APPENDIX F

TECHNICAL SPECIFICATIONS

SECTION 01652

PIPELINE PRESSURE TESTING

SECTION 01652
PIPELINE PRESSURE TESTING

PART 1 - GENERAL

1.1 SUMMARY

This Specification section covers the pipeline pressure testing associated with the Army's Groundwater Pump and Treat System Modification installation at the University Villages Project. The University Villages Project is located at former Fort Ord, California.

1.2 REFERENCES

The publications listed below shall form a part of this specification to the extent referenced and are referenced in the text by abbreviated designation only.

Manufacturers Standardization Society of Valve and Fitting Industry (MSS)
American Society of Mechanical Engineers (ASME)
American Water Works Association (AWWA)
American Society for Testing and Materials (ASTM)

PART 2 - PRODUCTS

Not Used

PART 3 – EXECUTION

3.1 HYDROSTATIC TESTING OF CARRIER PIPES

Carrier piping shall be visually inspected for mechanical completion and then hydrostatically pressure tested prior to being placed into service. Pressurizing equipment shall be equipped with a high pressure cut-out switch and/or high pressure water release valve that is field adjustable.

3.1.1 High Density Polyethylene Pipe

Underground pipe composed of high density polyethylene (HDPE) shall be partially covered with backfill. Welds, fittings, and flanges shall be left uncovered during pressure testing where feasible. For double-contained pipes, the annular space shall be left open to the atmosphere during the test sequence. The test sequence shall follow Paragraph 3.1.3 below.

3.1.2 Polyvinyl Chloride and Stainless Steel Pipe

Aboveground pipe composed of PVC and/or stainless steel pipe shall be adequately supported and secured with pipe clamps to support the weight and movement of the pipe and water. The test sequence shall follow Paragraph 3.1.3 below.

3.1.3 Hydrostatic Test Sequence

The hydrostatic test sequence includes the low pressure test, initial expansion, and test phase.

The pipeline, or portion of a pipeline, being tested shall be mechanically isolated and filled with potable water. High point valves shall be bled to minimize air entrainment. The water pressure in the pipe shall be initially raised to between 5 and 10 pounds per square inch gauge (psig). The pressurized section shall be inspected for leaks. Errors or omissions shall be corrected per manufacturer's requirements or the intended use of the pipeline before the isolated section is retested.

After the pipeline passes the low pressure test with zero leaks, the test section will be pressurized to the "Test Pressure" for the duration of "Initial Expansion Time" listed in Table 1. Makeup water may be added at 60-minute intervals for the HDPE, and 15-minute intervals for the PVC or stainless steel. The pressurized section shall be inspected for leaks. If the initial expansion duration exceeds the "Maximum Time" allowed, the pipe shall be allowed to rest at zero gauge pressure for at least 24 hours before retesting. If a leak is indicated by pressure or water loss, the isolated pipe section will be corrected per manufacturer's requirements or the intended use of the pipeline before the section is retested. Retesting shall commence with the low pressure test.

Table 1
Test Pressure for Various Piping Systems

Piping Description	Test Pressure (pounds per square inch gauge)	Initial Expansion		Test Phase	
		Time	Maximum Time	Time	Maximum Time
Extracted water pipeline – HDPE Carrier Pipe	100	3 hours	4 hours	1 hour	3 hours
Treated water pipeline – HDPE Pipe	100	3 hours	4 hours	1 hour	3 hours
Extracted Well Vault Pipe – Stainless Steel or PVC	150	15 min	4 hours	15 min	24 hours

After the pipeline passes the initial expansion time with zero leaks, the test section will be pressurized to the "Test Pressure" and "Test Phase Time" listed in Table 1. The test phase must immediately follow the initial expansion phase. Makeup water is allowed only at the end of the test. The pressurized section shall be inspected for leaks. If the test phase exceeds the "Maximum Time" allowed, the pipe shall be allowed to rest at zero gauge pressure for at least 24 hours before retesting. If a leak is indicated by pressure or water loss above those specified in Paragraph 3.1.4, the isolated pipe section will be corrected per manufacturer's requirements or the intended use of the pipeline before the section is retested. Retesting shall commence with the low pressure test.

3.1.4 Hydrostatic Pressure Test Passing Criteria

Allowable amounts of makeup water for expansion during the HDPE pressure test are presented in Table 2. The test results may also be adjusted for fluctuations in temperatures and materials of construction. If there are visible leaks or a significant pressure drop (greater than 2 percent) during the final test, the defective equipment shall be repaired or replaced and the pressurized section retested. The mechanical installer shall perform all rework as necessary to correct errors and omissions to bring the work into compliance with the specifications.

Table 2
Allowable Makeup Water Quantities for Expansion of
High Density Polyethylene (HDPE) Pipe*

Nominal Pipe Size (Inches)	Allowance for Expansion (US Gallons per 100 Feet of HDPE Pipe)		
	1-Hour Test	2-Hour test	3-Hour Test
3	0.10	0.15	0.25
4	0.13	0.25	0.40
6	0.30	0.60	0.90
8	0.50	1.0	1.5
10	0.75	1.3	2.1

* Values extracted from Driscopipe® HDPE manufacturing catalog. These allowances apply to the test phase and not to the initial expansion phase.

3.2 PRESSURE TESTING OF ANNULAR SPACE

Containment pipe shall be visually inspected for mechanical completion and then pressure or vacuum tested prior to being placed into service. This test is performed to identify damaged pipe or improper jointing by detecting whether air escapes or enters from an isolated section of pipe. The rate of air loss or gain will indicate the relative size of the damaged pipe and leaking joint. Pressurizing equipment shall be equipped with a high pressure cut-out switch and/or high pressure air release valve that is field adjustable.

Before testing the annular space in the double containment system, the primary piping shall be brought up to and held at a pressure equivalent to the containment pipe test pressure but less than the system test pressure listed above. This will reduce potential damage or erroneous test results caused by the collapse of the primary piping due to an external pressure differential.

3.2.1 Pneumatic Test Sequence

The annular space of the double containment system will be mechanically isolated, air pressurized to 5 psig for the initial expansion, and held for 60 minutes per 1,000 feet of

HDPE pipe. The temperature and pressure of the annular space sufficiently downstream of the air intake shall be monitored and logged during the test sequence. Makeup air may be added at 15-minute intervals and the pressurized section shall be inspected for leaks. If the initial expansion duration exceeds four hours, the pipe shall be allowed to rest at zero gauge pressure for at least 16 hours before retesting. If a leak is indicated by pressure loss, the isolated pipe section will be corrected per manufacturer's requirements or the intended use of the pipeline before the section is retested.

The test phase shall immediately follow the initial expansion phase. The temperature and pressure of the annular space sufficiently downstream of the air intake, and the outside air temperature shall be monitored and logged during the test sequence. The test section shall be maintained at 5 psig ±0.1 psi for one hour. Makeup air is allowed only at the end of the test. The pressurized section shall be inspected for leaks. If the test phase exceeds three hours, the pipe shall be allowed to rest at zero gauge pressure for at least 24 hours before retesting. Errors or omissions shall be corrected per manufacturer's requirements or the intended use of the pipeline before the isolated section is retested. Retesting shall commence with the initial expansion phase. If there are noticeable leaks or a significant pressure drop (greater than 5 percent) during any test, the pipeline, joints, or appurtenances shall be repaired or replaced and the pressurized section retested.

3.2.2 Pressure Test Passing Criteria

The air pressure test data shall be normalized for HDPE expansion, temperature differences and materials of construction. Pass criteria is a normalized pressure drop of less than 5 percent.

3.2.3 Test Record

All test data and results shall be recorded in field test logs or forms. All field records shall be maintained onsite and made available for inspection upon request by authorized parties.

END OF SECTION

SECTION 02224

EXCAVATION, TRENCHING, AND BACKFILLING

SECTION 02224
EXCAVATION, TRENCHING, AND BACKFILLING

PART 1 - GENERAL

1.1 SUMMARY

This Specification section covers the excavation, trenching, and backfilling associated with the Army's Groundwater Pump and Treat Modification conducted at the University Villages Project. The University Villages Project is located at former Fort Ord, California.

1.2 REFERENCES

The publications listed below shall form a part of this specification to the extent referenced and are referenced in the text by abbreviated designation only.

American Society for Testing and Materials (ASTM)

ASTM D1556	(1990) Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D1557	(1991) Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3)
ASTM D 2167	(1991) Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3)
ASTM D2216	Test Method for Laboratory Determination of water (Moisture) content of Soil, Rock, and Soil-aggregate Mixtures.
ASTM D2487	(1990) Classification of Soils for Engineering Purposes
ASTM D2922	(1991) Test Methods for Density of Soil and Soil Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D3017	(1996) Test Methods for Moisture Content of Soil and Soil Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 4318	Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
ASTM D 4643	Standard Test Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Method.

Occupational Safety and Health Administration (OSHA)

29 CFR 1926 Part P-Excavation, 29 CFR §1926.650, 651, 652 and Appendices

U.S. Army Corps of Engineers

EM 385-1-1 (Sept. 1996) *Safety and Health Requirements Manual*

1.3 DEFINITIONS

A. Cohesive Materials: Materials classified by the Unified Soil Classification System (USCS) as GC, SC, ML, CL, MH, and CH.

B. Cohesionless Materials: Materials classified by the USCS as GW, GP, SW, and SP.

C. Construction Quality Assurance (CQA) Laboratory: A laboratory capable of conducting the tests required by this specification. Also referred to as the Soils Laboratory.

D. Drain Rock: Rock and gravel fill placed for drainage of leachate.

E. Engineer: The individual or firm responsible for the design and preparation of the Project Contract Documents.

F. Optimum Moisture Content: Moisture content of soil at which the dry density of the soil is a maximum when compacted according to ASTM D 1557.

G. Percent Relative Compaction: Field dry density expressed as a percentage of the maximum dry density obtained by the test procedure presented in ASTM D 1557.

H. USCS: Unified Soil Classification System – ASTM D 2487

1.4 RECORD

The following data shall be maintained for record:

1.4.1 Test Reports

Laboratory and field test reports completed within 24 hours of the test completion.

1.4.2 Test Samples

Test samples per Paragraph 2.2.3 (submitted by borrow source 5 days prior to delivery to the project site).

1.5 QUALITY CONTROL

In-place density shall be tested by an independent laboratory by methods described in ASTM D2922, ASTM D1556, or ASTM D2167 to ensure that the roadway backfill and other fill have been properly compacted.

All excavation and trenching shall comply with the requirements of 29CFR1926, State of California requirements, and EM 385-1-1. When conflicts between regulations exist, the more stringent requirement shall apply.

PART 2 - PRODUCTS

2.1 SOURCE OF MATERIALS

Material shall be obtained from the excavation to the extent that suitable material is available, and from off-site sources, to the extent that suitable sources are not available.

2.1.1 Satisfactory Materials

Satisfactory materials shall consist of any chemical and contaminant free material from borrow sources or from the required excavation that have maximum particle size less than 3 inches and are free from excess moisture, organic matter, and debris. Satisfactory material within 4 inches of pipe or conduit shall additionally be compliant with Paragraph 2.2.1 and 3, below. To substantiate a chemical and contaminant free borrow source, the subcontractor/installer shall submit, as a minimum, a composite sample for every 1,000 cubic yards of borrow material to a California state-certified environmental laboratory for analysis of RCRA metals and volatile and semivolatile organic compounds, or show certification that the borrow material is free of the chemical substances based on laboratory analytical data.

2.1.2 Unsatisfactory Materials

Unsatisfactory materials are materials that do not comply with the requirements for satisfactory materials. Unsatisfactory materials include those materials containing roots and other organic matter, trash, debris, frozen materials, stones larger than 3 inches, and materials classified in ASTM D2487, including PT, OH, and OL. Unsatisfactory materials also include manmade fills, refuse, or backfill from previous construction.

2.1.3 Cohesionless and Cohesive Materials

Cohesionless materials shall include materials classified in ASTM D2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonelastic.

2.1.4 Unyielding Material

Unyielding material shall consist of rock and gravelly soils with stones greater than ½ inch in any dimension or as defined by the pipe manufacturer, whichever is smaller.

2.1.5 Unstable Material

Unstable material shall consist of materials too wet to properly support the utility pipe, conduit, or appurtenant structure.

2.2 MATERIALS

Initial and final backfill bedding around pipes or conduits shall consist of sand.

2.2.1 Sand Fill

Sand fill shall be graded sand within the following limits:

U.S. Standard Sieve	0.25-inch	No. 5	No. 200
Percent passing by weight	100	90 to 100	0 to 8

2.2.2 Aggregate Base Material

Aggregate base material (select granular material) shall consist of well-graded sand, gravel, crushed gravel, crushed stone, or crushed slag composed of hard, tough, and durable particles and shall contain 2 to 9 percent by weight of material passing a No. 200 mesh sieve and 100 percent by weight passing the 1-inch sieve.

2.2.3 Permeable Backfill Material

Permeable fill shall be clean, sound, and durable subrounded to rounded natural rock fragments containing no organic substances, anhydrite, gypsum, mica, calcareous, material, or other deleterious matter. Permeable fill shall be washed granitic, basic igneous, or quartzitic material, as approved by the on-site engineer. Particle size shall conform to the following gradation.

U.S. STANDARD SIEVE	PERCENT PASSING
1 inch	100
3/4-inch	90-100
3/8-inch	3-90
No. 4	0-3

Prior to delivery to the site, a minimum 25-pound sample of permeable fill shall be submitted for sieve testing and approval by the on-site engineer.

2.2.4 Rock

Rock shall consist of boulders measuring 0.5 cubic yard or more and materials that cannot be removed without systematic drilling and blasting, such as rock material in ledges, bedded deposits, unstratified masses and conglomerate deposits, and below ground concrete or masonry structures exceeding 0.5 cubic yard in volume, except that pavements will not be considered as rock.

2.3 PLASTIC MARKING TAPE FOR IDENTIFYING BURIED UTILITIES

Plastic marking tape placed in trenches to indicate the presence of buried utilities shall be acid and alkali-resistant polyethylene film, 4 or 6 inches wide with minimum thickness of 0.004 inch. Tape shall have a minimum strength of 1,750 pounds per square inch (psi) lengthwise and 1,500 psi crosswise. The tape shall be manufactured with integral wires, foil backing, or other means to enable detection by a metal detector when the tape is buried up to 3 feet deep. The tape shall be of a type specifically manufactured for marking and locating underground utilities. The metallic core of the tape shall be encased in a protective jacket or provided with other means to protect it from corrosion. Tape color shall be as specified below and shall bear a continuous printed inscription describing the specific utility.

Red:	Electric
Blue:	Water Systems

PART 3 - EXECUTION

3.1 EXCAVATION FOR PIPELINES

Check for underground obstructions. Hand excavate when within 2 feet of an obstruction. Excavation shall be performed to the lines and grades indicated on the drawings. Rock excavation shall include removal and disposition of material defined as rock in Paragraph 2.2.4 above. Blasting will not be permitted. During excavation, material satisfactory for backfilling shall be stockpiled in an orderly manner at a distance from the banks of the trench equal to one-half the depth of the excavation, but in no instance closer than 2 feet. Excavated material not required or not satisfactory for backfill shall be disposed on site. Grading shall be done as necessary to prevent surface water from flowing into the excavation, and any water accumulating therein shall be removed to maintain the stability of the bottom and sides of the excavation. Over excavation shall be backfilled in accordance with Paragraph 3.3, Backfilling and Compaction for Pipelines.

