

DRAFT

TECHNICAL SPECIFICATION

**MARCO ISLAND R.O.
WATER TREATMENT PLANT
WELLFIELD EXPANSION**

Prepared for:

Florida Water Services
P.O. Box 609520
Orlando, Florida 32860-9520

Water Resource Solutions
Project No. 01-03810.H0

Prepared by:

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March 11, 1999

Mr. John Losch
Florida Water Services
500 Construction Lane
Lehigh, Florida 33936

Re: Marco R.O. Wellfield Expansion
Transmittal of Draft R.O. Well Specifications

Dear John:

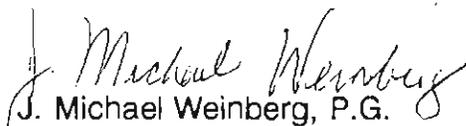
Water Resource Solutions is pleased to transmit a draft copy of the technical specifications and construction drawings for the new production wells on Marco Island for your review. An earlier draft was submitted to Boyle Engineering Corporation on February 5, 1999. Their comments have been addressed in draft that you have received.

The project manual can either be collated here (once we receive the front end documents) or by Florida Water Services, as you prefer. Let me know your thoughts on that.

We will have the right-of-way construction permit application material completed by the end of this week. Once done, we will send it on to Catherine Walker and coordinate with her to get the check for the permit fees processed ASAP. Permitting should be a relatively quick process, at least based on a previous conversation I had with Norm Trebilcock.

We look forward to your comments. Please call with any questions that you have.

Sincerely,


J. Michael Weinberg, P.G.
Senior Hydrogeologist

JMW:gng
encls.

pc: Catherine Walker
Ralph Terrero
Mike Switzer
Bob Cadle
Bill Hahn

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Cost Proposal Form

The Bidder hereby agrees to perform all work described in the Contract Documents for the following prices, which shall include all materials, permits, labor, equipment, transportation, overhead, all applicable taxes and costs of all kinds necessary to complete these work items in accordance with the Contract Documents.

**BID PROPOSAL FORM
THREE R.O. WELLS**

Item	Description	Unit	Anticipated Quantity	Unit Cost	Amount
1	General Requirements: Mobilization/Demobilization/Site Preparation, Indemnification, Insurance, Payment & Performance Bonds, Permits, etc.	Lump Sum	1	\$	\$
2	Surface Casing	Feet	180	\$	\$
3	Pilot Hole Drilling	Feet	925	\$	\$
4	Pilot Hole Reaming	Feet	925	\$	\$
5	Production Casing	Feet	1050	\$	\$
6	Cement Casing Grout	Sack	975	\$	\$
7	Open Hole Drilling	Feet	500	\$	\$
8	Well Development	Hours	36	\$	\$
9	Geophysical Logging (pilot, reamed and open hole)	Lump Sum	3	\$	\$
10	Step Drawdown Testing	Hours	15	\$	\$
11	Well Disinfection and Bacteriological Clearance	Lump Sum	3	\$	\$
12	Well Vault and Wellhead Installation	Lump Sum	3	\$	\$
13	Site Restoration	Lump Sum	3		
14	Extra work by drilling crews with drilling equipment	Hours	8	\$	\$
15	Extra work by crew with pump hoist	Hours	5	\$	\$
16	Extra work by crews	Hours	8	\$	\$
17	Standby time with rig and drilling crew on site	Hours	8	\$	\$
18	Standby time with rig on site and crew off site	Hours	8	\$	\$
TOTAL BID AMOUNT \$					

SECTION 2010 SUMMARY OF WORK

A. Project Description

Florida Water Services is expanding the capacity of a wellfield on Marco Island that supplies feedwater for a reverse osmosis (R.O.) water treatment plant. Three new R.O. wells will be constructed to augment the 15 existing wells in the dispersed wellfield. Production wells will be completed in the mid-Hawthorn aquifer at an estimated depth of 500 feet below land surface and cased to approximately 350 feet. The planned construction sites are within right-of-ways maintained by the City of Marco Island (Sheet 2 of the Drawings). Well locations may be changed by the Owner prior to initiating construction subject to permit approval, hydrogeologic conditions, or other factors.

The overall project consists of two separate construction contracts which are described as follows:

Contract 1: R.O. Well Construction, which involves well construction and testing, installation of well vaults, and furnishing of limited wellhead facilities.

Contract 2: Surface Facility Construction, which will be by others, involves installation of well pumps, construction of most wellhead facilities, and collection system installation.

B. Work Under This Contract

These Specifications and accompanying Drawings are for Work associated with the R.O. Well Construction Contract (Contract 1). Only Work included in Contract 1 is shown on the Drawings.

Generally, this Work will include, but not be limited to the following elements:

1. Construct three production wells to an estimated depth of 500 feet and cased to approximately 350 feet.
2. Develop, disinfect and provide bacteriological clearance of wells.
3. Furnish and install test pump and conduct step drawdown test at each well site.
4. Complete wells below grade in steel reinforced concrete vaults with traffic bearing (H-20 rated) aluminum hatch covers.

5. Install stainless steel well head adaptor, well seal, and miscellaneous fittings in accordance with the Drawings.

C. Coordination with Other Contractors

Another construction contractor(s) could be working on portions of Contract 2 at the same time that Work under this contract is being done. Coordinate your activities with other contractor(s) to allow orderly and timely completion of all Work.

D. Subcontractors

Contractor shall not employ any subcontractors against whom the Owner may have reasonable objection. The name, address and experience of all proposed subcontractors shall be submitted by the Contractor along with his Bid. All subcontractors must be approved by the Owner prior to Contract award.

E. Demobilization

At the completion of drilling, the Contractor shall remove all items and equipment which are not part of the completed wells and leave the site in a condition acceptable to the Owner. After demobilization is complete, the drilling area shall be clean and free of debris.

F. Site Restoration

Restore all areas disturbed by construction to a condition at least equal to the preconstruction condition including, but not limited to, all landscaping, driveways, roads, fences, and other improvements. Maintain ingress and egress to all properties adjacent to the construction sites and minimize inconvenience to abutting property occupants.

G. Photographic Records

Contractor shall prepare a photographic record of both pre-construction and post-construction conditions at the work sites. This shall include, but not be limited to, any surface improvements such as sidewalks and adjacent roadways, drainage features, landscaping, and completed work elements. Two sets of these labeled photographs shall be submitted to the Engineer prior to project closeout.

H. Compliance with Right-of-Way Construction Permits

The expected work sites are located in public right-of-ways maintained by the City of Marco Island. The Contractor will be provided with copies of the right-of-way construction permits and shall comply with the conditions contained therein. This shall include compliance with the "State of Florida Manual of Traffic Control and Safe Practices for Street and Highway Construction, Maintenance and Utility Operations" and with the Manual of Uniform Traffic Control Devices" and with all other governing safety regulations.

I. Surveying

Contractor shall retain a State of Florida licensed surveyor to layout the precise locations of wells and well vaults. It is critical that adequate setbacks from private property boundaries, roadways, and existing or future improvements such as sidewalks and drainage features are maintained in accordance with the Drawings and right-of-way construction permits.

J. Utility Location

Contractor shall have all existing utility services in the work areas located and marked prior to commencing construction. It shall be the Contractor's responsibility to verify that adequate clearance between existing services and work elements are present to complete the project as designed.

END OF SECTION

**SECTION 2020
DEFINITIONS AND ABBREVIATIONS**

A. General

The definitions and abbreviations used in the Drawings and Specification are as follows:

ANSI shall mean American National Standards Institute.

API shall mean American Petroleum Institute.

ASTM shall mean American Society of Testing and Materials.

AWWA shall mean American Water Works Association.

BLS shall refer to below land surface.

DHRS shall mean Department of Health and Rehabilitative Services.

FDEP shall mean the Florida Department of Environmental Protection.

EPA shall mean the United States Environmental Protection Agency.

NPT shall refer to National Pipe Threads

PVC shall refer to polyvinyl chloride.

SFWMD shall refer to the South Florida Water Management District.

USDA shall mean the United States Department of Agriculture.

