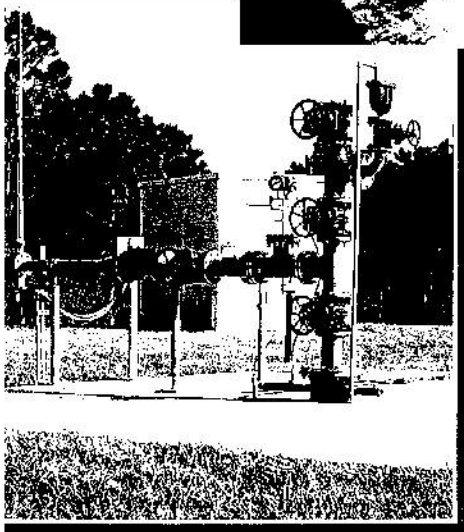
asparilla Island Water Association 4-4a

Reverse Osmosis WTP Deep Injection Well and Facilities Engineering Report



Prepared by:

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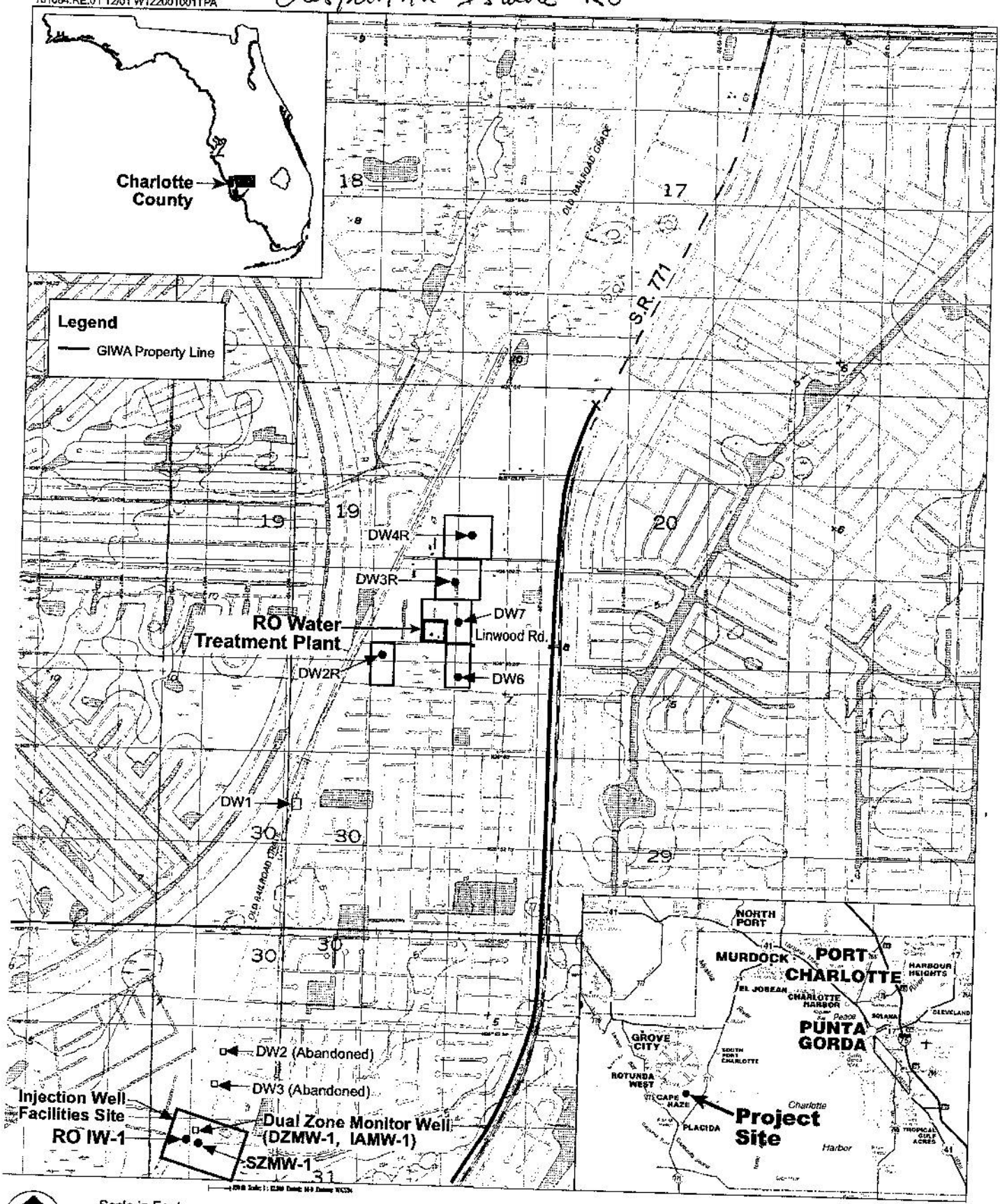
Gasparilla Island RO