3.1.1 Trench Excavation

The trench shall be excavated as recommended by the manufacturer of the pipe to be installed. Trench walls below the top of the pipe shall be of such width and either sloped

or vertical as recommended in the manufacturer's installation manual. When no manufacturer's installation manual is available, trench walls shall be made vertical. Trench walls shall be shored, cut back to a stable slope, or provided with equivalent means of protection for employees who may be exposed to moving ground or cave in, in accordance with EM 385-1-1. Vertical trench walls more than 4 feet high shall be shored when occupied by a worker. Trench walls that are cut back shall be excavated to at least the angle of repose of the soil. Special attention shall be given to slopes that may be adversely affected by weather or change in moisture content. The trench width below the top of pipe shall not exceed 24 inches plus pipe outside diameter (O.D.) for pipes of less than 24 inches inside diameter (I.D.) and shall not exceed 36 inches plus pipe O.D. for sizes larger than 24 inches I.D. When recommended trench widths are exceeded, redesign, stronger pipe, or special installation procedures shall be utilized by the subcontractor/Installer. The subcontractor/Installer shall perform all rework as necessary to correct errors and omissions to bring work into compliance with specifications.

3.1.1.1 Bottom Preparation

The bottom of trenches shall be graded to provide uniform bearing and support for the bottom quadrant of each section of pipe and pipe appurtenances. Bell holes shall be excavated to necessary size at each joint or coupling to eliminate point bearing. Stones of 2 inches or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, shall be removed to reduce point loading.

3.1.1.2 Removal of Unyielding Material

When unyielding material is encountered in the bottom of the trench, such material shall be removed 4 inches below the required grade and replaced with suitable materials as provided in Paragraph 3.3, Backfilling and Compaction for Utilities.

3.1.1.3 Removal of Unstable Material

Where unstable material is encountered in the bottom of the trench, such material shall be removed to the depth directed and replaced to the proper grade with select granular material as provided in Paragraph 3.3, Backfilling and Compaction for Utilities. When removal of unstable material is required due to the fault or neglect of the Subcontractor/Installer in his performance of the work, the resulting material shall be excavated and replaced by the Subcontractor/Installer.

3.1.1.4 Excavation for Appurtenances

Excavation for manholes, catchbasins, inlets, or similar structures shall be of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown in construction drawings. Rock shall be cleaned of loose debris and cut to a firm surface either level, stepped, or serrated, as shown in construction drawings or as directed. Loose disintegrated rock and thin strata shall be removed. Removal of unstable material shall be as specified above. When

concrete or masonry is to be placed in an excavated area, special care shall be taken not to disturb the bottom of the excavation. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

3.1.1.5 Jacking, Boring, and Tunneling

Unless otherwise indicated, excavation shall be by open cut. Exception may arise for road crossings or barriers that may interfere with the excavation of the trench. In these instances sections of a trench may be jacked, bored, or tunneled if the pipe, cable, or duct can be safely and properly installed and backfill can be properly compacted in such sections.

3.1.1.6 Stockpiles

Stockpiles of satisfactory and unsatisfactory materials shall be placed and graded as specified. Stockpiles shall be kept in a neat and well drained condition, giving due consideration to drainage at all times. The ground surface at stockpile locations shall be cleared, grubbed, and sealed by rubber-tired or smooth-drum equipment. Excavated satisfactory and unsatisfactory materials shall be separately stockpiled. Stockpiles of satisfactory materials shall be protected from contamination that may destroy the quality and fitness of the stockpiled material.

3.2 EXCAVATION FOR STRUCTURES

3.2.1 Preparation and Layout

Establish extent of structural excavation by area and elevation; designate and identify the datum elevation. Set required lines, grades, and levels in accordance with the drawings and maintain benchmarks and other reference points.

3.2.2 Protection

Shoring, including sheet piling, shall be furnished and installed as necessary to protect workmen, banks, adjacent paving, structures, and utilities. Shoring, bracing, and sheeting shall be removed as excavations are backfilled in a manner that prevents caving. Excavation support systems shall be designed in accordance with OSHA Standards and interpretations.

3.2.3 Excavation

Excavations shall conform to dimensions and elevations indicated on drawings and shall include trenching for utility and foundation drainage systems to a point 5 feet beyond the structure or foundation. Excavations shall extend a sufficient distance from walls and footings for placing and removing forms. Excavations below indicated depths will not be permitted except to remove unsatisfactory material. Unsatisfactory material encountered below the grades shown shall be removed as directed and replaced with satisfactory

material. Satisfactory material shall be placed and compacted as specified in Paragraph 3.4, Backfilling and Compaction for Structures.

3.2.4 Drainage and Dewatering

Surface water shall be directed away from excavation and construction sites to prevent erosion and undermining of foundations. Equipment (such as pumps and hoses) and resources shall be provided to remove construction water from excavations and to control erosion. Diversion ditches, dikes, and grading shall be provided and maintained as necessary during construction. Excavated slopes and backfill surfaces shall be protected to prevent erosion and sloughing. Excavation shall be performed so that the site and the area immediately surrounding the site and affecting operations at the site shall be continually and effectively drained.

Groundwater flowing toward or into an excavation shall be controlled to prevent sloughing of excavation slopes and walls, boils, uplift, and heave in the excavation and to eliminate interference with orderly progress of construction.

3.2.5 Blasting

Blasting will not be permitted.

3.2.6 Utility Trenches

Trenches for underground utility systems shall be excavated to the required alignments and depths in accordance with Paragraphs 3.1 and 3.3 of this specification.

3.2.7 Final Grade of Surfaces to Support Concrete

Excavation to final grade shall not be made until just before concrete is to be placed for cast-in-place concrete structures. Approximately level surfaces shall be roughened, and sloped surfaces shall be cut as indicated on the drawings into rough steps or benches to provide satisfactory bond.

3.2.8 Subgrade Preparation

Unsatisfactory material in surfaces to receive fill or in excavated areas shall be removed and replaced with satisfactory materials. When subgrades are less than the specified density, the ground surface shall be broken up to a minimum depth of 6 inches, pulverized, and compacted to the specified density. The surface shall be scarified to a depth of 6 inches before the fill is started. Sloped surfaces steeper than 1 vertical to 4 horizontal shall be plowed, stepped, benched, or broken up so that the fill material will bond with existing material. When the subgrade is part fill and part excavation or natural ground, the excavated or natural ground portion shall be scarified to a depth of 12 inches and compacted as specified for the adjacent fill. Material shall not be placed on surfaces that are muddy, frozen, or contain frost. Compaction shall be accomplished by

sheepfoots rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted. Material shall be moistened or aerated as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used. Minimum subgrade density shall be as specified in Paragraph 3.4.

3.3 BACKFILLING AND COMPACTION FOR UTILITIES

Backfill material shall consist of satisfactory material, select granular material, permeable fill, or initial backfill material as required. Backfill shall be placed in layers not exceeding 24 inches loose fill around pipe, unless otherwise specified. If further consolidation is noted within two days of final backfilling, additional material lifts will be added and compacted to bring the trench to final grade.

3.3.1 Trench Bedding

The trench shall be sand backfilled and compacted to at least 85-percent degree of compaction. This initial, compacted backfill shall be a minimum of 3 inches in depth and allow the pipe to rest on this surface without excessive bridging. The independent testing lab will test for 85 percent degree of compaction by the methods set forth in Paragraph 3.3.6.

3.3.2 Pipe Backfill and Pressure Test

After placement of the pipe, backfill prior to pressure testing. Leave the joints and couplings uncovered during the pressure test. After successfully completing the pressure test, sand backfill the pipeline. The backfill shall be compacted evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to ensure adequate compaction of the fill under the haunches of the pipe.

3.3.3 Replacement of Unyielding or Unstable Material

Unyielding material removed from the bottom of the trench shall be replaced with select granular material or initial backfill material. Unstable material removed from the bottom of the trench or excavation shall be replaced with select granular material placed in layers not exceeding 12 inches loose thickness.

3.3.4 Final Backfill

Final backfill will only be performed in areas where surface traffic by vehicles, including public transportation, is necessary for pipe installation or removal, or where matching pre-disturbed ground conditions is required. To complete final backfill, the remainder of the trench, except for special materials for roadways, shall be filled with satisfactory material. Backfill material shall be placed and compacted as follows:

a. Roadways. Backfill shall be placed and compacted to the elevations where shown on

the project drawings. Road backfill will be compacted to a 95 percent degree of compaction. Compaction of native sand or sand backfill by water flooding or jetting is permitted as long as there is proper drainage. The backfill shall be deposited in layers a maximum of 12-inch loose thickness.

b. Sidewalks. Sidewalk areas will be compacted to a 90 percent degree of compaction. Compaction of native sand or sand backfill by water flooding or jetting is permitted as long as there is proper drainage.

c. Turfed or Seeded Areas and Miscellaneous Area. Turfed or seeded areas and miscellaneous areas will be compacted to an 85 percent degree of compaction. Compaction of native sand or sand backfill by water flooding or jetting is permitted as long as there is proper drainage. This requirement shall also apply to all other areas not specifically designated above.

3.3.5 Backfill for Appurtenances

After any cast-in-place concrete vault structure has been constructed and the concrete has been allowed to cure for 3 days, backfill shall be placed in such a manner that the structure will not be damaged by the shock of falling earth. The backfill material shall be deposited and compacted as specified for final backfill and shall be brought up evenly on all sides of the structure to prevent eccentric loading and excessive stress.

3.3.6 Compaction Testing

3.3.6.1 Material Requiring Less Than 90 Percent Degree of Compaction

Lifts of material shall be compacted in a consistent manner and tested with a nuclear moisture density gauge per ASTM D2922 and ASTM D3017. A minimum of one nuclear density test per 100 cubic yards of backfill shall be performed. Density sand cone tests shall be performed one per 1,000 cubic yards of backfill.

3.3.6.2 Material Requiring 90 Percent or Greater Compaction

Material requiring 90 percent or greater compaction, such as under roads or structures, regular testing of lifts, is required. Nuclear moisture density gauges will be used to determine the degree of compaction. Material will be recompacted until a result of 90 percent or more is reached. For every 10 passing nuclear gauge tests, one sand cone test shall be performed per ASTM D1556. Testing will be done in a manner that will ensure the entire vertical profile of the lift is tested (i.e., the top 6 inches of a 24-inch lift will be removed to allow an 18-inch probe to test the lower 6 inches of the lift).

3.4 BACKFILLING AND COMPACTION FOR STRUCTURES

Satisfactory materials shall be placed to the lines and grades as indicated and for replacing unsatisfactory materials. When existing subgrades are less than the specified

density, the ground surface shall be broken up to a minimum depth of 6 inches, pulverized, and compacted to the specified density. Satisfactory materials shall be placed in horizontal layers not to exceed 12 inches in loose thickness. After placing, each layer shall be plowed, disced, or otherwise broken-up; moistened or aerated as necessary; and thoroughly mixed and compacted as specified. The independent testing lab shall test for compaction by the method stated in Paragraph 3.6. Backfilling shall not begin until construction below finish grade has been approved; underground utility systems have been inspected, tested, and approved; forms removed; and the excavation cleaned of trash and debris. Backfill shall be brought to indicated finish grade. Backfill shall not be placed in wet or frozen areas. When pipe is coated or wrapped for protection against corrosion, the backfill material, up to an elevation of 1 foot above other utility lines which are not wrapped or coated, shall be free from stones larger than 1 inch in any dimension. Backfill shall be placed carefully around pipes to avoid damage to coatings or wrappings.

Type and Area	**Percent Laboratory Maximum Density**	
	Cohesive Material	**Cohesionless Material**
Fill, embankment, and backfill under concrete structures, sidewalks, paved areas.	90%	90%
Under grassed areas	85%	90%
Existing subgrade under asphalt-paved areas (top 6 inches)	95%	95%

Approved compacted subgrades that are disturbed by pipe installation operations or adverse weather shall be scarified and compacted as specified herein to the required density prior to further construction. Recompaction of underground utilities shall be by hand tamping.

If further consolidation is noted within two days of final backfilling, additional lifts shall be added and compacted to bring the surface to final grade.

3.5 SPECIAL REQUIREMENTS

Special requirements for both excavation and backfill relating to the specific utilities are identified in the following paragraphs.

3.5.1 Water Lines

Trenches shall be excavated to provide a minimum cover of 36 inches or as stated in the drawings from the existing ground surface to the top of the pipe.

3.5.2 Electrical Distribution System

Direct burial of electrical or instrumentation lines shall have a minimum cover of 24-inches from the finished grade. If the electrical and instrumentation lines are placed in a PVC pipe, the top of the pipe must be at least 18 inches from the finished grade.

3.5.3 Plastic Marking Tape

The warning tape(s) shall be installed above the compacted sand and directly above the pipe, at a depth of 12 inches below finished grade unless otherwise shown on the drawings.

3.6 TESTING

3.6.1 Testing Facilities

Tests shall be performed by an approved independent testing laboratory .

3.6.2 Testing of Backfill Materials

Characteristics of backfill materials shall be determined. A minimum of one particle size analysis and one moisture-density relation test shall be performed on each different type of material used for bedding and backfill.

3.6.3 Field Density Tests

Tests shall be performed within roadway crossings and under structures to ensure that the specified density is being obtained. A minimum of one field density test per 20 cubic yards of backfill and a minimum of one test per roadway crossing shall be performed. One moisture density relationship shall be determined for every 1,500 cubic yards of material used. Field density testing shall be performed in accordance to ASTM D1556, ASTM D2922, or ASTM D2167.

Trenches, backfill, or fill improperly compacted shall be reopened to the depth directed, then refilled and compacted to the density specified.

3.6.4 Moisture Content

In the stockpile, excavation, or borrow areas, a minimum of two tests per day per type of material or source of materials being placed is required during stable weather conditions. During unstable weather conditions, tests shall be made as dictated by local conditions. Moisture content shall be determined in accordance with ASTM D2216 or ASTM D3017.

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3.6.5 Optimum Moisture and Laboratory Maximum Density

Tests shall be made for each type of material or source, including borrow material that will be used for structures to determine the optimum moisture and laboratory density

values. One representative test per 1,500 cubic yards of fill or backfill or when any change in material occurs that may affect the optimum moisture content or laboratory maximum density. Optimum moisture and laboratory maximum density shall be determined in accordance with ASTM D1557.

END OF SECTION

SECTION 02670

ROTARY DRILLED EXTRACTION WELLS

SECTION 02670
ROTARY DRILLED EXTRACTION WELLS

PART 1 - GENERAL

1.1 REFERENCES

The publications listed below shall form a part of this specification to the extent referenced and are referenced in the text by abbreviated designation only.

