine weight. Liquid chlorine shall be used only (1) in combination with appropriate gas-flow chlorinators and ejectors to provide a controlled high-concentration solution feed to the water to be chlorinated; (2) under the direct supervision of personnel familiar with the biological, chemical and physical properties of liquid chlorine and who are trained and equipped to handle any emergency that may arise; and (3) when appropriate safety practices are observed to protect working personnel and the public.
2. **SODIUM HYPOCHLORITE:** Sodium hypochlorite conforming to ANSI/AWWA B300 is available in liquid form in glass, rubber-lined, or plastic containers typically ranging in size from 1 quart to 5 gallons. Containers of 30 gallons or larger may be available in some areas. Sodium hypochlorite contains approximately 5 percent to 15 percent available chlorine, and the storage conditions and time must be controlled to minimize its deterioration. (Available chlorine is expressed as a percent of weight when the concentration is 5 percent or less, and usually as a percent of volume for higher concentrations. Percent x 10 = grams of available chlorine per liter of hypochlorite.)

3. **CALCIUM HYPOCHLORITE:** Calcium hypochlorite conforming to ANSI/AWWA B300 is available in granular form or in 5-g tablets, and must contain approximately 65 percent available chlorine by weight. The material should be stored in a cool, dry, and dark environment to minimize its deterioration.

CAUTION: Tablets dissolve in approximately 7 hours and must be given adequate contact time. Do not use calcium hypochlorite intended for swimming pool disinfection, as this material has been sequestered and is extremely difficult to eliminate from the pipe after the desired contact time has been achieved.

D. **Preventative and Corrective Measures to be Implemented during the Construction of Pipelines:**

Heavy particulates (dirt, soil, rocks, etc.) generally contain bacteria and prevent even very high chlorine concentrations from contacting and killing organisms. Therefore, the procedures of this Section shall be stringently implemented by the Contractor and enforced by the Owner's Representative to ensure that water pipelines, fittings, etc., have been thoroughly cleaned before flushing the pipeline for the final disinfection by chlorination. Also, any connection of a new water main to the active distribution system prior to the receipt of satisfactory bacteriological samples constitute a cross-connection in violation of the California Health Department requirements. The new main shall be isolated until bacteriological tests described later in this Section are satisfactorily completed. The Contractor shall complete the following tasks or observe the following precautionary measures during the installation of the water pipeline:

1. The interiors of pipes, fittings and valves shall be protected from contamination by dirt, debris, rocks, concrete residue, water and similar items.
2. Openings in the pipeline shall be closed with watertight plugs when pipe laying is stopped at the close of the day's work or for other reasons, such as rest breaks or meal periods. Rodent-proof plugs may be used when watertight plugs are not practicable and when thorough cleaning will be performed by flushing or other means.
3. Delay in placement of delivered pipe invites contamination. Pipe delivered to the site shall be covered with tarps. The

tarps shall be placed over the pipes and end of the pipes to minimize the entrance of dirt, dust and construction debris.

4. Sealing Materials: No contaminated material or any material capable of supporting growth of microorganisms shall be used for sealing joints. Sealing material or gaskets shall be handled in a manner that avoids contamination. The lubricant used in the installation of sealing gaskets shall be suitable for use in potable water and shall not contribute odors. It shall be delivered to the job in closed containers and shall be kept clean and applied with dedicated, clean applicator brushes.
5. If dirt or other contaminants enter a pipeline, fitting, transition coupling, valve or any other pipeline, it shall be swept from the interior of the pipeline, fitting, etc. The contaminated area shall be wiped clean with an ammonia solution disinfectant. After each pipe section is installed the end of the pipe shall be inspected for the entrance of dirt and other contaminants. If dirt or contaminants are identified the dirt and contaminants shall be removed prior to the installation of the next pipe length. Correspondingly, the pipe end to be “stabbed” into the previously installed pipe segment shall be checked for dirt contamination and cleaned and disinfected accordingly.
6. Flooding by Storm or Accident during Construction: If the pipeline is flooded during construction, it shall be cleared of the floodwater by draining and flushing with potable water until the main is clean. The section exposed to the floodwater shall then be filled with a chlorinated potable water that, at the end of a 24 hour holding period, shall have a free chlorine residual of not less than 25 mg/L. The chlorinated water shall then be drained or flushed from the main. After construction is completed, the main shall be disinfected for a second time using the continuous-feed method.

PART 3 - EXECUTION

3.01 GENERAL

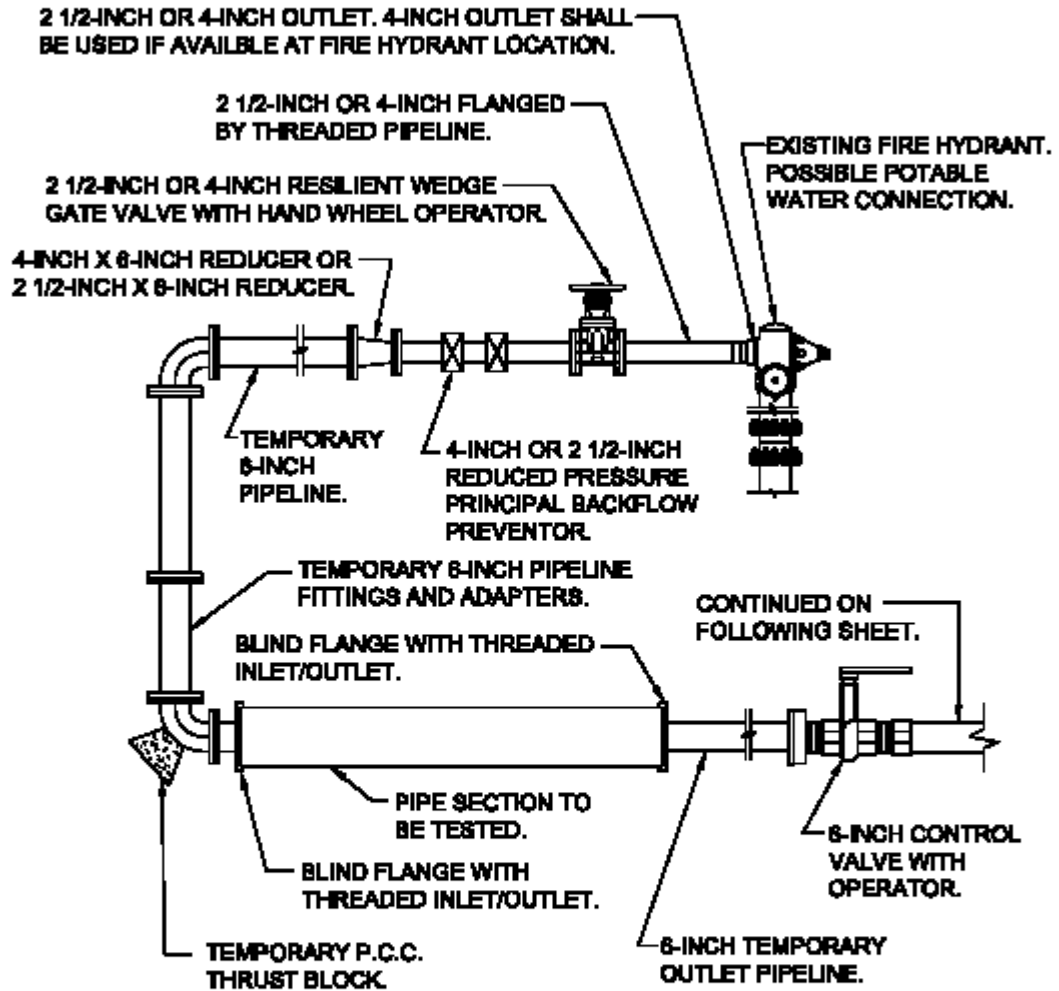
The water pipeline shall be thoroughly flushed with potable water prior to the chlorination of the pipeline. Prior to the flushing of the water pipeline it may be necessary to construct temporary flushing and testing connections

at the upstream and downstream ends of the pipelines to be tested. If new pipelines are to be connected to existing in-service pipelines with new valves installed at the connection fittings between the new and existing pipelines which reliably isolate the new pipeline from the existing in-service pipeline, then blowoffs and properly positioned fire hydrants allow for the adequate flushing of the pipeline and allow for the dispersion of chlorine by the continuous-feed method. This method is particularly applicable to new commercial or residential developments which occur within an existing pipe distribution system.

If new pipelines are to be connected to existing in-service pipelines, concrete structures and reservoirs with no reliable valve at the connection point of the new pipeline to isolate the new pipeline from the existing in-service pipelines, concrete structures and reservoirs, then temporary caps or plugs (blind flanges), supply hoses, control valves, backflow devices, discharge/flushing lines and sampling faucets shall be constructed. This pipeline condition often occurs within water treatment plants. The pipelines within water treatment plants in the condition described within this paragraph shall be flushed, chlorinated and tested while physically separated from existing in-service pipelines, reservoirs and concrete structures. The physically separated pipeline section shall be hydrostatically tested prior to the flushing, chlorination and testing of the pipeline section. Potable water from an outside source shall be required to be conveyed to the new pipeline for flushing and disinfecting via a temporary connection supplied and installed by the Contractor. The temporary connection shall be disconnected (physically separated) from the new pipeline during the hydrostatic pressure test. The temporary connection shall include a reducer fitting from the fire hydrant, 4 inch control valve, 4 inch backflow preventer based upon a reduced pressure principal, 4 inch supply hose or pipeline, temporary testing block, blind flange with 4 inch threaded outlet, 4 inch discharge piping, 4 inch discharge control valve and smooth, unthreaded sampling faucet. It shall be necessary for the Contractor to provide all other necessary fittings, adapters, hardware and other components. The discharge pipeline shall extend to a discharge point acceptable to the Owner's Representative. If the discharge pipeline extends through on-site roadways or into the public right of way then the Contractor shall place the temporary discharge pipeline below grade. The Contractor shall perform all cutting, demolition and replacement of P.C.C. infrastructure as required by Division 1 of the Technical Specifications. The Contractor shall core the side of manholes, install the discharge pipeline to the interior wall face of the manhole and grout the annular space between the exterior circular core and the exterior of the pipeline for the full thickness of the manhole shaft with a non-shrink grout. At the conclusion of the pipeline disinfection all upstream and downstream pipelines, supply hoses, valves, check valves, fittings, blind flanges and components shall be removed from the Project Site. The

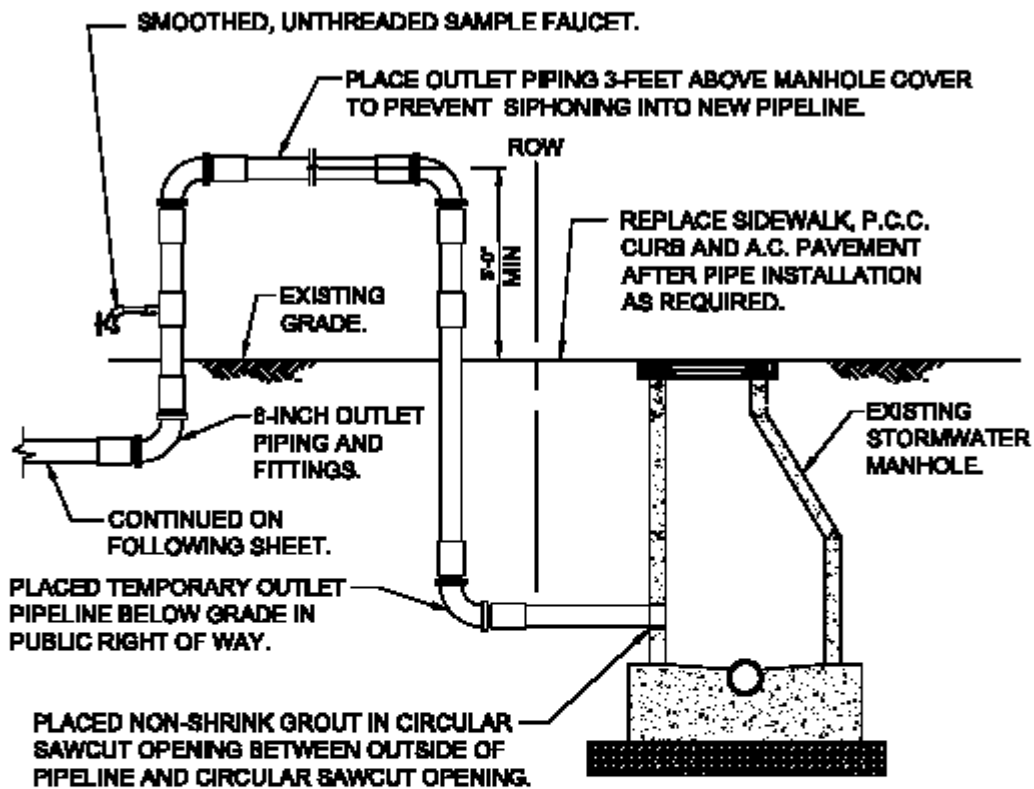
interior of any discharge pipeline extending into manholes shall be plugged for the full width of the manhole shaft wall width with a non-shrink grout.

A schematic of the temporary flushing/testing connection and schematic of the discharge blowoff/sampling tap pipeline follows. The schematic drawings are intended to illustrate the concept and major components required for the disinfection of the pipeline. The schematics do not illustrate each fitting, adapter and component required for the flushing/testing connection pipeline or the discharge blowoff/sampling tap pipeline nor do the schematics illustrate the lengths of pipelines required, number of fittings, number of valves, etc. The schematics do not illustrate where the source of water is to be obtained or the discharge point the blowoff pipeline is to extend to. It is the responsibility of the Contractor to determine the source of the potable water, length of the connection pipeline, exact number and type of fittings, valves and adapters, length of the blowoff pipeline, exact number and type of fittings, valves and adapters, paving and concrete demolition and replacement requirements and similar logistical placement, pipe mechanic and civil infrastructure issues. Following are the Temporary Flushing/Testing Connection Schematic and Blowoff Sampling Point Discharge Pipeline Schematic Drawings:



**TEMPORARY FLUSHING/ TESTING AND BLOWOFF/
SAMPLING FITTINGS AND PIPING SCHEMATIC**

SHEET 1 OF 2



**TEMPORARY FLUSHING/ TESTING AND BLOWOFF/
SAMPLING FITTINGS AND PIPING SCHEMATIC**

SHEET 2 OF 2

3.02 CHLORINATION PROCEDURE

- A. Pipeline shall be thoroughly flushed prior to the commencement of the introduction of chlorine disinfectant.

Pipelines within a distribution system or a network of pipelines shall be flushed at each hydrant, blowoff, or service pipeline. It shall be necessary to install sampling/blowoff assemblies at the termination ends of pipe segments to allow the extremities of the pipeline to be flushed and for chlorinated water to be dispersed throughout the new water pipeline section in the event blowoffs or fire hydrants are not placed at the extremities of the pipeline to be tested. At least one (1) blowoff/sampling point assembly shall be placed at the extremities of the pipe section to be tested for sampling purposes. Sampling shall not be allowed through fire hydrants or water fittings with threaded ends. The Contractor shall install at least one (1) blowoff/sampling assembly at the end of each pipeline section to be tested; even if the blowoff/sampling assembly is not illustrated on the Plans. The Contractor shall be required to install the blowoff/sampling assembly as a requirement of this pipeline disinfection specification section. The Contractor shall not be compensated for the costs of the blowoff/sampling assembly. The cost of the installation of the blowoff/sampling assembly shall be incidental to the costs of disinfecting the pipeline.

Pipelines physically separated from existing in-service pipelines, reservoirs and concrete structures (as is often the case at Water Treatment Plants), shall be flushed with temporary pipeline connections upstream and downstream of the pipeline section to be disinfected as described in Section 3.01 of this specification.

Flushing of pipelines within a distribution system shall occur through fire hydrants, blowoffs, water services and blowoff/sampling points for a minimum of 10 minutes with the potable water source placed at maximum flow and maximum pressure. Flushing shall continue until no evidence of dirt is evident from the discharge water. Flushing shall be accomplished through fire hydrants or blowoffs if possible. Flushing of the water pipeline shall occur through a blowoff/sampling point assembly as a last resort. The pipeline contractor shall take necessary precautions to avoid damage to existing structures and utilities.

Flushing of physically separated pipelines shall be accomplished for a minimum of 10 minutes with the potable water source placed at maximum flow and maximum pressure. Flushing of the pipeline shall continue until no evidence of dirt is visible from the discharge

water entering the downstream deposition point. The pipeline contractor shall take necessary precautions to avoid damage to existing structures and utilities.

- B. After flushing of the water pipelines is satisfactorily accomplished and approved by the Owner's Representative, chlorinated water shall be introduced to the pipeline. The pipelines shall be chlorinated in accordance with AWWA C 651.

The continuous-feed method of chlorine application shall be employed. The use of chlorine tablets or granules shall not be allowed.

Direct-feed chlorinators, which operate solely from gas pressure in the chlorine cylinder, shall not be used for the application of liquid chlorine. (The danger of using direct-feed chlorinators is that water pressure in the main can exceed gas pressure in the chlorine cylinder. This allows a backflow of water into the cylinder, resulting in severe cylinder corrosion and the escape of chlorine gas.) The preferred equipment for applying liquid chlorine is a solution-feed, vacuum-operated chlorinator and a booster pump. The vacuum-operated chlorinator mixes the chlorine gas in solution water; the booster pump injects the chlorine-gas solution into the main to be disinfected. Hypochlorite solutions may be applied to the water main with a fuel or electrically powered chemical-feed pump designed for feeding chlorine solutions. Feed lines shall be made of material capable of withstanding the corrosion caused by the concentrated chlorine solutions and the maximum pressures that may be created by the pumps. All connections shall be checked for tightness before the solution is applied to the pipeline.

Chlorine shall be dispersed through the pipeline at 100 ppm. Chlorine shall be flushed through all fire hydrants, blowoffs, water services and blowoff/sampling assemblies. Chlorine shall continue to be flushed through the above listed items until the chlorine concentration is measured at 100 ppm or greater.

The chlorinated water shall remain in the pipeline for a minimum 24-hour period and not longer than 48 hours. The chlorine residual shall be a minimum of 50 ppm after the 24 hour period; or prior to flushing the heavily chlorinated water from the pipeline. The heavily chlorinated water shall not remain in the pipeline over 48 hours as prolonged exposure to the heavily chlorinated water may damage (corrode) pipelines, fittings, valves and other piping components. The heavily chlorinated water shall be flushed from the pipeline, pipeline fittings, water services, fire hydrants, blowoffs,

blowoff/sampling assemblies and all other pipe connections. The heavily chlorinated water shall be flushed until chlorine samples of the flushed water confirm that the chlorine concentration is no higher than the water in the in-service distribution system or the water source used for the disinfection process.

The environment to which the heavily chlorinated water is to be discharged shall be inspected. In the opinion of the Owner's Representative, if there is a possibility that the chlorinated water will result in damage to the environment, then the Owner's Representative shall require a neutralizing chemical be applied to the water to be wasted (prior to discharge) by means of a neutralizing chemical. Neutralizing chemicals may be sulfur dioxide, sodium bisulfite, sodium sulfite, sodium thiosulfate or ascorbic acid. Appendix "C" of ANSI/AWWA C 651-05 lists the neutralizing chemicals and the suggested neutralizing chemical concentrations per 100,000 gallons of water.

The Contractor shall be responsible for the discharging of the heavily chlorinated water. The Contractor shall provide all piping, fittings, etc. to convey the heavily chlorinated water from the disinfected pipeline per Item 3.01 of this Specification.

- C. After final flushing and before the disinfected water pipeline is connected to the distribution system or in-service pipeline system, two (2) consecutive sets of acceptable samples, obtained a minimum of 24 hours apart, shall be collected from the disinfected pipeline.

One (1) set of samples shall be collected from every 1,200 feet of new water pipeline and one (1) set shall be obtained from the end point(s) of the disinfected water pipeline(s). If disinfected water pipelines terminate (dead-end) at cul-de-sacs, a sample shall be obtained from the termination point of the pipelines. As was noted by the previous sections, The Contractor shall install blowoff/sampling point assemblies at pipeline termination points as required.

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 chlorine residual. Turbidity, pH, and a standard heterotrophic plate count (HPC) test shall be required. New pipeline does not typically contain coliforms but does typically contain HPC bacteria.

Samples for bacteriological analysis shall be collected in sterile bottles treated with sodium thiosulfate, as required by *Standard Methods for the Examination of Water and Wastewater*. No hose, fire hydrant or threaded fitting outlet shall be used in the collection of samples. There should be no water in the trench up to the connection for sampling. The sampling pipe must be dedicated and clean and disinfected and flushed prior to sampling.

