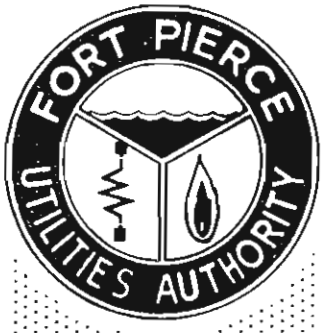


Application to Construct a

DEEP INJECTION WELL EFFLUENT DISPOSAL SYSTEM

Prepared for

Fort Pierce Utilities Authority
Fort Pierce, Florida

Prepared by

CH2M HILL

September 1991

56.096

Engineers
Planners
Economists
Scientists

September 30, 1991

SEF30361.D1

Mr. Al Mueller Jr., P.G. P.E.
TAC Chairman
Florida Department of
Environmental Regulation
1900 S. Congress Avenue, Suite A
West Palm Beach, FL 33406-0160

Dear Mr. Mueller:

Subject: Proposed Class I Municipal Deep Injection Well and Dual-Zone Floridan Aquifer Monitor Well at the Fort Pierce Utilities Authority (FPUA) Wastewater Treatment Plant

Enclosed is the Florida Department of Environmental Regulation's (FDER) construction permit application, technical specifications, and conceptual design for the construction of a deep injection well and dual-zone monitor well for disposal of treated effluent at the FPUA Wastewater Treatment Plant. The following are enclosed:

- Four sets of signed and sealed construction permit applications for the Class I Municipal Deep Injection Well.
- Four sets of technical specifications for the *Construction of a Deep Injection Well and Dual-Zone Monitor Well for Effluent Disposal at the Wastewater Treatment Plant,* prepared for the FPUA.
- Four copies of the *Conceptual Design of a Deep Injection Well Effluent Disposal System*, prepared for the FPUA.
- One check written to FDER in the amount of $5,000 for the deep injection well construction permit (Check No. 9009565).

CH2M HILL | Deerfield Beach Office | 800 Fairway Drive, Suite 350, Deerfield Beach, Florida 33441 | 305.426.4008, 407.737.6665, Fax 305.698.6010

This package is submitted in compliance with Chapter 17-28 of the Florida Administrative Code and Specific Condition (B) (i) of the Temporary Operating Permit No. DT 56-18451 to operate the FPUA Wastewater Treatment Plant.

If you have any questions regarding the enclosures, please contact Rick Nevulis or me at (407) 737-6665.

Very truly yours,

CH2M HILL

Thomas M. McCormick, P.G.
Project Manager

dbt095/070.51
Enclosures
cc: Harry Schindehette/FPUA
Elie Boudreaux/FPUA
Albert Muniz/CH2M HILL
Steve Riley/CH2M HILL
Rick Nevulis/CH2M HILL

CH2M HILL TRANSMITTAL

TO: Members of the TAC:
Mr. Mike Merritt/USGS
Mr. Steve Anderson/SFWMD
Mr. Richard Deuerling/FDER
Mr. Russ McLean/USEPA

FROM: Sean T. Skehan
CH2M Hill
800 Fairway Drive, Suite 350
Deerfield Beach, FL 33441

ATTN:

DATE: 10/3/91

RE: Fort Pierce Deep Injection Well

PROJECT NUMBER: SEF30361.D1

WE ARE SENDING YOU

- ☐ ATTACHED
- ☐ UNDER SEPARATE COVER VIA
- ☐ SHOP DRAWINGS
- ☑ DOCUMENTS
- ☐ TRACINGS
- ☐ PRINTS
- ☐ SPECIFICATIONS
- ☐ CATALOGS
- ☐ COPY OF LETTER
- ☐

QUANTITY	DESCRIPTION
1	Copy each of the "Application to Construct a Deep Injection Well Effluent Disposal System"

RECEIVED
OCT 04 1991
WATER USE DIVISION

IF MATERIAL RECEIVED IS NOT AS LISTED, PLEASE NOTIFY US AT ONCE

REMARKS

COPY TO: Tom McCormick

REV 1/87 FORM 6

CLASS I DEEP INJECTION WELL
CONSTRUCTION PERMIT APPLICATION

STATE OF FLORIDA

DEPARTMENT OF ENVIRONMENTAL REGULATION

TWIN TOWERS OFFICE BUILDING
2600 BLAIR STONE ROAD
TALLAHASSEE, FLORIDA 32301

BOB GRAHAM
GOVERNOR

VICTORIA J. TSCHINKEL
SECRETARY

APPLICATION TO CONSTRUCT/OPERATE/ABANDON CLASS I, III, OR V INJECTION WELL SYSTEMS

PART I. Directions

A. All applicable items must be completed in full in order to avoid delay in processing this application. Where attached sheets or other technical documentation are utilized in lieu of the blank space provided, indicate appropriate cross-reference in the space and provide copies to the department in accordance with (C) below. Where certain items do not appear applicable to the project, indicate N/A in the appropriate spaces. When this form is used in conjunction with DER Form 17-1.205(1), duplicative information requests need to be completed only once.

B. All information is to be typed or printed in ink.

C. Four (4) copies of this application and four (4) copies of supporting information such as plans, reports, drawings and other documents shall be submitted to the appropriate District/Subdistrict office. An engineering report is also required to be submitted to support this application pursuant to the applicable sections of Florida Administrative Code Rule 17-28. The attached lists* shall be used to determine completeness of supporting data submitted or previously received. A check for the application fee in accordance with Florida Administrative Code Rule 17-4.05 made payable to the Department shall accompany the application.

D. For projects involving construction, this application is to be accompanied by four (4) sets of engineering drawings, specifications and design data as prepared by a Professional Engineer registered in Florida, where required by Chapter 471, Florida Statutes.

E. Attach 8 1/2" x 11" USGS site location map indicating township, range and section and latitude/longitude for the project.

PART II. General Information

A. Applicant: Name Mr. Harry M. Schindehette, P.E. Title Director of Utilities

Address Fort Pierce Utilities Authority, 206 South 6th Street

City Fort Pierce, FL Zip 34950

Telephone Number (407) 464-5600

B. Project Status: [xx] New [ ] Existing

[ ] Modification (specify) _____

*"Engineering and Hydrogeologic Data Required for Support of Application to Construct, Operate and Abandon Class I, III, or V Injection Wells"

C. Well Type:

( ) Exploratory Well (x) Test/Injection Well

D. Type of Permit Application:

( ) Class I Exploratory Well Construction and Testing Permit

(x) Class I Test/Injection Well Construction and Testing Permit

( ) Class I Well Operating Permit

( ) Class I Well Plugging and Abandonment Permit

( ) Class III Well Construction/Operation/Plugging and Abandonment Permit

( ) Class V well Construction Permit

( ) Class V Well Operating Permit

( ) Class V Well Plugging and Abandonment Permit

E. Facility Identification:

Name: Fort Pierce Utilities Authority Wastewater Treatment Plant

Facility Location: Street: Seaway Drive

City: Fort Pierce County: St. Lucie

SIC Code:

F. Proposed facility located on Indian Lands: Yes____ No X

G. Well Identification:

Well No. 1 of 1 Wells
(total #)

Purpose (Proposed Use): Effluent Disposal, Secondary Wastewater Treatment Plan

Well Location: Latitude: 27°27'20" Longitude 80°18'27"

(attach separate sheet, if necessary, for multiple wells.)

Subpart B. General Projection Description:

(1) Describe the nature, extent and schedule of the injection well project. Refer to existing and/or future pollution control facilities, expected improvement in performance of the facilities and state whether the project will result in full compliance with the requirements of Chapter 403, Florida Statutes, and all rules and regulations of the Department. Attach additional sheet(s) if necessary or cross-reference the engineering report.

Please see attached "Supporting Information for the Application to Construct a Class I Injection Well System at the Fort Pierce Utilities Authority Wastewater Treatment Plant."

PART III Statement by Applicant and Engineer

A. Applicant

I, the owner/authorized representative* of Fort Pierce Utilities Authority, certify under penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. I understand that this certification also applies to all subsequent reports submitted pursuant to this permit. Where construction is involved, I agree to retain the design engineer, or other professional engineer registered in Florida, to provide inspection of construction in accordance with Florida Administrative Code Rule 17-28.34(1)(c).

Signed _____ Date _____

Mr. Harry M. Schindehette, P.E., Director of Utilities (407) 464-5600
Name and Title (Please Type) Telephone Number

*Attach a Letter of Authorization.

B. Professional Engineer Registered in Florida

This is to certify that the engineering features of this injection well have been designed/examined by me and found to be in conformity with modern engineering principles applicable to the disposal of pollutants characterized in the permit application. There is reasonable assurance, in my professional judgement, that the well, when properly maintained and operated, will discharge the effluent in compliance with all applicable statutes of the State of Florida and the rules and regulations of the Department. It is also agreed that the undersigned will furnish the applicant a set of instructions for proper maintenance and operation of the well.

Signed: _____

Albert Muniz, P.E.
Name (Please Type)

CH2M HILL Southeast, Inc.
Company Name (Please Type)

(Please Affix Seal)

800 Fairway Drive, Deerfield Bch, FL 33441
Mailing Address (Please Type)

FLORIDA REGISTRATION NUMBER 35587 Date: _____ Phone No. (407) 737-6665

ENGINEERING AND HYDROLOGIC DATA REQUIRED FOR SUPPORT OF APPLICATION TO CONSTRUCT, OPERATE, AND ABANDON CLASS I, III, OR V INJECTION WELL SYSTEMS

The following information shall be provided for each type of permit application.

N/A **(A) CLASS I EXPLORATORY WELL CONSTRUCTION AND TESTING PERMIT**

(1) Conceptual plan of the injection project. Include number of injection wells, proposed injection zone, nature and volume of injection fluid, and proposed monitoring program.

(2) Preliminary Area of Review Study. Include the proposed radius of the area of review with justification for that radius. Provide a map showing the location of the proposed injection well or well field area for which a permit is sought and the applicable area of review. Within the area of review, the map must show the number or name, and location of all producing wells, injection wells, abandoned wells, dry holes, surfacebodies of water, springs, public water systems, mines (surface and subsurface), quarries, water wells and other pertinent surface features including residences and roads. The map should also show faults, if known or suspected. Only information of public record and pertinent information known to the applicant is required to be included on this map.

(3) Proposed other uses of the exploratory well.

(4) Drilling and testing plan for the exploratory well. The drilling plan m specify the proposed drilling program, sampling, coring, and testing procedures.

(5) Abandonment Plan.

(B) CLASS I TEST/INJECTION WELL CONSTRUCTION AND TESTING PERMIT

(1) A map showing the location of the proposed injection wells or well field area for which a permit is sought and the applicable area of review. Within the area of review, the map must show the number or name, and location of all producing wells, injection wells, abandoned wells, dry holes, surface bodies of water, springs, public water systems, mines (surface and subsurface), quarries, water wells and other pertinent surface features including residences and roads. The map should also show faults, if known or suspected. Only information of public record and pertinent information known to the applicant is required to be included on this map.

(2) A tabulation of data on all wells within the area of review which penetrate into the proposed injection zone, confining zone, or proposed monitoring zone. Such data shall include a description of each well's type, construction, data drilled, location, depth, record of plugging and/or completion, and any additional information the Department may require.

(3) Maps and cross sections indicating the general vertical and lateral limits within the area of review of all underground sources of drinking water, their position relative to the injection formation and the direction of water movement, where known, in each underground source of drinking water which may be affected by the proposed injection.

(4) Maps and cross sections detailing the hydrology and geologic structures of the local area.

(5) Generalized maps and cross sections illustrating the regional geologic setting.

(6) Proposed operating data.

a. Average and maximum daily rate and volume of the fluid to be injected;
b. Average and maximum injection pressure; and,
c. Source and an anlysis of the chemical, physical, radiological and biological characteristics of injection fluids.

(7) Proposed formation testing program to obtain an analysis of the chemical, physical and radiological characteristics of and other information on the injection zone.

(8) Proposed stimulation program.

(9) Proposed injection procedure.

(10) Engineering drawings of the surface and subsurface construction details of the system.

(11) Contingency plans to cope with all shut-ins or well failures, so as to protect the quality of the waters of the State as defined in Florida Administrative Code Rule 17-3, including alternate or emergency discharge provisions.

(12) Plans (including maps) and proposed monitoring data to be reported for meeting the monitoring requirements in Florida Administrative Code Rule 17-28.25.

(13) For wells within the area of review which penetrate the injection zone but are not properly completed or plugged, the corrective action proposed to be taken under Florida Administrative Code Rule 17-28.13(5).

(14) Construction procedures including a cementing and casing program, logging procedures, deviation checks, proposed methods for isolating drilling fluids from surficial aquifers, proposed blowout protection (if necessary), and a drilling, testing and coring program.

(15) A certification that the applicant has ensured, through a performance bond or other appropriate means, the resources necessary to close, plug or abandon the well as required by Florida Administrative Code Rule 17-28.27(9).

N/A **(C) CLASS I INJECTION WELL OPERATING PERMIT**

(1) A report shall be submitted with each application for a Class I well operation permit, which shall include, but not be limited to, the following information:

a. Results of the information obtained under the construction permit described in (B)-CLASS I TEST/INJECTION WELL CONSTRUCTION AND TESTING PERMIT, including:

1. All available logging and testing program data and construction data on the well or well field;

2. A satisfactory demonstration of mechanical integrity for all new wells pursuant to Florida Administrative Code Rule 17-28.13(6)(b);

3. The actual operating data, including injection pressures versus pumping rates where feasible, or the anticipated maximum pressure and flow rate at which the permittee will operate, if approved by the Department;

4. The actual injection procedure;

5. The compatibility of injected waste with fluids in the injection zone and minerals in both the injection zone and the confining zone; and,

6. The status of corrective action on defective wells in the area of review.

b. Record drawings, based upon inspections by the engineer or persons under his direct supervision, with all deviations noted;

c. Certification of completion submitted by the engineer of record;

d. If requested by the Department, operation manual including emergency procedures;

e. Proposed monitoring program and data to be submitted;

f. Proof that the existence of the well has been recorded on the surveyor's plan at the county courthouse.

g. Proposed plugging and abandonment plan pursuant to Florida Administrative Code Rule 17-28.27(2).

N/A **(D) CLASS I WELL PLUGGING AND ABANDONMENT PERMIT**

(1) The reasons for abandonment.

(2) A proposed plan for plugging and abandonment describing the preferred and alternate methods, and justification for use.

a. The type and number of plugs to be used;

b. The placement of each plug including the elevation of the top and bottom;

c. The type and grade and quantity of cement or any other approved plugging material to be used;

d. The method for placement of the plugs.

(3) The procedure to be used to meet the requirements of Rule 17-28.27.

N/A **(E) CLASS III WELL CONSTRUCTION/OPERATION/PLUGGING AND ABANDONMENT PERMIT**

Construction Phase

(1) A map showing the location of the proposed injection wells or well field area for which a permit is sought and the applicable area of review. Within the area of review, the map must show the number or name, and location of all producing wells, injection wells, abandoned wells, dry holes, surface bodies of water, springs, public water systems, mines (surface and subsurface), quarries, water wells and other pertinent surface features including residences and roads. The map should also show faults, if known or suspected. Only information of public record and pertinent information known to t applicant is required to be included on this map.

(2) A tabulation of data on all wells within the area of review which penetrate into the proposed injection zone, confining zone, or proposed monitoring zone. Such data shall include a description of each well's type, construction, date drilled, location, depth, record of plugging and/or completion, and any additional information the Department may required.

(3) Maps and cross sections indicating the general vertical and lateral limits within the area of review of all underground sources of drinking water, their position relative to the injection formation and the direction of water movement, where known, in each underground source of drinking water which may be affected by the proposed injection.

(4) Maps and cross sections detailing the hydrology and geologic structures of the local area.

(5) Generalized maps and cross sections illustrating the regional geologic setting.

(6) Proposed operating data:

a. Average and maximum daily rate and volume of the fluid to be injected;

b. Average and maximum injection pressure; and,

c. Source and an analysis of the chemical, physical, radiological and biological characteristics of injection fluids, including any additives.

(7) Proposed formation testing program to obtain an analysis of the chemical, physical and radiological characteristics of and other information on the injection zone.

(8) Proposed stimulation program.

(9) Proposed injection procedure.

(10) Engineering drawings of the surface and subsurface construction details of the system.

(11) Contingency plans to cope with all shut-ins or well failures or catastrophic collapse, so as to protect the quality of the waters of the state as defined in Florida Administrative Code Rule 17-3, including alternate or emergency discharge provisions.

(12) Plans (including maps) and proposed monitoring data to be reported for meeting the monitoring requirements in Florida Administrative Code Rule 17-28.25.

(13) For wells within the area of review which penetrate the injection zone but are not properly completed or plugged, the corrective action proposed to be taken under Florida Administrative Code Rule 17-28.13(5).

(14) Construction procedures including a cementing and casing program, logging procedures, deviation checks, proposed methods for isolating drilling fluids form surficial aquifers, and a drilling, testing and coring program.

(15) A certificate that the applicant has ensured, through a performance bond or other appropriate means, the resources necessary to close, plug or abandon the well as required by Florida Administrative Code Rule 17-28.27(9).

(16) Expected changes in pressure, native fluid displacement, direction of movement of injection fluid.

(17) A proposed monitoring plan, which includes a plan for detecting migration of fluids into underground sources of drinking water, a plan to detect water quality violation in the monitoring wells, and the proposed monitoring data to be submitted.

Operation Phase

(1) The following information shall be provided to the Department prior to granting approval for the operation of the well or well field:

a. All available logging and testing program data and construction data on the well or well field;

b. A satisfactory demonstration of mechanical integrity for all new wells pursuant to Florida Administrative Code Rule 17-28.13(6)(b);

c. The actual operating data, including injection pressure versus pumping rate where feasible, or the anticipated maximum pressure and flow rate at which the permittee will operate, if approved by the Department;

d. The results of the formation testing program;

e. The actual injection procedure;

f. The status of corrective action on defective wells in the area of revie

Plugging and Abandonment Phase

(1) The justification for abandonment.

(2) A proposed plan for plugging and abandonment describing the preferred and alternate methods.

a. The type and number of plugs to be used;

b. The placement of each plug including the elevation of the top and bottom;

c. The type and grade and quantity of cement or any other approved plugging material to be used;

d. The method for placement of the plugs.

(3) The procedure to be used to meet the requirements of Florida Administrative Code Rule 17-28.27.

N/A (F) **CLASS V WELL CONSTRUCTION PERMIT.** (This form should be used for Class V wells instead of Form 17-1.209(1) when there is a need for a Technial Advisory Committee and an engineering report.)

(1) Type and number of proposed Class V Wells:

Wells Receiving Domestic Waste _____ Salt-water Intrusion Barrier Wells _____

Cooling Water Return Flow Wells, Open-looped System _____ Subsidence Control Wells _____

Sand Backfill Wells _____

Experimental Technology Wells _____

Radioactive Waste Disposal Wells* _____

Other non-hazardous Industrial or Commercial Disposal Wells (explain) _____

Wells used to inject spent brine after halogen recovery _____

Borehole Slurry Mining Wells _____

Other (explain) _____

*Provided the concentrations of the waste do not exceed drinking water standards contained in Chapter 17-22, F.A.C.

(2) Project Description:

a. Description and use of proposed injection system;

b. Nature and volume of injected fluid (The Department may require an analysis (including bacteriological analysis) in accordance with Florida Administrative Code Rule 17-4.27(2)(c));

c. Proposed pretreatment.

(3) Water well contractor's name, title, state license number, address, phone number and signature.

(4) Well Design and Construction Details. (For multi-casing configurations or unusual construction provisions, an elevation drawing of the proposed well should be attached.)

a. Proposed total depth;

b. Proposed depth and type of casing(s);

c. Diameter of well;

d. Cement type, depth, thickness;

e. Injection pumps (if applicable):_____gpm @____psi
Controls:_____
_____
_____

(5) Water Supply Wells - When required by Florida Administrative Code Rule 17-4.27, attach a map section showing the locations of all water supply wells within a one (1) mile radius of the proposed well. The well depths and casing depths should be included. When required by Rule 17-4.27(2)(g), results of bacteriological examinations of water from all water supply wells within one (1) mile and drilled to approximate depth of proposed well should be attached.

(6) Area of Review (may be required at Department's discretion).

Include the proposed radius of the area of review with justification for that radius. Provide a map showing the location of the proposed injection well or well field area for which a permit is sought and the applicable area of review. Within the area of review, the map must show the number or name, and location of all producing wells, injection wells, abandoned wells, dry holes, surface bodies of water, springs, public water systems, mines (surface and

subsurface), quarries, water wells and other pertinent surface features including residences and roads. The map should also show faults, if known or suspected. Only information of public record and pertinent information known to the applicant is required to be included on this map.

N/A(G) **CLASS V WELL OPERATION PERMIT** (Final report of the construction that includes the following information may be submitted with the application to operate.)

(1) Permit Number of Class V Construction Permit:_____

(2) Owner's Name:_____

(3) Type of Well:_____

(4) Construction and Testing Summary:

a. Actual Dimensions:

Diameter _____ inches; Well Depth _____ feet; Casing Depth _____ feet.

_____ _____ _____

_____ _____ _____

b. Results of Initial Testing.

(5) Proposed Operating Data:

a. Injection Rate (GPM);

b. Description of injected waste;

c. Injection pressure and pump controls.

(6) Proposed Monitoring Plan (If any):

a. Number of monitoring wells;

b. Depth(s);

c. Parameters;

d. Frequency of sampling;

e. Instrumentation (if applicable) Flow_____

Pressure_____

N/A(H) **CLASS V WELL PLUGGING AND ABANDONMENT PERMIT**

(1) Permit number of Class V construction or operating permit.

(2) Type of well.

(3) Proposed plugging procedures, plans and specifications.

(4) Reasons for abandonment.

Supporting Information for the Application to Construct a Class I Injection Well System at the Fort Pierce Utilities Authority Wastewater Treatment Plant

Part I. Directions, Page 1

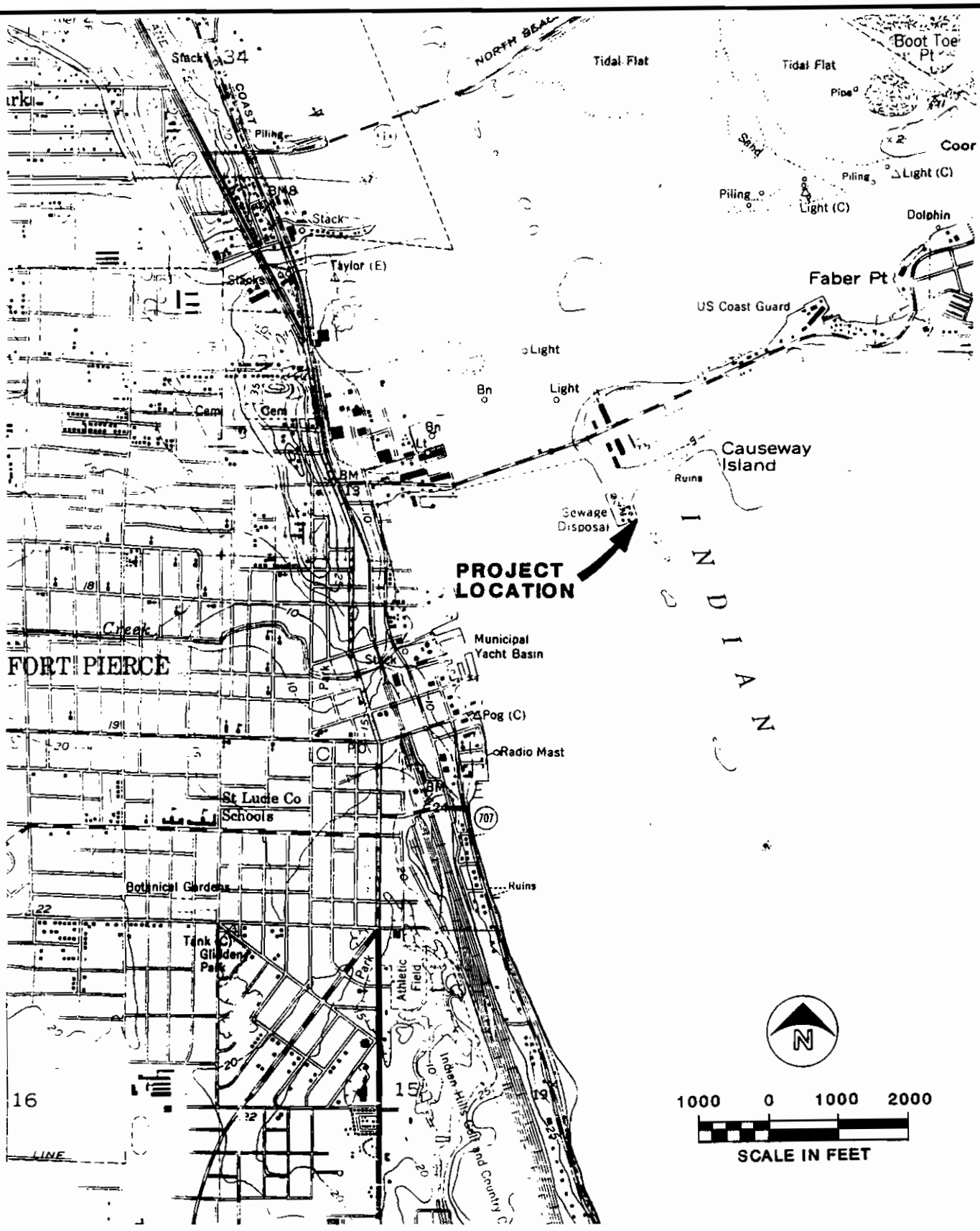
E. Refer to the attached site location map.

Part II. Subpart B - General Project Description, Page 2

The Fort Pierce Utilities Authority (FPUA) is a combined utility providing water, gas, electric, and wastewater services to the City of Fort Pierce and surrounding unincorporated areas. The FPUA wastewater system currently consists of a collection system and a 9.0-million gallon per day (mgd) wastewater treatment plant (WWTP) located on South Hutchinson Island. The project location is shown on Figure 1-1. The site plan is shown in Figure 1-2. The plant, which discharges secondary treated effluent to the Indian River through an outfall, operates under a Temporary Operating Permit (TOP) from the Florida Department of Environmental Regulation (FDER).

The TOP was issued to allow reasonable time for the FPUA to implement an alternate disposal system eliminating effluent discharge to the river as required by the Indian River Lagoon System Act of 1990 (House Bill 3247). The FPUA has evaluated reuse as an alternative but has found this method not to be economically feasible at present in Fort Pierce. The TOP requires FPUA to construct a Class I deep injection well (DIW) and specifies that construction on the DIW begin by June 1, 1992, and be completed by March 1, 1993.

The DIW, which will consist of concentric casings, will be constructed in accordance with the requirements of Florida Administrative Code (FAC) Chapter 17-28. It will be installed using staged construction and testing techniques, and the final casing will be of seamless steel pipe with a 0.500-inch wall thickness. Based on a review of geophysical and geological data from other wells in the area, the depth of the



PROJECT LOCATION:

TOWNSHIP: 35S
RANGE: 40E
SECTION: 2

LATITUDE: 27° 27' 20"
LONGITUDE : 80° 18' 27"

SITE LOCATION MAP

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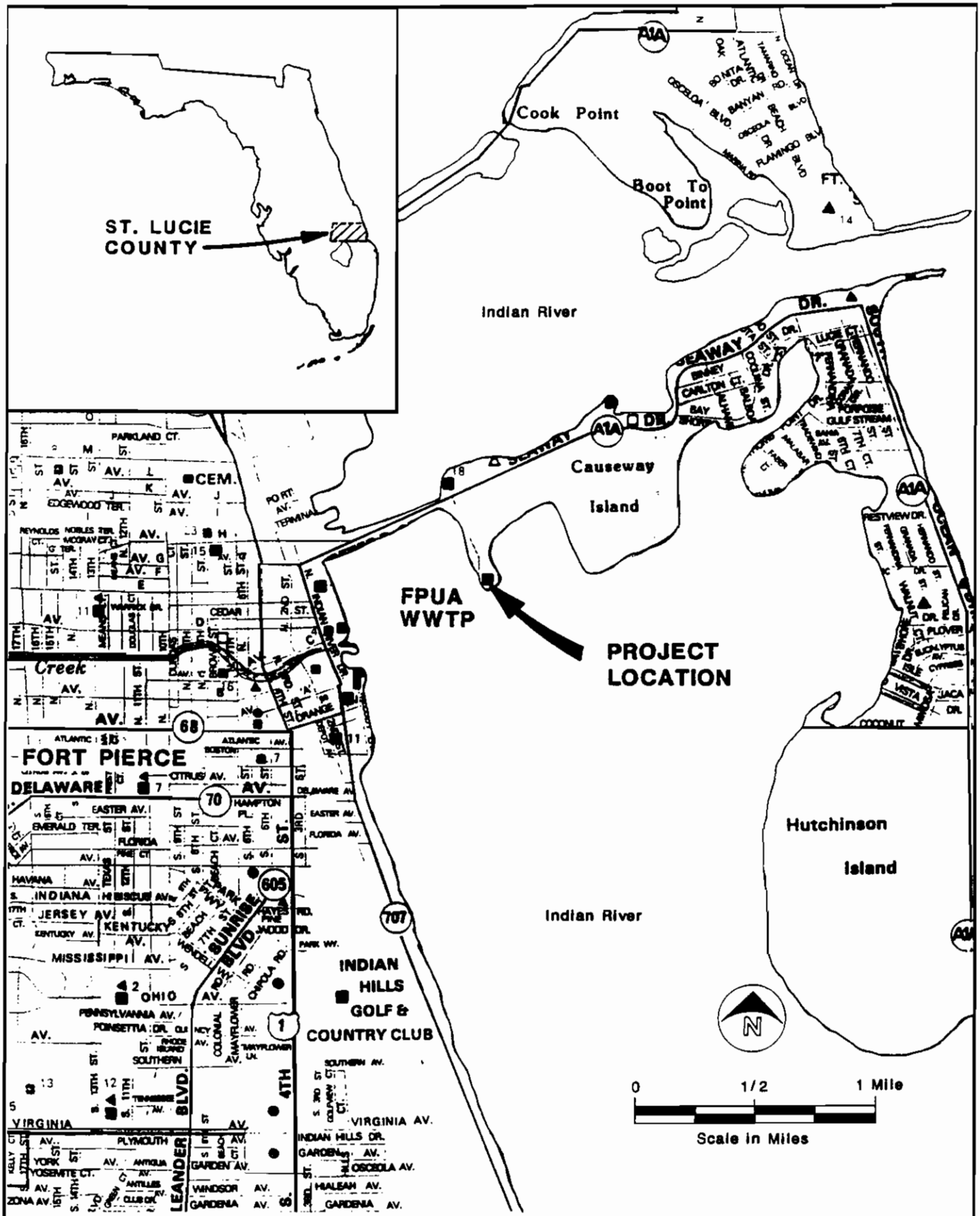

FIGURE 1-1

PROJECT LOCATION MAP

CH2MHILL

09-24-91

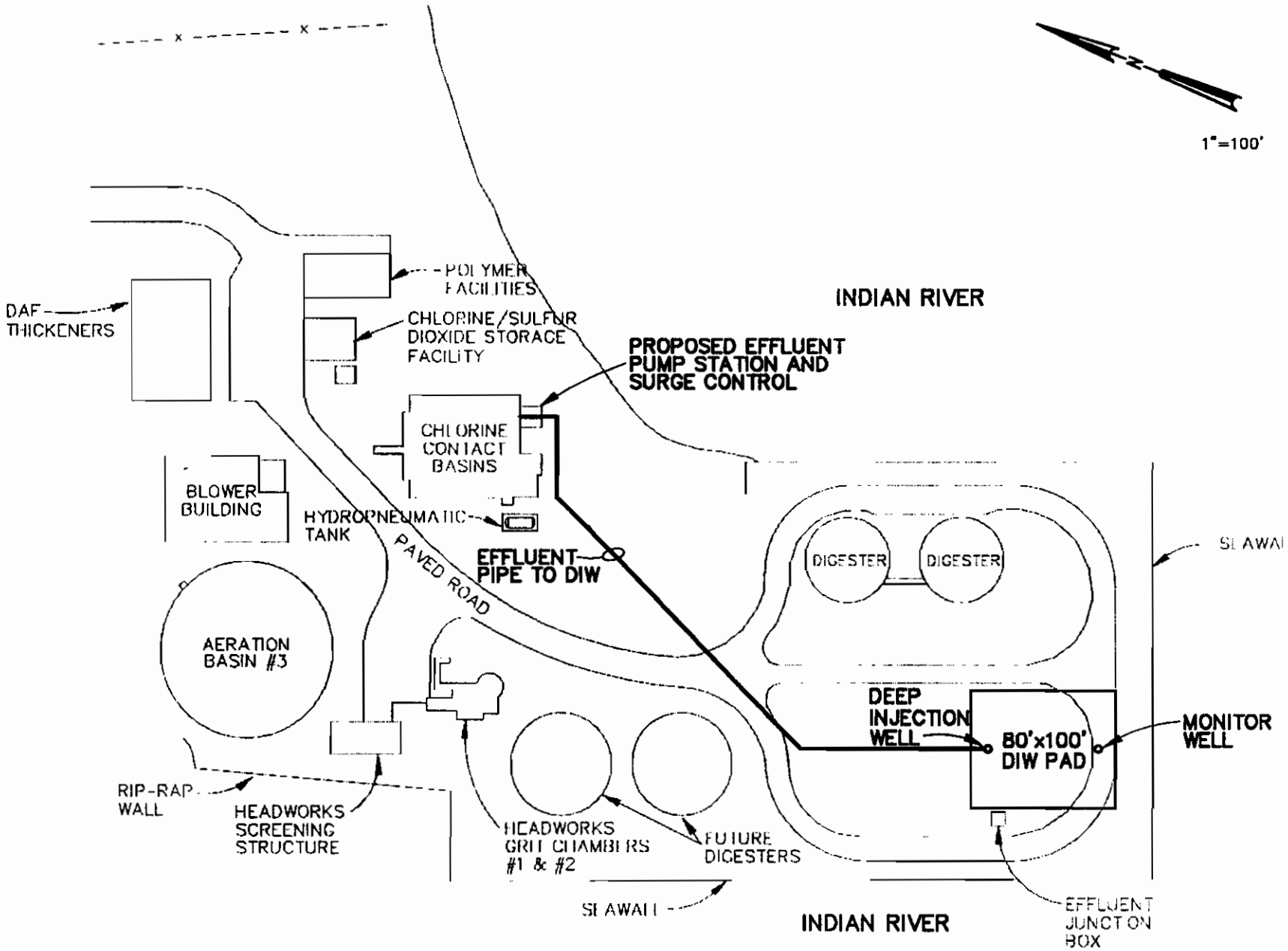

FIGURE 1-2
PROPOSED DIW FACILITIES LAYOUT
AT THE FPUA WWTP

CH2MHILL

D:\SEF30361.D1\0361F05.DWG

injection zone is anticipated to be between 2,800 and 3,100 feet below land surface (bls). Figure 3-1 presents the proposed design of the DIW.

One dual-zone Floridan aquifer monitor well with concentric casings, will be constructed as part of the DIW system. It will be placed 75 feet from the DIW. The upper zone will monitor the first suitable zone beneath the uppermost confining interval, which is anticipated to occur between 800 and 900 feet bls. The lower zone will be placed in the first permeable zone beneath the base of the underground source of drinking water (USDW). Based on a review of geophysical and water quality data from other wells in the area, it is anticipated that a suitable zone will occur at approximately 1,800 feet below land surface. The actual depth of this monitor zone will be dependent upon field testing performed during construction and will be subject to approval by the TAC and FDER. Refer to Figure 3-2 for the proposed design of the dual-zone monitor well.

Please refer to the following documents for a complete system description and technical specifications for the construction of the FPUA Class I deep injection well effluent disposal system.