Scale in Feet
0 1050 2100

USGS Quads:
El Jobean, FL - 1972
Placida, FL - 1987
Punta Gorda SW, FL - 1972
Englewood, FL - 1987

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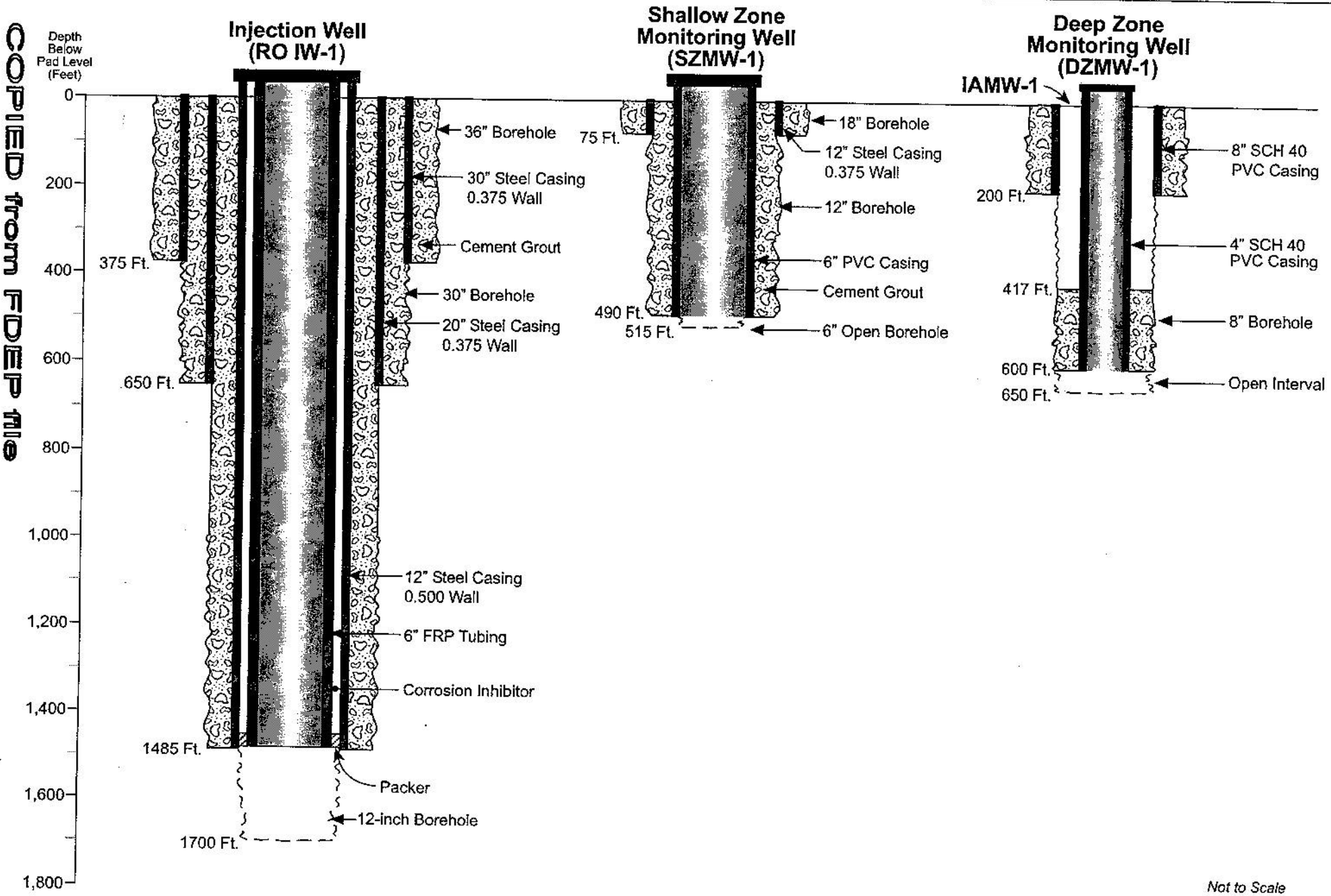
FIGURE 1
GIWA RO WTP and RO IW-1 Facilities Location