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 shall be obtained until no coliforms are present and the HPC is less than 500 cfu/ml.

The record of disinfection compliance shall be the bacteriological test results certifying that the water sampled from the disinfected water main is free of coliform bacteria contamination and is equal to or better than the bacteriologic water quality in the distribution system.

If the initial disinfection fails to produce satisfactory bacteriological results or if other water quality is affected, the disinfected pipeline may be reflushed and shall be resampled. If succeeding samples also fail to produce acceptable results, the disinfected pipeline shall be rechlorinated by the continuous-feed method until satisfactory results are obtained, satisfactory results being derived from two (2) consecutive sets of acceptable samples taken 24 hours apart.

The Contractor shall be responsible for all expenses relative to the chlorination and disinfection of the pipelines. The costs of re-testing shall also be borne by the Contractor. The City or District Water Department within which the disinfected pipeline is located shall coordinate obtaining the tests and select the testing laboratory to perform the tests. The Contractor shall be responsible for all expenses relative to the laboratory testing.

The disinfected pipeline shall not be placed in service until evidence that the bacteriological tests have proved negative and successfully met the testing requirements and are presented to the Owner's Representative. The Owner's Representative shall allow the disinfected pipeline(s) to be connected to the in-service pipeline after the evidence is presented to him/her by the Contractor. The evidence shall consist of the original laboratory report document certifying the laboratory test results comply with the disinfection requirements of this document.

3.03 FINAL CONNECTION PIPE SEGMENT DISINFECTION REQUIREMENTS

If approved by the Owner's Representative, final connection pipe segments (measuring 18.5 feet or less) located between the existing in-service pipeline and the valve or temporary termination point of a successfully disinfected pipe section may be spray disinfected or swabbed with a minimum 1-5 percent solution of chlorine prior to final installation. The installation of the final connection pipe segment shall be witnessed by the Owner's Representative. If dirt, debris or any contaminating substances enter the pipe section between the disinfection process and installation process the pipe section shall be removed and re-disinfected. The Contractor shall immediately remove the pipe section from the pipe trench and re-disinfect the pipe section if required by the Owner's Representative. The disinfection of the pipeline shall require that all dirt, construction residue, dust and contaminants be thoroughly pressure washed from the interior of the pipeline, valve, fitting, transition coupling and other pipe component interior surfaces. The interior surfaces shall be dried clean with a cloth or paper towels. The interior surfaces shall then be disinfected with the minimum 1-5 percent solution of chlorine. The pipe section shall not be allowed to be set in place for connection to the existing in-service pipeline until the Owner's Representative approves the witnessed disinfection of the pipeline section.

END OF SECTION 02670

SECTION 02733 – WATER WELL DRILLING, INSTALLATION AND TESTING

PART 1 - GENERAL

1.01 DESCRIPTION

The Contractor shall furnish all labor, equipment, and materials to perform all field operations pursuant to the installation or demolition of the water wells in accordance with Plans, Contract Documents, and any addendum(a).

Field operations shall include, but not be limited to, the construction of access roads and drilling pad areas, drilling and installing casing and screen, well development and production testing, equipping the well with submersible pumping units and casing drop pipe, installation of piping downstream of the well, installation of a flow metering system and installation of a native earth fill separation area.

1.02 PURPOSE

The purpose of this standard is to define the minimum requirements for the demolition and construction of water wells, including preparation of area, disinfection of wells, sampling and testing for water quality, and water well reports.

1.03 REFERENCE SECTIONS, CODES, AND STANDARDS

Section 02050 – Demolition and Salvage

Section 02630 – Ductile Iron Pipe

Section 02640 – PVC Pipe

Section 02666 – Pressure Pipeline Water Testing

Section 02670 – Disinfection of Potable Water Pipelines

AWWA Standard A 100-20 – Water Wells

AWWA Standard C 654-21 – Disinfection of Water Wells

California Water Well Standards – Bulletin 74-81

California Water Well Standards – Bulletin 74-90

California Code of Regulations – Title 17

California Code of Regulations – Title 22

1.04 QUALITY ASSURANCE

- A. The Contractor shall have been engaged in the business of test pumping, construction test holes, and hydraulic reverse circulation rotary-drilled gravel envelope wells of diameter, depth, and anticipated production equivalent to the proposed production wells for a period of at least ten (10) years.

All work shall be performed under the direct supervision of an experienced water well driller and/or drilling supervisor familiar and experienced with the DR drilling process. The Contractor shall employ only competent workers for the execution of this work and shall be held accountable for the conduct and actions of said workers during the entire drilling and construction process.

- B. The Contractor shall employ the services of a Registered Professional Geologist during the entire drilling process who is experienced and knowledgeable with the DR drilling method and associated well design. The well will be drilled, developed, pump tested and equipped in accordance with the recommendations of the Registered Professional Geologist in concurrence with the Engineer.
- C. All components used in the well system shall be certified as suitable for contact with or treatment of, drinking water by an accredited certification organization in accordance with NSF / ANSI 61.

1.05 SUBMITTALS

- A. All records shall be always available to the Owner and Engineer at the project site. The following records and submittals shall be provided:
1. Driller's lithologic log.
 2. E-log or Gamma Ray log.
 3. Drilling Fluid Additives (type and quantity) and Penetration Rate.
 4. Alignment / Plumb log.

5. Surging / air lift pumping records.
6. Step Test pumping records including specific capacities, drawdowns, pumping rates.
7. Sand production records.
8. Constant pumping rate, drawdown, times, and specific gravity.
9. Gravel pack sieve analyses, as applicable.
10. Water Quality / Bacteriological test.
11. Concrete material.
12. Casing material.
13. PVC Pipe material.
14. Screen material.
15. Gravel Pack Pipe material.
16. Sounder Tubes material.
17. Cement Slurry Grout material.
18. Submersible Pump.
19. Electrical Chord for Pump.

1.05 WARRANTY

A. Warranty Conditions

For a period of one (1) year after acceptance of the well by the Owner, the Contractor shall make the following guarantees and accept the following responsibilities concerning their work;

1. Sand production shall be less than 5 ppm within 15 minutes after start of pumping at the constant pump test rate of the well.

2. Sand production shall be less than 1 ppm within two (2) hours after start of pumping at the constant pump test rate of the well.
3. The well casing and screen shall remain intact throughout its entire length.
4. Plumbness and alignment shall remain within tolerances set forth in specifications.

SECTION 2 - PRODUCTS

2.01 MATERIALS

A. Drilling Fluid Additives

If it becomes necessary to add clays or chemicals to the drilling fluid, it must be borne in mind that it is desirable to maintain a mud system containing a minimum of clay and fine sand and to obtain representative lithologic samples and minimize sealing of well with mudcake or mud invasion into formation. If there should be a conflict between the mud requirements for ease in drilling and the mud requirements for sample attainment and minimal sealing; then the ruling requirements shall be those for sample attainment and minimal sealing.

B. Gravel Pack

The gravel to be installed shall be composed of sound, durable, well-rounded particles, containing no silt, clay, organic matter, gypsum, iron, manganese or other deleterious materials. It shall be selected by the Contractor with the submittal approval based on the test hole log, electronic log, and formation analysis. Material shall have an average specific gravity of not less than 2.5 and a uniformity coefficient no greater than 2.0. Gradation shall conform to that required to retain the 50th percentile of the finest aquifer material encountered in the zone(s) where screens are to be placed. Under no circumstances shall crushed rock be installed in the well. A certificate of quality and gradation of the gravel shall be submitted to the Engineer prior to gravel being delivered to the site. The Engineer may elect to have a certified testing laboratory perform an independent sieve analysis to verify conformance with submitted sample. Failure of the submitted sample to meet gradation requirements shall be grounds for rejection.

2.02 WATER QUALITY AND REPORTS

Upon completion of the project, the Contractor shall furnish a written well drillers report describing in detail the well drilling and construction process. In addition, as-built drawings shall be prepared. The as-built drawing shall be submitted to the Engineer for review and approval. The Contractor shall be responsible for filing the official Well Drillers Report, well log, pump test report and all other related documents to the County Imperial Public Health Department, County of Imperial Planning and Development Services Department and California Department of Water Resources for review and approval. See Section 19.1, Water Well Report, for additional Water Well Report requirements.

2.03 WATER WELL REPORT

The Contractor shall prepare a report concerning the construction of the new wells. The reports shall be prepared on California Department of Water Resources forms. The water well report forms shall be prepared in accordance with relevant provisions of Sections 13750 through 13754 (Division 7, Chapter 10, Article 3) of the California Water Code. The Water Well Report forms shall be forwarded as submittal documents for review and approval. Information concerning completion and submission of well construction, alteration, and destruction reports is contained in the Department of Water Resources "Guide to the Preparation of the Water Well Drillers Report", October 1977 or its latest revision. The completed forms shall be submitted to the County of Imperial Public Health Department, County of Imperial Planning and Development Services Department and California Department of Water Resources for review and approval no later than 10 days after the date the well is approved for operation.

PART 3 - EXECUTION

3.01 GENERAL

The contractor shall install a temporary 24-inch diameter surface casing set in cement grout to a depth of 50 feet within a 28-inch diameter nominal borehole. The temporary casing shall be removed as the grout is installed. The Contractor shall then use dual rotary (DR) drilling methods to advance a 12-inch diameter steel casing to a depth of 160 feet. 60-feet of the 12-inch diameter steel casing shall be pulled back to expose 60 feet of 10-inch diameter by 8-inch diameter pre-packed stainless-steel wire wrapped well screen with a 12-inch diameter by 10-inch diameter packer.

The Contractor shall furnish and install all casing, screens, and well pumping equipment.

3.02 WATER WELL DECOMMISSIONING

The existing well to be replaced at the Palo Verde Water Plant shall be decommissioned according to the sequence of events contained within the Project Description on sheet 1 of the improvement plans. The guiding principle to follow in sealing abandoned wells is the restoration, as far as feasible, of the controlling geological conditions that existed before the well was drilled and constructed. Wells are to be sealed for the following reasons:

- A. To eliminate physical hazards.
- B. To prevent contamination of groundwater.
- C. To conserve yield and hydrostatic head of aquifers.
- D. To prevent commingling of waters.

Before sealing operations are initiated the contractor shall confirm the depth of the well and check for obstructions within the well. The decommissioning and demolition of the existing well shall be accomplished in accordance with State of California Water Wells Standards, AWWA Standard A100-15, CCR Title 17 and 22 and the requirements of the County of Imperial Health Department.

The contractor shall maintain complete and accurate records of the entire decommissioning and demolition procedure as part of an Existing Well Decommissioning and Demolition Report. The depth of each layer of all sealing, backfilling materials used and quantity of backfill materials used shall be recorded. Any changes in the well made during the sealing, such as perforating the well casing, shall be recorded in detail.

The Existing Well Decommissioning and Demolition Report shall be submitted to the County of Imperial Health Department for review and approval within 10 days after the decommissioning and demolition of the existing wells.

The old wells shall be abandoned in strict accordance with all the applicable requirements of the County of Imperial Health Department and the previous referred to State of California Water Wells Standards, AWWA Standard A100 – 15 and CCR Titles 17 and 22.

3.03 CASING INSTALLATION

A new 24-inch diameter steel surface casing shall be set in a bore hole not less than four (4) inches greater in diameter than the surface casing. The casing shall be new mild steel casing ASTM A-53, Grade B or better, 0.250-inch wall thickness. No less than fifty (50) feet of surface casing shall be installed. The surface casing shall be installed using the retractable auger drilling method. Installation of the surface casing shall be straight and plumb in accordance with AWWA A100-20.

The annular space between the reamed bore hole wall and the surface casing shall be filled with a sand cement grout. The Contractor shall bring the grout to within (1) foot below the existing ground surface.

After installing the surface casing and cement grout seal, the borehole shall be drilled by the Contractor using the DR drilling method to advance a nominal 12-inch outside diameter, ASTM A53, Grade B or better, 0.375-inch wall steel casing to a depth of 160 feet.

The contractor shall contact the County of Imperial Health Department 48 hours prior to scheduling the pouring of the sanitary seal at telephone number (442) 265-1888. A representative of the County of Imperial Health Department must be present at the project site during the continuous sanitary seal pour.

The casing shall be manufactured with machine beveled ends. The casing shall be manufactured in 20-foot lengths. A Registered Geologist will collect and describe the geologic samples at 10 feet intervals during the drilling process. The samples shall be marked and stored so that they are not impacted by drilling equipment, onsite personnel, or the elements. The Contractor shall provide safe access and a method for sampling the drill cuttings that is satisfactory to the Engineer. Drill cuttings and all formation water developed during the drilling will exit via a cyclone separator where it can be observed and sampled. The drilling supervisor shall maintain a continuous record of borehole depth and drilling rates. The drilling supervisor shall maintain written daily logs of all drilling operations and provide copies of the daily logs to the Engineer and County of Imperial Public Health Department. If subsurface conditions encountered while drilling mandate that the Contractor must use drilling additives, the brand and type of any drilling additives must first be approved by the Engineer and County of Imperial Public Health Department. Any drilling additives must be NSF 60/61 approved for use in drilling potable water wells. Only clean potable water from the designated supply source plus any required NSF approved drilling additives shall be used to drill and construct the well.

3.04 WATER WELL SCREEN INSTALLATION

The Contractor shall have on order, or on location, the blank casing, wire wrapped stainless-steel screens, and centralizers by the time that the borehole drilling is completed. Following the completion of the work described in the preceding specification sections, the Contractor shall install the stainless-steel screen assembly in the borehole in accordance with these specifications, the contract drawings and any specific instructions issued by the Engineer.

The well screen shall be new 8-inch by 10-inch diameter stainless-steel wire wrapped screen with continuous slot width openings of fifty thousandths (0.050) of an inch. The stainless-steel screen shall have a specially sorted glass bead filter pack that has been pre-installed between the two screens to serve as a sand filter. A manufactured K packer assembly shall be attached to the stainless-steel screen. The bottom of the screened section shall be fitted with a closed end cap of stainless-steel. The exact length of the screened interval shall be 60 ft. as shown on the contract drawings. The top of the wire wrapped screen shall have a factory-made K packer assembly that will seal between the wire wrapped screen and the inside of the 12-inch blank steel casing. The stainless-steel screen shall be lowered to the bottom of the advanced casing. When the desired amount of the blank casing and screen has been installed in the 12-inch diameter blank casing, the 12-inch diameter blank casing shall be securely welded to the 24-inch diameter steel surface casing. The 12-inch diameter steel well casing shall become the final completed well diameter that will support the submersible pump and motor.

3.05 WATER WELL CAPACITY TEST

A water well capacity test shall be completed for the new well in conformance with California Code of Regulations Title 22, Sections 64554 (e) (f).

- A. Take an initial water level measurement (static water level) and then pump the well continuously at the pump discharge design rate of approximately 250 gallons per minute until a steady state is defined. Steady state is indicated if the last four (4) hours of drawdown measurements and the elapsed time yield a straight line per a plot which illustrates drawdown data versus the time data on semi-logarithmic graph paper, with the time intervals on the horizontal logarithm axis and the drawdown data on the vertical axis.
- B. While pumping the well, take measurements of the water level drawdown and pump discharge rates for a minimum of 8 hours at a frequency no less than every hour. During the first two (2) hours

discontinue pumping and take measurements of the water level drawdown no less frequently than every 15 minutes for the first two hours.

- C. To complete the test, the well shall demonstrate that, within a length of time not exceeding the duration of the pumping time of the well capacity test, the water level has recovered to within two feet of the static water level measured at the beginning of the test or to a minimum of ninety-five percent of the total drawdown measured during the test, whichever is more stringent.
- D. The capacity of the well shall be the pump discharge rate determined by a completed test.
- E. The well capacity test information obtained during the well capacity test shall be in accordance with California Code of Regulations Title 22, Section 64554 (e).

3.06 WELL DEVELOPMENT PRIOR TO SUBMERSIBLE PUMP INSTALLATION

The Contractor shall furnish an air compressor capable of performing airlift development from the bottom of the screened section to the top of it. Well development shall continue until all dirty water has been removed and all screened intervals have been fully developed. The Contractor shall use reverse circulation pipe in conjunction with a dual ring surge block of approximately 8-inch in diameter to closely fit and work the inside of the stainless-steel wire wrapped screened interval. Air lift development water must exit the same energy absorbing cyclone separator as the drill cuttings and formation water. Each 20-foot section of wire wrapped screen shall be agitated by multiple up and down movements of the drill pipe and surge block. The surge block shall then be slowly drawn upward and held at various intervals in order to observe that the well is producing only clean water. Each 20-foot section shall be worked until it can no longer be muddied and is producing sand free water. The Engineer shall make the determination that each screen interval has been fully developed and the well is ready for equipping. Development records should include the following:

- A. Quantity and description of material used in the well construction.
- B. Static and pumping water levels prior to pumping, during pumping and during recovery time.
- C. Methods of measurement.
- D. Duration of each operation.
- E. Observation of results.
- F. Pump discharge rates and specific capacity.

- G. Sand content as a function of pump discharge rates and time.
- H. Sand content as a function of pump discharge rates and specific capacity.
- I. All other pertinent information.

Sand content shall not average more than 5 mg/L for a complete pumping cycle of 2-hour duration when pumping at the design-discharge capacity. Well Development shall be accomplished and comply with applicable sections of AWWA A100-20, California Wells Standards Bulletin 74-90, California Well Standards 74-81 and the CCR Title 17 & 22, latest revision. Upon completion of well development, the Contractor shall tag the bottom of the well to verify the total open depth of the well.

3.07 WATER WELL SUBMERSIBLE PUMP INSTALLATION

The Contractor shall construct the well to be sufficiently straight and plumb in accordance with AWWA A100-20 to permit the free installation and operation of a shrouded 6-inch diameter submersible electric pump of the size and capacity specified.

The Contractor shall equip the newly drilled and developed wells with 15-HP, 277/480-volt three phase, 4 wire submersible motors and 250 GPM submersible pumps. The pumps and motors shall be made of stainless steel and be equipped with a built-in check valve and a motor cooling flow inducing shroud. The pump and motor shall be manufactured by Franklin Electric, Grundfos, Xylem, or an approved equal. A detailed submittal showing all of the precise characteristics of the pumps and motors shall be submitted for review and approval by the Engineer prior to the ordering and installation of the specific pumping units. The submittal shall include details of the sounding tubes and motor cooling shrouds. The permanent pumping equipment shall be installed under the direct observation of the Engineer or his designated representative.

3.08 WELL DISINFECTION

The Contractor shall disinfect the new water wells to remove bacteriological contamination that may cause the well-water supply to be unsafe for human consumption. The chlorine solution used for disinfecting the well shall be of such volume and strength and shall be so applied that a concentration of at least 50 mg/L of available chlorine shall be obtained for the entire water depth of the well. The disinfectant shall be circulated through the pump and back down the well. The inside well casing above the standing water level shall be washed with a chlorine solution of 200 mg/L concentration. All permanent equipment and material to be installed in the well shall be chlorinated immediately before installation. This shall be accomplished by spraying exposed areas with a solution having a

chlorine residual of not less than 200 mg/L. The water well shall be filled with a 50 mg/L available chlorine concentration independently of the downstream pipe. The chlorine solution shall remain in the well section for a minimum period of 12 hours.

If the samples collected after initial disinfection show bacteriological contamination, the Contractor shall prepare and apply a chlorine solution of at least 100 mg/L of available chlorine to the entire water depth of the well and downstream pipeline as noted previously. The inside well casing above the standing water shall be washed with a chlorine solution of 200 mg/L concentration. The contractor shall allow this solution to remain in the well section for a period of at least 24 hours.

The Disinfecting of the wells shall be accomplished in accordance with the procedures contained within ANSI/AWWA C654, latest revision. The Contractor shall provide sufficient flow control and a sampling point for the collection of the required water samples.

The Contractor shall assume the costs associated with the required disinfection sampling and testing of the water wells. A total of four (4) bacteria tests shall be required. Two (2) bacteria tests shall be obtained for the wells. A minimum of two (2) water samples shall be obtained for each bacteria test. The costs shall include the transportation of the Water Samples to the testing laboratory and the testing costs of the laboratory. If the disinfection test samples fail the contractor shall repeat the water well disinfection procedure including the required testing at the contractors cost until the disinfection testing produces approved results. The laboratory testing results shall be issued to the Palo Verde Water District, County of Imperial Public Health Department, and the Construction Manager.

3.09 WATER QUALITY TESTING

Water quality shall be determined by analyses of water samples collected from the well. The analyses shall be performed by a laboratory acceptable to the County of Imperial Public Health Department. Sampling procedures shall be accomplished according to the latest edition of the United States Environmental Protection Agency's, "*Manual of Methods for Chemical Analysis of Water and Wastes*".