- *Conceptual Design of a Deep Injection Well Effluent Disposal System* (CH2M HILL, September 1991), prepared for the FPUA

- Technical specifications for the construction of the FPUA deep injection well effluent disposal system

- Deep injection well and monitoring system design drawings provided as part of the technical specifications

An alternative for effluent discharge will be needed for periods when the DIW is out of service. The only anticipated period when the DIW will be inoperative is during mechanical integrity testing (MIT). MIT tests are scheduled once every 5 years and under current testing procedures typically require the DIW to be inoperative for

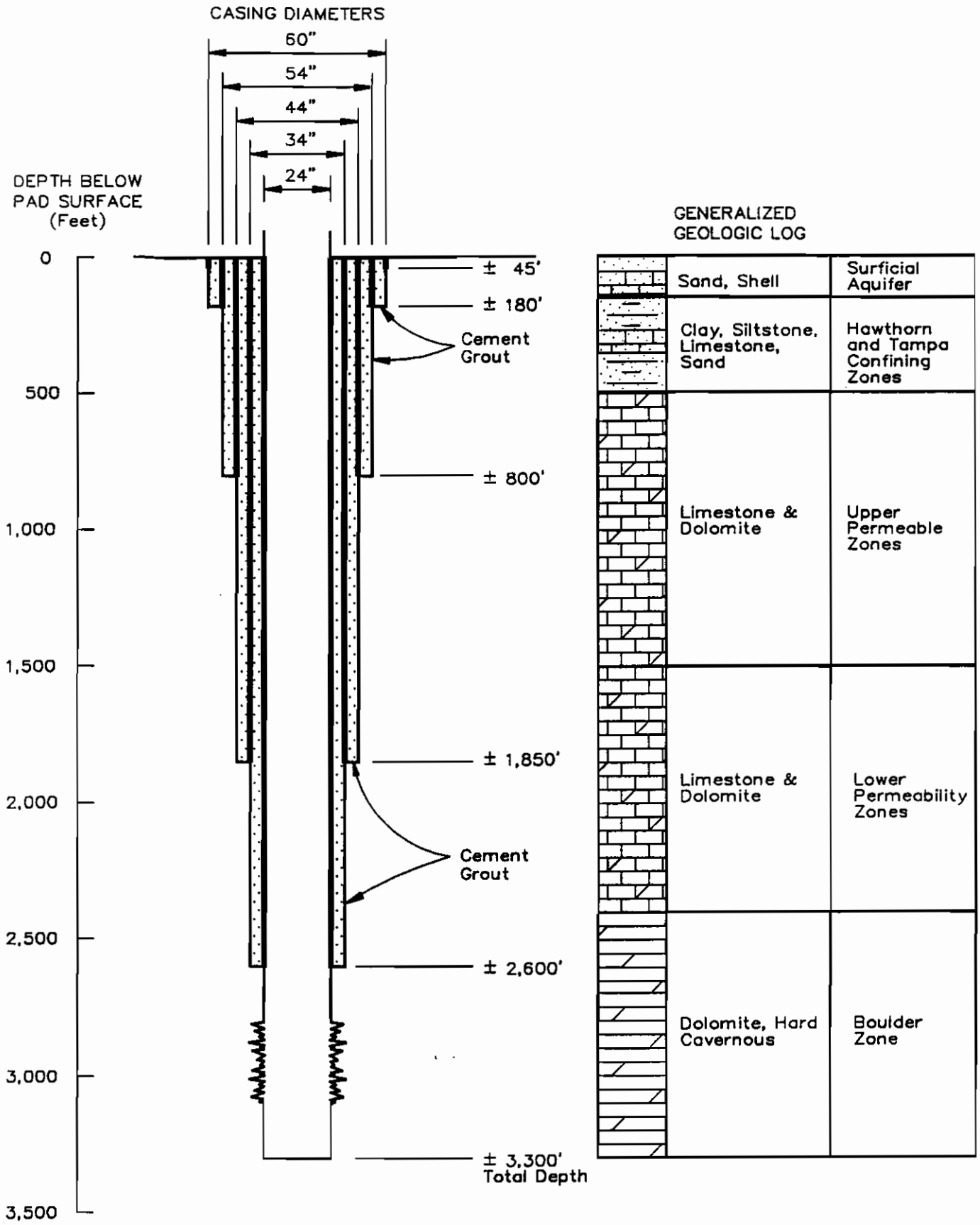

FIGURE 3-1

PROPOSED DEEP INJECTION WELL DESIGN AT THE FPUA WWTP

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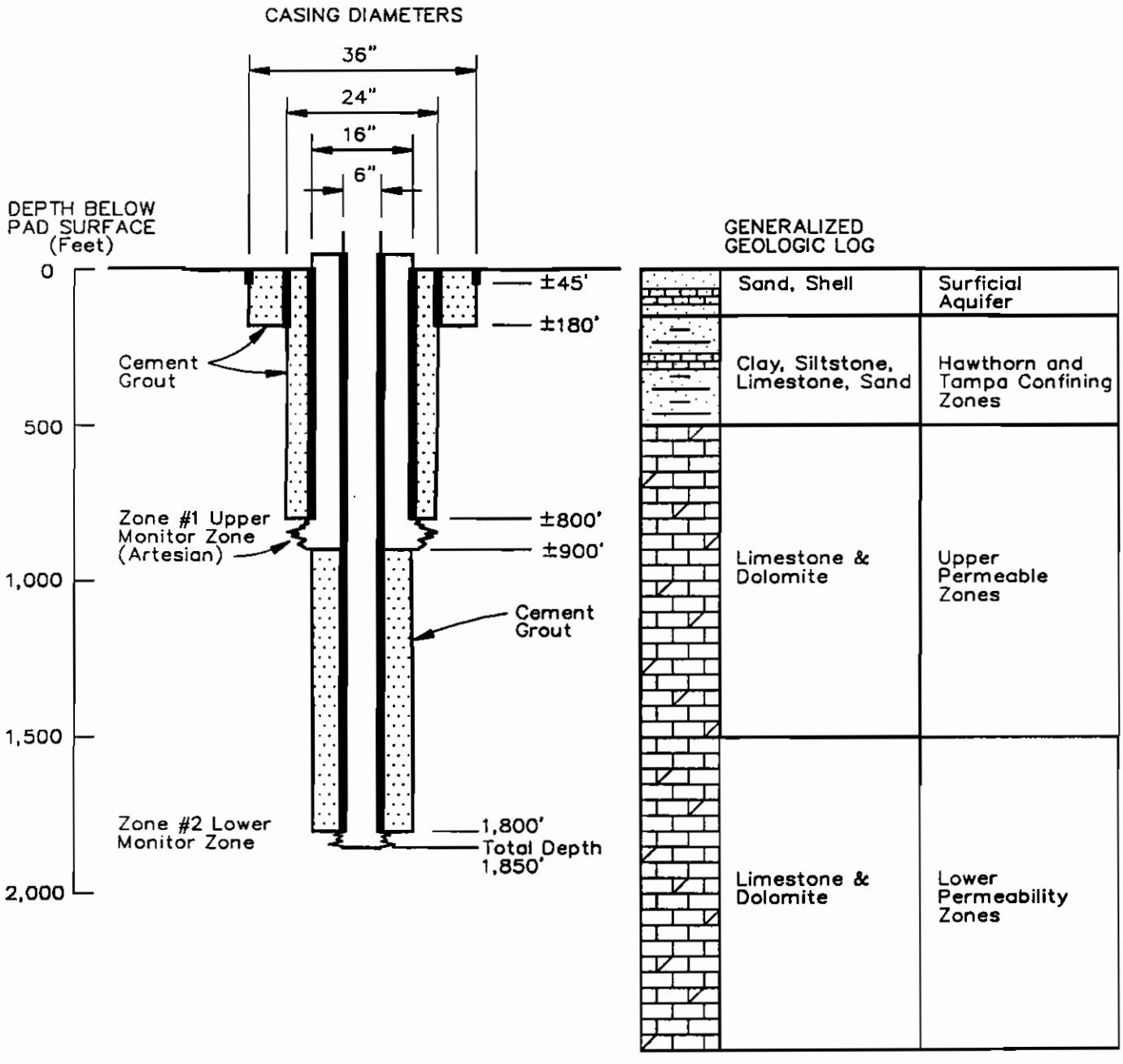

FIGURE 3-2

PROPOSED DUAL-ZONE MONITOR WELL DESIGN AT THE FPUA WWTP

CH2M HILL

about 5 days. With the injection well scheduled to go into full operation in 1993, the first scheduled mechanical integrity test would be performed in 1998.

Effluent reuse, via cooling water supply to a proposed privately-owned power plant, is being investigated as a potential alternative for disposal of part of the effluent when the DIW is down for testing. Implementation of this alternative, however, will not occur until some time in the future. To address current needs, FPUA will apply for a continuation of its current EPA NPDES permit, which would allow the emergency disposal of the treated effluent to the Indian River during the DIW shutdown. FDER approval for planned and emergency discharges to the Indian River will be sought by FPUA. The TOP requires FPUA to conduct additional studies to assess the impact of occasional discharges to the Indian River. If the studies yield favorable findings, the FPUA intends to construct a new outfall with multiple diffuser ports to achieve required dilution for a mixing zone within the river.

The proposed deep injection well program is an integral part of FPUA's effort to comply with conditions of the TOP and the Indian River Lagoon System Act. Figure 4-1 illustrates the design, construction, and testing schedule proposed for the deep injection well.

Engineering and Hydrologic Data, Part (B), Page 4

(1) Refer to Figures 1-1, 1-2, and 2-1 of the *Conceptual Design of a Deep Injection Well Effluent Disposal System*, (CH2M HILL, September 1991) prepared for the FPUA.

(2) A well inventory was conducted to locate existing wells near the proposed DIW using a review area of 1-mile radius around the WWTP. Data obtained from the South Florida Water Management District (SFWMD), the U.S. Geological Survey (USGS), and the Florida Bureau of Geology indicate that no wells within the area of review penetrate through the proposed injection zone, confining intervals, or proposed monitoring zones. Figure 2-1 of the

ACTIVITY	ACTIVITY DESCRIPTION	DAYS	PROPOSED START
1	PROJECT PLANNING		AUGUST 91
2	KICKOFF MEETING	1	AUGUST 91
3	CONCEPTUAL DESIGN	45	AUGUST 91
4	DETAIL DESIGN & SPECIFICATION	75	AUGUST 91
5	TAC MEETING	1	OCTOBER 91
6	FDER / PERMIT PROCESSING / RESPONSE	150	NOVEMBER 91
7	FINAL DESIGN / PREPARE & SUBMIT PERMIT APPLICATION	30	OCTOBER 91
8	CONSTRUCTION CONTRACTING (FDER REVIEW 120 DAYS)	20	APRIL 91
9	PRECONSTRUCTION MEETING	1	APRIL 92
10	WELL CONSTRUCTION	180	MAY 92
11	DRAFT O&M MANUAL / ENGINEER REPORT PREPARE OPERATING PERMIT APPLICATION	90	NOVEMBER 92
12	OPERATIONAL TESTING	180	NOVEMBER 92

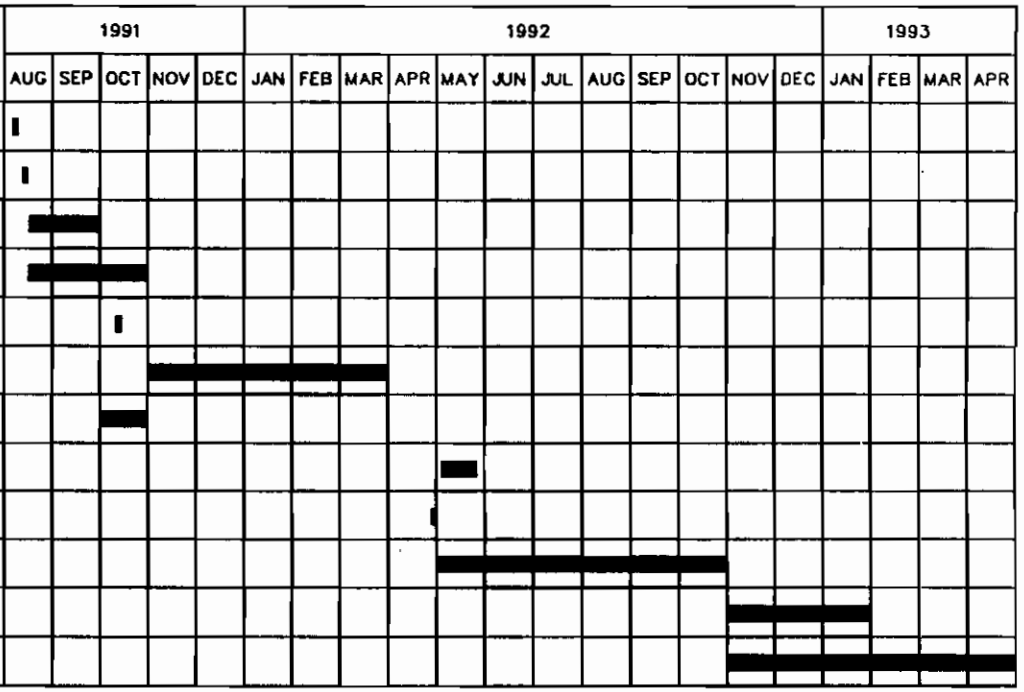

FIGURE 4-1

PROPOSED PROJECT SCHEDULE
-FPUA WWTP DIW

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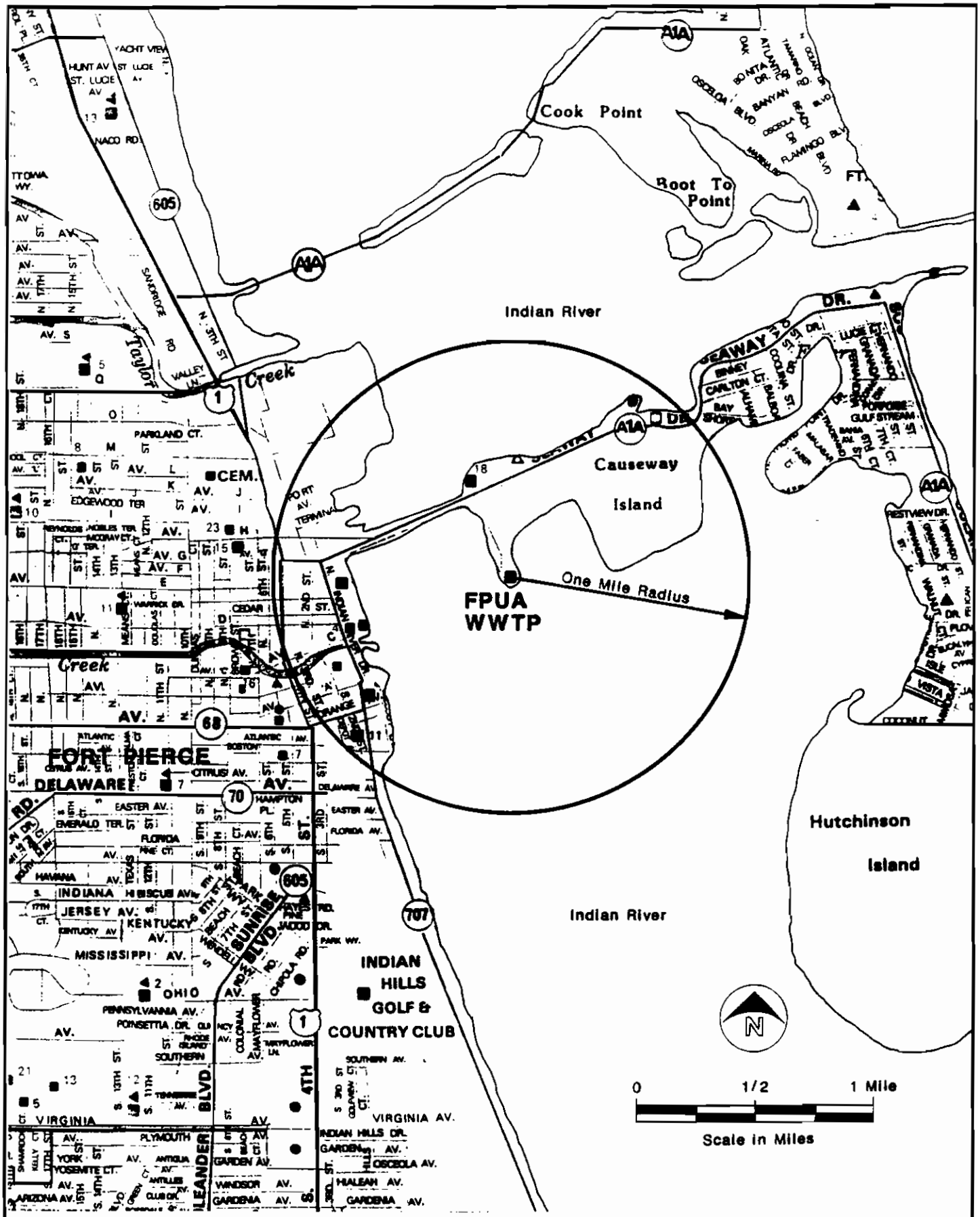

NOTE: NO WELLS WITHIN THE AREA OF REVIEW WERE FOUND TO PENETRATE THE PROPOSED INJECTION ZONE, CONFINING INTERVALS, OR PROPOSED MONITORING INTERVALS.

FIGURE 2-1

WELL INVENTORY AREA OF REVIEW

CH2MHILL

Conceptual Design, which is included in this package, shows the WWTP in relation to the 1-mile radius area of review.

(3), (4), and (5)

Refer to the following tables and figures in the *Conceptual Design of a Deep Injection Well Effluent Disposal System*, (CH2M HILL, September 1991) prepared for the FPUA.

- Expected Geologic Formations and Characteristics in St. Lucie County (Table 2-3)
- Anticipated Lithology and Hydrogeology at the FPUA WWTP (Table 2 -4)
- Location of Cross-Sections Used in Figure 2-4 (Figure 2-3)
- Stratigraphic Cross-Sections at DIW Sites (Figure 2-4)
- Piezometric Surface of the Floridan Aquifer (Figure 2-5)

(6) a. The FPUA wastewater system currently consists of a collection system and a 9.0 mgd wastewater treatment plant. The expected buildout annual average daily flow is 7.2 mgd. The expected maximum daily flow at buildout is 10.8 mgd.

b. The estimated average operation pressure is about 52 pounds per square inch (psi). The estimated maximum operation pressure is 65 psi.

c. The source of the injected fluids will be the secondary treated effluent from FPUA's wastewater treatment plant. The effluent for disposal will be in accordance with the criteria for discharge of secondary treated effluent to deep injection wells as specified in FAC 17-600.

(7) The characteristics of the injection zone will be evaluated by testing during construction. This testing includes lithologic sampling at 10 foot intervals, water quality sampling at 30 foot intervals during reverse air drilling, packer testing, coring, and injection testing. Geophysical logging performed during construction and testing of the wells will include LSN and SP Electric, Gamma, Caliper, Temperature, and fluid resistivity. The application of other geophysical logs will be discussed with FDER and TAC during the construction permit application review. Casing pressure tests, TV surveys and Radioactive Tracer Surveys (RTS) will be conducted as part of the Mechanical Integrity Testing (MIT).

(8) The need for a stimulation procedure is not anticipated, therefore no stimulation of the injection zone is proposed. The well will be cleaned by circulation and settling of fluids to remove mud and cuttings before commencing the injection test.

(9) The effluent injection pump station will be a reinforced concrete, wet sump design equipped with electrically driven vertical turbine pumps. Pumping capacity will be adequate for the total effluent flow from the treatment plant with the largest pump out of service. For emergency power backup the FPUA WWTP has dual independent power feeds to meet Class I reliability requirements.

The effluent disposal system will be equipped with a surge control system connected to the injection piping at the pump station. The surge control tank will be sized to meet the needs of the injection well system and will contain compressed air and water which dampen the effects of the downsurge and backsurge associated with water hammer during the start and stop of the injection pumps, thus reducing risk of damage to the system.

(10) Information on the subsurface construction of the proposed deep injection well and dual-zone monitor well is shown in Figures 3-1 and 3-2 of the *Conceptual Design of a Deep Injection Well Effluent Disposal System* (CH2M HILL,

September 1991) prepared for the FPUA. Additional construction details are contained in the technical specifications for the construction of the disposal system.

(11) In accordance with the requirements of the TOP, FPUA will apply for a continuation of its current EPA NPDES permit, which would allow the emergency disposal of the treated effluent to the Indian River during the DIW shutdown. FDER approval for planned and emergency discharges to the Indian River will be sought by FPUA. The TOP requires FPUA to conduct additional studies to assess the impact of occasional discharges to the Indian River. If the studies yield favorable findings, the FPUA intends to construct a new outfall with multiple diffuser ports to achieve required dilution for a mixing zone within the river.

(12) Instrumentation to monitor the operation of the injection well will include:

- One venturi flow meter with indicating, recording and totalizing functions
- One pressure gauge at the injection well wellhead
- One indicating and recording pressure recorder

For the Dual-Zone Monitor Well:

- One pressure gauge equipped with indicating and recording functions on each monitor zone

The formation pressures recorded in the two monitor zones and the injection pressure and the flow rate in the injection well will be recorded continuously and reported to FDER on a monthly basis.

Unless otherwise specified in the operating permit, water samples from the injection well, monitor well, and effluent will be collected and analyzed for the parameters listed in Table 3-1 of the Conceptual Design.

(13) Within the area of review, no wells are known to penetrate the injection zone of the proposed deep injection well.

(14) For a detailed description of construction features and procedures, refer to the technical specifications and contract documents for the FPUA deep injection well disposal system.

(15) The proposed abandonment procedure for the Class I injection well is as follows:

- Stop artesian flow from the well with heavy mud to lower the hydrostatic head below land surface.
- Drop burlap bags full of gravel down the well to bridge the open hole at a depth selected by the Engineer and approved by FDER and the TAC.
- Fill the remaining open hole with gravel up to the bottom of the 24-inch casing at approximately 2,600 feet
- Place a Class H neat cement cap from approximately 20 feet below the base of the 24-inch casing to approximately 100 feet above the base of the casing
- Place Class H cement with 12 percent bentonite in stages through grout pipe from the top of the neat cement plug to land surface.

The estimated cost to perform this work in 1991 dollars is as follows:

• Mobilize drilling rig and kill the well	$ 50,000
• Fill the open hole with gravel, approximately 50 yards at $50.00/yd	2,500
• Place 120 foot neat cement cap from 20 feet below the base of the 24-inch casing, 327 sacks at $27.00/sack	9,000
• Place cement from 2,500 feet up to ground surface, 3,600 sacks at $35.00/sack	126,000
SUBTOTAL	$187,500
20 Percent Contingency	37,500
TOTAL ESTIMATED COST	**$225,000**

This cost estimate does not include any costs associated with engineering, testing, water quality analysis, or long-term monitoring that may be required.

CONCEPTUAL DESIGN

Conceptual Design of a

DEEP INJECTION WELL EFFLUENT DISPOSAL SYSTEM

Prepared for

Fort Pierce Utilities Authority
Fort Pierce, Florida

Prepared by

CH2M HILL

September 1991

Conceptual Design of a Deep Injection Well Effluent Disposal System

Prepared for

Fort Pierce Utilities Authority
Fort Pierce, Florida

Prepared by

CH2M HILL Southeast, Inc.
800 Fairway Drive, Suite 350
Deerfield Beach, Florida 33441

September 1991
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CONTENTS

TABLES

FIGURES

Section 1

Introduction

The Fort Pierce Utilities Authority (FPUA) is a combined utility providing water, gas, electric, and wastewater services to the City of Fort Pierce and surrounding unincorporated areas. The FPUA wastewater system currently consists of a collection system and a 9.0-million gallon per day (mgd) wastewater treatment plant (WWTP) located on South Hutchinson Island. The project location is shown on Figure 1-1. The plant, which discharges secondary treated effluent to the Indian River through an outfall, operates under a Temporary Operating Permit (TOP) from the Florida Department of Environmental Regulation (FDER).

The TOP was issued to allow reasonable time for the FPUA to implement an alternate disposal system eliminating effluent discharge to the river as required by the Indian River Lagoon System Act of 1990 (House Bill 3247). The FPUA has evaluated reuse as an alternative but has found this method not to be economically feasible at present in Fort Pierce. The TOP requires FPUA to construct a Class I deep injection well (DIW) and specifies that construction on the DIW begin by June 1, 1992, and be completed by March 1, 1993.

The DIW, which will consist of concentric casings, will be constructed in accordance with the requirements of Florida Administrative Code (FAC) Chapter 17-28. It will be installed using staged construction and testing techniques, and the final casing will be of seamless steel pipe with a 0.500-inch wall thickness. Based on a review of geophysical and geological data from other wells in the area, the depth of the injection zone is anticipated to be between 2,800 and 3,100 feet below land surface (bls).

One dual-zone Floridan aquifer monitor well with concentric casing will be constructed 75 feet from the DIW. The upper zone will monitor the first suitable zone beneath the uppermost confining interval, which is anticipated to occur between 800 and 900 feet bls. The lower zone will be placed in the first permeable zone beneath the base of the underground source of drinking water (USDW)--water with

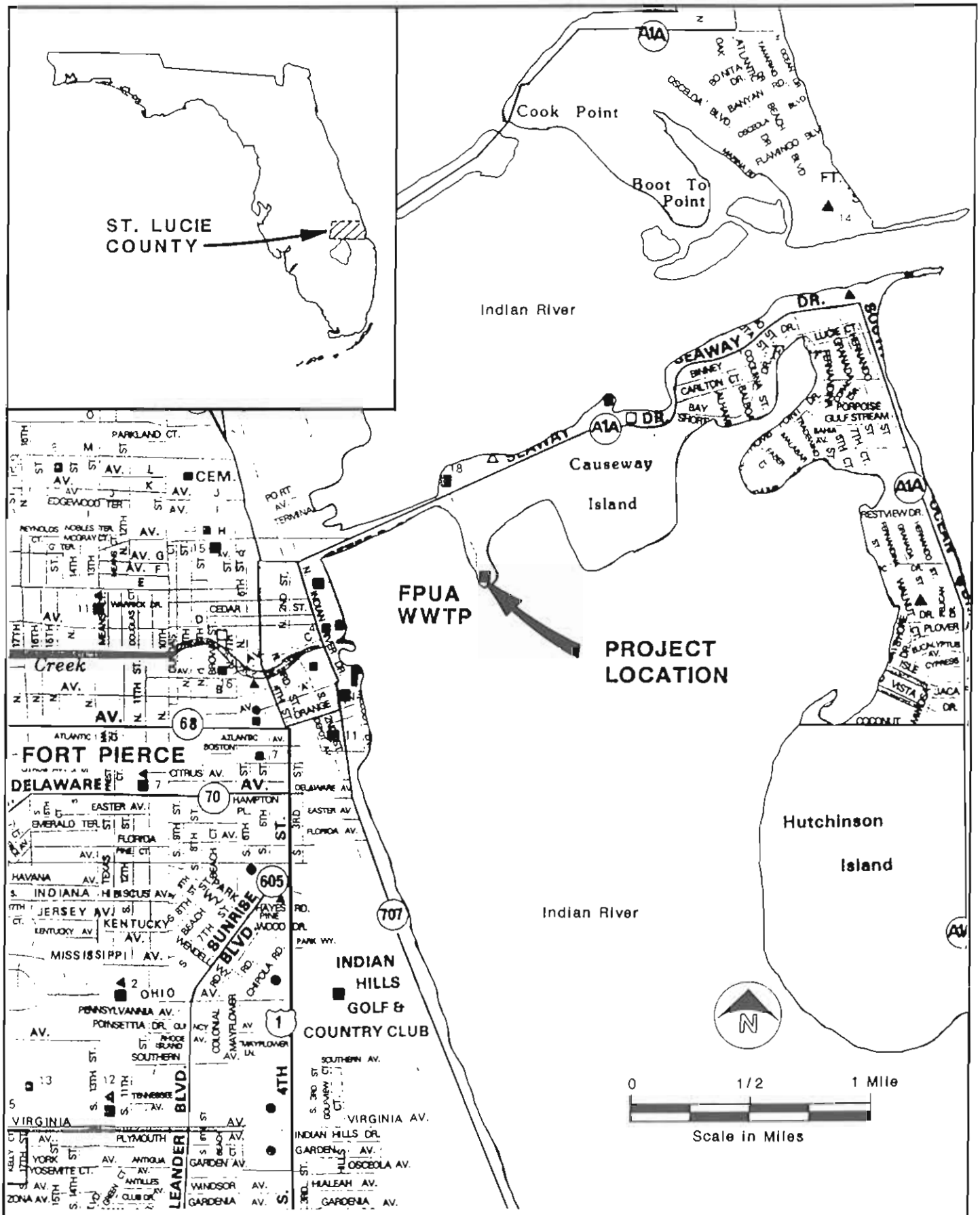

FIGURE 1-1

PROJECT LOCATION MAP

less than 10,000 milligrams per liter (mg/l) of total dissolved solids (TDS). Based on a review of geophysical and water quality data from other wells in the area, it is anticipated that a suitable zone will occur at approximately 1,800 feet below land surface. The actual depth of this monitor zone will be dependent upon field testing performed during construction and will be subject to approval by the TAC and FDER.

This report presents the results of a conceptual design study investigation for a deep well injection of secondary treated effluent at the FPUA WWTP. The general project location map and proposed DIW facility layout are illustrated in Figures 1-1 and 1-2.

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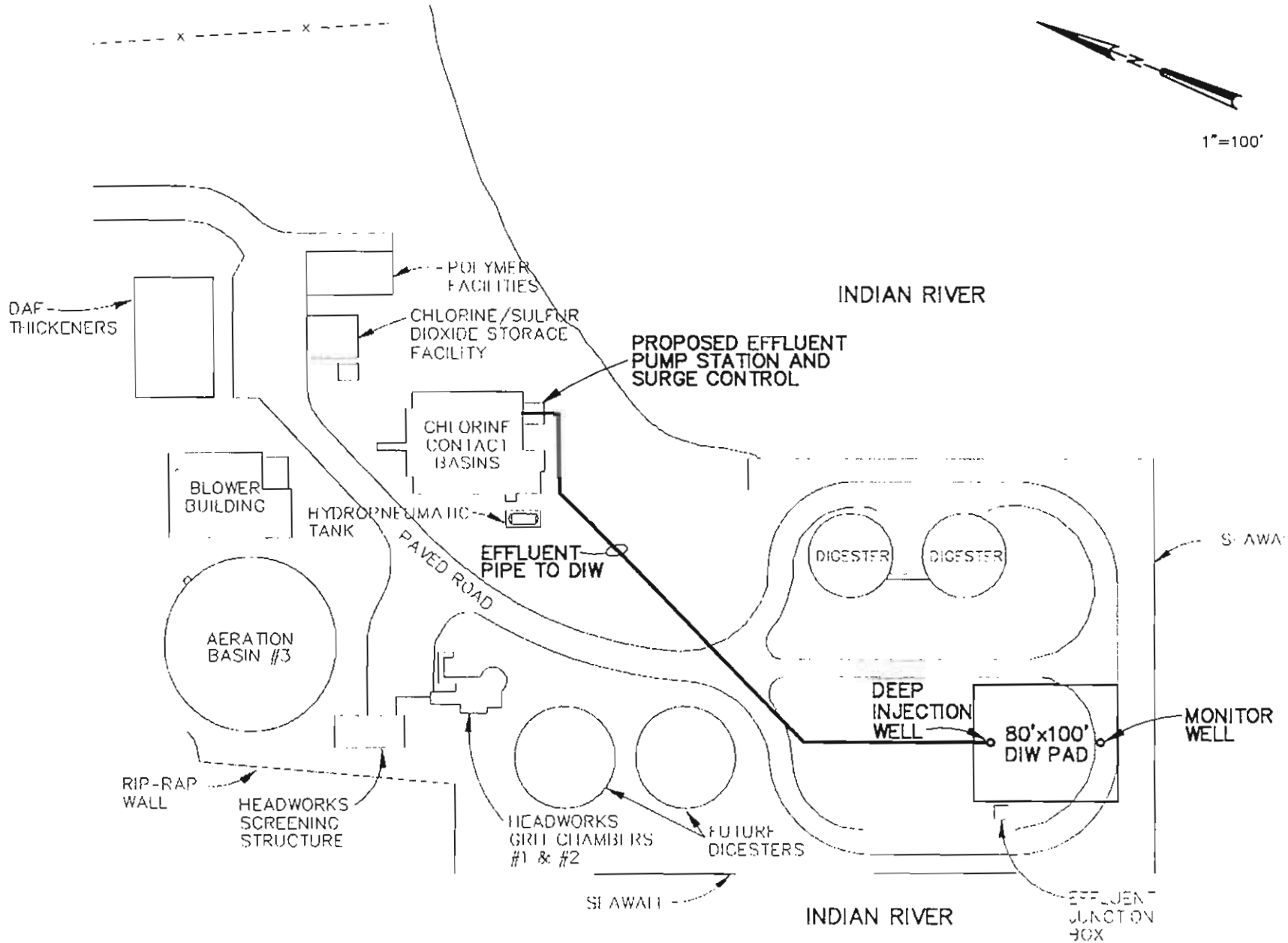

FIGURE 1-2

PROPOSED DIW FACILITIES LAYOUT
AT THE FPUA WWTP

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Section 2

Technical Feasibility

Regulatory Constraints

Deep injection of secondary treated effluent from the FPUA WWTP was chosen as a technically and economically feasible alternative to discharge to the Indian River provided that the system complies with the regulatory requirements contained in FAC Chapter 17-28 under the jurisdiction of the FDER. A TOP was issued by FDER to allow the WWTP to discharge treated effluent to the river until a DIW could be constructed. An operation permit for the DIW facilities must be obtained by January 1, 1994, under the TOP requirements.

Three of the basic requirements stated in FAC Chapter 17-28 are:

- Receiving zone capable of accepting the proposed maximum flows is present

- The receiving zone contains water with a TDS concentration in excess of 10,000 mg/l

- The receiving zone is overlain by a confining interval of sufficient thickness to prevent the migration of the injected effluent to zones containing water with a TDS concentration of less than 10,000

Compliance with the above requirements must be shown by construction, testing and performance of a deep injection well and an adjacent monitor well.

Regulatory requirements for underground injection are contained in FAC Chapter 17-28. One of the requirements for a DIW is that the flow velocity in the well casing cannot exceed 8 feet per second. Another requirement is that the final

casing string must extend to a depth below the lowermost USDW and must be overlain by a confining interval of sufficient thickness to prevent the migration of the injected fluids into a USDW.

Several other regulatory constraints involving monitoring are also included in FAC 17-28. For example, the monitoring well designed to confirm the long-term effectiveness of the confining zone must be installed near the DIW. Monitoring requirements include the installation of continuous indicating, recording, and totalizing recorders to monitor the injection pressure and injection flow. Regular measurement of water levels or pressures and the determination of water quality in the monitor well is also required.

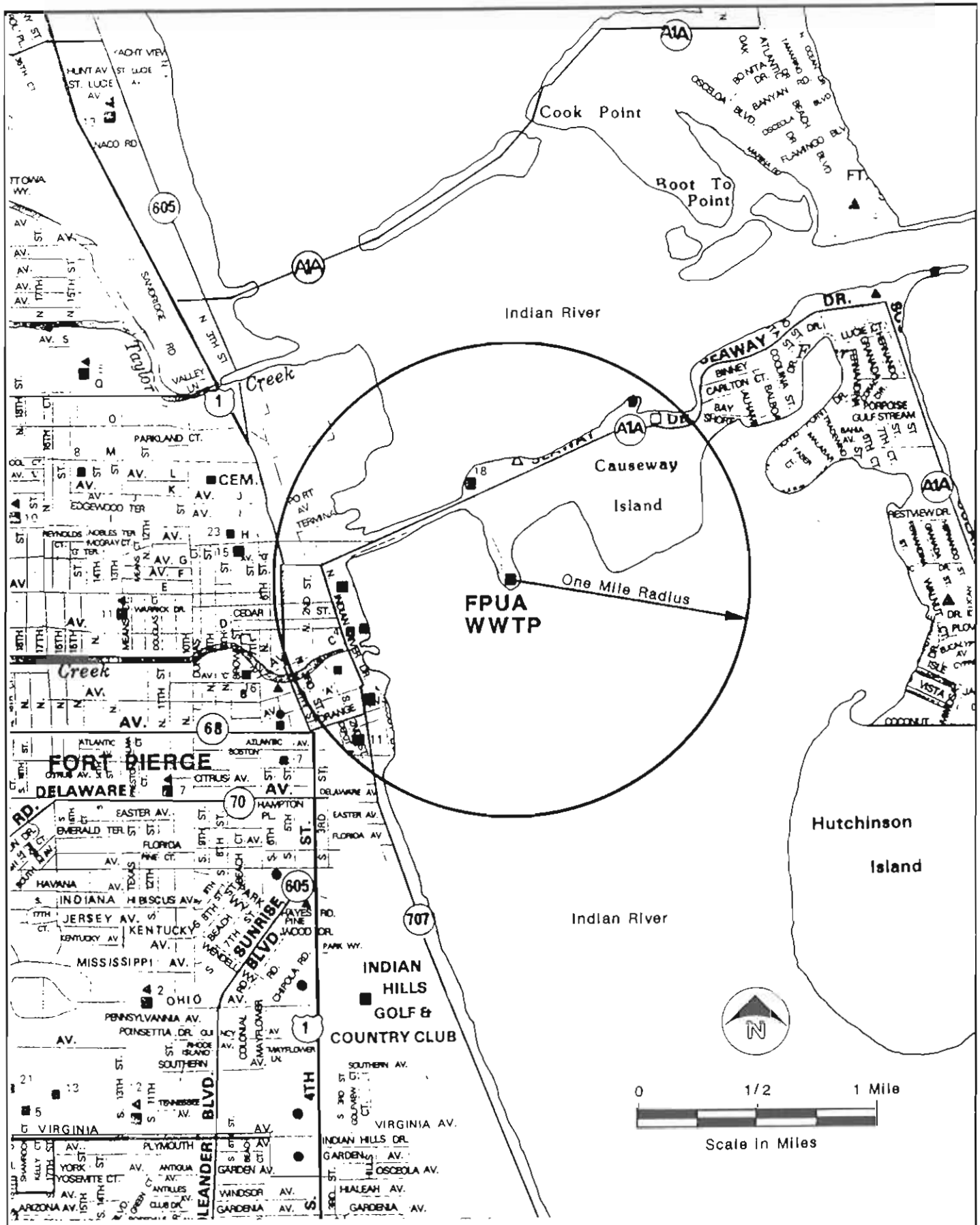
Several injection wells in the area have shown compliance with the above requirements; however, compliance at each site must be demonstrated by drilling and testing at that particular site.

Well Inventory

As required by FAC Chapter 17-28, a well inventory was conducted to locate existing wells near the proposed DIW using a review area of 1-mile radius around the WWTP. Data obtained from the South Florida Water Management District (SFWMD), the U.S. Geological Survey (USGS), and the Florida Bureau of Geology indicate that no wells within the area of review penetrate through the proposed injection zone, confining intervals, or proposed monitoring zones. Figure 2-1 shows the WWTP in relation to the 1-mile radius area of review.

Class I Injection Wells In the Surrounding Area

Two DIWs, located at the North Port St. Lucie WWTP and the South Port St. Lucie WWTP, are currently operational in St. Lucie County (Figure 2-2). Sixteen oper



NOTE: NO WELLS WITHIN THE AREA OF REVIEW WERE FOUND TO PENETRATE THE PROPOSED INJECTION ZONE, CONFINING INTERVALS, OR PROPOSED MONITORING INTERVALS.