Not to Scale

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FIGURE 2-3
Injection Well and Monitoring Well Completion Details

Three concentric steel casings were used to construct RO IW-1 (30-inch, 22-inch, and 12-inch outside diameters). Table 2-1 summarizes the casing depths and the types and quantities of cement used during the construction of RO IW-1. Figure 2-3 depicts the completion details diagram of RO IW-1. The casing mill certificates for all of the wells are provided in Appendix D.

TABLE 2-1
Summary of Casing Setting Depths and Cement Quantities; Deep Injection Well (RO IW-1)
GIWA – RO WTP Deep Injection Well and Facilities Engineering Report

Casing	Casing Material	Outside Diameter (inches)	Inside Diameter (inches)	Casing Thickness (inches)	Casing Depth (ft bls)	Date	Cement Stage	Type of Cement	Quantity of Cement (ft^3)
Shallow	Steel	30.00	29.25	0.375	375	3/09/2001	#1	Neat	280
						Remark: Pressure grout from bottom of casing.			
						3/09/2001	#1	4% bentonite	840
						Remark: Pressure grout from bottom of casing.			
Intermediate	Steel	22.00	21.25	0.375	650	4/12/2001	#1	Neat	370
						Remark: Pressure grout from bottom of casing.			
						4/12/2001	#1	4% bentonite	1064
						Remark: Pressure grout from bottom of casing.			
						4/13/2001	#2	4% bentonite	55
						Remark:Tremied into annulus from 159 ft bls.			
Final	Steel	12.75	11.75	0.500	1,485	5/22/2001	#1	Neat	190
						Remark:Tremied into annulus from 1,485 ft bls.			
						5/23/2001	#2	4% bentonite	1321
						Remark: Tremied into annulus from 1,369 ft bls.			
						5/24/2001	#3	4% bentonite	252
						Remark: Tremied into annulus from 1,147 ft bls.			
						5/25/2001	#4	12% bentonite	90
						Remark: Tremied into annulus from 1,123 ft bls. Stage also contained a total of 180 ft3 of gravel.			
						5/26/2001	#5	4% bentonite	2116
						Remark: Tremied into annulus from 1,077 ft bls.			
						5/31/2001	#6	4% bentonite	313
						Remark: Tremied into annulus from 202 ft bls.			
Final Tubing	FRP	7.625	6.625	0.500	1,480	6/4/2001	N/A	N/A	N/A
						Remark: FRP tubing was installed by representatives of Tubular Fiberglass & Weatherford, Inc.			
								Total Volume Neat:	840 ft^3
								Total Volume 4%:	5961 ft^3
								Total Volume 12%:	90 ft^3

Construction of RO IW-1 began with the mud drilling of a nominal 12.25-inch-diameter pilot hole to a depth of 375 feet bls. The pilot hole was then geophysically logged (caliper, gamma ray, spontaneous potential, and dual induction logs) and reamed to a nominal 36.5-inch-diameter to a depth of 380 feet bls. Caliper and natural gamma logs were then performed on the reamed hole and a 30-inch-diameter casing was installed and cemented through the surficial and intermediate aquifers to a depth of 375 feet bls.