Water temperatures, pH, specific conductance, and dissolved oxygen shall be determined from samples collected and analyzed in the field.

The County of Imperial Public Health Department was contacted during the design phase of this project. ***The County of Imperial Public Health Department shall require the following Inorganic Chemicals,***

Radionuclides, Organic Chemicals and Secondary Contaminants be tested:

1. Title 22 - California Code of Regulations – Chapter 15 (Domestic Water Quality and Monitoring Regulations) – Article 4 – Section 64431 – ***Table 64431 – A (Inorganic Chemicals), latest edition.***
2. Title 22 – California Code of Regulations – Chapter 15 (Domestic Water Quality and Monitoring Regulations) – Article 5 – Section 64442 – ***Table 64442 – (Gross Alpha Particle Activity, Radium 226, Radium 228, and Uranium), latest edition.***
3. Title 22 – California Code of Regulations – Chapter 15 (Domestic Water Quality and Monitoring Regulations) – Article 5.5 – Section 64444 – ***Table 64444 – A (Organic Chemicals), latest edition.***
4. Title 22 – California Code of Regulations – Chapter 15 (Domestic Water Quality and Monitoring Regulations) – Article 16 – Section 64449 – ***Table 64449 – A and Table 64449 – B (Secondary Contaminants), latest edition***

A set of the above tests shall be obtained for each well. The Contractor shall pay for all costs related to obtaining the samples, transporting the samples, and testing the samples. A full testing report is to be issued to the Palo Verde Water District, County of Imperial Health Department, and the Engineer. If the samples are contaminated or damaged and it is necessary to obtain a second set of test samples, the contractor shall incur all costs with regard to obtaining, transporting and testing the second set of samples.

END OF SECTION 02733

SECTION 03300 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The Contractor shall provide finished structural concrete, complete, in accordance with the Contract Documents.
- B. The following types of concrete are covered in this Section:
 - 1. **STRUCTURAL CONCRETE**: Normal weight (145 PCF) concrete to be used in all cases except where noted otherwise in the Contract Documents.
 - 2. **LEAN CONCRETE**: Concrete to be used for thrust blocks, anchor blocks, pipe trench cut-off blocks and cradles, where the preceding items are detailed on the Plans as unreinforced. Concrete to be used as protective cover for dowels intended for future connection.
- C. The term “hydraulic structure” used in these Specifications refers to environmental engineering concrete structures for the containment, treatment, or transmission of water, or other fluids.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 03100 - Concrete Formwork
 - 2. Section 03200 - Reinforcement Steel
 - 3. Section 03290 - Joints in Concrete Structures
 - 4. Section 03315 – Grout
 - 6. Section 09800 – Protective Coatings

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section, the Contractor shall comply with the latest adopted edition of the Standard

Specifications for Public Works Construction (SSPWC), together with the latest adopted editions of the Regional Amendments.

B. The current edition of the Uniform Building Code (UBC) of International Conference of Building Officials (ICBO).

C. National Sanitation Foundation

1. NSF / ANSI 61: Drinking Water System Components – Health Effects

D. Federal Specifications:

1. UU-B-790A(1)(2): Building Paper, Vegetable Fiber (Kraft, Water-Proofed, Water Repellant and Fire Resistant)

E. Commercial Standards:

1. ACI 117: Standard Tolerances for Concrete Construction and Materials

2. ACI 214: Recommended Practice for Evaluation of Strength Test Results of Concrete

3. ACI 301: Specifications for Structural Concrete for Buildings

4. ACI 309: Consolidation of Concrete

5. ACI 315: Details and Detailing of Concrete Reinforcement

6. ACI 318: Building Codes Requirements for Reinforced Concrete

7. ACI 350R: Environmental Engineering Concrete Structures

F. ASTM Standards in Building Codes:

1. ASTM C 31: Practice for Making and Curing Concrete Test Specimens in the Field

2. ASTM C 33: Specification for Concrete Aggregates

3. ASTM C 39: Test Method for Compressive Strength of Cylindrical Concrete Specimens
4. ASTM C 40: Test Method for Organic Impurities in Fine Aggregates for Concrete
5. ASTM C 42: Test Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
6. ASTM C 88: Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
7. ASTM C 94: Specification for Ready-Mixed Concrete
8. ASTM C 136: Test Method for Sieve Analysis of Fine and Coarse Aggregates
9. ASTM C 138: Test Method for Unit Weight, Yield, and Air Content of Concrete
10. ASTM C 143: Test Method for Slump of Hydraulic Cement Concrete
11. ASTM C 150: Specification for Portland Cement
12. ASTM C 156: Test Method for Water Retention by Concrete Curing Materials
13. ASTM C 157: Test Method for Length Change of Hardened Hydraulic Cement Mortar and Concrete
14. ASTM C 192: Practice for Making and Curing Concrete Test Specimens in the Laboratory
15. ASTM C 231: Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
16. ASTM C 260: Specification for Air-Entraining Admixtures for Concrete
17. ASTM C 289: Test Method for Potential Reactivity of Aggregates (Chemical Method)
18. ASTM C 309: Specification for Liquid Membrane-Forming Compounds for Curing Concrete

19. ASTM C 494: Specification for Chemical Admixtures for Concrete
20. ASTM C 107: Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
21. ASTM D 1751: Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-Extruding and Resilient Bituminous Types)
22. ASTM D 2419: Test Method for Sand Equivalent Value of Soils and Fine Aggregate
23. ASTM E 119: Method for Fire Tests of Building Construction and Materials

1.04 CONTRACTOR SUBMITTALS

- A. Mix Designs: Before starting the Work and within 14 days of the Notice to Proceed, the Contractor shall submit to the Owner's Representative, for review, preliminary concrete mix designs which shall illustrate the proportions and gradations of all materials proposed for each class and type of concrete specified herein in accordance with Specification Section 01330 – Submittals/Shop Drawings. The mix designs shall be checked and certified to conform to these Specifications by an independent testing laboratory acceptable to the Owner's Representative or Resident Project Representative to be in conformance with these Specifications. All costs related to such checking and testing shall be borne by the Contractor at no cost to the Owner.
- B. Delivery Tickets: Where ready-mix concrete is used, the Contractor shall furnish delivery tickets at the time of delivery of each load of concrete. Each ticket shall show the state-certified equipment used for measuring and the total quantities, by weight, of cement, sand, each class of aggregate, admixtures, and the amounts of water in the aggregate added at the batching plant, and the amount of water allowed to be added at the site for the specific design mix. In addition, each ticket shall state the mix number, total yield in cubic yards, and the time of day, to the nearest minute, corresponding to the times when the batch was dispatched, when it left the plant, when it arrived at the site, when unloading began, and when unloading was finished.

- C. The Contractor shall provide the following submittals in accordance with ACI 301:
 - 1. Mill tests for cement.
 - 2. Admixture certification. Chloride ion content must be included.
 - 3. Aggregate gradation and certification.
 - 4. Materials and methods for curing.
- D. The Contractor shall provide catalog cuts and other manufacturer's technical data demonstrating compliance with the requirements indicated and specified herein for all admixtures used in the concrete mix design.

1.05 QUALITY ASSURANCE

A. GENERAL

- 1. Tests on component materials and for compressive strength and shrinkage of concrete will be performed as specified herein. Test for determining slump will be in accordance with the requirements of ASTM C 143.
- 2. The cost of all laboratory tests requested by the Owner's Representative or Resident Project Representative for cement, aggregates, and concrete, will be borne by the Contractor. The laboratory must meet or exceed the requirements of ASTM C 1077.
- 3. Concrete for testing shall be supplied by the Contractor at no cost to the Owner and the Contractor shall provide assistance to the independent testing laboratory acceptable to the Owner's Representative or Resident Project Representative in obtaining samples, and disposal and clean up of excess material.
- 4. A minimum of one (1) set of concrete cylinders and a slump test shall be obtained for every major concrete placement. A minimum of one (1) set of concrete cylinders shall be obtained for all concrete structures, foundations and slabs. One (1) set of cylinders shall be obtained for every forty (40) yards of concrete placed for a particular pour. For instance, if the walls of a structure require eighty (80) yards of

concrete; then two (2) sets of concrete cylinders shall be required.

B. Field Compression Tests:

1. Compression test specimens will be taken during construction from the first placement of each class of concrete specified herein and at intervals thereafter as selected by the Owner's Representative or Resident Project Representative to ensure continued compliance with these Specifications. Each set of test specimens will consist of four (4) cylinders.
2. Compression test specimens for concrete shall be made in accordance with Section 9.2 of ASTM C 31. Specimens shall be 6-inch diameter by 12-inch high cylinders.
3. Compression tests shall be performed in accordance with ASTM C 39. One (1) test cylinder will be tested at 7 days and two (2) at 28 days. The remaining cylinder will be held to verify test results, if needed.

C. Evaluation and Acceptance of Concrete:

1. Evaluation and acceptance of the compressive strength of concrete shall be according to the requirements of ACI 318, Chapter 5, "Concrete Quality", and as specified herein.
2. A statistical analysis of compression test results will be performed according to the requirements of ACI 214. The standard deviation of the test results shall not exceed 640 PSI, when ordered at equivalent water content as estimated by slump.
3. If any concrete fails to meet these requirements, immediate corrective action shall be taken to increase the compressive strength for all subsequent batches of the type of concrete affected.
4. When the standard deviation of the test results exceeds 640 PSI, the average strength for which the mix is designed shall be increased by an amount necessary to satisfy the statistical requirement that the probability of any test being more than 500 PSI below or the average of any three (3) consecutive tests being below the specified compressive strength is 1 in 100. The required average strength shall be

calculated by Criterion No. 3 of ACI 214 using the actual standard deviation.

5. All concrete which fails to meet the ACI requirements and these Specifications is subject to removal and replacement at no cost to the Owner.

D. Construction Tolerances: Set and maintain concrete forms and perform finishing operations so as to ensure that the completed Work is within the tolerances specified herein. Surface defects and irregularities are defined as finishes and are to be distinguished from tolerances. Tolerance is the specified permissible variation from lines, grades, or dimensions shown. Where tolerances are not stated in the Specifications, permissible deviations will be in accordance with ACI 117.

1. The following construction tolerances are hereby established and apply to finished walls and slab unless otherwise illustrated:

<u>Item</u>	<u>Tolerance</u>
Variation of the constructed linear outline from the established position in plan.	In 10 feet: ¼ inch In 20 feet or more: ½ inch
Variation from the level or from the grades shown.	In 10 feet: ¼ inch In 20 feet or more: ½ inch
Variation from the plumb.	In 10 feet: ¼ inch In 20 feet or more: ½ inch
Variation in the thickness of slabs and walls.	Minus ¼ inch; Plus ½ inch
Variation in the locations and sizes of slabs and wall openings.	Plus or minus ¼ inch

E. Floor Slab Surface Hardener:

1. Job Mockup: In a location designated by the Owner's Representative or Resident Project Representative, place a minimum 100 square feet floor mockup using materials and procedures proposed for use in the Project. Revise materials and procedures as necessary to obtain acceptable finish surface. Maintain the same controls and procedures used in the acceptable mockup throughout the Project.

2. Field Service: During job mockup and initial period of installation, the manufacturer of the surface hardener shall furnish the service of a trained, full-time representative to advise on proper use of the product. Notify surface hardener manufacturer at least three (3) days before initial use of the product.
3. Installer Qualifications: Installer shall have a minimum of three (3) years experience and shall be specialized in the application of dry shake surface hardeners.

PART 2 - PRODUCTS

2.01 CONCRETE MATERIALS

A. General:

1. All materials specified herein shall be classified by the Environmental Protection Agency as acceptable for potable water use within 30 days of application.
2. Materials shall be delivered, stored, and handled so as to prevent damage by water or breakage. Only one (1) brand of cement shall be used. Cement reclaimed from cleaning bags or leaking containers shall not be used. All cement shall be used in the sequence of receipt of shipments.

B. All materials furnished for the Work shall comply with the requirements of Sections 201, 203, and 204 of ACI 301, as applicable.

C. Storage of materials shall conform to the requirements of Section 2.5 of ACI 301 or the SSPWC.

D. Materials for concrete shall conform to the following requirements:

1. Cement shall be standard brand Portland Cement conforming to ASTM C 150 for Type V. A minimum of 85 percent of cement by weight shall pass a 325 screen. A single brand of cement shall be used throughout the Work, and before its use, the brand shall be acceptable to the Owner's Representative. The cement shall be suitably protected from exposure to moisture until used. Cement that has become lumpy shall not be used. Sacked cement shall

be stored in such a manner so as to permit access for inspection and sampling. Certified mill test reports, including fineness, for each shipment of cement to be used shall be submitted to the Owner's Representative or Resident Project Representative if requested regarding compliance with these Specifications.

2. Water for mixing and curing shall be potable, clean, and free from objectionable quantities of silty organic matter, alkali, salts and other impurities. The water shall be considered potable, for the purposes of this Section, only if it meets the requirements of the local governmental agencies. Agricultural water with high total dissolved solids concentration (over 1,000 mg/l) shall not be used.
3. Aggregates shall be obtained from pits acceptable to the Owner's Representative, shall be nonreactive, and shall conform to ASTM C 33. Maximum size of coarse aggregate shall be as specified herein. Lightweight sand for fine aggregate will not be permitted.
 - a) Coarse aggregates shall consist of clean, hard, durable gravel, crushed gravel, crushed rock or a combination thereof. The coarse aggregates shall be prepared and handled in two or more size groups for combined aggregates with a maximum size greater than $\frac{3}{4}$ inch. When the aggregates are proportioned for each batch of concrete the two size groups shall be combined. See the Paragraph in Part 2 entitled "Trial Batch and Laboratory Tests" for the use of the size groups.
 - b) Fine aggregates shall be natural sand or a combination of natural and manufactured sand that are hard and durable. When tested in accordance with ASTM D 2419, the sand equivalency shall not be less than 75 percent for an average of three samples, nor less than 70 percent for an individual test. Gradation of fine aggregate shall conform to ASTM C 33, with 15 to 30 percent passing the number 50 screen and 5 to 10 percent passing the number 100 screen. The fineness modulus of sand used shall not be over 3.00.
 - c) Combined aggregates shall be well graded from coarse to fine sizes, and shall be uniformly graded

between screen sizes to produce a concrete that has optimum workability and consolidation characteristics. Where a trial batch is required for a mix design, the final combined aggregate gradations will be established during the trial batch process.

- d) When tested in accordance with ASTM C 33, the ratio of silica released to reduction in alkalinity shall not exceed 1.0.
 - e) When tested in accordance with ASTM C 33, the fine aggregate shall produce a color in the supernatant liquid no darker than the reference standard color solution.
 - f) When tested in accordance with ASTM C 33, the coarse aggregate shall show a loss not exceeding 42 percent after 500 revolutions, or 10.5 percent after 100 revolutions.
 - g) When tested in accordance with ASTM C 33, the loss resulting after five cycles shall not exceed 10 percent for fine or coarse aggregate when using sodium sulfate.
4. Ready-mix concrete shall conform to the requirements of ASTM C 94.
5. Admixtures: All admixtures shall be compatible and by a single manufacturer capable of providing qualified field service representation. Admixtures shall be used in accordance with manufacturer's recommendations. If the use of an admixture is producing an inferior end result, discontinue use of the admixture. Admixtures shall not contain thiocyanates nor more than 0.05 percent chloride ion, and shall be nontoxic after 30 days.
- a) Set controlling and water reducing admixtures: Admixtures may be added at the Contractor's option to control the set, affect water reduction, and increase workability. The addition of an admixture shall be at no increase in cost to the Owner. The use of an admixture shall be subject to acceptance by the Owner's Representative. Concrete containing an admixture shall be first placed at a location determined by the Owner's Representative.

Admixtures specified herein shall conform to the requirements of ASTM C 494. The required quantity of cement shall be used in the mix regardless of whether or not an admixture is used.

- 1) Concrete shall not contain more than one water-reducing admixture. Concrete containing an admixture shall be first placed at a location determined by the Owner's Representative.
- 2) Set controlling admixture shall be either with or without water-reducing properties. Where the air temperature at the time of placement is expected to be consistently over 80°F, a set retarding admixture such as Plastocrete by Sika Corporation; Pozzolith 300R by Master Builders; Daratard by W. R. Grace; or equal shall be used. Where the air temperature at the time of placement is expected to be consistently under 40°F, a noncorrosive set accelerating admixture such as Plastocrete 161FL by Sika Corporation; Pozzutec 20 by Master Builders; Daraset by W. R. Grace; or equal shall be used.
- 3) Normal range water reducer shall conform to ASTM C 494, Type A, WRDA 79 by W. R. Grace; Pozzolith 322-N by Master Builders; Plastocrete 161 by Sika Corporation; or equal. The quality of admixture used and the method of mixing shall be in accordance with the manufacturer's instructions and recommendations.
- 4) High range water reducer shall conform to ASTM C 494, Type F or G. Daracem 100 or WDRA 19 by W. R. Grace; Sikament FF or Sikament 86 by Sika Corporation; Rheobuild 1000 or Rheobuild 716 by Master Builders; or equal. High range water reducer shall be added to the concrete after all other ingredients have been mixed and initial slump has been verified. No more than 14 ounces of water reducer per sack of cement shall be used. Water reducer shall be considered as part of

the mixing water when calculating water cement ratio.

- 5) If the high range water reducer is added to the concrete at the job site, it may be used in conjunction with the same water reducer added at the batch plant. Concrete shall have a slump of 3 inches + ½ inch before adding the high range water reducing admixture at the job site. The high range water-reducing admixture shall be accurately measured and pressure injected into the mixer as a single dose by an experienced technician. A standby system shall be provided and tested before each day's operation of the job site system.
 - 6) Concrete shall be mixed at mixing speed for a minimum of 30 mixer revolutions after the addition of the high range water reducer.
 - 7) Fly ash: Fly ash shall not be allowed.
6. Shrinking Reducing Agent Admixture: All Structural Concrete shall include 0.5 gallons, per cubic yard of concrete, of W.R. Grace Eclipse, or an approved equal.

2.02 CURING MATERIALS

- A. Materials for curing concrete as specified herein shall conform to the following requirements and ASTM C 309:
 1. All curing compounds shall be white pigmented and resin based. Sodium silicate compounds shall not be allowed. Concrete curing compound shall be Spartan Cote Cure-Seal Hardener by the Burke Company; Super Rez Seal by Euclid Chemical Company; MB-429 as manufactured by Master Builders; or equal. Water-based resin curing compounds shall be used only where local air quality regulations prohibit the use of a solvent-based compound. Water-based curing compounds shall be Aqua Resincure by the Burke Company; Aqua-Cure by Euclid Chemical Company; Masterkure-W by Master Builders; or equal.

2. Polyethylene sheet for use as a concrete curing blanket shall be white, and shall have a nominal thickness of 6 mils. The loss of moisture when determined in accordance with the requirements of ASTM C 156 shall not exceed 0.055 grams per square centimeter of surface.
3. Polyethylene-coated water proof paper sheeting for use as concrete curing blanket shall consist of white polyethylene sheeting free of visible defects, uniform in appearance, having a nominal thickness of 2 mils and permanently bonded to waterproof paper conforming to the requirements of Federal Specification UU-B-790A(1)(2). The loss of moisture, when determined in accordance with the requirements of ASTM C156, shall not exceed 0.055 gram per square centimeter of surface.
4. Polyethylene-coated burlap for use as concrete curing blanket shall be 4 mils thick, white opaque polyethylene film impregnated or extruded into one side of the burlap. Burlap shall weigh not less than 9 ounces per square yard. The loss of moisture, when determined in accordance with the requirements of ASTM C 156, shall not exceed 0.055 gram per square centimeter of surface.
5. Curing mats for use in Curing Method 6 as specified herein, shall be heavy shag rugs or carpets or cotton mats quilted at 4 inches on center. Curing mats shall weigh a minimum of 12 ounces per square yard when dry.
6. Evaporation retardant shall be a material such as Confilm as manufactured by Master Builders; Eucobar as manufactured by Euclid Chemical Company; or equal.

2.03 NONWATERSTOP JOINT MATERIALS

- A. Materials for nonwaterstop joints in concrete shall conform to the following requirements:
 1. Preformed joint filler shall be a nonextruding, resilient, bituminous type conforming to the requirements of ASTM D 1751.
 2. Mastic joint sealer shall be a material that does not contain evaporating solvents; that will tenaciously adhere to concrete surfaces; that will remain permanently resilient and pliable; that will not be affected by continuous presence of water and

will not in any way contaminate potable water; and that will effectively seal the joints against moisture infiltration even when the joints are subject to movement due to expansion and contraction. The sealer shall be composed of special asphalts or similar materials blended with lubricating and plasticizing agents to form a tough, durable mastic substance containing no volatile oils or lubricants and shall be capable of meeting the test requirements set forth hereinafter, if testing is required by the Owner's Representative.