FIGURE 2-1

WELL INVENTORY AREA OF REVIEW

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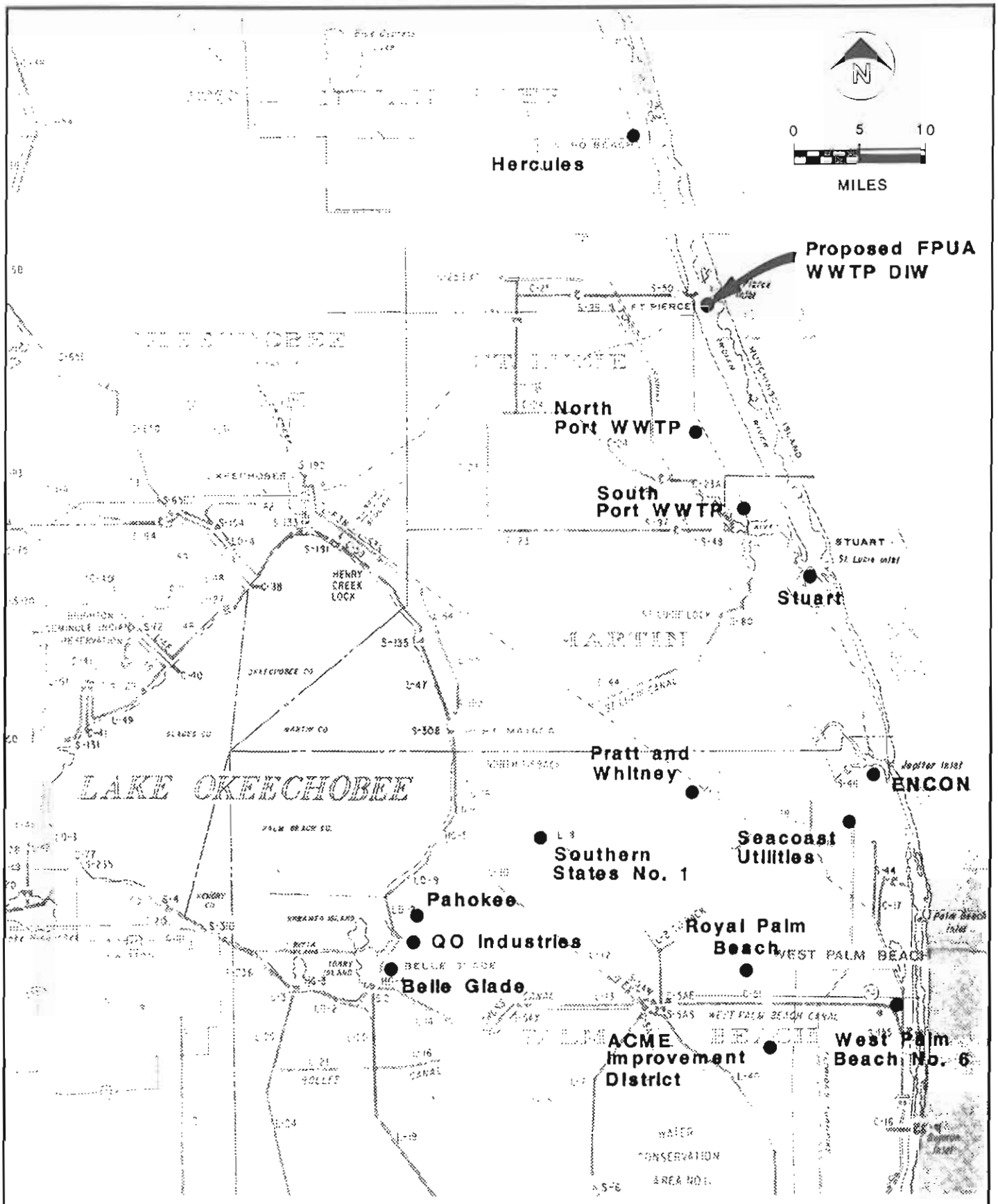

LEGEND

WWTP – Wastewater Treament Plant
DIW – Deep Injection Well

FIGURE 2-2

LOCATION OF OPERATIONAL INJECTION SYSTEMS IN THE SURROUNDING AREA

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ational deep injection wells at eleven locations in northern Palm Beach, Martin, St. Lucie, and Indian River Counties are listed in Table 2-1. Total design flow for these systems is 114.4 mgd, 95 percent of which is municipal effluent.

Data from other operating injection systems in St. Lucie County and adjacent counties indicate that hydrogeologic conditions favorable to injection wells are likely to be encountered at the FPUA WWTP (Table 2-2). Those wells use the same injection zone, the lower Oldsmar Limestone, which is more commonly known as the "boulder zone." The injection interval occurs in this area at depths between 2,400 - 3,800 feet. Injection pressures at the two other operational DIWs in St. Lucie County are approximately 48 pounds per square inch (psi) at the South Port St. Lucie WWTP and 53 psi at the North Port St. Lucie WWTP.

Hydrogeologic Considerations

The geology of St. Lucie County and the surrounding area is well documented by data from other injection wells and Floridan aquifer production wells drilled in St. Lucie and adjacent counties. Rock formations that are important to the injection process are found throughout the county, and are essentially horizontal and stratigraphically undisturbed. Figure 2-3 shows the location of two cross sections from Vero Beach to West Palm Beach (north-south) and from West Palm Beach to Belle Glade (east-west). The cross sections are shown in Figure 2-4.

Eocene limestone formations are present throughout the County, including Lower Eocene Oldsmar Limestone, Lake City Limestone, Avon Park Limestone, and the Upper Eocene Ocala Group. Suwannee Limestone of Oligocene age comprises the top of the Floridan aquifer system. The Tampa and Hawthorn Formations of Miocene age make up the upper confining unit, and Pleistocene Caloosahatchee Marl, Anastasia Formation, and the Pamlico Sand form the near-surface deposits. Table 2-3 summarizes the geologic formations found in St. Lucie County.

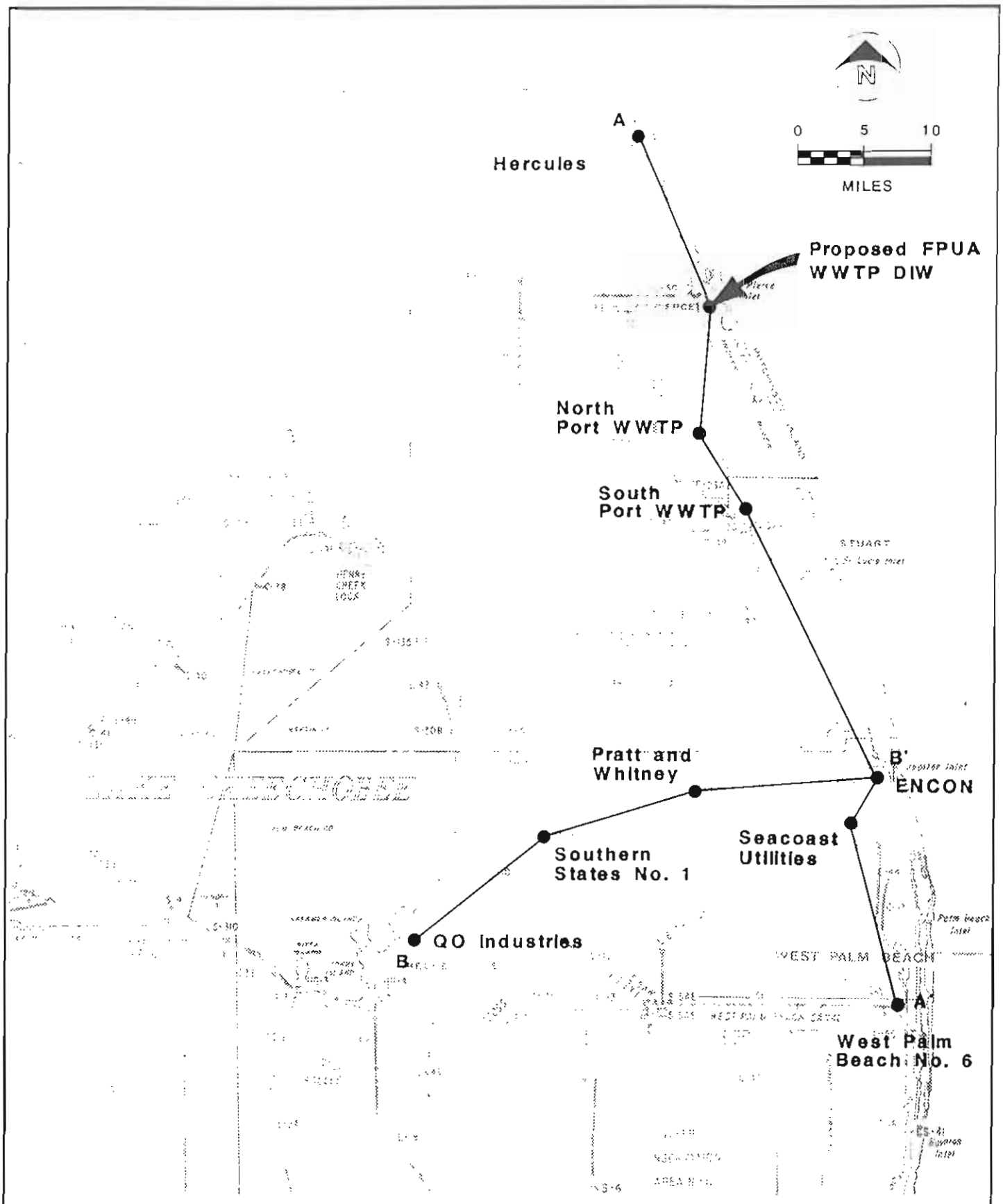
Table 2-1
Existing Deep Injection Well Facilities
in the Area Surrounding the Proposed FPUA DIW

Facility	No. Wells	Design Flow, mgd	Type of Effluent	Years in Operation
Pratt and Whitney	1	2.8	Industrial	6
Q.O. Industries	2	2.4	Industrial	14
Encon	1	16	Municipal	3
City of West Palm Beach (East-Central Regional)	5	55	Municipal	10
ACME Improvement District	1	5	Municipal	3
Hercules	1	0.9	Industrial	6
North Port St. Lucie WWTP	1	4.0	Municipal	3
South Port St. Lucie WWTP	1	4.0	Municipal	8
City of Stuart	1	3.0	Municipal	8
Seacoast Utilities	1	15.0	Municipal	2
Village of Royal Palm Beach	1	6.3	Municipal	3
Total	16	114.4		

Table 2-2
Summary of Information from of Deep Injection Wells in the Area Surrounding the Proposed DIW

Injection Well Site	Design Flow (mgd)	Injection Zone (feet)	Injection Pressures (psi)
City of West Palm Beach (East-Central Regional)	11	3,026-3,627	96
	11	3,026-3,627	100
	11	3,034-3,415	80
	11	2,963-3,023	70
	11	3,282-3,810	43
Encon	16	3,000-3,500	N/A
Q.O. Chemicals, Inc.	2.4	2,890-3,156 2,995-3,200	40 Standby
Pratt & Whitney	2.8	2,738-3,300	<40
Hercules	0.9	2,390-2,580	40
North Port St. Lucie WWTP	4.0	2,900-3,200	53
South Port St. Lucie WWTP	4.0	3,000-3,270	48
City of Stuart	3.0	2,670-3,305	67
Seacoast Utilities	15.0	2,750-3,320	40
Village of Royal Palm Beach	15.0	2,950-3,126	50

N/A = Not Available



LEGEND

WWTP – Wastewater Treament Plant
DIW – Deep Injection Well

FIGURE 2-3

LOCATION OF CROSS SECTIONS USED IN FIGURE 2-4

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Table 2-3
Expected Geologic Formations and Characteristics
In St. Lucie County

Formation	Physical Characteristics	Water - Bearing Characteristics
Pamlico Sand	Very fine to coarse, white to black or red quartz sand. Mantles sandy flatlands and coastal ridge.	Small yields to domestic wells. (Fresh)
Anastasia Formation	Coquina, sand, calcareous sand stone and shell marl. Some zones contain old mangrove-swamp or salt-marsh deposits composed of fine sand, silt, clay, and organic material.	Important shallow aquifer. Fair to good yields. (Fresh)
Caloosahatchee Marl	Sandy marl, clay, silt, sand and shell beds.	Shallow aquifer. Fair yields. (Fresh)
Hawthorn Formation	Sandy, phosphatic marl, inter bedded with clay, shell marl, silt, and sand.	Major part of aquiclude. Limited artesian water. (Brackish)
Tampa Limestone	White to tan, soft to hard limestone.	Yields some artesian water. Generally top of Floridan aquifer. (Brackish)
Suwannee Limestone	Creamy, soft to hard limestone.	Part of Floridan aquifer. Artesian. (Brackish)
Ocala Group	White to cream, porous and cavernous to dense limestone.	Major formation in Floridan aquifer. Artesian. (Brackish)
Avon Park Limestone	White to cream foraminiferal limestone.	Major formation in Floridan aquifer. Artesian. (Brackish to Saline)
Lake City Limestone	Interbedded dolomite and dense foraminiferal limestone.	Major part of intraqui-fer low permeability zone. (Saline)
Oldsmar Limestone	Highly fractured and cavernous dolomite.	Major formation in Floridan aquifer. High transmissivity. (Saline)

The hydrogeology throughout the County consists of a non-artesian shallow aquifer separated from a deeper artesian aquifer by several hundred feet of confining strata. The shallow unconfined aquifer, generally known as the surficial aquifer, is approximately 125 feet thick along the coastal sections of St. Lucie County. Most of the water supply wells in the area are constructed in the shallow aquifer. Formations comprising the shallow aquifer in eastern St. Lucie County consist of the Pamlico Sand, the Anastasia Formation and the Caloosahatchee Marl.

The Miocene confining interval (about 375 feet thick) underlies the surficial aquifer and is comprised of the Hawthorn Formation and Tampa Limestone. Confinement is provided by clays and marls which exhibit very low permeabilities and isolate the surficial aquifer from lower aquifers.

The Floridan aquifer system can be subdivided into upper and lower permeable zones with an intervening zone of lower permeability. The aquifer is composed of limestone and dolomite beds generally dipping to the east and south, and contains highly mineralized water. Figure 2-5 illustrates the piezometric (potentiometric) surface of the upper Floridan aquifer in the area.

The upper permeable zone consists of Oligocene to middle Eocene formations, including the Suwannee Limestone, Ocala Group, Avon Park Limestone, and Lake City Limestone. Portions of the Upper Oldsmar Limestone may be considered part of the confining interval.

The lower permeable zone is a solution-worked fracture and cavernous interval which occurs in the Oldsmar Limestone, and is also known as the "boulder zone." The matrix of the boulder zone consists of hard, cryptocrystalline to finely crystalline, moderately yellowish-brown dolomite with some interbedded white, fossiliferous fine- to medium-grained limestone.

Four important criteria for injection well feasibility are the thickness and areal extent of the confining intervals, impermeability of the confining intervals, transmissivity of the injection zone, and compatibility of the injected fluids with the native waters and

minerals of the injection zone. Municipal secondary treated effluent should be compatible with the native waters and should have little to no impact on the dolomites and limestones of the injection zone. To demonstrate confinement, cores will be taken in the confining intervals at selected depths and analyzed for vertical and horizontal permeability, and total porosity. TDS content of water in the injection zone typically ranges from approximately 30,000 to 35,000 mg/l. Deep injection wells currently operating in St. Lucie County and surrounding areas (Figure 2-2) have demonstrated the presence of a suitable environment.

Hydrogeology at the FPUA WWTP is expected to be similar to that found at adjacent well sites because of the regional extent of the stratigraphic formations and the low formation dips. Table 2-4 summarizes the anticipated lithology and hydrogeology at the FPUA WWTP site.

The surficial aquifer, consisting of undifferentiated Pliocene to recent sedimentary deposits, is estimated to extend to a depth of approximately 125 feet bls at the FPUA WWTP. Miocene confining beds (the Hawthorn and Tampa Formations) are expected to occur between approximately 125 and 500 feet bls.

The upper permeable portion of the Floridan aquifer probably lies between approximately 500 and 1,500 feet bls. The formations comprising the upper Floridan aquifer include Suwannee Limestone, the Ocala Group, and Avon Park Limestone. Microfossil identification will help determine whether Ocala Limestone is present. The transition from potentially potable water to waters containing greater than 10,000 mg/l TDS is expected to occur at an approximate depth of 1,800 feet bls.

The intra-aquifer, low permeability, confining sequence consists of Lake City Limestone and possibly the upper portion of the Oldsmar Limestone that is not dolomitized. This confining sequence is expected between 1,500 and 2,500 feet bls.

Table 2-4
Anticipated Lithology and Hydrogeology
At The FPUA WWTP

Depth (in feet)	Description
0 - 125	Surficial aquifer; fine to medium-grained sand; shells
125 - 500	Confining interval; phosphatic clay
500 - 1,500	Artesian aquifer; interbedded limestone and dolomite
1,500 - 2,500	Confining interval; interbedded chalky limestone and dolomite
2,500 - 3,300	Oldsmar limestone including the boulder zone; highly transmissive dolomite, fractured and cavernous

The top of the boulder zone is anticipated to occur at approximately 2,800 feet bls. The highly transmissive portion is expected to be between approximately 300 feet thick, based on thicknesses observed at the North Port St. Lucie, South Port St. Lucie, and Hercules DIWs.

Section 3

Conceptual Design of a Deep Injection Well

The proposed DIW system will consist of a drilling pad, a 24-inch-diameter deep injection well, a 6-inch diameter dual-zone monitoring well, pump station, and a surge control system.

Well Sizing Criteria

The projected annual average daily flow of treated effluent at buildout from the FPUA WWTP is 7.2 mgd. The diameter of the DIW is determined from the projected maximum daily flow at buildout (11.3 mgd). A 24-inch-diameter DIW will allow the injection rate of the treated effluent to remain below 8 feet per second, as required by FAC Chapter 17-28.

Drilling Pads

A reinforced concrete pad will be constructed prior to initiating drilling of the Class I DIW. The pad will provide a stable drilling platform to support drilling equipment loads and to contain minor spills that may occur during drilling operations. The pad will be approximately 80 feet by 100 feet and will be sloped to a sump with a valved drain, which will empty into the existing outfall. Spills will either be properly disposed of or reinjected into the system as conditions permit.

Injection System Details

A 24-inch-diameter Class I municipal DIW will be constructed in accordance with the requirements of FAC Chapter 17-28. Figure 3-1 shows the proposed DIW construction diagram. Multiple, concentric, carbon steel casings will be used and installed

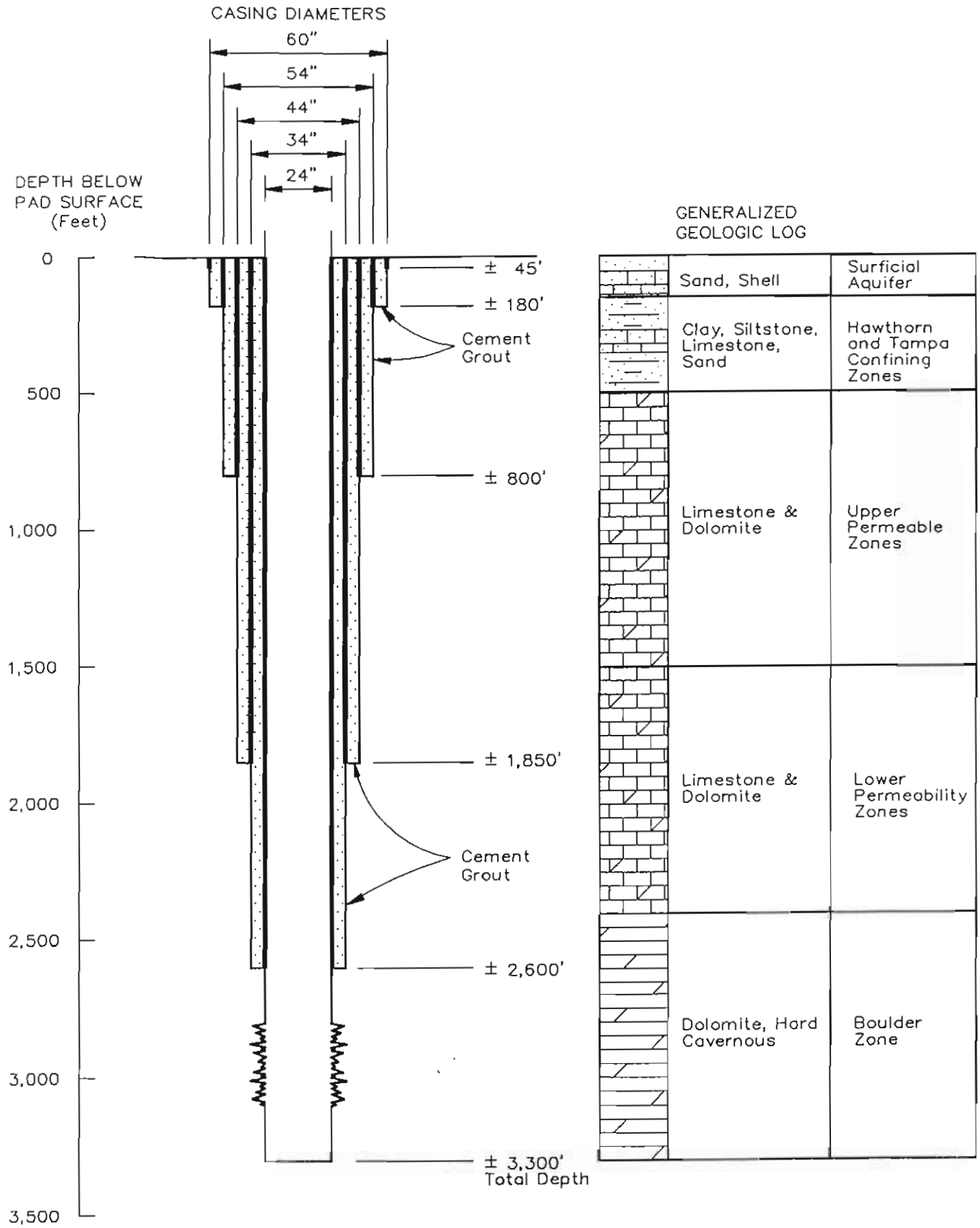

FIGURE 3-1

PROPOSED DEEP INJECTION WELL DESIGN AT THE FPUA WWTP

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with staged construction and testing techniques. The final casing will be of seamless carbon steel pipe with a 0.500-inch wall thickness conforming to American Society for Testing and Materials (ASTM) A 53, Grade B. The thickness, type of materials, and length of casing will conform to guidelines contained in FAC 17-28.

A cementing program will be specifically tailored for each casing on the DIW. The cement will be compatible with the injected and formation fluids and the formation rock type. Cements will be ASTM Type II or its equivalent.

The lower 200 feet of each casing will be cemented with neat cement. The remainder of the annulus will be cemented to land surface using cement with bentonite and other appropriate additives. Thicknesses of the cement sheath around each casing will be specified in the technical specifications. At minimum a nominal 5-inch sheath around the final and intermediate casings with a nominal 3-inch sheath around surficial casings will be used.

Proposed cement additives will be submitted to FDER for approval following contractor selection and prior to start of construction. Additives are most commonly used to overcome lost circulation zones in the formation. Bentonite (a sodium montmorillonite, colloidal clay) is often used to reduce permeability, lighten the cement slurry weight, and increase cement yields, thereby reducing costs.

A detailed construction plan for the DIW system is presented in Appendix A.

Pump Station and Surge Controls

The effluent injection pump station will be a reinforced concrete wet sump design equipped with electrically driven vertical turbine pumps. Pumping capacity will be adequate for the total effluent flow from the treatment plant with the largest pump out of service. For emergency power backup the FPUA WWTP has dual independent power feeds to meet Class I reliability requirements.

The effluent disposal system will be equipped with a surge control system connected to the injection piping at the pump station. The surge control tank will be sized to meet the needs of the injection well system and will contain compressed air and water to dampen the effects of the downsurge and backsurge associated with water hammer during the start and stop of the injection pumps, thus reducing risk of damage to the system.

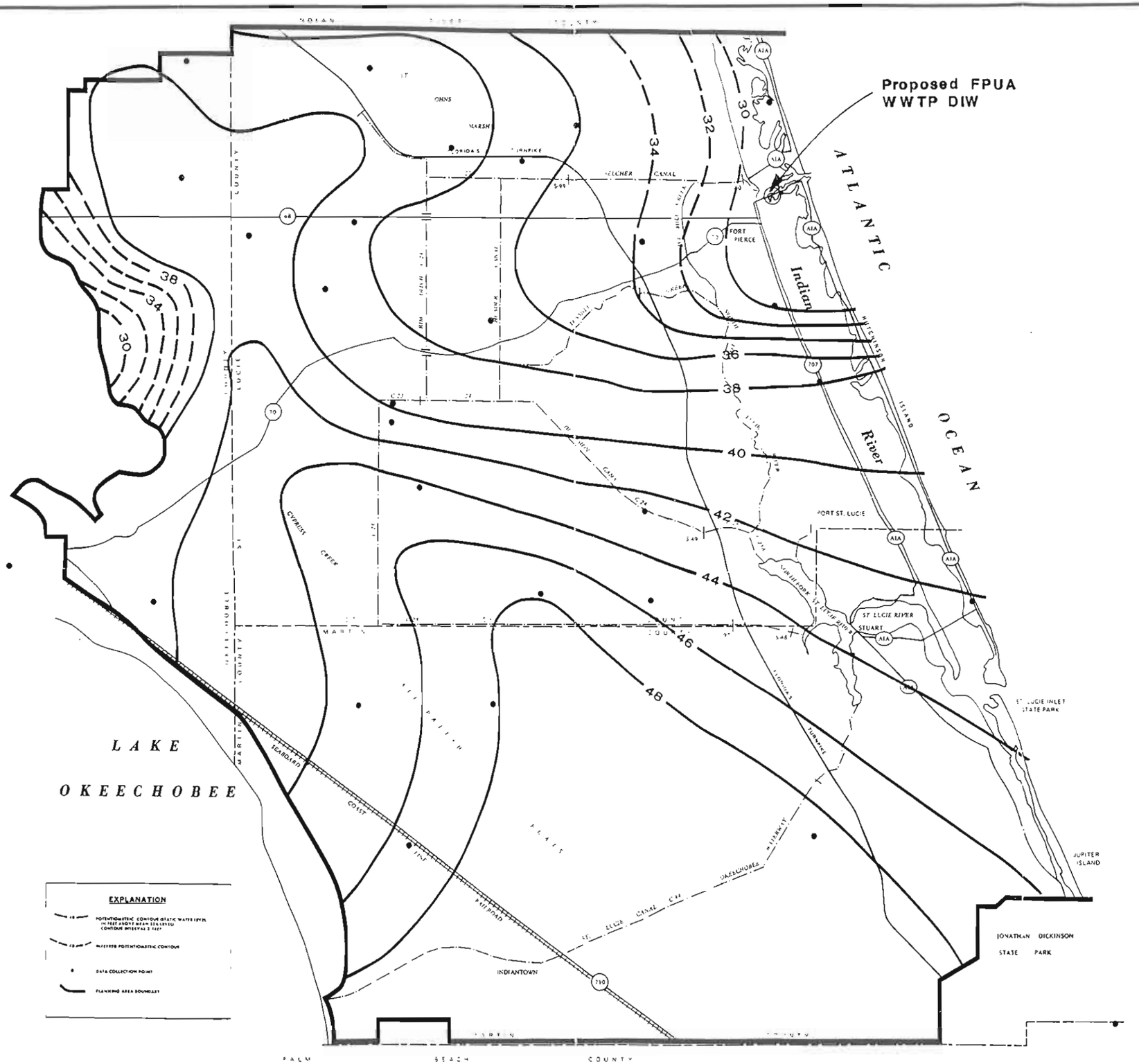
Monitoring System

Monitoring before and during injection is an essential part of injection system operation. One 6-inch diameter dual-zone monitor well is proposed for construction at the WWTP and will be located 75 feet from the DIW. Figure 1-2 shows the proposed layout.

The dual-zone monitor well will be constructed so that the upper zone monitors the first suitable zone beneath the uppermost confining interval. The lower monitor zone will be placed in the first permeable zone beneath the 10,000 mg/l TDS interface. It is anticipated that the upper zone will be found somewhere between approximately 800 and 900 feet in depth, and that the lower zone will occur at approximately 1,800 feet to 1,850 feet in depth. Figure 3-2 presents a generalized construction diagram of the dual-zone monitor well.

Establishment of background water quality in the monitor zones is critical for proper long-term operational monitoring. Water produced during the drilling and development of the monitor well will be discharged into the DIW. The specific development procedure for the monitor zones will be addressed in the technical specifications.

A monitoring program will be developed which will include parameters to be measured and recorded continuously, daily, monthly, quarterly, and yearly. The specific parameters to be measured and the frequency of measurement will be finalized during the permitting process after receipt of Technical Advisory Committee



Source: M.P. Brown and
D.E. Reece, SFWMD, 1979

FIGURE 2-5

PIEZOMETRIC SURFACE OF THE FLORIDAN AQUIFER

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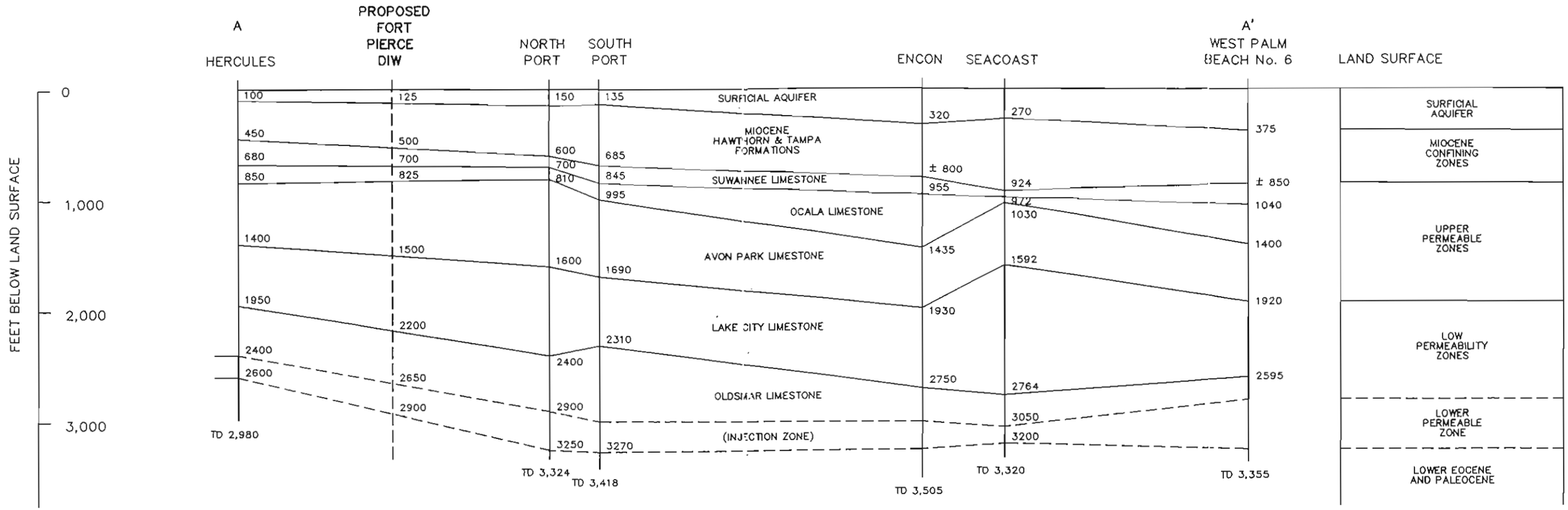

FIGURE 2-4

STRATIGRAPHIC CROSS SECTIONS AT DIW SITES

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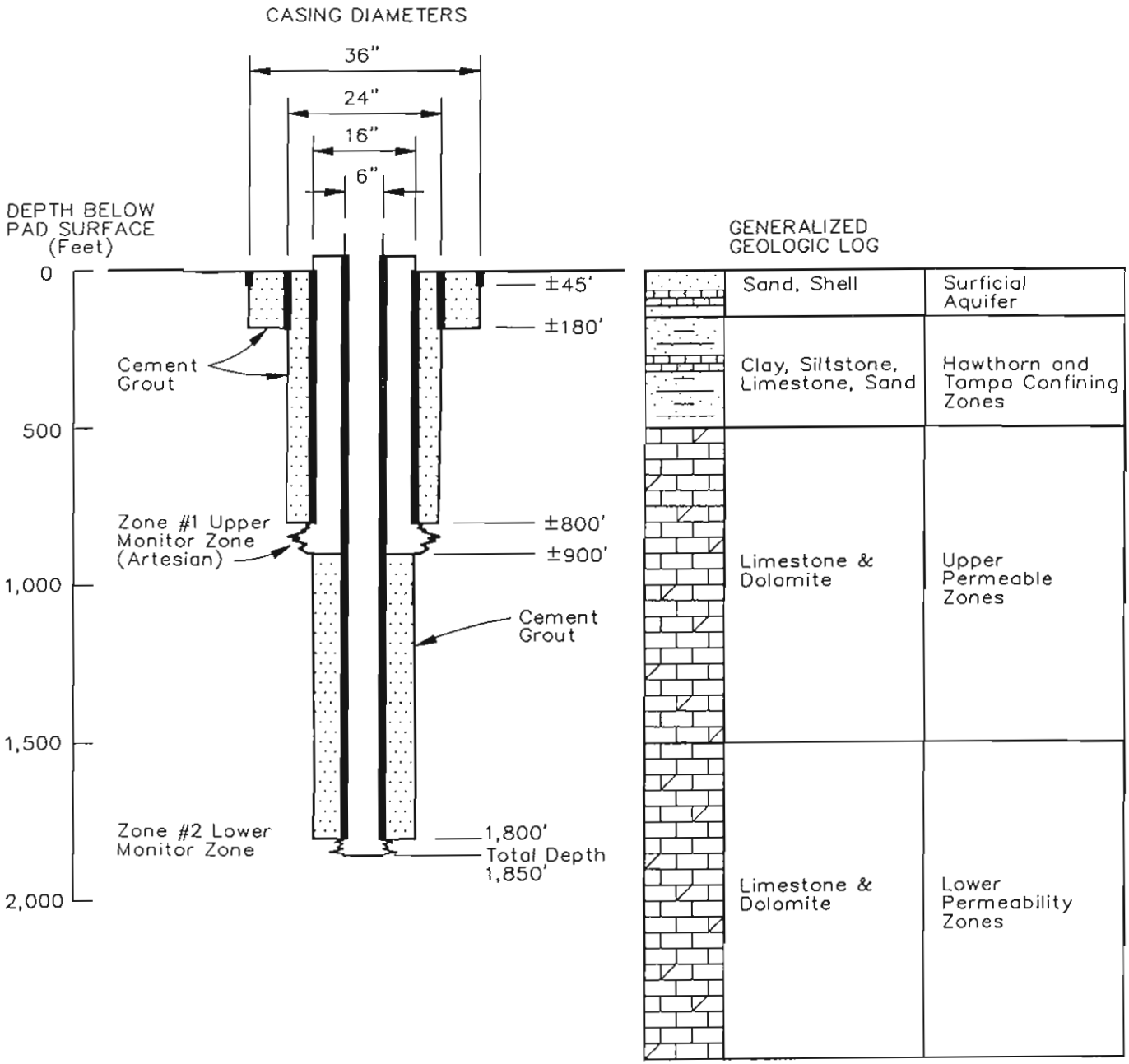

FIGURE 3-2

PROPOSED DUAL-ZONE MONITOR WELL DESIGN AT THE FPUA WWTP

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(TAC) comments. A proposed monitoring schedule is presented for consideration in Table 3-1.

Testing During Construction

A hydrogeologic evaluation will be conducted using the data collected during construction of the deep injection and monitor well. Testing during construction will include lithologic sampling at 10-foot intervals, water quality sampling during reverse air drilling at 30-foot intervals, geophysical logging, packer testing, coring, and injection testing. This information will be used during construction to establish casing setting depths and to select monitor intervals. Up to eight cores will be collected from the primary confining intervals of the injection zone (800 feet to 2,200 feet bls) during pilot hole drilling of the injection well. The mechanical integrity of the well will be performed by conducting a pressure test, a radioactive tracer survey (RTS), with supporting data from a borehole television survey, and temperature and cement bond logs. Table 3-2 lists the proposed geophysical and TV logging schedule for the DIW and the dual-zone monitor well.

Background water quality samples will be drawn from each monitor zone and analyzed for primary and secondary drinking water standards (FAC 17-550) as listed in Table 3-3, and those additional parameters required in the construction permit. Background water quality samples will not be collected until the chloride, conductivity, and pH analyses show that water quality from the monitor zones has stabilized.

Table 3-1
Proposed Deep Injection
Well System Monitoring Schedule

Monitoring Station	Parameter	Frequency
Injection Well	Primary/Secondary DWS	On Start-up
	Flow	Continuous
	Pressure	Continuous
	Specific Injectivity	Quarterly
Monitoring Well	Primary/Secondary DWS	On Start-up
	Pressure/Water Level	Continuous
	Conductance	Monthly
	pH	Monthly
	Chloride	Monthly
	Sulfate	Monthly
	Alkalinity	Monthly
Effluent	Conductance	Daily
	Chloride	Daily
	Turbidity	Daily
	Sulfate	Weekly
	BOD	Annual
	TOC	Annual

DWS - Drinking Water Standards
BOD - Biochemical oxygen demand
TOC - Total organic carbon

Table 3-2
Proposed FPUA WWTP Injection System
Geophysical Logging Schedule

	Deep Injection Well	Dual-Zone Monitor Well
Surface Casing	LSN and SP Electric Gamma Caliper	LSN and SP Electric Gamma Caliper
Intermediate Casing-1	LSN and SP Electric Gamma Caliper	LSN and SP Electric Gamma Caliper
Intermediate Casing-2[b]	LSN and SP Electric Gamma Caliper Temperature[a] Fluid Resistivity	
Final Casing	LSN and SP Electric Gamma Caliper Temperature[a] Fluid Resistivity	LSN and SP Electric Gamma Caliper Temperature[a] Fluid Resistivity Cement Bond Log
Total Depth	LSN and SP Electric Gamma Caliper Temperature Fluid Resistivity	LSN and SP Electric Gamma Caliper Temperature Fluid Resistivity
Pilot Hole and Reamed Hole	90-foot intervals-- single shot drift survey	90-foot intervals-- single shot drift survey
Injection Test	Flow Meter Temperature Caliper Fluid Resistivity	
Mechanical Integrity Testing	RTS Casing Pressure Test TV	Casing Pressure Test TV

[a]Temperature logs to be run on pilot hole and first stage casing cementing.
[b]Packer testing to be performed on the injection well pilot hole to confirm greater than 10,000 mg/1 TDS.
LSN - Long and short normal
SP - Spontaneous potential
RTS - Radioactive tracer survey

Table 3-3
Background Water Sample Analyses

Arsenic
Barium
Cadmium
Chloride
Chromium
Color
Copper
Flouride
Foaming Agents
Iron
Lead
Manganese
Mercury
Nitrate (as N)
Odor
Selenium
Silver
Sodium
Chlorinated Hydrocarbons
  Endrin
  Lindane
  Methoxychlor
  Toxaphene
Chlorophenoxys 2, 4-D

Silvex

Sulfate
Total Dissolved Solids
Turbidity
Zinc
Corrosivity
Alkalinity, Phenolphtalein
Calcium
pH
Stability Index
Coliform Bacteria
Gross Alpha and Beta
Total Trihalomethanes
Volatile Organics
  Trichloroethylene
  Tetrachloroethylene
  Carbon Tetrachloride
  Vinyl Chloride
  1,1,1-Trichloroethane
  1,2-Dichloroethane
  Benzene
  EDB
Temperature
Conductivity
Radium 220
Radium 228

Notes: Parameters to be tested will be Primary and Secondary Drinking Water Standards (FAC 17-550) and any additional parameters required in the construction permit.