The pilot hole was then advanced with reverse-air drilling techniques to a depth of 1,000 feet bls. Seven 4-inch-diameter cores were attempted from the interval of 400 feet to 1,000 feet bls during this phase of pilot hole drilling. Three core attempts resulted in returns greater than 5 feet in length. The core collected from 904 feet to 915 feet bls was analyzed to determine its hydrogeologic and physical properties. Core analyses and descriptions are discussed in Section 4 of this report. Caliper, gamma ray, spontaneous potential, dual induction, borehole compensated sonic, temperature, fluid conductivity, and flowmeter logs were then conducted on the open hole interval. Seven straddle packer tests were performed between the interval of 375 feet and 1,000 feet bls in order to provide confining characteristics of the tested intervals and identify the base of the Underground Source of Drinking Water (USDW) unit, defined as water with a total dissolved solids (TDS) concentration less than 10,000 milligrams per liter (mg/L). The water quality and testing data is presented in Section 4.

Based on the results of packer testing, coring, geophysical logging, and formation sample analyses, a 22-inch diameter casing-setting depth of 650 feet bls was recommended to and approved by the FDEP and the TAC. The pilot hole was then backplugged with cement and reamed to a nominal 28.5-inch-diameter to a depth of 655 feet bls. A caliper log was then run on the reamed hole and the 26-inch-diameter steel intermediate casing was installed below the base of the USDW to a depth of 650 feet bls.

The pilot hole was then advanced to a depth of 1,700 feet bls. Four 4-inch-diameter cores were collected from the interval of 1,130 to 1,245 feet bls during this phase of pilot hole drilling. Section 4 of this report presents core analyses, including detailed descriptions. Caliper, gamma ray, spontaneous potential, dual induction, borehole compensated sonic, temperature, fluid conductivity, video, and flowmeter logs were then conducted on the entire open hole interval. Three packer tests were then conducted between the interval of 1,465 and 1,700 feet bls to determine the confining characteristics and water quality of the tested intervals.

Based on flow results of packer testing, coring, geophysical logging, and formation sample analyses, a 12-inch diameter casing setting depth of 1,485 feet bls was recommended to and approved by the FDEP and TAC. The pilot hole was then reamed to a nominal 20-inch diameter to a depth of 1,485 feet bls. Following caliper and natural gamma ray logging, the final casing (12-inch-diameter) and the stainless steel Positive Seal Packer (PSP) hanger (female portion) was installed to a depth of 1,485 feet bls. An external casing plug was installed 5-feet below the PSP hanger and was used to stop the flow of cement below the bottom of the reamed interval. The final casing was then cemented, using the tremmie method, from 1,485 feet to 202 feet bls. Following a 72-hour waiting period, a cement sector bond log (CBL) was run from 1,483 feet bls to land surface. The CBL was conducted with approximately the top 200 feet of casing uncemented. This allows the CBL to show a response in uncemented and cemented casing. This CBL provided evidence of adequate cement behind the final 12-inch casing.

A pressure test was then conducted on the final casing string before cementing the casing to land surface. The casing was tested at 100 psi and showed a 5% pressure decrease over the 120-minute period. The 6-inch diameter fiberglass reinforced plastic (FRP) injection tubing was then installed to 1,480 feet bls with the PSP (male portion) attached by threading to the base of the casing. Prior to seating the PSP, approximately 5,500 gallons of Baracor 100 corrosion inhibitor fluid was pumped into the annulus. The FRP casing and PSP were then lowered into the PSP hanger at 1,480 feet bls.

A total of three pressure tests were conducted on the annular zone and inside the FRP casing. FDEP was onsite to witness a 60-minute test conducted on the annular zone. The casing was tested at 215 psi and showed a 3.2% decrease over the 60-minute test. The annulus was then retested for 120 minutes at 105 psi. The pressure decreased 4.75% during the test. The final test was conducted on the inside of the FRP. A temporary packer was installed to a depth of 1,469 feet bls and the FRP was pressurized to 105 psi. This test showed a pressure decrease of 3.8% during the 120-minute testing interval.

Final caliper, gamma ray, and video logs were conducted on September 11 and 12, 2001. These logs were run on the well before performing a radioactive tracer survey (RTS) to assess the external mechanical integrity of RO IW-1. The successful RTS test was conducted on September 18, 2001. Following the RTS test, a 12-hour injection test was conducted as described in Section 4.