END OF SECTION

**SECTION 2030
PERMITS AND FEES**

A. General

1. Contractor shall procure all permits, certificates, and licenses required by law for the execution of the Work, except those specifically excluded in B of this Section; and comply with all applicable Federal, State, and local regulations and ordinances.
2. Contractor shall schedule all inspections and obtain all written approvals of the agencies required by the permits and licenses.
3. The Owner and Engineer shall be furnished copies of each permit prior to the Contractor commencing work.

B. Permits by Owner

The Owner shall procure the following permits:

1. SFWMD Consumptive Water Use Permit modification. Execution of the Work is subject to approval of this application.
2. City of Marco Island Right-of-Way Construction Permits.

C. NPDES General Permit

1. It shall be the Contractor's responsibility to ensure that all fluid discharges to surface waters from well construction, development and testing comply with the requirements of the National Pollution Discharge Elimination System (NPDES), Generic Permit for Florida, as they apply to construction related discharges at Non-Contaminated Sites (FDEP Guidance Document June 19, 1995, or superseding documents).
2. Contractor shall be responsible to perform all sampling and analysis, monitoring, and reporting required under this Generic Permit.
3. Contractor shall provide a method of particulate removal or other treatment approaches to ensure that the discharge water is free of floating solids, visible foam, turbidity, or visible oil in such amounts as to form nuisances on surface water.

4. Contractor shall not be responsible for any additional treatment of the discharge caused by the presence of existing sources of contamination which would disqualify its coverage under the Generic Permit for Non-Contaminated Sites.

END OF SECTION

SECTION 2040 WORK SCHEDULES

A. Construction Schedule

The Contractor shall submit a detailed construction schedule as required in Article 2 of the General Conditions before commencing any site work. The schedule shall include the proposed spud date, completion date, and other significant construction and testing milestones for each well.

The schedule shall be revised monthly to reflect changes in the progress of the Work. If the work falls behind schedule, the Contractor shall take necessary action to get the project back on schedule and complete the Work within the contract times.

B. Working Hours

The Contractor shall perform work on site only within the designated official working hours as established by the local government, unless a special exception or permit is obtained from the local government by the Contractor. Requests for extended work hours must also be approved by the Owner and Engineer.

C. Delays for Extra Work

The Engineer may order the Contractor to stop operations so that extra work not included in the Specifications, such as previously unspecified testing and data collection, can be performed. The Engineer shall advise the Contractor when he proposes to do this and will schedule the request so that it causes a minimum of delay.

The Contractor shall be reimbursed for approved standby time and extra work at the hourly rates listed in the Cost Proposal Form. No payment for standby time or extra work shall be made unless advance written approval is granted by the Engineer or Owner.

D. Time of Completion

The Contractor shall achieve Substantial Completion of the Work within 100 calendar days of Notice to Proceed, and Final Completion within 125 calendar days. The Contractor may be assessed Liquidated Damages in accordance the Contract Documents for failure to complete the Work within the contract times.

END OF SECTION

SECTION 2050
MATERIAL, EQUIPMENT AND WORKMANSHIP

A. General

The Contractor shall be responsible for all labor, materials, transportation, tools, supplies, equipment, and appurtenances necessary to complete the Work in accordance with the Specifications and Drawings. All materials utilized shall be approved for use in potable water systems and shall be in general accordance with the latest revisions of the American Water Well Association Standard for Deep Wells (AWWA A100-66) and the National Water Well Association Standards as they apply to the particular needs or conditions encountered in the Work.

B. Certification of Chemicals

All chemicals used during the project or furnished for project operation that will come into contact with the drinking water supply shall conform with ANSI/NSF Standard 60-1998.

C. Remedial Work

If remedial work proves to be necessary to make a well acceptable and come within applicable regulations and/or the Specifications because of mechanical problems, loss of tools in the hole, defective material, or for any other cause, the Contractor shall propose a method of correcting the problem, in writing. Suggested methods shall be reviewed and approved by the Engineer before remedial work proceeds. Such work shall be performed at no additional cost to the Owner and shall not extend the length of the contract times. The Contractor is notified that all Specifications shall be met, including hole straightness and setting of casings to the points designated by the Engineer.

D. Abandonment of Well(s) by Contractor

Any hole in which the Contractor voluntarily stops work and/or fails to complete in a satisfactory manner in accordance with applicable regulations and/or the Specifications (and approved changes), shall be considered as abandoned by him. If the Engineer declares the hole abandoned by the Contractor, then no payment will be made for the abandoned hole. All abandoned holes shall be properly plugged and sealed by the Contractor at his own expense in accordance with federal, state, and local regulations. These holes shall be replaced by the Contractor at no cost to the Owner. The Contractor shall submit his plan of action for abandonment and plugging in writing to the Engineer. Casing strings may be removed only with the permission and approval of the Engineer.

E. Guarantee

Contractor guarantees that the work and service to be performed under the Contract and all workmanship, materials, and equipment performed, furnished, used, or installed for the Work shall be free from defects and flaws, and shall be performed and furnished in strict accordance with the Contract Documents; that the strength of all parts of all manufactured equipment shall be adequate and as specified; and that performance test requirements of the Contract Documents shall be fulfilled. The Contractor shall repair, correct, or replace all damage to the Work resulting from failures covered by the guarantee. The guarantee shall remain in effect for one year from the date of final acceptance by the Owner.

END OF SECTION

SECTION 2060 REPORTS

A. Contractor's Daily Log

The Contractor shall maintain a detailed log of his operations on the drilling rig during the construction of all wells. One copy of the most recent log shall be submitted to the Engineer on a daily basis. Each log report shall be signed by an authorized representative of the Contractor and the Engineer. The daily log shall include, but not be limited to, the following information:

1. A listing of all pay items including any authorized extra work or standby time completed by the Contractor during the day.
2. The reference point for all depth measurements.
3. The depth at which formation changes occur.
4. Identification of the material of which each stratum is composed.
5. The depth interval from which each formation sample is taken.
6. The depth interval from which each water sample is taken.
7. The bit size and depth at which hole diameters change.
8. The depth and interval of each cavity or lost circulation zone encountered during drilling.
9. Records of Marsh funnel viscosity and drilling mud density prior to production casing installation and production casing grout density in accordance with the Specifications.
10. Other pertinent data requested by the Engineer or Owner.

B. Well Completion Report

Upon completion of each well, the Contractor shall also submit to the Engineer a report and record drawings that include the following:

1. The total depth of the borehole and the length of casing installed in the well.

2. The nominal hole diameters.
3. The depth or location of any lost drilling fluid, drilling materials, or tools.
4. The type and amount of drilling fluid additives used.
5. The depth and diameter of any surface casing.
6. The amount, type, and weight of cement used in grouting production and surface casing strings. All cement additives must be identified.
7. A complete description (including length, diameter, depth, and mill certificates) of the well casing.
8. A summary of any drilling problems or remedial work performed.

END OF SECTION

**SECTION 2070
PROTECTION OF PROPERTY RIGHTS**

A. General

1. Contractor shall take special precautions to reduce to a minimum the nuisances and damage to property. Any damage to public or private property shall be immediately repaired or paid for by the Contractor at no expense to the Owner.
2. Equipment, tools, and materials shall be located in places where they will produce a minimum of nuisance.
3. Appropriate construction area warning signs required by the Right-of-Way Construction Permits and other applicable ordinances shall be posted at each work site.
4. Contractor shall remove all drilling fluids from any mud pits, fill the pits with clean material and grade the site at the completion of the Work.

B. Work on Private Lands

Execution of this work shall not convey to the Contractor any rights to work on private properties. All work shall be conducted in right-of-ways or easements and not on private land unless consent is agreed to by the property owner.

C. Public Nuisance

1. Contractor shall not create a public nuisance including, but not limited to, encroachment on adjacent lands, flooding of adjacent lands, excessive noise, or odor.
2. Contractor shall provide and maintain on site a hand-held decibel meter for recording noise levels. Sound levels shall not exceed 60 dBA from 6:30 A.M. to 7:00 P.M. This sound level shall be measured at a distance of 400 feet, or at the exterior wall of the nearest residence, whichever is nearest to the drill site. Levels at the drilling equipment shall not exceed 85 dBA at any time. Sound levels in excess of these values are sufficient cause to have the work halted until equipment can be quieted to these levels.

3. No extra charge or extension of contract times shall be approved for time lost due to work stoppage resulting from the creation of a public nuisance.