Section 4

Proposed Project Schedule

The proposed deep injection well program is an integral part of FPUA's effort to comply with conditions of the TOP and the Indian River Lagoon System Act. As a result, CH2M HILL will accelerate submittal of the permit application to the earliest practical date. Figure 4-1 illustrates the design, construction, and testing schedule proposed for the deep injection well.

ACTIVITY	ACTIVITY DESCRIPTION	DAYS	PROPOSED START
1	PROJECT PLANNING		AUGUST 91
2	KICKOFF MEETING	1	AUGUST 91
3	CONCEPTUAL DESIGN	45	AUGUST 91
4	DETAIL DESIGN & SPECIFICATION	75	AUGUST 91
5	TAC MEETING	1	OCTOBER 91
6	FDER / PERMIT PROCESSING / RESPONSE	150	NOVEMBER 91
7	FINAL DESIGN / PREPARE & SUBMIT PERMIT APPLICATION	30	OCTOBER 91
8	CONSTRUCTION CONTRACTING (FDER REVIEW 120 DAYS)	20	APRIL 91
9	PRECONSTRUCTION MEETING	1	APRIL 92
10	WELL CONSTRUCTION	180	MAY 92
11	DRAFT O&M MANUAL / ENGINEER REPORT PREPARE OPERATING PERMIT APPLICATION	90	NOVEMBER 92
12	OPERATIONAL TESTING	180	NOVEMBER 92

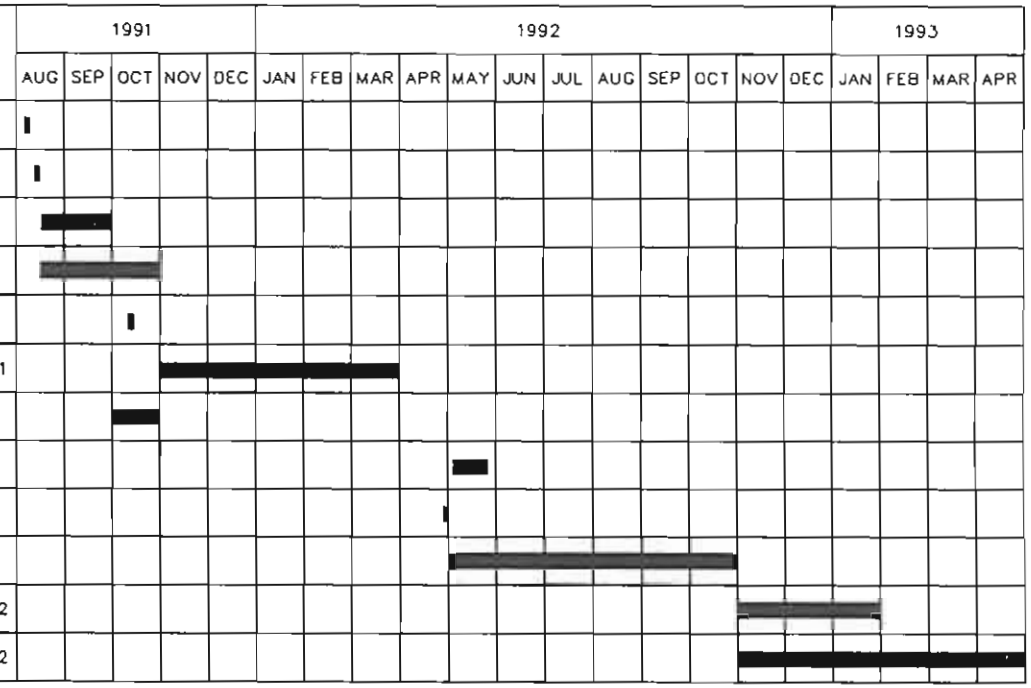

FIGURE 4-1

PROPOSED PROJECT SCHEDULE
-FPUA WWTP DIW

CH2MHILL

Section 5
Emergency Disposal

An alternative for effluent discharge will be needed for periods when the DIW is out of service. The only anticipated period when the DIW will be inoperative is during mechanical integrity testing (MIT), which is scheduled once every 5 years and under current testing procedures typically requires the DIW to be inoperative for about 5 days. With the injection well scheduled to go into full operation in 1993, the first scheduled mechanical integrity test would be performed in 1998.

Effluent reuse, via cooling water supply to a proposed privately-owned power plant, is being investigated as a potential alternative for disposal of part of the effluent when the DIW is down for testing. Implementation of this alternative, however, will not occur until some time in the future. To address current needs, FPUA will also apply for a continuation of its current EPA NPDES permit, which would allow the emergency disposal of the treated effluent to the Indian River during the DIW shutdown. FDER approval for planned and emergency discharges to the Indian River will be sought by FPUA. The TOP requires FPUA to conduct additional studies to assess the impact of occasional discharges to the Indian River. If the studies yield favorable findings, the FPUA intends to construct a new outfall with multiple diffuser ports to achieve required dilution for a mixing zone within the river.

Appendix A

Proposed Construction Plan for the Deep Injection Well at the FPUA WWTP

Part 1--Construction of the reinforced concrete drilling pad, four shallow monitor wells, and injection well shall proceed as follows:

1. Construct an 80 foot x 100 foot reinforced concrete drilling pad; install 60-inch surface casing; and construct four shallow groundwater monitor wells, one at each corner of the drilling pad.

2. Mobilize and set up drilling equipment at the injection well location.

3. Drill a nominal 12-inch hole to an estimated depth of 200 feet and perform geophysical logging.

4. Ream pilot hole to a nominal 60-inch-diameter to an estimated depth of 180 feet, and install an estimated 180 feet of 54-inch-diameter casing and cement with ASTM C-150 Type II neat cement.

5. Drill a nominal 12-inch pilot hole centered at the bottom of the 54-inch casing to an estimated depth of 1,000 feet and perform geophysical logging.

6. Ream pilot hole to a nominal 54-inch-diameter to an estimated depth of 800 feet and install an estimated 800 feet of 44-inch-diameter steel casing and cement with ASTM C-150 Type II cement. Cement shall be pumped in such a manner to insure placement of Type II neat cement around the lower 200 feet of casing. The remainder of the open hole annular

space surrounding the casing shall be filled with Type II cement with 4 percent bentonite. The annular space between casings shall be cemented with Type II cement with 12 percent bentonite.

7. Drill a nominal 12-inch pilot hole centered at the bottom of the 44-inch casing to an estimated depth of 2,200 feet and perform geophysical logging. Perform two straddle packer tests on the depth interval from approximately 800 to 2,200 feet.

8. Ream the pilot hole to a nominal 44-inch-diameter to an estimated depth of 1,850 feet, and install an estimated 1,850 feet of 34-inch-diameter steel casing and cement with ASTM C-150 Type II cement. Cement shall be pumped in such a manner as to insure that a minimum of 200 feet of neat cement is placed around the lower 200 feet of casing. The open hole annular space surrounding the casing shall be cemented using Type II cement with 4 percent bentonite. The annular space between casings shall be cemented with Type II cement with 12 percent bentonite.

9. Drill a nominal 12-inch pilot hole centered at the bottom of the 34-inch casing to an estimated depth of 3,300 feet and perform geophysical logging.

10. Ream the pilot hole to a nominal 34-inch-diameter to an estimated depth of 2,600 feet and perform geophysical logging.

11. Install a drillable bridge plug in the pilot hole no deeper than 20 feet below the depth selected for setting the 24-inch casing.

12. Install an estimated 2,600 feet of 24-inch-diameter casing and cement with ASTM C-150, Type II cement and perform geophysical logging. Cement shall be pumped in such a manner to insure placement of 200 feet of Type II neat cement around the

lower 200 feet of casing. The open hole annular space surrounding the casing shall be cemented using Type II with 4 percent bentonite. The annular space between casings shall be cemented with Type II cement with 12 percent bentonite.

13. Conduct a casing pressure test at 150 psi for a minimum of 1 hour.

14. Drill out the cement plug in the casing and bridge plug in the pilot hole. Ream the pilot hole to a nominal 24-inch-diameter to an estimated depth of 3,300 feet.

15. Develop the well.

16. Run a black and white video survey on the complete well and perform geophysical logging.

17. Install permanent wellhead and conduct 12 hour step injection test. Immediately following the injection test, perform a radioactive tracer test.

18. Demobilize drilling equipment, clean and restore the disturbed areas around the drilling site.

Part 2--Construction of the Dual-Zone Monitor Well. The construction of the dual-zone monitor well shall proceed as follows:

1. Mobilize and set up drilling equipment.

2. Drill a nominal 30-inch-diameter hole to an estimated depth of 180 feet.

3. Install an estimated 180 feet of 24-inch-diameter steel casing and cement with ASTM C-150, Type II neat cement.

4. Drill a nominal 12-inch pilot hole centered at the bottom of the 24-inch casing to an estimated depth of 800 feet and perform geophysical logging.

5. Ream the pilot hole to a nominal 24-inch-diameter to an estimated depth of 800 feet and install an estimated 800 feet of 16-inch-diameter steel casing and cement with ASTM C-150, Type II cement. Cement shall be pumped in such a manner to insure placement of 200 feet of Type II neat cement around the bottom of the casing. The remaining annular space will be cemented with Type II cement with 4 percent bentonite.

6. Drill a nominal 16-inch-diameter hole to an estimated depth of 1,800 feet and perform geophysical logging.

7. Install an estimated 1,800 feet of 6-inch-diameter steel casing and cement with ASTM C-150 Type II cement and perform geophysical logging. Cement shall be pumped in such a manner to insure placement of 200 feet of Type II cement neat cement, around the bottom of the casing. Type II cement with 4 percent bentonite shall be placed to an estimated depth of 900 feet, leaving an open annulus monitoring interval from 900 feet to the bottom of the 16-inch-diameter casing.

8. Conduct a casing pressure test on the 6-inch casing at a pressure of 100 psi for 1 hour.

9. Drill a nominal 6-inch-diameter hole from the bottom of the 6-inch casing to an estimated depth of 1,850 feet. Assist Engineer in running geophysical logs.

10. Run a cement bond log.

11. Install wellhead valves and piping.

12. Furnish and install temporary pumping equipment and continuously purge both monitor intervals until stable water quality is observed. Water produced during purging shall be disposed of in the completed injection well.

13. Demobilize drilling equipment and clean and restore disturbed areas around the drilling site.

TECHNICAL SPECIFICATIONS

TECHNICAL SPECIFICATIONS
For The Construction Of A

DEEP INJECTION WELL AND DUAL-ZONE MONITOR WELL FOR EFFLUENT DISPOSAL AT THE WASTEWATER TREATMENT PLANT

Prepared For The
Fort Pierce Utilities Authority

For information regarding this project, contact:

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SEF30361.D1
September 1991

SECTION 01000
ABBREVIATIONS

Whenever in these Contract Documents the following abbreviations are used, the intent and meaning shall be interpreted as follows:

AA	Aluminum Association
AAMA	Architectural Aluminum Manufacturers' Association
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AFBMA	Anti-Friction Bearing Manufacturers' Association
AGA	American Gas Association
AGMA	American Gear Manufacturers' Association
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AMCA	Air Moving and Conditioning Association
ANSI	American National Standards Institute
APA	American Plywood Association
API	American Petroleum Institute
AREA	American Railway Engineering Association
ASAE	American Society of Agricultural Engineers
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWI	Architectural Woodwork Institute
AWPA	American Wood Preservers' Association
AWPB	American Wood Preservers Bureau
AWS	American Welding Society
AWWA	American Water Works Association
BHMA	Builders Hardware Manufacturers' Association
CBMA	Certified Ballast Manufacturers' Association
CDA	Copper Development Association
CISPI	Cast Iron Soil Pipe Institute
CMAA	Crane Manufacturers' Association of America
CRSI	Concrete Reinforcing Steel Institute
Fed. Spec.	Federal Specifications
HI	Hydraulic Institute
HMI	Hoist Manufacturers' Institute
ICBO	International Conference of Building Officials
ICEA	Insulated Cable Engineers' Association

IEEE	Institute of Electrical and Electronics Engineers, Inc.
ISA	Instrument Society of America
JIC	Joint Industry Conferences of Hydraulic Manufacturers
MMA	Monorail Manufacturers' Association
NBHA	National Builders' Hardware Association
NEC	National Electrical Code
NEMA	National Electrical Manufacturers' Association
NESC	National Electric Safety Code
NFPA	National Fire Protection Association
NLMA	National Lumber Manufacturers' Association
NWMA	National Woodwork Manufacturers' Association
OECI	Overhead Electrical Crane Institute
OSHA	Occupational Safety and Health Act (both Federal and State)
PS	Product Standards Section - U.S. Department of Commerce
RLM	RLM Standards Institute, Inc.
RMA	Rubber Manufacturers' Association
SAE	Society of Automotive Engineers
SDI	Steel Door Institute
SSPC	Steel Structures Painting Council
TEMA	Tubular Exchanger Manufacturers' Association
TCA	Tile Council of America
UBC	Uniform Building Code
UL	Underwriter's Laboratories, Inc.
WWPA	Western Wood Products Association

Unless a particular issue is designated, all references to the above specifications, standards, or methods shall, in each instance, be understood to refer to the issue in effect (including all amendments) on the first published date of the Invitation to Bid.

* * * * * *

SECTION 01001
GENERAL REQUIREMENTS

PART 1 GENERAL

1.1 WORK INCLUDED

A. The Specifications included in these Contract Documents establish the performance and quality requirements for material and equipment and the minimum standards for the quality of workmanship and appearance for the construction and testing of a test deep injection well and a dual-zone monitor well with alternate for installation of centrifugal booster pump, and construction of a surge control system for effluent disposal at the Fort Pierce Utilities Authority Wastewater Treatment Plant.

B. Part 1 Consists of the Following: Site preparation including construction of a reinforced concrete drilling pad, drain pipe, four surficial monitor wells, mobilization, demobilization and cleanup, construction of one 24-inch diameter deep injection well to approximately 3,300 feet in depth, injection testing, and installation of wellhead and appurtenances.

C. Part 2 Consists of the Following: Mobilization, demobilization and cleanup, construction of one 6-inch diameter Floridan aquifer dual-zone monitor well to approximately 1,850 feet in depth, temporary background water quality collection period, and installation of wellhead piping and appurtenances.

D. Alternate Part 2 will consist of installation of one centrifugal booster pump, and associated discharge piping, electrical, instrumentation and controls, and appurtenances.

E. Part 4 Consists of the Following: Site preparation, construction of a reinforced concrete pad and supports, installation of piping, valves, surge tank, electric, I&C, and appurtenances.

PART 2 REASONABLY IMPLIED PARTS OF THE WORK SHALL BE DONE ALTHOUGH ABSENT FROM SPECIFICATIONS

2.1 GENERAL

A. Specific tasks not completely described in these Specifications, that are necessary or normally required as a part of the work described, or that are necessary or required to make each installation satisfactorily or legally operable, shall be performed by the Contractor as incidental work without extra cost to the Engineer, as if fully described in these Specifications. The expense of such work shall be included in the applicable unit or lump sum prices for the work described.

PART 3 SITE ACCESS

3.1 GENERAL

A. The Owner has the responsibility to provide legal access to the drilling site. The Contractor has the responsibility to provide physical access to the drilling site.

PART 4 MATERIALS AND WORKMANSHIP

4.1 GENERAL

A. The Contractor shall, except as specifically stated in the Contract Documents, provide all labor, materials, equipment, tools, and other facilities and services necessary for proper completion of all work under the Contract Documents.

B. The Contractor, in addition to furnishing the services of drillers experienced in the type of formations to be encountered, shall also furnish an adequate number of competent helpers. The drillers shall keep well logs and reports of the drilling, developing, and test-pumping operations. Drillers shall also be capable of making accurate lithologic classifications of the formations and handle representative rock cuttings and water samples as indicated in Section DRILLING.

C. The Contractor shall guarantee that all work will be performed in a workmanlike manner by qualified well drillers, and will conform with these Specifications.

4.2 EQUIPMENT

A. The Contractor shall furnish capable equipment to construct the wells by rotary drilling with conventional mud and reverse air circulation, as specified in Section DRILLING. The Contractor's drilling rigs, tools, equipment, and methods shall be subject to the Engineer's approval.

4.3 COORDINATION

A. Contractor shall cooperate in the coordination of its work with the activities of other Contractors on this project in a manner that will provide the least interference with the Owner's operations and other Contractors and utility companies working the area, and in the interfacing and connection of the separate elements of the overall project work without additional costs to the Owner.

B. If any difficulty or dispute should arise in the accomplishment of the above, the problem shall be brought immediately to the attention of the Engineer.

C. Contractor's project superintendent shall attend construction coordination meetings to be held at the site during normal working hours when requested by the Engineer. No additional charge shall be made to the Owner or the Engineer for attendance at such meetings.

D. All Contractors working on this site are subject to this requirement for cooperation, and all shall abide by the Engineer's decision in resolving project coordination problems.

4.4 PERMITS

A. Upon Notice of Award, the Contractor shall acquire all necessary permits with local and state regulatory agencies for the drilling of the injection well and dual-zone monitor well.

B. The required Florida Department of Environmental Regulation Class I injection well construction permit shall be obtained by the Owner.

C. Drilling operations shall not commence until all other necessary construction permits have been obtained. Contractor shall be solely responsible for acquiring other necessary permits. No construction shall be allowed until all permits are obtained or written evidence is submitted to the Owner demonstrating that the permitting agency has given permission to proceed.

4.5 SCHEDULING

A. The Contractor shall plan the work and carry it out with minimum interference to the Owner and other Contractors. Prior to starting the work, the Contractor shall confer with the Engineer and Owner's representative to develop an approved work schedule with will permit the project to progress as normally as practical. The Contractor may do certain parts of the construction work outside normal working hours to avoid undesirable conditions.

4.6 STANDBY TIME

A. General:

1. During the progress of the work under these Specifications, it will be necessary for the Engineer to perform work of an experimental nature on the injection well and monitor well that will require the services of the drilling crew and drilling equipment, or work that may require such crew and equipment to standby during normal working hours.
2. In such an event, the representative of the Engineer shall request the Contractor to furnish such assistance or to cease operations, and will state the anticipated extent or duration thereof. The Contractor shall promptly furnish such assistance or cease operations. The time required for this purpose, as may be thus ordered, shall be recorded on the Contractor's daily log and the Engineer's daily log. If there are any discrepancies, the time noted on the Engineer's daily log shall

prevail. The time shall be paid on an hourly basis at the unit Contract prices as stated in the Proposal of these Specifications for standby.

3. Engineer's Standby Time: All well testing and geophysical logging shall be done during daylight hours Monday through Saturday, or as approved by the Engineer. The Owner and the Engineer shall be given 24 hours' notice, exclusive of Sundays and holidays, prior to any testing, geophysical logging, or cementing. Payment to the Contractor for standby time shall commence at the end of the 24-hour notice period, as long as such time is within normal working hours. If the Owner and the Engineer are notified to be onsite for testing, geophysical logging, pumping tests, or cementing and the Contractor is not ready, then the Owner shall be reimbursed for the Engineer's time by the Contractor at a rate of $75.00 per hour starting at the time scheduled by the Contractor and notified to the Engineer and the Owner. Approval for any standby time to be paid to the Contractor must be made in writing by the Engineer within 24 hours of such an occurrence.

4.7 PROTECTION OF PROPERTY AND ENVIRONMENT

A. The Contractor shall take special precautions to reduce to a minimum the nuisances and damages to property which could result from working in a residential or industrial area. Any damage to public or private property shall be immediately repaired at the Contractor's sole expense. Equipment tools and material shall be located in places where they will produce a minimum of nuisance.

B. In all cases, the Contractor will use mud tanks and all the necessary equipment to substitute for mud pit. A mud pit shall not be used. Any water fluid, or drill cuttings resulting from any of the operations, or excess water from the well development work shall be disposed of by hauling the fluids to a predetermined disposal site provided by the Contractor. Such site shall be approved in writing by the St. Lucie County Health Department before the start of construction. No drilling operations shall begin without an approved disposal site for cuttings and drilling fluids. It shall be the Contractor's sole responsibility to obtain the necessary agency approvals.

C. The Contractor shall observe the rules and regulations of the State of Florida and agencies of the United States Government prohibiting the pollution of stream or river waters by the dumping of any refuse, rubbish, or debris therein.

D. Contractor shall not cause nor permit an action to occur which would allow an overflow of drilling fluids or saline waters to escape the confines of the concrete drilling pad. The Contractor shall remain solely responsible for any property damage, remediation costs, or regulatory fines which might result from such occurrence.

PART 5 DESCRIPTION OF WORK

5.1 CONSTRUCTION SCHEDULE

A. Time constraints imposed upon the construction schedule require that the Contractor have all construction activities completed within the 180 days allowed in the Contract. The Contractor will be allowed to dispose of fluids developed during reverse air drilling of the pilot hole of the dual-zone monitor well by injection into the injection well, provided that the injection well has reached such a stage of construction that pilot hole drilling has been completed to the total depth of the well. The Contractor shall schedule his start of construction for the dual-zone monitor well accordingly. Injection testing of the well shall commence after completion of the dual-zone monitor well.

B. Construction activities for the surge control system may proceed independently of those for the effluent disposal well, except that the Contractor shall be required to coordinate his construction activities with those of other contractors working at the site.

C. The construction schedule presented in PART 6, DETAILED CONSTRUCTION SCHEDULE, has been prepared to illustrate the general manner in which the Engineer intends that construction shall proceed. As presented in PART 6, DETAILED CONSTRUCTION SCHEDULE, construction of the deep injection well effluent disposal system has been separated into three distinct parts as follows: Part 1, Construction of the Deep Injection Well, Part 2, Construction of the Dual-Zone Monitor Well; Alternate Part 2, Installation of Centrifugal Booster Pump; and Part 3, Construction of the Surge Control System.

D. Upon award of the Contract and before start of construction, the Contractor shall prepare and submit to the Engineer for his approval a detailed construction schedule containing anticipated start and completion dates for each of the steps in PART 6, DETAILED CONSTRUCTION SCHEDULE as outlined in Section SUBMITTALS under Division 1, GENERAL REQUIREMENTS.

E. With each submittal for monthly pay estimate, the Contractor shall provide a revised construction schedule which reflects construction activities completed to date and anticipated start and completion dates for remaining construction activities.

PART 6 DETAILED CONSTRUCTION SCHEDULE

6.1 PART 1: CONSTRUCTION OF DRILLING PAD AND CONSTRUCTION AND TESTING OF DEEP INJECTION WELL

A. The site preparation, drilling pad construction, and construction and testing for the deep injection well shall generally proceed as follows:

1. Install temporary power, water service, and Engineer's construction office in accordance with Section MOBILIZATION AND CLEANUP.
2. Compact ground and build soil subbase for drilling pad in accordance with Section EARTHWORK.
3. Construct one 100-foot by 80-foot reinforced concrete drilling pad with surface casings, and drain pipe in accordance with the Drawings and Section REINFORCED CONCRETE, EARTHWORK, CASING, and PLANT PIPING - GENERAL. Install four surficial monitor wells around pads in accordance with Section SURFICIAL MONITOR WELLS.
4. Set up drilling equipment at Deep Injection Well in accordance with Section MOBILIZATION AND CLEANUP.
5. Drill a nominal 12-inch diameter pilot hole using standard mud rotary drilling techniques to approximately 200 feet in depth in accordance with Section DRILLING. Assist Engineer in performing geophysical logging in accordance with Section GEOPHYSICAL LOGGING.
6. Ream the pilot hole to a nominal 60-inch diameter using standard mud rotary drilling techniques to approximately 180 feet in accordance with Section DRILLING.
7. Install approximately 180 feet of 54-inch diameter casing and cement with ASTM C150, Type II neat cement as directed by the Engineer in accordance with Sections CASING and GROUT SEAL.
8. Drill out cement plug and drill a nominal 12-inch diameter pilot hole centered at the bottom of the 54-inch casing using standard mud rotary drilling techniques to approximately 1,000 feet in depth in accordance with Section DRILLING. Assist Engineer in performing geophysical logging in accordance with Section GEOPHYSICAL LOGGING.
9. Ream the pilot hole to a nominal 54-inch diameter using standard mud rotary drilling techniques to approximately 800 feet in depth in accordance with Section DRILLING.
10. Install approximately 800 feet of 44-inch diameter casing and cement with ASTM C150, Type II cement with 4 percent bentonite by weight followed by ASTM C150, Type II neat cement as directed by the Engineer in accordance with Sections CASING and GROUT SEAL. The quantity of neat cement shall be sufficient to fill the lower 200 feet of the annulus around the 44-inch diameter casing. Assist Engineer in performing geophysical logging in accordance with Section GEOPHYSICAL LOGGING. Cement annulus between 44-inch diameter and 54-inch diameter casing with ASTM C150, Type II cement with 12 percent bentonite by weight as direct by the Engineer and in accordance with Section GROUT SEAL.

11. Drill out cement plug and drill a nominal 12-inch diameter pilot hole centered at the bottom of the 44-inch casing using reverse-air drilling techniques to approximately 2,200 feet in depth in accordance with Section DRILLING. During pilot hole drilling obtain 4-inch diameter rock cores in eight 10-foot intervals at depths selected by the Engineer and in accordance with Section CORING. Assist Engineer in performing geophysical logging in accordance with Section GEOPHYSICAL LOGGING. Collect water samples during reverse-air drilling in accordance with Section DRILLING.
12. Perform two straddle packer tests as directed by the Engineer on the interval from approximately, 800 to 2,200 feet in accordance with Section INFLATABLE PACKER TESTING. Additional straddle packer tests may be run a the discretion of the Engineer at the depth or lower depths.
13. Ream the pilot hole to a nominal 44-inch diameter to approximately 1,850 feet in depth in accordance with Section DRILLING.
14. If required by the Engineer, install a drillable bridge plug at the depth selected by the Engineer. Work shall be performed in accordance with Section GROUT SEAL.
15. Install approximately 1,850 feet of 34-inch diameter casing and cement with ASTM C150, Type II cement with 4 percent bentonite by weight followed by ASTM C150, Type II neat cement as directed by the Engineer in accordance with Sections CASING and GROUT SEAL. The quantity of neat cement shall be sufficient to fill the lower 200 feet of the annulus around the 34-inch diameter casing. Assist Engineer in performing geophysical logging in accordance with Section GEOPHYSICAL LOGGING. Cement annulus between 34-inch diameter and 44-inch diameter casing with ASTM C150, Type II cement with 12 percent bentonite by weight as directed by the Engineer and in accordance with Section GROUT SEAL.
16. Drill out cement plug and drill a nominal 12-inch diameter pilot hole centered at the bottom of the 34-inch casing using reverse-air drilling techniques to approximately 3,300 feet in depth in accordance with Section DRILLING. Assist Engineer in performing geophysical logging in accordance with Section GEOPHYSICAL LOGGING. Run borehole compensated sonic log on the entire open hole in accordance with Section GEOPHYSICAL LOGGING.
17. Ream the pilot hole to a nominal 34-inch diameter to approximately 2,600 feet in accordance with Section DRILLING. Assist Engineer in performing geophysical logging in accordance with Section GEOPHYSICAL LOGGING.
18. If required by the Engineer, install a drillable bridge plug at the depth selected by the Engineer. Work shall be performed in accordance with Section GROUT SEAL.
19. Install approximately 2,600 feet of 24-inch diameter casing and cement with ASTM C150, Type II cement with 4 percent bentonite by weight followed by ASTM C150, Type II neat cement as direct by the Engineer in accordance with Sections CASING and GROUT SEAL. The quantity of neat cement shall be sufficient to fill the lower 200 feet of the annulus around the 24-inch diameter casing. Assist

Engineer in performing geophysical logging in accordance with Section GEOPHYSICAL LOGGING.

20. Conduct a casing pressure test at 150 psi for a minimum of one hour in accordance with Section CASING.
21. Drill out cement plug and bridge plug. Drill a nominal 24-inch diameter hole to a depth of approximately 3,300 feet in accordance with Section DRILLING.
22. Develop the deep injection well in accordance with Section WELL DEVELOPMENT.
23. Install temporary wellhead assembly and conduct a preliminary capacity injection test in accordance with Section INJECTION TEST.
24. Conduct a step injection test in accordance with Section INJECTION TEST. While injecting, assist Engineer in performing geophysical logs in accordance with Section GEOPHYSICAL LOGGING.
25. Immediately following injection test, run TV survey and assist Engineer in performing geophysical logging in accordance with Section GEOPHYSICAL LOGGING.
26. Immediately following TV survey, perform radioactive tracer survey in accordance with Section RADIOACTIVE TRACER SURVEY.
27. Install permanent wellhead assembly, finish cement slab around the well, electric instrumentation and paint all exposed metal in accordance with Sections WELLHEAD CAPPING AND VALVES, ELECTRICAL, PROCESS INSTRUMENTATION AND CONTROLS, and PAINTING.
28. Demobilize drilling equipment clean and restore the disturbed areas around the drilling site in accordance with Section MOBILIZATION AND CLEANUP.

6.2 PART 2: CONSTRUCTION OF THE DUAL-ZONE MONITOR WELL

A. The construction of the dual-zone monitor well shall proceed as follows with the Contractor scheduling his work such that he is complete with Step 16 of Part 1 before performing the work outlined in Step 7 of Part 3:

1. Set up drilling equipment at the dual-zone monitor well in accordance with Section MOBILIZATION AND CLEANUP.
2. Drill a nominal 34-inch diameter hole using standard mud rotary drilling techniques to approximately 180 feet in depth in accordance with Section DRILLING. Assist Engineer in performing geophysical logging in accordance with Section GEOPHYSICAL LOGGING.
3. Install approximately 180 feet of 24-inch diameter casing and cement with ASTM C150, Type II neat cement as direct by the Engineer in accordance with Sections CASING and GROUT SEAL.
4. Drill a nominal 12-inch diameter pilot hole using standard rotary drilling techniques centered at the bottom of the 24-inch casing to approximately 800 feet in depth in accordance with Section DRILLING. Assist Engineer in performing geophysical logging in accordance with Section GEOPHYSICAL LOGGING.

5. Ream the pilot hole to a nominal 24-inch diameter using standard rotary drilling techniques to approximately 800 feet in depth in accordance with Section DRILLING.
6. Install approximately 800 feet of 16-inch diameter casing and cement with ASTM C150, Type II cement with 4 percent bentonite by weight followed by ASTM C150, Type II neat cement as directed by the Engineer in accordance with Sections CASING and GROUT SEAL. The quantity of neat cement shall be sufficient to fill the lower 200 feet of the annulus around the 16-inch diameter casing. Assist Engineer in performing geophysical logging in accordance with Section GEOPHYSICAL LOGGING. Cement annulus between 16-inch diameter and 24-inch diameter casing with ASTM C150, Type II cement with 12 percent bentonite by weights as directed by the Engineer and in accordance with Section GROUT SEAL.
7. Drill a nominal 16-inch diameter hole using reverse-air drilling techniques centered at the bottom of the 16-inch casing to approximately, 1,800 feet in depth, dispose of water produced from reverse-air drilling in deep injection well No. 1 in accordance with Section DRILLING. Assist Engineer in performing geophysical logging in accordance with Section GEOPHYSICAL LOGGING. Collect water samples during reverse-air drilling in accordance with Section DRILLING.
8. Install approximately 1,800 feet of 6-inch casing and cement up to approximately 900 feet with ASTM C150, Type II cement with 4 percent bentonite by weight followed by ASTM C150, Type II neat cement of sufficient volume to fill the lower 200 feet of the annulus around the 6-inch casing. The annulus around the 6-inch casing from approximately 900 feet to ground surface shall be left uncemented. Casing and cementing shall be in accordance with Sections CASING and GROUT SEAL. Assist Engineer in performing geophysical logging in accordance with Section GEOPHYSICAL LOGGING.
9. Conduct a casing pressure test at 100 psi for a minimum of one hour in accordance with Section CASING.
10. Drill a nominal 6-inch diameter hole to approximately 1,850 feet in depth in accordance with Section DRILLING.
11. Develop the dual-zone monitor well open hole from approximately 1,800 to 1,850 feet and the open annulus around the 6-inch casing to obtain maximum flow in accordance with Section WELL DEVELOPMENT.
12. Install temporary wellhead assemblies, pumps, piping between dual-zone monitor well and Test Deep Injection Well in accordance with Sections WELLHEAD CAPPING AND VALVES, and HORIZONTAL END SUCTION CENTRIFUGAL PUMP.
13. Remove drilling equipment and clean the disturbed area around the dual-zone monitor well site in accordance with Section MOBILIZATION AND CLEANUP .
14. Provide bi-weekly service and operator to operate pumps for sampling as directed by the Engineer and in accordance with Sections GENERAL REQUIREMENTS and WELL DEVELOPMENT.

15. Upon notice from Engineer, remove temporary wellhead assembly and install permanent wellhead assembly, pump, piping, electrical instrumentation, and paint all exposed metals as directed by the Engineer in accordance with Sections WELLHEAD CAPPING AND VALVES, ELECTRICAL, PROCESS INSTRUMENTATION AND CONTROLS, and PAINTING.

6.3 PART 3: CONSTRUCTION OF SURGE CONTROL SYSTEM

A. The site preparation, reinforced concrete foundation, surge tank, piping, valves, and I&C complete shall proceed as follows:

1. Compact ground and build soil subbase for reinforced concrete foundation in accordance with Section EARTHWORK.
2. Construct reinforced concrete pad and pipe supports in accordance with the Drawings and Section REINFORCED CONCRETE.
3. Install surge tank, piping, valves, air compressor and paint all exposed metal surfaces in accordance with the Drawings and Sections SURGE CONTROL SYSTEM, WELLHEAD CAPPING AND VALVES, PLANT PIPING - GENERAL, and PAINTING.
4. Install electrical equipment and appurtenances in accordance with the Drawings and Sections SURGE CONTROL SYSTEM, ELECTRICAL, and PROCESS INSTRUMENTATION AND CONTROLS.
5. Perform hydrostatic and functional testing in accordance with Section SURGE CONTROL SYSTEM.
6. Clean and restore the disturbed areas around the site in accordance with Section MOBILIZATION AND CLEANUP.

PART 7 PAYMENT

7.1 GENERAL

A. Payment for the work in this section will be included as part of the applicable unit or lump sum prices as stated in the Proposal.

* * * * * *

SECTION 01040
SITE CONDITIONS

PART 1 GENERAL

1.1 SITE INVESTIGATION AND REPRESENTATION

A. The Contractor acknowledges that he has satisfied himself as to the nature and location of the work, the general and local conditions, particularly those bearing upon availability of transportation, disposal, handling and storage of materials, availability of labor, water, electric power, roads, and uncertainties of weather, tide stages, river stages, or similar physical conditions at the site, the conformation and conditions of the ground, the character of equipment and facilities needed preliminary to and during the prosecution of the work and all other matters which can in any way affect the work or the cost thereof under this Contract.

B. The Contractor further acknowledges that he has satisfied himself as to the character, quality, and quantity of surface and subsurface materials to be encountered from inspection of the site and from evaluating information derived from exploratory work that may have been done by the Owner or included in these Contract Documents. Any failure by the Contractor to acquaint himself with all the available information will not relieve him from responsibility for properly estimating the difficulty or cost of successfully performing the work.

1.2 SUBSURFACE INVESTIGATION

A. General: Information obtained by the Owner from other sources regarding site conditions, topography, subsurface information, groundwater elevations, existing construction of site facilities as applicable, and similar data will be available for inspection at the office of the Engineer upon request. Such information is offered as supplementary information only. Neither the Engineer nor the Owner assumes any responsibility for its accuracy or completeness or for the Contractor's interpretation of such information.

1.3 BIDDER'S SUBSURFACE INVESTIGATION

A. Prospective bidders are invited, at their own expense, to make such additional subsurface investigation, by boring or test hole excavation, as may be desirable, provided, however, that such work be scheduled by appointment with the Engineer.

1.4 DIFFERING SUBSURFACE CONDITIONS

A. In the event subsurface or latent physical conditions are found materially different from those indicated in these Documents, and differing materially from those ordinarily encountered and generally recognized as inhering in the character of work covered in these Contract Documents, the Contractor shall promptly, and before such conditions are disturbed, notify the Engineer in writing or such changed conditions.

B. The Engineer will investigate such conditions promptly and following this investigation, the Contractor shall proceed with the work, unless otherwise instructed by the Engineer. If the Engineer finds that such conditions do so materially differ and cause an increase or decrease in the cost of, or in the time required for performing the work, the Engineer will recommend to the Owner the amount of adjustment in cost and time he considers reasonable. The Owner will make the final decision on all Change Orders to the Contract regarding any adjustment in cost or time for completion.

C. Existing Utilities:

1. Location:
   a. Any known utilities and facilities adjacent to or within the work area are shown on the Drawings. The locations shown are taken from existing records and the best information available from existing utility plans; however, it is expected that there may be some discrepancies and omissions in the locations and quantities shown. Those shown are for the convenience of the Contractor only, and no responsibility is assumed by either the Owner or the Engineer for their accuracy or completeness.
   b. Contractor shall exercise reasonable care to verify locations of utilities and facilities shown on the Drawings and to determine the presence of those not shown. Immediate and adjacent areas where excavations are to be made shall be thoroughly checked by visual examination for indications of underground facilities, and also checked with electronic metal and pipe detection equipment. Where there is reasonable cause to verify the presence or absence of an underground facility, make exploratory excavations prior to proceeding with major excavation in the area.
2. Contractor's Responsibilities:
   a. Where Contractor's operations could cause damage or inconvenience to railway, telegraph, telephone, television, power, oil, gas, water, sewer, or irrigation systems, the Contractor shall make arrangements necessary for the protection of these utilities and services. Replace existing utilities removed or damaged during construction, unless otherwise provided for in these Contract Documents.

b. Notify utility offices that are affected by construction operations at least 48 hours in advance. Under no circumstances expose any utility without first obtaining permission from the appropriate agency. Once permission has been granted, locate, expose, and provide temporary support for the utilities.
c. Utility poles less than 10 feet from the trench centerline will be removed or protected by the Owner at its expense. Protect all other poles from damage. If interfering utility poles will be encountered, notify the Engineer at least 48 hours in advance of construction operations to permit necessary arrangements with the utility company for protection or relocation of the interfering poles.
d. Contractor shall be solely and directly responsible to owner and operator of such properties for damage, injury, expense, loss, inconvenience, delay, suits, actions, or claims of any character brought because of injuries or damage which may result from construction operations under this Contract.
e. Neither Owner nor its officers or agents shall be responsible to Contractor for damages as a result of Contractor's failure to protect utilities encountered in the work.
f. In event of interruption to domestic water, sewer, storm drain, or other utility services as a result of accidental damage due to construction operations, promptly notify the proper authority. Cooperate with said authority in restoration as promptly as possible and pay for repair. Prevent interruption of utility service unless granted by the utility owner.