2.04 MISCELLANEOUS MATERIALS

- A. Damp-proofing agent shall be an asphalt emulsion, such as Hydrocide 600 by Sonneborn; Damp-proofing Asphalt Coating by Euclid Chemical Company; Sealmastic by W. R. Meadows Inc., or equal.
- B. Bonding agents shall be epoxy adhesives conforming to the following products for the applications specified:
 - 1. For bonding freshly-mixed, plastic concrete to hardened concrete, Sikadur 32 Hi-Mod Epoxy Adhesive, as manufactured by Sika Corporation; Concsive Liquid (LPL), as manufactured by Master Builders; BurkEpoxy MV as manufactured by The Burke Company; or equal.
 - 2. For bonding hardened concrete or masonry to steel, Sikadur 31 Hi-Mod Gel as manufactured by Sika Corporation; BurkEpoxy NS as manufactured by The Burke Company; Concsive Paste (LPL) as manufactured by Master Builders; or equal

2.05 CONCRETE DESIGN REQUIREMENTS

- A. Mix Design:
 - 1. General: Concrete shall be composed of cement, admixtures, aggregates and water. These materials shall be of the qualities specified. The exact proportions in which these materials are to be used for different parts of the Work will be determined during the trial batch. In general, the mix shall be designed to produce a concrete capable of being deposited so as to obtain maximum density and minimum shrinkage and, where deposited in forms, to have good consolidation properties and maximum smoothness of

surface. In mix designs, the percentage of sand of the total weight of fine and coarse aggregate shall not exceed 41 for hydraulic structures or 50 for all other structures, unless noted otherwise. The aggregate gradations shall be formulated to provide fresh concrete that will not promote rock pockets around reinforcing steel or embedded items. The proportions shall be changed whenever necessary or desirable to meet the required results at no additional cost to the Owner. All changes shall be subject to review by the Owner's Representative.

2. Water-Cement Ratio and Compressive Strength: The minimum compressive strength and cement content of concrete shall be not less than that specified in the following table:

<u>Type of Work</u>	Min. 28-Day Compressive Strength (PSI)	Max Size Aggregate (in)	Minimum Cement Per CU YD (lb)	Max W/C Ratio (by weight)
Structural Concrete:				
Normal weight reinforced concrete (145 pcf)	5,000	3/4	658	0.45
Lean Concrete	4,500	3/4	611	0.45

NOTE: The Contractor is cautioned that the limiting parameters specified above are not a mix design. Additional cement or water-reducing agent may be required to achieve workability demanded by the Contractor's construction methods and aggregates. The Contractor is responsible for any costs associated with furnishing concrete with the required workability.

3. Adjustments to Mix Design: The mixes used shall be changed whenever such change is necessary or desirable to secure the required strength, density, workability, and surface finish and the Contractor shall be entitled to no additional compensation because of such changes.

B. Consistency:

1. The quantity of water entering into a batch of concrete shall be just sufficient, with a normal mixing period, to produce a concrete which can be worked properly into place without segregation, and which can be compacted by the vibratory methods herein specified to give the desired density, impermeability and smoothness of surface. The quantity of water shall be changed as necessary, with variations in the nature or moisture content of the aggregates, to maintain uniform production of a desired consistency. The consistency of the concrete in successive batches shall be determined by slump tests in accordance with ASTM C 143. The slumps shall be as follows:

<u>Part of Work</u>	<u>Slump (in)</u>
All concrete, unless noted otherwise	4 inches + 1/2-inch
With high range water reducer added	5 inches + 1/2-inch

C. Trial Batch and Laboratory Tests:

1. Before placing any concrete, a testing laboratory approved by the Owner's Representative or Resident Project Representative will prepare a trial batch of each class of structural concrete, based on the preliminary concrete mixes submitted by the Contractor. During the trial batch the aggregate proportions may be adjusted by the testing laboratory using the two coarse aggregate size ranges to obtain the required properties. If one size range produces an acceptable mix, a second size range need not be used. Such adjustments shall be considered refinements to the mix design and shall not be the basis for extra compensation to the Contractor. All concrete shall conform to the requirements of this Section, whether the aggregate proportions are from the Contractor's preliminary mix design, or whether the proportions have been adjusted during the trial batch process. The trial batch will be prepared using the aggregates, cement and admixture proposed for the project. The trial batch materials shall be of a quantity such that the testing laboratory can obtain 3 drying shrinkage, and six compression test specimens from each batch. The cost, of not more than three laboratory trial batch tests for each

specified concrete strength will be borne by the Contractor. The Contractor shall furnish and deliver the materials in steel drums to the approved testing laboratory. Any additional trial batch testing required shall be performed by the testing laboratory at no additional cost to the Owner.

2. The determination of compressive strength will be made by testing 6-inch diameter by 12 inch high cylinders; made, cured and tested in accordance with ASTM C 192 and ASTM C 39. Three compression test cylinders will be tested at 7 days and 3 at 28 days. The average compressive strength for the three cylinders tested at 28 days for any given trial batch shall not be less than 125 percent of the specified compressive strength.
3. A sieve analysis of the combined aggregate for each trial batch shall be performed according to the requirements of ASTM C 136. Values shall be given for percent passing each sieve.
4. In lieu of trial batch and laboratory tests specified in this Section, the Contractor may submit previously-designed, tested, and successfully-used concrete mixes, using materials similar to those intended for this project, together with a minimum of three certified test reports of the 28 day strength of the proposed concrete mix.

D. Shrinkage Limitation:

1. The maximum concrete shrinkage for specimens cast in the laboratory from the trial batch, as measured at 21 day drying age or at 28 day drying age shall be 0.036 percent or 0.042 percent, respectively. Use a mix design for construction that has first met the trial batch shrinkage requirements. Shrinkage limitations apply only to structural concrete.
2. The maximum concrete shrinkage for specimens cast in the field shall not exceed the trial batch maximum shrinkage requirement by more than 25 percent.
3. If the required shrinkage limitation is not met during construction, take any or all of the following actions, at no additional cost to the Owner for securing the specified shrinkage requirements. These actions may include changing the source of aggregates, cement and/or admixtures; reducing water content; washing of aggregate to

reduce fines; increasing the number of construction joints, modifying the curing requirements; or other actions designed to minimize shrinkage or the effects of shrinkage.

E. Measurement of Cement and Aggregate:

1. The amount of cement and of each separate size of aggregate entering into each batch of concrete shall be determined by direct weighing equipment acceptable to the Owner's Representative.

2. Weighing Tolerances:

<u>Material</u>	<u>Percent of Total Weight</u>
Cement	1
Aggregates	3
Admixtures	3

F. Measurement of Water:

1. The quantity of water entering the mixer shall be measured by a suitable water meter or other measuring device of a type acceptable to the Owner's Representative or Resident Project Representative and capable of measuring the water in variable amounts within a tolerance of one percent. The water feed control mechanism shall be capable of being locked in position so as to deliver constantly any specified amount of water to each batch of concrete. A positive quick-acting valve shall be used for a cut-off in the water line to the mixer. The operating mechanism must be such that leakage will not occur when the valves are closed.

2.06 READY-MIXED CONCRETE

A. At the Contractor's option, ready-mixed concrete may be used meeting the requirements as to materials, batching, mixing, transporting, and placing as specified herein and in accordance with ASTM C 94, including the following supplementary requirements.

B. Ready-mixed concrete shall be delivered to the site of the Work, and discharge shall be completed within one and one-half hour (90 minutes) after the addition of the cement to the aggregates or before the drum has been revolved 250 revolutions, whichever is first.

- C. Truck mixers shall be equipped with electrically-actuated counters by which the number of revolutions of the drum or blades may be readily verified. The counter shall be of the resettable, recording type, and shall be mounted in the driver's cab. The counters shall be actuated at the time of starting mixers at mixing speeds.
- D. Each batch of concrete shall be mixed in a truck mixer for not less than 70 revolutions of the drum or blades at the rate of rotation designated by the manufacturer of equipment. Additional mixing, if any, shall be at the speed designated by the manufacturer of the equipment as agitating speed. All materials including mixing water shall be in the mixer drum before actuating the revolution counter for determining the number of revolution of mixing.
- E. Truck mixers and their operation shall be such that the concrete throughout the mixed batch as discharged is within acceptable limits of uniformity with respect to consistency, mix, and grading. If slump tests taken at approximately the one-quarter (1/4) and three-quarter (3/4) points of the load during discharge give slumps differing by more than one inch (1") when the specified slump is 3 inches or less, or if they differ by more than 2 inches when the specified slump is more than 3 inches, the mixer shall not be used on the Work unless the causing condition is corrected and satisfactory performance is verified by additional slump tests. All mechanical details of the mixer, such as water measuring and discharge apparatus, condition of the blades, speed of rotation, general mechanical condition of the unit, and clearance of the drum, shall be checked before a further attempt to use the unit will be permitted.
- F. Each batch of ready-mixed concrete delivered at the job site shall be accompanied by a delivery ticket furnished to the Owner's Representative or Resident Project Representative in accordance with Subsection 03300-1.04B.
- G. The use of nonagitating equipment for transporting ready-mixed concrete will not be permitted. Combination truck and trailer equipment for transporting ready-mixed concrete will not be permitted. The quality and quantity of materials used in ready-mixed concrete and in batch aggregates shall be subject to continuous inspection at the batching plant by the Owner's Representative.

2.07 FLOOR HARDENER (SURFACE APPLIED)

- A. Surface hardener shall be a light reflective nonoxidizing metallic aggregate dry shake surface hardener.
 - 1. Surface hardener shall be premeasured, premixed and packaged at the factory.
 - 2. Apply surface hardener at the rate of 1.8 to 2.5 lb per square foot.
 - 3. Surface hardener shall be Alumiplate®, by Master Builders, Inc., or equal.
- B. Curing Compound shall meet the moisture retention requirements of ASTM C 309 and surface hardener manufacturer's recommendations.
- C. Monomolecular Film: Evaporation retarder shall be used to aid in maintaining concrete moisture during the early placement stages of plastic concrete. Evaporation retarder shall be as recommended by surface hardener manufacturer.

2.08 NSF / ANSI STANDARD 61

- A. All cementitious material, admixtures, curing compounds, and other industrial produced materials used in concrete, or for curing or repairing of concrete, that can contact potable water or water that will be treated to become potable shall be listed in NSF / ANSI Standard 61.

PART 3 - EXECUTION

3.01 PROPORTIONING AND MIXING

- A. Proportioning: Proportioning of the concrete mix shall conform to the requirements of Chapter 3, "Proportioning" of ACI 301.
- B. Mixing: Mixing of concrete shall conform to the requirements of Chapter 7 of said ACI 301 Specifications.
- C. Slump: Maximum slumps shall be as specified herein.
- D. Retempering: Retempering of concrete or mortar which has partially hardened shall not be permitted.

3.02 PREPARATION OF SURFACES FOR CONCRETING

- A. General: Earth surfaces shall be thoroughly wetted by sprinkling, before the placing of any concrete, and these surfaces shall be kept moist by frequent sprinkling up to the time of placing concrete thereon. The surface shall be free from standing water, mud, and debris at the time of placing concrete.
- B. Joints in Concrete: Concrete surfaces upon or against which concrete is to be placed, where the placement of the concrete has been stopped or interrupted so that, as determined by the Owner's Representative, the new concrete cannot be incorporated integrally with that previously placed, are defined as construction joints. The surfaces of horizontal joints shall be given a compacted, roughened surface for good bond. The joint surfaces shall be cleaned of all laitance, loose or defective concrete, foreign material, and roughened to a minimum of ¼ inch amplitude. Such cleaning and roughening shall be accomplished by hydroblasting or sandblasting (exposing aggregate) followed by thorough washing. All pools of water shall be removed from the surface of construction joints, and the joint surface shall be coated with an epoxy-bonding agent, unless indicated otherwise, before the new concrete is placed.
- C. Placing Interruptions: When placing of concrete is to be interrupted long enough for the concrete to take a set, the working face shall be given a shape by the use of forms or other means, that will secure proper union with subsequent Work; provided that construction joints shall be made only where acceptable to the Owner's Representative.
- D. Embedded Items: No concrete shall be placed until all formwork, installation of parts to be embedded, reinforcement steel, and preparation of surfaces involved in the placing have been completed and accepted by the Owner's Representative or Resident Project Representative at least 4 hours before placement of concrete. All surfaces of forms and embedded items that have become encrusted with dried grout from concrete previously placed shall be cleaned of all such grout before the surrounding or adjacent concrete is placed.
- E. All inserts or other embedded items shall conform to the requirements herein.
- F. All reinforcement, anchor bolts, sleeves, inserts, and similar items shall be set and secured in the forms where illustrated on the Plans or by approved shop drawings and shall be acceptable to the Owner's Representative or Resident Project Representative before

any concrete is placed. Accuracy of placement is the responsibility of the Contractor.

- G. Casting New Concrete Against Old: Where concrete is to be cast against old concrete (any concrete which is greater than 60 days of age), the surface of the old concrete shall be thoroughly cleaned and roughened by hydroblasting or sandblasting (exposing aggregate). The joint surface shall be coated with an epoxy bonding agent unless indicated otherwise by the Owner's Representative.
- H. No concrete shall be placed in any structure until all water entering the space to be filled with concrete has been properly cut off or has been diverted by pipes, or other means, and carried out of the forms, clear of the Work. No concrete shall be deposited underwater nor shall the Contractor allow still water to rise on any concrete until the concrete has attained its initial set. Water shall not be permitted to flow over the surface of any concrete in such manner and at such velocity as will injure the surface finish of the concrete. Pumping or other necessary dewatering operations for removing ground water, if required, will be subject to the review of the Owner's Representative.
- I. Corrosion Protection: Pipe, conduit, dowels, and other ferrous items required to be embedded in concrete construction shall be so positioned and supported before placement of concrete that there will be a minimum of 2 inches clearance between said items and any part of the concrete reinforcement. Securing such items in position by wiring or welding them to the reinforcement will not be permitted.
- J. Openings for pipes, inserts for pipe hangars and brackets, and the setting of anchors shall, where practicable, be provided for during the placing of concrete.
- K. Anchor bolts shall be accurately set, and shall be maintained in position by templates while embedded in concrete.
- L. Cleaning: The surfaces of all metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar, and other foreign substances immediately before the concrete is placed.

3.03 HANDLING, TRANSPORTING AND PLACING

- A. General: Placing of concrete shall conform to the applicable requirements of Chapter 8 of ACI 301 and the requirements of this Section. No aluminum materials shall be used in conveying any concrete.
- B. Nonconforming Work or Materials: Concrete which upon or before placing is found not to conform to the requirements specified herein shall be rejected and immediately removed from the Work. Concrete which is not placed in accordance with these Specifications, or which is of inferior quality, shall be removed and replaced at no additional expense to the Owner.
- C. Unauthorized Placement: No concrete shall be placed except in the presence of duly authorized representative of the Owner's Representative. The Contractor shall notify the Owner's Representative or Resident Project Representative in writing at least 48 hours in advance of placement of any concrete.
- D. Placement in Wall Forms: Concrete shall not be dropped through reinforcement steel or into any deep form, nor shall concrete be placed in any form in such a manner as to leave accumulation of mortar on the form surfaces above the placed concrete. In such cases, some means such as the use of hoppers and, if necessary, vertical ducts of canvas, rubber, or metal shall be used for placing concrete in the forms in a manner that it may reach the place of final deposit without separation. In no case shall the free fall of concrete exceed 4 feet below the ends of ducts, chutes, or buggies. Concrete shall be uniformly distributed during the process of depositing and in no case after depositing shall any portion be displaced in the forms more than 6 feet in horizontal direction. Concrete in forms shall be deposited in uniform horizontal layers not deeper than 2 feet; and care shall be taken to avoid inclined layers or inclined construction joints except where such are required for sloping members. Each layer shall be placed while the previous layer is still soft. The rate of placing concrete in forms shall not exceed 5 feet of vertical rise per hour. Sufficient illumination shall be provided in the interior of all forms so that the concrete at the places of deposit is visible from the deck or runway.
- E. Conveyor Belts and Chutes: All ends of chutes, hopper gates, and all other points of concrete discharge throughout the Contractor's conveying, hoisting and placing system shall be so designed and arranged that concrete passing from them will not fall separated into whatever receptacle immediately receives it. Conveyor belts, if used, shall be of a type acceptable to the Owner's Representative. Chutes longer than 50 feet will not be permitted. Minimum slopes

of chutes shall be such that concrete of the specified consistency will readily flow in them. If a conveyor belt is used, it shall be wiped clean by a device operated in such a manner that none of the mortar adhering to the belt will be wasted. All conveyor belts and chutes shall be covered.

- F. Placement in Slabs: Concrete placed in sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the placement. As the Work progresses, the concrete shall be vibrated and carefully worked around the slab reinforcement, and the surface of the slab shall be screeded in an up-slope direction.
- G. Temperature of Concrete: The temperature of concrete when it is being placed shall be not more than $90^{\circ}F$ nor less than $55^{\circ}F$ for sections less than 12 inches thick nor less than $50^{\circ}F$ for all other sections. Concrete ingredients shall not be heated to a temperature higher than that necessary to keep the temperature of the mixed concrete, as placed, from falling below the specified minimum temperature. When the temperature of the concrete is $85^{\circ}F$ or above, the time between the introduction of the cement to the aggregates and discharge at the Site shall not exceed 45 minutes. If concrete is placed when the weather is such that the temperature of the concrete would exceed $90^{\circ}F$, the Contractor shall employ effective means, such as precooling of aggregates and mixing water using ice or placing at night, as necessary to maintain the temperature of the concrete, as it is placed, below $90^{\circ}F$. The Contractor shall be entitled to no additional compensation on account of the foregoing requirements.
- H. Cold Weather Placement:
1. Placement of concrete shall conform to ACI 306.1 - Standard Specification for Cold Weather Concreting, and the following.
 2. Remove all snow, ice and frost from the surfaces, including reinforcement, against which concrete is to be placed. Before beginning concrete placement, thaw the subgrade to a minimum depth of 6 inches. All reinforcement and embedded items shall be warmed to above $32^{\circ}F$ before concrete placement.
 3. Maintain the concrete temperature above $50^{\circ}F$ for at least 3 days after placement.
- I. Hot Weather Placement:

1. Placement of concrete shall conform to ACI 305R - Hot Weather Concreting, and the following.
2. Only set retarding admixture shall be used in concrete when air temperature is expected to be consistently over 80°F.
3. The maximum temperature of concrete shall not exceed 90°F immediately before placement.
4. From the initial placement to the curing state, concrete shall be protected from the adverse effect of high temperature, low humidity, and wind.

3.04 PUMPING OF CONCRETE

- A. General: If the pumped concrete does not produce satisfactory end results, discontinue the pumping operation and proceed with the placing of concrete using conventional methods.
- B. Pumping Equipment: The pumping equipment must have two (2) cylinders and be designed to operate with one (1) cylinder only in case the other one is not functioning. In lieu of this requirement, the Contractor shall maintain a standby pump on the site during pumping.
- C. The minimum diameter of the hose (conduits) shall be in accordance with ACI 304.2R.
- D. Pumping equipment and hoses (conduits) that are not functioning properly, shall be replaced.
- E. Aluminum conduits for conveying the concrete shall not be permitted.
- F. Field Control: Concrete samples for slump, air content, and test cylinders will be taken at the placement (discharge) end of the line.

3.05 ORDER OF PLACING CONCRETE

- A. The order of placing concrete in all parts of the Work shall be acceptable to the Owner's Representative. In order to minimize the effects of shrinkage, the concrete shall be placed in units as bounded by construction joints. The placing of units shall be accomplished by placing alternate units in a manner such that each unit placed shall have cured at least 7 days for hydraulic structures

and 3 days for all other structures before the contiguous unit or units are placed, except that the corner sections of vertical walls shall not be placed until the two (2) adjacent wall panels have cured at least 14 days for hydraulic structures and 7 days for all other structures.

- B. The surface of the concrete shall be level whenever a run of concrete is stopped. To ensure a level, straight joint on the exposed surface of walls, a wood strip at least $\frac{3}{4}$ inch thick shall be tacked to the forms on these surfaces. The concrete shall be carried about $\frac{1}{2}$ inch above the underside of the strip. About one (1) hour after the concrete is placed, the strip shall be removed and any irregularities in the edge formed by the strip shall be leveled with a trowel and all laitance shall be removed.