The RO IW-1 wellhead is constructed of 6-inch diameter stainless steel piping with epoxy coated valves, a 4-inch magnetic flowmeter, and a 3-inch air/vacuum release valve. The wellhead allows for sampling of the RO brine injectate and the injection of monitor well purge water during required sampling. Appendix E.1 presents the record drawings for the RO IW-1 wellhead.

2.3 Deep Zone Monitoring Well (DZMW-1)

A decommissioned 8-inch diameter, PVC-cased production well, DW4, is located approximately 60 feet from the injection well. After the project was started it was decided, as a cost saving measure, to modify DW4 into a dual-zone monitoring well. The original production interval monitoring zone of 200 feet to 417 feet bls is referred to as IAMW-1 in the FDEP injection well construction permit. This zone was maintained as the upper monitoring zone for the dual-zone monitoring well. The proposed deep zone monitoring well is designated DZMW-1 and is the lower zone for the dual-zone monitoring well.

The lower monitoring zone was constructed by drilling through the bottom of the existing 8-inch PVC casing (set to a depth of 200 feet bls) from 385 feet bls. The bottom of DW4's open borehole was determined to have a depth of 385 feet bls, however, the record construction data reports the bottom of the well to be at 417 feet bls at the time it was constructed. Drilling proceeded to a total depth of 650 feet bls. The deep zone monitoring interval was constructed in a permeable zone below the USDW, geophysically located at approximately 575 feet bls through geophysical methods.

Construction of DZMW-1 began on July 2, 2001, with the mud drilling of a nominal 7.875-inch diameter pilot hole from 385 feet bls to 417 feet bls which is the recorded original depth of the well. Once drilling reached 417 feet bls, the remainder of the well was drilled using reverse-air techniques to a total depth of 650 feet bls. The pilot hole was then geophysically logged from land surface to 650 feet bls. A caliper, gamma ray, spontaneous potential, dual induction, temperature, fluid conductivity, and a flowmeter log were conducted. After logging, 4-inch CertainTeed Certa-Lok™ PVC casing was installed to a depth of 600 feet bls. Two cement baskets were placed near the bottom of the 4-inch casing at 595 feet and 598 feet bls. To preserve the existing upper monitoring zone from 200 feet to 417 feet bls, the 4-inch casing was cemented from 600 feet to 417 feet bls. The final monitoring interval of DZMW-1 is from

600 feet to 650 feet bls. Table 2-2 summarizes the casing depths and the types and quantities of cement used for construction of DZMW-1. Figure 2-3, presented previously, depicts the DZMW-1 well completion details diagram.

A one-hour pressure test was conducted on DZMW-1 using an inflatable packer assembly on the inside of the 4-inch diameter PVC casing. The packer was installed at 587 feet bls and the starting pressure was 55 psi. Over the 1-hour test, a pressure decrease of 2.5 psi (or 4.5% reduction) was observed during the pressure test which demonstrated that the well was adequately constructed. Following the pressure test, the final well was geophysically logged. The final well characteristics were verified with caliper, gamma, and video logs.

TABLE 2-2
Summary of Casing Setting Depths and Cement Quantities; Dual Zone Monitoring Well (DZMW-1)
GIWA – RO WTP Deep Injection Well and Facilities Engineering Report

Casing	Casing Material	Outside Diameter (inches)	Inside Diameter (inches)	Casing Thickness (inches)	Casing Depth (ft bls)	Date	Cement Stage	Type of Cement	Quantity of Cement (ft^3)
Final	PVC	4.500	4.026	0.237	600	8/14/2001	#1	Neat	10
	CertainTeed Certa-Lok™					Remarks	Tremied into annulus from 593 ft bls.		
						8/15/2001	#2	Neat	22
						Remarks	Tremied into annulus from 587 ft bls.		
						8/16/2001	#3	4% Bentonite	31
						Remarks	Tremied into annulus from 560 ft bls.		
						8/16/2001	#4	4% Bentonite	34
						Remarks	Tremied into annulus from 487 ft bls.		
						8/15/2001	#5	4% Bentonite	11
						Remarks	Tremied into annulus from 436 ft bls.		
							Total Volume Neat:		32 ft^3
							Total Volume 4%:		76 ft^3

The dual-zone monitoring well wellhead is constructed of 2-inch diameter stainless steel piping, stainless steel ball valves, a paddle wheel flowmeter, and a 1-inch air/vacuum release valve, and pressure gauges, for both IAMW-1 and DZMW-1. Well DZMW-1 also has a pressure transducer and a stainless steel submersible sample pump, and IAMW-1 has a centrifugal sample pump. The wellhead allows for sampling of the individual monitoring zones and directs the monitor well purge water during required sampling to the injection well. Appendix E.2 presents the completion diagram for the IAMW-1 and DZMW–1 dual-zone monitoring well wellhead.