D. Interfering Structures:

1. Take necessary precautions to prevent damage to existing structures whether on the surface, aboveground, or underground. An attempt has been made to show major structures on the Drawings. While the information has been compiled from the best available sources, its completeness and accuracy cannot be guaranteed.
2. Protect existing structures from damage, whether or not they lie within limits of easements obtained by the Owner. Where existing fences, gates, barns, sheds, buildings, or other structure must be removed to properly carry out work, or are damaged during work, restore them to original condition and to the satisfaction of property owner.
3. Without additional cost to the Owner, Contractor may remove and replace in equal or better than original condition, small structures such as fences, mailboxes, and signposts that interfere with Contractor's operations.

E. Field Relocation: During construction, it is expected that minor relocations of proposed facilities will be necessary. Make such relocations only by direction of the Engineer. If existing structures are encountered that prevent construction as shown, notify the Engineer before continuing with work so Engineer may make necessary field revisions.

F. Monuments and Markers:

1. Preserve and protect survey monuments and markers throughout construction. If damage occurs or removal becomes necessary, immediately notify Engineer and restore monument or marker to original condition.
2. Preserve private and public monuments that are found. If monument must be removed, replace at original location using registered land surveyor. Notify Engineer when monuments are encountered. If government monuments are encountered, reference the monument for later replacement and provide 10-day advance notification to Engineer who will notify the proper authority.

G. Easements:

1. Before final payment will be authorized, Contractor shall furnish the Owner written releases from property owners or public agencies where side agreements or special easements have been made, or where Contractor's operations have not been kept within the Owner's construction right-of-way.
2. In the event Contractor is unable to secure written releases, inform the Owner of the reasons.
   a. Owner or its representatives will examine the site, and Owner will direct Contractor to complete work that may be necessary to satisfy terms of the easement.
   b. Should Contractor refuse to do this work, Owner reserves the right to have it done by separate contract and deduct the cost of same from the Contract amount, or require the Contractor to furnish a satisfactory bond in a sum to cover legal claims for damages.
   c. When Owner is satisfied that work has been completed in agreement with the Contract Documents and terms of easements, the right is reserved to waive the requirement for written release if:
      1) Contractor's failure to obtain such statement is due to the grantor's refusal to sign, and this refusal is not based upon any legitimate claims that Contractor has failed to fulfill the terms of the easement, or
      2) Contractor is unable to contact or has had undue hardship in contacting the grantor.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

PART 4 PAYMENT

4.1 GENERAL

A. Payment for work in this section will be included as part of the applicable lump sum price stated in the Proposal for mobilization.

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SECTION 01300
SUBMITTALS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Requirements and procedures necessary for scheduling, preparation, and submission of submittals.

1.2 RELATED WORK SPECIFIED UNDER OTHER SECTIONS

A. Individual Specification sections in these Contract Documents contain additional and special submittal requirements. Individual sections shall take precedence in the event of a conflict with this section.

1.3 SUBMITTAL PROCEDURES

A. Owner reserves the right to modify the procedures and requirements for submittals, as necessary to accomplish the specific purpose of each submittal. Direct inquiries to Engineer regarding the procedure, purpose, or extent of any submittal.

B. Review, acceptance, or approval of substitutions, schedules, shop drawings, lists of materials, and procedures submitted or requested by Contractor shall not add to the Contract amount, and additional costs which may result therefrom shall be solely the obligation of Contractor.

C. Owner is not precluded, by virtue of review, acceptance, or approval, from obtaining a credit for construction savings resulting from allowed concessions in the work or materials therefor.

D. Owner is not responsible to provide engineering or other services to protect Contractor from additional costs accruing from such approvals.

1.4 ADMINISTRATIVE SUBMITTALS

A. The Contractor is reminded of his obligation as required by law to make required submittals promptly to the applicable federal, state, or local agency. Failure to comply with this requirement may result in the withholding of progress payments and make the Contractor liable for other prescribed action and sanctions.

B. The Contractor shall submit to the Owner a copy of all letters relative to the Contract, transmitting notifications, reports, certifications, payrolls, and the like, that he submits directly to a federal, state, or other governing agency.

C. During performance of the Contract, maintain on a daily basis, and submit to Engineer, full and correct information as to the number of persons employed in connection with each subdivision of the work, source, and amount of each class of materials delivered, equipment received, and major construction equipment used in each subdivision of the work.

D. Submit to Engineer two copies of each purchase order for materials and equipment furnished under these Specifications for incorporation in the work.

1. Include manufacturer's name, type of materials and equipment, model number, size, quantity, accessory list, and requested delivery date of material and equipment ordered.
2. Submit purchase order copies to Engineer before or at the time they are issued.

1.5 SCHEDULES

A. General:

1. Submit estimated progress schedule and preliminary schedule of submittals in duplicate to Engineer.
2. Revise and resubmit as specified, and identify all changes made from previous schedule submittal.

1.6 SHOP DRAWINGS

A. General:

1. Shop drawings, as defined herein, consist of all drawings, diagrams, illustrations, schedules, and other data which are specifically prepared by or for Contractor to illustrate some portion of the work; and all illustrations, brochures, standard schedules, performance charts, instructions, diagrams, and other information prepared by a manufacturer and submitted by Contractor to illustrate material or equipment for distinct portions of the work.
2. Submittal of incomplete or unchecked shop drawings will not be acceptable. Shop drawing submittals which do not clearly show Contractor's review stamp or specific written indication of Contractor review will be returned to Contractor for resubmission.
3. Submittal of shop drawings not required under these Contract Documents and not shown on the schedule of submittals will be returned to Contractor unreviewed and unstamped by Engineer.
4. Shop drawing submittals processed by Engineer do not become Contract Documents and are not Change Orders; the purpose of shop drawing review is to establish a reporting procedure and is intended for Contractor's convenience in organizing the work and to permit Engineer to monitor Contractor's progress and understanding of the design.
5. Delays caused by the need for resubmittal shall not constitute basis for claim.

B. Procedures:

1. Submit to Engineer for review and approval in accordance with the accepted schedule of submittals, six copies of shop drawings.
2. Combine submittals specified in each Specification section into a single package. Partial packages will not be reviewed until all submittals required for the section have been received.
3. Transmit each submittal on Engineer accepted form.
4. Sequentially number the transmittal forms; resubmittals to have original number with an alphabetic suffix.
5. Identify project, Contractor, Specification section number, pertinent drawing sheet and detail number(s), products, units and assemblies, and the system or equipment identification or tag number as shown.
6. Apply Contractor's stamp, signed or initialed certifying that review, verification of products required, field dimensions, adjacent construction work, and coordination of information, is in accordance with requirements of the Contract Documents.
7. Transmit submittals in accordance with finalized schedule of submittals, and deliver as follows:
   a. Submittals to Owner: Mr. Elie J. Boudreaux, P.E., Fort Pierce Utilities Authority, 206 S. Sixth Street, Fort Pierce, FL 34950.
   b. Submittals to Engineer: Mr. Sean Skehan, CH2M HILL, 800 Fairway Drive, Suite 350, Deerfield Beach, Florida 33441.
8. Revise and resubmit submittals as required; identify all changes made since previous submittal.
9. Submittals will be acted upon by Engineer and transmitted to Contractor not later than 20 working days after receipt by Engineer.
10. When shop drawings have been reviewed by Engineer, two copies will be returned to Contractor appropriately annotated.
    a. If major changes or corrections are necessary, shop drawing may be rejected and one set will be returned to Contractor with such changes or corrections indicated.
    b. Correct and resubmit the shop drawings in the same manner and quantity as specified for the original submittal.

C. Foreign Manufacturers: Submit names and addresses of companies within the United States that maintain technical service representatives; include complete inventory of spare parts and accessories for each foreign-made item proposed for incorporation into the work. Failure to prove these capabilities shall be just cause for rejection of foreign-manufactured items.

D. Interfacing Work: Where called for in the Specifications, and as determined necessary by Engineer to provide proper correlation with other work, complete interface information shall be submitted. This interface information shall be accurate, and contain all information necessary to allow for manufacturing and construction of the interfacing or connecting work.

E. Material and Equipment Colors: Engineer will provide a schedule of selected colors within 30 days after approval of submittals and after receiving samples of the manufacturers' standard colors for those items requiring Owner's selection.

1.7 SAMPLES AND TEST SPECIMENS

A. Where required in the Specifications, and as determined necessary by Engineer, submit test specimens or samples of materials, appliances, and fittings to be used or offered for use in connection with the work. Include information as to their sources, prepay cartage charges, and submit such quantities and sizes for proper examination and tests to establish the quality or equality thereof, as applicable.

B. Submit samples and test specimens in ample time to enable Engineer to make tests or examinations necessary, without delay to the work.

C. Submit additional samples as required by Engineer to ensure equality with the original approved sample and/or for determination of Specification compliance.

D. Laboratory tests and examinations that Owner elects to make in its own laboratory will be made at Owner's cost except that, if a sample of any material or equipment proposed for use by Contractor fails to meet the Specifications, Contractor shall bear cost of testing subsequent samples.

E. Tests required by the Specifications to be performed by an independent laboratory shall be made by a laboratory licensed or certified in accordance with state statutes.

F. Samples and laboratory services shall be at the expense of Contractor and included in the prices bid for the associated work.

G. Approved sample items (fixtures, hardware, etc.) may be incorporated into the work upon approval and when no longer needed by Engineer for reference.

1.8 QUALITY CONTROL SUBMITTALS

A. Manufacturers' Certification of Proper Installation: the Contractor shall provide certification stating the following:

1. The product or system has been installed in accordance with the manufacturer's recommendations.
2. The product or system has been inspected by a manufacturer's authorized representative.
3. The product or system has been serviced with the proper lubricants.
4. Applicable safety equipment has been properly installed.
5. Proper electrical and mechanical connections have been made.
6. Proper adjustments have been made and the product or system is ready for functional testing, plant startup, and operation.

B. Certification of Compliance:

1. Furnish certification of compliance for products specified to a recognized standard or code prior to the use of such products in the work.
   a. Engineer may permit use of certain materials or assemblies prior to sampling and testing if accompanied by a certification of compliance.
   b. Certifications shall be signed by the manufacturer of the product; state that the components involved comply in all respects with the requirements of the Specifications.
   c. Furnish certification of compliance with each lot delivered to the jobsite and clearly identify the lot so certified.
2. Products used on the basis of a certification of compliance may be sampled and tested at any time. The fact that a product is used on the basis of a certification of compliance shall not relieve Contractor of responsibility for incorporating products in the work which conforms to requirements of the Contract Documents. Products not conforming to such requirements will be subject to rejection whether in-place or not.
3. Engineer reserves the right to refuse permission for use of products on the basis of a certification of compliance.

C. Functional Test Certification: Where a certification of functional testing is specified for certain equipment, Contractor (as applicable to the equipment furnished) shall state in writing that:

1. Necessary piping systems and valves, have been successfully tested.
2. Necessary equipment systems and subsystems have been checked for proper installation, started, and successfully tested to indicate they are operational.
3. Adjustments and calibrations have been made.
4. The systems and subsystems are capable of performing their intended functions.
5. The facilities are ready for performance testing, or for startup and intended operation, as applicable.

D. Performance Test Reports: Prepare and submit performance test reports where specified for equipment and systems.

1.9 OPERATION AND MAINTENANCE (O&M) MANUALS

A. General: Engineer will determine adequacy of each O&M Manual as to content, organization, quality, and adequacy. Furnish acceptable manuals as requested by the Engineer.

B. Procedures:

1. Furnish five copies of complete instruction manual for installation, operation, maintenance, and lubrication requirements for each unit or common units of mechanical and electrical equipment or system. Contractor shall assemble the O&M Manuals into one set for the entire project.
2. Furnish manuals 60 days prior to the scheduled completion of work, but in no case shall submission of the manuals be delayed beyond 75 percent completion point of work. Correct deficiencies found in the submitted manual within 30 calendar days following notification of the deficiencies.
3. Manuals shall be customized to describe the equipment actually furnished, and shall not include extraneous data for models, options, or sizes not furnished.
   a. Where more than one model, option, or size of an equipment type is furnished, clearly indicate the information pertaining to each model, option, or size furnished.
   b. Manufacturer's preprinted literature may be accepted provided it has been customized to clearly indicate the models, options, and sizes actually furnished.
4. Assemble each copy of the manual in one or more three-ring, hard-back type binders.
   a. Clearly label each binder to designate the system or equipment for which it is intended with reference to the building and equipment number, and the Specification section where the equipment is specified.
   b. Provide each binder with title page, typed table of contents with page numbers, and heavy section dividers with numbered plastic index tabs.
   c. Divide each manual into sections paralleling the equipment Specifications.
   d. Where more than one binder is required, they shall be labeled "Vol. 1", "Vol. 2", and so on. Place the table of contents for the entire set, identified by volume number, in each binder.
   e. Submit manual organization and format to Engineer for approval prior to manual preparation.
   f. Punch all data for binding and composition; arrange printing so that punching holes does not obliterate data.
5. Material in manuals shall be suitable for photographic reproduction. Where copies of identical material are included, clarity and quality of copies shall equal the original.

C. Contents: Each manual shall be complete in all respects for equipment, controls, accessories, and associated appurtenances, and shall include the following:

1. Diagrams and illustrations.
2. Detailed description of the function of each principal component of the system.
3. Performance and nameplate data.

4. Installation instructions.
5. Procedure for starting.
6. Proper adjustment.
7. Test procedures and results of factory tests where required.
8. Procedure for operating.
9. Shutdown instructions for both short and extended durations.
10. Emergency operating instructions and troubleshooting guide.
11. Safety precautions.
12. Maintenance and overhaul instructions, illustrated with detailed assembly drawings showing each part with part numbers and sequentially numbered parts list. Include instructions for ordering spare parts, and complete preventive maintenance and overhaul instructions required to ensure satisfactory performance and longevity of the equipment.
13. Lubrication instructions and diagrams showing points to be greased or oiled; recommend type, grade, and temperature range of lubricants and frequency of lubrication; see Paragraph MAINTENANCE SUMMARY FORMS.
14. List of electrical relay settings and control and alarm contact settings.
15. Electrical interconnection wiring diagram for equipment furnished, including all control and lighting systems.
16. See Division 16, ELECTRICAL, for additional specific O&M Manual requirements.

D. Maintenance Summary Forms:

1. In addition to the O&M Manuals, provide Maintenance Summaries in the format of the form bound at the end of this section and described below; submit at same time as prescribed above for the OPERATION AND MAINTENANCE (O&M) MANUALS.
2. Compile individual Maintenance Summary Form for each equipment item following the outline provided; submit six copies for review by Engineer. The manufacturer's standard form will not be acceptable as a substitute for the Maintenance Summary.
3. The term "Maintenance Operation" as used in the TYPICAL MAINTENANCE SUMMARY FORM is defined to mean any routine operation required to ensure the satisfactory performance and longevity of the equipment. Examples of typical Maintenance Operations are lubrication, belt tensioning, adjustment of pump packing glands, and routine adjustments.
4. The Maintenance Summary may take as many pages as required; however, the order and format shown must be adhered to. Use only 8-1/2-inch by 11-inch paper.

1.10 CONTRACT CLOSEOUT SUBMITTALS

A. Record Drawings: Each month, or as otherwise agreed, submit to Engineer a current listing and description of each change incorporated into the work since the preceding submittal. Engineer will prepare a set of record drawings for the project which will include the changes made in materials, equipment, locations, and dimensions of the work.

B. O&M Manuals: Submit final revised O&M Manual incorporating field testing results and additional instructions deemed necessary by Engineer after testing and startup.

PART 4 PAYMENT

4.1 GENERAL

A. Payment for work in this section will be included as part of the applicable lump sum price stated in the Proposal for mobilization.

(Typical Maintenance Summary Form attached)

TYPICAL MAINTENANCE SUMMARY FORM

1. EQUIPMENT ITEM _____

2. MANUFACTURER _____

3. EQUIPMENT IDENTIFICATION NUMBER(S) _____

4. WEIGHT OF INDIVIDUAL COMPONENTS (OVER 100 POUNDS) _____

5. NAMEPLATE DATA (hp, voltage, speed, etc.) _____

6. MANUFACTURER'S LOCAL REPRESENTATIVE

   Name _____ Telephone No. _____

   Address _____

7. MAINTENANCE REQUIREMENTS

Maintenance Operation	Frequency	Lubricant (If Applicable)	Comments
List briefly each maintenance operation req'd. & refer to specific information in mfr's. std. maintenance manual, if applicable.	List req'd frequency of each maintenance operation.	Refer by symbol to lubricant list req'd.	

8. LUBRICANT LIST

Reference Symbol	Shell	Std. Oil	Gulf Arco Or Equal
List symbols used in Item 7. above.	List equivalent lubricants, as distributed by each manufacturer for the specific use recommended.		

9. SPARE PARTS. Include your recommendations regarding what spare parts, if any, should be kept on the job.

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SECTION 01500
CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Temporary utilities required during construction.

B. Temporary construction facilities, including access roads, field offices and project signs.

1.2 MOBILIZATION

A. Use area designated for Contractor's temporary facilities as shown on Drawings. Arrange for additional area if needed for construction operations, as acceptable to Owner and Engineer.

B. Notify Engineer's of obstructions not shown or not readily apparent by visual inspection of the designated area. If such obstructions adversely affect Contractor's operations, proper adjustment to Contract will be considered. Do not remove obstructions without Owner's prior consent.

1.3 TEMPORARY UTILITIES

A. Electric Power:

1. Electric power will be available at or near the site. Determine the type and amount available and make arrangements for obtaining temporary electric power service, metering equipment, and pay all costs for the electric power used during the Contract period, except as specifically provided for utilities used by the Owner on portions of the work designated in writing by the Engineer as substantially complete.
2. Temporary electric power installations shall meet construction safety requirements of OSHA, state, and other governing agencies.
3. Cost of electric power used in performance and acceptance testing shall be borne by Contractor.

B. Water: Owner will provide a place of temporary connection for water at the site. Provide temporary facilities and piping required to bring water to the point of use, and remove them when no longer needed. Install an acceptable metering device and report water used to the Owner.

C. Sewage: Provide chemical toilets of suitable types and maintain them in a sanitary condition at all times, conforming to code requirements and acceptable to the health authorities. They shall be of watertight construction so that no contamination of the area can result from their use. Make arrangements for frequent emptying of toilets with local sewage treatment authority. Upon completion of the work, remove toilets and restore area to original condition.

D. Telephone:

1. The Contractor shall furnish onsite telephone service for the Contractor and the Engineer during the period of construction of the Contract. The cost of installation and monthly bills for the Engineer's telephone service shall be borne by the Contractor.
2. The Engineer shall pay the cost of his long distance telephone charges.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 TEMPORARY CONSTRUCTION

A. Access Roads and Parking: Construct temporary construction detours as necessary to execute the work and as approved by the Engineer. Maintain in good condition until no longer needed, then remove the temporary detours and leave the area in a condition satisfactory to the Engineer.

B. Storage Yards: Construct temporary storage yards for the storage of products that are not subject to damage by weather conditions. Materials such as pipe, reinforcing and structural steel, shall be stored on pallets or racks, off the ground, and in a manner to allow ready access for inspection and inventory.

C. Fencing and Barricades:

1. Security Fence: A temporary security fence with gates and locks may be constructed around the construction site, and as approved by Engineer.

D. Engineer's Field Office:

1. Contractor shall provide, maintain, and subsequently remove as its property, a field office as specified below, for the exclusive use of Engineer and its representatives.
2. Engineer's field office, equipped as specified below, shall be available for Engineer's use prior to the start of work at project site, located where directed by the Engineer.

3. Contractor shall maintain field office in good repair and acceptable appearance. Provide weekly cleaning service and maintenance and replenishment, as applicable, of paper towels, paper cups, soap, toilet paper, and bottled water service.
4. Field office shall be trailer type mobile structure(s) with the following features and equipment, new or like new in appearance and function:
   a. All-metal frame.
   b. All-metal exterior, sides, and roof.
   c. Security guard screens on all windows.
   d. Toilet and wash basin in separate compartments with cold water and drains.
   e. Provide sanitary facilities in compliance with state and local health authorities.
   f. Insulated double walls, floor, and roof.
   g. Self-contained, built-in electric heater with self-contained air conditioning unit.
   h. Fluorescent ceiling lights.
   i. 110-volt electric wall plugs.
   j. Minimum Interior Height: 7 feet.
   k. Minimum Interior Width: 12 feet.
   l. Minimum Interior Length: 30 feet.
   m. Railed stairway to entrances.
   n. Number of Offices: One.
   o. Shelving: 30 LF, 18 inches deep.
   p. Doors with Cylinder Locks: Entrance door.
   q. Number of Windows with Blinds: Four.
   r. Work Surface: One, 30 inches by 10 feet at desk height.
   s. Bottled Water Service: One, with cooler.
   t. Paper Towel Dispenser with Towels: Two.
   u. Paper Cup Dispenser with Cups: One.
   v. Desks: Two, 30 inches by 60 inches.
   w. Swivel Chairs: Two.
   x. Straight Chairs: Two.
   y. Drafting Table: One, 3 feet by 6 feet.
   z. Drafting Stool: One.
   aa. Four-Drawer Steel File with Lock: One.
   ab. Drawing Rack with Drawing Hangers: One.
   ac. Wastepaper Basket: Four.
   ad. Clothes Rack: One.
   ae. First-Aid Kit: One.
   af. Telephone with 12-Foot Cord: One with incoming line.
   ag. Dry Copier (Xerox) Machine: One, or Contractor shall permit Engineer to access his xerox.
   ah. Carbon Dioxide (10-Pound) Fire Extinguisher: One.

3.2 SAFETY AND PROTECTION

A. Safety Requirements:

1. Contractor shall do whatever work is necessary for safety and be solely and completely responsible for conditions of the jobsite, including safety of all persons (including employees) and property during the Contract period. This requirement shall apply continuously and not be limited to normal working hours.

2. Safety provisions shall conform to Federal and State Departments of Labor Occupational Safety and Health Act (OSHA), and other applicable federal, state, county, and local laws, ordinances, codes, requirements set forth herein, and regulations that may be specified in other parts of these Contract Documents. Where these are in conflict, the more stringent requirement shall be followed. Contractor shall become thoroughly familiar with governing safety provisions and shall comply with the obligations set forth therein.

3.3 ENVIRONMENTAL CONTROLS

A. General: The Contractor in executing the work shall maintain affected areas within and outside project boundaries free from environmental pollution that would be in violation of federal, state, or local regulations.

B. Noise Control: Minimize noise by executing work using appropriate construction methods and equipment. Provide acoustical barriers so noise emanating from tools or equipment will not exceed legal noise levels as defined by local ordinances.

PART 4 PAYMENT

4.1 GENERAL

A. Payment for work in this section will be included as part of the applicable lump sum price stated in the Proposal for mobilization and demobilization and cleanup.

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SECTION 01505
MOBILIZATION AND CLEANUP

PART 1 GENERAL

1.1 WORK INCLUDED

A. This section covers the work necessary to move in and move out personnel and equipment, set up and remove drill rigs, locate temporary facilities, install surface casing, and clean up site, complete.

PART 2 PRODUCTS

2.1 GENERAL

A. Provide all materials and equipment required to accomplish the work as specified.

PART 3 EXECUTION

3.1 GENERAL

A. Set up well drilling equipment within the area designated on the Drawings. Accomplish all required work in accordance with applicable portions of these Specifications.

B. Some obstructions may not be shown. Bidders are advised to carefully inspect the existing facilities before preparing their proposals. The removal and replacement of minor obstructions such as electrical conduits, water, waste piping, and similar items shall be anticipated and accomplished, even though not shown or specifically mentioned.

3.2 SECURITY FENCE

A. Contractor's security fence may be constructed for the protection of materials, tools, and equipment of the Contractor and subcontractors. At completion of the work, remove fence from the site and restore the area.

3.3 CONTAMINATION PRECAUTIONS

A. Avoid contamination of the project area. Do not dump waste oil, rubbish, or other similar materials on the ground.

3.4 CLEANUP OF CONSTRUCTION AREAS

A. Upon completion and acceptance of each well, remove from the site the drill rig and equipment, complete, and all debris, unused materials, temporary construction buildings, and other miscellaneous items resulting from or used in the operations. Replace or repair any facility which has

been damaged during the construction work. Restore the site as nearly as possible to its original condition.

PART 4 PAYMENT

4.1 GENERAL

A. Payment for all work, materials, and equipment specified in this section will be at the applicable lump sum price as stated in the Contractor's Proposal for mobilization, and demobilization and cleanup.

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SECTION 01700
CONTRACT CLOSEOUT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Procedures to be followed in closing out the Contract.

1.2 FINAL SUBMITTALS

A. No Contract will be finalized until all of the following have been submitted as required in Section SUBMITTALS:

1. Final shop drawings.
2. Record drawings.
3. Interface information.
4. Operation and Maintenance Manuals.
5. Equipment maintenance summaries.
6. Manufacturer's certification of proper installation.
7. Submittals required in Division 16, ELECTRICAL.
8. Submittals required by funding agency and state and local agencies.

B. No Contract will be finalized until all guarantees, bonds, certifications, licenses, and affidavits required for work or equipment as specified are satisfactorily filed with the Engineer.

1.3 RELEASE OF LIENS OR CLAIMS

A. No Contract will be finalized until satisfactory evidence of release of liens has been submitted to Owner as required by the General Conditions.

PART 2 PRODUCTS

2.1 ACCESSORIES

A. Furnish to Owner, upon acceptance of equipment, all accessories required to place each item of equipment in full operation. These accessory items include, but are not limited to, adequate oil and grease as required for first lubrication of equipment (after field testing), light bulbs, fuses, hydrant wrenches, valve keys, handwheels, chain operators, special tools, and other items as required for initial operation.

PART 3 EXECUTION

3.1 FINAL CLEANING

A. At completion of work and immediately prior to final inspection, clean entire project according to the following provisions:

1. Clean, sweep, wash, and polish work and equipment provided under the Contract, including finishes. Leave the structures and site in a complete and finished condition to the satisfaction of the Engineer.
2. Should Contractor not remove rubbish or debris or not clean the facilities and site as specified above, the Owner reserves the right to have final cleaning done at the sole expense of the Contractor.

3.2 FINAL INSPECTION

A. After final cleaning and upon written notice from Contractor that work is completed, Engineer will make preliminary inspection with the Owner and Contractor present. Upon completion of preliminary inspection, Engineer will notify Contractor in writing of particulars in which the completed work is defective or incomplete.

B. Upon receiving written notice from Engineer, Contractor shall immediately undertake work required to remedy defects and complete the work to the satisfaction of Engineer and Owner.

C. After the items as listed in Engineer's written notice are corrected or completed, inform Engineer in writing that required work has been completed. Upon receipt of this notice, Engineer, in the presence of Owner and Contractor, will make final inspection of the project.

D. Should the Engineer find all work satisfactory at the time of final inspection, Contractor will be allowed to make application for final payment in accordance with provisions of the General Conditions. Should Engineer still find deficiencies in the work, Engineer will notify Contractor in writing of deficiencies and will not approve Contractor's request for final payment until such time as Contractor has satisfactorily completed the required work.

3.3 ELEVEN-MONTH INSPECTION

A. Eleven months after Engineer and Owner find all work satisfactory, the Engineer will perform an inspection with the Owner and Contractor present. Upon completion of eleven-month inspection, Engineer will notify Contractor in writing of particulars in which the warranted work has become defective.

B. Upon receiving written notice from Engineer, Contractor shall immediately undertake work required to remedy defects and repair the work to the satisfaction of Engineer and Owner.

PART 4 PAYMENT

4.1 GENERAL

A. Payment for work in this section will be included as part of the applicable lump sum price stated in the Proposal for demobilization and cleanup.

* * * * * *

SECTION 02200
EARTHWORK

PART 1 GENERAL

1.1 WORK INCLUDED

A. This section covers the work necessary for the earthwork, complete.

1.2 DEFINITIONS

A. Relative Compaction: The ratio, in percent, of the as-compacted field dry density to the laboratory maximum dry density as determined by ASTM D 1557. Corrections for oversize material may be applied to either the as-compacted field dry density or the maximum dry density, as determined by the Engineer.

B. Optimum Moisture Content: Determined by the ASTM standard specified to determine the maximum dry density for relative compaction. Field moisture content shall be determined on the basis of the fraction passing the 3/4-inch sieve.

C. Prepared Ground Surface: The ground surface after clearing, grubbing, stripping, excavation, and scarification and/or compaction.

D. Completed Course: A course or layer that is ready for the next layer or next phase of the work.

E. Well-Graded: A mixture of particle sizes that has no specific concentration or lack thereof of one or more sizes. Well-graded does not define any numerical value that must be placed on the coefficient of uniformity, coefficient of curvature, or other specific grain size distribution parameters. Well-graded is used to define a material type that, when compacted, produces a strong and relatively incompressible soil mass free from detrimental voids.

F. Unclassified Excavation: The nature of materials to be encountered has not been identified or described herein.

G. Selected Backfill Material: Material available onsite that the Engineer determines to be suitable for a specific use.

H. Imported Material: Material obtained by the Contractor from sources off the site.

I. Structural Fill: Fill material as required under STRUCTURES, PAVING, etc.

1.3 SHORING, SHEETING, BRACING, AND SLOPING

A. Install and maintain shoring, sheeting, bracing, and sloping necessary to support the sides of the excavation, to keep and to prevent any movement which may damage adjacent pavements, utilities, or structures, damage or delay the work, or endanger life and health. Install and maintain shoring, sheeting bracing, and sloping as required by OSHA and other applicable governmental regulations and agencies.

1.4 CODES, ORDINANCES, AND STATUTES

A. Contractors shall familiarize themselves with, and comply with, all applicable codes, ordinances, statutes, and bear sole responsibility for the penalties imposed for noncompliance.

1.5 TOLERANCES

A. All material limits shall be constructed within a tolerance of 0.1 foot except where dimensions or grades are shown or specified as minimum. All grading shall be performed to maintain slopes and drainage as shown. No reverse slopes will be permitted.

PART 2 PRODUCTS

2.1 GENERAL

A. Provide all labor, materials, and equipment necessary to accomplish the work specified in this section.

2.2 UNCLASSIFIED EXCAVATION

A. Excavation is unclassified. Complete all excavation regardless of the type, nature, or condition of the materials encountered. Make own estimate of the kind and extent of the various materials to be excavated in order to accomplish the work.

2.3 EARTHFILL

A. Excavated material free from roots, organic matter, trash, debris, rocks larger than 3 inches, and other deleterious materials.

2.4 GRANULAR FILL

A. One-inch minus crushed gravel or crushed rock, free from dirt, clay balls, and organic material, well graded from coarse to fine, containing sufficient finer material for proper compaction, and less than 8 percent by weight passing the No. 200 sieve. Provide imported material of equivalent quality, if required, to accomplish the work at no extra cost to the Owner.

2.5 WATER FOR COMPACTION

A. Furnish as required.

2.6 COMPACTION EQUIPMENT

A. Compaction equipment shall be of suitable type and adequate to obtain the densities specified, and shall provide satisfactory breakdown of materials to form a dense fill.

B. Compaction equipment shall be operated in strict accordance with the manufacturer's instructions and recommendations. Equipment shall be maintained in such condition that it will deliver the manufacturer's rated compactive effort. If inadequate densities are obtained, larger and/or different types of additional equipment shall be provided by the Contractor. Hand-operated equipment shall be capable of achieving the specified densities.

2.7 TOPSOIL

A. Selected topsoil at the site, properly stored and protected, free from roots, sticks, hard clay, and stones which will not pass through a 1-inch square opening. Remove existing grass and overburden before topsoil is excavated. Provide imported topsoil of equal quality if required to accomplish the work.

2.8 MOISTURE CONTROL EQUIPMENT

A. Equipment for applying water shall be of a type and quality adequate for the work, shall not leak, and shall be equipped with a distributor bar or other approved device to assure uniform application. Equipment for mixing and drying out material shall consist of blades, discs, or other approved equipment.

2.9 STANDARD PENETRATION TEST SOIL BORINGS

A. One 20-foot-deep standard penetration test soil borings shall be conducted at each corner of the concrete drilling pads and at the center of surge control foundation. The borings shall be conducted in accordance with ASTM D1586. Continuous split-spoon soil samples shall be taken to a depth of 10 feet and 5-foot intervals thereafter.

B. Geotechnical data to be reviewed, signed, and sealed by a professional civil engineer registered in the State of Florida. Data to accompany drilling pad submittal.

PART 3 EXECUTION

3.1 CLEARING, GRUBBING, AND STRIPPING

A. Complete clearing, grubbing, and stripping work as specified in CLEARING, GRUBBING, AND STRIPPING prior to beginning work in this section.

B. Clearing, grubbing, and stripping in the construction area are to be completed by others. However, if additional clearing, grubbing, and stripping are required proceed as detailed below.

3.2 CLEARING AND GRUBBING

A. Clear the site within the limits required to accomplish construction. Prevent damage to adjacent trees which are to remain. Dispose of waste materials offsite in accordance with all federal, state, and local laws relating to such disposal. After completion of clearing and grubbing, get Engineer's acceptance before commencing stripping.

3.3 STRIPPING

A. Prior to beginning any excavation or fill, strip the topsoil to a depth of 6 inches or to a depth sufficient to remove all organic material. In general, topsoil shall be removed where structures are to be built, or similar improvements constructed within the areas presently covered with topsoil. Take reasonable care to prevent the topsoil from becoming mixed with subsoil.

3.4 GENERAL EXCAVATION

A. Perform all excavation of every description, regardless of the type, nature, or condition of material encountered, as specified, shown, or required to accomplish the construction.

3.5 LIMITS OF EXCAVATION

A. Excavate to the depths and widths, as shown. Allow for forms, working space, granular base, and finish topsoil as shown or required. Do not carry excavation for footings and slabs deeper than the elevation shown. Excavation carried below the grade lines shown or established by the Engineer shall be replaced with the same fill material as specified for the overlying fill or backfill, and compacted as required for such overlying fill or backfill. Where the overlying area is not to receive fill or backfill, replace the overexcavated material and compact to a density not less than that of the underlying ground.

3.6 REMOVAL OF WATER

A. Provide and operate equipment adequate to keep all excavations and trenches free of water. Remove all water during periods when concrete is being deposited, when pipe is being laid, during the placing of backfill, and at such other times as required for efficient and safe execution of the work. Avoid settlement or damage to adjacent property. Dispose of water in a manner that will not damage adjacent property. When dewatering open excavations, dewater from outside the structural limits and from a point below the bottom of the excavation when possible. Design dewatering system to prevent removal of fines from existing ground.

3.7 FOUNDATION PREPARATION

A. After completion of excavation, and prior to foundation or fill construction, proof-roll the excavation surface with a 10-ton or heavier vibratory roller to detect soft or loose zones. Notify the Engineer prior to commencement of proof-rolling. If soft or loose zones are found, excavate the soft or loose material to a depth accepted by the Engineer, and then compact as specified for such fill. Compact the upper 12 inches of foundation subgrade to 95 percent relative compaction.

3.8 GRANULAR FILL UNDER FACILITIES

A. Place hereinbefore specified GRANULAR FILL under piping, and slab. Do not exceed loose lift of 8 inches. Compact each lift to not less than 95 percent of relative compaction. Moisten material as required to aid compaction. Place material in horizontal lifts and in a manner which avoids segregation.

3.9 EARTH BACKFILL AROUND STRUCTURES

A. Place hereinbefore specified EARTHFILL in all areas not designated to be granular fill. Deposit material from the excavation in horizontal lifts of maximum 8-inch uncompacted depth and compact each lift to not less than 90 percent relative compaction. Maintain material at optimum moisture content, ± 2 percentage points. Place backfill material free of roots, organic matter, trash, and rocks larger than 4-inch diameter. Stop backfill at specified grade. Make allowance for topsoil where required.

3.10 COMPACTION

A. Compact all materials by mechanical means. Flooding or jetting will not be permitted. If compaction tests indicate that compaction or moisture content is not as specified, material placement shall be terminated and corrective action shall be taken by the Contractor prior to continued placement.

3.11 MOISTURE CONTROL

A. During all compacting operations, maintain optimum practicable moisture content required for compaction purposes in each lift of fill. Maintain moisture content uniform throughout the lift. Insofar as practicable, add water to the material at the site of excavation. Supplement, if required, by sprinkling the fill. At the time of compaction, the water content of the material shall be at optimum moisture content, ± 2 percentage points.

B. Do not attempt to compact fill material that contains excessive moisture. Aerate material by blading, discing, harrowing, or other methods, to hasten the drying process.

3.12 FIELD DENSITY AND MOISTURE TESTS

A. A soil testing company retained by the Contractor and approved by the Owner and Engineer shall determine, at the expense of the Contractor, in-place density and moisture content by any one or combination of the following methods: ASTM D2922, D1556, D2216, D3017, or other methods selected by the Engineer. A minimum of two tests per lift shall be conducted.

3.13 DISPOSAL OF EXCESS EXCAVATION

A. Dispose of all excess excavated materials, not required for backfill or fills, outside of the area of work. Make arrangements for the disposal of the excavated material and bear all costs or retain any profit incidental to such disposal.

3.14 SITE GRADING

A. Perform all earthwork to the lines and grades as shown and/or established by the Engineer. Shape, trim, and finish slopes of channels to conform with the lines, grades, and cross sections shown. Make slopes free of all exposed roots and stones exceeding 3-inch diameter that are loose and liable to fall. Round tops of banks to circular curves, in general, not less than a 6-foot radius. Rounded surfaces shall be neatly and smoothly trimmed. Neatly blend all new grading into surrounding, existing terrain. Overexcavating and backfilling to the proper grade will not be acceptable. Finished site grading will be reviewed by the Engineer.