END OF SECTION

SECTION 3010 WELL SPECIFICATIONS

PART 1 - WELL CONSTRUCTION SEQUENCE

The information listed in the following construction sequence is only approximate. Actual casing and open hole depths will vary depending on the specific subsurface conditions encountered. In addition, the Contractor should be aware that the well testing plan described in these Specifications may be changed in order of occurrence, or deleted, and additional work may be added by the Owner.

- (1) Site preparation and mobilization.
- (2) Install pit casing per Contractor requirements.
- (3) Drill 8-inch diameter pilot hole from base of pit casing to ± 350 feet bls by mud-rotary method.
- (4) Perform logging as specified in Section 2000 (4.1).
- (5) Ream hole from surface to ± 350 feet bls to 18-inch nominal by mud-rotary method. Contractor to perform inclination or straightness surveys as directed by the Engineer.
- (6) Install PVC casing string as indicated on Sheet 3 of the Drawings.
- (7) Grout casing string in hole. Grouting shall be undertaken in stages. The first stage shall utilize the pressure grouting method. All subsequent stages shall be performed using a tremie pipe. Contractor shall take appropriate measure to avoid exceeding the allowable collapse and burst pressure of the casing during installation and cementing. The maximum cement stage shall not exceed 180 feet without prior approval of the Engineer.
- (8) Clear casing of drilling mud.
- (9) Drill nominal 11-inch diameter open hole using reverse-air from the base of production casing to ± 510 feet bls. Monitor formation water level drawdown and reverse air discharge in accordance with the Specifications.
- (10) Collect clean water samples at least every 20 feet during reverse-air drilling.
- (11) Develop well by a combination of reverse-air and high-volume pumping and surging until discharge is sediment free.

- (12) Disinfect well as specified in Part 4(K) of this Section.
- (13) Perform geophysical logging as specified in Part 5(A) of this Section.
- (14) Conduct step drawdown test as specified in Part 5(C) of this Section.
- (15) Install well vault and complete wellhead as specified in Part 7 of this Section.
- (16) Perform bacteriological survey as specified in Part 4(K) of this Section.

PART 2 - SITE PREPARATION, MOBILIZATION AND DEMOBILIZATION

A. Mobilization

Contractor shall set-up equipment necessary to achieve the quality of workmanship required by these Specification and to complete the Work on schedule.

B. Site Preparation

1. Contractor shall submit a site preparation plan for approval by the Owner prior to commencing work. Within the limits of the work areas, the Contractor shall clear grub trees (as directed), stumps, down timber, brush, and other objects standing on or protruding from the ground. All roots shall be grubbed and removed to a minimum of 18-inches below the surface of the ground. Holes caused by grubbing operations shall be filled to natural grade elevations. The disposal method of all material and debris resulting from clearing and grubbing operations shall be subject to review by the Engineer. It shall be the responsibility of the Contractor to obtain any permits that are required for these procedures.
2. Land surfaces shall be filled and graded as needed to ensure that final well vault elevations and slopes are in compliance with Right-of-Way Construction Permit requirements. Surfaces adjacent to wells shall be graded such that runoff is directed away from the vaults.
3. Contractor shall maintain an all-weather temporary access to the wells and construction staging areas. Any turf that is destroyed by the Contractor shall be replaced with like-kind sod.

C. Demobilization and Site Restoration

At the completion of the Work, Contractor shall remove all excess materials and equipment and restore work sites to original contours. Drilling areas shall be clean and free of debris, holes, and/or piles of dirt, brush or other natural and synthetic materials. Any formerly existing sod or landscape vegetation shall be replaced with vegetation equal to that destroyed or damaged. All drilling fluids and drill cuttings shall be removed from the work sites.

PART 3 - CONDITIONS AND HAZARDS

A. General

Information regarding subsurface conditions and potential drilling hazards is intended to assist the Contractor in preparing his Bid. The Owner or Engineer does not guarantee its accuracy or that it is necessarily indicative of conditions to be encountered in drilling the wells. Contractor shall satisfy himself regarding all local conditions affecting the Work by personal investigation and neither the information on local geology, nor that derived from maps or plans provided by the Owner or his agents shall act to relieve the Contractor of any responsibility hereunder or from fulfilling any and all of the terms and requirements of the Contract and Specifications.

B. Anticipated Geology and Potential Hazards

The upper 40 to 50 feet of sediment is expected to consist of unconsolidated quartz sand with minor shell and clay. Indurated limestone is expected from 50 to about 150 feet. The interval from 150 to 275 feet contains variable sediments that include unconsolidated sand, sandstone, limestone and lime mud. Lost circulation zones are common here, particularly between 150 and 200 feet. Clayey sediments are expected from 275 feet until the top of the production zone at about 340 feet. The production zone is expected to consist of indurated limestone with some interbeds of lime mud and lenses of quartz sand.

Swelling clays and caving sands may be present in cased portions of the wells. Production casings must seal off all formations encountered along their entire length.

C. Hydrologic Considerations

Static hydraulic heads in the production zone are expected to be about 20 feet above land surface. It shall be the Contractor's responsibility to control flow during all stages of well construction, development and testing. This shall be implemented using drilling mud only as a weight material to suppress flow during mud-rotary

drilling and through the use of a blowout preventor or other approved flow control device during reverse-air drilling. The use of salt or other brines as a weight material shall not be allowed without approval by the FDEP and Engineer. The blowout preventor provided shall be a commercially available, single annular type, or approved equivalent. Manufacturer's specifications pertaining to the type of preventor proposed by the Contractor shall be approved by the Engineer in advance of use. The wellhead shall be sealed at all times when no work is being performed in zones where flowing conditions may be present.

PART 4 - DRILLING REQUIREMENTS

A. Equipment Requirements

1. Only equipment in top working condition shall be provided. The Owner and Engineer shall reserve the right to inspect the equipment of bidding contractors to assure qualifications. The Contractor shall use his own drilling equipment having the capabilities necessary to do the described work. Any unnecessary delays or work stoppages due to equipment failure shall not be considered a valid reason for extending the length of the contract. The Contractor shall be held responsible and payment may be withheld for damages to a well due to any cause of negligence, faulty operation, or equipment failure.
2. Contractor shall provide and operate equipment capable of handling the largest load that will be placed upon the rigs' drilling and supporting equipment. If conditions develop in the field that prove the rig and supporting equipment supplied by the Contractor are incapable of completing a well, the Contractor will be required, at his own expense, to provide a larger rig with the necessary capacity.

B. Water Supply

It shall be the responsibility of the Contractor to provide an adequate supply of water for makeup of drilling fluids, grout mixing, or other purposes required to complete Work. Only potable water or recirculated formation water can be introduced into the wells.

C. Drilling Methods

Pit casings can be installed by one of various methods selected by the Contractor and approved by the Engineer. Pilot hole drilling and reaming for production casing installation shall be by the mud-rotary method. The reverse-air method shall be used for all open hole drilling, except in limited cases where formation yields are

inadequate and an external source of potable water is required to circulate cuttings.

During reaming operations, Contractor shall incorporate the use of a lead bit or stinger and a staged drilling assembly to facilitate pilot hole tracking. Drilling mud shall be conditioned and recirculated employing suitable devices such as screens, shale shakers, and desanders.

D. Drilling Fluids

Fluid used for mud-rotary circulation shall be a mixture of potable water and high-grade bentonite unless other types of drilling fluid or fluid additives have been approved in advance by the Engineer. All drilling additives must be approved for use in public supply wells by FDEP. No drilling fluid other than potable water shall be used in the open hole interval.

Proper makeup and conditioning of drilling mud should be applied to maintain a fluid density ranging from 8.6 to 9.0 lbs/gallon under normal drilling conditions. The borehole should be prepared for casing installation by continuing fluid circulation until cuttings have been completely removed and the drilling fluid is uniform. Excessive mud thickening should be corrected prior to casing installation. Care should be taken to prevent swabbing due to high mud viscosity or high gel strength while tripping the drill string in or out of the hole.

Contractor shall provide a mud balance and weigh several samples of conditioned drilling fluid during final circulation before installing the production casing string. Contractor shall also measure Marsh funnel viscosity, which should be below 40 seconds when circulating drilling fluid prior to cementing. Sample weight, viscosity, and collection time shall be recorded in the Contractor's daily log.