American Society for Testing and Materials (ASTM)

ASTM C136 (1995) Sieve Analysis of Fine and Coarse Aggregates

ASTM C150 (1995) Portland Cement

ASTM D1784 (1996) Rigid Poly Vinyl Chloride (PVC) Compounds and Chlorinated Poly Vinyl Chloride (CPVC) Compounds

ASTM D2488 (1993) Description and Identification of Soils (Visual-Manual Procedure)

ASTM F480 (1994) Thermoplastic Well Casing Pipe and Couplings Made in Standard Dimension Ratios (SDR) Schedule 40 and Schedule 80

Driscoll Manufacturer's Information

DRISCOLL (1986) Groundwater and Wells, Johnson Filtration Systems

1.2 Record

The following data shall be maintained for record:

1.2.1 Records/ Permits

All permits required for drilling.

A well as-built drawing and lithologic log for each well installed. As a minimum, the log shall include depths, elevations, and descriptions of all formations encountered; identification of each stratum according to the Unified Soil Classification System or standard rock nomenclature, as necessary, and depths at which groundwater is encountered; and lithologic logs will be prepared using ASTM Method D2488, and be completed under the supervision of a California Registered Geologist. Soil grab samples shall be collected from the cyclone discharge a minimum of every 5 feet of bit penetration.

1.3 GENERAL REQUIREMENTS

The Subcontractor (hereinafter also referred to as the driller) shall provide each system complete and ready for operation. Each system, including equipment, materials, installation, and workmanship, shall be in accordance with industry standards for environmental applications. Well construction permits will be obtained from the Monterey County Department of Health, Environmental Health Division.

1.4 ENVIRONMENTAL PROTECTION

The Subcontractor shall take all precautions as may be required to prevent contaminated water or water having undesirable physical or chemical characteristics from entering the water supply stratum through the well bore or by seepage from the ground surface. The Subcontractor also shall take all precautions necessary to prevent contamination of the ground surface or of surface waters resulting from drilling of the test hole or well. Any borings made that are not completed for whatever reason will be plugged and abandoned in accordance with State Regional Water Quality Control Board requirements for well abandonment.

1.5 DELIVERY, STORAGE, AND HANDLING

The Subcontractor shall deliver material in an undamaged condition. Store materials off the ground to provide protection against oxidation and possible contamination caused by ground contact. The Subcontractor shall replace defective or damaged materials with new materials.

PART 2 - PRODUCTS

2.1 MATERIALS

All materials shall conform to the respective specifications and other requirements as specified herein.

2.1.1 Casing

All extraction well casings shall consist of either 6-inch or 10-inch nominal inside diameter (I.D.), flush threaded, schedule 80 polyvinyl chloride (PVC) pipe. Casings for piezometers shall consist of 1.5-inch nominal I.D. and sand tubes shall consist of 1-inch nominal I.D., flush threaded, schedule 40 PVC pipe. All PVC casings shall conform to ASTM D1784 and ASTM F480.

2.1.2 Well Screens

Extraction well screens shall be stainless steel, type 304, and 6- inch nominal I.D., as shown on the construction drawings. The well screens shall be directly connected to the

bottom of the casing by a flush threaded joint. Extraction well screen lengths shall be based on aquifer thicknesses measured in the field. However, approximate well screen completion intervals are shown in attached documents. Extraction well screen openings shall be 0.045 inch. Piezometer screens shall be 1.5-inch nominal I.D., schedule 40 PVC with machine slotted 0.020-inch slot width. Extraction well screens shall be wire-wrapped, with the outer wire welded to an internal structure. The wire shall be V-shaped in cross section, so the slots between the wire widen inwardly to minimize clogging. The outside width of the slots shall be 0.045 inch. All stainless-steel screens shall conform to ASTM A312. All PVC screens shall conform to ASTM D1784 and ASTM F480. The screen and all accessories required shall be standard products from manufacturers regularly engaged in the production of such equipment. Field constructed screen is not acceptable.

2.1.3 Sand Pack

Sand pack sand shall be a product of a commercial sand and gravel manufacturer and shall be properly sized and graded and be composed of round, hard, waterworn siliceous sand, free of flat or elongated pieces, organic matter, or other foreign matter. Sand pack sand used for the extraction well shall pass through the number 8 standard sieve and be 100 percent retained by the number 16 sieve when tested by ASTM C136 (Lonestar 8/16 or equivalent).

2.1.4 Bentonite Seal

The bentonite seal shall consist of a mixed slurry, bentonite chips, or bentonite pellets prepared per manufacture's specifications. The levels of hazardous constituents in the bentonite shall be below Resource Conservation Recovery Act Toxicity Characteristic Leachate Procedure limits.

2.1.5 Cement/Bentonite Grout

Cement/bentonite grout shall consist of Portland cement conforming to ASTM C150, Type I or II, sand, bentonite, and water. Cement grout shall be proportioned not to exceed 6 gallons of water per cubic foot of cement, with a mixture of such consistency that the well can be properly grouted. Between 3 to 5 percent by weight bentonite powder will be added to reduce shrinkage.

2.1.6 Bottom Sump

The bottom sump shall consist of 5 feet of blank schedule 80 PVC casing as specified in Section 2.1.1, capped by a PVC end cap.

2.1.7 Centralizers

Stainless-steel or PVC well centralizers shall be used to stabilize the well assembly in the center of the borehole. One centralizer shall be located below the well screen at the

bottom sump, and the second shall be located immediately above the top of the well screen. Stainless steel centralizers shall be placed at 40-foot intervals along the well casing. Stainless steel standoffs shall be used to separate the piezometer and well screen from coming in contact; a minimum 1-inch standoff is required.

PART 3 - EXECUTION

3.1 WELL CONSTRUCTION

Boreholes shall be drilled using either air rotary casing hammer (ARCH) or direct circulation mud rotary drilling methods or both. Borehole diameters shall be of sufficient size to allow each well assembly to be placed with sufficient annulus to place the sand pack. Three assemblies will be installed in each extraction well. The assemblies well are: a 6- nominal I.D. extraction well casing/screen assembly; a 1.5-inch I.D. piezometer casing/screen assembly; and a 1-inch nominal I.D. sand tube.

3.1.1 Drilling

Work shall be performed using either an ARCH or direct circulation mud rotary drilling rig capable of drilling a 16-inch diameter boring. The all equipment shall be securely mounted on the rig. Rigs that require a man to climb the mast and attach a cable to the hammer will not be allowed. Rigs shall include a casing puller capable of applying at least 200,000 pounds of pull. Backhammering the casing and other unsafe casing extraction methods will not be allowed. Temporary drive casings shall be smooth wall threaded casing with water tight connections. Casing strength shall be rated at a minimum of 100,000 pounds per square inch. No cutting or welding of casing will be allowed.

Drilling using direct circulation mud rotary method shall utilize a drilling fluid that will not cause deleterious effects to the groundwater or aquifer formation. The drilling fluid shall be easily removed during well development, and not cause a lowering of the aquifer hydraulic conductivity.

3.1.2 Decontamination

All equipment that may contact the interior of a borehole or that may contact other equipment that will enter the hole (including, but not limited to drill rods, drive casing, bits, and tools) shall be thoroughly cleaned by the subcontractor and monitored by the Shaw Field Representative. The subcontractor will be responsible for the mobilization, operation, and demobilization of a decontamination station. Decontamination begins when the rig is demobilized from a drill site. In the event that a decontamination pad is unavailable, rig downtime will not be charged.

The decontamination pad(s) shall be durable, portable, and capable of supporting all equipment to be decontaminated without risk of damage resulting in loss of rinsate, and

shall contain all decontamination fluids for collection and placement in a tank supplied by Shaw . Decontamination pads made of plastic and earth, or other temporary structures, shall not be used. Shaw will designate an area, equipped with power and potable water, for the decontamination station(s).

All downhole drilling and development equipment will be: 1) cleaned of caked drill cuttings, soil or other material using a brush; 2) steam cleaned using a hot water, high pressure washer; and 3) rinsed with potable water prior to its use downhole, and between boreholes. The subcontractor will supply steam cleaners and brushes.

Between drilling sites, the drilling rig will be decontaminated following the procedure outlined above. Between boreholes at the same site, the back-end of the drilling rig will be scrubbed and washed with potable water until surfaces are visibly free of soil buildup.

After cleaning and decontamination, all tool and drilling equipment which may be used downhole must be kept clean and free of contaminants. Decontaminated equipment shall be kept off the ground by storing on clean metal racks (not wooden pallets) and wrapped in plastic.

All well materials, exclusive of sand pack, bentonite, and grout, shall be decontaminated before placement into the borehole as described above. Following decontamination, all materials shall be placed on clean metal racks or clean plastic sheeting. If materials are not used immediately, they shall be wrapped or covered with clean plastic sheeting.

3.1.3 Well Construction

Wells will be constructed inside the drive casing which shall be driven to depth, or a stable direct circulation mud rotary drilled boring. The screen and well casing, fitted with sediment trap and end cap, will be suspended in the center of the borehole so that the screen interval occurs at a depth acceptable to the field representative. The depth of all materials placed in the well will be measured as directed by the field representative. The sand pack material for the extraction wells will be placed through the drive casing to an elevation approximately 3 feet above the top of the well screen. If used, the drive casing will slowly be removed from the borehole as the sand pack is placed around the screen. The drive casing will never be pulled higher than 2 feet below the top of the sand pack during installation. During placement of the sand pack, frequent measurement of the top of the sand pack shall be made to assure that the bottom of the drive casing is never above the top of the sand pack. For direct circulation rotary drilled borings, the sand shall be placed using a tremie pipe from the bottom of the borehole, displacing the drilling fluid as it is placed. Prior to placing the bentonite seal, the filter pack will be carefully surged and then remeasured to assure correct sand pack placement. If necessary, additional sand pack material will be added to assure correct sand pack position. A transitional filter pack, consisting of a smaller grain size, will be placed above the primary filter pack to prevent bentonite seal intrusion into the sand pack.

A 3- to 5-foot thick bentonite seal will be placed above the top of the sand pack.

Bentonite slurry, chips, a 50-50 mixture of granular bentonite and No. 60 size sand or pellets will be used as the seal. If a bentonite slurry is used it will be tremied into the annulus of the borehole and allowed to set for a minimum of one hour to allow for setting and settling prior to grouting. If bentonite chips or pellets are used they will be hydrated (with potable water if placed above the water table) and allowed to set for a minimum of one hour to allow for proper hydration. The depth to the seal will be remeasured following setting to and topped-off if settling has occurred.

Following placement of the bentonite seal, the remainder of the borehole annulus will be backfilled with a grout mix. The grout will be placed in the borehole using a tremie pipe and filled from the bottom up. During grouting operations the tremie pipe and drive casing will not be lifted higher than the top of the grout plug. Grout will be as specified in Section 2.1.5 above.
After the well has been grouted to the surface or the specified well vault depth, the grout will be allowed to set up and settle. If the grout plug settles, it will be topped-off before well vaults will be constructed.

3.2 WELL DEVELOPMENT

Following construction, each well will be developed to maximize yield and minimize turbidity of the water. Air rotary casing hammer drilled wells will be developed using a bailer and a vented surge block, and submersible pump. Well development will not commence until the cement-bentonite grout has been in place and allowed to set up for at least 24 hours.

Direct circulation mud rotary drilled wells will be developed to remove all residual drilling fluid. Once all traces of the drilling fluid are gone, the well will be developed using a bailer and a vented surge block, and submersible pump. Well development will not commence until the cement-bentonite grout has been in place and allowed to set up for at least 24 hours.

Extraction wells will be developed by alternately surging with a vented surge block and bailing. Care shall be taken so as not to dislodge the well end plug during surging and bailing. Wells will be bailed prior to surging to remove debris. Following bailing, the well will be carefully surged for a minimum of 15 minutes. During well surging, the vented surge plug will be placed at different depths in the well to expedite the well development. If this development technique does not produce satisfactory results within one hour, then pumping the well with a submersible pump may be conducted. Restraint will be used when developing with a submersible pump so as not to overpump the well and plug the sand pack. Additives and dispersing agents may not be used during well development.

During well development a sample of the purged water will be collected for measurement of turbidity, pH, temperature, and specific conductance. A water meter will be used to measure total gallons removed from the well. The well will be considered adequately developed when pumped at 125 percent of the anticipated production flow rate or

50 gallons per minute (gpm), whichever is greater, and the water produced is sand free clear and the pH, temperature, and specific conductance have stabilized (±5 percent). In some instances it may not be possible or practical to pump a well at 125 percent of its anticipated production flow rate, due to limited water storage capacity. In this case, the flow rate shall be 50 gpm. If mud rotary drilling is used a mud additive will be used to assist in dispersing the mud from the interstitial spaces in the formation. Use of mud dispersants will only be used at the direction of the Shaw Field Representative.

Specific capacity tests will be run on all newly installed wells. The well development rig will be used for this task. The rig will be equipped with a constant flow pump. Specific capacity tests will not be run until water levels are static. During the test, a stable drawdown will be maintained for a period of at least 10 to 20 minutes. The development rig and equipment will be decontaminated between wells.

3.3 WASTE DISPOSAL

Wastes will be kept separate by type (i.e., drill cuttings and fluids will not be mixed with wastewater). Wastes generated on-site may be transported as necessary or as recommended by the field representative. Any surface release of contaminants caused by inadequate drilling and waste handling procedures shall be promptly cleaned up.

END OF SECTION

SECTION 02671

INFILTRATION GALLERY

SECTION 02671
INFILTRATION GALLERY

PART 1 - GENERAL

1.1 SUMMARY

This Specification section covers infiltration gallery installation associated with the Army's Groundwater Pump and Treat System Modification conducted at the University Villages Project. The University Villages Project is located at former Fort Ord, California.

1.2 REFERENCES

The publications listed below shall form a part of this specification to the extent referenced and are referenced in the text by abbreviated designation only.

American Society for Testing and Materials (ASTM)

ASTM D1777 (1996) Standard Method for Measuring Thickness of Textile Materials

ASTM D3776 (1996) Standard Test Method for Mass Per Unit Area (Weight) of Woven Fabric

ASTM D3786 (1987) Standard Test Method for Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics-Diaphragm Bursting Strength Tester Method

ASTM D4533 (1991) Standard Test Method for Trapezoid Tearing Strength of Geotextiles

ASTM D4632 (1986) Standard Test Method for Grab Breaking Load and Elongation of Geotextiles

ASTM D4751 (1999) Standard Test Method for Determining Apparent Opening Size of a Geotextile

1.3 RECORD

The following data and drawings shall be maintained for record:

1.3.1 A composite boring as-built drawing and lithologic log for each infiltration gallery will be submitted. As a minimum, the log shall include depths, elevations, and descriptions of all formations encountered; identification of each stratum according to the Unified Soil Classification System or standard rock nomenclature, as necessary, and depths at which groundwater is encountered; and lithologic logs will be prepared using ASTM Method D2488, and be completed under the supervision of a California Registered Geologist.

Soil grab samples shall be collected from the cyclone discharge a minimum of every 5 feet of bit penetration.

1.3.2 Permeable fill gradation data, as per Paragraph 2.4 of this specification.

1.3.3 Manufacturer's Catalog Data

Manufacturer's information regarding materials of construction. This shall include geotextile, vault boxes, and other materials of construction.

1.3.4 Drawings

As-built drawings of precast concrete vault, including concrete vault cover.