2.4 Shallow Zone Monitoring Well (SZMW-1)

Drilling of SZMW-1 began on July 2, 2001, utilizing the same drilling techniques used for the injection well. The monitoring zone was targeted as the first permeable zone above the base of the USDW. The final monitoring interval is from 490 feet to 515 feet bls.

Construction of SZMW-1 began with the mud drilling of a nominal 7.875-inch diameter pilot hole to a depth of 90 feet bls. The pilot hole was then geophysically logged (caliper, gamma ray, spontaneous potential, and dual induction logs) and reamed to a nominal 18-inch-diameter to a depth of 90 feet bls. A caliper log was then performed on the reamed hole and a 12-inch diameter casing was installed and cemented to a depth of 97 feet bls.

Following a 24-hour waiting period to allow the cement surrounding the casing to cure, the pilot hole was advanced to a depth of 515 feet bls and geophysically logged. Logs conducted were caliper, gamma ray, spontaneous potential, dual induction, borehole compensated sonic, temperature, fluid conductivity, and flowmeter. After logging, the hole was backplugged with sand to 494 feet bls and a neat cement bridge plug was installed from 494 feet to 491 .5 feet bls. The pilot hole was then reamed to an 11.5-inch diameter to a depth of 491.5 feet bls. Following the caliper log, the 6.625-inch CertainTeed Certa-Lok™ PVC casing was installed and cemented to a depth of 490 feet bls. Figure 2-3, as presented previously, depicts the well completion details diagram of SZMW-1. Table 2-3 summarizes the casing depths and the types and quantities of cement used for construction of SZMW-1.

A 1-hour pressure test was conducted with a starting pressure of 57.2 psi on SZMW–1 prior to removing the bridge plug. A pressure decrease of 4.7% during the test indicated that the well was adequately constructed. The sand and cement bridge plug were removed with a 4-inch diameter bit and the well was cleaned out to a total depth of 515 feet bls. The final well characteristics were verified with a caliper, gamma, and video log.

The shallow zone monitoring well wellhead is constructed of 2-inch diameter stainless steel piping, stainless steel ball valves, a paddle wheel flowmeter, and a 1-inch air/vacuum release valve, a pressure gauge, a pressure transducer and a stainless steel submersible sample pump. The wellhead allows for sampling of the shallow monitoring zone and directs the monitor well purge water during required sampling to the injection well. Appendix E.3 presents the completion diagram for the SZMW–1 wellhead.

TABLE 2-3
Summary of Casing Setting Depths and Cement Quantities; Shallow Zone Monitoring Well (SZMW-1)
GIWA – RO WTP Deep Injection Well and Facilities Engineering Report

Casing	Casing Material	Outside Diameter (inches)	Inside Diameter (inches)	Casing Thickness (inches)	Casing Depth (ft bls)	Date	Cement Stage	Type of Cement	Quantity of Cement (ft^3)
Shallow	Steel	12.75	12.00	0.375	87	7/3/2001	#1	Neat	89
						Remarks	Pressure grout from bottom of casing.		
Final	PVC CertainTeed Certa-Lok™	6.625	5.845	0.390	490	7/24/2001	#1	Neat	78
						Remarks	Pressure grout from bottom of casing.		
						7/25/2001	#2	4% bentonite	118
						Remarks	Tremied into annulus from 413 ft bls.		
						7/26/2001	#3	4% bentonite	137
						Remarks	Tremied into annulus from 306 ft bls.		
						7/26/2001	#4	12% bentonite	157
						Remarks	Tremied into annulus from 201 ft bls.		
							Total Volume Neat:		167 ft^3
							Total Volume 4%:		412 ft^3