3.06 TAMPING AND VIBRATING

- A. As concrete is placed in the forms or in excavations, it shall be thoroughly settled and compacted, throughout the entire depth of the layer which is being consolidated, into a dense, homogeneous mass, filling all corners and angles, thoroughly embedding the reinforcement, eliminating rock pockets, and bringing only a slight excess of water to the exposed surface of concrete during placement. Vibrators shall be Group 3 (per ACI 309) high speed power vibrators (8,000 to 12,000 rpm) of an immersion type in sufficient number and with (at least one) standby units as required. Group 2 vibrators may be used only at specific locations when accepted by the Owner's Representative.
- B. Care shall be exercised in placing concrete around waterstops. The concrete shall be carefully worked by rodding and vibrating to make sure that all air and rock pockets have been eliminated. Where flat-strip type waterstops are placed horizontally, the concrete shall be worked under the waterstops by hand, making sure that all air and rock pockets have been eliminated. Concrete surrounding the waterstops shall be given additional vibration, over and above that used for adjacent concrete placement to assure complete embedment of the waterstops in the concrete.
- C. Concrete in walls shall be internally vibrated and at the same time rammed, stirred, or worked with suitable appliances, tamping bars, shovels, or forked tools until it completely fills the forms or excavations and closes snugly against all surfaces. Subsequent layers of concrete shall not be placed until the layers previously placed have been worked thoroughly as specified. Vibrators shall be provided in sufficient numbers, with standby units as required, to

accomplish the results herein specified within 15 minutes after concrete of the prescribed consistency is placed in the forms. The vibrating head shall be kept from contact with the surfaces of the forms. Care shall be taken not to vibrate concrete excessively or to work it in any manner that causes segregation of its constituents.

3.07 FINISHING CONCRETE SURFACES

- A. General: Surfaces shall be free from fins, bulges, ridges, offsets, honeycombing, or roughness of any kind, and shall present a finished, smooth, continuous hard surface. Allowable deviations from plumb or level and from the alignment, profiles, and dimensions shown are defined as tolerances and are specified in Part 1, herein. These tolerances are to be distinguished from irregularities in finish as described herein. Aluminum finishing tools shall not be used.
- B. Formed Surfaces: No treatment is required after form removal except for curing, repair or defective concrete, and treatment of surface defects. Where architectural finish is required, it shall be as specified or as shown.
1. Surface holes larger than ½ inch in diameter or deeper than ¼ inch are defined as surface defects in basins and exposed walls.
- C. Unformed Surfaces: After proper and adequate vibration and tamping, all unformed top surfaces of slabs, floors, walls, and curbs shall be brought to a uniform surface with suitable tools. Immediately after the concrete has been screeded, it shall be treated with a liquid evaporation retardant. The retardant shall be used again after each Work operation as necessary to prevent drying shrinkage cracks. The classes of finish specified for unformed concrete surfaces are designated and defined as follows:
1. FINISH U1 - Sufficient leveling and screeding to produce an even, uniform surface with surface irregularities not to exceed 3/8-inch. No further special finish is required.
 2. FINISH U2 - After sufficient stiffening of the screeded concrete, surfaces shall be float finished with wood or metal floats or with a finishing machine using float blades. Excessive floating of surfaces while the concrete is plastic and dusting of dry cement and sand on the concrete surface to absorb excess moisture will not be permitted. Floating shall be the minimum necessary to produce a surface that is

free from screed marks and is uniform in texture. Surface irregularities shall not exceed 1/4-inch. Joints and edges shall be tooled where shown or as determined by the Owner's Representative.

3. FINISH U3 - After the floated surface (as specified for Finish U2) has hardened sufficiently to prevent excess of fine material from being drawn to the surface, steel troweling shall be performed with firm pressure such as will flatten the sandy texture of the floated surface and produce a dense, uniform surface free from blemishes, ripples, and trowel marks. The finish shall be smooth and free of all irregularities.
 4. FINISH U4 - Steel trowel finish (as specified for Finish U3) without local depressions or high points. In addition, the surface shall be given a light hairbroom finish with brooming perpendicular to drainage unless otherwise shown. The resulting surface shall be rough enough to provide a nonskid finish.
- D. Unformed surfaces shall be finished according to the following schedule:

UNFORMED SURFACE FINISH SCHEDULE

<u>Area</u>	<u>Finish</u>
Grade slabs and foundations to be covered with concrete or fill material	U1
Floors to be covered with grouted tile or topping grout	U2
Slabs which are water bearing with slopes 10 percent and less	U4
Sloping slabs which are water bearing with slopes greater than 10 percent	U4
Slabs not water bearing	U4
Slabs to be covered with built-up roofing	U2
Interior slabs and floors to receive architectural finish	U3

E. Floor Hardener (Surface Applied) - Required

1. Provide concrete with the following additional requirements:
 - a) Maximum slump of 4 inches when peak ambient temperatures are expected to be more than 65°F, and no more than 3 inches when ambient temperatures are below 65°F.
 - b) Maximum air content of 3 percent.
 - c) Do not use calcium chloride or set-accelerating admixtures containing calcium chloride.
 - d) Do not use admixtures that increase bleeding.
 - e) Do not use fly ash.
2. After the concrete has been leveled and as soon as the concrete will support an operator and machine without disturbing the level or working up excessive fines, float the surface of the slab with a mechanical float fitted with float shoes. Following floating, apply 1/2 to 2/3 of the total amount of dry shake surface hardener so that a uniform distribution of surface hardener is obtained. The use of a mechanical spreader is recommended. Once the shake has absorbed sufficient moisture (indicated by the darkening of the shake), float the surface. Immediately apply the remaining 1/3 to 1/2 of the shake and allow to absorb moisture. Do not place dry shake on concrete surface when bleed water is present.
3. Use finishing machines with detachable float shoes. Compact surface by a third mechanical floating if time and setting characteristics of the concrete will allow. Do not add water to the surface.
4. As surface further stiffens, indicated by loss of sheen, hand or mechanically trowel with blades set relatively flat. Remove all marks and pinholes in the final raised trowel operation.

5. Follow all application instructions of the floor surface hardener manufacturer.
6. Cure finished floors using fill-forming curing compound recommended by surface hardener manufacturer. Uniformly apply curing compound over the entire surface at a coverage that will provide moisture retention in excess of the requirements of ASTM C 309. Maintain ambient temperature of 50°F or above during the curing period.
7. Keep floors covered and free of traffic and loads for a minimum of 14 days after completion.

3.08 ARCHITECTURAL FINISH

A. General: Architectural finishes shall be required only where specifically called out on the Plans. In all other cases, the paragraph above, entitled "Finishing Concrete Surfaces", shall apply.

1. Immediately after the forms have been stripped, the concrete surface shall be inspected and any poor joints, voids, rock pockets, or other defective areas shall be repaired and all form-tie holes filled as indicated herein.
2. Architectural finishes shall not be applied until the concrete surface has been repaired as required and the concrete has cured at least 14 days.
3. All architecturally treated concrete surfaces shall conform to the accepted sample required herein in texture, color, and quality. It shall be the Contractor's responsibility to maintain and protect the concrete finish.

B. Smooth Concrete Finish:

1. The concrete surface shall be wetted, and a grout shall be applied with a brush. The grout shall be prepared by mixing one (1) part Portland Cement and one (1) part of fine sand that will pass a No. 16 sieve with sufficient water to give it the consistency of thick paint. The cement used in said grout shall be 1/2 gray and 1/2 white Portland Cement, as determined by the Owner's Representative. White Portland Cement shall be Atlas White or equal. Calcium chloride in the amount of 5 percent by volume of the cement shall be used in the brush coat. The freshly applied grout shall be

vigorously rubbed into the concrete surface with a wood float filling all small air holes. After all surface grout had been removed with a steel trowel, the surface shall be allowed to dry and, when dry, shall be vigorously rubbed with burlap to remove completely all surface grout so that there is no visible paint-like film of grout on the concrete. The entire cleaning operation for any area shall be completed the day it is started, and no grout shall be left on the surface overnight.

2. Cleaning operations for any given day shall be terminated at panel joints. It is essential that the various operations be carefully timed to secure the desired effect which is a light-colored concrete surface of uniform color and texture without any appearance of a point or grout film.
3. In the event that improper manipulation results in an inferior finish, rub such inferior areas with carborundum bricks.
4. Before beginning any of the final treatment on exposed surfaces, treat in a satisfactory manner a trial area of at least 200 square feet in some inconspicuous place selected by the Owner's Representative or Resident Project Representative and preserve said trial area undisturbed until the completion of the job.

C. Sandblasted Concrete Finish:

1. Sandblasting shall be done in a safe manner acceptable to local authorities and per OSHA requirements. The sandblasting shall be a light sandblast to remove laitance and to produce a uniform fine aggregate surface texture with approximately 1/32 to 1/16 inch of surface sandblasted off. Corners, patches, form panel joints, and soft spots shall be sandblasted with care.
2. A 3 square foot sample panel of the sandblasted finish shall be provided by the Contractor for acceptance by the Owner's Representative or Resident Project Representative before starting the sandblasting Work. The sample panel shall include a corner, plugs, and joints and shall be marked after approval. All other sandblasting shall be equal in finish to the sample panel.
3. Protection against sandblasting shall be provided on all surfaces and materials not requiring sandblasting but within or adjacent to areas being sandblasted. After sandblasting,

the concrete surfaces shall be washed with clean water and excess sand removed.

3.09 CURING AND DAMP-PROOFING

- A. General: All concrete shall be cured for not less than 14 days after placing, in accordance with the methods specified herein for the different parts of the Work, and described in detail in the following paragraphs:

<u>Surface To Be Cured or Damp-proofed</u>	<u>Method</u>
Unstripped forms	1
Wall sections with forms removed	6
Construction joints between footings and walls, and between floor slab and columns	2
Encasement concrete and thrust blocks	3
All concrete surfaces not specifically provided for elsewhere in this Paragraph	6
Floor slabs on grade	6
Slabs not on grade	6

- B. Method 1: Wooden forms shall be wetted immediately after concrete has been placed and shall be kept wet with water until removed. If steel forms are used the exposed concrete surfaces shall be kept continuously wet until the forms are removed. If forms are removed within 14 days of placing the concrete, curing shall be continued in accordance with Method 6, herein.
- C. Method 2: The surface shall be covered with burlap mats which shall be kept wet with water for the duration of the curing period, until the concrete in the walls has been placed. No curing compound shall be applied to surfaces cured under Method 2.
- D. Method 3: The surface shall be covered with moist earth not less than 4 hours, nor more than 24 hours, after the concrete is placed. Earthwork operations that may damage the concrete shall not begin until at least 7 days after placement of concrete.

- E. Method 4: The surface shall be sprayed with a liquid curing compound.
1. It shall be applied in accordance with the manufacturer's printed instructions at a maximum coverage rate of 200 square feet per gallon and in such a manner as to cover the surface with a uniform film which will seal thoroughly.
 2. Where the curing compound method is used, care shall be exercised to avoid damage to the seal during the curing period. Should the seal be damaged or broken before the expiration of the curing period, the break shall be repaired immediately by the new application of additional curing compound over the damaged portion.
 3. Wherever curing compound may have been applied by mistake to surfaces against which concrete subsequently is to be placed and to which it is to adhere, said compound shall be entirely removed by wet sandblasting just before the placing of new concrete.
 4. Where curing compound is specified, it shall be applied as soon as the concrete has hardened enough to prevent marring on unformed surfaces, and within 2 hours after removal of forms from contact with formed surfaces. Repairs required to be made to formed surfaces shall be made within the said 2 hour period; provided, however, that any such repairs which cannot be made within the said 2 hour period shall be delayed until after the curing compound has been applied. When repairs are to be made to an area on which curing compound has been applied, the area involved shall first be wet-sandblasted to remove the curing compound, following which repairs shall be made as specified herein.
 5. At all locations where concrete is placed adjacent to a panel which has been coated with curing compound, the previously coated panel shall have curing compound reapplied to an area within 6 feet of the joint and to any other location where the curing membrane has been disturbed.
 6. Before final acceptance of the Work, all visible traces of curing compound shall be removed from all surfaces in such a manner that does not damage surface finish.

F. Method 5:

1. Until the concrete surface is covered with curing compound, the entire surface shall be kept damp by applying water using nozzles that atomize the flow so that the surface is not marred or washed. The concrete shall be given a coat of curing compound in accordance with Method 4, herein. Not less than 1 hour nor more than 4 hours after the coat of curing compound has been applied, the surface shall be wetted with water delivered through a fog nozzle, and concrete-curing blankets shall be placed on the slabs. The curing blankets shall be polyethylene sheet, polyethylene-coated waterproof paper sheeting or polyethylene-coated burlap. The blankets shall be laid with the edges butted together and with the joints between strips sealed with 2 inch wide strips of sealing tape or with edges lapped not less than 3 inches and fastened together with a waterproof cement to form a continuous watertight joint.
2. The curing blankets shall be left in place during the 14 day curing period and shall not be removed until after concrete for adjacent Work has been placed. Should the curing blankets become torn or otherwise ineffective, replace damaged sections. During the first 3 days of the curing period, no traffic of any nature and no depositing, temporary or otherwise, of any materials shall be permitted on the curing blankets. During the remainder of the curing period, foot traffic and temporary depositing of materials that impose light pressure will be permitted only on top of plywood sheets 5/8 inch minimum thickness, laid over the curing blanket. Add water under the curing blanket as often as necessary to maintain damp concrete surfaces at all times.

G. Method 6: This method applies to both walls and slabs.

1. The concrete shall be kept continuously wet by the application of water for a minimum period of at least 14 consecutive days, beginning immediately after the concrete has reached final set or forms have been removed or until the concrete surface is covered with the curing medium. The entire surface shall be kept damp by applying water using nozzles that atomize the flow so that the surface is not marred or washed.
2. Heavy curing mats shall be used as a curing medium to retain the moisture during the curing period. The curing

medium shall be weighted or otherwise held in place to prevent being dislodged by wind or any other causes and to be substantially in contact with the concrete surface. All edges shall be continuously held in place.

3. The curing blankets and concrete shall be kept continuously wet by the use of sprinklers or other means both during and after normal working hours. The concrete shall be maintained in a cool condition from the heat of hydration and the solar heat of the sun.
 4. Immediately after the application of water has terminated at the end of the curing period, the curing medium shall be removed, any dry spots shall be rewetted, and curing compound shall be immediately applied in accordance with Method 4, herein.
 5. Dispose of excess water from the curing operation to avoid damage to the Work.
- H. Damp-proofing: The exterior surface of all buried roof slabs shall be damp-proofed as follows:
1. Immediately after completion of curing the surface shall be sprayed with a damp-proofing agent consisting of an asphalt emulsion. Application shall be in two (2) coats. The first coat shall be diluted to 1/2 strength by the addition of water and shall be sprayed on so as to provide a maximum coverage rate of 100 square feet per gallon of dilute solution. The second coat shall consist of an application of the specified material, undiluted, and shall be sprayed on so as to provide a maximum coverage rate of 100 square feet per gallon. Damp-proofing material shall be as specified herein.
 2. As soon as the asphalt emulsion, applied as specified herein, has taken an initial set, the entire area thus coated shall be coated with whitewash. Any formula for mixing the whitewash may be used which produces a uniformly coated white surface and which so remains until placing of the backfill. Should the whitewash fail to remain on the surface until the backfill is placed, apply additional whitewash.

3.10 PROTECTION

- A. Protect all concrete against injury until final acceptance by the Owner.

- B. Fresh concrete shall be protected from damage due to rain, hail, sleet, or snow. Provide such protection while the concrete is still plastic and whenever such precipitation is imminent or occurring.

3.11 CURING IN COLD WEATHER

- A. Water curing of concrete may be reduced to 6 days during periods when the mean daily temperature in the vicinity of the worksite is less than $40^{\circ}F$; provided that, during the prescribed period of water curing, when temperatures are such that concrete surfaces may freeze, water curing shall be temporarily discontinued.
- B. Concrete cured by an application of curing compound will require no additional protection from freezing if the protection at $50^{\circ}F$ for 72 hours is obtained by means of approved insulation in contact with the forms or concrete surfaces; otherwise the concrete shall be protected against freezing temperatures for 72 hours immediately following 72 hours protection at $50^{\circ}F$. Concrete cured by water curing shall be protected against freezing temperatures for 3 days immediately following the 72 hours of protection at $50^{\circ}F$.
- C. Discontinuance of protection against freezing temperatures shall be such that the drop in temperature of any portion of the concrete will be gradual and will not exceed $40^{\circ}F$ in 24 hours. In the spring, when the mean daily temperature rises above $40^{\circ}F$ for more than 3 successive days, the specified 72 hour protection at a temperature not lower than $50^{\circ}F$ may be discontinued for as long as the mean daily temperature remains above $40^{\circ}F$; provided, that the concrete shall be protected against freezing temperatures for not less than 48 hours after placement.
- D. Where artificial heat is employed, special care shall be taken to prevent the concrete from drying. Use of unvented heaters will be permitted only when unformed surfaces of concrete adjacent to the heaters are protected for the first 24 hours from an excessive carbon dioxide atmosphere by application of curing compound; provided, that the use of curing compound for such surfaces is otherwise permitted by these Specifications.

3.12 TREATMENT OF SURFACE DEFECTS

- A. As soon as forms are removed, all exposed surfaces shall be carefully examined and any irregularities shall be immediately rubbed or ground in a satisfactory manner in order to secure a smooth, uniform, and continuous surface. Plastering or coating of

surfaces to be smoothed will not be permitted. No repairs shall be made until after inspection by the Owner's Representative. In no case will extensive patching of honeycombed concrete be permitted. Concrete containing minor voids, holes, honeycombing, or similar depression defects shall have them repaired as specified herein. Concrete containing extensive voids, holes, honeycombing, or similar depression defects, shall be completely removed and replaced. All repairs and replacements herein specified shall be promptly executed by the Contractor at its own expense.

- B. Defective surfaces to be repaired shall be cut back from trueline in a minimum depth of ½ inch over the entire area. Feathered edges will not be permitted. Where chipping or cutting tools are not required in order to deepen the area properly, the surface shall be prepared for bonding by the removal of all laitance or soft material, and not less than 1/32 inch depth of the surface film from all hard portions, by means of an efficient sandblast. After cutting and sandblasting, the surface shall be wetted sufficiently in advance of shooting with shotcrete or with cement mortar so that while the repair material is being applied, the surfaces under repair will remain moist, but not so wet as to overcome the suction upon which a good bond depends. The material used for repair proposed shall consist of a mixture of 1 sack of cement to 3 cubic feet of sand. For exposed walls, the cement shall contain such a proportion of Atlas White Portland Cement as is required to make the color of the patch match the color of the surrounding concrete.
- C. Holes left by tie-rod cones shall be reamed with suitable toothed reamers so as to leave the surfaces of the holes clean and rough. These holes then shall be repaired in an approved manner with dry-packed cement grout. Holes left by form-tying devices having a rectangular cross-section, and other imperfections having a depth greater than their least surface dimension, shall not be reamed but shall be repaired in an approved manner with dry-packed cement grout.
- D. All repairs shall be built up and shaped in such a manner that the completed Work will conform to the requirements of this Section, as applicable, using approved methods which will not disturb the bond, cause sagging, or cause horizontal fractures. Surfaces of said repairs shall receive the same kind and amount of curing treatment as required for the concrete in the repaired section.
- E. Before filling any structure with water, all cracks that may have developed shall be "vee'd" and filled with construction joint sealant for water-bearing structures conforming to the materials and

methods specified in Section 03290 - Joints in Concrete Structures. This repair method shall be accomplished on the water bearing face of members. Before backfilling, faces of members in contact with fill, which are not covered with a waterproofing membrane, shall also have cracks repaired as specified herein.

3.13 PATCHING HOLES IN CONCRETE

A. Patching Small Holes:

1. Holes which are less than 12 inches in their least dimension and extend completely through concrete members, shall be filled as specified herein.
2. Small holes in members which are water-bearing or in contact with soil or other fill materials, shall be filled with nonshrink grout. Where a face of the member is exposed to view, the nonshrink grout shall be held back 2 inches from the finished surface. The remaining 2 inches shall then be patched according to the paragraph in Part 3 entitled - Treatment of Surface Defects.
3. Small holes through all other concrete members shall be filled with nonshrink grout, with exposed faces treated as above.