PART 4 PAYMENT

4.1 GENERAL

A. Payment for work in this section will be included as part of the lump sum price stated in the Proposal for construction of concrete drilling pads.

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SECTION 02671
SURFICAL MONITOR WELLS

PART 1 GENERAL

1.1 WORK INCLUDED

A. These Specifications cover the work necessary for construction of the surfical monitor wells, complete.

B. The Contractor shall furnish all labor, materials, tools, and equipment necessary to drill and complete the wells, including drilling, casing, sealing, gravel pack, and completion of well head, and all other work required to complete the work as specified herein and as shown on the Drawings.

C. When complete, this project will provide the Owner with wells to enable the Owner to monitor the groundwater around the drilling pad.

PART 2 PRODUCTS

2.1 PVC PIPE

A. PVC pipe shall be the size shown on the Drawings and meet all the requirements of Schedule 40 PVC pipe in ASTM D1785. Slots to be 0.020-inch wide.

2.2 GRAVEL

A. Gravel for packing around the 2-inch PVC pipe shall be free from roots, trash, and other deleterious material. The material shall be reasonably well graded.

PART 3 EXECUTION

3.1 WELL DEVELOPMENT

A. Following placement of the casing screen assembly and gravel pack, the well shall be developed by airlift pumping or an alternative method approved by the Engineer. Development shall continue until clean, uncontaminated formation water is being produced from the well. The Engineer shall be the sole judge as to when this condition exists.

PART 4 PAYMENT

4.1 MONITOR WELLS

A. No measurement of quantities will be made.

B. Payment for the work to install the surfical monitor wells to the depths shown on the Drawings shall be included as part of the lump price stated in the Contractor's Proposal, for construction of the concrete drilling pad.

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SECTION 02673
DRILLING

PART 1 GENERAL

1.1 WORK INCLUDED

A. This section covers the work, materials, and equipment necessary for drilling the well bores, complete.

PART 2 PRODUCTS

2.1 GENERAL

A. All equipment shall be in good working condition prior to use in the work. Operate and maintain equipment in conformance with manufacturer's recommendations.

2.2 DRILLING EQUIPMENT

A. Provide commercially available reverse air rotary drilling rigs capable of completing the wells as shown on the attached well construction drawings.

B. Provide all tools, bits, and all other necessary equipment for drilling.

2.3 DRILLING FLUID

A. Provide all drilling fluids, water, and additives as required. Review fluids and additives with the Engineer prior to drilling. Additives and fluids are subject to approval by the regulatory agencies.

2.4 TEST AND SAMPLING EQUIPMENT

A. Provide equipment for measuring drilling fluid properties.

B. Provide sampling bags or containers to be approved by the Engineer.

C. Provide water sample containers, to be approved by the Engineer.

PART 3 EXECUTION

3.1 DRILLING

A. Notify the Engineer 5 days (Saturdays, Sundays, and holidays excepted) prior to drilling.

B. Provide at all times a thoroughly experienced, competent, and licensed driller during all operations at the drill site.

C. Wells are to be of the type and characteristics described in Section GENERAL REQUIREMENTS. The exact depth of well and length of casings are to be determined in the field in accordance with information obtained in each site from the corresponding pilot hole or from actual drilling operations.

D. The cost of furnishing and installing any surface casing or accessory in any well shall be included in the lump sum price for construction of the appropriate drilling pad. Surface casings shall be driven, vibrated, or grouted in place.

E. The wells shall be drilled by the rotary method using mud circulation through the unconsolidated formations to a depth of approximately 1,000 feet. Reverse air circulation shall be used below the depth of 1,000 feet to total depth of the well.

F. Drill a minimum 12-inch diameter pilot hole to full depth as determined by the Engineer and prepare the borehole for geophysical logging. Borehole preparation shall include, but not be limited to: (1) continuation of circulation until drill cuttings have been removed from the borehole and (2) circulation of the drilling mud in the borehole until it is uniform and the drill pipe has been removed from the borehole. The Contractor must make all reasonable efforts to leave the borehole free from obstructions in preparation for geophysical logging.

G. Drill the boreholes of the dimensions and at the approximate location shown on the attached well construction drawing. The exact location will be determined by the Engineer in the field.

H. The boreholes shall be drilled so as to permit the installation of the casing and screen(s), if used, straight and plumb to the tolerances specified in Section CASING.

I. Use only drilling fluids and additives specifically recommended by the manufacturer for use in water well drilling. Avoid contamination of the samples or the aquifer. Do not introduce muds, clays, or drilling aids into the well or use lime, cement, organic matter, or other material to stop circulation losses of the drilling fluid, without reviewing the proposed program with the Engineer.

J. Reaming of the pilot holes shall be done with a stepped bit reamer with a lead bit the size of the pilot hole bit and progressively larger diameter bits up to the reamer size required. Each bit shall be a minimum of 2 feet apart in the reamer bit assembly to ensure that the reamer assembly follows the pilot hole.

K. When disposing of formation water and during reverse-air drilling, Contractor shall allow proper settlement time to prevent cuttings from entering the injection well as directed by the Engineer.

L. Whenever a well is being drilled in an area of artesian flow, the Contractor shall provide for all the tools, piping, equipment, and operations necessary to prevent the uncontrolled artesian flow of water.

M. A blowoff preventer (BOP), capable of setting in the well, shall be placed at the wellhead and shall be ready for service at all times when drilling in areas of artesian flow. The Contractor shall demonstrate proficiency in using the BOP to the satisfaction of the Engineer. BOP shall be capable of closing in the well within 10 minutes of actuation.

N. It is the intent of this Contract that no drilling fluids or waters developed during construction be allowed to escape the confines of the drilling pad.

3.2 ALIGNMENT REQUIREMENTS

A. Pilot holes and reamed holes shall be drilled round and straight throughout.

B. A mechanical drift indicator shall be run in pilot holes and reamed holes at intervals not greater than 60 feet. Tool scale shall clearly delineate 10 minutes or less. Any deviation in plumbness greater than 45 minutes of 1 degree shall be corrected by the Contractor at his own expense.

C. The Engineer may modify the requirements for plumbness and straightness if, in his judgment:

1. Deviations are due to subsurface conditions, and the Contractor has exercised all possible care to avoid deviations.
2. The deviations will not materially affect the usefulness or performance of the well or further drilling operations, including setting of casings and future testing.

3.3 COMPLIANCE WITH GOVERNMENTAL REGULATIONS

A. Construct the well in strict conformance with all laws, rules, regulations, and standards related to the construction of wells in the State of Florida, and in Palm Beach County.

3.4 FORMATION SAMPLES

A. Two sets of representative formation samples shall be collected between 10 feet below the ground surface to the full depth of the well. Samples shall be taken every 10 feet and each change in formation or material type. The method must yield samples that are representative of the actual depth to which drilling has progressed.

B. Formation samples shall be collected and handled in accordance with formation sampling methods contained in "Groundwater and Wells", second edition, published by Johnson Division, and also in accordance with the instructions for collecting samples given in the Department of the Army's Technical Manual TM5-297, Wells, August 1957.

C. One set of samples shall be kept in cloth bags which will be secured by the Contractor from the Florida Geological Survey, Department of Natural Resources, 903 West Tennessee Street, Tallahassee, Florida 32304. After being put in their containers, they shall be properly labeled and one set delivered by the Contractor to the Florida Geological Survey, Department of Natural Resources, 903 West Tennessee Street, Tallahassee, Florida 32304, upon completion of each well.

D. The Contractor shall submit the second set of samples, collected in 1.8 mil zip-lock plastic bags to the Engineer for inspection at a location onsite chosen by the Engineer as often as requested. It shall be the Contractor's sole responsibility to secure, protect, and deliver the undisturbed samples to the Engineer. The second set of samples shall be retained by the Engineer.

E. Each sample shall be approximately 1 pint in volume. Place each sample in a container labeled with the date, well identification, and depth from which the sample was taken clearly marked on the container. Submit sample to the Engineer immediately.

3.5 WATER SAMPLES

A. While drilling with reverse air circulation, the Contractor shall collect representative water samples every 30 feet. Samples shall be collected in perfectly clean plastic bottles with nonmetallic caps and of a capacity of not less than 16 fluid ounces. Each bottle shall be rinsed twice with the water to be sampled before collecting the corresponding sample.

B. Sample bottles shall be clearly labeled in an indelible way with the depth, time, and date. It shall be the Contractor's sole responsibility to collect, protect, and deliver the water samples, properly labeled after collection, to the Engineer.

3.6 PROTECTION OF WATER QUALITY

A. Take all necessary precautions to prevent brackish water, saltwater, diesel fuel, gasoline, or other deleterious substances from entering the well, either through the opening or by seepage through the ground surface. Maintain precautions during and after construction of the well until accepted by the Owner.

3.7 DRILLING AND WELL LOGS

A. Furnish the Engineer a daily drilling log. The log shall accurately describe the geologic materials and depths encountered; the presence or absence of water; depths of lost circulation zones and methods of regaining circulation; drilling rates; time, depth, and description of any unusual occurrences or problems during drilling; and diameters and lengths of casing installed. Keep the log up-to-date with the progress of drilling. Keep a copy at the drill site for inspection by the Engineer. Use reproductions of the Daily Drilling Report located at the end of this section, or equal.

B. Prepare and submit a final well log which shall include geologic log; borehole diameters; depth of the bottom of the casing and/or the bottom of the borehole; casing diameters and wall thicknesses; cemented zones; perforated or screened interval(s); type, size, and quantity of gravel pack installed, amount of sand removed during development; and other information from the daily logs pertinent to the well construction. File all records and reports with the proper agencies required by federal, state, and local codes or regulations.

C. Furnish, maintain, and operate a continuous strip chart drilling rate, bit weight, and footage recorder such as a Geolograph recorder, or equal, on the injection well drilling rig. Submit copies of the strip charts to the Engineer daily.

3.8 DISPOSAL OF CUTTINGS

A. Remove from the drill site all cuttings, water, or other material removed by drilling operations which are not required to complete the work. Solid materials shall be disposed of in accordance with local and state regulations at an approved disposal site. Approval of such a disposal site shall be secured in writing by the Contractor and submitted to the Engineer before start of construction.

3.9 DRILLING FLUID AND SALTWATER DISPOSAL

A. No discharge of drilling fluid or saltwater will be allowed at the drilling site.

B. The Contractor shall be responsible for providing, installing, and maintaining all necessary tank trucks, pipe, pumps, and equipment necessary to pump and haul excess pad drainage, drilling fluid, and pumped water to a predetermined disposal site as required in Section GENERAL REQUIREMENTS, in accordance with federal, state, and local regulations.

PART 4 PAYMENT

4.1 GENERAL

A. Drilling will be measured in linear feet of hole drilled, to the nearest foot.

B. Payment for all work, materials, and equipment specified in this section will be made at the unit price per foot drilled as stated in the Contractor's Proposal.

(See next page for Daily Drilling Report)

DAILY DRILLING REPORT

Date: _____ Owner: _____

Well No.: _____

Casing/Hole Diameter _____ -inch

Depth of Well

Start of Shift _____ feet

End of Shift _____ feet

Depth to Water (below ground)

Start of Shift _____ feet

End of Shift _____ feet

Log of Materials Encountered

Description	Depth From	Depth To

Remarks: (Character of drilling, casing added, miscellaneous work items, etc.)

_____

_____

_____

Driller: _____

Helper: _____

(Use other side for more comments)

* * * * * *

SECTION 02674
CASING

PART 1 GENERAL

1.1 WORK INCLUDED

A. This section covers the work, materials, and equipment necessary for furnishing, and installing well casing, complete.

PART 2 PRODUCTS

2.1 GENERAL

A. Provide all materials and equipment necessary for joining and installing the casing as specified.

2.2 SURFACE CASING

A. Use pipe of sufficient strength to hold drilled hole open until grouting is completed and to withstand pulling.

B. Contractor shall install surface casings at the injection wells and monitor well to hold drilled hole open until grouting is completed. Surface casing shall be driven, vibrated or grouted into place.

C. The nominal diameter of the injection well surface casing shall be a minimum of 60 inches. The nominal diameter of the dual-zone monitor well surface casing shall be a minimum of 36 inches. Surface casing shall extend a minimum of 45 feet below land surface or to such depth as the Contractor judges necessary to prevent washout or undermining of the drilling pad.

2.3 WELL CASING

A. All casing for the injection wells and dual-zone monitor well shall be new and unused carbon steel pipe, and shall conform with the latest revision of ASTM 139, Grade B. Final casing strings shall be seamless and shall conform to ASTM A 53, and/or API 5L Grade B latest revision. Ends of plain end pipe shall be perfectly square and shall be furnished beveled for field V-notch butt welding.

B. Contractor shall furnish 3 copies of the mill certificates to the Engineer for approval before delivering pipe to jobsite. All pipe shall be clearly labeled with manufacturer's heat numbers, which will be reviewed by both the Contractor and the Engineer upon delivery.

C. Casing shall be as follow:

Diameter (Inches) (ID/OD)	Wall Thickness (Inches)	Weight (Pounds/Ft)	Approximate Total Length (Feet)
5.501/6.625	0.562	36.39	1,800
15/16	0.500	82.77	800
23/24	0.500	125.49	2,780
33/34	0.500	178.89	1,850
35/36	0.500	189.74	45
43/44	0.500	232.29	800
53/54	0.500	285.69	180
59/60	0.500	317.73	45

D. Steel casings shall be equal to those manufactured by Bethlehem Steel Company, National Tube Division of the U.S. Steel Company, or equivalent. Casings shall be furnished uncoated, except that ends may be coated for protection.

E. Casing that is delivered to the site in a condition which will not yield an acceptable cement bond shall be sandblasted prior to installation. The Engineer shall determine when the casing is suitable for installation.

2.4 FITTINGS

A. Provide all fittings, drive shoes, and centering guides as shown on the attached well construction drawing or as necessary to complete the well.

B. Casings to be cemented shall be provided with the following accessories:

1. A full opening guide shoe fabricated from steel casing.

C. Casing centralizers spaced 90 degrees around the casing as follows:

1. One at 5 feet above the bottom end.
2. One at 20 feet above the bottom end.
3. One at 40 feet above the bottom end.
4. One at 100 feet above the bottom end.
5. One at every 100 feet thereafter to nearest 100 feet from ground surface.

D. All accessories shall be manufactured by the Halliburton Company, Duncan, Oklahoma; Dowell of Tulsa, Oklahoma; or equal.

E. Centralizers shall be manufactured by Pathfinder Oil Tool, Lawton, Oklahoma; Halliburton Company, Duncan, Oklahoma; Dowell of Tulsa, Oklahoma, approved equal, or may be fabricated in the field from carbon steel casing.

F. Fabricated centralizers for carbon steel casings shall be constructed of the same material as the casing attached. Fabricated centralizers shall be welded to the casing and must provide at least 3-1/2 inches of clearance all around the casing. They shall be arranged in four vertical and straight lines, located 90 degrees apart allowing maximum clearance for tremie pipes. Centralizers shall be curved steel bands a minimum of 12 inches long, 2 inches wide, a minimum of 0.375-inch thick with a radius of 12 inches and welded vertically to the side of the casing at 90-degree angles. Their concave surface shall be against the casing.

G. Provide a minimum 8-inch pressure gauge for the final casing pressure tests. Gauge shall have an accuracy of 0.25 percent. Gauge shall have a scale of 0 - 160 or 0 - 200 psi and shall have increments of 1.0 psi or less. Calibration certification shall be furnished to the Engineer two days before the test, gauge shall have been calibrated within the previous 60 days. Calibration certification shall also be furnished to the Engineer within 15 days after testing, gauge shall be recalibrated immediately following testing.

PART 3 EXECUTION

3.1 GENERAL

A. All casing shall be installed by a method appropriate to the attached well construction drawing, as selected by the Contractor.

B. Casing lengths shall be joined watertight by a method appropriate to the material used, as selected by the Contractor, so that the resulting joint shall have the same structural integrity as the casing itself.

C. The standards of the American Welding Society shall apply for all welded joint casing and accessories. All welds shall conform to the latest revision of ANSI B31.1.

D. Threaded and coupled joints shall be API or equivalent, made up so that when tight, all threads will be buried in the lip of the coupling.

E. Surface and intermediate casings shall be installed and cemented in a hole not less than 5 inches greater than the nominal diameter of casing. Final casing string shall be installed and cemented in a hole at least 10 inches greater than nominal diameter of casing.

F. Casing which fails, collapses, or separates during construction shall be removed from the hole and repaired or replaced at Contractor's sole expense. Positive internal pressure shall be maintained inside the casings during cementing operations and until the cement has set.

G. Upon completion of cementing of the innermost casings on the deep injection and monitor wells, and prior to drilling out the cement plug, a casing pressure test shall be performed using instrumentation furnished by the Contractor. The final casings shall be pressure tested at 150 and 100 psi for the deep injection wells and dual-zone monitor well, respectively, for at least 60 minutes with no greater than plus or minus 5 percent pressure gain or loss. In the event that specified pressure cannot be maintained for 60 minutes within the stated range of pressure, corrective measures shall be undertaken by the Contractor at his own expense until the test is satisfactorily accomplished. The casing pressure test shall be witnessed by the Engineer.

3.2 WELDING PERFORMANCE QUALIFICATIONS

A. All welders and welding operators shall be certified at the Contractor's sole expense by a qualified testing laboratory before performing any welding under this section. Qualification tests shall be in accordance with Section IX, Article III of the ASME Boiler and Pressure Vessel Code. Welders and operators shall be qualified for making groove welds in carbon steel and stainless steel pipe in positions 2G and 5G for each welding process to be used.

B. Prior to the start of the work, Contractor shall submit a list of the welders he proposes using and the type of welding for which each has been qualified.

C. Qualification tests may be waived if evidence of prior qualification is deemed suitable by the Engineer. The Contractor shall retest any welders at any time the Engineer considers the quality of the welder's work substandard. When Engineer requests the retest of a previously qualified welder, the labor costs for the retest will be at Owner's expense if the welder successfully passes the test. If the welder fails the retest, all costs shall be at the Contractor's expense.

3.3 END PREPARATION

A. Pipe ends shall be prepared preferably by machine shaping. Beveled ends for but welding shall conform to ANSI B16.25.

3.4 CLEANING

A. Surfaces shall be clean and free of paint, oil, rust, scale, slag, or other material detrimental to welding.

3.5 ALIGNMENT AND SPACING

A. Align ends to be joined within existing commercial tolerances on diameters, wall thicknesses, and out-of-roundness. Root opening of the joint shall be as stated in the procedure specification.

B. The shielded metal-arc process shall be used for all carbon steel field welding.

C. No welding shall be performed if there is impingement of any rain, or high wind on the weld area or if the ambient temperature is below 32 degrees F. If the ambient is less than 32 degrees F, local preheating to a temperature warm to the hand is required.

D. Tack welds, if not made by a qualified welder using the same procedure as for the completed weld must be completely removed. Tack welds which are not removed shall be made with an electrode that is the same as or equivalent to the electrode to be used for the first weld pass. Tack welds that have cracked shall be removed.

E. Each layer of deposited weld metal shall be thoroughly cleaned prior to the deposition of each additional layer of weld metal, including the final pass, with a power-driven wire brush. Surface defects which will affect the soundness of weld shall be chipped out or ground out.

F. There shall be a minimum of three weld passes on pipe sizes 6 inches and larger. There shall be a minimum of a full root and second pass on all welded pipe 4 inches and under.

G. Welded joints shall be allowed to cool for not less than 30 minutes before weld is placed in contact with water.

PART 4 PAYMENT

4.1 GENERAL

A. Installed casing will be measured in linear feet to the nearest foot.

B. Payment for providing and installing all well casing will be made at the unit prices per foot installed, as stated in the Contractor's Proposal for casing.

C. Payment for providing and installing the surface casings shall be included in the lump sum amount stated in the Proposal for construction of the concrete drilling pads.

D. Providing and installing all fittings specified in this section shall be included in the unit prices as stated in the Contractor's Proposal for casing.

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SECTION 02677
GROUT SEAL

PART 1 GENERAL

1.1 WORK INCLUDED

A. This section covers the work, materials, and equipment necessary for furnishing and installing the grout seal, complete.

B. Work covered by this section shall be performed by a service company specialized in the field of grout sealing and cementing of oil, water, and wastewater wells. The service company shall provide onsite, during cementing operations, the services of a technical representative with demonstrated experience in the field and area related to this project.

PART 2 PRODUCTS

2.1 GENERAL

A. Provide all grout and the materials and equipment necessary for placement of the grout as specified.

2.2 PORTLAND CEMENT

A. Conform to ASTM C 150, Type II.

2.3 BENTONITE AND OTHER ADDITIVES

A. Furnish all Bentonite required for cementing in the proportions specified in the Proposal and as directed by the Engineer.

B. Furnish other cementing additives formulated specifically for well cementing as required by the Engineer.

2.4 MIXING WATER

A. An adequate and safe water supply for cementing will be the Contractors's responsibility as specified in Section CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS.

PART 3 EXECUTION

3.1 NEAT CEMENT GROUT

A. Portion one sack of cement to not more than 5.8 gallons of water. All grout formation shall have 0 percent free water when pumped.

3.2 ADDITIVES

A. The use of special cements, bentonite, or other admixtures (ASTM C 494) to reduce permeability, increase fluidity or yield, and/or control set time, and the composition of the resultant slurry shall be approved by the Engineer prior to their use.

B. Consistency and method of mixing must be approved by the Engineer prior to grouting. Type of cement and cement formulations shall be in accordance with the Bid Schedule and this section.

3.3 PLACING

A. Cementing of casing shall be accomplished in the presence of the Engineer or his representative, filling completely the annular space between hole and casing from the bottom of the casing or the top of the previous cement stage, to the level shown on the Drawings, or as instructed by the Engineer. Maximum theoretical lifts shall be 500 feet unless otherwise instructed by the Engineer.

B. The method used shall be optional with the Contractor among those described in Section A1-8.4 "Grouting of Annular Space Surrounding Protective Casing", AWWA Standard for Deep Wells (AWWA A100-66), and provided there is no conflict with requirements of these Specifications.

C. The method of grout placement shall be reviewed by the Engineer. No method shall be permitted that does not force grout from the bottom of the space to be grouted to the surface. The grouting shall be done continuously and in such a manner as will ensure the entire filling of the annular space around the casing.

D. Cement placed through grout pipes shall be pumped through two pipes spaced 180 degrees apart in the annulus. Grout pipes shall have an inside diameter of not less than 1.0 inch. Grout pipes shall be withdrawn as the annulus is filled, and before the cement has begun to set. Grout pipes shall be set not more than 5 feet above the top of the previous cement stage tagged.

E. The Engineer will inform the Contractor of the amount and type of cement to be used per operation. The Contractor will submit to the Engineer 24 hours before cementing starts a detailed schedule for the complete operation including capacity of the injection pump and equipment to supply and mix cement slurry. For the primary cement stage on the injection and monitor wells, the Contractor is required to provide a backup cement pumping capability. During each cement stage pumped, grout samples shall be collected by the Contractor and checked for density by both a pressurized fluid density balance or by a recording radiometric densometer. These grout samples must be collected a minimum of three times for each cement batch pumped; before pumping, in the middle of the batch, and near the end of the batch. The slurry density determination should be conducted

in accordance with the latest edition of API Spec 10. The slurry density determined in the field will be compared with the specified slurry density indicated on the mill certificate which will be presented to the Engineer prior to the start of cementing operations. No cement slurry will be pumped until the specified slurry density is obtained.

F. The Contractor shall collect and label one cement sample from each stage pumped in a container approved by the Engineer. The samples shall be stored onsite until completion of the project.

G. The Contractor shall be solely responsible for any defect in the cementing work due to improper, or lack of, equipment, technology, personnel or experience, either of Contractor or of any of his subcontractors. Contractor shall pay all costs necessary to correct such defects. Should Contractor fail to correct defects, the Engineer may refuse to accept the well.

3.4 DRILLABLE BRIDGE PLUG

A. The Contractor shall furnish equipment and personnel to install a commercial drillable bridge plug as approved by the Engineer or may construct a bridge plug in place using cuttings and a lift of at least 10 feet of portland ASTM C 150, Type II neat cement. Amount of cement and placement method shall be reviewed and approved by the Engineer.

3.5 SETTING TIME

A. No drilling operations will be permitted until the grout has cured.

B. Minimum setting time between stages will be at least 12 hours. Longer time may be necessary if a high yield cement is used. After cementing is completed on a casing, casing and well must remain undisturbed for at least 24 hours for setting of the cement. Further setting requirements are contained in Section CASING.

PART 4 PAYMENT

4.1 GENERAL

A. The cost of drillable bridge plug, cement and cement pumping shall be paid at the lump sum price or applicable unit price per sack of cement pumped as stated in the Proposal. This shall include all necessary equipment, materials, and subcontracted services required to properly cement the casings as specified in these Specifications.

B. Waiting on cement to set for each stage shall be included in the applicable unit price per sack of cement pumped as stated in the Proposal.

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SECTION 02678
WELL DEVELOPMENT

PART 1 GENERAL

1.1 WORK INCLUDED

A. This section covers the work, materials, and equipment necessary for the development of the well, complete.

B. Development of the injection well shall be by circulation until all visible particulate matter has been removed from the drilling fluid to the satisfaction of the Engineer. Total development time is estimated to be a total of 12 hours for each deep injection well and 24 hours for the completed dual-zone monitor well. However, the Engineer shall be the sole judge as to when development is complete and may, therefore, increase or decrease the total development time.

C. Development of the dual-zone monitor well shall be as detailed below with waters developed from the system being disposed of by injection into the completed deep injection well after settling.

D. Temporary background water quality collection for the dual-zone monitor well shall continue for approximately 60 days after completion, as detailed below in Paragraph TEMPORARY PUMPING EQUIPMENT.

PART 2 PRODUCTS

2.1 AIRLIFT EQUIPMENT

A. Furnish all necessary compressors, piping, tools, pumps, and any other equipment to develop the wells by airlifting to obtain a maximum flow.

2.2 TEMPORARY PUMPING EQUIPMENT

A. Furnish necessary pump, piping, and other equipment to continue development of the dual-zone monitor well after completion. Water from both monitor zones shall be purged into the dual-zone monitor well sump at the same time. The pump shall be capable of injecting the produced water from the sump into the injection well. Estimated flow for both zones is approximately 120 gpm. Injection wellhead pressures are estimated to be approximately 30 psi for this procedure.

B. Temporary background water quality collection will commence upon substantial completion of the deep injection well disposal system and will continue for a period of approximately 60 days. It is anticipated that activities associated with the collection of background water will extend beyond the 210 days allowed for construction of the effluent disposal system. In this event, the background water quality collection period will

be considered to be outside of the Contract construction period and liquidated damages will not be assessed for activities associated with the collection of the background water quality.

PART 3 EXECUTION

3.1 PUMPING DEVELOPMENT

A. Operate the development equipment continuously at such rates of discharge and for such periods of time as determined by the Engineer. The well shall be pumped until the water is free from sand, silt, and turbidity and/or until no further increase in specific capacity can be observed and in a manner that will contain all water produced during development and as approved by the Engineer.

3.2 INSTALLATION OF TEMPORARY PUMPING EQUIPMENT

A. After initial development, install temporary pump, discharge piping, and other necessary appurtenances for pumping the dual-zone monitor well into the deep injection well.

PART 4 PAYMENT

4.1 GENERAL

A. Payment for development of the well, regardless of the method(s) used, will be made at the unit price per hour as stated in the Contractor's Proposal for well development. The Contractor will not be paid the hourly rate for development during the time the equipment is not actually in use in the development of the well, or for any equipment repair, or for any time, in the opinion of the Engineer, that the development procedure is not being accomplished in accordance with these Specifications. Payment at the hourly rate shall constitute full compensation for all work, materials, and equipment specified in this section.

B. Payment for installation and removal of temporary pumping equipment and appurtenances will be included as part of the lump sum bid price stated in the Proposal for temporary background water quality pumping of the dual-zone monitor well.

C. Payment for operation of the temporary pumping equipment will be included as part of the unit price stated in the Proposal for operation of temporary background water quality pumping equipment.

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SECTION 02679
GEOPHYSICAL LOGGING

PART 1 GENERAL

1.1 WORK INCLUDED

A. This section covers the work, materials, and equipment necessary for geophysical logging of the borehole, complete.

PART 2 PRODUCTS

2.1 GENERAL

A. Contractor will provide continuous-recording geophysical logging equipment capable of running borehole compensated sonic log, radioactive tracer survey and TV video and include other logs as needed as provided by a commercial logging service such as Wellex, Schlumberger, or equal.

B. Engineer will provide geophysical logging equipment and services to the Owner for the following logs:

1. Long and short normal electric and spontaneous potential.
2. Gamma ray.
3. Caliper.
4. Temperature.
5. Fluid resistivity.
6. Fluid Velocity.

PART 3 EXECUTION

3.1 GENERAL

A. Open Hole Logging:

1. The borehole and well shall be logged in stages.
2. The open hole intervals shall be prepared for logging by circulating all drill cuttings from the hole and conditioning the drilling fluid until uniform and properly weighted to prevent the well from flowing and/or the formation from collapsing into the hole. Logging shall be done as soon as possible after drilling and preparation of the hole.
3. The Contractor shall be responsible for keeping the borehole open and free of obstructions during geophysical logging, and shall remove any obstruction to the logging tools at his own expense. In the event the logging tools do not reach within 20 feet of the bottom of the hole as measured with the drill pipe, the Contractor shall clean the hole to the original drilled depth at his own expense. The logs shall be rerun at the Contractor's expense. Standby time necessary to rerun the logs shall not be paid.

4. Geophysical logs are to be run on the most sensitive scale available which is consistent with a minimum of off-scale deflection. The use of logging equipment that does not operate at sufficiently sensitive scales will not be approved by the Engineer.
5. All logs shall be clearly labeled with all pertinent information regarding the well, location, depths, scales, etc. Repeat sections shall be run to verify logging tool performance on all logs. Provide to the Owner for all Geophysical Logs 5 field copies at the time of logging and 35 report quality copies and 1 reproducible original within 3 days of logging.
6. Video surveys of the borehole shall be recorded on video recording tape (1/2-inch VHS format). Contractor shall furnish the Owner with the master tape of all runs and eight copies of the video survey of the completed injection well.

PART 4 PAYMENT

4.1 GENERAL

A. Payment for all work, materials, subcontracted services, and equipment specified in this section will be made at the lump sum price as stated in the Contractor's Proposal for geophysical logging. Standby time while the Engineer is performing logging shall be paid at the unit price as stated in the Proposal for standby time.

B. No additional payment will be made to the Contractor for assistance to the Engineer during geophysical logging procedures.

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SECTION 02980
CORING

PART 1 GENERAL

1.1 WORK INCLUDED

A. This section covers the work necessary to drill core samples, complete.

PART 2 PRODUCTS

2.1 GENERAL

A. Provide all materials and equipment necessary for drilling, collecting, and storing the core samples as specified.

2.2 CORE BARREL AND BIT

A. The core barrel and bit shall be of the appropriate sizes to recover 4-inch diameter cores. The length of the core barrel shall not exceed 10 feet.

2.3 CORE BOXES

A. Cores shall be stored in sturdy wooden boxes of the proper size for the diameter of core collected. Each core box shall hold no more than 10 feet of 4-inch core.

PART 3 EXECUTION

3.1 GENERAL

A. A minimum of eight 4-inch diameter cores each 10 feet in length shall be taken during the drilling of the pilot hole between 800 and 2,200 feet in depth.

B. The exact depths and length of the interval to be cored may be changed by the Engineer based on subsurface conditions.

C. The method of coring and the sequence of coring and reaming the hole to full diameter is subject to the Engineer's approval and shall conform to the requirements stated in these Specifications.

D. Cores shall be stored at the site until completion of the work in sturdy wooden boxes of the proper size. All boxes shall be clearly and permanently labeled with the depth, the top, and the bottom of the core.

PART 4 PAYMENT

4.1 GENERAL

A. Payment for coring shall be at the unit price stated in the Proposal per 10 foot core run. At least 36 inches of core must be recovered in whole and undisturbed sections of not less than 8 inches in length. No payment for a core trip shall be made if the above minimum recovery is not obtained.

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SECTION 02985
INJECTION TEST

PART 1 GENERAL

1.1 WORK INCLUDED

A. This section covers the work necessary to run the injection test, complete.

B. The estimated length of each injection test is 12 hours. The Engineer may increase or decrease the length of the test as necessary. The source of water for this test shall be the Indian River Lagon as shown on the Drawings.

C. Contractor's pumping equipment will be required to be fitted with screens and accessories to prevent the pumping of fish and plant life into the well during testing.

PART 2 PRODUCTS

2.1 INJECTION PUMP

A. Furnish and install an injection pump and driver in the adjacent waters of the Indian River Lagoon capable of pumping from 3,000 to 11,000 gallons per minute against a total head of a minimum of 150 feet of water at the wellhead.

B. Provide a throttling valve on the injection line downstream of the flow measuring device.

C. Provide all necessary pipe, fittings, equipment screens and accessories to install and operate the injection pump.

D. Provide a water sampling tap on the injection line and a 1/4-inch tap for the Engineer's pressure gauge on the well head.

2.2 FLOW MEASURING DEVICE

A. Furnish and install a flowmeter between the injection pump and injection well capable of accurately (plus or minus 5 percent) and continuously indicating injection rates from 3,000 to 11,000 gallons per minute. Flowmeter calibration data shall be submitted to the Engineer at least 3 days prior to the test.

B. Flowmeter shall read instantaneous flowrate and totalize the flow.

2.3 LOGGING STAND PIPE

A. Furnish an 8-inch diameter stand pipe on top of the injection well head with a minimum length of 13 feet, a gate valve at its base, and flanged at the top. Furnish scaffolding to allow safe access to the top of the stand pipe for geophysical logging.

PART 3 EXECUTION

3.1 PRELIMINARY CAPACITY INJECTION TEST

A. Run a preliminary capacity injection test for the purpose of checking the operation of the injection test equipment and to fill the injection well with test water. Duration of this test shall be approximately one hour at rates to be determined by the Engineer.

3.2 STEP INJECTION TEST

A. The injection test shall be run at the rates ranging from 3,000 to 11,000 gpm as directed by the Engineer. The test shall be run for approximately 12 hours as directed by the Engineer. The Contractor shall be responsible for obtaining any permits required to obtain water from the Indian River Lagoon.

B. In the event the Contractor's pumping units should fail and interrupt the injection test, the test shall be started over at the Contractor's expense.

PART 4 PAYMENT

4.1 INJECTION EQUIPMENT SETUP

A. Payment for furnishing, installing, and removing the injection pump, pipe, appurtenances, and preliminary testing shall be at the lump sum price as stated in the Proposal for injection test setup.

4.2 HOURLY OPERATION

A. The cost of hourly operation of the injection test equipment shall be included in the unit price as stated in the Proposal for injection testing.

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SECTION 02987
RADIOACTIVE TRACER SURVEY

PART 1 GENERAL

1.1 WORK INCLUDED

A. This section covers the work necessary to perform the mechanical integrity radioactive tracer survey (RTS) on the deep injection wells.

B. This section specifies the background geophysical logs to be performed prior to RTS, the type of geophysical tool necessary to perform RTS, and the procedure for performing the RTS.

PART 2 PRODUCTS

2.1 GEOPHYSICAL LOGGING EQUIPMENT

A. The RTS tool shall have a casing collar locator (CCL) device integral to the tool.

B. The RTS logging tool shall be assembled with three gamma detectors positioned one above and two below the ejector port.

C. The geophysical recording equipment shall be capable of time driven recording with multiple settings for time interval adjustment.

2.2 TRACE FLUID

A. The radioactive isotope used to trace the fluid will be Iodine 131.

B. Contractor shall be currently licensed to handle radioactive material and shall conform to all applicable restrictions and regulations governing the use of such materials.

C. All materials that the radioactive fluid comes in contact with shall be containerized and removed from the site by the geophysical service company.

2.3 PUMPING EQUIPMENT

A. Furnish pumping equipment capable of injecting water at approximately 20 to 30 gallons per minute (gpm).

B. Furnish appropriate calibrated flow measuring devices capable of accurately measuring the flow at each injection rate.

C. The Contractor's pumping equipment and flow measuring devices shall be approved by the Engineer prior to their use. Flow measuring devices shall be calibrated and certified prior to and after testing. Calibration information shall be furnished to the Engineer prior to testing.

D. Furnish all valving and appurtenances necessary to adjust and control the injection rate into the injection well while testing.

E. Furnish a standpipe and pack off sufficient to install the geophysical logging tools and to seal and control leakage from the wellhead. The Contractor's wellhead setup shall be reviewed by the Engineer prior to its use.

PART 3 EXECUTION

3.1 TESTING

A. Perform CCL and gamma ray background logs of the casing prior to installing radioactive tracer into the borehole.

B. Prior to proceeding with ejector testing, displace the borehole with at least three well volumes of potable and perform a background Geiger counter survey of the site. Potable water will be supplied by the County from plant construction source. Contractor shall be responsible for temporary piping for hook up. Submit certified letter to the Engineer summarizing the results of the Geiger counter survey.

C. Proceed with installing RTS tool into the borehole and position the tool so that the ejector port is 3 feet above the bottom of the casing. The upper gamma detector should be a minimum of 10 feet above the casing bottom and the two lower detectors should be below the casing bottom. Two ejections will be made at the 20 to 30 gpm injection rates. Allow approximately 1 hour for tracking of each ejection. The gamma traces and procedures must be accepted by the Engineer. Log the borehole between each ejection to locate the position of the tracer slug.

D. Position the tool so that the ejector port is 3 feet below the bottom of the casing. Perform two static ejections and allow each to remain undisturbed for 1 hour prior to logging through each to locate the position of the tracer slug.

E. After removing RTS equipment from the well, the borehole shall be flushed as recommended by the logging subcontractor.

F. A final sweep of the site with a Geiger counter will be performed by the Contractor to demonstrate no increased radioactivity over pretest background measurements. Submit certified letter to Engineer summarizing the results of the final Geiger counter survey.

PART 4 PAYMENT

4.1 GENERAL

A. Payment for performing the radioactive tracer test complete with all pumping and miscellaneous equipment shall be included in the lump sum price stated in the Proposal for the radioactive tracer survey.