PART 2 - PRODUCTS

2.1 PRECAST CONCRETE VAULT

The precast concrete vault shall be 4 by 4 by 12 feet and able to withstand a hydraulic load of 1,400 gallons of water. The concrete vault may be comprised of one or more sections. Eight knockouts or blockouts (two on each side of the vault) for 4-inch diameter pipes shall be provided 3 feet from the bottom of the vault as shown on the drawings. One knockout or blockout for a 6-inch diameter pipe shall be provided, 3 feet 6 inches from the top of the gallery, on one side of the gallery as shown on the drawings. A 2-foot diameter concrete vault cover shall also be provided. A 4-inch diameter knockout or blockout shall be located on the concrete vault cover.

2.2 GEOTEXTILE

Geotextile used to prevent fines from entering the permeable fill will be nonwoven, needle-punched, polypropylene fabric, Mirafi 160N^{TM} as manufactured by Mirafi, or an approved equivalent. Fabric will be of uniform thickness and surface texture. Typical properties, within ±5 percent, will be as follows:

Property	Values	Test Method
Weight (oz/yd^2)	6.0	ASTM D3776
Thickness (mils)	75	ASTM D1777
Grab Strength (lbs)	150	ASTM D4632
Elongation at Break (%)	50	ASTM D4632
Trapezoidal Tear Strength (lbs)	60	ASTM D4533
Mullen Burst Strength (psi)	325	ASTM D3786
Equivalent Opening Size (U.S. Standard Sieve)	100 or Larger	ASTM D4751

2.3 BACKFILL

Backfill material shall meet the specifications set forth in Specification 02224, Excavation, Trenching, and Backfilling, and project drawings.

2.4 PERMEABLE FILL

Permeable fill shall be clean, sound, and durable subrounded to rounded natural rock fragments containing no organic substances, anhydrite, gypsum, mica, calcareous material, or other deleterious matter. Permeable fill shall be washed granitic or quartzitic material. Particle size shall conform to the following gradation.

U.S. Standard Sieve Size	Percent Passing
1 inch	100
3/4-inch	90 - 100
3/8-inch	3 - 90
No. 4	0- 3

2.5 SELECT AGGREGATE MATERIAL

Select granular material used for the concrete vault base shall consist of well-graded sand, gravel, crushed gravel, and crushed stone composed of hard, tough, and durable particles. It shall contain 2 to 9 percent by weight of material passing a No. 200 mesh sieve and 100 percent by weight passing the 1-inch sieve.

PART 3 - EXECUTION

Installation shall include drilling soil borings through the water table; excavation and backfilling of infiltration gallery area; and installation of geotextile wrap, permeable fill, slotted screen piping, precast concrete vault, and all necessary piping. All underground utilities in the area of excavation shall be located and marked prior to drilling.

3.1 DRILL POINTS

Soil borings shall be drilled using an air rotary casing hammer drill rig to below the groundwater table at the locations as indicated on the project drawings. The drill points shall be backfilled with permeable fill material from the bottom of the borehole to the surface. The boreholes shall be logged by the well site geologist in accordance with Specification Section 02670, Rotary Drilled Extraction Wells.

3.2 EXCAVATION

Soil excavation for gallery surface preparation shall be in accordance with Specification Section 02224, Excavation, Trenching, and Backfilling, to lines and grades indicated on project drawings.

3.3 INSTALLATION OF INFILTRATION GALLERY

The concrete vault shall be installed per manufacturer's specification. If the vault is multisectional, seal all joints with a manufacturer's approved watertight sealant. Knock out all areas as appropriate for pipeline installation.

Two feet of permeable fill shall be placed around the infiltration gallery vault and piezometers to the lines and grade indicated on project drawings. Care shall be taken in the placement of the permeable fill so as not to damage the piezometers.

Prior to the installation of the slotted polyvinyl chloride (PVC) piping and permeable backfill, the PVC piezometers shall be installed at the locations indicated on project drawings. The piezometers shall be installed at a depth equivalent to the bottom of the infiltration gallery. The slotted PVC piping shall be installed as indicated on project drawings and in accordance with Specification Section 15060, Piping, Valves, and Appurtenances. Precast concrete blocks (6 by 6 by 24 inches) shall be placed under each slotted PVC pipe approximately 2 feet from the end of the pipe. Care shall be taken so as not to damage the pipe.

The remaining permeable fill shall be placed in the infiltration gallery to the lines and grade indicated on project drawings. The geotextile cover shall be installed as indicated. The geotextile shall be held to the concrete vault and piezometers with stainless steel strapping.

Prior to the installation of the conveyance piping, native backfill shall be placed as indicated and in accordance to Specification Section 02224, Excavation, Trenching, and Backfilling.

The conveyance piping and the piping within the infiltration gallery vault shall be installed as indicated and in accordance with Specification Section 15060, Piping, Valves, and Appurtenances. Corrosion resistance shims shall be used to support PVC piping within the infiltration gallery vault.

Final backfill shall be placed to the lines and grades indicated and in accordance to Specification Section 02224, Excavation, Trenching, and Backfilling.

END OF SECTION

SECTION 03302

CAST-IN-PLACE AND PRECAST CONCRETE STRUCTURES

SECTION 03302
CAST-IN-PLACE AND PRECAST CONCRETE STRUCTURES

PART 1 - GENERAL

1.1 SUMMARY

This Specification section covers concrete structures associated with the Army's Groundwater Pump and Treat System Modification conducted at the University Villages Project. The University Villages Project is located at former Fort Ord, California.

1.2 REFERENCES

The publications listed below shall form a part of this specification to the extent referenced and are referenced in the text by abbreviated designation only.

American Concrete Institute (ACI)

ACI 301	1999 Specifications for Structural Concrete
ACI 304R	2000 Guide for Measuring, Mixing, Transporting and Placing Concrete
ACI 305R	1999 Hot Weather Concreting
ACI 306R	1988(R2002) Cold Weather Concreting
ACI 306.1	1990(R2002) Standard Specification for Cold Weather Concreting
ACI 318/318R	2002 Building Code Requirements for Structural Concrete and Commentary
ACI 347R	2003 Guide to Formwork for Concrete

American Society for Testing and Materials (ASTM)

ASTM C 31/C31M	2003A Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C 33	2003 Specification for Concrete Aggregates
ASTM C 39/C39M	2004A Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C 42/C42M	2004 Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C 94/C94M	2004A Specification for Ready-Mixed Concrete

ASTM C 143/C143M	2003 Test Method for Slump of Hydraulic Cement Concrete
ASTM C 150	2004A E1 Specification for Portland Cement
ASTM C 231	2004 Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 494/C494M	2004 Specification for Chemical Admixtures for Concrete
ASTM A615/A615M	2004B Specification for Deformed and Plain Carbon Steel Bars For Concrete Reinforcement
ASTM C 618	1994 Fly Ash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete
ASTM A675/A675M	2003 Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties
ASTM C 857	2001 Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
ASTM C 858	2004 Standard Specification for Underground Precast Concrete Utility Structures
ASTM C 891	2003 Standard Practice for Installation of Underground Precast Concrete Utility Structures
ASTM C 1037	2002 Standard Practice for Inspection of Underground Precast Concrete Utility Structures

U.S. Department of Commerce

PS 1	Construction and Industrial Plywood
PS 20	American Softwood Lumber

1.3 RECORD

Manufacturer and/or supplier shall submit the following for approval and record purposes:

1.3.1 Certificates for Cast-in-Place Concrete

a. Concrete mix design -including data sheets for cement, admixtures, and aggregate, at least 14 days prior to commencing placement of concrete.

b. Delivery Tickets-submit with each concrete load delivered to job site. Ticket shall include strength of concrete, number of pounds of cement, size of coarse aggregate, batching time, slump ordered, and amount and types of admixture.

c. Mill Certificates for all reinforcing steel

1.3.2. Test Results for Cast-in-Place Concrete

Concrete test results for slump, air entrainment, and compression shall be submitted by an independent concrete testing laboratory.

1.3.3. Product Data for Precast Concrete

a. Cut sheets showing conformance to project drawings and requirements and applicable standard specifications listed in this specification shall be submitted. The precast concrete supplier shall certify that the products will meet the applicable requirement of the specification.

b. Supporting calculations and design details shall be made available by the precast concrete supplier upon request. The precast concrete supplier shall warrant that the products will meet the specification requirements.

1.3.4. Shop Drawings for Precast Concrete

Shop drawings for precast concrete structures shall show all dimensions, weights, locations and sizes of openings, reinforcement details (where required), and associated installation details. Details of steel reinforcement size and placement as well as supporting design calculations, where appropriate, shall also be included. The precast concrete structures shall be produced in conformance to the shop drawings as approved.

1.4 GENERAL REQUIREMENTS

1.4.1 Delivery, Storage, and Handling

For cast-in-place concrete, do not deliver concrete until ready for concrete placement. Store concrete aggregates to prevent contamination or segregation. Store reinforcement and forming materials of different sizes and shapes in separate piles or racks raised above the ground to avoid damage and excessive rusting. Protect from contaminants such as grease, oil, and dirt. Provide for accurate identification after bundles are broken and tags are removed.

Precast products shall be stored, handled, shipped, and unloaded in a manner to minimize damage. Lifting holes or inserts shall be consistent with industry standards. Lifting shall be accomplished with methods or devices intended for this purpose.

1.4.2 Hot Weather Cast-in-Place Concrete

Hot weather concrete placement shall be in strict accordance with ACI 305R. Maintain moist subgrades or lay waterproof sheathing paper on subgrade to prevent water extraction from concrete. At time of placement, mix temperature shall not exceed 90˚F.

1.4.3 Cold Weather Cast-in-Place Concrete

Cold weather concrete placement shall be in strict accordance with ACI 306R and 306.1. When ambient temperature is below 40˚F, mix temperature shall not be less than 50˚F or more than 70˚F at time of placement.

PART 2 - PRODUCTS

2.1 CONCRETE

2.1.1 Concrete Mix Design

ACI 301, except as modified herein. Unless indicated otherwise, concrete shall have a 28-day compressive strength of 3000 pounds per square inch. Slump shall be between 2 inches and 4 inches in accordance with ASTM C143. Provide ASTM C33 aggregate Size No. 57 or 67.

2.1.2 Ready-Mixed Concrete

ASTM C 94, except as modified herein. Ready-mixed concrete is defined in this specification as concrete produced regularly by a commercial establishment and delivered to the purchaser in the plastic state.

2.1.3 Cement

ASTM C 150, Type I or II.

2.1.4 Fly Ash and Pozzolan

ASTM C 618, Type N, F, or C. The pozzolan/fly ash content shall not exceed 25 percent or the ground iron blast furnace slag 50 percent by weight of the total cementitious material.

2.1.5 Water

Water shall be potable.

2.1.6 Aggregates

ASTM C 33. Obtain aggregates for exposed concrete surfaces from one source. Aggregates shall not contain any substance which may be deleteriously reactive with the alkalis in the cement.

2.1.7 Admixtures

ASTM C 494 for water reducing (Type A, D, or E), accelerating (Type C), and retarding (Type B or D), to be used only when approved. Calcium chloride shall not be used as an admixture.

2.2 REINFORCEMENT

2.2.1 Reinforcing Bars

ASTM A615/A615M Grade 60

2.2.2 Dowels

Dowels shall conform to ASTM A675

2.2.3 Wire Ties

Wire ties shall be 16-gauge or heavier, black annealed steel wire.

2.2.4 Supports

Precast concrete blocks shall have wire ties and shall not be less than 4 inches square when supporting reinforcement on the ground. Precast concrete blocks shall have compressive strength equal to that of the surrounding concrete. Where concrete formed surfaces will be exposed to weather or where surfaces are to be painted, steel supports within ½ inch of concrete surface shall be galvanized, plastic protected, or stainless steel. Concrete supports used in concrete exposed to view shall have the same color and texture as the finish surface.

2.3 FORMWORK

2.3.1 Solid Lumber

Use stress-graded lumber that has adequate strength and properties to safely support anticipated loads and conforms to National Forest Products Association (NFPA) Specifications and PS 20. Use dressed and matched boards of uniform thickness and width for exposed concrete surfaces.

2.3.2 Plywood

Use Plyform Class II, 5/8-inch B-B-Exterior Type, mill-oiled and edge sealed. Use high density overlay Plyform Class I where rubbed finish is indicated. Plywood shall conform to PS 1.

2.3.3 Form Ties

Form ties for liquid containment structures shall have waterstops and shall be nonremovable.

Design form ties to provide adequate strength for holding forms. Ties shall be fixed or adjustable in length, and shall contain no devices capable of leaving holes larger than 7/8-inch in diameter in concrete surface.

Nonremovable ties shall be supplied with conditions for positive breakoff or for internal disconnection. Metal remaining after removal of external tie parts shall not be left closer than 1-1/2 inches to finished concrete surface. Flat ties providing no positive breakoff will not be permitted.

2.3.4 Form Coating

Use bond breaking, nonstaining form coating agent conforming to ACI 347R. Form coating agent shall be nontoxic after 30 days for liquid containment structures. Form coating agent shall not soften concrete and shall be compatible with paint, waterproofing material, or damp-proofing material to be applied to finished surface.

2.4 PRECAST PRODUCTS

2.4.1 Precast concrete vaults shall be provided for below-grade structures as shown in drawings and as needed for a complete and proper installation. Provide all reinforcement, accessory and connection materials required. Concrete reinforcement shall be steel bars or welded wire fabric, or a combination thereof. Portland cement with enough water for the required strength and sand for proper consistency shall be used; cement may contain mineral or chemical admixtures, if approved. Use premixed, packaged expansive and non-expansive shrink- resistant grout, as needed.

2.4.2 Vault frames and covers fabricated from aluminum with stainless steel hardware shall be installed as shown on drawings. Vault frames and covers shall be constructed of concrete or corrosion-resistant aluminum, be rated for H-20 traffic loading, be lockable, and shall be water-tight when closed. Mounting bolts and nuts, vault frames, mounting hardware, washers, and other fittings shall be composed of stainless steel. Anchor bolts, if used, shall be stainless steel type 304 and shall penetrate the concrete a minimum of 4 inches on the vertical axis or 3 inches on the horizontal axis. Vault frames shall be equipped with a locking device and removable key wrench for operating lock from outside. Heavier covers shall be fabricated with structural grade 6061 T6 aluminum diamond plate, with a spring-loaded, hinged-door, and recessed lock boxes. Vault frames shall

open from 0 to at least 90 degrees, and shall be capable of being locked open at some point 90 degrees or greater. Covers shall not require more than 60 pounds of force to open. More than one cover or a spring loaded design may be required to meet the 60 pounds maximum. Vault covers shall be provided with a weather resistant gasket or seal between the concrete and cover. The gasket or seal shall allow the cover to be opened and closed frequently without adjustment or reapplication. When the cover is closed, falling rain shall not enter the concrete vault. A maximum of one removable I-beam is allowed across the center of the concrete vault for support. Covers with frames shall be delivered fully assembled and delivered with all components necessary for attachment to the concrete vault.

PART 3 - EXECUTION

3.1 FORMS

3.1.1 Preparation

Surfaces to receive concrete shall be clean and free from frost, ice, mud, water, and any deleterious material that may interfere with the proper bonding between old and new concrete.