B. Patching Large Holes:

1. Holes which are larger than 12 inches in their least dimension, shall have a keyway chipped into the edge of the opening all around, unless a formed keyway exists. The holes shall then be filled with concrete as specified.
2. Holes which are larger than 24 inches in their least dimension and which do not have reinforcing steel extending from the existing concrete, shall have reinforcing steel set in grout in drilled holes. The reinforcing added shall match the reinforcing in the existing wall unless required otherwise by the Improvement Plans or approved shop drawings.
3. Large holes in members which are water bearing or in contact with soil or other fill, shall have a bentonite type waterstop material placed around the perimeter of the hole as specified in the Section 03290 - Joints in Concrete Structures, unless there is an existing waterstop in place.

3.14 CARE AND REPAIR OF CONCRETE

- A. The Contractor shall protect all concrete against injury or damage from excessive heat, lack of moisture, overstress, or any other cause until final acceptance by the Owner. Particular care shall be taken to prevent the drying of concrete and to avoid roughening or otherwise damaging the surface. Any concrete found to be damaged, or which may have been originally defective, or which becomes defective at any time before the final acceptance of the completed Work, or which departs from the established line or grade, or which, for any other reason, does not conform to the requirements of the Contract Documents, shall be satisfactorily repaired or removed and replaced with acceptable concrete at the Contractor's expense.

END OF SECTION 03300

SECTION 05220 - CONCRETE BOLTS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The Contractor shall provide concrete anchor bolts, inserts, complete, in accordance with the Contract Documents. Principal items are anchor bolts placed in concrete, adhesive anchors, expansion bolts, and drilled anchors.

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Except as otherwise indicated in this Section of the Specifications, the Contractor shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC), together with the latest adopted editions of the Regional Amendments.
- B. The current edition of the Uniform Building Code (UBC) of International Conference of Building Officials (ICBO).
- C. Federal Specifications:
1. MIL-A-907E Antiseize Thread Compound, High Temperature
- D. Commercial Standards (Current Edition):
1. American Welding Society AWS A 5 Series.
 2. ANSI/AWS B 3.0 Welding Procedure and Performance Qualifications
 3. ANSI/AWS D 1.1 Specification for Welding Code - Steel
 4. ANSI/AWS D 1.3 Specification for Welding Sheet Steel in Structure
 5. AISC American Institute of Steel Construction - Manual of Steel Construction
- E. ASTM Standards in Building Codes (Current Edition):
1. ASTM A 36 Specification for Structural Steel

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| 2. | ASTM A 123 | Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products |
| 3. | ASTM A 153 | Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware |
| 4. | ASTM A 193 | Specifications for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature Service |
| 5. | ASTM A 194 | Specifications for Carbon and Alloy Steel Nuts for Bolts and High Pressure and High Temperature Service |
| 6. | ASTM A 307 | Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile |
| 7. | ASTM A 320 | Specification for Alloy Steel Bolting Materials for Low-Temperature Service |
| 8. | ASTM A 563 | Specification for Carbon and Alloy Steel Nuts |

1.04 CONTRACTOR SUBMITTALS

- A. Shop Drawings: Shop drawings of all concrete bolts shall be submitted to the Owner's Representative for review in accordance with the Specification Section 01330 – Submittals/Shop Drawings.

- B. An International Conference of Building Officials (ICBO) report listing the ultimate load capacity in tension and shear for each size and type of adhesive and expansion concrete anchor used shall be submitted for review. The Contractor shall submit manufacturer's recommended installation instructions and procedures for all adhesive and expansion anchors for review and approval. The Contractor shall follow approved procedures during installation of concrete anchors.

- C. No substitution for the indicated adhesive anchors will be considered unless accompanied with ICBO report verifying strength and material equivalency, including temperature at which load capacity is reduced to 90 percent of that determined at 75° F.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Anchor Bolts: Anchor bolts shall be fabricated of materials complying with SSPWC Subsections 206-1.4.1 and 209-2.2, and as follows:
1. Steel bolts: ASTM A 307 Grade A.
 2. Fabricated steel bolts: ASTM A 36.
 3. Stainless steel bolts, nuts, washers: ASTM A 320, Type 316.
- B. Standard Service Bolts (not Buried or Submerged): Except where otherwise indicated, all bolts, anchor bolts, and nuts shall be steel, galvanized after fabrication as indicated herein unless the bolts are for pipe fittings, transition couplings, mechanical restrained joint fittings, flanged coupling adapters or other piping or piping fittings. The bolts and hardware for these items are specified in Section 02650. Threads on galvanized bolts and nuts shall be formed with suitable taps and dies such that they retain their normal clearance after hot-dip galvanizing. Except as otherwise indicated, steel for bolts, anchor bolts and cap screws shall be in accordance with the requirements of ASTM A 307, Grade A or B, or threaded parts of ASTM A 36.
- C. Buried or Submerged Bolts: Unless other corrosion-resistant bolts are indicated, all bolts, anchor bolts, nuts and washers which are buried, submerged, or below the top of the wall inside any hydraulic structure shall be Type 316 stainless steel conforming to ASTM A 193 for bolts, and to ASTM A 194 for nuts, unless the bolts are for pipe fittings, transition couplings, mechanical restrained joint fittings, flanged coupling adapters or other piping or piping fittings. The bolts and hardware for these items are specified in Section 02650. All threads on stainless steel bolts shall be protected with an antiseize lubricant suitable for submerged stainless steel bolts, to meet government specification MIL-A-907E.
- 1, Antiseize lubricant shall be classified as acceptable for potable water use.
 2. Antiseize lubricant shall be "PURE WHITE" by Anti-Seize Technology, Franklin Park, IL, 60131; AS-470 by Dixon Ticonderoga Company, Lakehurst, NJ, 08733, or equal.

D. Bolt Requirements:

- 1, The bolt and nut material shall be free-cutting steel.
2. The nuts shall be capable of developing the full strength of the bolts. Threads shall be Coarse Thread Series conforming to the requirements of the American Standard for Screw Threads. All bolts and cap screws shall have hexagon heads, and nuts shall be Heavy Hexagon Series.
3. The length of all bolts shall be such that after joints are made up, each bolt shall extend through the entire nut, but in no case, more than ½ inch beyond the nut.

E. Adhesive Anchors: Unless otherwise indicated, all drilled, concrete or masonry anchors shall be adhesive anchors. No substitutions will be considered unless accompanied with ICBO report verifying strength and material equivalency.

- 1, Epoxy adhesive anchors are required for drilled anchors where exposed to weather, in submerged, wet, splash, overhead, and corrosive conditions, and for anchoring handrails, pumps, mechanical equipment, and reinforcing bars. Epoxy anchor grout shall comply with Section 03315 - Grout. Threaded rod shall be stainless steel Type 316.
2. Unless otherwise indicated, glass capsule, polyester resin adhesive anchors will be permitted in locations not indicated above, and shall be Hilti HVA, or equal. Threaded rod shall be galvanized steel.

F. Expanding-Type Anchors: Expanding-type anchors, if indicated or permitted, shall be steel expansion-type ITW Ramset/Redhead "Trubolt" anchors; McCulloch Industries "Kwick-Bolt"; or equal. Lead caulking anchors will not be permitted. Size shall be as indicated. Expansion-type anchors, which are to be embedded in grout, may be steel. Nonembedded buried, or submerged anchors shall be stainless steel.

G. Powder-Driven Pins: Powder-driven pins for installation in concrete shall be heat-treated steel alloy. If the pins are not inherently sufficiently corrosion-resistant for the conditions to which they are to be exposed, they shall be protected in an acceptable manner. Pins shall have capped or threaded-heads capable of transmitting the loads the shanks are required to support.

- H. Impact Anchor: Impact anchors shall be an expansion-type anchor in which a nail-type pin is driven to produce the expansive force. It shall have a zinc sleeve with a mushroom-style head and stainless steel nail pin. Anchors shall be Metal Hit Anchors, manufactured by Hilti, Inc.; Rawl Zamac Nailin, manufactured by the Rawlplug Company, or equal.

2.02 GALVANIZING

- A. Iron and Steel: ASTM A 123, with average weight per square foot of 2.0 ounces, and not less than 1.8 ounces per square foot.
- B. Ferrous Metal Hardware Items: ASTM A 153 with average coating weight of 1.3 ounces per square foot.
- C. Touch-Up Material For Galvanized Coatings: Repair galvanized coatings marred or damaged during erection or fabrication by use of DRYGALV, as manufactured by the American Solder and Flux Company, Galvalloy, Galvion, Rust-Oleum 7085 Cold Galvanizing Compound, or equal, applied in accordance with the manufacturer's instructions.

2.03 WELDING ELECTRODES

- A. Steel Electrodes: Use welding electrodes conforming with AWS D 1.1, except E7024 rods or electrodes shall not be used.
- B. Aluminum Electrodes: Contingent upon alloys being welded, use only inert gas-shielded arc or resistant-welding process with filler alloys conforming to UBC Standard No. 28, Table 28-1-C. Use no process requiring a welding flux.
- C. Stainless Steel Electrodes: Perform welding of stainless steel with electrodes and techniques as contained in pertinent AWS A5 series specification, and as recommended in Welded Austenitic Chromium-Nickel Stainless Steel Techniques and Properties as published by the International Nickel Company, Inc., New York, New York.

PART 3 - EXECUTION

3.01 FABRICATION AND INSTALLATION REQUIREMENTS

- A. Fabrication and Installation: Except as otherwise indicated, the fabrication and installation of anchor bolts shall conform to the

requirements of the American Institute of Steel Construction “Manual of Steel Construction”.

- B. Install adhesive expansion and drilled anchor bolts in accordance with method specified in ICBO for manufacturer product.
- C. Powder-Driven Pins: Powder-driven pins shall be installed by a craftsman who is certified by the manufacturer as being qualified to install the manufacturer’s pins. Pins shall be driven in one initial movement by an instantaneous force that has been carefully selected to attain the required penetration. Driven pins shall conform to the following requirements where “D” = Pin’s shank diameter:

Material Penetrated by Pin	Material’s Minimum Thickness	Pin’s Shank Penetration in Supporting Material	Minimum Space From Pin’s CL to Edge of Penetrated Material	Minimum Pin Spacing
Concrete	16D	6D minimum	14D	20D

3.02 WELDING

- A. Perform all welding in accordance with the “Structural Welding Code-Steel”, AWS D 1.1, and current revisions. Use only welders qualified by tests in accordance with AWS B 3.0.

3.03 GALVANIZING

- A. Bolts, anchor bolts, nuts and similar threaded fasteners, after being properly cleaned, shall be galvanized in accordance with the requirements of ASTM A 153. Field repairs to galvanizing shall be made using “Galvinox”, “Galvo-Weld”, or equal.

3.04 INSPECTION

- A. The Owner’s Representative reserves the right to inspect all materials and workmanship covered in this Section. Such inspections will not relieve the Contractor’s responsibility to furnish materials and workmanship in accordance with the Specifications. If inspections indicate that materials or workmanship are defective, the Contractor shall remove and replace the defective work at no additional cost to the Owner.

END OF SECTION 05220

SECTION 05650 - PRE-ENGINEERED SHADE STRUCTURE

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Install Pre-Engineered Shade Structure per dimensions and type illustrated in the Plans.
- B. **PRODUCT DESIGN LOADS:** To meet governing Building Department requirements. Soil loading and seismic design criteria to be obtained from project specific Geotechnical Report. Minimal Building Department requirements shall be used when no specific Geotechnical Report is provided.
- C. **DESIGN METHOD:** Per applicable building code. Note: Manufacturer to use three-dimensional structural analysis to determine member load and forces.
- D. The pre-engineered package shall be a pre-cut and pre-fabricated package that shall include powder coated structural frame members, roof material, fasteners, and trim as well as the installation instructions. The structure shall be shipped knocked down for minimum shipping charges. Field labor will be kept to a minimum by pre-manufactured parts. No onsite welding will be permitted. Connection bolts shall be concealed within the tubing where possible.
- E. Where possible, tube column to concrete base will be surface mounted with all anchor bolts hidden within the column.
- F. Where possible, the structure will have a moment connection at the top of the column and a pinned connection at the base of the column to ensure a clean connection at the base, reduce the size of the concrete base, and provide for one-step concrete installation process.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03300 – Cast-In-Place Concrete

1.03 REFERENCES

- A. American Institute of Steel Construction (AISC)

- B. American Iron and Steel Institute (AISI) Specifications for Cold Formed Members.
- C. American Society of Testing and Materials (ASTM)
- D. American Society for Quality (ASQ)
- E. American Welding Society (AWS)
- F. California Building Code (CBC)
- G. International Building Code (IBC)
- H. Leadership in Energy and Environmental Design (LEED)
- I. Lightning Protection Institute (LPI)
- J. National Fire Protection Association (NFPA)
- K. OSHA Steel Erection Standard 29 CFR 1926 Subpart R-Steel Erection
- L. Steel Structures Painting Council (SSPC) SSPC-SP10 Near White Blast Cleaning

1.04 SUBMITTALS

- A. Submit 3 set shop drawings and 2 sets structural calculations wet signed and sealed by a Professional Engineer licensed in the State of California.

1.05 QUALITY ASSURANCE:

Provide evidence of commitment of quality craftsmanship as demonstrated by the following:

A. SUPPLIER QUALIFICATIONS:

1. The product shall be designed, produced, and finished at a facility owned and directly supervised by the supplier who has at a minimum of ten years under same ownership making steel frame pre-manufactured structures. Cumulative experience in fabrication will not be an acceptable alternative.
2. The product shall be shipped from a single source.

3. Membership in American Institute of Steel Construction.
4. Membership for American Society of Quality.
5. Membership in American Welding Society.
6. Membership in Chemical Coaters Association International.
7. Membership in Construction Specifications Institute.
8. Full time on-staff Licensed Engineer.
9. Full time on-staff Quality Assurance Manager.
10. Published Quality Management System.
11. Full time on-staff AWS Certified Welding Inspector.
12. Continued certification by an independent inspection agency.
13. Control of finishing quality by in-house shot blast, pretreatment, primer and powder coating.

1.06 PRODUCT STORAGE AND HANDLING

- A. Comply with the requirements of Section 01600 – Materials and Equipment.

1.07 WARRANTY

- A. Supply manufacturer's standard 10 year limited warranty on frame and 10 years limited warranty on paint system.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURER

- A. USA SHADE & Fabric Structures,
Ph: 800-966-5005
www.usa-shade.com
- B. Pre-Fab Builders
1364 East Valencia Drive
714-575-9265
www.prefabinc.org

- C. Substitutions must be approved a minimum of ten (10) days before bid. All approved manufacturers shall be notified in writing before the bid date and shall not be allowed to bid without written notification.
- D. Alternate suppliers must meet the qualifications and provide proof of certifications listed.
- E. Alternate suppliers must provide equivalency to paint system.
- F. Alternate suppliers must provide proof that their designs do not infringe on patents or copyrights.

2.02 MATERIALS

- A. STRUCTURAL FRAMING: structural steel tube minimum ASTM A500 grade B, "I" beams; tapered columns, open channels, or wood products shall not be accepted for primary beams.
- B. COMPRESSION RING: structural channel or welded plate minimum ASTM A36 or COMPRESSION TUBE: structural steel tube minimum ASTM A500 grade B.
- C. STRUCTURAL FASTENERS: ASTM A325 high strength bolts and A563 high strength nuts, ASTM A307 anchor bolts.
- G. "R" PANEL/MULTI-RIB METAL ROOFING: Multi-rib roofing shall be 24 gauge ribbed galvalume steel sheets with ribs 1 3/16" high and 12" on center. Roof surface shall be painted with Kynar 500 to the manufacturer's standard color. Ceiling surface shall be white. Roof panels are factory precut to size and angle to provide one-step installation.
 - 1. Metal roofing trim shall match the color of the roof and shall be factory made of 26 gauge Kynar 500 painted steel. Trim shall include panel ridge caps, eave trim, splice channels, roof peak cap, and corner trim as applicable for model selected., reference drawings for additional information. Painted screws and butyl tape are included.
 - 2. Ridge Caps shall be performed with a single central bend to match the roof pitch and shall be hemmed on the sides.

2.03 ACCESSORIES / OPTIONAL

- A. ELECTRICAL ACCESS AND BOX CUTOUPS: Electrical access to be provided per manufacturer's electrical access sheet. Electrical cut outs shall be marked as height above finish floor and size of cutout required.
- B. Electrical access at compression shall be provided.
- C. Electrical access up through columns to be provided.

2.04 FABRICATION

- A. All steel fabrication of tubes and plates shall be factory controlled under a documented Quality Management System. All parts shall be permanently etched with identification numbers. Fabrication facility will be experienced for a minimum of ten years in precision tube and plate fabrication. Cumulative experience in fabrication will not be an acceptable alternative.
- B. Certified AWS welders, shall make all welded connections in accordance with AWS Specifications and trained by an AWS Certified Welding Inspector.

2.05 FINISH STEEL

- A. For quality control purposes, steel shall be cleaned, pretreated and finished at a facility owned and directly supervised by the manufacturer. Steel shall be shot blasted to SSPC-SP10 near-white blast cleaning. SSPC-SP2 hand tool cleaning will not be an acceptable alternative. Parts shall be pretreated in a 3 stage iron phosphate or equal washer. Epoxy primer powder coat to be applied to parts for superior corrosion protection. Top powder coat of Super Durable TGIC Powder Coat to color selected from manufacturer's standard color chart. For environmental purposes, finish shall allow no VOC emissions. Sample production parts shall have been tested and meet the following criteria:
 - 1. Salt spray resistance per ASTM B 117/ ASTM D 1654 to 5000 hours with no creep from scribe line and rating of 10.
 - 2. Humidity resistance per ASTM D2247-02 to 3000 hours with no loss adhesion or blistering.
 - 3. Color/UV resistance per ASTM G154-04 to 2000 hours exposure, alternate cycles with results of (a) no chalking (b) 75% color retention (c) Color variation maximum 3.0 E

variation CIE formula (before and after 2000 hours exposure).

PART 3 - ERECTION

- A. Footings: The structure shall be set on prepared footings designed by the Shade Structure Manufacturer. Anchor bolts shall also be provided by Shade Structure Manufacturer. Concrete slab (if required) is to be provided by others.
- B. The contractor must use appropriate construction practices for the specific site conditions.
- C. Install all components according to manufacturer's installation instructions and these specifications.

END OF SECTION 05650

SECTION 11660 – FINISH WATER TURBIDIMETER EQUIPMENT

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The Contractor shall furnish and install a Finish Water Turbidimeter(s), together with supports, controls, accessories, and appurtenances necessary for monitoring finish water, complete and operable, as illustrated on the Plans and in accordance with the requirements of the Contract Documents.
- B. Turbidimeter to monitor finish water turbidity is to be located as illustrated on the Plans and in accordance with the requirements of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 11000 – Equipment General Provisions, as applicable.

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

Comply with the applicable reference specifications as specified in the General Requirements.

1.04 CONTRACTOR SUBMITTALS

Submittals shall be made in accordance with Section 01300 - Contractor Submittals.

1.05 WARRANTY

The Turbidimeter shall have a one (1) year warranty from date of installation.

PART 2 - PRODUCTS

2.01 GENERAL

- A. The turbidimeter shall be in-line type and monitor low-range (0.001 to 100 NTU) turbidity.
- B. Measurement Procedure: The method of measuring turbidity will be nephelometric. An incandescent light will be directed into the sample stream in the turbidimeter. The light scattered at 90

degrees will be sensed by a submerged photocell in the measuring chamber. Other methods that may foul or fog a glass window will not be acceptable.

The method will meet or exceed instrument design criteria set by USEPA method 180.1 and Standard Methods 2130B.

2.02 PERFORMANCE REQUIREMENTS

- A. Measurement Range: 0.001 to 100 Nephelometric Turbidity Units (NTU).
- B. Accuracy:
 - 1. ± 2 percent of reading or 0.020 NTU from 0 to 40 NTU
 - 2. ± 5 percent of reading from 40 to 100 NTU
- C. Resolution:
 - 1. 0.001 NTU up to 9.9999 NTU
- D. Repeatability: ± 1.0 percent of reading
- E. Recorder Outputs: two selectable for 4-20 mA and RS-485 Modbus.
- F. Alarm: Two (2) set point alarms, each equipped with an SPDT relay with unpowered contacts rated 5A resistive load at 230 Vac

2.03 OPERATIONAL CRITERIA

- A. Sample flow rate: 1 gallon per minute
- B. Sample Temperature: 32 to 122 degrees F (0 to 50 degrees C)
- C. Operating Temperature: 32 to 104 degrees F (0 to 40 degrees C)
- D. Input Pressure: 1 to 101 psi

2.04 MANUFACTURED SYSTEM

- A. The turbidimeter shall consist of an incandescent light source, photocell, and bubble trap.
- B. The turbidimeter shall be housed in a NEMA 4X/IP66 enclosure made of corrosion-resistant polystyrene.