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SECTION 02989
WELLHEAD CAPPING AND VALVES

PART 1 GENERAL

1.1 WORK INCLUDED

A. This section covers the work necessary for furnishing and installing the well heads and various manually operated valves and check valves in the well heads, complete.

1.2 GENERAL

A. Like items of equipment specified herein shall be the end products of one manufacturer in order to achieve standardization for operation, maintenance, spare parts, and manufacturer's service.

1.3 SUBMITTALS DURING CONSTRUCTION

A. Submittals during construction shall be made in accordance with Division 1, GENERAL REQUIREMENTS.

PART 2 PRODUCTS

2.1 GENERAL

A. Provide all materials and equipment necessary for capping the wells as specified and shown on the Drawings.

B. All valves shall be complete with all necessary operating handwheels, extension stems, worm and gear operators, operating nuts, chains, and wrenches which are required for the proper completion of the work included under this section.

C. Renewable parts including discs, packing, and seats shall be of types recommended by valve manufacturer for intended service.

D. All units shall have the name of the manufacturer and the size of the valve cast on the body or bonnet or shown on a permanently attached plate in raised letters.

E. For the purpose of designating the type and grade of valve desired, a manufacturer's name and list or figure number is given in the following specifications. Valves of equal quality by other manufacturers will be considered in accordance with the General Conditions.

2.2 DESIGN FEATURES

A. Brass and Bronze Components:

1. Brass and bronze components of valves and appurtenances which have surfaces in contact with the water shall be alloys containing less than 16 percent zinc and 2 percent aluminum.
2. Approved alloys are of the following ASTM designations:
   a. B61, B62, B98 (Alloy A, B, or D), B139 (Alloy A), B143 (Alloy 1-B), B164, B194, B292 (Alloy A), and B127.
   b. Stainless steel Alloy 18-8 may be substituted for bronze at the option of the manufacturer and with the approval of the Engineer.
3. All gland bolts on iron body valves shall be bronze and shall be fitted with brass nuts.

2.3 VALVE OPERATORS

A. All valve operators shall open by turning counterclockwise. Handwheel operators shall be provided unless otherwise shown or specified. Worm and gear operators used on manually operated valves shall be of totally enclosed design, so proportioned as to permit operation of the valve under full operating head with a maximum pull of 40 pounds on the handwheel or crank. The valve operators shall be of the self-locking type to prevent the disc or plug from creeping. Self-locking worm gears shall be a one-piece design of gear bronze material, accurately machine cut. The worm shall be hardened alloy steel, with thread ground and polished. The reduction gearing shall run in a proper lubricant. Valve operators shall be provided with position indicators, where specified, to show the position of the valve disc or plug. Handwheels shall be galvanized and painted the same color as the valve and associated pipeline.

2.4 VALVES

A. See hereinbefore Paragraph DESIGN FEATURES for additional material requirements.

2.5 TAGGING REQUIREMENTS

A. Each valve operator shall be provided with a 1-1/2-inch minimum diameter heavy brass tag. Each tag shall bear the valve number shown on the Drawings.

B. The tags shall be attached to the operator with soldered split key rings so that ring and tag cannot be removed. The numbers and letters shall be of block type, with 1/4-inch high numbers and letters stamped thereon and filled with black enamel.

2.6 GATE VALVES

A. V120: Gate valves 2-1/2 inches and larger for water service shall be iron body, bronze mounted valves with flanged ends, solid wedge gate, and outside screw and yoke. Valves shall be rated 125-pound SWP, 200-pound WOG, and shall be Walworth Figure 726F; Crane Figure No. 465-1/2; or equal.

2.7 GLOBE VALVES

A. V200: Globe valves 2 inches and smaller shall be all-bronze with screwed ends, union bonnet, inside screw, rising stem, and plug type disc with replaceable stainless steel plug and seat. Valves shall be rated 150-pound SWP, 300-pound WOG, and shall be Walworth Company Figure 237P; Jenkins Figure 546-P; or equal.

B. V235: Angle type valves 2 inches and smaller shall have brass or bronze body, with rising stem and stainless steel disc, rated 150-pound WOG minimum. Valves shall have iron pipe thread to thread adapter on the outlet end; 2-inch size shall have National Standard Thread, 9 threads per inch. Valves shall be Jenkins Figure 548-P; Crane Figure 16-1/2P; or equal.

2.8 BALL VALVES

A. A line size ball valve and union shall be installed upstream of each solenoid valve, in-line flow switch, or other in-line electrical device, excluding magnetic flowmeters, for isolation during maintenance.

1. Type 300: Ball valves 2 inches and smaller, for general water and air service, shall be all-bronze, top entry type, with screwed ends, full bore ports, Teflon seats, and hand lever operators, rated 250-pound WOG minimum 125 psi SWP. Valves shall be Crane Co. Accesso, Cat. No. 2330-TF; Lunkenheimer Figure No. 700-SB; or equal.
2. Type 307: Ball valves 2 inches and smaller shall have Type 316 stainless steel bodies with Type 316 stainless steel balls. Valves shall be of the top entry type with screwed ends, rated 300-pound WOG. Seat, body seal, and stem packing shall be reinforced TFE; valves shall have lever operators. Valves shall be Hills-McCanna Figure 5302-S6-R, Contromatics Figure C-1611-CC, or equal.
3. Type 462: Gauge cocks shall be 1/4-inch bronze body valves, hexagon end pattern with tee head and male and female ends, rated for 125-pound SWP. Cocks shall be Lunkenheimer Figure 1180; Crane No. 744; or equal.

2.9 BUTTERFLY VALVES

A. All butterfly valves, except as herein noted, shall conform to AWWA C504, latest revision. All valve shafts shall be connected to operators by the use of keys and keyways. The use of compression or friction connections is not acceptable.

B. The seat on disc seated valves shall be continuous around the periphery of the disc and shall not be penetrated by the valve shaft.

1. Type 510: Standard service butterfly valves 18 inches and larger shall be flanged end, short body type, AWWA Class 75B minimum, with enclosed worm-gear manual handwheel operators. Valves shall have ASTM A126, Class B cast iron valve body with 125-pound full-faced flanges, drilled in accordance with ANSI B16.1. Valve disc shall be contoured ASTM A126, Class B cast iron. Valve shaft shall be Type 304 stainless steel with self-lubricating, corrosion-resistant sleeve type bearings. Stub shafts shall be considered standard on valves 36 inches and larger. Thrust assemblies shall be adjustable for sizes 30-inch and larger. Valve seats shall be attached to the valve body and shall be of neoprene. Where indicated on the Drawings, provide operator extension bonnets. Valves shall be Henry Pratt Company Triton XR-70, Allis Chalmers Streamseal Type 75FR, BIF Sure-Seal Model 0668, American-Darling 75B, or equal, with Limitorque Model HBC or EIM Company Type MG geared operators, or equal.

2.10 CHECK VALVES

A. Each discharge line from the monitoring well to the sump shall be equipped with a swing check valve installed.

B. Check valves 2 inches and smaller shall be all-bronze, with screwed ends and cap, regrinding seat, Y-pattern body, and swing type disc. Valves shall be rated for 125-pound SWP, 200-pound WOG, and shall be Walworth Company Figure 406; Crane Cat. No. 37; or equal.

C. Check Valves 2-1/2 inches and larger shall be flanged end, cast iron body, bronze mounted swing type, with solid bronze hinges and stainless steel hinge shaft. Valves shall be rated 200-pound WOG, and shall be List 37, clearway check valves as manufactured by Ludlow-Rensselaer Valve Division of Patterson Industries, East Liverpool, OH; Crane Co. Cat. No. 373; or equal.

1. Type 815: Surge control check valves shall be flanged end, all-iron, swing type with Type 316 stainless steel seat and other wetted parts, Buna-N seat ring, outside lever and weight, and oil dashpot to cushion last 10 percent of closing stroke. Valves shall be 125-pound ANSI flanged, rated 150-pound WOG, Valve and Primer Corporation, Apco Series 6000; Golden-Anderson Valve Specialty Company Figure No. 25-D; or equal. Wetted surfaces of valves shall be near-white blast-cleaned (SSPC SP-10), primed with one 2-mil coat of epoxy primer, and coated with two 4-mil coats of high solids epoxy, total MDFT 10 miles.

2. Type 870: Ball check valves 3 inches and larger shall be iron body with a floating type hollow steel ball with vulcanized nitrile rubber exterior. Flanges shall be ANSI B16.1, Class 125 flat faced. Valve shall be rated 150-pound WOG, suitable for vertical up or horizontal flow.

2.11 AIR AND VACUUM RELEASE VALVE

A. Type 925:

1. Combination air and vacuum valve shall have a cast iron body, cover, and baffle (ASTM A480), stainless steel float and Buna-N seat.
2. The valve shall consist of a body, cover, baffle, float and seat. The baffle will be designed to protect the float from direct contact of the rushing air and water to prevent the float from closing prematurely in the valve. The seat shall be fastened into the valve cover, without distortion, and shall be easily removed, if necessary.
3. The entire float and baffle assembly must be shrouded with a perforated water diffuser to prevent the water column entering the valve, from slamming the float shut and eliminate water hammer in the system.
4. The discharge orifice shall be fitted with an adjustable throttling device to regulate the flow of air escaping to establish a pressure loading on the rising column of water to minimize shock to the pump and check valve.
5. The float shall be stainless steel, designed to withstand a minimum of 1,000 psi. The float shall be center guided and not free-floating for positive seating. The valve shall be properly adjusted for working conditions after installation.
6. The valve shall be a Model 1604/153 with optional air release as manufactured by Valve and Primer Corp., Schaumburg, IL.

PART 3 EXECUTION

3.1 GENERAL

A. Bolt holes of flanged valves shall straddle the vertical centerline of the pipe run. Prior to installing flanged valves, the flange faces shall be thoroughly cleaned. After cleaning, insert gasket and bolts, and tighten the nuts progressively and uniformly. If flanges leak under pressure, loosen or remove the nuts and bolts, reseat or replace the gasket, retighten and/or reinstall the nuts and bolts, and retest the joints. Joints shall be watertight at test pressures before acceptance.

B. Thoroughly clean threads of screwed joints by wire brushing, swabbing, or other approved methods. Apply approved joint compound to threads prior to making joints. Joints shall be watertight at test pressures before acceptance.

3.2 PLACING

A. Generally, unless otherwise indicated on the Drawings, all valves installed in horizontal runs of pipe having centerline elevations 4 feet 6 inches or less above the finish floor or grade shall be installed with their operating stems vertical. Valves installed in horizontal runs of pipe having centerline elevations between 4 feet 6 inches and 6 feet 9 inches above the finish floor or grade shall be installed with their operating stems horizontal. If adjacent piping prohibits this, the stems and operating handwheel shall be installed above the valve horizontal centerline as close to horizontal as possible. Valves installed in vertical runs of pipe shall have their operating stems oriented to facilitate the most practicable operation.

3.3 TESTING

A. Valves shall be tested at the same time that the adjacent pipeline is tested per testing requirements in Section PLANT PIPING - GENERAL. Joints shall show no visible leakage under test. Repair joints that show signs of leakage prior to final acceptance. If there are any special parts of control systems or operators that might be damaged by the pipeline test, they shall be properly protected. The Contractor will be held responsible for any damage caused by the testing.

B. If requested by the Engineer, the valve manufacturer shall furnish an affidavit stating the materials options furnished and/or that he has complied with these and other referenced Specifications.

3.4 CAPPING

A. Top of casings and capping shall be prepared for painting by cleaning thoroughly. Carbon steel fittings shall be sandblasted or power scraped to bare metal. Cement encasement and capping shall be painted in accordance with Section PAINTING, System No. 4A.

PART 4 PAYMENT

4.1 GENERAL

A. Payment for the work in this section will be included as part of the lump sum price stated in the Proposal for wellhead capping and valves.

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SECTION 02990
INFLATABLE PACKER TESTING

PART 1 GENERAL

1.1 WORK INCLUDED

A. This section covers the work, materials, and equipment necessary for performing the packer tests.

PART 2 PRODUCTS

2.1 PACKER

A. Furnish and install a dual-seal, open-hole straddle packer, as manufactured by LYNES, TAM J, or equal, of a diameter appropriate for the size of hole drilled.

B. Packer shall be run on drill pipe or tubing having a minimum inside diameter of 6 inches from the surface to a depth of 140 feet.

C. Furnish drill pipe or tubing and all required fittings for running and setting the packer to the maximum depth of the well and for packer element separations of from 10 to 30 feet in 2-foot increments, and as specified by manufacturer.

2.2 SUBMERSIBLE PUMP AND FITTINGS

A. Provide two 4-inch submersible pumps and piping capable of being set a minimum of 120 feet below the water level inside the drill pipe. Pumps shall have a capacity of not less than 60 gpm at a total head of 140 feet, and not more than 5 gpm at a total head of 140 feet.

B. Provide pump discharge with 2-inch throttling valve to regulate flow from 5 to 60 gpm, and a volumetric turbine meter.

C. Provide piping of appropriate size and length to conduct discharged fluid to a mobile tanker trunk with capacity not less than 5,000 gallons. Discharge fluid to be disposed of at the FPUA Wastewater Treatment Plant Wet Well. Contractor to supply pump, piping, and any additional materials required to dispose of water from tanker to wet well.

PART 3 EXECUTION

3.1 GENERAL

A. Run packer pump-out tests in the intervals selected by the Engineer as follows: Set packer assembly to the deepest interval selected for testing and open ports between packer at the test interval determined by the Engineer. Install submersible pump selected by the Engineer to a depth of 120 feet below the water level inside the tubing or drill pipe. Install water level measuring device provided by the Engineer to a depth of 100 feet below the water level inside the tubing or drill pipe. Perform a specific capacity step drawdown pumping test as directed by the Engineer. An estimated four intervals shall be packer tested.

B. Engineer may change pumps if the first pump selected does not match the producing capability of the formation being tested. Changing pumps shall be included in the cost of each packer test.

C. Prior to commencing each packer test the Contractor shall in the presence of the Engineer run a preliminary test to confirm that the packer has seeded and that all equipment is functioning properly. Preliminary testing shall be run for 1 hour or until the Engineer is satisfied that equipment is functioning properly.

D. If, in the opinion of the Engineer, there is evidence of a leak in or around a packer element or a malfunction in any way, Contractor shall release and reset the packers at a depth selected by the Engineer. Up to four resets shall be included in the cost of each packer test.

E. A packer test shall consist of a pumping test lasting approximately 25 hours in duration or as directed by the Engineer. Up to 30 hours of pumping shall be included in each test. Stop pump and allow for recovery for up to 12 hours. Remove pump and water level measuring device, deflate packers and reset at next upper interval and repeat packer testing as per above.

PART 4 PAYMENT

4.1 GENERAL

A. Payment for furnishing, installing, performing preliminary tests, operating, and removing packer, submersible pump, fittings, and disposing of discharge fluid will be at the lump sum price as stated in the Proposal for straddle packer testing. Payment shall constitute full compensation for all time, materials, and equipment required to obtain, assemble, and disassemble the equipment. In the event of packer failure and/or unsatisfactory performance of the equipment, the test shall be rerun with no payment made for the failed test.

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SECTION 03301
REINFORCED CONCRETE

PART 1 GENERAL

1.1 WORK INCLUDED

A. This section covers the work necessary for the reinforced concrete, complete.

B. The Drilling Pad Design shown on the Drawings is based upon assumed drilling equipment loads. Dimensions and details shown are minimum requirements, "FINAL DESIGN OF THE DRILLING PADS, I.E., THICKENED AREAS, DIMENSIONS AND SIZE AND LAYOUT OF REINFORCING STEEL, SHALL BE PROVIDED BY THE CONTRACTOR." The Contractor's design, prepared and sealed by a professional engineer registered in Florida, shall be submitted to the Engineer for review.

C. The Contractor is responsible for the structural integrity of the pad and will warrant the drilling pad against structural failures and cracking for the period of construction and one year upon completion of construction.

D. Any structural failure or cracking during the warranty period shall be corrected by the Contractor at his sole expense.

PART 2 PRODUCTS

2.1 CONCRETE

A. Concrete shall be ready-mixed conforming to ASTM C94, Alternate 3, and these Specifications. Portland cement shall be Type I or Type II. The use of nonagitating equipment will not be allowed.

B. Concrete shall be agitated by at least 70 revolutions of the mixing drum but not by more than 270 revolutions. Concrete shall be placed within 1-1/2 hours after the cement has been added to the mix. A delivery ticket shall be furnished to the Engineer with the following information:

1. Name of concrete firm.
2. Serial number of ticket.
3. Date.
4. Truck number.
5. Specific class of concrete.
6. Amount of concrete.
7. Time loaded.
8. Water added.
9. Time unloaded.

C. Minimum allowable 28-day compressive field strength shall be 4,000 psi when cured and tested in conformance with ASTM C31 and C39. Size of coarse aggregate shall be 1 inch. Approval of other aggregate gradations must be received in writing before use on the project.

D. Slump range shall be 2 to 4 inches and the air entrainment between 3 percent and 6 percent by volume. The minimum cement content shall be 540 pounds per cubic yard and the maximum water to cement ratio shall be 0.49. Submit complete data on the concrete mix for approval in conformance with the requirements of ASTM C94, Alternate 3. The Owner reserves the right to have test cylinders taken and tested by an approved testing laboratory to verify the strength of the concrete. Acceptance and evaluation of the concrete strengths shall be by the Owner in accordance with ACI 318, current edition.

E. No concrete additives shall contain chlorides. Submit appropriate manufacturer certification.

2.2 REINFORCING STEEL

A. Deformed bars of sizes shown conforming to ASTM A615, Grade 60.

B. Provide concrete blocks of same strength as the concrete mix to support reinforcing bars. Do not use broken concrete brick or stone. Conform to requirements of "Placing Reinforcing Bars" published by CRSI.

2.3 EXPANSION JOINT FILLER

A. ASTM D994, 1/2-inch thick, or as shown.

2.4 NONSHRINK GROUT

A. Upcon High Flow, the UPCO Company, Cleveland, OH; Masterflow 713, The Master Builder Company, Cleveland, OH; Crystex, L&M Construction Chemicals, Inc., Omaha, NE.

2.5 FORMS

A. New plywood for exposed areas, new shiplap or plywood for unexposed areas. Materials shall produce tight forms and an acceptable finish.

2.6 FORM TIES

A. Form ties on exposed surfaces shall be located in a uniform pattern or as indicated on the Drawings. Form ties shall be constructed so that the tie remains embedded in the wall, except for a removable portion at each end. Form ties shall have conical or spherical type inserts, inserts shall be fixed so that they remain in contact with forming material, and shall be constructed so that no metal is within 1 inch of the concrete surface when the forms, inserts, and tie ends are removed. Wire ties will not be permitted. Ties shall withstand all pressures and limit deflection of forms to acceptable limits.

B. Flat bar ties for panel forms shall have plastic or rubber inserts having a minimum depth of 1 inch and sufficient dimensions to permit proper patching of the tie hole.

2.7 WATER STOPS

A. Water Stop for Construction Joints: 16-gauge, hot-dip galvanized sheet metal, 6 inches wide, unless otherwise noted on the Drawings. Provide galvanized self-tapping sheet metal screws for securing 12-inch laps.

2.8 WATER STOP SEALANT

A. One-Part Polyurethane, Immersible: Polyurethane base, single-component, Chemical Curing; conforming to Federal Specification TT-S-00230, Self-Leveling Type I, Nonsag Type II; capable of being continuously immersed in water, withstand movement of up to 25 percent of joint width; Shore "A" hardness of minimum 15 and maximum 50; nonstaining, nonbleeding. Use Sikaflex-LA No. 430 manufactured by Sika Chemical Corp.; Vulkem 116 manufactured by Mameco International; or equal.

2.9 CURING COMPOUND

A. Use water curing as hereinafter specified on slabs. Vertical formed surfaces shall be cured using one of the following:

1. Masterseal, manufactured by Master Builders Co., Cleveland, OH.
2. Euco Floor Coat, manufactured by Euclid Chemical Co., Cleveland, OH.

B. When curing compound is used, conform to the requirements of ASTM C309, with the additional requirement that permeability not exceed 0.039 gm/square cm/72 hours.

C. Submit manufacturer's certification stating quantity or coverage required to meet or exceed tests and method of application. The Contractor shall submit manufacturer's certification that the product meets ASTM C309 and the additional permeability requirement, and shall specifically state coverage required to meet these requirements.

2.10 CLEANUP

A. Prior to the placing of the sand and concrete slab, cleanup all waste materials and debris resulting from this operation and dispose of such waste materials offsite.

2.11 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the jobsite in original packages with manufacturer's labels thereon.

PART 3 EXECUTION

3.1 FORMS

A. Construct forms accurately to dimensions and elevations required and to be strong and unyielding. Construct forms with tight joints to prevent the escape of mortar and to avoid the formation of fins. Brace as required to prevent distortion during concrete placement.

3.2 PLACING REINFORCING STEEL

A. Place reinforcing steel in conformance with the information on the Drawings and CRSI Recommended Practice for Placing Reinforcing Bars, except as modified herein. Minimum length of splices shall be as herein specified. Top bars shall be defined as any horizontal bar placed such that 12 inches of fresh concrete is cast below in any single pour. Horizontal wall bars are considered top bars. All top bars shall have 42 diameter-lap with minimum of 24 inches. All other bars shall have 30 diameter-lap with minimum of 18 inches. Tie splices with 18-gauge annealed wire as specified in the referenced CRSI Standard.

3.3 PLACING CONCRETE

A. Prior to placing concrete, remove water from excavation and all debris and foreign material from forms. Check the reinforcing steel for proper placement and correct any discrepancies.

B. Before depositing new concrete on old concrete, clean surface using a sandblast or bushhammer or other mechanical means to obtain a 1/4-inch rough profile, and pour a cement sand grout to a minimum depth of 1 inch over the surface. Proportions of cement and sand shall be as in the concrete mix.

C. Place concrete as soon as possible after leaving mixer, without segregation or loss of ingredients, without splashing forms or steel above, and in layers not over 2 feet deep. The vertical drop to final placement shall not exceed 6 feet. Placement shall conform to the requirements of ACI 318, except as modified herein.

D. Do not place concrete when the ambient temperature is below 40 degrees F or approaching the 40 degrees F and falling, without special protection as approved by the Engineer. Any concrete damaged by freezing shall be removed and replaced at no additional cost to the Owner.

3.4 COMPACTION

A. Apply approved vibrator at points spaced not farther apart than vibrator's effective radius. Apply close enough to forms to vibrate surface effectively but not damage form surfaces. Vibrate until concrete becomes uniformly plastic. Vibrator must penetrate the fresh place concrete and into the previous layer of fresh concrete layer below.

3.5 CONSTRUCTION JOINTS

A. Locate as shown or as approved, except that maximum spacing between construction joints shall be 40 feet.

3.6 FINISHING

A. Screed surfaces of floor slabs and tops of exposed walls to true level planes. After the initial water has been absorbed, float with wood float and trowel with steel trowel to a smooth finish free from trowel marks.

B. Do not absorb wet spots with neat cement. Concrete floors shall not vary from level or true plane more than 1/4-inch in 10 feet when measured with a straightedge. Surfaces of concrete slabs which will not be exposed to view in the finished work shall be screeded to a true surface and bull floated with a wood float, and wood trowel to seal surface.

C. All exposed edges shall be finished with a steel edging tool, or shall be formed using a 3/4 inch, 45-degree chamfer.

3.7 EXTERIOR SLABS AND SIDEWALKS

A. Slabs shall be bull floated with a wood float, wood troweled, and lightly troweled with a steel trowel, and finished with a broom to obtain a nonskid surface.

3.8 REMOVAL OF FORMS

A. Remove after concrete has set sufficiently to carry the dead load and construction load it has to sustain and when approved by the Engineer. Remove forms with care to prevent scarring and damaging the surface.

3.9 FINISHING FORMED SURFACES

A. Areas Not Subject to Water: Cut out all honeycombed and defective areas. Cut edges perpendicular to surface at least one inch deep, no feather edge allowed, and patch. Using bonding agent fill holes flush with cement mortar composed of 1 part cement and 2 parts sand. Rub surface with wood float and burlap. Keep patches damp for a minimum of 7 days or spray with curing compound to minimize shrinking. Fill all form tie holes in same manner.

B. Areas Subject to Water:

1. Cut out all honeycombed and defective areas, cut edges perpendicular to surface at least 1-inch deep, no featheredge allowed, soak area to be patched for 24 hours, then allow surface to drain free of standing water, then patch with color matched nonshrink grout.
2. The grout used shall be cured as recommended by grout manufacturer.
3. As soon as forms are removed, remove fins or projections from surface of exposed areas and rub surfaces with wood float or burlap sack to provide a uniform surface texture.

3.10 PROTECTION AND CURING

A. Protect fresh concrete from direct rays of the sun, drying winds, and wash by rain. Keep concrete slabs continuously wet for a 7-day period. Intermittent wetting is not acceptable. Cure formed surfaces with an approved curing compound applied in conformance with the manufacturer's directions as soon as the forms are removed and finishing completed.

PART 4 PAYMENT

4.1 GENERAL

A. Payment for the work in this section will be included as part of the lump sum bid price stated in the Proposal for construction of the concrete drilling pads and surge control system.

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SECTION 09900
PAINTING

PART 1 GENERAL

1.1 WORK INCLUDED

A. This section covers surface preparation, furnishing, and application of protective coatings, complete.

B. It is the intent that existing surfaces, as enumerated herein, and all new exposed FRP/PVC, metal and submerged metal surfaces be painted, whether specifically mentioned or not, except as modified herein.

1.2 GENERAL

A. See CONDITIONS OF THE CONTRACT and Division 1, GENERAL REQUIREMENTS, which contain information and requirements that apply to the work specified herein and are mandatory for this project.

1.3 ABBREVIATIONS

ANSI	American National Standards Institute
AWWA	American Water Works Association
FRP	Fiberglass Reinforced Plastic
HC1	Hydrochloric Acid
MDFT	Minimum Dry Film Thickness
MDFTPC	Minimum Dry Film Thickness Per Coat
mil	Thousandths of an Inch
MIL-P	Military Specification - Paint
OSHA	Occupational Safety and Health Act
PSDS	Paint System Data Sheet
SFPG	Square Feet Per Gallon
SFPGPC	Square Feet Per Gallon Per Coat
SP	Surface Preparation
SSPC	Steel Structures Painting Council

1.4 SURFACES NOT REQUIRING PAINTING

A. Unless otherwise specifically indicated in the Specifications or on the Drawings, the following areas or items will not require painting:

1. Nonferrous and corrosion-resistant ferrous alloys such as copper, bronze, monel, aluminum, chromium plate, and stainless steel, except where:
   a. Required for electrical insulation between dissimilar metals.
   b. Aluminum and stainless steel is embedded in concrete or masonry, or aluminum is in contact with concrete or masonry.
   c. Color coding of equipment and piping is required.

2. Prefinished electrical items such as motor control centers, switchboards, switchgear, panelboards, transformers, disconnect switches, etc.
3. Nonsubmerged aluminum electrical conduits attached to unpainted concrete surfaces need not be painted.
4. Items specified to be galvanized after fabrication unless specifically required elsewhere in these Specifications; specifications for repair of damaged galvanized surfaces are contained hereinafter.
5. Insulated piping and/or insulated piping with jacket.

1.5 QUALITY ASSURANCE

A. Inspection:

1. The Contractor shall give the Engineer a minimum of 3 days advance notice of the start of any surface preparation work or coating application work. All such work shall be performed only in the presence of the Engineer, unless the Engineer has granted prior approval to perform such work in his absence.
2. For all coatings subject to immersion, full cure must be obtained for the completed system. Consult the coatings manufacturer's written instructions for these requirements. The coating shall not be immersed for any purpose until completion of the curing cycle.
3. Inspection by the Engineer, or the waiver of inspection of any particular portion of the work, shall not be construed to relieve the Contractor of his responsibility to perform the work in accordance with these Specifications.

1.6 PAINT DELIVERY AND STORAGE

A. All materials shall be new and shall be delivered to the project site in unopened containers that plainly show, at the time of use, the designated name, date of manufacture, color, and name of manufacturer. Paints shall be stored in a suitable protected area that is heated or cooled as required to maintain temperatures within the range recommended by the paint manufacturer.

1.7 WARRANTY

A. The Contractor shall warrant to the Owner and guarantee the work under this section against defective workmanship and materials for a period of 2 years commencing on the date of final acceptance of the work.

1.8 SUBMITTALS

A. Submittals shall be made as specified in Division 1, GENERAL REQUIREMENTS. In addition, the following specific information shall be provided:

1. Data Sheets: For each paint system used herein, the Contractor shall obtain from each paint manufacturer for submittal to the Engineer, a Paint System Data Sheet (PSDS), Technical Data Sheets, and paint colors for each product used in the paint system. The required information shall be submitted on a system-by-system basis. A sample PSDS form is appended at the end of this section.
2. Samples:
   a. The Contractor shall, prior to the start of surface preparation, furnish the Engineer with a 4-inch by 4-inch steel panel for each grade of sandblast specified herein, prepared by the Contractor to the specified requirements. The panel shall be representative of the steel used and shall be prevented from deterioration of the surface quality. Upon review by the Engineer, the panel shall be preserved as a reference source for inspection.
   b. Unless otherwise specified hereinafter and before any painting work is started, prepare with type of paint and application specified, and on similar substrate to which paint is to be finally applied, samples not less than 8-inch by 10-inch in size.
   c. Furnish additional samples as required until colors, finishes, and textures are approved. Retain approved samples to be used as the quality standard for final finishes.

1.9 RELATED PAINTING WORK PERFORMED UNDER OTHER SECTIONS, BUT SYSTEMS DESCRIBED IN THIS SECTION

Section	Item
WELLHEAD CAPPING AND VALVES	Piping and Related Components
HORIZONTAL END SUCTION CENTRIFUGAL PUMPS - GENERAL	Pumps, Motors, and Related Components
PLANT PIPING - GENERAL	Piping and Related Components
SURGE CONTROL SYSTEM	Surge Tank and Air Compressor

PART 2 PRODUCTS

2.1 PAINT AND COATINGS SUPPLIERS

A. The letter code will be found following the generic descriptions of materials outlined in the Specifications. Alternate suppliers will be considered, subject to the review of the Engineer. Address given is that of the general offices; contact these offices for information regarding the location of their representative nearest the project site.

2.2 SUPPLIER CODE A - COATINGS SUPPLIERS (Able to supply most heavy-duty industrial coatings and architectural paints):

A. Koppers Company, Inc., Pittsburgh, PA.

B. Porter Coatings, Louisville, KY.

C. Rustoleum Corporation, Evanston, IL.

D. Tnemec Coatings, Kansas City, MO.

2.3 PAINT MATERIALS

A. The following paint products are listed according to their approximate order of appearance in the paint systems. Deviations from the specified paint systems must be reviewed by the Engineer prior to use. The letter designating the supplier code references the listing of paint suppliers able to furnish these specific materials. Alternate systems will be considered subject to the review of the Engineer.

Product	Definition
Polyamide, Anti-Corrosive, Epoxy Primer	Converted epoxy primer containing rust-inhibitive pigments; 46% minimum volume solids SUPPLIER CODE: A
Coal-Tar Epoxy	Amine or polyamide type, 68% volume solids minimum, suitable for immersion service SUPPLIER CODE: A
Organic Zinc Rich Primer	Converted epoxy, epoxy/phenolic or urethane type, minimum 10 lbs. metallic zinc content per gallon SUPPLIER CODE: A
Wash Primer	Vinyl butyral acid SUPPLIER CODE: A
Polyurethane Enamel	Two-component, aliphatic or acrylic based polyurethane; 45% minimum volume solids; high gloss finish SUPPLIER CODE: A
Bituminous Paint	Single-component, coal-tar pitch based; 68% minimum solids by volume SUPPLIER CODE: A

Product	Definition
Polyamide High Build Epoxy	Capability of 4 to 8 MDFT per coat; gloss finish SUPPLIER CODE: A
Alkyd-Phenolic Primer	Single-component, 43% minimum solids by volume, specifically designed as a barrier coat between conventional finishes and specialized coating systems SUPPLIER CODE: A

2.4 COLORS

A. Colors, except where otherwise noted, shall be selected by the Owner as reviewed by the Engineer.

B. Colors shall be formulated with colorants free of lead, lead compounds, or other materials which might be affected by the presence of hydrogen sulfide or other gas likely to be present at the project.

1. Equipment Colors: Equipment shall be meant to include the machinery or vessel itself plus the structural supports and fasteners and attached electrical conduits.

Equipment	Tag No.	Color
Dangerous parts of equipment and machinery	N/A	OSHA Orange
Fire protection equipment and apparatus	N/A	OSHA Red
Physical hazards in normal operating area	N/A	OSHA Yellow

2. Pipe Identification Colors:
   a. All nonsubmerged metal piping except electrical conduit shall be color coded. Fittings, valves, and pipe supports shall be painted with the same background color as the pipe.
   b. Steel pipe supports (not stainless steel) for stainless steel piping shall be painted to match the wall or equipment color to which they are attached.
   c. Pipe identification colors shall be as indicated on Piping Schedule on Mechanical Drawings.

3. Labels for Piping: Separate flow directional arrows shall be installed with each label. Labels shall include black lettering on orange self-adhesive vinyl or vinyl cloth. The label and adhesive shall be long lasting, resistant to moisture, oils, solvents, and weathering, and shall conform to OSHA requirements. Labels shall be located at all connections to equipment, valves, or branching fittings, at wall boundaries, and at intervals along the piping not greater than 18 feet on center, with at least one label applied to each exposed run of pipe. Labels and directional arrows shall be as manufactured by W. H. Brady Co., Milwaukee, WI; Seton Nameplate Corp., New Haven, CT; or equal.

Pipe System	Pipe Colors[1]	Arrows & Letters	Abbreviation
Air-High Pressure	Silver Fox, BC72	Black	AHP
Effluent-Deep Well Feed (high pressure)	Lakeland, BA72	White	SE
Sample Lines	Cantebury, AF62	White	SA

[1]Tnemec's colors from Master Color Charts. Equivalent colors by other acceptable manufacturers shall be used.

NOTE: Other pipes and systems which are not listed may need to be color coded. Colors will be selected by the Engineer during the shop drawings phase.

PART 3 EXECUTION

3.1 GENERAL

A. All materials of a paint system, including primer and finish coats, shall be produced by the same paint manufacturer. Thinners, cleaners, driers, and other additives shall be as recommended by the paint manufacturer of the particular coating.

3.2 INTENT

A. It is the intent of these Specifications that Contractor and their subcontractors employed on the jobsite will leave the surfaces of their work in such a condition that only minor cleaning, sanding, and filling is required prior to surface preparation and painting. It is the responsibility of the Contractor to inspect and provide substrate surfaces that are prepared in accordance with these Specifications and the printed directions and recommendations of the paint manufacturer whose product is to be applied.

3.3 PROTECTION OF MATERIALS NOT TO BE PAINTED

A. Remove, mask, or otherwise protect hardware, lighting fixtures, switchplates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not intended to be painted. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting process. Openings in motors shall be masked to prevent paint and other materials from entering the motors.

3.4 ENVIRONMENTAL CONDITIONS

A. Paint shall not be applied in temperatures exceeding the manufacturer's recommended maximum and minimum allowable, nor in dust, smoke-laden atmosphere, damp or humid weather.

B. Abrasive blast cleaning shall not be performed whenever the relative humidity exceeds 85 percent, nor whenever the surface temperature is less than 5 degrees F above the dew point of the ambient air.

3.5 SAFETY

A. Painting shall be performed in strict accordance with the safety recommendations of the paint manufacturer; with the safety recommendations of the National Association of Corrosion Engineers contained in the publication, Manual for Painter Safety; federal, state, and local agencies having jurisdiction.

3.6 PAINT MIXING

A. Multiple-component coatings shall be prepared using all of the contents of the container for each component as packaged by the paint manufacturer. No partial batches will be permitted. Multiple-component coatings that have been mixed shall not be used beyond their pot life. The Contractor shall provide small quantity kits for touch-up painting and for painting other small areas. Only the components specified and furnished by the paint manufacturer shall be mixed. No intermixing of additional components for reasons of color or otherwise, even with the same generic type of coating, will be permitted.

B. Paint materials shall be kept sealed when not in use.

C. Where more than one coat of a material is applied within a given system, color will be alternated to provide a visual reference that the required number of coats have been applied.

3.7 SHOP BLAST CLEANING

A. Items such as structural steel, specified equipment, and similar items may be shop prepared and primed. All work shall be blast cleaned and primed in accordance with these Specifications.

3.8 FIELD SANDBLASTING

A. Perform sandblasting for items and equipment where specified and as required to restore damaged surfaces previously shop or field blasted and primed. Materials, equipment, procedures, and safety equipment for personnel shall conform to the Steel Structures Painting Council.

3.9 PREPARATION OF SURFACES

A. Metal Surface Preparation:

1. General:
   a. No surface preparation blasting will be permitted prior to submission of samples. All workmanship for metal surface preparation as specified shall be in strict conformance with the current Steel Structures Painting Council (SSPC) Specifications as follows:

Solvent Cleaning	SP 1
Hand Tool Cleaning	SP 2
Power Tool Cleaning	SP 3
White Metal Blast Cleaning	SP 5
Commercial Blast Cleaning	SP 6
Brush-Off Blast Cleaning	SP 7
Pickling	SP 8
Near-White Blast Cleaning	SP 10

   b. Wherever the words "solvent cleaning", "hand tool cleaning", "wire brushing", or "blast cleaning" or similar words of equal intent are used in these Specifications or in paint manufacturer's specifications, they shall be understood to refer to the applicable SSPC Specifications listed above.
   c. Hand tool clean areas that cannot be cleaned by power tools cleaning.
2. Pre-Blast Cleaning Requirements:
   a. All oil, grease, welding fluxes, and other surface contaminants shall be removed prior to blast cleaning. Preblast cleaning methods shall use steam, open flame, hot water, or cold water with appropriate detergent additives followed with clean water rinsing.
   b. Small isolated areas shall be cleaned as above or solvent cleaned with suitable solvents and clean cloths.
   c. All sharp edges shall be rounded or chamfered and all burrs, jagged edges, and surface defects shall be ground smooth.

d. Welds and adjacent areas shall be prepared such that there is: (1) no undercutting or reverse ridges on the weld bead, (2) no weld spatter on or adjacent to the weld or any other area to be painted, and (3) no sharp peaks or ridges along the weld bead. All embedded pieces of electrode or wire shall be ground flush with the adjacent surface of the weld bead.