E. Lost Circulation

Lost circulation conditions may be encountered while drilling with mud. The use of lost circulation materials shall be restricted to those materials approved by FDEP.

F. Cuttings and Drilling Fluid Disposal

1. Drill cuttings and fluids from mud-rotary drilling shall be removed from the construction sites and disposed at an approved location. Contractor shall furnish to the Owner, prior to beginning construction, the name and location of his disposal site along with documentation that the site has been approved by the appropriate regulatory agencies. Fluids displaced from the borehole during cementing operations shall be considered excess drilling fluid and shall also be disposed in an approved manner.

2. Drilling fluids from reverse-air drilling, well development, and well testing shall be filtered to remove suspended solids and discharged to a stormwater drainage conveyance or other discharge point. The fluid discharge plan shall be subject to review by the Engineer. For purpose of the Bid, the Contractor should assume that the discharge point shall be located no more than 500 feet from any well site.

F. Cementing Procedures

Cementing shall be accomplished in stages by means of a collarless tremie pipe with the exception of the first stage cement, which shall be pressure grouted. Before each cementing stage, Contractor shall tag the top of the cement emplaced in the previous stage with a collarless tremie pipe and recondition the mud to assure proper mud displacement by the cement. The maximum cement stage shall not exceed 180 feet without prior approval of the Engineer.

Procedures for each stage of cementing shall be continuous. If loss of circulation or no return of fluid is encountered, the Engineer shall be notified immediately of what remedial measures are underway to re-establish the circulation and complete the cementing program according to the Specifications. When casing is being set and cemented in place, Contractor's shall ensure that operations do not cause collapse or failure of the casing.

Contractor shall provide a mud balance and weigh at least two samples of grout collected at widely-spaced intervals during each stage of production casing cementation. Sample weight and collection time shall be recorded in the Contractor's daily log. Grout weights should be consistent with those reported in the Halliburton Cementing Tables (15.6 lbs/gal for neat cement, 13.5 lbs/gal for 6% bentonite slurry).

It may be necessary to plug back a portion of the borehole with cement. In such cases cementing shall be done through a tremie pipe positioned beneath the top point in the borehole to which the cement plug will be placed.

G. Well Plumbness and Alignment

All boreholes shall be circular, straight and plumb. No doglegs or departures from a straight line shall be permitted which would interfere with or prevent casings or pumps from being set at their required depths or impede achievement of proper cement seals.

The maximum allowable inclination from the vertical at any portion of a hole or survey point shall be one (1) degree. Changes in the inclination measurements should not exceed 0.5 degrees between two adjacent measurements. At the

direction of the Engineer, Contractor shall perform an inclination survey or a test of hole straightness to confirm compliance with these specifications.

The hole straightness test shall be performed by lowering a section of pipe 40 feet long or a dummy of the specified pump length into the well to a depth of at least 200 feet. The outer diameter of the test pipe or dummy shall be not more than ½-inch smaller than the inside diameter of that part of the casing or hole being tested. The lowered unit shall pass freely through the entire tested section. The inclination survey shall be performed using a TOTCO wireline survey tool, or other device approved by the Engineer. Contractor shall perform all tests of hole straightness and alignment at his own expense.

Contractor shall submit to the Engineer a remediation plan to repair any well that fails to meet the specifications for a straight and plumb hole. If the well cannot be repaired, it shall be plugged in accordance with current state requirements and a new well constructed at the Contractor's expense.

H. Formation Samples

One set of formation samples (drill cuttings) per well shall be collected at intervals of 5 feet and at every formation change. Samples shall be preserved in cloth sample sacks furnished by the Contractor. Sample containers shall be plainly marked with the well identification and shall show the depth below land surface from which they were collected. Contractor shall collect the samples, deliver them to the Engineer, and provide acceptable facilities for sample storage while they remain on site. Samples shall be of such volume that they can later be divided by the Engineer into three sets (one for the Engineer, one for the SFWMD, and one for the Florida Geological Survey).

I. Water Samples

During reverse-air drilling operations, Contractor shall collect a clean, clear water sample from the drill stem discharge at every rod change, or at least every 20 feet. Contractor shall provide an appropriate sampling port in the discharge pipe for collection these samples. Samples shall be analyzed in the field by the Engineer for chloride ion and specific conductance.

J. Well Development

Contractor shall utilize a combination of reverse-air circulation, straight-air circulation and high volume pumping to develop the well until, to the satisfaction of the Engineer, the discharge water is free of sediments. During reverse-air development, the drill stem shall be placed in the well and the intake depth varied through the

entire open-hole while pumping. This shall be followed by straight-air development and repeated surging of the well.

In the final stage of development, Contractor shall provide and install a pump, and pump the well at a rate of at least 1.5 times the design capacity of 500 gpm. Contractor shall also provide a centrifugal sand sampler, or other approved method of quantifying sand content in the parts/million range and a silt density index (SDI) test device. Contractor shall determine sand content and SDI every hour during final development and provide this data to the Engineer.

K. Well Disinfection and Bacteriological Clearance

Disinfection Procedure

Contractor shall disinfect the wells in accordance with AWWA standards for Deep Wells (AWWA A100-66) soon after well construction and cleaning procedures have been completed. Where test pumping equipment is to be used, such equipment shall be installed prior to or during a follow-up disinfection of the well and all equipment shall be thoroughly cleaned and disinfected in accordance with AWWA A100-66 prior to installation. Contractor shall carry out adequate cleaning procedures immediately preceding disinfection where evidence indicates that normal well construction and development have not adequately cleaned the well. All oil, grease, soil, and other materials, which could protect bacteria from disinfectants shall be removed from the well.

Disinfection procedures shall ensure that the disinfecting agent is uniformly applied throughout the entire water depth of the well. The disinfecting agent shall be left in the well for a period of at least 24 hours. Any portion of the well casing above the water level shall be maintained in a damp condition with water containing the required concentration of disinfecting agent for a period of not less than 20 minutes. After a 24 hour or longer contact period, the well is to be pumped to clear it of the disinfecting agent. The disposal point for the purged water shall be selected so as to avoid potential damage to aquatic life or vegetation.

Disinfectants

A chlorinating agent approved by applicable state and local regulatory agencies shall be used as the disinfectant. The disinfectant shall be delivered to the site of the work in original, closed containers bearing the original label indicating the percentage of available chlorine. During storage, disinfectants shall not be exposed to the atmosphere or to direct sunlight. Unless superseded by governmental regulation, the quantity of chlorine compounds used for disinfection shall be sufficient to produce a minimum of 100 ppm and not more than 200 ppm residual chlorine in solution when mixed with the total volume of water in the well.

Bacteriological Clearance

Following disinfection, a bacteriological survey shall be conducted in accordance with Chapter 62-555.315, FAC. Samples of raw water from the well shall be submitted to the DHRS or a state certified laboratory for bacteriological analysis. Sampling points and collection procedures shall be approved by FDEP prior to initiating the survey. It is the responsibility of the Contractor to coordinate his efforts with the analytical laboratory to effect successful clearance of the wells.

Contractor is to notify the Engineer at least three days in advance of initiating the bacteriological survey. In the event that samples analyzed exceed FDEP standards, the Contractor may elect to either 1) continue sampling until the required number of samples meet the disinfection standards, or 2) discontinue testing, re-disinfect the well, and start the test procedure over. The later method is advisable where coliform densities exceed the standard on a regular basis.

Upon successful completion of the bacteriological survey(s), the Contractor shall provide the Owner and Engineer with all sampling records including sampling time, date, and collector name; and copies of all laboratory analytical reports and correspondences with DHRS or FDEP generated as a result of the bacteriological survey(s).

N. Wellhead Security

At all times during the progress of the Work, the Contractor shall use reasonable precautions to prevent either tampering with the well or the entrance of foreign material into it. When flowing conditions may be encountered, the well shall be sealed at the end of the work day to prevent flow from occurring.

PART 5 - DATA ACQUISITION

A. Geophysical Logging

The borehole shall be prepared and conditioned prior to geophysical logging to ensure that it is open and can be logged with a minimum of delay. Contractor shall perform the required logging listed below and provide the Engineer with ten hard copies of each log and one copy of each log in electronic format (ASCII, or other approved format). The same number of copies of logs displaying percent flow as a function of depth based on computer-processed flow meter and caliper log data shall also be provided.