- C. The optical components of the turbidimeter are mounted in a sealed, removable head assembly.

2.05 EQUIPMENT

- A. The turbidimeter operates using 100 to 240 VAC power.
- B. The turbidimeter operates continuously.
- C. The sample stream into the turbidimeter flows through an internal bubble trap.

2.06 COMPONENTS

- A. Standard Equipment:
 - 1. Turbidimeter sensor head
 - 2. Turbidimeter body
 - 3. Manual
 - 4. Calibration Kit
 - 5. Floor stand, when wall or panel installation is not called out on drawings.
- B. Connectors
 - 1. Sample inlet fitting: 0.25-inch NPT female.
 - 2. Drain fitting: 0.5-inch NPT female
 - 3. Contractor to coordinate, provide, and complete connections to piping/tubing.

2.07 ACCESORIES

- A. Calibration / verification module
- B. Desiccant Refill
- C. Power Cord 120 VAC / 240 VAC
- D. Replacement Ultrasonic Cuvette Assembly

2.08 SPARE PARTS

- A. All spare parts recommended by the manufacturer shall be provided and shipped with equipment.

2.10 MANUFACTURER

A. Manufacturers:

1. Model: 28053 MTOL+ Online Process Turbidimeter
HF Scientific
www.watts.com
2. Or equal.

PART 3 - EXECUTION

3.01 DELIVERY, STORAGE AND HANDLING

- A. Equipment shall be shipped tightly with padding to prevent damage to components.
- B. All fittings shall be installed and, if necessary, removed for shipping and shipped separately unless otherwise noted by the Contractor.
- C. Upon arrival at the destination, inspect equipment and accessories for damage in transit. If damage has occurred, Manufacturer / Supplier is to be notified immediately.

3.02 INSTALLATION

- A. Turbidimeter and appurtenances shall be installed in accordance with manufacturer's instruction and recommendations or approved procedures submitted with the shop drawings and as shown.

3.03 TRAINING

- A. Manufacturer and Contractor are to coordinate appropriate time for training in relation to start-up. The Contractor will then coordinate an appropriate date and time for training with Owner and Engineer.
- B. The manufacturer's representative shall furnish the service of a competent technical service representative for a eight (8) hour training session with Owner's personnel.

END OF SECTION 11660

SECTION 15615 - VALVES

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The Contractor shall provide all tools, supplies, materials, equipment, and labor necessary for furnishing, epoxy coating, installing, adjusting, and testing of all valves, check valves, combination air and vacuum release valves and appurtenant work, complete and operable, in accordance with the requirements of the Contract Documents. Where buried valves are illustrated on the Plans, the Contractor shall furnish and install valve boxes to grade, with covers, extensions, and position indicators.
- B. The provisions of this Section shall apply to all valves and valve operators specified in the various Sections of Divisions 2, 13, 15 and 17 of these Specifications except where otherwise specified in the Contract Documents. Valves and operators in particular locations may require a combination of units, sensors, limit switches, and controls specified in other sections of these Specifications.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Divisions 2 and 15, applicable sections, Pipe, Fittings, and Valves
- B. Section 09800 - Protective Coatings
- C. Division 16 - Electrical, applicable sections

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Comply with the reference specifications of the General Requirements.
- B. Comply with the current provisions of the following Codes and Standards.
 - ANSI B 16.1 Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800
 - ANSI B 16.5 Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and Other Special Alloys

ANSI/ASME B 1.20.1	General Purpose Pipe Threads (inch)
ANSI/ASME B 31.1	Power Piping
ASTM A 36	Specification for Structural Steel
ASTM A 48	Specification for Gray Iron Castings
ASTM A 126	Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A 536	Specification for Ductile Iron Castings
ASTM B 61	Specification for Steam or Valve Bronze Castings
ASTM B 62	Specification for Composition Bronze or Ounce Metal Castings
ASTM B 148	Specification for Aluminum-Bronze Castings
ASTM B 584	Specification for Copper Alloy Sand Castings or General Applications
ANSI/AWWA C 500	Gate Valves for Water and Sewage Systems
ANSI/AWWA C 502	Dry-Barrel Fire Hydrants
ANSI/AWWA C 503	Wet-Barrel Fire Hydrants
ANSI/AWWA C 504	Rubber-Seated Butterfly Valves
ANSI/AWWA C 506	Backflow Prevention Devices - Reduced Pressure Principle and Double Check Valves Types
ANSI/AWWA C 507	Ball Valves 6 inches through 48 inches
AWWA C 508	Swing-Check Valves for Waterworks Service, 2 inches Through 24 inches NPS
ANSI/AWWA C 509	Resilient-Seated Gate Valves for Water and Sewage Systems

AWWA C 550	Protective Interior Coatings for Valves and Hydrants
SSPC-SP-5	White Metal Blast Cleaning
MSS-SP-70	Manufacturers Standardization Society of the Valve and Fitting Industry; Cast Iron Gate Valves. Flanged and Threaded Ends
NSF / ANSI 61:	Drinking Water System Components – Health Effects

1.04 CONTRACTOR SUBMITTALS

- A. Submittals shall be made in accordance with General Requirements. In addition to product information, the Contractor shall submit for approval lay-out drawings showing valve locations within the piping system, supports, and identification numbers.
- B. The following submittals and specific information shall be provided.
 1. Shop Drawings: Shop drawings of all valves and operators including associated wiring diagrams and electrical data, shall be furnished as specified in General Requirements. Submit for approval the following:
 - a. Manufacturer's literature, illustrations, paint certifications, specifications, detailed drawings, data and descriptive literature on all valves and appurtenances.
 - b. Deviations from Contract Documents
 - c. Engineering data including dimensions, materials, size and weight.
 - d. Fabrication, assembly and installation drawings.
 - e. CV values, head loss curves, and as required, calculations.
 - f. Special tools list.

2. Valve Labeling: The Contractor shall submit a schedule of valves to be labeled indicating in each case the valve location and the proposed wording for the label. Complete nameplate data of valves and actuators is required.
3. Operation and Maintenance Manuals:
 - a. Submit complete installation, operation and maintenance manuals including test reports, maintenance data and schedules, description of operation, and spare parts information.
 - b. Furnish Operation and Maintenance Manuals in conformance with the requirements of the General Requirements.
4. Shop Tests: Hydrostatic tests shall be performed, when required by the valve specifications included herein.
5. Certificates: Where specified or otherwise required by Engineer, submit Test Certificates and Certificates of Compliance with AWWA standards and other specifications, especially where it concerns the suitability of the materials of construction for the particular application.

1.05 QUALITY ASSURANCE

- A. Valve Testing: Valves shall be shop tested per manufacturer's recommendations and applicable AWWA/ANSI specifications prior to shipment. Manufacturer's certification that valves have been shop tested shall be submitted for approval 30 days prior to scheduled shipment.
- B. Bronze Parts: Where specified, all interior bronze parts of valves shall conform to the requirements of ASTM B 62, or, where not subject to dezincification, to ASTM B 584.
- C. Shop Inspection: Shop inspection of valve construction, testing and coating shall be witnessed and approved by the ENGINEER. All valves will be shop inspected unless otherwise waived in writing by the Engineer.
- D. The Contractor shall demonstrate that each valve installed as a part of a piping system will operate under field conditions in a manner consistent with the design of the system. All testing of valves shall be witnessed and approved by the Engineer.

- E. For all pneumatic, hydraulic, and electric motor operators and controls, it shall be the responsibility of the Contractor to provide a qualified representative of the valve manufacturer to perform all field adjustments to set operator limit switches for the required functions. The cost of providing a qualified representative of the valve manufacturer for field adjustments shall be included in the Contractor's bid. All wiring of motor operators shall be identified with a unique number unlike any other wiring identification. It is the responsibility of the Contractor to coordinate the requirements of this section with those involving both specifications of Division 16, "Electrical" and Division 17, "Instrumentation."
- F. All adjustments, calibration, and/or testing shall be done in the presence of the Engineer.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site to ensure uninterrupted progress of the Work. Deliver anchorage devices, which are to be embedded in cast-in-place concrete, in ample time to not delay the Work.
- B. All boxes, crates and packages shall be inspected by Contractor upon delivery to the site. Contractor shall notify Engineer if any loss or damage exists to equipment or components. Replace loss and repair damage to new condition, in accordance with manufacturer's instructions.
- C. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms or other supports. Protect steel members and packaged materials from corrosion and deterioration.
- D. Provide full-face protectors of waterproof material fastened to each side of the valve body to protect joints and the valve interior.

PART 2 - PRODUCTS

2.01 GENERAL VALVE REQUIREMENTS

- A. General: The Contractor shall furnish all valves, operators, actuators, valve-operating units, stem extensions, and other accessories as shown or specified. All valves shall have the name of the manufacturer and the site of the valve cast on the body or bonnet or shown on a permanently attached plate in raised letters.

All valves shall be new and of current manufacture. All valves, 6 inch and larger, shall have operators with position indicators. Where buried, these valves shall be provided with valve boxes and covers containing position indicators, and valve extensions.

- B. Valve Flanges: The flanges of valves shall be in accordance with Divisions 2 and 15.
- C. Valve Stems: Except where otherwise specified, valves with motorized operators shall have stems conforming to ASTM A 276 Type 316 stainless steel with minimum tensile strength of 95,000 psi, and a minimum yield point of 75,000 PSI, and elongation of 25% in 2 inches. Manually operated valves shall have silicon-bronze stems conforming to ASTM B 584-875, having minimum tensile strength of 60,000 PSI, a minimum yield point of 24,000 PSI, and elongation of 16% in 2 inches. Where subject to dezincification, manually operated valve stems shall be of bronze conforming to ASTM B 62, containing no more than 5% zinc, nor more than 2% aluminum.
- D. Protective Coating: Except where otherwise specified, ferrous surfaces, exclusive of stainless steel surfaces, in the water passages of all valves 4 inch and larger, as well as the exterior surfaces of all submerged, buried or aboveground valves and operators, shall be fusion bonded epoxy. Flange faces of valves shall not be coated. The valve manufacturer shall certify in writing that such coating has been applied and tested in the manufacturing plant prior to shipment, in accordance with these Specifications.
- E. Valve Operators:
 - 1. Valve operators shall be provided for specific valves as required by the specification section.
 - 2. When one, or more, underground valve is installed, an adjustable valve key shall be provided to the Owner.
- G. Nuts and Bolts: All nuts and bolts on valve flanges and supports shall be coated with a flouropolymer as manufactured by Tripac (Tripac 2000 Blue), or an approved equal. All bolts on valve bonnets and exterior valve hardware shall be Type 316 stainless steel.

2.02 RESILIENT SEATED GATE VALVES

Resilient seated gate valves shall conform to AWWA C 509, latest edition. The wedge shall be fully encapsulated in the elastomer, including the guides. The brass stem nut shall be rigidly enclosed in the wedge to maintain alignment. The valve body shall be composed of ductile iron.

The stem shall have two (2) O-rings and a wiper above the collar and one (1) O-ring below the collar. Stem seals must be replaceable with the valve under pressure.

The stem material shall be standard bronze. Stainless steel (ANSI-420) shall also be acceptable for use as an alternative.

The waterway shall be full size to allow for tapping use; no cavities or depressions shall be permitted in the seat area.

Valve body and bonnet shall be electrostatically applied, fusion bonded, epoxy coated both inside and out by the valve manufacturer. The coating shall meet the requirements of AWWA C 550, latest edition. Coating shall be applied only at the valve manufacturer's facilities. Exterior hardware shall be composed of Type 316 stainless steel.

The bonnet bolts shall not be exposed to the environment.

O-ring style seals shall be used as gaskets on the bonnet and on the stuffing box. The below grade valves shall be supplied with a standard 2 inch operating nut. All valves shall be wrapped with a polyethylene material.

Available Manufacturers: Subject to compliance with requirements, manufacturers offering resilient wedge gates valves which may be incorporated into the work are:

- a. AFC
- b. Clow
- c. AVK
- d. Waterous
- e. M&H Valve Company
- f. Mueller
- g. Or Equal.

2.03 BUTTERFLY VALVES

A. General:

All butterfly valves shall be of the rubber-seated tight-closing type. They shall meet or exceed AWWA Standard C 504.

Both valve ends shall be mechanical-joint (or other, as available) per AWWA Standard C 111. Accessories (bolts, glands and gaskets) shall be supplied by the valve manufacturer.

Available Manufacturers: Subject to compliance with requirements, manufacturers offering butterfly valves which may be incorporated into the work are:

- a. Bray
- b. Pratt
- c. Dezurik
- d. Clow
- e. Or Equal.

All valves must use full AWWA C 504 Class 150B valve shaft diameter, and full Class 150B underground-service-operator torque rating throughout entire travel, to provide capability for operation in emergency service. All valves shall be NSF approved.

B. Valve:

Valve body shall be composed of ductile iron with 18-8 Type 304 stainless steel body seat. Valve vane shall be ductile iron, having rubber seat mechanically secured with an integral 18-8 stainless steel clamp ring and 18-8 stainless steel self-locked screws.

Rubber seat shall be a full-circle 360 degree seat not penetrated by the valve shaft. For valves 4" - 12", the valve shaft shall be one piece, extending full size through the entire valve. Valve shaft shall be 304 stainless steel. Packing shall be O-ring cartridge designed for permanent duty in underground service. For 14 inches and larger valve shaft shall be 18-8 stainless steel stub shaft design keyed to the vane with stainless steel taper pins.

Body Type: All butterfly valves shall be of the rubber-seated tight-closing type. They shall meet or exceed AWWA Standard C 504.

Valve ends shall be: As noted in the Plans.

Wafer: Suitable for installation between 125# or 150# ASA flanges (available 4 inch through 20 inch).

Flanged: Short body valves per Table 2 of AWWA Spec C 504. Flanges shall be 125# ANSI (available all sizes). Also flanged by MJ in 6 inch, 8 inch and 16 inch sizes.

Mechanical Joint: Both ends of valve shall be "MJ" per AWWA C 111. "MJ" accessories (bolts, glands, gaskets) must be supplied by valve manufacturer (available all sizes - also flanged by MJ in 6 inch, 8 inch, 12 inch and 16 inch sizes). Both ends of valve shall be "MJ" per AWWA C111. "MJ" accessories (bolts, glands, gaskets) shall be supplied by valve manufacturer (available all sizes - also flanged by MJ in 6 inch, 8 inch, 12 inch and 16 inch sizes).

C. Operator:

Valve operator shall be of the traveling-nut type, sealed, gasketed, and lubricated for underground service. It shall be capable of withstanding an overload input torque of 450 ft. lbs at full-open or full-closed position without damage to the valve or valve operator. It shall be designed for submergence in water to 25 feet head pressure for up to 72 hours.

Valve shall be capable of easy closure by one man using standard valve key, even under emergency line-break conditions as severe as those that would cause a valve maximum opening torque requirement of as much as two times AWWA Class 150B.

All valves shall open left (clockwise to close), and be equipped with 2 inch AWWA operating nut.

Crank, Handwheel or Chainwheel: All manual operators for service other than underground shall have position indicator and shall be totally enclosed and permanently lubricated. In any event, a maximum pull of 80 pounds on the crank or wheel shall produce full Table 1 output torque throughout entire travel. Operators shall full-closed positions without damage to valve or operator. Operators shall be of the "traveling-nut" type. All valves shall open left (clockwise to close).

Cylinder: Cylinder operator shall be of the base mounted configuration. Cylinder barrel shall be of molybdenum-disulfide lined glass fiber reinforced epoxy tubing, to provide a corrosion-free, self-lubricated high strength barrel. Rod seal shall be of urethane, molybdenum-disulfide filled, to provide a self-lubricated, long life seal.

Piston rod shall be of hard chromium plated 18-8 stainless steel, and shall be top and bottom guided in a heavy cast iron mechanism housing for positive alignment. Guiding shall be accomplished by bronze bearings at ends of housing straddling all side loads improved in operation. Entire operator including piston rod shall be fully enclosed. Operator shall produce full AWWA Standard C 504 Table 1 output torque throughout entire travel for Class (25A) (25B) (75B) (150B) with a minimum supply pressure of PSI (water) (air) (oil).

Electric Valve Actuators: Actuators shall be provided as called out in the improvement Plans. The actuator shall be compact and low profile to minimize space requirements. The actuator shall operate over 90°. The actuator shall provide easy access for field wiring and adjustment. The actuator shall be built to withstand line vibration and shock without failure.

The enclosure shall be die-cast aluminum for environmental protection. The waterproof enclosure shall be certified to UL, CSA and CE NEMA 4 waterproof standards. The waterproof/explosion proof enclosure shall be certified to UL NEMA 4 hazardous locations. The enclosure shall be provided with captive cover bolts to prevent loss of cover bolts when cover is removed. The enclosure shall have two conduit connections (one for power wiring and one for control signal wiring) in either NPT or metric threads as specified. The actuator enclosure shall be provided with a high visibility valve position display prominently labeled and color coded to indicate the valve position throughout the full range of travel.

The motor shall be a single phase, permanent split capacitor reversible induction type with Class F or better insulation. The motor shall contain a built-in UL approved automatic reset thermal overload protector set at 275° F (135°C) embedded in the motor windings. Motors shall be 24 VAC, 120 VAC 50/60 Hz or 240 VAC 50/60 Hz as specified on the Electrical and or Instrumentation Plans.

The actuator shall have a self-locking gear train system consisting of a worm and worm gear output drive mechanism which will hold the valve in the desired position without the need for an electro-mechanical braking system. The spur gear train shall have precision cut multi-staged gears which will withstand locked rotor conditions and are permanently lubricated at the factory.

Mechanical stainless-steel travel stops shall be provided and located outside the actuator enclosure for ease of adjustment.

Stainless steel lock nuts to hold the travel stops in position and o-ring seals for waterproof protection shall be provided. The mechanical travel stops shall be capable of limiting the travel of the actuator in either direction from full closed to full open.

The actuator shall be equipped with a manual override handwheel to rotate the valve without electrical power. The manual override system shall ensure positive and efficient manual operation without the use of extra tools or levers.

An automatic power cutout switch shall be provided to cut power to the motor when the actuator manual override is engaged. This cutout shall also function as a safety emergency power shutdown device and shall be accessible from outside the actuator enclosure.

All travel switches shall be:

Single Pole, Double Throw Form C Type
UL Listed and CSA Approved
10A at 125/250 VAC and 1/2A at 125 VDC

The actuator switches shall be pre-wired to a terminal block for ease of access and all internal wiring shall range from 12-22 AWG. The travel limit switches shall limit the actuator travel in both the open and closed direction of travel. Cams for each travel limit switch shall be infinitely adjustable by finger touch or screw driver.

Actuators shall be designed for electric operation for the following service conditions:

Temperature ranges of -40°F (-40°C) to +150°F (+65°C)
Duty Cycle: 25% for Intermittent Operation
100% for Continuous Operation

All actuators shall be factory tested to ensure proper operation.

All actuators shall mount directly to the valve mounting flange and stem without the need for any brackets or couplings.

The actuator shall be designed to accept any of the following optional accessories if specified during the submittal review process:

- A. Torque Limiting System:
 - Shall include a 2 SPDT mechanical switches and 2 factory calibrated adjusting screws.

- The switches, in response to a predetermined load on the actuator output shaft, shall interrupt power to the motor.
- The switches shall operate at any point and in both directions of actuator level.

B. Heater:

- Shall include a self-regulating temperature control to prevent condensation build-up.
- Shall be pre-wired to the terminal block for ease of connection to external source.
- Rated output shall be 15W at 120 or 220 VAC.

C. Microprocessor Servo:

- Shall provide precise modulating control of the valve position in response to an analog input signal.
- Shall have an analog output signal proportional to the actual valve position and the signal shall be configurable to either current or voltage output.
- Voltage spike protection shall be provide on all input terminals.
- Independent adjustments shall be provided for Deadband and for both open and closed Speed Control of the actuator.
- Input signals shall be:
 - 4-20 mADC 250 Ohm Input Impedance
 - 0-10 VDC 2.1k Ohm Input Impedance
 - 2-10 VDC
 - 10k Ohm or great potentiometer
- Calibration shall be accomplished by pressing a single button to initiate the calibration routine.
- Control characteristics shall be linear and duty cycle shall be 100%.
- Internal feedback shall be by means of a 10k Ohm potentiometer.
- Retransmission outputs shall be:
 - 4-20 mADC
 - 0-5 VDC
 - 0-10 VDC
 - 2-10 VDC
- Separate Speed Control adjustments shall be provided for adjustment of open and close travel speeds.

- Inputs for the control box, handwheel, LED status indicators and self-diagnostic capability shall also be provided.
- DeviceNet Servos shall also be available if specified.