3.1.2 Form Construction

Forms shall be constructed to conform to required shape, form, line, and grade, and shall have sufficient rigidity to maintain specified tolerances. Form joints shall be mortar tight. Construct forms to account for deflection due to weight of fresh concrete. Brace forms securely against lateral deflections. Ensure that forms are set to conform to desired lines, planes, and elevations.

Form exposed external concrete corners with chamfers. Chamfers shall be accurately placed and secured to form uniformly straight lines and shall be mitered at changes in direction.

Coat wood and steel forms with form coating agent prior to placing reinforcement. Do not allow excess form coating agent to stand inside forms or to come into contact with fresh concrete. Use form coating agent in strict accordance with manufacturer's recommendations.

3.1.3 Form and Shore Removal

Form and shore removal shall be conducted in accordance with ACI 301. Remove forms in a manner to assure complete structural safety. Do not remove shoring until supported member has acquired sufficient strength to support its weight and superimposed loads. Superimposed loads shall not exceed design live load unless members are adequately shored to support both the members and construction loads in a manner to protect members from damage. Formwork may be removed after expiration of time periods

listed in ACI 347R, provided concrete will not be injured, damaged, or overstressed.

3.2 REINFORCEMENT

Reinforcement shall be fabricated to shapes and dimensions shown on the approved project drawings and shall be in accordance with ACI 318. Reinforcement shall be cold bent unless otherwise authorized and shall conform to ASTM A615 grade 60. Bending may be accomplished in the field or at the mill. Bars shall not be bent after embedment in concrete. Safety caps shall be placed on all exposed ends of vertical concrete reinforcement bars that pose a danger. Wire tie ends shall face away from forms.

3.2.1 Placement

Reinforcement shall be free from loose rust and scale, dirt, oil, or other deleterious coating that could reduce bond with the concrete. Reinforcement shall be placed in accordance with ACI 318 at locations shown on the approved drawings plus or minus one bar diameter. Reinforcement shall not be continuous through expansion joints and shall be as indicated through construction or contraction joints.

Concrete coverage shall be as indicated or as required by ACI 318. If bars are moved more than one bar diameter to avoid interference with other reinforcement, conduits or embedded items, the resulting arrangement of bars, including additional bars required to meet structural requirements, shall be approved before concrete is placed.

3.2.2 Splicing

Splices of reinforcement shall conform to ACI 318 and shall be made only as required or indicated on the approved drawings. Splicing shall be by lapping. Lapped bars shall be placed in contact and securely tied. Lapped bars shall not be spaced farther apart than one-fifth the required length of lap or 6 inches, whichever is less.

3.2.3 DOWELS

Dowels shall be installed at locations indicated on the approved drawings and at right angles to the joint being doweled. Dowels shall be accurately positioned and aligned parallel to the finished concrete surface before concrete placement. Dowels shall be rigidly supported during concrete placement. One end of the dowels shall be coated with a bond breaker.

3.3 CAST-IN-PLACE CONCRETE

Before placement of concrete, care shall be taken to determine that all embedded items are firmly and securely fastened in place as indicated on the drawings or as required. Conduit and other embedded items shall be clean and free of oil and other foreign matter such as loose cuttings or rust, paint, and scale. Voids in sleeves, inserts, and anchor slots shall be filled temporarily with readily removable materials to prevent the entry of

concrete into voids. Welding shall not be performed on embedded metals within 1 foot of the surface of the concrete. Tack welding shall not be performed on or to embedded items. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent in accordance with manufacturer's instructions.

3.3.1 Placing Concrete

ACI 304R and ASTM C 94, except as modified herein. Machine mix concrete and provide mandatory batch ticket information for each load of ready mix concrete. Place concrete within 90 minutes of addition of mixing water to cement and aggregates. Additional water may be added at the site, provided that both the specified maximum slump and water-cement ratio are not exceeded. Do not place concrete when weather conditions prevent proper placement and consolidation; in uncovered areas during periods of precipitation; or in standing water.

Concrete shall not be dropped freely into forms from more than a 36-inch height. If greater drops are required, a tremie or other approved means must be used. Concrete shall be placed continuously between predetermined expansion, control, and construction joints. Care shall be taken to avoid over vibration to prevent aggregate segregation. Consolidate concrete slabs greater than 4 inches in depth with high frequency, internal, mechanical vibrating equipment supplemented by hand spading and tamping. Consolidate concrete slabs 4 inches or less in depth by tamping, spading, and settling with a heavy leveling straight edge.

Saw-cut control joints shall be cut within 24 hours of placement or as soon as the blade will not pull the concrete. All construction and control joints for slab-on-grade shall be filled with epoxy or urethane joint filler. These compounds shall be mixed and installed in strict accordance with the directions of the manufacturer.

3.3.2 Surface Finishes

Concrete finishes shall conform to ACI 301, Class A tolerance. Top of concrete shall be brought to a uniform elevation which shall conform to the grade indicated on the drawings and shall be free of waves. High spots shall be cut down, and low spots shall be filled to produce surfaces with the required tolerances. Concrete surfaces shall be floated to a uniform sandy texture. Finished surfaces shall be free of trowel marks, and shall be uniform in texture and appearance.

Broom finishes shall be used for all concrete surfaces designed for pedestrian traffic. Broom finishes shall occur following steel surface finish as described above. After steel finish is completed, concrete surface shall be scored by drawing a flexible bristled broom across surface immediately after applying float finish.

3.3.3 Repair of Surface Defects

Utilize ACI 301 for repair and finish, unless otherwise specified. Surface defects, including tie holes, shall be repaired immediately after form removal. Honeycombed and defective concrete shall be removed down to sound concrete. Provide edges perpendicular to the surface and patch with nonshrink grout. Patch tie holes and defects when the forms are removed. Concrete with extensive honeycomb (including exposed steel reinforcement, cold joints, entrapped debris, separated aggregate, or other defects) which affect the serviceability or structural strength will be rejected, unless correction of defects is approved. Obtain approval of corrective action prior to repair. The surface of the concrete shall not vary more than the allowable tolerances of ACI 301. Exposed surfaces shall be uniform in appearance and finished to a smooth form finish, unless otherwise specified.

3.3.4 Curing and Protection

Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury. Maintain concrete with minimal moisture loss at a relatively constant temperature for a period necessary for hydration of cement and hardening of concrete.

Concrete curing and protection shall conform to ACI 301. Concrete shall be cured by means of one of the following methods:

- Ponding or Immersion - Maintain 100 percent coverage of water over floor slab areas for at least three days.

- Spraying - Spray water over floor slab areas and maintain wet for seven days.

- Burlap, Cotton Mats, and Rugs - Maintain continuously wet for at least three days.

- Curing Agent - Use water based environmentally compatible curing agent within 30 minutes of completion of performing the concrete finish. Ensure 100% coverage of the exposed concrete surface. Curing agents that utilize pigments to ensure 100% coverage are acceptable.

- Polyethylene Film - Ensure 4 mils of material are in constant contact with concrete for at least three days with laps and edges secured.

- Form Curing - Leave the forms in place and cure by use of one of the above methods for exposed concrete surfaces.

Curing compounds shall not be used on any surface against which additional concrete or mortar is to be placed or on surfaces where floor tile or other cemented coverings are to be placed.

3.4 INSTALLATION OF PRECAST CONCRETE

Precast concrete products shall be installed to the lines and grades shown in the drawings or otherwise specified. Products shall be lifted by suitable lifting devices at points provided by the precast concrete supplier or manufacturer. Products shall be installed per the precast concrete supplier's or manufacturer's recommendation.

3.5 FIELD QUALITY CONTROL

Collect samples of fresh concrete to perform tests on cast-in-place concrete specified below. Contractor shall provide and maintain adequate facilities for safely storing and properly curing the compression test specimens on the project site.

3.5.1 Slump Tests

ASTM C 143. Take samples during concrete placement. The maximum slump may be increased as specified with the addition of an approved admixture provided that the water-cement ratio is not exceeded. Perform tests at commencement of concrete placement and for each batch (minimum) or every 10 cubic yards (maximum) of concrete.

3.5.2 Air Entrainment

Air content shall be determined at the same time as the slump tests are being performed. Air content tests at the job site shall be performed in accordance with ASTM C231.

3.5.3 Field-Cured Compression Test Specimens

Make four test cylinders for each set of tests in accordance with ASTM C 31. Precautions shall be taken to prevent evaporation and loss of water from the specimen. Test two cylinders at 7 days, and test two cylinders at 28 days. Samples for strength tests shall be taken if more than 4 cubic yards of concrete is field placed, or once a day, and for each mix design of concrete placed. For the entire project, take no less than two sets of samples and perform strength tests. Additional cylinders shall be made and tested when deemed necessary. Compression tests shall be made in accordance with ASTM C39. Each strength test result shall be the average of two cylinders from the same concrete sample tested at 28 days.

If one specimen in a compression test manifests evidence of improper sampling, molding, or testing, the specimen shall be discarded, and the remaining cylinder strength shall be considered the test result. If both specimens in a compression test manifest evidence of improper sampling, molding, or testing, the entire test shall be discarded. If the average of any three consecutive strength test results is less than f'_c, or if any strength test result falls below f'_c by more than 500 psi, take a minimum of three ASTM C 42 core samples and test. Concrete represented by core test shall be considered structurally adequate if

the average of three cores is equal to at least 85 percent of f'_c and if no single core is less than 75 percent of f'_c. Locations represented by erratic core strengths shall be re-tested. Concrete not meeting strength criteria shall be removed and new acceptable concrete shall be provided. Do not drill cores in vault walls. Bottom core holes shall be repaired with non-shrink grout. Match color and finish of adjacent concrete.

END OF SECTION

SECTION 11214

SUBMERSIBLE WELL PUMPS

SECTION 11214
SUBMERSIBLE WELL PUMPS

PART 1 - GENERAL

1.1 SUMMARY

This Specification section covers extraction well pump installation associated with the Army's Groundwater Pump and Treat System Modification conducted at the University Villages Project. The University Villages Project is located at former Fort Ord, California.

1.2 RECORD

The following data shall be maintained for record:

1.2.1 Manufacturers Catalog Data

Manufacturer's descriptive data and technical literature, performance charts and curves for representative impeller sizes for a given casing, materials of construction, and dimensions for each pump model. Data shall include a list of major parts and supplies.

1.2.2 Manufacturer's Instructions

Manufacturer's instructions describing the initial installation of each pump assembly and any special considerations.

1.2.3 Reports

Manufacturer's shop performance test reports on each pump delivered. Minimum information shall include the pump and motor serial number, technical pump and motor information, and a chart listing flow versus water column head and amp draw information. Motors of 5 horsepower and larger shall also be factory tested for decibel output and temperature rise over the rated output.

1.2.4 Operations and Maintenance Manuals

Operation and maintenance manuals detailing operating conditions, frequency of required maintenance, and spare parts list. The operating instructions shall outline the step-by-step procedures required for equipment start up, operation and shutdown. The instructions shall include the manufacturer's name, model number, service manual, parts list and source of supply, and a brief description of all equipment and their basic operating features.

Maintenance instructions listing routine maintenance procedures, potential breakdown scenarios and repair options, and a troubleshooting guide; warranty information shall include telephone numbers and contact person.

1.3 QUALITY ASSURANCE

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate equipment that has been in satisfactory operation at least 2 years prior to bid opening. Equipment shall be supported by a service organization that is reasonably convenient to the job site. Similar flow and head-rated pumps shall be the product of one manufacturer.

1.4 DELIVERY, STORAGE AND HANDLING

All equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

PART 2 - PRODUCTS

2.1 GROUNDWATER EXTRACTION WELL PUMPS:

2.1.1 Groundwater extraction well pumps shall be submersible pumps. All wetted parts shall be constructed of materials compatible with both the intended service and the corrosive effects of groundwater. Materials specified as American Iron and Steel Institute (AISI) stainless steel 304 (SS304) shall be deemed as the minimum acceptable. Pump shall be supplied with motor, inlet screen, check valve, driver, flow inducer sleeve/shroud, thermal overload device, hanging hook, and associated wires/cables. Pump deadhead shall be kept below 380 feet of water column. The submersible pumps shall meet the following requirements:

Table 1
Submersible Pump Requirement for Each Extraction Well

Extraction Well Identification	Operating Parameter (minimum requirements)	Anticipated Horsepower	Mandatory Electrical Requirements	Suggested Pump
EX-1	70 gpm @ 240 ft	7.5 hp	460 volt, 3 phase, 60 hertz	Grundfos 75S75-12
EX-2	70 gpm @ 240 ft	7.5 hp	460 volt, 3 phase, 60 hertz	Grundfos 75S75-12
EX-3	70 gpm @ 240 ft	7.5 hp	460 volt, 3 phase, 60 hertz	Grundfos 75S75-12

2.1.2 Motor: Each submersible pump shall be driven by a continuous-duty motor designed for underwater operation. Motors shall have normal starting torque, low-starting-current characteristics, and shall be of sufficient size so that the nameplate horsepower rating will not be exceeded throughout the entire published pump characteristic curve. Motor bearings shall provide smooth operations under the conditions encountered for the life of

the motor. Adequate thrust bearings shall be provided in the motor to carry the weight of all rotating parts and shall be capable of withstanding upthrust imposed during pump starting. The rating shall be stamped on the nameplate. Motors shall conform to NEMA MG-1. Motors shall be enclosed in AISI SS304. Deviations from this material must be clearly stated.

2.1.3 Check Valve: The check valve shall be constructed of AISI SS304. The check valve seat shall be an AISI 304 SS or Buna-N.

2.1.4 Diffuser Chamber: The diffuser chamber shall be AISI SS304.

2.1.5 Bearings: Top and intermediate bearings shall be either AISI SS304 or Buna-N.

2.1.6 Impellers: Impellers shall be constructed of AISI SS304 and statically and dynamically balanced. All bolts and nuts shall be of AISI SS 302/3. Impellers shall be securely fastened to the drive shaft in such a manner as to make it readily removable.

2.1.7 Impeller Seal Rings: All submersible pumps to be installed in extraction wells to be manufactured with Teflon® impeller seal rings and Teflon® wear rings.

2.1.8 Flow Sleeve: Pumps shall be installed with flow sleeves that force water intake to the pump from below pump motor. Flow sleeves shall aid in adequate cooling of pump motor when low flow rates are encountered and be constructed of AISI SS304 or polyvinyl chloride (PVC). Flow sleeve inner diameter shall permit adequate flow at design rates, while the outer diameter shall allow placement in a 6-inch well casing.

2.1.9 Power Cable: The pump manufacturer shall supply power cable from each pump to reach the local control panel. Power cable length assumes a 10-foot spool piece between the top of the well cap to the control box. Anticipated size and length of the power cables are presented in Table 2.

Table 2
Submersible Pump Requirement for Each Extraction Well

Extraction Well Identification	Anticipated Wire Size	Anticipated Wire Length [ft]	Anticipated Drop Pipe Length [ft]
EX-1	#8 AWG	150	135
EX-2	#10 AWG	150	135
EX-3	#10 AWG	150	140

Piping and Connection for Submersible Pump: Wellhead drop pipe shall be threaded Schedule 40, SS304. Wellhead drop pipe fittings shall be threaded and compatible with Schedule 40 pipe.