3. Blast Cleaning Requirements:
   a. The type of equipment and speed of travel shall be such that the specified degree of cleanliness is obtained. The type and size of abrasive shall be selected to produce a surface profile that meets the coating manufacturer's recommendations for the particular primer to be used. Only dry blast cleaning methods will be permitted. The abrasive shall not be reused.
   b. The Contractor shall comply with the applicable, federal, state, and local air pollution control regulations for blast cleaning.
4. Post-Blast Cleaning and Other Cleaning Requirements:
   a. All surfaces shall be cleaned of all dust and residual particles of the cleaning operations by dry (no oil or water vapor) air blast cleaning or other method prior to painting. Enclosed areas and other areas where dust settling is a problem shall be vacuum cleaned and wiped with a tack cloth.
   b. Surfaces shall be painted the same day they are sandblasted. Surfaces that have started to rust before they are painted shall be reblasted.

B. Plastic Surface Preparation: All plastic surfaces to be coated shall be hand sanded with a medium grit sandpaper to provide tooth for the coating system. Large areas may be power sanded or brush-off blasted, provided sufficient controls are employed so the surface is roughened without removing excess material.

C. Preparation of Existing Coated Surfaces:

1. Existing coated surfaces to be repainted shall be detergent washed and fresh water rinsed. Loose, abraded, or damaged coatings shall be cleaned to substrate by Hand or Power Tool, SP 2 or SP 3. Surrounding intact coating shall be feathered. One spot coat of the specified primer shall be applied to bare areas overlapping the prepared existing coating. One full finish coat of the specified material shall be applied overall.
2. The exact nature of the existing coatings is not known in all cases; and, while it is assumed that they have oxidized sufficiently to prevent lifting or peeling when overcoated with the paints specified, the compatibility shall be checked by application to a small area prior to starting the painting. If lifting or other problems occur, request disposition from the Engineer.

3.10 BRUSH-OFF BLAST CLEANING

A. The equipment, procedure, and degree of cleaning shall conform to the Steel Structures Painting Council Surface Preparation 7, Brush-Off Blast Cleaning. The abrasive may be either wet or dry blasting sand, grit, or nut shell. The various surface preparation parameters such as size and hardness of the abrasive, nozzle size, air pressure, and nozzle distance from the surface shall be selected such that the surface is cleaned without pitting, chipping, or otherwise damaging the surface. The Contractor shall verify his parameter selection by blast cleaning a trial area that will not be exposed to view. The trial blast cleaned area shall be subject to the review of the Engineer and shall be used as a representative sample of the surface preparation. Surfaces that are damaged by blast cleaning shall be repaired or replaced by the Contractor to the satisfaction of the Engineer.

3.11 ACID ETCHING

A. After precleaning, the following solution is spread by brush or plastic sprinkling can: 1 part commercial muriatic acid reduced by 2 parts water by volume. Adding acid to water in these proportions gives an approximate 10 percent solution of HC1. Workmen shall be equipped with necessary protective clothing. The application rate shall be approximately 2 gallons per 100 square feet. Work the acid solution into the surface by hard-bristled brushes or brooms until complete wetting and coverage is obtained. The acid will react vigorously for a few minutes, during which time brushing is continued. After the bubbling has subsided (10 minutes), hose down the remaining slurry with high pressure clean water. Rinsing must be done immediately to avoid formation of salts on the surface which are difficult to remove. Thorough rinsing is necessary to remove any residual acid surface condition which can impair adhesion. The surface shall be completely dry before coating is applied. After etching, the surface shall be "grainy" to the touch. If not, repeat the treatment.

3.12 SOLVENT CLEANING

A. Solvent cleaning shall consist of removal of foreign matter such as oil, grease, soil, drawing and cutting compounds, and any other surface contaminants by the use of solvents, emulsions, cleaning compounds, steam cleaning, or similar materials and methods which involve a solvent or cleaning action. This method conforms with Steel Structures Painting Council SP 1.

3.13 APPLICATION OF PAINT

A. General:

1. Manufacturer's written instructions for applying each type of paint or protective coating shall be furnished the Engineer prior to application. Cleaned surfaces and all coats shall be inspected prior to the succeeding coat. Schedule such inspection with the Engineer in advance. Apply all coatings in strict accordance with the paint manufacturer's recommendations, as reviewed by the Engineer. Sufficient time shall be allowed between coats to assure thorough drying of previously applied paint.
2. Units to be bolted together and to structures shall be painted prior to assembly or installation.

B. Shop Primed Surfaces: All shop primed items shall be inspected at the jobsite for compliance with these Specifications. Schedule such inspection with the Engineer in advance. Areas of chipped, peeled, or abraded primer shall be hand or power sanded feathering the edges. The areas shall then be spot primed with the specified primer. Prior to application of finish coats, shop primed surfaces shall be cleaned free of all dirt, oil and grease, and a mist coat, 1.0 mil dry film thickness, of the specified primer applied, complete. Holdback areas for welding shall be prepared and primed, after welding, as required for the specified paint system. Application of primer shall be in accordance with manufacturer's instructions.

C. Manufacturer Applied Paint Systems: Abraded areas on factory finished items shall be repaired in strict accordance with the equipment manufacturer's directions. Repaired areas shall be carefully blended into the original finish.

D. Film Thickness:

1. Coverage is listed as either total minimum dry film thickness in mils (MDFT) or the spreading rate in square feet per gallon (SFPG). Per coat determinations are listed as MDFTPC or SFPGPC. The number of coats is the minimum required irrespective of the coating thickness. Additional coats may be required to obtain the minimum required paint thickness, depending on method of application, differences in manufacturers' products, and atmospheric conditions. Maximum film build per coat shall not exceed the coating manufacturer's recommendations.
2. Film thickness measurements and electrical inspection of the coated surfaces shall be performed with properly calibrated instruments. Recoat and repair as necessary for compliance with the Specifications. All coats will be subject to inspection by the Engineer and the coating manufacturer's representative.
3. Particular attention shall be given edges, angles, flanges, etc. Where insufficient film thickness are likely to be present, ensure proper millage in these areas.

4. After repaired and recoated areas have dried sufficiently, final tests will be conducted by the Engineer. Coating thickness specified in mils will be measured with a magnetic type dry film thickness gauge such as Mikrotest, supplied by Nordson Corp., Anaheim, CA. The finish coat (except zinc primer and galvanizing) will be tested for holidays and discontinuities with an electrical holiday detector, low voltage, wet sponge type such as Model M-1, manufactured by Tinker and Rasor, San Gabriel, CA.
5. Each coat shall be checked for the correct millage. No measurement will be made under a minimum of 8 hours after application of the coating.

E. Damaged Coatings:

1. Damaged coatings, pinholes, and holidays shall have the edges feathered and repaired in accordance with the recommendations of the paint manufacturer, as reviewed by the Engineer.
2. All finish coats, including touch-up and damage-repair coats shall be applied in a manner which will present a uniform texture and color-matched appearance.

F. Unsatisfactory Application:

1. If the item has an improper finish color, or insufficient film thickness, the surface shall be cleaned and topcoated with the specified paint material to obtain the specified color and coverage. Specific surface preparation information to be secured from the coating manufacturer and the Engineer.
2. All visible areas of chipped, peeled, or abraded paint shall be hand- or power-sanded feathering the edges. The areas shall then be primed and finish coated in accordance with the Specifications. Depending on the extent of repair and its appearance, a finish sanding and topcoat may be required by the Engineer.
3. Work shall be free of runs, bridges, shiners, laps, or other imperfections. Evidence of these conditions shall be cause for rejection.
4. Any defects in the coating system shall be repaired by the Contractor per written recommendations of the coating manufacturer.
5. Leave all staging up until the Engineer has inspected the surface or coating. Staging removed prior to review by Engineer shall be replaced.

3.14 SHIPPING

A. In all cases where precoated items are to be shipped to the jobsite, all efforts will be made to protect the coating from damage. Coated items shall be battened to prevent abrasion. Contractor shall use nonmetallic or padded slings and straps in handling. Items will be rejected for excessive damage, in the opinion of the Engineer.

3.15 CLEANUP

A. All cloths and waste that might constitute a fire hazard shall be placed in closed metal containers or destroyed at the end of each day. Upon completion of the work, all staging, scaffolding, and containers shall be removed form the site or destroyed in a legal manner. Paint spots, oil, or stains upon adjacent surfaces and floors shall be completely removed, and the entire job left clean and acceptable to the Engineer.

3.16 COATING SYSTEMS

A. System No. 2 Submerged Metal - Domestic Sewage:

Surface Prep.	Paint Material	Min. Coats, Cover
Abrasive Blast, or Centrifugal Wheel Blast (SP 5)	Polyamide, Anti-Corrosive, Epoxy Primer	1 coat, 2.5 MDFT
	Coal-Tar Epoxy	2 coats, 16 MDFT

B. System No. 4 Exposed Metal - Highly Corrosive:

Surface Prep.	Paint Material	Min. Coats, Cover
Abrasive Blast, or Centrifugal Wheel Blast (SP 6)	Organic Zinc Primer	1 coat, 2.5 MDFT
	Polyamide High Build Epoxy, Gloss	2 coats, 5 MDFT

C. System No. 4A Exposed Equipment - Highly Corrosive:

Surface Prep.	Paint Material	Min. Coats, Cover
Power Tool (SP 3) as needed	Alkyd-Phenolic Primer	1 coat, 2.5 MDFT
	Polyamide High Build Epoxy, Gloss	2 coats, 5 MDFT

D. System No. 8 Buried Metal - General:

Surface Prep.	Paint Material	Min. Coats, Cover
Abrasive Blast, or Centrifugal Wheel Blast (SP 10)	Standard AWWA C203-73 Hot Coal-Tar Enamel, or AWWA C210-78 Coal-Tar Epoxy	Per Specification

E. System No. 11 Galvanized Metal Repair:

Surface Prep.	Paint Material	Min. Coats, Cover
Solvent Clean (SP 1)	Organic Zinc Rich Primer	1 coat, 3 MDFT
Followed by Hand Tool (SP 2), Power Tool (SP 3), or Brush-Off Blast (SP 7)		

F. System No. 24 Exposed PVC/FRP:

Surface Prep.	Paint Material	Min. Coats, Cover
Plastic	Polyurethane Enamel	1 coat, 320 SFPGPC

G. System No. 27 Aluminum and Dissimilar Metal Insulation:

Surface Prep.	Paint Material	Min. Coats, Cover
Solvent Clean (SP 1)	Wash Primer	1 coat, 0.4 MDFT
	Bituminous Paint	1 coat, 10 MDFT

3.17 PAINT APPLICATION SCHEDULE

A. Unless otherwise indicated in the Specifications or on the Drawings, the work shall be painted or coated in accordance with the following application schedule. In the event of discrepancies or omissions in the following, request clarification from the Engineer before starting the work in question.

1. System No. 2 Submerged Metal - Domestic Sewage: This system shall be used where specified for factory-application and on all metal surfaces below a plane 1-foot above the maximum liquid surface and all metal surfaces above the maximum liquid surface which are a part of any immersed mechanism. In addition, the following specific surfaces shall receive this system:

a. All concrete embedded surfaces of metallic items under submerged conditions, such as wall pipes, pipes, pipe sleeves, access manholes, gate guides and thimbles, and structural steel (except reinforcing steel).
b. All submerged ferrous metal and ductile iron piping and related components.

2. System No. 4 Exposed Metal - Highly Corrosive: This system shall be used on exposed metal surfaces located outside of structures and exposed to weather, and the following specific surfaces shall receive this system:
   a. All exposed ferrous metal and ductile iron piping and related components.
   b. All exposed ferrous metal piping and related components at the WELLHEAD.
   c. All ferrous metal components at stairs and elevated walkways.
3. System No. 4A Exposed Equipment - Highly Corrosive: This system shall be used on exposed metal surfaces of pumps, motors, and related components, and on exposed metal surfaces of air compressor and related components.
4. System No. 8 Buried Metal - General: This system shall be used on all buried, belowgrade portions of steel items, except buried stainless steel or ductile iron, and the following specific surfaces shall receive this system:
   a. All ferrous metal piping and related components.
5. System No. 11 Galvanized Metal Repair: This system shall be used on all galvanized surfaces which are abraded, chipped, or otherwise damaged.
6. System No. 24 Exposed PVC/FRP: This system shall be used on all exposed PVC/FRP piping and related PVC/FRP components requiring painting for color coding.
7. System No. 27 Aluminum and Dissimilar Metal Insulation: This system shall be used where specified and on the following items or areas:
   a. All nonsubmerged concrete embedded aluminum surface.
   b. All aluminum in contact with concrete or masonry.
   c. All contacting dissimilar metals.

PART 4 PAYMENT

4.1 GENERAL

A. Payment for work in this section will be included as part of the lump sum bid price stated in the Proposal for wellhead capping and valves and the surge control system.

(See PSDS form following this section)

PAINT SYSTEM DATA SHEET

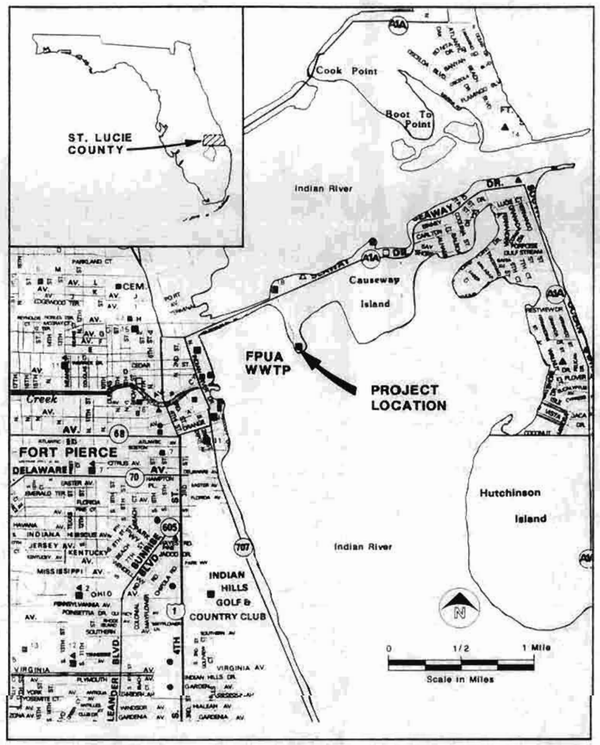
Attached products' Technical Data Sheet (if applicable) to this sheet for each paint system submittal.

Paint System Number (from Spec.):
Paint System Title (from Spec.):
Coatings Supplier:
Representative:
Surface Preparation:

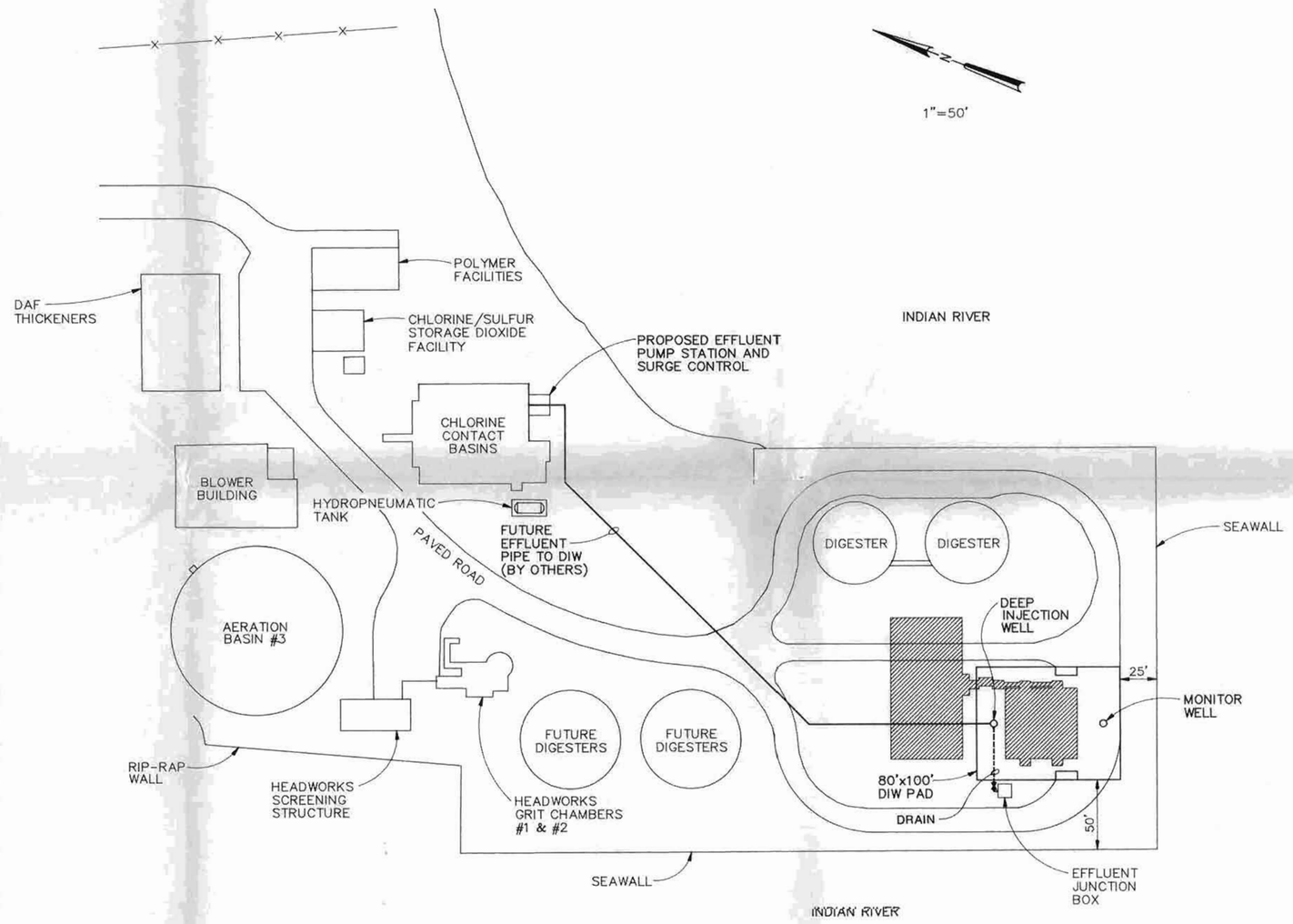
Paint Material (Generic)	Product Name/Number (Proprietary)	Min. Coats Coverage

* * * * * *

09-17-91 NDM\FPUA_WWTP\0361M010.DWG



PROJECT LOCATION MAP



SITE PLAN

CH2M HILL

DSGN	S. SKEHAN
DR	0361M010 C. BLAISDELL
CHK	R. RILEY
APVD	A. MUNIZ

NO.	DATE	REVISION	BY	APVD

REUSE OF DOCUMENTS

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

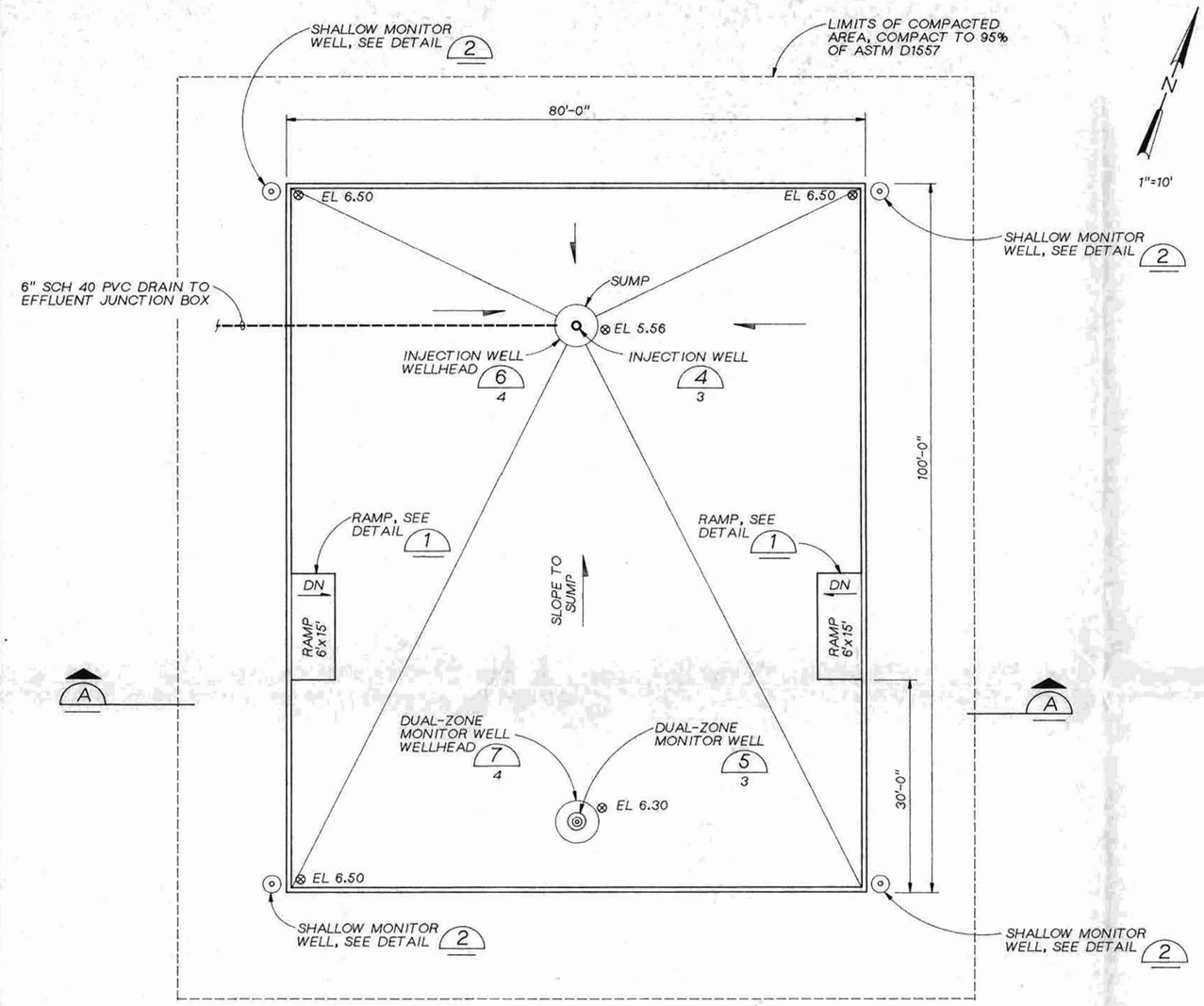
FORT PIERCE UTILITIES AUTHORITY
DEEP INJECTION WELL AND DUAL-ZONE MONITOR WELL

PROJECT LOCATION MAP AND SITE PLAN

SHEET	1
DWG NO.	
DATE	SEPT. 1991
PROJ NO.	SEF30361.D1

1=600.0

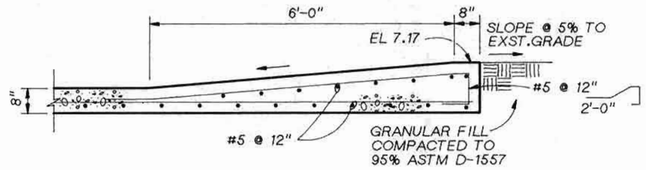
PRELIMINARY



NOTES:

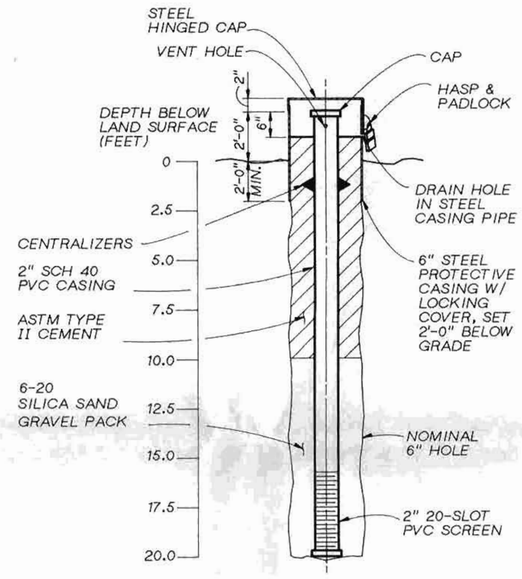
1. FINAL DESIGN OF THE DRILLING PAD I.E. THICKENED AREAS, DIMENSIONS, SIZE AND LAYOUT OF THE REINFORCING STEEL IS THE RESPONSIBILITY OF THE DRILLING CONTRACTOR
2. ALL ELEVATIONS ARE APPROXIMATE. CONTRACTOR SHALL VERIFY ELEVATIONS PRIOR TO BID AND BASE BID ON ACTUAL ELEVATIONS

DRILLING PAD PLAN



ACCESS RAMP DETAIL 1

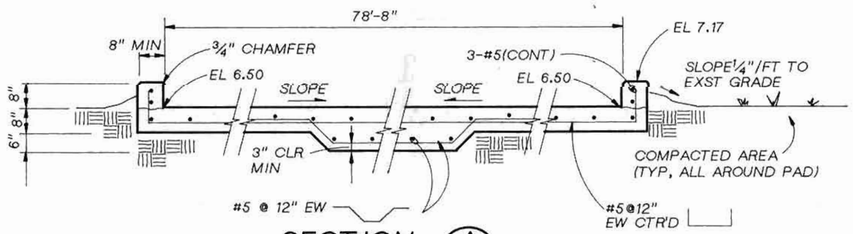
NTS



NOTE: EXACT DEPTH OF WELL AND SCREEN SETTING WILL BE DETERMINED IN THE FIELD. TOP OF SCREEN WILL BE A MINIMUM OF 5 FEET BELOW WATER TABLE.

SHALLOW MONITORING WELL DIAGRAM 2

NTS



SECTION A

1/2" = 1'-0"

DSGN S. SKEHAN							
DR C. BLAISDELL							
CHK S. RILEY							
APVD A. MUNIZ	NO.	DATE	REVISION	BY	APVD		

BAR IS ONE INCH ON ORIGINAL DRAWING.
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

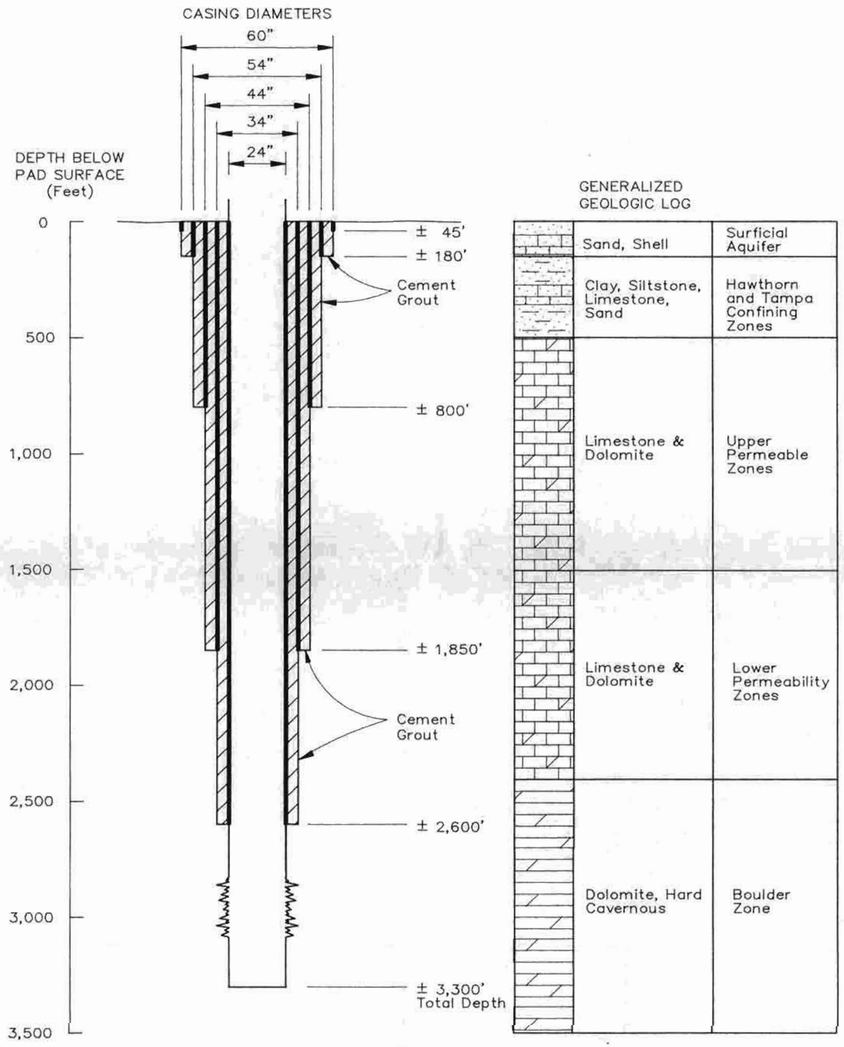
FORT PIERCE UTILITIES AUTHORITY
DEEP INJECTION WELL AND DUAL-ZONE MONITOR WELL

DEEP INJECTION WELL PLAN AND DETAILS

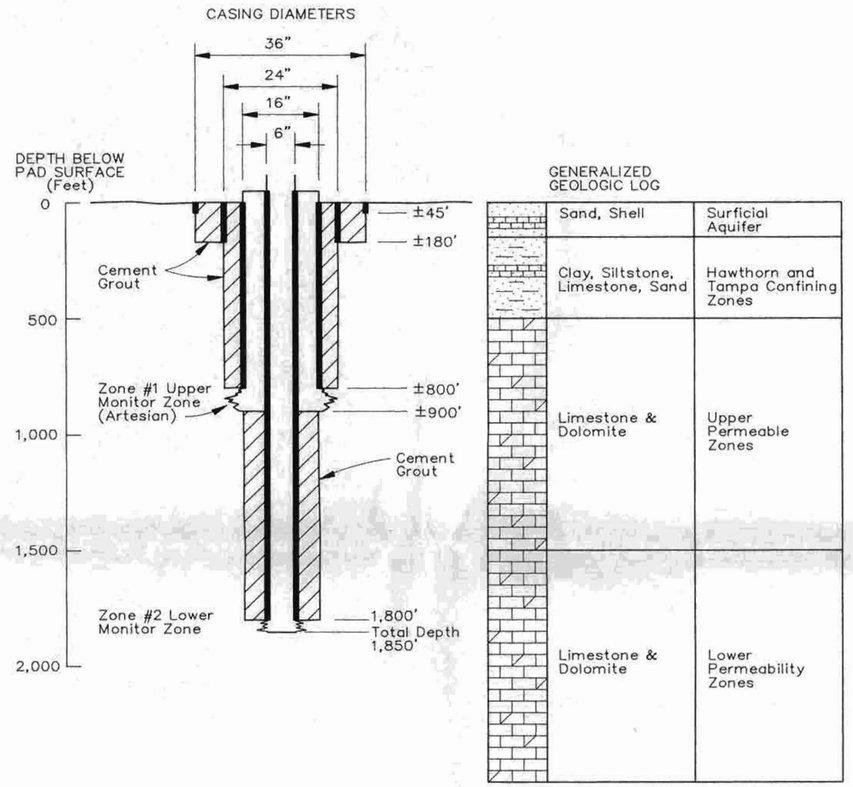
SHEET 2
DWG NO.
DATE SEPT. 1991
PROJ NO. SEF30361.D1

PRELIMINARY

OVERLAY IDENTIFICATION: COMPOSITE, OVERLAY SCREEN, PROJID, FILE



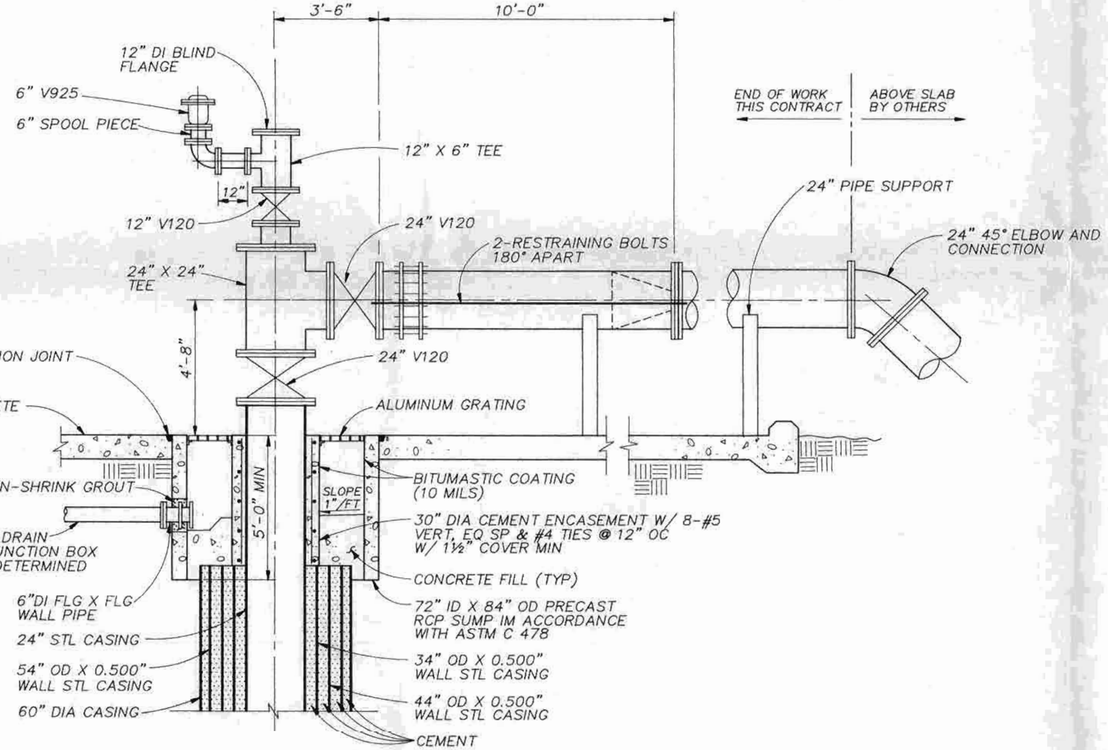
DEEP INJECTION WELL CONSTRUCTION DIAGRAM (4)
NTS 2



DUAL-ZONE MONITOR WELL CONSTRUCTION DIAGRAM (5)
NTS 2

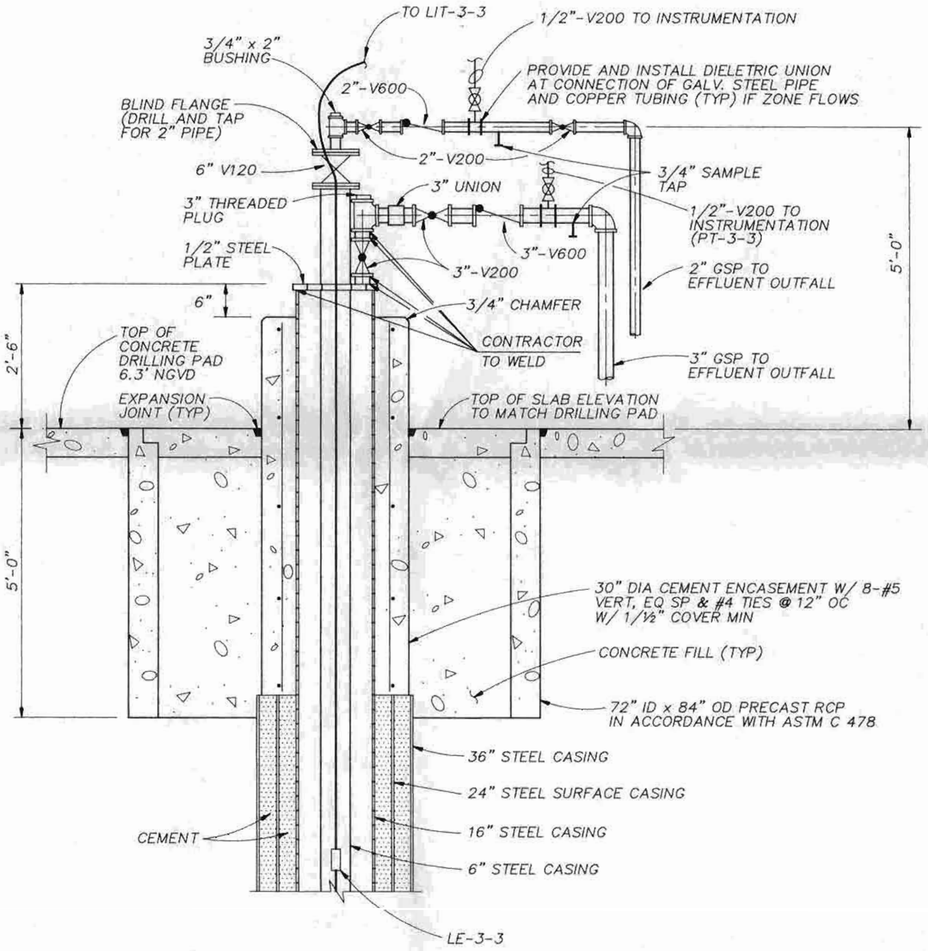
CH2M HILL	DSGN S. SKEHAN DR 0361M012 C. BLAISDELL CHK S. RILEY APVD A. MUNIZ	NO.	DATE	REVISION	BY	APVD	**REUSE OF DOCUMENTS** THIS DOCUMENT, AND THE IDEAS AND DESIGNS INCORPORATED HEREIN, AS AN INSTRUMENT OF PROFESSIONAL SERVICE, IS THE PROPERTY OF CH2M HILL AND IS NOT TO BE USED, IN WHOLE OR IN PART, FOR ANY OTHER PROJECT WITHOUT THE WRITTEN AUTHORIZATION OF CH2M HILL. ©CH2M HILL	VERIFY SCALE: BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.	FORT PIERCE UTILITIES AUTHORITY DEEP INJECTION WELL AND DUAL-ZONE MONITOR WELL	WELL CONSTRUCTION DIAGRAMS	SHEET 3 DWG NO. DATE SEPT. 1991 PROJ NO. SEF30361.D1

1=1.0



DEEP INJECTION WELL WELLHEAD DETAILS (6/2)

NTS



DUAL-ZONE MONITOR WELL WELLHEAD DETAILS (7/2)

NTS

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1=16.0