The following geophysical logs shall be run in the 8-inch pilot hole of each well prior to reaming:

Natural gamma
Dual inductance

The following geophysical logs shall be run in the reamed hole prior to installing the production casing string:

Caliper

Following the completion of each well, the following geophysical logs shall be run:

Natural gamma
Dual inductance
Caliper
Flowmeter
Fluid Resistivity
Percent Flow (from caliper and flow logs)

Flow and resistivity logs shall be run with the well flowing at a rate of at least 250 gpm. Contractor shall provide discharge piping to a catch basin or other approved discharge point. If the static head is not adequate to sustain a 250 gpm withdrawal rate, Contractor, at no additional charge, shall also furnish and install a pump of sufficient capacity to complete the logging work.

B. Water Level and Flow Measurements

During reverse-air drilling, the Contractor shall furnish and install an accurate device (such as an orifice plate) to measure the total discharge rate from the well and an electric water level indicator to monitor well levels. Contractor shall record static water level in the well at the beginning of each drilling day, the level after each break in circulation, and the level and discharge rate every 20 feet during reverse-air drilling.

C. Step Drawdown Tests

A step drawdown test of at least 4-hour duration shall be conducted after each well has been satisfactorily developed. Contractor shall furnish, install, and remove all equipment necessary to conduct the test, including but not limited to, an electric pump, appropriately-sized electric generator to operate the pump, and a discharge system connected to a stormwater drainage conveyance or other approved discharge point located no more than 500 feet from the well site.

The discharge system shall be equipped with a throttling valve and a calibrated flow meter to control and accurately measure discharge, and a sampling tap in an easily accessible location. Clear access to the wellhead for water level measurement must

be maintained. The test pump shall be capable of pumping the well at constant rates ranging from 350 to 1,200 gpm.

If the test pump for step drawdown tests is also used for high volume well development, the time between completing development and initiating the test must be sufficient to allow water levels to return to static conditions.

D. Water Quality Testing

Water samples for analysis of chloride ion, total dissolved solids, specific conductance, and primary and secondary drinking water standard constituents will be collected by the Engineer during the step-drawdown test. Laboratory analytical costs for this work shall be the responsibility of the Owner.

PART 6 - MATERIAL SPECIFICATIONS

A. General

The minimum standards described in the following Specifications shall apply to all well construction activities. Contractor may propose to the Engineer the use of alternative well casing materials of an equivalent or higher grade than specified herein.

B. Pit Casing

The material, length, and method of pit casing installation shall be determined by the Contractor, subject to approval by the Engineer. The inside diameter of the pit casing shall be sufficient to accommodate a drill bit that will provide a minimum annulus of two inches between the production casing collars and the reamed borehole.

C. Production Casing

The casings for all wells shall be new, unused Schedule 80 PVC (Cell Class 12454), or approved equivalent, that is approved for use in public supply wells. Pipe joints shall be solvent welded and pinned at each joint connection with stainless steel screws sized and spaced such that they will support the pipe load in the absence of strength from the solvent weld. The screws shall be installed in a manner that will prevent them from penetrating through the internal surface of the casing. Spline connected SDR 17 PVC casing as manufactured by the CertainTeed Corporation is an approved substitute for solvent-welded PVC pipe. Contractor shall supply the Engineer with casing mill certificates before installing any casing.

D. Centralizers

Casing for all wells shall be fitted with Halliburton type hinged centralizers meeting API Specification 10D at 0, 90, 180, and 270 degrees around the casing at each position. Centralizers shall be fastened to the casing using clamps or screws provided by the manufacturer and shall not penetrate the casing material. Centralizers shall be placed directly below casing joints as follows.

Pit Casing

1. One set at 5 feet above the bottom end of the casing
2. One set within 5 feet of land surface

Production Casing

1. One set 5 feet above the base of the casing.
2. One set 20 feet above the base of the casing.
3. One set at 40 foot intervals above the centralizer placed 20 feet above the base of the casing.
4. One set 20 feet below land surface.

All centralizers shall be in a precise vertical alignment, one above the other, to allow for the placement of a tremie pipe in the annulus and have sufficient size and strength to keep the casing centered in the borehole.

E. Cement

Sulfate-resistant cement shall be used for all cementing of casings and hole plugging. The lower 100 feet of the production casing grout shall be ASTM Type II (API Class B) cement mixed with no more than 5.2 gallons of water per sack of cement. Additional casing grout shall be ASTM Type II cement mixed with up to 6% bentonite and no more than 9 gallons of water per sack of cement. No more mix water than that specified in the Halliburton Cementing Tables shall be utilized. Cement additives such as Flocele or gilsonite may be used to regain lost-circulation, if approved in advance by the Engineer. Organic polymers, peanut shells, and cotton seed hulls shall not be used as lost circulation materials. All grout mixtures shall be approved by the Engineer in advance of placement. The unit cost for grout shall include cement and all additives and lost circulation materials.

PART 7 - WELL VAULT AND WELLHEAD COMPLETION

1.0 Well Head Assembly

Contractor shall furnish all labor, materials, and equipment required for well head completion in conformance with the Specifications and Drawings.

A. Materials

Stainless-steel components shall conform with Section 4010 of the Specifications.

Poly vinyl chloride (PVC) pipe and fittings shall be constructed of Schedule 80 conforming to ASTM F-480, latest version. Solvent-welded joints shall conform to ASTM D-2855, latest version.

Flanges shall be joined using full-faced gaskets in conformance with Section 4010(2.0)(K).

All openings through the well vaults shall be secured with removable plugs made of PVC or other water resistant material to prohibit sediment and construction debris from entering the vaults until permanent piping has been installed by others.

B. Shop Drawings

Submittals shall be made as required in Section 4010(1.0)(b). A drawing shall be included that shows the elevation of all major well head components relative to the base of the well vault. A certification shall be provided to demonstrate that the welder who will fabricate the wellhead assembly is qualified for stainless steel welding.

Contractor through his own efforts shall confirm all measurements shown on the Engineer's Drawings. It shall be the Contractor's responsibility to ensure that the top of the completed well head assembly is at the elevation of 22-inches above the vault base and that adequate tolerances are maintained to allow for unobstructed installation and use of the wellhead equipment.

C. General Description

The well head assembly shall consist of a 12-inch diameter stainless-steel adaptor joined to the top of the production casing string, and a stainless steel well seal supplied with miscellaneous PVC fittings as shown on the Drawings.

The well head adaptor shall consist of a 12-inch diameter, Schedule 10s, 316L stainless-steel spool fillet-welded above and below to forged 150-Class, 316 stainless-steel flanges. The base of the adaptor shall be securely bolted to a 12-inch diameter Schedule 80 PVC flange which is solvent-welded to the top of the production casing string. This joint shall be encased in steel-reinforced concrete as shown on the Drawings.

The well seal shall consist of a 6-inch diameter, Schedule 10s, 316L stainless-steel spool fillet-welded above to a forged 150-Class, 316 stainless-steel flange; and fillet-welded as shown on Sheet 4 to a 1-inch thick, 12-inch diameter, 316L stainless-steel compression flange. The 12-inch flange shall contain four 1.5-inch diameter 316 stainless-steel couplings (access ports) spaced 90-degrees apart that are secured with threaded 316 stainless-steel plugs. The base of the 6-inch spool shall be threaded (6-inch FNPT) for connection of the pump column by others.

Contractor shall provide the PVC fittings and valves shown on Drawing 4 to secure the well head assembly until subsequent surface facilities have been constructed by others.

2.0 Well Vaults

A. Materials

Each well shall be completed in a pre-cast, steel-reinforced concrete vault as shown on Sheet 3 of the Drawings. The rebar schedule shall conform with manufacturer's specifications based on the design and intended use of the product. Interior and exterior surfaces of vaults shall be coated to inhibit infiltration of groundwater. Interior surfaces shall be pre-treated by grit blasting then coated with prime, intermediate and finish coats of polymorphic resin (Integrated Environmental Technologies, DS-101, DS-301, DS-401; or approved equivalent) applied following manufacturer's specifications. Exterior vault surfaces shall be grit blasted, then coated with Bituminous Epoxy also applied following manufacturer's recommendations.