D. Local Control Station:

- For local electrical operation of the actuator.
- Shall flush mount to the actuator and include:
 - a local/off/remote control switch
 - an open/stop/close switch
 - two lights which indicate open and closed valve position
- Enclosure shall be aluminum and waterproof (NEMA 4, 4X, IP 65)

D. Coating:

Standard coating shall be universal primer. Coating shall be applied to entire valve body and vane before final assembly.

Valve body shall be electrostatically applied, fusion bonded, epoxy coated to all surfaces of valve body and vane to an average minimum film thickness of 5 mils, conforming to AWWA C 550 Standard. Coating shall be applied only at the valve manufacturer's facilities. Exterior valve hardware shall be composed of Type 316 stainless steel hardware for butterfly valve flanges shall consist of flouropolymer coated hardware as manufactured by Tripac (Tripac 2000 Blue) or an approved equal.

E. Tests:

All valves shall be tested bottle-tight at rated working pressure by the manufacturer as follows:

4" through 12"	200 PSI
14" Up	150 PSI

In addition, a hydrostatic test with vane partially open shall be given to the assembled valve as follows:

4"	400 PSI
14" Up	300 PSI

2.04 SWING CHECK VALVES

The check valves shall be manufactured of gray cast iron in conformance with ASTM A 126 Grade B. The swing check valves shall comply with AWWA C 508, latest revision. The check valve shall be provided with flanges in accordance with ANSI B 16.1, Class 125.

The valve design shall be full flow equal to nominal pipe diameter at all points through the valve. The valve shall be capable of passing 3-inch diameter sphere. The seating surface shall be on a 45-degree angle to minimize disc travel. A threaded port with pipe plug shall be provided on the bottom of the valve to allow for field installation of a backflow actuator, without special tools or removing the valve from the line.

The top access port shall be full size, allowing removal of the disc without removing the valve from the line. The access cover shall be domed in shape to provide flushing action over the disc for operating in lines containing high solids content. A threaded port with plug shall be provided in the access cover to allow for field installation of a mechanical, disc position indicator.

The disc shall be of one-piece construction, precision molded with an integral O-ring type sealing surface and contain alloy steel and nylon reinforcement in the flexible hinge area. The flex portion of the disc shall be warranted for 25 years. Non-slam closing characteristics shall be provided through a short 35-degree disc stroke and a memory disc return action.

The valve body and cover shall be constructed of ductile iron per ASTM A 536 Grade 65-45-12.

The disc shall be precision molded Buna N (NBR), ASTM D 2000-BG.

The exterior and interior of the valve shall be coated with an ANSI/NSF 61 approved fusion bonded epoxy coating.

2.05 SILENT CHECK VALVES

The Silent Check Valve shall be globe style. The check valve shall be the silent operating type that begins to close as the forward flow diminishes and fully closes at zero velocity preventing flow reversal and resultant water hammer.

The valves shall be constructed for potable water service use and shall be certified to NSF/ANSI 61, Drinking Water System Components – Health

Effects, and certified to be Lead-Free in accordance with NSF/ANSI 372. The manufacturer shall have a quality management system that is certified to conform with ISO 9001 by an accredited, certifying body. The Globe Style valves shall be supplied with 125- or 150-pound flanges.

The valve design shall incorporate a center guided, spring loaded disc and having a short linear stroke that generates a flow area equal to the nominal valve size. The operation of the valve shall not be affected by the position of the installation. The valve shall be capable of operating in the horizontal or vertical positions with the flow up or down. All component parts shall be field replaceable without the need of special tools. Globe style valves shall be provided with a replaceable guide bushing held in position by the spring. The spring shall be designed to withstand 100,000 cycles without failure and provide a cracking pressure of 0.50 psi. The globe disc shall be concave to the flow direction providing for disc stabilization, maximum strength, and a minimum flow velocity to open the valve. The valve disc and seat shall have a seating surface finish of 16 micro-inch or better to ensure positive seating at all pressures. A resilient seal shall be provided on the seat to provide zero leakage at both high and low pressures without overloading or damaging the seal. The seal design shall provide both a metal to metal and a metal to resilient seal.

The valves shall be hydrostatically tested at 1.5 times their rated cold working pressure (CWP) and seat tested at the valve CWP. The manufacturer shall provide the test certificates, dimensional drawings, parts list drawing and operation and maintenance manuals with each valve. The exterior of the valve shall be coated with a universal alkyd primer.

Valve interiors and exteriors shall be coated with an NSF/ANSI 61 certified fusion bonded epoxy in accordance with AWWA C550. The valve body shall be constructed of ASTM A126 Class B Cast Iron. The globe style valve seat and disc shall be ASTM A351 Grade CF8M stainless-steel. The compression spring shall be ASTM A313 Type 316 SS with ground ends.

2.06 VALVE RISER AND VALVE COVER

A 6-inch diameter cast iron valve riser and ductile iron cover shall be placed over each below grade valve. The 6-inch diameter cast iron valve riser and cover shall be manufactured by Star Pipe Products, or an approved equivalent of equal substance and function.

Place an 8 inch deep, 8-inch wide PCC collar concentric with the exterior of the valve extension riser. Place the top of the riser 0.10-feet above the finish grade.

Two (2) 6-foot valve keys for operating of gate valves shall be furnished by the Contractor to the Owner prior to completion of the project.

PART 3 - EXECUTION

3.01 VALVE INSTALLATION

- A. General: All valves, operating units, controls, stem extensions, valve boxes, and accessories shall be handled in a manner to prevent any injury to any part of the valve. Valves shall be installed in accordance with the manufacturer's written instructions and as shown and specified. All valves shall be adequately braced to prevent warpage and bending under the intended use. Valves shall be firmly supported to avoid undue stresses on the pipe. All valves shall be installed so that the valve stems are plumb.
- B. Access: All valves shall be installed to provide easy access for operation, removal, and maintenance and to avoid conflicts between valve operators and structural members or handrails.
- C. Valve Accessories:
 - 1. Where combinations of valves, sensors, switches, and controls are specified, it shall be the responsibility of the Contractor to properly assemble and install these various items so that all systems are compatible and operating properly. The relationship between interrelated items shall be clearly noted on Shop drawing submittals.
 - 2. Valve operators and controls are to be installed where specified and designated on the Plans. The Contractor is responsible for installation of the correct valve operator and control as specified to provide a complete piping system as specified.
- D. All valves shall be field tested following installation to demonstrate that the valve operates under field conditions in a manner consistent with the design of the system.
- E. All testing of valves shall be witnessed and approved by the Engineer.

- F. The Contractor shall demonstrate that each valve operator and control installed as a part of a piping system will operate under field conditions as designed and in the manner for which the operator was specified.

END OF SECTION 15615

SECTION 15830 - MISCELLANEOUS VALVES

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The Contractor shall furnish and install miscellaneous valves as shown and as specified herein, complete and operable including accessories and, where designated, operators, in accordance with the requirements of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Division 2 - Sitework.
- B. Section 11000 – Equipment General Provisions.
- C. Division 15 - Mechanical.

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Comply with the reference specifications of the General Requirements.
- B. NSF / ANSI STANDARD 61: Piping, fittings, and appurtenances in contact with potable water or water that will be treated to become potable shall be listed in NSF / ANSI Standard 61 as being suitable for contact with potable water.

1.04 CONTRACTOR SUBMITTALS

- A. Submittals shall be made in accordance with Section 01300 - Contractor Submittals.

1.05 QUALITY ASSURANCE

- A. QUALITY ASSURANCE shall comply with the quality requirements specified in RELATED WORK SPECIFIED ELSEWHERE above.
- B. All valves shall be tested in accordance with manufacturer's recommendation and applicable AWWA/ANSI specifications

PART 2 - PRODUCTS

2.01 COMBINATION AIR-VACUUM VALVES

- A. Combination Air and Vacuum Valves: Combination air valves shall combine the characteristics of air and vacuum valves and air release valves by exhausting accumulated air in systems under pressure and releasing or re-admitting large quantities of air while a system is being filled or drained, respectively. They shall be of the size shown, with flanged or screwed ends to match piping. Bodies, the float, seat, and all moving parts shall be constructed of Type 316 stainless steel. Seat washers and gaskets shall be of a material insuring water tightness with a minimum of maintenance. Valves shall be designed for minimum 150 PSI water-working pressure, unless otherwise shown.

2.02 BACKFLOW PREVENTER VALVES

- A. General: Backflow preventers shall work on the reduced pressure principle. They shall consist of two (2) spring-loaded check valves, automatic differential pressure relief valve, drain valves, and shut-off valves. The body material shall be bronze or cast iron for a working pressure of not less than 150 PSI, with bronze or stainless steel trim. Drain lines with air gaps shall be provided.

B. Manufacturers, or Equal:

1. Model: 4000B
AMES Fire & Waterworks
1427 North Market Boulevard, Suite #9
Sacramento, CA 95854
916-928-0123
916-928-9333: FAX
2. Model: 850V
FEBCO
4381 North Brawley, Suite 102
Fresno, CA 93722
559-441-5300
559-441-5301: FAX
3. Or Equal.

2.03 SMALL PRESSURE REDUCING VALVES (Air, Chemical and Water Systems)

- A. General: Small air and water pressure reducing valves shall be of the spring-loaded diaphragm type with a minimum pressure rating of 250 PSI, with bronze body, nickel alloy or stainless steel seat,

and threaded ends. Each valve shall be furnished with built-in or separate strainer and union ends.

- B. Small chemical (i.e. ammonium hydroxide, sodium bisulfite, and sodium hypochlorite) pressure reducing valves shall be of the spring-loaded diaphragm type with Teflon body, hastelloy or Teflon trim material, and Teflon seat material. Value body shall be flanged.

2.04 LARGE WATER PRESSURE REDUCING VALVES

- A. General: Large water pressure reducing valves shall be of the piston-type or diaphragm-actuated globe type, with cast iron body and stainless steel trim. Unless otherwise shown or specified, the valves shall have a pressure rating of not less than 150 PSI, shall have 125 lb flanges, and shall have an adjustable downstream pressure range with a downstream setting as required.

2.05 PRESSURE RELIEF VALVES

- A. Pressure Relief Valves for chemical piping systems shall be in-line pattern with three ports. Excess pressure shall be relieved through the port in the bottom of the valve. The valve materials shall be as described in Table 2.1. For the diaphragm material, Teflon or other suitable material may be substituted for EPDM.

TABLE 2-1 RELIEF VALVE MATERIALS FOR CHEMICAL SYSTEMS

ITEM	Systems					
	Ammonium Hydroxide	Scale Inhibitor	Sodium Bisulfite	Polymer	Sodium Hypochlorite	Sulfuric Acid
Relief Valves (Body) (Diaphragm)	PVC or Teflon EPDM	PVC EPDM	PVC or Teflon EPDM	PVC or Teflon Teflon	PVC or Teflon Teflon	PVDF or Teflon Teflon

2.06 CORPORATION STOPS

- A. Unless otherwise shown, corporation stops shall be made of solid brass for key operation, with screwed ends with corporation thread or iron pipe thread, as required.
- B. Manufacturer, or Equal:
 1. James Jones.
 2. Mueller.

3. Or equal.

2.07 SOLENOID VALVES

- A. Solenoid valves shall be of the size, type, and class shown and shall be designed for not less than 150 PSI water-working pressure. Valves for water, air, or gas service shall have brass or bronze body with screwed ends, stainless steel trim and spring, Teflon or other resilient seals with material best suited for the temperature and fluid handled. Solenoid valves in corrosive environment shall have stainless steel bodies. For chemicals and all corrosive fluids, solenoid valves with Teflon bodies and springs or other suitable materials shall be used. General purpose enclosures for indoors shall be NEMA type 2. For explosion proof, corrosive, special purpose, or outdoor locations NEMA type 4, 7, 8, 9, 9E, 9F, or 9G enclosures shall be used, as applicable. All coil ratings shall be for continuous duty. For electrical characteristics see electrical drawings or specifications.

2.08 STAINLESS STEEL VALVES

- A. General:
 1. All valves shall be furnished and installed as illustrated on the Plans.
 2. Valves with pneumatic, hydraulic, and electric motor operators and controls shall be in accordance with Division 17.
- B. Fasteners: All bolts, nuts, and washers shall be made of Type 316 stainless steel.
- C. Ball Valves:
 1. Sizes 1/2" - 2 1/2":
 - a. Class: 900 PSI, Screwed.
 - b. Type: Full port.
 - c. Body: 316 Stainless Steel ASTM A 351.
 - d. Ball: 316 Stainless Steel.
 - e. Seat: Reinforced PTFE Fire Safe.
 - f. Stem: 316 Stainless Steel.

MISCELLANEOUS VALVES

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g. Operator: Manual, Lever.

2.10 WELL SERVICE AIR VALVE

The well service air valves shall be fully automatic float operated valves designed to exhaust air which is present in the pump column on pump startup and allow air to re-enter the column on pump shutdown or should a negative pressure occur. The dual port throttling device shall provide adjustable control of the exhaust rate and allow free flow into the valve through a separate inlet port.

The valves shall be manufactured and tested in accordance with AWWA Standard C512. The manufacturer shall have a quality management system that is certified to ISO 9001 by and accredited, certifying body. The valves shall have full size NPT inlets and outlets equal to the nominal valve size. The body inlet connection shall be hexagonal for a wrench connection. The valves shall have two additional NPT connections for the addition of Air Release Valves, gauges, testing and draining.

The valve body shall provide a through flow area equal to the nominal valve size. A bolted cover with alloy screws and flat gasket shall be provided to allow for maintenance and repair. Floats shall be unconditionally guaranteed against failure including pressure surges. The float shall have a hexagonal guide shaft supported in the body by circular bushings to prevent binding from debris. The float shall be protected against direct water impact by an internal baffle. The resilient seat shall provide drop tight shut off to the full valve pressure rating.

Valves 3 inches (75mm) and smaller will be equipped with a *dual port throttling device* to control the discharge of air from the valve and allow full vacuum flow through a separate port. The device shall have an externally adjustable screw and locknut for adjusting the discharge control disc. The disc shall be sized to allow a 5% flow area when fully throttled. The vacuum port shall be equipped with a spring-loaded disc to allow flow into the valve during negative pressure conditions. Throttling devices with a common exhaust and vacuum port are not acceptable. The material of the body shall be consistent with the Well Service Air Valve. The spring shall be ASTM A313 Type 316 SS. The dual port throttling device shall be mounted on the inlet of the well service air valve to allow free air flow in and restricted flow out of the valve to reduce valve pressure surges. The device shall be a flanged, globe pattern, with a center guided disc and seat assembly. The disc shall have threaded holes to provide adjustment of the flow rate through the valve. The material of the body shall be consistent with the well service air valve. The seat and disc shall be Bronze ASTM B584, alloy C83600.

The well service air valve body, cover and baffle shall be constructed of ASTM A126 Class B cast iron for Class 125 valves. The float, guide shafts and bushings shall be constructed of Type 316 SS. Non-metallic guides and bushings are not acceptable. Resilient seats shall be Buna-N. The valve interior shall be coated with an NSF/ANSI 61 certified fusion bonded epoxy in accordance with AWWA C550. The exterior of the valve shall be coated with a universal alkyd primer. The valve manufacturer shall provide test certificates, dimensional drawings, part list drawings and operation and maintenance manuals.

2.10 NSF / ANSI STANDARD 61

Piping, fittings, and appurtenances in contact with potable water or water that will be treated to become potable shall be listed in NSF / ANSI Standard 61 as being suitable for contact with potable water.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Backflow preventers shall be installed in all potable water lines and as illustrated in the Plans.
- B. All valves shall be installed in accordance with the Manufacturer's printed recommendations.
- C. Field testing of valves shall be performed in accordance with manufacturer's recommendations.
- D. All field testing shall be witnessed and approved by the Engineer.

END OF SECTION 15830

SECTION 17137 – MAGNETIC FLOWMETER

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The Contractor shall furnish and install magnetic flowmeters as shown on the Plans and as specified herein, complete and operable including accessories in accordance with the requirements of the Contract Documents. The flowmeters shall consist of two parts with the manufacturer supplied interconnecting wiring, the field installed flow element and the flow indicating transmitter.
- B. The contractor shall include an aluminum shade to cover the flowmeter. The aluminum shade shall fully shade the flowmeter.
- C. The transmitter is to be installed remote from the flowmeter within the Control Building as illustrated on Plans. The contractor shall provide the necessary Unistrut and other required backing material and hardware to mount and secure the amplifier/transmitters to the Control Building walls. The Contractor shall install all required control and power circuitry for the transmitters and the entire flow metering system.
- D. The Contractor shall install all necessary conduit and conductors (circuitry) between the transmitter and the existing RTU (Remote Terminal Unit) within the Control Building. The location of the existing RTU is within the Control Building. The RTU will transmit the flowmeter output information from the transmitter to the Palo Verde Water District Office or other locations as determined by the Palo Verde Water District.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Division 2 - Sitework.
- B. Division 15 - Mechanical.

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Comply with the reference specifications of the General Requirements.
- B. NSF / ANSI STANDARD 61: Flowmeters and appurtenances in contact with potable water or water that will be treated to become

potable shall be listed in NSF / ANSI Standard 61 as being suitable for contact with potable water.

1.04 CONTRACTOR SUBMITTALS

- A. Provide complete manufacturer's part number, identifying scaling, operating range, housing and wetted parts materials, NEMA rating, product options, consumable materials, and other pertinent information.

1.05 QUALITY ASSURANCE

- A. Equipment to furnished under this section shall be the product of firms regularly engaged in the design and manufacture of this type of equipment. Manufacturer shall assume responsibility for, and guarantee performance of equipment furnished. However, this shall not be construed as relieving the Contractor from responsibility for the proper installation and functioning of the work.

PART 2 - PRODUCTS

2.01 MAGNETIC FLOMETERS:

- A. Manufacturers, or Equal:
 - 1. Ultra Mag by McCrometer
 - 2. TigerMag by Sparling
 - 3. Or Equal.
- B. Materials:
 - 1. All mounting hardware shall be 316 stainless steel, the instrument enclosure shall be rated NEMA 4X, the flow sensor liner shall be Polyurethane lined, and the electrode material shall be 304/316 stainless steel.
- C. Design and Fabrication:
 - 1. Utilize characterized field principle of electromagnetic induction to produce signal directly proportional to flow rate.
 - 2. Provide flanged end connections per ANSI B16 rated for piping system operating and test conditions.

3. Operating pressure: 100 psi. min.
4. Operating temperature (transmitter): 140 Deg F.
5. Grounding requirements:
For non-metallic or lined pipe, the inlet and outlet grounding rings of same material as electrode.
For conductive piping, the conductive path between the meter and the piping flanges.
6. Provide cable between magnetic flowmeter and transmitter. Appropriate length of the sensor cable shall be provided by the Manufacturer.
7. Pulsed DC magnetic field excitation.
8. Automatic zero.
9. Adjustable low flow cutoff.
10. 16-character alphanumeric display shall indicate user-defined flow units and total flow. All menu advise and commands shall be viewed on this display.
11. Minimum signal lock (empty tube zero) to prevent false measurement when tube is empty.
12. Power and outputs:
 - a. Power supply: 117 V +/- 10 percent, 60 Hz.
 - b. 4-20 mA DC isolated output into maximum 800 ohms.
 - c. Scaled frequency output, 24 VDC
 - d. Flow direction with open collector.
13. Accuracy:
 - a. +/- 5 percent of rate above 1 fps.
 - b. +/- 0.01 fps below 1.0 fps.
 - c. Meter operable as specified in liquids with 5.0 micromho/cm or more conductivity.

14. Electrodes shall be self-cleaning.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Equipment and materials specified in this section shall be installed and connected as specified, and as shown on the plans. The contractor shall coordinate the installation with the other trades, to insure proper installation of the flow element, transmitter, and associated conduit and cables.
- B. The Contractor shall calibrate the instruments to the proper ranges, as required by the Owner and the Engineer. Where analog signals are connected to local, or remote monitoring equipment, the Contractor shall verify that the calibrated ranges and scaling of the local and remote indicators are correct.
- C. Contractor shall follow manufacturer's recommendations for the minimum upstream and downstream installation requirements for the flow sensor.
- D. The Manufacturer's representative shall provide an 8-hour day of project site visit to assist with set up, calibration, and testing of the flowmeter and transmitter unit.

3.02 ACCEPTANCE

- A. Prior to final acceptance of the work, the Contractor shall certify the equipment and installation included under this section to be free of defects, and suitable for trouble-free operation under the conditions set forth in these specifications. This requirement is in addition to the manufacturer's guarantee.

3.03 SPARE PARTS

- A. Provide the Owner with a list of the manufacturers' recommended spare parts.

END OF SECTION 17137