2.2 TOOLS

Furnish a complete set of all special tools which may be necessary for the adjustment, operation, maintenance, and disassembly of each equipment. Special tools are considered to be those tools which because of their limited use are not normally available, but which are necessary for the particular equipment. Special tools shall be high-grade, smooth, forged, alloy, tool steel.

PART 3 - EXECUTION

3.1 SUBMERSIBLE PUMP INSTALLATION

Submersible pumps shall be installed into the well casings to the depths specified. All pumps shall be installed in accordance with the manufacturer's written instructions. Install all pipe connections to pumps as indicated on drawings. Piping shall be installed to reduce formation of air pockets.

END OF SECTION

SECTION 13446

FIELD INSTRUMENTATION

SECTION 13446
FIELD INSTRUMENTATION

PART I - GENERAL

1.1 SUMMARY

This Specification section covers requirements pertaining to field instrumentation installation associated with the Army's Groundwater Pump and Treat System Modification to be conducted at the University Villages Project. The University Villages Project is located at former Fort Ord, California.

1.2 REFERENCES

The publications listed below shall form a part of this specification to the extent referenced and are referenced in the text by abbreviated designation only.

American National Standards Institute (ANSI)

ANSI C39.1 (1981) Electrical Analog Indicating Instruments

American Society of Mechanical Engineers

ASME B16.1 (1989) Cast Iron Pipe Flanges and Flanged Fittings

ASME B16.5 (1988; Errata Oct 1988; B16.5a) Pipe Flanges and Flanged Fittings

American Water Works Association (AWWA)

AWWA C701 (1988) Cold Water Meters - Turbine Type

National Electrical Manufacturer's Association (NEMA)

NEMA ICS 1 (1993) Industrial Control and Systems

NEMA ICS 2 (1993) Controllers, Contactors and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC

NEMA ICS 6 (1993) Industrial Control and Systems Enclosures

NEMA WD 1 (Revised 1989) Wiring Devices

NEMA WD 6 Wiring Devices

NEMA WD 6 (1988) Wiring Devices - Dimensional Requirements

National Fire Protection Association (NFPA)

NFPA 70 (1999) National Electrical Code

1.3 DOCUMENTATION

The following technical information will be maintained, as applicable, for field instruments specified herein:

1.3.1 Manufacturer's Catalog Data

Provide manufacturer's catalog data for all instrumentation and field devices.

1.3.2 Drawings

Provide elementary wiring diagrams indicating wiring to all instruments and electrical devices.

1.3.3 Operation and Maintenance Manuals

Provide complete operation and maintenance manuals for all instruments.

PART 2 - PRODUCTS

2.1 MATERIALS OF CONSTRUCTION

In general, wetted surfaces of instruments and installed equipment shall be constructed of materials that exhibit excellent resistance to the corrosive effects of brackish groundwater that also contains low levels of volatile organic compounds (mainly trichloroethylene, cis-1,2-dichloroethylene, and vinyl chloride) in parts per billion ranges. Exposed surfaces of instruments and installed equipment shall be constructed of materials exhibiting excellent resistance to the corrosive effects of a marine coastal and high humidity environment. Pre-approved materials of construction include stainless steel, types 302, 303, 304, and 316, and Viton® seals and gaskets.

2.2 PRESSURE SWITCHES

2.2.1 Pressure Switches (Manual Reset Type)

Manual reset type pressure switches shall be rated 15 amps (A), 120 volts alternating current (VAC), and have an adjustable set point with at least one single pole double throw (SPDT) contact. Burst pressure shall be a minimum of 400 pounds per square inch (psi).

2.2.2 Pressure Switches (Automatic Reset Type)

Automatic reset type pressure switches shall reset automatically with a decrease in pressure. Pressure switches shall be rated 15 A, 120 VAC, and have an adjustable set point with at least one SPDT contact. Burst pressure shall be a minimum of 400 psi.

2.3 PRESSURE GAUGES

Pressure gauges shall be analog type with a minimum accuracy of ±2 percent of span. Visible face shall be glycerine filled, with a face diameter between 4 and 4.5 inches. Each pressure gauge shall have a 1/4-inch normal pipe thread connection. Gauge reading ranges are as shown on the drawings.

2.5 FLOWMETERS

2.4.1 Electric Flowmeter (4-20 mA Type)

Electronic 4-20 milliamp (mA) flowmeters shall be turbine type. Manufacturer's standard brass and bronze constructed bodies are acceptable for the flowmeter only. Pipe connections shall be flanged and shall conform to ASME B16.1 Class 125. Meter register shall be powered by 14 to 30 volts direct current (VDC) input and shall have liquid crystal display, rate and totalizer displays. The meter registers shall provide a 4-20 mA analog output signal that is factory calibrated using water at 60 degrees Fahrenheit and corresponding to the rated flow range, as shown on the drawings.

2.4.2 Mechanical Flowmeters

Mechanical flowmeters shall be rated for 125 psi, calibrated to measure water flow in gallons. Flowmeters shall be mechanically actuated requiring no power input and no electronic output signal. Flowmeters shall perform accurately over the range of 0 to a minimum 200 percent of nominal flow rate. Flowmeter registers shall have a cover and shall be hermetically sealed to prevent fogging and condensation.

2.5 WATER LEVEL SWITCHES AND TRANSMITTERS

2.5.1 Level Switches and Controllers (Conductance Type for Downwell Use)

Conductance-type level switches shall be suspended AISI 304 stainless-steel electrodes. Level switches shall be wired to a solid state level controller with a liquid sensitivity of between 12,000 and 16,000 ohms resistance, and capable of providing pump down, differential level operation. Controller shall have, at a minimum, one SPDT contact, 10 A at 120 VAC.

2.5.2 Level Switches and Controller (Conductance Type)

Level switches shall be AISI 304 stainless steel conductance type electrodes which connect to an electrode fitting. Level switches shall be wired to a solid state level

controller with a liquid sensitivity of between 12,000 and 16,000 ohms resistance and capable of providing pump down, differential level operation. The controller shall have, at a minimum, one 10 A, SPDT contact at 120 VAC.

2.5.3 Level Switch for Leak Detection (Float Type)

Float type level switch shall have, at a minimum, one SPDT contact at 120 VAC.

2.6 PRESSURE TRANSDUCER

Pressure transducer shall be of AISI 304 stainless steel construction and designed for continuous submersible operation. Pressure transducer shall be designed to withstand 150 percent of the maximum water depth. The pressure transducer shall have a 4-20 mA output signal.

2.7 LEAK DETECTION SENSORS

a. The fluid sensors shall detect the presence of groundwater type liquid.

b. Minimum acceptable sensitivity is 1.0 inch of water column.

c. Leak detection sensors shall not operate at greater than 24 VDC or greater than 120 VAC.

d. Leak detection sensor operation shall be indicative of a normally closed circuit which opens when presence of liquids is detected.

PART 3 - EXECUTION

3.1 MECHANICAL INSTALLATION

Install in accordance with manufacturer’s recommendation and in accordance with the Drawings.

3.2 ELECTRICAL INSTALLATION

Make all electrical connections in accordance with the Drawings or as required within this Specification.

3.3 LEAK DETECTION INSTALLATION

The leak detection system shall be installed in accordance with manufacturer's instructions.

Installed instruments, except mechanical gauges, shall be field tested to ensure that they function properly and as designed. Dry and/or wet tests may be conducted during field

testing depending upon the instruments and installed locations. Dry testing may involve manually energizing an instrument to test for the response without use of any process fluid. Wet testing will be similar, except with the use of process fluid or potable water. All electrical connections shall be tested as part of the electrical installation testing.

END OF SECTION

SECTION 15060

PIPING, VALVES, AND APPURTENANCES

SECTION 15060
PIPING, VALVES, AND APPURTENANCES

PART 1 - GENERAL

1.1 SUMMARY

This Specification section covers piping, valves, and appurtenances installation associated with the Army's Groundwater Pump and Treat System Modification conducted at the University Villages Project. The University Villages Project is located at former Fort Ord, California.

1.2 REFERENCES

The publications listed below shall form a part of this specification to the extent referenced and are referenced in the text by abbreviated designation only.

American National Standards Institute (ANSI)

ANSI B16.5 (1988; Errata Oct 1988; B16.5a) Pipe Flanges and Flanged Fittings
ANSI B16.11 (1991) Forged Fittings, Socket-Welding and Threaded

American Society for Testing and Materials (ASTM)

ASTM A182 (1995; Rev. b) Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High Temperature Service

ASTM A312 (1994; Rev. b) Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipe

ASTM D1785 (1994) Standard Specification for Polyvinyl Chloride (PVC), Plastic Pipe, Schedules 40, 80, and 120

ASTM D2467 (1994) Standard Specification for Socket-Type Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80

ASTM D2564 (1993) Standard Specification for Solvent Cements for Polyvinyl Chloride (PVC) Plastic Pipe and Fittings

ASTM D2855 (1993) Standard Practice for Making Solvent-Cemented Joints with Polyvinyl Chloride (PVC) Pipe and Fittings

ASTM D3261 Specification for Butt Heat Fusion Polyethylene Plastic Fittings for Polyethylene Plastic Piping and Tubing

1.3 RECORD

The following data shall be maintained for record:

1.3.1 Manufacturer's Catalog Data

a. Pipe and fittings
b. Valves
c. Pipe supports

PART 2 - PRODUCTS

Wetted surfaces shall be constructed of materials that exhibit excellent resistance to the corrosive effects of groundwater that also contains low levels of volatile organic compounds (mainly trichloroethylene, cis-1,2-dichloroethylene, and vinyl chloride) in parts per billion ranges. Exposed surfaces shall be constructed of materials exhibiting excellent resistance to the corrosive effects of a marine coastal and high humidity environment. Pre-approved materials of construction include stainless steel (SS), types 302, 303, 304, and 316, and Viton® seals and gaskets.

2.1 POLYVINYL CHLORIDE (PVC)

PVC pipe shall be schedule 80, ASTM D1785 Type 1, and sized as indicated on the project drawings. PVC fittings shall be socket-type, schedule 80, ASTM D2467 or flanged, ANSI B16.5, class 150-pound dimensions, Van Stone style. PVC solvent cement for PVC pipe and fittings shall conform to ASTM D2564. Schedule 40 dimensions or threaded PVC pipe or fittings are not approved.

2.2 STAINLESS STEEL

Not used.

2.3 BOLTS, NUTS, AND WASHERS

Large diameter bolts, those 9/16-inch outside diameter and larger shall be composed of SS316. Large diameter nuts and washers shall be SS304, which is a softer stainless steel than SS316. Anti-seize, or similar compound containing no volatile organic constituents, shall be used on SS316 treaded members. Large, medium and small bolts shall be sized to allow at least two threads to show past the nut, after the gasket and washer are correctly placed and the nut is tightened to the manufacturer’s recommended torque.

Small diameter bolts and screws, those 5/16-inch outside diameter and less, and ancillary nuts shall be composed of SS302 or SS303. A minimum of 50 percent, calculated by bulk weight, of the medium diameter bolts and screws, those with 3/8-inch to ½-inch outside diameter, and ancillary nuts shall be composed of SS302 or SS303. The balance of the medium size bolts may be composed similar to the large bolts. SS302 and SS303 bolts shall be used with SS302 and SS303 nuts.

2.4 FIELD APPLIED PROTECTIVE COATING

All exposed non-metallic piping, fittings, and appurtenances shall receive paint or wrapping material to protect it from ultraviolet radiation according to manufacturer's recommendations. UV-inhibited PVC piping and appurtenances need not be wrapped. Protection shall be applied prior to final field inspection.

2.5 VALVES

2.5.1 Globe Valves

Class 150 globe valves shall be constructed of bronze, have an equal percentage plug, class 150 threaded end with brass close nipples, rising stem, union bonnet, and B-bronze disc. Wellhead valve connections shall be welded socket type or 150-pound flange connection as indicated. If the globe valve requires threaded connections, connect with brass close nipples and bronze flanges.

Class 300 globe valves shall be constructed of stainless steel, have an equal percentage plug, rising stem, union bonnet, and stainless steel disc. Wellhead valve connections shall be welded socket type or 300-pound flange connection as indicated.

2.5.2 Ball Valves and Gate Valves

Stainless steel ball and gate valves shall be SS304 or SS316 and rated for 300 psi at 73.4°F. Valve connections shall be butt or socket welded unless specifically indicated as a threaded connection that conforms to the pressure requirements. Valves that are 1 inch or smaller and designated as gate valves may be either a ball or gate valve.

PVC ball and gate valves shall be rated for a minimum of 150 psi at 73.4°F. Valve connections will be socket type or 150-pound flange. PVC valve seats shall be TFG and seals shall be EPDM or Viton®. Valves that are 1 inch or smaller and designated as gate valves may be either a ball or gate valve.

All ball valves shall be quarter turn type. Plastic ball valves shall be of true union, while metallic ball valves shall be of full port types. Gate valves shall be of the standard rising stem type.

2.5.3 Butterfly Valves

Butterfly valves shall be wafer type single piece body design, rated at 125 psi at 73.4°F bubble tight shut off. Valve bodies shall be molded of PVC with disc molded of PVC. The valve shaft shall be stainless steel type 316, or similar, and blow out proof. Liner and o-ring seals shall be EPDM or Viton®. Valves of size 6 inches and above shall be equipped with gear operators.

2.5.4 Check Valves

Class 300 check valves shall be of wafer-style silent-check type and sized as indicated on the drawings. Minimum acceptable materials of construction include a stainless steel seat, plug, and spring. The check valve shall be rated for not less than 300 psi at 73.4°F. The valve plug shall be center guided at both ends with a thru integral shaft and spring loaded for silent shut-off operation. The spring must be helical or conical. The seat, plug, and spring shall be hand replaceable in the field for ease of maintenance.

Class 150 check valves shall be of wafer-style silent-check type and sized as indicated on the drawings. Minimum acceptable materials of construction include a bronze seat, bronze plug, and stainless steel spring. The check valve shall be rated for not less than 125 psi at 73.4°F. The valve plug shall be center guided at both ends with a thru integral shaft and spring loaded for silent shut-off operation. The spring must be helical or conical. The seat, plug, and spring shall be hand replaceable in the field for ease of maintenance.

Class 150 PVC, horizontal swing type check valve shall be rated for not less than 125 psi at 73.4°F. Valve size and connections shall be socket type or 150-pound flange connection as indicated on the construction drawings.

2.5.5 Sample Port Valves

Water sample port valves shall be 1/4-inch gate valves. Wellhead valve shall be SS304 construction with a pressure rating for not less than 300 psi at 73.4°F. Other valves shall be SS304 construction with a pressure rating for not less than 125 psi at 73.4°F. All sample port valve discharges shall be fitted with an SS compression fitting and 4 inches of 1/4-inch SS tubing pointed downward.

2.5.6 Air and Vacuum Valves

Class 300 air and vacuum valves shall be installed to exhaust air during filling of the pipeline, and to allow air into the pipeline under vacuum conditions. The discharge orifice area shall be equal to or greater than the inlet orifice area of the valve. Maximum working pressure for water service shall not be less than 300 psi at 73.4°F. A ball valve conforming to Paragraph 2.5.2 above shall be installed on the inlet of each air release valve. The ball valve size shall match the size of the air release valve inlet.