Concrete shall have a 28-day compressive strength of 3,000 psi and conform with Section 4020 of the Specifications.

Access doors for the vaults shall be H-20 rated, heavy duty channel frame, double-leaf aluminum type with stainless steel hinges and attaching hardware, stainless steel hold open arms with positive locking features, stainless steel compression spring assist, recessed stainless steel handles, and flush-mounted stainless steel locks.

B. Shop Drawings

Shop drawings for the vaults, access doors, and vault interior and exterior coating materials shall be included in the Contractor's submittals.

C. General Description

Equipment installations shall conform with Right-of-Way Construction Permit specifications, to include completion of the vaults and access doors at the elevations, setbacks and slopes shown on Sheet 3 of the Drawings. Adjacent land surfaces shall be graded as necessary to direct runoff from precipitation away from the vaults.

END OF SECTION

SECTION 4010 STAINLESS-STEEL PIPE

1.0 GENERAL

A. Description

This section includes materials and installation of stainless-steel pipe and fittings 24-inch in diameter and smaller conforming to ASTM A 312 and having a maximum design pressure of 150 psi.

B. Submittals

1. Submit shop drawings in accordance with the General Conditions.
2. Submit materials list showing material of pipe and fittings with ASTM reference and grade. Submit manufacturer's certification of compliance with referenced standards, e.g., ASTM A 53, A 135, A 587, AWWA C200. Show piping service (fuel oil, gasoline, water air, etc.).
3. For piping 6-inches and larger, submit piping layout drawings showing location and dimensions of pipe and fittings. Include laying lengths of valves, meters, in-line pumps, and other equipment determining piping dimensions. Label or number each fitting or piece of pipe and provide the following information for each item:
 - a. Material of construction, with ASTM or API reference and grade.
 - b. Wall thickness of steel cylinder.
 - c. Paint prime coating, where prime coat is required.
 - d. Manufacturer's certificates of compliance with referenced pipe standards, e.g., ASTM A 53, ASTM A 135, API 5L, AWWA C200.
4. Submit coating application test records for field measuring paint coating thickness and holiday detection for each pipe section and fitting. Describe repair procedures used.

2.0 MATERIALS

A. Pipe

1. Pipe smaller than 3-inches shall conform to ASTM A 312, Grade TP 316L. Pipe 3-inches and larger shall conform to ASTM A 312, Grade TP 316L.
2. Pipe sizes and wall thicknesses shall conform to ANSI B36.19 as follows:

Pipe Size	Wall Thickness
1-inch and smaller	Schedule 80s
1¼-inches through 3-inches	Schedule 40s
3½-inches through 12-inches	Schedule 10s
Larger than 12-inches, through 24-inches	Schedule 5s

B. Fittings

1. Fittings 3-inches and smaller shall be threaded or socket welded, conforming to ANSI B16.11, 3,000-pound CWP. Material for threaded fittings shall conform to ASTM A 403, Class WP316 or ASTM A 182, Grade F316. Material for socket welded fittings shall conform to ASTM A 403, Class WP316L or ASTM A 182, Grade F316L.
2. Fittings for buried or submerged pipe 3-inches through 24-inches shall be butt-welded, conforming to ASTM A 403, Class WP, Same Material and wall thickness as the pipe, conforming to ANSI B16.9. Elbows shall be long radius.
3. Fittings for aboveground or exposed pipe 3-inches through 24-inches shall be flanged, conforming to ASTM A 403, Class WP, same material and wall thickness as the pipe, conforming to ANSI B16.9. Elbows shall be long radius.

C. Pickling, Passivating, Final Cleaning, and Quality Control

1. Pipe and fittings shall be final pickled and passivated per ASTM A 380. Final cleaning shall be in accordance with AWWA C220, Section 3.8.

After final cleaning, wet surfaces and inspect for rust spots after 24 hours. Reclean if there is any evidence of rusting.

2. Include the "Hydrostatic Test" and "Flattening Test" requirements described in ASTM A 530.

D. Protective End Caps

Provide protective end caps on each piece of pipe or fabricated section, completely sealing the piece from contamination during shipment and storage. Provide the same type of seals on each fitting, or ship and store fittings in sealed boxes or containers.

E. Joints

1. Joints for pipes 3-inches and smaller shall be threaded or socket welded, same material as specified for fittings, 3,000-pound WOG, conforming to ANSI B16.11.
2. Joints for buried or submerged pipe larger than 3-inches shall be butt-welded.
3. Joints for aboveground or exposed pipe larger than 3-inches shall be flanged.

F. Outlets and Nozzles

Outlets of size 3-inches and smaller in piping 4-inches and larger shall be of the Thredolet type, per AWWA Manual M11 (1989 edition), Figure 13-23. Outlets shall be 3,000-pound WOG stainless steel per ASTM A 182, Grade F316L, or ASTM A 403, Grade WP316L. Threads shall comply with ANSI B1.20.1. Outlets shall be Bonney Forge Co. "Thredolet," Allied Piping Products Co. "Branchlet," or equal.

G. Thread Lubricant

Use Teflon thread lubricating compound or Teflon tape.

H. Flanges

1. Provide weld-neck flanges (conforming to ANSI B16.5) for piping 3-inches and smaller to connect to flanged valves, fittings, or equipment. Provide weld-neck or slip-on flanges for piping large than 3-inches. Flanges shall be Class 150 per ANSI B16.5. Flanges shall match the

connecting flanges on the adjacent fitting, valve, or piece of equipment. Flanges shall be flat face.

2. Material for weld-neck and slip-on flanges shall conform to ASTM A 182, Grade F316L.

I. Bolts and Nuts for Flanges

1. Bolts and nuts for flanges shall be Type 316 stainless steel conforming to ASTM A 193, Grade B8M, for bolts and ASTM A 194, Grade 8M, for nuts.
2. Provide washer for each unit. Washers shall be of the same material as the nuts.

J. Lubricant for Stainless-Steel Bolts and Nuts

Lubricant shall be chloride free and shall be TRX-Synlube by Ramco, Anti-Seize by Ramco, Husk-It Huske Lube O'Seal, or equal.

K. Gaskets for Flanges

Gaskets shall be full face, 1/8-inch thick. Gaskets shall be one of the following nonasbestos materials:

1. Cloth-inserted rubber, with a Shore "A" hardness of 75 to 85 and conforming to ASTM D 1330, Grade I or II. Gaskets shall be suitable for a pressure of 200 psi at a temperature of 180°F.
2. Acrylic or aramid fiber bound with nitrile. Products: Garlock "Bluegard," Klinger "Klingersil C4400," or equal. Gaskets shall be suitable for a water pressure of 500 psi at a temperature of 400°F.

3.0 EXECUTION

A. Fabrication, Assembly, and Erection

1. Beveled ends for butt welding shall conform to ANSI B16.25. Remove slag by chipping or grinding. Surfaces shall be clean of paint, oil, rust, scale, slag, and other material detrimental to welding. When welding the reverse side, chip out slag before welding.
2. Fabrication shall comply with ANSI B31.3, Chapter V. Welding procedure and performance qualifications shall be in accordance with

Section IX, Articles II and III, respectively, of the ASME Boiler and Pressure Vessel Code.

3. The minimum number of passes for welded joints shall be as follows:

Steel Cylinder Thickness (inch)	Minimum Number of Passes for Weld
Less than 0.1875	1
0.1875 through 0.25	2
Greater than 0.25	3

Welds shall be full penetration.

4. Use the shielded metal arc welding (SMAW) submerged arc welding (SAW), flux-cored arc welding (FCAW), or gas-metal arc welding (GMAW) process for shop welding. Use the SMAW process for field welding.
5. Welding preparation shall comply with ANSI B31.3, paragraph 328.4. Limitations on imperfections in welds shall conform to the requirements in ANSI B31.3, Table 341.3.2, and paragraph 341.4 for visual examination.
6. Identify welds in accordance with ANSI B31.3, paragraph 328.5.
7. Clean each layer of deposited weld metal prior to depositing the next layer of weld metal, including the final pass, by a power-driven wire brush.
8. Purge the interior of the pipe with inert gas prior to the root pass.
9. Welded butt joints (both longitudinal and circumferential) shall comply with AWWA C220, Section 3. Do not allow heat tint to form in the heat affected zone (HAZ) or remove heat tint completely from the HAZ of the finished weld. The maximum depth of grinding or abrasive blasting to remove defects shall not exceed 10% of the wall thickness. Do not perform abrasive blasting with steel shot, grit, or sand.
10. Welding electrodes shall comply with AWS A5.4. Bare wire shall comply with AWS A5.9. Use electrodes E 316 for Type 316 stainless steel.