Class 150 air and vacuum valves shall be installed to exhaust air during filling of the pipeline, and to allow air into the pipeline under vacuum conditions. The discharge orifice area shall be equal or greater than the inlet orifice area of the valve. Maximum working pressure for water service shall not be less than 125 psi at 73.4°F. A ball valve conforming to Paragraph 2.5.2 above shall be installed on the inlet of each air release valve. The ball valve size shall match the size of the air release valve inlet.

2.5.7 Control Valves and Actuators

2.5.7.1 Solenoid Valves

Solenoid valves shall provide on/off control at 120 VAC. Valves shall be capable of being wired either normally open or normally closed.

2.5.7.2 Pressure Control Valves

Pressure control valves shall be capable of accurately maintaining a constant, preset upstream pressure, regardless of changing upstream potential and/or flow rate. Upstream adjustment range shall be adjustable from 7-80 psi, at a minimum. Pressure control valves sized 2 inches and larger shall be flanged and shall conform to ASME B16.1 Class 125 or ASME B16.5 Class 150.

2.5.7.3 Actuators - Electric (on/off control)

Electric actuators shall provide on/off control for the size and type of valve indicated. Electric actuators shall have, at a minimum, a 35 percent duty cycle and shall be enclosed in an NEMA 4X rated housing.

2.5.7.4 Actuators - Electric (modulating control)

Electric actuators shall provide modulating control for the size and type of valve indicated. Electric actuators shall have a 100 percent duty cycle and shall be enclosed in an NEMA 4X rated housing. Modulating control shall be performed by a 4-20 mA positioner or controller.

2.6 PIPE SUPPORTS

Pipe supports shall be sized and installed to support pipe and appurtenances when filled with water. Baseplates will be a minimum of 4 inches wide and 4 inches long and 1/8 inch thick. Pipe supports, baseplates, saddles and anchor bolts shall be SS304 or of fiberglass construction.

2.7 GASKETS

Gaskets and seal rating for joining flanges shall be EPDM or Viton®, full face, with ANSI B16.5 150-pound or 300-pound dimensions as appropriate.

2.8 VALVE AND APPURTENANCE IDENTIFICATION TAGS

Not used.

2.9 WYE FITTING

Wye fitting shall be of Schedule 80 PVC construction, ASTM D1785 Type I, and sized as indicated on drawings. Each wye shall have socket-end or flange-end connections. Flange-end connections shall conform to ANSI B16.5 Class 150-pound dimensions, Van Stone style.

2.10 WELL CAP

Well cap for the groundwater extraction wells shall be of SS304L or SS316L construction. The dimensions and shape of the well cap are as indicated on the drawings.

PART 3 - EXECUTION

3.1 PIPE HANDLING

Handle pipe and accessories in a manner to ensure delivery to the installation location in an undamaged condition. Hand carry pipe into position. Before installation, inspect the pipe for defects. Remove defective material from the site and replace defective material with sound material.

3.2 INSTALLATION

Piping shall be installed in accordance with the manufacturer's installation instructions.

3.2.1 Vertical Piping

Piping shall be secured at sufficiently close intervals to keep pipe in alignment and to support weight of pipe and contents. Piping shall be secured in position by approved stakes or braces when piping is to stand free, or when no structural element is available for providing stability during construction.

3.2.2 Horizontal Piping, Suspended

All piping shall be supported at intervals in accordance with the manufacturer's instructions.

3.2.3 Horizontal Piping, Underground

The full length of each section shall rest solidly upon the pipe bed, with recess excavated to accommodate couplings or joints. Do not lay pipe in water or when conditions are unsuitable for the work. Securely close open ends of the pipes, fittings, and valves when work is not in progress to prevent foreign material from entering the pipes and fittings. Piping laid on grade shall be fully braced prior to embedment in concrete where concrete encasement is required.

3.2.4 Cutting

Cuts shall be made square with pipe, and burrs shall be removed by smoothing edges. Cut pipe in a manner that will not cause damage to the pipe. Pipe cutting should be in accordance with the manufacturer's recommendations and consistent with the type of joint to be used.

3.2.5 Joints, PVC

All joints shall be solvent cemented in accordance with ASTM D2855.

3.2.6 Joints, Stainless Steel

All stainless steel joints, where used, shall be butt or socket welded unless specifically indicated as a threaded connection. Threaded pipe and threaded fittings only shall be a minimum Schedule 40 thickness and may be either Type 304L or 316L.

3.2.7 UV Protection, PVC Pipe

All aboveground PVC pipes, fittings, valves shall be treated according to the manufacturer's recommendations to minimize degradation caused by UV light. Such treatment shall not interfere with the normal operation of valves or fittings.

3.2.8 Piping Connections to Socket-Welded Valves, Flowmeters and Strainers.

All socket-welded valves, flowmeters, and strainers installed in pipelines that may have to be removed for repair, maintenance, or replacement shall be installed with adjacent flange connections to allow easy removal of the appurtenance for repair, maintenance, or replacement. If two or more valves, flowmeters, and/or strainers are installed adjacent to each other on a pipeline, one set of flange connections on either upstream and downstream of all appurtenances shall be sufficient if appurtenance can be easily removed for repair, maintenance, or replacement.

3.3 FIELD TESTING AND CORRECTION OF DEFICIENCIES

Where double-contained piping is used, primary piping shall be hydrostatically tested per Specification Section 01652, Pipeline Pressure Testing. If leaks are discovered in primary piping, secondary piping, joints, or appurtenances, the defective equipment shall be repaired or replaced and the entire line retested.

END OF SECTION

SECTION 15102

CONVEYANCE SUBSYSTEM

SECTION 15102
CONVEYANCE SUBSYSTEM

PART 1 - GENERAL

1.1 SUMMARY

This Specification section covers conveyance pipeline subsystem installation associated with the Army's Groundwater Pump and Treat System Modification conducted at the University Villages Project. The University Villages Project is located at former Fort Ord, California.

1.2 REFERENCES

The publications listed below shall form a part of this specification to the extent referenced and are referenced in the text by abbreviated designation only.

Manufacturers Standardization Society of Valve and Fitting Industry (MSS)

American National Standards Institute (ANSI)

ANSI B 16.5 Steel Pipe Flanges, Flange Valves, and Fittings

American Society for Testing and Materials (ASTM)

ASTM D3261 Specification for Butt Heat Fusion Polyethylene Plastic Fittings for Polyethylene Plastic Piping and Tubing

1.3 RECORD

The following data shall be maintained for record:

1.3.1 Manufacturer's Catalog Data

Each manufactured item shall be current manufacturer's descriptive literature of catalogued products, equipment drawings, performance and characteristic curves, and catalog cuts.

1.3.2 Shop Drawings

Manufacturer's or supplier's working drawings of the products used for the project shall include: construction materials, thicknesses, performance standards, dimensioning, fittings, joint details, and methods of installation.

1.4 QUALITY ASSURANCE

All pipe fittings, and accessories shall be furnished by a single manufacturer who has a minimum of 5 years experience producing the items to be supplied and is experienced, reputable, regularly engaged, and qualified in the manufacture of the items to be furnished. The systems shall be designated, fabricated and installed in accordance with industry and the manufacturer's standards and as specified herein and shall be suitable for their intended service.

1.5 DELIVERY, HANDLING AND STORAGE

Care shall be taken in loading, transporting, and unloading to prevent damage to the pipes. All pipes or fittings shall be examined before installing, and no piece shall be installed which is found to be defective. Handling and installing of pipe and fittings shall be in accordance with the manufacturer's instruction and as specified herein.

PART 2 - PRODUCTS

2.1 PIPING

The untreated water pipeline shall be double wall containment underground piping and the treated water pipeline shall be single wall underground piping. The piping material shall be high density polyethylene (HDPE). The piping size shall be in accordance with the drawings.

2.1.1 Piping Requirements

a. The extracted water pipeline shall be designed to prevent leakage of groundwater containing volatile organic compounds (VOCs).

b. Extracted water pipeline shall be SDR 11 for the carrier pipe and SDR 17 for the secondary containment pipe.

c. Extracted water pipeline shall be equipped with a low-point leak detection system.

d. All extracted and treated water pipelines shall be of the same material and from the same manufacturer.

2.1.2 Fittings and Accessories

Fittings shall be manufactured from the same material as the pipes. Minimum “quick-burst” strength of the fittings shall not be less than that of the pipes to which the fittings are being joined.

2.1.3 End Seals

Each system shall have end seals and other subassemblies designed and factory prefabricated to prevent the ingress of moisture and to provide complete drainage and pressure testing of the secondary containment piping.

2.1.4 Flange Adapters

Back up rings for flange adapters shall be stainless steel, metallic convoluted or flat plate rings. All rings shall comply with the vital dimensions of the Class 150 ANSI B16.5 such as outside diameter, bolt circle, bolt hole number, and size.

2.1.5 Pipe Marking

At a minimum, containment pipe shall be marked during manufacture with the following information in durable printing: nominal size, dimension ratio, pressure rating, manufacturer's name, and date of manufacture.

2.1.6 Pipe Maximum Nick

The maximum allowable nick on an extraction pipe is listed in Tables 1 and 2. Pipe shall be rejected if it contains a nick deeper than the maximum allowable value.

Table 1

Carrier Pipe Size [inch]	Maximum Nick Allowed [mil]
2	50
3	50
4	75

Table 2

Containment Pipe Size [inch]	Maximum Nick Allowed [mil]
4	50
6	50
8	75

2.1.7 Low Point Leak Detection

A leak detection assembly shall be constructed as shown in the drawings. The assembly shall consist of an access port to allow physical verification of pipe leak. The access port shall be of the same material as the double wall containment pipe and from the same manufacturer as the double containment pipe. All access ports shall rise up to grade, if

underground, and be protected by a manhole cover set in concrete to prevent damage to the piping. The surface shall be one-inch higher and gradually sloped down to the surrounding surface to resist drainage into the manhole.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING SYSTEM

Installation of untreated and treated water pipelines shall be performed in accordance with manufacturer's specifications and instructions.

3.1.1 Pipe Joining

HDPE pipe and fittings shall be joined by thermal butt fusion in accordance with ASTM D3261 and/or the recommendations of the manufacturer of the pipes and fittings. Junction with other materials shall be the type of adapter and technique recommended by the pipe manufacturer.

3.1.2 Pipes and Accessories

Pipes and accessories shall be carefully lowered into the trench by means of derrick, ropes, belt slings, or other authorized equipment. Piping materials shall not be dropped or dumped into the trench. Care shall be taken to avoid abrasion of the pipe coating. The full length of each section of pipe shall rest solidly upon the pipe bed. Pipe that has the grade or joint disturbed after laying shall be taken up and re-laid. Pipe shall not be laid in water or when trench conditions are unsuitable for the work. Water shall be kept out of the trench until joints are complete. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that no trench water, earth, or other substance will enter the pipes or fittings. Pipe ends left for future connections shall be valved, plugged or capped, and anchored.

3.1.3 Unsatisfactory Conditions

Unsatisfactory conditions include improper diameter of pipe ends, poorly prepared joints, improper curing of joints, movement of pipe before joints are cured, bending of pipe to follow abrupt changes in trench contours, pipe ends left open in trench overnight, improper drying of joints after rain storms, expiration of effective adhesive life, sharp objects in trench bed, backfill that could damage pipe, improper procedure for concrete encasement of pipe, omission of thrust blocks at changes in direction, or any other conditions which could have an adverse effect on the satisfactory completion and operation of the piping system.

3.2 FIELD TESTING AND CORRECTION OF DEFICIENCIES FOR PIPING SYSTEM

Pressure testing shall be performed in accordance with Section 01652, Pipeline Pressure Testing. If leaks are discovered in primary piping, secondary containment piping, joints,

or appurtenances, the defective parts shall be repaired or replaced and the entire line retested.

END OF SECTION

SECTION 16410

ELECTRICAL WIRING SYSTEM

SECTION 16410
ELECTRICAL WIRING SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

This Specification section covers electrical wiring system installation associated with the Army's Groundwater Pump and Treat System Modification conducted at the University Villages Project. The University Villages Project is located at former Fort Ord, California.

1.2 REFERENCES

The publications listed below shall form a part of this specification to the extent referenced and are referenced in the text by abbreviated designation only.

American National Standards Institute (ANSI)

ANSI C80.1 (1990) Rigid Steel Conduit - Zinc Coated

ANSI C80.3 (1995) Electrical Metallic Tubing - Zinc Coated (EMT)

American Society for Testing and Materials (ASTM)

ASTM B1 (1990) Hard-Drawn Copper Wire

ASTM B8 (1993) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

National Electrical Manufacturer's Association (NEMA)

NEMA AB 1 (1996) Molded Case Circuit Breakers and Molded Case Switches

NEMA FU 1 (1986) Low Voltage Cartridges Fuses

NEMA ICS 1 (1993) Industrial Control and Systems

NEMA ICS 2 (1993) Controllers, Contractors and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC

NEMA ICS 4 (1993) Industrial Control and Systems: Terminal Blocks

NEMA ICS 6 (1993) Industrial Control and Systems Enclosures

NEMA ST 20 (1992) Dry-Type Transformers for General Applications

NEMA TC 2 (1990) Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80)

NEMA TC 3 (1990) PVC Fittings for Use with Rigid PVC Conduit and Tubing

NEMA WD 1 (Revised 1989) Wiring Devices

NEMA WD 6 (1988) Wiring Devices - Dimensional Requirements
National Fire Protection Association (NFPA)

NFPA 70 (1999) National Electrical Code

Underwriter's Laboratories, Inc. (UL)

UL 6	(1993; Bul. 1993) Rigid Metal Conduit
UL 50	(Revised 1994, Bul. 1994) Safety Enclosures for Electrical Equipment
UL 67	(Revised 1994) Panelboards
UL 83	(Revised 1994) Thermoplastic-Insulated Wire and Cables
UL 360	(Revised 1994) Liquid-Tight Flexible Steel Conduit
UL 467	(1993) Grounding and Bonding Equipment
UL 486A	(1991) Wire Connectors and Soldering Lugs for Use With Copper Conductors
UL 486C	(1991; Bul. 1994) Splicing Wire Connectors
UL 489	(Revised 1994) Attachment Plugs and Receptacles
UL 498	(1996) Attachment Plugs and Receptacles
UL 506	(1994) Specialty Transformers
UL 508	(Revised 1994) Industrial Control Equipment
UL 510	(Revised 1994) Chloride, Polyethylene, and Rubber Insulating Tape
UL 514A	(Revised 1993) Metallic Outlet Boxes
UL 514B	(Revised 1993) Fittings for Conduit and Outlet Boxes
UL 514C	(Revised 1989) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL 797	(1993) Electrical Metallic Tubing
UL 869	(Revised 1991) Service Equipment
UL 817	(1994) Cord Sets and Power-Supply Cords
UL 943	(Revised 1995) Ground-Fault Circuit Interrupters
UL 984	(1996) Hermetic-Refrigerant Motor-Compressors

1.3 RECORD

The following data shall be maintained for record for products installed as part of this project:

1.3.1 Manufacturer's Catalog Data

a. Panelboards
b. Enclosures

c. Wires and cables
d. Receptacles
e. Motor overcurrent devices
f. Conduit and fittings (each type)
g. Terminals and terminators
h. Electrical boxes and covers
i. Motor controllers
j. Switches
k. Circuit breakers

1.3.2 Drawings

Drawings for the panelboards and transformers.