B. Shop Testing of Fabricated or Welded Components

After completion of fabrication and welding in the shop and prior to the application of any lining or coating, test each component according to the referenced standards. Test fabricated fittings per AWWA C200. Test the seams in fittings which have not been previously shop hydrostatically tested by the dye penetrant method as described in ASME Boiler and Pressure Vessel Code Section VIII, Appendix B. In lieu of the dye penetrant method of testing, completed fittings may be hydrostatically tested. Use the field hydrostatic test pressure or 125% of the design pressure, whichever is higher.

C. Installing Threaded Piping

Ream, clean, and remove burrs from threaded piping before making up joints. Apply thread lubricant to threaded ends before installing fittings, couplings, unions, or joints.

D. Installing Flanged Piping

1. Set pipe with the flange bolt holes straddling the pipe horizontal and vertical centerline. Install pipe without springing, forcing, or stressing the pipe or any adjacent connecting valves or equipment.
2. Clean flanges by wire brushing before installing flanged fittings. Clean flange bolts and nuts by wire brushing, lubricate carbon steel bolts with oil and graphite, and tighten nuts uniformly and progressively. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reset or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight.

E. Installation of Stainless-Steel Bolts and Nuts

Prior to assembly, coat threaded portions of stainless-steel bolts and nuts with lubricants.

F. Installing Aboveground or Exposed Piping

Install pipe without springing, forcing, or stressing the pipe or any adjacent connecting valves or equipment.

END OF SECTION

**SECTION 4020
CONCRETE CONSTRUCTION**

1.0 SCOPE

- A. Reinforced concrete construction and related items necessary to complete work shown or specified are a part of the Contract unless specifically excepted.
- B. Construction of all concrete items shall be shown on the Drawings and in accordance with the Specifications.

2.0 MATERIALS

- A. Portland cement shall conform to the requirements of ASTM Specifications C 150, Type I or II. Only one brand and manufacturer of approved cement shall be used for any one structure.
- B. Regular fine and coarse aggregates shall conform to the requirements of ASTM Specification C 33.
- C. Water shall be clean and free from oils, acids, alkalis, organic materials of other substances that may be deleterious to concrete or steel.
- D. Reinforcing steel shall be deformed bars conforming to the requirements of ASTM Specification A 615, Grade 60.
- E. Welded wire fabric or wire shall conform to the requirements of ASTM Specification A 185.
- F. Air-entraining admixtures shall conform to the requirements of ASTM Specification C 260.
- G. Water-reducing and retarding admixtures shall conform to the requirements of ASTM Specification C 494.
- H. Curing compounds shall conform to the requirements of ASTM Specification C 309, Type I.
- I. Preformed expansion joint filler shall conform to the requirements of ASTM Specifications D 994, D 1751, or D 1752.

3.0 GENERAL

- A. Concrete shall have a 28-day compressive strength of 4000 psi.
- B. Concrete shall be measured, mixed, and placed in accordance with ACT 304.
- C. Maximum size of coarse aggregate shall be $\frac{3}{4}$ -inch.
- D. Unless specifically excepted, the air content by volume of all concrete shall be 6 percent, \pm 11 percent.
- E. The water-cement ratio shall not exceed 4 U.S. gal. per 94 pound bag of cement for air-entrained structural concrete. The water-cement ratio shall include the moisture in both fine and coarse aggregates.

4.0 READY-MIXED CONCRETE

- A. All ready-mixed concrete shall be mixed, delivered and placed in accordance with ASTM Specification C 94.
- B. Concrete shall discharge from the truck within 1 hour after the water has been added to the mix.
- C. The delivery ticket shall contain the cubic yards in the load, the percent of air, the total weight of cement in the load and the total gallons of water in the load.

5.0 PREPARATION OF SUBGRADE

- A. Subgrade shall be freed of sawdust, debris, water, extraneous oil, mortar or any other substances that may be deleterious to the concrete.
- B. Earth surfaces shall be firm and damp.

6.0 FORMS

- A. All formwork shall be done in accordance with recommended practices contained in ACI 347.
- B. Forms shall be of wood, plywood, steel or other approved material and shall be mortar-tight.

- C. The forms shall be substantial and unyielding and shall be constructed so that the finished concrete will conform to the dimensions as shown on the Drawings.
- D. Form surfaces shall be smooth and free of holes, dents, sags or other irregularities.
- E. Forms shall be coated with non-staining oil before being set in place.
- F. Metal ties or anchorages within the forms shall be equipped with cones, she-bolts or other devices that permit their removal to a depth of at least 1 inch without injury to the concrete.
- G. Remove forms in a manner and at such time to insure complete safety to the structure. In no case shall supporting forms or shoring be removed until sufficient strength has been obtained to support weight and load.

7.0 REINFORCING STEEL

- A. Reinforcement shall be free from excessive amounts of scale, rust, oil and other coating that will reduce bond.
- B. Reinforcement shall be cut and bent in accordance with recommended practices contained in ACI 315.
- C. Bar supports shall conform to standards recommended in ACI 315.
- D. Steel shall be stored on a level site on wooden dunnage, free from contact with the ground.

8.0 FINISHING

- A. All concrete surfaces shall be true and even, and shall be free from open or rough spaces, depressions or projections.
- B. All exposed surfaces of the concrete shall be accurately screened to grade and then floated prior to final finishing. Excessive floating or troweling while the concrete is soft will not be permitted. The addition of dry cement or water to the surface of screened concrete to expedite finishing will not be allowed.
- C. After removal of forms, all bulges, fins, form marks or other irregularities that may adversely affect the appearance or function of the concrete shall be removed.

D. All cavities left by form ties of any other device shall be cleaned and patched by non-shrinking mortar.

E. Concrete shall be wood float finished.

9.0 CURING

A. All concrete shall be cured by drying for a period of 7 days after it is placed.

B. Curing may be accomplished by any of the approved methods as listed in ACI 308.

10.0 TEMPERATURE

A. If concrete is to be placed when the atmospheric temperature is expected to exceed 90°F, methods as outlined in ACI 305 shall be strictly followed.

END OF SECTION

**SECTION 4030
EXCAVATION AND BACKFILLING**

1.0 SCOPE

- A. Excavation, backfilling, and related construction necessary to complete work shown or specified are a part of the Contract unless specifically excepted.
- B. In general, excavation and backfilling includes clearing and grubbing, for well sites and digging of trenches for pump discharge and the excavation of mud pits including appurtenances, dewatering of excavations, replacement of materials removed from excavations, removal of surplus excavated materials, and related work.
- C. Restoration is included as next section.

2.0 METHODS OF EXCAVATION

Excavation shall be accomplished in a workmanlike manner utilizing approved methods of construction which will insure the expeditious and proper progress of the work and the safety of workmen and all other persons and property.

3.0 WIDTH AND DEPTH OF EXCAVATION

- A. Excavation shall be of sufficient depths and widths to permit the installation of the work called for on the Drawings or as otherwise specified.
- B. Excavation shall be to the depths required to allow installations of future water mains at the depths shown or specified, but in no case shall excavations be such that less than thirty-six inches (36") of cover is provided over the installed water main.
- C. Mud pit excavation locations will be coordinated with the Engineer prior to commencing the excavation.

4.0 BACKFILL MATERIALS

- A. All Backfill material shall be free from cinders, sashes, refuse, vegetable or organic material, boulders, rock, or stones, or other material which, in the opinion of the Engineer, is unsuitable.

- B. After well construction, mud pits will be excavated to undisturbed soil and backfilled with new, clean material.
- C. If sufficient suitable backfill material is not available from the excavated material, the Contractor shall haul in the necessary additional proper fill materials, at his expense.

5.0 REMOVAL OF SURPLUS MATERIALS

All surplus and/or deleterious materials shall be removed and disposed of by the Contractor as the work progresses. These materials shall not be stored on the site after backfilling has been accomplished. The Contractor shall comply with all Municipal and County regulations regarding hauling, disposal, and/or destruction of materials.