1.3.3 Reports

A summary of testing performed on equipment and wiring installed in field as per Paragraph 3.10 of this specification.

1.3.4 Operation and Maintenance Data

Information pertaining to the operation and maintenance of the electrical components, including schematic diagram of electrical control systems and updated single line drawings to reflect “as built” conditions.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials, equipment, and devices shall meet UL requirements (where UL standards are established for those items) and NFPA requirements.

2.2 CONDUIT AND FITTINGS

2.2.1 Rigid Metal Conduit

Rigid, heavy wall, mild steel, hot dip galvanized, smooth interior, tapered threads and carefully reamed ends. Material shall be UL listed.

2.2.2 Electrical Metallic Tubing

UL 797, ANSI C80.3

2.2.3 Liquid-Tight Flexible Metal Conduit, Steel

UL 360

2.2.4 Fittings for Metal Conduit, Electrical Metallic Tubing, and Flexible Metal Conduit

Ferrous fittings shall be cadmium or zinc-coated in accordance with UL 514B. Fitting shall adapt the conduit to standard threaded connections, shall have an inside diameter not less than that of the corresponding standard conduit size.

2.3 OUTLET BOXES AND COVERS

Outlet boxes and covers shall be cadmium- or zinc-coated, in accordance with UL 514A, if ferrous metal, or UL 514C, if nonmetallic.

2.4 CABINETS, JUNCTION BOXES, AND PULL BOXES

Cabinets, junction boxes, and pull boxes shall be in accordance with UL 50 and shall be hot-dip, zinc-coated, if sheet steel.

2.5 WIRE AND CABLES

Wires and cables shall meet applicable requirements of NFPA and UL for the type of insulation, jacket, and conductor specified or indicated. Wires and cables manufactured more than 12 months prior to date of delivery to site shall not be used.

2.5.1 Conductors

Conductors, No. 8 American Wire Gauge (AWG) and larger diameter, shall be stranded. Conductors, No. 10 AWG and smaller diameter, shall be either solid or stranded; except conductors for remote-control and signal circuits, classes 1, 2, and 3, shall be stranded. Conductor sizes and ampacities shown are based on copper, unless indicated otherwise.

When manufacturer's equipment requires copper conductors at the termination or requires copper conductors to be provided between components of equipment, provide copper conductors or splices, splice boxes, and other work required to satisfy manufacturer's requirements. Furthermore, all conductors shall be copper unless specifically stated otherwise in the drawings.

2.5.2 Minimum Conductor Sizes

Branch power and lighting circuits	No. 12 AWG
Control circuits (field wiring)	No. 14 AWG
Control circuits (interior panel wiring)	No. 16 AWG
Instrumentation - shielded/twisted (field wiring)	No. 16 AWG
Instrumentation - shielded/twisted (interior panel wiring)	No. 18 AWG

2.5.3 Color Coding

Provide for service, feeder, branch, control, and signaling circuit conductors. Color shall be green for grounding conductors and white for neutrals; except where neutrals of more than one system are installed in same raceway or box, other neutral shall be white with colored (not green) stripe. Color of ungrounded conductors in different voltage systems shall be as follows:

a. 277/480-volt, 3-phase
   Phase A - brown
   Phase B - orange
   Phase C - yellow
   Neutral - gray

b. 208/120-volt, 3-phase
   Phase A - black
   Phase B - red
   Phase C - blue
   Neutral - white

c. 120/240-volt, single phase: Black and red

d. Three-phase, 4-wire delta system, high leg (stinger) shall be orange, as required by NFPA-70.

2.5.4 Conductor Insulation

Should individual pieces of equipment, to which electrical power and/or control wiring must be connected, be equipped with terminals rated for less than the temperature rating of the wire utilized, or the expected wire temperature, then the wire size shall be increased to assure that the wiring does not exceed the terminal temperature rating.

2.5.5 Bonding Conductors

Bonding conductors shall be ASTM B1, solid bare copper wire, for sizes No. 8 AWG and smaller diameter; and ASTM B8, Class B, stranded bare copper wire, for sizes No. 6 AWG and larger diameter.

2.5.6 Grounding Cables

Grounding cables shall be bare or shall have green insulation as indicated on project drawings.

2.5.7 Cord Sets and Power-Supply Cords

UL 817

2.5.8 Telephone Cables

ICEA S.80.576

2.6 SPLICES AND TERMINATION COMPONENTS

Splices and termination components shall conform to UL 486A for wire connectors and UL 510 for insulating tapes. Connectors for No. 10 AWG and smaller diameter wires shall be in accordance with UL 486A or UL 486C (twist-on splicing connector). Provide solderless terminal lugs on stranded conductors.

2.7 DEVICE PLATES

Provide UL listed, one-piece device plates for outlets to suit the devices installed. Plates installed in wet locations shall be gasketed and UL listed as raintight while in use.

2.8 RECEPTACLES

Receptacles shall conform to UL 498 and NEMA WD 1, general grade, heavy-duty, grounding-type. Ratings and configurations shall be as indicated. Bodies shall be of ivory thermosetting plastic supported on a metal mounting strap. Dimensional requirements shall be per NEMA WD 6. Provide screw-type, side-wired wiring terminals. Connect grounding pole to mounting strap. Duplex receptacles shall be 15 amperes, 125 volts, No. 5242.

2.8.1 Weatherproof Receptacles

Receptacle shall be UL listed for use in "wet locations with plug in use."

2.8.2 Ground-Fault Circuit Interrupter Receptacles

Ground-fault circuit interrupter (GFI) receptacles shall conform to UL 943, duplex type for mounting in standard outlet box. Device shall be capable of detecting current leak of 6 milliamperes or greater and tripping per requirements of UL 943 for Class A GFI devices.

2.9 PANELBOARDS

Panel boards shall be in accordance with UL 67 and UL 50. Panelboards for use as service disconnecting means shall additionally conform to UL 869. Panelboards shall be circuit breaker-equipped.

2.9.1 Panelboard Buses

Support bus bars independent of circuit breakers. Main buses and back pans shall be designed so that breakers may be changed without machining, drilling or tapping. If neutral circuit conductors are required, provide isolated neutral bus in each panel for connection of circuit neutral conductors. Provide separate ground bus identified as equipment grounding bus per UL 67 for connecting grounding conductors; bond to steel cabinet. In addition to equipment grounding bus, provide second "isolated" ground bus, where indicated. Provide copper panelboard buses.

2.9.2 Panelboard Circuit Breakers

2.9.2.1 General

UL 489, thermal magnetic-type having a minimum short-circuit current rating equal to the short-circuit current rating of the panelboard in which the circuit breaker shall be mounted. Breaker terminals shall be UL listed as suitable for type of conductor provided. Series rated circuit breakers and plug-in circuit breakers are unacceptable.

2.9.2.2 Multiple Breakers

Common trip-type with single operating handle. Breaker design shall be such that overload in one pole automatically causes all poles to open. Maintain phase sequence throughout each panel so that any three adjacent breaker poles are connected to Phases A, B, and C, respectively.

2.9.3 Panelboard Directory

Each panelboard shall have a directory with the name and number of the equipment served by each circuit breaker which shall correspond with the final circuit arrangement. The directory shall also indicate the panel designation, voltage and phase at the top. Each directory shall be mounted inside the panelboard.

2.10 ENCLOSED CIRCUIT BREAKERS

Enclosed circuit breakers shall conform to UL 489. Individual molded case circuit breakers shall have voltage and continuous current ratings, number of poles, overload trip setting and short circuit current interrupting rating as indicated. Enclosure type shall be as indicated.

2.11 FUSES

Fuses shall conform to NEMA FU 1. Time-current characteristics curves of fuses serving motors or connected in series with circuit breakers shall be coordinated for proper operation. Fuses shall have voltage rating not less than circuit voltage.

2.12 COMBINATION MOTOR STARTER

Combination starter shall have motor circuit protector type disconnect, with magnetic type motor controller with thermal overload protection. Motor circuit protectors shall conform to NEMA AB 1 and UL 489, and shall consist of an adjustable instantaneous trip circuit breaker in conjunction with a combination motor controller which provides coordinated motor circuit overload and short circuit protection. Motor circuit protectors shall be rated in accordance with NFPA-70.

Dry, indoor locations shall have a NEMA 1 enclosure. In outdoor or damp or wet indoor locations, enclosure shall be NEMA 4X. Cover of combination motor controller and manual switch or circuit breaker shall be interlocked with operating handle of switch or circuit breaker so that cover cannot be opened unless handle of switch or circuit breaker is in "off" position.

2.13 MOTOR CONTROLLERS

Motor controllers shall be in accordance with UL 508, NEMA ICS 1, and NEMA ICS 2; and shall be magnetic type with thermal overload protection in each phase. Motor controllers shall have undervoltage protection when used with momentary-contact pushbutton stations or switches and shall have undervoltage release when used with maintained-contact pushbutton stations or switches. When used with automatic-type maintained-contact PLC control, controller shall have hand/off/automatic selector switch. For each motor not in sight of controller or where controller disconnecting means is not in sight of motor location and driven machinery location, controller disconnecting means shall be capable of being locked in open position. Overload protective devices shall provide adequate protection to motor windings; be thermal inverse-time-limit; and include manual reset-type pushbutton on outside of motor controller case.

2.13.1 Control Circuits

Control circuits shall have maximum voltage of 120 volts derived from control transformer in same enclosure. Transformers shall conform to UL 506, as applicable. Transformers, other than transformers in bridge circuits, shall have primaries wound for voltage available and secondaries wound for correct control circuit voltage. Size transformers so that 80 percent of rated capacity equals connected load. Provide fuses on primary side. One secondary lead shall be fused; other shall be grounded.

2.14 TELEPHONE SYSTEM

If used, provide system of telephone wire-supporting structures, including conduits with pull wire, junction boxes, and other accessories for telephone outlets.

2.15 GROUNDING AND BONDING EQUIPMENT

Grounding and bonding equipment shall conform to UL 467. Ground rods shall be copper-clad steel, with minimum diameter of 3/4 inch and minimum length of 10 feet.

2.16 NAMEPLATES

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.17 PULLBOXES

Pull boxes shall be precast concrete with minimum dimension as required by NFPA 70.

PART 3 - EXECUTION

Electrical installations shall conform to requirements of NFPA 70 and to requirements specified herein.

3.1 CABLE AND WIRE INSTALLATION

Cable and wire shall be installed in the appropriate raceway as indicated in the drawings. 24 VDC cable and wires shall be installed in separate conduits from all AC cable and wires. Cables and wires sharing the same conduit shall have the same insulation voltage rating. Cable pulling forces shall not exceed cable manufacturer's recommended maximum values. Conductors shall be continuous from box to box. Splices shall not be permitted in conduit. Instrumentation cable shall be installed to avoid splices. Grounding conductor shall be separate from electrical system neutral conductor. Provide insulated green equipment grounding conductor for circuit(s) installed in raceways.

3.2 RACEWAY INSTALLATION

Unless specified otherwise, all raceway systems shall utilize conduit. Minimum conduit size shall be 3/4" inch in diameter for power and control circuits except low voltage (120 VAC) lighting and/or receptacle circuits may be ½ inch in diameter. Below ground conduit shall be PVC, rigid nonmetallic conduit, except where specified otherwise or required by NFPA 70. Conduit in concealed and exposed locations where it may be subjected to damage during use shall be rigid galvanized steel. Flexible conduit will be allowed only at motors and equipment which are subject to vibration or require movement for maintenance purposes

Conduit runs, burial depths, and sizes shall be as indicated on the drawings. Conduit shall be installed parallel with or at right angles to ceilings, walls, and structural members unless concealed. Wherever possible conduits shall be run in groups. Conduit shall be supported by pipe straps, wall brackets, hangers, or ceiling trapeze. Conduit support separation shall meet the minimum requirements listed in NFPA 70.

3.3 BOXES, OUTLETS, AND SUPPORTS

Boxes in wiring and raceway systems shall be provided wherever required for pulling of wires, making connections, and mounting of devices or fixtures. Boxes for metallic raceways shall be cast-metal, hub-type when located in wet locations, when surface mounted on outside of exterior surfaces.

3.4 CONDUCTOR IDENTIFICATION

Conductor identification shall be provided in each enclosure where tap, splice, or termination is made.

3.5 SPLICES

Splices shall be made in accessible locations. Splices in conductors, No. 10 AWG and smaller diameter, shall be made with insulated, pressure-type connector. Splices in conductors, No. 8 AWG and larger diameter, shall be made with solderless connector, and covered with insulation material equivalent to conductor insulation.

3.6 ELECTRICAL PENETRATIONS

Openings around electrical penetrations through fire resistance-rated walls, partitions, floors, or ceilings shall be sealed and weathertight.

3.7 EQUIPMENT GROUNDING

Equipment grounding and bonding shall be in accordance with NFPA 70. Ground exposed, noncurrent-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductor in metallic and nonmetallic raceways, and neutral conductor of wiring systems.

3.8 GROUNDING SYSTEM

System grounding shall be installed to limit voltages due to lightning, line surges, unintentional contact with higher voltage lines, and to stabilize voltage to ground during normal operation. System grounding shall meet, at a minimum, the requirements of the NFPA. If not otherwise indicated on the drawings, system grounding shall consist of a minimum of two grounding electrodes.

3.9 FIELD QUALITY CONTROL

3.9.1 Devices Subject to Manual Operation

Upon installation, each device subject to manual operation shall be operated at least three times, demonstrating satisfactory operation each time.

3.9.2 Cable and Wire Testing

Perform testing with all conductor splices and intermediate terminations completed, with lightning arrestors removed, and disconnections made at points of final termination. Electrical conductors shall be tested to ensure continuity, phasing, proper splicing, freedom from unwanted grounds, and insulation values. Perform insulation resistance tests on all 600V power and control wiring (twisted/shielded instrumentation cable shall not require insulation testing). Insulation resistance shall be performed by an instrument which applies voltage of approximately 500 volts to provide direct reading of resistance. The minimum resistance shall be 250,000 ohms. Apply all insulation resistance testing of multiple conductor cables between one conductor and ground with all other conductors connected to the same ground. Test each conductor in a like manner.

3.9.3 Ground-Fault Circuit Interrupter Receptacle Test

Test GFI receptacles with a "load" (such as a plug in light) to verify that the "line" and "load" leads are not reversed.

3.9.4 Grounding System Test

Test each grounding electrode for resistance to ground before making connection to the grounding system. Tie grounding electrodes together and test grounding system to ensure continuity, and that resistance to ground does not exceed 25 ohms.

END OF SECTION

Specification Section	Title
01652	Pipeline Pressure Testing
02224	Excavation, Trenching, and Backfilling
02670	Rotary Drilled Extraction Wells
02671	Infiltration Gallery
03302	Cast-In-Place and Precast Concrete Structures
11214	Submersible Well Pumps
13446	Field Instrumentation
15060	Piping, Valves, and Appurtenances
15102	Conveyance Subsystem
16410	Electrical Wiring System