END OF SECTION

SECTION 4040 RESTORATION

1.0 SCOPE

- A. Restoration and related construction indicated or specified are a part of the Contract.
- B. In general, restoration includes repair and replacement of areas at and adjacent to the well sites.
- C. A preconstruction inspection of all new well sites shall be made by representatives from the Owner, the Engineer and the Contractor. All necessary labor and equipment for this inspection shall be supplied by the Contractor and shall be considered as part of the Contract. Detailed records of the inspection shall be the responsibility of the Engineer.

2.0 STATE, COUNTY, AND CITY RIGHT-OF-WAY

All restoration within State, County, and City right-of-way shall be in full compliance with any and all requirements of the affected agency.

3.0 TEMPORARY MAINTENANCE

- A. The Contractor shall maintain areas disturbed by construction, including streets, roads, ditches, canals, etc., in a safe condition until permanent restoration is accomplished.
- B. Permanent restoration shall be completed as soon as practicable after construction has been accomplished.

4.0 VEGETATION

- A. Any existing sod or landscape vegetation damaged during construction shall be replaced with vegetation equal to that destroyed or damaged, or as directed by the Engineer.
- B. Top soil removed shall be replaced with the same or equal top soil. Areas to be seeded and sodded shall be made smooth and uniform and shall conform, with the finished grade.

5.0 SIGNS

All traffic, street, and information signs removed or damaged during construction shall be replaced or repaired in the manner prescribed by and to the satisfaction of the State, City or County agency having jurisdiction and the Engineer.

END OF SECTION

**SECTION 5010
CONTRACT PAY ITEMS**

1.0 FINAL MEASUREMENT

- A. Contractor shall make all measurements and check all dimensions necessary for the proper construction of the Work called for by the Drawings and Specifications, and during the prosecution of the Work shall make all necessary measurements to prevent misfitting in said Work, and shall record such accurate measurements of the construction as provided for herein and as to be submitted to the Engineer.
- B. The method of measuring the Work for payment under the various items shall be as indicated below. In any event, the unit or lump sum price for the respective items shall include the installation complete in all details and ready for use.

2.0 PAY ITEMS

- A. The unit prices stated in the Cost Proposal Form to be paid for the respective items shall constitute payment in Full for the completion of all work. Payment will be made under each item only for work as it is not specifically included under other items.
- B. Contractor shall furnish all material, labor and equipment required to complete the construction and testing of three mid-Hawthorn aquifer production wells for reverse osmosis supply as follows:

3.0 THREE R.O. PRODUCTION WELLS

ITEM NO. 1 - GENERAL REQUIREMENTS,
MOBILIZATION/DEMobilIZATION, SITE PREPARATION

This item shall be paid for at the lump sum price listed in the Cost Proposal Form. The said price shall include the furnishing of all material, labor, equipment and permits necessary to complete the Work; equipment setup; equipment dismantling and removal when the Work is complete; site preparation; and all project startup costs including, but not limited to, indemnification, insurance, and bonding fees where applicable. Site preparation includes all clearing, grubbing, grading, fill, sod work, pipe supports, and setup of required traffic barriers/warning signs.

ITEM NO. 2 - SURFACE CASING

The actual length of surface casing installed shall be measured from land surface to depth of casing. It shall be paid for at the unit price per foot listed in the Cost Proposal Form. The said unit shall include labor, equipment, grout, and all materials necessary for proper casing installation.

ITEM NO. 3 - PILOT HOLE DRILLING

The actual length of hole drilled shall be measured vertically from bottom of surface casing to bottom of the hole. Pilot hole shall be paid for at the unit price per foot listed in the Cost Proposal Form. The said unit shall include the furnishing of all material, labor, and equipment necessary to complete the Work.

ITEM NO. 4 - HOLE REAMING

The actual length of hole reamed shall be measured from bottom of the surface casing to bottom of reamed hole and may or may not be equivalent to the pilot hole length. Hole reaming will be paid for at the unit price per foot listed in the Cost Proposal Form. The said unit shall include the furnishing of all material, labor, and equipment necessary to complete the Work including any inclination or hole straightness surveys ordered by the Engineer.

ITEM NO. 5 - PRODUCTION CASING

The actual length of production casing installed shall be measured from land surface to depth of casing. It shall be paid for at the unit price per foot listed in the Cost Proposal Form. The said unit shall include labor and materials including centralizers.

ITEM NO. 6 - PRODUCTION CASING GROUT

Grout in place for the production casing shall be paid for at the unit price per 94 lb. bag of cement as listed in the Cost Proposal Form. The said unit shall include all required labor and materials to complete the Work, costs for any cement additives, and set up and removal of equipment for grout emplacement.

ITEM NO. 7 - OPEN HOLE DRILLING

The actual depth of hole drilled shall be measured vertically from bottom of production casing to bottom of well. Open hole shall be paid for at unit price per foot listed in the Cost Proposal Form. The said unit shall include the furnishing of all material, labor, and equipment necessary to complete the Work.

ITEM NO. 8 - WELL DEVELOPMENT

Well development, which shall involve reverse-air and high volume pumping, shall be paid for at the unit price listed on the Cost Proposal Form based on actual development time. No additional cost shall be paid for mobilizing or demobilizing equipment used for development.

ITEM NO. 9 - GEOPHYSICAL LOGGING

Geophysical logging shall be paid for on a lump sum per well basis at the rate listed in the Cost Proposal Form. The said unit shall include all labor and equipment required to pre-condition the borehole and perform the logging at the stages indicated the Specifications and to provide the Engineer with logging records in hard copy and electronic format.

ITEM NO. 10 - STEP DRAWDOWN TESTS

Costs for step drawdown tests shall be paid for at the unit price listed in the Cost Proposal Form. The said unit shall include the furnishing of all material, labor and equipment required to perform the tests as specified. The pay period shall begin with the onset of pumping and end when pumping is terminated. No additional cost shall be paid for mobilizing or demobilizing equipment used in the tests.

ITEM NO. 11 - WELL DISINFECTION AND BACTERIOLOGICAL CLEARANCE

Disinfection and bacteriological clearance shall be paid on a lump sum per well basis at the unit price listed in the Cost Proposal Form. The said unit shall include successful performance of a bacteriological survey and clearance of the well by FDEP.

ITEM NO. 12 - WELL VAULT AND WELLHEAD INSTALLATION

Furnishing and installation of the well vault, well head adaptor, well seal and miscellaneous fittings in accordance with the Specifications shall be paid on a lump sum per well basis at the unit cost listed in the Cost Proposal Form.

ITEM NO. 13 - SITE RESTORATION

After completion of well construction and testing, the site shall be restored to its original contours and all drilling fluids removed. Payment for this item shall be on a lump sum per well basis at the unit cost listed in the Cost Proposal Form.

ITEM NO. 14 - EXTRA WORK BY DRILLING CREW WITH DRILLING EQUIPMENT

Extra work authorized by the Owner or Engineer and performed by the drilling crew with drilling equipment will be paid for at the unit price listed on the Cost Proposal Form based on the amount of approved time used.

ITEM NO. 15 - EXTRA WORK BY CREW WITH PUMP HOIST

Extra work authorized by the Owner or Engineer and performed by the drilling crew with pump hoist will be paid for at the unit price listed on the Cost Proposal Form based on the amount of approved time used.

ITEM NO. 16 - EXTRA WORK BY DRILLING CREW

Extra work authorized by the Owner or Engineer and performed by the drilling crew will be paid for at the unit price listed on the Cost Proposal Form based on the amount of approved time used.

ITEM NO. 17 - STANDBY TIME WITH RIG AND DRILLING CREW ON SITE

Standby time authorized by the Owner or Engineer and performed by the drilling crew and drilling equipment will be paid for at the unit price listed on the Cost Proposal Form based on the amount of approved time used.

ITEM NO. 18 - STANDBY TIME WITH RIG ON SITE AND CREW OFF SITE

Standby time authorized by the Owner or Engineer and performed with drilling equipment on site and the drilling crew off site will be paid for at the unit price listed on the Cost Proposal Form based on the amount of approved time used.

END OF SECTION